ORAL PRESENTATIONS

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OP01: Conscious Behaviors Following Bilateral Pallido-Thalamic Low Frequency Stimulation in Patients with Continuing Disorders of Consciousness

Authors:

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Keywords: DBS, consciousness

Abstract:

Introduction: Chronic electric deep brain stimulation (DBS) has been proposed to enable consciousness recovery, targeting mainly the central thalamus. Our aim was to study clinical effects of bilateral pallido-thalamic low frequency stimulation intended to overdrive neuronal activity in continuing disorders of consciousness.

Methods: Five patients were included in a prospective, monocentric, 12-month clinical observational study, with blind crossover period (NCT01718249): P1 male, 32 y/o, 12 years after traumatic brain injury (TBI), vegetative status (VS); P2 female, 62 y/o, 14 months after intracerebral hemorrhage (ICH), minimally conscious state (MCS); P3 male, 24 y/o, 3 years after TBI, MCS; P4 female, 22 y/o, 4 years after TBI, MCS; P5 female, 47 y/o, 27 months after ICH, MCS. Four phases were individualized: (1) Baseline, at least 2 months; (2) DBS surgery and titration, 1 month; (3) blind, random, 3-month cross over (CO) period with 1.5month ON (CO-ON) and OFF (CO-OFF) conditions; (4) unblinded, at least 5 months, DBS period (DBS-ON). Electrodes (DBS 3389, Medtronic, USA) were placed within the right and left targets accounting for the lesions of patients. Two neuropacemakers (ACTIVA, Medtronic, USA) were implanted. Primary outcome was the analysis of scores of the Coma Recovery Scale Revised (CRS-R; 0-23): assessments 2 times per week; for the 5 patients, n=419, scores ranging from 1 to 18. Statistical analyses were conducted for a two-sided Type I error of 5% using random-effects models accounting between and within patient variability due to repeated measurements.

Results: No mortality related to surgery and DBS. By individual we observed statistically significant improvement of CRS-R during DBS-ON versus baseline (P1, P3) and CO-On versus baseline (P3). For the 5 patients (group analysis) auditory, visual, motor, oromotor-verbal, communication subscores of CRS-R were significantly improved during DBS-ON versus baseline. Cross-over analysis did not show statistically significant improvement of CRS-R and subscores during CO-ON versus CO-OFF, except P2 and P3 motor sub scores.

Conclusion: Bilateral low frequency DBS in severe continuing disorders of consciousness improved patients on the short term without irreversible adverse effects. Individual analysis seems preferable facing the complexity of clinical features and pathophysiology. Given the current state of knowledge, expectations of relatives, caregivers and physicians should be weighted.

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OP02: A randomised controlled trial of Deep Brain Stimulation in Severe Refractory Obsessive Compulsive Disorder

Authors:

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Keywords: Obsessive compulsive disorder, Deep Brain Stimulation, anteromedial subthalamic nucleus, ventral capsule, Y-BOCS, GAF, quality of life

Abstract:

Objectives: A significant minority of patients with Obsessive Compulsive Disorder (OCD) remain severely affected despite high quality standard treatment. We present the clinical results of a double-blind randomised crossover pilot trial of deep brain stimulation (DBS) for OCD.

Methods: Six patients with severe refractory OCD were recruited. Minimum inclusion criteria were: symptoms refractory to ≥ 2 selective serotonin reuptake inhibitors for ≥ 12 weeks at optimal doses, ≥ 2 trials of cognitive behavioural therapy (CBT) involving Exposure and Response Prevention (> 10 hours) plus intensive inpatient treatment within a specialist unit; ≥ 10 years' illness duration; ≥ 2 years of unremitting symptoms; ≥ 32 on the Yale-Brown Obsessive Compulsive Scale (YBOCS).

Bilateral anteromedial subthalamic nucleus (amSTN) and bilateral ventral capsule/ventral striatum (VC/VS) DBS leads were implanted in each patient using an MRI-guided & MRI-verified approach. Patients were randomised to amSTN or VC/VS stimulation. After 3 months, the stimulation site was switched for a further 3 months, then both sites were stimulated for 3 months. Following this, patients received open label DBS optimisation and CBT. Patients and psychiatrists were blinded to stimulation site during the randomisation phase. YBOCS and global assessment of function (GAF) scores were performed at key time points.

Results: There were no surgical complications. YBOCS improved from baseline by a mean of 45% with amSTN DBS, 53% with VC/VS DBS and 61% with DBS at both sites. Following open label DBS plus CBT, mean YBOCS reduction was 74%, 3 patients were in remission (YBOCS < 8), all patients were "responders" (defined as YBOCS decrease of >35%). GAF scores improved from 22 to 72. Effective contacts at the VC/VS target were within the ventral aspect of the anterior limb of the internal capsule, above the nucleus accumbens. During the course of the trial, DBS was associated with a number of transient mood and behavioural changes that required close supervision and stimulation adjustment.

Conclusion: DBS was safe and efficient at both sites with improvement in OCD symptoms that was also accompanied by improvements in quality of life scores. In this patient group, the VC target provided greater benefit than the amSTN target. It must be emphasised that DBS is a labour-intensive and lifelong therapy that requires close surgical and psychiatric follow up.

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OP03: Stereotactic radiosurgery capsulotomy for refractory OCD: Lesion location and connectivity analysis in 30 patients

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Keywords: OCD, Radiosurgery, Functional, Tractography

Abstract:

Background: Obsessive-compulsive disorder (OCD) affects 2-3% of the population, and approximately 20% of these patients are refractory to medical and behavioral therapy. These patients may be candidates for stereotactic radiosurgery capsulotomy (SRSC). In this study we identified SRSC lesion locations predicting favorable outcome, as well as lesion prefrontal connectivity.

Methods: SRSC Lesions were traced on T1 scans in 30 OCD patients, and transformed to standard imaging space. Yale-Brown Obsessive Compulsive Scale (Y-BOCS) reduction was regressed against a threshold-free cluster enhanced voxel-wise analysis of lesions. Tractography was performed on 40 patients from the Human Connectome Project, using the significant cluster center as a seed.

Results: 24 of the 30 participants (80%) were full responders. A cluster (Fig1), centered in the right internal capsule, correlated with outcomes (corrected p < 0.05). Tractography showed that fibers through this cluster radiate to inferior medial prefrontal cortex (Fig2).

Conclusion: SRSC remains an effective treatment for refractory OCD. These results suggest a specific area in the right ventral capsule whose inclusion increases the likelihood of response. This region demonstrates connectivity to the orbitofrontal and ventromedial prefrontal cortex, highlighting the importance of these regions in OCD pathophysiology. Further analysis of individual variability and connectivity will be essential for improving outcomes.



outcomes. This seed was used for subsequent tractography analysis.

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OP04: Deep Brain Stimulation of the Medial Forebrain Bundle: Marked Responses in Treatment Resistant Depression

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Keywords: deep brain stimulation; tractography; medial forebrain bundle; treatment resistant depression

Abstract:

Background: Treatment resistant depression (TRD) is a serious and debilitating disorder. Deep brain stimulation (DBS) to the superolateral branch of the medial forebrain bundle (MFB) has been reported by Schlaepfer et al. (2013) to lead to rapid antidepressant effects. Here, we report the interim analysis of an ongoing pilot study investigating the efficacy of DBS- MFB in TRD. This report extends our recently published results (Fenoy et al., 2016).

Methods: We assessed the efficacy of MFB-DBS in a cohort of six TRD patients over a 52-week period using improvement on the Montgomery-Åsberg Depression Rating Scale (MADRS) as the primary outcome measure. Implanted patients entered a 4-week single-blinded sham stimulation period prior to stimulation initiation. Deterministic fiber tracking analysis was performed to compare modulated fiber tracts between patients.

Results: Upon stimulation at target intraoperatively, responders reported immediate increases in energy and motivation. During a 4 week sham stimulation phase, there was no significant mean change in mood. After initiating stimulation, 3 of 6 patients had a >50% decrease in MADRS scores relative to baseline at 7 days. The difference in MADRS score between baseline and week 1 of active stimulation was significant (mean change = 15 pts, 43% reduction, p = 0.005) as was the difference between baseline and week 2 (mean change = 17 pts, 49% reduction, p = 0.001). One patient withdrew from study participation for personal reasons. At 26 weeks, 4 of 5 patients have >75% decrease in MADRS scores relative to baseline. At 52 weeks, 2 of 3 remaining patients continue to have >80% decrease in MADRS scores; 2 patients have not yet completed their 52 week assessments. Evaluation of modulated fiber tracts reveals significant frontal connectivity to the target region in all 5 responder at 26 weeks.

Conclusion: This study of MFB-DBS shows rapid anti-depressant effects within the first week of stimulation, as reported by Schlaepfer et al. (2013). The striking effects observed are very promising, but we await full completion of this pilot study before drawing further conclusions about efficacy.

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OP05: Sweet Spot of antidystonic effect in pallidal neurostimulation: a European multicentre imaging study

Authors:

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Keywords: Dystonia, DBS, imaging

Abstract:

Objective: We investigated Volumes of Tissue activated (VTA) in dystonia subjects under effective bilateral pallidal DBS. We aimed to disentangle the sweet spot for dystonia suppression within the pallidal region.

Background: GPi-DBS is an established therapy for generalized and cervical dystonia. Average improvement of dystonia severity amounts to 50-60%, but outcomes are often variable and clinical studies report up to 25% non-responders. Variability in electrode placement may account for a large proportion of outcome variability. So far no study has been able to identify an "optimal efficacy volume" within the GPi.

Methods: 85 subjects with dystonia (41 cervical mean TWSTRS 20.3 ± 3.6 points/44 generalized dystonia, mean BFMDRS 45.8 ± 20.5 points) under chronic bilateral GPi-DBS from 8 European DBS centres were stratified for chronic motor improvement (median reduction of $46.7(\pm27.7)$ % after 12.0 months in cervical / median reduction of $52.3(\pm35.9)$ % after 34.8 months in generalised dystonia). We simulated VTAs for each lead in subject's related MRI space based on chronic stimulation parameters obtained from a chart review and associated with BFMDRS/TWSTRS improvement. All patient images were registered to a common average MRI. Only VTAs with a motor improvement >50% were taken for the visualisation of three different areas, defined by allegorizing only voxels that were overlapped by >15(*green*); >30(*orange*) VTAs and the "sweetspot", overlap volume of >50(*red*) VTAs.

Results: Wide variability of lead location, stimulation parameters and chronic motor improvement was observed in this cohort of 85 subjects. VTA size did not exhibit a significant correlation with improvement in motor symptoms. Model-based analysis of 108 responding VTAs showed a core mean volume (="sweetspot") located within and below the ventroposterior GPi. Stereotactic coordinates of the center of gravity were *lateral: 20.0, anterior: 2.3 and inferior 2.6* (based on AC-PC in mm).

Conclusions: In this study, we showed that the magnitude of current injection is not decisive for the therapeutic DBS effect. *In fact*, the outcome is highly correlated with the precise location of neuromodulation within the region of interest. The most beneficial (sweet-)spot hints to a relevant contribution of subpallidal white matter, which could indicate a possible modulation of the ansa lenticularis for the anti-dystonic effect of DBS in addition to stimulation of the presumed sensorimotor region of the GPi.

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OP06: A phase I pilot study of magnetic resonance-guided focused ultrasound pallidotomy for Parkinsonian dyskinesia

Authors:

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Keywords: Parkinson disease, Dyskinesia, Magnetic resonance imaging, Focused ultrasound, Pallidotomy

Abstract:

Objectives: Recently, magnetic resonance-guided focused ultrasound (MRgFUS) has emerged as an innovative treatment for numerous neurological disorders. This clinical trial was designed to identify the feasibility, effectiveness, and potential side effects of unilateral MRgFUS pallidotomy for the treatment of Parkinsonian dyskinesia.

Methods: Ten patients with severe, medication-refractory Parkinson's disease (PD) with motor fluctuation underwent unilateral MRgFUS pallidotomy using the Exablate 4000 device (Insightec, Israel) between December 2013 and May 2016. All patients provided written informed consent. Clinical assessments were conducted to evaluate the therapeutic effects after unilateral MRgFUS pallidotomy and according to our follow-up protocol. Technical failure and safety issues were also carefully assessed by monitoring all events during the study period.

Results: Seven of ten patients were followed-up for at least six months. Three patients were dropped from the study for various reasons. All patients who underwent MRgFUS pallidotomy experienced immediate and sustained improvements in dyskinesia, particularly in the treated hand. This reduction was accompanied by functional improvement in activities of daily living. However, thermal lesioning via MRgFUS also failed in several cases. In addition, several side effects were associated with MRgFUS, although no patient experienced persistent aftereffects.

Conclusion: In the present study, which marks the first phase I pilot study of unilateral MRgFUS pallidotomy for advanced PD, we demonstrated the benefits of unilateral MRgFUS pallidotomy in PD, as well as certain limitations of this technique associated with incomplete thermal lesioning of the globus pallidus interna.

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OP07: Comparing 12 month treatment outcomes for intensive psychological therapy (ITP) and Anterior Cingulotomy (ACING) for severe OCD

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Keywords: anterior cingulotomy, psychiatric neurosurgery, OCD, CBT, outcomes

Abstract:

Objectives: To describe and compare the clinical outcomes for two consecutive series of patients within our clinical service receiving either intensive psychological therapy (ITP) or bilateral anterior cingulotomy (ACING) for chronic severe OCD.

Methods: We reviewed data from the 8 most recent patients completing our intensive treatment programme and also the 5 most recent patients treated neurosurgically (ACING). All ACING patients had previously failed to achieve a sustained improvement from an intensive treatment programme. In controlled treatment trials, a decrease of greater than or equal to 35% on the Yale Brown Obsessive Compulsive Rating Scale (Y-BOCS) is generally considered a clinically meaningful treatment response, with a reduction of greater than or equal to 25% a significant, but lesser improvement. Outcomes were examined at the following time-points: baseline (pre-treatment); immediate post treatment (discharge); and 12-months after treatment.

Results: Prior to treatment, ITP group Y-BOCS severity scores were in the moderate to extreme range (30.25±5.4) whilst the ACING patients were in the severe to extreme range (32.4±5.7). At discharge, 50% of the ITP group achieved a clinically meaningful response to treatment; 13% achieved a lesser, but significant response; whilst 37% failed to benefit from treatment. Of the ACING patients 40% achieved a clinically meaningful response, whilst the remaining 60% showed no response. This equates to the ITP group experiencing an average 30.5% improvement in symptom severity (20.21±8), compared to 22.4% improvement for the ACING group (19.75±9.8). However, at 12 months the ITP group showed **no change** in response rates and maintained a 30.3% overall improvement in Y-BOCS severity scores (20.25±8.8), but the ACING group **continued to progress** with 60% of patients now achieving either a significant or a clinically meaningful response; with remaining patients, although not achieving a significant response, gaining a 20% overall reduction in their Y-BOCS severity scores (25.5±3.5). This gives the ACING group an overall improvement at 12 months of 48.5%.

Conclusion: Improvements made on discharge by ITP patients were maximal, with no additional improvements over the following 12 month period. ACING patients, however, continued to improve. This suggests that the trajectory of response following surgery may differ from that of ITP.

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OP08: Gamma Knife subthalamotomy for Parkinson's disease: A prospective trial

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Keywords: STN, hemiballism, safety, efficacy

Abstract:

Objective: To assess the feasibility of Gamma Knife subthalamotomy in Parkinson's disease.

Background: Chronic STN stimulation is an established treatment for complicated PD. Bilateral subthalamotomy may induce significant and long-lasting results when DBS is not available. However, which alternative can be proposed for patients with surgical contraindications for electrodes implantation? Gamma Knife (GK) thalamotomy is an effective therapy for treating disabling tremor. This technique encounters very few contraindications. We report the results of a prospective trial on GK Subthalamotomy for patients with absolute contraindications for DBS. The primary endpoint was tolerance.

Methods: 14 PD patients (10men, mean age 66.4) with severe motor complications were included. STN DBS was contraindicated because of vasculopathy or anticoagulant treatment. Patients were assessed before and quarterly for at least 24 months after GK subthalmotomy. A unilateral GK subthalamotomy on the most affected side was proposed first followed by contralateral subthalamotomy after M12 if necessary. STN lesioning was performed with Leksell Gamma unit with a single exposure through a 4mm collimator. Radiosurgical dose was 110Grays.

Results: 12 patients were assessed at 2 years. 2 patients died before M6 (stroke, suicide). 7 patients had bilateral GK subthalamotomy, 5 unilateral (2 previous contralateral STN DBS, 2 refusals, 1 unilateral disease). UPDRS motor score was improved by 17.6% at M24, motor fluctuations by 18% and dyskinesia were reduced by 66%. Cognitive score was stable except for one patient. No significant decrease in LEDD was observed. MRI STN lesion appeared 9 months after radiosurgery. One patient was a hyporesponder and 4 had an hyperresponse with clinical consequences: Severe transient dyskinesia (2), transient hemiparesia and delirium (1), permanent hemiplegia.

Conclusions: Apart from a significant decrease in dyskinesias, the patients did not improve following STN GK and several experienced adverse effects. Although the cohort is small and with high comorbidities, this study does not indicate that GK subthalamotomy may be a good alternative to DBS for advanced PD.

OP09: Quantifying activation of the hyperdirect pathway during subthalamic deep brain stimulation

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Keywords: Axon, Model, Action Potential

Abstract:

Deep brain stimulation (DBS) of the subthalamic region is an established clinical therapy for the treatment of late stage Parkinson's disease. A fundamental biophysical effect of DBS is the generation of action potentials in axons surrounding the stimulating electrode. One axonal pathway of special interest is the corticofugal hyperdirect pathway to the subthalamic nucleus. Therefore, we developed a highly detailed patient-specific DBS model to study hyperdirect activation and action potential propagation. The DBS patient model was based on 7T MRI data. Subcortical nuclei were segmented from T1-weighted, T2-weighted, and susceptibility-weighted images. The hyperdirect pathway was reconstructed, as well as the internal capsule, with the assistance of tractography derived from diffusion-weighted images. Each of the 5000 axons reconstructed were modeled as a multi-compartment cable structure. The voltage distribution generated by the DBS electrode was calculated using a finite element method. This voltage distribution was then used to stimulate the model axons, and the response of the axons to DBS was quantified. We found that the hyperdirect pathway was robustly activated at the clinically effective stimulation parameters. In addition, we found that hyperdirect axons must be of especially large axon diameter (~10 um) to match the signal conduction velocity necessary to generate the cortical evoked potentials (~1 ms delay) recorded experimentally in DBS patients.



OP10: Estimation of effective target area in the globus pallidus during deep brain stimulation for Tourette syndrome

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Keywords: Tourette syndrome, deep brain stimulation, globus pallidus, finite element simulations

Abstract:

Objectives: Deep brain stimulation (DBS) of the anteromedial globus pallidus internus (amGPi) is emerging as a helpful method for severe cases of Tourette syndrome (TS) in adult patients but the optimal target is still under investigation.

Methods: Patient-specific finite element method simulations of affected voxels were made in 15 patients in order to determine which are associated with symptom improvement at latest follow up (17-82 months from surgery). The equation for steady currents was solved with electric conductivities estimated from tissue classification into grey matter, white matter and cerebrospinal fluid in T1-weighted preoperative images. Voxels experiencing an electric field intensity sufficient to trigger axons with a diameter of 2 µm were assumed to be activated and were co-registered with the MNI 152 averaged T1-weighted brain space in which linear regression between each voxel and the DBS outcome scores were performed.

Results and conclusion: Tics (YGTSS: p < 0.0001) and mood (BDI: p = 0.012) improved significantly by DBS while obsessivecompulsive behavior (OCB) improved for some severe cases but the improvements did not reach statistical significance for the whole group. It was found that an area of the anterior pallidum encompassing the medial medullary lamina between GPi and GPe, and at the level of the AC-PC line, was significantly related to tic improvement. Improvements in mood or OCB could not be significantly associated with any specific area.



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OP11: Crucial white matter tracts involved in successful sIMFB DBS in major depression

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Keywords: depression, DBS, Diffusion Tensor Imaging, Psychiatric surgery

Abstract:

Introduction: The superolateral branch of the medial forebrain bundle (sIMFB) is currently investigated as a putative DBS target for the treatment of major depression (MD) and OCD. DTI FT- assisted targeting is necessary. A total of 24 patients have been bilaterally implanted and stimulated for MD at our institutions in two IITs. We present a first analysis focusing on the effectively stimulated fiber tracts and their connections using probabilistic DTI FT.

Methods: n=24, 9f, 47.3+/-10.5 years. Imaging data consisted of high-resolution anatomical T1W and T2W MRI sequences (3T, Philips Intera, Best, Netherlands) and 32-direction diffusion tensor imaging. Postoperative (after DTI assisted DBS (1)) helical CT scans were used to delineate electrode positions. A complex pipeline of Probabilistic streamline tractography was performed with MRtrix 3 (http://www.mrtrix.org/).

Results: A total of 21 data sets had sufficient quality for further evaluation. In all cases only the sIMFB and not the inferomedial branch of the medial forebrain bundle (imMFB) where included in the VAT, as expected. On the group level (not normalized), fibers that were affected by DBS connected bilaterally to the nucleus accumbens, the corpus callosum and the medial prefronal cortex (BA 24 and 32). The strongest connection was seen with the rostral prefrontal cortex (BA10) and BA46 (but only before normalizing data).

Conclusion: The presented data supports the modulation of a widespread network containing the rostral prefrontal cortex and parts of the forceps minor and the medial prefrontal cortex in sIMFB DBS together with subcortical structures of the reward system. BA10 is a unique part of the human brain. Involvement of this region has also been described before with cg25 as target regions (2). BA10 might represent a common denominator for antidepressant efficacy. A combined modulation of cortical and subcortical structures might explain the short and long-term clinical effects (2).

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OP12: Six-month outcomes of tractography targeted subgenual cingulate DBS for treatment resistant depression

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Keywords: DBS, treatment resistant depression, subgenual cingulate

Abstract:

Background: The subgenual cingulate (SGC) is an investigational target for DBS in treatment-resistant depresion (TRD). Case series have reported 40-60% response rates, however a large industry sponsored randomized sham controlled trial failed futility analysis and closed accrual prematurely. In 2013, we developed an open label study to examine the safety and efficacy of SGC DBS using two types of stimulation (long pulse width or high amplitude) and targeted the confluence of uncinate, frontothalamic, cingulate and forceps minor using 3T MR tractography.

Methods: In this pilot study of bilateral SGC-DBS we enrolled 23 patients with TRD (12M: 11F, mean age 47, range 23-69) into two different DBS protocols: 'short pw', where we increased amplitude (from 4-8 V, keeping pulse width at 90 µs, 130 Hz); 'long pw', where we increased pulse width (from 210-450 µs, keeping 3 V, 130 Hz) monthly based on response. Non-responders at 6 months were crossed over to the other stimulation protocol for another 6 months. Study psychiatrist and patients were blinded to stimulation type. Primary outcome was the Hamilton Depression Rating Scale (HDRS-17) and 50% reduction from baseline was considered response. Several other scales, imaging (PET, MRI), electrophysiological (EEG), and chemical biomarkers were also obtained.

Results: Among the 23 patients enrolled one did not receive an implant and another committed suicide shortly after surgery. Six month outcomes are available in 18 patients, at present. HDRS-17 scores improved from a baseline of 23.2 ± 3.9 (mean \pm SD) to 12.7 ± 6.0 at 6 months (paired t-test, t=5.9, p<0.001), with 9 of 18 patients fulfilling response criteria. Responders were younger than non-responders (37.6 ± 11.9 vs. 54.0 ± 13.2 , p=0.014). Four responders were on long pulse duration DBS. Aside from the 1 suicide and 3 intra-op seizures, no complications were encountered at the 6 month time point.

Conclusion: Our preliminary results support ≈50% efficacy of SGC DBS for TRD. The surgery is overall safe and phenytoin prophylaxis has eliminated the seizure complications. There is no obvious advantage of one type of stimulation over the other, which may suggest that optimization of stimulation over time is more important than type of stimulation. We are examining possible predictive biomarkers of response, however these data suggest that younger patients do better. FUNDING: Alberta Innovates Health Solutions.

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OP13: Characterizing capsulotomy targets for OCD based on frontal structural connectivity

Authors:

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Keywords: OCD, capsulotomy, DTI, neuroimaging

Abstract:

Introduction:Although most patients with obsessive-compulsive disorder (OCD) are well controlled with pharmacological and cognitive behavioral therapy, 10-20% remain severe and refractory. Stereotactic lesions in the anterior limb of the internal capsule (ALIC) have been used for decades to treat these patients. However, there is controversy about optimal sites for lesions within the ALIC as different locations appear to have variable efficacy in alleviating symptoms. Using diffusion tensor imaging (DTI), we segmented the ALIC based on frontal connectivity and used the resulting segmentation to evaluate capsulotomy targeting in OCD.

Methods: A segmentation of the ALIC based on frontal structural connectivity was generated using connectivity-based seed classification on 40 control subjects from the Human Connectome Project (HCP) (Figure 1a). Literature review revealed five differentially defined stereotactic radiosurgical (SRS) and radiofrequency (RF) targets for capsulotomy for OCD performed between 2003 and 2014. Capsulotomy lesions were modeled as 5mm-spheres centered on these targets (Figure 1b) and were evaluated for overlap with the created ALIC segmentation and with surrounding gray matter structures (Figure 1c). Modeled lesions were used as seed regions for deterministic tractography on an 842-subject diffusion data template from HCP in order to identify involved connectomic networks.

Results: Across the five targets, a mean of 25.4% of modeled lesions overlapped with the ALIC by volume. Means of 16.2%, 12.7%, and 36.8% of modeled lesions coincided with nucleus accumbens, caudate, and putamen, respectively. According to the ALIC segmentation, a mean of 63.9% of the volume of modeled lesions within the ALIC intersected with the subregion connecting primarily to Brodmann area 11 (orbitofrontal cortex, OFC). All five modeled lesions exhibited connectivity to OFC as per the 842-subject HCP template (Figure 2).

Conclusion: These results indicate that anterior capsulotomies for OCD have generated lesions extending outside of the ALIC. The overlap between lesions and gray matter structures surrounding the ALIC could represent incidental effects of capsulotomy or it could possibly represent alternate therapeutic mechanisms. These findings also suggest that capsulotomy for OCD may involve the modulation of frontal-subcortical tracts connecting to the OFC, which bears relevance to the cortico-striato-thalamo-cortical (CSTC) model of OCD pathophysiology.

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OP14: Graphical analysis of lead position in regard to outcome for nucleus accumbens/anterior limb of internal capsule (Nacc/ALIC) deep brain stimulation (DBS) in obsessive compulsive disorder (OCD)

Authors:

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Keywords: DBS, deep brain stimulation, OCD, obsessive compulsive disorder, Nacc, Nac, nucleus accumbens, ALIC, VC/VS, anterior limb of internal capsule, target, Suretune

Abstract:

Objective: OCD is a sometimes debilitating psychiatric disease with a 2% lifetime prevalence. Up to 10% of patients do not respond to conservative treatment. For severe cases, DBS targeting the Nacc/ALIC is a viable option, receiving CE-mark in 2009. However, because of variable success rates and side effects, 8 different targets have been proposed for OCD in the last 18 years - the search for a hotspot continues.

In this study, using a novel visualization software, we correlated lead position and resulting volume of tissue activated (VTA) with clinical outcome and side effects in order to narrow down the optimal target area.

Methods: We analyzed data for 16 consecutive patients treated at our center over a period of 3 years with DBS of the Nacc/ALIC, following a routine targeting procedure. Based on improvement on the Yale-Brown obsessive compulsive scale (YBOCS) and clinical profit at 12 months follow up, four outcome groups were defined. Subgroups were also designated for unexpected side effects.

Individual ROIs from all patient hemispheres were stacked to create a median intensity image, and then registered to the resulting intermediate to create a common anatomical space (Patient average MRI, PAM). Using the Suretune Expert Tuning Tool software (Medtronic), the location of the individual contacts used and the resulting VTA were aggregated into the PAM and probabilistic stimulation maps (PSM) were calculated. The adapting Yelnik-Bardinet atlas was aligned to the PAM as an anatomical reference.

Results: The graphical analysis indicates anatomical localization to be correlating with both clinical outcome as well as sideeffects. PSM of non- and fair responders were revealed to be distinct from - but nearby to - the PSM of good and excellent responders. All patients reporting unwanted weight-gain had their active contacts clustered in a circumscript area, independent of their improvement in OCD. These patients are followed up with a multidisciplinary approach to further elucidate the underlying mechanism.

Conclusion: While data and analysis is preliminary, this novel tool shows promise for correlation of lead location and clinical effect in the way that PSM suggest an area of best profit. The results also open the way for further research into the insufficiently understood side effect of weight gain through DBS in OCD.

OP15: Identifying brain regions implicated in OCD using simultaneous EEG-fMRI

Authors:

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Keywords: fMRI, EEG, OCD, neuroimaging, psychiatric disorders, cognitive control

Abstract:

Obsessive-compulsive disorder (OCD) affects 2-3% of the American population. Patients suffering from severe, refractory OCD have limited therapeutic options. Neurosurgical interventions (e.g. deep brain stimulation (DBS) and stereotactic lesions (cingulotomy, capsulotomy)) are currently employed in treating OCD, but are limited in their applications owing to the complexity of potential targets and involved circuitry. Therefore, it is essential to delineate imaging correlates of pathological circuits in OCD. The objective of this study is to use multimodal imaging (simultaneous EEG-fMRI) to identify specific brain regions that are implicated in OCD.

We used multimodal imaging to identify correlates of cognitive control impairment that correspond to OCD by comparing results from healthy controls (n=6) and patients with severe, refractory OCD preparing to undergo neurosurgical intervention (n=5). We simultaneously acquired fMRI and EEG data while subjects engaged in the Multi-Source Interference Task (MSIT), a Stroop-like cognitive interference task that is known to engage the dorsal anterior cingulate cortex (dACC). Cue-locked midline frontal theta power (4-8Hz) from EEG was used in the general linear model as a modulator of fMRI regressors. Implicated regions were determined by thresholding the images at a corrected cluster significance of p = 0.05.

Results from the EEG analyses confirm that midline frontal theta power, as measured at electrode Fz, is modulated during the MSIT. Additionally, we observed increased task-relevant BOLD activations in the dorsolateral prefrontal cortex (dIPFC) in the control group and in the dIPFC, supplementary motor area (SMA) and the insula for the OCD group. Compared to controls, OCD subjects exhibited increased BOLD activations in the OFC, insula, and the dIPFC in high conflict versus low conflict trials (Figure 1). These results are specific to the cue-locked analysis using an EEG-informed fMRI model and were not observed in the fMRI-only model.

We used simultaneous EEG and fMRI in this study to overcome their respective limitations in spatial and temporal resolution. The fMRI model incorporated behavioral task (trial type and reaction times) and EEG data, thereby optimizing the information obtained from the neural signals. The results of this study are a step towards precisely understanding the dysfunction of cognitive control in OCD and delineating specific regions in the brain that are implicated in OCD.



Figure 1: Increased activation in the OFC, insula and dlPFC in OCD subjects versus control subjects when comparing Conflict and no-Conflict conditions using an EEG-informed fMRI model.

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OP16: Deep brain stimulation in the caudal zona incerta for essential head tremor: Long-term results

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Keywords: essential tremor, deep brain stimulation, zona incerta, posterior subthalamic area, DBS, head tremor

Abstract:

Background: Essential tremor (ET) is the most common adult movement disorder and is usually confined to the upper extremities. However, head and voice tremor is also common, with reports indicating the prevalence of head tremor to be around 50%.

Objective: The aim of this study was to analyse the short- and long-term results in a patient cohort with essential head tremor treated with DBS in the caudal Zona incerta (cZi).

Methods: Retrospective analysis of patients fulfilling the following criteria: Essential tremor (ET); Unilateral or bilateral cZi-DBS without previous DBS or lesional surgery on either side; Completed evaluation with Essential Tremor Rating Scale (ETRS) at baseline before surgery and on/off stimulation at short-term follow-up 12 months after surgery, and at long-term follow-up, at least 24 months after surgery.

15 patients with unilateral and 2 with bilateral DBS, thus in total 19 leads were identified and included in the present study. The two bilaterally implanted patients were evaluated separately for each side and analysed as two unilateral procedures. Friedman test with Wilcoxon as a post hoc analysis was used for ordinal values. One-way ANOVA with repeated measurements with Bonferroni correction was used for continuous variables. A *p-value<0.05* was considered significant.

Results: Of 36 unilateral and 12 bilateral DBS procedures fulfilling the inclusion criteria, 15 and 2, respectively, had head tremor. Nine were women and 12 men with a mean age at surgery of 70.4±9.3 years. Evaluations were done at a mean of 12 months and 35 months after surgery.

Total ETRS before surgery at baseline was 55.5 ± 10.3 points. This was improved by 55% and 54% with unilateral stimulation at short-term and long-term follow-up, respectively ($p\leq0.00001$). Contralateral tremor of the hand (item 5/6) was improved by 94% with stimulation at short-term and by 83% at long-term follow-up ($p\leq0.00001$). The mean head tremor score was reduced from 1.7 at baseline to 0.2 with stimulation at both short- and long-term follow-up (88%, $p\leq0.0001$).

The mean coordinates of contacts used for stimulation was 11.7 mm lateral to the AC-PC-line, 6.8mm posterior to the midcommissural point (MCP) and 2.1 mm inferior to the MCP. The mean coordinates did not change over time.

Conclusion: Unilateral stimulation in the cZi was effective in alleviating essential head tremor and the effect did not diminish over time.

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OP17: Comparison of 1.5, 3.0 and 7.0-Tesla MRI for STN targeting in DBS

Authors:

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Keywords: Deep Brain Stimulation, Magnetic Resonance Imaging, Subthalamic Nucleus, targeting

Abstract:

Background: High field MRI is expected to increase visibility of STN contour representation and considered an advantage for direct planning in STN DBS. Whether this results in significant alterations of target coordinates in comparison to lower field strengths is currently unknown.

Objective: Evaluating possible influence of different field strength T2-weighted MRI on STN target planning.

Methods: STN target planning was performed by three DBS surgeons on 1.5, 3.0 and 7.0-Tesla MRI in order to evaluate if higher field strength leads to significant alterations of STN target coordinates. For all sequences X, Y and Z coordinates were compared.

Results: Direct planning of the target point based on STN representation on 1.5 Tesla, 3.0 Tesla and 7.0 Tesla showed high correspondence for X, Y and Z coordinates between the three field strengths (intra-rater) and between surgeons (inter-rater).

Conclusion: STN targeted coordinates were comparable on 1.5, 3.0 and 7.0-Tesla T2-weighted MRI. This could be explained by the fact that visibility of anatomical references used for target planning as red nucleus and medial STN border were comparable on the different sequences.

Figure: Axial midbrain section showing STN at maximal diameter of RN on three different MRI sequences. The horziontal red dotted line coincides with the Bejjani line, the cross section of the lines coincides with the medial STN border, identification of both references is readily done on all field strengths.



OP18: Defining the dorsolateral STN using 7-Tesla MRI

Authors:

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Keywords: Deep Brain Stimulation, Subthalamic Nucleus, Magnetic Resonance Imaging

Abstract:

Background: 7-Tesla T2-weighted Magnetic Resonance Imaging (MRI) offers improved visibility of the dorsolateral subthalamic nucleus (STN), which is considered the optimal location for deep brain stimulation (DBS) in Parkinson's Disease (PD). However, it is unknown whether the dorsolateral STN on 7-Tesla T2 corresponds to the neurophysiological location.

Objective: To compare dorsolateral STN border identified on 7.0-Tesla T2-weighted MRI with the border obtained during microelectrode recordings (MER) in patients undergoing DBS for PD.

Methods: Dorsolateral border identification was done using axial and coronal orientated 7.0-Tesla T2-weighted MRI. This was compared to dorsolateral border identified by MER.

Results: A total of 108 microelectrode tracks were evaluated in 19 patients. For the central and anterior microelectrode channel, the dorsolateral STN border on MRI was located more superior in 74% of trajectories compared to MER. Average distance from MRI to MER border was 1.0 millimeter.

Conclusion: 7-Tesla T2 MRI offers the possibility of dorsolateral STN identification. In the vast majority of cases this border was located more superior compared to MER. For STN DBS, the optimal location on 7-Tesla MRI is located just below the dorsolateral border.

Figure: Axial and coronal midbrain sections showing optimal DBS location within the STN on three different MRI field-strenghts. The cross section of the two dotted red lines coincides with the defined optimal DBS location.



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OP19: Frequency and Characterization of Lead Revision and Removal Rates following DBS from the Product Surveillance Registry

Authors:

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Keywords: DBS, Complications, Leads

Abstract:

Background: Previous retrospective studies of DBS lead revision and removal rates conducted at single sites have reported a percentage between 4.7-12.4%. However, patient follow-up time in these analyses had wide variation. A recent retrospective report evaluating United States Medicare data, as well as from a smaller patient cohort where data was collected at two sites, reported a revision and removal rate of 15.2% and 34.0%, respectively. In order to characterize the rates and types of events that result in lead revisions or removals in a prospective study, information was analyzed from the Product Surveillance Registry (PSR). The PSR tracks data across a large practice population beyond Medicare or single payor systems. It provides insights in how the therapy is utilized at DBS implanting and managing centers while collecting product and safety information on DBS systems and patients.

Methods: Data was analyzed on 2109 DBS patients registered from July 2009-2016 from 36 centers located in three continents. Lead survival was the primary endpoint, and analyses were performed to quantify the duration of time until a lead revision or removal occurs while adjusting for varying lengths of post-implant follow-up time.

Results: Of the 2109 DBS patients, 67.1% were implanted for Parkinson's disease (n=1416), 21.3% for Essential Tremor (n=449), 7.1% for Dystonia (n=150), and 4.5% for other indications (n=94). Based upon survival analyses for all indications, lead revision and removal rates were 2.7% at 6 months and 7.9% at 57 months. There were no observed differences by indication; however the study was not powered for that endpoint. The technical reasons for lead revision and removal were unacceptable lead impedance issues (6/16), lead fracture (5/16), and lead migration (5/16). Whereas, the reasons for lead revision and removal due to non-technical reasons were device-related infections (39/57), other infections (6/57), implant site erosion (4/57), wound dehiscence (4/57), subdural hygroma (2/57), and other reasons (2/57).

Conclusion: Results from this large, prospective global registry demonstrated lead revision and removal rates of 7.9% at approximately five years post-implant. Lead revision and removals were predominately due to non-technical issues such as infection versus technical issues. Further analyses of this registry over time will enable comparison across anatomical lead locations or other variables of interest.

Figure 1. DBS Lead Survival to Revision or Removal



Data are shown if there are at least 20 devices in each 3-month interval

OP20: Impact of segmented leads in deep brain stimulation

Authors:

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Keywords: DBS, segmented leads

Abstract:

Introduction: Deep Brain Stimulation is an established treatment modality in various movement disorders. Targets are usually located within the basal ganglia. Due to the proximity of the target points to critical functional structures as the internal capsule, therapeutic yield might be limited by side effects. Furthermore energy consumption is potentially higher in conventional monopolar stimulation. Recently, segmented DBS leads have been made available. This technique comes with the promise of increased efficacy and side effect reduction. We therefore compared our preliminary data with segmented leads with the data from the Libra study conducted 4 years ago. Materials/Methods: The purpose of the Libra study was to evaluate the effects of a new Deep Brain Stimulation System for reducing symptoms of advanced, Parkinson's disease Also the Activities of Daily Living, UPDRS scores, Quality of life of subject, device parameters including active contact in relation to efficacy, frequency, type and severity will be compared to the Libra data (6 patients).

Results: DBS Targeting was guided by three micro electrode recording tracts and a directional lead system (Infinity DBS, SJM) was implanted in an all-in-one GA setting in 6 patients. The segmented contacts were intensively tested at 90µs and 130 Hz in the postoperative course. Distinct effect/side-effect patterns for each contact were observed. Comparison of Parkinson's symptoms as demonstrated by the UPDRS motor scores in the medication "off" state at Baseline compared to the medication "off" with stimulation "on" 3 months after device implantation. No differences in efficacy where seen between Libra and Infinity data among those 6 patients. However compared to the Libra data, no stimulation dependent side effects occurred in the Infinity group. Amplitude and frequency did not differ, however lower pulse width was used in 2 patients.

Discussion: Segmented leads allowing current steering offer new perspectives for DBS and will likely result in increased treatment efficacy while reducing side effect at the same time.

Conclusions: Since the threshold for side effects is higher in segmented leads, they are more adaptable to the individual patients' needs and potentially resulting in a longer battery life

OP21: How does vagal nerve stimulation modify functional connectivity? A study based on intracerebral EEG recordings and comparison between 'on' and 'off' stimulation periods

Authors:

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Keywords: Vagal nerve stimulation mechanisms of action deep recordings

Abstract:

Introduction: The mechanisms of the anti-epileptic action of vagal nerve stimulation (VNS) are still poorly understood. In this study, we investigated the impact of VNS on functional connectivity (Fc) using direct intracerebral recordings of several cortical areas (SEEG) by comparing the "on" versus "off stimulation periods.

Methods: Six patients with drug resistant epilepsy who underwent SEEG recordings during ongoing VNS therapy were investigated. Five patients were regarded as non responders to VNS whereas one was deemed responder (> 50% seizure-frequency decrease). SEEG signal was acquired during resting periods without sleep at a distance from seizures. The functional connectivity was computed from co-occurrence of signal estimated by nonlinear regression analysis based of h^2 coefficient between pairs of selected bipolar SEEG channels from all sampled cortical areas of the patients. Comparisons were performed during 'on' and 'off' periods of stimulation. The parameters were similar to those chronically used for the patients. For four patients, different stimulation amplitude were also tested and in one patient different stimulation frequencies and pulse widths.Levels for significance were adjusted according to Bonferroni's method.

Results: In comparison with 'off' periods, the 'on' periods disclosed significantly higher values (increased Fc) for five patients (P1, P3, P4, P5, P6) and lower values for one patient (P2). In P6, we observed a significant but nonlinear effect of stimulation parameters on Fc (Fc increased by setting the frequency from 20 to 25 Hz, the amplitude from 1 to 1.25 mA or the pulse-width from 250 to 500µs but without additional effect of setting the parameters to higher values (*plateau* effect).Finally, the only decreased Fc occurring during VNS corresponded to the responder patient suggesting that the therapeutic benefit might be related to this mechanism.

Conclusion: Our study suggests that VNS alters brain functional connectivity but in a complex and variable way according to the brain areas and parameters settings. The only patient in whom the functional connectivity was decreased was the only patient deriving a true benefit from VNS. The study is too preliminary to draw any solid conclusion but the mechanisms of action may involve a decrease in Fc. These results are consistent with the existing literature (decreased Fc of interictal activity during VNS in responders).

OP22: Comparative Analysis of pre- and post-operative Magnetoencephalography for Patients with Medically Intractable Epilepsy

Authors:

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Keywords: epiepsy, Magnetoencephalography, outcome, electroencephalography

Abstract:

Objective: Magnetoencephalography (MEG) is a functional neuroimaging technique for mapping brain activity by recording magnetic fields produced by electrical currents occurring naturally in the brain. The clinical uses of MEG are in detecting and localizing pathological activity in patients with epilepsy. Single dipole method is an established procedure for analyzing single or spatially and temporally limited activities such as interictal epileptiform activities; however, it has limitations for analyzing spatially propagated and temporally prolonged rhythmic magnetological activity including ictal data during the secondary generalization. Thus, a reliable confirmatory method for analyzing ictal MEG is needed. We analyzed MEG using time-frequency method. It estimated the time frequency component of the signal and it could show the spectral distribution of signal. In such spectral distributions, the gamma oscillation (GOS) is known as useful indicator of epileptogenic focus. In the present study, we investigated GOs of pre-and post-operative MEG to define it had value of prognostic factor.

Methods: From July 2012 to July 2016, a total of 31 patients received the pre- and post-operative MEG test. Among them, we selected ten patients which composed of 5 patients with seizure free and 5 with symptoms after surgery. We find to the epileptic spike on pre-operative electroencephalography (EEG), and then we estimate epileptogenic zone on the brain. Then, based on the EEG, we designate a region of interest location (ROI). Then, we did time frequency analysis of MEG for ROI.

Results: In seizure free group, all patients showed spike wave and GOs on pre-operative EEG and MEG. However, despite the absence of symptoms, spike wave and GOs were seen in one patient on post-operative tests. In the group with seizure after surgery, all patients showed spike wave and GOs on pre-operative tests. However, on post-operative tests, while three patients showed spike wave on EEG, a total of five patients showed GOs still on MEG. We evaluated the relationship between surgical outcome and epileptogenic sign. There was statistical significance between GOs and surgical outcome (p=0.048).

Conclusion: MEG could provide valuable information for post-surgical evaluations to define epileptic focus for patients with persistent symptom after surgery and GOs on MEG is correlated with epileptic focus. Ascertaining the presence of GOs on MEG after epilepsy surgery could predict the prognosis of seizures.

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OP23: Clinical Outcome and Location of Active Contacts in the Centromedian Thalamic Nucleus Deep Brain Stimulation in Refractory Epilepsy

Authors:

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Keywords: Centromedian nucleus, Deep brain stimulation, Epilepsy, Epilepsy surgery, Seizure, Thalamus

Abstract:

Objectives: To investigate the clinical outcome and location of active contacts in chronic centromedian nucleus (CM) deep brain stimulation (DBS) for refractory epilepsy.

Methods: The outcome of CM stimulation was evaluated with percent (%) seizure reduction compared to the baseline three months. To determine the location of active contacts, 27 leads in 14 patients with refractory epilepsy were studied. An analysis was conducted to determine whether any coordinates of the center of the active contacts predicted percent seizure reduction (Fig. 1).

Results: With an average follow-up of 18.2 ± 5.6 months, the mean percent seizure reduction (n=14) was $68 \pm 22.4\%$ (25-100%). Eleven of 14 patients (78.6%) could achieve >50% improvement in the frequency of seizure. Specifically, all four patients (100%) with generalized epilepsy (Lennox-Gastaut syndrome) and seven out of 10 patients (70%) with multilobar epilepsy showed >50% reduction in seizure frequency (Fig. 2).

The mean coordinates of center of the active contact were located in the superior part of anterior ventrolateral CM. The calculated coordinates of laterality from midline (x), anterior-posterior (y) and height (z) from posterior commissure (PC) did not correlate with seizure outcome measured by percent seizure reduction. However, the locations of active contacts used during chronic CM stimulation in multilobar epilepsy were identified more dorsal to those used in generalized epilepsy (Fig. 3).

Conclusions: Chronic CM stimulation is a safe and effective means in the treatment of refractory epilepsy.



Fig. 1. Deep brain stimulation (DBS) of the centromedian nucleus (CM) for refractory epilepsy. **Fig. 2.** Mean plot of percentage seizure reduction in the centromedian nucleus stimulation for refractory epilepsy.

OP24: Magnetic resonance-guided stereotactic laser amygdalohippocampotomy for mesial temporal lobe epilepsy is not inferior to anterior temporal lobectomy

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Keywords: Mesial Temporal Lobe Epilepsy, Epilepsy, Stereotactic Laser Amygdalohippocampotomy, Laser Interstitial Thermal Therapy

Abstract:

Objectives: Stereotactic laser amygdalohippocampotomy (SLAH) is a less invasive alternative to anterior temporal lobectomy (ATL) for medically intractable mesial temporal lobe epilepsy (MTLE). To properly compare SLAH to ATL, a large series with 12-month seizure outcomes is required. Here we present 12-month outcomes on 50 SLAH MTLE patients, the largest single center series. We hypothesized that ATL was superior to SLAH.

Methods: Outcomes 12-months following SLAH were retrospectively analyzed and the proportion of patients who were seizure free was compared to that following ATL, as demonstrated by the Wiebe et al. 2001 randomized controlled trial (64%). The outcome of patients who had recurrent seizures and underwent repeat SLAH (N=9) was re-categorized only if they were seizure free at 12-months. A performance goal of 43% seizure free was also set, the threshold at which SLAH is predicted to achieve higher quality adjusted life years than ATL (Attiah et al. 2015). A select subgroup of MTLE patients with mesial temporal sclerosis (MTS) and without evidence of dual pathology or previous epilepsy surgery was similarly analyzed as an "ideal MTS" subgroup (N=29).

Results: 56.0% (95% CI ±14.3%) of all patients, and 65.5% (95% CI ±18.4%) of the ideal MTS subgroup were seizure free for ≥12 months following all SLAH procedures. These outcomes were not significantly different from the ATL historical comparator group (all: p=0.24; ideal: p=0.87). Further, the ideal MTS subgroup's seizure free rate was superior to the 43% performance goal. Four of the 9 patients who underwent repeat SLAH became seizure free for ≥12 months, which was included in the above analysis. Four patients not seizure free following SLAH underwent ATL, only 1 of whom became seizure free. Complications were minimal, including 4 postoperative visual field deficits (1 transient; 1 disabling), 2 hemorrhages without persistent deficit and 3 transient cranial nerve palsies.

Conclusion: These results fail to reject the null hypothesis that there is no statistically significant difference between ATL and SLAH with respect to 12-month seizure freedom, supporting SLAH as a minimally invasive alternative to open resection for patients with MTLE. Additionally, consistent with ATL outcomes, a higher seizure free rate was achieved in the ideal MTS subgroup. Furthermore, in the minority of patients where seizure freedom remains elusive following SLAH, this procedure does not preclude subsequent open resection.

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OP25: Relevant behavioral events may be signaled by the Centromedian-Parafascicular Complex

Authors:

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Keywords: attention, intralaminar thalamus, local field potentials

Abstract:

Objective: The centromedian-parafascicular complex (CM-Pf) of the intralaminar thalamus was shown to be activated during attentional orienting and processing of behaviorally relevant stimuli. Therefore, the CM-Pf was suggested to be a part of a subcortical cognitive control loop. Here, we investigated the human CM-Pf and its involvement in processing of task relevant information during an auditory three-class oddball paradigm with simultaneous cortical recordings.

Methods: Simultaneous intracranial local field potentials (LFPs) and scalp electroencephalographic (EEG) recordings were obtained in 6 patients (2 woman; mean age=48±12 years) who received deep brain stimulation (DBS) electrodes in the CM-Pf for the treatment of their pain syndromes. Within 2 days after surgery, they performed an auditory three-class oddball paradigm with externalized DBS electrodes. Subcortical and cortical event-related potentials (ERPs) were analyzed upon presentation of one frequent standard stimulus (900Hz; 72%) and two infrequent stimuli (600Hz and 1200Hz; 14%), either being a relevant or a distractor stimulus.

Results: Analysis revealed high accuracy (>70%) for all participants. As expected, the rare relevant stimuli elicited a P3 response over parietal regions in the EEG. The P3 component of an ERP is known to reflect attentional processes in tasks requiring stimulus detection and discrimination. Recordings in the CM-Pf revealed highest amplitudes to the relevant stimuli as well. Interestingly, peak latencies of the CM-Pf precede the cortical P3 response.

Conclusion: The CM-Pf seems to be involved in goal-oriented action selection and attentional mechanisms. Importantly, subcortical responses in the CM-Pf precede cortical responses, suggesting that auditory information is labelled as behavioral relevant from subcortical circuits and is then distributed to cortical areas; possibly via thalamo-striatal loop mechanisms.

OP26: Image-guided and image-verified DBS in a surgical theatre equipped with an MRI scanner: A 5-year experience

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Keywords: Deep brain stimulation, intraoperative MRI, MRI-guided and MRI-verified DBS, safety, accuracy

Abstract:

Background: Deep brain stimulation (DBS) is a commonly used treatment for movement disorders with additional indications including epilepsy and neuropsychiatric diseases. Although DBS has proven to be effective and safe, success highly depends on the accuracy of stereotactic targeting and the prevention of surgery related complications, such as haemorrhage, infection and suboptimal lead placement. Our centre employs an image-guided image-verified approach with direct targeting on tailored MRI sequences that allow direct visualisation of the anatomical target followed by routine immediate postoperative stereotactic imaging. We report safety and accuracy data from a large consecutive series of image-guided and image-verified DBS within an intraoperative MRI suite.

Methods: The records of all patients who underwent DBS surgery in the period from August 2011 to August 2016 at The National Hospital for Neurology and Neurosurgery, Queen Square, London were reviewed. Data collected included the accuracy of targeting and the need for immediate relocation of DBS leads, as well as the occurrence of surgical complications.

Results: A total of 399 patients underwent 725 electrode implantations on a total of 13 targets. All patients were operated under general anaesthesia except when targeting the ventral intermediate nucleus of the thalamus for tremor. It was often possible for two patients to undergo DBS in one day. The indications for surgery were: Parkinson's disease (PD) 208 (52.1%), dystonia 77 (19.3%), tremor 34 (8.5%), Tourette's syndrome 17 (4.3%), PD dementia or Lewy body dementia 12 (3.0%), obsessive-compulsive disorder (OCD) 6 (1.5%), trigeminal autonomic cephalalgia 42 (10.6%), chronic post-stroke pain 2 (0.5%) and progressive supranuclear palsy (PSP) 1 (0.3%). Based on stereotactic accuracy and anatomical location, 21 (2.9%) leads were relocated immediately by 1.5 to 3.0mm. Final placement of all leads was within 2mm of the intended target with a maximum of (0.5%), one asymptomatic subcortical and one peduncular, the latter associated with permanent cognitive, behavioural and gait difficulties.

Conclusion: MRI-guided and MRI-verified DBS is a safe and accurate technique. A surgical theatre equipped with an MRI scanner allows immediate verification of targeting accuracy and is time-saving, allowing to implant more than one patient in one day.

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OP27: Different stimulus response properties and short-term plasticity in subthalamic and nigral neurons in patients with Parkinson's disease

Authors:

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Keywords: basal ganglia, microelectrode recordings, Parkinson's disease, subthalamic nucleus, substantia nigra, synaptic plasticity

Abstract:

Background: Deep brain stimulation (DBS) of the subthalamic nucleus (STN) is an effective procedure for the treatment of Parkinson's disease (PD) symptoms. The therapeutic benefits of DBS are frequency-dependent, but the underlying physiological mechanisms remain unclear. We previously reported short-term plasticity changes in substantia nigra pars reticulata (SNr) with short trains of high frequency stimulation (HFS), but long-trains have not been investigated. Objectives: (i) Compare frequency-dependent effects on cell firing in STN and SNr neurons, (ii) quantify frequency-dependent dynamics of short-term plasticity in SNr, and (iii) compare effects of continuous long-train HFS on short-term plasticity to our previous study.

Methods: In PD patients undergoing stereotactic DBS surgery, two microelectrodes (600um spacing) were advanced into the STN and SNr. One microelectrode recorded single units and evoked field potentials (fEPs) during stimulation trains of different frequencies (1Hz, 10s - 100Hz, 0.5s) from the adjacent microelectrode.

Results: STN neuronal firing showed significant attenuation with 20Hz (p<0.01) stimulation and greater (silenced at 100Hz), while SNr decreased with 3Hz (p<0.05) and greater (silenced at 50Hz). The average peak amplitude of the fEP in SNr neurons was attenuated above 30Hz (p<0.05). However, the first-fEP within the train was potentiated above 30Hz (p<0.01). This is suggestive of synaptic facilitation, followed by rapid synaptic depression. Furthermore, the fEP amplitude during 1Hz pulses showed significant inhibitory synaptic potentiation after continuous HFS (100Hz, 10s). The fEP amplitude increased by a factor of 1.72 (p<0.001), while the time delay between stimulation pulses and the first spike increased by 1.88 (p<0.01).

Conclusion: STN neurons exhibited a higher frequency threshold to stimulation either due to a differing ratio of GABA:glutamate terminals on the soma compared to SNr, and/or the nature of their GABAergic inputs (pallidal vs striatal). Nevertheless, this supports the hypothesis that HFS produces predominantly GABA release, resulting in a reduction of neuronal firing through excitation of pre-synaptic axon fibers. We also showed enhancement of inhibitory synaptic plasticity in SNr by continuous HFS, and the frequency-dependent dynamics of short-term synaptic plasticity (believed to be modulated by neurotransmitter release properties) and consider these to be additional putative mechanisms of DBS.

OP28: Outcomes of a prospective, multicenter international registry of Deep Brain Stimulation for Parkinson's disease

Authors:

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Keywords: Deep Brain Stimulation, DBS, Parkinson's disease, Subthalamic Nucleus, Neurostimulation

Abstract:

Objective: The effectiveness and safety of the use of DBS to reduce motor complications of PD patients has been substantiated by several randomized controlled trials (Schuepbach et al., 2013). Motor improvement following DBS is sustained for up to 10 years as reported by Deuschl et al. 2013. An in-depth evaluation of real world outcomes following DBS will add to the existing database of knowledge and be a useful tool for physicians. As part of an on-going, large scale registry study, we investigated the effectiveness and safety-related real-world outcomes of a multiple independent current source control (MICC) Deep Brain Stimulation (DBS) System for use in the management of motor symptoms of levodopa-responsive Parkinson's disease (PD).

Methods: This is a prospective, on-label, multi-center, international registry sponsored by Boston Scientific Corporation. Patients were implanted with a CE-marked, MICC-based DBS system (Vercise, Boston Scientific). Subjects will be followed up at 6 and 12 months and up to 3 years post-implantation where their overall improvement in quality of life and PD motor symptoms will be evaluated. Clinical endpoints will be evaluated at baseline and during study follow up that include Unified Parkinson's disease Rating Scale (UPDRS), MDS-UPDRS, Parkinson's disease Questionnaire (PDQ-39), and Global Impression of Change. Adverse events are also collected.

Results: Preliminary data suggests an overall improvement in Quality of life at 6 months post implant as compared with Baseline as measured by a 17.6% (n = 89) improvement in PDQ-39 Summary Index. Over 90% of patients, caregivers and clinicians reported improvement as compared with Baseline. This report will provide the safety and effectiveness outcomes of the first cohort of subjects analyzed at 6 (N=150) and 12 months (N=100) post-implantation as compared with baseline.

Conclusion: Deep Brain stimulation (DBS) of the subthalamic nucleus (STN) is an established treatment option for patients with advanced Parkinson's disease (PD). A device that enables fractionalization of current using a multiple source mode of delivery (MICC) can permit the application of a well-defined, shaped electrical field. This registry represents the first comprehensive, large scale collection of real-world outcomes and includes evaluation of the safety and effectiveness of the Vercise DBS System up to 12 months post lead placement.

OP29: The evolution of automatic microelectrode guided navigation for deep brain stimulation surgery

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Keywords: microelectrode recording, subthalamic nucleus

Abstract:

Objective: Microelectrode recording (MER) is a widely-used tool to confirm and define deep brain targets during deep brain stimulation (DBS) surgery. However, MER has been considered a time-consuming technique necessitating expertise. Our objective was to design an automatic recording and display algorithm to both simplify and reduce the time necessary for MER during surgery.

Methods: Previous work has utilized techniques exploiting cellular firing patterns to accurately help define the borders and sub territories of the subthalamic nucleus (STN) and the substantia nigra. These methods were combined within an automatic "push-button" algorithm and tested on 40 patients.

Results: Automatic MER guided navigation successfully extracted and displayed all the necessary and important features of an STN trajectory in real time. MER time was reduced on average by 49% (from 37 minutes to 19 minutes per trajectory).

Conclusion: Automatic navigation is safe and has a high level of reliability. Results of an MER track can easily be displayed in an inbuilt, user friendly, graphical form providing all the information necessary to help make a decision concerning the most appropriate place to position the permanent DBS electrode contact(s). Furthermore, automatic navigation is associated with very significant surgical time savings. Additional electrophysiological data may be added in the future to further refine this tool for navigation in the STN and to other deep brain targets.







OP30: Nucleus accumbens projections: validity and reliability of fiber reconstructions based on high-resolution diffusion-weighted MRI

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Keywords: Nucleus accumbens, probabilistic fibertracking, deep brain stimulation, medial prefrontal cortex, ventral tegmental area, psychiatric diseases

Abstract:

Objective: The N. accumbens (NAc) is a key relay in the mesolimbic dopaminergic reward system, also connected to the amygdala, dorsomedial thalamus and hippocampus. As such, it is a promising target for deep brain stimulation (DBS) in patients with psychiatric diseases. In the present study, we aimed to reconstruct the neural projections connecting the NAc with the ventral tegmental area (VTA) and the medial prefrontal cortex (mPFC) using probabilistic fiber tractography based on diffusion-weighted MR imaging (DWI).

Methods: MR data (T1-MPRAGE; FLAIR; DWI: 1.6 mm isotropic resolution, 60 gradient directions) for 11 healthy subjects were acquired in two sessions on a Siemens Magnetom Prisma 3T MRI scanner. For each subject, the bilateral NAc, mPFC, and VTA were manually segmented based on the T1 and FLAIR data and transformed to the session-specific DWI space for probabilistic fiber tractography. The results were subject to detailed visual inspection to assess their validity in terms of anatomical plausibility by comparing them with the relevant literature. To quantitatively assess the reliability of the reconstructions, the fiber density maps corresponding to the individual tracts (NAc \leftrightarrow VTA and NAc \leftrightarrow mPFC) were transformed to a study template constructed from the T1 data before correlation analysis.

Results: Using MRI data from 11 healthy subjects, we were able to reconstruct neural projections connecting the NAc with the mPFC and the VTA. The connectivity patterns formed by the obtained fibers were in good concordance with the literature (anatomical tracer studies). The reliability assessment yielded moderate to high correlations, which were higher for projections between NAc and mPFC (r = 0.85) than for those between NAc and VTA (r = 0.696).

Conclusion: In the present work, we assessed the feasibility and reliability of the *in vivo* reconstruction of neural fibers connecting the human NAc with the mPFC and the VTA from high-resolution DWI data using probabilistic fiber tractography. In clinical practice, the presented procedure may guide selective electrical stimulation of the mesolimbic fibers using directional lead technology. Compared to undirected neuromodulation of the entire NAc, this could improve the efficacy of DBS for the treatment of mental disorders, such as addiction and obesity compulsive disorder.

OP31: Surgical approach to the superolateral branch of the medial forebrain bundle (sIMFB) for DBS in depression

Authors:

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Abstract:

Background: Deep brain stimulation (DBS) of the superolateral branch of the medial forebrain bundle (sIMFB) emerges as an interesting alternative - yet experimental - treatment for therapy refractory psychiatric diseases. First experiences have been reported from a pilot trial in major depression (1) and an uncontrolled case series for obsessive compulsive disorder (OCD) (2).

Objectives: To describe the surgical technique for deep brain stimulation (DBS) of the supero-lateral branch of the medial forebrain bundle (sIMFB). To report our experience with the successful bilateral implantation in a larger patient group.

Methods: Surgical experience from bilateral implantation procedures in n=27 patients is reported. The detailed procedure of diffusion tensor imaging magnetic resonance imaging fiber tracking (DTI FT) assisted targeting together with detailed descriptive electrophysiology in 144 trajectories of the target region (recording and stimulation) and intraoperative testing are addressed.

Results: Bilateral sIMFB DBS requires DTI FT assisted targeting combined with in depth intraoperative electrophysiological investigation of the target region.

Conclusion: The sIMFB is a promising target for the treatment of depression and possibly OCD (1,2). DTI FT assisted DBS of the sIMFB is based on an imaging technology that is readily addressed in other indications (3). To the authors' knowledge the sIMFB is the only target region for psychiatric disorders that allows for intra-operative testing with clear therapeutic effects and side effects to guide implantation. In our eyes, this makes surgery of the sIMFB is in many features comparable to typical movement disorder surgery.

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OP32: Functional connectivity alterations of brainstem arousal centers in temporal lobe epilepsy

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Keywords: brainstem, epilepsy, fMRI, functional connectivity, reticular activating system

Abstract:

Introduction: Seizures in temporal lobe epilepsy (TLE) disturb brain network physiology and lead to brain connectivity disturbances. We have previously hypothesized that recurrent seizures in TLE may lead to abnormal connections involving subcortical activating structures including the ascending reticular activating system (ARAS), contributing to neocortical dysfunction and neurocognitive impairments. However, no prior studies of ARAS connectivity have been previously reported in epilepsy patients.

Methods: We used resting-state functional MRI (fMRI) recordings in 27 TLE patients (67% right-sided) and 27 matched controls to examine functional connectivity (partial correlation) between eight brainstem ARAS structures and 105 cortical/subcortical regions. ARAS nuclei included: cuneiform/subcuneiform, dorsal raphe, locus coeruleus, median raphe, parabrachial complex, pontine oralis, pendunculopontine, and ventral tegmental area. Connectivity patterns were related to factors of interest.

Results: In control subjects, regions showing the most positive connectivity to ARAS structures included limbic structures, thalamus, and certain neocortical areas, consistent with prior studies of ARAS projections. Overall ARAS connectivity was significantly lower in TLE patients than controls (p < 0.05, paired t-test), particularly to neocortical regions including insular, lateral frontal, posterior temporal, and opercular cortex. Diminished ARAS connectivity to these regions was related to increased frequency of consciousness-impairing seizures (p < 0.01, Pearson correlation), suggesting an association with severity of illness. Furthermore, reductions in ARAS connectivity were associated with impairments in verbal IQ, attention, executive function, language, and visuospatial memory on formal neuropsychological evaluation (p < 0.05, Spearman's rho or Kendell's tau-b).

Conclusion: Recurrent seizures in TLE may lead to disturbances in ARAS functional connectivity, contributing to more widespread network dysfunction which may help explain neurocognitive problems suffered in this devastating disorder.

OP33: Double-blind Randomized Trial of V1 Trigeminal Stimulation for Refractory Major Depression

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Keywords: Depression, Trigeminal Nerve, Trigeminal Stimulation, Refractory Depression

Abstract:Introduction: One-third of patients with Major Depression are refractory to combined medication trials and psychotherapy. We conducted a double-blind, one-way crossover randomized surgical trial of trigeminal stimulation (TNS) in unipolar treatment resistant depression patients.

Methods: Twenty patients, mean age: (50.3; SD+7.23 years), 16-females, enrolled after IRB approval. Bilateral electrodes under the eyebrow aiming the V1 branch of the trigeminal nerve were implanted and connected to a generator subcutaneously below the right clavicle. Ten participants were randomized to active stimulation (AS) at 2-weeks after surgery. The other half was turned-on for 1 minute and then remained turned-off, sham stimulation (SS) for 12 weeks. At 3- month the SS non-responders were turned-on. Placebo responders were rescued during the additional 12 weeks of blinded stimulation. The double-blind stimulation period lasted 6-months. Medications were unchanged throughout the study, unless prompted modification by the Psychiatrist. Depression was evaluated with Hamilton -Depression-Scale-17-items (HDS17), Beck-Depression-Inventory(BDI), Inventory of Depression-Symptomatology(IDS) and Ugvlag for Kiniske Undersgelsen(UKU).

Results: Stimulation was well tolerated. Three patients asked for a slight surgical retraction of the electrode because it was bothersome at the eyebrow area. There were no infections or erosions. Baseline-HDRS17 fell in the AS and SS groups by placebo effect. However, the fall in the AS was more robust and statistically significant at 12 weeks (p<0.023) as compared to the SS (20.4+2.9 to 16.9+5.3 versus 22.3+4.0 to 10.2+2.5), confirmed with the crossover. BDI and IDS decreased in both groups without reaching statistical significance at 12-weeks. UKU demonstrated safety and tolerability of the procedure.

Conclusion: Patients tolerated well the V1 stimulation electrodes, as well as the continuous stimulation. It was well tolerated cosmetically. The treatment was robust with a significant decrease in HDS17 and a great adherence to the treatment.

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OP34: Deploying autologous peripheral nerve grafts in patients with Parkinson's disease at the time of deep brain stimulation surgery

Authors:

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Keywords: deep brain stimulation, cell therapy, Parkinson's disease

Abstract:

Introduction: We are investigating a strategy that couples the delivery of a cell therapy at the time of DBS surgery in an attempt to restore areas of the brain affected in Parkinson's disease (PD). We deployed nerve grafts containing Schwann cells from the sural nerve; Schwann cells, after injury, transdifferentiate to become "repair cells" and release a host of factors including GDNF, NGF, BDNF, and NT-3. We have ongoing clinical trials (NCT01833364) and (NCT02369003) examining the safety and feasibility of implanting single or multiple autologous peripheral nerve grafts to one more target locations in patients with PD undergoing DBS surgery.

Methods: DBS surgery targeting the subthalamic nucleus or internal globus pallidus was performed using standard procedures. A 5mm section of sural nerve was excised, stripped of the epineurium, cut into 1mm pieces, and unilaterally delivered into the area of the substantia nigra (SN) and/or nucleus basalis of Meynert (NBM). Adverse events were continuously monitored. The primary endpoint was safety. Secondary endpoints include neurocognitive performance, quality of life, gait, (123I-ioflupane) SPECT imaging, and Unified Parkinson's Disease Rating Scale (UPDRS) scores.

Results: To date, 41 participants have received grafts with an adverse event profile comparable to standard DBS surgery and with no serious adverse events related to the delivery of the graft. So far, 17 participants who received a graft to the SN have reached the 1 year time point and have had a *decrease* of 7.3 ± 10.6 points (considered a moderate clinically important difference, mean \pm SD) in the mean UPDRS motor score off medication and off stimulation compared to before surgery. Meanwhile, a review of 16 patients in our clinic who received only DBS showed an *increase* of 0.3 ± 15.0 points in their mean UPDRS motor score compared to before surgery. We recently began a dose escalation to either deploy grafts to the SN and NBM (one participant) or dual deployments to the SN (six participants) unilaterally. Immediate post op adverse event profiles were comparable to standard DBS surgery.

Conclusion: We are finding that combining the delivery of cell therapy at the time of DBS surgery appears to be safe and feasible. While more time is needed to fully assess the efficacy of this therapy, preliminary clinical evidence is showing baseline improvements in motor function at one year.

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OP35: Direct Electrical Stimulation of the Amygdala Enhances Event-Specific Declarative Memory in Humans

Authors:

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Keywords: Amygdala, Memory Enhancement, Electrical Stimulation, Hippocampus, Perirhinal Cortex

Abstract:

Introduction: Significant events are often prioritized to become lasting memories. A common example is that emotional events are often remembered better than neutral events. This prioritization is mediated by the amygdala, which modulates memory consolidation processes in the hippocampus and related medial temporal cortices, including the perirhinal cortex. Further, rodent studies have demonstrated that direct activation of the amygdala enhances memory consolidation even during non-emotional events. Here we show that brief electrical stimulation to the amygdala in humans can enhance declarative memory without eliciting an emotional response.

Methods : Fourteen epilepsy patients undergoing monitoring of seizures via intracranial depth electrodes viewed a series of neutral object images, half of which were immediately followed by brief low amplitude electrical stimulation to the amygdala (8 trains of 50-Hz pulses for 1-second at 0.5 mA; no epileptiform activity was elicited by the stimulation). Recognition memory for different subsets of objects was tested immediately and one day after the study phase.

Results: When recognition memory was tested the next day, the specific images previously followed by amygdala stimulation were consistently better remembered than images previously presented without such stimulation. Analysis of oscillatory activity from the amygdala, hippocampus, and perirhinal cortex during this next-day memory test showed increased synchrony in theta and gamma frequency bands at presentation of the remembered object images previously paired with amygdala stimulation on the previous day compared to objects not paired with stimulation. In addition, the objects in the stimulation condition during the one-day test appeared to elicit patterns of oscillations in the memory network that were similar to those used for amygdala stimulation. In addition, the objects not previous day. In a separate test, patients, blinded to experimental conditions, were unable to detect the stimulation.

Conclusion: These results demonstrate that amygdala stimulation in humans can lead to a prioritization of specific memories in long-term storage, and suggest that the memory enhancement involves an interaction between the amygdala and medial temporal lobe structures essential for declarative memory. This study extends prior rodent studies on the role of the amygdala in influencing synaptic plasticity in the medial temporal lobe and suggests a novel target of therapeutic intervention for memory disorders.

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OP36: Sonication conditions influencing the efficacy and safety of blood-brain barrier modulation by low-intensity focused ultrasound

Authors:

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Keywords: blood-brain barrier, drug delivery, focused ultrasound

Abstract:

Background: The application of pharmacological therapeutics in neurological disorders is limited by the ability of these agents to penetrate the blood-brain barrier (BBB). We examined several FUS conditions in order to optimize FUS sonication for BBB opening in small animals.

Methods: Changes in BBB permeability were observed during transcranial sonication with contrast agent microbubbles (MB) using low-intensity focused ultrasound (FUS) in rats (N = 20). We examined the effects of FUS sonication with different sonication parameters, varying acoustic pressure, center frequency, burst duration, MB type, MB dose, pulse repetition frequency (PRF), and total exposure time. The focal region of BBB opening was identified Evans blue dye extravasation. Additionally, hematoxylin and eosin staining was used to identify tissue damage in the sonicated region.

Results: Acoustic pressure amplitude, burst duration, and total exposure time were associated with increased damage in the sonicated region of the brain when parameter values were increased. In contrast, variations in MB type, MB dose, and PRF had little effect on the degree of tissue damage after FUS sonication.

Conclusions: The clinical application of FUS sonication for drug delivery across the BBB requires the guarantee of both safety and efficacy and thus the careful optimization of relevant sonication conditions. Our study aimed to identify these influential conditions and provide optimized values for further studies.



Figure 1. Method, (A) focused ultrasound experimental setup, (B) 515 kHz axial focal beam (C) 515 kHz 3D scan focal beam (D) 1.6 MHz axial focal beam (E) 1.6 MHz 3D scan focal beam (F) Ultrasound wave parameter factors: pressure amplitude, frequency, burst duration, and total exposure time are displayed. (G) Experimental procedure.

OP37: Diffusion metrics and fiber tracts changes after MRI-guided high intensity focused ultrasound surgery in a swine model

Authors:

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Keywords: MR-guided focused ultrasound, tracts changes, swine model

Abstract:

Objective: MR-guided focused ultrasound (MRgFUS) is increasingly used as a lesioning tool in functional neurosurgery. While the generated lesion can be visualized using traditional MR imaging, these do not provide detailed information about tissue microstructure or direct visualization of affected tracts. To study this, we used a neonatal swine model to investigate *in-vivo* acute changes in water diffusion and fiber tracts after MRgFUS treatment of the fornix.

Methods: Four piglets (5-6.7kg) were treated with MRgFUS system (Sonalleve, Philips Medical Systems, Finland). Treatment cells were positioned along the anterior body of the fornix with a cross-sectional diameter of 4mm and a length of 10mm (volume= 83.78mm³). 3-4 sonications from 40W to 80W, frequency 1.2MHz were performed to generate the ablation with a peak temperature above 60°C. Between each sonication, there was a 5-minute cool-down interval. Pre- and post-treatment T1, Diffusion weighted images (DWI), and histological data were collected. DWI metrics (FA, AD, RD, MD, and ADC) were calculated for the lesion core, inner and outer boundaries of the lesion determined on the hyper-intensity signal in the mean DWI image. Paired t-test was performed for DWI metrics from each region of interest. One-way ANOVA followed by post-hoc Tukey's HSD was applied for each DWI metric across the three regions of interest for pre- and post-treatment separately. Fornix fiber tracts were generated before and after the treatment for qualitative assessment.

Results: In all treatments, final peak temperature reached a range between 60.8°C and 68.8°C. The volume of treatment was comparable (correlation= 0.88) between values measured through mean DWI (347.5±58.12 mm³) and histological data (342.35±44.69mm³), however this was significantly larger than the treatment cell volume. MRgFUS resulted in a significant decrease in diffusion metrics in the treatment region (Ps<0.05 FDR-corrected). The fiber disruption was most pronounced as the lesion core was approached.

Conclusion: Diffusion metrics and tractography can accurately assess treatment location, volume and necrotic core after MRgFUS treatment. DWI can successfully advance MRgFUS targeting. In our case, ablated tissue volume was much larger than the planned cell likely due to the set peak temperature. Further comparative tract alterations based on peak temperature should help determine the relationship between temperature and final lesion volume more accurately.

OP38: Segmenting the anterior limb of the internal capsule by structural connectivity: a potential tool for neuromodulatory targeting

Authors:

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Keywords: Neuromodulation, neuroimaging, DTI, OCD

Abstract:

Introduction: The anterior limb of internal capsule (ALIC) is a promising target for neuromodulatory interventions for severe, treatment refractory psychiatric disorders, including deep brain stimulation (DBS) and capsulotomy, for obsessive-compulsive disorder (OCD) and depression. These disorders are heterogeneous phenomena and there is controversy about optimal targets within the ALIC. Using diffusion tensor imaging (DTI), we parcellated the ALIC based on structural connectivity. We then compared the ALIC segmentations between individuals to evaluate regional patterns of consistency.

Methods: ALIC segmentations were generated for 40 subjects from the Human Connectome Project (HCP) using connectivitybased seed classification in FSL v5.0. Voxels within the ALIC were treated as seed regions and frontal Brodmann areas (BAs) as independent targets. We combined patient-specific segmentations by assigning each ALIC voxel to the most frequently associated frontal BA in the 40 individual segmentations. We compared this combined individual-based parcellation to one similarly created using a template from HCP that averaged diffusion data from 842 subjects. Segmentations were compared to one another using the Sørensen-Dice Index of similarity (SDI).

Results: All 40 segmentations exhibited a posterior-superior to anterior-inferior axis of organization (Figure 1). On average, the frontal BA assignments of voxels in the group analysis were consistent with 66.2% of individuals' segmentations. In this analysis, the region assigned to BA11 (orbitofrontal cortex, OFC), exhibited the highest degree of consistency across individuals, with 12.1% of this region being assigned to BA11 in all 40 subjects. The mean SDI between the individual-based combined segmentation and the template-based segmentation regions was 0.283. The mean SDI between individual segmentations, with a mean SDI of 0.714.

Conclusion: These results clarify the organization of the ALIC in humans. They also demonstrate the high variability in ALIC organization between individuals, albeit with some loci of focal consistency. This variability suggests that patients may benefit from tractography prior to neuromodulation in order to facilitate patient-specific targeting. Interestingly, the most consistent regions of the ALIC, those connecting to OFC, are the regions most frequently targeted by neuromodulatory procedures.

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OP39: Localizing Ventral Intermediate nucleus of the thalamus using primary fiber direction

Authors:

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Keywords: Functional Neurosurgery, Radiosurgery, Movement Disorders, Essential Tremor, Tractography

Abstract:

Introduction: While pharmacological therapy for essential tremor is the first line of treatment, some patients may only experience partial benefits. For these patients, surgical lesion or deep brain stimulation (DBS) of the ventral intermediate (VIM) nucleus of the thalamus has been shown to ameliorate tremor symptoms. Precise targeting of the VIM has been correlated with superior outcomes, but targeting of this structure based on MRI may be challenging. Diffusion tensor imaging (DTI) has been used to approximate the VIM indirectly by calculating the pyramidal tracts (PT) and medial lemniscus (ML) trajectories as anatomical reference. Here we show that the primary diffusion vector map can be used to directly delineate VIM without the need for post processing tractography calculation.

Methods: DTI from 40 subjects in the Human Connectome Project was used to compare methodologies. Free surfer library's FDT toolkit was used to calculate the primary diffusion vector map, PT, and ML. Using the vector map we identified the VIM internal capsule boundary and sensory boundary, and compared the location to the indirect DTI localization (Fig1). The average Euclidian distance between both methods was compared.

Results: By comparing methods, the Euclidian distance in the VIM internal capsule boundary in the ACPC plane was found to differ by 0.53mm(+/- 0.70mm), and the VIM sensory boundary was found to differ by 0.96mm(+/- 0.99mm).

Conclusion: Our localization method allows delineation of VIM thalamus utilizing a primary vector map. The method is able to produce a direct VIM delineation similar to tractography calculated methods within a millimeter on average. This map can be produced using most current surgical navigation software packages, making this technique easy to use and readily accessible. Future directions include comparing the localized area to both efficacy and side effects resulting from DBS implantation and radio surgery lesions.



OP40: Caudate is involved in human associative learning

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Keywords: Learning, caudate, deep brain stimulation

Abstract:

Introduction: Disorders of learning and memory account for an increasing disease burden in our aging population with significant social and financial consequences. Unfortunately, existing treatments have limited utility. Research in humans and primates supports an important role for the caudate in learning. Our objective was to further characterize the role of the caudate in human learning and to determine whether caudate stimulation could alter performance on a learning task.

Methods: Five subjects who underwent depth electrode placement for seizure localization for medically refractory epilepsy participated in our study. Local field potentials were recorded from intracranial electrodes while subjects participated in study tasks. A learning task required subjects to learn an association between a series of presented images and a button press. A gambling task required subjects to place a wager on the outcome of a simulated card game. We computed power in caudate electrodes and compared power during the feedback epoch of the task between correct and incorrect trials for the learning task and between winning and losing trials for the gambling task. Three subjects additionally played a stimulated block of the learning task during which half of the images received bilateral caudate stimulation at 200Hz and 2mA for 1 second during the feedback epoch after correct responses.

Results: There was a significant increase in caudate beta (15-30Hz) power during the feedback period of the learning task. There was a significant difference between beta power following correct versus incorrect trials. There was no difference in beta power following winning versus losing trials in the gambling task. Of the three subjects who underwent caudate stimulation during the feedback epoch of the learning task, 2 had a significant improvement in learning for stimulated versus unstimulated images.

Conclusion: Changes in caudate beta power during feedback differed between correct and incorrect trials in the learning task. Stimulation during feedback following correct trials enhanced learning. These findings suggest that the caudate plays an important role in updating response associations in human associative learning.

OP41: Four year outcomes of a prospective, multicenter study evaluating Deep Brain Stimulation with a new multiplesource, constant-current rechargeable system in Parkinson's disease

Authors:

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Keywords: Deep Brain Stimulation, DBS, subthalamic nucleus, neurostimulation, Parkinson's disease, constant current, multiple-source, rechargeable

Abstract:

Objective: A DBS device that enables current fractionalization using a multiple-source mode of delivery can permit the application of a well-defined, shaped electrical field. Thus, we postulated that a multiple-source, constant-current device that permits a well-defined distribution of current would lead to motor improvement in patients with Parkinson's disease (PD). Previously, results from the VANTAGE clinical study demonstrated highly significant improved motor function (p < 0.0001) as assessed by UPDRS III "meds off" at 6 months post-first lead implant as compared with Baseline "meds off," thereby successfully achieving the study primary endpoint. Here we present the four year, long-term follow up results of patients in the VANTAGE clinical study that employed multiple independent current control (MICC) Deep Brain Stimulation (DBS) in the management of motor symptoms of Parkinson's disease.

Methods: VANTAGE is a prospective, multi-center, non-randomized, open-label study sponsored by Boston Scientific Corporation. Forty subjects with idiopathic PD were implanted bilaterally with a DBS system (Vercise, Boston Scientific) targeting the subthalamic nucleus and followed up to three years post-lead placement. Assessments measured up to 3 years post-lead placement included the following: Levodopa Equivalent Dose (LED), Parkinson's Disease Questionnaire (PDQ-39), Global Impression of Change (GIC), and Modified Schwab and England (SE) scores.

Results: Data from three years post-lead placement has been collected and analyzed. Anti-parkinsonian medications were found to have remained stable (average of 1399 mg at baseline versus average of 699 mg at 3 years follow up). PDQ-39 summary index scores demonstrate continued improvement (versus baseline values) in quality of life based on assessments of bodily discomfort, activity of daily living, mobility, emotional well-being, and stability of cognition. Further, a high proportion of GIC responses were characterized as "improved" (Clinician: 88.2%; Subject: 82.4%), and modified Schwab and England scores remained stable. Results from 4 years post-lead placement to be presented.

Conclusion: The collected outcomes from the VANTAGE clinical study will inform clinicians on the use of this system, and its flexibility to manage the motor symptoms of idiopathic PD.

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OP42: Deep brain stimulation of subthalamic nucleus increases dopamine transporter binding in the ventral striatum in patients with Parkinson's disease

Authors:

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Keywords: Parkinson's disease, deep brain stimulation, subthalamic nucleus, dopamine transporter

Abstract:

Introduction: It is well known that deep brain stimulation (DBS) of the subthalamic nucleus (STN) alleviates motor symptoms of Parkinson's disease (PD). However, the effects of STN-DBS on presynaptic dopaminergic systems are still unclear. The nigrostriatal neuronal degeneration usually continues to progress in PD patients without DBS. Positron emission tomography (PET) with ¹¹C-Labeled 2- β -carbomethoxy-3- β -(4-fluorophenyl)tropane ([¹¹C]CFT) is a marker for loss of presynaptic dopamine transporters in the striatum in PD. Here we used [¹¹C]CFT PET in order to evaluate binding to the dopamine transporter in PD patients before and after neurosurgical treatment with STN-DBS.

Methods: 10 patients with PD were examined with [¹¹C]CFT-PET pre-operatively (within one month before surgery), and 12 months after surgery. [¹¹C]CFT binding was evaluated using the region-of interest (ROI) method. ROIs were set bilaterally over the head of the caudate (divided into ventral and dorsal segments at its midpoint), nucleus accumbens, and putamen (divided into anterior-ventral, anterior-dorsal, posterior-ventral, and posterior-dorsal segments at its midpoint).

Results: There was a significant reduction in postoperative [¹¹C]CFT uptake in the posterior-dorsal putamen contralateral to the clinically more affected side (to 7.4% of the preoperative mean, p<0.05). However, there was significant increase in [¹¹C]CFT uptake in the contralateral anterior-ventral putamen and ipsilateral ventral caudate (to 4.9% and 10.1% of the preoperative mean, respectively, p<0.05). [¹¹C]CFT uptake was also increased in the bilateral nucleus accumbens although it did not reach statistical significance.

Conclusion: Our result showed that STN-DBS increases dopamine transporters in the ventral striatum, which is different from natural course of PD. This result may indicate the compensative and neuroprotective effect of STN-DBS on the presynaptic dopaminergic systems of PD.

OP43: Long-term outcome and post-mortem studies of bilateral pallidotomy performed by Roeder and Orthner from Göttingen in the 1960's

Authors:

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Keywords: history, stereotactic surgery, stereotactic lesioning, pallidotomy, Parkinson's disease, post-mortem

Abstract:

Before The Advent of levodopa, pallidotomy was the most effective treatment for Parkinson's disease but was soon superseded by thalamotomy. It is widely unknown that, apart from Lars Leksell in Sweden, two neurologists from Göttingen, Hans Orthner and Fritz Roeder, held on to pallidotomy. Using a unique and sophisticated stereotactic technique lesions were individually tailored, and lesion volume was reduced over time. Post-mortem studies demonstrated that eventually true posterior and ventral pallidoansotomy sparing the overwhelming mass of the pallidum was accomplished. During surgery complete alleviation of rigidity was observed as well as associated pain. In 1962, the long-term effects (3 years follow-up on average) of the first 18 out of 36 patients (largest published cohort) with staged bilateral pallidotomies were reported in great detail. In detailed descriptions of each case, long-term improvements of parkinsonian posture, gait, and akinesia (e.g. improved repetitive movements and arm swinging) were reported. Alleviation of tremor was found to require larger lesions than needed for suppression of rigidity. No improvement of speech, drooling or seborrhea was observed. By 1962 the team had operated 13 patients with postencephalitic oculogyric crises with remarkable results (mean follow-up 5 years). They also described alleviation of hyperkinetic disorders (e.g. hemiballism, chorea) with pallidotomy. Surgical mortality and complications (e.g. hemorrhages; inadvertant lesioning of the corticospinal or optic tract; cognitive and behavioural abnormalities) had been remarkably low. In the mid-1980ies, unilateral posteroventral pallidotomy was re-introduced by Laitinen after that long-term complications of levodopa treatment had become evident, but none of the contemporary approaches did reach the same technical sophistication as the Göttingen technique. The intricate history of pallidotomy is incomplete without the appreciation of the achievements of these pioneers who perpetuated pallidotomy against the mainstream of that time, and mastered bilateral and safe pallidal lesioning in an era long before modern imaging was available.

OP44: Clinical Outcomes of Asleep versus Awake Deep Brain Stimulation for Parkinson's Disease

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Keywords: Deep Brain Stimulation, Parkinson's Disease, Asleep, Awake, Outcome

Abstract:

Background: DBS for Parkinson's Disease has traditionally been performed awake using microelectrode recording to confirm accurate placement of electrodes. Newer technologies have allowed DBS to be performed asleep, using intraoperative image guidance to confirm electrode placement without the need of multiple passes into the brain.

Methods: DBS candidates with PD referred to Oregon Health & Science University underwent asleep DBS using image guidance. Patients underwent awake DBS by the same surgeon at the same center. Assessments at preoperative baseline and 6-month follow-up included an OFF-levodopa motor UPDRS part II, the PD Questionnaire quality of life scale, motor diaries, the dementia rating scale and speech fluency with the controlled oral word association category fluency and F-A-S phonemic fluency tests.

Results: 62 subjects underwent asleep DBS using iCT and 39 subjects underwent awake DBS using MER guidance. No significant difference was observed in the change of motor UPDRS (14.5 \pm 9.9 point improvement in asleep DBS, 17.6 \pm 12.3 point improvement in awake DBS, t=1.24, p=0.222) or UPDRS II score (9.3 \pm 2.7 point improvement in asleep DBS, 7.4 \pm 5.8 point improvement in awake DBS, t=1.75). Improvement in ON time without dyskinesia was superior in the asleep DBS group (+6.4 hours/day versus +1.7 hours/day, p=0.04). Quality of life scores significantly improved in both the asleep and awake groups (17.7 \pm 15.7 and 8.9 \pm 11.5 points respectively), with improvement in the total score (p=0.004) and subscores for cognition (p=0.002), communication (p<0.001) and emotional well-being (p=0.03) being superior in asleep DBS. Speech fluency outcomes were superior in asleep DBS (category fluency 3.66 \pm 11.9 point improvement versus 6.31 \pm 9.7 point decline, p<0.001; phonemic fluency 0.18 \pm 10.6 point improvement versus 5.5 \pm 9.6 point decline, p=0.023). The dementia rating scale remained stable without significant change in both the asleep and awake cohorts (p=0.44). One subject in the awake DBS cohort and two subjects in the asleep DBS cohort had treatment-related adverse events.

Conclusions: Asleep DBS for PD with intraoperative imaging guidance improved motor outcomes over 6 months that were on par with or better than awake DBS at our center, and superior with regard to speech fluency and quality of life. Serious adverse events were uncommon in both groups.

OP45: Surgical Revision Rescues Suboptimal Outcomes in Subthalamic Deep Brain Stimulation for Parkinson's Disease.

Authors:

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Keywords: Parkinson disease, deep brain stimulation, stereotactic lead revision, subthalamic nucleus, poor responder

Abstract:

Introduction: STN-DBS is a well-established treatment for motor complications in PD. However, there is a significant individual outcome variability. This includes patient/disease related factors and differences in lead placement/DBS programming. It's important to identify patients with suboptimal outcome after DBS for an intensified reevaluation of programming or lead revision. The levodopa response correlates significantly with the DBS stimulation response and is therefore used as a DBS eligibility criterion. Here we propose to use a ratio between best levodopa and DBS response as a benchmark for individual DBS outcome quality and show that surgical revision can rescue suboptimal outcome, when re-programming is inefficient.

Methods: We investigated 9 PD patients with STN DBS (Øage 63,7 years, ØUPDRS III(off): 54) 6-60 months after implantation. Motor symptoms control (in UPDRS III) by STN-DBS (after median reprogramming time of 60 hours) and Levodopa challenge were assessed after an overnight medication (+1h stim off) washout. The DBS response ratio (DBSrr) was defined as stimulation effect / levodopa response. Surgical revision was considered if the primary electrodes were placed outside the dorsolateral part of the STN (>2mm) in MRI-CT fusion analysis and the DBSrr was <0,7. Surgical techniques included explantation and reimplantation in two or one sessions.

Results: 15 electrodes were revised (6 bilateral, 3 unilateral), six were initially located in the anterio-medial part of STN, one lateral to the STN and four slightly medial (red cylinders, Figure 1). Median vector distance between active contact pre/postrevision was 4.08mm (range 1.6mm–8.42mm). Mean UPDRS III under DBS was significantly improved after revision (38.2±6.6 to 15.5±7.9 points, p<0.001), being even superior to the levodopa effect (15.5±7.9 vs. 27.1±9.7 points, p=0.014). Therefore, the DBSrr was significantly increased from 57% to 132% after revision.

Conclusion:STN-DBS has proved to be a very effective treatment for PD on a group level, but there is an increasing concern about DBS "failures", in whom postoperative outcomes do not match the preoperative expectations. Our study suggests this patients, can be rescued with surgical replacement to a response similar to the levodopa-induced one, even years after surgery. The computation of the ratio of STN-DBS and levodopa motor improvement might support clinicians managing DBS "failure" cases, anticipating the benchmark of possible improvement after revision.



Figure 1: Reconstruction of the active contact (before) and mean volume of tissue activates (after revision of the electrode) on a standard MRI. Active Contacts before revision surgery (red cylinders) and mean VTA (voxels covered by >2 VTA in the ce registration of each subject in 10 and axial place on T2-weighed MRI Space. In summery the mean VTA becaute close to the documentar appeer of the subblankar, moreling index the mean VTA in the center of the sub-

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OP46: Interaction patterns of brain activity across space and frequency in obsessive-compulsive disorder

Authors:

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Keywords: Obsessive compulsive disorder, Resting state network, EEG rhythm

Abstract:

Objectives: Despite available pharmacological and psychotherapeutic treatments about 10% of obsessive-compulsive disorder (OCD) patients remain severe, treatment-refractory. For some of these patients deep brain stimulation (DBS) offers an appropriate treatment method. In hopes of identifying better treatment options such as DBS, many attempts have been made to clarify pathological brain mechanisms, but neurophysiological measures have not been systematically examined yet. To address this question, the aim of the present study was to search for specific functional correlates cross brain region/frequency interactions in OCD patients.

Methods: Routine scalp-EEG (19 electrodes) was recorded in ten OCD patients and ten healthy controls matched for age, while they were at rest with eyes closed. The investigation compares current source density measures of patients with OCD to the control group by using the techniques of low-resolution brain electromagnetic tomography (LORETA; Pascual-Marqui, et al, 1994). We also used the functional independent component analysis (fICA) to examine the interaction patterns of brain activity across region and frequency in the resting state networks by comparing between OCD patients and control subjects (Pascual-Marqui, et al, 2011).

Results: The findings of the current source density measure indicated that OCD patients were characterized by significantly higher activities in the following three regions, compared to control subjects. 1) In the delta, theta and alpha bands in the fronto-temporal region, 2) in the alpha and beta bands in the cingulate and 3) in the theta, alpha and beta bands in the nucleus accumbens and the bed nucleus of the stria terminalis (BNST).

Although both groups of brain utilized the common resting networks, the fICA study showed how the OCD brain used following two resting state networks differently from the healthy control brain. OCD patients have 1) excess left prefrontal (PFC) delta and reduced right PFC delta, and 2) excess left frontal alpha and reduced parieto-occipital alpha.

Conclusion: The nucleus accumbens as well as adjacent nucleus BNST are suggested as feasible targets for DBS in OCD from LORETA current density measures. Although most resting state networks were common to both groups of subjects, two resting state networks (between PFC hemispheres for delta activity, between left frontal and parieto-occipital area for alpha activity) differently used in OCD brain.

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OP47: Deep brain stimulation of bed nucleus of stria terminalis in obsessive-compulsive disorder

Authors:

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Keywords: obsessive compulsive disorder, deep brain stimulation, bed nucleus of stria terminalis

Abstract:

Background: Deep brain stimulation (DBS) is under investigation for severe obsessive-compulsive disorder (OCD) resistant to other therapies. OCD is a chronic disorder affecting approximately 2 % of the population. The disorder is characterized by persistent obsessive, intrusive thoughts generating anxiety, and related compulsions (tasks or "rituals") with the aim of neutralizing the distress. Up to 10 % of patients with OCD continue to demonstrate severe therapy-refractory symptoms despite trying multiple available treatments. We present here the 12-month follow-up data from 6 patient with severe therapy resistant OCD treated with DBS in the bed nucleus of the stria terminalis (BNST).

Methods: 6 patients with severe OCD who had tried psychotherapy and several different pharmacological treatments with little effect were included in an ongoing study of DBS for OCD. The patients underwent bilateral electrode implantation in the BNST and the stimulation was started immediately after surgery. The patients were evaluated at baseline and at 6 and 12 months after surgery with the Yale-Brown Obsessive-Compulsive Scale (YBOCS) as the primary outcome measure.

Results: Twelve months after surgery the mean YBOCS had improved from 33 to 18 points (46%). Thus, the severity of the OCD had decreased from severe to moderate on average. Similar effects were seen in secondary outcome measures for depression and anxiety. Minor signs of hypomania, reversed with a change of stimulation parameters, were seen in one patient. No serious adverse events occurred.

Conclusion: The preliminary results from this study of BNST DBS in severe therapy-refractory OCD are promising and in line with previous publications. Nevertheless, DBS for OCD is still an investigational therapy and should therefore be performed in clinical studies driven by multidisciplinary teams.

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OP48: Tau Accumulation and Neurodegeneration in Lobotomized Schizophrenic brains: Neuropathological Study coupled with Diffusion Tensor Imaging

Authors:

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Keywords: lobotomy, tau, diffusion tensor imaging, schizophrenia, network, neurodegeneration

Abstract:

Objectives: Neuropsychiatric disorders can be caused by dysfunction in specific brain circuits. Accordingly, the stereotactic neurosurgical techniques for intractable mental disorders, such as deep brain stimulation, might have effect through modulation of the aberrant circuit and the interest of this field has been rapidly increasing. Although prefrontal lobotomy was performed to treat psychiatric disorders such as severe schizophrenia in the past, such procedure became an obsolete remedy in 1970s. Therefore, the neuroimaging and neuropathological studies in the lobotomized brains have not been systematically made until now.

Methods: We identified fiber connectivities in the lobotomiized brains using diffusion tensor imaging (DTI). Voxelwise statistical analysis of the fractional anisotropy (FA) data in white matter tracts were carried out to compare between non lobotomized schizophrenic group (n=4), lobotomized schizophrenic group (n=4) and healthy control subject group (n=4). Furthermore, in two lobotomized schizophrenic brains, the sections were stained with hematoxylin-eosin and Kluver-Barrera stains. Immunohistochemistry was performed with the antibodies specific to tau protein. This study was approved by the local ethical committee and ethical aspects have been fully considered.

Results : In the DTI study, lobotomized schizophrenia group had lower FA in the bilateral white matter of ventromedial prefrontal lobe, forceps minor, forceps major, corpus callosum, nucleus accumbens, cingulate bundle, the medial nucleus of thalamus, the anterior and part of posterior limb of internal capsule and brainstem. As for histological study, gliosis and neural cell loss were found not only in prefrontal ablated lesion but also in the medial nucleus of thalamus, cingulate gyrus and nucleus accumbens, all of which connect to prefrontal related areas. Tau accumulation was detected in lobotomized prefrontal area and in thalamus or striatum which connect to prefrontal areas, similar to the pattern found in the DTI study. These findings may support the idea that abnormal tau aggregation reflects the afflicted pathways with the secondary degeneration by the surgical impact.

Conclusion: This study demonstrated that the connectivity sacrificed by lobotomy is largely divergent, which was confirmed by the secondary neurodegeneration in the pathological study. Abnormal tau aggregation may propagate along the pathways with the secondary degeneration in lobotomized brains.

OP49: Deep Brain Stimulation (DBS) of the Accumbens Nucleus (NA), Ventral Striatum (VE) and Internal Capsule (IC) for medication resistant Obsessive Compulsive Disorder, multicentric prospective study on eight patients

Authors:

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Keywords: obsessive-compulsive disorder, deep brain stimulation, nucleus accumbens, internal capsule, ventral striatum

Abstract:

Objective: Deep brain stimulation (DBS) of the accumbens nucleus (AN), ventral striatum and ventral capsule (VC/VS) region has shown a 50% response in adults with severe treatment-refractory obsessive-compulsive disorder (OCD), no matter which target is used. We sought to improve the effectiveness of DBS, by inserting the electrode along the three targets, so we might change the stimulation site depending on the patient's response.

Methods: A multicentric prospective study was conducted on eight patients, four from the University Hospital La Princesa, two from the University Hospital Central de Asturias, and two from University Hospital Fundación Jiménez Díaz. All patients were operated on under the same protocol. Qualitative and quantitative data were collected.

Results: Out of the 8 patients (mean age 42 \pm 9), 7 had a reduction in OCD symptoms, as objectified in an improvement in their YBOCS rates (preoperatory and 6 months follow-up means were 31 \pm 7 y 13 \pm 9, respectively). Six of them responded with stimulation at the AN (the first area we set for stimulation), while in one patient, stimulation needed to be switched to the ventral capsule to be effective.

Discussion: These data indicate that DBS was safe and conferred a benefit in reduction in Y-BOCS scores in our series of patients with obsessive-compulsive symptoms. The insertion of the electrode through the three stimulation sites might improve effectiveness to the therapy, although this results need to be confirmed with further studies.

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OP50: Deep brain stimulation for the early treatment of the minimally conscious state and vegetative state

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Keywords: deep brain stimulation (DBS), minimally conscious state (MCS), vegetative state (VS), centromedian-parafascicular nucleus of thalamus

Abstract:

Introduction: An effective treatment of patients in a minimally conscious state (MCS) or vegetative state (VS), caused by hypoxic encephalopathy (HE) or traumatic brain injury (TBI), is not yet available. Deep brain stimulation (DBS) of the thalamic reticular nuclei, as a therapeutic procedure, has been attempted mainly in patients with TBI.

Methods: Fourteen out of 49 patients were included in this study (4 patients had TBI and 10 patients had HE, 4 being in MCS and 10 patients in VS). The selection criteria for DBS, evaluating status of cerebral cortex and thalamocortical reticular formation, included: neurological evaluation, electrophysiological evaluation and the use of imaging techniques such as positron emission tomography (PET) and magnetic resonance imaging (MRI). The target for DBS was the centromedian-parafascicular nucleus (CM-pf) complex. Patient follow-up was between 38 and 60 months.

Results: Two MCS patients regained consciousness and regained their ability to walk, to speak fluently and live independently. One MCS patient reached the level of consciousness, but currently is still in a wheelchair. One VS patient (after cerebral ischemic lesion) improved to the level of consciousness and currently responds to simple commands. Three VS patients died from respiratory infection, sepsis or cerebrovascular insult, respectively. Other patients remained without substantial improvement of consciousness.

Conclusion: The spontaneous recovery of MCS/ VS to the level of consciousness with no or minimal need for assistance in everyday life is very rare, therefore if a patient is a candidate according to the above mentioned criteria, DBS could be a treatment option.

OP51: Hemispheric Analysis of Cerebellar Thalamic Deep Brain Stimulation on Voice Tremor: Is it Left, Right, or Both?

Authors:

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Keywords: voice tremor, deep brain stimulation, speech neuroscience, randomized controlled double-blinded trial, neurophysiology

Abstract:

Objectives: Essential Voice Tremor (EVT) is the phonatory manifestation of Essential Tremor (ET). Several publications cite the prevalence of EVT in ET patients to be 10-25%. EVT is associated with significant social embarrassment, discontinuation of employment and hobbies, and an overall decrease in quality of life. In this study, we investigated whether unilateral (left / right) or bilateral thalamic Vim stimulation is necessary to treat EVT in a prospective, randomized, double-blinded fashion. Our goal was to determine hemispheric dominance in voice tremor as this may provide insight into speech motor neural control and treating medically-refractory isolated EVT.

Methods: All ET patients who were implanted at the Surgical Center for Movement Disorder, Vancouver, BC were screened for a pre-operative EVT. We identified n=8 right-handed patients. These patients underwent bilateral Vim DBS surgery. After several sessions of optimizing DBS parameters for limb tremor, patients were randomized to receive: none, left-only, right-only, or bilateral Vim stimulation for 15 minutes each to assess voice tremor. A five-minute washout period was used in between settings. With their limbs at rest, subjects read the 'Rainbow Passage', sustained vowels 'a' and 'e', and produced one minute of spontaneous speech. A speech-language pathologist blinded to these settings then evaluated voice recordings using the Consensus Auditory-Perceptual Evaluation of Voice (CAPE-V) scale, a standard scale used in speech-language pathology and otolaryngology.

Results: CAPE-V results were examined in relation to hemispheric Vim DBS stimulation. Preliminary findings indicate that the left thalamic Vim plays a critical role in laryngeal speech motor control. This has not been reported before. This suggests that there is hemispheric dominance in speech production similar to language. A detailed analysis will be presented at the WSSFN meeting along with DBS kinetics of voice and limb tremor benefit/washout.

Conclusion: This study adds to our knowledge of the effects of high-frequency left, right, and bilateral Vim thalamic stimulation on voice tremor in a prospective, randomized, double blinded, controlled manner. The results from this study should be taken into consideration for future endeavours using DBS for treatment of voice-related disorders and provides further information on the neurophysiology of speech motor control.

OP52: Simultaneous electrical stimulation of DBS electrodes and fMRI in movement disorders

Authors:

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Keywords: Deep Brain Stimulation, fMRI, BOLD, simultaneous

Abstract:

Background: We present a new intra-operative MRI technique for evaluating placement of DBS electrodes in patients with movement disorders, using simultaneous electrical stimulation and fMRI, which elicits a strong BOLD effect whose pattern can reflect underlying networks. The strong spatial sensitivity of these maps suggests clinical utility in predicting clinical response and unwanted side-effects. DBS for patients with movement disorders is now FDA approved. While motor symptoms can improve, a drawback is non-motor side effects that overwhelm benefits. Implantation typically requires the patient awake, which deters many patients. This motivates this work to permitting functional implantation with patients under anesthesia. To address this we obtain functional information about DBS location in patients under GA, by using intra-operative fMRI while the DBS electrodes are electrically stimulated.

Methods: Patients were scanned in a 1.5T intra-operative MRI, during DBS implantation while under GA. After anatomically guided implantation, a BOLD sensitive EPI sequence was acquired during stimulation of the electrodes in a block design of 30 seconds on/off. Stimulation parameters were 2,5,8 volts across bipolar contacts, at 130 Hz. A total of up to 4 DBS-fMRI sequences were obtained during the imaging session, each with variations of stimulation parameters such as voltages, contacts, and duration. Analysis was performed using AFNI.

Results: A total of 7 patients have been studied and there have been no adverse reactions. Various stimulation parameters explored parameter space, generally showing robust BOLD activation with voltages greater than 5 volts. BOLD activation was both proximal & distal to leads, with patterns reflecting motor circuits. Patterns were very sensitive to lead location.

Conclusion: We present initial results from simultaneous stimulation of DBS electrodes and fMRI, performed in patients with movement disorders at 1.5T while under GA. Robust BOLD activation can be easily elicited at voltages greater than 4V, whose patterns are both proximal and distal, with high spatial sensitivity, and whose patterns reflect clinical efficacy. This technique offers a possible alternative for patients wishing DBS implantation while under GA, in which the functional location of electrodes is desired to maximize clinical response and minimize side effects. This technique could easily be generalized to any functional localization electrodes during implantation.



OP53: Stereotactic accuracy of a compact, mobile intraoperative MRI

Authors:

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Keywords: iMRI, intraoperative, stereotactic

Abstract:

Introduction: Intraoperative imagers provide neurosurgeons with real-time information required to maintain precise navigation during surgery. In this study, we assessed the stereotactic accuracy of a compact, intraoperative magnetic resonance imager (iMRI), the 0.15 Tesla (T) PoleStar N30 (PN30).

Methods: Images were acquired using a water-filled phantom model of the brain. The phantom was scanned using T1weighted, T2-weighted, PSIF, and FLAIR sequences. Data collected with the PN30 were compared with those obtained in a previous study assessing the PoleStar N20 (PN20), an earlier model of this iMRI system. Additionally, the stereotactic accuracy of PN30 was measured against that of standard surgical navigation on a 1.5T diagnostic scan MRI using T1 weighted images (with the same water phantom).

Results: Navigation with PN30 images was more accurate than that using diagnostic MRI. Mean error with the PN30 using T1W images was 1.24 ± 0.47 mm and 1.28 ± 0.49 mm with T2W images, vs 2.43 ± 0.81 mm for navigation based on T1W images from the 1.5 T scan (95% Cl, p = 0.016 and 0.001, respectively). This higher degree of accuracy with iMRI-based navigation may reflect the ability to bypass the registration that is needed when employing a scan acquired before surgery, a step that introduces another source of error into the process. In addition, we found that T2W images from the PN30 yielded a lower navigation error than those acquired with the PN20, 1.28 ± 0.49 mm vs. 3.15 ± 0.63 mm at the 95% Cl, p < 0.0001.

Conclusion: A high degree of stereotactic accuracy can be achieved with a compact, low field iMRI. Improvements in magnet design can yield progressive increases in accuracy, validating the concept of these devices designed for use during intracranial surgery. Avoiding the need for registration between image and surgical space also can increase navigation accuracy.

OP54: Bilateral VIM Radiosurgery for severe Essential Tremor: preliminary results of a prospective trial

Authors:

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Keywords: Tremor, Thalamus, diffusion, trial, minimally invasive

Abstract:

Objective: To assess the feasibility and tolerance of bilateral Gamma Knife thalamotomy (GKT) in Essential Tremor (ET).

Background: Unilateral GKT is an established treatment for severe tremors. However, essential tremor is usually bilateral. The persistence of contralateral tremor may induce an impairment in activities of daily living (ADL). Bilateral procedures with thermocoagulation were contraindicated because of the risk of balance, cognitive or speech problems. As the lesion induced by radiosurgery within the VIM is progressive and limited, we proposed a study on bilateral GKT. Here are the preliminary results.

Methods: 15 patients (8 women) with severe ET who had benefit from a first GKT and who had a severe permanent contralateral tremor were included. Patients were included if there was no impairment in their balance or speech and if the neuropsychological assessment was stable. The 2nd GKT was performed at least 18 months after the first GKT. Patients were assessed before and quarterly for at least 12 months after GKT2, with tremor rating scale, neuropsychological and gait/balance assessments and MRI. VIM lesioning was performed with Leksell Gamma unit with a single exposure through a 4mm collimator. Radiosurgical dose was 130 Grays.

Results: here are the preliminary results for 9 patients who completed the study at 1 year. Tremor score on the treated hand was improved by 57%. The improvement of ADL was 95%. Cognitive score and gait assessment were stable. No patient had hypophonia or dysarthria. Two patients were not significantly improved. One patient had a side effect related to GKT2. She developed hemiataxia and dysarthria induced by a hyperresponse pattern 11months after GKT.

Conclusion: These preliminary results on bilateral GKT for severe ET in a selected cohort of patients shows that the procedure is feasible without a major risk of cognitive or balance problems. However, a longer follow-up is needed.

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OP55: Spinal cord stimulation improves antecipatory postural adjustment and freezing of gait in Parkinson disease in chronic implanted STN-DBS patients: Preliminary Data

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Keywords: gait disturbances, Parkinson's disease, spinal cord stimulation

Abstract:

Background: Gait disturbances and freezing of gait (FoG) are common in late Parkinson's disease (PD), often leading to loss of independence and increasing morbidity. A recent pilot study suggested positive effects of spinal cord stimulation (SCS) in PD patients previously treated with DBS. Despite the encouraging clinical results, no mechanistic approach was investigated at the initial trial. Anticipatory postural adjustment (APA) is an essential aspect of postural control required for starting any successful voluntary movement. APA combines motor and cognitive components of movement preparation involving the supplementary motor area (SMA) and prefrontal cortex.

Aim: To evaluate the effects of SCS over the APA measurements in PD patients and its correlation to gait improvement.

Methods: 4 PD patients with gait disorder and FoG, previously treated with STN DBS underwent evaluations in 3 conditions: SCS at 300 Hz, SCS at 60 Hz and SCS turned off. DBS was kept always on. We evaluated the SCS effects on APA and FoG. The assessment comprised: 1) Force plate analysis during step initiation (3 trials) measuring the amplitude and time of APA (time between onset of APA and the step); 2) Accelerometry spectral analysis during 10m-walk test (3 trials) providing the percentage of FoG occurrence and trunk acceleration. For each patient was calculated the average of 3 trials, so in each one the following calculations were made: 60-OFF/OFF*100 or 300-OFF/OFF*100, which is the gain of the condition (60Hz or 300Hz) in relation to OFF condition. For the group (N=4)a t-test was applied and a simple t-test contrasting 60 and 300hz.

Results:FoG index was reduced in SCS 300Hz in relation to SCS Off and 60Hz stimulation (p0.042), so patients had significantly less in freezing time while under SCS at 300Hz. APA time decreased in 300Hz condition comparing with OFF and 60 Hz conditions (p0,041), suggesting better coupling between preparation and movement during step initiation.

Conclusion: 300 Hz SCS seems to improve gait by decreasing FoG and increasing the efficiency of the preparation and movement coupling during step initiation.

Figure 1 (A) shows the position of the accelerometer in lumbar region; (B) represents vertical curve acceleration; The dotted square shows a window to frequency analysis domain; (C) Spectral analysis of acceleration: band representing the locomotor period (0-3Hz) and the FoG band (3-8Hz). (D) FoG index showing the clinical threshold (>2=FoG).



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OP56: Functional Brain Imaging of DBS-treated Essential Tremor

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Keywords: DBS, causal zona incerta, Essential tremor, fMRI

Abstract:

Background: Essential tremor (ET), characterised by postural and/or action tremor, is the most common movement disorder. Several brain regions along the cerebello-thalamo-cortical network have been hypothesised to be involved in the generation of tremor oscillations, but the pathophysiology of ET is poorly understood.

ET can be disabling to the grade of necessitating invasive Deep Brain Stimulation (DBS). DBS in the caudal zona incerta (cZi) has shown a considerable reduction in tremor for patients with otherwise medically intractable tremor. However, the mechanisms underlying the effects of DBS remain unclear.

Objective: Investigating, by using blood oxygenation level-dependent functional magnetic resonance imaging (BOLD fMRI), whether regions within the cerebello-thalamo-cortical network are influenced by therapeutic DBS.

Method: Sixteen patients with cZi-DBS for ET underwent 1.5 T fMRI. During fMRI, the patients executed right-arm tremorinducing postural holding movements as well as a baseline resting task. Tremor and hand movements were recorded by an MRcompatible single-axis accelerometer attached to the hand. The tasks were performed with the DBS turned on and off, with the initial stimulation setting (on/off) counterbalanced across patients. fMRI data were pre-processed and analysed using a general linear model implemented in SPM12.

Results: Clear therapeutic effects of cZi-DBS, in terms of tremor intensity reduction, were measured by the accelerometer. fMRI analysis showed effects of DBS in brain regions related to right-arm movement control: the contralateral motor cortex and ipsilateral cerebellum. However, different parts of this network showed different effects of the DBS depending on the motor task. Specifically, two circuits within these areas demonstrating different responses to DBS. Neural activity, expressed as BOLD, in the primary sensorimotor cortex and lobule VIII in the cerebellum decreased when performing postural holding while DBS was turned on. In contrast, neural activity in the supplementary motor area and lobule VI in the cerebellum increased during the resting condition when DBS was turned on.

Conclusion: Our results support the notion of DBS acting upon modulation of the cerebello-thalamo-cortical loop in ET. Furthermore, the study illustrates the complexity of DBS mechanisms by demonstrating different DBS actions depending on the motor state of the patient and in brain areas distant to the stimulated target.

OP57: Patient-specific model of subthalamic local field potentials recorded from deep brain stimulation electrodes

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Keywords: subthalamic nucleus, local field potential

Abstract:

Emerging innovations in deep brain stimulation (DBS) therapy are attempting to use local field potentials (LFPs) as biomarkers in the control of closed-loop algorithms. However, understanding of the biophysical origin of LFP signals remains elusive, and little is known about how the patient's unique brain anatomy and electrode placement impact the recording of such signals. Therefore, we developed a computational framework to theoretically analyze LFP recordings from clinical DBS electrodes that can be customized to individual patients. To demonstrate our model system, we selected a subject with Parkinson's disease implanted with a Medtronic Activa PC+S DBS system. First, we virtually reconstructed the subthalamic nucleus (STN) using MRI data. This virtual STN was then populated with ~250,000 realistic STN neuron models, each receiving time varying synaptic input. Finally, a finite element volume conductor model was used to represent the DBS electrode and tissue medium. We studied the role of subpopulations of highly synchronous neurons within the STN on the LFP recorded by DBS electrodes. We used three bipolar combinations of experimental LFP recordings to combinatorially determine the best fit model parameters. The results show that incorporating patient-specific STN anatomy impacted the LFP signal and varying the synchrony of spatially discrete subpopulations of neurons near the electrode had a strong effect on the LFP.



OP58: Deep Brain Stimulation Of The Ventral-Striatum And Ventral-Capsular Area For Post-Stroke Pain Syndrome

Authors:

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Keywords: Deep Brain Stimulation, Pain, Depression

Abstract:

Objective: To test our hypothesis that targeting neural pathways underlying emotion and affective behavior could alleviate the suffering and disability associated with chronic pain, we conducted a first-in-humans study of deep brain stimulation (DBS) targeting the ventral striatum (VS) / anterior limb of the internal capsule (ALIC) in 10 patients with post-stroke pain syndrome.

Method: Patients presenting with persistent and medically-refractory post-stroke hemibody pain and anesthesia dolorosa due to contralateral lesion(s) of thalamic areas and somatosensory pathways were enrolled in a prospective, double-blind, randomized, placebo-controlled, double-arm crossover trial over 24 months. The figure summarizes the trial design. Patients had had severe pain for more than six months and had failed treatment with at least one antidepressant, one anticonvulsant and one opioid. A quadripolar lead was implanted along the ALIC into the VS bilaterally, with the tip ~3-5 mm ventral to the junction between the ALIC and the anterior commissure.

Results: A total of 10 patients were enrolled in the trial and primary and secondary clinical outcome measures were prospectively acquired in each study phase. Active DBS versus sham stimulation was associated with an increased probability of response (i.e. \geq 50% improvement) in the Montgomery-Åsberg Depression Rating Scale (44% DBS ON v. 19% DBS OFF, p=0.02), Beck's Depression Inventory (45% DBS ON v. 27% DBS OFF, p=0.004), and the Affective Pain Rating Index (39% DBS ON v. 18% DBS OFF, p=0.002) and Present Pain Intensity (10% DBS ON v. 3% DBS OFF, p=0.002) in the Short-form McGill Pain Questionnaire. Individual patients showed changes in the following measures but we did not observe significant group effects: Visual Analog Scale, Pain Disability Index and the Sensory Pain Rating Index in the Short-form McGill Pain Questionnaire.

Conclusion: Our results suggest that DBS of the ventral capsule and ventral striatal area is safe and can effectively modulate the affective sphere of chronic pain, benefiting select patients.



OP59: Radiofrequency stereotactic lesions versus chronic stimulation of anterior thalamic nuclei for treatment of epilepsy

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Keywords: epilepsy, seizure, anterior thalamic nucleus, stereotactic lesion, deep brain stimulation, microelectrode recording

Abstract:

The aim of this study was to compare the results of chronic stimulation and bilateral radiofrequency lesions of anterior thalamic nuclei in patients with pharmacoresistant epilepsy. The selection of the anterior nucleus of thalamus (ANT) as a potential target for treatment of pharmacoresistant epilepsy was based on data suggesting its crucial role in seizure propagation. This article describes the results of bilateral ANT lesions and chronic stimulation in 31 patients with refractory epilepsy. 19 patients underwent the stereotactic radiofrequency lesions of ANT (I group) and 12 have the ANT-DBS (II group). Targeting was based on stereotactic atlas information with correction of the final coordinates according to location of clearly visible structures and microelectrode recording. Both groups were quite similar in age, gender, seizures frequency and duration of disease. The median x, y, and z coordinates of ANT were found to be 2.9, 5, and 11 mm anterior, lateral, and superior to the midcommissural point, respectively. Mean seizures reduction reached 80,3% in I group with 2 non-responders and 91,2% in II group. 3 patients form I group and 4 patients from II group are seizure-free now. The morbidity rate was low in both groups. The stereotactic lesion and chronic stimulation of ANT both effective for seizure control in epilepsy originated from frontal and temporal lobes. Secondary generalized seizures more demonstrated more sensitivity to ANT lesions and stimulation comparatively to simple partial seizures. Microelectrode recording allows identifying the physiological borders of ANT and improves the surgical outcomes.

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OP60: Feasibility and consistency of chronic visual cortex stimulation for vision restoration using an implanted neurostimulator

Authors:

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Keywords: Visual cortex, cortical stimulation, blind

Abstract:

Introduction: Chronic stimulation of visual cortices could potentially be used to restore some vision in individuals with blindness. However, the feasibility, utility, and consistency of response to chronic epicortical stimulation of the medial occipital lobe remains uncharacterized. Our goal was to evaluate the nature, stimulation thresholds, retinotopic localization, and reproducibility over time, of cortical stimulation-evoked phosphenes in a blind volunteer over 6 months.

Methods: A 30 year old with an 8 year history of bare light perception blindness due to Voght-Koaynagi-Harada Syndrome underwent implantation of a Neuropace responsive neurostimulation device with 2 parallel 4-contact leads implanted over the right medial occipital lobe via a posterior interhemispheric approach. Postoperatively, the subject's perception of cortically-stimulated phosphenes was assessed with systematic manipulations of stimulation intensity, pulse width, frequency, and site of stimulation over a period of 6 months.

Results: Phosphenes were elicited with stimulation of every contact; percepts elicited at each electrode varied in brightness, shape, color, and spatial location. Phosphene characteristics were related to charge density and could be elicited with as little as a single stimulation pulse. The perceived quality and spatial localization of elicited phosphenes varied with eye position but was stable over time. The perception of simultaneous stimulation of two contacts as distinct phosphenes varied depending on distance between contacts. Percepts did not change over 6 months. There were no significant adverse events.

Conclusion: This is the first demonstration of chronic epicortical stimulation of visual cortices (primary and secondary) demonstrating feasibility and safety of chronic stimulation in providing reproducible phosphenes. Based on these results, further studies exploring using epicortical visual cortex stimulation, including biobehavioral studies, are warranted to evaluate the utility of this approach to restore some form of useful vision to blind individuals who were previously sighted.



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OP61: Thalamic Deep Brain Stimulation for neuropathic pain: efficacy at 3 years' follow-up

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Keywords: DBS, Neuropathic pain, Thalamic VPL

Abstract:

Introduction: Chronic neuropathic pain is estimated to affect 3%-4,5% of the worldwide population. Deep Brain Stimulation (DBS) is established for movement disorders but, for the treatment of chronic, drug refractory, neuropathic pain, DBS has shown variable outcomes, in the few studies performed in the past. Thus, this procedure has consensus approval in parts of Europe but not in the USA. This study prospectively evaluated the efficacy at 3 years of DBS for neuropathic pain.

Methods: Sixteen consecutive patients received 36 months post-surgical follow-up in a single-center. Five had phantom limb pain after amputation and eleven deafferentation pain after brachial plexus avulsion (BPA), all due to trauma. To evaluate the efficacy of DBS, patient-reported outcome measures were collated before and after surgery, using a visual analogue scale (VAS) score, University of Washington Neuropathic Pain Score (UWNPS), Brief Pain Inventory (BPI), and 36-Item Short-Form Health Survey (SF-36).

Results: Contralateral ventroposterolateral sensory thalamic DBS was performed in sixteen patients with chronic neuropathic pain over 29 months. A postoperative trial of externalized DBS failed in one patient with BPA. Fifteen patients proceeded to implantation. One patient with phantom limb pain after amputation was lost for follow-up after 12 months. No surgical complications or stimulation side effects were noted. After 36 months, mean pain relief was sustained, and the median (and interquartile range) of the improvement of VAS score was 52.8% (45.4%) (p=0,00021), UWNPS was 30.7% (49.2%) (p=0,0590), BPI was 55.0% (32.0%) (p=0,00737) and SF-36 was 16.3% (30.3%) (p=0,4754). Among the BPA patients, VAS score improved by 40% (31,9%) (p=0.01298), UWNPS by 22.7% (37.1%) (p=0.4632), BPI by 47.8% (62.8%) (p=0.189) and SF-36 by 16.0% (42.7%) (p=0.9953). In the amputation group, after 36 months median VAS score improved by 66.7% (51.7%) (p=0.0494), UWNPS by 50.8% (62.9%) (p=0.3225), BPI by 65.2% (31.6%) (p=0.1623) and SF-36 by 16.7% (140,2%) (p=0.2406). Initial mean parameters were 2.1V, 23Hz and 187 µs and after 36 months both amplitude and pulse width were increased with parameters of 4.1V, 15 Hz and 196 µs.

Conclusions: DBS demonstrated efficacy at 3 years for chronic neuropathic pain after traumatic amputation and BPA, with benefits sustained across all pain outcome measures and slightly greater improvement in phantom limb pain.

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OP62: Bifocal thalamic deep brain stimulation for treatment of chronic neuropathic pain

Authors:

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Abstract:

Objective: To assess long-term efficacy of deep brain stimulation (DBS) for chronic neuropathic pain in consecutive patient.

Methods: Patients with chronic neuropathic pain which were refractory to medication underwent bifocal thalamic implantation of DBS electrodes. Targets were the centromedian parafascicular nucleus (CM-Pf) and somatosensory thalamus (either nucleus ventralis postereolateralis, VPL, or ventralis postereomedialis, VPM) Elektrodes were implanted by CT-stereotactic surgery and externalized for 4-14 days to assess the effect of the two targets and to decide whether chronic stimulation could be administrated. Therefore DBS electrodes were either removed or a pulse generator was implanted. Assessment of pain included VAS scores and patient self rating. Patients were follow-up regularly at annual visits on longterm.

Results: Over a period of 16 years, a total of forty patients (20 women, 20 men; mean age of surgery 53.8 years, range 24-73 years) underwent bifocal implantation of thalamic DBS electrodes. Etiologies included central pain after stroke or hemorrhage (11 patients), complex regional pain syndrome (10 patients), a typical facial pain (5 patients), post Zoster pain (4 patients), post-amputation pain (2 patients), myelon injury (2 patients), and others. There were no surgical complications. Impulse generator were implanted in 33/40 patients for chronic stimulation, while 7 patients did not a chieve adequate benefit during test stimulation. Three patients were lost to follow-up in longterm followup, and in five patients the neurostimulation system was explanted due to infection. On longterm 20/33 had chronic CM-Pf stimulation and 13/33 had VPL/VPM stimulation. The properties of marked/ excellent vs moderate/ minor vs no improvement was similar with both targets in longterm follow-up according to patient self-rating.

Conclusion: Thalamic DBS is a useful treatment option in selected patients with severe and medically refractory neuropathic pain. While some patients achieve greater benefit with CM-Pf stimulation (which is thought to represent the paleospinothalamic projection associated with the sensation of unpleasant of pain), others prefer somatosensory thalamic stimulation (which relates to the neospinothalamic pathway transferring the most immediate pain experience. Bifocal implantation is helpful to select the optimal stimulation target in the individual patient.

OP63: Stereotactic anterior cingulotomy for intractable oncological pain

Authors:

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Keywords: stereotactic, cingulotomy, oncological pain Abstract:

Background: Stereotactic anterior cingulotomy has been reported to be effective in the treatment of patients suffering from refractory oncological pain by influencing pain perception. However, the optimal target as well as suitable candidates have not been well defined. We have established a specialized palliative service consisting of palliative care specialists, pain specialists and a neurosurgeon to aid in the patients' selection process and outcome assessment. We report our initial experience in the ablation of two cingulotomies targets on each side and the use of brief pain inventory (BPI) as a perioperative assessment tool.

Methods: This is a retrospective review of all patients who underwent stereotactic anterior cingulotomy in our department between November 2015 and February 2017. All patients had advanced metastatic cancer with limited prognosis and suffered from intractable oncological pain.

Results: Thirteen patients (10 females) underwent 14 cingulotomy procedures. Mean age was 56±13.5, and median KPS was 50. Median pain duration was 12 months (range 1-48). All patients reported significant pain relief immediately after the operation and out of the 6 pre-operatively bedridden patients, 3 started ambulating shortly after. Eight patients were discharged home, 3 were referred for rehabilitation and 2 for hospice care. Median pre-operative and post-operative VAS scores were 9/10 (range 8-10) and 3/10 (range 0-5), respectively. Mean pre-operative BPI pain severity and interference scores were 30±12 and 59±11, respectively, as compared with post-operative values of 14±9 and 32± 13, respectively. During the 1-month and 3-months follow-up visits, 10/11 patients (90%) and 5/7 patients (71%) available for follow-up, reported significant pain relief. No patient reported worsening of the pain.

Adverse events included transient confusion or mild apathy in 5 patients (38%) lasting 1-4 weeks. Two of these patients developed transient urinary incontinence that resolved after 1 week.

Neuropsychological analyses of 5 patients showed mild deficits in focused attention and visual memory, while the rest of cognitive functions were relatively stable. There was a significant improvement in depression symptoms.

Conclusions: Two-target stereotactic cingulotomy is safe and effective in alleviating refractory pain of cancer patients. BPI score may add to VAS for the evaluation of response to cingulotomy. No substantial cognitive changes were detected.

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OP64: Extended dorsal root entry zone-lesioning for alleviating intractable arm pain following brachial plexus avulsion injury

Authors:

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Keywords: DREZ, neuropathic pain, brachial plexus avulsion

Abstract:

Introduction: Arm pain following brachial plexus avulsion injury is known to be refractory to any conventional method for pain relief. Dorsal root entry zone (DREZ)-lesioning has been the most effective surgical treatment for the relief of pain this kind. However, residual pain and a decrease in pain relief in the follow-up period have been reported in 23-70% of patients. Based on the most recent studies on neuropathic pain, we modified the conventional DREZ lesioning procedure to improve clinical outcomes.

Methods: Both the original DREZ-lesioning, employing electrode insertion and coagulation technique by Nashold and microsurgical technique by Sindou, intended destruction of the dorsal horn cells at Rexed layer I & II. We extended area of microsurgical destruction deep into Rexed layer V. Fourteen patients underwent surgery between 2011 and 2017.

Results: All patients achieved excellent (n=10, pain relief without medication) or good (n=4, pain relief with medication) pain relief post-operatively, and the recurrence was not reported in any patients (median of 28 months after surgery,6-84 months). Twelve patients (88%) achieved total pain relief (0 or 1 on the VAS) with or without medication. Although, intraoperative MEP amplitude attenuation down to 10% of the original level were observed in 1/3 of the cases, no motor deficit was observed. A sensory deficit was observed in 2 patients and disappeared within one month in 1 patient. New pain at the adjacent level of DREZ lesioning was observed in 3 patients and disappeared within one month in 2 patients. In the other patient, new pain persisted and required analgesics. The most prominent gliotic change were observed at the gray matter of the spinal segment which was compatible with the most painful area.

Conclusion: Our preliminary results demonstrated that total and persistent global pain relief was achieved with the modified DREZ lesioning procedure in 90% of patients without major neurological deficits. Our results clearly suggested that the wide dynamic range neuron in Rexed layer V played a cardinal role in pain formation in case of brachial plexus avulsion injury.

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OP65: Deep Cerebellar Stimulation For Post-Stroke Motor Recovery: Early Trial Experience

Authors:

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Keywords: Deep brain stimulation, stroke, neurorehabilitation

Abstract:

Objective: To review our initial experience with a first-in-human FDA-approved trial of deep cerebellar nucleus deep brain stimulation (DBS) for post-stroke recovery, including intraoperative physiological data and observations as well as the effects of acute stimulation titration on behavior and on cortical excitability indexed by transcranial magnetic stimulation (TMS).

Background: Over the past decade, our group has demonstrated that chronic electrical stimulation of the lateral cerebellar nucleus (LCN) can enhance motor recovery following cortical ischemia in preclinical rodent models. Those motor rehabilitative findings were accompanied by enhanced synaptogenesis and increased expression of markers of long-term potentiation in perilesional cortex as well as modulation of cortical excitability and motor representation.

Methods: All data are being collected as part of a first-in-man, single-center, prospective, open-label, single-arm, safety and feasibility trial for patients with persistent (>12 months post-stroke), moderate-to-severe upper extremity hemiparesis secondary to middle cerebral artery ischemic stroke.

Results: Two participants have been enrolled to date. In addition to safety and feasibility indices we will present measures of therapeutic efficacy as well as modulation of perilesional cortical excitability and changes in motor representations measured by TMS. Intraoperative electrophysiological data including EEG and local field potential data acquired during lead implantation will also be presented. Finally, we will review our development of patient-specific biophysical models of DBS of the dentatothalamocortical network based upon pre- and post-operative imaging data.

Conclusion: This study and its data represent the initial steps in the translation of more than a decade worth of preclinical work towards the development of deep brain stimulation of the dentatothalamocortical pathway as a therapy for post-stroke motor rehabilitation. Its review will provide an interactive forum concerning the process and timing of translating neurostimulation-based research for neurorehabilitation.



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OP66: Targeting of the Ventral intermediate Nucleus (VIM) of the Thalamus by Direct Visualization with High-Field MRI 3-Tesla: a follow-up

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Keywords: Essential Tremor, Deep Brain Stimulation, Ventral Intermediate Nucleus, Stereotactics, Functional Neurosurgery, Movement Disorders, Imaging

Abstract:

Objective: Over ten years ago we reported a protocol for direct visualization of the Venterointermediate Nucleus (VIM) on 3 Tesla MRI and its use in a small number of stereotactic procedures. Since then, direct anatomical targeting of the VIM has been supplemented with micro-electrode recording. We report here our experience in 29 surgical cases.

Methods: In 29 patients selected for VIM Deep Brain Stimulation (DBS) surgery due to intractable appendicular tremor, anatomical targeting of the VIM was done in every case using a modified fast spin echo protocol in axial cuts running from the midbrain to the corpus callosum. The thalamus, capsula interna, anterior and posterior commissures were clearly delineated. On the day of surgery, stereotactic CT was fused with the MRI and the stereotactic coordinates of the directly determined VIM target were used for electrode placement. During surgery, micro-electrode recording was used to verify target boundaries. Macro-stimulation was used to test tremor arrest.

Results: The thalamic VIM was clearly and consistently delineated on the 3 Tesla images which highly corresponded with the micro-electrical recordings and macro-stimulation of patients. Post-operative CT confirmed adequate electrode positioning in the selected target.

Conclusion: Targeting of the VIM of the Thalamus by direct visualization with High-Field MRI 3 Tesla showed high accuracy in electrode placement and was closely correlated with micro-electrode recordings and clinical outcomes.

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OP67: Voxel-based morphometry after Gamma Knife thalamotomy of the Vim for tremor could help discriminating clinical responders from non-responders the Vim nucleus for tremor

Authors:

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Keywords: thalamotomy; Vim; radiosurgery; Gamma Knife; voxel-based-morphometry

Abstract:

Objective: To assess for the first time structural brain changes, by voxel-based morphometry (VBM), before and after unilateral Gamma Knife thalamotomy (GKT) for drug-resistant tremor. To identify differences between clinical responders and non-responders to GKT.

Methods: Thirty-eight patients (mean age 71.8 years) with severe refractory right essential tremor (ET) were treated with unilateral left GKT. Targeting of ventro-intermediate nucleus (Vim) was performed with Leksell Gamma Knife using a single 4-mm collimator and 130 Gy. Neurological, neuropsychological and neuroimaging (3 Tesla, including 3D T1 weighted) assessment had been done at baseline and 1 year after GKT. Clinical responders were considered those improved in tremor score (Fahn-Tolosa-Marin) with at least 45%.

Results: Thirty-one (81.6%) patients were responders (R) and 7 (18.4%) non-responders (NR). With regard to GM changes after GKT, independently of clinical answer, atrophy was present in extensive areas (right globus pallidus, left putamen, left thalamus, right anterior and medio-dorsal thalamus, cerebellar, right premotor and supplementary motor area, left and right visual association cortex, right ventral temporal, left parahippocampal and posterior cingulate gyrus). The interaction between R - NR with time showed brain plasticity in R remote areas, within left temporal pole (BA 38) and cluster including left occipital cortex (BA 19), visual areas V4 and V5, parahippocampal place area (p_{unc}<0.005, k>120).

Conclusions: Our results show brain plasticity after unilateral left GKT. Responders present changes in areas involved in motion, mainly locomotor monitoring towards the local and distant environment, suggesting the requirement to recruit in the targeting specific visuomotor networks.

OP68: Radiofrequency (RF) lesions involving different fiber tract components of Prelemniscal radiations (Raprl) and their effect on individual Parkinson's disease symptoms

Authors:

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Keywords: Prelemniscal radiations, stereotatic surgery, radiofrequency lesions, tremor, rigidity, bradykinesia, gait and posture, Parkinson disease

Abstract:

Objective: DBS and RF lesions of Raprl may induce different degree of improvement on tremor, rigidity, bradykinesia, posture and gait in PD patients, which indicates that different symptoms are mediated by different fiber tracts. The goal was to determine the fiber tract lesion related of individual symptom improvement.

Methods: Eleven PD patients had stereotactic ally placed unilateral RF lesions in Raprl to treat contralateral prominent symptoms. Prior surgery, symptoms' severity was evaluated through specific items of UPDRS part III in off medication condition and a 3T-MRI-DTI high resolution was performed. Two lesions were made using bipolar 1.3 mm diameter electrode introduced by a frontal parasagittal approach, with temp 80°C, 60 seconds, 3 mm apart in dorsal-caudal direction. MRI were repeated 6 months post-operatively and co-registered with preoperative MRI, to determine the place and size of lesions as well as the degree of different tract components involved. UPDRS-III was applied 2 years after surgery in off medication condition to determine the percent improvement of different symptoms. Spearman correlation was performed between the tract lesions and symptom improvement.

Results: Three main tracts were composing Raprl in all cases: cerebellar-thalamic-cortical, Globus pallidum (Gp)-peduncle pontine (PPN) and orbital and prefrontal-mesencephalic. Patients with optimum improvement (>75% decrease in global score) had lesions impinging the 3 fiber tracts. Patients with suboptimum results had lesions in one or 2 tracts. Positive correlation was obtained between improvement of tremor and rigidity with lesion in cerebellar-thalamic fibers, while negative correlation was obtained between posture and gait and fibers connecting with pre frontal cortex. In one case with improvement mainly in tremor and poor for rigidity and bradykinesia a lesion was placed over zona incerta caudalis; another patient with improvement only in gait and posture lesion was placed in Gp-PPN component; a third case with prominent tremor completely controlled without decrease in muscular tone, the lesion involved only fibers ending in Vim.

Conclusion: Cerebellar-thalamic cortical fibers seem related to the physiopathology of tremor and rigidity. Gp-PPN fibers related to gait and posture. Orbitofrontal-mesencephalic component might be related to bradykinesia as part of the medial forebrain bundle. Surgery directed to individual symptoms is feasible.

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OP69: Correlations between the clinical results and the MR characteristics of the thalamic lesion in Vim Gamma Knife radiosurgery for tremor

Authors:

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Keywords: radiosurgery tremor Vim lesion characteristics

Abstract:

Objective: This study aims at reporting the correlation between the clinical results and the one-year postoperative MR neuroimaging characteristics of the thalamic lesion after Gammaknife radiosurgery for tremor.

Methods: Between April 2004 and March 2015, a Vim Gammaknife thalamotomy was performed in 319 patients for essential or Parkinsonian tremor in Marseille University hospital with a very stereotyped procedure. A neuro-imaging and clinical assessment was performed at one year FU for 253 patients. The volume of the lesion defined as the whole area of post-contrast enhancement was calculated for each patient in mm³, the pattern of lesion determined and the amount of edema evaluated according to a semi-quantitative scale. A clinical evaluation by expert neurologists was performed at the same time. Statistical analysis was performed using R software (RStudio,Version 1.0.136-2016).

Results: Imaging data were analyzable and reviewed for a total of 169 patients at one year follow-up.Complete neurological clinical evaluation were obtained for 91 patients. The median percentage of tremor reduction was 70% (0-100%, SD:30%).The median volume of the lesion at 12 months FU was 91,45 mm³ (Mean = 104, Min:0, Max :1120, SD:284).A correlation was established between the volume of the lesion and the percentage of tremor reduction (Pearson's coefficient of correlation r =+ 0,26 (p=0,0178).In patients regarded as clinical failure (< 45% of tremor improvement), the lesion volume was significantly smaller than in patients deemed responders (> 45% tremor reduction),p <0,0001).The amount of edema surrounding the lesion was significantly related to the clinical improvement (p = 0.022). The "cocade" pattern enhancement type was strongly related to good outcome (p<0,0001) and the absence of enhancement to the absence of improvement (p<0,00001,62% vs 0,07%).

Conclusion: These data confirm our previous results derived from 50 patients with blinded analysis of clinical outcome (Witjas et al. Neurology, 2015). Even though a significant correlation exists between lesion volume, edema and clinical improvement, concordance is far from being very strong and linear between the imaging and clinical responses. These findings prompt to look for additional factors in order to better characterize the effects of Gammaknife that might also rest upon a delayed non-lesional neuromodulatory mechanism. These fascinating questions are of utmost importance and currently under investigation.

OP70: Factors affecting stereotactic accuracy in image-guided deep brain stimulator electrode placement

Authors:

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Keywords: Deep Brain Stimulation, stereotactic error, image-guided DBS

Abstract:

Deep Brain Stimulation (DBS) is a safe and effective therapy for movement disorders. Intraoperative imaging allows near realtime assessment of stereotactic accuracy during implantation of intracranial leads. These technologies can be used to examine factors impacting stereotactic error. This study quantifies and identifies factors contributing to stereotactic error during imageguided DBS.

Intra-operative CT imaging was reviewed in patients undergoing DBS placement at OHSU. The AC/PC coordinates of the target electrode were compared to the operative plan to characterize magnitude and direction of stereotactic error with respect to side of implantation, target and electrode approach angles.

169 leads in 94 patients were examined. Targets were GPi (n=86), STN (n=31) and Vim (n=52); 85 were placed on the left and 84 on the right. Average Euclidean error was 1.63 mm (SD: 0.87). Error magnitude is higher for Vim (1.95 mm) than for GPi (1.44 mm), while STN (1.65 mm) did not differ from either Vim or GPi (ANOVA: F=6.15, p=.003). Electrodes targeting Vim and STN were significantly more likely to deviate medially compared to GPi (ANOVA: F=9.13, p<.001) Coronal approach angle affects error when targeting Vim (rho=0.338, p=.01). These findings were confirmed during multivariate analyses.

This study shows a significant effect of target on the accuracy of electrode placement for DBS. Targeting Vim results in greater Euclidean error and greater medial deviation off target. The degree of target-specific error appears to be related to penetration of the internal capsule. These systematic deviations should be taken into account during electrode implantation.



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OP71: Deep brain stimulation in patients with essential tremor using directional lead technology increases the therapeutic window – Preliminary results

Authors:

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Abstract:

Objective: To define possible benefits of deep brain stimulation (DBS) of the Dentatorubrothalamic-Tract (DRT) using directional lead technology (DLT) in patients suffering from essential tremor (ET) compared to DBS with conventional, spherical current distribution (cDBS).

Methods: From 04/2016 through 10/2016 8 ET-patients were treated with bilateral DBS of the DRT using DLT (St. Jude Medical) in our institution. 6/8 patients (median age: 74 years) with a minimum FU of 3 months (median: 8.5 months) were considered for analysis. We performed stereotactic implantation of the brain electrodes (two triple-segmented contacts and two spherical contacts) and impulse generator in one session. Targeting based upon preoperative probabilistic Fiber Tractography (pDTI) visualizing the DRT. We used intraoperative stereotactic X-ray to confirm the electrode position and to determine the 3D-arrangement of the segmented contacts. Three months after surgery, DBS-effects were analyzed according to a standardized protocol with monopolar stimulation of all contacts in the cDBS mode and of segmented contacts in the DLT-mode (individual stimulation in three directions). To define the therapeutic window we determined thresholds for tremor improvement and for side effects such as dysarthria, paresthesia or ataxia. Test results allowed ranking of different stimulation directions by therapeutic window for each contact. We compared results of stimulation in best direction vs. cDBS (n=12).

Results: In 9 out of 12 tested electrodes, DLS of the most efficient segmented contact increased the therapeutic window. Compared to cDBS, the benefit gained by DLT was 0.81 mA (p<0.01). DLT increased the threshold for side effects significantly by 0.61 mA (p<0.05).

Conclusion: DRT-DBS in ET-patients using segmented electrode contacts and DLT instead of spherical contacts increases the therapeutic window in comparison to cDBS. This result suggests that DLT allows steering current away from anatomic structures causing side effects while stimulating specifically in direction towards structures supposed to be responsible for improvement of symptoms.

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OP72: First experience with deep brain stimulation of the ventrolateral thalamus and subthalamic area with directional leads in 9 essential tremor patients

Authors:

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Keywords: essential tremor, vim stimulation, directional leads, segmented leads

Abstract:

Introduction: Deep brain stimulation (DBS) within the ventrolateral thalamus with directional leads may result in improved tremor suppression and reduced adverse events.

Methods: Nine essential tremor patients (1 female; mean age 69 yrs; average disease duration 23 yrs; follow-up 1 to 8 months) were implanted bilaterally (8) with directional leads into the ventrolateral thalamus and subthalamic region (Infinity™; St. Jude Medical). Intraoperatively clinical effects elicited by stimulation in different directions via bipolar activation of corresponding segments pointing into the same direction (lower segment = cathode) were assessed. Monopolar reviews involved the assessment of tremor suppression, including quantitative accelerometer assessments to be completed for some patients, and side effects, in particular paraesthesias. Patients and raters were blinded with regard to the direction of DBS (chosen in random order) and stimulation amplitude. Clinical Global Impression (CGI; 1= very much improved, 7=very much worsened) scale was used to track subjective treatment responses over time.

Results: There were no adverse events related to surgery or implanted hardware. All patients exhibited microlesioning effects followed by sustained tremor suppression with DBS. The improvement was rated CGI = 2.6±2.1. Intraoperative assessments revealed a lower threshold for paraesthesia if stimulation was performed into the posterior-(medial and lateral) direction. Monopolar review revealed differential thresholds for tremor suppression and paraesthesias that were very variable among patients, and for three electrodes paraesthesia thresholds did not differ between directions or were lower with stimulation in the anterior direction. Tetanic muscle contractions could not be elicited to an extent allowing meaningful comparisons. In two patients permanent stimulation with one of both electrodes was performed in a directional mode in order to widen the therapeutic window or because gait ataxia had worsened under ring mode stimulation.

Conclusion: Directional stimulation maps did not reveal a uniform pattern with regard to tremor suppression and thresholds for paraesthesia. In particular the influence of directional DBS on the therapeutic windows was highly variable among patients. This may be related to actual contact positions, electrode angulations, individual anatomy and biophysical characteristics of directional DBS that need to be unraveled.

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OP73: Deep brain stimulation for refractory tics associated with Tourette syndrome: NCNP experience

Authors:

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Keywords: Deep brain stimulation, Tourette syndrome, Centromedian-parafascicular nucleus

Abstract:

Objective: Deep brain stimulation (DBS) is an emerging therapeutic option for selected cases of severe and refractory tics of Tourette syndrome (TS). After a preliminary experience (Kaido et al. 2011), we have launched a prospective clinical trial on the centromedian-parafascicular nucleus (CM-Pf) DBS for severe TS in 2011. Interim results of the study are reported.

Methods: The study enrolled patients with an established diagnosis of Tourette syndrome and severe motor and phonic tics with a Yale Global Tic Severity Score (YGTSS) 35 or greater, despite appropriate medical and behavioral therapies. DBS was targeted at the bilateral CM-Pf nuclei.

Results: A total of 15 patients were enrolled (mean age 26 [16 - 34], including 3 women). DBS implantation was performed without acute surgical complication in all cases. Pre-operative YGTSS (median 40, ranging from 36 to 45) decreased significantly at one year after surgery (median 20, ranging from 12 to 33, p < 0.01, Wilcoxon signed rank test). The improvement was sustained at the last follow-up in all patients (maximum 6 years). No neurological adverse events were observed. One patient required multiple surgeries for wound infection. Repositioning of electrode and replacement for lead breakage were required in one patient each. None of the patients terminated DBS for the complication. All patients experienced reduction in their social impairment.

Conclusion: In line with recent clinical reports, CM-Pf DBS is a promising therapeutic option for selected cases of severe and refractory tics of TS.

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OP74: Meta-analysis of 103 studies assessing adverse events associated with deep brain stimulation surgery and implanted hardware: proposal of categories suited for pro- and retrospective assessments

Authors:

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Keywords: adverse event, complication, infection, erosion, revision, hemorrhage

Abstract:

Objective: To determine the rate of adverse events (AEs) related to deep brain stimulation (DBS) surgery and implanted devices in the literature.

Methods: Three categories were used for a systematic review of 103 publications retrieved from the PubMed database and reference lists: (1) inctracranial AEs (hemorrhages, infarction, abscess, edema) because these might result in neurological deficit or death; (2) infections requiring (partial) hardware removal with interruption of DBS; (3) lead revisions due to fracture, misplacement or migration since this involves an additional intracranial procedure. AE incidences were related to the number of patients (not procedures or electrodes) to prevent dilution of AEs rates. Cumulative patient-years were also used to assess hardware-related AE rates and to compare studies with different follow-up. For non-pooled analysis AE rates from studies were averaged giving equal weight to each study irrespective of cohort size. For pooled analysis AE rates from all applicable studies were summed up and divided by the total number of patients included in these studies.

Results: Exact rates could not be derived from the majority of studies including most monitored trials. The average rate of intracranial AEs was 3.8% (non-pooled) and 3.4% (pooled). Only with pooled analysis intracranial AEs were less frequent in studies with >200 patients (3.1%; p> 0.05) compared to studies with 500 patient-years) exhibited significantly (p< 0.05) lower infection rates than smaller studies (<100 patients and/or 5%). Lead revision rates were 5.8% (non-pooled) and 4.5% (non-pooled). Analysis based on patient-years revealed lower rates in larger (>500 patient-years) than smaller studies (<100 patients and/or 5%).

Conclusions: Although the analyzed AEs cover *severe* and *serious* complications, a heterogeneous reporting practice and poor information in several publications including tightly monitored prospective trials prevented clear assessments. For purposes of benchmarking and proper patient counseling clear AE categories are required. The proposed triad has the following advantages: (1) unequivocal definition of AEs; (2) coverage of the most relevant DBS surgery and hardware-related complications; (3) insensitivity to study design and quality; (4) postoperative imaging and a complete set of surgical records are the only requirements making accurate retrospective assessments possible.

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OP75: Real world clinical outcomes using a novel directional lead from a multicenter registry of Deep Brain Stimulation for Parkinson's disease

Authors:

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Keywords: Deep Brain Stimulation, DBS, subthalamic nucleus, neurostimulation, directional lead, Parkinson's disease, therapeutic window

Abstract:

Objective: Deep Brain Stimulation (DBS) systems have traditionally used ring-shaped electrodes that produce a spherical stimulation field which can only be varied in intensity, thereby limiting the extent of volume of tissue activated. A pilot study of 7 PD subjects reported that a novel, directional permanently implanted DBS system, combining an eight-contact directional lead and an implantable pulse generator (IPG) capable of multiple independent current control (MICC), can accomplish directional current steering (Steigerwald F. et al., Mov Disord, 2016). This study was conducted to evaluate clinical outcomes in subjects implanted with a directional lead for use in the management of motor symptoms of levodopa-responsive Parkinson's disease (PD) as part of an on-going registry.

Methods: The Vercise DBS Registry is a prospective, on-label, multi-center, international registry sponsored by Boston Scientific Corporation. The Vercise PC system (Boston Scientific) is a CE-marked, MICC-based DBS system with a non-rechargeable battery. Subjects will be followed up out to 3 years post-implantation. Clinical endpoints will be evaluated at baseline and during study follow up that include Unified Parkinson's disease Rating Scale (UPDRS), MDS-UPDRS, Parkinson's disease Questionnaire (PDQ-39), and Global Impression of Change. Adverse events are also collected. Subjects in this specific cohort were implanted with a directional lead included as part of a directional DBS system (Vercise Cartesia, Boston Scientific) for bilateral STN-DBS.

Results: Subjects from several European centers and implanted with a directional lead as part of an on-going Registry study will be evaluated. Preliminary data suggests an overall improvement in quality of life as assessed by PDQ-39. Baseline data for this cohort as well as follow up data at 6 mos. (n = 50) and 12 mos. (n = 20) post-implant as available will be presented. Preliminary analysis shows improvement of quality of life comparable to conventional leads.

Discussion: A DBS device that enables fractionalization of current using a multiple source mode of delivery (MICC) can permit the application of a well-defined, shaped electrical field. Additionally, use of a directional lead allows for the steering of current in horizontal directions by combining segmented leads and MICC, which is thought to permit increased stimulation thresholds for side effects as compared to using standard ring-shaped electrodes.

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FLASH PRESENTATIONS

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OF01: Improvement of consciousness after severe traumatic brain injury with deep cerebellar stimulation

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Keywords: Traumatic Brain Injury, Deep brain stimulation, Cerebellum, Consciousness

Abstract:

Introduction: The failure of the brain mechanisms following severe traumatic brain injury is mostly assumed to be the result of widespread loss of cerebral connectivity. Extensive plastic potential of brain can be limited by chronic underactivation of the large–scale networks. There are indications that properly selected DBS techniques could effectively modulate brain activity and promote recovery.

Methods: The deep cerebellar stimulation has been applied for symptomatic treatment of spasticity and dyskinesias in 49 patients. Four quadruparetic spastic patients were 6, 7 12, 18 month after severe brain injury, three in vegetative state, one in minimally conscious state. Two electrodes were bilaterally implanted into medial vermal lobar white matter region of the anterior cerebellar lobe, superiorly to the brachia conjunctiva, position verified by intraoperative stimulation tests. Chronic high frequency stimulation (250 Hz, 2-4mA, 20min ON, 3 hours OFF) were applied. Patients were followed up during 14, 16, 40, 69 months respectively.

Results: All three patients emerged from vegetative state, however two became able to obey verbal commands, remained in bedridden state, but third one was able to speak, feed himself, move on wheelchair. Forth patient emerged from MCS, walks with support, speaks, oriented, feed himself.

Conclusion: The role of the cerebellum in sensorimotor regulation is well known. Its widespread reciprocal connections with the areas of the brain involved in processes of emotion, consciousness and cognitive functions is especially documented in recent fMRI studies. According to our observations specific augmentation of cerebellar modulation on the brain network could be taken account.

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OF02: The importance of somatotopy to achieve clinical benefit in motor cortex stimulation for pain relief

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Abstract:

Introduction: The aim of this study was to search the relationship between the anatomical location and the eventual analgesic effect of each contact.

Methods: 22 patients (14 men and 8 women) suffering from central and / or peripheral neuropathic pain were implanted with stimulation of the precentral cortex. The implantation of the electrodes was performed using intraoperative: 1) Anatomical identification by Neuronavigation with 3D MRI, 2) Somesthetic evoqued potentials monitoring to check the potential reverse over the central sulcus, 3) Electrical stimulations through the dura to identify the motor responses and its somatotopy. In order to locate postoperatively the electrodes, a 3D-CT was performed in each case and fused with the preoperative MRI. The clinical analgesic effects of cortical stimulation were collected on a regular basis (VAS reduction > 50%, drugs consumption). Data were analyzed to search a correlation between the anatomical position of contacts and analgesic effects.

Results: Post implantation analgesic effects were obtained in 18 (81.81 %) patients out of 22. The analgesic effect was companied with reduction of the drugs consumption in 15 patients (68.18 %). The post-operative 3D CT analysis shows a correspondence between the effective contacts localization and the motor cerebral cortex somatotopy in the patients with post-operative good analgesic effects. No correspondence was found between the contacts localization and the motor cerebral cortex somatotopy in the 4 patients with no analgesic effects. In three out of these four patients, analgesic effects were obtained after a new surgery allowing a replacement of the electrode position over the motor cortex somatotopy corresponding to the painful area.

Conclusion: This study shows the correlation between position of the contact over the precentral cortex and the analgesia obtained when the somatotopy of the stimulated cortex correspond to the painful area.

OF03: High-density spinal cord stimulation for chronic neuropathic pain: a prospective observational study

Authors:

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Keywords: Failed Back Surgery Syndrome, Neuralgia, Spinal Cord Stimulation, Salvage Therapy, Prospective Studies, Follow-Up Studies

Abstract:

Introduction: High-density spinal cord stimulation (HD-SCS) is an emerging treatment modality for chronic neuropathic pain, based on the concept that the amount of electric charge is the key determinant of SCS efficacy. HD-SCS is paraesthesia-free and may represent a treatment option for patients who do not derive benefit from conventional SCS. This study sought to determine the effect of HD-SCS on pain intensity and quality of life, when initiated either primarily during the test phase following SCS lead implantation or as a salvage treatment following unsuccessful treatment with conventional SCS.

Methods: This prospective, IRB-approved observational study enrolled consecutive patients with chronic neuropathic pain who began receiving high-density SCS in July-December 2015. We examined medical history, procedural information, programming parameters, and clinical outcomes including pain reduction, activities of daily living, and change in pain medications.

Results: The median age of the 16 study participants was 60 years (SD 10, range 45-79) and 9/16 were female. The indications for initial SCS included failed back surgery syndrome (11 patients), syringomyelia, pudendal neuralgia, post-thoracotomy syndrome, peripheral neuropathy and phantom upper limb pain (each 1 patient). 5/16 cases represented primary HD-SCS therapy, while 11/16 cases involved conversion from standard SCS after a mean period of 33 months (SD 3). The most common reason for such conversion was refractory or residual pain (8 patients) despite SCS, followed by undesired side-effects of SCS including intolerable paraesthesia (2 patients). The median duration of follow-up after HD-SCS initiation was 7 months (SD 4.5). The mean pulse density utilised was 15% (SD 7.2, median 15). 15/16 subjects reported improved pain with HD-SCS. Overall, a mean VAS pain reduction of 2.9 points (SD 1.8, p<0.001, paired t-test) from 7.1 (baseline, SD 1.5, IQR 6-8) to 4.2 (SD 1.8, IQR 3-5.5) in overall pain at last follow-up was observed. Patients receiving HD-SCS as a salvage therapy were, however, more likely to have VAS improvement (p<0.05, Fischer's exact test). Improvement in activities of daily living and reduction in pain medication usage were also reported.

Conclusion: HD-SCS represents a safe, well-tolerated and efficacious alternative to conventional SCS, offering particular promise in patients with pain refractory to conventional SCS therapy.

OF04: Limbic leucotomy for self-injurious behavior: Long term follow-up of two cases

Authors:

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Keywords: Limbic Leucotomy, Self-Injurious Behavior, Psychosurgery

Abstract:

Self-injurious behavior (SIB) is amongst the most severe and treatment refractory of all psychiatric conditions. SIB is associated with a variety of psychiatric disorders and can manifest in various ways and is potentially life threatening. Limbic leucotomy, which combines the lesions of the anterior cingulotomy and subcaudate tractotomy, has been shown to be beneficial in a small cohort of patients with severe, intractable SIB. However, to date there have been no long-term follow-up reports. We describe the long term effects of limbic leucotomy in two adult female patients with severe repetitive SIB that was unresponsive to an exhaustive treatment regimen. Both patients had been chronically institutionalized with 24 hour 1:1 or 2:1 care. Both patients underwent MRI guided stereotactic limbic leucotomy after comprehensive review and careful ethical deliberation. Throughout >18 years of follow-up, both patients have demonstrated slow, steady improvement without significant cognitive or behavioral side effects. Both experienced eventual cessation of SIB and are now working and living independently. The favorable outcomes of these two cases demonstrate the safety and sustained therapeutic benefit of ablative limbic leucotomy in the treatment of severe, intractable SIB.



OF05: Intraoperative neurophysiological monitoring in Dorsal Rhizotomy for Spasticity: Usefulness in a prospective series of 10 spastic diplegic patients

Authors:

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Keywords: Spasticity, Intraoperative Monitoring, Dorsal Rhizotomy, Cerebral Palsy, Neurophysiology

Abstract:

Introduction: Intraoperative explorations, especially muscular responses to radicular stimulation, remain controversial. A few teams deny interest of any monitoring and base their surgeries on anatomical identification of roots. Others favor studying not only responses to ventral root (VR) stimulation to identify radicular levels, but also to stimulation of dorsal roots (DR) - or even of each of their constituting rootlets. Most teams use variable intermediate modalities. We carried out a prospective study associating VR stimulation to map anatomical levels and DR stimulation as physiological testing for metameric reflex excitability to assess the usefulness of monitoring.

Methods: Ten children with spastic diplegia were operated on with the following protocol: bilateral intradural approach of L2-S2 roots at exit/entry of/to their respective dural sheaths, through multi-level inter-laminar enlarged openings; stimulation of VR (2Hz) for checking topography, i.e., radicular myotome distribution, then of DR (50Hz) as excitability test of root circuitry; identification of the muscle responses by the physical therapist and EMG recordings. The study consists of comparing the amount and levels of root sectioning after monitoring-guidance, with those determined by the multidisciplinary team written in the pre-surgical chart.

Results: Intra-operative observations and EMG-recordings resulted in changes in the pre-operative program in 9 of the 10 patients. Changes in L2-S1 on both sides in the 9 patients were 13.5% compared to Chart guidelines, with SD \pm 10.2%. These changes were either a decrease (3.7%) or an increase (7.1%) in the amount of section. In the 9 patients the chart indicated a symmetrical section, which was modified in one patient, at four levels. Changes also affected the sectioning amount/level. Thus, in the 9 patients (18 dorsal root levels) the changes were as follows: at L2 and L3 roots: sectioning was decreased in 6 and 5 roots and increased in 0 and 2 roots, respectively; at L4 and L5 roots: sectioning was decreased in 0 and 2 roots and increased in 5 and 6 roots, respectively; at S1 root: sectioning was decreased in 2 and increased in 4 roots.

Conclusion: Changes in the targets and quantity of the sections according to the intraoperative information helped to adjust surgery. Use of IONM allowed to better tailor the Dorsal Rhizotomy according to clinical presentation and therefore reach therapeutic goals.

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OF06: The "iron sights" method to determine the orientation of directional deep brain stimulation electrodes using 3D rotational fluoroscopy

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Keywords: Directional Lead; Deep Brain Stimulation; 3D Rotational Fluoroscopy

Abstract:

Background and Purpose: New Deep Brain Stimulation leads with electrode contacts that are split along their circumference allow steering the electrical field in a pre-defined direction. However, imaging-assisted directional stimulation requires detailed knowledge of the exact orientation of the electrode array. The purpose of this study was to evaluate if this information can be obtained by rotational 3D fluoroscopy.

Methods: Two directional leads were inserted into a 3D printed plaster skull filled with gelatin. Torsion of the lead tip versus the lead at burr hole level was investigated. Then, three blinded raters evaluated twelve 3D fluoroscopies with random lead orientations. They determined the lead orientation considering the x-ray marker only and considering the overlap of the gaps between the contact segments (like iron sights). Intraclass Correlation Coefficients (ICC) and an extended version of the Bland-Altman plot were used to determine inter-rater-reliability and agreement of the measurements of different raters.

Results: Electrode torsion of up to 35° could be demonstrated. Evaluation of the lead rotation considering the x-ray marker only revealed limits of agreement of \pm 9.37° and an ICC of 0.9975. Additionally, taking into account the lines resulting from overlapping of the gaps between the electrode segments, the limits of agreement to the mean were \pm 2.44° and an ICC of 0,9998.

Conclusion: In directional DBS systems, intraoperative correction of the lead orientation is limited by torsion of the electrode. Rotational 3D fluoroscopy in combination with the described evaluation method allows determining the exact orientation (\pm 2.44°) of the leads after surgery, enabling the full potential of imaging-assisted personalized programming.

OF07: Two Birds with One Stone: Single electrode Deep Brain Stimulation for dual targeting at dual frequency for the treatment of chronic pain

Authors:

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Keywords: Chronic Pain, Deep Brain Stimulation, Robot-Guidance, Stereotaxis

Abstract:

Deep brain stimulation (DBS) has been used to treat chronic pain for many years. Research has led to the discovery of many potential deep brain targets amenable to stimulation but with variable results which are sometimes short-lived or subject to tolerance. The Periaqueductal Grey and Periventricular Grey (PAG/PVG) has been demonstrated to be an effective target for the treatment of nociceptive pain. However, not all patients with chronic pain benefit from PAG/PVG stimulation particularly those with neuropathic pain arising from central and peripheral causes. The centromedian intra-laminar parafascicular complex (CMPf) is a thalamic target with promising results following DBS for neuropathic pain modulating medial pain pathways and potentially addressing the affective aspects of pain perception. Stimulation of multiple deep brain targets may offer a strategy to optimise management of patients with complex pain symptomatology. However, such an approach presents several challenges. A pre-requisite of stimulating multiple targets is the ability to use different stimulation parameters simultaneously. Indeed, multiple targeting using multiple trajectories has additional safety implications and costs. We describe a novel technique in 3 patients with chronic pain syndromes beyond the technological capabilities of spinal cord stimulation using a single electrode technique to stimulate PVG/PAG and CMPf at dual frequencies.

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OF08: New imaging insights in the technique of Motor Cortex Stimulation

Authors:

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Keywords: motor cortex stimulation, central neuropathic pain, mcs

Abstract:

Introduction: In the 1990's, Motor cortex stimulation (MCS) was introduced as a last-resort treatment for chronic neuropathic pain syndromes such as central post-stroke pain, neuropathic orofacial pain, phantom limb pain, and pain due to brachial plexus avulsion. It has recently been estimated that over 700 patients have been treated with MCS worldwide, using a variety of surgical and stimulation protocols. This heterogeneity makes comparison of results difficult, which resulted in scepticism. The discrepancies in the field of MCS concern, apart from the inclusion and exclusion criteria and definition of effect, most importantly, surgical issues like targeting and methods of stimulation.

Objective: To address the aforementioned issue, the authors developed a technique that allows direct perioperative visualization of the lead in relation to the cortical surface. With this method we are able to confirm the correct position of the lead as well as to determine the exact location of each contact to the cortical surface. The latter has great advantages for the postoperative screening and programming. This method provides the opportunity to optimally define positive and negative electrodes necessary to create stimulation of the desired area.

Methods: A pre-operative functional MRI (fMRI) was fused with a volumetric T1 weighted MRI scan. The target location was determined and the craniotomy planned to accommodate the intended lead placement. The target was redefined intraoperatively with the help of intraoperative neurophysiology. To verify the targeting, we developed a new technique introducing intra-operative imaging in a hybrid operating room (MITeC®, Radboudumc, Nijmegen, the Netherlands), using the Siemens Artis Zeego® robotic C-arm system, that generates 3D CT scan. The images are immediately fused with the preoperative imaging and lead contacts are plotted on the cortical surface and reviewed.

Discussion: In our experience, MCS shows to be effective at long-term follow-up (> 3 yrs, during 2005-2012, N=18) in patients suffering from neuropathic facial pain, especially caused by a central lesion. We expect that results will improve with this new approach as the exact position of the lead can be visualized. Further research is indicated to show a probable beneficial effect of programming based on visualization of each individual contact on the cortical surface.



OF09: Delineation of cerebellar-thalamic fibers for deep brain stimulation

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Keywords: deep brain stimulation, movement disorders, deterministic tractography, probabilistic tractography, dentate-rubrothalamic tract

Abstract:

This study compared tractography approaches for identifying cerebellar-thalamic fiber bundles relevant for planning target sites for deep brain stimulation (DBS). In particular, probabilistic and deterministic tracking of the dentate-rubro-thalamic tract (DRTT) and differences between the spatial courses of the DRTT and the cerebello-thalamo-cortical (CTC) tract were compared.

Six patients with movement disorders were examined by magnetic resonance imaging (MRI) including two sets of diffusionweighted images (12 and 64 directions). Probabilistic and deterministic tractography was applied on each diffusion-weighted dataset to delineate the DRTT. Results were compared with regard to their sensitivity in revealing the DRTT and additional fiber tracts and processing time. Two sets of regions-of-interests (ROIs) guided deterministic tractography of the DRTT or the CTC, respectively. Tract distance to an atlas-based reference target were compared.

Probabilistic fiber tracking with 64 orientations detected the DRTT in all twelve hemispheres. Deterministic tracking detected the DRTT in nine (12 directions) and in only two (64 directions) hemispheres. Probabilistic tracking was more sensitive in detecting additional fibers (e.g., ansa lenticularis and medial forebrain bundle) than deterministic tracking. Probabilistic tracking lasted substantially longer than deterministic. Deterministic tracking was more sensitive in detecting the CTC than the DRTT. CTC tracts were located adjacent but consistently more posterior to DRTT tracts.

These results suggest that probabilistic tracking is more sensitive and robust in detecting the DRTT but harder to implement than deterministic approaches. Although sensitivity of deterministic tracking is higher for the CTC than the DRTT, targets for DBS based on these tracts likely differ.

OF10: Threats to DBS patients posed by the ethical debate about personal identity changes

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Keywords: Deep brain stimulation, ethics, personal identity

Abstract:

Many neuroethicists and some legal theorists are worried that patients are no longer the same persons after deep brain stimulation (DBS). These concerns are fueled by reports about patients whose personality or behavior had changed or who had feelings of self-estrangement after DBS. These reports are often interpreted that deep brain stimulation threats the "personal identity". Suchlike metaphysical interpretations of psychological alterations following DBS have gained currency in neuroethics. However, it is questionable whether metaphysical interpretations of ambiguous statements of patients are useful for deriving ethical and legal conclusions.

First, patients describe quite different and even contradictory experiences. Some patients lose their "self", others find their "true self". Some patients who feel as different persons enjoy it; others feel estranged from themselves. The neuroethicists who debate about "personal identity changes" take the patients' metaphorical, vague and colloquial reports at face value. In light of empirical science, particularly psychological test theory and psychometrics, it is inacceptable to ground far-reaching ethical and legal claims on such weak evidence.

Second, these metaphysical interpretations imply highly questionable ethical and legal revisions, namely the denial of psychiatric advance directives (Ulysses contracts). Patients can use Ulysses contracts for stipulating that in case of stimulationinduced mania the stimulation has to be switched off, if necessary against the present, mania-determined will. If legal theorists would really regard patients, who have certain personality changes after DBS, as new persons, then Ulysses contracts written before DBS would have to be regarded as inapplicable. The denial of advance directives would significantly affect the patients' self-determination and possibly their (mental) health, freedom, social status, and relationships.

For ethically evaluating the risk of personality changes following DBS, metaphysical concepts are superfluous and harmful. Rather empirical research work is necessary that is based on standardized psychometric assessments, clinical trials with sufficient sample size and power, and continued psychiatric follow-up assessment.

OF11: Effects of 5 weeks fornix deep brain stimulation in a transgenic Alzheimer rat model

Authors:

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Keywords: Deep Brain Stimulation, Alzheimer, Fornix, Neuroprotection

Abstract:

Background: Deep brain stimulation (DBS) is promising therapy in patients with Alzheimer's disease (AD). Few studies have suggested that stimulation of the forniceal area might slow down the cognitive decline of AD patients, but its biological effects on memory circuits remain unclear.

Objective: To study the behavioral and histological effects of continuous chronic DBS of the fornix in a transgenic Alzheimer murine model and wild type (WT) rats.

Methods: We used a transgenic Alzheimer rat model TgF344-AD that manifests age-dependent cerebral amyloidosis, taupathy, gliosis and apoptotic loss of neurons in the cerebral cortex and hippocampus, as well as cognitive disturbance. All the 18 monthold rats were surgically implanted in stereotactic conditions, using a DBS system specially adapted for rats, allowing a chronic continuous stimulation for 5 weeks. Cognitive tests (open field and Novel Object recognition test) were performed before surgery, and after 2 and 5 weeks. At 5 weeks the animals were sacrificed for immunohistochemical study. Implanted but non stimulated rats were used as controls.

Results: We confirmed the above described differences between transgenic AD rats and WT rats. Moreover we found that DBS led to a significantly reduce in $A\beta$ deposition and in neuroinflammation markers (Iba1 and GFAP); DBS prevented neuronal (NeuN staining) and synaptic (Synaptophysin stainig) loss. Cognitive tests suggested an improvement of memory in the DBS transgenic rat model but did not differ significantly between groups.

Conclusion: In the Tg-F344-AD rat model, 5 weeks of forniceal DBS decreased amyloidosis and inflammatory responses, prevented neuronal and synaptic loss in the cortex and hippocampus. These findings show a neuro protective effect of forniceal DBS.

OF12: Lateral cerebellar nucleus stimulation promotes motor recovery in a rodent model of traumatic brain injury

Authors:

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Keywords: Traumatic Brain Injury, Deep Brain Stimulation, Neurorehabilitation

Abstract:

Objective: To evaluate the effect of deep brain stimulation of the lateral cerebellar nucleus (LCN) on motor recovery in a rodent model of traumatic brain injury.

Background: We have previously shown that chronic electrical stimulation of the LCN enhances motor rehabilitation in different rodent models of ischemic stroke. Those improvements were further associated with enhanced synaptogenesis and expression of markers of long-term potentiation in the perilesional cortex, suggesting that stimulation induced significant, functional plasticity even in chronic, post-ischemic animals. Based on these findings, we speculated that LCN stimulation may similarly enhance motor rehabilitation following traumatic brain injury (TBI).

Methods: Ten male Long Evans rats were trained on the pasta matrix retrieval task, followed by induction of TBI using the fluid percussion injury (FPI) model (1.3-1.5 atms) and implantation of an electrode in the contralesional LCN. Electrical stimulation was initiated at four weeks after FPI induction and sustained for an additional four weeks during which rats were evaluated continually on the pasta matrix task. Motor recovery was also evaluated using the cylinder test. After sacrifice, 30µm cryosections of the motor cortex and thalamus were collected onto polysine slides for histology and immunohistochemistry. The FPI induced primary lesion was visualized by Nissl staining and quantified, while the FPI-mediated perilesional area was visualized by Fluoro-Jade C staining. Neuroinflammation markers, including CD68 and IBA1, were analyzed by immunohistochemistry.

Result: The FPI injury model yielded a focal lesion centered over the primary and secondary motor as well as the primary sensory cortical regions with penetration to the corpus callosum. Animals that received stimulation showed enhanced motor recovery relative to sham controls, with retrieval rates 34.8%, 70.7%, 58.0%, and 36.3% higher in treated animals over weeks 1, 2, 3, and 4 following stimulation onset. Notably, stimulation was associated with a significant reduction in lesion volume in the treated rats compared to sham controls.

Conclusion: DBS of the dentatothalamocortical pathway, targeting the LCN, was found to promote motor rehabilitation in a TBI rat model. These findings are consistent with our previous work in the ischemic rodent model and have strong implications for the potential use of DBS to promote recovery after traumatic brain lesions.



The effect of lateral cerebellar nucleus (LCN) deep brain stimulation (DBS) on performance on the pasta matrix reach/retrieval task in a fluid percussion injury (FPI) model of traumatic brain injury (TBI). All rats underwent LCN DBS electrode and FPI hub implantation, with only animals in the STIM+ (red; n = 5) group receiving continuous, 12-hour-daily, 30Hz LCN DBS beginning three weeks after TBI induction. Surgical control animals in the STIM- (red; n = 5) were similarly tethered, but no electrical current was delivered. Each data point represents the average (+/- SD) over up to five days of testing. Notably, the two groups begin to diverge in motor function beginning as early as one-week after the initiation of LCN DBS.

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OF13: DBS of the STN causes impulsive responses to bursts of evidence

Authors:

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Keywords: DBS, STN, decision-making, evidence

Abstract:

In addition to its motor functions, the subthalamic nucleus (STN) has a cognitive role in inhibiting impulsivity. Previous studies have suggested that the STN raises the evidence threshold for making decisions. We tested this theory in 8 patients receiving bilateral DBS of the STN using an auditory task (n=5085 trials) in which subjects listen to bilaterally presented "clicks" and decide which side has more. Subjects' decision-making could be interrupted prior to reaching their evidence threshold. The statistics of stimulus presentation and trial ending were designed so that subjects could not predict when these events would occur resulting in evidence accumulation to a bound. We expected performance to decline in the DBS ON compared to the OFF condition on trials where subjects hit their decision bound (i.e. responded before stimulus-offset). However, DBS caused a performance decrease in only leftward trials (p=1.82 * 10⁻⁴, Fisher's exact test, Figure A-C). Drift-diffusion modeling showed that DBS caused 6/8 subjects to increase the value of clicks that occur temporally close to other clicks. There was no clear effect on decision bound. Using model-free analysis, we found that subjects responded impulsively to bursts of evidence that were associated with high levels of conflicting evidence, as shown in Figure D-G. While DBS of the STN may lower the decision bound, our data suggests that it may also prevent premature responses to bursts of evidence that portend conflict.



Figure: A) Fraction of trials in which subjects responded prior to termination of stimulus (RT trials) for DBS OFF (blue) and ON (red), *** p=0.001. Subject responses as a function of click difference (positive is more left clicks) for competed trials (B) and RT trials (C). Markers represent data and curves are the logistic fit. D-F) Impulsivity index (higher is more impulsive) calculated for 3-click bursts of particular frequencies for all RT trials (D), correct RT trials (E), and incorrect RT trials (F). G) The conflict index (higher is lower conflict) for different frequencies is plotted for 3-click bursts. Shading is 95% confidence intervals for impulsivity index and standard error for conflict index. Blue and red bars at the top of each plot indicate statistical significance (from 0.05, which is the expected value if there is no impulsivity) of DBS OFF and ON impulsivity indices, respectively. Black bars indicate significant differences between DBS OFF and ON indices. Statistical significance is p<0.01 for 3 successive frequencies.

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OF14: Clinical Trial on Deep Brain Stimulation in subiculum for mesial temporal lobe epilepsy, an 18 months of follow-up

Authors:

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Keywords: DBS, subiculum, mesial temporal lobe seizures

Abstract:

Objective: Recent studies have proposed that the subiculum (SC) plays an important role in the genesis and propagation of epileptic seizures, and another group report correlated improvement of seizures by DBS to the proximity of active contacts to the SC. Since in most cases of hippocampal sclerosis (HCS) the SC is well preserved, the aim of this study was to test SC-DBS in cases of mesial temporal lobe epilepsy with HCS. We had already presented a preleminary report, in this case we present an 18 months follow-up.

Methods: Seven patients with mesial temporal lobe seizures and HCS were implanted in the interface between hippocampus and parahippocampus for DBS. All had previously intracranial recordings to identify the side and precise location of seizure onset. Patients entered a randomized, double blind (DB) protocol in which, after a 4 months baseline (BL) period and one month post-implantation period OFF stimulation, 3 cases had the DBS turned ON, while 4 patients continued OFF DBS for a period of 3 months. Thereafter DBS was turned ON in all and followed for a period of 14 months. DBS parameters were cycling mode 1min ON/4 min OFF, 3.0 V, 450microsec and 130HZ. AED's were maintained unchanged along the study. The outcome for this series was compared with a similar number of cases with HCS treated by DBS in the sclerotic tissue and reported before.

Results: In BL mean total number of seizure per month for the group was 8.29 with 7.26 ending in Generalized Tonic-Clonic (GTC) seizures. Seizure number decrease during the 1st month after implantation and returned to BL levels by the 2nd month. Thereafter, there was not a significant difference between patients ON/OFF stimulation during DB period. When all patients were turned ON, there was a reduction of 56.94% in total number of seizures (p=0.027) and 78.25% for GTC (p<0.017), which was no different to what has been reported for DBS in HCS.

Conclusion: Electrode placement in the SC induced a transient decrease in seizures. Thereafter decrease in number of seizures was more prominent for GTC than for partial complex seizures. Therefore subiculum seems related to seizure propagation more than seizure onset.

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OF15: Altered somtatosensory cortex neuronal activity in a rat model of Parkinson's disease and levodopa-induced dyskinesias

Authors:

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Keywords: sensorimotor area, dyskinesias, 6-OHDA, rat, GABA signaling

Abstract:

Objective: Several findings support the concept that sensorimotor integration is disturbed in Parkinson's disease (PD) and in levodopa-induced dyskinesias. In this study, we explored the neuronal firing activity of excitatory pyramidal cells and inhibitory interneurons in the forelimb region of the primary somatosensory cortex (S1FL-Ctx), along with its interaction with oscillatory activity of the primary motor cortex (MCtx) in 6-hydroxydopamine lesioned hemiparkinsonian (HP) and levodopa-primed dyskinetic (HP-LID) rats as compared to controls. Further, gene expression patterns of distinct markers for inhibitory GABAergic neurons were analyzed in both cortical regions.

Methods: Single unit activity and local field potential were recorded under urethane (1.4 g/kg, i.p) anesthesia by using quartz coated micro-electrode. Additionally, an electrocorticogram (ECoG) was acquired via a 1 mm diameter jeweller's screw, positioned on the dura mater above the MCtx ipsilateral to the 6-OHDA lesioned hemisphere.

Results: While firing frequency and burst activity of S1FL-Ctx inhibitory interneurons were reduced in HP and HP-LID rats, measures of irregularity were enhanced in pyramidal cells. Further, enhanced coherence of distinct frequency bands of the theta/alpha, high-beta, and gamma frequency, together with enhanced synchronization of pyramidal cells and interneurons with MCtx oscillatory activity were observed. While GABA level was similar, gene expression levels of interneuron and GABAergic markers in S1FL-Ctx and MCtx of HP-LID rats differed to some extent.

Conclusion: Our study shows both electrophysiological alterations and changes in gene expression in the sensorimotor cortices in a rat model of PD, which differ depending on the functional state after dopamine depletion and treatment indicating maladaptive neuroplasticity.

OF16: Characteristic features of cortical and pallidal alpha and beta oscillations during ipsilateral and contralateral movements in Parkinson's disease

Authors:

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Keywords: Alpha oscillations, Beta Oscillations, movement, motor control, Parkinson's Disease

Abstract:

Introduction: The precise functional roles of alpha (8-12 Hz), low beta (12-20 Hz), and high beta (21-35 Hz) oscillations within cortical and subcortical sensorimotor circuits remain unclear. Studies on subjects with Parkinson's disease (PD) demonstrated alpha and beta modulation within bilateral subthalamic nuclei (STN) during unilateral movement. Is bihemispheric movement-modulation of alpha and beta oscillations a consequence of direct cortical-STN pathways or intrinsic features of the cortical-basal ganglia motor network? In this study, we investigated both alpha and beta oscillations within the globus pallidus interna (GPi) and sensorimotor cortices during ipsilateral and contralateral movement.

Methods: Local field potentials (LFP) within the right GPi and sensorimotor cortices were recorded intraoperatively during contralateral self-paced hand grasping and rest in 18 PD subjects. In a subset of 5 subjects, recordings were also carried out during ipsilateral movement. Hand activity was captured concurrently with a sensor-embedded glove.

Results: Attenuation of alpha, low beta, and high beta oscillations were observed with both contralateral and ipsilateral movement within the GPi and sensorimotor cortices. In general, movement attenuation of low beta was greater than alpha or high Beta. Low beta attenuation was greater during contralateral movement than ipsilateral movement (65 % versus 45 % respectively). Resting sensorimotor cortical alpha power was found to be 39 % higher on average during ipsilateral as compared to contralateral movement states. Coherence results demonstrated two main features; 1) High Beta cortico-pallidal coherence persists during movement and rest with both contralateral and ipsilateral movements and 2) Resting cortico-pallidal alpha coherence was greater during ipsilateral as compared to contralateral movements states.

Conclusion: While movement-related modulation of alpha and beta oscillations occurs irrespective of movement side, distinguishing features of ipsilateral movement states include a higher resting sensorimotor cortical alpha power, increased resting cortico-pallidal alpha coherence, and a reduced low beta attenuation during movement. Our findings support the proposed concepts of; 1) the inhibitory function of alpha oscillations on unneeded cortical circuits, 2) 'akinetic' role of low beta oscillations and 3) a pathological high beta coupling in Parkinson's disease.

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OF17: Response to Deep Brain Stimulation is Associated with Increased Resting State Connectivity in the Associative Basal Ganglia Circuit

Authors:

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Keywords: Parkinson's disease, deep brain stimulation, neuroimaging, resting state fMRI

Abstract:

Introduction: Deep brain stimulation (DBS) of the subthalamic nucleus (STN) or globus pallidus pars interna (GPi) is indicated in patients with refractory Parkinson's disease (PD) with significant motor fluctuations. While clinical characteristics facilitate patient selection, no objective tool to predict response to DBS exists. We examined resting state functional magnetic resonance imaging (rsfMRI) to determine the feasibility of this modality to serve as such a predictive tool.

Methods: Eight patients (3 female) with advanced PD underwent a preoperative MRI under anesthesia in preparation for DBS surgery. Motor scores (UPDRS-III) were collected before and after DBS (mean follow-up of 5.9 months). Scans were performed in a 3T Achieva Philips MR scanner, including rsfMRI (TR=2000ms, TE=25ms, FOV=68×68mm, flip angle=90°, spatial resolution=1.87×1.87×3.5mm, matrix size=128×128). Images were preprocessed to correct for spatial and temporal artifacts. Regions of interest (ROIs) were defined using the Harvard-Oxford atlas and the ATAG-MNI04 basal ganglia atlas. Functional connectivity (FC) was calculated using the MatLab-based CONN toolbox via two-tailed bivariate correlations. Significant FC differences between patients who had improved UPDRS-III scores following DBS versus those who had worse UPDRS-III scores following DBS were evaluated with both a ROI-to-voxel and ROI-to-ROI analysis (FDR-corrected p<0.05).

Results: Patients were 66.5 \pm 8.9 years old with disease duration of 7.3 \pm 1.8 years. Preoperative UPDRS-III was 29.3 \pm 10.6 and postoperative UPDRS-III was 21.9 \pm 9.0. Patients who responded more favorably to DBS had increased resting state connectivity within the basal ganglia (STN, pallidum, thalamus, striatum) and increased connectivity between the striatum and the frontal operculum (*p*=0.001).

Conclusion: Three major basal ganglia networks consisting of motor, associative, and limbic circuits have been described. While much focus has been on motor circuits in PD, our findings suggest that the associative circuit may play a role in response to DBS. Our findings echo a related study, which demonstrated a similar increase in associative circuit connectivity in patients who had a greater response to L-DOPA. Together, these results show promise in the ability for rsfMRI to provide better presurgical consultation and guidance to patients regarding prognosis from DBS.



OF18: Identification of a Resting State Biomarker for Prediction of Disease Severity in Parkinson's Disease

Authors:

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Keywords: Parkinson's disease, neuroimaging, resting state fMRI

Abstract:

Introduction: Parkinson's disease (PD) is a neurodegenerative disorder that primarily affects the motor system. Prominent motor symptoms in the disease include unilateral tremor, rigidity, and bradykinesia. For the clinical standardization of disease severity, the motor scores from the Unified Parkinson's Disease Rating Scale (UPDRS-III) have long been used but recent evidence suggests there can be significant inter-rater variability in these scores that can be influenced by experience level. Our project therefore aims to identify a resting state functional magnetic resonance imaging (rsfMRI) biomarker that provides a more objective determination of disease severity.

Methods: Seven patients (3 female) with advanced PD underwent a preoperative MRI under anesthesia in preparation for DBS surgery. Motor scores (UPDRS-III) were collected before and after DBS (mean follow-up of 5.9 months). Scans were performed in a 3T Achieva Philips MR scanner, including rsfMRI (TR=2000ms, TE=25ms, FOV=68×68mm, flip angle=90°, spatial resolution= $1.87 \times 1.87 \times 3.5$ mm, matrix size= 128×128). Images were preprocessed to correct for spatial and temporal artifacts. Regions of interest (ROIs) were defined using the Harvard-Oxford atlas and the ATAG-MNI04 basal ganglia atlas. Functional connectivity was calculated using the MatLab-based CONN toolbox via two-tailed bivariate correlations. Significant connectivity differences were evaluated in a linear fashion based on UPDRS-III scores with both a ROI-to-voxel and ROI-to-ROI analysis (FDR-corrected p<0.05).

Results: Patients were 66.1 ± 8.9 years old with disease duration of 7.2 ± 1.8 years. Preoperative UPDRS-III was 26.6 ± 8.5 and postoperative UPDRS-III was 22.3 ± 9.5 . Individuals with higher UPDRS-III scores demonstrated increased resting state connectivity within the basal ganglia (STN, pallidum, thalamus, striatum) (p=0.006).

Conclusion: Our findings demonstrate that Parkinson's disease severity is associated with increased resting state connectivity between the various nuclei of the basal ganglia, which have long been hypothesized to be key players in disease progression. In the future, rsfMRI may be beneficial in offering a more objective measurement of disease severity in PD.



OF19: Spikes and Field Potential Oscillations in the Nucleus Accumbens during Impulsivity: Evidence from Mice and Man

Authors:

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Keywords: Nuclues accumbens, local field potential, single unit activity, impulsivity, responsive neurostimulation

Abstract:

Introduction: Impulsivity is one of the most pervasive and disabling features common to many neurological disorders. Heightened responsivity in the nucleus accumbens (NAc) during anticipation of rewarding stimuli predisposes to impulsivity. Electrophysiological correlates have been reported during brief windows of anticipation. This period represents a critical opportunity for intervention, but no available therapy is capable of sensing and therapeutically responding to this vulnerable moment. The objectives of our research are: to identify biomarkers of anticipation of highly-reinforcing food reward in mouse NAc, to use these biomarkers to guide responsive neurostimulation (RNS) to suppress binge-like behavior, and to examine the translatability of these biomarkers in a human subject anticipating monetary rewards.

Methods: Multielectrode arrays were implanted into the mouse NAc, and were put on a limited high-fat (HF) exposure protocol known to induce binge-like behavior. Power spectral density analysis of NAc local field potentials (LFPs) and spike analysis before HF intake were performed to identify electrophysiological biomarkers. Identical analyses were performed before house chow intake. RNS was triggered whenever potential biomarkers appeared, and reduction in HF intake induced by RNS was examined. RNS was applied during juvenile interaction test to assess behavioral specificity. In parallel, NAc spikes and LFPs from a human subject performing Monetary Incentive Delay Task were recorded and analyzed.

Results: Unique spike patterns and increased delta oscillations were observed immediately prior to HF intake after mice developed binge-like behavior, which was not detected immediately prior to chow intake. RNS utilizing delta power as biomarker significantly reduced HF intake. Unique spike patterns and prominent delta oscillations during anticipation of monetary reward were also revealed in human NAc.

Conclusion: We demonstrate that anticipation of rewards is correlated with certain spike patterns and increased delta oscillations in NAc in both mice and a human subject. NAc electrophysiological signals carry critical information relevant to reward anticipation, and have the potential to be used as a biomarker to guide RNS treatment for neuropsychiatric disorders exhibiting impulsivity.

OF20: Assessing the impact on bradykinesia and dyskinesia in patients with Parkinson's disease undergoing deep brain stimulation using a novel and objective automated assessment tool

Authors:

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Keywords: Parkinson's Kinetigraph, PKG, deep brain stimulation, DBS

Abstract:

Introduction: The Parkinson's KinetiGraph[™] (PKG) is a wrist-worn device for patients with Parkinson's disease (PD). Inbuilt accelerometers capture real-time movement data and utilise frequency and spectral analysis to generate dyskinesia (DKS) and bradykinesia scores (BKS), which correlate to clinical severity, quantified against scores such as the Unified Parkinson's Disease Rating Scale (UPDRS-III/IV) and modified Abnormal Involuntary Movement Scale (mAIMS)¹. The fluctuation and dyskinesia score (FDS) summarises the interquartile range of bradykinesia and dyskinesia into a single score and represents symptom variability. Deep brain stimulation (DBS) is used to alleviate the motor symptoms of PD and its impact was assessed in depth with this continuous automated monitoring tool.

Methods: 16 PD patients (10M, 6F) wore the device on their most symptomatic arm and continuous recordings over a 6-day period were obtained and analysed. In 6 patients (4M, 2F), 6 months after DBS, postoperative PKG was obtained to determine changes in BKS, DKS and FDS. This was compared against validated control data derived from the PKG database¹. Wilcoxon signed-rank test was used for paired analysis.

Results: PKG data analysis generates BKS and DKS across 25-50-75 percentiles and a single FDS score. Pre-operatively, median BKS in all 16 PD patients (PKG control data) was 13.8 (12.7), 20.2 (18.6), 28.6 (26.1) with DKS, 1.3 (0.9), 7.2 (4.3), 22.1 (16.5) indicating PD patients with symptomatic motor dysfunction. In the DBS-subset, there was a statistically significant difference in DKS postoperatively (p = 0.03) and FDS (p = 0.03) with a non-significant difference in BKS. Mean FDS improved 25.2% from 14.8 (high fluctuations) preoperatively to 10.6 (controlled and stable fluctuations) postoperatively (reference range 7.7-12.8). Median DKS improved 31.8% from 7.55 preoperatively to 5.15 postoperatively.

Conclusion: Scores generated following the use of a PKG can objectively demonstrate dyskinesia and bradykinesia variability and correlate changes following an intervention. PKG can complement existing clinical tools to assess motor symptoms in PD patients objectively and automatically. Larger numbers are needed to determine the effect of disease progression and therapeutic intervention.

Reference: 1 Griffiths et al. J Parkinsons Dis. 2012; 2(1): 47-55.

OF21: LRRK2+ R1441G and G2019S-related Parkinson's disease: are these mutations a distinctive inclusion criteria for DBS surgery?

Authors:

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Keywords: Parkinson's disease, Dardarin, deep brain stimulation, LRRK2+, Genetics, Leucine-rich repeat kinase 2, R1441G

Abstract:

Introduction: Mutations in LRRK2+ gene in chromosome 12 (also called dardarin, from the Basque word *dardara*, meaning tremor) have been related to the appearance of Parkinson's disease in several families. One particular mutation on this gene (R1441G) is specific to subjects of a Basque inheritance, whereas others have been described in families around the world, being G2019S the most frequent one. A previous study in our unit with a small sample size suggested that R1441G carriers had a worse outcome after DBS compared to an idiopathic PD group.

Objective: To determine if DBS is equally valuable and has the same outcome to patients with PD with G2019S or R1441G mutation in LRRK2+ gene as is to idiopathic PD patients.

Methods: Patients with LRRK2+ anomalies who have had surgery in Cruces University Hospital (Barakaldo, Basque Country) have been included in this analysis with a minimum of one year after procedure follow-up. As a control, patients matched 2:1 have been selected being similar in age at surgery and time of evolution of disease. Clinical data included variation of UPDRS and Schwab-England at onset and one year postoperatively, as well as variation of levodopa equivalent daily dose (LEDD).

Results: Seventeen patients have been found in our cohort with LRRK2+ mutations, 12 of these with the R1441G mutation and 5 with G2019S one. Mean age at surgery in the case group was 60.05 (61.8 in the control group) and patients had a mean of 12.5 years of evolution of disease in the case group (12.3 in the control group). Implementing a linear mixed model, no differences were found related to UPDRS-III reduction after one year of surgery (31.05% in the genetic group and 30.29% in the control group) (p=0.857). No differences were found in the reduction of the Schwab-England scale (18.82 point reduction in the genetic group versus 17.71 point reduction in the control group) (p=0.886). LEDD was reduced in mean 572.53 mg in the genetic group versus 530.44 mg in the control group, which also was non-significant (p=0.734). Comparing between both mutated groups, no differences have been found in any parameter.

Conclusion: There is no evidence in our study that DBS outcomes may be different in the LRRK2+ mutated group including G2019S or R1441G mutations PD than in the idiopathic PD group. Therefore, contrary to our previous report, LRRK2+ mutation carrier status should not be relevant criteria to select patients to surgery.

OF22: The potential need for deep brain stimulation in depression

Authors:

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Keywords: deep brain stimulation, depression, treatment resistant, inclusion, criteria

Abstract:

Background: Deep brain stimulation (DBS) is currently under investigation for therapy resistant major depressive disorder (MDD). It has been suggested that 12-30% of patients with MDD will present with a therapy resistant form. The question remains how many of these patients would qualify for treatment with DBS. Therefore, the aim of this study was to derive an estimate of a naturalistic clinical sample of MDD patients, on how many would fulfill common DBS trial criteria and common causes for exclusion.

Methods: Data from 393 patients diagnosed with MDD were analyzed based on our ongoing controlled trial of DBS for MDD. The data was analyzed in regards to age, sex, comorbid psychiatric disorders, duration of current depressive episode, numbers of hospitalizations, history of suicide-attempts and history of treatment with psychopharmacology, psychotherapy and electroconvulsive therapy.

Results: After application of available criterion 79 of the 393 patients met avialiable screening criteria for DBS. Figure 1 shows the process of remaining subjects after application of each criterion that was available from the database extraction. The most common cause for exclusion was psychatric comorbidity (aproximately 50% of the sample). The most common psychiatric comorbidities were attention deficit hyperactivity disorder, bipolar disorder, personality disorder, post-traumatic stress disorder, generalized anxiety disorder, obsessive compulsive disorder and psychotic disorder.

Conclusion: MDD is a highly heterogenous disorder with many interacting risk factors that contributes to its etiology (biological, psychological, genetic, environmental and social). This is also reflected in treatment heterogeneity and varying nonresponse rates. Consequently, given the limited number of MDD patients who receive DBS, it is too premature to put forth specific recommendations for improving identification of optimal DBS candidates. It has been difficult to characterize this heterogeneous group and even more difficult to begin to identify characteristics of those candidates most likely to benefit from DBS. Therefore, future DBS trials for MDD should seek to identify subgroups of patients who may respond differentially to the treatment and to different brain targets. This would serve to further refine candidate selection and optimize patient outcomes for this diverse group of patients.



OF23: The Re-emergence of Psychiatric Neurosurgery: A Cross-National Comparison of Media Coverage

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Keywords: psychiatric neurosurgery, media coverage, deep brain stimulation, cross-national

Abstract:

In light of the dark history of many surgical approaches to treat psychiatric disorders, understanding contemporary trends around the re-emergence of different methods to which patients and the public are exposed is essential to understanding their views and receptivity to them, both for healthcare and society.

To achieve this goal, we conducted an in-depth content analysis of media articles reporting on psychiatric neurosurgery between 1960 and 2015. We characterized and compared the themes and trends of media coverage of different interventions with a focus on North America (Canada and the USA), Germany and Spain–collaborating countries in an international research consortium on this subject. We used Factiva and the media websites to generate the samples for the study from full-length articles published in major national newspapers and magazines of the target countries. After curating for duplicates and irrelevant articles, the samples comprised 167 Spanish articles, 160 German articles, and 217 articles from North America. Articles were analyzed for content inductively and coded for the phenomena of interest.

Overall, coverage increased steadily beginning in 2005. Deep brain stimulation received the most coverage from all the different psychiatric neurosurgery interventions (Spain=49%, Germany=53%, and North America 63%). Depression was the most frequently mentioned condition. The tone across articles was generally positive across psychiatric neurosurgical interventions, although the German press tended to be more critical than the others. Risk was the disadvantage most commonly cited, and particularly so in German media. Identity and privacy and mind control were the most frequently cited ethical and philosophical issues among the few noted, and again found mostly in the German press.

The findings suggest that media in these three countries has focused predominantly on one method and condition. They also reveal few differences across the countries except Germany, which seems to be more cautious than the others. Empirically studied views from affected people and health care providers will further inform the future application of older techniques and translation of new ones for the benefit of people with intractable mental illness, and the influence that popular news is having on their values, perceptions of risk and hope for benefits.

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OF24: Clinical outcome in 14 severe refractory aggressivity cases with deep brain stimulation (DBS) of the posteromedial hypothalamus (PMH)

Authors:

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Keywords: Aggressivity, Deep Brain Stimulation, Hypothalamus, Modified Over Aggressivity Score MOAS.

Abstract:

Background: Deep Brain Stimulation (DBS) of the posteromedial Hypothalamus (PMH) has shown significant improvement in aggressive patients with a long and complex history of ineffective therapies. We have previously observed beneficial outcomes in the first 8 of these refractory patients undergoing DBS for aggressivity.

Objective: To report the clinical follow-up in 14 patients who underwent DBS of the PMH for severe and refractory aggressivity.

Methods: 14 patients between 10 and 40 years old, 6 women and 8 men, with moderate and severe cognitive impairment, were evaluated by a multidisciplinary group, and after multiple failed treatments and with the approval of the ethics committee were implanted bilaterally with electrodes Medtronic 3387. The Leksell frame was applied under general anesthesia and most cases, and a 3T MRI was taken. Target planning (Surgiplan) was carried out with coordinates of 2mm lateral to the wall of the third ventricle, 0-3 mm posterior, and 2-5 mm inferior with respect to the AC PC line. Microrecording (FHC system) was performed in all 14 cases using 1mm above the dorsal border of Red Nucleus as the final target to tip of the electrode. Responses to macrostimulation such as temperature, blood pressure and heart rate were monitored. A second 3T MRI was done to confirm the position of the electrodes before battery internalization in most cases, and another 1.5T MRI was also performed within the first post-operative week. Parameters ranged, between 180-200Hz, 80-140 usec, and 1.5-5 volts, with contacts 0 and 8 both negative and case positive.

Results: For this medium term follow-up of 1-48 months, quality of life(EQ-5D-5L) improved between 70-85%, MOAS(Modified Over Aggressivity Score) improved between 58-90%, and Health Status improved between 60-90% with stable outcome over time. Some cognitive improvements were developed in some of the patients, and were correlated to findings in cerebral PET(Positron Emission Tomography). Minor complications: one device was removed as a result of skin erosion, one infection in antibiotic treatment, and one case of central fever which improved with decreased pulse width. We also performed one repositioning due to lead migration.

Conclusion: DBS of th PMH is safe with manageable complications and an option for severe refractory aggressivity patients. Improvements were long-standing and some cognitive benefits were observed, but more cases and longer follow-up should be carried out.



OF25: Stereotactic electroencephalography guided laser ablation for neocortical epilepsy

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Keywords: epilepsy, stereo EEG, depth electrodes, laser ablation

Abstract:

Stereotactic electroencephalography (sEEG) is a standard minimally invasive approach to identifying seizure networks. Magnetic resonance thermometry-guided stereotactic laser ablation (SLA) is a minimally invasive surgical approach to treating epilepsy. While SLA for mesial temporal lobe epilepsy (MTLE) has been studied, less is known about its combined use in neocortical epilepsy.

We reviewed all patients that underwent SLA after sEEG localization (intracranial depth electrodes with occasional subdural strips), excluding patients with MTLE. Under general anesthesia SLA was performed by stereotactic twist-drill craniostomy, or by placing the laser assembly down an existing sEEG bolt. The assembly consisted of a saline-cooled cannula through which was passed an optical fiber to deliver laser energy (Visualase, Medtronic). Anatomic MRI provided confirmation of accuracy and MR thermometry provided real-time feedback on extent of thermocoagulation during the procedure. Postoperative clinical status was recorded at 3, 6, and 12mo.

Thirteen patients were treated (7 male, 6 female, median age 26, interquartile range [iqr] 22). Inciting pathologies included tuberous sclerosis (3), prior tumor resection (2), trauma (2), cavernous malformation (1), cortical dysplasia (2), and unidentified (3). Seven patients had already failed one or more prior epilepsy operations (resection, transection, radiofrequency ablation, laser ablation). Median symptom duration was 13yrs (iqr 15). Median antiepileptic drugs trialed was 6 (iqr 1.25). Median number of depth arrays was 15 (iqr 10) and median number of strip arrays was 2 (iqr 6). Seizure localizations were frontal (7), parietal (2), temporal (1 inferior, 1 lateral), occipital (1), and specifically insula (2) and cingulate (3). There were no procedural complications and no unanticipated neurologic deficits (ablating supplemental motor area caused temporary expected deficit in one subject). Median length of postoperative stay was one day (iqr 1, max 4). Median follow-up was 500 days (iqr 578) of which 10 (77%) had >12mo follow-up. At 12mo, outcomes were n=5 Engel-1, 1 Engel-2, 1 Engel-2/3 (unclear), 2 Engel-3, 1 Engel-4. The remaining three cases with <12mo follow-up were seizure free at 3-6mo follow up. All cases with Engel 2-4 outcomes had failed prior epilepsy operations.

Minimally invasive sEEG and MR-guided ablation is a safe and effective alternative to open resection. Additional experience and longer follow-ups are needed.

OF26: Modulation of subthalamic nucleus (STN) neuronal firing by macrostimulation at sites dorsal to the STN during surgery for Parkinson's disease (PD)

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Keywords: deep brain stimulation, microelectrode recordings, Parkinson's disease, subthalamic nucleus

Abstract:

Background: Deep brain stimulation (DBS) of the subthalamic nucleus (STN) is standard therapy for Parkinson's disease (PD) symptoms including tremor, but effective sites can also be produced dorsal to STN in the subthalamic area. This subthalamic area has been targeted for the treatment of tremor by interruption of pallidofugal and dentatothalamic pathways (Struppler, Stereotact Func Neurosurg 52: 205, 1989. However significant pallidosubthalamic afferents impinge on central STN from GPe (Shink et al Neurosci 73: 335 1996) and therefore activation of this pathway may be involved in the therapeutic effects of the subthalamic area on PD symptoms, particularly for tremor relief.

Objective: To perform macrostimulation at different intensities in the subthalamic area dorsal to STN and observe the effects on neuronal activity within STN itself.

Methods: Two concentric bipolar microelectrodes were used with macrostimulaton contacts at 3 or 5 mm distant to the tip (LP+ FHC, Bowdoin, MA). One microelectrode was used to record the spikes and the other was used to macrostimulate (1 - 3 mA, 130 Hz, 0.5Hz) in the subthalamic area. Stimulation was repeated up to 3 times and the amount of inhibition was measured up to the first spike and termed "silent period".

Results: A total of 139 STN neurons was tested in 12 PD for effects of stimulation in the subthalamic area. The average depth of all tested cells was -0.56 +/- 2.83 (SD, with n= 139), consistent with a broad sampling across the entire 5-6 mm dorsoventral extent of the nucleus. Of these well isolated spikes, 20 (14.3%) were found with modulatory effects from macrostimulation dorsal to STN. The average depth of these responsive neurons tended to cluster more dorsal in STN at 0.80 +/- 1.67 (SD). A majority of neurons showed inhibition following the train (18 neurons or 90 %) with an average silent period of 1.1 +/- 1.2 s (SD) and only a minority were excited (2 neurons or 10 %). Rebound burst was seen in 13 neurons (65 %) and oscillatory bursts following macrostimulation near the cell soma produced the same inhibitory effect as distal macrostimulation on the few STN neurons tested.

Conclusion: Inhibition of STN activity produced by stimulation of the subthalamic area dorsal to the nucleus is mediated by the pallidosubthalamic afferents. It may be a clinically useful indicator of the optimal target for DBS electrode implantation in somatosensory part of STN.

OF27: Spend well to spend less: making sense of the Oxford directional DBS for tremor study

Authors:

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Keywords: DBS, Current-Steering, Tremor

Abstract:

Introduction: We previously presented our clinical experience with the use of the InfinityTM Directional Deep Brain Stimulation (D-DBS) system in treating symptoms associated with tremor¹. In addition to the therapeutic benefits of D-DBS in treating tremor symptoms, we also showed that utilization of D-DBS resulted in significantly larger therapeutic windows (TW), and fewer side-effects at significantly lower therapeutic amplitudes (TA)¹. Here, we present VTA differences between N-DBS and D-DBS at their most effective TA in the same cohort of tremor patients.

Methods: A two-stage computational model (Sim4Life v3.2) was used to compare the VTA resulting from the most-effective N-DBS and D-DBS monophasic cathodic stimulation configurations (N=8 Tremor patients; 15 implanted leads). The first stage involved using a finite element analysis (FEA) model to calculate electrical potentials using the Infinity (Abbott, Plano, TX) lead. The second stage used biophysical cellular models of 5.7 μ m diameter myelinated axons². Each axon had 21 nodes of Ranvier and 0.5 mm node-to-node spacing. A total of 6888 axons were distributed around the lead by creating a 21×41 grid centered at contact 2, with the axons oriented perpendicular to the lead axis, and then replicating and rotating this grid. The electrical potentials from the FEA model were interpolated along each axon, and delivered as extracellular stimulation to determine the VTA for each configuration.³

Results: The mean difference in average VTA size between D-DBS (52.0mm³) and N-DBS (60.7mm³) for the patient cohort was minimal (14%), despite the mean most-effective D-DBS TA (1.51 mA) being 31% lower than mean most-effective N-DBS TA (2.19 mA). Moreover, there was a greater extent of directionality for the D-DBS configuration (78% of VTA volume was on the side with contact 2A) than the N-DBS configuration (49.3%).

Conclusion: D-DBS leads enable spatial directionality of neural activation, and achieve VTA sizes similar to N-DBS leads at lower stimulation amplitudes. This may explain the significantly better TW and TA observed clinically for directional DBS leads compared to conventional DBS leads.

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OF28: PaCER - Precise and Convenient Electrode Reconstruction for Deep Brain Stimulation: Preliminary Results

Authors:

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Keywords: deep brain stimulation, electrode reconstruction, computer aided surgery, image guided procedures, accuracy

Abstract:

Background: There are various drawbacks to existing approaches to the reconstruction of DBS electrode trajectories from post-operative imaging, including restricted straight-line trajectory models or a need for subjective manual interaction for contact localization.

Methods: We present PaCER, a novel algorithm for fully-automatic high-accuracy DBS electrode trajectory and contact reconstruction from post-operative imaging. Unlike most existing approaches, our algorithm accurately preserves curved electrode trajectories, thus enabling additional analysis of electrode behavior (e.g. to assess influence of brain shift). Furthermore PaCER features a fully automatic contact localization.

Results: PaCER was evaluated using clinical CT data of DBS patients as well as CT scans of an individually-fabricated highaccuracy phantom. The phantom experiments enabled precise measurements of the algorithm's accuracy with a known groundtruth. For a Medtronic 3387 electrode, the average trajectory reconstruction error was 0.049±0.029mm (< 4% of the electrode diameter of 1.27mm).

Conclusion: In phantom experiments, PaCER yielded excellent trajectory reconstruction accuracy, with errors below 100 micron. This holds true for curved trajectories and along the whole trajectory path. Accordingly, to the best of our knowledge, PaCER has higher accuracy than any other published method. PaCER is fully automatic and enables a convenient adoption for both clinical and research use.



Figure: (a) Workflow for validation of PaCER using an high-accuracy acrylic glass phantom with an embedded 3387 electrode (b) comparison of trajectory and and contact reconstruction to ground truth. Note the visually near perfect accuracy of the reconstruction.

OF29: White matter edema associated with implanted deep brain stimulation electrodes

Authors:

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Keywords: DBS, edema, MRI, complication

Abstract:

Objective: Retrospective studies have been published documenting the appearance of white matter edema surrounding implanted deep brain stimulation (DBS) electrodes. This is usually asymptomatic but often prompts workup for possible hardware infection. While the incidence and evolution over time of this phenomenon is presumed to be rare, no systematic examination of this has been published. The goal of this study is to determine the prevalence and time course of this edema following DBS implantation by obtaining a series of postoperative MRI scans from patients who undergo DBS surgery.

Methods: Postoperative MRIs were obtained following DBS surgery. Patients underwent either unilateral (N=11, 3 were the second hemisphere[M1]) or bilateral (N=2) DBS electrode implants (Medtronic models 3387 or 3389) in a single implant session. MRIs occurred one day, two weeks (+/- two days), four weeks (+/- two days), six weeks (+/- two days) and ten weeks (+/- two days) postoperatively. Edema volume was quantified in cubic centimeters (cc) by measuring the length of the perielectrode T2 signal change in the white matter in perpendicular maximal planes.

Results: Data was collected on thirteen patients. Eleven patients exhibited white matter edema in at least one MRI, with the largest volume being 29.76cc. Eight patients had maximal edema volume at two weeks postoperatively, while in three patients the maximal edema volume was at at ten weeks. The first incidence of edema was observed at day one in five patients, two weeks in five patients and ten weeks in one patient. Edema completely resolved in two patients. In both patients, edema was first observed at two weeks, resolving at four weeks for one patient and six weeks for the second. The edema observed in the other nine patients did not fully resolve by ten weeks.All patients in the study were asymptomatic.

Conclusion: This small case series shows that edema following DBS surgery is not a rare occurrence. It often presents without symptoms, and is therefore likely missed in patients that do not return for a postoperative MRI. This edema can first appear at up to ten weeks postoperatively and may persist for many weeks, but may improve without removal of the electrode. This study demonstrates the need for a much larger study examining the incidence, time course, and cause of this edema following DBS surgery.

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OF30: Complications in impulse generator exchange surgery for Deep Brain Stimulation: A single center, retrospective study

Authors:

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Keywords: deep brain stimulation, complications, exchange of generator

Abstract:

Introduction: Low or empty battery status of non-rechargeable deep brain stimulation impulse generators (IG) requires a surgical IG exchange several years after initial implantation. Complications in patients undergoing DBS surgery are reported in the range between 7,6 % up to 25,3 %. The aim of this study was to investigate the rate of complications after IG exchanges and to identify risk factors for complications.

Methods: We retrospectively analyzed the complications in IG exchange surgery from 2008 to 2015 in a single center university hospital setting. Medical reports from all patients, who had undergone IG exchange surgery were systematically reviewed. The shortest follow-up was 11 months.

Results: From 2008 to 2015, 438 generators were exchanged in 319 patients. Overall complication rate and revision rate was 8,9 % of cases. 13 patients (2,96%) developed an infection of the IG with a secondary removal of the IG. Five patients (1,14 %) suffered from local wound erosions surrounding the IG; for this particular complication in one patient the IG had to be removed while in the other 4 patients a local wound revision was sufficient. We found hardware malfunctions in 11 patients (2,51 %) and local hemorrhage surrounding the IG in three cases (0,68 %)requiring surgical revision. In two patients (0,46 %) the IG needed to be refixated. In two patients (0,46 %) the sion of the connecting cables triggered a surgical revision because of patient's discomfort. One 80 years patient (0,23%) suffered from worsened severe heart failure and died 4 days after IG exchange in discomfort from initial positioning. Infection rate after the first exchange was 1,92 %, after the second exchange 7,78 % and after three or more exchanges 8,70 %.

Conclusion: IG exchange surgery, although often considered a" minor surgery", is associated with a complication rate of roughly 9% in our center. Infection is the most relevant complication as it causes removal of the IG. The implantation of smaller IGs might reduce complications such as wound erosions or local hemorrhages. Patients and physicians should know the rate of complication in IG exchange surgery since this information might facilitate a decision in favor of a rechargeable IG.



Proportion of complications in percentage of all complications

OF31: Fibre based optical techniques for guidance during stereotactic neurosurgery - a review

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Keywords: Deep brain stimulation, biopsy, biomedical optics, navigation

Abstract:

Introduction: During the last decade the interest for using optical-based techniques for guidance during brain surgery has increased [1]. A review of fibre optical methods applicable in stereotactic neurosurgery is presented.

Methods: Measurement probes and systems have been designed, constructed and evaluated during DBS implantations, stereotactic biopsies and open tumour surgery. The optical fibres along the probe can be connected to laser Doppler flowmetry (LDF) for measurements of microcirculation and tissue greyness [2] to diffuse reflectance spectroscopy (DRS) for estimation of the tissues SO₂[3] and to a fluorescence spectroscopy system for real-time tumour detection after administration of 5-ALA [4].

Results and Conclusions: The LDF-DRS probe acts as a guide during DBS implantations and no other instruments are necessary for creation of the trajectory. It's forward looking feature make detection of increased blood flow and grey-white matter borders along a trajectory possible during DBS implantations. The fluorescence spectroscopy makes direct indications of tumour tissue possible during the intervention, i.e open surgery and stereotactic biopsies. By combining the various features added values are gained within the same measurement session. The LDF-DRS probe has been used in more than 120 DBS implantations and the fluorescence probes during more than 50 surgeries, about 25 of them together with blue light microscopy and five during stereotactic biopsies. As a next step the LDF-optical guidance method will be combined with microelectrode recording.

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OF32: Tractography-based VIM identification for deep brain stimulation: Initial results

Authors:

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Keywords: tractography-based targeting, tremor surgery, deep brain stimulation, ventral intermediate nucleus

Abstract:

Introduction: Stereotactic targeting of ventral intermediate nucleus (VIM) relies on formulaic methods due to the limitations of current imaging sequences. Tractography-based VIM (T-VIM) targeting may address these limitations. We prospectively targeted T-VIM in consecutive patients undergoing deep brain stimulation (DBS) for essential tremor (ET) and tremor-dominant Parkinson's disease (PD). Here we report the short-term clinical outcomes using this technique.

Methodology: All patients underwent imaging with structural (3D T1) and diffusion weighted sequences (60 diffusion directions, 2 mm isovoxel). The images were processed using streamline tractography (Stealth Viz, Medtronic Inc.) with a methodology described previously. Besides visualizing T-VIM, this method also localizes the pyramidal tract and medial lemniscus for avoiding off-target side effects. A T-VIM object was overlaid on the DICOM images for stereotactic targeting (Framelink, Medtronic Inc.). The composite tremor scores (for ET - rest, posture, action, handwriting & Archimides spiral and for PD - tremor scores from UPDRS-III, rated on a 5-points scale each) were compared before and after surgery. The T-VIM coordinates, stimulation parameters were also analyzed.

Results: Eight patients (7ET and 1 PD) successfully underwent T-VIM targeting (n=9 hemispheres). We performed DBS implantations both in awake patients with MER guidance (n=5) and in asleep patients with intraoperative MRI guidance (n=4). T-VIM was more medial (12.5 ± 1.5 vs. 14.3 ± 0.6) and anterior (7.7 ± 1.5 vs. 6.6 ± 0.4 in relation to PC) than the standard coordinates. During a mean follow-up of 5 months (range 2-12 months) tremor improved significantly (treated side: $80.1\pm17.7\%$, overall: $58.1\pm12.8\%$). Monopolar stimulation was most commonly used at contact 1 with a mean voltage of 2.8 ± 0.9 Volts. Tremor medications were decreased in 4 patients and maintained at baseline in 2 others (2 patients were not on medications at baseline).

Conclusion: The short-term clinical results are satisfactory in both awake and asleep T-VIM DBS implantations. Long-term tremor outcomes are being assessed to determine the usefulness of this technique.

OF33: Tailored Deep Brain Stimulation with directional leads for movement disorders: 12 months follow-up of a multicenter series

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Keywords: Directional leads, movement disorders, follow-up

Abstract:

The efficacy of DBS in basal ganglia depends upon the effective stimulation of target nuclei: altogether, it results from a careful anatomical reperage, a refined intraoperative neurophysiology and a scrupulous postoperative reglage. Light errors in surgical positioning, individual anatomy and possible variables in local electrical fields, due to different tissue impedances or fibers versus nuclei stimulation, may impinge upon the efficacy of DBS. Tailoring at best the electric field may overcome some of these constrains. This goal may be reached nowadays, after the developing of segmented directional electrodes, able to configure anisotropic electric fields, as to cover variable tissue volumes, according to clinical clues.

The aim of this investigation is to verify the efficacy of directional leads in patients undergoing DBS for movement disorders of different origin on a 12 months follow-up time.

12 patients (7M-5F, mean age 53 - mean disease duration 9 yrs) suffering from movement disorders (10 PD, 1 Generalized dystonia, 1 cerebellar tremor), underwent DBS (8 Stn, 3 Gpi, 1 RaPl) with stereotactic approach, anatomical reperage in volumetric Mri normalized over S&W atlas and intraoperative multitraces MERs. Intraoperative confirmation of electrode positioning and orientation of the segmented contacts were obtained by means of plain fluoroscopy. Patients were selected after the usual London BB criteria; pre and postoperative clinical evaluation followed validated scores (UPDRS - BFMDRS - TRS). Mean FU is 12 months: for each patient were considered stimulus parameters, electrode configurations and possible adverse events.

11 patients are actually on FU; 1 drop out for infection of the IPG. Active leads are 22; 18 in directional configuration and 4 in "ring" configuration; in all the cases with monopolar stimulation, with two directional contacts, current splitting 25% and 75%, PW 60 microsec, Fr 130 Hz, mean current 2.3 mA, mean voltage 2.2 V. Last FU reported mean decrease of UPDRS III 50%, UPDRS II 70%, BFMDRS 60%, TRS 85%. Mean LEDD decrease 50%. No surgical complications were observed. Collateral effects of stimulation were better managed with directional stimulation; the overall time of the postoperative reglage was non consistently longer than in conventional stimulation mode.

Directional leads allowed us to obtain tailored electric fields in 18 sides out of 22, obtaining clinical effects more consistent than in "ring" mode, particularly for the decrease of stimulation collateral effects. No troubles were observed for the higher impedances typical of these configurations. The follow-up at 12 months confirmed the efficacy of the DBS and only minor modifications to the electrode configurations were required.

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OF34: DIRECT DBS: A prospective, multi-center clinical study with blinding for a directional Deep Brain Stimulation (DBS) lead

Authors:

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Keywords: Deep Brain Stimulation, DBS, subthalamic nucleus, STN, STN-DBS, Parkinson's disease, directional DBS, neurostimulation

Abstract:

Objective: Historically, DBS systems have delivered stimulation using leads with cylindrical electrodes, which may stimulate neurons around the entire circumference of the lead. In this study, we test a directional DBS system with leads that include radially segmented electrodes designed for selective stimulation in directions orthogonal to the lead trajectory, in addition to standard cylindrical electrodes. This directional system is also capable of current steering to shape stimulation in the plane orthogonal to the long axis of the lead (directional stimulation), as well as providing Ring Mode (omnidirectional) stimulation equivalent to historical leads. We aim to characterize the effects of directional stimulation in subjects implanted with this system.

Materials: DIRECT-DBS is a prospective, randomized, multi-center, double-blind study employing a crossover design. Up to a total of 12 subjects will be enrolled and implanted per standard of care with bilateral directional DBS leads (Vercise Cartesia, Boston Scientific) connected to a pulse generator providing an independent current source for each of the 16 contacts. Visits occur in 3 major periods: implant visit, 3-5 months visits, and a 1 year visit. Programming is restricted during the first 3 months post-implant to Ring Mode. At 3 months, multiple single-day programming visits will be undertaken to optimize directional programming. Patients are then randomized to one of two arms (4 weeks per arm) for a double-blind crossover comparison between Ring Mode and unrestricted (e.g. directional) programming. After the crossover phase, subjects enter an open-label phase of the study, with follow-up at 1 year.

Results: This evaluation has no prospective statistical hypothesis, but collects data such as therapeutic thresholds, side effect thresholds, therapeutic window, UPDRS-III, PDQ-39, and quantitative accelerometer-based measures of bradykinesia and tremor. The preliminary data obtained so far will be reported.

Conclusion: Preliminary results so far show differences in the clinical responses related to different directional stimulation. Results will inform future studies.

OF35: Therapy impedance reflects active contact location and associates with outcome after ANT-DBS in patients with refractory epilepsy

Authors:

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Keywords: epilepsy, deep brain stimulation, therapy impedance, seizure

Abstract:

Background: Deep brain stimulation (DBS) of the anterior nucleus of thalamus (ANT) is an emerging form of adjunctive therapy in focal refractory epilepsy. ANT is encapsulated by incomplete white matter layers and located immediately adjacent to cerebrospinal fluid space which may be reflected to impedance values of implanted DBS leads.

Objective: In the present study we asked whether therapeutic impedance values correlate with the location of a given contact and/or patient outcomes. Patients and methods: A total of 16 patients with chronic ANT-DBS for refractory epilepsy comprising 57 contacts and 604 impedance measurements recorded on regular outpatient clinic visits were studied. Contact locations were analyzed in detail using postoperative CT - 3T MRI STIR fusion images previously shown to demonstrate anatomical boundaries of ANT.

Results: The contacts in leads implanted using transventricular trajectory (n=21) which were located immediately below the CSF surface showed overall lower and slightly decreasing impedances over time compared to higher and more stable impedances in contacts with deeper parenchymal location implanted either transventricularly (n=3) or extraventricularly (n=6). Impedance values in contacts in ANT (n=35) were significantly lower compared to the outside-ANT (n=19) location (821 ± 170 Ω vs. 1070 ± 146 Ω ; p<0,001) or location at the inferior, lateral and posterior border of ANT (998 ± 102 Ω ; p<0,001, figure 1A). We found a significant correlation between therapeutic impedance and the distance of contact from CSF surface in leads implanted using transventricular trajectory (r=0.75; R²=0.56, figure 1B). We also found that therapy impedance values were significantly lower (mean 748 ± 176 Ω) in contacts with favorable therapy response (n=25) compared to non-responding contacts (n=29) (mean 988 ± 200 Ω ; p<0,001; independent samples t-test, Figure 1C). Finally, we observed a significant correlation between impedance of total number of seizures (r=0.60; R²=0.36, Figure 1D).

Conclusion: Therapeutic impedance values may be used to select active contact with most optimal location at ANT (between CSF and deeper thalamic structures) with most probable therapeutic effect.



OF36: Influence of Disease Lateralization in Movement Disorders on Fiber Tracking and Deep Brain Stimulation

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Keywords: Lateralization, Deep Brain Stimulation, DBS, DTI, Tractography, Fiber Tracking, Movement Disorders

Abstract:

Background: Lateralization is commonly encountered in movement disorders, especially Parkinson's disease. Besides being an important diagnostic criterion the side of the onset may have implications on the prognosis of the disease. Recent studies have looked at the integration of tractography in Deep Brain Stimulation (DBS) in general and in Parkinson's disease in particular. Therefore, exploring the lateralization aspects of tractography in movement disorders is an important step for a better understanding of the heterogeneity of tractography results. So far, no study looked at the implications lateralization has on fiber tracking (figure 1). This study focused on the influence of disease and hand dominance on fibers, fractional anisotropy and seed points.

Methods: Diffusion tensor imaging (DTI) was acquired in 10 DBS candidates with movement disorders. Tractography was carried out in a standardized setting using standard regions of interest and a 75% FA threshold. The number of fibers, seed points and the number of voxels were measured. Statistical analysis was performed using students t-test and for categorical data a fisher's exact test. A p<= 0.05 was considered significant.

Results: DTI Datasets of 10 patients (Parkinson's 7, Dystonia 3). Disease dominance was left in 3 and right in 7 cases. The left disease group had a mean of 7723 (SD 10935) for the left and 784 (SD 524) for the right hemisphere. The right disease group had a mean of 7723 1087 (SD 1012) left and 1858 (SD 1443) right hemisphere. A trend indicates that disease dominance is reflected by the lack of fibers and seed points of the corresponding contralateral hemisphere. Hemisphere dominance of fibers and seeds and their association to disease dominance where statistically significant (fisher's exact test p= 0.008).

Conclusion: There is an important correlation of disease dominance and the density of fibers and seed points in movement disorders and especially in Parkinson's disease. This might be an expression of the degeneration of the striatum and cortical neurons in the more affected hemisphere and corroborates with prior investigations of the motor cortex. The implications of these findings on Deep Brain Stimulation might be multifold, such as optimal positioning of the electrode, side effect thresholds and prediction of outcome.



OF37: Identifying postoperative structural MRI biomarkers of seizure freedom after temporal lobe epilepsy surgery

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Keywords: Neuroimaging, Drug-resistant epilepsy, Hippocampus

Abstract:

Objectives: It is difficult to reliably predict durable treatment response following surgery for temporal lobe epilepsy (TLE). We hypothesized that limbic structural change after surgery could be a potential biomarker of seizure control and neuropsychological outcomes in TLE. Consequently, we characterized limbic structural change in the days, weeks, months and years after TLE surgery using anatomical and diffusion tensor imaging (DTI) MRI.

Methods: Pre- and post-operative (mean 4.3 ± 3 years post-surgery) 1.5-T T1-weighted and DTI MRI were obtained in 26 surgical TLE patients. Ten patients were also scanned on post-operative days 1, 2, 3, 6, 60, 120 & > 360. Blinded, manual volumetry of the contralateral hippocampus (cHC), fornix (FO) and mammillary bodies (MB) was performed. cHC mean diffusivity (MD) and fractional anisotropy (FA) were also measured. Imaging metrics were correlated with seizure outcome (at 5 \pm 4 years) and neuropsychology (at 2 \pm 2 years).

Results: There was significant postoperative bilateral atrophy of the FO (38% ipsilateral, p < 0.0001; 13% contralateral, p < 0.001), MB (38%; p < 0.001) and cHC (12%, p < 0.001)(Fig 1A-C). cHC volume loss was significant within the first week after surgery while atrophy of the FO and MB was not evident until 1 year. There was significant postoperative recovery of cHC MD (preop: 960 ± 50, postop: 990 ± 70 µmm²/s; p=0.008) and decline in FA (preop: 0.18 ± 0.02, postop: 0.16 ± 0.02; p < 0.001; Fig 1E-F) in contrast to age-matched healthy controls. cHC volume loss was significantly more pronounced in patients with ongoing disabling seizures (Engel > 1, n = 6; p = 0.048; Fig 1D). Postoperative neuropsychological testing revealed significant improvement in figural memory performance in dominant hemisphere resections (p = 0.02) with no observed correlation to limbic structural measures.

Conclusion: Significant postoperative, contralateral limbic macro- and micro-structural changes occur after TLE surgery. Taken together, these findings suggest deafferentation resulting in a removal of tonic subclinical transsynaptic forniceal commissural excitatory input from the circuit. Postoperative recovery of cHC diffusivity may be due to resolution of preoperative cytotoxic edema. cHC atrophy may represent an early biomarker of TLE surgery failure, requiring prospective evaluation in future work.



OF38: Focal MRI findings as a positive predictor factor for good outcome in a large series of resective epilepsy surgery procedures

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Keywords: MRI, epilepsy, outcome

Abstract:

Introduction: The introduction of MRI in clinical practice 25 years ago changed the epilepsy surgery landscape considerably. Scalp and invasive neurophysiology are still part of a comprehensive workup of refractory epilepsy patients, but the relevance of standalone MRI anatomical findings in defining outcome related to seizures has been evaluated over the years. We compared the outcome of MRI positive or negative refractory epilepsy patients submitted to resective procedures in a large single-center series.

Methods: One thousand five hundred and eighty-six patients were studied. One thousand and sixteen patients (160 with normal MRI; 16%) had temporal lobe epilepsy, 233 (46 with normal MRI; 20%) had frontal lobe epilepsy, 77 (40 with normal MRI; 52%) had Rolandic epilepsy, 120 (no patient with normal MRI) had hemispheric pathology, 79 (11 with normal MRI; 14%) had posterior quadrant epilepsy, 31 (11 with normal MRI; 35%) had parietal epilepsy, 21 (4 with normal MRI; 19%) had occipital epilepsy, and 9 (2 with normal MRI; 12%) had insular epilepsy. Eighty-six percent of the patients with normal MRI were submitted to invasive recordings.

Results: Outcome regarding seizures could be summarized as follows (type of resection: seizure freedom in positive MRI patients %/seizure freedom in negative MRI patients %):

Temporal resections: 86-67; frontal resections: 92-66; Rolandic resections: 94-60; posterior quadrant resections: 91-77; parietal resections: 89-80; occipital resections: 85-81 and insular resections: 85-50. Patients who received temporal, frontal, Rolandic, posterior quadrant and parietal and were MRI positive had a significantly better outcome. There was no significant difference in patients submitted to occipital lobe resection or insular (small number) resection.

Discussion: MRI was a good positive outcome predictor in a large epilepsy surgery, irrespective to any other clinical findings. Patients submitted to hemispherectomy always had a positive MRI; patients with Rolandic epilepsy were more prone to disclose no lesion on MRI. Results in normal MRI patients were systematically poorer compared to those obtained in MRI positive patients, but consistently efficacious compared to medical therapy in this carefully selected series of refractory epilepsy patients. Invasive recordings are likely to be part of the work-up of patients with refractory epilepsy and normal MRI. Conversely, invasive neurophysiology is unlikely to be needed in positive MRI patients.

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OF39: Behavior of post-radiosurgery tumor progression and treatment with magnetic resonance guided laser induced thermal therapy

Authors:

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Keywords: Magnetic Resonance-guided Laser Induced Thermal Therapy, post-radiosurgery tumor progression

Abstract:

Objective: Recurrence or progression after maximal radiation therapy for brain metastasis is a well-known problem. At our institution, magnetic resonance-guided laser induced thermal therapy (MRgLITT) is used for the treatment of progressive in-field recurrences, regardless of the underlying physiology. We analyze the volumetric trends from the time of radiosurgery to laser ablation to understand the behavior of progression prior to laser therapy.

Methods: A retrospective review of patients who underwent MRgLITT for treatment of post Gamma Knife (GKS) recurrent metastatic tumors between November 2010 and October 2016 was performed. Lesion volumes were calculated using OsiriX Software. Volumetric trends were obtained by plotting individual lesion volumes from the nadir volume after radiosurgery to volume at laser ablation. The majority of tumors followed an exponential growth pattern (n=23), while a smaller number followed a linear trend (n=11). Here, we examine the major exponential growth pattern by inverting a three-parameter exponential decay curve fit and applying it to the recurrence data. Parameters derived from the exponential decay function, $f=y^0+a^{bx}$, were used to identify the asymptote or nadir volume and to calculate a doubling factor for the rate of tumor growth.

Results: A total of 23 post-radiation recurrent lesions in 20 patients followed a non-linear exponential growth after GKS and were treated using MRgLITT. At an average of 299 days before laser ablation, the average nadir volume was 0.28 cm³ (SEM=0.07) with average absolute difference from the nadir regression estimate being 0.08 cm³ (SEM= 0.02). The mean volume at ablation was 2.83 cm³ (SEM= 0.45) with a mean absolute difference of 0.14 cm³ (SEM= 0.06) from the end volume regression estimate. The average adjusted coefficient of determination, adj. r², was 0.93 (SEM= 0.014). The mean value for the half-life or doubling factor for tumor growth was 75.46 days (SEM= 14.87).

Conclusion: The three- parameter exponential decay regression is an accurate representation of tumor progression behavior following radiation. The regression estimates may predict tumor volume at a given time from nadir volume to pre-ablation end volume. These preliminary results, most importantly the doubling factor, can be valuable in future cases to predict tumor growth and determine an optimal time window when MRgLITT can be used to ablate progressive in-field recurrences following prior GKS treatment.

OF40: Evolution of Stereotactic Targeting in Anterior Capsulotomy and Deep Brain Stimulation for Treatment Refractory Obsessive-Compulsive Disorder: A Systematic Review

Authors:

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Keywords: Obsessive-compulsive disorder, Stereotactic radiosurgery, Radiofrequency, Deep brain stimulation

Abstract:

Objective: The anterior limb of the internal capsule (ALIC) is an established target for anterior capsulotomy and deep brain stimulation (DBS) for the treatment of refractory obsessive-compulsive disorder (OCD). Although the DBS target was initially based on the capsulotomy experience, both targets have diverged over time. We performed a systematic review to evaluate the evolution of stereotactic targeting for capsulotomy and DBS in OCD, with the goal of better understanding the underlying neuro-circuitry of OCD.

Methods: We identified studies reporting stereotactic coordinates for anterior capsulotomy (stereotactic radiosurgery [SRS] or radiofrequency [RF]) or DBS for OCD. Stereotactic coordinates were plotted onto a standard Montreal Neurologic Institute (MNI) brain to trend target evolution over time.

Results: There were 7 anterior capsulotomy studies (3 RF, 3 SRS, 1 RF+SRS) and 10 DBS studies. We found that both the capsulotomy and DBS targets have moved more ventrally, medially, and posteriorly from their earliest coordinates, but to different degrees (Figure). The average capsulotomy target in recent years was 14 mm lateral to midline, 10 mm anterior to the posterior border of the anterior commissure (AC), and 3 mm above the intercommissural line. The average DBS electrode tip target in recent years was 9 mm lateral to midline, 5 mm anterior to the posterior border of the AC, and 3 mm inferior to the intercommissural line.

Conclusion: These results show that both targets have moved ventral, medial, and posterior to the original lesion target, but to different degrees, with greater excursion for the DBS target. Further work using connectivity analyses will shed light on the physiological significance of this difference. A better understanding of this difference and its effect on patient outcomes will advance our knowledge of the underlying circuit-level pathophysiology of OCD.



Figure: Coronal and axial MRI slices representing earlier (blue) and recent (red) average targets for both (A) anterior capsulotomy and (B) DBS.

OF41: Is complete tumor ablation required for optimal tumor control? The effect of the extent of ablation on the rate of recurrence in MgLITT in the treatment of recurrent cerebral metastatic disease

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Keywords: MgLITT, Recurrent Metastasis, Radiation Necrosis, Ablation

Abstract:

Introduction: Targeting ablation to superficial or deep seated tumors, Magnetic resonance guided laser induced thermal therapy (MgLITT) provides a safe and minimally invasive alternative to open surgery and radiosurgery in the management of recurrent cerebral metastatic disease. It still remains to be determined what proportion of recurrent tumor must be ablated to provide optimal local control. In our series, we evaluated the effect of percentage of ablation and residual tumor volume on the rate of recurrence in MgLITT treated recurrent cerebral metastatic disease.

Methods: 46 tumors in 38 patients were treated with the Visualase Thermal Therapy System. One patient had three tumors treated at once and two patients had two tumors treated at once. Five patients were treated again for the same or different tumor at a later date. Volumetric analysis was performed, and the effect of percentage volume ablated (PVA) and residual tumor volume (RTV) on the rate of local recurrence was determined using a two tailed t-test with unequal variance.

Results: There were eight total recurrences in 46 tumors. The average PVA was 96.36 + 7.59% in the non-recurrent and 81.89 + 7.18.10% in the recurrent groups. The average RTV was 0.21 + 7.051 cm³ in the non-recurrent and 0.92 + 7.117 cm³ in the recurrent groups. The volume of residual tumor did not have an effect on recurrence (p=0.136). The PVA did approach significance (p=0.059).

Conclusion: Through using RTV and PVA, we determined that it is not critical to ablate the entire tumor volume of a recurrent metastatic tumor to provide optimal local control. Furthermore, leaving residual tumor may be a safer and yet, still effective treatment strategy for tumors located near eloquent or critical structures. Subtotal ablation from MgLITT may have a role in the management of recurrent cerebral metastatic disease.

OF42: Frequency and Characterization of Speech Problems following DBS from the Product Surveillance Registry

Authors:

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Keywords: DBS, Complications, Speech

Abstract:

Background: There has been a relatively high frequency of dysarthria and speech disorders reported to occur after DBS, and often attributed to current spread to adjacent internal capsule/corticobulbar fibers. In order to address the reversible nature of these speech disorders, we characterized the rate of speech problems across DBS indications, unilateral or bilateral placement, lead location and time to resolution as documented in the Product Surveillance Registry (PSR). The PSR tracks data in real-world clinical environments to provide insights in how the therapy is utilized while collecting product and safety information on DBS systems.

Methods: Data was analyzed on 2109 patients registered from July 2009-2016 from 36 centers located in three continents. Speech problems were defined as dysarthria, speech disorder, or device stimulation issue (adverse event related to speech).

Results: A total of 41 events in 37 patients have been reported to date, resulting in a patient occurrence rate of 1.8% (37/2109). In the PSR, speech-related events which quickly resolved through reprogramming, especially during the initial optimization period may not be reported and may account for the relatively low rate. Thirty-one of the 37 patients with speech events had complete lead location information available. Of these patients, based on the anatomical lead location, the rate of speech disorder events in GPI, STN, and VIM were 1.2% (3/243), 2.0% (18/910), and 2.6% (10/391), respectively (table 1). For bilateral VIM the rate was 3.3% (10/304) and 0% (0/87) in unilateral VIM. Importantly, the majority of speech related events (n=28) resolved over an average of 3.3 months, and unresolved or ongoing speech disorders (n=13) lasted a mean of 19.9 months to date (table 2).

Conclusion: Results from the PSR suggest that dysarthria and speech disorder events are an infrequent event, and are more common with bilateral implants of the VIM but most of them resolve within three months post implant. Further studies may be warranted to further elucidate and characterize these types of events.

Table 1. Speech problem events, by anatomical lead location

*10 events in bilateral placed leads, 0 events in unilateral

Anatomical lead location	All patients Events, % pts (n/N)
GPI	3, 1.2% (3/243)
STN	21, 2.0% (18/910)
VIM	11, 2.6% (10/391)*

Table 2. Time to resolution	n (months), by sta	atus
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Outcome	All patients Mean ± SD (N) Median [Min, Max]
Resolved	3.3 ± 4.8 (28) 1 [0.0, 19.1]
Ongoing	19.9 ± 8.7 (13) 25 [5.9, 32.3]

OF43: Cervical and high-thoracic dorsal root ganglion stimulation (DRG) in chronic pain

Authors:

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Keywords: DRG, CRPS, cervical pain,

Abstract:

Introduction: Dorsal root ganglion stimulation is a promising new technique in chronic pain states of different origin. Commonly used in the lumbar region, DRG can be used in the upper thoracic and cervical region with slight alterations of the surgical approach. Data on outcome and complications rates of DRG in this region are limited.

Methods: We report on a consecutive series of 11 patients treated with DRG stimulation (Spinal Modulation®) in the upper thoracic and cervical region. All patients suffered from chronic pain due to peripheral nerve or brachial plexus injuries, spinal cord surgery, post-herpetic neuralgia or CRPS II. All patients were trialed with externalized electrodes for 3-7 days; a successful trial was defined as at least 50% pain reduction.

Results: Out of all 11 patients trialed, 9 were successfully trialed and implanted with a permanent stimulation system. All but one patient (suffering from post-herpetic neuralgia) reported permanent clinical significant pain reduction (VAS reduction from mean 8.1 to 2.3). Loss of treatment effect requiring reprogramming was commonly observed during the first few month of treatment. In one patient a transient paresis of the arm and hand was observed immediately following electrode implantation.

Conclusion: Cervical and upper thoracic DRG stimulation is feasible and resulted in good overall response rates to trialing and excellent long-term pain relief in primary responders. A modified approach has to be used when compared with lumbar DRG electrode placement. Surgery itself in this region is more complication prone and challenging. Best results were seen in patients with brachial plexus and peripheral nerve injuries.

OF44: Stereotactic thalamotomy and contralateral pallidotomy for Parkinson's disease

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Keywords: Parkinson's disease, stereotactic radiofrequency thalamotomy, pallidotomy

Abstract:

Objectives: Parkinson's disease (PD) is one of the most widespread progressive neurodegenerative diseases, which in most cases has bilateral clinical signs. The application of ablative surgical procedures remains important in the treatment of movement disorders in view of economical, geographical and some other reasons. The purpose of the study is to evaluate the effectiveness of bilateral stereotactic lesion procedures for PD.

Methods: From 2011 to 2017 in Romodanov Neurosurgery Institute 473 patients with PD underwent ablative stereotactic interventions, among them 26 patients (15 males and 11 females) underwent stereotactic thalamotomy and contralateral pallidotomy. At the time of the first surgery patient's age ranged from 42 to 71 years (mean 56.6 years). Surgery performed on CRW stereotactic system. Intraoperative macrostimulation was used to delineate the optimal target location. Postoperative follow-up was from 6 months to 5,5 years (mean 2.6 years).

Results: The mean duration of disease before first surgery was 7.3 years. Term between two interventions ranged from 1.1 to 7.5 years (mean 2.7 years). Before first treatment 19 from 26 pts (73.1%) used L-dopa therapy from 3 to 21 years (mean 4.7 years) and 10 (38.5%) of them had motor fluctuations and or levodopa-induced dyskinesia.

In 1 year after the second intervention UPDRS score improved by 48% in ON period and by 44% in OFF period. Regression of tremor observed in 21 (80.8%) patients, rigidity - in 24 (92.3%), bradikinesia - in 16 (61.5%) patients. Levodopa-induced dyskinesia stopped in all five patients who had it before treatment. The dose of levodopa decreased in average on 32% - from 756.8±204.6 mg/day to 514.8 mg/day. After treatment Schwab and England score increased from to 54% to 71%. Complications after treatment observed in 4 (15.4%) cases among them in 3 (12%) cases neurological deficit was temporal and in 1 (4%) case was permanent.

Conclusion: Our results demonstrate that bilateral ablative surgery is effective and safe method of treatment for PD. Such treatment improves overall motor function, increased patient's mobility, daily living activities and improves quality of life. Bilateral lesion interventions allow to reduce levodopa dose, providing them with increased freedom from a complex medication regimen. Careful identification and selection of patients for ablative surgery allows to achieve optimal results in the treatment of PD.

OF45: Visualization and computer-assisted classification of the microelectrode recording data in real time during STN DBS surgery

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Keywords: microelectrode recording, visualization, computer learning, STN DBS

Abstract:

Introduction: Intraoperative microelectrode recording (MER) helps to define the limits of the subthalamic nucleus (STN) and is a standard procedure for deep brain stimulation (DBS) in patients with Parkinson's. The MER evaluation of the STN is usually done by acoustic and visual analysis of the curves (raw data). In this study we use computer-learning and spectral analysis of multiunit activity (MUA) to find the electrophysiological borders of STN and to visualize the obtained 3D data in individual MRI space, in real-time during DBS surgery.

Methods: The STN DBS surgery with real-time automatic STN Mapping and visualization was performed as awake-surgery in 3 Parkinson's patients. The stereotactic MRT and CT data with the stereotactic plan calculated in Surgiplan Software (Elekta, Sweden) were coregistered and displayed three-dimensionally in a newly developed Brainviz visualization software. Intraoperatively, the MER data were recorded via microelectrodes and MER device (FA Inomed, Emmendingen). Recordings were made from 3 parallel trajectories per implantation side in 1 mm steps. The raw data were passed in real time to the high performance visualization station via a network connection, where the data were spectrally analyzed and classified using a neural network algorithm (perceptron). The results of the spectral analysis and classification were color coded and visualized on the planned implantation trajectories according to recording depths immediately after each recording step. The results were compared with conventional MER analysis.

Results: Results of data analysis and visualization provided a realistic representation of the target area, which was consistent with clinical stimulation effects and the assessment of the surgical team. The definition of STN / SNR transition was not clear in spectral MUA analysis in 2 of 3 cases, but computer learning classification provided plausible results. The application of the procedure did not lead to an extension of the operating time.

Conclusion: The use of spectral analysis, computer learning and multimodal visualization in real time is able to support the intraoperative determination of the STN target area. Whether this will increase the safety in DBS surgery and save decision time required for traditional MER analysis will be examined in further studies.

OF46: Early results of DBS Vs Lesioning in Parkinsons disease in Nepal

Authors:

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Keywords: Parkinsons disease, DBS, Lesioning

Abstract:

Introduction: Surgical treatment of Parkinsons disease (PD) is already an established mode of treatment. Both Deep brain stimulation and Lesioning (pallidotomy) surgeries may be used in PD.

Methods: All the patients who underwent either DBS or lesioning for idiopathic Parkinsons disease in Annapurna Neurological institute and Allied Sciences from 2014 to till date were included in this study. The demographics and their clinical status were measured in terms of Unified Parkinsons Disease Rating Score(UPDRS). The preoperative and postoperative UPDRS score was compared and analysed. All surgeries were done in awake state except for IPG(implantable pulse generator) implantation which was done under general anesthesia. The standard functional coordinates for STN and GPi was used. We used ZD Fisher Frame with its software and rechecked the targets with inbuilt Shaltenbrant Atlas. Intraoperative MER recording(inmito) was also done in these cases. For DBS we used Brio rechargeable system with 10 years battery life. For lesioning we either used Cosman RF generator with 1mm diameter and 2 mm exposed tips. The decision for DBS and lesioning was based on patients preference and affordability. In cases of Pallidotomy we used staged lesioning with at least three months gap in most of the cases.

Results: There were total of fourteen cases out of which 7 cases were DBS and 7 cases were that of lesioning. There were total of 9 male and 5 female patients. The mean age of patients in DBS was 54 years and in Lesioning was 53 years(p value>0.05). The mean preoperative UPDRS in DBS was 61 and in lesioning was 63. Mean postoperative UPDRS was 22 in DBS group and 16 in lesioning group(p value<0.05). Mean change in UPDRS in DBS 65% and was 71% in lesioning was (p value = 0.47).One patients of DBS developed postoperative hematoma which had to evacuated but eventually recovered. One patient of pallidotomy developed Parkinsons crisis and it took us almost one month for his recovery. Otherwise there were no other procedure related complications

Conclusion: Though DBS is more popular than lesioning nowadays, our results show that there is no significant difference in improvements in terms of UPDRS score. We still believe that lesioning has a definite place in PD and it is cheaper and does not require time consuming battery adjustment. We believe that in context of developing country like Nepal lesioning may surpass DBS in long term.

OF47: Improved atypical tremor control after DBS directly targeting the dentatorubrothalamic tract

Authors:

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Keywords: atypical tremor, DBS, dentatorubrothalamic tract, direct targeting

Abstract:

Background: Atypical tremors secondary to a subcortical insult are ataxic and characterized as irregular, coarse, high amplitude movements affecting the proximal and distal limb present at rest, posture and/or with intention. Direct targeting of the dentato-rubro-thalamic tract (DRTt) has been suggested to be efficacious in deep brain stimulation (DBS) for tremor suppression (Coenen et al., 2011; Fenoy et al., 2017); we analyzed outcomes after such use in atypical tremor patients.

Methods: 6 consecutively enrolled atypical tremor patients obtained pre-operative MRI with diffusion tensor (dTi) sequences. Mean baseline tremor amplitude based on The Essential Tremor Rating Assessment Scale (TETRAS) was recorded. The DRTt was drawn for each individual on StealthViz software (Medtronic) using the dentate nucleus as the seed region and the ipsilateral pre-central gyrus as the end region and then directly targeted during surgery. Intraoperative testing confirmed improved tremor control. Post-operative analysis of electrode position relative to the DRTt was performed, as was assessment of tremor improvement.

Results: Patient demographics are shown in Table 1. Mean voltage used was 3.5 V. Mean distance from the center of the active electrode contact to the DRTt was 0.5 mm. Improvement in arm tremor amplitude from baseline after DBS was significant (p<0.005).

Conclusion: Direct targeting of the DRTt in DBS is an effective strategy for tremor improvement in patients with atypical tremor.



Figure 1

(A,B,C): Illustration depicting the left (red) and right (green) constructed DRT using StealthViz software (Medtronic) using merged preoperatively obtained dTi and T2 MRI sequences, in three planes, in an example patient with cystic brainstem degeneration following cerebellar pilocytic astrocytoma resection. The constructed tracts were then merged with the post-op CT showing DBS electrode location. The seed region of interest (ROI) in the cerebellar deep nuclei used for construction of the left DRTt (purple box) is shown in (C) in the sagittal plane (Coenen et al., 2011).

(D,E,F): Depiction of the estimated volume of tissue activated (VTA) (Butson et al., 2006) from the right active electrode contact using therapeutic parameters, drawn as a blue circle; the VTA radius was used to draw a 2-dimensional area on each plane. Distance from this active contact to the drawn DRT was then calculated. Crosshairs on (A,B,C) images are at center of the therapeutic contact on the left electrode and in (D,E,F) images on that of the right electrode.

OF48: Target-specific deep brain stimulation of the ventral capsule/ventral striatum for the treatment of intractable obsessive-compulsive disorder

Author:

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Keywords: deep brain stimulation, ventral capsule/ventral striatum, obsessive-compulsive disorder

Abstract:

Deep brain stimulation (DBS) is a procedure that is widely used for the treatment of movement disorders. The United States Food and Drug Administration has granted limited approval, i.e., Humanitarian Device Exemption, for the use of DBS in adults with treatment-resistant obsessive-compulsive disorder (OCD). Although DBS is approved in the U.S. and Europe, and this technology has demonstrated effectiveness in patients with difficult-to-treat OCD, the application of DBS in OCD has not yet been reported in China. Here, we report target-specific use of DBS, using a SceneRay 1242 electrode, on the ventral capsule/ventral striatum (VC/VS) in a case of refractory OCD. The SceneRay 1242 (SceneRay, SuZhou, China) electrode with a diameter of 1.27 mm containing 4 contacts was used (Figure 1). This novel electrode shares common technology with the Medtronic device, but allows for simultaneous and independently programmed stimulation of the nucleus accumbens and the anterior limb of the internal capsule. The contact length is 3.0 mm and the spacings between the ventral and dorsal contacts are 2 mm, 4 mm, and 4 mm, respectively, covering a total length of 22.5 mm (3 + 2 + 3 + 4 + 3 + 4 + 3 mm, with 0.5 mm projecting from the electrode tip). These electrodes were designed to enable simultaneous implantation in the nucleus accumbens (NAc) and the anterior limb of the internal capsule (ALIC), with 2 ventral contacts located in the ventral NAc and 2 dorsal contacts located in the ALIC. The 2 ventral and 2 dorsal contacts can be programmed with different stimulation parameters, i.e., voltage, pulse width, and frequency. Our experience suggests that such target-specific DBS in VC/VS is effective for refractory OCD, which is concurrent with its approved indication. Increased impulsivity could be redressed in this patient by reducing the amplitude of the stimulation. Further studies are required to determine whether this treatment is superior to the use of traditional electrodes and to determine the exact mechanisms by which these changes occurred.

Figure 1 The SceneRay 1242 (SceneRay, SuZhou, China) electrode. Diameter = 1.27 mm; contains 4 contacts. This allows for simultaneous and independently programmed stimulation of the nucleus accumbens and the anterior limb of the internal capsule.

Figure 2. Post-surgerical magnetic resonance image of the patient.



OF49: INTREPID trial: a prospective, double blinded, multi-center randomized controlled trial evaluating Deep Brain Stimulation with a new multiple-source, constant-current rechargeable system in Parkinson's disease

Authors:

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Keywords: Deep Brain Stimulation, DBS, subthalamic nucleus, STN, STN-DBS, Parkinson's disease, clinical trial, neurostimulation

Abstract:

Objective: The objective of the INTREPID clinical trial is to assess the improvement in motor function and quality of life in patients with advanced, levodopa-responsive Parkinson's disease (PD) following bilateral subthalamic nucleus Deep Brain Stimulation (DBS) using a new device capable of multiple current sources that provides selective activation of individual contacts on the DBS lead. DBS is a surgical therapy used for treatment of the motor signs and fluctuations associated with Parkinson's disease (PD). Its efficacy has been substantiated by several randomized controlled trials. Moreover, motor improvement following DBS may be sustained for up to 10 years (Castrioto et al. 2011).

Methods: INTREPID is a multi-center, prospective, double blinded, randomized controlled trial (RCT) sponsored by Boston Scientific Corporation. Subjects with advanced PD were implanted bilaterally in the subthalamic nucleus (STN) with a multiple-source constant current DBS System (Vercise, Boston Scientific). Subjects were randomized to either receive active vs. control settings for a 12 week blinded period. Subjects were blinded to their treatment assignment and study assessments were administered by a clinician blinded to the treatment condition; thus maintaining the double blind in the study. Following completion of a 12-week blinded period, all subjects were programmed to receive best therapeutic settings in the open label period. Motor improvement was evaluated using several assessments including subject motor diaries, UPDRS scores, etc. Assessments for quality of life such as the PDQ-39, SF-36, and functional independence, Schwab and England, were also administered. Adverse events were recorded.

Results: The INTREPID trial is currently ongoing at over 20 centers in the US. The accompanying report provides the study design, demographics, and other preliminary data.

Conclusion: INTREPID is the first US double-blinded RCT of a multiple-source, constant-current rechargeable system in PD.

OF50: The cerebello-thalamo-cortical network as the putative target in diffusion tensor imaging tractography - assisted DBS for tremor: an observational case series

Authors:

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Keywords: DTI, DBS, DRT, Tremor, Tractography

Abstract:

Introduction: Deep brain stimulation (DBS) alleviates tremor of various origin. We report the results of an uncontrolled case series of patients with refractory tremor who underwent Diffusion Tensor Imaging fiber tractography (DTI FT) - assisted DBS of the dentato-rubro-thalamic tract (DRT).

Methods: 36 patients (64 +/- 13.6 years, 17 female) were enrolled (Essential Tremor (17), Parkinson's tremor (8), Encephalitis disseminate (7), dystonic head tremor (3), tardive dystonia (1)) and received 60 DBS electrodes. Preoperatively, diffusion tensor magnetic resonance imaging sequences were acquired together with high-resolution anatomical T1W and T2W sequences. The DRT was individually tracked with deterministic tractography (StealthViz DTI, MEdtronic USA) and used as a direct target. Stereotactic surgery was performed with a Leksell G-Frame (Elekta, Sweden) with the patients awake. Electrodes were lowered into the target region via Microdrive (FHC, USA) in 2mm steps typically starting 10 mm above target. Intraoperative tremor reduction was graded on a 4-point scale (0=no tremor reduction, 3=full tremor control) and recorded together with the current amplitude, respectively (0.5-4 mA, 150Hz, 100us, lesion generator, Cosman, USA). 241 stimulation points were analyzed in this cohort in the planning system (MCP coordinates of stimulation points, closest distances to DRT border and center were recorded). The relation of the current amplitude needed to reduce tremor was expressed as TiCR (tremor improvement to current ratio = Ti /I [1/mA]).

Results: TiCR values increase significantly in proximity to the DRT (* p<0.001). The TiCR is a new efficiency measure for tremor control and appears to be interesting in the definition of optimal stimulation points. A total of 51 out of 60 finally implanted DBS electrodes were positioned on the planned trajectory (85%) and 68 trajectories were tested in 60 electrode placements (1.13 trajectories tested per implanted DBS electrode).

Discussion: The DRT is a fiber bundle that shows tremor-reducing effects when modulated with the DBS technology. Tremor signals can sufficiently be perturbed at different points in the system (above and below the MCP plane). Tractography techniques can be used to directly visualize the DRT and therefore optimize target definition in individual patients. The TiCR is a newly introduced measure to define the efficiency of stimulation and by that to identify an optimal stimulation point.



OF51: Microsurgical re-decompression for recurrent trigeminal neuralgia after microvascular decompression

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Keywords: Microsurgical re-decompression, recurrent trigeminal neuralgia

Abstract:

Objective: Microvascular decompression (MVD) is a well-accepted treatment option for trigeminus neuralgia (TN). The initial success rate is high, however, in a subset of patients TN might recur in the longterm. Recurrent TN after MVD might be due to several reasons and treatment algorithms remain unclear. Here, we present the surgical findings and clinical outcome of patients with recurrent TN after MVD who underwent another microsurgical decompression procedure.

Methods: Twenty-four patients with recurrent TN underwent microsurgical re-decompression over a period of 10 years. Patients with multiple sclerosis were excluded. All patients had magnetic resonance imaging before surgery. Microsurgical re-decompression included meticulous preparation of the previously inserted Teflon and scar tissue avoiding any damage to the trigeminal nerve. In no case the trigeminal nerve was lesioned or "combed" or dissected. New Teflon felts were placed in case a nearby artery was found. There was no operative morbidity or mortality. All patients were available for postoperative follow-up. The outcome of the repeat intervention was graded according to the Barrow Neurological Institute (BNI) pain score. Mean follow-up was 32 months.

Results: Recurrent TN was thought to be caused by the following findings identified intraoperatively: scar tissue at the trigeminal entry zone (21/24), deformation of the trigeminal nerve/ tefloma (16/24), new nerve/ vein contact (8/24), artery/ Teflon contact with marked pulsation (12/24), and compression of the trigeminal nerve by a cavum Meckeli electrode for treatment neuropathic pain (1/24). Early postoperative pain relief was achieved in all patients. On longterm follow-up 20 patients had complete pain relief (BNI I), 3 patients had pain relief under medication (BNI III) and one patient had a BNI pain score of IV. Hypaesthesia secondary to the microsurgical re-decompression occurred in only 2/24 patients.

Conclusion: In the present study microsurgical re-decompression was highly successful for recurrent TN. There were no serious side effects and the frequency of postoperative hypaesthesia was low. We conclude that microsurgical re-decompression avoiding any damage to the trigeminal nerve is a very useful treatment option in this context. Any manoeuvres such as dissecting or "combing" the trigeminal nerve are unnecessary and should be avoided.

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OF52: Changes in Intracortical Inhibition and Clinical Symptoms After STN-DBS in Parkinson's Disease

Authors:

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Keywords: subthalamic nucleus deep brain stimulation, intracortical inhibition, Parkinson's disease

Abstract:

Objectives: To examine the effects of subthalamic nucleus deep brain stimulation (STN-DBS) on intracortical inhibition in Parkinson's disease (PD) and the correlation between intracortical inhibition and clinical symptoms after alteration of STN-DBS status.

Methods: Nine PD patients treated by STN-DBS were compared with eight age-matched controls. Antiparkinsonian medication was withdrawn 12 hours before the study. Short-interval intracortical inhibition (SICI) with a 3-ms interval and silent period (SP) were examined using transcranial magnetic stimulation. The SP, SICI and motor symptoms (rigidity and tremor) were evaluated sequentially before and after withdrawal of STN-DBS.

Results: Even during STN-DBS, PD patients showed a shortened SP and reduced SICI relative to the normal controls. SICI was decreased significantly 10 min after STN-DBS withdrawal resulting in facilitation rather than inhibition, whereas SP was shortened 120 min later. Both rigidity and tremor were significantly worsened at 10 min after STN-DBS withdrawal.

Conclusion: Even during STN-DBS, both SICI and SP in PD patients remain impaired without medication. The changes in SICI, but not SP, show a time course similar to those of motor symptoms.

Significance: The dissimilarity of SICI and SP changes suggests differences in how inhibitory mechanisms are mediated and/or superimposition of exaggerated intracortical facilitation on SICI.



OF53: Deep brain stimulation in routine clinical practice: monocentric study of the battery lifetime of different generations of neurostimulators

Authors:

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Keywords: deep brain stimulation, battery lifetime,

Abstract:

Routine clinical practice of Deep Brain Stimulation (DBS) enters a new era where battery-related events are challenging. The important number of primary implantations and replacements pushed industrials to develop new generations of devices. We aimed to analyze the battery lifetime of different kinds of non-rechargeable devices, manufactured by a single company (Medtronic, USA): the first generation of 4-contact neurostimulator for one DBS-lead (1 channel; Soletra®) and 8-contact neurostimulator for two DBS-leads (two channels of 4 contacts; Kinetra®); the second generation of advanced programming neurostimulator (Activa® PC, two channels of 8 contacts, and SC, 1 channel of 8 contacts).

We retrospectively reviewed 281 consecutive patients operated on in a single institution (from 1995 to 2016): 584 surgeries for primary implantation or replacement of neurostimulator (infection and traumatic etiologies of battery replacement were excluded). The battery lifetime was defined as the period between the surgical implantation and the removal at battery depletion. Two hundred and eighty eight battery-lifetimes were analyzed in 157 patients suffering of Parkinson disease (n=129), essential tremor (n=19), dystonia (n=9). Exclusion criteria were: battery related, still operational (n=217); patient related, died before battery depletion (n=50); missing follow-up (n=3); and other diseases treated by DBS (n=2). Battery lifetime was analyzed using survival methods (univariate, Log-Rank test; multivariate, marginal cox model; two-sided tests) accounting for the following parameters: gender, neurological disease, age at the primary implantation, the UPDRS-score before DBS surgery, the deep brain target, battery model, mean voltage (low < 2V; usual from 2V to 4V; high v> 4V), location of battery (abdominal or sub clavicular) and presence of an adapter for replacement of first generation (Kinetra or Soletra) by second generation model (Activa).Results: The battery lifetime was shorter in male (p=0.03) and young (p<0.001) patients suffering of essential tremor (p<0.001). High voltage reduced battery lifetime (p<0.001). The second generation device, Activa models, had shorter lifetime than first generation, Soletra and Kinetra (p<0.001). Replacement of battery decreased lifetime independently of models (p<0.001).

Patient and disease characteristics, high voltage, second generation devices and replacement seem to shorten lifetime of battery.

OF54: GPi DBS rescue for severe dyskinesia or dystonia following STN DBS in Parkinson's Disease - dual or replacement therapy

Authors:

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Keywords: deep brain stimulation, dual, STN DBS, GPi DBS, combined therapy

Abstract:

It is well known that either STN DBS or GPi DBS can improve the cardinal symptoms of Parkinson's Disease (PD). Studies have demonstrated similar overall efficacy on "motor parkinsonism" symptoms although the two targets have differential effects on individual parkinsonian symptoms and a varying side effect profile. A significant clinical problem arises when a DBS target is selected which long term does not effectively control a disabling symptom- in this case dyskinesia/dystonia. The surgical team is then faced with the dilemma of switching from one stimulation site to another either as replacement therapy or perhaps adding another system to provide dual stimulation of both STN and GPi. Over the past 16 years ,Sydney DBS has operated on more than 400 patients with PD performing >800 STN implants and 30 posteroventral GPi implants.3 of the 400 patients,<1% have required GPi DBS due to the development of refractory dyskinesia and or dystonia. These 3 patients(cases1,2&3) are now treated with dual STN and GPi DBS. A fourth patient (case 4), treated with STN DBS at another Australian centre has undergone GPi DBS in our surgical unit with STN DBS removal. All four patients suffered both diphasic and peak dose dyskinesia and "off" dystonia. In case 2, dyskinesia emerged one month after STN DBS. Tremor was the principal initial indication for surgery in this instance and despite one year of stimulation and medication trials, control of tremor could not be consistently achieved without troublesome dyskinesia. In the other 3 cases, good control of parkinsonism was initially achieved with STN DBS but with the requirement over the years to re-introduce increased doses of anti-Parkinsonian medication, troublesome dyskinesia re-emerged. Empirically, we have found optimal control to be achieved with simultaneous use of both STN and GPi DBS in the patients with dual systems. Either system in isolation was not as effective as combining the effect of dual stimulation. Parkinsonian control also was significantly improved in the patient switched from STN DBS to GPi DBS. The predominance of dyskinesia and dystonia and the absence of tremor in this patient likely underscores the greater efficacy of pallidal DBS in this instance.

Conclusion: All four patients had successful surgical rescue treatment with dramatic control of dystonia/dyskinesia with GPi DBS. In our experience, simultaneous use of STN DBS and GPi DBS provided better symptomatic control than either system alone in the cases treated.

OF55: Differential approach to surgical management of facial pain

Authors:

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Keywords: Facial pain

Abstract:

Introduction: In addition to classic trigeminal neuralgia (TN), multiple other facial pain (FP) conditions may be successfully addressed with surgery.

Purpose: To evaluate usefulness of published FP treatment algorithm on the base of clinical experience analysis in a large multi-center group of FP patients.

Methods: We analyzed 378 FP patients surgically treated in 4 neurosurgical centers (Novosibirsk, Irkutsk, St.-Petersburg and Chicago); they were chosen for analysis based on diagnostic and follow-up data availability. FP treatment algorithm (Slavin, 2007) was used to facilitate decision making. Patients not expected to benefit from surgery were excluded during screening and referred to other specialists. 56.7% were diagnosed with TN type 1; 18.7% - TN 2; 7.5% - trigeminal neuropathic pain; 3.6% - symptomatic TN (multiple sclerosis (MS)); 1.6% - postherpetic neuralgia; 1.7% - deafferentation facial pain; 0.3% - geniculate neuralgia; 8.4% - secondary TN (other than MS); 1.1% - glossopharyngeal neuralgia. Severity of clinical symptoms was assessed with Visual Analog Scale (VAS), Barrow Neurological Institute Pain Scale (BNIPS), DN4 and BPI-Facial.

Results: A total of 426 surgeries were undertaken: 40.2% - MVD; 15.7% - radiofrequency gangliolysis; 9.5% - balloon compression; 9.2% - glycerol gangliolysis; 7.3% - peripheral nerve stimulation; 0.2% - percutaneous trigeminal tractotomy; 0.2% - open trigeminal nucleotractotomy; 0.2% - neurectomy; 8.9% - stereotactic radiosurgery; 6.9% - posterior fossa tumor resection; 1.7% - motor cortex stimulation.

According to Miller scale surgical results were classified as excellent (75-100% pain reduction), good (25-74%) and poor (0-25%). Open surgery results were excellent in 91% cases, good – 4%, poor – 5%. Percutaneous treatment had excellent results in 58% cases, good – 19%, poor – 23%. Neuromodulation options showed excellent results in 42% cases, good – 18%, poor – 39%. Success of stereotactic radiosurgery was evaluated as excellent in 53% cases, good – 14%, poor – 33%.

Conclusion: Differentiation of FP type is essential for effective choice of surgical treatment. The existent algorithm allowed us to clearly classify large volume of FP patients and establish optimal surgical treatment based on diagnosis and individual patient characteristics.

OF56: Tractography-guided Stereotactic Anterior Capsulotomy for Depression or OCD: Teaching an Old Procedure New Tricks

Authors:

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Keywords: tractography, depression, obsessive compulsive disorder, functional neuroimaging, DTI

Abstract:

Objectives: Bilateral Anterior Capsulotomy (BAC) has been traditionally performed by placing lesions in the anterior limb of the internal capsule (ALIC) based on standard MR-imaging. This 'anti-sadness' surgery is a powerful operation designed to eliminate 'psychic pain' and destroy the circuit that mediates separation-distress (PANIC system). In this study, for the first time ever, we demonstrate a tractography-guided approach in performing BAC for treatment-refractory depression (TR-D) or obsessive-compulsive disorder (TR-OCD).

Methods: After acquiring a 3T 64-direction DTI scan, we mapped the Medial Forebrain Bundle (MFB) and the Anterior Thalamic Radiations (ATR) with DTI tractography on StealthViz in n=6 subjects: three who became medication-free following BAC, one who became chronically fatigued following BAC, one healthy control, and one surgical candidate for BAC. Figure 1 illustrates a sample of this pre-operative limbic white matter mapping step. We then prospectively targeted the ATR white matter tracts in BAC surgery in the last subject.

Results: Details of tractography- and functional-mapping will be presented at the WSSFN meeting. We will provide neuroimaging and behavioral confirmation that: 1) a distinct topography in the ALIC can guide BAC surgery, 2) partial destruction of the supero-lateral branch of the MFB leads to sustained apathy/fatigue, and 3) selective destruction of ATR fibers leads to rapid resolution of suicidality and then gradual neuro-rehabilitation to cessation of psychiatric medications. Functional neuroimaging analysis revealed that the Anterior Nucleus of the Thalamus could be subdivided to serve as a pre-operative seed region.

Conclusion: We provide a new and refined version of BAC surgery for TR-D or TR-OCD using fiber tractography and functional mapping. In our 20-year experience, BAC has been demonstrated to have powerful and reproducible results for mood disorders. Unlike DBS, this surgery can be effective in low-resource countries, requires no post-operative programming, and infections are non-existent. We argue the merits of BAC over cingulotomy. We hope that functional neurosurgeons continue using ablative surgical procedures until more robust and reproducible DBS research emerges for psychiatric disorders. We hope this work stimulates the application and development of circuit-, rather than disorder-, based, therapeutics for psychiatric illnesses and advance the NIH's RDoC and Precision Medicine initiatives.



OF57: Long term results of the selective dorsal rhizotomy

Authors:

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Keywords: spasticity, cerebral palsy, selective dorsal rhizotomy

Abstract:

Object: Long-term results of the selective dorsal rhizotomy are estimated insufficiently neatly and controversial. The aim of investigation is to estimate the long-term results of SDR in different groups of patients with cerebral palsy and to compare these results with the control group.

Methods: 33 patients with spastic CP have been operated. In all cases SDR of L1-S1 roots have been performed under EMG control. In all cases we have use laminoplasty. The control group includes 19 patients with CP. All patients received conservative therapy only (rehabilitation treatment + oral drug treatment + botulinum toxin injections). The results of treatment have been estimated by the Ashworth scale and GMFM 88 scale. The data have been exposed statistically analysis. The duration of follow-up was 3 years.

Results: Significantly decreasing of spasticity have been revealed in most cases: from 4,24±0,54 points before the operation till 1,53±0,37 points after the operation (p < 0,05). In the control group we also observed the dynamic of spasticity: from 3,57±0,6 before till 3,11±0,55 after (p < 0,05). But we have seen the relapse and increasing of spasticity in the follow-up in 3 cases. The dynamic of motor function after SDR was maximal in the 3-th GMFM class: from 49%±3% points before the operation till 54%±5% points 36 month after the operation (p< 0,05). In 4-th GMFM class the dynamic of motor function was less – only 2% and in 5-th it was minimal. In the control group the maximal dynamic of locomotion status was in patients concerning to 3 GMFM class - 6% (from 49%±7% till 55%±9%). In 4-th and 5-th GMFM class the dynamic of motor function was minimal. We have not observe any spinal cord deformities in follow-up.

Conclusion: Decrease of spasticity is most significant after SDR in comparison with the conservative therapy. The functional result of SDR depends on not only decreasing of spasticity but also initial motor status and age of patients. SDR is optimal procedure in patients belonged to 3-th GMFM class and high spasticity. In all cases laminoplasty should be performed to prevent the spinal cord deformities.

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OF58: Relationship between body mass index and efforts for optimal conditioning of STN-DBS

Authors:

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Keywords: Parkinson disease, STN-DBS, body weight, BMI

Abstract:

Anti-Parkinson drugs can be decreased after subthalamic nucleus-deep brain stimulation (STN-DBS) in many cases, however, the dose should be carefully reduced especially in low body weight patients. Because Parkinson disease (PD) often causes body weight loss, slight dose changes might influence their symptoms prominently. We studied an impact of low body weights for conditioning of DBS and medication after surgery, analyzing relationships between body weight or body mass index (BMI) and frequency of outpatient follow-up for conditioning of STN-DBS after discharge.

Methods: Clinical data were obtained from 12 patients with Parkinson disease (average age 62.3, 8 females) who underwent STN-DBS from 2010 to 2013. Body weight, BMI, age, dose of anti-Parkinson drugs before and after DBS surgery, UPDRS and disease duration were estimated. We studied correlations between these parameters and frequency of outpatient visits for conditioning DBS parameters and medication within 3 months after surgery.

Results: After STN-DBS, L-DOPA was reduced to 60-80% (300-350mg/day) of preoperative dose in each patient. There was no significant correlation between numbers of their outpatient visits in 3 months after surgery and preoperative L-DOPA dose while there were significant negative correlations between the outpatient visit and both body weight and BMI, and also a strong correlation with L-DOPA dose per body weight or BMI were observed. The mean number of the outpatient visits within 3 months was 3.6 times in the patients with BMI > 20, and 7.0 times in those with BMI <20. A multiple regression analysis revealed that BMI was an only significant factor that affects outpatient visit frequency. There was no patient with depression before STN-DBS.

Discussion: Conditioning of medication and stimulation after STN-DBS could be difficult especially for patients with low body weight or BMI, and thus should be carefully managed, considering possible psychiatric symptoms of PD.

OF59: Safe approach to the subthalamic nucleus

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Keywords: ablative surgery, subthalamotomy, Parkinson's disease, subthalamic nucleus.

Abstract:

Objective: To evaluate the accuracy, effectiveness and safety of STN targeting using a non-standard method for image-guided surgical approach. Special attention was focused on the impact of ventricular dilatation and brain atrophy over the electrode trajectory and targeting accuracy.

Methods: A prospective study of targeting data collected during 36 stereotactic planning for ablation of the STN in 36 patients with PD was performed. The targeting method was based on stereotactic computed tomographic imaging, deep brain activity recording with semi-microelectrode and electrical stimulation. Parasagittal recommended trajectory for this type of procedure is between 0 and 15 degrees, this was modified to values over 20 degrees in the first recording track in order to avoid the lateral ventricle. The trajectories of the electrodes relative to the lateral ventricles were analyzed in postoperative CT or MR images. The efficacy of the targeting procedure for STN localization and ablation was statistically evaluated.

Results: The average number of recorded trajectories per procedure was 5, and the average number of tracts necessary to lesion the STN was two. Average parasagittal approach angle in the first recording track was 21.6 degrees, with minimum of 20 and maximum of 25.5 degrees. STN's electrical activity was identified in the first pass of deep brain neuronal activity recording in the 86.7% of the procedures. No complications were reported related to the surgical procedure.

Conclusions: The proposed method for anatomical and neurophysiological targeting of the STN using a parasagittal approach angle over 20 degrees, was found to be effective and surgically safe in patients with PD with ventricular dilatation and brain atrophy.

OF60: Sacral Nerve Neuromodulation for the Management of Intractable Bowel Incontinence

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Keywords: Neuromodulation, Incontinence

Abstract:

Background: In the treatment of urinary incontinence, spinal or supra-spinal neuromodulation has been reported. Fecal incontinence (FI) result in significant secondary disability in bowel incontinence. In 1995, sacral nerve root stimulation was reported that the effective management against FI. The aim of current presentation was to discuss our clinical outcome of sacral nerve stimulation and to review previous reports.

Methods: We retrospectively reviewed fecal incontinence, occurred 5-year ago. He experienced hemorrhoidectomy, Discectomy L4-5 and liver lobectomy for hepatocellular cancer with bilateral L5-S1 radiculopathy and complained of incontinence. Motor power of the legs were intact, Anorectal physiology testing and electromyographic recruitment done for the motor unit potential of the puborectalis muscle. Endo-anal ultrasound was investigated. Test stimulation period was 3 to 7 days, up to 14 days at Stage 1. We choose the test based on frequency of FI. Long-term therapy was applied to the patient with implantation of lead and extension. Finally implantation of neurostimulator (INS) was done. Review of literatures were discussed with the three of patients.

Results: All of the three patients underwent test stimulation with good successful responses, of whom two of males and one female with a mean age of 71.5 years and a mean duration of fecal incontinence of 5 years received chronic implantation. Mean duration of follow-up was 1.3 (range, 0.5-2.1) years. Two patients completed about 2-year follow-up for assessment and one patient for 5 months. All of patients reported more than 50% reduction of Fl episodes compared with baseline. Cleveland clinic Incontinence Score (CCIS) were checked and the number of incontinent episodes per week improved from the average of 12.3 at baseline to 4.7. The fecal incontinence severity (FIS) index showed 18 to 14 with improvement of episodes. Sacral nerve stimulation had a positive impact on daily living. The adverse events through the mean two years of follow-up included local pain on implant site, and the unusual tingling sensation of stimulation. There were no significant adverse effects associated with sacral neuro-modulation in this study.

Conclusion: Sacral nerve neuromodulation is a safe and effective management for patients with FI. These data support short-term safety and effectiveness to 21 months. Literatures support our presentation.

OF61: Stereoelectroencephalography for refractory localization-related epilepsy: initial experience in 50 patients

Authors:

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Keywords: stereoelectroencephalography, robotic surgery, medically refractory epilepsy, epilepsy surgery

Abstract:

Introduction: Patients with pharmacotherapy-resistant localization-related epilepsy (LRE) may be candidates for surgical intervention if the seizure onset zone can be well localized. Long used in Europe, intracranial recording with stereoelectroencephalography (sEEG) is emerging as an alternative to subdural strip and grid techniques in North American centers.

Methods: We reviewed our initial experience in a consecutive cohort of patients who underwent sEEG for extraoperative monitoring of LRE between May 2014 and September 2016.

Results: Fifty patients (37 adult, 13 pediatric) were implanted with 536 depth electrodes (mean 10.7 per patient, 7.9 per implanted hemisphere). Among 18 patients with suspected lesional epilepsy (including 3 with bilateral and 4 with multiple unilateral lesions), sEEG identified lesional foci in 16 (89%) cases (15 unifocal, 1 bitemporal). Two patients required further localization with subdural grids. Of 20 patients with nonlesional epilepsy, sEEG localized foci in 16 (80%) cases (13 unifocal, 2 bitemporal, 1 multifocal). Two patients had foci near eloquent cortex requiring grid placement for further mapping and two could not be focally localized. Finally, of 12 patients who had previous resections or ablations, sEEG localized foci in 11 (92%) cases (10 peri-cavity, 1 multifocal) and 1 was not focally localized. Complications were minor and rare. In 536 electrodes, there were no (0.0%) infections or symptomatic hemorrhages and 3 (0.6%) small, asymptomatic hemorrhages. One electrode was deflected into the subdural space during placement and 1 patient required replacement of 2 electrodes that were broken during seizures in the monitoring unit.

Conclusion: Robot-assisted sEEG is a safe and useful method for localizing epileptogenic foci in patients with lesional, nonlesional, and previously treated LRE. The success of seizure onset localization and safety compare favorably with invasive subdural monitoring. Longer clinical follow up will be required to determine whether sEEG monitoring improves long-term seizure freedom in these challenging epilepsy patients.

Figure 1. SEEG Visualization Tool. Visualization tool displaying locations of depth electrodes in representative sample of 8 subjects who underwent sEEG. Each color represents a different subject. We report electrode placement patterns separated by seizure subtype.



OF62: Clinical accuracy of customized stereotactic fixtures for Stereo-EEG

Authors:

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Keywords: Epilepsy, Stereo-EEG, Frameless Stereotaxy

Abstract:

Objectives: The aim of this study was to evaluate the clinical accuracy of a new generation of custom stereotactic fixtures for placement of depth electrodes in stereo-EEG presurgical evaluation of patients with drug-resistant epilepsy.

Methods: A newly designed custom stereotactic fixture based on the StarFix technology (FHC Inc, Bowdoin, ME) has been used for anchorless implantation of 101 depth electrodes (Integra, Plainsboro, NJ) in 13 patients undergoing presurgical evaluation for drug resistant epilepsy. The stereotactic fixture (a) incorporates tool guides, anchoring and structural elements whose location and geometry are calculated and optimized using algorithms implemented in Matlab (Mathworks, Natick, MA). DEETO (Arnulfo et al., 2015) software package was used to automatically detect the electrodes' contacts on post-implantation CT (b), therefore eliminating any subjectivity in calculating the targeting errors.

Results: As a result of using custom geometry of the stereotactic platform, calculated through algorithms we have developed, the new design is optimized for each patient and streamlines the surgical procedures. The most important result characterizing platform's accuracy is the value of 1.75 mm for the mean lateral target localization error (c).

Conclusions: Personalized stereotactic fixtures are a safe and accurate alternative to using robotic arm for the implantation of depth electrodes in patients undergoing presurgical evaluation for drug-resistant epilepsy.



OF63: SEURAT: A semi-automated pipeline to localize and visualize intracranial electrodes

Authors:

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Keywords: intracranial electrodes, sEEG, neuroimaging, epilepsy

Abstract:

Intracranial electrode implantations for deep brain stimulation (DBS) and seizure localization are common functional neurosurgical procedures. In order to refine therapeutic targets and draw meaningful inferences from electrophysiological data, intracranial electrodes need to be accurately localized. The demand for simpler and more efficient methods to localize implanted electrodes has grown as the volume of these procedures continues to increase. In this study, we aimed to build a semi-automated, user-friendly pipeline (SEURAT) to determine electrode locations.

The pipeline integrates MATLAB and FSL, and uses intensity-thresholds and Gaussian-kernel convolution on the CT scan to determine the centroids of potential electrode contacts. If all contacts are not localized through the automated algorithm, users also have the ability to interpolate contacts on depth electrodes and to manually choose to add or remove contacts. These contacts are localized in patient-CT space, but can also be mapped on to the patient-MRI space and standard-MNI space.

We tested SEURAT on imaging data from epilepsy patients (n=16) who underwent implantation of sEEG depth and/or surface grid/strip electrodes. We successfully determined coordinates for all contacts on implanted electrodes. Without using the manual option available in the pipeline, the tool was able to localize coordinates for a total of 1427 contacts out of 1520 implanted. The discrepancy can be attributed to low image-quality or to some contacts being outside the brain; the toolbox defines a search area based on patient-specific brain extraction. Within-patient accuracy for the number of contacts localized was 94.5% (Figure 1). Visual inspection demonstrated that contacts were localized and mapped on to the correct brain regions; this was validated with clinical implant maps.

SEURAT is an accurate and user-friendly pipeline for intracranial electrode localization and visualization. Compared to similar open access methods, this pipeline requires minimal user input, which significantly reduces time and error. The pipeline would be useful to clinicians who need to identify the precise anatomical location of intracranial electrodes, and also for basic science investigations that require an understanding of the relationship between contact location and physiology. This pipeline allows for seamless analysis of surgical targets with the potential to inform prospective image-guided surgical protocols.



Figure 1: A) Snapshot from MATLAB with localized contacts superimposed on an axial CT slice. B) All contacts for the example patient mapped and visualized on a standard-MNI brain

OF64: Stimulation of the anterior nucleus of thalamus in patients with refractory epilepsy has a major effect on the number of seizures with impaired awareness

Authors:

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Keywords: anterior nucleus of thalamus, epilepsy, deep brain stimulation, complex partial seizure

Abstract:

Background: The effectiveness of ANT-DBS has been demonstrated by a randomized controlled (SANTE) trial. Originally, ANT was selected as a stimulation target based on its presumed role in seizure spread leading to impairment of consciousness and secondarily generalization. Unfortunately, no data is available at this moment guiding patient selection to ANT-DBS.

Objective: In the present study we have analysed the effect of ANT-DBS on specific seizure types with emphasis on the impairment of consciousness.

Methods: Sixteen consecutive patients with ANT-DBS implanted in Tampere University Hospital with at least two years of follow-up were included in the study. The seizure diaries of patients were carefully evaluated for reliability based on previous video-EEG studies taking into account the patients' ability to remember and count seizures. The presence of caregivers and family members during the day/night was assessed to get a comprehensive understanding of the details of seizure reporting.

Results: The dominant seizure type was seizures with impaired awareness (CPS) present in all patients, aware seizures (SPS) were present in 31% and focal to bilateral tonic-clonic seizures (SGTCS) in 63% of patients. The reduction of seizures can already be seen after the first 3 months of treatment with ANT-DBS (Figure 1). The most prominent change was seen in CPS seizures; from mean monthly baseline seizure count of 56 down to 22 seizures. When CPS were analyzed in terms of duration of disturbance of consciousness, the seizures with impaired awareness for more than 30 seconds decreased significantly more than very short CPS seizures.

Discussion: This study demonstrates that the effect of ANT-DBS treatment in epilepsy is largest for the seizures with disturbance of consciousness, where it seems to decrease both the frequency and duration of these seizures. Furthermore, also tonic-clonic seizures decreased significantly. The effect was not dependent on the epilepsy type and there was no difference with regard to the seizure onset zone of the seizures.

Conclusion: Our results suggest that patients with predominantly seizures with long lasting disturbance in consciousness may be optimal candidates for this form of therapy.



OF65: Magnetic Resonance Guided Laser Interstitial Thermal Therapy for Mesial Temporal Lobe Epilepsy: A Single Institution Case Series

Authors:

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Keywords: laser interstitial thermal therapy, selective laser amygdalohippocampotomy, magnetic resonance thermometry, mesial temporal lobe epilepsy, medically refractory epilepsy, minimally invasive epilepsy surgery

Abstract:

Introduction: Selective laser amygdalohippocampotomy (SLAH) using magnetic resonance guided laser interstitial thermal therapy (MRgLITT) is emerging as a treatment option for drug-resistant mesial temporal lobe epilepsy (MTLE). SLAH is less invasive than open resection, but there are limited series reporting its safety and efficacy.

Methods: We performed a retrospective chart review from January 2013 to October 2016 to identify patients who underwent SLAH for drug-resistant MTLE at our institution.

Results: Twenty-three patients were identified. At the time of surgery, median age was 48 years (range 19 to 69 years) and median epilepsy duration was 20 years (range 2 to 66 years). Seventeen patients had unilateral mesial temporal sclerosis (MTS), 5 had nonlesional MTLE, and 1 had bilateral MTS. Eight of the 16 patients (50.0%, 95% CI 24.7% to 75.4%) with at least 1-year of follow-up since surgery achieved Engel class I seizure freedom. One patient (6.3%) was Engel class II, 6 (37.5%) were class III, and 1 (6.3%) was class IV. Mean length of inpatient stay was 1.2 days (range 1-3 days). Six of 23 patients experienced a clinically significant language or memory deficit after surgery. These deficits were largely associated with ablations in the dominant hemisphere and most improved over time. Three patients had procedural complications without long-term sequelae including one transient superior quadrantanopia, one small hematoma at the ablation site without associated neurologic deficit, and one elective reoperation to complete the planned ablation through a second trajectory.

Conclusion: We report a slightly lower rate of seizure freedom (50%) with SLAH than typically observed with surgical resection (60-80%), consistent with early literature. SLAH is less invasive than open surgery with shorter hospital stays and recovery. Neuropsychological outcomes may be better with SLAH, and serious procedural complications are rare. SLAH may be a reasonable first line surgical option for some patients with MTLE with the option of a subsequent ablation or resection if seizures persist. Larger studies of SLAH will help define its long-term outcomes and exact role in the treatment of MTLE.

OF66: Anatomical location of the Anteromedial Globus Pallidus internus nucleus (GPi) relative to the Mid-commissural point (MCP) in Deep brain stimulation surgery in Tourette syndrome (TS) patients

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Keywords: DBS, Tourette syndrome, Anteromedial Globus Pallidus internus nucleus, GPi

Abstract:

Introduction: Tourette's syndrome (TS) is a neuropsychiatric disorder characterized by various motor and vocal tics and psychological problems, arising in patients, most commonly, prior to the age of 8, and usually remitting by the age of 20. It is associated to other psychiatric disorders, especially OCD and ADHD. First line treatments for these patients include behavior-therapies and pharmacotherapy. Although in most patients the tics are controlled with these treatments, a minority of patients are resistant to all non-surgical management.

One of the best treatment options for this group of patients is Deep Brain Stimulation (DBS). Many targets were introduced for DBS surgery with various result. Since now there is no general agreement about the best target.

One of the regions that has gained attention as a target is the anteromedial part of the Globus Pallidus internus (GPi).

Objective: Our aim was to identify the anatomical location of the anteromedial GPi in relation to the mid-commissural point in DBS surgery in TS.

Methods: Seven patients with TS who received bilateral anteromedial GPi-DBS (14 sites) were studied. Anteromedial coordinates; medial/lateral (X), anterior/posterior (Y), superior/inferior (Z) relative to Mid-Commissural Point (MCP), Axial angle (Arc) and Sagittal angle (Ring) were calculated on both sides separately and together.

Results: Five of the patients were male and two were female. Mean age was 25 years (interval 19-40), while the mean time since the diagnosis was 13.1 years (interval 6-22). The location of Anteromedial GPi was 14.30 mm (SD=1.83) *lateral* (X-axis), 8.82 mm (SD=2.95) *anterior* (Y-axis) and 0.36 mm (SD=4.34) *superior* (Z-axis) to the mid commissural point (MCP). The Axial angle (Arc) was 12.70° (SD=5.9). Also, the sagittal angle (Ring) was 17.42 (SD=4.94).

Conclusion: The results of this study help find the anatomical location of the anteromedial of Anteromedial GPi for DBS surgery in TS patients. The accumulation of this type of data in more patients could lead to an improvement in target identification, treatment outcome, and the rate of post-operative complications, especially for neurosurgeons who are new to this procedure.



OF67: Systematic stereotactic error reduction using a calibration technique in single-brain-pass and multi-track deep brain stimulation

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Keywords: Deep brain stimulation; stereotactic error; calibration technique; coronal approach angle; brain shifts; MRI distortion

Abstract:

Background: A calibration technique that adjusts frame coordinates from intended coordinates to correct systematic stereotactic error has been reported for single-brain-pass deep brain stimulation.

Objective: We analyzed the inter-center reproducibility of this method for deep brain stimulation.

Methods: In all, 310 leads from 166 patients operated on using the calibration technique were analyzed. There were 220 multitrack (mostly three-track) subthalamic nucleus leads, 17 single-brain-pass subthalamic nucleus leads, and 73 single-brain-pass globus pallidus interna leads. We adopted the previously reported calibration factors. Calibration shifts the frame coordinates from the target coordinates to left, anterior, and inferior directions by 0, 0.5, or 1 mm according to the arc angles in each axis. We analyzed 9 subgroups of single-brain-pass or multi-tracks, operated sides and technical and instrumental variations.

Results: In total, the stereotactic error decreased from 1.5 ± 0.8 mm in the distance to frame coordinates (error calculation before using the calibration technique) to 1.1 ± 0.6 mm in the distance to intended target coordinates (error after using the calibration technique, 28% reduction, p<0.001). Frame-related errors were 0.1-0.3 mm when measured with the stereotactic simulator. Reduction of stereotactic errors by the calibration technique (median 0.4 mm, 0.1-0.7 mm, median 28 %, 7-45 % in each subgroup) was significant in 8 of 9 subgroups (p < 0.05).

Conclusion: Calibration is an effective and reproducible method for reducing systematic stereotactic error not only in singlebrain-pass but also in multi-track deep brain stimulations and in both sides and various instrumental and technical conditions. Systematic stereotactic errors requiring calibration may be similar between DBS centers on the condition that errors from instruments, MRI distortions and brain-shifts are similar.

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OF68: Surgical treatment of drug-resistant epilepsies in Russian Federation

Authors:

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Keywords: epilepsy, surgery, Moscow, Russia

Abstract:

Purpose: To evaluate seizure outcomes in patients with drug-resistant epilepsy surgically treated in Moscow.

Methods: The study population included 117 patients with drug-resistant epilepsy. The patients underwent surgery between 01.01.2014 and 01.02.2017. Patients were followed up at 12 months after surgery. Surgical outcomes (Engel's classification), complication rate, MRI results, pathology findings were analyzed. Duration of epilepsy before surgery was notably long (17,59 years). Invasive EEG monitoring was made for 46 patients (39%). Average duration of invasive EEG monitoring was 100,42±40,7 hours.

Results: Temporal lobe epilepsy was diagnosed in 56 (48%) patients, generalized forms - 3 (3%) patients, temporal plus - 57 (49%) patients, parietal form – 1 patient. 31 (26, 5%) patients had bilateral lesions. These 117 patients had 117 surgical procedures: 97(83%) patients had anteriomedial temporal resections (AMTLE), 6 (5%) patients - AMTLE plus extra temporal resections, 3 (2,5%) patients had temporal tumor resections, one patient – amygdalohippocampectomy, one patient – DNET (dysembryoplastic neuroepithelial tumor) plus amygdalohippocampectomy resection, 4 (3,5%) patients – VNS and 3 (2,5%) patients – gamma-knife and 1 patient endoscopic transnasal resection of hypothalamic hamartoma and 1 patient - endoscopic transnasal tumor resection. Two (1,7%) patients had repeat surgery procedure because of failed surgery. Right resections were made in 39 patients (35%), left – in 71 (65%). The most common complication was hemianopsia 62 (56%), but in most cases it was asymptomatic for the patient. Forty five patients evaluated 12 months after surgery: 31 patients (67%) became seizure free: 21 patients (45%) – Engel Ia, 6 (13%) - Engel Ib, 4 patients (9%) – Engel Id. Twelve patients (26%) had - Engel II. The unsatisfactory results of treatment were noted at four patients (9%): one patient – Engel IIIa, and three patients (6%) - outcome Engel IVa. According to histological study the most common seizure-causing lesion was FCD (92%). In 40% of cases we saw a combination of focal cortical dysplasia with hippocampal sclerosis was seen in only three cases.

Conclusion: The three-year results in the surgical treatment of drug-resistant epilepsy demonstrate its efficacy and safety. 67% patients become seizure free.

OF70: Stereotactic radiosurgery for patients with ten or more brain metastases

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Keywords: Gamma Knife, SRS, Brain Metastases, Tumor Control,

Abstract:

Objective: To evaluate the efficacy of Gamma Knife radiosurgery (GKRS) as treatment in patients with 10 or more metastatic brain tumors.

Methods: Between February 2014 and January 2016, 20 patients were treated with GKRS for 10 or more brain metastases. We retrospectively analyzed the data from these patients, with survival and tumor control as primary endpoints. Brain volumes treated with 8 Gy and 12 Gy were measured to explore volume of treated tissue as a contributing factor to tumor control. Pre-treatment and post-treatment magnetic resonance imaging (MRI) studies were reviewed at intervals of 3 months, as were patient records on site.

Results: Of the 20 patients treated, 3 were excluded due to insufficient follow-up data. For the 17 included patients the median age was 61 (range 19-76). These patients were treated for a total of 323 tumors, with a median of 17 tumors per patient (10-34). The median survival for these patients was 12.5 months (1.3-16.9). Patient survival was censored at the time of data collection, and the true upper limit of survival is higher than recorded here. The mean percent of brain volume treated was 0.9, with a median of 0.41 (0.07 – 3.38). The mean percent of brain volume that received a dose of 12 Gy was 5.0 (0 – 21.0), and of 8 Gy was 9.0 (1.0 – 31.0). For each of the first three 3-month intervals, the median percent of tumor control was 97%, 96%, and 100%, respectively in the patients with available data.

Conclusion: GKRS effectively treats and controls brain tumors, even in patients presenting with 10 or more tumors simultaneously. The number of tumors initially present was not found to have a significant correlation with general tumor control.

OF71: Long term result of pallidal DBS for cervical dystonia

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Keywords: Cervical dystonia, Deep brain stimulation, Surgical treatment, Prognosis

Abstract:

Background: Dystonia has been treated well using deep brain stimulation at globus pallidus internus (GPi DBS). Dystonia can be categorized as two basic types of movement, phasic- and tonic-type. Cervical dystonia is the most common type of focal dystonia, and sequential difference of clinical outcome between phasic- and tonic-type cervical dystonia has not been reported.

Methods: Retrospective cohort of 56 patients with primary cervical dystonia underwent GPi DBS was included in this study. Age, disease duration, dystonia direction, movement types, employment status, relevant life events, and neuropsychological examinations were analyzed whether clinical outcomes following GPi DBS were affected by those.

Results: The only significant factor affecting clinical outcomes was movement types (phasic- or tonic-type). Sequential changes of clinical outcome showed significant differences between phasic- and tonic-type cervical dystonia. A delayed benefit was found both in phasic- and tonic-type dystonia.

Conclusion: The clinical outcome of the phasic-type cervical dystonia is more favorable than that of the tonic-type cervical dystonia following GPi DBS.

OF72: Deep brain stimulation of the caudal zona incerta: Stimulation induced side effects in relation to anatomy

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Keywords: Deep brain stimulation: Essential tremor: Caudal zona incerta: Posterior subthalamic area: Stimulation induced side effects: Probalistic stimulation maps

Abstract:

Background: In Essential Tremor (ET), Deep Brain Stimulation (DBS) targets the thalamic and/or subthalamic areas contralateral to the side of the body that's aimed to treat. However, some reports have also indicated ipsilateral effects of unilateral DBS for ET.

Objectives: To investigate the degree of ipsilateral effects from unilateral DBS in patients with ET.

Methods: A retrospective cohort of 49 patients (29 males) with unilateral Vim or cZi DBS for ET were evaluated using the Essential Tremor Rating Scale (ETRS) preop, at short term (\approx 1 year) and at long term follow up (\geq 2 years).

Results: Total ETRS was reduced from 50.2 at baseline to 21.9 at short term and 30.1 at long term follow up. Contralateral tremor (item 5/6) was improved from 6.2 to 0.6 and 1.3, respectively. Contralateral hand function (items 11 - 14) was improved from 11.1 to 2.7 and 4.9, respectively. No significant improvement was seen regarding ipsilateral tremor or hand function at short or long term follow up. At the individual level, a clear improvement was seen in a few patients also concerning ipsilateral items, but this did not seem to be consistent over time.

Conclusion: No significant improvement of DBS was seen on ipsilateral hand tremor or hand function in our material.

OF73: The effects of bilateral, continuous, and chronic Deep Brain Stimulation of the medial forebrain bundle in the Flinders Sensitive Line rodent model of depression

Authors:

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Keywords: neuromodulation, DBS, medial forebrain bundle, depression, animal model

Abstract:

Clinical trials of supra-lateral medial forebrain bundle (MFB) Deep Brain Stimulation (DBS) in treatment resistant major depressive patients have shown rapid and long-term benefits. However, the biological consequences of stimulation and its mechanisms are unknown. The Flinders Sensitive Line (FSL) rat is a validated animal model with identified short and long-term depressive-like phenotype.

Male FSL (n=10) and wild-type Sprague-Dawley (n=10) rats as Controls were used in the study. Animals were tested on a variety of tests probing mood/anxiety/exploration, cognitive and motor behaviors. FSL depressive-like phenotype was confirmed using the Forced Swim Test. The animals were implanted with bipolar stimulation electrodes in the MFB, and recovery was followed by 10 days of bilateral, chronic and continuous stimulation. Weight dynamics was assessed throughout the study and indicated similar growth rates although the FSL rats weighed approximately 20-25% less. MFB DBS had no impact on ultrasound calls emitted and the FSL rats continued to vocalize significantly less in the positive affect frequency compared to Controls. Similarly, stimulation did not influence the FSL's exploration level (Elevated Plus Maze), nor locomotion (Open Field), although it reduced their freezing behavior (Open Field). Importantly, MFB DBS improved cognitive performance (Double-H) compared to Controls by reducing the time required and the number of errors committed to complete a spatial task.

In summary, MFB DBS in the FSL animals affected certain types of behaviors but not others. Explorative and vocalization behaviors were not changed, but some aspects of cognitive performance such as speed and precision of memory recall were improved compared to both the unstimulated condition and the stimulated Controls. Future studies will focus on the mechanisms of action of MFB DBS, and in particular on the role of dopamine in the stimulation-dependent phenotype changes.

OF74: Spinal cord stimulation for central poststroke pain

Authors:

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Keywords: Spinal cord stimulation, Central poststroke pain, Neuromodulation

Abstract:

We previously reviewed clinical outcomes of spinal cord stimulation (SCS) in 30 patients with central poststroke pain (CPSP). In this paper, we updated clinical outcomes of SCS for CPSP with additional cases.

65 patients with CPSP underwent a puncture trial stimulation (mean age, 64 years old; mean pain duration, 46 months; 45 men and 20 women). Stroke lesions were located in the thalamus (n=29), lenticular nucleus (n=25), brainstem (n=7), and subcortex (n=4). We tested cervical stimulation in 46 patients and lower thoracic stimulation in 19 patients during a puncture trial. Clinical outcomes were evaluated with pain reduction in visual analogue scale (VAS). Puncture trial stimulation produced good pain relief (≥50% reduction in VAS) in 23 patients (35%), fair (30-49% reduction) in 13 patients (20%), and poor (<30% reduction) in 29 patients (45%). Permanent SCS devices were implanted in 24 patients (38%). After a follow-up period of at least one year, 16 of 22 patients reported fair or good pain relief, and mean reduction rate in VAS was 41%. Three patients with permanent implantation fell from fair or good pain reduction to poor during a follow-up period.

SCS was previously believed to be ineffective for CPSP on the basis of a few case series. However our clinical results indicate that SCS could modestly benefit patients with CPSP. SCS may have therapeutic potential for intractable CPSP considering the less invasiveness of SCS and the refractory nature of CPSP. The mechanism of pain relief provided by SCS are poorly understood in CPSP. According to previous neuroimaging and neurophysiological studies, modulation of spinal activity may affect brain-level activity in the central pain network. Further studies of SCS treatment for CPSP and investigating the mechanisms of SCS should be encouraged.

OF75: 2017: a year of multiple jubilee celebrations for functional stereotactic neurosurgery!

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Keywords: Stereotactic neurosurgery. Parkinson's disease. Deep brain stimulation. History. Anniversary

Abstract:

Objective: 2017 is the year when the WSSFN is holding its 17th Quadrennial Meeting. 2017 is also a jubilee year commemorating several major historical events (such as events that took place in 1917 or 1967, among others). The aim of this presentation is to investigate the significance of the number "7" in the field of functional stereotactic neurosurgery, and to highlight and summarise during this 17th meeting of the WSSFN, some major events pertinent to our field that deserve their jubilee anniversaries to be celebrated during 2017.

Methods: Major historical events of the last two centuries, which took place during a year terminating by the number **7** were reviewed. After excluding world historical events that had no relevance to functional neurosurgery, we identified three major events highly pertinent to functional stereotactic neurosurgery.

Results: In 1817, Mr. James Parkinson, fellow of the Royal College of Surgeons of England, had observed the behavior of six individuals and described his meticulous observations in a pamphlet published with the title "An Essay on the Shaking Palsy". Sixty years later, neurologist Jean-Martin Charcot from La Salpêtrière, bestowed upon this illness the name "La maladie de Parkinson". In 1947 a paper by Austrian Neurologist Ernest Spiegel and American Neurosurgeon Henry Wycis, titled "Stereotaxic Apparatus for Operations on the Human Brain" was published in Science. That paper marks the birth of Human stereotactic functional neurosurgery. In 1987, The Proceedings of the meeting of the ASSFN held in Montreal were published in Applied Neurophysiology, Volume 50; one paper in those proceedings, authored by biophysicist and neurosurgeon Alim-Louis Benabid and neurologist Pierre Pollak was titled: "Combined (Thalamotomy and Stimulation) Stereotactic Surgery of the VIM Thalamic Nucleus for Bilateral Parkinson Disease". This paper is universally considered as marking the birth of DBS.

Conclusion: In this year of 2017, at the 17th meeting of the WSSFN, the present authors aim to celebrate the 200 year anniversary of publication of "an Essay on the Shaking Palsy" (1817), the 70 year anniversary of the birth of human stereotactic functional neurosurgery (1947) and the 30 year anniversary of Deep Brain stimulation (1987). It seems that the number seven, as in the 7 wonders of the world and the 7 heavenly spheres, carries also a historical special significance for the field of stereotactic functional neurosurgery.

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OF76: Individual variations in the sterotactic position of prelemniscal radiations fiber components and its significance in the surgical treatment of Parkinson's disease patients

Authors:

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Keywords: Prelemniscal radiations, tractography, stereotactic surgery, Parkinson's disease, target localization

Abstract:

Objective: Raprl has been recognized as a target to treat the symptomatic triad of PD.The stereotactic location of DBS electrodes is not different in cases with excellent and suboptimal outcomes, which made us suspect that they were individual variations in the position of fiber components within the target.

Methods: We carried out a quantitative analysis of stereotactic position of fiber components at the Raprl in a group of 15 PD patients and 10 controls paired in sex and age, for a total of 50 hemispheres analyzed. Preoperative 3T MRI were obtained in T1 and T2 sequences axial sections, 1 mm thick without intersection space.Segmentation of sub thalamic area was performed manually to distinguish Raprl from neighbor structures.High resolution (0.25x0.25x0.25 voxel), DWI probabilistic tractography, with constrained spherical deconvolution, determined fiber composition, fiber crossing and fiber tracts highest density (HD) within Raprl.Stereotactic position of HD from each fiber component was analyzed for x, y and z distances and significance of variations estimated between right and left hemispheres in the same person and among individuals was evaluated by student "t" test and ANOVA. Distances were obtained in millimeters, thereafter they were standardized in relation to an AC-PC mean value for the group and by dividing AC-PC distance in 10ths and using the resultant units to measure distances.

Results: In all cases, 3 major fiber components of Raprl were identified:cerebellar-thalamic-cortical, Globus pallidum-pedunculo pontine and Orbital frontal-mesencephalic. All components had a point of HD of fibers. The stereotactic position of HD did not varied between right and left hemispheres in the same person. In contrast, variations of HD were significant for each fiber tract among subjects when distances were considered in millimeters. When distances were adjusted to a standard AC-PC distance mean value for the group, individual variations were significantly decreased to a volume of 3.36 mm in diameter that included all fiber tracts. The same occurred when distances were measured using units resulting from dividing AC-PC distance in tenths, with the advantages that this could be applied for different patient's populations.

Conclusion: Raprl position is better defined by DWI and CSD.Optimum target volume for lesions or DBS to include all fiber component in Raprl may be reduced to 3.36 mm diameter using standardization methods.

OF77: The Virtual Brain: biologically realistic network modeling merging structure and dynamics

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Keywords: Connectome, Hodology, Epilepsy

Abstract:

Over the past decade we have demonstrated that constraining computational brain network models by structural information obtained from human brain imaging (anatomical MRI, diffusion tensor imaging (DTI)) allows patient specific predictions, beyond the explanatory power of neuroimaging alone. This fusion of an individual's brain structure with mathematical modelling allows creating one model per patient, systematically assessing the modeled parameters that relate to individual functional differences. The functions of the brain model are governed by realistic neuroelectric and neurovascular processes and allow executing dynamic neuroelectric simulation; further modeling features include refined geometry in 3D physical space; detailed personalized brain connectivity (Connectome); large repertoire of mathematical representations of brain mapping including functional Magnetic Resonance Imaging (fMRI), Magnetoencephalography (MEG) Electro-encephalography (EEG) and StereoElectroEncephalography (SEEG). So far our large-scale brain modeling approach has been successfully applied to the modeling of the resting state dynamics of individual human brains, as well as aging and clinical questions in stroke and epilepsy. In this talk we will focus on the example of epilepsy and systematically demonstrate the individual steps towards the creation of a personalized epileptic patient brain model.

OF79: Burst or tonic stimulation? Results of a placebo controlled, double blinded, randomized study for the treatment of FBSS patients – 3y follow-up

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Keywords: SCS, burst, FBSS

Abstract:

Objective: Spinal cord stimulation is an established method for treatment of chronic pain in FBSS patients. In the last decades only tonic stimulation patterns were used to modulate the pain. There were several reports that indicate that burst stimulation offers other opportunities and advantages. The goal of this study was to evaluate the pain level during placebo stimulation, burst stimulation, 500 Hz tonic stimulation with tonic 40-50 Hz stimulation as a baseline and to show long-term outcome among this population.

Methods: The study was designed as a double blind, randomized, prospective, cross over study. 20 patients were enrolled and completed the study at the investigational site. The patients were randomized to one of six treatment sequences. Twenty patients with FBSS and a pre-existing SCS system each received 3 treatment allocations in random order for a period of 1 week: Tonic 500 Hz Stimulation, Burst Stimulation, and Placebo Stimulation.

Results: The primary outcome measure was overall pain intensity measured on a numerical rating scale (NRS), 6.9 (baseline) vs. 4.2 (tonic) (p<0.001), tonic vs. 2.08 (burst) (p<0.001). Secondary outcome measures were pain quality measured using the Short Form McGill Pain Questionnaire (SFMPQ). Additional data were collected relating to pain related disability measured using the Oswestry Disability Index (ODI). Mean overall NRS and SFMPQ scores were not significantly different between Tonic 500 Hz Stimulation and Placebo Stimulation. Although the lowest mean ODI score was observed under Burst Stimulation, no significant differences were found between the ODI categories. No adverse events occurred, and Burst Stimulation was significantly preferred by 17 patients (80%). Positive results sustained during the long-term follow up. After two years mean VAS score under burst stimulation was three (range 0-6) (p<0.001), one pat. died, one was lost for FU, one suffered from stroke and was switched off.

Conclusion: The lowest mean NRS and SFMPQ scores were observed under Burst Stimulation. For the Burst Stimulation treatment group, mean NRS and SFMPQ scores were significantly decreased compared with the other treatment groups. Overall, Burst Stimulation resulted in significantly better constant pain relief and improved pain quality during the 2y follow-up.

OF80: Global fiber tractography along propagation pathways of ictal epileptic activity in stereotactic stereo-EEG recording

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Keywords: Global fiber tractography, epilepsy, stereo-EEG

Abstract:

Objective: Focal epilepsy due to structural changes is a major cause of pharmaco-resistant epilepsy. Stereo-EEG recording enables the detection of the epileptogenic focus and propagation patterns of epileptic activity. The aim of the study was to precisely delineate structural pathways of early epileptogenic propagation defined by stereotactic electrode position by global fiber tracking and to evaluate the possible diagnostic value for presurgical assessment.

Methods: Seven patients with focal epilepsy undergoing invasive epileptological assessment were included in the study. Preoperative high-angular diffusion weighted images were acquired (61 directions) on a 3T MRI scanner and whole brain global fiber tracking was performed. Multiple temporal and extratemporal depth electrodes were placed (mean n=10/patient) in framebased stereotactic surgery. The electrode position was confirmed by post-operative MRI and stereo-EEG recording was performed. The exact electrode contact positions (total n=64) detecting the epileptogenic focus and the target points of early propagation were identified on the stereotactic treatment plan and were transferred into a MCP-based coordinate system. MRI T1w3D sequences were superimposed on color encoded DTI images, postprocessed for global fiber tracking and transferred into a common space using an in house software. Fiber tracts were extracted and connectivity was analyzed along the electroencephalographic propagation pathway. For control, fiber tracts originating in the epileptogenic lesion but without functional connectivity to randomly chosen contacts (n=28) were analyzed for structural connection.

Results: The exact localization of ictal epileptogenicity and delineation of fiber tracts by global fiber tracking reveals a significantly higher structural connectivity (47.2%) of the epileptogenic focus to regions of early propagation (p<0.001) compared to those without detected propagation (34.7%).

Conclusion: The analysis of functional and structural connectivity based on a high spatial accuracy and global tractography methods reveals a significantly higher connectivity along pathways of early propagation of epileptic activity. This method therefore proves to be promising for further investigation and may offer an additional diagnostic method for profound presurgical assessment.

OF81: Combined approach for large vestibular schwannomas: planned subtotal resection followed by Gamma Knife surgery in a series of 40 consecutive cases

Authors:

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Keywords: combined approach, radiosurgery, Gamma Knife, functional preservation, vestibular schwannoma

Abstract:

Background: The surgical management of large vestibular schwannomas (VS) yields a high risk for the facial and cochlear nerve functions. Gamma Knife radiosurgery (GKRS) allows optimal functional results in small- and medium-size VS, but cannot be used upfront in large VS because of the high rate of volume-related side effects.

Methods: To develop of a new treatment paradigm of combined approach with microsurgery and GKS, aiming at optimal functional outcome for the facial and cochlear nerves in patients with large VS (i.e. Koos grade IV). To perform planned subtotal resection followed by GKRS in a consecutive a series of patients with large VS.Data pertaining to patient characteristics, surgical and dosimetric features and outcome were collected prospectively at time of treatment and during the follow-up course.

Results: A consecutive a series of 40 patients was treated between 2010 and January 2017. The mean presurgical tumor volume was 12 cm³ (1.47-34.9). All cases had normal facial nerve function (HB I) before surgery, except for one who was in HB IV. Postoperative status showed normal facial nerve function (House-Brackmann grade I) in all patients. In a subgroup of 22 patients in which cochlear nerve preservation was attempted at surgery (patients with residual hearing before surgery), 21 of them (95.4%) retained residual hearing. Among them, 16 patients had normal hearing (Gardner-Robertson class 1) before surgery, and 13 (81.2%) retained normal hearing after surgery. The mean duration between surgery and GKRS was 6.2 months (4-13.9, median 6 months). The mean tumor volume at the time of GKRS was 3.6 cm³ (0.5-12.8), which corresponds to a mean residual volume of 31.4% (range 3.6-50.2) of the pre-operative volume. There was a tendency towards larger postoperative servation at the time of GKRS was 11.9 Gy (range 11-12, median 12 Gy). Following GKRS, there were no new neurological deficits, with facial and hearing functions remaining identical to that after surgery. The mean follow-up after surgery was 31 months (range 3-72).

Conclusion: Our data suggest that the management of large VS with planned subtotal resection followed by GKRS may yield an excellent clinical outcome with respect to retaining facial and cochlear nerve functions. Our results with this approach are comparable to those obtained with GKRS alone in small- and medium-size VS.

OF82: Early trigeminal nerve microstructure changes prognosticate long-term clinical outcome for trigeminal neuralgia after Gamma Knife radiosurgery

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Keywords: trigeminal neuralgia, radiosurgery, DTI, MRI, treatment

Abstract:

Background & Aims: Focal radiosurgery is an important treatment modality for trigeminal neuralgia (TN), a severe chronic neuropathic facial pain disorder. Despite extensive clinical use and high efficacy of Gamma Knife radiosurgery (GKRS) for the treatment of TN, a viable prognostic model has not been established. Using diffusion tensor imaging (DTI), we aimed to determine whether early trigeminal nerve microstructural abnormalities as a consequence of radiosurgery would predict long-term treatment response.

Methods: 3T magnetic resonance imaging data were acquired from 32 TN patients (20F, mean age 68.8±13.5 years), 6 months post-GKRS (range: 5-7 months). Tissue microstructure measures of fractional anisotropy (FA), axial, radial, and mean diffusivities (AD, RD, and MD, respectively) were extracted from the radiosurgical target area of the affected trigeminal nerve. The contralateral, asymptomatic nerve served as the control. Early, 6-month trigeminal nerve diffusivity data were compared with long-term clinical results. Patients were classified as responders if they achieved at least 75% reduction in preoperative pain for 12 months or longer following treatment.

Results: Based on clinical follow-up data, we identified 17 long-term responders and 15 non-responders. Radiosurgical target FA value at 6 months was predictive of long-term clinical outcome, demonstrating significantly lower FA in responders versus non-responders. FA of the asymptomatic nerve did not differ significantly between the two groups.

Conclusion: Early trigeminal nerve microstructural abnormalities as a result of radiosurgery successfully prognosticate long-term treatment response. Specifically, the lower FA of responders, which is indicative of disrupted nerve organization, prognosticates better long-term pain relief. DTI serves as a promising tool to assess the effects and prognosis of focal radiosurgery on the trigeminal nerve.

OF83: A novel method for stereotactic implantation neurosurgery based on individual rat coordinates derived from preoperative CT imaging coregistered to a stereotactic MR atlas

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Keywords: stereotaxy, implantation accuracy, neuro-imaging

Abstract:

Introduction: While brain implants in laboratory animals are becoming more and more sophisticated, implantation methods have not evolved over the last century. Stereotactic neurosurgery in humans has moved away from the use of atlases toward purely individual-based surgical planning, thereby improving implantation accuracy. The introduction of similar techniques in animal stereotactic surgery with a similar increase in implantation accuracy could result in (1) a reduction in laboratory animals needed; (2) less unnecessary suffering and time loss from surgeries and postoperative testing; and (3) a direct impact on the scientific results.

We aim to assess the differences in accuracy, time and costs between the conventional method and a new technique based on individual CT registered to an in-house developed CT atlas for stereotactic implantation of electrodes into rat brains.

Methods: In 24 male rats (289g Wistar, n=12; 424g Sprague-Dawley, n=12), pre-operative computed tomography (CT) imaging was followed by stereotactic implantation of 2 electrodes (1 per hemisphere), randomly targeting 4 targets. One electrode was implanted using the conventional technique (skull-flat positioning using bregma and lambda, atlas-based coordinates with bregma as origin), while the second electrode was implanted using a novel technique (skull-flat positioning using 2 individual CT-based landmarks, atlas-based coordinates recalculated from co-registration of the individual CT to an in-house developed CT atlas, with a third individually chosen CT-based individual landmark as origin). Next, the electrode tips were localized by a blinded assessor using ex vivo CT imaging.

Results: In Wistar rats, the dorsoventral offset at target was larger with the conventional vs. novel technique (0.9 vs. 0.1mm, P<.05). Similarly, in Sprague-Dawley rats, the dorsoventral offset at target was larger using the conventional vs. novel technique (0.7 vs. 0.0mm, P<.05). In the other orthogonal planes, the offsets did not differ.

With the novel technique, 47 minutes extra are needed for imaging and planning. The surgical procedure itself is not prolonged when using the novel technique.

The cost for obtaining the pre-operative CT was 7.5 euros per rat in our institution.

Conclusion: While being more time-consuming and expensive, preoperative CT-based individualized stereotactic implantation surgery in rats could result in a higher implantation accuracy relative to the intended target.

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OF84: Beta Band Analysis of Movement using Local Field Potential Recordings in STN During DBS Surgery in the Human Parkinson's Disease OFF State

Authors:

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Keywords: Local field potentials, Parkinson's, subthalamic nucleus, deep brain stimulation

Abstract:

Introduction: Local field potential(LFP) recordings from the subthalamic nucleus(STN) of the human Parkinson's disease(PD) state have shown characteristic beta frequency oscillations and harmonic bicoherence. We sought to further describe characteristic signatures of the PD OFF state by recording LFP activity both at rest and during repetitive hand grasp movement in PD patients undergoing DBS surgery.

Methods: LFPs were recorded from 10 hemispheres in 7 patients with PD during DBS lead placement within the STN. Following DBS lead insertion, recordings were performed for 2 minutes at rest and another 2 minutes with contralateral repetitive hand grasp movements. All recordings were performed in the OFF state. Recordings were transformed into the frequency domain via the fast Fourier transform(FFT). The power spectra was analyzed with particular attention to beta bands using Matlab software. While the power spectra represents the independent energies associated with oscillations at a specific frequency, it does not describe interactions between those frequencies. Bispectral analysis is a first order, non-linear descriptor of the strength of correlations between two frequencies and a third frequency which is the sum of the two analyzed frequencies. A significant bicoherence represents phase locking of the two frequencies. Beta oscillation power and bicoherence at each DBS contact were subsequently compared with the contact independently chosen for stimulation during programming.

Results: Predominance of low and high beta band frequencies(13-20 and 20-35 Hz respectively)was observed both at rest and during continuous active movement. Paradoxically, stronger beta-beta coupling occurred during active movement as opposed to rest in the PD OFF state, and this coupling correlated with the chosen contact for programming in 8 out of 10 hemispheres.

Conclusions: In patients with PD, beta band coupling that paradoxically synchronizes with movement may be a unique feature of the OFF state. This beta band activity may correlate with the most active DBS lead contact.



OF85: Deep brain stimulation of the H fields of Forel alleviates tics in tourette syndrome

Authors:

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Keywords: Deep Brain Stimulation, Tourette Syndrome, H fields of Forel, CSTC, pallidothalamic fibers

Abstract:

Deep Brain Stimulation constitutes a promising treatment option in the therapy of chronic, medically intractable Tourette syndrome. However, despite extensive research, the ideal target for optimal control of tics and comorbid symptoms is still under debate with many structures being neglected and underexplored. Based on clinical observations and taking into account the prevailing hypotheses of network processing in Tourette syndrome, we chose field H1 of Forel as a target for Deep Brain Stimulation in two patients suffering from chronic, therapy-refractory Tourette syndrome. Significant alleviation of tics, state and trait anxiety, depression, global functioning and quality of life was observed in the postoperative course in both patients. In one patient, deep brain stimulation furthermore yielded marked improvement of obsessive-compulsive symptoms. Stimulation related side-effects could be reduced to a minimum. Successful stimulation can be attributed to the central position of Forels fields both anatomically and functionally. Located within the posterior subthalamus, the H fields form a "bottleneck" comprising a dense concentration of thalamic afferents that carry sensorimotor, associative and limbic information from core anatomical structures to their respective thalamic nuclei. Functionally, the fields of Forel are embedded within the cortico-striato-thalamoor might consequently disrupt faulty information processing within the circuit by equilibrating reduced pallidal inhibitory control on downstream thalamic nuclei.

OF87: Hemi-Laryngopharyngeal Spasm (HELPS) Syndrome: The Discovery, Characterization, and Cure of a New Neurosurgical Condition

Authors:

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Keywords: neuro-laryngology, vagal nerve compression, laryngospasm, new indications

Abstract:

Objectives: We recently described the first case of a novel cranial neuropathy, hemi-laryngopharyngeal spasm (HELPS syndrome), that was successfully treated with microvascular decompression (MVD) of the Xth cranial nerve. We now provide data from n=5 patients to better delineate the common presentations of this condition and highlight the appropriate investigations and surgical treatment.

Methods: The clinical presentation, pre-operative investigations, intra-operative findings and long term follow-up of n=5 HELPS syndrome patients are presented.

Results: All five patients presented with a combination of choking & coughing. The intermittent but progressively severe throat contractions were lateralized in 4 of the 5 and corresponded with the side of vascular compression. The contractions typically lasted several seconds to several minutes and eventually occurred while sleeping. These episodes resulted in intubation (Patient 1), trachesotomy (patient 2), and loss of consciousness (patient 4). Unilateral Botulinum toxin injections in the throat reduced the severity of the spasms but did not change their frequency, duration or triggers. All five patients also complained of intermittent coughing in response to a 'tickling sensation' deep to their xiphisternum. Episodes of coughing were progressively more severe and eventually occurred at night. Botox did not influence the coughing. Other symptoms described by some but not all the patients included intermittent changes in their voice, sensation of tongue thickening, constant sense of circumferential throat tightness, and abdominal pain. Examples of pre-operative videolaryngoscopy will be shown and compared to intraoperative videolaryngoscopy during vagal rootlet stimulation. Pre-operative MRI will be compared with intraoperative video during MVD. The clinical outcomes will be presented highlighting the course of symptom resolution and surgical complications.

Conclusion: Our understanding of HELPS syndrome is rapidly evolving. We believe it may one day take its place amongst the well recognized neurovascular compression syndromes if other centers begin to recognize and treat this condition. Historically, patients with similar symptoms have been described in otolaryngology as having episodic laryngospasm – a condition thought to be either psychogenic or response to acid reflux. We hope to introduce this syndrome to our neurosurgical colleagues and urge them to educate and collaborate with the otolaryngologists.

CLINICAL TRIALS PRESENTATIONS

CT01: Phase I Trial of MR-guided Focused Ultrasound Blood Brain Barrier Opening in Early-to-Moderate Alzheimer's Disease

Authors:

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Abstract:

Despite decades of advances in the pathology, genetics and imaging of Alzheimer's disease (AD), there remain no effective treatments that significantly alter its natural history. Several late phase clinical trials, focused largely on amyloid beta metabolism and clearance, have unfortunately demonstrated no significant benefit in early AD patients. Recent work investigating bloodbrain barrier opening using MR-guided focused ultrasound (MRgFUS) in transgenic animal models has shown that repeated ultrasound administration coupled with microbubble-containing contrast can reduce plaque burden and reverse memory deficits. While the mechanisms underlying plaque clearance are under investigation, this image-guided, noninvasive technique appears promising. We have designed a phase I, pilot trial to investigate the safety and technical feasibility of temporary and reversible MRgFUS-mediated BBB opening in patients with early to moderate AD. Patients will have confirmed amyloid deposits based on PET imaging, and undergo two sessions of BBB opening in a staged fashion. Follow-up investigations will focus on safety, tolerability, technical feasibility, as well as structural and functional imaging. This trial represents the first attempt at focal, image-guided BBB opening in AD, with results used to design further studies to determine whether this technology, either alone or in conjunction with targeted therapies, can be of potential benefit for patients.

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CT02: Long-term results of posteromedial hypothalamic deep brain stimulation for patients with resistant aggressiveness

Authors:

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Abstract:

Object. Erethism describes severe cases of unprovoked aggressive behavior, usually associated with mental impairment and gross brain damage. Erethism is often refractory to medication, and patients need to be managed with major restraining measures. Deep brain stimulation (DBS) of the posteromedial hypothalamus (PMH) has been proposed as a treatment for resistant erethism, although experience with this treatment around the world is scarce. The objective of this study was to examine the long-term outcome of PMH DBS in 6 patients with severe erethism treated at the authors' institution.

Methods. Medical records of 6 patients treated with PMH DBS for intractable aggressiveness were reviewed. The therapeutic effect on behavior was assessed by the Inventory for Client and Agency Planning (ICAP) preoperatively and at the last follow-up visit.

Results. Two patients died during the follow-up period due to causes unrelated to the neurosurgical treatment. Five of 6 patients experienced significant reduction in aggressiveness (the mean ICAP general aggressiveness score was -47 at baseline and -25 at the last follow-up; mean follow-up 3.5 years). One patient experienced a marked sympathetic response with highfrequency stimulation during the first stimulation trial, but this subsided when stimulation was set at low frequency. A worsening of a previous headache was noted by 1 patient.

Conclusions. In this case series, 5 of 6 patients with pathological aggressiveness had a reduction of their outbursts of violence after PMH DBS, without significant adverse effects. Prospective controlled studies with a larger number of patients are needed to confirm these results.

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CT03: Clinical cognitive improvement and Positron Emission Tomography changes in patients who underwent deep brain stimulation in the hypothalamus for severe aggressivity behaviour but also with previous cognitive impairment

Authors:

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Keywords: Deep Brain Stimulation (DBS). Cerebral Positron Emission Tomography (PET). Hypothalamus. Aggressivity behaviour. Cognitive impairment. Modified Over Aggressivity Score (MOAS). Diagnostic Adaptive Behaviour Scale (DABS)

Abstract:

Background: Deep Brain Stimulation (DBS) of the hypothalamus has shown significant Improvement in agressive patients with a long and complex history of ineffective therapies. Some groups described case reports about it but we did not find described association between some learning skills and improvement in adaptive skills scale related with changes in Cerebral Positron Emission Tomography(PET).

Objective: To report the clinical follow-up in 14 patients who underwent DBS of the hypothalamus for severe and refractory aggressivity and improvement in adaptive skills scale related with changes in cerebral PET.

Methods:14 patients between 10-14 years old, 6 women and 8 men,with moderate and severe cognitive impairment,were evaluated by a multidisciplinary group, and after multiple failed treatments, and with the approval of the ethics committee were taken to surgery.12 of them had the Cerebral PET within one year before the surgery and so far 5 also have done that test within 18 months after the procedure.All of them have been evaluated by neuropsychology and psychology before and after surgery.Diagnostic Adaptive Behaviour Scale (DABS), Quality of Life(EQ-5D-5L), Modified Over Aggressivity Score(MOAS), were applied.

Results:The 14 patients have improved their adaptive skills scale by at least 60%,which has helped them to improve the functions in the activity of daily living according to the quality fo life scales(EQ-5D-5L) which has improved between 70-85% and(MOAS) improvement between 58-90%.5 patients underwent Cerebral PET showing homogeneity and diffuse increase in the metabolic activity for the cerebral cortex practically in all of the lobes, ganglia of the base, thalamus and subthalamic area. Same areas prior to surgery showed complete heterogeneity and decreased metabolism. Most common clinical skills that patients have been learned were going to the bathroom to do their needs such as urinating and defecating, eating by themselves,dressing alone, waiting, and those with greater cognitive impairment allow their caregivers to feed, clean and dress them without opposing.One of the patient is learning to read and write and another learned how to choose music and play it.

Conclusions: There is a relation between adaptative behaviour and Cerebral PET findings in relation with adaptative skills scale in patients who underwent DBS for extreme and refractory aggressivity. Further studies with increase number of patients and longer term follow-up should be carried out.

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CT04: The Neurosurgical Treatment of Spasmodic Dysphonia: Interim Results of DEBUSSY

Authors:

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Keywords: spasmodic dysphonia, dystonia, deep brain stimulation, DTI, PET, Phase 1 clinical trial

Abstract:

Objectives: Spasmodic dysphonia (SD) is a neurological speech disorder characterized by sudden, involuntary contractions in the laryngeal musculature during speech production. Since the 1980s, SD has been treated with Botox (BTX) injections into the throat, a therapy with several well-known limitations to the functional neurosurgery community. After extensive preliminary experiments, we launched a Prospective, Randomized, Double-Blinded, Cross-Over, Phase 1 Left Vim Thalamic DBS trial (DEBUSSY- DEep Brain stimUlation for SpaSmodic dYsphonia).

Methods: Institutional ethics (H15-02535) and clinicaltrials.gov (NCT02558634) registration were completed. Through our institution's laryngology clinic, n=6 isolated adductor SD patients with inadequate response to BTX were identified. Patients were excluded if they presented with dystonia in other body parts. The medial left Vim was targeted on pre-operative T1 imaging with intraoperative electrophysiological confirmation. Six weeks after surgery, patients were programmed over a 14-day a period in a variety of acoustic, stressful, and pragmatic conditions. A randomized, double-blind, three month cross-over trial was then conducted with patients receiving active treatment followed by sham or vice versa. The primary endpoints were the Unified Spasmodic Dysphonia Rating Scale (USDRS) and the Voice-Related Quality of Life (Vr-QoL), assessed in a double-blinded fashion at the 3 and 6-month mark.

Results: Interim results of our trial will be presented at the WSSFN meeting with details on target justification, kinetics of benefit/washout, programming strategy, and side effect profiles for DBS in SD. Interim imaging results of VTA, DTI, PET, and laryngoscopy will also be presented. Finally, the analysis of each unique component of SD (dystonic spasm, dystonic tremor, and muscle tension dysphonia) and its response to DBS will be presented.

Conclusions: Interim results of DEBUSSY suggest the left Vim is a promising target for SD despite its classification as a dystonia and speech disorder. Dystonia relating to jaw, eyes, tongue are clearly best treated with pallidal neuromodulation or ablation. However, to our initial surprise, dystonia of the larynx appears to require treatment of the cerebello-thalamic circuitry, likely related to the evolution of the speech motor neural networks. We provide a neurophysiological explanation of this phenomenon and highlight our future work in the emerging field of neuro-laryngology.

CT05: Predicting pain relief: The role of diffusion tensor imaging metrics as a pre-surgical tool for individualized prediction of response to trigeminal neuralgia surgery

Authors:

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Keywords: trigeminal neuralgia, diffusion tensor imaging, surgical outcome prediction, personalized medicine, machine learning, chronic facial pain

Abstract:

Introduction: Trigeminal neuralgia (TN) is a chronic neuropathic facial pain disorder with commonly excellent surgical response. A proportion of patients do not respond well and require frequent re-treatments. No imaging tools can currently predict treatment response, yet this would be of crucial value when considering further surgeries. We used diffusion tensor imaging (DTI) as a tool to determine whether pre-surgical trigeminal nerve microstructural diffusivities can predict clinical response to TN surgery.

Methods: 31 TN patients and 16 healthy controls were recruited for this study retrospectively. Multi-tensor DTI tractography allowed microstructural DTI metrics—axial, radial, mean diffusivity (AD, RD, MD), and fractional anisotropy (FA)—to be extracted from the trigeminal nerve cisternal segment, root entry zone and pontine segments bilaterally. TN patients were subdivided into responders and non-responders based on the presence of pain 1-year following TN surgical treatment (microvascular decompression or Gamma Knife radiosurgery). Differences in diffusivities between nerves and across response groups were assessed with false discovery rate-corrected Student's t-tests. Group-level diffusivity thresholds of long-term response were obtained through bootstrap resampling of ipsilateral diffusivities (n=2000). Individual-level prognosticator of measurements of AD and RD across all trigeminal nerve regions of interest.

Results: Non-responders were highlighted by abnormal pontine diffusivities. Three ipsilateral diffusivity thresholds of response separated 85% of non-responders from responders, two of which were thresholds based on pontine diffusivities. The DFA prognosticator of response was 83.9% accurate at separating responders from non-responders, discriminating equally well for both groups.

Conclusion: A highly predictive, individualized prognostication tool for clinical response to surgical interventions for TN can be constructed from pre-surgical trigeminal nerve DTI metrics. Diffusivity abnormalities within pontine segment of the trigeminal nerve are key features of non-responders to surgical interventions for TN, suggesting a more central role of pain in non-responders. Our study represents an important step towards a more objective, imaging-based personalized treatment of TN and prediction of pain outcome after surgery.

CT06: Enabling volitional motor control using spinal cord neuromodulation in a human patient with paraplegia

Authors:

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Abstract:

Severe spinal cord injury (SCI) leads to functional disconnection of ascending and descending spinal pathways, impairing neural circuitry through and below the SCI. An emerging therapy for enabling motor function following SCI is epidural electrical stimulation (EES). In SCI subjects diagnosed with ASIA-A or B, EES of the lumbosacral spinal cord was initially shown to drive non-volitional rhythmic motor circuitry. In a recent study, EES facilitated volitional control of joint-specific muscles and independent standing after months of training with EES. Although these findings were powerful, they have yet to be reported by other research teams. Therefore, the initial goal of this study was to replicate the findings from work performed at the University of Louisville that reported: 1) EES enabled volitional control of motor activity; 2) and EES enabled independent standing. In addition to the initial goal of replication, we set out to determine if EES could enable volitional control over rhythmic locomotor activity. We report a case of chronic traumatic paraplegia in which epidural electrical stimulation (EES) of the lumbosacral spinal cord enabled: 1) volitional control of task-specific muscle activity; 2) independent standing; 3) and voluntary control of step-like movements and rhythmic muscle activity. This is the first time the application of EES enabled all of these tasks in the same subject within the first eight sessions of EES.

CT07: A phase 1B trial evaluating the safety and feasibility of autologous peripheral nerve grafts in patients with Parkinson's disease

Authors:

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Abstract:

We present an open-label, Phase Ib trial examining the safety and feasibility of grafting autologous peripheral nerve tissue to target brain areas in patients with Parkinson's disease (PD). Grafts are harvested from sural nerve and deployed during routine DBS surgery. Peripheral nerve tissue was chosen because it contains Schwann cells, which transdifferentiate after nerve injury or transection to become "repair cells" for neural tissue. Immediately following DBS surgery (targeting STN or GPi) a 5mm section of sural nerve was excised, stripped of the epineurium, cut into 1 mm pieces, and unilaterally delivered into the substantia nigra (SN). Our primary endpoint is safety. Secondary endpoints include Unified Parkinson's Disease Rating Scale (UPDRS) scores and changes in DaTscan quantification. To date, 25 participants have received a single implantation to the SN, and 8 with two separate implants to the SN unilaterally. The overall adverse event profile is comparable to standard DBS surgery, with no serious adverse events related to the delivery of the graft. Seventeen participants who received a single graft to the SN have reached the 1 year time point and have demonstrated a decrease of 7.3 \pm 10.6 points (considered a moderate clinically important difference, mean \pm SD) in the UPDRS motor scores off medication and off stimulation compared to before surgery. Combining the delivery of cell therapy at the time of DBS surgery is beginning to show a good safety profile and positive preliminary clinical data that warrants further investigation.

CT08 : Real-time MRI-guided intraputaminal AADC gene therapy for advanced Parkinson's disease

Authors:

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Abstract :

In PD, loss of aromatic L-amino acid decarboxylase (AADC), which converts levodopa into dopamine, is associated with loss of oral levodopa effectiveness. We are evaluating the safety of AADC gene therapy in an ongoing Phase 1b clinical trial. To improve upon limited coverage of the anatomic target in prior studies, intraputaminal gene expression is achieved by intraoperative-MRI-guided co-infusion of AAV2-hAADC and gadoteridol. Fifteen subjects (N=5/cohort) with advanced PD received bilateral infusions of either a lower concentration (0.83x1012vg/ml), \leq 450 µl/putamen (cohort 1), \leq 900 µl/putamen (cohort 2), or higher concentration (2.7x1012vg/ml) \leq 900 µl/putamen (cohort 3). The infusion strategy evolved to maximize coverage of the putamen by modifying cannula design, altering the position of infusion sites along cannula trajectories, and increasing infusion volumes. These steps resulted in an increase in average infusate coverage of the putamen from 21% to 34% and 42% (cohorts 1,2 and 3, respectively). Infusions were well tolerated. Enzyme activity on 18F-dopa PET increased from 13% (cohort 1) to 56% (cohort 2). Imaging and clinical data are pending for cohort 3. We observed coverage-dependent reductions in dopaminergic medications and improvements in motor function in subjects who have reached 12-month follow-up, including: 10% (cohort 1) and 35% (cohort 2) reductions; 1.6-hour (cohort 1) and 4.1-hour (cohort 2) increases in on-time without troublesome dyskinesia. Real-time-MRI-guided delivery allows modification of infusions that maximize target coverage and potential coverage-related clinical benefits.

CT09: Deep Brain Stimulation for Treatment Resistant Depression Clinical Trial

Authors:

Albert Fenoy (1)

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Abstract:

Currently, we have open an FDA-approved clinical trial for patients with treatment resistant depression to undergo deep brain stimulation (DBS) of the medial forebrain bundle (MFB); our interim analysis of this study shows encouraging results (Fenoy et al., 2016).

Patients are considered candidates if they meet Inclusion Criteria: (a) Major depression, severe, unipolar, diagnosed by Structured Clinical Interview for DSM-IV, judged to be of disabling severity; (b) Hamilton Depression Rating Scale (HDRS) score > 21; (c) Montgomery- Asburg Depression Rating Scale (MADRS) score > 21; (d) Global Assessment of Function (GAF) score of < 45; (e) a recurrent (>4 episodes) or chronic (episode duration >2 y) course and a minimum of 5 y since the onset of the first depressive episode; (f) age 22-65 y; (g) refractory to > 6 weeks of multiple medication regimens; (h) refractory to > 20 sessions psychotherapy; (i) refractory to a trial of ECT.

Exclusion criteria are as follows: (a) current or past non-affective psychotic disorder, schizophrenia, or schizo-affective disorder; (b) severe personality disorder; (c) significant neurological disorder; (d) previous surgery to destroy the target region of the brain; (e) surgical contraindications to DBS.

Candidates who meet such criteria will then undergo placement of DBS electrodes into the bilateral MFB. Participants and clinicians performing behavioral assessments will be blinded to onset of stimulation, which will occur four weeks after implantation. Behavioral assessments will occur weekly for 52 weeks. MADRS is the primary outcome measure. For more information, visit ClinicalTrials.gov (identifier: NCT02046330).

CT10: Combined Anterior and Posterior Lumbar Rhizotomy for Treatment of Mixed Dystonia and Spasticity in Children with Cerebral Palsy

Authors:

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Abstract:

BACKGROUND:

Children with cerebral palsy (CP) can present with severe secondary dystonia with or without associated spasticity of their extremities.

OBJECTIVE:

To assess the outcomes of combined anterior and posterior lumbar rhizotomy for the treatment of mixed hypertonia in the lower extremities of children with CP.

METHODS:

Fifty children with CP were subjected to combined anterior and posterior lumbar rhizotomies in a prospective study. Clinical outcome measurements were recorded preoperatively and were evaluated at 2, 6, and 12 months postoperatively. The operative techniques were performed by laminotomy from L1- S1, and intraoperative monitoring was used in all cases. All patients underwent intensive postoperative physiotherapy programs.

RESULTS:

Changes in muscle tone, joint range of motion, and dystonia were significant (P = .000) at postoperative assessment visits. CONCLUSION:

This study demonstrated the potential of combined anterior and posterior lumbar rhizotomies to improve activities of daily living in children with CP and with mixed spasticity and dystonia.

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POSTERS

P001: Predictive factors of unfavorable events after gamma knife radiosurgery for vestibular schwannoma

Authors:

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Keywords: Complication, Gamma Knife Surgery, Hearing Preservation, Hydrocephalus, Predictive Factor, Pseudoprogression, Vestibular Schwannoma

Abstract:

Objective: Gamma knife radiosurgery (GKS) for the treatment of vestibular schwannoma (VS) introduces risks to the facial nerve and auditory perception, and may involve post-treatment complications such as pseudoprogression, hydrocephalus, and other cranial neuropathies. This study of patients with VS who underwent GKSinvestigatedradiosurgical results, focusing on post-treatment complications and identifying the factors that predict such complications.

Methods: We undertook a retrospective review of all VS patients treated with the PerfexionLeksellgamma knife between November 2007 and October 2010 at our institution. Patients who had a minimum of 12months of clinical and radiological assessments before and after GKS were included.

Results: The 5-year serviceable hearing and facial nerve preservation values were 84.9% and 94.3%, respectively. Following GKS, 43 patients (18.30%) showed pseudoprogression, 15(6.38%) exhibited hydrocephalus, 22 (9.36%) showed trigeminal neuropathy, 14 (5.96%) showed vertigo or balance disturbances, and 25 (10.64%) showed facial myokymia. According to multivariate analysis, solid tumor nature was significantly associated with pseudoprogression and patient age was significantly associated with hydrocephalus. Patients receiving margin dose \geq 13Gy or who underwent no prior surgical resection had a significantly higher probability of loss of serviceable hearing.Patients with smaller tumors had a trigeminal nerve preservation rate comparable to patients harboring larger tumors. Patients receiving margin dose < 13 Gy or older patients had a significantly higher probability of vestibular nerve dysfunction.

Conclusions:

Further prospective studies should be designed to provide further insight into the exact relationship between the predictive factors we investigated and post-treatment complications.

P002: Deep brain stimulation as novel approach for Alzheimer disease: the emerging ethics of research rationale

Author:

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Keywords: Research Ethics, Deep Brain Stimulation, Alzheimer Disease

Abstract:

Question: Deep brain stimulation (DBS) has been investigated as potential intervention into the disease progression of Alzheimer's disease (AD). There is an urgent need for improvement of existing dementia treatments. Any new investigational approach should adhere to high ethical requirements in order to protect participants' safety with regard to uncertainties like unknown risk of side effects and adverse events. The assessment of such unknown risks is best conceived on a continuum from conservative protectionism to experimental adventurism (certainty-uncertainty continuum). Protectionism may impede scientific progress and can harm patients by hampering the development of new and better treatment possibilities. Because DBS involves (narrowly restricted) craniotomy, it belongs to "Class III" of medical devices implying "high risk" according to regulation by the European Parliament. This coarse classification into three classes (I, II and III) is unlikely to decompose the certainty-uncertainty continuum adequately into distinct categories. Other relevant features need also to be considered. Due to its reversibility and minimal-invasiveness, DBS paves the way for emerging new technologies and indications, although ethical justification of research rationale relying on conclusive evidence remains key. We recommend a linear relationship between risk and evidence: the riskier a novel approach, the higher the demands on quality criteria used to assess some research hypothesis.

Methods and results: We searched systematically (EMBASE and MEDLINE) for data on DBS for DBS (preclinically, case studies, investigational trials or feasibility studies and reviews), assessed the findings, and rated the published material according to established standards (AMSTAR-Checklist, Cochrane levels of evidence).

Conclusion: The first aim was to evaluate the research rationale for DBS of AD by examining the uncertainties associated with DBS' mechanism of action, target selection and stimulation parameters specific to AD symptomatology and pathomechanism. The second aim was to classify the unknown risks and uncertainties on the basis of standardized criteria and the expert's views held in the scientific community. Since the responsibility for novel investigational clinical trials is shared among ethics committees, researchers involved, and patients and caregivers affected, this classification will facilitate evidence-based decision-making and thus promote patients' informed consent.

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P003: Shortening of battery-life of Activa-PC-generators in Deep Brain Stimulation under use of adaptors?

Authors:

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Keywords: Deep brain stimulation, IPG, Activa-PC, Kinetra, battery-life, adaptor

Abstract:

Objective: The operative change of generators after DBS-surgery is necessary after several years, especially in patients with non-rechargeable generators. Since 2008 the new generation of Medtronic generators is available and the non-rechargeable Activa-PC replaced the Kinetra. The change from Kinetra to Activa-PC in patients who need new generators requires an adaptor when extension cables are not changed. From a clinical view the hypothesis was generated that the battery-life of Activa-PC generators is reduced under use of an adaptor. The aim of this study was to verify this.

Methods: We retrospectively investigated patients suffering from Parkinson's disease, dystonia and tremor who had an implantation of DBS electrodes and generators in our department. We investigated times from first-implantation to change or from change to change before and after change to Activa-PC with adaptor. The battery-lifes data were compared by Wilcoxon test.

In a second step the total electrical energy delivered was calculated for each patient before and after the change to Activa-PC with adaptor. Data were again compared by using Wilcoxon test.

Results: In our department up to now 20 patients who got an Activa-PC generator connected with an adaptor had a change of their new generator. One of these patients could not be included in further investigations. From the 19 patients 16 were suffering from PD, one from tremor and two from dystonia. The mean durability of the Kinetra generator was $54,58 \pm 13,77$ months and $29,31 \pm 5,84$ months of the Activa-PC generator with adaptor. Differences were significant using Wilcoxon test (p = 0,000276). In order to reveal reasons for this shortening of battery-life, stimulation parameters were compared. In 16 patients stimulation parameters were documented. As the impedance was not available for all patients the total electricity delivered per impedance was calculated. For the Kinetra generator TEED/impedance was $290,5834 \pm 96,6859$ mW * Ω and for the Activa-PC 293,7803 \pm 95,0821 mW * Ω . Differences were not significant using Wilcoxon test (p = 1).

Conclusion: A shorter durability of Activa-PC generators under use of adaptors was seen in this study. This could not be reasoned by higher stimulation parameters. Patients have to be informed that durability of generators is shortened under use of adaptors. This might lead in some cases to a recommendation of rechargeable systems or to a change of the extension cables during the exchange of the generator.



Boxplot of durability of generators. *** p ≤ 0,001. ¹ Kinetra. ² Activa-PC with adaptor.

P004: Usefulness of segmented leads in anatomical variants of the brain

Authors:

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Keywords: DBS, Segmented Leads

Abstract:

Introduction: Deep Brain Stimulation is an established treatment modality in various movement disorders including dystonia. Due to the close proximity of the most common target point (GPi) to critical functional structures as the optic tract and the internal capsule, therapeutic yield might be limited by side effects. Recently, segmented DBS leads have been made available. This technique comes with the promise of increased efficacy and side effect reduction. We hereby report on the first case of dystonia treated with directional lead deep brain stimulation.

Materials/Methods: A 31 year old female presented with a 20 year history of generalized dystonia. The severe additional ataxic component left her wheelchair bound and she suffered from severe dysarthria. The neurological complex was proven caused by isolated Vitamin Ē deficiency thought to be а syndrome. MRI revealed structural changes of the basal ganglia anatomy with anatomical distortions the left (Image 1). Standard coordinates did pronounced on not match the individual She anatomy of the patient. therefore underwent bilateral GPi DBS surgery using direct targeting of the left GPI. Directional leads were implanted in both hemispheres.

Results: After calculation of standard AC-PC coordinates (3.5 mm anterior, 22.0 mm lateral and 4.0 mm below MCP) the trajectory was adapted guided by MRI anatomy to the lateral border of the optic tract. The posterior communicating artery took a atypical course above the optical tract further limiting the approach. Targeting was guided by three micro electrode recording tracts and a directional lead system (Vercise DBS, Boston Scientific) was implanted in an all-in-one GA setting. Conventional stimulation caused a fast worsening of the dysarthria and painful stimulation induced side effects. The segmented contacts were intensively tested at 90µs and 130 Hz in the postoperative course. Distinct effect/side-effect patterns for each contact were observed.

Conclusion: Segmented leads allowing current steering offer new perspectives for DBS and will likely result in increased treatment efficacy while reducing side effect at the same time. While this is true for well known disorders and their targets (PD, generalized dystonia) this technique also yields the potential to treat disorders currently not amendable to DBS as no good benefit/side-effect ratio could be achieved with conventional DBS.

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P005: Dissociation between effect of STN-DBS and dopaminergic responsiveness 10 years after STN-DBS surgery

Authors:

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Keywords: STN-DBS, Dopamine, 10 years

Abstract:

Objectives: Subthalamic deep brain stimulation (STN-DBS) has been presumed closely related to dopamine system. Levodopa responsiveness has been discussed as an important predictor for success of STN-DBS for Parkinson disease (PD). However, the long-term outcome of the relationship between STN-DBS and levodopa responsiveness are still unclear. It is well known that lebodopa responsiveness for PD will fall year by year, but it is unclear whether STN-DBS responsiveness also falls in accordance with the fall of levodopa responsiveness. We tried to clarify whether STN-DBS responsiveness for PD also falls as levodopa responsiveness more than 10 years after surgery.

Methods: We compared UPDRS part III scores in four different conditions with or without medication or DBS in seven PD patients who received bilateral STN-DBS and followed up more than 10 years. Levodopa infusion test was also carried out in six of these patients.

Results: STN-DBS showed statistically better improvement (17.2±7.5 points) in UPDRS part III score compared to medication (4.2±4.0 points). STN-DBS also showed better improvement (18.0±8.1 points) in UPDRS part III score compared to levodopa intravenous infusion (6.4±4.3 points). Two patients developed hallucination and one patient developed facial dystonia after levodopa infusion.

Conclusions: It showed dissociation between STN-DBS responsiveness and levodopa responsiveness more than 10 years after surgery. It also suggested that mechanisms of STN-DBS may isolated from dopamine system.

P006: Deep Brain Stimulation in Parkinson's disease: short pulse width increases the therapeutic window and the total energy delivered

Authors:

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Keywords: Deep Brain Stimulation; Parkinson's Disease; Pulse Width; Therapeutic Window; TEED

Abstract:

Objectives: We investigated the effect of short pulse width on the therapeutic window in Parkinson's disease patients with deep brain stimulation in the subthalamic nucleus (STN).

Methods: Five pulse width values ranging from 10 to 60 microseconds were applied randomly, in a double blinded fashion, during a single programming session. Ten patients with Vercise DBS leads, Boston Scientific, were included at least 3 months after surgery. The principal outcome was the therapeutic window, i.e. the difference between the amplitude threshold for pyramidal side effects (tolerance threshold) and the amplitude threshold for rigidity suppression (efficacy threshold). The secondary outcome was the total electrical energy delivered (TEED) by the neurostimulator on different pulse width values.

Results: The therapeutic window widened when pulse width decreased, with increasing tolerance and efficacy thresholds. The widest therapeutic window was obtained at 20 microseconds. In order to achieve the same clinical efficacy at 20 microseconds as at 60 microseconds, the total electrical energy delivered (TEED) was increased.

Conclusion: This double-blinded study confirms that low pulse width widens the therapeutic window. Nonetheless, TEED is increased to reach clinical efficacy when pulse width is shortened. Therefore, in routine post-operative management, we advocate for lowering the pulse width only if the therapeutic window is narrow, but not systematically.

P007: Comparison of battery-life of non-rechargeable Generators in Deep Brain Stimulation- Kinetra versus Activa-PC

Authors:

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Keywords: Battery-Life, DBS, Generator, Kinetra, Activa-PC

Abstract:

Objective: The operative change of non-rechargable generators after DBS-surgery is necessary after several years. Since 2008 a new generation of Medtronic generators is available and the non-rechargeable Activa-PC replaced the Kinetra. From a clinical view the hypothesis was generated that Kinetra has a longer battery-life than Activa-PC. The aim of this study was to verify these findings.

Methods: We retrospectively captured the battery-life of every single patient after implantation of DBS electrodes and generators between 2005 and 2012 in our department due to Parkinson's disease and compared the battery-life of the Kinetraand the Activa PC groups. To calculate the current usage, the total energy delivered (TEED) was estimated for each patient using stimulation parameters one year after electrode implantation and compared the TEED in both groups.

Results: 192 patients could be included in the study, among those 105 with Kinetra generators and 86 with Activa-PC generators. The mean battery-life of the Kinetra was significant longer $(5,439 \pm 0,199 \text{ y})$ than of the Activa PC $(4,438 \pm 0,165 \text{ y})$ (p = 0,023).

The mean TEED without impedance for the Kinetra group was 219,9031 ± 121,5310 mW * Ω and for the Activa-PC group 145,1321 ± 72,6729 mW * Ω , which implied significant lower stimulation parameters in the Activa PC group (p = 0,00038).

Conclusion: A significant shorter battery-life of the new generator Activa-PC in comparison to the older model Kinetra was shown. Since higher battery consuming stimulation parameters as a reason could be excluded, a shorter battery-capacity is probable. Reasons for this e.g. the smaller size of the new implant, new functions or other causes could not be revealed by this study.


P008: Usefulness of intraoperative neurophysiological monitoring in pallidal deep brain stimulation surgery in paediatric patients

Authors:

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Keywords: DBS, Deep Brain Stimulation, Pallidal, Dystonia, Intraoperative Neurophysiological Monitoring

Abstract:

Objectives: Internal pallidal nucleus stimulation surgery for the treatment of dystonia is performed under general anesthesia in paediatric patients. The recording of evoked activity in the visual and motor cortex by intraoperative stimulation of the therapeutic electrodes could be useful to optimize their localization.

Methods: We perform intraoperative electrical stimulation through the cerebral electrodes according to the usual therapeutic parameters while recording motor cortical and visual evoked activity. We collect the intensity in wich capsular and visual responses appear. We search for a possible correlation between the intraoperative findings and the response after the activation of the system.

Results: Five patients aged between 7 and 16 years old have been operated. Visual evoked response was obtained in all of them at an intensity between 1 and 6 volts. Involvement of the internal capsule has been recorded in four of them between 4 and 6 volts. We did not change the location of the electrodes despite these findings. Postoperative CT monitoring showed the placement of the electrodes according to preoperative planning. In the patients that intraoperative motor stimulation was obtained, a lower threshold of adverse effects due to internal capsule involvement was observed in the postoperative period. In all cases we solved this using higher contacts for therapeutic stimulation.

CONCLUSIONS: Intraoperative neurophysiological monitoring may be useful to optimize the location of the internal pallidal electrodes and to predict the stimulation window due to its proximity to the internal capsule.

P009: Neuromate®(Renishaw®) robot assisted pallidal stimulation surgery in paediatric patients: accuracy and clinical results. Initial experience

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Keywords: DBS, Pallidal Stimulation Surgery, Dystonia, Robot Assisted Surgery, Neuroate, Renishaw

Abstract:

Objectives: We have initiated a pallidal stimulation program for the treatment of paediatric patients with dystonia. For the implantation of the cerebral electrodes we use the Neuromate® (Renishaw®) robot without associating a stereotactic frame. We intend to verify the accuracy of the robot for this technique and the effectiveness of it.

Methods: We prospectively collect the distances between the electrodes and their respective planned trajectories merging the postoperative CT with the preoperative plan. We record the clinical results comparing preopeative and postoperative BFM (Burke-Fahn-Marsden) and UMRS (Unified Motor Rating Scale) scales and the complications derived from "hardware" and from stimulation.

Results: We have operated five patients with ages ranging from 7 to 16 years, three with primary dystonia and two with myoclonus-dystonia (SGCE), with a follow up from 0 to 10 months. The average precision in the placement of the electrodes has been 1mm at the target level. In all cases there has been a clear clinical improvement as well as a significant reduction in the motor (62-73%) and functional (53%) BFM scale in the dystonic patients, and in the UMRS scale for action myoclonias (90%). Also functional tests (62.5%-72%) in the patients with myoclonus due to SGCE mutation. There have been no hardware-related complications. In the first operated patient with primary dystonia dysartria limits intensity of stimulation in lower contacts of right electrode. This is the only complication derived from stimulation, probably due to medility of the electrode.

Conclusions: The Neuromate®(Renishaw®) stereotactic robot is an accurate tool for the placement of internal pallid electrodes in children with movement disorders. This is an effective and safe technique for the treatment of these entities.

P010: Use of Multiple Trajectories in Deep Brain Stimulation (DBS) of the Nucleus ventralis intermedius (VIM)

Authors:

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Keywords: DBS, Nucleus Ventralis Intermedius, Trajectories

Abstract:

Objective: Meanwhile the DBS targeting the VIM region is a standard procedure for the treatment of medical refractory tremor. In difference to other target points a direct visualization of the VIM in standard MRI's is not possible. Therefore the intraoperative testing of symptoms is essential. For essential tremor data for clinical outcome in larger series exist, for other indications only case reports or small series were published. Indications, intraoperative methods and the optimal target are under discussion. The aim of this study was, to control our advancement for this target point.

Methods: We retrospectively analyzed data of all patients, who have undergone DBS-surgery with targeting the VIM, in our department from 2008 until 2016. We recorded age, gender, indications for surgery, number of microelectrodes, trajectory for the permanent electrode, intraoperative reduction of symptoms, reasons for avoiding the central trajectory, the coordinates of the active contacts of the permanent electrode and compared these data with the clinical outcome. Surgeries were all performed under local anesthesia with MRI-planning and intraoperative micro recording and testing of symptoms.

Results: In the 9 years period 89 DBS-surgeries targeting the VIM were performed, indications for surgery were Essential Tremor 68.5%, MS-Tremor 15.7%, PD-Tremor 4.5%, Orthostatic Tremor 3.4%, Holmes Tremor 2.2%, and other Tremor minorities 5.6%. Mean age of the patients was 61 years ± 14.7 years (range 15 years to 81years). Bilateral stimulation was performed in 83 patients (93.2%), unilateral in 6 patients.

Within the 172 implantations of VIM-electrodes we were able to use 3 or more microelectrodes for a three-dimensional view in 76.2%, 2 in 14.5%, 1 in 4.1% and no microelectrodes in 5.2%, regarding an individual risk evaluation. For the permanent electrode the central trajectory was chosen in 60.5% 39.5% were implanted over periphery trajectories. Reasons were a better effect (14.7%), less side effects (27% left and 14.6%) or sometimes a combination of both (23.6%) with sometimes just slight differences.

A good reduction of the symptoms was mainly shown intraoperatively (range from 20% effect up to 100% tremor reduction) and was compared to the symptoms reduction under permanent stimulation.

Conclusion: For the optimal outcome of the patients the intraoperative testing of the tremor symptoms over multiple trajectories is an essential addition to the MRI-based target planning.

P011: Brain shifts during deep brain stimulation found on immediate post-operative magnetic resonance image

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Keywords: Brain shift, Pneumocephalus, Deep brain stimulation

Abstract:

Introduction: Brain shift during deep brain stimulation (DBS) surgery result in mistargeting of electrode especially at second electrode insertion. Leakage of cerebrospinal fluid (CSF) is thought to be a cause of brain shifting.

Methods: Fourty five patients who took immediate magnetic resonance image (MRI) after DBS were retrospectively reviewed. Their air volume which represent leakage of CSF were segmented and calculated by 3D-slicer. Stereotactic coordinates of anatomical structures of anterior commissure, posterior commissure and structures that visualize better in MRI which represents location of common DBS targets (anterior thalamic nucleus (ATN), globus pallidus interna (GPi and subthalamic nucleus (STN)) are measured by Surgiplan software.

Results: Mean air volume measured was 14.7 cc. Brain shifting was most prominent in y axis (every structure, <0.01) and shift of more than 1mm in vector were seen in AC, ATN and both STN. Air volume was most contributing factor for brain shifts. Other factors such as sex, age, diagnosis for DBS, and operation time did not show significant relation in most targets. However, age seems to be related with air volume (p=0.086) and operation time showed trend toward increasing air volume (p=0.082). No significant difference was seen related to diagnosis of patients for DBS (p=0.104).

Conclusion: Though we failed to show operation time nor air volume result in brain shifting, brain seems moving toward direction of gravity. If operating elderly patients and taking long operation time, more posterior the actual target would be located.

P012: Does deep brain stimulation impair swimming performance: A randomized crossover study

Authors:

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Keywords: Deep Brain Stimulation, Movement Disorders, Drowning Hazard, Swimming

Abstract:

Objective: A stimulation-induced drowning hazard has recently been described in a patient with Parkinson's disease, who developed a profound inability to swim following treatment with deep brain stimulation (DBS) at the posterior subthalamic area. The impairment was present despite normal neurological examination, and was reversible with withdrawal of stimulation. This study aimed to systematically determine whether DBS impairs swimming ability in a larger patient cohort.

Methods: 18 participants (including index case) with Parkinson's disease (n=13), essential tremor (n=3), Tourette's syndrome (n=1) or post-traumatic brain injury proximal tremor (n=1), treated with posterior subthalamic area (n=15) or globus pallidus interna (n=3) DBS, were assessed in a randomized, double-blind crossover study. Ability to swim with DBS ON versus OFF was compared within each participant, during three trials of freestyle and breaststroke, in a standardized pool environment. Outcome measures were distance covered, lap time, and Aquatic Skills Proficiency Assessment (ASPA) score.

Results: Paired-sample t-tests showed no statistically significant effect of stimulation status on measures of swimming ability for freestyle or breaststroke. However, clinically observable changes were seen in three participants. The index case displayed severe persisting impairment in all measures of swimming ability with DBS ON, which normalized with DBS OFF. With stimulation ON, the index case's freestyle trial time increased by 54% (±2.0), distance covered reduced by 40% (±10.0), and ASPA score reduced by 69% (±0.0). The impairment predominantly involved difficulty with limb coordination and postural control, rendering him unable to swim effectively. Two participants showed clinically observable improvements in trial time and ASPA scores with DBS ON during freestyle and breaststroke.

Conclusion: The index case demonstrated that DBS can induce a serious and persisting swimming impairment that is not evident during routine neurological assessment. However, systematic analysis revealed no significant swimming impairment in other participants with DBS (n=17). There were no discernable features unique to the index case regarding pathology or stimulation site. Patients should be informed that DBS may rarely worsen swimming ability to a level affecting safety, and that DBS is unlikely to improve swimming above pre-DBS baseline.

P013: Learning more about the optimal anatomical position for deep brain stimulation in essential tremor patients: 3D visualisation of intraoperative stimulation test results

Authors:

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Keywords: Deep Brain Stimulation, Essential Tremor, Simulations, Intraoperative Visualization

Abstract:

Introduction: The outcome of deep brain stimulation (DBS) depends heavily on the position of the implanted lead. After a preoperative anatomical planning, most groups collect numerous intraoperative data such as therapeutic effects induced by stimulation tests. To choose the final implant position, physicians "mentally" visualise all available data. The aim of the present work was to develop a method visualising intraoperative stimulation test results, patient's images, electric field (EF) simulations for the patient-specific stimulation conditions and the corresponding therapeutic effects quantitatively evaluated by accelerometry. The application to five essential tremor (ET) patients should give a first idea about the optimal target position.

Methods: In Clermont-Ferrand University Hospital the anatomic target structure and the neighbouring structures were manually outlined, a target and a trajectory defined and two parallel trajectories per hemisphere intraoperatively evaluated. Stimulation tests were performed at 7 to 8 positions per trajectory and several stimulation current amplitudes. The therapeutic effect was evaluated using a previously published method based on accelerometry. Finite element models and simulations were performed for up to three stimulation amplitudes per position and EF isosurfaces (0.2V/mm) were extracted. For the 3D visualization of the numerous overlapping isosurfaces, we generated "improvement maps" by assigning to each voxel within the isosurfaces the highest tremor improvement. Those maps were visualized together with anatomical images, delineated structures and trajectories (Paraview, Kitware Inc). The method was applied to 5 ET patients implanted in the ventro-intermediate nucleus of the healamus (VIM). Results were analysed by the neurosurgeon regarding the optimal implant position.

Results: The clinical teams were able to identify the optimal implant position for all patients with more ease and in less time compared to the routine discussion using pen and paper. Additionally, for 7 of the 9 improvement maps, the highest improvement region was found to be in the posterior subthalamic area, inferior and posterior to the VIM.

Conclusion: Improvement maps assist the clinicians in determining the optimal implant location of the chronic DBS lead. Results support findings of other studies that the fibre tracts in the posterior subthalamic area like prelemniscal radiations may be responsible for alleviating tremor in ET patients.

P014: Combining tractography-based cortico-subthalamic connectivity and electrode position to inform post-operative management of stimulation settings

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Keywords: DWI, Tractography, DBS, STN

Abstract:

Diffusion-Weighted Imaging (DWI) and tractography allow noninvasive mapping of the structural connections of the brain, and may provide important information for optimizing Deep Brain Stimulation (DBS) treatment. The hyperdirect pathway (HDP), connecting the subthalamic nucleus (STN) with motor cortex, is assumed to play a key role in mediating the beneficial effects of DBS. Less is known about the HDP, connecting the STN to prefrontal regions, and whether this might play a role in adverse effects of DBS on cognitive function.

This study aims to apply recent methodological advances in DWI acquisition and analysis to generate a connectivity-based map of the STN. This can be combined with postoperative electrode position localization with the aim of guiding postoperative stimulation management.

By combining high spatial and angular resolution DWI data with state-of-the-art tractography frameworks (Constrained Spherical Deconvolution based probabilistic tractography) we delineated connections to the STN from motor cortex (MC) and prefrontal (PF) regions. Analyzing these connections, we identified regions of the STN that were dominated by MC or PF connectivity. Post-operative electrode positions were identified and correlated to manual STN segmentations and cortico-subthalamic motor connectivity using in-house Matlab tools.

Our method can delineate a motor connectivity gradient going from high in the dorsolateral aspect of the STN to low towards the antero-medial aspect. We also examined the motor connectivity gradient at each electrode contact point in seven patients with Parkinson's Disease at 3 month follow up. We found no clear relationship between the 'active' (therapeutic) electrode contact and degree of STN-motor connectivity. However, when analyzing the electrode position with the manually delineated STN outline, we find that in 12/14 DBS leads the active contact is the one with the largest or second to largest STN volume coverage. Further analysis will be carried out to model the volume and connectivity of STN tissue stimulated with patient-specific stimulation parameters.

These preliminary results are promising and in line with the previously established anatomy of the STN. This framework could potentially help both neurosurgeons during pre-operative STN targeting and clinicians in optimizing the post-operative testing and management of stimulation settings.

P015: Prepulse Inhibition is Modulated by Electric Stimulation of the Nucleus Subthalamicus in Parkinson's Disease

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Abstract:

Objective: Deep Brain Stimulation (DBS) of the subthalamic nucleus (STN) improves motor symptoms and quality of life in patients suffering from idiopathic Parkinson's disease (PD). How DBS of the STN affects neuronal network activity is not completely understood. Prepulse inhibition (PPI) of acoustic startle response (ASR) is an operational method to measure the pre-attentive filtering process known as sensorimotor gating. Changes in PPI indicate alteration in network activity as found in neuropsychiatric disorders like Parkinson's disease. Thus in the present clinical study we investigated how STN-DBS affects sensorimotor gating in patients with idiopathic Parkinson's disease.

Methods: Nine patients with PD and treated with STN-DBS were investigated three months after implantation of the DBSsystem (Medtronic, ACTIVA). The medication was stopped 12h before testing. After UPDRS measurement PPI was assessed under two conditions: without stimulation (STN-OFF) and STN high frequency stimulation (STN-ON) with the best UPDRS-IIIimprovement. PPI was tested with an Interval of 30, 60 and 100ms between prepulse and pulse.

Results: DBS of the STN (STN-ON) compared to no stimulation (STN-OFF) significantly increased PPI (F(1,8)=16,4; p<.01) in patients with Parkinson's disease.

Conclusion: STN-DBS improves PPI in patients with Parkinson's disease. Conceivably. PPI could be used as a surrogate marker to indicate how DBS modulates network activity. Our results render PPI measurement as a potential marker for disease-and target specific optimization of DBS settings independent of the examiner or the patient. Further studies integrating also results from functional imaging are warranted.

P016: Postoperative lead movement after deep brain stimulation surgery and changes of stimulation area

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Keywords: Deep Brain Stimulation, Lead Tip Displacement, Electric Field

Abstract:

Introduction: Lead movement after deep brain stimulation (DBS) may occur and influence the area of stimulation. The cause of the displacement is not fully understood. The aim of the study was to investigate differences in lead position between the day after surgery and approximately one month postoperatively and also simulate the electric field (EF) around the active contacts.

Methods: 23 patients with movement disorders underwent DBS surgery (37 leads). CT at the two time points were co-fused respectively with the stereotactic images in Surgiplan. The coordinates (x, y, z) of the lead tips were compared between the two dates (paired t-test). 8 of these patients were selected for the EF simulation in Comsol Multiphysics.

Results: There was a significant discrepancy (mean \pm s.d.) on the left lead: x (0.44 \pm 0.72, p < 0.01), y (0.64 \pm 0.54, p < 0.001), z (0.62 \pm 0.71, p < 0.001). On the right lead, corresponding values were: x (-0.11 \pm 0.61, n.s.), y (0.71 \pm 0.54, p < 0.001), z (0.49 \pm 0.81, p < 0.05). No correlation was found between bilateral (n =14) vs. unilateral DBS, gender (n = 17 male) and age < 60 years (n = 8). The lead movement affected the EF spread (Fig. 1).

Conclusion: The left lead tip displayed a tendency to move lateral, anterior and inferior and the right a tendency to move anterior and inferior. Lead movement after DBS can be a factor to consider before starting the stimulation. The differences in the area of stimulation might affect clinical outcome.



Zona incerta, right lead

P017: Comparison between intraopereative and chronic deep brain stimulation

Authors:

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Keywords: DBS, Simulations, Intraoperative Stimulation

Abstract:

Introduction: The success of the deep brain stimulation (DBS) therapy relies primarily in the localization of the implanted electrode, implying the need of utmost accuracy in the targeting process. Intraoperative microelectrode recording and stimulation tests are a common procedure before implanting the permanent DBS lead to determine the optimal position with a large therapeutic window where side effects are avoided and the best improvement of the symptoms is achieved. Differences in dimensions and operating modes exist between the exploration and the permanent DBS electrode which might lead to different stimulation fields, even when ideal placement is achieved. The aim of this investigation is to compare the electric field (EF) distribution around the intraoperative and the chronic electrode, assuming that both have exactly the same position.

Methods: 3D models of the intraoperative exploration electrode and the chronically implanted DBS lead 3389 (Medtronic Inc., USA) were developed using COMSOL 5.2 (COMSOL AB, Sweden). Patient-specific MR images were used to determine the conductive medium around the electrode. The exploration electrode and the first DBS contact were set to current and voltage respectively (0.2mA(V) - 3 mA(V)) in 0.1 mA(V) steps). The intraoperative model included the grounded guide tube used to introduce the exploration electrode; for the chronic DBS model, the outer boundaries were grounded and the inactive contacts were set to floating potential considering a monopolar configuration. The localization of the exploration and the chronic electrode was set according to the planned trajectory. The EF was visualized and compared in terms of volume and extension using a fixed isocontour of 0.2 V/mm.

Results: The EF distribution simulated for the exploration electrode showed the influence of the parallel trajectory and the grounded guide tube. For an amplitude of e.g. 2 mA/2 V, the EF extension of the intraoperative was 0.6 mm larger than the chronic electrode at the target level; the corresponding difference in volume was 76.1 mm³.

Conclusion: Differences in the EF shape between the exploration and the chronic DBS electrode have been observed using patient-specific models. The larger EF extension obtained for the exploration electrode responds to its higher impedance and the use of current controlled stimulation. The presence of EF around the guide tube and the influence of the parallel trajectory require further experimental and clinical evaluation.

P018: Identification and surgical management in suboptimal DBS lead placement

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Keywords: Morbus Parkinson, Lead Revision, DBS

Abstract:

Objective: If outcome of DBS treatment does not meet expectations, identification of suboptimal lead placement needs to be placed on objective grounds, as a tool for planning lead revision and for deciding on details of the surgical procedure.

Patients and Methods: Electrode positions are routinely controlled by fusion of post-surgical CCT to pre-surgical stereotaxy CT and to the on-fused T2 and contrast enhanced T1 weighted MRI. Additional post-surgical MRI may be used for confirmation. Electrode tip and electrode catheter are compared to the the pre-surgical planning of tip and trajectory and intra-operative decision on final trajectory. Depending on clinical development, early or late lead revision is indicated in case of insufficient (unilateral) response, persistent fluctuations or walking disturbance. If a trajectory different to the first chosen is feasible, a one-step-procedure is considered whereas a serious conflict between existing site and new plan are found, a two-step procedure with explantation and new implantation is chosen. Standardized control of clinical status before and thereafter by UPDRS-III at Med-On/ Med-Off and Stim-On/ Stim-Off conditions are included in the protocol.

Results: Within a series of 130 consecutive DBS procedures for PD, indication for lead revision was set in 4 patients (3%) and in 10 further transferred after DBS elsewhere. In two patients two-step-procedures were chosen and in 12 patients single step operations were possible by fluoroscopy control of stepwise insertion of new microelectrodes and removal of old electrodes. Distance of electrode sites to planned ideal site ranged from 2mm to 8.4 mm. Except for two patients who were lately identified as suffering from multi system atrophy MSA, all the other 12 patients showed marked improvement in overall mobility and satisfaction with decision for lead revision and outcome.

Conclusion: Suboptimal outcome in DBS deserves precise investigation of lead location and may be successfully treated by lead-re-positioning. In view of severe lead artefacts on post-surgical MRI especially in the STN region, the use of the presurgical MRI is essential.

P019: Neurosurgical experience with segmented lead implantation for directional deep brain stimulation

Authors:

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Keywords: Morbus Parkinson, DBS, Segmented Lead

Abstract:

Objective: The feasibility of applying new directional leads (D-leads) in standard DBS procedures, possible difficulties or complications were the focus of this study.

Background: Deep brain stimulation is mainly used for treatment of movement disorders. Despite high precision in electrode placement, side effects can occur by stimulating adjacent fibers or nuclei by the volume of tissue activated (VTA). Leads with smaller electrode contacts by horizontal segmentation into three contacts instead of one ring contact are designed to apply and to direct smaller stimulation volumes.

Methods: 31 patients (23 male, Ø age 59,9, 27 PD, 1 dystonia, 3 tremor, 3 unilateral) underwent a DBS procedure with 59 segmented leads. Stereotactic planning, micro-electrode recording and testing were identical to the previous procedure. The decision for directional leads was made intraoperatively, if test stimulation through the microelectrodes indicated a narrow therapeutic window. Lateral fluoroscopy was used to control implantation of the definite DBS lead. In contrast to standard electrodes not only the depth and possible sagittal deviation from the planned trajectory was important, but also the rotation of the electrode, which was controlled by alignment of a X-ray marker above the electrode level. For placing the two middle contacts with D-lead components at the spot of best response, the lowest tip was planned to be placed about 3 mm deeper than usual.

Results: In three cases complications occurred (1 subcutaneous hematoma, 1 electrode dislocation, 1 brain edema) not different from conventional lead implantation. Slightly longer fluoroscopy time was needed for D-leadplacement compared to conventional leads (415.53 vs. 32896 Gycm²; p=0.09). Mean operation duration did not differ between either lead type (08:59 vs. 08:55 h:min). In early follow-up, in most patients at least unilateral D-lead segment has been activated for chronic stimulation.

Conclusion: From a surgeon's point of view, the exact implantation of the directional leads in a correct horizontal mode is slightly more challenging than a conventional DBS lead, but feasible. The higher x-ray-dose is minimal and surely acceptable in view of the estimated long-term advantage. Prospective studies to compare ring-mode-stimulation with directional-stimulation are needed and are already in process.

P020: Comparison of lead localization in postoperative CT versus MRI

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Keywords: Lead Localization, MRI, CT, DBS

Abstract:

Background: Evaluation of lead position accuracy may be accomplished by postoperative CT or MRI. Image distortion induced by the lead contacts in MRI question the accuracy and usefulness of this technique. Here, we compare the electrode position in postoperative CT and MRI by direct fusion of both modalities in DBS for Parkinson's Disease (PD). Therefore, visual electrode selection and related determination of stimulation parameters in post-OP MRI or CT-MRI fusion is of rising importance

Method: After DBS 9 subjects (2 dystonia, Ø age 57.7, 8 male) were investigated by postoperative imaging including MRI T1-MPRAGE (3Tesla, Trio, Siemens Inc, 1mm slices) and CT-scan (64-channel, Philips, 1mm axial slices) at a minimum of 4 weeks post-operatively to avoid pneumocephalus artefacts. Image analysis was performed in three steps, first direct image fusion of postoperative MRI T1-MPRAGE and postoperative CT was performed, second anterior and posterior commissure distance (AC_PC) and its midpoint were identified and third coordinates of the most distal electrode contact tip relative to AC_PC-midpoint were registered. These coordinates were compared in either modality and the average difference of the electrode position was measured taking modality induced MRI or CT artefacts into account as previously described.^{1,2}

Results: 18 electrodes were analyzed. Average vector distances of the distal electrode tip in post-op MRI versus CT fused images was 1.04mm (range 0.1- 2.74mm). Further statistical analysis showed special differences in z coordinates, with significant deeper electrode position in CT versus MRI by a mean of 0.61mm (SD 0.9 mm, $p = 0.03^*$), but no statistically significant differences in other planes by either technique.

Discussion: Comparison of electrode localization showed on average differences below pixel resolution, although, in few individuals discrepancies above 2 mm were detected. In most patients a systematic deeper localization of the most inferior electrode contact was identified by CT compared to MRI. These findings could be of clinical relevance in attempts of prediction of neurostimulation effects by VTA models. For optimal implementation of postoperative MRI into the control and programming planning work flow, these cases need further systematic analysis in order to identify a gold standard for lead localization.

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P021: A device-based quantification and assessment of tremor in deep brain stimulation patients

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Keywords: Deep Brain Stimulation, Movement Disorders, Tremor, Sensor, Quantification

Abstract:

Background: Deep brain stimulation (DBS) is an established method for the treatment of movement disorders, such as in Parkinson's disease or essential tremor. The involuntary tremor movements occur primarily in the upper limb. In clinical practice, the physician's visual observations provide the basis for intraoperative test stimulations and stimulator reprogramming. However, this approach is highly subjective. Objective measurements may improve clinical practice by quantifying the severity of tremor and other relevant scores.

Objectives: Sensor-based information can help physicians to fine-tune DBS parameters to suppress tremors while minimizing the energy delivered to the brain. In this context, we developed a wearable sensor with a software tool to capture, filter and analyze sensor data online.

Methods: Our initial focus is to quantify and classify pathological hand tremor, using both commercially-available and our custom-built device. We measured kinematic and bioelectrical activity on the patient's forearm. To assess tremor in real-time, we developed a semi-automated software tool (based on custom-written MATLAB[™] software). Bandpass-filtered tremor-dominant acceleration waveforms of the respective hand tremor can be recorded and analysed online for progressive status tracking during either the intraoperative test stimulations or reprogramming sessions of the implanted pulse generator. To this end, we analyse signal components of relevant movement events in the power spectrum and statistical metrics in the time domain.

Results: Our study focuses on the principal dynamics of DBS input–output relationships. In practical terms, we can reliably identify relations between clinical outcomes capturing tremor dynamics and changes in electrical stimulation amplitude. Our preliminary results demonstrate that the developed techniques could be utilized to help clinicians to find optimal stimulation parameter settings. In addition, multiple observations during reprogramming sessions of deep brain stimulators have shown that features extracted from the wearable sensor data correlate with clinical rating scores.

Conclusion: This work presents a first step toward the optimization of clinical outcomes for tremor patients based on systematic data capture and analysis. The future work will focus on pathological tremor modelling and on the long run to check, if the proposed signals may be usable for self-steering feedback controlled stimulators.

P022: Accuracy of stereotactic electrode placement in deep brain stimulation by intraoperative computed tomography

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Keywords: Stereotaxy, Functional Neurosurgery, Imaging, Intraoperative Computed Tomography, Stereotactic x ray Device, Intraoperative Imaging, Surgical Accuracy

Abstract:

Introduction: The purpose of this study was to evaluate the accuracy of stereotactic electrode placement in patients undergoing deep brain stimulation by using pre- and post-operative stereotactic computed tomography (CT).

Material & Methods: 23 patients with movement disorders (Parkinson disease (n = 7), tremor (n = 9), dystonia (n = 7)) treated with bilateral deep brain stimulation (DBS) (overall 46 target points) were investigated. The target point of the electrode was planned stereotactically in combination with a pre-operative stereotactic helical computed tomography (CT). A post-operative CT, which was carried out still in the operating room while the patient had the stereotactic frame on the head, was performed in order to control the position of the electrodes in relation to the previously planned target point. The position of the four electrode contacts was measured according to the Talairach space (AC-PC line) and compared with the coordinates of the planned target point. Image fusion by anatomical landmarks or the next day and other electrode positions than the calculated center electrode position in the 5 electrode carrier Ben's Gun were an exclusion criterion.

Results: The mean spatial distance of planned target perpendicular to the electrode was 1.32 ± 0.75 mm.

Discussion: These results show the high accuracy of stereotactic implantation of DBS electrodes assisted by pre-and postoperative image fusion with computed tomography (CT).

P023: Rescue DBS leads for persistent symptomatology following Subthalamic deep brain stimulation for Parkinson's disease

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Keywords: DBS, Rescue Leads, STN

Abstract:

While DBS of the STN is highly effective in treating PD motor symptomatology, a subset of patients may continue to be troubled by refractory DBS-responsive symptoms, despite appropriate lead placement and clinical optimization. Out of approximately 600 deep brain stimulation surgeries performed at our center over 10 years, 6 STN DBS patients (5 bilateral, 1 unilateral, 1 of whom underwent initial surgery at a different institution) received "rescue" DBS targeting a second brain area for additional control of their Parkinson's symptoms. All patients had reasonable lead placement and tolerability, and experienced clinical improvement with STN stimulation. Unilateral globus pallidus interna (GPI) electrodes were placed in three patients for persistent dyskinesias, and three patients underwent unilateral ventral intermediate (VIM) thalamic electrode placement for breakthrough tremor. All patients suffered from relatively young onset PD (median age of onset 34 years old, range 17- 43). The median age at surgery was 45 years old (range 36-53 yo). The median interval from PD onset to the first DBS surgery was 9 years (7-27 years), and between the first and second surgeries was 3 years (0.5-12 years).

In the three patients who received GPI leads, the symptoms that led to the first STN surgery were painful dystonia, dyskinesia and fluctuations. Although both improved with STN stimulation, they continued to experience troublesome dyskinesias despite reasonable lead placement, extensive programming and medication adjustments. All three reported significant improvement of dyskinesia following addition of the GPI rescue lead.

In three patients requiring addition of a VIM lead, all had severe tremor and one also had dyskinesia. All experienced moderate degree of tremor improvement with STN DBS but required high settings and continued to experience tremor breakthrough. All three subsequently experienced further tremor improvement, although two patients continued to have some residual positional tremors that impacted certain activities.

These cases, along with similar reports from other centers (Cook et al. 2015; Matias et al. 2016) demonstrate the potential for a second "rescue" lead – GPI for dyskinesias and VIM for tremor - to provide additional benefit in select cases.

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P024: Dual-target Deep Brain Stimulation for Co-morbid Tourette's syndrome and Tardive Dyskinesia

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Keywords: Deep Brain Stimulation, Tourette Syndrome, Tardive Dyskinesia

Abstract:

Emerging evidence has demonstrated DBS to be efficacious in the treatment of refractory Tourette's syndrome (TS), although the optimal target remains a matter of debate. Pallidal DBS has been reported as effective in treating both TS as well as Tardive Dyskinesia (TD). We present a case of a patient with co-morbid TS and TD referred for surgical intervention. A 59 YO female with TS since childhood was referred to our center. Her condition was complicated by haloperidol-induced TD, characterized by facial movements and teeth grinding. Multiple medication trials were attempted, limited by side effects including worsening of tardive movements. The frequent neck tics caused radicular symptoms of severe neck and left shoulder pain. Initial exam demonstrated recurrent bruxism with tongue movements, brow lifting and frequent neck jerking movements. YGTSS: 18+0+30=48, YBOCS: 5+4=9.

The decision made to implant both CM thalamic and pallidal leads bilaterally. She underwent staged dual-lead DBS, with the left hemispheric leads followed by the right three weeks later. The GPI leads were initially programmed alone with improvement in teeth grinding but not tics leading to introduction of thalamic stimulation one month later with subsequent improvement in tics. Postoperatively, her tics significantly diminished and her neck and shoulder pain completely resolved. Her teeth grinding transiently improved then returned despite several programming adjustments. She experienced continued OCD behaviors. 10 months post-DBS, her YGTSS: 8+0+10=18, YBOCS: 0+8=8.

Conclusions:

- 1. Simultaneous GPI and CM thalamic stimulation has proven well tolerated with no apparent stimulation-related side effects beyond those typically encountered with higher stimulation parameters with either target.
- 2. Thalamic stimulation led to a significant and sustained improvement in tics with less impact on OCD behaviors.
- 3. Meige-like tardive movements initially improved when only GPI DBS was initiated but recurred without significant lasting improvement to date.
- 4. Determining whether GPI or CM stimulation alone or in combination is most responsible for tic improvement is challenging but it appeared that tic improvement became more apparent following introduction of CM stimulation.



P025: Limiting brain penetrations during DBS surgery using an interventional-MRI guided DBS placement platform

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Keywords: DBS, MRI

Abstract:

Background: Deep brain stimulation (DBS) has become a well-accepted surgical treatment option for medically refractory Parkinson's disease. The surgery traditionally has involved stereotactic techniques refined with microelectrode (MER) mapping and stimulation of the target. These techniques may require multiple trajectory passes through the brain prior to final implantation of the leads. There is evidence that the number of trajectories may increase the risk of hemorrhage. Interventional-mri guided (iMRI) DBS is a new technique that allows real-time image guided implantation of the electrodes without MER or stimulation, limiting the number of passes through the brain.

Methods: 50 patients underwent iMRI guided implantation of DBS electrodes for Parkinson's disease since September of 2011. There were 23 female and 27 male patients. Mean age was 67.8. (SD 7.14) Mean years with PD prior to surgery was 9.77 years (SD 5.73). All patients underwent DBS implantation with the ClearPoint technique using a diagnostic MR scanner. 11 were implanted using a Siemens Symphony 1.5 T scanner, and 39 were implanted using a Siemens AERA 1.5T scanner. All had bilateral implants with 47 having had the STN as the target and 3 the GPi.

Results: 100 leads were implanted via MRI guided technique. For six leads, a second trajectory was performed for improved accuracy. Our overall mean error in accuracy was 0.56 mm on the left and 0.63 mm on the right without the corrective trajectory. With the correction our overall error was 0.56 mm on the left and 0.53 mm on the right. We had an average of 1.06 passes for 100 DBS implants. This compared to an average of 1.69 brain passes in our cohort of MER guided patients (P<.005).

Conclusion: iMRI guided DBS implantation allows implantation of leads with reduced number of brain penetrations. This may reduce the risk of surgical related hemorrhages compared to traditional MER guided surgery.

P026: Combination of CT angiography and MRI in surgical planning of Deep Brain Stimulation

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Keywords: Deep Brain Stimulation, CT angiography

Abstract:

Background: For safe DBS planning an accurate visualization and localization of vessels is mandatory. Contrast enhanced (ce) MRI depicts both arteries and veins. Computed tomography angiography (CTA) detects arteries with high geometric accuracy. We routinely combine both modalities for DBS planning. In this study we analyzed the number and location of vessels visible in ceMRI and CTA in each trajectory.

Methods: A total of 222 trajectories in a consecutive series of 113 patients who underwent DBS operations from March 2014 to February 2017 were included. In all patients a preoperative T1-weighted 3D ceMRI sequence, a CTA and a postoperative native CT scan were available. In all 222 trajectories the number of veins and arteries in a 5 mm diameter around the planned trajectory was counted in both modalities (T1w-3D-ceMRI and CTA). If a vessel was visible in both modalities the distance was measured.

Results: A total of 371 vessels were counted in a total of 222 trajectories. 240 vessels (65%) were visible in both modalities. In 134 vessels we detected a difference of the vessel's location with an average distance of 1.24 mm (SD 0.58). 81 vessels (22%) were visible only in ceMRI, 50 vessels (13%) only in CTA. We had a total of 4 bleedings in 3 patients (1.8% per lead) of which 1 was symptomatic (0.45%). All of them were implants into the subthalamic nucleus, one with a posterior approach. In all but one we performed microelectrode recording.

Conclusion: The majority of vessels were visible in both modalities. However, in more than half of these cases the location was not identical. Here, the location in CTA can be regarded as ground truth. Moreover, both CTA and ceMRI depicted vessels not seen in the other imaging modality. We therefore assume that the combination of both imaging modalities for DBS planning increases the chance to detect vessels along the planned trajectories, thus reducing the risk of intracranial bleeding. This assumption is supported by our low bleeding rate of 1.8%.

P027: Rechargeable pacemaker technology in deep brain stimulation: a step forward, but not for everyone

Authors:

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Keywords: DBS, Recharbeable technology, Twiddlers-Syndrome

Abstract:

Objective: Since a few years rechargeable pacemaker technology is available in deep brain stimulation. This technical innovation becomes more and more important in clinical practice, particularly for patients with a need for high energy delivery. Unforeseen handling issues, however, may compromise its use in certain patients.

Methods: Over a period of ten years, 360 patients underwent deep brain stimulation for various indications. Rechargeable pacemakers are increasingly used upon replacement after battery depletion. Despite meticulous screening for suitability, we had to switch battery to non-rechargeable technology because of unforeseen technical difficulties in two patients.

Results: A 73-year-old man with a high cognitive performance with Parkinson's disease, underwent bilateral deep brain stimulation in the internal globus pallidus. Pulse generators were replaced because of battery depletion in 2-year intervals. At the time of third replacement, it was decided to use rechargeable technology because of the relatively frequent need of pacemaker replacements. Two years later the patient requested to remove the pacemaker and reimplant a non-rechargeable once more because of increasing problems with handling of the recharger and inconvenience with the daily monitoring of the battery level.

A 62-year-old woman underwent bilateral deep brain stimulation in the nucleus accumbens for alcohol addiction. She needed biennial pacemaker replacements, the pacemaker was replaced against a rechargeable device at the time of the second replacement. Two years later system malfunction was detected with fracture of the extension cable secondary to twiddler's syndrome. The patient for the main part had had increased difficulties recharging the battery.

Conclusion: Rechargeable pacemakers undoubtedly are a step forward in providing standard of care medical treatment. Many patients stand to benefit from rechargeable technology, smaller devices and fewer replacement operations. However, with new technology we also have new requirements concerning technical capabilities and compliance. Although removal of a rechargeable device before end of service of the battery and replacement with a non-rechargeable pacemaker poses an undue economic burden, it may be the only solution under certain circumstances to guarantee the benefit of chronic stimulation.

P028: Improvement of dystonic storm after relocation of pallidal electrodes in dyt-6 positive generalized dystonia

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Keywords: DBS, Dystonia, Status Dystonicus

Abstract:

Objective: Dystonic storm is a rare but life threatening condition. DBS or radiofrequency lesioning have been used in severe cases, however, there is no agreement on the optimal target. Patients who had already previous basal ganglia surgery pose a particular challenge with limited treatment options available.

Methods: An 11-year-old boy with pallidal DBS for treatment of DYT-6 positive generalized dystonia since 2 years developed severe dystonic storm. After implantation of DBS electrodes at age 9 his condition had improved for more than 2 years. Upon the occurrence of dystonic storm, re-programing of DBS could not ameliorate the severe status dystonicus. Only sedation with high dose benzodiazepines, baclofen, gabapentin and trihexyphenidyl resulted in transient improvement.

Results: The BMFDR motor score on admission was 138. MRI imaging showed positioning of the DBS electrodes in the globus pallidus internus (GPi), however, more lateral and posterior than at the usual target. It was decided to reimplant the GPi electrodes and to implant thalamic Vim electrodes in addition. Early postoperatively this resulted in marked and immediate improvement of dystonic storm (BMFDRS 100,5). At 12-month follow-up, there was remarkable benefit and the patient could walk and attend school without medication.

Conclusion: Dystonic storm may develop despite periods of beneficial response to pallidal DBS for several years. If electrodes are no optimally placed in the posteroventral lateral GPi, repositioning should be considered, which might not only abate status dystonicus, but also provide lasting benefits.

P029: Frame mounting and stereotactic accuracy: a phantom study

Authors:

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Keywords: Deep Brain Stimulation, Frame, Mounting, Accuracy, Phantom

Abstract:

Mounting the stereotactic frame is one of the most crucial steps in deep brain stimulation surgeries. In the routine clinical practice, we aim to mount the frame as symmetrical as possible parallel to the Reid's line. However, in several cases the frame is mounted asymmetrical, often due to patient-related reasons. In this study, we addressed the question whether this influences the accuracy of stereotactic electrode implantation, and if yes, to which extent. A citrullus lanatus was used for this study. Symmetric and asymmetric mounting of the frame was performed and CT and MR images were obtained. Three different stereotactic software packages were used to analyze the results. In addition, manual calculations were performed. We have found that an asymmetrically mounted frame (deviated, tilted or rotated) does not affect the accuracy in the medio-lateral axis (X coordinate) or the antero-posterior axis (Y coordinate). However, it can lead to a clinically relevant error in the supero-inferior axis (Z coordinate). These results suggest that asymmetrical frame mounting can lead to stereotactic inaccuracy.

P030: Complications in Deep Brain Stimulation - Surgical Revision Approaches

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Keywords: DBS, Deep Brain Stimulation, Parkinson's, Dystonia, Complications, Infection, Rejection, Exposure, Hardware, Removal, Approaches, Revision, Surgery, Preserving, Technique

Abstract:

Background: The non-elective surgical revision of deep brain stimulation (DBS) patients is a growing concern amongst neurosurgeons. Scarce literature is available concerning the surgical management of DBS complications, particularly the non-infectious kind and there are no globally accepted guidelines on how to handle these complications. Furthermore, both the epidemiology and surgical management provided in each case vary greatly and are therefore worthy of study.

Methods: Retrospective cohort study of patients submitted to DBS surgery between 2006 and 2016 at our centre. The demographics - gender, age - and clinical variables - disease, the reason for non-elective re-intervention, and the performed surgical technique - were analysed.

Results: 195 patients were included (119 males; 76 females). The majority suffered from Parkinson's disease (PD)–166 (85.1%) versus 25(12.8%) with Dystonia (DYST) and 2 (1%) with Essential Tremor (ET) and 2 (1%) with Tourette Syndrome. 18 non-elective surgical interventions were performed– 9% of treated patients (88.9% DP–16 patients and 11.1% DYST–2 patients). In this subgroup, 8 patients had an infection (44.4%), 1 had a central nervous system infection, 5 presented with hardware exposure and 4 displayed a foreign body reaction. An initial system-preserving technique (non-removal of the entire system) was used for every patient as a first line treatment. Only 3 patients (16.7%) required a second surgery for removal of the entire system, of which 2 presented with an infection of the subclavian IPG pouch and 1 with hardware exposure. Neither PD, nor DYST were related with an increased risk for non-programmed surgical intervention (p-value=0.596).

Conclusion: Even though entire system removal has been the consensual approach to DBS-related complications, this data supports that a system-preserving technique is of high-value and should be taken into consideration whilst planning for a surgical revision of patients presenting with these complications.

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P031: Effect of frontal angle of approach on microelectrode recording and clinical parameters in STN-DBS surgery

Authors:

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Keywords: Deep Brain Stimulation, Frontal Angle, Levodopa, Microelectrode Recording, Subthalamic Nucleus, UPDRS

Abstract:

Objective: Subthalamic nucleus (STN) is a widely used anatomical target in deep brain stimulation (DBS) surgery. Highly precise targeting the STN in Parkinson's disease is vital. Furthermore, the length of the STN passed by the final electrode is desired to be as possible as long to achieve more stimulation combinations and flexibility in further programming. For these reasons, we questioned the relation between different stereotactic approach angles and clinical parameters in our series of STN DBS surgeries.

Methods: The DBS database of Maastricht University Medical Center Neurosurgery Department between 2005 and 2015 was retrospectively analyzed. Patient demographics, preoperative and postoperative UPDRS-III (Unified Parkinson Disease Rating Scale) scores, levodopa equivalent doses (LED), intraoperative microelectrode recording (MER) data and sagittal and coronal stereotactic angles were documented. 94 STNs of 51 patients met the criteria and were included into study. Effects of stereotactic angles were analyzed statistically.

Results: Twenty-two patients were females and 29 were males. Mean electrophysiological STN length was calculated 4.7 mm ± 1.5 SD (0.5-7.5). The mean sagittal angle of approach was 57.2° ± 10.3 SD (34.2-83.9) and the coronal angle was 24.8° ± 5.7 SD (11.6-52.0). A mean 44.3% decrease was found between preoperative and postoperative med-off UPDRS-III scores. Postoperative analysis for levodopa doses showed a mean 50.9% decrease in postoperative LED. Two tailed correlation analysis between groups showed a positive correlation between the length of electrophysiological motor STN and postoperative sagittal angle and percentage of UPDRS-III decrease. Another significant negative correlation was also found between the sagittal angle and STN length.

Conclusion: Our study showed that a lower sagittal trajectory angle (around 50°) is correlated with a longer electrophysiological STN and better improvement in postoperative UPDRS score. However, the coronal angle did not affect the clinical and electrophysiological parameters. Another interesting finding was that a longer intraoperative STN recording was related to a lower postoperative LED. Thus, we may speculate that a patient with longer STN recording may require less dopaminergic medication postoperatively.

P032: Bilateral deep brain stimulation of the subthalamic nuclei in Parkinson's disease patients with camptocormic posture

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Keywords: Camptocormia; Deep Brain Stimulation (DBS); Parkinson's Disease (PD); Subthalamic Nucleus (STN)

Abstract:

Objective: Camptocormia is a disabling syndrome characterized by forward flexion that can be an idiopathic or associated with numerous diseases like movement disorders, especially Parkinson's disease (PD). Treatment options are usually futile and L-dopa shows little or no effect. Posture improvement could be expected in bilateral deep brain stimulation (DBS) of the globus pallidus internus (GPi) or subthalamic nucleus (STN) in PD patients with camptocormia. Outcome results are inconsistent, especially for STN. The aim of this study was to determine the efficacy of bilateral STN DBS in alleviating the degree of camptocormia in two PD patients.

Patients and methods: Two patients (67 year old female and a 66 year old male) suffering from PD in the last ten years and more were subjected to bilateral STN DBS procedure. The positions of electrodes were verified with a postoperative magnetic resonance imaging. The results were objectivized by measuring thoracolumbar flexion angle before and after operation and using all recommended scales for the international survey of DBS.

Results: The degree of forward flexion of the spine has substantially decreased and the quality of life, motor symptoms and functioning improved in both patients.

Conclusion: STN DBS should be considered as a potential treatment option for PD patients with camptocormia. Further analysis is needed to conclude what PD patients are candidates for bilateral STN or GPi stimulation in the treatment of camptocormia.

P033: Psychosis immediately after the subthalamic nucleus lesion effect

Authors:

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Keywords: STN, DBS, Delirium, Lesion Effect, Psychosis

Abstract:

Introduction: Deep brain stimulation (DBS) is used for the treatment of movement disorders in Parkinson's disease (PD) and the standard targets are globus Pallidus interna (GPi) and subthalamic nucleus (STN)[1]. DBS can improve the psychiatric symptoms by altering the tonic activity of subcortical circuits but the exact mechanism is still remains unclear[2]. In STN stimulation some transient manias, or hallucinations complications reported, but these complications usually occurred after onset of STN stimulation. We want to share our two patient's experiences who developed agitated psychosis and hallucinations complications, immediately after bilateral STN DBS implantation but before stimulation on.

Methods:

The patient's ages were 48 and 51 years old they had no prior psychiatric history. They were underwent to operations without prior medication interruption. Three guide cannulas were passed first on left and later on right. On each side and microelectrode recording (MER) was recorded from 5.0 mm above to 2.0 mm below the target. In two patients during the right side MER, hallucinations and meaningless speech developed. The patients were took quickly to the computerized tomography (CT) after the macrostimulation and skin closure. CT scans did not reveal any abnormality. The first patient underwent to operation theatre again for implantable pulse generator implantation and after the operation he was taken to intensive care unit (ICU). The pulse generator implantation of the second patient was made after 7 days. The second patients' agitation and hallucination complications was ceased only 3 or 4 hours after and he didn't remember anything. However, complications of the first patient prolonged approximately 6 or 7 days.

Discussion: Both patients DBS leads were placed within STN and substantia nigra (SN). Injury of SN (esp. in young patients) may lead to excess dopamine release (Particularly when medication is on). The injury on ventral STN and SN especially in young patients may associated with limbic side effects.

Conclusion: There are a lot of reports about psychosis as a consequence of electrical STN stimulation, but the report about to arise directly from injury of STN and surrounding structures by a DBS lead is limited. Immediately anesthesia after the delirium symptoms may be questioned therefore the second part of the surgery may be postponed.

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P034: The Effect of Vancomycin Powder on Surgical Site Infections in Deep Brain Stimulation Surgery

Authors:

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Keywords: Vancomycin, Deep Brain Stimulation, Infection

Abstract:

Introduction: Surgical site infections are a problematic complication in deep brain stimulation, with estimates ranging as high as 10%. Application of vancomycin powder to the surgical bed prior to closure has shown positive results in instrumented spine surgery. To assess its impact in reducing infections in deep brain stimulation (DBS) surgery, we compared a prospective cohort of patients undergoing DBS lead and generator placements using vancomycin powder with a retrospective cohort off patients that did not receive vancomycin powder.

Methods: A total of 450 DBS cases were included between April 2015 and December 2016 (215 cases without vancomycin powder, analyzed retrospectively and 235 cases, analyzed prospectively with vancomycin powder) with a minimum of three month follow-up. Operations included all DBS lead insertions, extension wire and pulse generator implantations and generator exchanges. A surgical site infection was defined as culture positive evidence of infection that necessitated antibiotic therapy and/or removal of hardware, including superficial wound infections. Infection rates were recorded and compared.

Results: Infections were noted in 5/215 (2.3%) of the pre-vancomycin powder group compared to only 1/235 (0.4%) in the vancomycin powder group. The sole infection in the vancomycin powder group consisted of a patient who presented with gross infection of the left chest generator necessitating removal of the entire system. Culture data tested positive for methicillin-sensitive *S. aureus* and was successfully treated with a prolonged course of intravenous antibiotics.

Conclusion: The use of vancomycin powder in DBS surgery appears to be a safe and feasible protocol to decrease surgical site infections without increasing the risk of antibiotic resistant organisms. Larger prospective randomized trials are necessary to determine vancomycin powders ability to significantly reduced the infection rate in DBS surgery.

	Pre Vancomycin group	Vancomycin powder group
Total patients	215	235
Total infections	2.3% (5/215)	0.4% (1/235)
Bilateral DBS lead placement	2.7% (1/37)	0.0% (0/48)
Initial generator placement	6.1% (3/49)	1.8% (1/56)
Subsequent generator exchanges	1.7% (1/60)	0.0% (0/57)

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P035: Cardiovascular effects of deep brain electrical stimulation in human: the neurogenic heart systematic review

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Keywords: Deep Brain Stimulation, Cardiovascular System, Heart Rate, Blood Pressure, Autonomic Nervous System, Subthalamic Nucleus, Periaqueductal Or Periventricular Gray, Globus Pallidus Interna, Hypothalamus, Nucleus Accumbens, Amygdala

Abstract:

Introduction: Deep brain stimulation (DBS) has been applied to treat various neurological disorders and to record from different brain regions. The effects of electrical stimulation of different brain parts on cardiovascular physiology have been investigated in several reports. Here in, we review brain stimulation effects on cardiovascular function.

Methods: A systematic review of the English literature using PubMed search. Brain targets resulted in clinical cardiovascular effects with DBS were included. Cortical stimulation was excluded. The stimulated targets were classified based on anatomical location and type of cardiovascular effect.

Results: Intraoperative electrical stimulation of Subthalamic nucleus (STN) showed heart rate (HR) increment in several studies, particularly dorsal stimulation of STN in contrast to ventral. Globus pallidus internus (GPi) stimulation evoked a paradoxical arousal reaction resulted in transient increase in blood pressure (BP). Moreover, amygdaloid nucleus and nucleus accumbens (NAc) DBS showed an increase in both HR and BP. Hypothalamic stimulation varied with the site of stimulation. Posterior hypothalamic area showed no change in HR or BP, whereas Ventroposterior Hypothalamus and Posteriomedial hypothalamus showed an increase in both. In regards to periaqueductal gray matter/periventricular gray matter (PAG/PVG) DBS, decrement in BP was noted with stimulation of the ventral part and an increment with dorsal stimulation.

Conclusion: STN is the most studied target. Other targets that showed positive cardiovascular effect include amygdala, NAc, hypothalamus and PVG/PAG. Stimulating the GPi, per se, does not appear to have any positive effects. In addition to various neurological disorders, DBS could be used in the future to treat disorders related to the cardiovascular system.

P036: Deep brain stimulation: software for patient-specific electric field simulations

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Keywords: DBS, Brain Model, Computer Simulations, Movement Disorders

Abstract:

Introduction: The electric field (EF) around the active deep brain stimulation (DBS) contact is of interest for optimizing the therapeutic effect. We have previously developed a method for simulation and visualization of the EF. The aim of the project is to improve the software for quick and user friendly simulations.

Methods: The ELMA software for brain model creation has been improved by adding quick ROI selection and transformation to an electrical conductivity map based on tissue classification through multiple slices of the preoperative MRI. These data are used as input for Comsol Multiphysics simulations of the EF. Two points along the position of the lead, as seen in the postoperative images, are used for correct placement in the brain model. Multiple DBS lead models are pre-programmed. The active contact and amplitude are user-selected.

Results: After a simulation the result is visualized with a user defined isolevel or isosurface superimposed on the patients preoperative MRI. An example is shown in Fig. 1. The 3389 lead is places in zona inserta (Zi) and contact 1 activated with 2 and 4 V respectively. An isolevel of 0.2 V/mm is used corresponding to a ~ $3-4 \mu m$ axon diameter when using a pulse length of 60 μ s. More examples will be presented at the meeting.

Conclusion: The software for patient-specific simulations of EF around DBS electrodes has been improved for quicker simulations and more DBS leads. As a next step user friendly Apps will be implemented.



Fig. 1. Example of a patient-specific simulation of the electric field in Zi. Contact 1 is activated with 2 V (orange) and 4 V (yellow) respectively. The simulated electric field is superimposed on the preoperative MRI.

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P037: Factors influencing patients' choice of fixed life or rechargeable implantable pulse generators for deep brain stimulation

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Keywords: Movement Disorders, Deep Brain Stimulation, Patient Preference

Abstract:

Background: Deep brain stimulation is increasingly used for movement disorders. Recently, an increasing variety of implantable pulse generators (IPGs) have been available, including rechargeable types which are associated with a longer battery life and high satisfaction. However, patients' views on which factors are important when deciding whether to use a fixed life or rechargeable IPG have not been well studied.

Methods: We surveyed 12 consecutive adult patients attending a pre-DBS neurosurgery clinic (11 males, 1 female). They were asked which type of battery they would prefer and the main reasons for their choice.

Results: 10 patients opted for a fixed-life battery and 2 opted for the rechargeable. For those who chose the fixed-life battery, the main reasons were they will forget to recharge the battery (8 patients), that a fixed-life battery would require less responsibility (6 patients), be more convenient (5 patients) and will offer a better lifestyle (4 patients). For the 2 patients who chose the rechargeable battery, the main reason was the avoidance of further surgery. The size of the battery was a concern in 8 patients (2 neutral, 2 not concerned). The need to have surgery to replace the battery was a concern in 3 patients (9 not concerned). The need to recharge the battery was a concern in 8 patients (4 not concerned). Acceptable charging frequency for a rechargeable battery was reported to be yearly (5 patients), monthly (6 patients) and fortnightly (1 patient). Acceptable duration of charging was reported to be less than 15 minutes (2 patients), 15-30 minutes (5 patients), 30 to 45 minutes (2 patients) and 45mins to 1 hour (3 patients).

Conclusion: In our sample of patients most chose the fixed-life battery. Many factors affect a patient's choice of type of battery. The charging frequency, the possibility of forgetting to charge the battery and the convenience and lifestyle of not having to recharge the battery were important factors.

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P038: Trajectory angle revisions in subthalamic deep brain stimulations for Parkinson's disease

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Keywords: Deep Brain Stimulation; Lead Reposition; Outcome; Side-Effects; Trajectory Angle

Abstract:

Purpose: Previously deep brain stimulation revision due to misplaced leads from targets were reported previously. However, the importance of trajectory angle is not well known. Anteriorly slanted low ring angled trajectories may be farther from sensory-motor subthalamic nucleus and closer to corticospinal tracts with lower outcomes and side-effects.

Materials and methods: Among 200 patients treated by deep brain stimulation from March 2013 to Dec 2016 in the Asan Medical Center by one neurosurgeon and one neurologist (J.K. Lee and C.S. Lee), subthalamic lead reposition cases were collected. Patients with ring angles < 55° were defined as having low ring angle trajectory. We defined trajectory revision as the ring angle change \geq 15°. Patient's global impression (PGI) were scored postoperatively. For a subgroup of four referred patients with six leads we could collect ring angles of all operated cohort by a surgeon. The ring angles of these patients were compared to patients indicated for revisions.

Results: Leads were repositioned in nine patients of 15 electrodes. Intervals between the initial lead insertions and revisions ranged from 1 to 157 months (median: 38 months). Before revision, patients improved by 24 ± 19 % (0 – 55 %) in UPDRS part III motor scores. All patients indicated for revision showed various side effects and suboptimal outcomes.

Five of fifteen leads (33 %) indicated for revisions had low ring angles, < 55°. In seven of fifteen leads (47 %), ring angles were increased \geq 15°. Patients improved in PGI (patients' global impression of improvement) scores by 1.2±1.5. Patients with either target or trajectory revisions showed improvements in PGI scores except one patient with PGI score -1.

For all subthalamic 40 leads operated by surgeon A, mean ring angles were $55\pm8^{\circ}$. Revised leads previously operated by surgeon A had $47\pm7^{\circ}$, significantly lower than the all surgery patients by the surgeon A (p = 0.02) in Mann-Whitney U test.

Conclusion: We show that low ring angled trajectory may be associated with suboptimal outcome which are indicated for revisions. A subgroup of patients who had suboptimal outcomes had low ring angles. Previously, only target revisions were reported for DBS. Low ring angled trajectory which can be closer to corticospinal tracts and farther from sensory-motor STN may be a potential target of DBS revision.

P039: Deep Brain Stimulation Leads with Segmented Contacts Enable Directional Control of Neural Activation in the Subthalamic Nucleus

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Keywords: DBS, Directional Leads, Volume of Tissue Activated, Computational Modeling

Abstract:

Objectives: Conventional deep brain stimulation (DBS) leads stimulate brain targets in a nondirectional fashion, whereas directional DBS leads with segmented electrodes allow for more flexibility in shaping the stimulation field. The latter may be used to optimize therapeutic efficacy and reduce stimulation-related side-effects. A computational model was used to evaluate directional neural activation in the subthalamic nucleus (STN) resulting from stimulation with the InfinityTM DBS lead (Abbott, Plano, TX).

Methods: A two-stage computational model of STN-DBS was used to analyze neural activation generated with the Infinity directional lead (1.5 mm spacing, 1-3-3-1 configuration). The first stage involved using a finite element analysis (FEA) model to calculate electrical potentials generated in the brain with cathodic monopolar DBS (1.5 mA, 90 µs). The FEA model incorporated a multimodal, imaging-based detailed anatomical (MIDA) model of the human head, and the DBS lead was placed with contact 1 at the ventral STN boundary and surrounded by a 0.5mm thick encapsulation layer. In the second stage, electrical potentials from the FEA model to biophysical cellular models of 1,000 STN projection neurons with realistic morphological and electrophysiological characteristics. Volume of tissue activation (VTA) was compared between nondirectional (segments 2A-C) and unidirectional (segment 2A) DBS. The extent of directionality was calculated as the percentage of VTA volume on the side of the lead with segment 2A.

Results: VTAs were distinct for nondirectional and unidirectional DBS (Figure). At 1.5 mA amplitude, the VTA volume was larger with unidirectional stimulation (4.29 mm³) than nondirectional stimulation (3.85 mm³). Additionally, the extent of directionality was greater for unidirectional stimulation (93%) compared to nondirectional stimulation (56%).

Conclusion: An anatomically-precise computational model of STN-DBS demonstrated that unidirectional stimulation increases directionality in the region of neural activation and produces a larger VTA volume at a given stimulation amplitude, compared to nondirectional stimulation. Clinically, these results indicate that directional DBS leads may be used to increase the therapeutic window by providing a customized stimulation field focused only on targeted brain regions, and may increase battery life by reducing the stimulation amplitude required to activate a given volume of tissue [Rebelo *NANS* 2017].



P040: Involvement of the subthalamic nucleus in the maintenance of cognitive flexibility: Evidence from local field potential recordings

Authors:

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Abstract:

Imaging techniques have revealed that several cortical brain regions like the prefrontal cortex, the anterior cingulate cortex, and the posterior parietal cortex are involved in the maintenance of cognitive flexibility. However, the role of basal ganglia in the ability to switch between several concepts remains unknown. To address this issue we recorded local field potentials from the nucleus subthalamicus (STN) while participants performed a task that required executive processes like planning and set shifting. Seven patients with Parkinson disease that underwent STN deep brain stimulation have been included in the study. The patients performed a computerized version of the Wisconsin Card Sorting Test. The participants were required to match the cards according to three possible matching rules (color, shape and number). After the sorting choice was made, a feedback 'switch' or 'repeat' indicated that the rule had to be changed or repeated respectively. Integration cue is the first repeat cue following a shift cue. The results show that the amplitudes of the integration cue are larger than those of the repeat condition. Moreover, there is a significant late higher activation of beta band for the integration trials. In conclusion, there are broadband oscillatory changes in the STN during executive processes. STN appears to be involved in shifting cognitive sets and modulating responses.

P041: Establishing Deep Brain Stimulation Surgery Program in developing countries; Shiraz (Southern Iran) Experience

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Keywords: Deep Brain Stimulation, Developing Countries

Abstract:

Deep brain stimulation (DBS) is an effective therapy for Parkinson's disease and dystonia, as well as some other evolving indications. This therapy has been utilized since 1990 in many centers across the world, and in many countries and cities more than one center is providing this therapy. Yet, many large parts of the developing world still miss such therapy due to numerous strategic and economic issues. Establishing a new center in a developing country faces unique challenges and dilemmas for the responsible team.

We established the DBS surgery program in Shiraz in 2014, as the second center in Iran with a population of over 80 million people countrywide. Shiraz is one of the major cities located in the Southeast of the country, and is the major referral medical center for most of the Southern provinces, covering one fourth of the whole population.

We started DBS surgery in Shiraz with the support of the new national health reform program since 2014. Loyalty to the team work principles and provision of enough international exposure and training to the whole team were essential considerations in our experience. Major changes have occurred in the team, technique, hardware, programming, and financial supply since the beginning, which are thoroughly discussed in this presentation.

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P042: Oh Dear, the neurostimulator battery has depleted: Lund experience of the consequences of depleted neurostimulators

Authors:

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Keywords: Dbs, Neurostimulator Depeletion, Parkinson's Disease, Essential Tremor, Dystonia

Abstract:

Background: Even though the clinicians as well as the patients have an idea of when it is time to exchange the neurostimulator (NS) due to reduced battery capacity, it is not always the exchange is done before depletion due to various reasons. Due to changes in the management of scheduled NS exchange 16% of the patients had total DBS treatment arrest due to battery depletion before exchange.

Aim: Investigate consequences of DBS treatment arrest due to depleted NS batteries in terms of reoccurrence of symptoms and time to recovery after exchange and which actions that were taken while waiting for surgery.

Methods: The patient records for the 23 out of the 25 whom during the years 2015 and 2016 had battery depletion before the exchange of NS were reviewed. Diagnosis, target(s) consequences (hospital care, increased home care, symptoms etc.), reason (hospital or patient delay) time between decreased battery capacity and battery depletion, DBS settings and time until recovery.

Results: In most patients the hospital delay were the major reason for depletion. The majority (n=13) had Parkinson's disease (PD), followed by essential tremor (n=7) and dystonia (n=3). All patents had bilateral electrodes, 11 of them had bilateral NS. DBS targets were Thalamus VIM, STN and GPi. The time between battery depletion and exchange 0 to 57 days and during this time 3 patients were hospitalized (or nursing home). In PD the medication was increased especially in those with one dual channel NS. All patients' their movement disorder symptoms were perceived as worsened. Family members or care givers needed to help/support in everyday activities.

None of the patients had a life-threatening condition and all perceived good DBS effects (may be not as good as before depletion) after the DBS has been optimally programmed (1-6 mth postop).

Conclusion: Battery depletion had severe impact on the patients and their families' everyday life due to severe movement disorder symptoms, furthermore it also increased the healthcare needed especially in patients with PD pre- as well as postoperative. Thus, it is really worthwhile minimizing time without DBS treatment due to battery depletion and it is better to exchange NS sooner than later and create routines for calling nursing care homes for report of residual battery capacity.

P043: Beyond Staph: A single center's experience with infectious complications in Deep Brain Stimulation

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Keywords: deep brain stimulation, infection, complication

Abstract:

Introduction: Infection is estimated to affect 5-15% of DBS implantation cases. IPG infections are more common than intracerebral infections, but likely these figures have been underreported. Device-related infections are most often associated with Staph aureus, but other pathogens may be encountered. Especially as the volume of DBS procedures increases, we anticipate unusual infectious complications. We review a single center's experience with DBS-related infections.

Methods: A retrospective review of all DBS-related procedures performed by a single surgeon was performed. Both new system implantations, generator exchanges and other procedures were cataloged, and not was made of any infection that required further surgical treatment for infections. A survey of the pathogen involved was performed and antibiotic susceptibilities noted. Patient outcomes are summarized.

Results: IPG site infections occurred more often than extension site or intracranial infections. While Staphylococcus aureus was the most common pathogen in this series, other notable pathogens included other Staphylococcus species, Enterebacter cloacae, Klebsiella pneumoniae, and Candida parapsilosis. These unusual cases are discussed in detail.

Conclusion: While infectious complications of DBS are uncommon, the incidence of infection and the range of pathogens should be appreciated.
P044: Concordance of MR-imaging based automatic segmentation of the Subthalamic Nucleus and intraoperatively recorded electrophysiology

Authors:

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Keywords: Automatic Segmentation, Subthalamic Nucleus, Micrcoelectrode Recordings

Abstract:

Background and Purpose: Automatic segmentation methods are gaining relevancy in image-based targeting of neural structures. In order to evaluate the feasibility of such approaches we retrospectively analyzed the concordance of MR-imaging based automatic segmentation of the Subthalamic Nucleus (STN) and intraoperatively recorded mircoelectrode recordings (MER).

Methods: The data of ten patients STN-implanted with 20 DBS electrodes for the treatment of PD (9) and dystonia (1) were processed using Brainlab Elements Anatomical Mapping segmentation of the STN - with two volumetric T1 (with and without contrast) and volumetric T2 images as input. The stereotactic CT was co-registered with that imaging and the stereotactic coordinates for these cases originally planned using ELEKTA Surgiplan were imported, so that the actually surgically executed trajectories could be overlaid onto the segmentation. Records of the electrophysiology (MER, measured in 0.5 mm steps) along the central trajectory were analyzed with respect to distance of noted STN entry and STN exit to the segmented STN boundary (40 distances).

Results: In none of the patients did the independently pre-planned trajectory miss the subsequently segmented STN - indicating a good overlap of the trajectory planning concept employed in our center and the automatic segmentations. Along those trajectories the electrophysiological STN entry deviated (median) 1,6 mm (n=20, min=0, max=4,5) and the STN exit deviated 0,7 mm (n=20, min=0, max=3,9) from the segmented STN boundary. In 8 instances the STN entry showed electrophysiologicaly deeper (closer to target) than the segmented boundary (12 instances STN entry was recorded higher than the boundary), in 2 instances the STN exit showed electrophysiologically higher (still within than the STN boundary) and in 18 instances deeper, respectively.

Conclusions: In the trajectories analyzed with intraoperative MER, the electrophysiological borders of the STN and the borders of the automatically segmented STN in the MRIs had a high level of concordance. To further characterize this observation, we are currently analyzing a larger patient cohort and factoring in recordings from alternate tracks. If this trend is confirmed, automatic three-dimensional segmentation of the STN is an exciting method to visualize patient anatomy for neurosurgeons and neurologists.

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P045: The Wake Up Time Evaluation After Subthalamic Nucleus Deep Brain Stimulation Surgery – Pilot Study

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Keywords: Anesthesia, Deep brain Stimulaton, Subthalamic Nucleus, Wake Up Time, Recovery Time

Abstract:

Introduction: Deep brain stimulation surgery (DBSS) is the treatment modality for medical refractory movement disorders especially Parkinson's disease (PD), essential tremor and dystonia. The Subthalamic Nucleus (STN) and the Globus Pallidus Internus are accepted effective areas for PD. DBSS could be separate in two parts. The first part is the placement of the electrode(s) and the second part is the implantation of impulse generator. Several reports suggested that the first part of the operation should be make awake because to verify that the test stimulation of the electrode improves the patient's symptoms with minimal side-effects. The second part of the surgery could be made by cervical regional anesthesia or under general anesthesia.

The management of the patients after the general anesthesia is important and it continues until the patient has returned to their physiological preoperative state. Especially in PD the postoperative management is important because the PD patients are more sensitive to sedatives and are prone to hypoventilation. The Aldrete scoring system (ASS) is the most widely used scoring system to clinically assess the status of the patients about recovering from anesthesia. The maximum score of the ASS is 10 and the minimum is 2 and when the ASS reached up to nine the patients assume as returned to their physiological preoperative state and could be sent from postoperative care unit.

Methods: 6 patients were presented with PD that were undergone STN DBSS reviewed. The first part of the surgery was made under local anesthesia and the second part of the surgery was made under general anesthesia. The time interval from the extubating time to reach up score 9 according to ASS has been calculated (Wake up time).

Results: The minimum and maximum wake up time has been found 13 minutes and 15 minutes respectively and the mean wake up time has been found 14,2 minutes.

Discussion and Conclusion: There are a few reports in the literature about the recovering time from anesthesia after DBSS. Our aim to evaluate and compare the recovering time of DBSS with other surgeries. The number of patients are insufficient because our study is a pilot study and it is still continue.

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P046: Comparison of direct MRI guided versus atlas based targeting for subthalamic nucleus and globus pallidus deep brain stimulation

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Keywords: DBS, Targeting, STN, GPi

Abstract:

Introduction: Subthalamic nucleus (STN) and globus pallidus (GPi) targets for deep brain stimulation (DBS) can be defined by reference to atlas coordinates or direct visualisation of the target on MRI. The aim of this study was to evaluate the difference between atlas-based targeting and direct MRI guided targeting.

Methods: We reviewed prospectively collected records of adult patients who underwent DBS surgery from 2007 to 2016. MRI guided targeting was used to implant 206 STN electrodes and 62 GPi electrodes in 139 patients with Parkinson disease or dystonia. Surgery was performed using a Leksell G frame and targeting performed on 2mm thick T2 weighted MRI (for STN) and proton density (for GPi) scans acquired preoperatively. The Cartesian STN and GPi coordinates were normalised to the AC-PC plane and compared with atlas coordinates. Atlas STN coordinates were 12mm lateral (x), 2mm posterior (y) and 4 mm ventral (z); atlas GPi coordinates were 22mm lateral (x), 2 mm anterior (y), and 4 mm ventral (z) in relation to the AC-PC plane (y=distance from midpoint of AC-PC line).

Results: The directly targeted coordinates (mean, SD, range) for STN were: $x (9.9 \pm 1.1 (7.1 - 13.2))$, $y (-0.8 \pm 1.1 (-4.2 - 2))$, $z (-4.7 \pm 0.59 (-5.9 - -1.5))$ and for GPi were: $x (22.3 \pm 2.0 (17.8 - 26.1))$, $y (-0.2 \pm 2.1 (-4.5 - 3.4))$, $z (-4.3 \pm 0.8 (-6.1 - -2.3))$. The mean of the directly visualised STN was 2.1mm more medial (4.9 to -1.2, p < 0.0001), 0.2mm more anterior (-2.2 to -6, p < 0.0001) and 0.7mm more ventral (-1.9 to 2.5, p < 0.0001) than the atlas target. The mean of the directly visualised GPi target was 0.3mm (-4.2 to 4.1) more medial (not significant) 2.2mm (-6.5 to 1.4, p < 0.001) more posterior and 0.3mm (-2.1 to 1.7, p=0.009) more ventral than atlas coordinates.

Conclusion: MRI guided direct targeting may be more accurate than atlas based targeting due to individual variations in anatomy.

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P047: Electric current changes iron metabolism in patients with deep brain stimulation

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Keywords: Deep Brain Stimulation, Parkinson's Disease, Iron Metabolism

Abstract:

Background: Alterations in iron homeostasis can participate in development of Parkinson disease (PD) due to accumulation of iron in the substantia nigra. Blood serum concentration of labile iron, transferrin and ferritin play important role in transfer of peripheral iron into the brain. Deep brain stimulation (DBS) is an established and effective method of treatment of motor symptoms in PD. DBS delivers a constant low, electrical current to a small region of the brain through implanted electrodes. The aim of this study was to evaluate changes in iron metabolism in PD patients after DBS.

Methods: Examined group consisted of 18 patients with PD: 13 patients who underwent unilateral implantation of electrode in subthalamic nucleus (STN), 4 patients who underwent bilateral implantation of electrodes into the STN, and 1 who underwent unilateral thalamotomy, 3 patients with dystonia: 1 with unilateral GPi electrode implantation, 1 with bilateral GPi electrode implantation and 1 with pallidotomy, Another 1 patient with essential tremor who underwent thalamotomy. Iron, ferritin and transferrin blood levels were assessed before and at least 12 hours after the commencement of DBS or the day after surgery.

Results: The reduction of iron concentration after the electric stimulation was significant from 13,8 umol/l before to 7,7 umol/l on stimulation. After stimulation a significant rise of ferritin (from 146 ng/ml before to 181,3 ng/ml after)(p=0,023), significant reduction of transferrin concentration from 2,4 to 2,1 g/l (p=0,001) and reduction of transferrin saturation from 24,6% to 13,3% (p=0,001) were observed. In group of patients who underwent thalamotomy or pallidotomy there were no statistically significant differences in iron concentrations (17,4umol/l and 13,3umol/l; p=0,46), ferritin levels (168ng/l and 197ng/l p=0,7), transferrin levels before and after surgery (2,41g/l and 2,41g/l p=1,0) and transferrin saturation (29,8% and 22,7% p=0,54).

Conclusions: Alterations in iron metabolism can be seen after surgeries with implantation of neurostimulators and further with electric DBS, but are not observed after lesion surgeries without postoperative electric stimulation. Findings of this study indicate that DBS by delivering electric current, alternates the iron metabolism in PD patients. It could suggest that DBS not only improves motor symptoms, but may also influence on pathogenesis of this disease, which is associated with proper iron homeostasis.

P048: Stimulation on the boundary of anterodorsal STN and the area above the STN in a patient with Parkinson's disease and levodopa-induced peak-dose dyskinesia

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Keywords: Parkinson's Disease, Deep Brain Stimulation Of Subthalamic Nucleus, Levodopa-Induced Dyskinesia, Antidyskinetic Effect

Abstract:

The direct antidyskinetic effect of deep brain stimulation of the subthalamic nucleus (STN-DBS) in Parkinson's disease (PD) patients with levodopa-induced dyskinesia (LID) is provided by involvement of the white matter above the STN into the stimulation. For this purpose bipolar stimulation or monopolar two-contact stimulation with active contacts within the aforementioned structures is performed. We observed the direct relief of LID as well as appropriate antiparkinsonian effect by monopolar stimulation by one contact located on the boundary of anterodorsal STN and the area above the STN.

Methods: A 60-year-old woman with 6-year history of akinetic-rigid PD with on-of motor fluctuations and severe peak-dose dyskinesia (levodopa equivalent dose = 1580 mg/day) underwent bilateral STN-DBS procedure according to the standard stereotactic coordinates. Postoperative CT-MRI fusion demonstrated mild proximal dislocation of both electrodes in such a way that the most distal contacts were located on the boundary of anterodorsal STN and the white matter above the STN. The patient underwent monopolar stimulation using both most distal contacts (130 Hz, 60 msec, 2,5V). There were no adverse effects. The levodopa dosage was unchanged perioperatively.

Results: During the follow up pre-existing choreiform LID transformed into akathisia and after the first month of stimulation the complete control of LID was observed. Almost complete control of OFF-state motor symptoms and motor fluctuations was achieved. The patient's quality of life improved significantly. After two months of follow up the daily levodopa equivalent dose was gradually reduced to 300 mg/day.

Conclusion: Monopolar one-contact stimulation on the boundary of anterodorsal STN and the area above the STN was observed to induce direct relief of LID as well as appropriate antiparkinsonian effect.

P049: Electrode-Brain Interface in Globus Pallidus Internus Deep Brain Stimulation

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Keywords: Deep Brain Stimulation, Estimated electrical Field Density, Clinical Effect

Abstract:

Introduction: In this study we analyze the electrode-brain interface (EBI) in the globus pallidus internus (GPI) and the estimated electrical field density geometry and radial extension required to induce an internal capsule and optic tract clinical response.

Methods: A total of 184 electrode contacts implanted in the GPI were analyzed. The anatomical distance between the center of each contact and the optic tract and internal capsule was measured on the magnetic resonance image (MRI). Monopolar electrical stimulation was applied to elicit a clinical response from the internal capsule and optic tract. The threshold-distance data for the estimated electrical field *ET* (V/mm).

Results: Five contacts were excluded due to relatively high impedance. The mean distance between the distal contact and optic tract was 1.84 mm, and the mean distance from the electrodes' nearest contacts to the internal capsule was 3.4 mm. DBS stimulation parameters were at 60 us, 130 Hz, and monopolar mode. The clinical response threshold was 0.8 V/mm for optic tract and 1.2 V/mm for the internal capsule. The overall estimated isolevel of the electrical field that activated a clinical response around each contact was 2.4 mm at 1 volt stimulation.

Conclusion: This study revealed the extent of electrical field delivered from a cylindrical electrode contact. Utilizing an electrode with multiple small contacts to steer the electrical field toward the target can minimize the unintended stimulation side effects.

P050: Long term follow up of subthalamic deep brain stimulation for Parkinson's Disease confirms stability of Levodopa equivalent dose drug reduction

Authors:

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Keywords: subthalamic deep brain stimulation, parkinson's disease, drug reduction

Abstract:

Objectives: To determine the long-term levodopa equivalent dose (LED) drug reduction following deep brain stimulation (DBS) of subthalamic nucleus (STN) in Parkinson's patients.

Methods: Retrospective observational study of 106 Parkinson's disease (PD) patients who underwent bilateral STN stimulation between October 2002 and December 2014. Variables recorded included age, sex, first symptom, date of diagnosis of PD, duration of diagnosis at operation date, last clinical follow up. Also, the voltage, rate and pulse width of DBS in last clinical follow up were recorded. Medications at both preoperative and last clinical follow up were recorded and total LED dose in milligrams were calculated using Parkinson's disease measurement calculator.

Results: Of the 106 patients, 70 were male and 36 were female. The average preoperative total LED was 1352.13 mg and the post operative total LED was 618.86mg. The average percentage of drug reduction post DBS was 48.25 % at the last clinic follow up .The median period of follow up post DBS was 45.5 months (3.7 years, Range = 9.8 months (0.8 years) -154 months (12.7 years). Using Spearman's Correlation coefficients, there was a negligible correlation between the percentage reduction in LED and the duration of follow up (rho=-0.01, p=0.93) and also between the post-operative LED and duration of follow-up (rho=0.004, p=0.97). This implies that both the percentage reduction in LED and post-operative LED are maintained over time. Also noted was a weak, but non-significant positive correlation between the duration of diagnosis and the percentage of drug reduction (rho=0.17,p=0.139) implying that patients with longstanding disease had a greater percentage reduction in LED at the final follow up but statistically not significant.

Conclusion: Our study confirms that LED reduction does not change significantly in the long term for patient with STN DBS which suggests that DBS may have a protective neuro-modulatory effect.

P051: Widening possibilities in DBS for essential tremor: 8-contact-lead for cZI and vin aligned in the same trajectory

Authors:

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Keywords: Essential Tremor, Deep Brian Stimulation

Abstract:

Bilateral deep brain stimulation (DBS) of the thalamic Vim nucleus has been accepted as the standard treatment for essential tremor (ET), but results are limited by side effects such as speech impairment, ataxia and stimulation tolerance in long term¹; in extreme cases reoperation may be required². More recently, stimulation of the caudal Zona Incerta (cZI)³ emerged as a promising target for tremor control, aiming the ascending cerebello-rubro-thalamic fibers with encouraging results. We proposed bilateral implantation of 8-contact-electrodes aligning the VIM and the cZI in the same trajectory, offering multiple stimulation targets with no additional risk for the patient. The index case of refractory ET treated with bilateral double target DBS is presented here. A 65-year-old man diagnosed with ET for 49 years referred progressive functional impairment especially in the last 5 years. Action tremor was quite disabling, particularly when trying to perform simple daily tasks, such as grabbing a cup, using a fork or shaving. Stigmatizing tremor also compromised his professional activity as salesman. He scored 37/144 in Fahn-Tolosa-Marin Tremor Rating Scale (FTMRS) even receiving propranolol 40mg/day and primidone 700 mg/day limited by side effects. Bilateral DBS was proposed as a treatment option for the tremor, which was performed using 8-contact leads. The stereotactic planning included the Vim and the cZI in one straight trajectory in each side according to the anatomy of the region. As a single trajectory was performed in each side, no additional risk for the patient was taken. In the first 6 weeks, the therapeutic window (130Hz and 60µs) was tested in each of the contacts. Satisfactory tremor control was achieved with monopolar stimulation in upper contacts (Vim) and also in lower ones (cZI), with different profiles of adverse effects. Since the tremor control was outstanding and no significant side effects were observed at the level of cZi (monopolar stimulation in contact 3 as the cathode), we kept this as therapeutic stimulation for 10 months. The patient experienced close to full tremor control most of the time and we observed 86% improvement in global scores in FTMRS (5/144). Tremor amplitude in the dominant hand was also assessed by accelerometry (Lift Pulse Software - Lift Labs, USA) with 92.3% improvement when compared to no stimulation. Studies comprising more cases can determine which level of this complex region is best for tremor control.



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P052: 87 Deep Brain Stimulation patients with rechargeable battery. Selection criteria, follow up and satisfaction survey

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Keywords: Deep Brain Stimulation (DBS). Rechargeable Battery.

Abstract:

Background: Deep Brain Stimulation(DBS) has been traditionaly implanted with non rechargeable battery. Some groups argue that the implantation of the rechargeable battery is associated wiht difficulty to learn to handle it, pain in the moment of recharghing it and the much greater cost of the system. Nevertheless, the implantation of rechargeable battery since the electrodes are implanted for the first time, or in the replacement of the previous non rechargeable battery is increasing in some centers like ours.

Objective: To report clinical follow-up in 87 patients who underwent DBS with rechargeable battery. Criteria inclusion, follow up and satisfaction survey.

Methods: 87 patients between 13 and 77 years old,56% female,in a period of time between December 2012-February 2017 and follow up between 1-50 months, underwent DBS mainly for movements disorders, but also for psychiatric, epilepsy and pain illness. Based on diagnosis and calculating duration of the battery, relation between chest wall thickness and battery size and cost of the device to long term, patients received rechargeable battery most of them since the electrodes were implanted for the first time, but also as a second stage changing previous non rechargable battery. Surgeries were performed with Leksell frame, Surgiplan software, 3TMRI, microrecording, macrostimulation, all of it with awake patient in most of the cases. Sedation or general anesthesia was used for the battery implantation, all in one stage procedure. Satisfaction survey was applied focusing on the learning process to handle the battery, efficiency in the use of the battery, damages presented in the recharging device and side effect such as pain.

Results: All patients are adequately recharching the battery,55% by themselves, and the others by close relatives or caregivers. 87% learned to handle it within the first week,11% within the first month and 2% within the 3 first months after surgery.4% has had the battery at 0 charge one time.72% has full communication expressed in 8 cubes in black.5% have damaged part of the rechargeable system that was repaired in a timely manner. 15% have had minor pain or discomfort any time after surgery and 6% when they were charged. The most frequent areas of pain were: subclavicular area, right neck and shoulder.

Conclusion: DBS with rechargeable battery is easy to handle with minor damages in the system per se and manegeable pain. Long term it is less expensive. More cases and longer follow up should be carried out.

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P053: Altered Brain White Matter Integrity in Patients with Parkinson Disease Treated by Deep Brain Stimulation: A Tract Based Spatial Statistics Study

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Keywords: Diffusion tensor imaging, Deep Brain Stimulation, Tract Based Spatial Statistics

Abstract:

Introduction: Diffusion tensor imaging (DTI) is widely used in neurological and neuropsychiatric diseases, such as Parkinson's disease (PD). We intended to evaluate the effectiveness of white matter tract based spatial statistics (TBSS) generated from DTI in patients with PD in detecting differences in patient motor response to deep brain stimulation (DBS).

Methods: Six subjects with advanced PD from 55-66 years old were scanned for DTI protocol under anesthesia in a 3.0T Philips Achieva MR scanner before surgery. Motor scores (UPDRS-III) were collected before and after DBS (mean follow-up 5.9 months). The group was divided into two cohorts: patients with improvement in UPDRS-III after DBS; and patients without improvement in UPDRS-III after DBS.

The diffusion volumes were first corrected for eddy current distortions and motion artifacts. Diffusion tensor maps were computed from the pre-processed DTI volumes for each subject on a voxel-by-voxel basis using FSL FDT diffusion toolbox. Various DTI indices such as fractional anisotropy (FA), mean diffusivity (MD), and diffusion traces along main Cartesian axes (L1, L2, L3) were generated. To generate TBSS, all FA maps were aligned MNI space and FA skeletonisation was then applied to all FA images with a threshold of 0.2 set to only constrain analysis to highly anisotropic white matter tissue. Also, TBSS were applied to the none FA images (MD, L1, L2 and L3).

Results: Significant differences were identified between 'responders' and 'nonresponders'. In summary, FA shows high number of white matter skeleton voxels (4.23%) altered significantly between two groups of PD patients compared to the other DTI maps. Compared to the patients with low UPDRS-III score, FA shows significant increase in patients with higher UPDRS-III score or responders and diffusion trace along z direction shows significant decreases in patients with lower UPDRS-III score or nonresponders.

Conclusion: The results suggest that many regions of white matter pathology were altered differently and show the variability of DTI parameters related to the neuropathology of the PD patients. While the focus has generally been on the motor component of the cortico-basal ganglia-thalamo-cortical circuit, diffuse changes affecting the associative and limbic components may also play a role in DBS response. While studying all brain networks is not feasible, TBSS has potential to serve as an screening tool to identify regions of interest.

P053b: The use of rechargeable or non-rechargeable deep brain stimulation devices in parkinson's disease (PD) and dystonia: A cost analysis

Authors:

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Keywords: Deep Brain Stimulation, Parkinson's Disease, Dystonia, Rechargeable Device, Cost Analyses

Abstract:

Objectives: Deep brain stimulation (DBS) is a recommended option for the treatment of movement disorders in well-selected patients. Both rechargeable and non-rechargeable devices are available; one of the advantages of a rechargeable DBS device may lie in the avoidance of costs for battery replacements and associated risks and hospitalisations. The objective of this study was to evaluate the economic impact of using a rechargeable DBS device over a non-rechargeable device in patients treated for either Parkinson's Disease (PD) or Dystonia.

Methods: An economic model (Markov Model) was built to follow a group of dystonia and PD DBS patients over time comparing two scenarios, one assuming a rechargeable and one assuming a non-rechargeable device, for first implant and replacements. The model captures patients' replacement surgeries, hospitalisations, adverse events and deaths. Data for the model were sourced from the Medtronic product surveillance registry (PSR; patient characteristics, adverse events and consequences associated with implant and replacement surgeries) and non-rechargeable device longevity data from Medtronic performance registry based modelling analyses. For the rechargeable device longevity, current longevity (9 years) and a hypothetical longevity scenario (15 years) were tested. Clinical expert advice was used to inform model assumptions. Costs were estimated from a UK health care perspective. Sensitivity analyses were undertaken to test for parameter uncertainty, including time horizon.

Results: Results of the base case analysis (16 year time horizon) show:For PD,an average of 3.68 battery replacements in the non-rechargeable vs 0.62 in the rechargeable group; for Dystonia, 5.08 and 0.74 replacements in the non-rechargeable vs the rechargeable group(15-year hypothetical device longevity). Over 16 years, the model suggests cost savings of £15,564 (PD) and £27,954 (Dystonia) using the 9 year device longevity, and £20,418 and £32,060, respectively, for a 15-year hypothetical device longevity. Sensitivity analyses showed that over a patient's life time, cost savings were £28,450(PD) and £65,413(dystonia)(15-year hypothetical device longevity).

Conclusion: The use of a rechargeable DBS device in this model is cost saving in the long-term compared to a non-rechargeable device. Prolonging rechargeable device life to 15 years is predicted to reduce DBS treatment costs and would thus improve DBS therapy cost-effectiveness, for both PD and dystonia.

This analysis was funded by Medtronic. Simon Eggington, Katherine Stromberg, Silke Walleser Autiero and Todd Weaver are employees of Medtronic. Professor Paul Eldridge received compensation for his work providing clinical advice and review on this project.

P054: Deep Brain Stimulation for Depression: using an individual patient-level registry to explore patient characteristics and clinical outcomes

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Keywords: deep brain stimulation, psychiatric neurosurgery, depression, registry, outcomes

Abstract:

Objectives: There is now a significant body of published literature reporting the outcomes from Deep Brain Stimulation (DBS) for major depression (MDD). To explore patient characteristics, we constructed a patient-level registry based on reported studies between 2005 and 2017.

Method: Studies published reporting outcomes from DBS for MDD between 2005 and 2017 were included. All study types were included if patient outcomes were reported. Duplicate reporting was flagged so that reports of outcomes from the same patients could be excluded.

Results: The registry currently contains data for 234 patients from 25 studies. Of these, 171 patients from 17 published studies were unique. Patients who received DBS for indications other than MDD were excluded (N=11). The median number of participants in included studies was 7 (range 1 – 30). The mean \pm SD duration of follow-up was 12.8 \pm 5.4 months; and 41.1% of studies reported follow-up of less than one year. Countries with the most DBS electrode implantations were: USA (40.4%); Canada (29.3%); and Netherlands (14.6%). Gender breakdown was: males (41.5%); females (58.5%); unreported (19.5%). The mean age of onset was 27.2 \pm 7.1 years and the average age of surgery was 48.8 \pm 4.9 years. The average duration of the current depressive episode was 8.7 \pm 2.2 years. The most common targets for DBS were: CG25 (43.9%); VC/VS (25.7%); and ALIC (14.6%). Other targets made up 15.8% of cases. The mean baseline HRSD-17 score was 24.4 \pm 3.5, indicating symptoms in the severe range. However, 32.1% of patients had baseline scores in the 'moderate' range. The surget of failed antidepressant trials was unreported in 56.1% of cases. Most (67.3%) had previously had ECT, but 6.4% had not. This was unreported for 26.3%. Comorbidity was poorly reported. Axis I comorbidity is not reported in 84.2% of cases. Although personality disorder is reported in 5.9%, it is unreported in 70.2% of cases. The overall response rate was 40.4%, but 53.2% did not respond. The response status was not known in 6.4% of patients.

Conclusion: Inconsistent reporting of baseline patient characteristics means that there is uncertainty about comparability of DBS patients to ablative neurosurgical patients in terms of severity. It is still unclear what the optimum target is and further work is required to determine this. Patient characteristics remain poorly reported and this limits generalisability to patients for whom neurosurgery may be considered.

P055: Changes in Interpersonal Functioning following Bilateral Anterior Cingulotomy (ACING) or psychological therapy for chronic, treatment-refractory Depression

Authors:

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Keywords: Psychiatric Neurosurgery, Anterior Cingulotomy, Psychological Therapy, Interpersonal Functioning

Abstract:

Objectives: Interpersonal dysfunction is a core component of depressive illness but is poorly studied or understood. Here, we report profiles of interpersonal functioning in 16 patients undergoing anterior cingulotomy (ACING) for chronic depression and compare them with 42 patients undergoing a specific psychological therapy developed for chronic depression.

Methods: The 64-item Inventory of Interpersonal Problems (IIP-64) is a self-report measure of difficulties that people encounter in their interpersonal relationships. The IIP-64 assesses interpersonal problems in eight specific domains of interpersonal functioning. The Total T-score reflects the overall burden of difficulties. Sixteen patients undergoing ACING completed the IIP-64 at baseline and 12-months following surgery. This group was compared to 42 patients with chronic depression who underwent a course of psychological therapy (CBASP). The outcome measure in both groups was change on the 17-item Hamilton Rating Scale for Depression (HRSD-17). Response was defined as ≥50% improvement from baseline score. We compared changes in scores on the IIP-64 in relation to changes in symptom burden and response to both treatments. Total T-score post-treatment were compared between responders and non-responders for both groups. Finally, we attempted to relate change in depressive symptoms to changes in interpersonal functioning.

Results: Sixteen individuals (M:F - 1:15) underwent ACING. The mean \pm SD age was 48.9 \pm 8.3 years. The mean \pm SD baseline HRSD-17 score was 28.6 \pm 4.9. Forty-two patients (M:F ratio 9:33) received CBASP. The mean \pm age was 51.0 \pm 9.8 years. The mean \pm SD baseline HRSD-17 score was 20.5 \pm 4.7. In the ACING group, 7 (43.8%) were responders. In the CBASP treated group, 13 (31.0%) were responders. In all responders, there was a statistically-significant correlation between change in HRSD-17 score and change in IIP-64 total score: ACING (Pearson's *r*=0.896, P=0.006); CBASP (Pearson's *r*=0.599, P=0.03).

Conclusion: Following **both** neurosurgery and psychological therapy, responders showed changes in interpersonal functioning that were not seen in non-responders. In responders, there was a relationship between change in symptoms and change in interpersonal functioning. There was no evidence of deterioration in interpersonal functioning following ACING; even in non-responders. It is likely that improvements in interpersonal functioning are mediated by a common factor – improvement in depressive symptoms.

P056: Prospective Care Planning for Patients Receiving Neurosurgical Treatments for Depression: Essential For Optimised Outcomes

Authors:

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Keywords: Psychiatric Neurosurgery, Anterior Cingulotomy, Vagus Nerve Stimulation, Care Planning

Abstract:

Objectives: Care planning is an important component of the pathway for individuals undergoing neurosurgical treatment for depression. All patients have prolonged histories of ill health and are typically embedded within complex networks of care and support. We developed audit criteria to assess whether our care planning was consistent with WSSFN Consensus Guidance (Nuttin et al, 2014). Here we describe the operationalisation of this process.

Method: We designed a care-planning audit tool focusing on eight key domains: multi-disciplinary involvement; immediate postop period; focus of treatment; engagement with patient; collaboration between neurosurgical service and local services; consistency of follow-up; adherence to care plan; and frequency of contact. These domains reflect the care planning of both our service *and* the patient's locality mental health services.

Pre-operative care plans and adherence at 12-month follow-up were rated for 27 anterior cingulotomy patients and 5 Vagus Nerve Stimulation patients. We compared two time periods: 1999-2008 (21 procedures); 2010-2015 (15 procedures) to examine changes over time. We also compared scores between procedures.

Results: Highest scores were seen in the 'consistency of follow-up' domain, which reflected consistency in key healthcare personnel. Next highest scores were in the 'frequency' domain, indicating that patients were seen regularly in the 12-months following surgery. Lowest scores were seen in the 'adherence to care plan' and 'immediate post-op period'.

Scores on 'adherence to care plan' reduced a little over time, whilst the domains that showed improvement were: 'immediate post-op period; and 'focus of treatment'. Scores for ACING patients were higher than scores for VNS.

These findings suggest that there are consistent challenges relating to care planning but that more structured approaches by neurosurgical services may help to overcome these difficulties.

Conclusion: Care planning is vital and has the potential to impact upon patient outcomes. Whilst neurosurgical services may not be able to control all aspects of care provided by other services, we clearly have a role in establishing explicit, realistic, and collaborative care plans for patients undergoing neurosurgery. We are now developing standards for care planning that we can use in discussions with local services when planning care for patients undergoing psychiatric neurosurgery. We will audit against these new standards in the future.

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P057: Oculomotor side effects due to deep brain stimulation of the medial forebrain bundle: tractography analysis

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Keywords: DBS, Medial Forebrain Bundle, Tractography, Diplopia

Abstract:

Background: Deep brain stimulation (DBS) to the superolateral branch of the medial forebrain bundle (MFB) has been reported to incur rapid anti-depressant effects (Schlaepfer et al., 2013, Fenoy et al., 2016). Diplopia is a side effect often experienced when programming. We sought to identify modulated fiber tracts associated with diplopia so they can be avoided and targeting improved.

Methods: 6 patients were implanted with electrodes targeting their individually mapped MFB. Optimal parameters resulting in anti-depressant effect were 1+2-3-, 130 Hz, 60 µs, 3-4V; stimulation of electrode contact 0 resulted in diplopia in every patient at 1V. The volume of tissue activated (VTA) was estimated using cathodal contact parameters; this was used as the seed region in deterministic fiber tracking to identify modulated fiber tracts.

Results: Use of contact 0 as a seed region revealed modulated tracts that were in proximity to atlas-defined oculomotor fibers. These tracts were consistently ventral and dissociable from those correlated with anti-depressant effect. Both sets of modulated fibers traversed the targeted MFB region. Mean coordinate of contact 0 was (5, -2.5, -9); contact 2 was (5.2, -0.5, -5).

Conclusion: Modulated fibers that incurred diplopia were consistently ventral to those producing anti-depressant effect. More rostral targeting within the MFB region is preferable. It is unlikely that current steering would improve side effect avoidance with Z as the critical dimension.



FIGURE 1

Depiction of modulated fiber tracts (assuming an isotropic model (Butson et al., 2007)) from cathodal contacts at specified parameters in 2 example patients. Deterministic fiber tracking using StealthViz software (Medtronic) was used to draw the target MFB region (Coenen et al., 2012) and then again for post-hoc analysis. Post-op CT showing positions of Medtronic 3389 DBS electrode contacts was merged onto pre-operatively obtained dTI-MRI.

(A,B,C) and (D,E,F) depict coronal, axial, and sagittal orientation of modulated fiber tracts of 2 patients, respectively. Modulated fibers using optimal stimulation parameters for antidepressant effect (130Hz, 60μs, 3.5V) using contact 2 as a seed region (red) are rostral and dissociable to those modulated by contact 0 (blue) at 130Hz, 60μs, 1V which incur diplopia.

Crosshairs are at therapeutic contact 2 for each patient.

P058: Metabolic Brain Networks in Parkinson's Disease Patients with Depression Symptom Based on 18F-FDG PET Imaging

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Keywords: PET, Parkinson's Disease, Depression, Functional Imaging, Glucose Metabolism

Abstract:

Objectives: Parkinson's disease (PD), characterized by loss of dopamine neurons in the substantia nigra (SN) and the subsequent deficiency in striatal dopaminergic system, is the second most common neurodegenerative disorder with a frequent comorbid symptom of depression. Drawing the brain metabolic pattern of PD may help to target the core biological and psychological features of the psychiatric comorbidity and to the diagnosis and recovery criteria. In this study, we use ¹⁸F-FDG PET to show brain metabolic network for Parkinson's Disease-associated depression.

Methods: Glucose metabolism in 21patients and 17 age-matched healthy controls were studied using ¹⁸F-FDG PET. SPM was used to compare brain metabolism in PD patients with depression with that in healthy controls.

Results: The SPM (statistical parametric mapping) analysis showed hypermetabolism in the putamen (bilateral), the globus pallidus (bilateral), lentiform nucleus (bilateral) and striatum compared with the controls (P < 0.01). PD patients with depression had bilateral area of hypometabolism in the frontal lobe, temperal lobe and parahippocampal gyrus compared with healthy controls. (P < 0.01).

Conclusion: The changes in brain glucose metabolism illustrated the brain metabolic pattern in PD patients with depression. Furthermore, the pattern went accordance with the severity of depression. The regions with altered metabolism could interconnected to form a network and integrate information related to depression in PD patients. Our study may provide information for targeting the potential candidate brain regions for understanding the pathophysiology of depression in PD patients and assessing the severity of the illness.

P059: Temporal dynamics of local field potential activity recorded in the ventral tegmental area and the nucleus accumbens in the flinders sensitive line rodent model of depression

Authors:

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Keywords: Depression, Electrophysiology, Local Field Potential, Mesolimbic, Medial Forebrain Bundle, Nucleus Accumbens,

Ventral Tegmental Area, Rodent

Abstract:

Depression is a common disorder and comprises the leading cause of disability worldwide. Within the limbic circuitry passing through the medial forebrain bundle (MFB), the mesolimbic pathway is particularly implicated in the pathophysiology of depression, since it is associated with reward, aversive learning, social behavior, and addictive behavior. It is known that, in rodents, specific dopaminergic cells from the ventral tegmental area (VTA) project to the medial shell of the nucleus accumbens (NAc). Furthermore, appetitive motivation for rewards and fearful motivation toward threats are organized in circuits arranged in an environment-dependent keyboard fashion in the NAc medial shell. However, if and how this circuitry is altered in depression is not yet understood.

In order to detect electrophysiological signatures associated with a depressive phenotype, we recorded local field potentials (LFP) in the VTA and NAc medial shell of control (Sprague-Dawley) and Flinders Sensitive Line (FSL) rats using stereotactically inserted bipolar concentric electrodes. Recordings were performed at several time points in vivo, during free behavior, both while the rats were in their usual home environment and in a stressful environment. Correct electrode placement was evaluated through histological analysis.

The data are currently being analyzed using time-frequency domain and connectivity analysis techniques in MATLAB and will be presented at the meeting. Between-group and within-group comparisons are being performed for both home environment and stressful environment conditions. Early assessment suggests differences across the groups in the VTA and NAc power spectra and connectivity measurements, differences which are accentuated in the stressful environment.

The data point towards altered electrophysiological activity in a rodent model of depression in neural structures associated with major depressive disorder and provides guidance to future studies that will integrate LFP recordings with electrical and optogenetic stimulation of the MFB in the FSL rat.

P060: Optogenetic stimulation of the MFB in the Flinders Sensitive Line rat model of Depression with an Intact vs. a Depleted Dopamine-System

Authors:

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Keywords: Optogenetics, Medial Forebrain Bundle, Model of Depression, Dopamine

Abstract:

Major Depression is a common, multifactorial psychiatric disease with heterogeneous symptoms, including anhedonia and reduced motivation. These symptoms are associated with the dysfunction of the limbic circuitry in the brain. The dopaminergic neurons of this circuitry are involved in reward and motivation, and targeted for the treatment of depression. Modulation of these neurons by antidepressant medication or the pathways with Deep Brain Stimulation can reverse a depression-like phenotype in rodents. Nevertheless, mechanisms of the disease and the therapeutic effects of stimulation are not understood.

In this study, we used optogenetic stimulation of the medial forebrain bundle (MFB) as a treatment attempt in a rodent model of depression, the Flinder's Sensitive Line (FSL) rat. The FSL rat has been bred selectively for more than 25 years and shows a depressive-like phenotype due to decreased BDNF levels, decreased 5-HT synthesis, hyperactive HPA-axis and more.

FSL rats with an intact dopamine system (DA+) were compared with rats that received a bilateral 6-OHDA lesion of the Nucleus accumbens (DA-), depleting the reward circuitry. The effect of the stimulation in depleted vs. intact animals was investigated in freely moving rats in a number of behavioral tests. Animals of the stimulation groups received 30 min of light stimulation directly prior to each behavior test. The behavior was tested using the sucrose preference test, forced swim test, social interaction test, open field test, ultrasonic vocalization and activity measurements, induced by amphetamine or stimulation.

Results show an increase in amphetamine-induced activity in both groups, but the effect is much less prominent in the DAgroups, confirming the partial lesion. Activity is also enhanced by stimulation of the MFB. Stimulation increased the track length in the open field in all groups, but the track length in the center zone was only increased in the DA+ group. Besides, stimulation of the MFB enhanced social interactions in the DA+ group.

The increased activity due to stimulation of the MFB and the observed exploratory behavior of the rats indicate a robust SEEKING (enhanced drive) response, thus an activation of the brain reward circuitry. Extended track length in the center zone of the open field and increased social interactions only in the stimulated DA+ group point towards an important role of the dopaminergic part of the limbic system in possible treatments for Major Depression.

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P061: Deep Brain Stimulation for Dystonia - Pallidal stimulation and thalamic stimulation

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Keywords: Dystonia, DBS, GPi, Thalamic Vo nucleus

Abstract:

Background: Deep brain stimulation of globus pallidus internus (GPi-DBS) has proved efficient in primary dystonia and some secondary dystonias. However, 15% to 20% of dystonia patients underwent GPi-DBS respond to this therapy insufficiently. Exploration of alternative DBS target is important to provide further treatment. We have performed stimulation or ablation of thalamic Vo nucleus for focal hand dystonia and some generalized dystonia, in addition to GPi-DBS. Here, we report the clinical featrures of patient with dystonia underwent GPi-DBS and Vo-DBS/ablation.

Method: A total of 46 patients with dystonia underwent DBS from 2003 to 2014 at Tokushima University Hospital. All patients were assessed every one to three months after surgery. Motor symptoms of dystonia were assessed by the Burke-Fahn-Marsden Dystonia Rating Scale (BFMDRS).

Results: Forty-four patients underwent only GPi-DBS (GPi group) and six patients underwent GPi-DBS followed by thalamic Vo surgery (GPi+Vo group). The improvement ratio of BFMDRS after surgery was 54% in the GPi group, and 67% in the GPi+Vo group, four of six were focal hand dystonia (FHD), and two of six were primary generalized dystonia (DYT-6 and sporadic dystonia).

Discussion: In 2005 and 2006, two multicenter randomized controlled trial proved GPi-DBS has the efficacy in primary generalized/segmental dystonia. However, recent reports revealed the presence of the poor responders to GPi-DBS by limitation of therapy due to the stimulation related side effect, and by a pathogenetic reason such as DYT-6 positive. Although it is known that thalamic Vo-DBS is effective for FHD, in our case, DYT-6 dystonia also well responded to Vo-DBS. Recently, the genesis of dystonia has been suggested to be associated with altered activities, not only of the basal ganglia, but also of the cerebellum. In the Vo-complex nucleus, the Voa is largely associated with the pallido-thalamic pathway while the Vop is with the activities of not only the pallidal pathway but also the cerebellar pathway at the thalamus level. We suggest that the thalamic Vo-complex nucleus could serve as an alternative target for some generalized dystonia with a relation to the cerebello-thalamic pathway as well as FHD.

P062: Experience on surgical treatment of dystonia in Nepal

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Keywords: Dystonia, Pallidotomy

Abstract:

Introduction: Medical treatment of dystonia is very complex and sometimes unsuccessful. Surgical treatment like thalamotomy, pallidotomy and Deep brain stimulation (DBS) can be beneficial for the patients.

Methods: Two cases of dystonia have been treated surgically in Annapurna Neurological Institute and Allied Sciences in last two years. First case is a case of 47 years old lady with tardive dystonia who underwent bilateral GPi(Globus Pallidus Interna) pallidotomy under local anesthesia. Her preoperative Burke-Fahn-Marsden Dystonia rating score(BFMDRS) was 36/123. There were no postoperative complications and her postoperative BFMDRS was 1/123. There was no recurrence in two years follow up period. Second case is a 48 years old male with primary dystonia involving the neck and trunk muscles. His preoperative BFMDRS score was 42/123. He neither responded to medical treatment nor to botulism toxins. He also underwent bilateral GPi Pallidotomy under local anesthesia. His postoperative BFMDRS score was 2/123. This patient developed mild dysarthia after surgery and it is improving with time. There is no recurrence of symptoms in nine months follow up period.

The standard functional targets were used. Then fusion of MRI(3 Tesla Philips) and CT (1 slice Siemens) stereotaxy(with ZD Fisher frame) was used and it was reconfirmed with the inbuilt Schaltenbrant Atlas. Total eight lesions were made in each side with 70 degree centigrade for 40 second each using Cosman Radiofrequency (RF) generator and the lesioning probe was 1 mm in diameter with 2 mm exposed tip. Continuous monitoring of motor symptoms and visual symptoms were done during the surgery.

Results: The patients' dystonia improved in terms of BFMDRS score and there were no major postoperative complications.

Conclusion: Patients with dystonia can benefit from bilateral GPi pallidotomy but GPi DBS is also an alternate option for affordable patients.

P063: Botulinum Toxin Injection for the Treatment of Hemifacial Spasm-Technical Note

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Keywords: Botulinum Toxin, Hemifacial Spasm, Outcome, Ptosis

Abstract:

Objective: To introduce the botulinum toxin injecton technique on the periocular area for the treatment of hemifacial spasm and report the treatment results.

Materials and Methods: Thirteen sessions with five patients were performed with botulinum toxin therapy injected to the periocular area. Botulinum toxin was injected at four sites on the affected side at a dose of 2.5 unit botulinum toxin per site.

Results: All treated patients had symjptom improvement. The degree of improvement measured on the visual analogue scale was 89.3%, and the average duration of the effect was 6.3 months. One patient had ptosis after his third session.

Conclusion: Botulinum toxin therapy is effective for the treatment of hemifacial spasm. Our patients were satisfied with the treatment results. Ptosis is the most common complication reported in the literature, but it can be avoided by preventing the spread of neurotoxin after the injection and avoiding inadvertent injections.



P064: Clinical outcomes after pallidal Surgery for Secondary dystonia

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Keywords: Secondary dystonia, clinical outcomes, Surgery

Abstract:

Secondary dystonia is extremely disabling affecting the quality of life of the individual as well as the caretaker. Multiple treatment options are aimed at improving physical ability. Treatment options for generalised, hemi-dystonia or segmental dystonia are limited. Lesioning and /or Deep Brain Stimulation have become the treatment of choice for primary dystonia. The results in secondary dystonia are variable. We share our experience of patients with secondary dystonia including, clinical details, technical difficulties, complications and outcomes.

Materials: Nineteen patients with secondary dystonia were analysed. The clinical picture varied from inability to swallow, breathing difficulties, inability to sit, oromandibular dystonia, truncal dystonia and deformities. The patients were evaluated with standardised rating scales and treatment planned in consultation with the team. Patients underwent either lesioning or Deep Brain stimulation. The targets were either in the globus pallidus interna and thalamus, decided after team discussion. Quality of life and outcomes were analysed.

Results: The clinical improvement in secondary dystonia is not as good as in primary dystonia. The quality of life improved in segmental dystonia and in some cases of generalised dystonia. Generalised dystonia secondary to hypoxic ischemic damage did not show any significant improvement.

Conclusion: Clinical outcomes are variable in secondary dystonia though not as rewarding as in primary dystonia.

P065: Long-term follow-up after Deep brain stimulation of the VOA (Nucleus oralis anterior thalami) for Dystonic-jerkyunsteady-hand-syndrome

Authors:

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Keywords: DBS, VOA-Stimulation, Poststroke Dystonia

Abstract:

Objective: In the literature data of deep brain stimulation for post stroke dystonia are rare, particularly for long-term outcome. Due to disappointing benefits after single target stimulation multiple targets are discussed.

Methods: We report one patient with a dystonic-jerky-unsteady-hand-syndrome, who presented with hyperkinetic movements of the right arm. MRI showed small explaining lesion in the left ventroposterior thalamus and additional small lesions in the cerebellum. Due to failure of noninvasive therapies we have planned the unilateral stimulation of the left VOA and supplementary the GPI in standby. The surgery was performed using stereotactic MRI and multiple trajectories for micro recording and macro stimulation under local anaesthesia in 2008.

Results: Intraoperative we found good thalamic activity on the trajectory of the VOA. A good reduction of the symptoms was shown under macro stimulation without relevant side effects. Owing to the impressive effect the GPI-stimulation wasn't performed. Under permanent stimulation improvement with complete reduction of tremor and dystonic movements was achieved from first day of stimulation and meanwhile in the nine year follow-up. No adapting of stimulation parameters was necessary. Patient is absolute independent in every day's life and ongoing on work.

Conclusion: We conclude that the deep brain stimulation of the VOA could be an effective method for the long-term treatment of post stroke tremor and dystonia with outstanding economic importance.

P066: Complications of deep brain stimulation for secondary dystonia in the early postoperative period (30-day morbidity): experience in 49 patients

Authors:

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Keywords: Complications, DBS, Dystonia

Abstract:

Objective: Deep brain stimulation (DBS) has been shown to be efficacious in the treatment of primary dystonia (idiopathic and inherited dystonia). There is less experience in, however, secondary dystonia (acquired dystonia). Since patients with secondary dystonia, who are often more disabled, may be more vulnerable to postoperative complications we aimed to investigate the 30-day morbidity in a large cohort of patients with secondary dystonia operated over a period of 19 years.

Methods: From 1997 until 2016, a total of 49 patients (27 women and 22 men; mean age 43,5 years (range 13-77)) with secondary dystonia underwent DBS with electrodes implanted either in the thalamic Nucl. ventralis intermedius (Vim) or the posteroventral lateral globus pallidus internus (GPi). Most frequent cause of for dystonia was cerebral palsy in 17 patients.

Results: There were no intraoperative complications or complications in the early postoperative period related to surgery. The electrode location was corrected in 2 instances. Two patients developed a wound infection, one patient had a subdural hematoma and subcutaneous collection of cerebrospinal fluid (CSF). Three weeks after DBS the subdural hematoma and CSF resolved.

Conclusion: The 30-day morbidity rate in DBS for secondary dystonia is comparable to that in primary dystonia. DBS surgery may be offered to patients with secondary dystonia without concerns about higher morbidity.

P067: Long term follow-up in Mohr-Tranebjaerg syndrome after pallidal stimulation

Authors:

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Keywords: Mohr-Tranebjaerg Syndrome, DBS, Pallidal Stimulation

Abstract:

Objective: Pallidal deep brain stimulation (DBS) has been established as a treatment option in patients with medically refractory dystonia. Mohr-Tranebjaerg syndrome (MTS) or Dystonia-Deafness-Syndrome is a rare genetic disorder characterized by deafness, dystonia and neurological abnormalities like impaired vision, dementia and cortical blindness. So far little is known about the efficacy of DBS in MTS.

Methods: A 44-year- old man with a history of generalized dystonia, deafness, visual blindness, ataxia and tremor was diagnosed with MTS which was confirmed by genetic analysis. He underwent bilateral stereotactic implantation of DBS electrodes in the posteroventral lateral globus pallidus internus (GPi). Electrode location was confirmed by postoperative stereotactic CT.

Results: Bilateral pallidal stimulation yielded modest improvement of dystonia at 6-months follow-up. During the next four months there was an increase of tremor and ataxia. The initial benefit was lost within the next two years. Extensive reprogramming did not yield additional improvement. After three years of chronic stimulation it was decided to switch off the pacemaker because of loss of efficacy.

Conclusion: It is important to check for the genetic background in patients with unusual clinical symptoms. As opposed to inherited isolated dystonia, patients with MTS may achieve little benefit from pallidal DBS.

P068: Case series of deep brain stimulation of globus pallidus internus as therapy for dystonic storm in a single center in Colombia

Authors:

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Keywords: Deep brain Stimulation, Status dystonicus, Dystonic Storm.

Abstract:

Introduction: Dystonic Storm (DS) is a life-threatening complication of dystonia characterized by sudden and persistent episodes of dystonic movements that become increasingly frequent and severe, requiring urgent hospital admission, leading to respiratory, metabolic and bulbar complications^{1,2}. Pharmacologic treatment has been the mainstay management, however, many refractory patients will still require further treatments. Deep brain stimulation (DBS) of bilateral globus pallidus internus (GPi) is an interesting therapeutic strategy that has been used for dystonia and now it has been proposed to be used for DS.

Case series: We describe 5 cases (Two pediatric and three adults) with DS, admitted to our institution that required emergent placement of a bilateral GPi DBS to control their symptoms (Table 1). Dystonia etiology was identified as secondary in two of them (cerebral palsy with dyskinetic predominance), other case with a genetic syndrome, and two cases continue in studies for primary genetic causes. All five patients coursed with dystonic movements of different body regions including neck, extremities and trunk that interfered with ambulation. Severity was measured with the UDRS scale. Precipitating factors were identified in two cases (superior airway infection and electrode dislocation). Pharmacologic therapy wasn't effective in any of the cases and ICU admission was necessary before surgery. Before discharge, symptomatic relief (diminution of dystonic movements and resolution of abnormal postures) was achieved in all five patients in a mean period of 6,6 days (1,6 days adults, 14 days pediatric).

Discussion: DS treatment is challenging. As reported by Fassano et al. in 89 cases of DS, pharmacological therapy was used as first line treatment in 82.4% of cases, ceasing DS only in 9 cases (10.1%), while surgery [either DBS (13 cases) or ablations] was used in the 30.2% of cases being effective in the 33.7% of these events¹. In our case series, pharmacologic therapy wasn't sufficient to abort DS and DBS placement in bilateral GPi was effective for symptoms control.

Conclusion: GPi DBS can be a suitable, versatile, reversible and adequate therapy of DS. Further research is needed to establish adequate criteria in respect of the proper moment of implantation, initial and follow-up parameters configuration changes as well as concomitant pharmacological therapy.

P069: Dystonic status in a 10-year-old patient with dystonic cerebral palsy and a previously implanted deep brain stimulation: case report

Authors:

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Keywords: Deep brain Stimulation, Status dystonicus, dystonic cerebral palsy, Electrode migration.

Abstract:

Introduction: Deep brain stimulation (DBS) devices may be used for refractory dystonia, which do not respond to medical management⁴.Despite it is not widely used, this surgery is becoming a more common practice because it can be safely performed as a last resort. This is one of the few reported cases of SD in a child with a DBS previously implanted.

Case Presentation: A 10-year-old boy with a previous history of perinatal kernicterus and mixed cerebral palsy, developed progressive dystonic symptoms over the course of a year.He began to have markedly cervical and trunk spasms; extension of upper right limb appeared, which lead to dystonic posture.Furthermore, he was developmentally disabled and progressed to becoming wheelchair bound. At age 5, bilateral DBS electrodes were placed into the Globus Pallidus Internus (GPi). The patient was admitted to our pediatric emergency department with feeding problems and worsening of dystonic movements in the upper limbs and a painful opisthotonic posture. UDRS scale was 42. CT-scan-findings revealed bilateral electrode displacement of 2.5mm from both GPi.Three days following admission, he underwent bilateral replacement of GPi DBS, with a new system. Targeting the nucleus was made using direct technique, because of important discrepancy between coordinates, functional brain atlas and kid's brain. Subsequently, stimulation was titrated to an amplitude of 2.0mAmp, a pulse width of 100mcseg and a frequency of 130Hz, afterwards he was transferred to the ICU.The patient improved completely on POD-7 and was discharged home on POD-21.

Discussion: SD is a life-threatening-condition usually related to metabolic disturbances, surgery, infections or changes in medication³. In our case, we believe that migration of the electrodes triggered a SD. A European cohort reported 2,3 % cases of electrodes displacement, with 4,6% of the cases associated to dystonic status². Several causes have been theorized to explain electrodes upward migration. Brain shift, steady growth of the patient, dystonic movements of the head and neck and surgical errors are the most common causes involved¹. Dislocation of the device causes gradual loss of stimulation efficacy.

Conclusion: DBS electrodes displacement is a rare condition which neurosurgeons seldom see.Despite its infrequency, it must be considered in cases of worsening dystonic movements, with prior successful DBS implantation, especially in the pediatric population.



Figure 1. Comparative neuroimaging showing the location of deep brain stimulation leads, at initial implantation and 5-years later, evidencing bilateral electrode displacement of 2.5 mm from both GPi. A) Initial axial CT scan B) Initial coronal CT scan C) Initial sagittal CT scan D) 5-years follow up axial CT scan E) 5-years follow up coronal CT scan F) 5-years follow up sagittal CT scan

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P070: Comparative Study Between The Outcomes of Neuroablative And Neuromodulation Techniques In The Treatment Of Secondary Dystonia

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Abstract:

Background: Secondary dystonia are the syndromes that have dystonic symptoms due to brain insult which can be associated with neonatal encephalopathy syndromes, trauma, vascular injury, infections, demyelinations, or hereditary disorders associated with neurodegenerative process. The disability inflected by dystonia encouraged the development of many neurosurgical procedures in order to improve the quality of life of these patients. The aim of this study was to compare the outcomes of different Neuroablative and modulation techniques in treatment of secondary dystonia.

Methods: This is a prospective study included 80 patients suffering from intractable secondary dystonia. Ablative techniques included the brain lesioning procedure and combined anterior and posterior lumbar rhizotomy (CAPR). Modulation techniques were deep brain stimulation (DBS). Patients with generalized dystonia were included in either of the brain lesioning or the deep brain stimulation, and patients with predominant affection of both lower limbs were included in the (CAPR) group. Assessment measures included the evaluation of the muscle tone, range of motion, and the Burke-Fahn-Marsden dystonia rating scale through a follow up period of one year.

Results: Muscle tone was significantly reduced in the ablative techniques, but the changes in the DBS group were not significant. The range of motion improved in all groups; the changes were significant in the ablative techniques but were not significant in the DBS group. The BFMDRS showed improvement in all groups, the changes were significant in all groups except the DBS group.

Conclusion: Both neuroablative and neuromodulation techniques have the beneficial impact on secondary dystonias especially with stationary neurological pathologies with no significant statistical difference between both techniques. While the neuromodulation techniques had the advantages of being adjustable, titratable, reversible, and can be performed bilaterally.

P071: Deep brain stimulation of the internal globus pallidus in dystonia- predominant paroxysmal nonkinesigenic dyskinesia

Authors:

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Keywords: Deep Brain Stimulation, Paroxysmal Dystonia, Globus Pallidus, Nonkinesigenic Dyskinesia

Abstract:

Paroxysmal nonkinesigenic dyskinesia (PNKD) is a rare inherited movement disorder characterized by sudden episodes of dystonia, chorea, ballism or a combination of these, precipitated by several stimuli but not by movements or physical effort. We report a 19 year-old man with treatment-refractory PNKD since the age of 4 with daily severe episodes of generalized dystonia who displayed a successful outcome 6 months after bilateral globus pallidus internus (GPi) deep brain stimulation (DBS). Baseline severity and improvement in motor function was evaluated using the UDRS for his constant dystonic features and during the paroxysmal events. Two 3387- Medtronic electrodes were implanted under microrecording and semi-macrostimulation with patient awake, and connected to an ACTIVA RC pulse generator. The stimulation was turned ON three weeks after the implant. At 6-months follow-up with stimulation On, fixed dystonia severity reduced 43% in the UDRS score from preoperatory baseline (50 vs. 28). The total UDRS score during the paroxysmal generalized dystonia. These events disappeared during the immediate weeks after the implant of the electrodes; they came back at the end of week 3. After 2 weeks of turning the stimulation On, the severity of the paroxysmal dystonic episodes reduced 46.5% (86 vs 53.5%) with a progressive reduction in their frequency until the total disappearance of the paroxysmal events after 4 months On- stimulation. No major adverse effects were recorded. Bilateral GPi- DBS resulted in a complete control of the paroxysmal dystonia events, including the severe axial features, with no neurological complications.

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P072: Significant functional improvement in a patient with Myoclonus Dystonia after unilateral and simultaneous Vim thalamotomy and posteroventral pallidotomy

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Keywords: Myoclonus Dystonia, Thalamotomy, Pallidotomy, Radiofrequency Lesion

Abstract:

Myoclonus- dystonia (MD) is a severe movement disorder with a negative functional impact due to its severity and poor pharmacological response. Bilateral deep brain stimulation (DBS) has been used to treat MD patients, targeting the GPi, the Vim or both targets simultaneously. No reports of radiofrequency lesions have been described in recent literature due to the limitations of a unilateral approach. We present a case of a right-handed 19 year-old girl, with severe hereditary myoclonus dystonia who had simultaneous left-side Vim thalamotomy (VimTh) and posteroventral pallidotomy (PVP), who showed a significant benefit in postoperatory functional scores. Motor improvements were evaluated with rest/action and total subscores of the Unified Myoclonus Rating Scale (UMRS), functional improvements with the patient questionnaire and functional test subscores of the UMRS, Dystonia severity was evaluated with the Unified Dystonia Rating Scale (UDRS), preoperatively and 6 months after surgery. At 6-months follow-up, myoclonus improved 60% in the total UMRS score. The motor improvement in the right limbs using rest and action subscores was 98%, with no benefit observed in the left side limbs. Functional improvement was highlighted by the right side benefit obtained, with a 74% improvement in the overall functional tests, and a 94% improvement if the left hand spiral score was drawn out of the sum. The patient perception of improvement was 92% according to the patient questionnaire subscore of the UMRS. The severity of dystonia reduced 38% according to the total UDRS; the subscore for right shoulders, hip and limbs displayed a more significant improvement with a 79% severity reduction, with no benefits observed in left side hemi-body. No major adverse effects were recorded. Improvements are consistent with those reported in DBS cases. We did not find any limitations in functional benefits with this unilateral procedure, since the largest improvement was directed towards the dominant side of the patient. The combined approach of VimTh and PVP allowed us to reach a better control not only in the dystonic features but also in the severity of the myoclonus with no neurological complications. Unilateral and simultaneous radiofrequency Vim thalamotomy and posteroventral pallidotomy are safe and highly effective in patients with MD, with a profound positive impact in motor severity and functional scores when aimed at the dominant side.

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P073: Pallidal oscillation in a patient with posttraumatic secondary dystonia

Author:

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Keywords: Pallidal DBS, Local Field Potential, Dystonia, Posttraumatic

Abstract:

Objective: To evaluate pallidal oscillation in secondary dystonia following a head injury.

Methods: The patient was an 18-year-old male. At the age of 15, he suffered a left brain contusion due to a traffic accident. At the age of 17, he experienced forced opening of the mouth while sitting (upright position), chewing, and speaking. He was able to drink with a straw, but was unable to chew or speak. We diagnosed him with secondary dystonia induced by movement. Bilateral pallidal deep brain stimulation (DBS) was performed under general anesthesia. Bilateral local field potentials (LFPs) and EEG over the sensorimotor areas in the resting state were recorded from four bilateral contacts of the DBS electrodes 1 week after the operation. Contacts 0 and 1 were located in the internal pallidum (GPi), and Contacts 2 and 3 were in the external pallidum (GPe). LFPs were calculated for the three bipolar contact pairs of DBS electrodes. Power spectra of 2-35Hz were identified as sub-frequency bands and defined as follows: 2-4Hz (delta), 5-7Hz (theta), 8-13Hz (alpha), and 14-35Hz (beta).

Results: (1) Oscillatory activities: Spectral peaks of the delta band in the GPi, GPe, and motor cortex (MCx) were more prominent than those of the theta, alpha, and beta bands. The delta power was increased more on the right than on the left. (2) Functional coupling between the GPe and GPi: The coherences between the GPe and GPi in the delta and theta bands were stronger on the right than on the left. (3) Functional coupling between the ipsilateral MCx and GPe or GPi: On the left, no prominent coherence in the four bands was observed between the MCx and GPi or GPe. However, on the right, the delta band in the GPi was strongly coherent with the MCx, and the theta band in the GPe was also coherent with the MCx.

Conclusion: The left brain was affected, but the right brain was not. The left and right oscillatory activities were quite different. The delta power increased in the right GPi and GPe, and was functionally coupled with the MCx. DBS treatment using monopolar stimulation with contact 0 bilaterally was very effective. The phenomenon of oscillatory activities in the non-affected GP may be similar to the functional compensation that occurs in patients with chronic stroke.

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P074: Subtle sensory abnormalities in patients with isolated idiopathic and hereditary dystonia

Authors:

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Keywords: QST, dystonia, sensory alterations

Abstract:

Sensory abnormalities are increasingly being recognized as an accompanying symptom in patients with dystonia. The aim of this study was to investigate whether sensory abnormalities could be related to age or the distribution of motor symptoms in patients with idiopathic and hereditary dystonia. For this purpose we recruited 20 dystonic patients from which 8 had generalized dystonia, 7 cervical dystonia and 5 segmental dystonia with arm/hand involvement. The patients with arm/hand involvement were divided into two subgroups: younger than 40 years (6 patients) and older than 40 years (7 patients). All patients with cervical dystonia were older than 40 years. We used Quantitative Sensory Testing (QST) at the back of the hand in all patients and at the shoulder in patients with cervical dystonia. The other impairments were characteristic of the subgroups. The alterations were present on the clinically more and less affected side, but more pronounced on the side more affected with dystonia. Patients with cervical dystonia showed a reduced hot detection threshold (HDT) and CDT, enhanced TSL and DMA at the back of the hand, whereas the shoulder QST only revealed increased CPT and DMA. In summary, QST clearly shows distinct sensory abnormalities in patients with diopathic and hereditary dystonia, which partly varied with age and which may also manifest in body regions without evident dystonia.

P075: Subthalamic Nucleus Deep Brain Stimulation in primary dystonia: An over 10-years fellow-up study

Authors:

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Keywords: Primary dystonia; Subthalamic nucleus; Deep brain stimulation; BFMDRS; SF-36

Abstract:

Objective: To investigate over 10-years efficacy of the subthalamic nucleus-deep brain stimulation (STN-DBS) on primary dystonia.

Methods: All patients are selected from the group consisting of 13 primary dystonia patients receiving bilateral STN-DBS implantation treatment from May 2002 to November 2006.All patients were evaluated with the Burke–Fahn–Marsden dystonia rating scale (BFMDRS) and 36-item short form (SF-36) before surgery and at 1 month, 1 year and then over 10 years later postoperatively, follow-up time ranged from 10 to 15 years (mean: 12.7±1.8 years).

Results: All patients with bilateral STN DBS experienced a remarkable long-term and stability improvement after STN-DBS stimulation. The mean increase in movement score of the BFMDRS was 60%, 82%, and 84% after 1 month, 1 year and at least 10 years later stimulation. The quality of life (SF-36 questionnaire) significantly improved with 1 month stimulation (P<0.001), the improvement progressed within 1 year (P<0.05), and then kept stable. Adverse events included misplacement of the electrode, wire breakage and exclusive reaction.

Conclusion: This over 10-years follow-up study confirms the benificial effect of STN DBS in primary dystonia, significantly improving motor symptoms and quality of life,long-term efficacy and stability.

P076: Evaluation of DBS GPi treatment in dystonia - 2 year follow-up

Authors:

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Keywords: Deep Brain Stimulation, Dystonia, Globus Pallidus, STN

Abstract:

Background: Dystonia, with variety of its clinical forms is a multidisciplinary challenge for physicians. Author presents a group of patients with various dystonia types treated with subthalamic (STN) or pallidal (GPi) deep brain stimulation (DBS).

Methods: 42 patients (20 male, 22 female) age from 6 to 64 (mean 31,4) affected by dystonia were treated with DBS. 16 patients diagnosed with idiopathic general dystonia, 14 NBIA- related general dystonia, 5 hemidystonia, 3 torcicollis, 2 DYT-1-related general dystonia, 1 myoclonic dystonia and 1 oromandibular dystonia. The patients were evaluated with the Fahn-Marsden Scale (FMS), Unified Dystonia Rating Scale (UDRS), Global Dystonia Scale (GDS) and torticollis patients were evaluated with Toronto Western Spasmodic Torticollis Rating Scale (TWSTRS) before treatment and 6, 12 and 24 moths after the procedure. The permanent electrodes were implanted to GPi in 31 cases or to STN in 9 patients or GPi and STN in 2 patients. The target was identified with direct and indirect method. Intrasurgical macrostimulation and microrecording were used for neurophysiological evaluation of the target.

Results: No serious morbidity or mortality were noticed in the group. Local chest hematoma was reported at the region, where internal pulse generator was implanted. Best results were achieved among patients with with DYT-1 related general dystonia (mean 91%) and oromandibular dystonia (84%). The poorest results were noted at the PKAN group (mean 41%). Mean improvement of 72% was achieved in all groups.

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P077: Bilateral posteroventral Pallidotomy in the management of post-anoxic generalized dystonia

Authors:

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Keywords: Bilateral Posteroventral Pallidotomy, Secondary, Post-Anoxic, Generalized, Dystonia, Functional, Movement Disorder, Stereotaxy

Abstract:

Dystonia is the third most common movement disorder after tremors and Parkinson's disease, that significantly renders the functionality of an individual and hence the society. Secondary post-anoxic generalized dystonia isn't uncommon in developing countries with lack of effective perinatal care and facilities. Our aim is to clinically assess the role of bilateral pallidotomy on seven patients with post-anoxic generalized dystonia.

Method: This study is done on a retrospective manner on seven patients (3 males- 4 females), with age range from (8- 29) diagnosed with post-anoxic generalized dystonia, who received Bilateral posteroventral Pallidotomy, aiming to lessen the severity of the dystonia. Guided by a peri-operative clinical assessment and scaling with Burke–Fahn–Marsden dystonia rating scale. All patients had a post operative MRI to confirm pallidotomy lesion site.

Results: The seven patients had a noticeable improvement on BFM score and the severity of the dystonia after one month follow up, but for one patient who had an associated contracture and scoliosis that rendered his clinical improvement. where the BFM score mean pre-operative 53.57, with a standard deviation 20.13, while post operative BFM score mean was 42.5 with standard deviation 20.31 (p value= 0.007), thus there is a 20.75% reduction in the mean BFM score.

Conclusion: Bilateral posteroventral Pallidotomy is considered a safe and effective line of management in generalized dystonia especially secondary dystonia. None the less it doesn't carry the drawbacks of other alternative managements as in DBS, like hardware hazards, from infection or dislocation, or its long term maintenance and high costs. By highlighting the efficacy of pallidotomy and studying more patients and with applying our data to more comparative studies, that will lead us to more understanding to the most suitable option for each patient.

P078: Unilateral Stereotactic RF Lesion of Posterior Zona Incerta as a Treatment Hemidystonia: Comparative Study

Authors:

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Keywords: Secondary Dystonia, Hemidystonia, Zona Incerta, Lesioning

Abstract:

Introduction: Hemidystonia is a neurological condition caused by plastic changes developed after an injury to cortical-thalamicspinal pathways, usually secondary to different causes. In the past various cases series have shown encouraging results of lesions in various targets for the treatment secondary dystonia. More recently reports applied DBS showing no better results. Currently, there is no standardized treatment for this condition.

Objectives: We present preliminary results of an open trial comparing best medical treatment (oral medication and botulin toxin) with unilateral single lesion of the posterior *zona incerta*.

Methods: Fourteen patients entered the study. All patients had baseline evaluation (BL) with dystonia (FMDS) and quality of life rating scales (SF-36) at 1, 3 and 6 months after BL evaluation. Patients had the choice either surgery or best medical treatment. Six patients accepted the surgical procedure while 7 were followed under medical treatment for at least 180 days.

Results: Patients under medical treatment presented FMDS average score of 30.4 ± 8 and 6.3%, 18% and 18% improvement at 1, 3 and 6 months respectively. Patients operated had FMDS average score of 33.6 ± 7.6 and 34.5%, 43.8%, 37% in in 1, 3 and 6 months respectively in FMDS (ANOVA + Bonferroni post-test *p* < *0.05*). The operated patients revealed average of 75.6\% improvement in the subscore of functional capacity of SF-36, while the medically treated patients revealed average 8.5\%. The operated group had 65.6\% improvement in pain subscore while the medically treated patients had 17.3%.

Conclusion: Despite the limited number of patients and relatively short follow up, the preliminary results revealed that surgical treatment was significantly better than best medical treatment for patients with hemidystonia. Further trials should be performed to confirm the results in long term.
P079: sEEG is a safe procedure for a comprehensive anatomical exploration of the insula in drug resistant epilepsy: A retrospective study of 108 procedures representing 254 transopercular insular electrodes

Authors:

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Keywords: Complications, Depth electrodes, Epilepsy surgery, Insula, Neuroimaging, SEEG (stereoelectroencephalography), Stereotactic procedure

Abstract:

Background: The exploration of the insula in pre-surgical evaluation of epilepsy is considered to be associated with a high vascular risk resulting in an incomplete exploration of the insular cortex.

Objective: We report a retrospective observational study of insular exploration using stereoelectroencephalography (sEEG) with transopercular and parasagittal oblique intracerebral electrodes from January 2008 to January 2015. The first purpose of this study was to evaluate the surgical risks of insular cortex sEEG exploration. The second purpose was to define the ability of placing intracerebral contacts in the whole insular cortex.

Methods: Ninety-nine patients underwent 108 magnetic resonance imaging (MRI)-guided stereotactic implantations of intracerebral electrodes in the context of pre-operative assessment of drug-resistant epilepsy, including at least one electrode placed in the insular cortex. On post-operative computed tomography (CT) images co-registered with MRI, followed by MRI segmentation and application of a transformation matrix, intracerebral contact coordinates of the insular electrodes' contacts were anatomically localized in the Talairach space. Finally, dispersion and clustering analysis was performed.

Results: There was no morbidity, in particular hemorrhagic complications, or mortality related to insular electrodes. Statistical comparison of intracerebral contact positions demonstrated that whole insula exploration is possible on the left and right sides. In addition, the clustering analysis showed the homogeneous distribution of the electrodes within the insular cortex.

Conclusion: In the pre-surgical evaluation of drug-resistant epilepsy, the insular cortex can be explored safely and comprehensively using transopercular sEEG electrodes. Parasagittal oblique trajectories may also be associated to achieve an optimal exploration.

P080: MRI-Guided Stereotactic Bilateral Anterior Capsulotomy improves the clinical treatment of psychiatric comorbidity in epilepsy

Authors:

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Keywords: Bilateral Anterior Capsulotomy; psychiatric comorbidity in epilepsy

Abstract:

Objective: Investigation of the long-term efficiency in clinical treatment and social function improvements of the MRI-guided stereotactic bilateral anterior capsulotomy in chronic epileptic patients with psychiatric comorbidity.

Methods: 15 patients with psychiatric comorbidity in epilepsy who underwent the capsulotomy were included. The treatment effects were evaluated with Positive and Negative syndrome scale (PANSS), Barratt impulsiveness scale (BIS-11-C), Buss-Perry scale (BPS) and Social Disability Screening Scale.

Results: Evaluations were performed at baseline, 1 week, 6 months and 1 year after surgery. There was an improvement based on the statistical analysis for Positive Symptom($21.07\pm7.17vs11.40\pm3.43vs9.20\pm2.14vs8.29\pm1.86$); Negative Symptom($26.60\pm5.79vs17.00\pm3.51vs13.07\pm4.40vs11.67\pm4.82$); Barratt no-planning impulsiveness Scale($29.00\pm5.96vs10.67\pm4.95vs9.17\pm3.86vs8.50\pm3.64$); Barratt Cognitive impulsiveness Scale($32.33\pm6.97vs11.33\pm3.76vs7.67\pm3.59vs7.14\pm4.14$); Barratt Motor impulsiveness Scale($51.50\pm9.81vs27.83\pm4.71vs6.16\pm4.99vs5.18\pm4.75$); Buss-Perry Scale($78.07\pm7.96vs61.40\pm6.13vs51.47\pm8.69vs48.73\pm10.03$); Social disability screening Scale($12.53\pm3.67vs7.80\pm2.98vs5.60\pm3.48vs5.14\pm3.61$).

Conclusion: MRI-Guided Stereotactic Bilateral Anterior Capsulotomy could improve the positive symptom such as aggressive behavior disorder(ABD) and impulsive behavior disorder(IBD) ,the negative symptom such as depression, and the compliance of other treatments, also further reconstitute their social function for the epilepitic patients with psychiatric comorbidity.

P081: Neuroprotective Effects of Anterior Thalamic Nuclei Stimulation on Epileptic Monkeys

Authors:

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Keywords: Neuroprotective Effects, Anterior Thalamic Nuclei Stimulation, Epilepsy

Abstract:

Background: Anterior thalamic Nuclei (ANT) stimulation has been proven effective in controlling epilepsy in many studies, but its mechanisms remain unclear.

Objective: To study the neuroprotective effects of ANT stimulation on epileptic monkeys.

Methods: Eight male rhesus monkeys were randomly assigned to a stimulation group (n=3), a sham-stimulation group (n=2). DBS devices were implanted into the left ANT of monkeys from the stimulation and sham-stimulation groups. Kainic acid was injected into the left hippocampi of monkeys from the stimulation and sham-stimulation groups, and saline of the same amount was injected in the control monkeys. Chronic ANT stimulation was administered in the stimulation monkeys. All animals were continuously video-monitored for epileptic seizures in the following 6 months. Immunohistochemical stainings were performed to determine the pathological alterations.

Results: The monthly seizure frequency was 45.7% lower in the stimulation group than in the sham-stimulation group. The amount of survival neurons of the stimulation group was significantly higher than that of the sham-stimulation group. The gliosis was also lower in the stimulation group.

Conclusions: Chronic ANT stimulation can reduce the hippocampal injury and gliosis, which may be an important mechanism of ANT stimulation on the temporal epilepsy.



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P082: Early stereotactic radio frequency ablation of hypothalamic hamartoma using robotic guidance is safe: A case report and review of literature

Authors:

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Keywords: Hypothalamic Hamartoma, Robotic Guided Radiofrequency Ablation, Secondary Epileptogenesis

Abstract:

Management of hypothalamic hamartoma (HH) with intractable gelastic epilepsy remains challenging. We performed robotic (ROSA) guided radiofrequency ablation for the treatment of HH with intractable gelastic epilepsy in a child of 6 months age. During the surgery, intracranial depth electrode implanted to the hamartoma to identify the ictal onset. Planning for surgery was performed under ROSA assistance with MRI guided targeting and radiofrequency ablation of the hypothalamic hamartoma was performed to achieve disconnection effects. No intraoperative complications occurred. The present study was primarily aimed at verifying the feasibility of using robotic guided radiofrequency disconnection technique in terms of safety, short surgical duration in younger patients to prevent further secondary epileptogenesis from hypothalamic hamartomas.

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P083: Surgical treatment for super-refractory status epilepticus

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Keywords: Status Epilepticus, Hemispherotomy, Epilepsy Surgical

Abstract:

Introduction: The super-refractory status epilepticus (SRSE), defined as a seizure that persist for more than 24 hours after the intravenous anesthetic pharmacological treatment, is associated with high morbidity and mortality. The maximum medical treatment fails in >30% of cases, in which discharge control can be achieved by neurosurgical procedures.

Objective: To report the application of neurosurgical treatment in patients with SRSE, both in pediatric and adults patients.

Methods: We present 5 cases of SRSE with hemispheric syndromes, without focal expansive lesions. All of them received maximum pharmacological treatment that included continuous infusion of propofol and / or midazolam, without seizure control. They were undergone surgically through disconnection or resection techniques.

- Patient 1: Female, 21 years old; left fronto-temporal dysplasia and maturational delay. EEG: left frontal acute seizure evolved to status epilepticus. Left hemispherotomy was performed. Seizure-free since surgery (07/07/13).

- Patient 2: Female, 18 years old; Parry-Romberg Syndrome. Left hemispherotomy was performed 36 days after admission. She developed hydrocephalus; requiring ventriculoperitoneal shunt. Seizure-free since surgery (05/21/14).

- Patient 3: Female, 8 years old; focal refractory epilepsy. EEG: refractory status epilepticus. Right temporal lobectomy is performed, improvement of epileptic seizure was obtained. She persisted with complex partial seizures every 2 months, controlled with pharmacological treatment.

- Patient 4: Female, 21 year old; Rasmussen encephalitis. EEG: refractory status epilepticus. Right hemispherotomy was performed. Seizure-free since surgery (03/06/15).

- Patient 5: Male, 4 months old; right hemimegalencephaly, associated with predominantly fronto-parietal pachygyria. EEG compatible with right hemi-hypsarrhythmia preceding refractory status epilepticus. Left hemispherotomy was performed (08/02/17). Seizure-free since the 9th postoperative day.

Outcomes: 4 of the 5 patients undergoing surgery were completely free of seizures and one persisted with medically managed seizures.

Conclusion: Management of SRSE is a challenge in clinical practice. The literature on therapeutic options after the maximum medical treatment is scarce. This encouraging experience proposes surgery as an effective measure in SRSE with non-expansive focal lesions in which pharmacological treatment has failed.

P084: Deep brain stimulation in refractory epilepsy: experience in a Latin American center

Authors:

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Keywords: DBS, Anterior Thalamic Nucleus, Transventricular, Refractory Epilepsy, Palliative

Abstract:

Introduction: Epilepsy surgery is a valid option for patients with refractory epilepsy, which constitute approximately 30% of the total of cases. Epileptic syndromes without structural lesions or bilateral or multiple foci are candidates for non-resective techniques, among which Neuromodulation as one of the most modern forms of emerging treatment.

Methods: In our experience in palliative surgery of epilepsy through neuromodulation, two patients have been implanted. The electrodes was bilaterally placed in orthogonal transventricular direction towards the anterosuperior portion of the anterior thalamic nucleus. The first case was a 45-year-old man with a history of monoxide poisoning who evolved at 3 years with refractory generalized seizures. MRI showed bilateral temporomesial sclerosis. VEEG showed bitemporal discharges without lateralization. 8 bilateral deep electrodes were implanted with stereotactic guidance in wich a bitemporal origin was observed. Resective surgery was contraindicated and DBS was implanted. The second patient was a 21-year-old man, with a history of 8 years of epilepsy with falls and tonic clonic seizure several times per day. Pharmacological treatment obtained just only an initial improvement, without sustained control of seizures. It was studied by MRI, VEEG and PET, without being able to determine indications of laterality of the epileptogenic focus. Finally, SEEG was performed using 15 deep electrodes, which showed bifronto-temporal foci. Based on the results obtained DBS was indicated.

Outcomes: Both DBS system implanted has been switched on, achieving a significant reduction of the seizures in the medium and short term, respectively. Longer follow-up time is necessary to give definitive results. The patients tolerated very well the procedure without intraprocedural neither post-surgical complications.

Conclusion: In view of the results obtained and the perspectives of our center, we plan to continue developing this type of treatment in an interdisciplinary way. In our experience, DBS of the anterior thalamus nucleus for refractory epilepsy is a safe form of treatment for the patient. The international literature demonstrated its effectiveness in the control of the amount of crisis and duration of the same, which projects us to develop this technique at the level of the worldwide reference groups.

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P085: Relationship between postoperative EEG recruiting response and lead location in deep brain stimulation of the anterior nucleus of the thalamus for refractory epilepsy

Authors:

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Keywords: anterior nucleus, deep brain stimulation, recruiting response, electrode, EEG, epilepsy, thalamus

Abstract:

Objectives: A controversy exist in interpretating the postoperative EEG driving response (DR) an indicator of electrode placement within the thalamic nucleus in the deep brain stimulation (DBS) of the anterior nucleus of the thalamus (ANT) for refractory epilepsy.

Methods: We retrospectively investigated the relation between postoperative EEG DR and the location of electrodes (n=11) in 6 patients who underwent ANT DBS for refractory epilepsy (Table 1).

Results: A cerebral synchronizing, EEG DR (Fig.1) was observed in 10 electrodes, however, 9 of 11 electrodes were found to be located within ANT. Among the 2 electrodes missed ANT, DR was observed in one, misplaced electrode facing the anterior surface of ANT within the third ventricle (Fig. 2a). The other misplaced electrode without DR elicitation showed a DR after repositioning of the electrode (Fig. 2b).

Conclusions: A diagnostic significance of DR as an indirect evidence of electrode within thalamic nuclei is limited. If DR is not elicicited, it should be regarded as a misplacement. Even if DR is elicited, it should not be interpreted as a sound indicator of proper electrode placement within the thalamus. Therefore, a sophisticated, postoperative imaging study is warranted in every case of ANT DBS.



Fig. 1. An image captured from a planning software showing the location of electrodes within the anterior nucleus of the thalamus (ANT) with fusion of the postoperative CT/preoperative MR images (left side) and a demonstration of driving response (DR) observed by bipolar high-intensity, low-frequency stimuli (5 Hz, 9 V, 180 µs; contact (-1)+; right-sided electrode) in patient #2 (right side).

Fig. 2. Postoperative images showing the location of misplaced electrodes and driving responses (DRs).

(a) A postoperative MR image showing misplacement of right-sided electrode (white arrow) in the third ventricle in patient #1 (left side). No driving response was observed in scalp EEG by external stimulation of the right-sided, misplaced electrode (5 Hz, 7 V, 180 us; contact 0-/3+) (right side). Note a clear stimulation artifact in right hippocampal depth electrode (black arrow).



(b) A postoperative CT/MR fusion image (left side) and absence of DR (5 Hz, 8 V, 180 us; contact 0-/3+) in patient #4. The left-sided electrode is placed in the third ventricle facing the anterior surface of the ANT (arrow).

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P086: Optogenetic retrogression of epileptogenesis

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Keywords: Epilepsy, Optogenetics, Kindling, Basic Research

Abstract:

Introduction: Optogenetics is a combination of optical and genetic methods used to control the activity of specific populations of cells using light with high temporal and spatial resolution. Our aim was to reproduce kindling phenomenon using optogenetics.

Method: Transgenic rats expressing light-sensitive protein, channelrhodopsin-2 (ChR2), on neuronal membrane were used. ChR2 is activated with blue light and has permeability of cations. We developed an observation facility where EEG and behaviors could be monitored 24hr/day for days with plastic optical fibers implanted into the hippocampus in freely moving animals. Short burst of optical stimuli was given once per hour, 12 times a day, for 4 days.

Results: Short burst of optical stimuli activated the neurons and oscillatory hyperexcitation wave sustained for a short period, which presented afterdischarges on EEG with minimal behavioral changes. The duration of afterdischarges progressively increased with each trial, and behavioral seizures also aggravated. Finally, generalized seizures were frequently induced, which meant that kindling phenomenon occurred. Surprisingly, when additional neuronal stimulation were added, the hyperexcitation began to be suppressed and simultaneous activation of astrocytes were observed. This suppressive effect was revealed to be the result of homeostatic increase in adenosine.

Conclusion: We proved that kindling phenomenon could occur evenby selective activation of neurons using optogenetics. Futhermore, we succeeded to identify the innate suppression mechanism towards neuronal excitation.

P087: Epilepsy surgery using three-dimensional cortico-vascular and SEEG reconstructions

Authors:

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Keywords: epilepsy surgery, cortical topography, cortical relief, SEEG, postprocessing

Abstract:

Introduction: The orientation in the intracranial space remains a neurosurgical challenge and transition from slices to threedimensional (3D) imaging makes surgeon closer to the reality. New developments in magnetic resonance imaging (MRI) and the release of free softwares as 3DSlicer, Freesurfer and FSL improved dramatically the quality of 3D reconstruction. Our aim to present the possibilities of 3D cortico-vascular and stereotactic electroencephalography (SEEG) reconstructions using common MRI sequences and free softwares.

Methods: This study has included fifty-five consecutive epilepsy patients operated on during the period between January 2015 and December 2016. All patients underwent 1.5 T preoperative MRI and DICOM data postprocessing using FSL, Freesurfer and 3DSlicer. Intraoperative neuronavigation was performed in 40 patients and SEEG was performed in 15 patients using postprocessed images and raw data.

Results: Three-dimensional reconstruction improve preoperative planning and intraoperative orientation especially in extratemporal epilepsy patients where the sulcal pattern is more complex and tailored SEEG implantations and cortical resctions are needed.

Conclusion: Postprocessing of raw MRI and CT DICOM sets could provide useful preoperative and intraoperative information.



P088: Automatic Detector for Interictal Pathologic Activities in Neocortical Epilepsy

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Keywords: Epilepsy surgery, electrocorticography, seizure outcome, low-frequency activity, high-frequency activity

Abstract:

Background: Previously, automatic detectors for electrocorticography pathologic low (LFAs) and high-frequency activities (HFAs) were trained based on expert's manual classification results. We introduce a new optimization method, reinforcement machine learning based on the resective epilepsy surgery seizure outcome, to improve the automatic detector for interictal pathologic activities in neocortical epilepsy (NE).

Methods: We analyzed electrocorticographies from 39 patients with medically intractable NE. We separately analyzed 38 frequency-bins from 0.9 to 600 Hz to sort out bands related with seizure outcome. An automatic detector using four kinds of thresholds of low and high amplitude, duration and number was used. The two different interictal electrocorticography dataset was selected containing epileptiform activities. In the first, training dataset, the automatic detector was trained to best differentiate the seizure-free group from the not-seizure-group based on ranks of resection percentages of detected activities using genetic algorithm. This fitness function is identical to the one-tailed U of the Mann-Whitney U test on the premise that resection percentages of the detected activities should be higher in the seizure-free group. We tested 70,000 threshold combinations in the training and found 6,000 optimized automatic detectors which can significantly differentiate seizure outcome groups (p < 0.05). These optimized automatic detectors were retested in the second validation dataset. Then, we also measured resection percentage differences of detected activities between seizure outcome groups (Dif-R) to evaluate detector performances and compare with literature.

Results: There were 16 seizure-free (41%) patients. The mean follow-up duration was 21 ± 11 months (13 to 44 months). Automatic detectors found significantly seizure outcome related activities in 2.3 – 30 Hz, 75 and 90 Hz and 155 – 555 Hz in the validation dataset. Dif-R of LFAs were median 16.5 % and the maximum 81 % in 4 Hz and median 32 % and the maximum 63 % in 5.8 Hz in the validation dataset. Dif-R of HFAs were median 53 % and the maximum 57 % in 223 Hz.

Conclusion: Using the reinforcement machine learning from seizure outcome, we could achieve Dif-Rs much higher than the best manual and automatic detections of HFAs in literature (17 to 27 %). Thus, we suggest this method would be useful for improving detector performance with minimal human intervention.



P089: Ictal pattern of temporal lobe epilepsy based on high frequency oscillations of stereotactic electroencephalography

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Keywords: brain connectivity, cross-coefficient, component, density, electroencephalography, epileptogenic zone, stereotactic, topology

Abstract:

Background: In this study, we attempted to establish the ictal HFOs network to figure out how focal HFOs generated from an epileptogenic cortex spread out and synchronize across large areas of cortex.

Methods: We applied the network topology measures to 20 seizures observed in 5 patients from their SEEG signals. We measured inter-electrode cross-coefficient between all pairs of electrodes for each 1 second window. By constructing the HFOs network, the topology was analyzed by network measures such as the density and the components.

Results: By using the SEEG to explore the dynamic topologies of cortical and subcortical HFOs networks, we found the HFOs network synchronization and ripple energy increase during seizure progression.

Conclusion: The improvement of spatiotemporal resolution established by SEEG and HFOs' network helped us to recognize and analyze the epileptic seizures. Consistent topologies changes implied the common epileptogenic pattern in temporal lobe epilepsy.



P090: Epilepsy Surgery for Focal Cortical dysplasia

Authors:

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Keywords: Epilepsy, FCD, LAMIC

Abstract:

Purpose: Epilepsy surgery for focal cortical dysplasia (FCD) often requires multiple non-invasive as well as invasive presurgical evaluations and innovative surgical strategies. There is limited data regarding surgical management of people with chronic drug resistant epilepsy (DRE) & FCD among the low and middle-income countries (LAMIC) including India.

Method: Presurgical evaluation, surgical strategy and outcome of 53 people who underwent resective surgery for DRE with FCD between January 2008 and November 2016 were analyzed. Blumcke et.al 2011 classification was used for histopathological categorization. Engel classification was used for defining seizure outcome. The surgical outcome was correlated with preoperative clinical, VEEG, MRI, invasive monitoring, surgical findings as well as histopathology and QOLIE- 89 scores.

Results: This cohort consists of 19 cases evaluated retrospectively and 34 cases prospectively. Age of onset ranged from 1 to 43 years (mean 9.28yrs; SD 7.25). Duration of epilepsy ranged from 1-39 years (mean 11.68; SD 8.99). The following regional distribution was found; Temporal-31 (Language-13), Frontal-9 (Motor Cortex- 5), Parietal-5 (Sensory Cortex-4), Occipital-3 and multilobar-5. Forty seven percent of the cases had FCD in the right hemisphere and 53% had FCD in the left hemisphere. Invasive monitoring was performed for identification of the epileptogenic zone (EZ) as well as eloquent cortex in 7 and intraoperative electro-corticography (ECoG) was used in 32 cases. Histopathology revealed the following distribution; FCD Ia-5, Ib-2, Ic-4, IIa-6, IIb-10, IIIa-20, IIIb -3, IIId-3. Overall outcome of Engel's class Ia was 61.3 %. Pre- operative QOLIE-89 score was 26.33-40.17 (mean 33.69, SD 4.35) and post-operative score was 59.21-89.79(mean 73.81; SD 8.29; p=0.04).

Conclusion: Surgical management of people with DRE and FCD is possible in countries with limited resources. Meticulous presurgical evaluation to localize epileptogenic zone and complete resection of the focus and lesion can lead to cure or control of epilepsy and improvement in QOL was observed along with seizure-free outcome. The author will present several illustrative cases with videos of the surgical strategy. The resected tissue is a gold-mine and can be subjected to proteomic, genomic and metabolomic evaluation through international research collaboration.

P091: Restricted resection of unilateral polymicrogyria for refractory epilepsy

Authors:

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Keywords: Polymicrogyria, Malformation Of Cortical Development, Refractory Epilepsy, Surgical Treatment

Abstract:

Polymicrogyria (PMG) is a highly heterogeneous malformation of cortical development. 60% to 85% of patients with PMG have epilepsy which could be partially or generalized and even catastrophic. We present two cases of unilateral PMG with partial seizure pattern refractory to medication treated by resective surgery with/without intracranial electroencephalogram (IEEG) at our center.

The presurgical evaluation methods included medical history assessment, neurological examination, magnetic resonance imaging (MRI), video- electroencephalogram (VEEG) monitoring with surface electrodes and stereotactic intracranial electrodes, and neuropsychological assessments. The surgical results, pathological diagnosis and follow-up data are analyzed.

The first patient (27 years old male, seizure begin at 4) has seizure onset with aura of dizziness and without functional deficit. MRI showed right hemisphere PMG mainly on frontal and parietal lobe. Ictal VEEG revealed right hemisphere epileptiform activity mainly on the posterior part. Stereotactic IEEG and functional mapping was performed followed with restricted resection of the part of the parietal PMG. (Fig.1) There was no neurological deficit and neuropsychological deterioration after surgery. And after 2 years of follow-up only 2 seizures was reported. The second patient (16 years old female, seizure begin at 2) has seizure onset with aura of right hand paresthesia and she has right hand paralysis. MRI showed small left hemisphere with PMG. Ictal VEEG revealed left hemisphere epileptiform activity. Because of her poor family, direct resection of the parietal PMG posterior to the central sulcus was performed. (Fig.2) There wasn't new neurological deficit and neuropsychological deterioration after surgery. She is seizure free till now which is 2.5 years after surgery. The pathological diagnosis revealed heterotopia and fusion of the molecular layer and deep underlying complex sulcal branching in both patients.

Schizencephaly (SZ) and PMG are malformations arising due to defects in postmigrational development of neurons. They are in the same pathological spectrum. This two cases showed that epileptogenic zone are mainly around the cleft in the area of PMG though the cleft are not connect with ventricle. And the pathological results showed the heterotopia in both patients. PMG may have different epileptogenic potential and our two cases showed that cortical cleft with heterotopia may highly facilitate to epileptogenesis.



P092: The changing landscape in epilepsy surgery: pathological substrate

Authors:

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Keywords: Epilepsy, Surgery, Pathology

Abstract:

Introduction: The number of procedures for treatment of refractory epilepsy boomed after the introduction of MRI in clinical practice. MRI was able to identify new brain pathology and adequately document the traditional ones. We studied the pathological findings over time of 982 patients submitted to surgery over the last 10 years.

Methods: 982 patients submitted to resective surgery for refractory epilepsy from 2006 to 2015 were studied. Their type of resection and the more frequent pathological findings were plotted over time.

Results: At the first year of the studied series (10 years ago), there were 43 mesial temporal sclerosis patients (MTS), 16 with cortical dysplasia, 25 with brain tumors, 8 with vascular pathology, 4 with Rasmussen syndrome, 2 with Sturge-Weber, 6 with HHE and 10 patients with no detectable lesion. During the last studied year (2015), there were 12 patients with MTS, 20 with cortical dysplasia, 27 with tumors, 10 with vascular pathology, 1 with Sturge-Weber, 5 with HHE, and 25 had no detectable lesion; there was no patient with Rasmussen syndrome. Overall, there was a progressive decrease in the number of patients with MTS, and in increment of patients with no detectable pathology. The number of procedures per year remained stable (ranging from 82 to 110). Rasmussen patients are now seen only sporadically.

Discussion: It appears that the pathological spectrum found in epilepsy surgery patients has been changing over the last decade. We are doing more non-lesional cases (in whom we could expect a worse outcome compared to lesional cases), and less MTS patients. The number of patients with brain tumors, vascular pathology and cortical dysplasia remained stable. Rasmussen syndrome patients are now rare; on the other hand, we have seen a significant increase in auto-immune encephalitis. Contrary to Rasmussen patients, patients with auto-immune encephalitis usually have bilateral lesions and are not surgical candidates.

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P093: Best responders" (>80% seizure reduction) to Vagal nerve stimulation in a paediatric drug-resistant epileptic population

Authors:

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Keywords: Epilepsy, Vagal Nerve Stimulation, Pediatric Age

Abstract:

Introduction: Although different Authors report the efficacy of VNS in paediatric population, only few papers focused on the so-called "best responders" (patients showing > 80% seizure reduction).

Materials and methods: Among all the paediatric cases operated upon in our centre, we focused on best responders, i. e. the children showing a decrease >80% in seizure rate.

Results: Between 2007 and 2015, 32 patients were implanted during paediatric age for drug-resistant epilepsies. 17 patients (58.6%) presented a decrease of the seizure rate > 80%. 3/17 patients became seizures free. The prevalence of the best responders did not differ significantly at 6 (50%), 12 (50%) and 24 months (55%). 12/32 patients underwent the scale PedsQl 4.0 to assess the health-related quality of life (HRQOL). Comparing the best-responders to all the other patients, we obtained a significant correlation in the following sub-items: alertness (p-values 0,010), concentration (p-value 0.032), memory (p-value 0.046), communication skills (p-value 0.005) and adaptive behaviour (p-value 0.010). Comparing various clinical features to the outcome, we found that only the etiology of epilepsy correlated with best outcome: the patients suffering from structural-metabolic epilepsies showed a p-value = 0.022; 4 patients presented with Tuberous Sclerosis Complex, becoming in 2/4 seizures free. Finally, comparing the age at the implant and the outcomes, youngests (<7 years) correlate with best results (Spearman i. + 0.425): 84.6% presented with decrease of the seizure rate >80% and 3 patients (23%) are currently seizure free.

Conclusions: In our experience, 58.6% of our patients presented a reduction > 80% of the seizures rate and at present 3/32 are seizures free. We suggest that the earlier the implant the better the outcome and that structural epilepsies, like TSC or large cortical dysplasias, obtained a best response when conpared to genetic or unknown aethiology epilepsies.

P094: Targeting perisylvian structures with depth electrodes in SEEG studies

Authors:

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Keywords: Functional Brain Mapping, StereoEEG, Epilepsy

Abstract:

Objectives: We aim at describing the surgical approaches for the implantation of perisylvian depth electrodes in patients with drug-resistant epilepsy. Based on a retrospective analysis of functional mapping using electrical stimulation in a population of patients, we aim at providing guidelines for targeting specific functional areas.

Methods: In a population of 8 patients undergoing presurgical evaluation for drug-resistant epilepsy, we have implanted depth electrodes that are targeting the insular-opercular areas using three main approaches: a) orthogonal trans-opercular; b) parasagittal oblique anterior; c) parasagittal oblique posterior. Functional mapping using 50 Hz electrical stimulation is performed, and the results are co-registered across patients using FreeSurfer and Matlab scripts to provide combined insular-opercular functional maps.

Results: Perisylvian implantations (Fig 1a, patient 8) have been performed without complications, including parasagittal oblique trajectories (Fig. 1b). A number of 142 clinical symptoms evoked by electrical stimulation were co-registered across patients to create functional maps. Some symptoms showed a spatial segregation, as illustrated in the cortical surface reconstruction (Fig. 1c) and the inflated version (Fig. 1d).

Conclusion: Targeting perisylvian structures using approaches guided by the functional maps contributes to the success of the SEEG investigations.



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P095: Cost-effectiveness of stereotactic laser amygdalohippocampotomy compared with open epilepsy surgery

Authors:

Lucas Philipp (1), Joel Eggebeen (2), John Willie (2), Robert Gross (2)

Keywords: Epilepsy Surgery, Amygdalohippocampotomy, Stereotactic, Functional Neurosurgery, Cost Effectiveness

Abstract:

Introduction: Stereotactic laser amygdalohippocampotomy (SLAH), performed with laser interstitial thermal therapy, is a recent addition to the minimally invasive alternatives to open epilepsy surgery. Several studies have demonstrated that stereotactic ablative procedures are capable of achieving short term outcomes in the range of traditional surgical resections. Despite the considerable advantages minimally invasive approaches offer to patients, they may be associated with additional costs related to disposable charges, but which may be counter-balanced by decreased length of stay and case acuity. We therefore undertook a short-term economic evaluation of SLAH in comparison to open epilepsy surgery.

Methods: 45 encounters were reviewed including the 15 most recent of 3 groups: SLAH cases using the ClearPoint[®] intraoperative-MRI system, SLAH cases using the CRW[®] stereotactic frame, and open surgery cases. One-way MANOVA determined differences for Total Cost among groups and between open surgery and combined SLAH procedures. Costs were stratified by category. Significant multivariate effects were defined at alpha=0.05. Bonferroni alpha correction defined significant univariate effects(p<0.0038).

Results: Significant differences were found for Total Costs (F[2,38]=10.48, p=0.0002), OR/Anesthesia Time (F[2,38]=54.90, p<0.0001), Hospitalization, Medication and Test Costs (all p<0.0001). On average, open surgery cost \$15,488 (95% Bonferroni CI: \$3,996, \$26,980) more than minimally invasive methods, which were not significantly different from each other. Open surgery costs associated with OR/Anesthesia Time and Hospitalization costs were also significantly different from comparators, with average excess costs of \$8,672 (\$5,387, \$11,956) and \$11,189 (\$7,338, \$15,041) respectively. There was no significant difference in procedure-related costs (p=0.04), or patient payment estimates (p=0.23).

Conclusion: Relative to open surgery, minimally invasive approaches offer measurable reductions in cost. Hospitalization costs account for the majority of the difference in cost, related to a mean 7-day increase in length of stay among open surgery patients. With no difference in payment estimates, it is unlikely that these findings are attributable to variations in billing or healthcare payer practices. In addition to other advantages such as decreased discomfort, stereotactic laser amygdalohippocampotomy (SLAH) is an economically sound alternative to open epilepsy surgery.

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P096: Disconnection or Resection

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Keywords: Epilepsy surgery, Disconnection, Resection

Abstract:

Newer techniques are evolving to perform surgeries for refractory epilepsy.

Focus is being laid on the making the surgery less invasive with good outcomes and reduced rate of complications.

Disconnection procedures are popular with its aim at tissue preservation and lesser long term complications.

Disconnection procedures need better understanding of the ventricular and white matter anatomy. Tissue viability and eloquent area preservation when feasible are the main aims of disconnection procedures.Though hemispheric disconnection is now established form of surgical treatment for epilepsy of hemispheric origin, the decision making in lobar epilepsy, scar epilepsy and epilepsy of deeper origin is pathology dependent.

Motor preservation is one of the main concerns in lobar disconnections. The decision making is largely dependent on surgeon's comfort and pathology.

Available data does not provide the guidelines to make the decision between resection and disconnection procedures for lobar epilepsy.

We analyse long-term seizure freedom, complication rates of the reported disconnection procedures.

An attempt is also made to provide some guidelines for use of resection or disconnection procedures.

P097: Intracranial EEG-guided radiofrequency thermocoagulation for refractory focal epilepsy

Authors:

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Keywords: Radiofrequency Thermocoagulation, Epilepsy

Abstract:

Background: Destructive surgery offers the chance of cure in refractory epilepsy patients. Radiofrequency thermocoagulation (RF-TC) is a minimally invasive technique that allows for the creation of small lesions through stereotactic intracranial EEG (sEEG) electrodes, potentially allowing patients to avoid open epilepsy surgery.

Methods: From 2014-2016, 7 patients with refractory focal epilepsy underwent sEEG and were treated with RF-TC after localization of seizures and related eloquent cortices. Electrode contacts involved in seizure onset and early spread were ablated using a radiofrequency lesion-generator system (Cosman Medical Inc., Burlington, MA, USA). In patients with seizure foci in eloquent cortex, neurologic function was tested after each increase in power. EEG was recorded before and after ablation. Brain MRI was performed within 24h to determine lesion extent. Postoperative seizure outcomes and neurologic deficits were assessed.

Results: Seven patients between 32-63 years (4 female, 3 male) were treated. Six patients were lesional (3 cortical dysplasias; 1 stroke; 1 cystic lesion; 1 encephalomalacia); one was non-lesional. All underwent sEEG using a median of 9 (range 6-19) 10contact depth electrodes; one patient also had 4 subdural strip electrodes. Onsets were left frontal (3), right frontal (1), left parietal (1), left temporal (1), and posterior cingulate (1). All patients underwent RF-TC during awake sEEG monitoring, either at the bedside (3) or in the operating theatre (4). Current was delivered stepwise from 1.5 to 6 Watt for up to 60 seconds. A median of 16 (range 5-28) contacts were ablated. Cortices underlying two strip electrode contacts were also ablated in 1 patient. Reablation was performed in 2 patients in subsequent hours or days that had continued epileptiform discharges post-ablation. Lesion size was inadequate on MRI in 1 patient, who then immediately underwent stereotactic laser interstitial thermal ablation under anesthesia along two existing electrode trajectories. Five of 7 pts were free of disabling seizures at a median of 12 (range 4-30) months postop. There were no permanent neurologic deficits.

Conclusions: RF-TC is a safe, minimally invasive treatment option for patients with refractory focal epilepsy. Though 71% of our patients were free from disabling seizures and avoided craniotomies with sEEG-guided RF-TC alone, longer follow-up and larger series are needed to confirm the efficacy of the procedure.

P098: Minimally invasive stereotactic laser ablation of the corpus callosum in adults with intractable epilepsy

Authors:

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Keywords: Laser Ablation, Corpus Callosotomy, Epilepsy

Abstract:

Rationale: Corpus callosotomy (CC) is a surgical disconnection to treat generalized and atonic seizures in refractory epilepsy patients. While minimally invasive MRI-guided stereotactic laser ablation is a safe, effective alternative for refractory focal epilepsy, stereotactic laser corpus callosotomy (SLCC) is less defined. We compare outcomes of 4 patients who underwent SLCC to 4 patients who underwent open CC.

Methods: At surgery, patients in the SLCC and CC groups were a median 32.5 (range 20-47) and 32 (range 26-39) y old, respectively. All but 1 SLCC patient had vagus nerve stimulators, 1 in each group had prior temporal lobe surgery, and all but 1 were male. All 4 SLCC patients had atonic seizures and diagnoses of Lennox Gastaut syndrome (LGS); 3 underwent anterior 2/3 SLCC; of which 1 had additional ablation (posterior 1/3 SLCC) 1 m later for continued seizures. A 4th SLCC patient that had prior incomplete CC had worse atonic seizures after mesial temporal lobe ablation for mesial temporal sclerosis and had completion SLCC (genu and splenium) 8 m later. Two CC patients had focal seizures with frequent generalization; 2 had LGS with atonic seizures; all underwent anterior 2/3 CC.

Results: Acute hospital stays in the SLCC and CC groups were median 3.5(range 2-9) and 13 (range 3-21) d, respectively. Total hospitalization stays in SLCC and CC groups were median 11(range 2-31) and 21(range 10-35)d, respectively, including subsequent inpatient rehab stays and a readmission in 1 CC patient for seizures. One patient in each group had an intracranial hemorrhage; 1 in each group had supplementary motor area syndrome. Two SLCC patients had persistent deficits (mild hemiparesis; incontinence); 1 CC patient had persistent abulia. With median postop follow-up of 9 m(range 6-16 m) and 5 y(range 9 m–9 y), atonic seizures ceased in all SLCC, but only 1 CC patient, respectively. Generalized seizures decreased by >50% in all patients except 1 SLCC patient. All SLCC patients had >50% decrease in absence seizures. Absence and focal seizures were unchanged in 3 of 4 CC patients. Two SLCC patients were seizure free; no open CC patients were seizure free.

Conclusions: Minimally invasive MRI guided SLCC is a safe, effective alternative to open CC. Patients undergoing SLCC had comparable rates of postop complications but shorter hospital and rehab stays. Seizure outcomes appear favorable after SLCC, but larger groups, longer follow up, and improved patient matching are required.

P099: Vagus nerve stimulation - Adapting the surgical technique to individual anatomical variations

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Keywords: Epilepsy, Vagal Nerve Stimulation, Surgical Results

Abstract:

Introduction: Vagus nerve stimulation (VNS) is one of the main surgical options for refractory epilepsy both in adult and pediatric population. The authors present here their surgical experience on the first series of patients with drug-resistant epilepsy operated for VNS in Romania and discuss how to adapt the surgical technique to individual anatomical variations of the vagus nerve and its relationship with common carotid artery and internal jugular vein.

Methods: We included in this series 300 patients with refractory epilepsy operated for VNS in Neurosurgery Clinic, "Bagdasar-Arseni" Clinical Hospital, between October 2012 and February 2017. In all cases we used the latest VNS generator model (103). For all patients we used a left latero-cervical approach. The medium follow-up period was 11 months and the minimum follow-up period was one month.

Results and Discussion: There were 63 children and 237 adults in our series. The gender distribution was 147 females and 153 males. The average period of hospitalization was 4,8 days. There were no deaths in our series. There was a single case of left vocal cord paresis which remitted at two months follow-up. Postoperative hoarseness was noticed in 26 patients (8,6%) and disphagia in 19 patients (6,3%). The anatomical variations observed by the authors include: a vertical orientation of the great vessels with the internal jugular vein located superiorly, common carotid artery located inferiorly and the vagus nerve in intermediate position (compared with normal "horizontal" orientation with jugular vein located laterally and common carotid artery located medially), and a greater size of the internal jugular vein. When we met both anatomical variants in the same individual (observed in 29 patients - 9,6%), the vagus nerve dissection became more difficult and the risk of the vascular injury increased, because the vagus nerve was practically covered by a voluminous internal jugular vein. Surgical technique should be addpted in this situation and includes a carefully dissection of the internal jugular vein with the mobilization and rotation of the vein in order to gain a proper access to the vagus nerve.

Conclusion: VNS is a safe and efficient surgical procedure with a short hospitalization period and minimum postoperative complications. Adapting the surgical technique to individual anatomical variants makes the intraoperative and postoperative complications related to VNS procedure to become very rare events.

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P100: Gamma Knife Radiosurgery for Idiopathic Glossopharyngeal Neuralgia: Experience with Five Cases

Authors:

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Keywords: Glossopharyngeal neuralgia, Gamma Knife, Radiosurgery

Abstract:

Objective: Gamma Knife radiosurgery (GKS) has been proposed as an alternative therapeutic option for patients with intractable glossopharyngeal neuralgia (GPN) who are poor candidates for microvascular decompression surgery. The role of GKS for GPN remains controversial, and only a few cases have been reported.

Methods: Forty-three patients with intractable idiopathic GPN have been surgically treated. Among them, five patients (3 males, 2 females; mean age 75 [range 50–80] years) were treated with Gamma Knife radiosurgery (Model C, Elekta Instruments AB, Sweden) because of serious medical problems or advanced age. The maximum target dose ranged from 50 to 85 Gray (Gy) was delivered using a single 4-mm collimator. The target for GPN was either the cisternal segment of the glossopharyngeal nerve (n=3) or the glossopharyngeal meatus (GPM) (n=2). The three patients with primary GPN treated with a dose \geq 80 Gy, regardless of the target. The other two patients were treated with prescribed doses of 50–75 Gy, because both the trigeminal nerve and GPM were needed to be targeted to treat trigeminal neuralgia simultaneously. The pre- and post-GKS pain outcomes were evaluated using the visual analog scale with the Barrow Neurological Institute pain intensity scoring system.

Results: The mean follow-up was 40.8 (range 2–75) months. The three patients with primary GPN treated with a dose ≥80 Gy had good pain relief (Class II-III), regardless of the target. Despite some improvement, pain relief was unsatisfactory in the other two patients (class IV). No GKS-associated complications were observed in any patient.

Conclusion: GKS appears to be a safe therapeutic modality for medically refractory GPN in selected patients.

P101: Comparison of Surgical Outcomes of Idiopathic Glossopharyngeal Neuralgia between Microvascular Decompression and Gamma Knife Radiosurgery

Authors:

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Keywords: glossopharyngeal neuralgia, microvascular decompression, Gamma Knife, radiosurgery, Bioglue-coated sling

Abstract:

Microvascular decompression (MVD) is considered as the first line therapeutic option for glossopharyngeal neuralgia (GPN). Gamma Knife radiosurgery (GKS) has been proposed as an alternative therapeutic option for the selected patients with intractable GPN. The objective of this study was to compare surgical outcomes of GPN between MVD and GKS. Forty-three patients (24 males, 19 females; mean age 55.8 [range 32–80] years) with intractable idiopathic GPN were surgically treated from 1996 to 2016. MVD was chosen as the first line therapeutic option in 38 patients and was performed with the transposition technique (26 cases, 68.4%) and the interposition technique (12 cases, 31.6%).

Five patients (3 males, 2 females; mean age 75 [range 50–80] years) were treated by GKS because of serious medical problems or advanced age. The maximum target dose was 50-85 Gray (Gy), delivered using a single 4-mm collimator. The target for GPN was either the cisternal segment of the glossopharyngeal nerve (n=3) or the glossopharyngeal meatus (GPM) (n=2). Three patients were treated with \geq 80 Gy. The other two patients were treated with reduced doses of 50–75 Gy, as the trigeminal nerve was targeted to treat concurrent trigeminal neuralgia. The pre- and post-GKS pain outcomes were evaluated using the Barrow Neurological Institute (BNI) pain intensity scoring system.

The average follow-up durations in patients treated with MVD and GKS were 55.97 months (range 3-251 months) and 41.5 months (range 3-75 months). Among 38 patients treated with MVD, 30 patients became pain free immediate post-operatively and maintained in BNI grade I state (78.9%). Among the 32 patients treated with MVD who were followed up for \geq 1 year, 31 good pain relief (BNI grade I-II, 96.8%). Neuralgic pain recurred in one patient; however, the pain was less frequent and less severe than that observed preoperatively. Cranial nerve impairments developed in 4 cases, but resolved in the following months. A permanent decrease in hearing occurred in one patient.

Among the five patients treated by GKS, the three patients with a dose ≥80 Gy had good pain relief (Class II- III). Despite some improvement, pain relief was unsatisfactory in the other two patients (class III-IV). No GKS-associated complications were observed in any patient.

The results suggest that MVD is the treatment of choice for medically intractable GPN. GKS appears to be a safe therapeutic modality for medically refractory GPN in selected patients.

P102: Improvement of facial sensory loss by motor cortex stimulation in trigeminal neuropathic pain

Authors:

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Keywords: facial pain- motor cortex stimulation

Abstract:

Introduction: Motor cortical stimulation (MCS) is a tool to treat intractable chronic neuropathic central pain mainly in patients operated for trigeminal pain. If the MCS can ameliorates dysesthesias and/or allodynia very few cases of sensory loss improvement have been reported. We describe two patients with partial recovery of painful trigeminal second branch sensory loss.

Clinical CASES: These two females 38 and 52 years-old underwent percutaneous trigeminal thermocoagulation respectively 2 and 5 years before the admission to our Department for typical trigeminal neuralgia. After these procedures a neuropathic pain in trigeminal second branch developed. Medical therapies were ineffective to treat the pain so a Motor Cortex Stimulation was carried out using a 16 poles paddle connected to a implantable multiple source generator. The surgical technique used to implant the device consisted in the use of neuronavigation and of intraoperative neurophysiological registration to find the somatotopic motor cortex area of the face.

Results: The pain one month after surgey decreases of 40%. Two month after MCS implant, the patients reported improvement of tactile sensitivity of second branch trigeminal sensory loss.

Discussion: The mechanisms leading to sensory restoration is unclear. One hypothesis could report that the sensory impairment, maintained by central mechanisms has been reversed by MCS, leading to the sensory restoration.

P103: Sensory changes and prognostic factors of microvascular decompression (MVD) in patients with primary trigeminal neuralgia. Experience of the General Hospital of Mexico

Authors:

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Keywords: Microvascular Decompression, Trigeminal Neuralgia, Superior Cerebellar Artery

Abstract:

Objective: To determine the postoperative outcome, recurrence and prognostic factors of MVD in patients with primary trigeminal neuralgia (TGN) operated at the General Hospital of Mexico.

Methods: The study included 70 patients with diagnosis of primary trigeminal neuralgia with a follow-up of 10 years. A Kaplan-Meier survival analysis was generated at 1 and 10 years of follow-up for the study of recurrence. We assessed pain using the Visual Analog Pain Scale (VAPS) before and after MVD. The results were analyzed using a Mann-Whitney test with a significant p < 0.05.

Prognostic variables were patient age, sex, affected segments of the trigeminal nerve, and conflicting blood vessel in relation to recurrence.

Results: The mean age of the patients was 35 years. 49 patients (70%) were female and 21 patients (30%) were male. The involvement of the ophthalmic branch (V1) was diagnosed in 17 patients (24.28%), mandibular branch (V3) in 17 patients (24.28%) and maxillary branch (V2) and mandibular branch (V3) in 36 patients (51.42%). 72% of the patients had affection on the right side of the face (n=50). All patients had an arterial neurovascular conflict. The conflicting artery was the Superior Cerebellar Artery (SUCA) in 97.14% (n = 68) and later the Anteroinferior Cerebellar Artery (AICA) in 2.85% (n = 2). According to Kaplan-Meier analysis, the success rate (defined as pain-free patients without any medication) was 96% at 1 year and estimated to be 84.24% after 10 years of follow-up. Immediate relief from pain occurred in all patients. None of the following patient-related factors played any significant role in prognosis: sex, patient age, affected segments of the trigeminal nerve, and conflicting blood vessel in relation to recurrence. Permanent hypoesthesia and motor function of the trigeminal nerve was intact in all patients. No other complication was found.

Conclusion: MVD offers patients affected by TGN due to vascular compression a long-lasting cure in 96% of the cases at 1 year and estimated to be 84.24% after 10 years of follow-up. MVD is a safe and effective management option for TGN with neurovascular conflict.

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P104: Fixing Fragmented Minds – The Role of International Law for the Freedom of Scientific Research – Using the example of psychiatric and functional neurosurgery

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Keywords: Freedom of Scientific Research, International Law

Abstract:

In an era of ongoing internationalization of medical research, the question of how medical science is guided by regulatory framework becomes increasingly important. This starts at a constitutional level with the freedom of scientific research and translates into national laws specific to certain research topics. However, there is a growing need for international rules, that apply to the medical research community as a whole. This becomes all the more apparent in highly specialized fields of medical research like functional and psychiatric neurosurgery, where the number of patients is small and research cooperations are indispensable to produce statistically relevant results.

I analyze sources of international law (e.g. the declaration of Helsinki or the International Covenant on Economic, Social and Cultural Rights) addressing the issue of freedom of scientific research. I centrally discuss the problem of whether and to what extend these documents impact on and are binding in national law. Specifically, I raise the question if international sources of law can become part of the constitutional framework of freedom of scientific research by shaping and developing its meaning according to time and social reality.

The freedom of scientific research has its origins at the beginning of the 20th century, when empirical approaches had gained enough public respect to be instrumentalized for state interests. Nowadays, many European constitutions have specific provisions protecting the freedom of scientific research, e.g. article 5 para. 3 of the German Basic Law. Other states, like the US or Canada, do not have explicit constitutional law for the freedom of scientific research and its protection falls under the provision of the freedom of thought and expression (in the US the First Amendment to the Bill of Rights).

The legal definition of content and scope of freedom of scientific research is not self-evident and needs to be readjusted as new challenges arise in the scientific community. I argue that in an era of increasing globalization of medial sience the international body of rules regulating scientific conduct needs to be more precise and binding. These rules should be primarily on an abstract and general level, applying to the entirety of medical research. However, each subspeciality encounters its particular challenges. My goal is to foster a discussion about the necessity of binding international guidelines in the field of psychiatric and functional neurosurgery

P105: Postoperative localization of intracranial electrodes for epilepsy surgery using open-source imaging programs: clinician's perspective

Authors:

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Keywords: Epilepsy, electrodes, coregistration

Abstract:

Visualization of implanted intracranial electrodes in three-dimensional space provides valuable information for surgeons in planning resection in epilepsy surgery. Many studies published various coregistration methods for accurately visualizing intracranial electrodes. From a clinician's point of view, coregesitration method should be easy to learn and fast to apply, especially in hospitals with limited human resources. We introduce simple coregistration method using two open source imaging programs (Freesurfer and Slicer) with acceptable accuracy and beautiful three-dimensional visualization. Seven consecutive patients with intractable drug-resistant epilepsy were included in this study. Subdural grids, strips and depth electrodes were inserted as needed. All patients underwent thin sliced preoperative MRI (3T, 0.9 mm thin-sliced T1 MPRAGE) and postoperative 2 mm thin-sliced CT scan. Freesurfer program was used for three-dimensional cortical reconstruction. Because this process generally takes several hours, it was prepared before the day before surgery. Reconstructed three dimensional images could be used as a reference for planning subdural electrode placement as well. Slicer program was used for coregistratimg postoperative CT and preoperative MRI or reconstructed cortical images by Freesurfer. A built-in registration module(BRAINS) with Rigid and Affine registration phases were used. In case of subdural or strip electrodes, electrode localization of postoperative CT over reconstructed cortical surfaces using markers. Linear transformation was needed when there was a brain shifting. Coregistration of depth electrodes were easier because of the minimal brain shifting. Required time for each coregistration process was less than 10 minutes. The accuracy of results was verified during the second surgery, which was satisfactory. We concluded that this method is easy and fast with acceptable accuracy for usual epilepsy surgery with intracranial electrode placement.

P106: Salvaging DBS Hardware Erosions without Explantation: Hydrogen Peroxide to the Rescue!

Authors:

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Keywords: Deep Brain Stimulation, Hardware, Erosion, Implantable Neural Stimulator, Complication

Abstract:

Objectives: Following a non-infectious DBS hardware erosion, the standard practice is to explant the device and re-implant after sufficient healing. This leads to significant hospital costs and a temporary cessation of therapeutic stimulation. In the published literature, erosion complications are typically lumped together within the category of infectious complications. In this study, we investigated if we can differentiate non-infectious erosions from infectious wound dehiscence and determine if erosions could be managed without explantation.

Methods: n=3 patients presented to our clinic with implantable neural stimulator (INS) erosions in their chest. Standard microbiology tests ruled out erosions of infectious etiology. Figure 1 is a typical presentation of a non-infectious INS erosion. Wound debridement was performed with hydrogen peroxide (HP) and the wounds were primarily revised without hardware explantation. Patients were followed-up a minimum of six months post-operatively. Clinical images were documented to demonstrate progress of wound healing.

Results: n=2 subjects were able to keep their DBS hardware and there was no cessation of therapeutic stimulation. The third patient presented two months later with an onbvious infection requiring explanation. Figure 1 demonstrates the erosion preoperatively and six months post-operatively of one of the successful cases. An analysis of hardware and hospital associated costs saved per case was approximately \$50,000 USD. We present a detailed algorithm to manage hardware-related complications in DBS.

Conclusion: The application of HP during wound debridement and revision for non-infectious INS and scalp erosions can be used as a hardware-saving procedure. Details of the procedure are provided for practical purposes. We expect this hardware-saving procedure is applicable to not only DBS practitioners, but also those using Spinal Cord Stimulation, Motor Cortex Stimulation, and experimental neurostimulator devices.



P107: Brindley device results in the treatment in patients with spinal cord injury

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Keywords: Sars, functional neurosurgery, voiding disorders, incontinence, neurogenic bladder and intestine, sacral root stimulation

Abstract:

Objective: to analyze the clinical and urodynamic results as well as the complications from SARS (sacral anterior root stimulator) extradural implantation in the treatment of patients with spinal cord injury (SCI) associated with neurogenic detrusor overactivity (NDO).

Methods: Descriptive study of the results obtained in a single center from 6 patients diagnosed SCI with NDO and implanted since 2012.

Results: All patients were male, aged 38 ±10 years, and suffered a traumatic complete spinal cord lesion. The average time of evolution was 84 months (48-108). 83% of the patients showed ASIA A classification, 83% located at dorsal level. Symptomatic recurrent urinary infection (more than three per year) rate before SARS was 100%, and 0% after the procedure (p<0,69). Before SARS all patients suffered urinary incontinence due to overactive detrusor, and after SARS 100% of the patients gained control and achieved a bladder capacity greater than 300 ml. Preoperative autonomic dysreflexia rate was 66% and afterwards only 5% (p<0,07). All patients achieved an effective voiding, with residual post-voiding volume lower than 50ml and stopped using catheters. 66% of the patients used the device for erectile function and 88% of the cases use for bowel function. Infection rate has been 0%. Failure of the device was seen in three patients but only in the external controller, all of them where solved without surgery.

Conclusion: Since 2012, our group has been carrying out SARS implants in selected patients using the extradural technique with good clinical and urodynamic results, in terms of improvement of urinary incontinence, infection rate, erectile and bowel function in patients with NDO due to SCI. It proves to be a safe procedure when carried out in an interdisciplinary team.

P108: Transcranial magnetic stimulation in brain language functional areas surgery

Authors:

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Keywords: Functional brain mapping, transcranial magnetic stimulation, speech

Abstract:

Introduction: Transcranial magnetic stimulation (TMS) can induce speech arrest at 25 Hz repetitive TMS used for brain mapping in a population of epileptic patients scheduled for epilepsy surgery (Pascual-Leone1991). It is based on reversible temporal brain tissue lesion principle. There are date suggesting that speech arrest could offer information not only on dominant hemisphere but on spatial Brocca area localization in the brain (Jennum).

Method: A total of 72 patients were evaluated for epilepsy surgery. An innovative Neuro MSD device was used for TMS studies. The maximum TMS output of this device is in the range of 0 to 4 Tesla (for iron core). The figure eight shaped stimulation coil and an iron cone shaped core were used for focalization. Motor threshold is the intensity of stimulation needed to induce contraction in thumb. This intensity was used to block Brocca area activity in digit span. Different word picture association tasks were used.

Results: None of our patients presented postoperative permanent language deficits. We found that TMS not even block speech but elicit misjudgment of word picture association. It was categorized as wrong, late, slow or absent. Wernike area was more difficult to localize, but we found that there are different patterns depending on stimulus timing before, during and short after naming tasks which are presented.

Discussion: Temporary lesions is comparable to current stimulation or Wada test and is obtained by TMS noninvasively. This is helpful during dominant hemisphere resection for epilepsy or other lesions. TMS blocks speech in most of subjects but not in all. Head motor primary area is mainly involved in speech arrest but real motor aphasia is rear and bilateral speech control is found mostly in reeducated left handed subjects.

Conclusion: TMS is a noninvasive method of modulating cortex and is proper for study of language in humans. It can give information on hemispheric dominance a motor area localization. Standardized study could provide important insights on the organization of this function not explained by evolution theory.

P109: "Functional" trephinations in Ancient Egypt

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Keywords: Egypt, trephination, Imhotep

Abstract:

Background: Trephinations performed for epilepsy and melancholy, such as described by Aretaeus the Cappadocian and Roger of Salerno, might arguably be considered as functional neurosurgery. However, trephinations have been performed since prehistoric times and our understanding of their rational and development is limited. Ancient Egypt is of certain interest here, since it might be considered the cradle of medicine and is often mentioned in the modern scientific literature in relation to trephinations, sometimes specifically in connection with the famous Imhotep.

Objective: To briefly present and analyze the claims regarding trephinations in Ancient Egypt; what was actually done by the Egyptians, and what may have been incorrectly ascribed to them.

Methods: About 1200 original sources, modern journals and books were reviewed concerning Egyptian medicine/surgery with special focus on "neurosurgery".

Results: There are a number of skulls with suggested trephinations. Further, the procedure is said to be depicted in a couple of paintings and described in the medical papyri. However, it seems as if the modern literature is rather too enthusiastic regarding trephinations in Ancient Egypt. A careful analysis of the material suggests that trephinations, if they existed at all, must have been extremely rare. Thus, possible rational/indications cannot be analysed. Concerning Imhotep, it is highly unlikely that he had anything to do with medicin in general, and even more so concerning trephinations.

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P110: Comparison of efficacy, safety, duration and advantages between a frameless fiducial-less brain biopsy method and the standard frame-based stereotactic biopsy

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Keywords: stereotactic biopsy, neuronavigation, brain tumor, frameless

Abstract:

Background: The purpose of the present study is to compare the characteristics, i.e. efficacy, duration and hospital stay, of a frameless fiducial-less brain biopsy method with those of the standard frame-based stereotactic technique.

Methods: In the present prospective cohort study were enrolled 56 adult patients: 1) for whom no conclusive diagnosis could be settled in a noninvasive manner; and 2a) who also had lesions involving deeply seated and eloquent areas, or multifocal lesions, or lesions for which the probable diagnosis is a contraindication for craniotomy, or 2b) were poor candidates for open craniotomy (over 80 years old or serious comorbidities that were considered contraindications for open craniotomy). 28 patients were operated on with each method. Regarding the frameless biopsy technique, we used a navigation system (StealthStation® S7[™]) without fiducials in combination with the Navigus trajectory guide. Concerning the frame-based stereotactic method we used the Cosman-Roberts-Wells (CRW) frame and a planning software (FrameLink[™] Stereotactic Planning Software).

Results: Failure of diagnosis was recorded in 4 cases (14.3%) of the frame-based method group and 3 cases (10.7%) of the frameless fiducial-less method group, in spite of the accurate targeting, without a statistically significant difference (p= 1.0). The mean duration of the overall procedure was 111.3min for the frame-based method and 79.1min for the frameless method, a statistically significant difference (p= 0.001). Concerning neurologic morbidity, new abnormal findings in the postoperative head CT scan (p= 1.0) and postoperative hospital stay (p= 0.66) the two methods did not differ significantly. The smallest maximal diameter of a lesion successfully targeted, acquiring samples which led to a diagnosis, was 15mm for both groups.

Conclusions: The above frameless fiducial-less brain biopsy method was shown to be equally efficacious and safe, compared with the standard stereotactic frame-based technique, in terms of diagnostic yield, neurologic complications, and new findings in the postoperative head CT scan. Moreover, the frameless method was associated with a shorter duration of the overall procedure and of the respective preparatory steps; however with similar duration of the operation only and similar time spent inside the operating room overall. Finally, the length of postoperative hospitalization did not differ significantly too.

P111: Occipital nerve stimulation (ONS) with body compliant leads for chronic migraine treatment

Authors:

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Keywords: chronic migraine, headache, ONS

Abstract:

Introduction: Migraine is a highly prevalent disease and often refractory to medical therapy. ONS has been shown to provide pain relief in patients with refractory primary headache disorders. It is also less invasive than other surgical approaches; however, drawbacks have been reported, including technical issues with implantable components and lack of efficacy of the treatment. The mobility of the head-neck region causes patient discomfort at the implantation sites, when conventional straight wire SCS leads are used in ONS. We therefore investigated a new flexible, body compliant SCS lead and system for its suitability in ONS in a series of patients for efficacy, complications and overall outcome.

Methods: We hereby present a series of 27 patients suffering from chronic migraine (CM) (ICH criteria), who underwent ONS lead implantation (12 contact leads bilaterally, Algovita, Algostim). Prior to implantation, all patients received unsuccessfully conservative and surgical therapies, including antidepressants, occipital nerve blocks, opioids and botulinum toxin injections. Using a midline incision at C1-2, two 12 contact leads were placed subcutaneously and positioned under fluoroscopy bilaterally at the level of C1, respectively. Leads were tunneled and the generator was placed in an all-in-one procedure under general anesthesia.

Results: At three months follow-up, a reduction in headache days in 16 out of 27 patients (26.5 to 20.4 days) was observed, corresponding to a pain relief (9.9/7.0 on the VAS). Ten (10) patients reported a pain reduction of more than 30%, one (1) patient did not benefit so far (3 months postop). Decrease in pain led to an improvement in functional capacity of the patient during the 3 months follow-up post implantation. (6-months results will be included at the time of presentation). One failure occurred due to skin erosion of the lead tip during initial placement with concomitant dislocation; a successful revision was performed. Frequent problems with stimulator rechargement could be solved in No other complications, side effects or reports on patients discomfort all cases. were noted.

Discussion: There is an ongoing debate about optimal implant technique, indications and outcome measurement of ONS. By using a new 20% stretchable implantable lead, mechanical complications can be reduced. Due to delayed effect of the treatment we used an all-in-one approach with an outcome follow-up of 3-6 months.

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P112: Accuracy of MR-guided focused ultrasound therapy - comparison with radiofrequency lesioning

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Keywords: MRgFUS, accuracy, lesioning

Abstract:

Objective: MR-guided focused ultrasound therapy (MRgFUS) for medication-refractory essential tremor (ET) was introduced as a clinical trial in Japan in 2013. Accuracy is certainly important in the stereotactic neurosurgery, and even in MRgFUS, it is important that a lesion is created accurately in the target. Therefore, we examined the positional error and the volume of the lesion created with MRgFUS comparing with radiofrequency lesioning (RF).

Method: We compared 10 cases treated with MRgFUS for refractory medication-refractory ET after June 2014 (group A) with 7 cases treated by RF for dystonia (Group B), regarding the positional error between the target and the center of the lesion, and the volume. Exablate Neuro® was used for MRgFUS. Elekta Stereotactic System® was used for RF to create a lesion at 70°C for 60 seconds after the test coagulation at 60°C for 30 seconds with 2 * 2 mm an uninsulated tip. We measured the positional error by measuring it between the target and the center of the lesion, and the volume of the lesion by vertical * horizontal * height / 2, and we compared them statistically.

Results: The positional error of the lesion was 1.06 ± 0.44 mm in group A and 3.47 ± 1.73 mm in group B, which was significantly smaller in group A (p = 0.007). The volume of the lesion was 62.1 ± 26.1 mm³ in group A and 126.2 ± 66.4 mm³ in group B, which was significantly smaller in group A (p = 0.018).

Conclusion: MRgFUS has a smaller positional error than RF, and it is possible to create a lesion with higher accuracy.

P113: Intrathecal baclofen therapy for Lesch-Nyhan disease: a case report

Authors:

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Keywords: intrathecal baclofen, lesch-nyhan disease, dystonia

Abstract:

Background and Objectives: Lesch-Nyhan Disease (LND) is extremely rare inherited disorder of purine salvage metabolism, clinically manifesting hyperuricaemia, compulsive self-injurious behavior, and extrapyramidal motor disorder. Various symptoms of LND is treated with pharmacological treatment such as antispastic drugs, antipsychoics, anti-parkinsonian drugs and dietary supplements, whereas their abnormal posturing or involuntary movement is difficult to control. Here we report a case of LND treated by intrathecal baclofen therapy (ITB), and discuss its role on their symptoms.

Case eport: A 22 year-old male genetically diagnosed as LND was referred to our clinic for his intermittent dyskinesia and hypertonic posturing. His abnormal posturing has been treated with oral haloperidol, diazepam and dantrolene as well as botulinum toxin A injection, but their efficacy was not satisfactory. The patient's family wished to undergo ITB. After the confirmation of the effect of intrathecal administration of baclofen on relief of his abnormal posturing, permanent implantation of infusion system was conducted under general anesthesia. Soon after operation, baclofen was administered with the dose of 28 ug/day, which sufficiently improved the score of Unified Dystonia Rating Scale from 40 to 19. Surface EMG study suggested his abnormal posture might be caused by dystonia, which improved after ITB. No adverse effects of ITB occurred so far.

Conclusion: Intrathecal administration of baclofen with relatively low dose is effective for relief of motor symptoms in LND, at least for a short-term follow-up period. Abnormal posturing seen in LND seems to be dystonia, in which ITB could be of therapeutic value.

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P114: Intradural Fibrin for Repair of Cerebrospinal Fluid Leaks

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Keywords: cerebrospinal, fluid, CSF, leak, baclofen, intrathecal pump, fibrin

Abstract:

Cerebrospinal fluid (CSF) leaks are common in patients undergoing new intrathecal pump catheter implantations. The incidence of CSF leaks has increased significantly with the advent of non-occluding intrathecal catheters. In general, CSF leaks following intrathecal catheterization are first treated with epidural blood patches. When patients do not respond to epidural blood patches, surgical repair is attempted through a laminectomy and direct sewing of the dural defect. While direct visualization and repair of the dural defect is often successful, it is also invasive and puts the patient at risk for future spinal instability. These procedures do not guarantee that the open laminectomy repair will fix the CSF leak either.

Rather than performing an invasive procedure, we have recently begun using a fibrin glue plug with intra- and extra-dural placement of fibrin glue. Initially, this procedure was performed intraoperatively after reopening the prior catheter incision and placing the needle close to the dural defect. We are now are transitioning to a percutaneous approach to sealing the csf leak that can be performed outside of the OR. In this report, we will provide two case studies in which intraoperative placement of tisseal was used to refractory CSF leaks following intrathecal catheterization.

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P115: Predictive Factors of Early Distant Brain Failure after Gamma Knife Radiosurgery Alone in Patients with Brain Metastases of Non-Small-Cell Lung Cancer

Authors:

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Keywords: Non-small cell lung cancer; Brain metastases; Radiosurgery; Predictive factor

Abstract:

Background: The objective of this study was to elucidate the predictive factors for early distant brain failure in patients with brain metastases of non-small-cell lung cancer (NSCLC) who were treated with gamma knife radiosurgery (GKRS) without previous whole-brain radiotherapy (WBRT) or surgery.

imaging We retrospectively reviewed clinical data of 459 with Methods: and patients brain metastases of NSCLC who underwent GKRS from June 2008 to December 2013. The primary end-point was early distant brain failure, defined as the detection of newly developed metastatic lesions on magnetic resonance imaging (MRI) 3 months after GKRS. Factors such as tumor pathology subtype, concurrent systemic chemotherapy, epidermal growth factor receptor (EGFR) mutation status, use of EGFR tyrosine kinase inhibitors (TKIs), systemic disease status, presence of a metastatic lesion only in delayed MRI, and volume and number of metastases were analyzed.

Results: There were no statistically significant differences with respect to pathologic subtype, concurrent systemic chemotherapy, EGFR mutation, and early distant brain failure. Patients treated with EGFR-TKIs (p = 0.004), with a stable systemic disease status (p = 0.028) and 3 or fewer brain lesions (p = 0.000) experienced a significantly lower incidence of early distant brain failure.

Conclusion: This study suggests that GKRS alone could be considered for patients treated with EGFR-TKIs who have a stable systemic disease status and 3 or fewer brain lesions. WBRT should be considered for other patients.

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P116: The Stony Brook awake craniotomy protocol: a technical note

Authors:

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Keywords: Brain tumor, cortical mapping, awake craniotomy

Abstract:

Background: Awake craniotomy allows for intraoperative cortical mapping and functional testing during the resection of brain tumors that involve an eloquent region of the brain. However, most current awake craniotomy techniques require a rigid fixation of the skull that can cause discomfort to the patient during the awake phase of the surgery. Furthermore, airway management during different stages of surgery is complicated, and can cause unnecessary stress on both the surgeon and staff. We have developed a simple protocol for craniotomy under general anesthesia, with subsequent "wake-up" testing, which maximizes both patient and operative team comfort, leading to optimal outcomes.

Objective: To discuss the protocol that we have developed at the Stony Brook University Hospital. Neurosurgical and anesthetic techniques along with two example cases involving motor and language mapping will be discussed in detail.

Methods: Patients were positioned in a supine (for frontal craniotomy) or a lateral position (for temporal craniotomy). We used the frameless Brainlab[™] skull-mounted array for stereotactic navigation. Rigid fixation of the skull was avoided. General anesthesia was used during the "asleep" phase of the surgery, with airways established by a laryngeal mask airway (LMA) or endotracheal (ET) tube. Following removal of the bone flap and opening of the dura, patients were woken up, and the LMA or ET tube was removed. Cortical mapping was performed to establish a safe entry zone for tumor removal. While the tumors were being removed, we continued motor examination and casual conversation with the patient to ensure safety. Completion of resection was confirmed with intraoperative ultrasound and microscope examination. Patients were lightly sedated during the remaining phase of the surgery until skin closure.

Results: No patient exhibited any neurological deficits or adverse anesthesia outcomes during the postoperative period. Gross total excision was achieved in the patient that underwent language mapping. In the patient that underwent motor mapping, resection was halted as a result of the patient developing hand weakness intraoperatively, which resolved immediately.

Conclusion: The protocol developed at Stony Brook University avoids rigid skull fixation and simplifies airway management, helping to maximize patient and physician comfort while allowing for successful tumor resection.

P117: Robotized stereotactic assistant system assisted stereotactic surgery for the treatment of hypertensive brainstem hemorrhage

Authors:

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Keywords: brain stem hemorrhage, robotized stereotactic assistant, stereotaxic techniques, minimally invasive treatment

Abstract:

Objective: To analyze robotized stereotactic assistant (ROSA) system assisted stereotactic surgery for the treatment of hypertensive brainstem hemorrhage. Methods: The clinical data of 33 patients with hypertensive brainstem hemorrhage undergoing minimally invasive surgery were analyzed retrospectively. According to the time node, the patients were divided into frame group (n=17, stereotactic frame assisted, January 2014 to March 2016) and ROSA group (n=16, the ROSA robot assisted, May to October 2016).

Results: The hematoma evacuation rate was higher in ROSA group than in frame group (χ^2 = 5.28, P<0.05). The operation time and postoperative extubation time were shorter in ROSA group than in frame group (t=1.762, P<0.05; t=2.493, P<0.05 respectively). The postoperative hemorrhage occurred in 3 cases and intracranial infection in 2 in frame group, while did not occur in ROSA group, and the difference was not statistically significant between the two groups (P=0.125, P=0.258 respectively).

Conclusions: The hematoma evacuation rate, operation time and postoperative extubation time is superior in ROSA system assisted to stereotactic frame assisted minimally invasive surgical treatment for hypertensive brainstem hemorrhage. ROSA system is suitable for ultra-early treatment of hypertensive brainstem hemorrhage.



P118: The feasibility of intraoperative local field potential recording from microelectrode during deep brain stimulation for Parkinson's disease

Authors:

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Keywords: Parkinson's disease, Deep brain stimulation, Local field potential

Abstract:

Evidences from many studies suggest the increased beta-band oscillatory activity of the local field potential (LFP) is a characteristic finding of the STN in the Parkinsonian off-medication state. Most LFPs were recorded postoperatively using the inserted macroelectrode. This method has the advantage of obtaining stable recordings but generally requires two-staged operations. We tested the feasibility of recording LFP from microelectrode simultaneously with neuronal spikes during the surgery. Data from 10 PD patients who underwent DBS surgery were included in this study.

Signals from microelectrodes were amplified and differently filtered to display both activities during the surgery. LFP recordings were also recorded postoperatively from implanted macroelectrodes and compared to intraoperative recordings in available cases. Intraoperative signals were sampled with the sampling rate of 50,000 Hz for spike activities and 1,000 Hz for LFPs. Postoperative LFP recordings were performed 3 or 4 days after the surgery before implanting subcutaneous pulse generators. The externalized temporary cables were connected to a signal amplifier and high pass filtered at 1 Hz with notch filtering at 60 Hz, and digitalized by A/D converter with a sampling rate of 1,000 Hz. Stable LFPs with prominent beta band activity were only noted in 5 out of 10 patients during the surgery. In contrast, all postoperative LFP recordings were stably recorded and prominent beta band activity was noted in all cases. Intraoperative LFPs showed lower signal-to-noise ratio and higher rate of unstable recording due to various artifacts. Postoperative LFPs showed smaller amplitude of waveforms and more prominent dual peaks at low- and high beta band.

We concluded that intraoperative LFPs from the microelectrode was not suitable for clinical purpose. Prominent beta band LFP activities were observed in all patients recorded from macroelectrodes postoperatively, but only in half of patients in intraoperative microelectrode recordings.

P119: Multiple single unit activity in ventral intermediate thalamus of essential tremor patients during intention tremor

Authors:

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Keywords: Essential tremor, DBS, accelerometer, Vim, LFP, single unit, Microelectrode, recordings

Abstract:

Essential Tremor is the most common movement disorder; however its pathophysiology is still unclear. Severe cases have been treated successfully with Deep Brain Stimulation of the Ventral Intermediate nucleus of the Thalamus (Vim).

To further elucidate the involvement of the Vim in the pathophysiology of this condition we recorded single unit and local field potential (LFP) activity in the bilateral Vim. Microelctrode recordings were made from 4 patients as part of the intra-surgical exploration during the implantation of deep brain stimulation electrodes. Accelerometric signal of the contralateral hand was also acquired, during intention tremor and rest state. All patients were awake during recording.

Spike sorting yielded 66 units (27 single cell activity and 39 multi cell activity) recorded during rest (n= 54) and tremor (n= 32). We characterised the firing rate, action potential duration, burst index, mean spikes per burst, burst rate and proportion of spikes in bursts between tremor and rest. No significant difference were found (non-corrected Wilcoxon rank sum test p>0.05), and recorded units could not be separated into distinct populations. Four out of 23 units tested during tremor were phase locked at tremor frequency (4-5Hz), one of which also displayed phase locking at double the tremor frequency. Two out of 28 units were phase locked at 15-20 Hz during baseline.

The LFP showed increased power at tremor frequency during tremor, coherent with tremor activity. In some cases, LFP power at tremor frequency showed a strong correlation with tremor intensity at sub-second time scale. This correlated activity occurred with a variable delay (~250-650 ms) with the accelerometer leading the LFP. LFP and tremor also showed frequency coupling at sub-second time scale, furthermore the tremor frequency appeared to oscillate at ~0.5 Hz.

This study revealed that although Vim neurons showed a different phase locking tendency between tremor and baseline, no difference could be detected by testing classical firing indexes. LFP and accelerometer signal of hand tremor were coupled both in amplitude and frequency, with a tendency of the tremor to lead the LFP. We find a periodical fluctuation of the tremor frequency at ~0.5 Hz both in LFP as well as the accelerometer signal, which to our knowledge is a new pathological feature of intention tremor.

P120: Microelectrode Recordings of the Globus Pallidus internus (GPi) in Cerebral Palsy Patients

Authors:

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Keywords: basal ganglia, cerebral palsy, globus pallidus, microelectrode recordings

Abstract:

Objectives: Individuals with cerebral palsy often develop secondary dystonic symptoms, for which deep brain stimulation (DBS) of the Globus Pallidus internus (GPi) can be indicated. However, DBS of the GPi has had mixed outcomes in these patients, and data on the neurophysiology of the GPi in dystonic CP is lacking. Previous models of dystonia suggest that low firing rates in GPi might be related to dystonic symptoms, but debate remains whether anesthetics are involved. We took microelectrode recordings (MER's) to measure the firing rates and patterns of GPi single-units in CP patients in awake and anesthetized states. Furthermore, subcortical lesions in CP patients are the principal reason for symptom generation, and could play a role in deafferenting cells. To test this hypothesis, we employed a new macro-stimulation technique.

Methods: 6 CP patients underwent Bi-lateral DBS surgery targeting the GPi. 4 out of the 6 patients were sedated under general anesthesia. Depth of anesthesia was monitored using the Bispectral index. MER's were taken prior to the implantation of DBS electrodes and GPi cells were identified from MER data. Firing rates, firing patterns and burst index values were measured. Comparisons were made between single units from anesthetized patients, and those from the awake patients. For the macrostimulations, a stimulating electrode was used to excite afferent connections by placing it 5mm away from the recording electrodes.

Results: The firing rate of CP GPi cells in patients under GA was found to be lower (mean \pm standard deviation; 22.8 \pm 11.3 Hz; n=56) than cells in the awake patient (52 \pm 22.2 Hz; n=18; P<0.0001). CP GPi cells under general anesthesia displayed a more bursty firing pattern and had a higher median burst index value compared to the awake patient (2.2 \pm 1.8 vs 1.5 \pm 0.3 respectively; P<0.01). Furthermore, GPi firing rate was positively correlated with Bispectral index (Pearson's r=0.99). Finally, using our stimulation technique, we found complete lack of inhibitory response localized to the damaged side of a patient's brain.

Conclusion: To our knowledge, this is the first evaluation of the neuronal properties of the GPi in cerebral palsy. Our results suggest that GA is responsible for the lower firing rate of GPi neurons, and hence not directly correlated with the dystonic symptoms of CP. Additionally, macro-stimulations seem to be a valid technique for the assessment of neuronal de-afferentiation in humans

P121: Technical Reasons for Differences in Intraoperative Findings in Semi - Macrostimulation and Postoperative Neurological State in Respect to Dysarthria or other Side Effects?

Authors:

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Keywords: Deep Brain Stimulation, Neuromodulation, Intraoperative Electrophysiology, Microrecording, Semimacrostimulation

Abstract:

Objective: Deep brain stimulation in parkinsons disease, essential tremor and various forms of dystonia is well established and in its effectiveness proven. To identify side effects like dysarthria or motor symptoms as early as possible surgery is performed under local anesthesia in combination with intraoperative semi macro stimulation. But despite of that, seldom patients show side effects postoperative.

Methods: We examined the recording microelectrodes and stimulating semi-macro-electrodes by magnifying glasses during surgery.

Results: We never discovered a problem in the tungsten electrodes for micro-recording but some of the stimulation probes exhibited an inappropriate removal of the isolation on the tip of the electrodes. The insulation was still covering the tip of the probe resulting in no stimulation side effects during surgery. It was leading the surgeon and the neurophysiologist to the wrong estimation that the electrode placement will be perfect being proven wrong in postoperative side effects.

Conclusion: Surgeons have to be aware that mal-production of electrodes may occure being not detectable by threshold measurement of the electrodes because of bridging liquids in the surgical site. The surgeon has to check every electrode before inserting into the guide tubes especially when electrodes are delivered in sterile trays by manufacturers.

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P122: Establishing an MRI-guided and MRI-verified deep brain stimulation service in Malta through cross border collaboration: Audit of the first five years

Authors:

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Keywords: Deep Brain Stimulation, Parkinson's disease, cross border collaboration, MRI-guided and MRI-verified, UPDRS III, quality of life, PDQ-39, Malta

Abstract:

Objectives: A specialist multidisciplinary approach and lifelong follow-up is required for patients undergoing Deep Brain Stimulation (DBS). Access can be a challenge for remote communities or small nation states where the population cannot support such specialised services for the relatively small numbers of patients. Malta has a population of just under 450 000. The number of patients likely to benefit from DBS was envisaged to be around 5 to 10 per year. The purpose of this study was to determine the outcome of a cross border collaboration between specialist services in London and a tertiary centre in Malta.

Methods: Between 2011 and 2015, the total number of patients undergoing deep brain stimulation was 35. Of these, 29 patients received bilateral subthalamic nucleus (STN) DBS for Parkinson's Disease. Surgery was performed using a Leksell G-frame under general anaesthesia using an MRI-guided and MRI-verified approach. Pre-operative motor function was compared with one year post-operative motor function assessments in 26 patients. Pre-operative and post-operative quality of life assessment was also completed in 24 patients.

Results: The demographics of the 26 patients were: 16 M; age 60 \pm 9, range 32-70; disease duration 8.8 \pm 2.7. There was a statistically significant improvement in off-medication Unified Parkinson's Disease Rating Scale (UPDRS) III motor function (41.7%), reduction in Levodopa Equivalent Dose (LED) (30.6%) and improvement in quality of life as measured by the Parkinson's Disease Questionnaire (PDQ-39) (52.3%). Sub analysis of the PDQ-39 dimensions showed significant improvement in all dimensions except communication, with greatest benefit for activities of daily living (ADLs) (72.4%) and stigma (66.3%). Surgical adverse events were transient with no permanent sequelae. Patients receiving DBS to targets other than the STN and for different indications also benefitted from the procedure.

Conclusion: This audit demonstrates the successful delivery of specialist services through cross border collaboration with achievement of expected results in terms of therapeutic benefit to patients. This positive outcome was contingent on the political desire to introduce and support the service and the close collaboration between specialists in both centres.

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P123: DBS lead fractures in movement disorder patients

Authors:

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2. Neurosurgery Dept., Inje University Busan Paik Hospital, Busan, KOREA

Keywords: Deep brain stimulation, fracture

Abstract:

Objectives: DBS is effective for movement disorder, pain, psychiatric disorders, etc. Sometimes, in Dystonia patient and parkinsonian-dystonia patient developed DBS lead fracture.

Methods: We operated over 500 DBS and SCS, MCS operations during last 15 years. Among 6 patients developed DBS lead fractures. Disease entity consisted with 5 parkinsonism patients, 1 dystonia patient. 1) Among 1 parkinsonian 43-year-male patient devloped Rt DBS lead extension line fracture after 4 DBS operation. IPG showed battery was gone. We changed into new IPG and extension line. 2) 56-year-male patient operated STN DBS surgery in other hospital. 2 year later, Rt DBS impetance was bad, we checked radiography of skull and lead extension line fracture was suspected. In operation view, we checked lead extension line fracture and changed into new one. 3) 61-year-female patient operated Gpi- DBS surgery in other hospital. 3 years later, IPG connecting extension line fracture was developed and changed into new extension line.

Results: 4) 65-year-male patient operated STN- DBS surgery in other hospital. 3 years later, IPG connecting extension line fracture was developed and changed into new extension line 5) 27-year-male dystonia patient operated Gpi- DBS surgery. 5years later, DBS lead connecting proximal extension line fracture was developed and changed into new extension line 6) 58-year-male Parkinsonism patient operated STN- DBS surgery. 5 years later, DBS lead connecting proximal extension line fracture was developed and changed into new extension line fracture was developed and changed into new extension line. DBS lead fracture site is 4 IPG connecting extension line, 2 DBS lead connecting proximal extension line.

Conclusion: DBS is safe and effective treatment for intractable movement disorder patients. If patient's symptom is aggravated after DBS surgery and should check radiography of skull and, chest but rarely developed lead fracture in dystonia or parkinsonism patients.

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P124: Delayed Responses to STN Deep Brain Stimulation in Patients with Parkinson's Disease

Authors:

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1. Beijing Tiantan Hospital, Beijing, CHINA

Keywords: Delayed Responses, STN Deep Brain Stimulation, Parkinson's Disease

Abstract:

Subthalamic nuclei (STN) deep brain stimulation (DBS) has become a widely accepted treatment modality in relieving tremor and rigidity for Parkinson's disease. Usually, if the DBS lead is accurately and properly placed in the STN, tremor and rigidity will attenuate almost instantly after DBS is turned on. Recently, we began to notice a "delayed response" phenomenon in STN DBS surgeries, in which case the intraoperative STN test stimulation failed to show its expected effects whereas the stimulation in the ward did. We identified 6 patients who demonstrated definite delayed responses to STN DBS in a 3-year period. The clinical data of these patients were collected and analyzed. Our findings remind us that if the MER is perfect but test stimulation fails, we should consider the possibility of the STN delayed response phenomenon, which may help us out from missing a good target and changing targets aimlessly.



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P125: Clinical Outcome and Location of Active Contacts in Caudal Zona Incerta (cZI) Deep Brain Stimulation (DBS) for Tremor-Dominant Movement Disorders

Authors:

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Keywords: Deep brain stimulation, Essential tremor, Parkinson's disease, Posterior subthalamic area, Ventral intermedius nucleus, Zona incerta

Abstract:

Objective: We investigated the clinical outcome and location of active contacts in chronic caudal zona incerta (cZI) deep brain stimulation (DBS) in the treatment of tremor-dominant movement disorders.

Methods: To evaluate the efficacy of cZI DBS on tremor in patients with essential tremor (ET) and Parkinson's disease (PD), assessment using the subscores of essential tremor rating scale (ETRS) and part III (motor) subscores of the unified Parkinson's disease rating scale (UPDRS) was performed at 12 month postoperatively. The changes in the severity of tremor was measured as percent (%) tremor reduction. To determine the location of active contacts, 10 leads in 9 patients with cZI DBS were inevestigated.

Results: The scores of item 5 and 6 (contralateral tremor) of the ETRS decreased by 76.5 % (8.38 ± 2.26 to 2.13 ± 1.89 , p<0.01, paired t test) and those of items 11-15 (contralateral hand function) improved by 72.6 % at postoperative 12 month (14.50 ± 4.21 to 4.38 ± 3.25, p<0.01, paired t test). The degree of improvement in PD was 81.9 % in items 20-21 (contralateral tremor), 50% in item 22 (contralateral rigidity), and 81.5 % in items 23-26 (contralateral bradykinesia). The head tremor improved by 83.3% in item 4 (from 6 to 1) with bilateral cZl stimulation. Three patient experience dysphasia. However, no permanent speech disturbance was observed. The mean intensity of stimulation at postoperative 12 month did not differ from that in early postoperative period, indicating stimulation tolerance was not significant during chronic cZl stimulation.

Conclusion: Chronic cZI stimulation is a safe and effective means in the treatment of tremor-dominant movement disorders.



Figure 2. Locations of active contact of caudal zona incerta deep brain stimulation plotted on the stereotactic atlas of the human thalamus and basal ganglia[12]. A: locations of all active contacts plotted on the axial plane 4.5 mm below the AC-PC. B: locations of all active contact plotted on the coronal plane 6 mm anterior from the PC. C: mean location of active contacts plotted on the axial plane 4.5 mm below the AC-PC. D: mean location of active contacts plotted on the coronal plane 6 mm anterior from the PC. AC; anterior commissure, al; ansa lenticularis, CP; cerebral peduncle, fct; fasciculus cerebello-thalamicus, fx; fornix, GP; globus pallidus, Hyp; hypothalamus, ic; internal capsule, MCP; mid-commisural point, ml; medial lemniscus, mtt; mammillothalamic tract, RN; red nucleus, scp; superior cerebellar peduncle, SNc; pars compacta of substantia nigra, SNr; pars reticulate of subtantia nigra,STh; subthalamic nucleus, PC; posterior commissure, ZI; zona incerta.

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P126: Freezing of gait after pallidal stimulation for Parkinson disease

Authors:

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Keywords: deep brain stimulation, globus pallidus internus, Parkinson disease, freezing of gait

Abstract:

Background and objectives: Established targets of deep brain stimulation (DBS) in Parkinson disease (PD) are the subthalamic nucleus (STN) or globus pallidus internus (GPi). An early comparative study revealed the superiority of STN DBS in improvement of motor score in the medication-off period and reduction of dopaminergic medication. Consequently, the STN has been the most common target of DBS for PD for a long time. However, a current randomized comparative study revealed the potential of GPi DBS, and revealed that GPi DBS improved motor functions similarly to STN DBS with less psychiatric or cognitive deficit after surgery. Therefore, we selected the target in each patient based on the characteristics of these targets and the number of cases with GPi DBS was increasing. However, we had some patients who suffered from freezing of gait despite improvement of cardinal PD symptoms and dyskinesia/dystonia after GPi DBS. We report cases with freezing of gait after GPi DBS.

Methods: We retrospectively reviewed 77 patients who underwent bilateral DBS for PD between 2012 and 2015. Among them, twelve patients (16%) underwent GPi DBS. The reason for selecting GPi was severe dyskinesia or dystonia with low dose medications (8 cases) and/or a high risk of neuropsychological or psychiatric complications such as high aged patients or patients with mild cognitive decline (7 cases).

Results: GPi DBS significantly improved motor function, fluctuation, and dyskinesia/dystonia as well as STN DBS. On the other hand, 5 patients (42%) showed apparent deterioration of freezing of gait after GPi DBS. We tried increasing of dopaminergic medication or readjustment of stimulation parameters using interleaving mode for these patients. However, sufficient improvement of gait problem was not obtained.

Conclusions: GPi DBS is effective in improving cardinal motor symptoms and dyskinesia/dystonia in PD. However, vigilance is needed, because significant incidence of freezing of gait occurs after GPi DBS. We discuss about the mechanism and treatments for this problem.

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P127: Deep brain stimulation for Holmes tremor, a case series

Authors:

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Keywords: Holmes tremor, case series

Abstract:

Objective : Deep brain stimulation is an established treatment in movement disorders. Holmes tremor following unilateral cerebellar brain lesions is rare and deep brain stimulation in these cases is always an individual decision. To reassess results of our surgical indications we compiled our cases related to the published literature for this special indication.

Methods : We report on our five patient case series with post lesion Holmes tremor, their indications, lesion positions, target points, stimulation parameters and overall outcome after deep brain stimulation between the years 2002 - 2014. In all patients conservative medical treatment failed or showed no significant improvement in the patients' overall quality of life. In addition we reviewed the published literature showing numerous case series but no randomized studies yet.

Results : Unilateral deep brain surgery was initiated in all five patients. We targeted the contralateral Nucleus ventralis intermedius (VIM). Intraoperative four out of five patients had significant symptom improvement, but one patient tremor was tested intraoperative and showed no significant effect with testing over 10 trajectories, therefore no electrode was implanted. From the beginning of stimulation a significant reduction of target symptoms appeared with up to complete disappearance and improvement of quality of life. This effect was ongoing until now with a medium follow up of 36 months.

Conclusion : In consent with published data deep brain stimulation for Holmes tremor can reduce the symptoms up to complete disappearance and improve the overall quality of life of patients. Since therapy may fail individual diagnosis should be strictly analyzed and maybe MRI-techniques like fibertracking could help to clarify the individual anatomy.

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P128: Intrathecal baclofen therapy for GAD(+) Stiff-Person Syndrome: A Case Series of 4 patients

Authors:

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Keywords: Intrathecal baclofen (ITB) Pump, GAD(+), Stiff-Person Syndrome

Abstract:

Objective: To report four cases of a rare disorder, GAD (+) Stiff Person Syndrome (SPS), treated with Intrathecal baclofen therapy.

Background: Stiff person syndrome is a rare disorder of unclear etiology characterized by progressive rigidity and stiffness resulting in postural deformities. Stiff-Person syndrome is an autoimmune disorder and highly correlates with the presence of anti–glutamic acid decarboxylase (GAD) antibodies. Baclofen, Benzodiazepines and autoimmune suppressive treatments as steroids, Rituximab, and plasma exchange have been used in SPS patients. However, when the above treatments are inadequate, intrathecal baclofen may be used.

Results: We report 4 patients with GAD(+) SPS which presented with severe refractory neurological manifestations of the disease, and greatly benefited from intrathecal baclofen (ITB) therapy. A 34 year old man diagnosed with SPS presented with refractory progressive spasms of the lower trunk. Unresponsive to oral baclofen, diazepam, steroids and eventually IVIG, the patient has lost his ability to walk. Treated with implantation of ITB, the patient's spasm had decreased dramatically, and he had regained his ability to walk. The second and the third patients were a 33 year old woman and a 17 years old girl diagnosed with acute SPS developed to a life threatening disease. Starting with increased muscular tonus, the two patients had developed progressive diaphragmatic spasm leading to respiratory failure. The patient underwent an implantation of ITB pump and the diaphragm contractility was regained. Soon after, the patient had withdrawal from mechanical ventilation. The two patients had been discharged from the hospital fully functional, with a substantial reduction in their symptoms. The fourth patient was a 31 year old woman with painful spasms of the legs and trunk. Despite IV immunoglobulin and plasma exchange therapy clinical improvement was demonstrated.

Conclusion: We describe four cases of GAD(+) SPS patients, presented with severe debilitating and even life threatening manifestations of their condition. After poor response to conventional SPS therapy, including oral baclofen, benzodiazepines, steroids and plasma exchange, all the 4 patients described here highly benefited from intrathecal baclofen (ITB) therapy.

P129: Long-term (10 to 14 years) follow-up of bilateral pallidal stimulation for patients with primary generalized dystonia

Authors:

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Keywords: pallidal stimulation, primary generalized dystonia, deep brain stimulation

Abstract:

Objectives: Bilateral pallidal stimulation is an established surgical management of patients with primary generalized dystonia (PGD). The aim of this study is to present our long-term results (with at least 10 years follow-up) of bilateral pallidal stimulation in patients with PGD.

Methods: The study population is composed of 9 patients with the diagnosis of PGD (5 patients with DYT-1 positive PGD and 4 patients with DYT-1 negative PGD with at least 10 years postoperative follow-up period). The patients were operated on in general anesthesia. The stereotactic target - posteroventrolateral pallidum was calculated according to the midcommissural point derived from fusion of stereotactic computer tomography images with magnetic resonance images. The formal objective assessment included the Burke-Fahn-Marsden Dystonia Rating Scale (BFMDRS). The BFMDRS assessment was performed usually before and after it annually up to 10 years when bilateral pallidal stimulation was switched on. The postoperative scores in stimulation on condition were compared to baseline scores. The internal pulse generators (IPGs) were not switched of in postoperative period for assessment. All the patients were primary implanted with single channel and reimplanted over follow-up period with non-rechargeable IPGs.

Results: At the last follow-up visit (ranging from 10 to 14 years after surgery) the functional and motor parts of the BFMDRS for patients with DYT-1 positive PGD were improved by 68 % and 65 % respectively when compared to baseline scores. The functional and motor parts of the BFMDRS for patients with DYT-1 negative PGD were improved by 65 % and 58 % when compared to baseline scores. The hardware-related complications were quiet common affecting 5 patients and included 2 breakages of DBS leads, 2 erosions located over the connector, 2 rapid depletions of IPG. 1 rapid IPG depletion resulted in severe life-threatening status dystonicus.

Conclusions: Bilateral pallidal stimulation is an effective treatment in patients with PGD with long-lasting antidystonic effect validated by objective BFMDRS. The incidence of hardware-related complications is relatively high. Most of these complications can be managed successfully by repeated procedures and reduced by appropriate surgical technique. The patients often needed the single channel IPG replacement surgeries due to frequent IPG depletions. There is a need to implant rechargeable IPGs in dystonic patients.

P130: Pallidal deep brain stimulation in the treatment of meige syndrome

Authors:

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Keywords: Meige syndrome, pallidal stimulation, deep brain stimulation

Abstract:

Objectives: Meige syndrome (MS) is characterized by blepharospasm, facial, oromandibular, and cervical dystonia. The medical treatment of this condition is challenging and unsuccessful over long time. Recent case reports and small clinical series showed that bilateral deep brain stimulation (DBS) of globus pallidus pars interna (GPi) improves dystonic features of MS validated by Burk-Fahn-Marsden Dystonia Rating Scale (BFMDRS).

Methods: We report on our experience in using bilateral GPi DBS in 5 cases of MS. We present short-term (3 months) follow-up as well long-term (from 24 months to 48 months) results. Preoperative and postoperative BFMDRS assessments were performed on each patient. The postoperative BFMDRS scores was done when both stimulators were switched on and compared to baseline scores.

Results: Bilateral GPi DBS reduced the BFMDRS total movement score by 75 % at short-term follow-up, and by 87 % at long-term follow-up when compared to baseline scores. The BFMDRS total disability score was reduced by 46 % at short-term follow-up, and by 56 % at long-term follow-up when compared to baseline scores.

Conclusions: Our results showed that bilateral GPi DBS in MS is effective and safe, if conservative treatment options failed. The benefit is not only observed at short and at long-term follow-up ranging from 24 to 48 months.

P131: Use of 80 HZ stimulation in subthalamic deep brain stimulation parkinson's disase patients may improve axial symptoms and speech with longstanding effect

Authors:

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Keywords: subthalamic stimulation, low frequency stimulation, Parkinson's disase, deep brain stimulation

Abstract:

Objectives: Bilateral subthalamic nucleus deep brain stimulation (STN DBS) remains an effective and long-lasting therapy for patients with advanced Parkinson's disease (PD). Some patients develop stimulation resistant symptoms like freezing of gait and gait disturbances in on condition. These axial symptoms in contrary to limb tremor, rigidity and bradykinesia are not well controlled by high frequency STN DBS over longer follow-up periods.

Interestingly, we observed that unilateral single-channel internal pulse generator (IPG) depletion may improve paradoxically axial symptoms and gait. After replacement of IPG and changing the stimulation frequency from high (130m Hz) to low (80 Hz) the axial and limb PD symptoms were well controlled. The aim of the study was to evaluate 80 Hz stimulation in advanced PD patients after unilateral IPG depletion.

Methods: We report on our experience in using low frequency 80 Hz bilateral STN DBS in 7 patients with longstanding PD. All patients experienced depletion of one IPG which paradoxically improved some axial symptoms. After replacement surgery and reinstitution of 130 Hz stimulation axial symptoms deteriorated. Subsequent lowering stimulation frequency to 80 Hz improved axial symptoms. The objective assessments included the UPDRS part II and III, Stand-Walk-Sit (SWS) test during 130 Hz and 80 Hz stimulation in medication off and on condition.

Results: We observed significant improvement of axial scores and gait after switching from 130 Hz to 80 Hz stimulation frequency. The gait (SWS) test and gait disorder scores of UPDRS part III improvements were clearly demonstrated in stimulation on 80 Hz condition. Interestingly, speech also improved under bilateral 80 Hz stimulation. In some patients the voltage had to be increased to better control segmental PD symptoms.

Conclusion: Rapid depletion of single channel IPG programmed with high frequency stimulation 130 Hz results in simultaneous improvement of axial symptoms like freezing of gait in on condition reported by the patients themselves. It can be concluded that bilateral 130 Hz in STN DBS may not be the preferred frequency for continuous stimulation and may impair some gait and balance problem seen in PD patients. Lowering the frequency to 80 Hz solved these problems in reported patients.

P132: A middle term results in surgery of Parkinson disease. Series of 58 cases, department of neurosurgery-Zemirli hospital, Algers, Algeria

Authors:

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Abstract:

Introduction: Parkinson's disease (PD) remains a major cause of neurological disability affecting millions of patients around the world. While pharmacotherapy remains the primary treatment of PD symptoms, surgical therapies have showed a resurgence of succeful appropriate selection of patients, deep brain stimulation (DBS) is now considered one of the most important advances in PD therapy.

Methods: Since July 2004 to 2016 fifty-eight (58) patients suffering from PD were operated in our department. This study included 36men and 22 women eanging between 34 complete form, 14 trembling and 10 rigid form; the age range from 37 to 70 years (mean age: 52 years and age onset 40 years. Lesionotomy of the GPI in 2 cases, of the VIM in 17 cases, 2 cases of unilateral lesionotomy with DBS and bilateral deep brain stimulation (DBS) in 39 patients. The coordinates X Y Z of STN and GPI are calculated on work station after realising a fusion between a stereotactic CTScan and an MRI. Usually the stimulation of the GPI,STN and thalamotomy were performed without anesthesia. Electrophysiological microrecordings and clinical per operative assessment were realized for the accuracy of the location of the electrode in the STN.

Results: Satisfactory to excellent results were precocous in surgery of PD .The comperative study of pre and post operative scores including the UPDRS III (motor score) has noted a significant reduction of 65% in the UPDRS OFF and 63% in the UPDRS ON .Thermolesion of the VIM has demonstreted efficacy on tremor in 70% the major post operativ complication observed wase the stimulator infection in two cases .we deplored no mortality or morbidity.

Conclusion: Parkinson disease surgery using both ablative and deep brain stimulation seems to be a reasonable option for medically intractable patients the appropriate selection of patients provide a good outcome.

P133: Tremulous spasmodic torticollis treated by bilateral pallidal stimulation. Case report

Authors:

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Keywords: pallidal stimulation, tremulous spasmodic torticollis, deep brain stimulation

Abstract:

Objective: The aim of the report is to present a case of a 72 year-old-woman with diagnosis of longstanding debilitating dystonic tremulous spasmodic torticollis. The patient had been suffering from dystonic condition for 23 years. Pharmacological treatment including benzodiazepines as well botulinum toxin injections failed to adequately control dystonic jerking movements of the head, neck as well action dystonic upper limb tremor. The patient was referred for deep brain stimulation (DBS) surgery.

Methods: The patient underwent bilateral implantation of DBS leads into the posterolateral segment of the globus pallidus internus. The surgery was uneventful. The right sided internal pulse generator due to development of seroma required reimplantation from chest wall to abdominal wall 1 month after surgery. The formal preoperative objective assessment included Toronto Western Spasmodic Torticollis Rating Scale (TWSTRS). The postoperative TWSTRS assessments were done every 6 months up to 2 years after surgery.

Results: At the last follow-up visit, the severity, disability and pain scores of TWSTRS were improved by 54 %, 64 % and 58 % respectively. There were no hardware-related complications over follow-up period. Increase of the voltage 1 year postoperatively produced bradykinetic gait which was reversible after lowering the stimulation voltage.

Conclusion: Our preliminary experience indicates that bilateral GPi DBS can be an effective treatment for disabling tremulous spasmodic torticollis. Bilateral GPi DBS in dystonic patients may produce bradykinetic symptoms which are reversible.

P134: STN Deep Brain Stimulation for Parkinsons disease, analysis of 27 cases in our setup

Authors:

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Keywords: STN, parkinson disease, UPDRS

Abstract:

Objective: To underscore the effectiveness of Deep brain stimulation for Parkinsonian patients with impaired quality of life in our setup with limited resources.

Background: Presently deep brain stimulation along with medical treatment stays the most effective treatment modality for patients with medically intolerant Parkinson's disease.

We present the results of STN DBS surgery for a series of 27 patients at our setup.

Methods: It's a prospective case series conducted at Neurosurgery Unit II, Lahore General Hospital. Total 27 patients were enrolled with 26 cases of Parkinson's disease and a case of Dopa responsive dystonia. Study duration was 2 years commencing Oct 2014- Sep 2016. STN was the target for electrode implantation in all cases. Clinical diagnosis and the merit to undergo Deep brain stimulation was done by Neurology department. Patients were assessed using UPDRS score preop and postop at 6 weeks, 3 months, 6 months ,12 months and 6 monthly thereafter.

Results: Of 27, 20 patients were male and 7 female. Age group ranged from 22-75 years. These patients had varying severity of symptoms ranging from 5-30 years. Scoring on UPDRS showed significant improvement in its various domains. In onstimulation & on-medication state, UPDRS part II was reduced by 50%, part III(motor score) was reduced by 68% and part IV reduced by 70%. Daily dosage of antiparkinsonian medications was reduced by 60% and therefore was able to achieve adequate control of dyskinesias & motor fluctuations. Daily off-time was reduced by 67%. Complications encountered were a case of small ICH, 1 case of seroma in IPG pocket, pneumonia (1) and 2 stimulation related (reversible).

Conclusion: Results of bilateral STN stimulation in carefully selected advanced parkinson's disease patients yield favourable outcome and these results are maintained at 2 years followup. These results are very encouraging for us in extending this procedure to other variety of movement disorders.

P135: Resting-state fMRI reveals tremor network alterations in Parkinson's disease versus essential tremor

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Keywords: resting-state connectivity, tremor, Parkinson's disease, essential tremor

Abstract:

Background: Tremor is a main feature of two different movement disorders, Parkinson's disease (PD) and essential tremor (ET), for which previously published data suggested functionally different underlying brain circuitry.

Objectives: We analyzed resting-state fMRI data of 16 patients: 8 with tremor-dominant PD, and 8 with ET (mean age 74 years). Tremor was predominant in the right upper limb in all patients. In PD, 7 out of 8 were under Levodopa medication at the time of scanning, with a mean dose of 525 mg (range 0-800).

Methods: The functional connectivity of the tremor network has been probed using a seed-to-voxel (further referred to as seed connectivity analysis) and ROI-wise (further referred to as network analysis) approach. Four seeds (dentate nucleus, red nucleus, thalamus, precentral gyrus) in both hemispheres were investigated.

Results: We report exclusive negative functional connectivity (FC) during resting-state in ET between the right dentate and left red nucleus towards the left precentral gyrus. Furthermore, the same connectivity is consistently positive in PD (independent of the medication levels).

Conclusion: The major differences in FC between two groups suggest an altered tremor network in PD and ET and further point toward the involvement of the putamen and globus pallidus (both internal and external) on one side, as well as the right ventral anterior thalamic nuclei, on the other side. In summary, our findings suggest that rs-fMRI could be used as an additional confirmation test, beside the clinical history and examination and the eventual adding of a DAT scan, in the differential diagnosis between PD and ET.



P136: The prognostic value of early relapsed lateral spread response after microvascular decompression in patients with hemifacial spasm

Authors:

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Keywords: hemifacial spasm, microvascular decompression, lateral spread response, prognosis

Abstract:

Objective: The lateral spread response (LSR) is a useful intraoperative tool to guide an adequate microvascular decompression (MVD). However, there has been controversy to consider it as a reliable prognostic indicator for MVD outcome. The purpose of this study was to evaluate the meaning of relapsed LSR after MVD, in terms of prognostic value of clinical outcome.

Methods: The authors performed MVD for 48 patients with hemifacial spasm from July 2016 to October 2016 in our institute. All patients were serially investigated with electromyographic test to detect LSR before surgery, 4 day and 2 weeks after MVD. A total of 42 patients were involved who showed complete disappearance of LSR during MVD. They were divided into 2 groups according to the LSR changes at 4 days after MVD; group 1) patients with relapsed LSR group 2) patients without LSR. The authors tried to correlate the postoperative LSR changes with clinical outcome after MVD for hemifacial spasm, over 3 months follow-up.

Results: A total of 14 patients (33.3%) demonstrated relapsed LSR 4 days after surgery (group 1). 12 of 14 patients (85.7%) showed residual spasm, more frequent than that of patients in group 2 (16 of 28 patients, 51.9%) at 1 week after MVD with statistical meaning (p<0.001). Similar results were found on the follow-up results of 1 month (57.1% vs 14.3%) and 3 months (28.6% vs 0%) after surgery.

Conclusions: The authors found that patients with positive LSR early after MVD required longer time to achieve spasm free, thus postoperative LSR findings could provide prognostic value of clinical outcome of MVD. The LSR can be used as a useful tool for intraoperative and postoperative monitoring.

P137: Surgical interventions for task specific dystonia (writer's dystonia)

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Keywords: Focal dystonia, Writer's cramp, Thalamotomy, GPi DBS

Abstract:

Objectives: Writer's cramp is a focal dystonia producing abnormal postures during selective motor activities. Thalamotomy or globus pallidus internus deep brain stimulation (GPi DBS) have been used as surgical treatment in patients not responding to medical treatment.

Methods: Four patients (all men, age 16-47 years) with refractory focal hand dystonia underwent either Ventrooralis (Vo) thalamotomy (three patients) or GPi DBS (one patient) using stereotactic techniques. Preoperative video recordings, writer's cramp rating scale for dystonic posture and latency of dystonia (WMS) and symptom severity scores (SSS) were evaluated at baseline and at latest follow up ranging from 1-4 years.

Results: All patients had difficulty in performing their most common tasks. The duration of symptoms ranged from 2-12 years. All patients obtained immediate postoperative relief from the dystonic symptoms and the effect was sustained during the follow up period. The WMS (range 0-28) improved from a mean of 17.5 before surgery to 2.5 after six months whereas the SSS (maximum 43 and minimum 10) improved from a mean of 30.75 before surgery to 11 after six months. There were no surgical complications, morbidity or mortality.

Conclusion: Vo thalamotomy or GPi DBS offer successful symptom relief in patients of task specific dystonia.

P138: Ipsilateral effects of unilateral Deep Brain Stimulation for Essential Tremor

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Keywords: Deep brain stimulation: Essential tremor: VIM: Caudal zona incerta: Ipsilateral effects

Abstract:

Background: In Essential Tremor (ET), Deep Brain Stimulation (DBS) targets the thalamic and/or subthalamic areas contralateral to the side of the body that's aimed to treat. But some reports have indicated that there also are some ipsilateral effects of unilateral DBS for ET.

Objective: To investigate the degree of ipsilateral effects from unilateral DBS in patients with ET.

Methods: A retrospective cohort of 49 patients (29 males) with unilateral Vim or cZi DBS for ET were evaluated using the Essential Tremor Rating Scale (ETRS) preop, at short term (\approx 1 year) and at long term follow up (\geq 2 years).

Results: Total ETRS was reduced from 50.2 at baseline to 21.9 at short term and 30.1 at long term follow up. Contralateral tremor (item 5/6) was improved from 6.2 to 0.6 and 1.3, respectively. Hand function (items 11 - 14) was improved with 11.1, 2.7 and 4.9, respectively. No significant improvement was seen regarding ipsilateral tremor or hand function at short or long term follow up.

Conclusions: Ipsilateral improvement on hand tremor or hand functions was not significant in our material. Some individuals displayed a pronounced improvement, but this does not seem to be consistent over time.

P139: Cribrous subthalamic nucleus as a target for deep brain stimulation in Parkinson's disease

Authors:

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Keywords: deep brain stimulation, Parkinson's disease, subthalamic nucleus, perivascular spaces, Virchow-Robin spaces, striatopallidal lacunar cysts, cribriform (cribrous) state

Abstract:

Background: Perivascular spaces (Virchow-Robin, PVS) are pial-lined slit-like spaces that surround perforating cerebral vessels. Small PVS (<2mm) can be detected in MRI in all ages. Enlarged PVS are considered a sign of normal brain aging and mostly asymptomatic. In patients with Parkinson's disease (PD), expanded PVS are often. Relationship between dilated PVS and PD is unclear; both alleviation and worsening of parkinsonian symptoms in contralateral extremities are described.

Objective: To report a case of successful DBS in patient with cribrous STN.

Methods: A 57-year-old woman had an 11-year history of PD. Motor symptoms manifested on the right side. Disabling pharmacoresistant motor fluctuations and dyskinesia appeared after 9 years and she was assigned for evaluation for PD-surgery. On admission, patient had bilateral akinetic-rigid syndrome with significant predominance in the right extremities, moderate postural instability, slight cranial and cervical dystonia. Levodopa-intake induced significant amelioration in hypokinesia and rigidity, improvement in balance and walking. Moderate dyskinesia was observed mainly in the right arm and leg. We used standard scales for clinical evaluation (UPDRS, PDQ-39, Schwab&England). Standard MRI revealed pronounced lacunar cysts in the left brain peduncle and striatum limiting stereotactic placement of DBS-electrode.

Results: In order to assess DBS-suitability, comprehensive neuroimaging evaluation was performed. Direct visualization of basal ganglia was performed using 3T MRI and MR-tractography. Overextended PVS were detected in the left subthalamic nucleus and posterior subthalamic area. However, shape and size of cribrous STN were within normal range and internal capsule was not dislocated. Subsequently, DBS-electrodes were implanted in STN bilaterally using standard procedure. Position of the left STN-electrode was calculated by the anterolateral margin of PVS. Microelectrode recording performed during surgery showed no differences in neuronal electrical activity of the cribrous and normal STN. At three-month follow-up, UPDRS-III in off-medication state reduced by 79%, levodopa equivalent daily dose by 61%, PDQ39 by 35%. Motor fluctuations and dyskinesia improved significantly. Daily activity in off-state increased by 30%.

Conclusion: Expanded PVS in midbrain and basal ganglia region may affect clinical manifestation of PD. Although, presence of cribrous changes do not hinder DBS or predict unfavorable outcome.

P140: Preliminary experience with SCS in primary freezing of gait and postural instability

Authors:

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Keywords: SCS, freezing, postural instability

Abstract:

Objective: Primary freezing of gait (PFOG) is difficult to manage and often not responsive to medical treatment. Spinal cord stimulation (SCS) has been introduced recently as a possible treatment for gait disorders in Parkinson disease. There is no experience with SCS treatment in PFOG. Here we report our preliminary experience of a prospective study in a patient with PFOG treated by SCS.

Methods: A 78-year-old woman with a 6-year history of PFOG and postural instability was referred for further treatment. Initially pedunculopontine nucleus DBS was considered. However, with regard to age it was decided to offer SCS. She underwent implantation of a paddle 5-6-5 electrode (Specify, Medtronic) into the epidural space between T8 and T9 under local anesthesia. Electrodes were placed in the midline where test stimulation induced paresthesias in both legs. A variety of different stimulation settings was tested. Finally, the following stimulation parameters were used: amplitude range 4-6 V, pulse width 300 µs, in cycle mode, frequency 130 Hz, 0.2 s/2 s.

Results: At 2-month follow-up, there was mild improvement in freezing of gait. Improvement of postural instability was not observed. Objective measurements (pre- vs. postoperative) were as follows: Time-up-and-go test (50s/35 s), Timed 10 meter test (109s/80s), Tinnetti scale score (12/22), UPDRS III motor score on (26/23), UPDRS III item 29, gait (3/2), UPDRS item 14, freezing (3/2), UPDRS item 30, postural instability (2/2).

Conclusions: Our preliminary studies indicate that SCS might be a possible treatment option in PFOG. Experience with long-term follow-up in a larger number of patients is needed.

P141: Holmes tremor: Algorithm to choose the surgical target

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Keywords: Holmes tremor, functional neurosurgery, DBS, VIM GPi

Abstract:

Holmes tremor is a disabling condition characterized by moderate to severe rest, action, and postural tremor. Treatment failure is frequent. Based in our previous casuistic with patients showing a major distortion of the thalamus or unsatisfactory Vim intraoperative tremor control, we developed an algorithm in which presurgical target planning included two nuclei: Vim and posteroventral Globus pallidus internus (GPi). The definitive target was decided after single-cell microelectrode recording, intraoperative test stimulation, thresholds for stimulation-induced adverse effects and best clinical response compared to baseline status. The electrode was implanted in the nucleus with the best tremor suppression. GPi DBS was initially decided if one of the following conditions was present: *When intraoperative tremor control was unsatisfactory despite Vim high-intensity stimulation or tremor worsening occurred. *If the Vim area appeared in neuroimaging studies (includ tractogeaphy) absent or grossly altered. *When the therapeutic range between clinical improvement and side effects was narrow. Seven patients received Vim DBS; all 10 cases achieved adequate tremor control. Presurgical planning of two targets allowed choosing best optimal response. Gpi stimulation could be considered in cases in which thalamic anatomy is considerably altered or Vim intraoperative stimulation does not produce satisfactory results.

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P142: Globus Pallidus pars interns (Gpi) deep brain stimulation for tardive syndrome: long term follow up of 12 cases

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Keywords: GPi DBS, tardive syndrome, dyskinesia, dystonia, functional neurosurgery

Abstract:

Tardive syndrome is a group of movement disorders secondary to prolonged exposure to dopamine receptor blocking agents or to other medications. The clinical expression include dystonic, dyskinetic, choreiform, athetoid, tremolous, or myoclonic patterns and tics isolated or frequently in combination. For some patients, withdrawal of the offending medication will be the main treatment, while for others a chronic course is the outcome. The nature of the disorder is functional, i.e, there is an intact brain anatomy. The results of GPi stimulation in 12 consecutive patients with tardive syndromes refractory to adequate medical treatment. Eight patients had dystonia and four dyskinesia as the dominant clinical feature. All received bilateral GPi stimulation. The mean improvement at the last examination was 75% (70-95%) using the BFMDRS. No longlasting or residual neurological deficit were observed. Conclusions: Gpi DBS for tardive syndromes is an effective and a safe approach for individuals whose symptoms do not respond to medical treatment.

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P143: Parietooccipital metabolic state in 18F-FDG PET reflects the reserve capacity of motor improvement after GPi DBS in Parkinson's disease patients

Authors:

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Keywords: Parkinson's disease, deep brain stimulation, motor outcome, 18F-FDG-PET, prognosis

Abstract:

Introduction: Although deep brain stimulation (DBS) considerably restores motor function of patients with advanced Parkinson's disease (PD), it only partially compensates for manifestations of dopaminergic neuronal cell death in the midbrain and there is a difference in the degree of motor improvement (MI) for each patient. Hence, we hypothesized that each patient has own reserve capacity for improvement in parkinsonian motor symptoms after DBS, and that ¹⁸F-fluorodeoxyglucose (FDG) PET would reveal the individual intrinsic capacity of recovery because it measures a local synaptic activity and regional cerebral metabolism. The aim of this study is to evaluate the utility of ¹⁸F-FDG PET in predicting the motor outcome of DBS for treatment of advanced PD.

Methods: Twenty-seven PD patients (M: F = 14: 13, age 28–64 years) undergoing DBS of globus pallidus interna were assessed pre- and post-operatively with Unified Parkinson's disease rating scale part III measured on and off levodopa. All patients performed ¹⁸F-FDG PET before surgery and we measured the regional resting cerebral metabolic rate of glucose based on the automated anatomical labeling template and estimated the standardized uptake value ratio (SUVR) as the reference regions of the cerebellum. The areas that are significantly different in metabolic rates between the MI groups (\geq 60% vs. < 60%) after GPi DBS were determined by voxel-based analysis using 2-sample t-test.

Results: There were no difference in age, sex, disease severity, response to levodopa challenge test, and electrode location between two MI groups of $\ge 60\%$ and < 60%. However, ¹⁸F-FDG PET of subjects with MI < 60% revealed significant SUVR decrease in the calcarine, cuneus, lingual, occipital superior, parietal superior, and parietal inferior gyri of the both hemispheres. The mean weighted SUVR of these areas were 1.05 ± 0.066 and 1.12 ± 0.78 in the groups of MI < 60% and $\ge 60\%$, respectively, and the difference was statistically significant on multivariate logistic regression analysis (P = 0.041).

Conclusion: These data show a significant relationship between preoperative ¹⁸F-FDG PET activity of parieatooccipital lobe and MI following GPi DBS in advanced PD patients. Preoperative ¹⁸F-FDG PET may be helpful in predicting the motor outcomes of DBS and selecting optimal candidates for surgery.

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P144: Three cases report of deep brain stimulation therapy for post-stroke movement disorders

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Keywords: deep brain stimulation, post-stroke, involuntary movement

Abstract:

It is reported that involuntary movements develop after 1-4 % of strokes. Poststroke movement disorders can manifest in Parkinsonism or a wide range of hyperkinetic movement disorders including chorea, ballism, athetosis, dystonia, tremor, myoclonus, stereotypies, and akathisia.

As we have performed deep brain stimulation therapy for three patients with post-stroke involuntary movement disorder, so we will report them with literature considerations.

Case one was 75 years old male who has developed the left putaminal hemorrhage at 44 years old. He has gradually developed the athetosis in the right hand since several month before. Although the patient was administrated various agents including anti dopaminergic agent, clonazepam, sodium valproate and topiramate etc. as pharmacological therapy, his athetosis was not improved at all.

Therefore he underwent deep brain stimulation. There is discussion about the target of post-stroke involuntary movements and either the Vop nuclei, Vim nuclei or GPi nuclei are considered as the target. Three patterns of deep brain stimulation by GPi alone, CZi-Vim-Vop alone and both were compared and examined. The GPi alone stimulation resulted in improvement of the abnormal posture and the patient was able to use the chopsticks well.

Case two was 72 years old man who developed the right putaminal hemorrhage in 58 years old and has suffered from left hemiparesis with spasticity since then. He underwent various medication, botulinus toxin and intrathecal baclofen therapy for spasticity. His spasticity was not improved with treatment and he has gradually developed painful athetots in the left hand. We performed GPi-DBS for his athetosis and he has been well since then.

Case three was 81 years old woman who underwent extirpation of the cavernous angioma in the left temporal lobe. She has suddenly developed the hemiballism two months before. The magnetic resonance image showed the small hemorrhage near the left subthalamic nucleus. The Vop-Vim-cZi DBS was carried out because the hemiballism was getting worse. The stimulation of Vop resulted in effectiveness for hemiballism.

P145: Correlating sensor data for essential tremor with tremor ratings and quality of life using machine learning techniques

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Keywords: movement disorder, essential tremor, tremor severity, smartphone, feature extraction, regression, machine learning

Abstract:

Background: Tremor related diseases affect millions of people around the world, hindering various everyday life tasks, such as holding a glass of water. Tremor severity assessment is an important element for the diagnosis and treatment decision making process. For decades, subjective clinical rating scales were mostly performed. Recently, remarkable attention around computerized tremor analysis has grown. While dedicated devices are expensive and not practical for the everyday use, smartphone applications are promising. Previous studies on Parkinson's disease or Essential Tremor mostly classified the Fahn score rating scale.

Objective: Using machine learning techniques to regress tremor severity observed by clinicians (ETRS) and patients (QUEST), and give the research accessibility and new insights that would later lead to decision making process improvements.

Methods: Five wrist-worn different tests were performed on 20 Essential Tremor patients from the open-source TREMOR12 iPhone/iWatch compatible application. Linear displacements and joint rotations are measured from in-device accelerometer and gyroscope. From these signals, time, frequency and time-frequency domain tools are used to extract the following features: dominant frequency, dominant magnitude, signal RMS, signal period and the power growth during the test.

Results: While the study demonstrates good predictive power, its feature extraction shows to bring improvements when compared to previous close setting studies.

Conclusion: This study gives the research new directions and tools in order to perform further investigations around tremor severity evaluation. Smartphone sensors improvement in the following years, research on the best predicted variable to use and larger data collection may lead to very robust models, measuring rapidly, accurately and more objectively tremor severity than clinical rating scales.



P146: Better than better: Multimodality-assistant microvascular decompression for hemifacial spasm

Authors:

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Keywords: Microvascular decompression, Hemifacial spasm, Intraoperative neurophysiological monitoring, Endoscopicmicrovascular decompression

Abstract:

Objective: Microvascular decompression (MVD) has become the standard treatment for hemifacial spasm(HFS). However, as a functional operation in the cerebellopontine angle (CPA), this process can be risky and the postoperative outcomes might not be good enough sometimes. In order to obtain a better result with less complication, how to perform this surgery better is worth to be further addressed.

Method: Between January 2009 and December 2016, we retrospectively analyzed 731 HFS patients who underwent MVD with at least 1-year follow up. Patients were divided into two groups on the basis of application of intraoperative neurophysiological monitoring(IONM) with facial electromyography(EMG) of lateral spreading response(LSR) and brainstem auditory evoked potential(BAEP) (group A, 2013-2016, n= 409) or not (group B, 2009-2012, n=322). The use of endoscopes is indicated for patients who had difficulty in identifying the nerve-vessel conflicts or unfavorable IONM signal. With regard to endoscopic assistance, patients were subdivided into two subgroup for the use of endoscopes such as redo, multiple offending vessels(group B-E,n=28), or the same indication plus persistent LSR after offending vessel separation (group A-E, n=49).

Result: After MVD surgery with one year follow up, 395 (98.5%) patients achieved excellent resolution of spasm in group A, and 288 (89.4%) patients in group B. In subgroups, 41 (83.7%) patients were completed relieved from spasm, and 7 (14.3%) patients partial relieved in group A-E. On the other hand, 19 (67.9%) patients were completed relieved from spasm, with 7 (25.0%) patients partial relieved in group B-E. There were postoperative complications with hearing impairment (0.2% in group A, 1.2% in group B), CSF leakage (2.2% in group A, 2.5% in group B), and partial facial palsy (0.5% in group A, 0.9% in group B). In the post-operative follow-up visits over more than one year, there were significant differences between the clinical outcomes of the two groups (p<0.05).

Conclusion: Intraoperative electrophysiological mentoring is helpful to distinguish the offending vessels and useful in guiding neurosurgeons to obtain sufficient decompression without complication. For difficult and complicated HFS, combined IONM and endoscopic assistance may raise up the success rate. Routine implementation of neurophysiological monitoring and meticulous attention to the microsurgical anatomy of the CPA under endoscopic assistance have made the satisfied outcome.

P147: Awake versus asleep DBS in the caudal zona incerta for essential tremor - an analysis of 60 patients

Authors:

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Keywords: DBS, Essential tremor, caudal Zona incerta, general anaesthesia

Abstract:

Background: Deep brain stimulation (DBS) based on visual anatomical targeting is today often performed with the patient in general anaesthesia. However, even if this is common regarding DBS in the pallidum and subthalamic nucleus, there has been more reluctance to perform thalamic/subthalamic DBS for essential tremor (ET) in this manner.

Objectives: To compare the results of DBS for ET in general anaesthesia versus awake surgery.

Methods: We retrospectively analysed the outcome in our last 30 patients undergoing awake DBS in the caudal Zona incerta (cZi) with the first 30 procedures done in general anaesthesia. Awake DBS was performed with visual anatomical identification of the target in the cZi, followed by intraoperative macrostimulation for target verification. In general anaesthesia only visual anatomical targeting was performed. Eleven patients had bilateral DBS, but were evaluated separately for each side, with the other side turned off.

Results: In awake surgery total ETRS improved from a mean of 53 at baseline to 21.7 (59%) on unilateral stimulation 12 months after surgery. Contalateral tremor of the hand (item 5/6) and hand function (item 11-14) improved from 6.7 to 0.3 (96%) and from 10.5 to 2.1 (80%), respectively. In general anaesthesia total ETRS improved from a mean of 47.2 at baseline to 19.7 (58%) on stimulation 12 months after surgery. Contralateral tremor of the hand (item 5/6) and hand function (item 11-14) improved from 5.3 to 0.5 (91%) and from 10.9 to 2.6 (76%), respectively. The improvements within the respective groups were significant, while the differences between the groups were not. Mean stimulation parameters in the awake group were 2.2 V, 63 u Sec and 165 Hz, rendering a pulse effective voltage of 0.22 V. The corresponding figures in general anesthesia were 1.9 V, 60 u Sec and 148 Hz, rendering a PEV of 0.17 V. The differences in amplitude and PEV were significant.

Discussion: In this retrospective non-randomized study no difference in outcome was seen between awake or asleep procedure, aside from a lower energy consumption in the asleep group. These findings suggest that DBS for ET based solely on visual anatomical targeting of the cZi might be a satisfying alternative to awake surgery.

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P148: Neuroanatomical distribution of adverse speech effects due to deep brain stimulation

Authors:

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Keywords: Speech, DBS

Abstract:

Background: Impaired speech production is one of the most common adverse effects with thalamic deep brain stimulation (DBS) affecting approximately 24% of patients. It has been suggested that a crucial factor for both beneficial and adverse DBS effects is the spread of electrical stimulation, from the targeted structure to neighbouring brain regions, but the neuroanatomical origin of adverse speech effects has been found to be elusive. The absence of a clear spatial distribution of DBS-induced speech effects may in part be due to methodological issues, most importantly the lack of thorough and detailed investigations into how DBS affect speech motor control in the individual patient.

Aim: We present a systematic stimulation evaluation designed to link reduced speech motor control in patients treated with DBS to neuroanatomical regions.

Methods: 36 patients diagnosed with Essential tremor treated with DBS targeting the posterior subthalamic area have been recorded 1) with DBS turned off, 2) with DBS turned on using the patient's ordinary clinical settings, and 3) in an experimental procedure with increasing stimulation amplitude, from 0.5V up to a maximum of 4.5V. A speech protocol, designed to provide a comprehensive, objective assessment of patients' articulatory and phonatory proficiency, was performed in-between stimulation adjustments. Identified DBS-induced speech and voice effects for the individual patient will be evaluated in relation to the verified electrode position and simulations of the electrical field spread for each stimulation setting, thus linking specific speech and voice effects to neuroanatomical regions. Based on all patient data, a neuroanatomical map will be created indicating the probability of stimulation-induced adverse effects on speech.

Significance: The presented study design is proposed to be well positioned to be able to increase our understanding of the contribution of neuroanatomical structures in the subthalamic region to speech motor control. The outcome may further be used to reduce DBS-induced adverse effects on speech, which would benefit all patients treated with DBS.

P149: Is the era of peroperative teststimulation outdated when implanting DBS leads for tremor?

Authors:

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Keywords: Teststimulation, Essentiel Tremor

Abstract:

Introduction: The development of the imaging technique has increased the possibility for direct targeting when implanting DBS leads, improving the possibility of direct targeting. This together with per-operative imaging (with the stereotactic frame on) for confirmation of lead placement may make peroperative teststimulation less useful in relation to its costs (time, possible liquor leakage). Furthermore, tremor is most often abolished/substantially reduced within minutes after positioning of the leads which makes it impossible to assess the tremorreduction/contact.

Aim: The aim with this study was to investigate if teststimulation induced/not induced side effects when implanting leads aiming PSA¹ and VIM/VOA/VOP² also occurred at test-stimulation >3 months postoperative.

Method: Data from per- and postoperative (>3 mth) test-stimulation of 15 patients with Essential tremor (ET) implanted with leads ((Medtronic Inc. lead 3387) aiming PSA and VIM/VOA/VOP were reviewed. Targeting was based on MRI, no MER³ was used, but peroperative confirmation images of lead placement was done with the frame on. The settings at teststimulation settings were: $60 \mu s$, 130 Hz and 1V-3V. Comparisons of the presence or absence of the predefined side effects (speech and voice, vision and eye movements, paraesthesia and dystonia) was done.

Result: Fourteen out of the 15 patients were in local anaesthesia implanted bilaterally. Thus 116 contacts were compared pairwise. There were no similarities between per- and postoperative teststimulation in terms of presence/absence of side effects, except from paraesthesia and that the side effects were sparse on the proximal contacts at both assessments. All patients had significant (ETRS = p<0.001) tremor reduction >6 months after surgery, 19 leads had monopolar setting with one cathode, 3 monopolar with two cathodes, and 7 had bipolar setting, 2.23V ±9; 62µs ±6; 145 Hz ±25.

Conclusion: Peroperative teststimulation may not be useful for target confirmation when targeting PSA and VIM/VOA/VOP since the result for the side effects not are reproducible. However, abandon peroperative teststimulation might only be possible in centres having good preoperative imaging as well as peroperative imaging with the frame on for confirmation of the lead placement.

P150: Clinical effects of posterior subthalamic area/globus pallidus interna deep brain stimulation for dystonic head tremor

Authors:

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Keywords: Dystonic head tremor, Deep brain stimulation, Posterior subthalamic area, Globus pallidus interna

Abstract:

Objectives: Dystonic head tremor (DHT) is predominant head tremor accompanied by dystonic involuntary movement in the craniocervical muscles. As so far, globus pallidus interna (GPi) and ventrooralis (Vo) is established as prospective surgical targets for dystonia, while ventral intermediate nucleus (Vim) and posterior subthalamic area (PSA) for tremulous symptom respectively. We report a patient with DHT successfully alleviated by simultaneous PSA and GPi deep brain stimulation (DBS).

Methods: A 70-year-old male had suffered from tremor in his bilateral upper limb since his 30s, then DHT for 15 years to date. Neither pharmaco- nor physiotherapy had relieved the symptoms, and he was referred to our department for neurosurgical treatment. In brain MR imaging, enormous dilatation of lateral ventricle presumably related to former intracranial surgery in his infancy period was noted, which made the stereotactic insertion of electrodes through the frontal cortex to thalamic area too hard to plan. In addition, the lateral border of thalamus was hardly contoured in MR imaging so that direct targeting of thalamic area was definitely impossible. From these morphologic factors, bilateral PSA and GPi instead of thalamus were chosen as DBS targets for the case.

Results & conclusions: At first, stimulation of PSA alone was applied, which was effective only on rhythmic tremulous movement but not on dystonic component. Then additional GPi stimulation succeeded in ameliorating the residual dystonia satisfactorily. Recent blind trial reported in 2014 underlined that thalamic/subthalamic area DBS was promising for DHT (Pauls KA et al). Besides those findings, the present case suggested that simultaneous PSA/GPi DBS is also powerful therapeutic option for DHT.
P151: Co-axial stimulation of the ventral tier of the thalamus and subthlamus for tremors

Author:

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Keywords: tremor, thalamus, subthalamus, deep brain stimulation

Abstract:

Objectives: Deep brain stimulation (DBS) is effective treatment of choice for various types of tremors. The targets are the ventral tier of the thalamus (Vo and Vim) and the subthalamus. For some tremors, these targets are simultaneously stimulated to have optimum outcomes. We have examined the effects of co-axial stimulation of the ventral tier of the thalamus and the subthalamus.

Methods: We have retrospectively analysed the preoperative imaging and postoperative clinical results of 10 patients with tremors who underwent deep brain stimulation. The age range of the patients were from 17 to 72 years old. Nine men and a woman were involved. The causes of the tremors were essential tremors in 6 patients, Parkinson's disease in 2 patients, atypical Parkinsonism in a patients and Holmes' tremor in a patient. Five patients had Vim-DBS and other 5 patients had coaxial Vo or Vim and SA-DBS. Severity of tremors in each patient was assessed using tremor rating scale. Preoperative imaging included diffusion weighted, T1, and T2 weighted imaging. Stereotactic coordinates for Vim were 13-15 mm lateral to the midline and 5-6 mm anterior to the posterior commissure on the plane of anterior and posterior commissures (AC-PC). Vo was located 2-3 mm anterior to the Vim. The SA was located at 11-13mm lateral to the midline, 5-8 mm posterior to the mid-commissural point, and 3.5-5mm below the AC-PC plane.

Results: The postoperative TRS was improved by 55-95% (mean 76%) after DBS. In patients Vim and SA DBS, two patients used Vim DBS only. Three patients utilised coaxial Vo/Vim and SA DBS. These patients were with Holmes tremor, atypical Parkinsonism, and essential tremors. The patients did not experience severe complications.

Conclusion: In patients with tremors, some patients have excellent outcome with coaxial stimulation of Vo/Vim and SA.

P152: GPi DBS treatment in Postural instability in Parkinson's disease with 8 contact lead experience

Authors:

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Keywords: gpi, dbs, postural instability, gait disturbance

Abstract:

Deep brain stimulation (DBS) has been a widely accepted treatment modality for advanced Parkinson's disease (PD). Postural instability in PD have been a great challenge in the clinical practice. In the PD patients with postural instability, the selection of DBS targets is still challenging. GPi target for deep brain stimulation (DBS) in the treatment of postural instability is more preferred. In this article we want to share our experience with GPi target in PD. We present 5 patients who underwent to Gpi DBS for PD and we compare preoperative condition with 6th month follow up. we used a variety of different scales to measure the severity of the patient's symptoms, including the Unified Parkinson's Disease Rating Scale (UPDRS), the freezing of gait questionnaire (FOG-Q) and the gait and falls questionnaire (GF-Q).GPi DBS have positive effects to postural instability as well as freezing of gait and falling after PD.

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P154: Unilateral raprI DBS in the treatment of Parkinson's disease symptoms. Results until 48 months follow-up

Authors:

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Keywords: Parkinson's disease, Deep Brain Stimulation, Prelemniscal Radiations

Abstract:

Objective: Prelemniscal radiations (Raprl) is an effective target to treat the symptoms of Parkinson's disease (PD). The objective of this study is evaluate the effectiveness of unilateral Raprl DBS through UPDRS-III scale, with a long term follow-up until 48 months.

Methods: PD patients with surgical criteria of Hoehn-Yahr stages II-III were unilateral implanted with a tetrapolar DBS electrodes in Raprl contralateral to the extremities with more prominent symptoms. Anatomical ubication was assisted by MRI/CT/atlas fusion, microelectrode recording, and included micro- and macro-stimulation. Motor symptoms were evaluated in an open label protocol through punctual items of the UPDRS-III score, and were applied pre-operatively and 6, 12, 24, and 48 months after the onset of stimulation in an OFF-medication/ON-stimulation condition. The scores were recorded focus to pre-operative condition and were obtained for each symptom in both sides and statistical significance determined through double-tail Wilcoxon test. Also the influence of demographic outcome variables was analyzed using Pearson test. Alpha was <0.05 and beta of 0.20.

Results: Nineteen patients were implanted. The most important symptoms that were decreased were tremor (p<0.001) and rigidity (p<0.001) from the beginning of the study and were sustained inclusive to the 48 months Bradykinesia was not reported with an important level of change. A greater than 80% decrease in UPDRS score for contralateral symptoms (classified as excellent results) occurred in 14 patients (73.7%), while in the other 5 it decreased from 33 to 79% (considered suboptimal results). These changes remained statistically significant up to 48 months (p<0.01), while ipsilateral symptoms progressively increased. Suboptimal results were associated with selective improvement of only one symptom

Conclusions: Unilateral RaprI DBS Stimulation were effective to treat contralateral symptoms including tremor and rigidity. This effect was sustained in a long term follow-up inclusive of 48 months

P155: Ventriculoperitoneal shunt for normal pressure hydrocephalus accompanied by degenerative brain disease: Correlation between metabolic neuroimages, pathological findings and surgical results

Authors:

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Keywords: Hydrocephalus, ventriculoperitoneal shunt, Neuro degenerative disorder, Alzheimer's disease, Dementia

Abstract:

Objective: Normal pressure hydrocephalus (NPH), which was occurred in elderly patients, has characteristic symptoms of cognitive disorder, gait disturbance disorder, and urinary incontinence. In these patients, ventricular peritoneal shunt surgery is known to be the most effective treatment. However, for some patients, the symptom is rarely improved after surgery. In addition, symptoms of NPH can also be caused by other degenerative diseases of the brain. Therefore, we performed a histological analysis of the possibility that other degenerative brain diseases that may cause typical symptoms of NPH may be combined with hydrocephalus.

Methods: In 2016, we analyzed 12 patients who underwent shunt surgery for hydrocephalus and who underwent brain biopsy at the same time. Patients underwent preoperative FDG, 18FP-CIT and Amyloid PET examinations. The histologic analysis was performed with various staining methods to identify other degenerative diseases overlapping with hydrocephalus.

Results: Of the 12 patients, four patients had brain biopsies with significant results suggesting other degenerative brain diseases. Among them, two patients had senile plaques due to beta amyloid staining and they were likely to have Alzheimer disease. One patient had amyloid angiopathy and the other one had p62 neuronal accumulation, suggesting the possibility of frontotemporal dementia. All patients had gait disturbances, and 1 month after surgery, gait symptoms improved in 7 patients. The improvement of other symptoms was not clear. Patients with Alzheimer disease on biopsy had symptomatic improvement at 1 month but deteriorated at 3 months after surgery. Other Patients with other neurodegenerative diseases had no improvement after surgery. There was no significant association was observed between PET scan and clinical symptoms and biopsy results. The patients with Alzheimer had showed increased uptake in amyloid PET.

Conclusion: Symptoms of NPH can have a significant effect on surgical treatment. However, overlapping other degenerative brain diseases that may cause similar symptoms can lead to confusion in clinical evaluation. The current study also revealed the possibility of other degenerative brain diseases in patients whose clinical symptoms did not improve significantly after surgery. Therefore, in patients with NPH, if there is no specific improvement in the experimental CSF drainage or other degenerative disease was suspected, it is recommended that a test or brain biopsy be performed to identify other degenerative brain diseases. We thought that it would be able to give accurate diagnosis and effective treatment to the patients.

P156: Accuracy of intraoperative CT-based frameless stereotaxy compared with frame-based stereotaxy

Authors:

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Keywords: Stereotaxy, Navigation, CT

Abstract:

Objective: Frameless stereotaxy is known to have the disadvantage of a possible mismatch of between 2 and 6 mm, depending on co-registration technique and patient positioning. Combination of frameless stereotaxy with intraoperative CT-based automatic co-registration might increase the overall accuracy.

Methods: Since introduction of a Brainlab Airo CT Scanner, a consecutive series of 5 patients received frameless stereotactic biopsies of deep seated brain lesions. After insertion of the biopsy needle, a second CT scan was taken with the needle still in place. The intraoperative scan was fused with the planned trajectory and deviation from the trajectory was measured.

Results: In all 5 cases, deviation from the planned trajectory at the target was below 1 mm. No adverse events occured during surgery.

Discussion: In a small series of 5 patients, only careful interpretation is possible. The results indicate, that combination of frameless stereotaxy with intraoperative CT leads to a high accuracy comparable with frame-based stereotaxy. A prospective study on this topic is planned.

P157: Effects of two different registration methods on the accuracy of the robotized stereotactic assistant system

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Keywords: robotized stereotactic assistant, deep brain stimulation, bone marker, laser surface recognition, registration

Abstract:

Objective: To investigate the effects of two different registration methods on the accuracy of the robotized stereotactic assistant (ROSA) system via experiments simulated by the skull model.

Methods: Using the skull model, bony landmark group (bonylandmark registration) and laser group (laser registration) were applied to simulate implantation of electrode by 20 times. The deviation range of the distance was observed between microelectrode recording needle tips and designed targets.

Results: In bony lanfmark group, the average distance error of 20-time experiments was 0.41 mm (maximum 0.51 mm, minimum 0.30 mm), and the average time was 3 minutes 15 seconds, with the whole microelectrode recording needle tips arrived to the scope of 1 mm diameter hollow screw inner ring. But in laser group, the average time was 17 minutes 22 seconds, with 7 records of needle tips pointed to 1 mm diameter hollow screw inner ring, while the other 13 times only meeting the standard of 1.6 mm diameter hollow screw inner ring.

Conclusion: ROSA system has a high precision, and bony landmark registration method is more accurate than the laser registration method.



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P158: The application of computed tomographic angiography in the deep brain stimulation assisted by robotized stereotactic assistant system

Authors:

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1. Department of Neurosurgery, General Hospital of Shenyang Military Command, Shenyang, CHINA

Keywords: robotized stereotactic assistant, computed tomography angiography, deep brain stimulation, image fusion

Abstract:

Objective: To evaluate the application value of computed tomographic angiography (CTA) in the deep brain stimulation (DBS) assisted by robotized stereotactic assistant (ROSA) system.

Methods: A total of 18 Parkinson's disease patients and 2 essential tremor patients undergoing DBS assisted by ROSA system. The ROSA system was used to observe the overlap of the puncture path and the vessel on the images of CTA.

Results: A total of 39 planned implant electrodes were successfully implanted in all 20 patients. Thirty-seven electrodes were implanted into the subthalamic nucleus and 2 into the ventral intermediate nucleus. A total of surgical planning of 17 side overlapped with vascular images of CTA, and the surgical path was readjusted.

Conclusion: CTA helps to improve the safety and accuracy when applied to DBS assisted by ROSA system.



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P159: Project RONNA - robotic neuronavigation

Authors:

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Keywords: robotic neuronavigation, stereotactic neurosurgery

Abstract:

Introduction: Project RONNA – robotic neuronavigation, innovative and commercially competitive robotic system for applications in neurosurgery, was initiated by a group of researchers within the Department of Robotics and Production System Automation at the Faculty of Mechanical Engineering and Naval Architecture, University of Zagreb.

Methods and Results: The RONNA system was tested through rigorous preclinical trials which resulted in numerous improvements and in the development of the new RONNA G3 system. RONNA G3 is used for stereotactic neuronavigation procedures and in its basic version has three main components: a) a robotic arm on a universal mobile platform, b) a planning and navigation system and c) a global optical tracking system (OTS). One specific characteristic of the RONNA G3 system in respect to most current state of the art robotic neurosurgical systems is an additional mobile platform equipped with a compliant and sensitive robotic arm. The extended version of the RONNA G3 which uses the compliant robotic arm is intended for automated robotic bone drilling applications and manipulation of surgical instruments. The second arm was not used in this case study. The global optical tracking system uses an infrared stereo camera and two reference frames, one attached to the patient in form of a "x" shaped localizer and the other to the robotic arm. The OTS is only used for coarse positioning of the robot with respect to the patient in the global localization phase of the procedure. We have further developed a specific infrared stereovision system which uses macro lenses in order to obviate any errors that may arise from the low resolution and wide field of view of the global OTS.

Conclusion: Benefits of using the RONNA system in neurosurgery are: better and faster performance of surgical procedures, less invasive procedures, faster recovery of the patient (shorter hospital stay, reduced costs), better utilization of operational resources of the hospital, mastering new skills within a clinical team and introduction of new technologies in medical practice.

P160: Electrode tip localization in rats using CT imaging and BlockFace is accurate, fast and cheap as compared to histology

Authors:

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Keywords: stereotaxy, animal research, electrode, imaging

Abstract:

Introduction: While brain implants, such as electrodes, used in laboratory animals are becoming more and more sophisticated, implant tip localization methods have not evolved over the last century. Even nowadays, histology and copying to stereotactic atlases remains not only the gold standard but also the most commonly used method for implant tip localization. We aim to compare various modalities for electrode tip localization in terms of accuracy, time and costs.

Methods: In 24 male rats (289g Wistar, n=12; 424g Sprague-Dawley, n=12), pre-operative computed tomography (CT) imaging was followed by stereotactic implantation of 2 electrodes (1 per hemisphere). After in vivo postoperative CT imaging, all rats were euthanised. Now, ex vivo postoperative CT with skull and electrodes in place was followed by a 14-day iodine immersion and a new CT with and without skull and electrodes in place in half of the specimens. Finally, BlockFace (a 3D reconstruction of photographic images acquired with a digital camera facing the remainder of the paraffin block on the microtome) and histology were performed in all specimens. Electrode tips were picked by 6 researchers with different levels of experience.

For co-registration of the images to the Johnson-Paxinos MR-atlas, we first constructed a CT atlas based on the preoperative images of the Wistar rats. The postoperative CTs with bony anatomy were co-registered to this CT-atlas and via this atlas to the MR-atlas, while the modalities without bony anatomy were co-registered directly to the MR-atlas.

Results: All CT modalities and BlockFace allowed for electrode tip localization, both in rats identical to and different from those used to create atlases, with low inter- and intra-observer variability. There was a high correlation with histology, although the correlation between the different CT modalities was even higher. Average total time needed for localization of 2 electrodes in 1 rat brain ranged from 27 minutes (in vivo CT) to 94 minutes (histology). Average costs, as charged in our institution, for localization of 2 electrodes in 1 rat brain ranged from 5.50 euro (CT ex vivo) to 21.24 euro (histology).

Conclusion: We conclude that CT imaging techniques and BlockFace are valuable alternatives to histology for electrode tip localization, and are both faster and cheaper as compared to histology.

P161: A review of clinical outcomes with diffusion tensor imaging during deep brain stimulation

Authors:

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Keywords: Diffusion tensor imaging, deep brain stimulation, tractography, clinical outcome

Abstract:

Introduction: Deep brain stimulation (DBS) is a restorative neurosurgical treatment for an expanding list of intractable neurological and psychiatric conditions. The purpose of this study was to review the use of diffusion tensor imaging (DTI) tractography in DBS to improve clinical outcomes.

Methods: A search of PubMed was performed to identify all articles using the search terms "(diffusion tractography OR diffusion tensor imaging OR DTI) AND (deep brain stimulation OR DBS)". Studies were included if they described clinical outcomes, and DTI was used. The studies were categorized into whether DTI was used in surgical planning to guide electrode implantation, or used to evaluate the location of the implanted electrode retrospectively. Proximity of the final electrode position to the tract of interest and the correlation for clinical outcomes was analyzed.

Results: A total of 32 studies were identified reporting the use of DTI in DBS for movement disorders (15 studies), psychiatric disorders (10 studies), and pain disorders (7 studies). Out of the 32 studies, 9 studies with a median sample size of two patients (range 1-7) used DTI during surgical planning. The remaining studies used DTI for retrospective evaluation of electrode implantation location with a median sample size of six patients (range 1-22 patients). Both deterministic and probabilistic tractography were used. Overall, these studies show that the use of DTI for surgical planning is feasible, provide additional information over conventional targeting methods, and can be used to improve surgical outcome.

Discussion: Advances in surgical planning using DTI in DBS can lead to improved surgical outcome. The use of DTI in DBS planning appears under-utilized and further studies are warranted given that surgical outcome may by optimized using this non-invasive technique.

P162: Ex vivo iodine immersion of rat brains yields higher internal brain CT contrast but affects histological quality

Authors:

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Keywords: computed tomography, rat neuro-imaging, contrast enhancement

Abstract:

Introduction: Histology is historically considered as the gold standard for localising brain implants such as electrodes in rats. However, imaging techniques such as Computed Tomograpy (CT) and Magnetic Resonance Imaging (MRI) for small laboratory animals are available. MRI is prone to artefacts from metal implants, is relatively time-consuming, costly and has a lower availability as compared to CT. On the other hand, the main disadvantage of CT is in its very low internal brain contrast. We use an iodine immersion protocol to enhance the internal brain contrast of ex vivo CT in rats. In this study, we aim to optimise the immersion time and iodine concentration, and to assess the quality of histology after iodine immersion with and without iodine wash-out.

Methods: Sprague-Dawley rat brains (n=9) were soaked into iodine (n=8) or used as a reference for histology (n=1). The brain CT density and internal contrast, measured as contrast-to-noise ratio (CNR) and signal-to-noise (SNR) ratio for grey matter, white matter and cerebrospinal fluid was assessed over 6 months, using 3 different iodine concentrations (100, 200 and 300 mg iodium/ml) with and without skull (n=6). Next, in the specimens immersed in 200 mg iodium/ml (n=4), the quality of Cresyl Violet stained histology was compared qualitatively and quantitatively to reference histology (n=1), either with (n=2) and without (n=2) a 5-day iodine wash-out protocol.

Results: Iodine immersion significantly improves internal brain contrast from 1 day onwards. Peak SNR and CNR were obtained with 100 and 200mg iodium/ml at 5 and 7 weeks, respectively, after which SNR and CNR remained constant. Compared to a non-iodine immersed rat brain, the histological quality, SNR and CNR were lower in iodine immersed rat brains, although this was largely reduced by a 5-day wash-out protocol.

Conclusion: Iodine immersion of rat brains yielded higher brain CT density and internal contrast after 100 and 200mg/ml iodium immersion for 2 months, and histology remains possible after a short wash-out period.

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P163: Exploring Local Diffusion MRI Properties for Vim Localization: Evaluation in Clinical Cases

Authors:

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Keywords: Ventro-intermediate nucleus, diffusion MRI, functional neurosurgery, thalamic nuclei

Abstract:

The lack of possibility to directly visualize the Ventro-intermediate thalamic nucleus (Vim) on current routine MRI lead to application of indirect targeting methods in stereotactic neurosurgical procedures, such as Gamma Knife Surgery (GKS) and Deep Brain Stimulation (DBS), for treatment of drug-resistant tremor.

Recently, our group proposed an automated robust and reproducible method across healthy subjects and tremor patients for parceling the thalamus in seven main groups of nuclei while exploring the local diffusion information from the spherical harmonics representation of the orientation distribution functions (ODFs) in k-means clustering framework. One among the resulting parcel is the Ventral-Lateral-Ventral group (VLV) enclosing all motor-related nuclei including the Vim. We aim at further automatic subdivision the VLV cluster. To this end, within the VLV, we first build a k-nn graph with edges corresponding to the respective ODFs distances and then, we perform a partition in 3 sub-clusters using the Normalized Cut algorithm.

The outcome of the proposed subdivision was compared to the radiological response in the follow-up images of 17 patients treated for tremor with GKS unilaterally. The MRI protocol included pre-operative diffusion-weighted images with 64 (or 72) gradient direction, b=1000s/mm² and voxel size of 2.2x2.2x2.2mm³, pre-operative and post-operative MPRAGEs with isotropic resolution of ~1mm³, all of them acquired at field of 3T. In general, the sub-partition followed a spatial-distribution pattern and for 12 out of 17 cases we observed that one specific sub-cluster encloses entirely or the major part of the contrast enhancement corresponding to the GKS target that appeared on the follow-up images.

The evaluation of the sub-partition outcome was further extended in one additional tremor patient treated with DBS, bilaterally. Similar pre-operative MRI data as for the GKS-treated patients was acquired. We observed that in each hemisphere both initial targeting point and the final position of the electrode are inside the anticipated sub-cluster.

This study shows that the diffusion-MRI-based sub-clustering of the VLV thalamic nuclei could potentially allow, in an automated manner, to narrow the area of Vim's localization. Our preliminary results will be further investigated in a larger cohort of patients (treated by either GKS or DBS) and on diffusion images with higher spatial resolution.

P164: Identification of Stria Medullaris Fibers in the Massa Intermedia Using Diffusion Tensor Imaging

Authors:

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Keywords: DTI, massa intermedia, stria medullaris, tractography, lateral habenula, probabilistic

Abstract:

Background: The massa intermedia(MI) or interthalamic adhesion is an inconsistent band spanning between bilateral medial thalami that is absent in up to 20-30% of individuals. Little is known of its significance, especially in regards to functional pathways. Probabilistic diffusion tensor imaging(DTI) has recently been used to seed the lateral habenula(LHb) and define its afferent white matter pathway, the stria medullaris thalami(SM). We sought to determine if the MI serves as a conduit for crossing of limbic fibers such as the SM.

Methods: Probabilistic DTI was performed on ten subjects who had presence of a MI as visualized on magnetic resonance imaging (MRI). Tractography was also performed on two subjects without MI. Manual identification of the LHb on axial T1 weighted MRI was used for the initial seed region for tractography.

Results: In all subjects, the SM was reliably visualized. In 7 out of the 10 subjects with MI, there was evidence of SM fibers that crossed to the ipsilateral hemisphere. Three subjects with small diameter MI did not have tractographic evidence of crossing SM fibers. Of the 7 subjects with crossing SM fibers within the MI, 5 showed predilection toward the right orbitofrontal cortex from both the left and right seed regions.

Conclusion: Probabilistic DTI provides evidence of SM fibers within the MI. Given its anatomic location as a bridging pathway between thalami, further studies are necessary to assess its role within the limbic functional network.

	Subject	MI present?	MI dimensions (axial x coronal plane, mm)	Crossing fibers within MI?	Dominant projecting SM?	SM projections from LHb
P CT P	1	Y	13 x 10	Y	R	Left SM preferentially crosses, right SM stays ipsilateral
1000 00	2	Y	12 x 8.4	Y	R	Left SM preferentially crosses, right SM crosses but majority of fibers stay ipsilateral
RA A A	3	Y	9.6 x 6.3	Y	N	Left and right SM both cross to contralateral side via MI
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	4	Y	7.7 x 7.9	Y	R	Left SM preferentially crosses, right SM stays ipsilateral
· 🐥 7	5	Y	5.5 x 5.2	Y	R	Both SM fibers cross to contralateral hemisphere but right LHb fibers project more ipsilateral, left LHb fibers project more contralateral
K / 💦 🦵	6	Y	4.7 x 2.2	Y	R	Both SM fibers cross to contralateral hemisphere but right LHb fibers project more ipsilateral, left LHb fibers project more contralateral
H Par	7	Y	4.3 x 2.1	N	N	No crossing fibers, each SM projects ipsilateral
A A HA	8	Y	2.7 x 2	Y	N	Both SM fibers cross equally contralateral side without a preference
C C C	9	Y	1 x 1	N	N	No crossing fibers, each SM projects ipsilateral
	10	Y	2 x 1.4	N	N	No crossing fibers, each SM projects ipsilateral
8. 45 . 3V	11	Ν	-	9	(*)	Both SM project unilaterally but right LHb also crosses via posterior commissure
	12	Ν	-	-	-	Both SM project unilaterally but also cross via posterior commissure

P165: Postmortem Diffusion Tensor Magnetic Resonance Tractography for preclinical studies in psychiatric Deep Brain Stimulation

Authors:

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Keywords: Tractography, Depression, Deep Brain Stimulation, Postmortem

Abstract:

Introduction: Different targets have been proposed for Deep Brain Stimulation (DBS) in refractory depression. Stimulation of the superolateral branch of the medial forebrain bundle (sIMFB) has shown promising clinical results (Schlaepfer 2014). Diffusion tractography is an important tool to assist neurosurgical procedures. Tractography in postmortem brains has been recently developed, with the steady state free precession (SSFP) sequence, but no description of more complex and interconnected tracts like MFB has been made. Our aim is to show the MFB, its course and connections for later validation, comparing imaging with histological sections of the same brains, and also to evaluate reproducibility of postmortem DTI.

Methods: We acquired SSFP diffusion from 3 postmortem brains, with no neurological pathologies. A fitting box for the brain was used with Perfluoropolyether (Galden, PFPE, Solvay Inc). The data was analyzed using a MATLAB-based-in house toolbox for fiber tracking (Uniklinik, Freiburg), and a single seed was set in the Ventral tegmental area (VTA).

Results: The MFB was reconstructed and its course was shown. The technique was reproducible in the 3 brains. Two branches were shown anterior to VTA; The inferomedial branch follows the lateral wall of the 3rd ventricle into the lateral hypothalamus. The superolateral branch travels through the Thalamus into the anterior limb of the internal capsule and ends in the frontal lobe, with less marked and reproducible tracts in the prefrontal cortex.

Conclusion: In this postmortem study, the human MFB was reproducible in all brains, showing similar depiction, course and relation to other brain regions. More variability was shown in the frontal end of the tracts. SSFP is a reproducible sequence for postmortem DTI and it could be helpful for validating clinical tractography.

P166: DTI analysis of major white matter tracts involved in temporal lobe epilepsy

Authors:

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Keywords: TLE, Diffusion anisotropy, Tractography, White matter

Abstract:

Introduction: Patient selection for epilepsy surgery remains a challenge, and using invasive electroencephalographic techniques is often necessary to help identify the epileptogenic foci in patients with temporal lobe epilepsy (TLE). The diffusion tensor image (DTI) allows us to detect small changes in the diffusion parameters of the different white matter tracts involved in TLE, so we hypothesize that preoperative DTI analysis might help lateralize seizure origin in patients with TLE. The goal of our study is to evaluate the utility of preoperative DTI in the lateralization diagnosis of TLE.

Methods: Twelve patients with TLE, who had undergone temporal lobectomy and amigdalectomy according to modified Spencer technique, were enrolled. They were selected for surgery following our Epilepsy Surgery Unit Protocol. A 1.5T MRI was used to obtain 25 diffusion gradient direction images per subject. All image processing and tractography analyses were completed using 3D Slicer software. In six patients, MRI showed the existence of signs suggestive of temporal mesial sclerosis, whereas the remaining MRIs were informed as normal. Twelve age and gender matched controls were also included in the study.Five pairs of white matter fiber tracts were traced, and fiber tract fractional anisotropy (FA) and mean diffusivity (MD) were calculated.

Results: Whole tract diffusion characteristics of patients with TLE were significantly different between patients and controls (p <0.05).Patients with TLE demonstrated a decreased FA in fascicles arcuate, inferior longitudinal, fornix, uncinate and cingulate in the hemisphere ipsilateral to the epileptogenic focus relative to the same side in controls.Whereas in right TLE these differences were more pronounced in ipsilateral side, in left TLE, there were changes both in the ipsilateral and the contralateral side. In the subgroup of patients with normal MRI, we found a statistically significant decrease in FA (p <0.05) in fascicles: cingulate, fornix, inferior longitudinal and uncinated.There were no differences in MD.

Conclusion: Our results suggest that there are alterations in diffusion in different white matter tracts in patients diagnosed with TLE. These alterations are more pronounced in the hemisphere ipsilateral to the epileptogenic focus. The study of DTI could be a useful presurgical tool to help establish the laterality of TLE. Further studies with a larger number of patients would be necessary to confirm these results.

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P167: Comparison of diffusion imaging tractography in live and non-fixed post-mortem porcine brains

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Keywords: diffusion tensor imaging, tractography, animal model, white matter, fractional anisotropy, diffusivity

Abstract:

Objectives

Tractography based targeting is gaining an increasing role, particularly in non-invasive lesioning methods of treatment. This requires the use of models such as post-mortem brains to complement *in vivo* diffusion studies. Most post-mortem brain studies use specimens that have been formalin-fixed or excised from their original biological environment, processes both of which are known to affect diffusion parameters. This study presents a method of diffusion imaging and tractography and a comparison of white matter diffusion metrics in a number of intracranial regions of interest. Diffusion data is compared for both *in vivo* and non-fixed post-mortem piglet brains.

Methods

Twelve live and nine post-mortem (age: 22±3 days, weight: 6.7±1.1 kg) piglets were studied. Post-mortem scan interval was <24 hours. T1 anatomical and diffusion weighted imaging (DWI) scans were acquired on a 3T MRI. DWI scanning parameters included 128 directions, 1.6 mm isotropic voxels, and b=800s/mm². Eddy current, motion, and susceptibility corrections were performed. Using MRTrix3, deterministic tractography was performed to reconstruct tracts of the corpus callosum, fornix, optic nerves and tracts, and trigeminal nerves. Tracts guided region of interest (ROI) placement to measure diffusion metrics of fractional anisotropy (FA), mean (MD), axial (AD), and radial (RD) diffusivity. Comparisons were performed across ROIs in live and non-fixed post-mortem brains.

Results

Visual reconstruction of all selected white matter bundles was successfully performed in both *in vivo* and post-mortem piglet brains. Across all ROIs, significant decreases of 68-88% were observed in the MD, AD, and RD of post-mortem subjects (p<0.0005). FA, however, was found to be unaltered between groups with no statistically significant differences observed for any white matter structure (p>0.068).

Conclusion

Consistent reconstruction of white matter tracts both *in vivo* and post-mortem was achieved. We observed unaltered anisotropy in both groups despite a five-fold reduction in diffusion post-mortem. This suggests that the barriers which restrict the motion of water persist following post-mortem status while the absolute rate of motion is inhibited. This decreased diffusivity is likely due to lower tissue temperature and diminished axonal transport rate post-mortem. Our study validates the use of post-mortem animal models for methodological development without the need for tissue fixation or scanning modification.

P168: SPECT neuroimaging and neuropsychological functions in different stages of Parkinson's disease

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Keywords: SPECT, Parkinson's disease, neurophysiology

Abstract:

Objectives: The present study investigated differences and associations between cortical perfusion, nigrostriatal dopamine pathway and neuropsychological functions in different stages of Parkinson's disease (PD).

Methods: We recruited 53 non-demented PD patients divided into four groups according to the Hoehn and Yahr (HY) staging system and 20 healthy controls who were used in the comparison of the neuropsychological findings. Each patient underwent two separate brain single photon emission computed tomography (SPECT) studies (perfusion and dopamine transporter binding) as well as neuropsychological evaluation. Perfusion images of each patient were quantified and compared with a normative database provided by the NeuroGam software manufacturers. Mean values obtained from the cortical areas and neuropsychological measures in the different groups were also compared by analysis of covariance (ANCOVA) controlling for disease duration and educational level.

Results: We found cognitive deficits especially in the late PD stages (HY 3, 4 and 5) compared to the early stages (HY 1 and 2) and associations between cognitive decrements and cortical perfusion deterioration mainly in the frontal and posterior cortical areas. Compared with controls, PD patients showed impairments of cognition and cerebral perfusion that increased with clinical severity. Furthermore, we found a significant correlation between the performance on the phonemic fluency task and regional cerebral blood flow (rCBF) in the left frontal lobe. Dopamine transporter binding in the left caudate nucleus significantly correlated with blood flow in the left dorsolateral prefrontal cortex (DLPFC), but not with measures of executive functions.

Conclusion: There are significant cognitive and perfusion deficits associated with PD progression, implying a multifactorial neurodegeneration process apart from dopamine depletion in the substantia nigra pars compacta (SNc).

P169: Establishing a DTI model of trigeminal neuralgia in piglet brains

Authors:

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Keywords: MR guided focused ultrasound, trigeminal neuralgia, brain imaging, tractography

Abstract:

Background: There is increasing interest in the role of diffusion tensor imaging (DTI) in the neuroimaging of pain and trigeminal neuralgia (TN). DTI permits the study of neural microstructure, its alteration in TN and the study of treatment effects as more novel methods are being explored. MR guided focused ultrasound (MRgFUS) has become a technical innovation in non-invasive lesioning, but has not been used for the treatment of TN. Here, we aim to establish a DTI-based piglet model to compare its diffusivity metrics and nerve characteristics with healthy human trigeminal nerves. A piglet brain model was used due to its size practicality, compatibility with the MRgFUS machine and overall ease of handling of animals.

Methods: The study group included MR imaging from 8M healthy humans (range 23-27Y), and 8M Yorkshire piglets 22±6 days, (6.1±1.2kg). 3TMR imaging included diffusion-weighted and T1 anatomical scans. Humans were scanned on an eight-channel 3TGE-Signa HDx-MRI; pigs were imaged in a 32-channel head coil Philips 3T Achieva. Preprocessing was done in FSL for both pigs and humans, FSL 4.1.8 FMRIB Diffusion Toolbox and FSL Topup respectively. Final processing included creation of colour by orientation maps, superimposition of trigeminal tracts on anatomical images, calculation of axial, radial, mean diffusivities and fractional anisotropy (FA). Trigeminal nerves root entry zone (REZ) and cisternal segment diffusivities in pigs and humans were compared using independent t tests.

Results: Piglet trigeminal nerves are large, robust and easily trackable. Axial, radial and mean diffusivities were significantly different between the cisternal segments of piglets and humans, however no statistical difference was observed between the two groups REZ. Statistical significance was much more pronounced for axial diffusivity (P<0.001), followed by mean (p<0.01) and radial (p<0.05). There was no significant difference between FA values in either group.

Discussion: Trigeminal nerve REZ diffusivities were similar between the two groups. The cisternal segment showed pronounced differences across all diffusivities, likely due to the piglets' developmental stage, yet when calculated proportionally (FA), no statistically significant difference was seen. Similarity between REZ values and cisternal segment FA suggests that the piglet trigeminal nerve is a viable option for a DTI model of TN and the study of role of MRgFUS as a novel non-invasive form of its treatment.

P170: Burst motor cortex stimulation in neuropathic trigeminal pain - first experience

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Keywords: MCS, chronic pain, burst

Abstract:

Objective: Motor cortex stimulation offers a therapeutic option in patients suffering from chronic neuropathic pain unresponsive to conventional means. Although best results are commonly observed in patients suffering from trigeminal neuropathy, sufficient pain reduction cannot be achieved in all patients. Some patients report stimulation induced side effects. Burst stimulation might be an add on option to increase responder rate, therapeutic efficacy and reduce side effects.

Methods: A 39y female patient suffered from severe neuropathic trigeminal pain following repeated neurovascular decompression procedures. Tonic motor cortex stimulation lead to some pain reduction (reduction VAS 10 to 3) in the first place. Over the time of 6 months treatment efficacy was partially lost and stimulation induced side effects (unpleasant stimulation sensation) occurred. Reprogramming did not solve these. We therefore decided to switch to burst stimulation.

Results: Reprogramming was done in an inpatient setting. Classic burst stimulation as used in spinal cord stimulation was applied (40-Hz burst, 5 spikes at 500 Hz per burst) with the lead configuration unchanged and stimulation intensity set at 60% of the motor threshold. Following a latency of around 20 hours the patients reported a significant decrease in pain intensity and side effects. Although stimulation induced side effects were still palpable for the patient these were not unpleasant. Pain reduction was again at 2-3/10 on the VAS. These results were stable at three month follow-up (9 months postoperative).

Conclusion: Burst stimulation seems to be an option in patients with loss of treatment effect and stimulation induced side effect in motor cortex stimulation for trigeminal pain. Regarding long term efficacy and safety and the question whether burst should be used as a first line stimulation setting further studies will be done. One has to keep in mind that burst stimulation has a high energy consumption, rechargeable device are mandatory. Further studies are warranted to proof this concept.

P171: Efficacy of burst spinal cord stimulation on central neuropathic pain caused by traumatic brain injury

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Keywords: spinal cord stimulation, traumatic brain injury, neuropathic pain

Abstract:

Introduction: Central neuropathic pain, which is very challenging to treat, occurs directly from central nervous system injury and often begins over months to years. Central neuropathic pain is common in a sequela of stroke, multiple sclerosis, or spinal cord injury but it is rarely caused by trauma. Burst spinal cord stimulation may cause pain reduction more effectively without eliciting paresthesia such as tonic stimuli in patient with central neuropathic pain due to traumatic brain injury.

Case: This case report describes a 52-year-old man with intractable, cold, throbbing, and shooting pain mainly on the left lower limb. He has complained the neuropathic pain during rehabilitation after having undergone craniotomy for multiple cerebral injuries resulting from a motorcycle accident five years ago. Burst spinal cord stimulation was then proposed due to his refractory pain and the result remains good.

Conclusion: Through burst spinal cord stimulation, we have successfully treated a patient with medication-resistant central neuropathic pain associated with traumatic brain injury, and in view of this fact, burst spinal cord stimulation may be effective in certain neuropathic pain syndromes.

P172: The role of psychological factors in the effecasy of motor cortex stimulation

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Keywords: psychological factors, motor cortex stimulation, pain

Abstract:

Background: Motor cortex stimulation is one of the reliable and effective methods of management of pain in patients with refractory pain syndrome. However, it is not effective in some patients. This creates the need to explore predictors of neurostimulation. In the literature quite a long discussion about the influence of psychological factors on the efficacy of neurostimulation.

Methods: Twelve patients (10 men and 10 women) with diagnosed neuropathic pain syndrome with an average age of 52 years participated in our series. All patients were tested DN4, Pain Detect, LANSS. Pain intensity were diagnosed with PQLC – Pain and Quality of Life Card before and after operation and in catamnesis. We appreciated the average of pain intensity, maximal and minimal values of pain, frequency, the effect of pain on daily activities.

Results: Average pain history made up of 3.75 years. Average follow-up amounted to 26.75 months. In our study motor cortex stimulation in test period was effective in 19 (95%) patients. Average intensity of pain before stimulation was 7 ± 0.4 (VAS) and 3 ± 0.4 three month after stimulation. The level of analgesia from 37.5% to 90%. In the long-term catamnesis (12-96 month) 73.7% of the patients had effective results. The indicators on the scale of emotional relationship to pain in all our patients was very high. Two patients have demonstrated a particularly high level of neuroticism (up to 6 points). They both were sick for several years, and already at the first examination exhibited poor fixation on their pain and painful experiences. However, in one clinical case the patient has Central tetraparesis after spinal cord injury with a good response to neurostimulation was observed a decrease in clinical effect. at the same time, in the psychological tests he was diagnosed with a high level of neuroticism. Another patient with the absence of impaired motor functions and also a positive result of employment of TKMS, stimulation lost its effectiveness in the test period. It should be noted that this observation comes to the fore other, more significant prognostic factor is the severity of the psychogenic component of pain, which we were unable to identify prior to the test stimulation. At the same time, stimulation of the motor cortex is effective in patients with phantom pain.

C onclusion: Psychological factors may be predictors of efficacy of the motor cortex stimulation, but it requires further research.

P173: Use of continuous focal stimulation of the dorsal anterior cingulate white matter to produce euphoria and anxiolysis without sedation in an epilepsy patient undergoing awake craniotomy

Authors:

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Keywords: Anxiety, depression, anxiolysis, awake neurosugery, epilepsy, mood, affective, relaxation, cingulate, cingulum, stimulation, deep brain stimulation, neuromodulation.

Abstract:

Objective: We sought to elucidate the mechanism of a serendipitous finding of evoked laughter, positive affect, and anxiolysis in an epilepsy patient undergoing a stimulation research paradigm. Stimulation was later applied during an awake neurosurgery to assist with anxiolysis and facilitate language functional screening during resection.

Methods: A 25-year-old woman with epilepsy and anxiety underwent grid, strip and stereotactic depth electrode implantation for seizure focus localization. Stimulation testing occurred during the intracranial monitoring phase, where electrical stimulation was delivered via a current-controlled cerebral stimulator. Subjective effects of stimulation were recorded via video, and objective effects were quantified in terms of network-evoked potentials, autonomic responses, and shifts in affective bias, a cognitive proxy for emotional state.

Results: Focal stimulation to the dorsal anterior cingulum bundle was observed to produce involuntary laughter and smiling which emanated from the side of the face contralateral to stimulation. The patient reported happiness and relaxation that persisted over the course of twenty minutes of stimulation. Stimulation was accompanied by a significant positive shift in emotional bias (p=.023), as well as dose-dependent transient increases in skin conductance and heart rate. Examination of local field potentials recorded prior to sham and active stimulation conditions revealed significant reductions in 6-11hz power as well as network coherence following stimulation (ps<.0001). Neuroimaging revealed stimulation engagement of the cingulum bundle and fibers innervating the supplementary motor area and dorsal prefrontal cortex. The patient's clinical team (neurosurgeon, neurologist, psychologist, and anesthesiologist) determined that cingulum stimulation was likely to provide substantive relief to the patient's anxiety during surgery, and it was successfully applied in the operating room to produce anxiolysis without sedation which facilitated a language screening procedure during resection.

Conclusion: The current findings significantly expand the literature on the role of the anterior cingulate on positive emotional function. The novel application of this stimulation to produce euphoria and anxiolysis without sedation during the patient's awake resection suggests it may be a novel target for anxiety management, especially in the context of awake neurosurgical procedures.

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P174: Long term results of simultaneous trial of deep brain and motor cortex stimulation in refractory neuropathic pain

Authors:

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Keywords: deep brain stimulation; motor cortex stimulation; neuropathic pain; thalamus

Abstract:

Objective: Although deep brain stimulation (DBS) and motor cortex stimulation (MCS) have been reported to be effective in selected patients with refractory neuropathic pain, their application is still empirical and there is no consensus on which one is better.

Methods: To enhance the success rate of test stimulation of invasive brain neuromodulation techniques and identify more proper stimulation targets in an individual patient, we performed a simultaneous trial of thalamic ventralis caudalis (Vc) DBS and MCS in 11 patients with chronic neuropathic pain and investigated the results of the stimulation trial and long-term pain relief (Table 1, Fig. 1).

Results: Of the 11 patients initially implanted with both DBS and MCS electrodes, nine (81.8%) had successful trials. Seven of these nine patients (77.8%) responded to MCS and two (18.2%) responded to Vc DBS. With long-term follow-up (56 \pm 27.5 months), the mean numerical rating scale (NRS) decreased significantly (p<0.05). Percentage pain relief values in the chronic MCS (n=7) and chronic DBS (n=2) groups were 34.1 \pm 18.2% and 37.5%, respectively, and there was no difference (p=0.807). Five out of the seven MCS patients (71%) and both patients with DBS were assessed successful with long-term success defined as more than 30% pain relief compared with baseline. (Table 2)

Conclusions: With the simultaneous trial of DBS and MCS, we could enhance the initial success rate of invasive trials. Considering the initial success rate and the less invasive nature of epidural MCS over DBS, we think MCS may be a more reasonable, initial means of trial in chronic intractable neuropathic pain. Further investigation including other subcortical target-associated medial pain pathway may be warranted.

Fig. 1. Anterior-posterior (a) and lateral (b) projections of skull x-ray films of a patient (#10) who underwent a simultaneous DBS/MCS trial for intractable, chronic neuropathic pain. This patient had both thalamic Vc and internal capsule DBS electrodes combined with a left-side MCS electrode. Note the previously implanted C1-C2 paddle lead for treatment-resistant complex regional pain syndrome with whole-body involvement, which was more severe in the right hemibody.

In this particular patient, we obtained >50% pain relief with the initial MCS trial. However, thalamic Vc stimulation aggravated the hemibody pain. The prominent analgesic effect of MCS faded within six months postoperative. However, the patient still today (24 months after MCS) uses chronic MCS for unremitting pain. He assessed MCS much more effective than spinal cord stimulation.



P175: Long-term Results of Motor Cortex Stimulation in the Treatment of Chronic, Intractable Neuropathic Pain

Authors:

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Keywords: Chronic pain, Motor cortex stimulation, Neuropathic pain, central poststroke pain

Abstract:

Background: Although motor cortex stimulation (MCS) has been used for more than 20 years in the treatment of chronic neuropathic pain, there is still a debate about the efficacy of MCS.

Methods: To investigate the long-term results and the factors associated with long-term success of chronic MCS, 21 patients who underwent MCS trial were classified as having central poststroke pain (CPSP), central pain after spinal cord injury (SCI pain), and peripheral neuropathic pain (PNeP), and we investigated the clinical factors associated with long-term success and degree of pain relief.

Results: Of the 21 patients, 16 (76.2%) had a successful trial and underwent chronic MCS. In the long-term follow-up (53 \pm 39 months), only the diagnosis (CPSP and PNeP) was associated with long-term success defined as more than 30% pain relief compared with baseline (p<0.05, chi-square test). The difference in pain relief was not significant in patients having SCI pain (p>0.05, one-way Anova). The other variables did not show any significant influence in the long-term success and degree of pain relief (p>0.05, one-way Anova).

Conclusion: MCS was more effective in the treatment of chronic neuropathic pain of CPSP and PNeP types than in the treatment of SCI pain in the long-term follow-up.

Diagnosis	success in trial	Mean follow-up (mo)	%pain relief at last F/U	Chronic responder (>30% of relief)
CPSP	8/10(80%)	35.9(±15.514)	40.7(±8.853)	7/8(87.5%)
SCI pain	3/6(50%)	34(±26.633)	16.93(±4.561)	0/3(0%)
PNeP	5/5(100%)	80.2(±58.917)	34.64(±7.086)	4/5(80%)

Table 3. Summary of long-term results of motor cortex stimulation

CPSP = central poststroke pain; SCI = spinal cord injury; PNeP = peripheral neuropathic pain

P176: Charge Injection Patterns of Spinal Cord Stimulation for Good Clinical Outcomes in Patients with Chronic Neuropathic Pain Syndromes

Authors:

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Keywords: Spinal cord stimulation, clinical outcome, parameter, charge injection pattern

Abstract:

Background: Spinal cord stimulation (SCS) is developed for medically intractable chronic pain, and its efficacy and clinical role has been extensively studies for several decades. Even SCS is widely performed by many clinicians, however, an exact mechanism how SCS plays a role in the central nervous system is yet to be investigated. Moreover, several issues, including role of stimulation induced paresthesia, proper stimulation parameters, and long-term benefits, is still under controversies. In this study, we addressed these issues based on our recent clinical experiences performed in our specific clinical strategy.

Methods: Between March 2014 and December 2016, nine patients were underwent spinal cord stimulation for chronic neuropathic pain syndromes. Electrical charge injection patterns was classified by four variables, distance between the active cathode and the midline of dorsal column, relative position of anode to the cathode, and frequency and pulse width of electrical pulses. Meanwhile, amplitude of SCS was not considered as a determinant factors for the classification because it is always dependent to other variables described above. Clinical status and stimulation variables were evaluated at the baseline and the last follow-up.

Results: There were distinct three groups of clinical outcomes (good, moderate, and poor outcome groups). Patients with good outcome (n=6) were able to back to their normal life with intermittent experience of bearable pain. One patient was regarded moderated outcome because he experience tingling sense on both low extremities even though his arm pain was significantly reduced after cervical SCS. Patients with both good and moderate outcome were operated using paddle type SCS device. Patients with poor outcomes (n=2) presented little or no benefits from SCS even though they had experienced significant pain reduction in a short-term. Average \pm SD distance of active cathode from the midline was 2.34 \pm 1.21 mm for good outcome group. Average \pm SD frequency and pulse width of good outcome group were 26.3 \pm 17.9 Hz and 567 \pm 216 µsec, respectively.

Conclusion: This study support that clinical benefit SCS may play their beneficial role by stimulating several sensory relay neurons sitting beside dorsal column such as wide dynamic range neuron, postsynaptic dorsal column neuron and spinocervical tract neurons rather than by stimulating dorsal column.

P177: Motor cortex stimulation in patient with post-stroke pain syndrome

Authors:

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Keywords: post-stroke pain syndrome, motor cortex stimulation

Abstract:

Background: Chronic pain after stroke found in up to one-half of stroke patients, it affects the quality of life of patients and is often refractory. Motor cortex stimulation one of the save and efficacy method in management pain syndromes, including after-stroke pain. In our submission we had conducted analysis our small series patients with after-stroke pain to prepared in Nikolay Nilovich Burdenko Neurosurgery Institute during eleven years.

Patients: four patients had poststroke pain syndrome, while three of these patients suffered hemorrhagic stroke and one patient was ischemic stroke. Among patients who suffered a hemorrhagic stroke, two the hemorrhage was localized directly in the thalamus, and one, in subcortical nuclei, including the thalamus.

Methods: All patients were tested DN4, Pain Detect, LANSS. Pain intensity were diagnosed with PQLC – Pain and Quality of Life Card before and after operation and in catamnesis. We appreciated the average of pain intensity, maximal and minimal values of pain, frequency, the effect of pain on daily activities. The stimulation parameters that were used in our study: amplitude of 1.0-5.5 V, frequency 20-50 Hz, pulse duration – 60 - 210 microseconds) Observation in the postoperative period and in follow-up.

Results: Average pain history made up of 3.75 years. Average follow-up amounted to 26.75 months. The stimulation parameters that were used in our study: amplitude of 1.0-5.5 V, frequency 20-50 Hz, pulse duration – 60 - 210 microseconds). Three patients received adequate therapy in adequate doses prior to the stimulation. The results of the employment of transcranial magnetic stimulation was positive in all patients.

The efficacy criterion was considered to decrease in pain of 50% or more at a threshold value of the pulse after two series of stimulation. The level of analgesia from 37.5% to 90%. One of the patients 3 months after implantation of the system has arisen purulent inflammation in the pocket of the pulse generator and the pressure sore over site of implantation of the connectors. The system was removed, in spite of the good analgesic effect.

Conclusion: Motor cortex stimulation may be used in patient with after - stroke pain. The use of modern schemes of antibiotic prophylaxis may reduce complications, which is one of the most important factors for the preservation of clinical effect.

P178: Long-term experience and outcomes of simultaneous intrathecal drug delivery and spinal cord stimulation for chronic pain

Authors:

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Keywords: Spinal Cord Stimulation, Intrathecal Drug Delivery, Chronic Pain, Neuralgia, Failed Back Surgery Syndrome, Case Series

Abstract:

Introduction: There exists an evidence gap concerning the management of chronic neuropathic pain, including failed back surgery syndrome (FBSS), using combined intrathecal analgesia and spinal cord stimulation (SCS).

Methods: This single-centre case series reports the experiences and outcomes of five consecutive patients receiving dual intrathecal drug delivery (IDD) and SCS at an academic neurosurgical pain service in central Germany. Relevant data were extracted from the patients' electronic medical records and paper-based hospital notes.

Results: Five patients (4 male, 1 female) received simultaneous IDD and SCC during the study period. The therapeutic indications were: FBSS (2 patients), cervical myelopathy (1 patient), tumor-associated conus medullaris syndrome (1 patient), and pudendal neuralgia (1 patient). 4/5 patients received SCS before IDD was initiated after a mean period of 19 months (range 12-25 months). 1/4 of these SCS-first patients additionally went on to receive additional permanent peripheral nerve stimulation therapy after a further 36 months. The remaining patient suffered from a conus medullaris syndrome and first received IDD, followed by SCS 10 years later. All patients reported a reduction in their mean level of pain (according to the numerical rating scale) after initiation of the second therapy. The complication rate was within the expected margin. To date, each of these patients continues to be managed with combined SCS and IDD.

Conclusion: This study presents our positive experience of combined IDD and SCS. Dual therapy, when clinically indicated and in the setting of careful candidate selection, appears to be safe and well tolerated, leading to pain reduction and patient satisfaction. Further high quality studies are needed to confirm these findings.

P179: Neural oscillations regulate somatosensory processing at the level of the human spinal cord

Authors:

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Keywords: Spinal cord, somatosensory, SCS, local field potentials, pain processing, neural occillations

Abstract:

Functional imaging shows that pain processing in the spinal cord is under top-down control by the brain, specifically by attention and expectation, mediating for example, placebo analgesia (Eippert et al., 2009; Sprenger et al., 2012). Understanding the neural signals and mechanisms underlying this top-down control coud enhance pain therapy, e.g., by optimizing spinal cord stimulation protocols. In the brain, sensory processing is regulated via neural oscillations (Jensen and Mazaheri, 2010; Arnal and Giraud, 2012; Bauer et al., 2014). Here, we ask whether neural oscillations play a similar role in gating sensory processing at the level of the human spinal cord. in our ongoing study we are recording local field potentials (LFPs) from epidural spinal electrodes implanted for pain relief in patients with different pain syndromes. Spedifically, we recorded LFPs as patients attend to electrical shocks on th skin whose onset is either predictable or unpredictable, i.e., which are expected or relatively unexpected. Preliminary results show a stimulus-induced gamma-increase at the level of sensory cortex. Importantly, when shocks are predictable, this stimulus-induced gamma-decrease in spinal LFPs is diminished. In addition, stimulus expectation suppresses the power of alpha- and low beta-oscillations in the spinal cord prior to stimulus onset. This anticipatory signal mirrors a well-known, similar phenomenon at the level of sensory cortex. Our preliminary data support the idea that neural oscillations, both pre-stimulaus and stimulus-induced, regulate somatosensory processing at the level of the spinal cord. Understanding these signals could inform physiologically guided protocols for optimized spinal cord stimulation in the future.

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P180: Mapping of motor evoked potentials to detect the motor side effects threshold during the DBS surgery

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Keywords: motor evoked potentials, MEP, DBS, motor side effects

Abstract:

Introduction: One of the main reasons to perform the DBS surgery in awake patient is the possibility to detect activation threshold of descending motor tracts, since this can be a therapy-limiting side effect. The current standard technique of such detection is based on the visual observation of muscle contraction during stimulation with conventional DBS stimulation parameters. The recording of motor evoked potentials (MEP) during DBS surgery are feasible, as already shown in the literature. We investigate the value of MEP mapping in as an alternative method to detect motor side effects threshold.

Methods: This study includes the results of the 20 patients who undergone bilateral DBS surgery in STN, VIM and GPI in 15 cases as in awake surgery and 5 under general anesthesia (GA). The recording data of 45 trajectories and 54 stimulation sites were available. A cathodal stimulation in the stereotactic target on the macroelectrode tip was applied using train-of-five technology in 1 mA steps of 0 to 5 mA. The recordings were obtained using surface electrodes in awake and needle electrodes in GA in the projection of m.mentalis, m. flexor dig., m. abd. policis brevis, and m. tibialis anterior on the contralateral side of the stimulation. The visual detection of the motor contraction under 130 Hz 60 µs stimulation in 1 mA steps (0-5 mA) was used as a standard control parameter.

Results: The MEP registration was successful in all stimulation sites. The MEP threshold correlates with visible muscle contraction at 130 Hz stimulation intraoperatively and with postoperatively documented DBS sideeffects. The recognition of activation of muscle response was muscle specific, more sensitive than visible muscle contraction, and remained stable under repeated stimulation. Patients described no complaints during the MEP mapping, only minimal contractions of the muscles, comparable to much more unpleasant, sometimes painful muscle contraction under classical detection of the motor capsule threshold with 130Hz-stimulation. The MEPs was easily obtainable in all cases under GA and showed comparable threshold values as the 130 Hz stimulation postoperatively.

Conclusion: The MEP mapping is a safe and robust alternative to the conventional testing of the motor capsule effects, which can improve the safety and comfort of the DBS operation. The motor thresholds of MEP and 130 Hz stimulation correlate well and can be reliably recorded under general anesthesia.

P181: A wireless brain prosthesis for epilepsy surgery and BCI

Authors:

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Keywords: Wireless, subdural, grid, epilepsy surgery, brain computer interface(BCI)

Abstract:

A novel wireless brain prostheses (ECOG-64-D) has been developed by AB Medica® in order to allow prolonged cortical recording in the context of epilepsy surgery. The system can also provide a platform for close-loop seizure control and for BCI. ECOG-64-D has 3 components: a subdural grid hosting 128 contacts, half of them dedicated to recording, the other half to stimulation; 4 intracranial connecting cables; a PEEK case allowing wireless transmission and recharge. Wireless ECOG recording is performed through 64 dedicated recording channels while cortical stimulation can be performed through a combination of each of the dedicated 64 stimulating channels. The grid can be divided in two simmetric parts to tailor the recording/ stimulation over multiple lobes. An external kit allows wireless recharge of the case. After preliminary experience on non-human primates and further testing on pigs, ECOG-64-D is now approaching clinical testing during epilepsy surgery.

P182: Effect of spinal cord stimulation on microcirculatory function and pain relief in patients with peripheral vascular disease

Authors:

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Keywords: spinal cord stimulation, ishemic pain, peripheral vascular disease

Abstract:

Introduction: Since 1976 spinal cord stimulation (SCS) is the option for treatment of peripheral vascular disease. The efficacy of technology in pain relief not only for neuropathic but ischemic genesis of pain is obvious. Besides, there is statement about improvement in microcirculatory function of damaged limb after SCS implantation.

Methods: We conducted a prospective analysis of 38 consecutive patients with non-reconstructable peripheral vascular disease who underwent spinal cord stimulation in Siberian Federal Biomedical Research Center (Novosibirsk) between 2012 and 2016. Preoperative and follow up LDF were performed in 16 patients. Pain relief was assessed by visual analog scale (VAS) in all 38 patients.

Results: Our study included patients with IIB (6 patients, 15.8%), III (23 patients, 60.5%) and IV (9 patients, 23.7%) stage by Fontaine classification with mean age of 64.68 (range 39-83). At baseline, the mean (\pm SD) index of LDF before operation was 2.97 \pm 2.671 ml/min/100g and on mean follow up of 19.7 months was 7.29 \pm 4.76 ml/min/100g. Only Valsalva functional test have demonstrated significant improvement in postoperative probes (p=0.006). Orthostatic and postocclusive probes showed no difference between results of pre- and postoperative tests (p=0.5317 and p=0.0651). There were 2 patient who had required postoperative amputation during follow up (5.2%). The patients showed 9.43 \pm 1.25 mean mark according to VAS before operation and pain relief to 1.03 \pm 0.1 on follow up (p<0.001).

Discussion: Our analysis of patients showed significant improvement in symptoms relief after SCS implantation. It proves effect of neuromodulation to microcirculatory function of damaged limbs. But results of functional tests were multidirectional and paradoxical in most cases. It claims that despite improvement in microcirculation, functional reactivity of damaged limb was not recovered enough after spinal cord stimulation.

Conclusion: Spinal cord stimulation is absolutely efficient modality in pain relief for patients with non-reconstructable peripheral vascular disease. But some improvements in microcirculatory function is also evident. Our results of functional probes (Valsalva test) prove the enlargement in microcirculatory reserves and improvement in collateral circulation in damaged limb after SCS procedure. However, further clinical trials with larger sample sizes and extended follow-up are required.

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P183: The siberian experience of spinal cord stimulation for refractory angina pectoris

Authors:

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Keywords: spinal cord stimulation, ishemic pain, refractory angina pectoris

Abstract:

Introduction: Refractory angina pectoris (RAP) is a chronic pain conditions caused by coronary artery diseases, which cannot be adequately controlled neither by combination of medical therapy nor by vascular surgery treatment (angioplasty or CABG). Spinal cord stimulation (SCS) is a neuromodulation therapy that appears to be an effective and safe treatment for these patients.

Methods: We had applied SCS in 17 patients with RAP. The first step procedure was trial neurostimulation to reveal the efficacy of pain relief before the second step to implant the permanent neurostimulation system. The leads were inserted in the epidural space at the Th1-Th2 level. Myocardium perfusion scintigraphy (MPS) was performed on admission, on the 7th day and in 1 year after procedure. The visual analogue scale (VAS) was used to assess the degree of pain both in rest and physical activity in all patients.

Results: The patients showed $8,49\pm0,14$ marks according VAS before the procedure and pain relief to $1,25\pm0,73$ marks (p<0,01) after 1 year of procedure. All the patients demonstrated the rise of tolerance to the physical activity. MPS detected the decrement of perfusion's defect from $13,36\pm4,16$ to $10,14\pm3,35$ prearranged units (which means increase in coronary reserve up to 24%). The quality of life according to SAQ increased by 60,29% (TS scale - 58,12% amount of growth and PL scale - 64,65%). There were no any procedural complications. But we had registered 1 patient's death from cardiac infarction in one-year catamnesis.

Discussion: According to 2002 American Heart Association guidelines, SCS is a class IIb alternative therapy for treatment of RAP. But based on recent comparative randomized studies reporting significant improvements and according to recommendations of Neuromodulation Appropriateness Consensus Committee (NACC), SCS now can be recommended as evidence level 2a, degree of recommendation A, for the patients with RAP.

Conclusion: Our experience confirmes that SCS is a minimally invasive technique to reduce the pain and improve quality of life with vascular reserve enhancement in RAP patients.

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P184: Voiding disorders clinic. The role of functional Neurosurgery

Authors:

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Keywords: Voiding disorders, functional neurosurgery, neuromodulation, SARS, sacral root stimulation

Abstract:

The scope pf this presentation is to provide neurosurgeons with the details on how to form part of an interdisciplinary clinic for the management of voiding disorders. General Neurobiology of continence is reviewed. The general mission of the clinic is to provide comprehensive diagnostic studies, medical and surgical treatments and clinical research of primary and secondary pathologies causing total or partial inability to control micturition and defecation. Urinary/fecal incontinence is a highly disabling disorder that significantly alters quality of life and poses health at risk of complications, among them sepsis, renal failure, skin ulcers. Our incontinence clinic was developed after recognizing that it is a complex problem, with neurogenic and non neurogenic causes, that requires an interdisciplinary approach. Needed specialties are Urology, coloproctology, Neurology, Functional Neurosurgery, Gastroenterology, Physiatry and Pelvic floor therapy and Psychotherapy Specialists. Every performed treatment is the result of collegial discussions. Functional Neurosurgery is an unique position to participate or to conduct neuromodulation therapies, research and to offer neurosurgical treatments in patients with neurogenic causes. Our general experience in neuromodulation for voiding disorders is discussed.

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P185: Deep Brain Stimulation for OCD: using an individual patient-level registry to explore patient characteristics and clinical outcomes

Authors:

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Keywords: deep brain stimulation, OCD, registry, outcomes

Abstract:

Objectives: We used an individual patient-level registry constructed from published reports, to describe the characteristics of patients undergoing DBS for OCD between 2003 and 2017.

Method: Data for individual patients were extracted and studies were examined for duplicate publication. Extracted data included: DBS target; information on demographics; symptom severity scores. Percentage change on the Y-BOCS was calculated along with 'responder' status. If individual-level data were not reported, then average values for the whole sample were applied.

Results: The registry currently includes 61 reports, covering 369 patient outcomes. The total no. of unique patients was 178 (from 33 primary studies), indicating that only 48.2% of patients reported are unique. The median number of patients per included study was 3. The duration of follow-up in all studies was 12-months, or longer, in only 58.3%. Duration wasn't reported for 23.6% patients. Eleven unique targets were reported. The most common targets for DBS in the 175 unique patients was: VC/VS (33.7%); NAcc (27.0%); BNST (14.0%); STN (9.6%); and ALIC (6.7%). The mean \pm SD age of patients undergoing DBS for OCD was 38.8 \pm 8.8 years. The mean \pm SD duration of illness was 21.7 \pm 9.0 years. Another primary psychiatric disorder was reported in 38.8% of patients, with the most common being: major depression (31.5%); bipolar disorder (2.8%); other anxiety disorder (2.8%); and substance misuse (2.2%). The degree of 'treatment resistance' was poorly reported. The number of robust antidepressant trials was unreported in 78.7% of all studies. The number of previous psychotherapy trials was unreported in 86.0% of studies. Information about 'adequacy' of previous treatments is unknown. The percentage improvement in Y-BOCS score for the targets with more than 10 unique patients was: VC/VS (41.2%); NAcc (33.6%); BNST (46.8%); STN (76.9%); and ALIC (40.6%). The overall percentage improvement for all patients was 40.6%. The percentage response for all targets was 38.8%, but it was unknown in 33.1%.

Conclusion: Duplicate publication in the DBS for OCD literature is common. Currently, at least 11 targets are reported, with only three (VC/VS, NAcc, BNST) having more than 25 patients. Fifty-percent of all published reports have 4 or fewer patients. Although overall response rate across all targets and all studies was 38.8%, sparse details on patient characteristics and extent of previous treatments make generalisability difficult.

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P186: Deep Brain Stimulation of the bed nucleus of the stria terminalis for obsessive-compulsive disorder, 12 months follow-up

Authors:

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Keywords: deep brain stimulation, obsessive compulsive disorder, bed nucleus

Abstract:

Deep brain stimulation (DBS) is a save and reversible neurosurgical procedure of implantation electrodes to selected area of brain. Obsessive-compulsive disorder (OCD) is a chronic psychiatric disorder that affects up to 2% of the general population. This is a case report presenting a 12 months follow up after deep brain stimulation procedure in 43 year old female with a 16 years history of psychiatric treatment for obsessive-compulsive disorder.

Patient was evaluated before surgery and on three follow-up visits, respectively 3 weeks, 6 and 12 months after the surgery, with Hamilton Depression Rating Scale, Beck Depression Inventory, Snaith–Hamilton Pleasure Scale, Brief Psychiatric Rating Scale, Young Mania Scale, Yale-Brown Obsessive Compulsive Scale.

The result of treatment was satisfying and improvement in all scales was significant and long term. A significant event was reported - on the follow up visit after 6 months patient reported a noticeable connection between a voltage on the left stimulator and drive, and voltage on right stimulator and mood. On the left stimulation a patient controll mode was turned on.

Deep brain stimulation for obsessive-compulsive disorder may have a positive therapeutic effect.

P187: Intraoperative Neurophysiological Monitoring during Dorsal Root Entry Zone Lesioning for Brachial Plexus Avulsion Pain

Authors:

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Keywords: brachial plexus avulsion, dorsal root entry zone (DREZ), Intraoperative monitoring, motor evoked potential, pain, somatosensory evoked potential

Abstract:

Objectives: Although the importance of intraoperative neurophysiologic monitoring (IONM) is being stressed in intraparenchymal spinal cord surgery, its importance in dorsal root entry zone (DREZ) lesioning for brachial plexus avulsion pain has not yet been reported.

Methods: Muscle motor evoked potential (mMEP) to monitor the motor pathways and somatosensory evoked potential (SSEP) to assess the integrity of the dorsal column were applied to the ipsilateral or bilateral upper and lower extremities during DREZ lesioning for brachial plexus avulsion pain. (Table 1).

Results: IONM of mMEPs and SSEPs was feasible for monitoring of the spinal cord during DREZ lesioning (Table 1, 2). With exception of 3 unrecordable mMEPs in ipsilateral arms, mMEPs were preserved and referenced to look for intraoperative changes according to DREZ lesioning in 6 upper extremities (66.6%) and 8 lower extremities. All 3 patients with >50% reduction in baseline mMEP amplitude after lesioning in either the ipsilateral upper or lower extremities showed postoperative ataxia and weakness of the lower extremities (100%) (Fig. 1). In addition, only 2 out of 9 patients (22.2%) with brachial plexus avulsion pain had discernible baseline SSEPs in the ipsilateral upper extremities. One of 2 patients with discernible SSEPs in the upper extremities showed significant SSEP events during the DREZ lesioning and experienced postoperative ataxia and weakness in the legs despite the absence of an SSEP event in the lower extremities (Fig. 2).

Conclusions: Significant events on IONM were common during DREZ lesioning for brachial plexus avulsion pain and were closely related to the occurrence of postoperative neurologic deficits (Table 3).
P188: Comparison of clinical efficacy and computed tomographic analysis of lead position between three-column and five-column paddle leads spinal cord stimulation for failed back surgery syndrome

Authors:

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Keywords: computed tomography; failed back surgery syndrome; paddle lead; spinal cord stimulation

Abstract:

Objectives: The authors investigated the difference in clinical outcome and the position of paddle lead spinal cord stimulation (SCS) between three-column and five-column paddle lead SCS in patients with FBSS.

Methods: In 21 patients who underwent paddle lead SCS at T9 (three-column, n = 9; five-column, n = 12) for FBSS, a 12-month follow-up numerical rating scale, percent pain relief, and CT assessment of contact angle and percent reduction of T9 canal area were investigated (Table 1, 2).

Results: There was no difference in paresthesia coverage of the painful area, trial success rate, clinical outcomes, and percent pain relief between the two groups (p>0.05). The contact angle in the five-column group was generally greater than that of the three-column group (p=0.067) (Table 3, 4, Fig. 1-4). Overall reduction of $35.51 \pm 4.76\%$ in the T9 canal was observed and there was no difference between two groups (p>0.05) and no correlation between the contact angle and percent T9 spinal canal reduction (r = -0.247, p>0.05) (Table 4, Fig. 3-4).

Conclusion: Although clinical efficacy of SCS using three-column and five-column paddle lead was not significant different from each other, significant inclination of paddle lead in posterior epidural space with significant reduction in T9 canal area were observed in both groups. The degree of inclination in the five-column group was greater than that in the three-column lead group. Close approximation of paddle lead contacts to dorsal spinal cord with reduced dorsal CSF space and intraoperative neurophysiologic guidance might have contributed to the high rate of trial success and long-term pain control.

P189: Motor cortex stimulation for poststroke pain

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Keywords: motor cortex stimulation, pain

Abstract:

Objectives: We assessed motor cortex stimulation for treatment of poststroke pain. Four patients with poststroke pain were studied. In three arm pain patients, we placed electrode grid in the epidural space to determine the best stimulation point for pain relief. In one leg pain patient, the 16-electrode array was implanted in the subdural interhemispheric fissure to treat lower-extremity pain guiding navigator system. In two patients with pain extending from the extremity to the trunk or hip, dual devices were implanted to drive two electrodes.

Methods: All patients were male, mean age was 60.6 years(44-78 years). Disease entity was consisted with 1 hemorrhage, 3 infarction patients. Symtom sites was 3 arm pain patients, 1 leg pain patient.

Results: All four patients experienced pain reduction (two each with excellent, and fair relief) from motor cortex stimulation. Testing performed with a subdural multiple-electrode grid was helpful in locating the best stimulation point for poststroke leg pain relief.

Conclusion: Motor cortex stimulation may be effective for treating intractable poststroke pain.

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P190: Phantom Remodeling Effect of Dorsal Root Entry Zone Lesioning in Phantom Limb Pain Caused by Brachial Plexus Avulsion

Authors:

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Keywords: brachial plexus avulsion · dorsal root entry zone (DREZ) · phantom limb · phantom limb pain

Abstract:

Introduction: Dorsal root entry zone (DREZ) lesioning has been reported to be effective for phantom limb pain caused by brachial plexus avulsion pain. Most reports on DREZ lesioning for brachial plexus avulsion pain have focused on the results of pain relief without detailed description on phantom sensation following DREZ lesioning.

Method: Two patients (one with amputation and the other non-amputated) with chronic intractable phantom limb pain caused by brachial plexus avulsion underwent DREZ lesioning on the avulsed segments of the cervical spinal cords. Changes of the phantom limb were observed (Fig. 1 and 2).

Results: Immediately following DREZ lesioning, the phantom limb pain disappeared in the amputee, the phantom arm was shortened, and the phantom hand disappeared. The other patient with the non-amputated arm reported an immediate 50% reduction in the size of the phantom hand, pain relief was up to 70% of the preoperative phantom limb pain. There was no further change in the phantom arm and hand during the follow-up of 1.5 to 2 years.

Conclusions: Phantom arms and hands showed a prompt shortening and reduction in size rather than disappearance, following successful DREZ lesioning in patients with chronic phantom limb pain caused by brachial plexus avulsion.

Fig. 1. Drawings of phantom arm in a patient with phantom limb pain caused by brachial plexus avulsion based on reports by patient #1. The phantom limb is indicated by a dotted line, while the black area indicates the area of phantom limb pain. a Preoperative status of phantom arm and hand in patient #1. b The phantom hand disappeared immediately after DREZ lesioning, and there was an acute telescoping of the phantom arm. Fig. 2. Drawings of phantom hand in a patient with phantom limb pain caused by brachial plexus avulsion based on reports by patient #2. The phantom limb is indicated by a dotted line, with black area to show the area of phantom limb pain. **a** The phantom hand in patient #2 was located in the proximal forearm, and with pain in the phantom hand. **b** Immediately after DREZ lesioning, the size of the phantom hand decreased by half.





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P191: Spinal cord stimulation alleviates pain in 17 years old boy with Superior mesenteric artery (SMA) syndrome: a case report

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Keywords: Spinal cord stimulation (SCS), Superior mesenteric artery (SMA) syndrome

Abstract:

Background: Superior mesenteric artery syndrome (SMAS) is a disorder characterized by vascular compression of the duodenum leading to mechanical obstruction. The manifestations of SMAS include early satiety, nausea, diarrhea, reflux, vomiting and extreme postprandial abdominal pain. Surgical intervention indicated in patients who fail standard non-operative management. This report describes the case of 17 years old boy with a refractory debilitating SMAS related abdominal pain which greatly benefited from Spinal cord stimulation (SCS) implantation.

Case presentation: The authors report on a 17 year old male patient which presented with abdominal pain at the age of 11. The patient underwent LAAD surgery and was later on diagnosed with SMAS syndrome. The patient continued to complain about abdominal pain, impacting his quality of life and was started on duodenal nutrition followed by total parenteral nutrition, which were later stopped. The patient was later started on several painkiller medications and biofeedback, with no pain relief. The patient underwent two SCS implants, a temporary one and permanent one which helped relief the patient's pain.

Conclusion: Spinal cord stimulation (SCS) is an established procedure for treatment of chronic neuropathic pain of peripheral origin, and persistent postoperative neuropathic pain. This case report exhibits the option of using a spinal cord stimulator to treat refractory pain caused by superior mesenteric artery syndrome.

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P192: O-arm guided percutaneous radiofrequency cordotomy

Authors:

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Keywords: cordotomy, pain

Abstract:

Background: There is a great importance to deliver good pain management to cancer patients suffering from advanced metastatic disease. Patients with localized pain refractory to medical treatment can benefit from selective percutaneous cordotomy that disconnects the ascending pain fibers in the spinothalamic tract. Over the past year we have been performing percutaneous radiofrequency cordotomy with the use of the O-Arm intraoperative imaging system that allows both 2D fluoroscopy in addition to 3D reconstructed computed tomography imaging.

We present our experience using this technique focusing on technical nuances and complications.

Methods: Retrospective analysis of all patients who underwent percutaneous cordotomy between January 2016 and January 2017.

Results: Sixteen patients underwent percutaneous cordotomy. 15/16 patients experienced excellent immediate pain relief (90-100%). One patient with iodine sensitivity in whom no intra-thecal contrast was used experienced only 50% pain reduction. At one month 13/16 had good outcome. At 3 months 9/12 patients available for follow-up were still pain free. Mirror pain developed in 5 patients (31%), but was usually mild and controlled with medications. We had 1 complication (6.25%) of ipsilateral hemiparesis.

Conclusion: Percutaneous cordotomy using the O-Arm is safe and effective in the treatment of intractable oncological pain.

P193: Clinical outcome of DREZotomy for intractable paraplegic pain: a single center experience

Authors:

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2. Neurosurgery, Hanyang University Seoul hospital, Seoul, KOREA

Keywords: DREZotomy, Paraplegic pain, Neuropathic pain

Abstract:

Objective: Generally, it is difficult to control a paraplegic pain due to spinal cord injury. Although strong opioids and anticonvulants are effective to reduce the pain scale, most of patients with paraplegic pain is necessary to surgical interventions. A microsurgical DREZotomy (MDT) is one of the treatments of choice in paraplegic pain. But the traditional MDT has poor outcomes when the nature of pain is diffuse, thermal, and continuous pain. So, we report clinical outcomes in these neuropathic pain conditions using a modified MDT technique.

Methods: Surgical procedure is done with prone position. Spinal cord is exposed from above 2 vertebral level of injured cord to below the level of injured cord level. A careful inspection of the level of intact nerve rootlets, MDT is started from the level of just below intact rootlets cord level and extended to the caudal exposed spinal injured level. At the level of injured cord, injured, atrophied and fused rootlets are cut and MDT is performed on imaginary line of dorsal root entry zone.

Results: In 66 patients with paraplegic pain resulting from a spinal cord injury occurring within the preceding 10 years, 32 of 38 patients (84%) with a diffuse pain distribution had a good reduction in pain. 27 patients (86%) with continuous pain noted good pain relief. In patients with thermal pain,3 patient (23%) demonstrated a good response to the investigational procedure.

Conclusion: These procedures, including the modified MDT technique, may be helpful in controlling various type of paraplegic pain due to spinal cord injury.

Authors:

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Keywords: Neuropathic Pain, Stereotaxy, Neuromodulation, Deep Brain Stimulation

Abstract:

Introduction: In the last 25 years neuromodulation by deep brain stimulation gained widely acceptance starting in the field of movement disorders and getting further indications in pain syndroms and mood disorders. The highly acclaimed success of deep brain stimulation in parkinson's disease, essential tremor, dystonia, chorea huntington, tourette syndrome, cannot be translated 1:1 to neuropathic pain syndromes. The EFNS guidelines on neurostimulation therapy for neuropathic pain published in the European Journal of Neurology 2007, 14: 952–970 revealed DBS against pain to be less effective than in movement disorders which still remains the same in the literature until now. The publication identified several reviews and one meta-analysis, which conclude that DBS is more effective for nociceptive pain than for neuropathic pain (63% vs. 47% long-term success). Moderately higher success rates were seen in patients with peripheral lesions. Because neuropathic pain syndromes are a complex compilation of missing information in different pathways to and within the brain resulting in the different aspects of pain consisting of sensation, perception, mood, emotion and vegetative aspects. Simply said 50% pain reduction in DBS against neuropathic pain is covering only 50% of the cortical input!

Methods: We will demonstrate 19 patients with three different neuropathic pain syndromes following neurosurgical stereotactic interventions for neuromodulation according to our development finished in 2012. We selected from all structures in the pain matrix two main input areas namely the sensory thalamus and the posterior limp of the internal capsule. We modified the implantation site in the internal capsule because of ineffectiveness of the historical target and an anatomical chaos in the literature on the anatomical construction of the posterior limp of the internal capsule. By doing so we are able to cover all essential afferent fibers to the sensori-motor and the parietal cortex. Fiber tracking is utilized in all cases. In comparison to all other methods or other implantation centers a minimum of 2 stimulation electrodes has to be implanted per cerebral hemisphere. We treated 4 trigeminal neuropathia (3 analgesia dolorosa) patients, 2 peripheral nerve injury patients, 10 post stroke patients and 3 post infection pain syndromes. Preoperative and postoperative testing included neuropsychological testing of cognition and memory, Mc. Gill Pain questionnaire, SF-36, EQ-5D, body region VAS, sensory testing of temperature, discrimination, reaction on repetitive stimuli. MRI evaluation of electrode position in relation to fiber tracts is performed in all cases.

Results: All patients had at least 90% pain reduction and improvement in sensory function and no deterioration in cognition. Discussion: Our method is safe and reliable. Our results are better than the results in the international literature. The methode is proving since more than three years a stable effectivity.

Prospective randomized double blind studies in neuromodulation against neuropathic pain are still missing and will be conducted in the near future.

P195: Possible reason for the loss of effectivity of motor cortex stimulation

Authors:

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Keywords: Neuropathic Pain, Stereotaxy, Neuromodulation, Motor Cortex Stimulation

Abstract:

Introduction: Over 300 cases reported in the medical literature since 1991 indicate that Motor Cortex Stimulation (MCS) using 4 or more contact electrode paddles is effective for the treatment of neuropathic pain, in particular for central post-stroke pain (CPSP) and trigeminal neuropathic pain (TGN) /facial pain.

Methods: We experienced in 8 patients a reduction in effectivity of treatment after two years of treatment. Some patient could life with that because they had a stable amount of pain reduction after two years of treatment and some therapeutic effect but reduced in all possible settings. The therapeutic effect got reduced slowly following a stable period of effectivity of 18 months. In three patients the therapeutic effect was reduced tramatically. We offered Deep Brain Stimulation for neuropathic pain therapy. One patient wanted the stimulator which was almost empty to be removed and for the moment no further therapy. Two patients had such a worsened situation that they were willing to suicide. We offered DBS of the thalamus and the capsula interna. For performing a stereotactic planning MRI for DBS we had to remove the electrode .

Results: We removed the systems by recraniotomy the patients. After removing the resume round electrode we found scare tissue between dura and electrode. After removing the scare tissue we discovered a calcified plate. Now we knew why we had no psotive stimulation effects anymore despite of full integrety of the stimulation system. The other patient had a thick scare tissue isolating the electrode.

Conclusion: Outside the brain isolating scare tissue is distributed by the organism to exclude current sources other than the organism to protect the functional integrity of the nervous system and the cardiac system. In the seventies we used percutaneous electric therapy for difficult fractures in athletes with some effectivity. In a few patients with surgical spinal chord electrodes we discovered spinal stenosis only in the area of the electrode. We did not have these findings in the percutaneous electrodes at all.

P196: Mesencephalic Rostral Reticulotmy for Cancer Pain

Authors:

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Keywords: Midbrain; Rostal reticulotomy; Mesencephalotomy; Cancer Pain; Intractable Pain

Abstract:

Introduction: Cancer pain is one of the most distressing events for cancer patients, substantially reducing their quality of life. Advances on the pharmacopoeia, improvement of opioids, understanding of the adjuvant drugs, and the approach by a multidisciplinary team brought down its incidence, but it is still refractory to the best conservative management in 5% to 15% of these patients. Surgical treatment may be an option in such cases. We here present our series of 8 cancer patients with primary or secondary lesions affecting the cranio-facial-cervico-brachial regions and pain resistant to clinical treatment and surgical peripheral approaches submitted to medial mesencephalotomy (MM) aiming the interruption of the reticulothalamic tract.

Methods: Between Aug 2015 and Feb 2017, eight patients (2F/6M), mean age of 60.6 (23-80) years, presenting with nociceptive (n=4) or mixed (nociceptive+neuropathic pain, but predominantly neuropathic) treatment-resistant pain underwent stereotactic MM in one of our institutions. The visual analogical scale (VAS) was used to determine the intensity of pain. The following coordinates were used: 5.0mm posterior, 5.0mm inferior, and 5.0mm lateral to PC. Appropriate electrode placement was confirmed by macrostimulation with 5/75/100Hz and 0.5-5.0V. In the absence of adverse effects, a single radiofrequency lesion was performed with a 1.1mm in diameter and 3.0mm exposed tip electrode with 65°/60" after a successful test lesion with 50°/30". MR or CT was performed on the second postoperative day in all patients.

Results: After a mean follow-up of 5 (0.5-18) months, the intensity of pain decreased from a mean of 7.9 (6-9) to 1.4 (0-4). Postoperative neuroimaging showed well placed lesions located on the superior/inferior colliculi transition (coronal plane), and 4.0-6.0mm lateral to the Sylvius aqueduct (axial plane). The only adverse effects observed were transient diplopia (n=2), and mild cognitive decline (n=1). Recurrence of pain occurred in one patient after a follow-up of 12 months.

Conclusion: Modern MM seems to be an underutilized, cheap, effective and safe procedure for the treatment of both nociceptive and neuropathic pain in cancer patients in this short-term follow-up study. Based on these results, we strongly recommend the use of this technique for the treatment of refractory nociceptive and neuropathic pain in cancer patients.

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P197: Deep brain stimulation targeting the thalamic cavity wall in a rat model for thalamic syndrome

Authors:

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Keywords: deep brain stimulation, central post-stroke pain

Abstract:

Introduction: Thalamic syndrome, first described by Dejerine and Roussy, is a central neuropathic pain syndrome occurring after thalamic stroke, often associated with a mild paresis. It is a form of central post-stroke pain. Treatment is challenging and often not satisfying.

Methods: 30 rats were tested for thermal and mechanical pain and motor performance, and were then randomly allocated into an experimental group (E; electrolytic thalamic lesioning; n=22) and a control group (C; sham surgery; n=8). Pain and motor tests were repeated weekly over the next 4 weeks. Next, using stereotaxy planning based on pre-implantation CT and MR imaging, 3 linear twisted bipolar electrodes were implanted. E was randomly divided into a cavity wall electrode group (W; electrodes targeting the ventral cavity wall; n=11) and a random electrode group (R; electrodes targeting a random brain region not known to be related to motor or pain behaviour; n=11). In C, electrodes were implanted at the same coordinates as in W. Motor tests were then repeated during deep brain stimulation (DBS; biphasic, 130Hz, 200µs at 0%-50%-75%-100% of the highest tolerated amplitude (HTA; amplitude above which side effects are observed)) and local field potentials were recorded.

Results: After but not before lesioning, motor scores were significantly (P<.05) worse in E vs. C, while pain scores did not differ. In W, DBS at 50%, 75% or 100% HTA did not improve motor scores significantly as compared to 0% HTA in W or to DBS in R or C. LFPs recorded from the cavity wall in W were significantly different and mainly hyperactive vs. LFPs recorded from identical anatomical locations in C.

Conclusion: In a thalamic syndrome rat model with motor deficits but no mechanical or thermal hyperalgesia, the tested DBS parameters did not alleviate symptoms.

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P198: Clinical and neurophysiological evidence that spinal cord stimulation works through dorsal column fibres. What about dorsal root ganglion stimulation?

Authors:

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Keywords: Neuromodulation, Pain, Spinal cord stimulation, Dorsal Root Ganglion Stimulation

Abstract:

SCS is a well-established treatment of several neuropathic pain syndromes and is the mainstay of neuromodulation for pain. Examining evidence pointing towards probable mechanisms led to the conclusion that SCS mainly works through long loops of dorsal column (DC) fibres.

Conscious perception of paresthesia in SCS may raise the question of a super-imposed placebo-effect. However, SCS has been shown to have a depressing effect on nociceptive RIII EMG reflex, objectively demonstrating that SCS modulates physiologic mechanisms in the DH circuitry. Local modulation at the level of the DH requires however functionally valid DC fibres. In a retrospective series correlating the long-term effect of SCS and the anatomical location of the lesions we found that interruption of primary afferent neurons central to the dorsal root ganglion (DRG) is associated with a very high rate of failure. Further, in a prospective study connecting the values of the central conduction time (CCT) of the somatosensory evoked potentials (SSEP) and the long-term effect of SCS, we established that when CCT was significantly abnormal the success rate was nil. This clinical and neurophysiological evidence that SCS works through dorsal column fibres to generate supraspinal mechanisms and descending inhibitory pathways to decrease activity of the DH.

Similarly, on the opposite (peripheral) side the DRG should no longer be considered a passive transducer of the peripheral influxes to the spinal cord. The sensory fibres connect by a T – junction to their cell body; this sets a low-pass filter for action potentials propagation to the DH. The DRG-neurons are surrounded by satellite glial cells, which-through production of cytokines regulate the signal processing.

In pain from peripheral afferent fibres lesions DRG stimulation can decrease hyperactivity of the DRG neurons. Relief results from either downstream effect of vasodilation and stabilisation of the sensitized peripheral receptors and/or upstream effects of deactivating the WDR DH neurons.

Based on these mechanisms principal logical indications are neuropathic pain from PAF damages and CRP Syndromes. Clinical studies enforce this hypothesis although further confirmation is needed.

Whatever the differences between the two methods, we advise that preoperative assessment of the functionality of the DC fibres using SSEP (CCT) should be a prerequisite before deciding implantation or even percutaneous trial for both techniques.

P199: Treatment of axial low back pain with Boston scientific spinal cord stimulation

Authors:

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Keywords: Spinal cord stimulation, low back pain

Abstract:

Introduction: The use of Spinal Cord Stimulation (SCS) for management of a variety of pain disorders has been well documented in the literature. What has been noted is that patients who present with radicular pain, or limb pain, often have better response to SCS than those patients who are treated strictly for axial low back pain. Here we present out data of patients 17 patients implanted with Boston Scientific Precision Spectra spinal cord stimulator for treatment of radicular and axial low back pain.

Methods: Seventeen patients had implantation of Boston Scientific Precision Spectra after having undergone a successful trialing period. Patients were assessed using the Visual Analogue Scale as well as a pain diary. One patient had only axial low back pain, one patient had only radicular pain, fifteen patients had both axial low back pain and radicular pain.

Results: For our cohort of patients 94% were being treated for axial low back pain. In follow up with patients it was found that there was an 81% average pain reduction specific to axial low back pain. Of the patients whose pain improved 40% had used multiple waveforms in their programming via the Multiwave Platforms.

Conclusion: Greater pain control for patients with axial back pain may be achieved through greater programming abilities that were attained with Boston Scientific's Ilumina 3D and Multiwave Platforms. Further research in to different programming modalities is needed to further illuminate the possibilities of expanding pain control with SCS.

P200: Decompression of the greater occipital nerve in occipital neuralgia

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Keywords: greater occipital nerve, lesser occipital nerve, occipital nerve

Abstract:

Introduction: Occipital neuralgia (ON) is an uncommon, specific syndrome of paroxysmal severe lightening-like sharp headache in the distribution of the greater or lesser occipital nerves (GON, LON). Although most cases of occipital neuralgia are considered idiopathic, they may be related to specific secondary causes. Most surgical treatment of ON has been reported in those occurred by peripheral compression of the GON. We report 4 cases of successful surgical decompression for ON due to entrapment of the GON and the LON.

Methods: 4 cases of refractory ON were treated with surgical decompression. The causes of GON/LON entrapment were; entrapment of GON within semispinalis capitis muscle (n=1), peripheral entrapment due to pathologic arterial contact of the occipital artery to GON (n=2), and LON entrapment within the C2/3 foraminal stenosis (n=1).

Results: In ON, typical symptoms of ON along with referred trigeminal pain and trigeminal sensory change was the clues in decision of exploration of GON. In 2 cases of chronic ON with referred trigeminal pain, pathological arterial contact with adhesion to the occipital artery was found. In another patient, the entrapment was the found at the piercing point within the semispinalis capitis. All 3 GON neuralgia and one LON neuralgia were immediately relieved along with neuralgic pain and hemifacial pain.

Conclusion: Decompression of the GON was effective in selected patients with chronic ON. Possible cause of entrapment of GON and LON should be thoroughly addressed before decompression. Hemifacial pain and sensory change following occipital neuralgia may be a symptomatic clue in decision of the exploration of GON.

Figure 1) A schematic demonstrating the distribution of occipital neuralgia and hemifacial sensory change and facial pain. (A) The grey areas over the left occipital area indicates the distribution of stabbing pain of occipital neuralgia. A tender point was present along the course of the greater occipital nerve.

(B) The obliquely hatched area denotes regions of facial pain in addition to hypesthesia. The horizontally hatched area shows the distribution of hemifacial hypesthesia and paresthesia.



Fig. 3. Intraoperative photographs showing the constriction (arrow) of the greater occipital nerve in its perforation site of the semispinaliscapitis muscle.



Figure 2) Intraoperative photographs during the decompression of the greater occipital nerve

(A) An intraoperative photograph showing the adhesions of the greater occipital nerve (*white arrows*) the connective tissue (*black arrow heads*) and occipital arteries (*black arrows*).

(B) (B) An intraoperative photograph after the decompression of the left greater occipital nerve. A reddish deformation is apparent in the compressed portion (*white arrows*) with pathological vascular contact comprared to the normal proximal course (*black arrows*) of the greater occipital nerve.



Fig. 3. A cervical 3D reconstruction image showing the narrowing of left C2/3 foramen in a case of chronic LON neuralgia. (b) An intraoperative photograph showing the C3 roots and adjacent bony spur at the foramen.

P200b: Malignant life-threatening deep brain stimulation withdrawal syndrome. The Hariz-Johansson initial description

Authors:

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Keywords: Deep Brain Stimulation, Parkinson's Disease, Severe complication.

Abstract:

Objectives: After the initial description by Hariz and Johansson in January 2001 in the Journal of Movement Disorders, drawing attention to the consequences of the abrupt cessation of chronic STN DBS (Subthalamic Nucleus Deep Brain Stimulation) in PD (Parkinson's Disease) patients, describing how this therapy can change patients' symptomatology into an acute condition with severe rebound of PD symptoms requiring emergency care if chronic stimulation fails, this condition has remain hidden in some way.

Methods: We present 2 cases with PD, male and female, 50 and 74 yrs old. In both cases initial DBS induced a significant improvement of symptoms without adverse effects. They were operated as usual using a Frameless System. Awake microrrecordings and stimulation were always obtained to assess STN targeting and absence of adverse side-effects.

In the first case admission to Hospital in the ICU was due to a pneumonia, and after 10 days and verified the battery was off its replacement was performed. His Hoehn & Yahr state changed from 5 to 2 after operation.

In the second case two similar episodes were present, the first 4 yrs after the first operation with pneumonia, the stimulator being replaced one month after admission, and a second one 3 yrs afterwards, the battery being replaced after 10 days, for a severe urinary tract infection and septic state. Her Hoehn & Yahr state changed from 5 to 3 after replacement.

Both cases presented with severe systemic and neurological deterioration, including rigidity, akinesia, dysphagia, pneumonia and severe respiratory distress

Results: In both cases quickly after the stimulator run out of battery, patients deteriorated unadvertedly systemic and neurologically early with severe rigidity and urinary or lung infections, that were attributed to their previous neurological condition and even required its emergency admission to the ICU.

Emergency replacement of the stimulator stopped the deterioration of the patient. Dopaminergic medication was not an effective treatment. Just the stimulator replacement changed the clinical course. Some deterioration in their neurological state remained even after replacement.

Conclusion: Other reports including the parkinsonian hyperpyrexia syndrome or psychiatric conditions related to DBS are not related. Deterioration was due to battery depletion shortly before replacement. Emergency stimulator replacement is mandatory in these cases.

P201: Improved ONS efficacy and increased pain relief in Occipital Neuralgia with Burst stimulation: Two Cases

Authors:

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Keywords: occipital nerve stimulation, neuromodulation, surgical technique, burst stimulation, occipital neuralgia

Abstract:

Introduction: Occipital Nerve Stimulation (ONS) is an effective treatment for refractory Occipital neuralgia (ON). ON is a disorder characterized by sharp, electrical, paroxysmal pain, originating from the occiput and extending along the posterior scalp, in the distribution of the occipital nerve. Traditionally ONS delivers low frequency stimulation with a fixed pulse width-usually 300-500 µsec--and frequency between 30-60 Hz. While new paradigms for spinal cord stimulation (SCS) including high frequency and burst stimulation have been introduced over the past several years, these stimulation techniques have not been investigated extensively in ONS.

Methods: We describe the use of burst stimulation in two patients previously implanted with ONS and receiving moderately effective conventional ONS. Stimulation parameters, VAS scores, medication use, and pain diary entries were tracked over an eight-week interval. As stimulation paradigms were adjusted, measurements of these parameters were tracked at several intervals, from baseline measurements during conventional stimulation, through a washout period and across during two separate phases of burst stimulation.

Results: VAS score prior to ONS implantation was 8-9. Scores fluctuated after implantation, ranging from 4-5 at their best to 8-9 at their worst. During baseline diary, VAS was 7-8. After burst stimulation was activated, the patient VAS for patient A consistently maintained between 3 and 4 (an overall reduction of over 50%) and for patient B between 4 and 6 (just under 50%). Medication use decreased, and Patient A discontinued all opioid medications by the end of the trial period. Patient satisfaction attained at its highest point since ONS implantation at the conclusion of the eight-week trial period.

Conclusion: Burst stimulation has been effective for spinal cord stimulation and there has been a "salvage" utility in implementing burst stimulation for patients with suboptimal results using convention stimulation to address back and leg pain. The significant decrease in VAS in these cases of refractory occipital neuralgia suggests that a similar benefit may be attainable in using burst stimulation in ONS. A larger prospective investigation of burst stimulation for ON and other craniocervical pain syndromes may be warranted. Furthermore, a more detailed investigation should be undertaken into the optimal waveforms to accomplish most effective pain control.

P202: The accuracy of deep brain stimulation assisted by robotized stereotactic assistant system (ROSA)

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Keywords: obotized stereotactic assistant, deep brain stimulation, electrodes, stereotaxic techniques, accuracy

Abstract:

Objective: To evaluate the accuracy and safety of deep brain stimulation (DBS) assisted by robotized stereotactic assistant (ROSA) system. Methods: A total of 18 Parkinson's disease patients and 2 essential tremor patients undergoing DBS assisted by ROSA system. The maximum and minimum distances of electrode deviation were recorded according to postoperative CT and the average distance was calculated. The intraoperative electrode related bleeding events and postoperative complications were also recorded. Results: A total of 39 planned implant electrodes were successfully implanted in the 20 patients. Thirty-seven electrodes were implanted into the subthalamic nucleus and 2 into the ventral intermediate nucleus. The maximum deviation distance of x-axis was 2.13 mm, and the minimum was 0.09 mm, with an average of 0.68±0.43 mm. The maximum electrodes implanted with the assistance of ROSA system is safe and accurate in implanting.



P203: An investigation into the effects and prognostic factors of cognitive decline following subthalamic nucleus stimulation in patients with Parkinson's disease

Authors:

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Keywords: Parkinson's disease; subthalamic nucleus stimulation; cognitive decline; prognostic facto

Abstract:

We retrospectively investigated the effects of subthalamic nucleus stimulation (STN-DBS) on new postoperative onset of cognitive decline and prognostic factors for advanced Parkinson's disease (PD). We studied 39 PD patients who had received bilateral STN-DBS. Clinical symptoms, cognitive function, psychiatric function, and health-related quality of life (HRQOL) were assessed before and six months after surgery. Based on the results of neuropsychological examinations six months after the surgery, the subjects were divided into those with and those without cognitive decline. We compared pre- and post-operative assessments between the two groups. Prognostic factors were investigated using multiple logistic regression analyses. Seven patients had cognitive decline six months after the operation (17.9%); they were significantly older than those without cognitive decline. Preoperative neuropsychological examinations revealed impairments in language and executive function. No differences were found in clinical symptoms. Patients with cognitive decline had significantly worse apathy scale scores. The HRQOL revealed significant declines in the Mental Component Summary (MCS), vitality, and mental health (MH) domains. Postoperative comparisons revealed novel significant differences in activities of daily living in the "on" and "off" states and in daytime drowsiness. Preoperative differences seen in the MCS and vitality indices were no longer present. Word fluency, and apathy scale and MH scores were independent preoperative prognostic factors for cognitive decline. New postoperative onset of cognitive decline due to STN-DBS affected activities of daily living and psychiatric function. Preoperative non-motor symptoms may be prognostic factors for new onset of cognitive decline.

P204: Improved sleep quality and nocturnal autonomic symptom after deep brain stimulation of globus pallidus internus

Authors:

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Keywords: GPi-DBS, sleep disturbance, autonomic dysfunction

Abstract:

Introduction: Sleep disturbance in Parkinson's disease is composed of multifactorial problems. Improved sleep quality after deep brain stimulation of subthalamic nucleus (STN-DBS) are frequently reported, while the effect of that of globus pallidus internus (GPi-DBS) has not been as clear.

Methods: We evaluated the baseline sleep quality of 18 patients (age: 62.2 ± 8.3 years; males: 6, females: 12) using Parkinson's disease sleep scale (PDSS). We obtained postoperative PDSS profile from 14 of them (age: 61.2 ± 7.7 years; males: 5, females: 9; 16.2 ± 21.3 months after surgery). Clinical profiles were evaluated by Unified Parkinson's disease rating scale (UPDRS) motor score, mini-mental state examination (MMSE) and levodopa equivalent daily dose (LEDD). Statistical significance was evaluated by Wilcoxon matched-pairs signed rank test and Pearson's correlation test.

Results: The total PDSS score increased from 100.9 ± 14.0 to 111.8 ± 17.1 after GPi-DBS. Among each item, only the item 8 (question about night urinary symptoms) improved significantly. The baseline PDSS total score correlated with disease duration (Pearson r = -0.51, p = 0.03).

Conclusions: Sleep quality evaluated by PDSS improved after GPi-DBS. DBS could alleviate nocturnal autonomic symptoms.

P205: A Method for Predicting the Outcomes of Subthalamic Deep Brain Stimulation Surgery for Parkinson's Disease

Authors:

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Keywords: Parkinson's Disease, Deep Brain Stimulation, Prediction Model

Abstract:

Introduction: Although significant progress has been made in computational simulation of deep brain stimulation (DBS), very few of these have been introduced into daily clinical use. Former computational models usually include imaging data in the attempt to give the visualized suggestion for post-operational programming. To date, the clinical characteristics and electrophysiology are not considered, thus traditional models do not accurately predict the simulated therapeutic outcomes of DBS. However, the micro-electrode recordings could provide both electrophysiological status and location information of the DBS electrode, which is worth its inclusion in the simulation model.

Methods: Clinical data of 31 patients treated with DBS for Parkinson's disease, with 107 post-DBS programming visits, were used to create a therapeutic prediction model. Based on the patient-specific clinical data, which included trajectory length within the subthalamic nucleus from micro-electrode recordings and total electric energy delivered by DBS, therapeutic outcomes were predicted using a step-wise multiple linear regression model.

Results: Post-operative outcomes were significantly correlated (P < 0.05) to the following parameters: measures of disease duration, age, pre-operative on-state duration, pre-operative non-dyskinesia duration, mini-metal state examination, visit time until surgery, trajectory length within subthalamic nucleus and total electric energy delivered. Using these results, the prediction model was able to predict 43.3% of the variance in motor score (UPDRS III) improvement ($R^2 = 0.433$, P < 0.01). Pre-operative response to levodopa and the reduction of levodopa equivalent dosage was not correlated to the motor score improvement.

Conclusions: Our findings provide an insight into the relationship between the therapeutic outcomes and a number of factors such as micro-electrode recordings, patient-specific clinical data and post-operative DBS settings. This multi-variate model represents a novel tool for predicting the therapeutic outcomes and may aid research into the mechanisms of DBS therapy.

P206: Cognitive symptoms in a rat model of Parkinson's Disease

Authors:

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Keywords: 6-hydroxydopamine, attention, impulsivity

Abstract:

Objective: We here investigated the effect of bilateral 6-hydroxydopamine (6-OHDA) lesions, a rat model for Parkinson's disease (PD), on impulsivity and attention in an auditory oddball paradigm. In PD, the progressive loss of dopamine (DA) neurons in the substantia nigra leads to disturbed motor function, but cognitive disturbances, including attentional deficits and impulsivity, are increasingly recognized as disabling factors. Rats with 6-OHDA induced nigrostriatal lesions of dopamine neurons show significant motor impairment reminiscent of PD, and recent studies also indicate cognitive impairment in this model.

Methods: Rats were trained in a 3-class auditory oddball paradigm, where they had to nose poke a hole after an infrequent correct tone, which was rewarded by a pellet, but to ignore a frequent standard tone and infrequent distractor tone. After reaching a criterion of 90% correct hits, retrograde degeneration of DA neurons in the substantia nigra were induced by bilateral striatal injection of 6-OHDA (10 μ g in 1 μ l PBS; n=12), sham-lesioned rats (controls; n=8) received vehicle. Four weeks after surgery the rats were re-tested in the oddball paradigm.

Results: After 6-OHDA lesions, rats show deteriorated attention, as indicated by a significant decrease in the hit rate to the correct tone. Additionally, the number of impulsive nose pokes was reduced compared to controls, which would indicate less impulsive behavior.

Conclusion: We conclude that rats with bilateral 6-OHDA lesions may be used to investigate the biological basis of attentional deficits in PD, and to develop and test new therapeutic strategies for these symptoms ranging from pharmacological treatment to neurosurgical intervention.

P207: Reward processing modulates subthalamic beta band activity in patients with Parkinson's disease

Authors:

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Keywords: Parkinson's disease

Abstract:

Tonic dopamine levels modulate the power of beta oscillations in the subthalamic nucleus. The physiological role of this relationship, however, remains unclear. Phasic changes in dopamine may be caused by rewards. Here, we investigated whether beta activity might therefore be related to reward processing. We recorded local field potentials (LFPs) from the subthalamic nuclei of 19 patients with Parkinson's disease who performed a computer-based reinforcement-learning task. Afterwards, we correlated the magnitudes of patients' obtained rewards with task-related power changes in their LFP oscillations. During reward presentation, beta activity was positively correlated with reward magnitudes. During responding, moreover, alpha and low beta activities were negatively correlated with previous reward magnitudes, while the likelihood of repeating the previous response correlated positively. Our results thereby suggest a role of beta activity in the processing of rewards, while alpha and low beta activity might be involved in reward-based response adaptation.

P208: Predicting psychiatric symptoms after subthalamic deep brain stimulation for Parkinson's disease

Authors:

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Keywords: Parkinson's disease, deep brain stimulation, subthalamic nucleus, complications, impulsivity

Abstract:

Introduction: A proportion of patients undertaking subthalamic (STN) deep brain stimulation (DBS) for Parkinson's disease (PD) develop postoperative psychiatric symptoms including mood and personality changes. For these individuals, quality of life after DBS may worsen rather than improve. We do not have a reliable method for predicting 'at risk' candidates. These symptoms may arise de novo even in individuals without clear pre-surgical neuropsychiatric co-morbidity.

Methods: We followed 65 PD patients and their spouses in a prospective, longitudinal study, from pre-DBS to 6-months post-STN-DBS. Patients were phenotyped extensively using a range of neuropsychological instruments and rating scales designed to capture neuropsychiatric co-morbidity, with a focus on impulsivity and empathy. The spouse also provided information on the patient's psychiatric symptom profile and the level of carer burden. These measures were repeated iteratively in the follow up period. All patients were reviewed by a neuropsychiatrist with specialist experience in DBS for movement disorders. We collected data on the position of the active electrode contact in relation to the dorsolateral and ventromedial border of the STN and we modelled the relation of the stimulation field to the limbic, associative and motor territories of the STN. We collected high resolution diffusion imaging on 35 patients and reconstructed key white matter tracts that may be modulated by STN DBS, including the hyperdirect pathway. We also modelled the connectivities of simulated stimulation fields in in each patient.

Results: We analysed the phenotypic data to identify predictors of post-DBS psychiatric change, utilising a Bayesian classifier, lasso and ridge regression and a random forest approach. We used the Calinski-Harabasz index to indentify the optimal number of phenotypic clusters, based on the trajectory of symptom change. We used a support vector machine to classify patients into 'cases' and 'non-cases' based on the position of their electrode contact and the relation of the stimulation field to the sub-territories of the STN. In the diffusion analysis, we used probabilistic tractography to compare streamline counts between key STN-frontal zones amongst cases and non-cases.

Conclusions: We present a comprehensive data set that may assist with the identification of surgical candidates at higher risk of post-DBS psychiatric symptoms. This information could be used to guide preventative care.



P209: Directional deep brain stimulation guided by local field potentials in Parkinson Desease

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Abstract:

Objective: Implementation of the new directional stimulation technique of subthalamic nucleus with segmented leads guided by local field potential recordings in order to personalize DBS parameters, optimize therapeutic window and minimizing side effects.

Methods: Since March 2016 to January 2017, 8 patients have been implanted with 15 directional Vercise Cartesia leads (Boston SC). Mean age of patients were 57 years (38-70 years). Postoperatively CT scan and skull x-rays were performed to asses lead placement. Local field potentials of all contacts from each lead in bipolar montage were recorded 5 days after surgery to analyze beta band peaks and its correlation to therapeutic window effect for rigidity.

Results: No postoperative complications after directional leads implantation have been observed in any patient. After analyzing data from local field potentials, contacts with higher beta peak amplitude have been selected to start stimulation parameters of the subthalamic nucleus with good clinical response, obtaining after 3 months on chronic stimulation, 75.5% improvement in UPDRS-III score and 85.5% reduction of dopaminergic medication. Directional deep brain stimulation guided by local field potentials in Parkinson Desease increased stimulation thresholds for side effects as compared to spherical stimulation. Statistically significant correlation (r= -0.31) between beta band peak amplitude and final score for rigidity was found.

Conclusion: Deep brain stimulation of subthalamic nucleus with directional leads is safe and efficient. Local field potentials and beta oscillations could optimize settings parameters and alleviating programming burden as it seems to predict the optimal directional contact for improving rigidity and other motor symptoms. In advance, these neurophysiological parameters may be taken into consideration to personalize directional stimulation and can be time saving tools for programming.

P210: A novel animal model of Parkinson's disease using optogenetics: representation of various disease stages by modulating the illumination parameter

Authors:

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Keywords: animal model, halorhodopsin, optogenetics, Parkinson's disease

Abstract:

The present study aimed to investigate whether a model expressing halorhodopsin (NpHR) in dopaminergic cells of substantia nigra (SN) can induce appropriate Parkinson's disease (PD) characteristics and whether motor symptom severity depends on the optical stimulation condition. To develop optogenetic PD models, 15 rats received hSynapsin1-NpHR-YFP adeno-associated virus injections targeted at the right SN, and then subjected to light illumination at 590 nm wavelengths for 16 h with 3 illumination conditions of 5 Hz-10 ms (n = 5), 5 Hz-100 ms (n = 5), and 50 Hz-10 ms (n = 5). To establish conventional models, 5 received 6-hydroxydopamine injections into the right medial forebrain bundle (complete model) and 6 received injections into the right striatum (partial model). The optogenetic models showed characteristic PD manifestations similar to those of the conventional models; the severity of forelimb akinesia correlated with the total illumination value (frequency x width). The group with a low illumination values (5 Hz-10 ms) was comparable to the conventional partial model. Immunofluorescent staining assays showed a decrease in tyrosine hydroxylase-positive dopaminergic neurons of SN in all optogenetic models.

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P211: Quantitative localization and 3D shape approximation of the Subthalamic Nucleus in Deep Brain Stimulation for Parkinson Disease

Authors:

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Keywords: Deep Brain Stimulation, Parkinson Disease, Subthalamic Nucleus

Abstract:

Background: Subthalamic nucleus (STN) stimulation is an effective therapy for alleviating Parkinson's symptoms, such as tremor, rigidity and bradykinesia. Extracellular recording using microelectrode is routine for the identification of STN and accurate implantation of deep brain stimulation leads, but it is mostly qualitative. It has been shown that power spectral density (PSD) of the recorded data can be used to accurately and quantitatively identify the STN.

Methods: We recorded human subthalamic nucleus activity during stereotactic surgery using a tungsten microelectrode (FHC, Inc). We inserted 3 parallel microelectrodes for extracellular recordings in 20 patients with Parkinson disease. Recorded data were filtered using a 500 to 3000 Hz band-pass filter, sampled at a rate of 24 kHz, converted to digital using a Leadpoint system (Medtronic, Inc) and stored in a computer for offline analysis. The PSD was calculated over the 10 second recorded data in each depth by using Welch's method. We compared PSD at high frequency band (500 to 3000 Hz) in each of the recording depth in order to identify boarders and length of the STN. Then we fitted the best ellipsoid-shape to the 3 entrance and 3 exit points. Ellipsoid was modeled as a quadratic equation by using the least squares approach.

Results: The high frequency band (500 to 3000 Hz) PSD increased significantly as the electrode entered the STN and remained significantly above the level of the thalamus and decreased as the electrode was exited from the STN. We approximated the 3-Dimension STN shape and orientation as an ellipsoid with respect to the 3 entrance and 3 exit points of the electrodes.

Conclusion: PSD estimation method can identify the boarders and length of the STN in a quantitative and objective manner. Its accuracy seems to be comparable to visual inspection of the recorded signals by an expert. Intraoperative 3D shape approximation of the STN may help the physician in better placement of the DBS lead.

P212: Deep Brain stimulation in bed nucleus of stria terminalis and medial forebrain bundle in two patients with generalized anxiety disorder

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Keywords: deep brain stimulation, depression, generalised anxiety disorder, medial forebrain bundle, bed nucleus of stria terminalis

Abstract:

Background: Deep brain stimulation (DBS) is under investigation for major depressive disorder (MDD). Here we present two patients with severe generalized anxiety disorder treated with DBS in the medial forebrain bundle (MFB) and in the bed nucleus of stria terminalis (BNST).

Case presentation: Patient 1: 57-year old male with a childhood onset of anxiety and MDD onset at the age of 43. When evaluated before surgery at baseline the patient scored 44 points on Montgomery-Asberg depresson scale (MADRS) and 40 on Hamilton anxiety scale (HAM-A). Patient 2: 52-year old male with onset of MDD and anxiety at the age of 20. At baseline the patient scored 49 points on MADRS and 40 on HAM-A.

In both cases there was a history of generalized anxiety inbetween the episodes of MDD. They had tried psychotherapy, several different pharmacological treatments and ECT. After screening and informed consent, they were included in an ongoing study of DBS for MDD.

Methods: In both patients two DBS electrodes were bilaterally implanted in the MFB and in the BNST. The stimulation was started directly after surgery and the patients were randomized to either MFB or BNST DBS for three months, followed by a cross over with three months of stimulation in the other target. The patients and evaluators were blinded as to the target for stimulation.

Results: Patient 1: Bipolar stimulation in BNST was titrated and at 3 months evaluation MADRS was reduced to 10 points and HAM-A 14. BNST stimulation was then cessated and MFB stimulation activated. After 3 months of MFB stimulation MADRS had increased to to 32 points and HAM-A 28. No adverse effects were seen in either.

Patient 2: Bipolar stimulation in MFB was initiated and at 3 month evaluation MADRS was at 44 and HAM-A 30. MFB stimulation was then cessated and BNST stimulation activated. After 3 months of BNST stimulation MADRS was 24 points and HAM-A 35. Transient visual side effects were noted during MFB stimulation and fatigue following BNST stimulation.

Conclusion: MDD patients with comorbidities such as an anxiety disorders are more likely to develop chronicity and experience a higher relapse rates. Several different brain targets are under evaluation for MDD. In this case report two patients with similar clinical picture and pre-operative symptoms responded differently to MFB and BNST stimulation. When sample sizes permit, studies on DBS for MDD might identify subgroups of patients who may respond differentially to DBS and different targets.

P213: Differences between DBS of the nucleus accumbens and the internal capsule in patients with OCD

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Keywords: obsessive-compulsive disorder, deep brain stimulation, nucleus accumbens, internal capsule

Abstract:

Objective: Several targets have been implicated in the study of the effects of deep brain stimulation (DBS) in patients with obsessive-compulsive disorder (OCD). The most common targeted areas are the nucleus accumbens (NAcc), the internal capsule (IC), the ventral capsule/ventral striatum, and the subthalamic nucleus. To these days, there is still an ongoing debate about the best target for DBS in OCD patients. Some of these structures cannot be considered as completely distinct targets since the NAcc is located immediately underneath the anterior limb of the IC and extends dorsolaterally into the ventral putamen and dorsomedially into the ventral caudate nucleus. Therefore, the differences between contact positions can decide the postoperative effect of DBS. Our objective was to study the correlation between location of active contacts within the NAcc and the IC and the clinical postoperative outcome in OCD patients.

Methods: Thirty-one OCD patients underwent implantation of either unilateral (N=3) or bilateral (N=28) electrodes for NAcc DBS. The Yale-Brown Obsessive Compulsive Scale (Y-BOCS) scale was applied pre and postoperatively at different time points to measure OCD symptoms. Location of the active contacts within the NAcc or the IC was determined preoperatively with MRI scans and postoperatively with CT scans.

Results: Stimulation parameters for the amplitude ranged between 2.5 and 6.5V (mean 3.7V), for the pulse-width from 90 to 150 μ s (mean 101 μ s), and for the frequency from 130 to 145Hz (mean 136Hz). Postoperative follow-up ranged from 9 to 51 months (mean 17 months). Y-BOCS scores from patients with active contacts in the NAcc decreased on average a 43% (p<0.05), while scores of patients with active contacts in the IC decreased a 30% (p<0.05). Interestingly, scores from patients with active contacts located in the transition zone between the NAcc and the IC (maximum distance of 1,5 mm in both directions) decreased a 54% (p<0.01).

Conclusion: DBS of the transition zone between the NAcc and the IC showed the best clinical outcome compared to stimulation of active electrodes located more than 1,5 mm of the transition zone in both the NAcc or the IC. Further studies are required to determine if multiple regions of this network are activated after stimulating this area.

P214: Benefits of microvascular decompression on social anxiety disorder and health-related quality of life in patients with hemifacial spasm

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Keywords: Health-related quality of life, Hemifacial spasm, Microvascular decompression, Social anxiety disorder.

Abstract:

Background: Hemifacial spasm (HFS), an involuntary movement disorder characterized by unilateral spasms of the muscles innervated by the facial nerve, is likely to cause social anxiety disorder due to its significant facial disfigurement and may have a significant influence on a patient's health-related quality of life (HRQoL). The goal of this study was to investigate the influence of microvascular decompression (MVD) on the severity of social anxiety symptoms and HRQoL in patients with HFS.

Methods: Patients who underwent MVD from January to May 2015 were included in this study. Demographic data were collected before surgery. Clinical data, including the standardized measures of anxiety and depression (Hospital Anxiety Depression Scale, HADS), social anxiety (Liebowitz Social Anxiety Scale, LSAS), and the severity of HFS were assessed before surgery, 6 months after surgery. HRQoL data were collected before surgery and 6 months after surgery using the Korean version of the short form 36 (SF-36).

Results: Six patients (21.4%) scored 60 or greater on the preoperative LSAS and were considered to have generalized social anxiety disorder (high-LSAS group). The duration of symptom was significantly higher in the high-LSAS group than in the low-LSAS group (7.8 \pm 2.2 vs. 4.1 \pm 2.6; p = 0.011). The high-LSAS group was more likely to have psychological comorbidities and had a more impaired quality of life than the low-LSAS group at preoperative evaluation. Six months after MVD, a significant improvement, compared to preoperative scores, was observed for the total LSAS score (*p*=0.007) and anxiety subscale score of HADS (*p*=0.012) in the high-LSAS group. Other significant improvements were also observed in role-emotional (*p*=0.039) and mental component summary (*p*=0.024) of the SF-36 in the high-LSAS group compared to the low-LSAS group.

Conclusion: This study shows that HFS patients seem to gain benefits from MVD not only for their facial disfigurement but also for social anxiety symptoms that may be associated with mental health improvements in their quality of life.

P215: DBS and lesional surgery for psychiatric disorders

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Keywords: DBS, Lesional Surgery, OCD, Depression, Autism, Tourette Syndrome.

Abstract:

Introduction: Neurosurgery for psychiatric patients had gathered interest in 1950s following advent of stereotaxy. However injudicious use and availability of new drugs restricted its application to a few indications practiced essentially at select centers. Following availability of DBS and its applications for treating OCD and depression there has been resurgence in the interest of offering these surgeries to the difficult to treat patients of psychiatric disorders. We report our experience in eleven patients of varied psychiatric disorders treated with DBS and lesioning procedures.

Methods: The psychiatric surgery program at Jaslok Hospital and Research Centre (JHRC) was setup in accordance to the guidelines of Indian psychosurgery group (2009) and guidelines for neurosurgery for psychiatric disorders (2012), by previous approval of the ethics and scientific committee of JHRC.

From 2009 to 2017, eleven cases were operated which included eight males and three females. This includes four patients of Obsessive Compulsive Disorder, four with major depression, two patients of Tourette syndrome and one having autism with OC behaviour. Four patients were offered lesional surgery and 7 were offered Deep Brain Stimulation.

Results: Comprehensive preoperative evaluation was carried out by psychiatrist using various scales including YBOCS, MADRS, HAM-D, HAM-A, YGTSC, YBOCS, PUTS, Video Based Tic Score as applicable for the underlying psychiatric disorder. Mean age of patients at the time of surgery was 34 years. The Postoperative follow-up ranged between 1-84 months. Significant improvement was observed in the Mean values of assessment scales after surgery. The surgical targets included area CG25 for three cases of depression, DBS of NAC for four OCD, bed nucleus of stria terminalis for one OCD DBS, NAC for autism and GPI for TS.

Conclusion: This is the first case series of lesional surgery and DBS both offered by a single surgeon (PKD) in one centre. The varied disorders treated underscore the importance of developing similar programmes at more centres.

P216: Early clinical results of deep brain stimulation on anteromedial globus pallidus for medically refractory Tourette syndrome

Authors:

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Keywords: Tourette syndrome, deep brain stimulation, globus pallidus, tic

Abstract:

Objective: Tourette syndrome (TS) is a chronic complex neuropsychiatric disorder characterized by tics which results psychosocial impairments to the patients. Neurosurgical treatments including lesioning or deep brain stimulation (DBS) have been tried to medically intractable cases and their outcomes were variable because of unproven mechanism and diverse treatment strategies. In this study, the authors investigated the use of DBS on anteromedial globus pallidus interna (GPi) for patients with treatment refractory TS, with discussion about efforts to achieve optimal outcomes.

Methods: The authors performed bilateral DBS of anteromedial GPi in four patients (1 male and 3 females with mean age of 20 years old) with severe TS from July 2016 to March 2017. Clinical outcomes were evaluated with Yale Global Tic Severity Scale (YGTSS) and Yale-Brown Obsessive-Compulsive Scale (Y-BOCS). Perioperative complication was also assessed during follow up period.

Results: Score of YGTSS was decreased right after starting electrical stimulation, reporting 23.5% for motor tic, 13.8% for vocal tic, and 19.7% for total tic score. Although 2 of 4 patients showed temporary worsened symptoms due to specific stressful events during follow up, 3 patients with preoperative obsessive compulsive symptoms showed significantly improvement up to 51.6% of YBOCS score. Only one patient complaint of dizziness and gait disturbance which were related stimulation parameter and were relived after stimulation adjustment.

Conclusion: The authors demonstrated that DBS on Gpi target could be effective to improve tic and comorbidities of TS in early stage. Although long-term follow up is necessary for more obvious assessment, DBS can be a promising treatment option for intractable patients. In addition, positive results of DBS treatment can be reached when patients undergo their managements via multidisciplinary approach, including psychological, neurological and social aspects.

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P217: Effects stimulation in the nucleus entopeduncularis on neuronal network activity after apomorphine-induced deficient sensorimotor gating in a rat model

Authors:

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Keywords: Nucleus accumbens, Deep brain stimulation, single neuronal activity and oscillatory activity

Abstract:

Introduction: Deficient sensorimotor gating induced by dopamine receptor agonists is used as an endophenotype for certain neuropsychiatric disorders, such as Tourette's syndrome. Deep brain stimulation (DBS) of the globus pallidus internus (GPi) is experimentally used to alleviate tics in Tourette's syndrome. One operational measure of sensorimotor gating is prepulse inhibition (PPI) of the acoustic startle response (ASR). We recently showed that DBS of the rat nucleus entopeduncularis (EPN, the equivalent to the human GPi) alleviates an apomorphine induced PPI deficit. The aim of our study was to investigate the effects of stimulation in the EPN on single neuronal activity of the medial prefrontal cortex (mPFC) and the nucleus accumbens (NAC) and coherence of oscillatory activity with sensorimotor cortex.

Methods: Neuronal recordings were carried out in urethane anesthetized (1.4 g/kg, i.p.) male Sprague-Dawley rats. A concentric bipolar electrode for stimulation was stereotaxically implanted in the EPN. Single neuronal recordings were acquired from the mPFC and NAC before and after apomorphine injection (1mg/kg BW). Thereafter, 60 sec EPN stimulation (130 Hz, 100 μ A current, with 120 μ s biphasic square wave pulses) was applied and the neuronal activity recorded.

Results: Neuronal firing rate was not affected by apomorphine injection in both regions, but enhanced after stimulation in the NAC. Measures of irregularity were enhanced after apomorphine injection in both regions. Stimulation normalized this measure in the NAC, but had no effect in the mPFC. Coherence of oscillatory theta (4-8 Hz) and alpha (8-12 Hz) band activity between the mPFC and NAC local field potentials and sensory motor cortical field potentials was enhanced after apomorphine injection. EPN stimulation reduced theta and alpha coherence in the NAC, while in the PFC only alpha activity was reduced.

Conclusion: These investigations shed new light on the effect of DBS on disturbed neuronal network activity in an animal model with sensorimotor gating deficit, which may be used to understand and improve this experimental therapy in neuropsychiatric disorders.

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P218: GKS for the multiple brain tumors and AVMs

Authors:

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2. Neurosurgery dept., Inje University Busan Paik Hospital, Busan, KOREA

Keywords: Gammaknife, multiple

Abstract:

Objective: The effectiveness of GammaKnife radiosurgery as primary treatment for small to medium sized brain tumors, AVM has been reported. But, the treatment of the multiple brain tumors and AVM, several times surgery is needed and we assessed the Gamma Knife Radiosurgery for multiple brain lesions.

Methods: Between October, 1994 and December 2014, 12 patients with multiple brain lesions were treated with Gamma Knife radiosurgery (GKS). 2 patients (16.7 %) had AVM, 2 patients (16.7 %) had germinomas, 6 patients (50.0%) had multiple meningiomas, 1 patients (8.4 %) had meningiomas and pituiatry adenoma, 1 patient (8.4 %) had meningioma and schwannoma. The mean radiosurgical tumor volume was 5.6 ml (range 0.5-36 ml). The mean dose delivered to the lesion center was 25.2 Gy (range 20-45) and to the margin was 14.1 Gy (10-22.5 Gy).

Results: All patients underwent serial MRI scanning with a mean duration of imaging follow-up 45 months (range 5-110). Among the 2 AVM patients, two lesions were treated with GammaKnife Surgery. In 1 patient the AVM was disappeared, 1 patient showed partial obliteration and retreated with Gamma Knife Surgery after 84 months.

Pre Gamma Knife surgery, 2 germinoma patients (44%) underwent biopsies. And they received treated with GammaKnife surgery and booster radiotherapy. Imaging in 2 patients (32.3 %) demonstrated complete response during mean 56.5 months (range 55-58 months).

Among the multiple meningioma patients, all 6 patients the tumor were stationary. Of 1 patient with meningioma and pituiatry tumor, initial she treated meningioma with GammaKnife surgery, but 4 years later, pituitary tumor was developed and retreated with GammaKnife surgery, which showed partial response through follow-up MRI image. In 1 pituiatry tumor and low cranial nerve schwannoma patient, partial response after GammaKnife surgery.

Conclusion: Gamma-Knife radiosurgery is safe and effective treatment of multiple brain tumors and AVMs. Especially in cases of multiple AVM or meningioma, pituiatry tumor, schwannomas, silmultaneously treatment showed better results than the surgery. GK provides one time treated an advantage for all multiple brain tumors or AVMs.

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P219: Gamma-Knife Radiosurgery for Vestibular Schwannoma

Authors:

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Keywords: Gamma-Knife Radiosurgery, Vestibular Schwannoma

Abstract:

Objective: The goals of radiosurgery include preservation of neurological function and prevention of tumor growth. We document the results of gamma-knife radio-surgery for vestibular schwannoma.

Methods: 215 patients underwent stereotactic radiosurgery for an vestibular schwannoma from October, 1994 to December, 2013. 162 of these patients were followed up for radiological and clinical evaluation. As pregamma-knife modality, surgical resection were done in 30 patients, and V-P shunt in 2 patients. Initial symptoms were headache (n=56), dizziness (n=39), tinnitus (n=42). While normal facial function(House-Brackmann grade 1) was present in 120 patients (74%), other patients showed grade 2 function in 19, grade 3 function in 16,and grade 4 function in 5. The Gardner/Robertson scale was used to code hearing function. Male to female ratio was 1 : 3. Mean tumor volume was 7.0 cm3. Mean dose delivered to the tumor margin was 14.3 Gy, and mean maximal dose was 27 Gy.

Results: Mean follow-up duration of 62 months. 87 showed decrease(53.3%) in size, 56 patients(34.6 %)stationary, 3(1.2%) initial decrease follow up increase, 5 (3%) initial increase follow up decrease, and 148 patients(91.3%) were well controlled. Two patients experienced transient facial neuropathy, one transient trigeminal neuropathy and two transient hearing deterioration. After gamma-kniferadiosurgery, ventriculoperitoneal shunt was done in 7 patients. In 16 intracanalicular tumors, 7 showed decrease(43.8 %) in size, 9 patients(56.3 %)stationary. 14 vestibular schwannomas with cyst, 8 showed decrease(57.1 %) in size, 2 patients stationary, 4(28.5 %) increased.Conclusions : Gamma-knife radiosurgery can be used to treat postoperative residual tumors as well as in patients with concomitant medical problems in patients with preserved hearing function. Gamma-knife radiosurgery is safe and effective method to treat small, medium sized(less than 3cm in extracanalicular diameter), intracanalicular vestibular schwannoma, associated with low rate of cranial neuropathy. In vestibular schwannomas with cyst, GammaKnife radiosurgery is effective except allmost cystic tumor.

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P220: Thalamic deep brain stimulation for midbrain Rubral tremor secondary to AVM of the midbrain

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Keywords: Thalamic deep brain stimulation, tremor

Abstract:

Objective: Tremor resulting from damage to midbrain structures is poorly understood and often difficult to treat. The authors report a case of AVM of the brainstem with resultant Rubral tremor which was successfully treated using a stimulating electrode placed in the contralateral ventralis intermedius nucleus (VIM) of the thalamus.

Clinical Presentation: A 60-year-old man presented with hemorrhagic lesion of the upper brainstem diagnosed. He received GammaKnife Surgery for AVM, but 5 years later, midbrain tremor was developed. The patient subsequently developed an incapacitating right -extremity tremor refractory to medical treatment.

Intervention: The patient underwent implantation of a deep brain stimulator in the VIM with symptomatic and functional improvement.

Conclusion: Deep brain stimulation is an effective and safe intervention for tremor of unusual etiology. Electrode placement should be based on an understanding of the structure-function relationships underlying the various and distinct types of tremor.

P221: Radiosurgery and Therapeutic Strategies for Ruptured Cerebral Arteriovenous Malformations (AVMs)

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1. Department of Neurosurgery, KonKuk University Medical Center, Seoul, KOREA

Keywords: Radiosurgery, AVMs

Abstract:

Introduction: Cerebral arteriovenous malformations (AVMs) are usually present with intracranial hemorrhage. The management of AVM is still under debate according to their possible complications. The reported cure rate of AVMs ranges from 53 to 86.6%. We present and discuss our radiosurgery experience with ruptured AVMs. Multi-modality managerial characteristics are included in this study.

Methods: We retrospectively reviewed 30 ruptured AVM patients with the mean follow-up duration of 3 and half years after radiosurgery. The included patients' median age was 38.4 year old. We analyzed AVM with the grade of Spetzler and Martin Scale. 57 neurosurgical procedures and 28 neuro-intervention of embolization (49.0%) reduced the volume of AVMs. 19 neurosurgical resections (25.0%) was achieved. We operated eight stereotactic LINAC radiosurgery (SRS). We will present two cases of AVM Gamma Knife Radiosurgery (GKS) among total 76 GKS procedure from Oct. 2005.

Results: Regular MRI – MRA and TFCA follow up defined complete nidus obliteration in 18 (60%) patients. AVMs locations were the cerebrum (19 patients), cerebellum (2 patients), or basal ganglia (3 patients) and cerebrum (6 patients). Complications occurred in two cases of cyst formation, two cases of re-bleeding and total five episodes of seizures among four patients after radiosurgery in this study. There were completely cured 22 AVM patients (73%) without mortality. 10 patients are under investigation with regular follow up.

Conclusions: Because of the low morbidity rate in association with multiple procedures, we may decrease the possibility of treatment failure by repeated radiosurgery. Radiosurgery could be one of the therapeutic choices for residual AVMs especially in complicated AVMs.

P222: Acute lower cranial nerve dysfunction and complication related factors of gamma knife radiosurgery for Jugular foramen schwannmas

Authors:

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Keywords: jugular foramen schwannoma, gamma knife radiosurgery, cranial nerve dysfunction, complication

Abstract:

Background: Jugular foramen schwannoma (JFS) is uncommon tumor and its surgical treatment is still challenging. Gamma knife radiosurgery (GKRS) for this kind of tumor has been getting considerable attention due to its good efficacy in tumor control and symptomatic improvement. In spite of popularity of GKRS for JFS, there have been few reports to demonstrate acute radiation effect on lower cranial nerve following GKRS. The purpose of this study is to review the clinical outcome and complication related to GKRS for JFS.

Methods: The authors retrospectively reviewed medical records of 35 patients (12 men and 23 women) with JFS who underwent GKRS from 2008 to 2016. All patients were treated with mean marginal dose of 13Gy (12-14Gy). The participants were divided into 2 groups according to lower cranial nerve dysfunction in early stage after GKRS. We analyzed demographic and radiologic factors related to complication following GKRS.

Results: 15 of 35 patients showed newly developed cranial dysfunction after GKRS. Four patients suffered from 7th and 8th cranial nerve dysfunction, and other 11 patients from lower cranial nerve. Among them, 3 patients demonstrated vocal cord palsy and swallowing difficulty in 3 weeks after GKRS. Tumor volume was the only related factor to develop lower cranial nerve dysfunction after GKS with statistical meaning (p=0.041). Their neurologic deficits recovered in several months of follow-up.

Discussion: The authors found that larger tumor volume could cause acute radiation effect on cranial nerve after GKRS for JFS. Although GKRS has been known for acceptable tumor control and complication risk in treatment of JF schwannoma, further research are required to settle treatment indication and prognostic factors such as tumor size, cranial nerve function, or location.
P223: Initial experience of frameless stereotactic radiosurgery with Gamma Knife

Authors:

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Keywords: radiosurgery, gamma knife, fractionation

Abstract:

Gamma knife is the most popular system used for stereotactic radiosurgery of the brain lesions. Traditionally it has been mandatory to maintain fixation of stereotactic frame through the procedure. The Gamma Knife Icon (Elekta AB, Stockholm, Sweden) allows frameless stereotactic treatment using a combination of cone beam computer tomography (CBCT), a thermoplastic mask system, and an infrared-based high-definition motion management (HDMM) camera system for patient tracking during treatment. We report our expeience of frameless stereotactic radiosurgery with gamma knife in 189 cases. Single session radiosurgery was done in 85 cases and fractionated radiosurgery in 104 cases. Mean translation between initial stereotactic CBCT and CBCT before tretament was 0.84 mm. Mean beam -on time for single session treatment was 25.0 minutes. (6 - 49.5). Abortion threshold of intrafractional montion was set at 0.5 mm for benign tumor nad 1.0 mm for malignant tumors with mean intrafractional movement of 0.26 mm and 0.36 mm, each respectively. Mean number of pause was 0.27 per treatment. In 4 among 26 benign tumors and 5 among 49 malifgnnat tumors abortion threshold for intrafractional movement had to be raised due to too frequent interruption of treatment. Fractionated radisourgery was doen in 104 cases mostly with metastases. Mean translation in each treatment session was 1.22 mm. Abortion threshold for intrafractional movement was set at 1.0 mm for beign lesion and 1.5 mm for malignnat lesions with mean itrafractional movement of 0.29 and 0.40 mm each respectively. Mean number of pause was 0.18 per session and abortion threshold had to be raiesed in 9 cases. In 36 patients with brain metastases (mean tumor volume 22.5 cc, 0.9 - 69, mean marginal dose of 7 Gy in 4 fraction) and available follow up iamges local tumor control rate was 81 %. With thermoplastic mask, cone beam CT and intrafractional motion monitoring, most of the cases can be treated with submilimeter range of accuracy. Adequate selection of cases with different fractionation scheme and level of accuracy may provide effective treatment with enhancing comfort of the patients.

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P224: A comparison of Inverse and Forward planning in Gamma Knife radiosurgery

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Keywords: Perfexion, Inverse Planning (IP), Forward Planning (FP), Selectivity, Gradient Index.

Abstract:

Background: Gamma Knife radiosurgery (GKRS) is being recognized as an alternative of neurosurgery to usually treat the lesions in the deep-seated position. GKRS is based on the results of the treatment planning system, Leksell Gamma Plan (LGP). Treatment planning using LGP in GKRS is usually performed through the Forward Planning(FP) approach by the experienced planner. Inverse Planning (IP) function loaded on LGP to optimize the performance of the latest Gamma Knife model, Perfexion, provides the short planning time and the appropriate treatment time. The purpose of this study is a evaluation of effectiveness for inverse treatment planning in LGP.

Methods: In the study 10 patients with intracranial lesion treated by Gamma Knife radiosurgery were included. We compared the data from forward treatment planning and inverse treatment planning in terms of Coverage, Selectivity, Paddick's Conformity index, Gradient index, and Beam-on times. All data were analyzed by Paired t-test, which is statistical method used to compare two different measurement techniques.

Results: No statistical significance in Selectivity, Paddick's Conformity index, Gradient index at 10 cases was observed between FP and IP. But statistical significance in Coverage, Beam-on times at 10 cases was observed between FP and IP. Differences in Coverage ranged from –0.02 to 0.22. We found out the statistical difference with p= 0.011, p=0.002 between FP and IP for Coverage, Beam-on times. On average the function of Inverse Planning improved the plan quality for the parameters like Selectivity, Paddick's Conformity index and prominently reduced Beam-on times as compared to the Forward Planning.

Conclusion: Based on the results, the inverse treatment planning of Leksell GammaPlan provides a excellent planning performance for single lesions as well as multiple lesions but might be worse if critical structure is nearby. Thus we find IP is very effective in most respects through the evaluation of several parameters, Coverage, Selectivity, Paddick's Conformity index, Gradient index, and Beam-on times. For GKRS to need short planning time, treatment time, and patient's comport, first of all we think we must make better use of IP and verify the treatment plan completed through IP using the parameters of verification.

P225: Treatment Effect of Gamma Knife Radiosurgery for Germinomas in Pineal Gland

Authors:

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Keywords: Pineal, germinomas, Gamma Knife radiosurgery

Abstract:

Objective: Germinomas in pineal gland is uncommon, so radiation therapy is generally accepted of primary treatment of choice, but there is controversy of optimal treatment strategy for pineal germinomas. We assessed treatment effect of Gamma Knife Radiosurgery (GKS) for germinomas in pineal region.

Methods: Between October, 1994 and December 2013, 18 patients with pineal germinomas were treated with GKS. 13 cases were treated with combined GKS and booster whole brain radiotherapy (70 Gy), while 5 cases were treated using GKS only. The mean radiosurgical tumor volume was 4.6 ml (range 0.5-36 ml). The mean dose delivered to the tumor center was 25.6 Gy (range 20-45) and to the tumor margin was 14.6 Gy (10-22.5 Gy).

Results: All patients underwent serial MRI scanning and mean duration of imaging follow-up was 40.6 months (range 23-148). Among 18 patients, 14 patients underwent shunts or external ventricular drainages (EVD) and biopsies were performed in all patients. Follow-up MR images were revealed complete response in 8 patients and partial response in 5 patients, while in 5 patients, it initially showed a partial response followed by no response after 8.3 months. Clinical outcome was showed better their symptoms in 13 patients and stable in 5 patients.

Conclusion: GKS is safe and effective treatment of pineal germinomas, and treatment combining radiosurgery with booster radiotherapy showed better results than the radiosurgery only treatment.

P226: Gamma Knife Radiosurgery after Stereotactic Cyst Aspiration on the Same Day

Authors:

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Keywords: GKS, cyst aspiration, same day

Abstract:

Objective: Cystic tumors are not suitable for gamma knife radiosurgery (GKS) owing to the risks associated with acute radiation effect; moreover, fixation of the Leksell stereotactic frame may cause several complications. GKS that was performed after stereotactic cyst aspiration on the same day is fewer complications from stereotactic frame fixation and allows for GKS by decreasing the cystic tumor size in large cystic tumors.

Methods: From March 2012 to July 2014, 4 patients was performed GKS after stereotactic cyst aspiration in the Simultaneous Day. A Leksell stereotactic frame was applied and MRI was used to guide cyst aspiration. The cystic fluid was aspirated and if needed an Ommaya reservoir was implanted. MRI was repeated for GKS and treatment was delivered using the Leksell Gamma Knife Perfexion on the same day.

Results: 3 patients were metastatic tumors and one patient was craniopharyngioma. 3patients were implanted Ommaya reservoir. Mean tumor volume before aspiration was 22.3cc and Mean tumor volume after aspiration was 9.7cc. Mean marginal dose was 12.25 Gy(10-15 Gy). All patients improved clinical symptoms associated with mass effect immediately after aspiration. Solid portion of tumor was decreased in 3 patients. No patient suffered from procedure related complications.

Conculsion: GKS after stereotactic cyst aspiration on the same day can be considered a safe and effective treatment option in patients with cystic tumors.

P227: Stereotactic Radiosurgery for Metastatic Brain Tumors from Squamous Cell Lung Cancer

Authors:

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Keywords: Gamma knife radiosurgery, Lung cancer, Metastatic brain tumor, Squamous cell lung carcinoma, Stereotactic radiosurgery

Abstract:

Objective: We investigated the outcome of the stereotactic radiosurgery (SRS) for brain metastases from squamous cell lung cancer (SQLC).

Methods: During the last 10 years, eighty-three patients with brain metastasis from pathologically confirmed SQLC underwent SRS. Mean age was 64.3, and the number of male patients were 72, and female 11. The number of patients with single metastasis was 44 and multiple 39, Thirty patients showed synchronous brain metastasis, and 53 patients metachronous metastasis.

Gamma knife radiosurgery (GKRS) was performed for 211 tumors in the 83 patients. At GKRS, the mean tumor volume was 3.26 cc (range, 0.1-24.3) and the median dose of 20.0 Gy (range, 9-25) was prescribed at the tumor margin.

Results: During the follow up period, 51 patients (61.4%) with 102 tumors were followed up with MR images. Seventy-five tumors (73.5%) were controlled with meaningful progression-free survival (PFS) of 294 days. On Kaplan-Meyer method, the tumor control was superior in small tumor (<5cc) than large tumors (\geq 5cc) (p=0.0001), and the cutoff value of 10cc was also significant (p=0.01). The high prescription dose of \geq 20Gy and \geq 18Gy was related to tumor control, and the p value was 0.003 and 0.006, respectively. However, the time of the metastasis (p=0.397) were not significantly related to the tumor control after GKRS.

The local tumor progression of the tumors after GKRS resection was observed in 47 tumors of 25 patients. They were managed by 2nd GKRS (N=11), radiation therapy (RT) (N=3), and surgery (N=1). However, for the other 10 patients, only simple palliation was done considering the patients' low performance. New metastasis during follow-up was observed in 26 patients (50.9%). They underwent 2nd GKRS (N=11), RT (N=3), and simple palliation (N=12).

The mean and median overall survival (OS) after GKRS of all 83 patients was 282 and 154 days, respectively. On Kaplan-Meyer method, younger patients (age \leq 65) (213 ± 75 days) had longer median survival than that of older patients (age \geq 65) (135 ± 44 days) (P=0.155). The median survival of single metastasis patients (178 ± 58 days) had longer survival than that of multiple metastasis patients (97 ± 38 days) (P=0.272). The KPS at GKRS was not significantly related to the OS after GKRS (p=0.553). However, the existence of extracranial metastasis was significantly related to OS (p=0.027). The control state of the primary cancer at GKRS was related to OS (215 ± 91 vs.135 ± 55 days), but statistically not significant (p=0.063). The timing (synchronous or metachrnous) of the brain metastasis was not significantly related to OS, either (p=0.987). Interestingly, graded prognostic assessment (GPA) score (3 or more vs. less than 3) was significantly related to the survival (p=0.019), but RPA was not significant (p=0.166) in this investigation.

Conclusion: SRS could be one of the treatment options for the brain metastasis from SQLC.

P228: Gamma knife radiosurgery for non-vestibular cranial nerve schwannomas

Authors:

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Keywords: Gamma knife, stereotactic radiosurgery, non-vestibular schwannoma

Abstract:

Introduction: Non-vestibular cranial nerve schwannomas represent a rare type of benign intracranial tumor. Few studies have evaluated the use of Gamma Knife stereotactic radiosurgery (SRS) as a primary treatment for these lesions. We report here a large series of patients with SRS-treated non-vestibular schwannomas with a focus on safety and efficacy.

Methods: We performed a retrospective study of patients who underwent SRS at our center for any type of non-vestibular schwannoma and for whom at least 6 months of radiological follow-up was available. The data collected included patient characteristics, clinical symptoms at time of treatment, treatment details, radiological response and clinical evolution and survival.

Results: Data was gathered for a total of 35 schwannomas amongst 34 patients treated between 2004 and 2016 with a median follow-up of 48 months. Median age at time of treatment was 51. Three patients had neurofibromatosis type 2. Schwannoma location was trigeminal in 57.2%, facial in 20%, jugular foramen in 14.3%, abducens in 5.7% and trochlear in 2.9% of patients. The median margin dose used was 13 Gy (range, 12-15 Gy), and median treatment volume was 2.1 cc (range, 0.1-8.5 cc). Crude local control was of 100% for trochlear, abducens and jugular foramen schwannomas, and of 95% and 85.7% for trigeminal and facial nerve schwannomas, with one failure amongst 20 and 7 cases respectively. At the last follow-up, clinical symptoms had resolved in 31.4% of patients, improved in 5.7%, remained stable in 40% and worsened in 20%.

Conclusions: SRS is a good modality for the treatment of non-vestibular cranial nerve schwannomas, with good efficacy and low morbidity. When compared to the published literature, tumor control rates appear similar to seen with vestibular schwannomas and the safety profile is satisfactory.

P229: Stereotactic radiosurgery alone for patients with 5 or more brain metastases

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Keywords: Stereotactic radiosurgery, gamma knife, multiple brain metastases

Abstract:

Background: The use of upfront stereotactic radiosurgery (SRS) as the sole treatment for patients with more than five brain metastasis (BM) is still a matter of debate. However, this approach seems to gain momentum. In this study we report our results using SRS alone in patients with \geq 5 BM as the initial treatment.

Methods: 103 patients underwent SRS between 2005 - 2016 for the treatment of \geq 5 BM at our institution. 30% were male, 70% were female and the median age at SRS was 58. Histology of the primary tumor was NSCLC in 57% of patients, breast cancer in 28%, melanoma in 12% and colorectal in 3%. All patients were divided by their KPS and by the RPA classification;12% were class 1, 82% class 2 and 6% class 3. Fifty-five (53%) patients had previous irradiation for 1-4 BM. The mean number of treated BM was 7 (5 – 19) and the mean cumulative BM volume treated was 3.6 cc (0.06 – 27.7). We performed subgroups analyses based on these characteristics. Extracranial disease status prior to SRS was classified as stable in 28% versus progressive in 72%.

Results: Median follow-up after SRS was months 5.1 months (0- 57). Local control, based on RANO criteria, was achieved in 75% of patients. Median overall survival (OS) was 6 months after SRS. 72% developed new distant metastases. Multivariate analyses revealed that cumulative volume of treated BM (p=0.0128), stable extracranial disease status (p=0.00195) and RPA (p=0.0221) were independent prognostic factors for OS. Specifically, patients with a cumulative volume of treated BM £ 6 cc (OR: 2.54, p=0.006, IC95: 1.3 – 4.99) had better prognosis. The total number of BM had no impact on survival (p= 0.206). No factor was found to be predictor for local recurrence. RPA was also significant (p=0.0265) in terms of distant recurrence in multivariate analyses.

Conclusion: This study suggests that SRS is a reasonable option for the management of patients with \geq 5 brain metastases, especially when the cumulative treatment volume is £ 6 cc, as it was associated with favorable OS and local control.

P230: Methods of stereotactic ablation of tumors located in eloquent areas of the brain

Authors:

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Keywords: Stereotaxis, neuronavigation, cryosurgery, radiofrequency thermoablation, transcranial focused ultrasound, glioma, PET, MRI

Abstract:

Brain tumors localized in difficult-to-access and eloquent areas, may be safely destroyed with a stereotactic method. The safety of such operations is provided by minimally invasive nature of stereotaxis, and also by performing trial intraoperative impacts under the neurological control. In the 70–80 of the last century, E.Kandel in Moscow Institute of neurology performed the stereotactic destruction of intracerebral tumors by means of the cryosurgery. There are also modern reports of stereotactic radiofrequency thermoablation of tumors and stereotactic high temperature laser destruction under MRI control. Radiosurgical techniques exist but in the cases of tumors of eloquent areas, their using is problematic, as there is no possibility of trial impacts, which increases the risk of long term neurological deterioration. In recent years, there have been reports about the possibility of using transcranial focused ultrasound for the safe aiming ablation of tumors.

Since 1999, at the Military Medical Academy and the N.P.Bechtereva Institute of human brain (Saint Petersburg), we perform multi-positional stereotactic cryodestruction of gliomas located in deep and eloquent areas when open removal is contraindicated. To date 172 patients with the tumors of the Central gyri region, thalamus, insula, basal ganglia and other deep locations are operated on. Cryoablation is performed using a specially designed cryosurgical device using temperature of solid carbon dioxide. MRI and PET with methionine are used for intratumoral targeting. Guidance the cryoprobe to the target points is performed using stereotactic frames or frameless neuronavigation. The technique allows to precisely destroy tumors or their proliferative active zones with total volume to 30 cm³.

Analysis of operated cases shows good results for increasing survival, and relatively low risk of neurological worsening in the postoperative period. However, there is an increased risk of postoperative intracerebral hemorrhages in patients previously treated with radiation therapy. In this regard, in this group of patients, we use stereotactic radiofrequency thermoablation. It is also possible to perform the trial impact by means of electrical stimulation and reversible heating of tissue. Postoperative hemorrhages in our cases are not marked. Thus, the stereotactic cryosurgery and radiofrequency thermoablation allow to broaden possibilities of surgical treatment of tumors localized in deep and eloquent areas of brain.



P231: Nuances of Gamma Knife Radiosurgery for Upper Cervical Spine Lesions with Leksell Frame Fixation at Maxilla

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Keywords: Radiosurgery, Maxilla, Leksell, Cervical Spine

Abstract:

Background: Traditional restriction of foramen magnum as the lower limit for target location for GKRS makes treatment of upper cervical spinal lesions formidable. Leksell frame fixation above supraorbital margins helps in achieving targets up to axis vertebra level (Figure). To target lesions in upper cervical spine with ensured immobility remains a challenging task. We describe our experience of treating lesions located in or extending into upper cervical spine while ensuring immobilisation and the precision of treatment.

Methods: We treated three cases of upper cervical spinal lesions (2 intradural extramedullary tumors and one skull base lesion). To minimize the movement at craniovertebral junction, Philadelphia collar was placed and frame was docked on it. The constant relative head neck position was maintained by keeping glabellar-floor and sternal-floor distance constant. Patient positioning system (PPS) and docking gamma angle were maintained at same values throughout the procedure.

Results: All patients tolerated the procedure well. There was no complication at one-year follow up interval. One patient showed >50% tumour size reduction at one-year follow up.

Conclusion: We tried to push the limits of stereotactic frame by fixing it on maxilla while maintaining immobilization by using strict protocol. Zygomatic process of maxilla might be considered a potential alternate site for frame fixation to target lesions upto C3 vertebra. The well-established dose algorithm for Cyberknife/LINAC system helps in validation of safe dose range for spinal lesions. This proof of concept model also facilitates treatment of lesions in patients with bony defects of previous surgeries (e.g. bifrontal decompressive craniectomy etc.).

Legend to figure:

Lesksell frame fixation at maxilla (actual patient and diagrammatic representation)



P232: Radiosurgical decompression for benign perioptic tumors causing compressive cranial neuropathies: a feasible alternative to microsurgery?

Authors:

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Keywords: radiosurgery, fractionation, perioptic tumors, microsurgery

Abstract:

Several studies have reported the efficacy and safety of hypofractionated stereotactic radiosurgery (hSRS) in the treatment of benign perioptic tumors. This study went further and evaluated the feasibility of hSRS in the treatment of those causing compressive cranial neuropathies (CCNs) among perioptic tumors with special consideration of functional improvement. Twenty-six patients with CCNs (CN II = 19; CN III/IV/VI = 9; CN V = 3) caused by perioptic tumors underwent hSRS between 2011 and 2015. hSRS was delivered in five fractions with a median marginal dose of 27.8 Gy (\approx 14 Gy in a single fraction, assuming an α/β of three) to a tumor volume of 8.2 ± 8.3 cm3. All tumors except one shrank after treatment, with a mean volume decrease of 35 % (range 4–84 %) during the mean follow-up period of 20 months. In 19 patients (38 eyes) with compressive optic neuropathy, vision improved in 55.3 % of eyes (n = 21), was unchanged in 36.8 % (n = 14), and worsened in 7.9 % (n = 3) (2.6 % after excluding two eyes deteriorated due to transient tumor swelling). A higher conformity index (p = 0.034) and volume of the optic apparatus receiving >23.0 Gy (p = 0.019) were associated with greater tumor shrinkage. A greater decrease in tumor volume (p = 0.035) was associated with a better improvement in vision. Ophthalmoplegia and facial hypesthesia improved in six of nine (66.7 %) and three of three (100 %) patients, respectively. There was no newly developed neurological deficit. Decompressive SRS for benign perioptic tumors causing CCN is feasible using hypofractionation, representing a useful alternative to microsurgical resection.

P233: Efficacy of CyberKnife RadioSurgery with Proximal Target of Root Entry Zone for Trigeminal Neuralgia

Authors:

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Keywords: Cyberknife, Radiosurgery, Trigeminal neuralgia

Abstract:

Objective: In this study, we retrospectively analyzed the outcome of patients with intractable Trigeminal Neuralgia(TN) to evaluate whether CyberKnife RadioSurgery (CKRS) with Proximal Target of Root Entry Zone and CT cisternography planning is an effective and safe mode of therapy.

Methods: 51 patients with TN were treated by CKRS since March 2004. 10 patients were male and 41 were female falling between 28 and 86 years old (Mean age 65.32 years). CT cisternography should be performed. Firstly, Isovist of 5cc should be injected into a thecal sac. The whole head should be scanned at intervals of 1.25mm by CT in order that the anatomical shape of basal cistern can be well shown. The target was usually defined as a 3- to 5-mm segment of the trigeminal nerve localized in the cisternal portion, 3mm anterior to the dorsal root entry zone. Patients were treated in a uniformed fashion according to treatment planning that was established to the end that radiation targets could be included in the 80-percent isodose curve with 60-64Gy radiosurgery doses.

Results: The results of pain relief in 51 patients with TN after CKRS with proximal target of REZ and CT cisternography planning showed that pain relief was achieved in 28 patients within the first 24 hrs after treatment. Within 7 days, 45 of the 51 study patients reported early pain relief. The overall pain control rate was 71% (36/51) for follow-up period (12-40 months, mean: 18 months). But two patients had a painful dysesthesia without lancinating pain and three patients had recurred pain but pain was free with medication.

Conclusion: We believe that CKRS is safe and effective treatment for the patients with TN in this study. The pains of most patients were alleviated within 7 days after the CKRS with proximal target of REZ on trigeminal nerve and CT cisternography planning.

P234: Radiosurgery with linear acelerator for vestibular schwannomas: A peruvian experience (2007-2015)

Authors:

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Keywords: Radiosurgery, LINAC, vestibular schwannomas

Abstract:

Introduction: Radiosurgery is a therapeutic alternative in the management of neurosurgical pathologies such as brain tumors and vascular malformations of difficult surgical approach and usually small. By irradiating specific lesions accurately we can increase the dose of radiation with low risk of injury to neighboring areas. The biological response may occur up to three years after treatment.

Methods: We collected clinical information of patients with vestibular schwannomas who were treated with linear accelerator (LINAC) radiosurgery at the Institute of Oncology and Radiotherapy of Ricardo Palma Clinic (Lima – Perú) during the period November 2007 - September 2015. Epidemiological data were analyzed, treatment dose, number of isocenters and clinical evolution.

Results: Of a total of 308 patients with brain tumors treated with radiosurgery with linear accelerator (LINAC), 85 patients had vestibular schwannomas, aged 27 and 58 years. 51 patients were initially treated surgically and were then treated with radiosurgery. All patients were treated with 1 isocenter except 3 who received two isocenters. The average number of arcs in the treatment was 7. The average total dose was 13 Grays. The short-term clinical outcome was favorable. 86% of patients had a favorable outcome with remarkable decrease in tumor size.

Conclusions: The clinical and radiological outcome of patients with vestibular schwannoma treated with linear accelerator (LINAC) radiosurgery is being favorable. The biological response was adequate in most cases, demonstrating that this therapeutic alternative is a safe, very low morbidity and offers optimal results in patients with vestibular schwannomas.

P235: Intrathecal baclofen pump implantation for hypothalamic-midbrain dysregulation syndrome

Authors:

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Keywords: Intrathecal pump implantation, baclofen, central fever, spasticity, hypothalamic midbrain dysregulation syndrome

Abstract:

Objective: The hypothalamus is the coordinating center for temperature regulation in the human brain. It is activated by thermal receptor in the skin and by direct stimulation by blood perfusing the area. Body temperature regulation disturbances have been associated with diencephalic and hypothalamic syndromes secondary to brain trauma, tumor, ischemia, infection, congenital malformations, and degenerative diseases. "Central fever" following brain injury is a diagnosis of exclusion, entertained only when all other possibilities, infectious and non-infectious, have been ruled out. The following cases of fever associated with dystonic posturing and sustained muscle contraction in the patients with brain injury were subsided the symptoms after intrathecal baclofen pump insertion in our institute. These cases illustrate the importance of evaluating muscle activity as a source of fever after central nerve system injury.

Case description: 1. A patient of 18 years old was diagnosed to diffuse axonal injury after motor cycle accident. He presented stuporous mentality and quadriparesis of grade II. At 2 weeks after accident, the patient was suffered from spasticity and sustained fever more over 38°C. There was no infectious sign. Although the patient was received continuous injections of antibiotics and antipyretics, the patient's condition showed no further improvement. At last, the patient underwent trial test of intrathecal baclofen injection. Then, the patient was freed from spasticity with fever. The patient underwent surgery for intrathecal baclofen pump insertion. The patient gets on well without symptoms.

2. A 61-year-old man, diagnosed with pontine hemorrhage in January 2016. He showed stuporous mentality and quadriparesis of grade II. The patient received conservative management involving rehabilitation. At 6 months after occurrence of hemorrhage, the patient presented intermittent severe spasticity and accompanying fever. The patients showed no infectious sign too. The patient received EEG monitoring because the form of spasticity of the patient seem like tonic seizure movement. However, the EEG did not reveal specific finding. The patient underwent trial test of intrathecal baclofen injection. Then, the symptoms disappeared. The patient received the implantation of intrathecal baclofen pump. The symptoms do not appear until now.

Conclusion: Fever was occurred by various reasons such as infection, hypothalamic injury, and seizure in the patients with brain injury. However, the fever was not controlled well and the patient present spastic movement simultaneously. At such times, it is suspicious of symptom that was derived from hypothalamic-midbrain dysregulation syndrome. In that case, intrathecal baclofen injection can be effective.

P236: Spinal cord compression from hypertrophic epidural scar tissue formation around SCS leads: rare but serious event

Authors:

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Keywords: hypertrophic scar, spinal compression, leads

Abstract:

Neurological complications of SCS are exceptionally observed and result generally from intraoperative root or spinal cord injury or from compression by spinal infection or epidural hematoma. In some patients long-term SCS can result in the development of epidural mass lesion with loss of stimulation efficacy and myelopathy This rare complication may occur in majority of cases using paddle lead placed via open surgical approach and but it was reported also using percutaneous wire lead. Due to the diagnostic difficulties it is possible that it is diagnosed with delay or remains underestimated and unreported.

We review the long-term complications of 439 definitive implants of SCS systems using 373 percutaneous wire leads (50/13.4% cervical and 323/86.6% thoracic) and 66 surgical paddle leads (12/18.2% cervical and 54/81.8% thoracic): in our series we found only two cases of symptomatic spinal cord compression due to epidural scar tissue formation at the site of implanted lead, one with paddle lead implanted surgically at cervical level and one with wire lead implanted percutaneously at thoracic level. In both cases leads were removed and thick scar tissue overlying the dura was dethaced by means of laminectomy with use of microscopic dissection technique. After surgery patients experienced progressive but incomplete improvement of neurological signs without the develop of new deficits. To put this complication into an appropriate context we performed a review of the pertinent literature and we discuss the pathogenetic hypothesis.

In conclusion formation of hypertrophic epidural scar tissue at the level of implanted lead must be considered in presence of onset of progressive myelopathy with loss of stimulation efficacy. Resolution of CT imaging and artifacts generated by lead make difficult to detect the mass lesion around lead and its true extension. Despite severity of spinal cord compression the rapid removal of lead and scar tissue may allow satisfactory functional recovery.

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P237: Spinal cord stimulation for two patients with critical ischemia of upper limb

Authors:

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1. Department of Neurosurgery, Henri Mondor Hospital, Paris, FRANCE

Keywords: spinal cord stimulation, critical upper limb ischemia, pain reduction, trophic disorders

Abstract:

Objective: To report the cases of two patients with upper limb ischemia treated with thrombectomy, complicated with trophic limb disorders and severe neuropathic pain resistant to medical treatments, which were successfully treated with spinal cord stimulation. A significant improvement of pain and a regression of trophic disorders were noticed.

Case 1: A 40-year-old woman with multiple cardiovascular risk factors was treated for a critical ischemia of the right arm by humeral thrombectomy and placement of a stent. Two weeks later, she developed an intense neuropathic pain and an early necrosis of one side of her arm. A cervical spinal cord stimulation was proposed to this patient, and it was significantly improved her symptoms.

Case 2: A 37-year-old woman was treated for an obliteration of the left radial artery causing acute ischemia of the left arm, complicated with unbearable pain in her limb, which did not respond to any medical treatment. This patient benefited of spinal cord stimulation and that is significantly reducing her access to medications. She is very satisfied with the result in her 2 years follow-up.

P238: Evaluation of selective peripheral neurotomies in the treatment of refractory lower limb spasticity in adults

Authors:

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Keywords: Selective peripheral neurotomies, spasticity, neuroablative surgeries, functional neurosurgery.

Abstract:

Background: "Selective peripheral neurotomies" (SPNs) of tibial, obturator, sciatic and/or femoral nerves were indicated for the treatment of focal and multifocal spasticity of lower limbs in adults.

Objective: To evaluate the surgical results of selective peripheral neurotomies of tibial, obturator, sciatic and/or femoral nerves in 20 adult patients who had refractory focal & multifocal spasticity of the lower limbs, follow up period of one year.

Methods: Prospective study included 20 adult patients who had refractory focal and multifocal spasticity of the lower limbs due to cerebral or spinal upper motor neuron lesion. Preoperative evaluation for muscle tone using Modified Ashworth Score (MAS), muscle power using Medical Research Council Scale (MRCS), functional assessment using Oswestry Functional Scale (OFS) and Range Of Motion (ROM) using manual goniometry was done for all patients. All cases underwent surgery in the form of SPNs of tibial, obturator, sciatic and/or femoral nerves depending on the pattern and distribution of spasticity. Follow up of the patients was done at 10th day, 3, 6 months and one year postoperatively.

Results: The mean age of patients was 31.35 ± 12.42 years. The distribution of spastic lower limbs were paraparesis in 55% of patients, hemiparesis in 35% and quadriparesis in 10%. There were statistically significant improvement of muscle tone, muscle power, functional assessment and range of motion between preoperative and one year follow up postoperative. improvement of the muscle tone was from a preoperative Mean \pm SD of 3.60 ± 0.68 on MAS to a postoperative 2.30 ± 0.86 at one year, improvement of muscle power on MRCS was from preoperative Mean \pm SD 3.75 ± 1.08 to postoperative 4.08 ± 0.69 at one year, There was a functional improvement from a preoperative Mean \pm SD of 3.0 ± 0.73 on OFS to 3.60 ± 0.60 at one year postoperatively, also, there was a significant improvement between preoperative ROM Mean \pm SD 61.25 ± 15.29 and one year postoperatively 72.25 ± 12.19 .

Conclusion: Selective peripheral neurotomies could effectively improve muscle tone, muscle power, functional performance, range of motion and ease of care in patients with refractory focal and multifocal spasticity in the lower limbs.

P239: Simultaneous biplanar fluoroscopy facilitates percutaneous lead implantation for spinal cord stimulation

Authors:

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Keywords: Spinal Cord Stimulation, Electrode Placement, Fluoroscopy, Chronic Pain, Retrospective Study, Operative Time, Radiation Exposure

Abstract:

Introduction: Fluoroscopy allows real-time intraoperative assessment of electrode position during percutaneous lead implantation for spinal cord stimulation (SCS). However, the C-arm may need to be repositioned several times during each surgery to facilitate imaging in different planes and this may increase operative time. This study aimed to assess the efficacy and safety of a biplanar configuration using two C-arms to facilitate percutaneous SCS lead implantation.

Methods: This single-centre, retrospective, IRB-authorised study evaluated patients who underwent percutaneous implantation of an SCS lead at a tertiary-level neurosurgical department during the period 2006-11. Relevant demographic and procedural data were extracted from electronic patient records and the hospital's surgical scheduling database. Operative time time (i.e., time from knife-to-skin until skin closure) was recorded, along with the duration of the patient and C-arm positioning phase in the operating room (OR). Total radiation exposure time per case was also recorded.

Results: 94 individuals underwent percutaneous implantation of an SCS lead (72 thoracolumbar, 22 cervical) during the study period. In 73/94 cases a biplanar C-arm configuration was used; 21/94 cases were performed using a single C-arm. In the both the cervical and thoracolumbar implantation groups, use of a biplanar configuration significantly reduced the mean length of surgery, by 28.6 minutes (p=0.017) and 13.5 minutes (p=0.016) respectively. The duration of the preoperative patient and C-arm positioning phase was, however, lengthened by the use of two C-arms. There was no significant difference in the total duration in the OR or in the total radiation exposure time between groups.

Conclusion: This comparative study demonstrates that the use of a biplanar fluoroscopic configuration for SCS test lead implantation led to a significantly reduced operative time in comparison with a configuration using a single C-arm. The reduced surgical time has the potential to enhance the intraoperative compliance of patients suffering from chronic pain who are undergoing SCS lead implantation in local anaesthesia and may help to reduce surgical site infection rates by shortening procedure time. Importantly, the biplanar setup did not increase total radiation exposure or reduce electrode placement accuracy. Further high quality studies are needed to confirm these findings.

P240: The Relief of Pain in Post Spinal Surgery Syndrome after Spinal Cord and L2 Sympathetic Ganglion Stimulation

Authors:

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Keywords: PSSS, SCS, Sympathetic ganglion

Abstract:

Objective: To demonstrate the effect of spinal cord stimulation (SCS) and L2 sympathetic ganglion stimulation for relief of pain caused by post-spinal surgery syndrome (PSSS)

Methods: 12 patients with PSSS were treated by SCS and L2 sympathetic ganglion stimulation since January 2010. These patients complained lumbago and segmental pain around leg with vague, burning and sharp characteristics unresponsive to medication with opioid. Diagnostic block with Epidural and L2 sympathetic ganglion block was performed. Inclusion criteria of SCS and L2 sympathetic ganglion stimulation was to relieve pain more than 50 percentage over seven days after diagnostic block. Pain intensity was measured using a visual analogue score (VAS) and daily morphine consumption was measured at baseline and follow up visits after SCS and L2 sympathetic ganglion stimulation.

Results: In all patients, pain relief (VAS 4.79 ± 1.63 (mean \pm SD)) had been achieved after SCS and L2 sympathetic ganglion stimulation and lasted for 12 months (4.71 ± 0.83 after 1 month: 4.50 ± 0.88 after 2 months: 4.29 ± 0.83 after 6 months: 5.21 ± 1.63 after 12 months). Daily morphine consumption was reduced to a maximum by 67.34% after SCS and L2 sympathetic ganglion stimulation compared to the baseline. Complications during SCS and L2 sympathetic ganglion stimulation did not occur in this study.

Conclusion: SCS and L2 sympathetic ganglion stimulation is an effective and safe technique for relief of PSSS with segmental pain.

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P241: Clinical outcome in 34 chronic refractory pain patients with spinal cord stimulation (SCS), in one stage surgery: positive awake testing + implantation

Authors:

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Keywords: spinal cord stimulation (SCS) Chronic Refractory Pain (CRP) Awake surgery

Abstract:

Background: Different Spinal Cord Stimulation (SCS) techniques for the management of chronic refractory spinal pain have been described. Some techniques with the electrode externalized to test for days or weeks before the definitive implantation, and others with intraopeative mapping to define in one stage surgery the definitive implantation of the electrode and battery.

Objective: To report the clinical 1-43 months follow-up in 34 patients who underwent SCS with awake procedures testing with the definitive (5-6-5) electrode, the anatomical distribution of the pain and final implantation of the electrode and battery in one stage surgery.

Methods: 35 patients with chronic refractory pain were evaluated by a multidisciplinary group, with an exhaustive psycological,full family and social support network evaluation.Surgery with minimal laminectomy was performed. Local anesthesia and sedation for approaching in most of the cases and with a complete awake stage in all of them for mapping. Closure under sedation again. Parameters ranged: 60-80Hz, 240-400sec, and 0.5 y 4 volts. Quality of life and pain were measured with EQ-5D-5L and visual analogue scale (VAS).

Results: Mean age: 40 years, 80% were male, most common diagnoses were complex regional pain and failed back surgery syndrome. We found a proper anatomical correlation with the pain distribution area the day of surgery in comparision with usual distribution of the pain in dayli life. As a result, the improvement of the pain was achieved with dedicated adjustments of stimulation parameters. Patients reported a mean improvement of 60% in their pain after the implantation of the SCS and the average improvement of EQ 5D 5L at 1-43 months post-op was 8 points. Minor complications:One patient underwent reimplantation of the electrode in order to optimize the pain coverage area distribution and two patients had foreing body granuloma having to remove one of them.

Conclusion: The SCS in one stage surgery with awake patients is safe, with manageable complications and is correlating in our cases with usual and individual distribution of the pain allowing improvement in visual analogue scale and quality of life scores. Only one case of the 34 required electrode relocation to cover the area of pain and this also improved after it. Extended follow up and more cases are necessary to adopt one stage surgery in SCS as the mainstay.

P242: Brain pseudotumor in Neurobehcet disease: a case report and review of literature

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Keywords: Neurobehcet disease, Brain pseudotumor.

Abstract:

We present the case of a 30 years old man, Cape Verdean, admitted for a rapid onset of left sided weakness. A MRI was performed and showed a tumoral lesion regarding the brainstem and the right middle cerebellar peduncle. A stereotactic biopsy was performed. The morphologic result was aspecific and molecular analysis (IDH1 mutation) was negative for glial tumor. One month later, the patient presented to the emergency for gait disturbance. A new MRI showed a bilateral extension of the lesion in the rhombencephalon, the diencephalon and the basal ganglia with aspecific hyperintense T2 spots in the supratentorial subcortical white matter. The anamnesis revealed recurrent bipolar ulcerations since adulthood and acne on both arms in the childhood without ocular mannifestation (uveitis). The patient therefore fullfiled the ICBD 2006 (International Criteria for Behcet's Disease) criteria. He beneficited from corticotherapy and IV Endoxan with good clinical response. Behcet disease is a multisystemic inflammatory disease with typical recurrent bipolar ulceration (bucal and genital). The diagnostic is based on anamnesis and clinical findings. According to literature, neurological extension of the disease affects 1 to 50 percent of the patient suffuring from this systemic vasculitis. However, the onset of neurological manifestation ususally occurs 2 to 4 years after diagnosis. A pseudotumoral form of Neurobehcet with brutal onset is uncommon. From 1987 to 2016, to our knowledge, only 29 cases have been described. According to those cases, it tends to be more frequent among young men. The lesion is preferentially located in the brainstem, the basal ganglia and the thalami explaining the wide range of symptoms and the the delay diagnostic. MRI is the gold standard examination but remains aspecific for that type of pseudo-tumoral brain lesion. The main differential diagnoses are glial lesion, lymphoma, infectious disease and granulomatous disease. We emphasize on the importance of the anamnesis for young patients with atypical brain lesions and discuss the indication of stereotactic biopsy to rule out neoplasic disease.

P243: Aseptic or aborted meningitis by stereoelectroencephalografy (SEEG) that presents as paralysis of the third cranial nerve contralateral to the implantation

Authors:

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Keywords: Stereoelectroencephalografy, SEEG, meningitis

Abstract:

Objectives: Stereoelectroencephalografy (SEEG) is an effective technique to help to define the epileptogenic area and its relationships with functional cortical areas in patients with refractory epilepsy. But it is an invasive and non-risk-free technique.

Methods: We describe a patient who was submitted to SEEG for refractory epilepsy and presented a meningitis without proven causative germ as a complication. We review the bibliography.

Results: It is a 17-rear-old patient with focal refractory epilepsy of probable left frontotemporoinsular origin. He required a prolonged recording of 16 days due to the absence of spontaneous seizures in the first postoperative days and including a reimplantation of 3 electrodes [for better localization at a posterior opercular temporal level (Wernicke)].

After removing the electrodes the patient presented dysphasia and right mydriasis and ophtalmoplegia. Brain MRI showed meningeal enhancement after contrast administration at the level of the temporal implantation area and at the right tentorial cleft.

The patient remained afebrile and did not present a significant alteration of the acute phase reactants in blood. The biochemistry of CSF by lumbar puncture at 12h after initiation of antibiotic tratment showed moderate inflammation (40 leukocytes, 30 red blood cells, 300 proteins and 58 of glucose) ant its culture was negative, being compatible with aseptic or aborted meningitis. Given the initial suspicion of possible infection, antibiotic therapy was administered according to usual guidelines and intravenous corticosteroids with good clinical and radiological response.

Aseptic meningitis is described with subdural grids, but in deep electrodes it is exceptional. The incidence of infection is 0.3-3.8%. The latter being the second most frequent complication after bleeding.

Conclusions: Meningitis is a rare complication, but it must be considered in the case of a focal neurological deficit in a patient submitted to SEEG once a haemorrhagic complication has been ruled out.

P244: Implantation of deep brain electrodes assisted by the Neuromate® (Renishaw®) robot for stereoelectroencephalography (SEEG). Initial experience in a paediatric hospital

Authors:

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Keywords: Stereolectroencephalografy, SEEG, epilepsy surgery, robot, Neuromate, Renishaw

Abstract:

Objectives: Stereoelectroencephalography (SEEG) is an effective tool to locate and delimit the epileptogenic area and/or define relationships with functional cortical areas when this is not possible by non-invasive techniques. In our paediatric hospital we have begun to implant the deep electrodes for SEEG assisted by the robot Neuromate® (Renishaw®). We intend to verify the accuracy, safety and effectiveness of this technique in our environment.

Methods: We prospectively collect the indication, precision calculated by fusion of postoperative CT with preoperative planning, complications, location of ictal onset in SEEG and hypothesis of epileptogenic area, indication of resective surgery and evolution of epilepsy (according to Engel's classification).

Results: Six patients between the ages of 5 and 19 years with pharmacoresistant epilepsy of probable right frontotemporoinsular origin, right premotor, left motor (foot), left frontotemporo-insular, right posterior quadrant and right postcentral have been operated. There were implanted between 9 and 15 electrodes per patient with a total of 69 electrodes. The mean accuracy was 1.38 mm at the entry point and 1.45 mm at the target. One patient suffered meningitis without a demonstrated germ. In 5 cases the SEEG showed the ictal onset and was congruent with the preimplantation hypothesis and/or lesion. In 2 patients surgery was rejected, in one by overlapping the ictal onset with the primary motor and sensory area and in other by multiple ictal initiations. Two patients underwent resective surgery without complications and are seizure free at 3 and 4 months after the operation. The remaining 2 patients are waiting for the operation.

Conclusions: Stereoelectroencephalography (SEEG) is an effective and safe invasive technique to locate and delimit the epileptogenic area and/or define relationships with functional cortical areas and the Neuromate® robot is an accurate tool for the insertion of the deep electrodes that it requires.

P245: Preoperative radiological findings predicting the possible failure of stereotactic biopsy

Authors:

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Keywords: Brain tumor, Computerized Tomography, Failure, Magnetic Resonance Image, Stereotactic biopsy

Abstract:

Objectives: We experienced 258 cases of stereotactic biopsy during the last 12 years with Leksell stereotactic system. Among them, the procedure was failed in 4 cases (1.6%) despite no procedure-related errors. We reviewed the three patients' preoperative radiological findings at the stereotactic biopsy, and tried to find special features which might predict the failure of stereotactic biopsy.

Methods: We measured Hounsfieled (HF) scale on the pre-enhanced CT and the value of region of interest (ROI) on T2weighted magnetic resonance image (MRI). The objects were both the mass and the adjacent brain. At measuring, the HF scale and the value of ROI on T2-weighted MRI, the area of ROI was randomly selected from 25mm² to 1cm², and the measuring was repeated ten times at the randomized selected areas of the mass and the adjacent surrounding brain.

Results: The diameter of the tumor was relatively small and ranged from 10 to 25 mm. On the pre-operative CT, the ratio of HFS of the mass to the adjacent mass were 2.1 (25.3 to 12.2), 1.6 (39.3 to 24.3), 2.1 (38.1 to 17.8), and 1.9 (29.0 to 15.5). On the pre-operative T2-weighted MRI, the ratio of ROI value of the mass to the adjacent brain were 0.76 (683.9 to 891.5), 0.64 (582.9 to 915.8), and 0.66 (327.7 to 494.9), and 0.74 (718.8 to 976.4) The density of the mass was higher than the adjacent brain on the preoperative CT, and the peri-lesional edema was severe at the adjacent brain. Actually, the three patients underwent craniotomy for resection or open biopsy, and we identified the hardness of the three masses. The final diagnosis of three was tuberculoma, B-cell lymphoma, and metastatic carcinoma, respectively, but the other patient did not undergo further management.

Conclusion: The four masses indicated that the they were harder than the adjacent brain on the preoperative CT, and all showed severe peri-lesional edema on T2-weighted MRI. Finally, we identified hard masses during the consecutive craniotomy in three paients.

We suspected that the density difference between the two matrix (mass and adjacent edematous brain) might be the cause of the biopsy failure. The biopsy needle with round end might be able to penetrate the wall of the masses but move it slightly in the low density edematous brain.

P246: Frameless stereotactic-guided procedures in pediatric brain tumors

Authors:

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Keywords: Frameless stereotaxy, stereotactic biopsy, pediatric, brain tumors

Abstract:

Objective: Frameless stereotactic-guided biopsies play an important role in the diagnosis and management of pediatric brain tumors. In tumors located in deep or eloquent areas such as the brain stem and the thalami, those procedures become progressively beneficial for diagnosis and grading of the tumors together with detecting non-neoplastic pathologies.

Methods: Revision of the medical records of children presenting with brain tumors operated in Children's Cancer Hospital of Egypt (CCHE-57357). Cases operated utilizing frameless stereotactic-guided techniques are included. Data obtained include the indication of biopsy, the accuracy and diagnostic yield, location and size of the lesion, impact of the final diagnosis on the plan of management and complications.

Results: The diagnostic accuracy of biopsies was 95%. In 5% of cases biopsy was repeated to confirm pathology. The indication of biopsy was either due to deep or eloquent location of the lesion, tissue diagnosis to determine proper adjuvant therapy or in lesions suspected to be non-neoplastic or inflammatory. Location and size of the lesion have no correlation with the diagnostic yield or accuracy. Among cases with totally changed management plan are some cases of assumed high grade brainstem gliomas which proved to be tuberculoma, abscess or low grade gliomas. In 15% of the cases a totally different plan of management was proposed after biopsy. Complications included small post-operative hematoma and seizures.

Conclusion: Frameless stereotaxy has a crucial role in safe and reliable diagnosis and management of pediatric brain tumors. It may dictate different line of management than initially expected and can affect decision making especially in thalamic and brainstem lesions. Electromagnetic based neuronavigation is helpful in the very young children where rigid head fixation may not be feasible.

P247: Identification of Blood Vessels with Micro Duplex Ultrasound in Stereotactic Functional Neurosurgery

Authors:

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Keywords: Stereotaxy, Duplex Sonography, Safety

Abstract:

Introduction: In 1982 transcranial duplex ultrasound sonography got introduced to the medical community by Rune Aaslid. Soon transcranial duplex sonography became the bedside method in monitoring of patients with subarachnoidal hemorrhages and vasospasm. Small ultrasound probes with diameters around 2.5 mm were used around 1990 in stereotactic and vascular neurosurgery. We and few others are utilizing intraoperative duplex ultrasound sonography in stereotactic procedures like diagnostic biopsies. The smallest range in diameter of the probes up to the year 2000 varied from 1.3 mm up to 2.5 mm. Considering certain rules stereotactic surgery is very safe. One of these rules is: never penetrate the brain by a sharp edged instrument like an intravenous needle – it will cause bleeding. All tips of stereotactic instruments are rounded like "dolphin noses". Microrecording electrodes are able to carry a higher risk of bleeding because of its sharp (2-3 µm) tungsten electrode tip. Multichannel microrecording is able to increase the risk of intracerebral bleeding because of more brain penetrations per operation and because of the anatomy of the electrode.

Methods: We developed in 2000 the prototype of an intraoperative duplex ultrasound probe with a diameter less than 0.8 mm. The probe is fitting into the microelectrode guide tubes and is able to examine the trajectories of microrecording electrodes for blood vessels unseen in imaging bearing the risk of hemorrhage.

Results: In the last 12 years a single subcortical bleeding occurred in our patients. It occurred while inserting five microelectrode guide tubes transcortically by touching the subarachnoidal space in a sulcal depth. It was not causing a neurological deficit but it was visible in the routinely performed postoperative stereotactic control CT. We will demonstrate the instrument and its usage. The development and utilization of that instrument is supported by our surgical data.

Conclusion: In 30 years duplex ultrasound examinations has proven its value for stereotactic surgery.

P248: Intraoperative imaging: stereotactic orthogonal x ray radiography versus intraoperative computed tomography – MRI issues?

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Keywords: Stereotaxy, Functional Neurosurgery, Imaging, Intraoperative Computed Tomography, Stereotactic x ray Device, Intraoperative Imaging, Magnet Resonance Tomography

Abstract:

Introduction: Neurosurgery and especially stereotactic procedures are imaging dependent surgical disciplines. The brain and its function are not accessible by auscultation, percussion and palpation.

Methods: After Wilhelm Röngtens detection of the x-rays it was possible to implement anatomical drawings in form of atlases into the internal bony boundaries of a patient skulls dimension controlled by orthogonal x-ray radiography. Further information was gained by pneumencephalography, ventriculography and angiography. The mid seventies brought us computed tomography and the eighties magnet resonance tomography. Functional imaging by positron emission tomography and magnet resonance tomography payed tribute to the individual functional distribution. Diffusion tensor imaging added the tractography and completed imaging up to now so far. During end of the nineties ventriculography was replaced by mri measurements. Still many stereotaxy centers perform x-ray radiography before and after surgery in the operating room to prove surgery being performed as originally planned. The intraoperative x-ray radiography devices are out of production since mid ninetees and have to be custom made from replacement parts for each order or intraoperative installation. The price for a new device is more than 300 kilo €. The price is in the range of an intraoperative computed tomography devices with a larger gantry opening because of instalment for other indications like vascular and minimal invasive spinal surgery. We want to compare intraoperative x-ray radiography and minimal singery and computed tomography in its content on information for the surgeon and the patient. Further we will discuss issues with magnet resonance tomography.

Results: Intraoperative x-ray imaging delivers a quick and easy performed distribution of instruments, electrodes, catheters and implants in the three x-y-z planes in relation to a stereotactic frame affixed to a patient skull. Information on soft tissue and vascularisation of the brain are not accessible. Bleedings or haemorrhages are invisible and not direct detectable. Indirect signs for a haemorrhagia are distortion or displacement of the implant. Than it would be wise to perform a computed tomography to see what happened. Than you have to go back to the surgical theatre to react on what happened. All that can easily be avoided by bringing the computer tomography into the operation room and not buying an intraoperative stereotactic x-ray device. The content on information is far beyond stereotactic radiography. Patient safety can be improved and the examination is performed in less than 5 minutes proven by more than 1000 patients.

Discussion: Intraoperative computed tomography became the new standard in stereotactic imaging and in spine and vascular neurosurgery.

P249: Stereotactic intracranial biopsy: backward and forward correlations in the diagnosis accuracy of brain lesions

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Keywords: stereotactic biopsy, diagnostic accuracy, intracranial lesion

Abstract:

Background: Stereotactic (ST) biopsy has been used to establish histopathological diagnosis prior a specific treatment of brain lesions. The diagnostic accuracy of this method is an important issue and have major implications. In this work, we focus on identified some variables that affect the accuracy of the ST biopsy for diagnosis of intracranial lesions in our hospital.

Methods: A total of 135 cases undergoing CT-guided stereotactic biopsy in the General Hospital of Mexico were included in this study. Neuroradiological information, ST biopsy diagnosis, sampling features and final histological diagnosis of the lesion (resected specimens or autopsy) were retrospectively analyzed.

Results: The lesions were lobar in 52.6 % of cases and deep-seated in 47.4 %. The etiology was tumoral in 87.6 % of the cases and infectious in 12.4 %. After the procedure, 4.3 % of patients presented a transitory motor deficit and 6.5 % cases presented silent bleeding. There was no mortality after the ST biopsy. In 37 cases, the ST biopsy diagnosis was compared both to the presurgical radiological diagnosis and to histological diagnosis obtained from resected specimens or autopsy. Correlation between the presurgical MRI and histopathologic diagnosis following stereotactic biopsy matched in 75.6 % of the cases. The histological diagnoses of the ST biopsy and resected surgical material or autopsy were in complete agreement in 86.5 % of cases. A complete correlation between of imaging findings, ST biopsy, and resected surgical material or autopsy histology was found in a 70.2 % of the cases. The accuracy for ST biopsy was 91.8 % when the neuropathologist had available clinical and radiological data. Taking 5 or more biopsy bits, sampling at the periphery of the lesions and high-grade lesions were features that had a tendency to correlate with an accurate ST biopsy.

Conclusion: CT-guided stereotactic biopsy of intracranial lesions is a safe and efficacious technique. Sampling profile, type of the lesion, and careful interpretation of clinical/neuroradiological data are important factors that are correlated with diagnostic accuracy in stereotactic biopsies.

P250: Safety and diagnostic-yield of frame-based stereotactic biopsy

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Keywords: stereotactic biopsy, safety, diagnostic yield

Abstract:

Objective: To determine the diagnostic yield and safety of frame-based stereotactic biopsy.

Methods: Stereotactic biopsy was performed in 80 patients with supratentorial lesions treated in Regional Centre of Neurosurgery and Neurology from January, 2009 till January, 2017. 33 (41.3%) patients were male, and 47 (58.7%) – female. Mean age of the patients was 49.8 years. Indications for stereotactic biopsy were: deep location (basal ganglia, thalamus, internal capsule, corpus callosum), multiple lesions, eloquent cortical location or poor somatic condition of the patient. In all cases frame-based CT-navigated stereotactic biopsy was performed using ELEKTA FrameG. Computed tomography was performed on first postoperative day in all cases.

Results: Histologic results: glioblastoma – 33 patients (41.1%), anaplastic astrocytoma – 13 patients (16.3%), anaplastic oligodendroglioma – 6 patients (7.5%), oligodendroglioma – 5 patients (6.3%), diffuse astrocytoma – 5 patients (6.3%), primary CNS lymphoma – 5 patients (6.3%), metastasis – 5 patients (6.3%), inflammatory lesion – 3 patients (3.7%), demyelination – 2 patients (2.5%), radiation necrosis – 2 patients (2.5%), negative result – 1 patient (1.2%). None of the patients deteriorated neurologically. Hemorrhage in biopsy site was found in 3 patients (3.7%) on CT, but was asymptomatic in all cases. 1 patient (1.2%) had superficial wound infection. Diagnostic yield in our series was 98.8%, as we had negative result in only 1 patient.

Conclusion: Frame-based stereotactic biopsy can be considered a safe procedure with high diagnostic yield.

P251: Prediction of effective electrodes for deep brain stimulation in essential tremor

Authors:

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Keywords: Deep brain stimulation; model; simulation; prediction; essential tremor; probabilistic

Abstract:

Introduction: Deep Brain Stimulation (DBS) is an established neurosurgical treatment that can be used to alleviate symptoms in essential tremor (ET) and other movement disorders.

Objective: To develop a method and software tool for prediction of effective DBS electrodes based on probabilistic stimulation maps in patients with ET treated by DBS.

Methods: 34 patients (39 leads) treated with DBS in the caudal zona incerta were evaluated with the Essential Tremor Rating Scale (ETRS) at 12 months after surgery. In addition, hand tremor and hand function (ETRS items 5/6 & 11-14) were evaluated for every electrode contact during stimulation with best possible outcome without inducing side effects. Prediction of effective electrode contacts was carried out in a retrospective leave-one-out manner based on probabilistic stimulation maps (PSMs), simulated stimulation fields, and a scoring function. Electrode contacts were ranked according to their likelihood of being used in the clinical setting. Ranked electrodes contacts were compared to actual clinical settings.

Results: Predictions made by the software tool showed that electrodes with a rank of 1 matched the clinically used electrode contacts in 62% of the cases. Electrode contacts with a rank of 1-2, and 1-3 matched the clinical electrode contacts in 79% and 97% of the cases, respectively. Improvement of hand tremor and hand function was 79% (SD 21%) and 77% (SD 22%) for the clinically used and the predicted electrode contacts, respectively.

Conclusions: Effective electrode contacts can be predicted based on PSMs in patients treated with DBS for ET. Predictions may in the future be used to reduce the number of clinical assessments that are carried out before a satisfying stimulation setting is defined.

P252: Anatomical Localization of Brain Lesions: Single Centre Experience in Abuja, Nigeria

Authors:

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Keywords: Anatomical, Localization, Stereotaxis, Neuronavigation

Abstract:

Introduction: Despite longstanding application of stereotaxis in neurosurgery, the utilization of stereotactic principles is still at basic level in some countries. Neurosurgeons in these countries depend on external anatomical landmarks with neuroimaging for freehand targeting of intracranial lesions. In these areas intraoperative image-guided lesion localization and microsurgical operations remain the norm.

Objective: To enunciate brain lesions which were operated via microsurgery with the aid of preoperative neuroimaging-guided anatomic localization at National Hospital Abuja, Nigeria.

Methods: This is a case series of patients that underwent brain surgery using anatomic localization. Clinical details of the patients were retrieved from medical records. Preoperative planning included determination of lesion location using computer softwares. The images were used as guide to approach the lesions.

Cases: 1. A 22 year old female presented with headaches, poor vision, previous fever and sixth nerve palsy. Neuroimaging revealed left occipital ring enhancing lesion. She had preoperative localization and excision of abscess capsule.

2. A 37 year old female admitted with fever, loss of consciousness and immunodeficiency. Neuroimages revealed a deep seated left frontoparietal abscess with massive oedema and midline shift. Preoperative anatomic localization done, accurate placement of craniotomy and abscess excision was achieved.

3. A 6 year old male presented with progressive visual impairment and hydrocephalus. Had VP-shunt for obstructive hydrocephalus and subsequent open biopsy of pineal region tumour

4. A 6 year old girl with persistent fever, headache and altered consciousness. There is background history of congenital cardiac defect. Neuroimages revealed a ring enhancing right thalamic mass with obstructive hydrocephalus. She had an image guided craniotomy and ultrasound guided aspiration of a thalamic abscess with complete resolution of symptoms.

5. A 13 year old female with headaches and visual impairment. Brain imaging revealed a cystic suprasellar mass. She had image guided placement of Ommaya reservoir via Kocher's point.

Conclusion: Anatomical localization of brain lesions is a time-proven practice in neurosurgery. It has been yielding results but it is cumbersome and observer dependent. Alternative is neuronavigation which is more accurate in lesion location. However, wider coverage and long learning curve still remain a challenge in developing countries.

P253: Stereotactic laser ablation of symptomatic cavernous malformations: imaging and clinical outcomes

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Keywords: cavernous malformations, epilepsy, laser ablation

Abstract:

Introduction: MRI-guided laser interstitial thermal therapy (stereotactic laser ablation, SLA) is a novel, minimally invasive treatment of symptomatic cerebral cavernous malformations (CCMs). We describe clinical/imaging outcomes of the largest series of SLA for CCMs to date.

Methods: Twenty consecutive patients with presumed CCM and medically refractory epilepsy, intractable headaches, or aggressive natural history (bleeding, neurological deficit) underwent anatomic MRI. Epilepsy patients also underwent functional MRI, EEG, PET, and neuropsychometric testing. Patients underwent stereotactic twist-drill craniostomy and insertion of a saline-cooled laser fiber delivering 980-nm diode laser energy (Visualase, Medtronic); one large thalamic CCM underwent 3 distinct stereotactic trajectories entering the CCM at same point to minimize risk of hemorrhage. MRI provided accuracy confirmation and near-real-time thermography. Patients underwent clinical and imaging follow-up.

Results: CCM locations were temporal (11), frontal (4), parietal (2), thalamic (2), and pallidal (1). Complications occurred only in subcortical cases, and included transient scalp numbness (thalamus, n=1), transient hemiparesis associated with hemorrhage (pallidum, n=1), and worsening hemiparesis persistent at early follow-up (thalamus, n=1). Eleven of 12 epileptic patients with >1-year follow-up were seizure-free (92% Engel class 1 outcome) from ablation alone. All 6 remaining epilepsy patients with 1-year follow-up were improved. All ten CCMs with postoperative imaging >6 mo revealed clear involution.

Conclusion: Minimally invasive MR-guided ablation of symptomatic CCMs is an effective alternative to open resection. Neurological complications were location-dependent. Operative hemorrhage rate was 1/20 (5%) overall, and 0/17 for cortical cases. Additional experience and longer follow-up are needed.

P254: Stereotactic Catheter Ventriculocisternostomy for Clearance of Subarachnoid Hemorrhage: A Matched Cohort Study

Authors:

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Keywords: Subarachnoid hemorrhage, vasospasm, stereotactic ventriculostomy

Abstract:

Background and Purpose: Delayed cerebral infarction (DCI) is a major source of morbidity and mortality after aneurysmal subarachnoid hemorrhage (aSAH). We report a novel intervention – stereotactic catheter ventriculocisternostomy (STX-VCS) and fibrinolytic/spasmolytic lavage therapy - for DCI prevention. Outcomes of 20 consecutive patients are compared to 60 matched controls.

Methods: STX-VCS was performed in 20 high-risk aSAH patients admitted to our department between September 2015 and October 2016. DCI was assessed by CT or MRI≥21 days after aSAH. Neurological outcome was assessed by modified Rankin Scale rating at 3 months and dichotomized (favorable: 0-3 vs unfavorable: 4-6) for analyses. Three controls matched for age, sex, aneurysm treatment method and admission Hunt&Hess grade were assigned to each case treated by STX-VCS. The association between STX-VCS and DCI, in-hospital mortality and 3-months mRS was assessed by conditional logistic regression.

Results: Stereotactic procedures were performed without surgical complications. One adverse event due to cisternal lavage was without sequelae. DCI occurred in 30/60 (50%) controls and 3/20 (15%) STX-VCS patients (OR 0.14, 95% CI: 0.034 – 0.56). In-hospital mortality occurred in 18/60 (30%) controls and 1/20 (5%) STX-VCS patients, respectively (OR 0.11, 95% CI: 0.013 – 0.89). Favorable outcome at 3 months (mRS≤3) was observed in 17/20 STX-VCS patients (85%) vs. 28/60 (46%) matched controls (OR 0.14, 95% CI 0.036 – 0.57).

Conclusions: Stereotactic catheter access to the basal cisterns was feasible and safe. Initial results indicate that DCI and mortality can be reduced and neurological outcome may be improved with this method.

P255: Management of intraoperative bleeding during stereotactic biopsy: technical note

Authors:

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Keywords: stereotactic biopsy, intraoperative bleeding, electrocautery coagulation

Abstract:

Introduction / Objective: Stereotactic biopsy (SB), despite being a relatively safe procedure, is not exempt of complications. The most feared one is hemorrhage. The knowledge of the true frequency of this complication would require the realization of early postoperative neuroimaging evaluation in all patients submitted to SB. In two studies addressing this issue, the frequency of hemorrhage was determined, varying from 3.4% (excluding punctuate hemorrhage at the biopsy site) to 53.9%. Even more important is the hemorrhage detected intraoperatively unresponsive to simple maneuvers such as gentle irrigation of the biopsy cannula, elevation of the head, and induced hypotension. A wide review of the literature on this subject provided only three possible solutions for this hazardous complication: balloon inflation of the Fogarty catheter placed through the biopsy needle, for the control of intraoperative bleeding during SB.

Methods: A 77-years-old male patient presenting with a tumor located at the left temporo-insular region underwent SB. Intraoperatively, after collection of the second sample, significant bleeding through the biopsy needle (Sedan needle) was observed. After failure of simpler manipulations (irrigation through the biopsy needle, head elevation, anti-hipertensive drugs, and increased sedation with midazolam) to control the hemorrhage, electrocautery (intensity set at 20) was applied to the biopsy cannula for approximately 4.0 seconds, which was repeated 7 times, resulting in complete control of the bleeding.

Results: No adverse effects resulted from surgery. CT-scan, performed a few hours after the biopsy, revealed only a punctate hemorrhage at the biopsy site, and the MR, performed on the 20th postoperative day, showed a hiperintense signal along the needle track on T2-weighted coronal slices. The histopathological study demonstrated a grade III astrocitoma.

Conclusion: Electrocautery monopolar coagulation seems to be a simple, safe, cheap, and fast technique for the control of intraoperative bleeding during SB. Great care should be taken during biopsy planning so as to avoid transgression of eloquent areas and major projection fibers. Electrocautery coagulation of these structures could lead to unacceptable neurologic deficits. To the best of our knowledge, this technique has not been previously reported.

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P256: Stereotaxy in rats. Current state of the art

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Keywords: stereotaxy, rats

Abstract:

Introduction: Stereotaxy in laboratory animals was established more than a century ago and it is still frequently used as a technique to perform precise injections or implantations of brain implants. Although clinical stereotaxy is much younger, it has evolved rapidly from atlas-based targets and ventriculography-based references to current imaging-based techniques, while laboratory animal stereotaxy has remained largely unaltered.

With this literature review, we intend to map the current practice in rat stereotaxy in terms of (1) subjects; (2) targets aimed for; (3) stereotactic origin/reference chosen; (4) postoperative implant position verification; and (5) how subjects with off-target implants are analysed.

Methods: We conducted a literature search and selected 235 publications on rat stereotaxy from the last 5 years. We collected data on the subjects, targets, coordinate system used, postoperative implant verification and analysis of subjects with off-target implants.

Results: Approximately 10,000 rats were subjected to stereotaxy, averaging 42 per publication. Sprague-Dawley and Wistar rats were most popular. Only 10% of the rats used correspond to those used to construct the Paxinos rat brain stereotactic atlas, although 57% of the studies referred to this atlas. 74% of the studies exclusively used male rats. Stereotactic procedures consisted of injections in 62% of the studies, followed by cannula implantation (20%), electrode implantation (8%) and combinations.

Right-sided and bilateral targets were more often used than left-sided targets. Bregma served as a stereotactic origin in 96% of the publications. However, in 27% of the targets, lambda was closer than bregma to the entry for a ventral trajectory to the target, and the Euclidian distance from the target to the midpoint of the interaural line and to lambda was shorter than to bregma in 38 and 5% of the cases, respectively. As a reference for the dorsoventral coordinates, bregma and the dura/brain surface were most often used.

Implantation accuracy was assessed almost exclusively with histology, but 39% of the studies did not perform any quality check and the actual number of on-target implants was mentioned in only 8% of the studies.

Conclusion: Although stereotaxy is a well-established and frequently used research technique, there is much room for potential improvement, mainly in coordinate determination, stereotactic origin selection, implantation accuracy verification and reporting.



P257: Frequency of primary central nervous system lymphoma revealed by stereotactic biopsy in Slovenian immunocompetent patients

Authors:

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Keywords: Central nervous system lymphoma, Stereotactic biopsy, Prevalence, Immunocompetent patients

Abstract:

Background: Stereotactic biopsy (STB) is a safe and effective procedure for evaluating the intrinsic brain lesions including the primary central nervous system lymphoma (PCNSL). This tumour is a rare form of non-Hodgkin lymphoma that is limited to the CNS. However, PCNSL in immunocompetent hosts has significantly increased during the last decades. The radiological suspicion of the diagnosis should be followed by early neurosurgical STB. The present study evaluates the frequency of PCNSL in immunocompetent patients undergoing stereotactic biopsy for CNS lesions in University Clinical Centre Maribor, Slovenia.

Methods: We retrospectively studied medical documentations for patients who had undergone diagnostic STB of intracranial lesions from December 2007 to March 2017 at Maribor Department of Neurosurgery.

Results: One hundred and seventy-one stereotactic brain biopsies were carried out on 167 patients by single neurosurgeon. All patients were immunocompetent. The histopathological diagnosis revealed 22 cases of PCNSL (13%), 12 males and 10 females. The mean age was 62,5 years (min. 37 years, max. 78 years). The other diagnoses included 71 malignant gliomas (43%), 21 metastases (13%), 27 benign brain tumours (16%), 10 infections (6%), and 9 neurologic disorders (5%). Seven biopsies (4%) were negative. Overall diagnostic yield of the stereotactic procedure was 96%.

Conclusion: Stereotactic needle biopsy followed by conventional histopathology and immunohistochemistry remains the standard diagnostic methods for patients with suspected primary brain lymphomas to perform a differential diagnosis among other brain lesions, such as gliomas.

P258: Toolkit for Analysis of Stereotactic Implantation Errors: Demonstrated by Analysis of Different Stereotactic Frames Relative to Varying Positions and Loads

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Keywords: Stereotactic Surgery, Stereotactic Error, Stereotactic Frames

Abstract:

The hallmark of stereotactic functional neurosurgery is the ability to accurately and precisely localize and target small structures located superficially and often deep within the brain. While methods have been developed to provide for highly accurate and precise targeting, technological changes have led to new stereotactic instrument development intended to improve accuracy, improve operating room workflow or to allow their use in new environments (such as the MRI). Potential errors in stereotactic techniques can include factors such as: imaging distortions, inaccurate co-registration of data, lead migration and mechanical errors of the stereotactic frame. Here we present a toolkit that uses 2D and 3D space analysis as well as circular statistics to quantify and report stereotactic errors.

To illustrate the utility of our toolkit we compared errors between a set of simulated penetrations using three stereotactic systems commonly used in deep brain stimulation surgeries, Leksell, CRW and STarFix. Each system was affixed on a phantom and assessed in four different experimental configurations: 1) Upright-Unloaded, 2) Upright-Loaded, 3) Supine-Unloaded, and 4) Supine-Loaded. In each of these configurations, a cannula was aimed toward a preset target and its disparity from the intended target was measured in 3D (x, y, z) coordinate space. Measurements were repeated five times for each frame and configuration. The 2D and 3D space analysis and statistics were carried out using custom made MatLab scripts in combination with the circular statistics toolbox.

Overall, our analysis shows that each frame tested has relatively high precision and accuracy. In addition, we also demonstrate that inferences made on how frames differ is dependent on the dimension for which the data is analyzed (i.e. 2D or 3D space). In conclusion, our toolkit allows users to examine and statistically test for stereotactic errors using a single computational environment and may provide a standardized means to compare evolving stereotactic techniques.
P259: Stereotactic biopsies from deep cerebral lesions - a 10 year summary

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Keywords: Stereotactic Neurosurgery, Metastatic Disease,

Abstract:

Method: Data from patients who had undergone stereotactic biopsy from deep intracranial lesions in the department of neurosurgery in the University hospital of Lund were collected in retrospect. The patients were identified using a specific code given to the procedure. Data was collected from their charts.

Results: 224 patients were registered. 95 were women and 129 were men. The age of the patient undergoing the procedure ranged between 5-82. 7 different surgeons performed the procedures. The 30 day mortality rate was 6%, representing 15 cases. Complications were reported in 26 (11%) cases.

Peroperative planning was made with CT in 124 (55%) cases, MRI in 97 (43%) cases and CT and MRI combined in 3 (2%) cases. The PAD concluded infections in 10 (4%) cases, various degrees of malignancies in 188 (84%) cases, benign cysts in 5 (2%) cases and 21 (9%) were inconclusive. The most common malignant diagnose were glioma, which was found in 143 (64%) cases. Those were graded according to the WHO classification. Of all gliomas, 105 were considered high malignant (WHO grade 3-4), 29 low malignant (WHO grade 1-2) and 7 were graded as between WHO grade 2-3.

Of the 15 cases were patients died within 30 days, 2 cases reported a postoperative complication (in both cases bleeding). The PAD showed high malignant glioma in 9 of these cases, lymphoma in 3 cases, metastasis in 2 cases and 1 was inconclusive. In cases were PAD was inconclusive, CT was used as peroperative guidance in 7 cases, MRI in 12 cases and both CT and MRI in 2 cases.

Conclusion: Using stereotactic guidance for taking biopsies in deep intracranial lesions is a safe and accurate method. The relatively high 30 day mortality rate is most likely due to the diagnoses leading to the rather than the biopsy itself in most cases. There seem to be no difference in conclusive results whether you choose to use MRI or CT as peroperative guidance.

P260: Oblique azimuth based robotic assisted implantation of SEEG electrodes - accuracy and safety

Authors:

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Keywords: SEEG, depth electrodes, stereotactic surgery

Abstract:

Objectives: Stereoelectroencephalography (SEEG) is a widely used method for localizing the epileptogenic focus in drugresistant epilepsy patients using intracranial depth electrodes. We report our experience with the Medtech robotic stereotactic surgery assistant (ROSA) for depth electrodes implantation in a consecutive series of 86 patients over a period of 38 months.

Methods: Registration of the patient to the robotic arm was performed in all cases using bone fiducials implanted in the patient's skull after which a CTA was obtained. A T1 weighted MRI scan was used for trajectory planning in the ROSANNE Medtech software. The CT was co-registered with a T1 MRI with submillimeter error in each case. PMT depth electrodes with 0.8mm diameter were implanted. Accuracy was assessed by measuring the entry point lateral error (EPE) and the target point lateral error (TPE) as the distance from the outmost contact of the SEEG electrode to the planned trajectory axis, and the Euclidean distance between the deepest contact of the SEEG electrode and the planned target point, respectively. The side deviation (SDE) of the target was computed as the distance from the deepest contact to the planned trajectory axis. The planned trajectory and the target point respectively as the assured as the angle between the planned trajectory and the normal of the skull surface on a CT scan, computed at the trajectory–surface intersection.

Results: 1161 depth electrodes (median trajectory length 45 mm) were implanted without clinical complications. The median EPE was 1.29 mm, while the median TPE was 2.43 mm. The median SDE was 1.49 mm. Multiple comparison of group means, corrected by Tukey's honest significant difference criterion, revealed significant differences in TPE (2.8 vs. 3.1 mm) and SDE (1.6 vs. 2 mm) means for angles between 0-25 and 25-50, and significant differences in EPE means for angles between 50-75 (2.22 mm) and the other two angle groups (1.38 and 1.46 mm). The estimated contribution of angles to each error type was tested by linear mixed effects models with case number, trajectory's length and angle as predictors (R^2 <0.05 in all cases). The angle's contribution was statistically significant, but its model estimates were 0.007, 0.018, 0.017 for EPE, TPE and SDE.

Conclusion: The small differences in error across wide variations in the angle of incidence suggest that the placement of depth electrodes may be driven principally by anatomic goals, with few constraints imposed by trajectory angles.

P261: Save time with deep brain stimulation electrode implantation with electromyography assistance

Authors:

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Keywords: stimulation, stereotactic, electromyography, parkinson, neurophysiology

Abstract:

Objective: Electromyography (EMG) during stereotactic deep brain stimulation (DBS) surgery for Parkinson's disease (PD) to avoid structures injury while optimizes positioning and trajectory of the electrode.

Methods: 84 consecutive stereotactic DBS procedures were performed in 43 Consecutive patients. All patients had PD diagnosis at least 5 years. Stereotactic implant of DBS was performed with macroelectrodes alone without microelectrode techniques. Surface EMG electrodes were placed on the face and multiple muscle groups of the extremities. The DBS electrode (Medtronics[®] lead 3877) was introduced via MRI-CT guided stereotaxis image fusion toward a target determined by MRI-visualized anatomy image. Stimulation at 5 and 100 Hz thresholds for detection of EMG responses, usually seen at 3 to 6 mA. EMG responses were consistently seen prior to visual observation of muscle activity (Figure). Timing of EMG response relative to stimulus aided in differentiating stimulus-related movement from spontaneous tremor. Resting spontaneous EMG activity was seen to decrease as rigidity was improved by stimulation. EMG activity related to tremor was recorded and tremor decrease by stimulation was documented by EMG recording. Intraoperative EMG monitoring provides an adjunct to improve reliability of assessment of capsular stimulation and rigidity while providing documentation of lesion impact on rigidity, ocular movements and tremor.

Results: The rates of immediate improvement of rigidity and tremor were better than those observed in the routine. There were no major complications. In two patients the electrode was not implanted due to technical difficulties. The surgical time was increased in range of 4 - 12 minutes. The follow up time was 36 months and UPDRS differences were 32% for UPDRS III and 27% for UPDRS II and this differences was significant (chi-square test, p = 0.04).

Conclusions: Currently image-guided stereotactic system would be expected to deliver with reliable accuracy DBS electrodes, compared with standard frame-based stereotaxy coordinates. Intraoperative EMG monitoring provides an adjunct to improve reliability of assessment of capsular and third nerve stimulation admeasurement while providing documentation of stimulation impact on rigidity, ocular movements and tremor, without adding significant surgical time or aggressiveness to the procedure.



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P262: Long-Term Results of stereotactic Brachytherapy (Temporary 125Iodine Seeds) for the Treatment of Low-Grade Strocytoma (Grade II)

Authors:

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1. Neurosurgery, Tehran Hospital, Tehran, FRANCE

Keywords: Survival, Long-Term, Astrocytoma, Brachytherapy

Abstract:

Background: Treatment of low-grade astrocytoma (WHO grade II) (LGA II) remains a challenge. There is limited information regarding the long-term effects of Stereotactic Brachytherapy (SBT) (temporary 125lodine seeds) on patients with LGA II.

Objectives: The purpose of this study was to evaluate disease control and survival after Stereotactic Brachytherapy in patients, with circumscribed and relatively small sized tumors.

Methods: A retrospective review of 29 patients, treated between 1991 and 2011, was conducted to evaluate survival, complications and local disease control after Stereotactic Brachytherapy. They belonged to a larger group of 48 cases with low-grade gliomas, treated with Stereotactic Brachytherapy. The demographic and clinical characteristics in patients including age, sex and survival time were extracted from records.

Results: Thirteen patients were male and 16 were female, with the median age of 29 years (range, 2.5 - 64 years). The median follow up was 95 (range, 6 - 240) months. High and low risk patients were 10 and 19 based on Pigantti classification. The median overall survival and progression-free survival for patients were 135 months (95% confidence interval, 76 - 194), and 96 months (95% confidence interval, 1 - 199), respectively. The five and 10 year progression-free survival were 41.4 % and 34.5 %, and the 5 - and 10 year overall survivals were 65.5 % and 44.8% respectively. Progression-free survival was not significantly higher for smaller tumor sizes (P = 0.224), nor for spherical versus non-spherical tumors (P = 0.307). There was no treatment-related morbidity after Stereotactic Brachytherapy and no radiogenic complications occurred during the follow-up period. Mortality due to tumor progression occurred in 4 patients (14%) and 11 patients were alive at the last follow-up.

P263: Single-unit activity of the anterior and posterior Internal Globus Pallidus in subjects with Tourette Syndrome and Dystonia

Authors:

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Keywords: Dystonia, Tourette, Pallidum, Neurophysiology, Deep Brain Stimulation

Abstract:

The Internal Globus Pallidus (GPi) is an output nucleus of the basal ganglia that has been used as a target for deep brain stimulation (DBS) in Dystonia and Tourette's syndrome. The goal of this study was to provide a detailed analysis of neurons' electrophysiological activity recorded in sub-territories of GPi used as a DBS targets for these clinical conditions. We used intraoperative microelectrode recording during stereotactic neurosurgery to guide implantation of DBS leads. We recorded 101 units in the medial anterior part of GPi (GPia) of 7 Tourette's patients under general anaesthesia. The mean and median activity were 32.1 and 21 Hz respectively, with 45% of spikes fired during bursts and 21.3 bursts per minute. We recorded 27 units in the latero-posterior part of GPi (GPip) of 7 dystonic patients under local anaesthesia. The mean and median activity were 46.1 and 30.6 Hz respectively, and a mean of 21.7 bursts per minute was observed, with 30% of all spikes occurring during these bursts.

We grouped units from each region based on their activity pattern – slow-irregular, fast-irregular or fast-regular – and compared their respective proportions between the two targets. An analysis of local field potential power revealed that peak power in different frequency bands was not correlated with recording depth. We found significant differences in activity between the two regions with neurons in GPia (Tourette's patients) showing narrower action potentials, more bursting and stronger oscillation. Furthermore, LFP power in the alpha band was lower in Tourette's patients (GPia) as compared to dystonic patients (GPip). Although similar firing patterns were present in the two groups of patients, the distribution of cells grouped by firing modes (fast regular, fast irregular and slow regular) was different.

The electrophysiological characteristics of GPia and GPip can potentially be used to assist DBS electrode targeting in patients with the surgical conditions considered. This electrophysiological characterisation will also support the refinement of pathophysiological models of Tourette's syndrome and Dystonia.

P264: Diagnostic value of MRI for the identification of neurovascular conflicts in patients with classical trigeminal neuralgia

Authors:

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Keywords: Trigeminal neuralgia, Microvascular decompression, Neurovascular conflict, MR diagnosis

Abstract:

Introduction: Identifying patients suffering from classical Trigeminal Neuralgia (TN) who can be relieved by Microvascular Decompression (MVD) is important with alternative methods are available. This mostly relies on correctly evaluating potential, Neurovascular Conflicts (NVCs), therefore making proper interpretation of MRI the key to the therapeutic decision. This study aimed to test the capability to foresee and describe NV relations (NVRs) in patients with classical TN, the examiner being blinded to clinical and surgical data including the side of the neuralgia.

Methods: The study was conducted on a group of 100 patients suffering from TN in whom MVD had been performed, the surgical indication having been retained after examination of the MRI in normal clinical conditions. The MRI studies, all performed at our institution (containing the 3 following sequences: high resolution 3D-T2, 3D TOF Angio, 3D T1+ Gado) were re-examined in a blinded fashion. NVRs described bilaterally and determination of the side of the neuralgia was attempted. These were then compared with actual findings.

Results: Overall sensitivy for the presence of a conflict was 97% with a positive predictive value of 97% and an accuracy of 94%. However, in this series of preselected patients, 6 did not harbour a NVC, and specificity upon re-examination was 50%. Specific sensitivity and specificity for each vessel was calculated being highest for the VBA (100%/100%) and SCA (97%/69%) and lower for veins (70%/80%) and AICA (33%/98%).

The grade of the conflict was underestimated by MRI examination (average grade 1.7) whereas at surgery it was 2.3 (p=0.0002). Sensibility for the presence of a conflict when a higher-grade compression (II/III) was identified on MRI was 98% with a specificity of 89%, with a cut-off between grades I and II.

Blinded examination of the MRI showed unilateral conflicts in 60 cases and bilateral ones in 40 out of these 30 being considered symmetrical and 10 asymmetrical. The side of the conflict was correctly identified in 75% of cases. Fig 1 shows that the correct identification of the side of neuralgia was related to the configuration of NVRs (unilateral, bilateral symmetrical-asymmetrical).

Conclusions: MRI has high sensibility for the identification of NVCs. Although the degree of compression was often underestimated NVCs of grade II and III were generally identified which is important since it is these patients that benefit the most from the surgery.





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P265: The role of primary percutaneous balloon compression in managing MS and non-MS trigeminal neuralgia

Authors:

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1. Neurosurgery, Queens Medical Centre, Nottingham, UK

Keywords: percutaneous balloon compression, trigeminal neuralgia, Multiple sclerosis

Abstract:

Objectives: Trigeminal neuralgia (TGN), a relatively prevalent pathology with up to 20-fold increase in MS, has many described treatments ranging from medical to (destructive/non-destructive) surgical, each with it's respective indications, pros and cons. Patients are often subject to multimodal treatments which makes it difficult to disambiguate the effectiveness of individual treatments measured by degree and period of pain relief. Our aim is to identify the success rate of primary percutaneous balloon compression (PBC) as a 1st-line-treatment of TGN based on pain outcome (resolution vs persistence of noxious stimulus in V1/2/3 branches of trigeminal CN V). Our secondary aim is to identify the pain free interval in cases of recurrence.

Methods: Retrospective study of 42 cases of PBC for TGN, 2006-14, identified at QMC neurosurgical unit. 21 of which were primary interventions analysed. 11 MS and 10 non-MS patients. Success was classified on a 3-tier post-op pain relief scale; No improvement (NI), partial pain relief (PPR), total pain relief (TPR). In the TPR cohort, recurrence and subsequent interventions were also recorded. Recurrence was also classified on a 4-tier-scale; failed (recurrence in less than 3 months), temporary relief (recurrence in less than 2 years), prolonged relief (recurrence after 2 years), successful (no recurrence). Significant complication rate was also recorded. Secondary PBC not included to avoid ambiguity.

Results: MS arm: 11 recruited (3/11 bilateral TGN). 6 right-sided and 5 left-sided primary PBC procedures performed. 4/11 men (36.3% - mean age 53.5) and 7/11 women (63.6% - mean age 49.9). Success Rate: NI 1/11 (9%), PPR 1/11 (9%), TPR 9/11 (82%). Recurrence: Failed 2/11 (18.2%), TR 2/11(18.2%), PR 2/11(18.2%), Successful 5/11(45.5%). Non-MS arm: 10 recruited. 9/10 right-sided and 1/10 left-sided primary PBC procedures performed. 2/10 men (20% - mean age 64) and 8/10 women (80 % - mean age 65.5). Success Rate: NI 1/10 (10%), PPR 1/10 (10%), TPR 8/10 (80%). Recurrence: Failed 2/10 (20%), TR 2/10 (20%), PR 1/10(%), Successful 5/10 (50%). 2/10 (20%) developed hypoesthesia and keratitis 20 to xerophthalmia.

Conclusions: This study demonstrates the advantage of PBC as first line treatment in management of both MS and non-MS TGN. This is reflected in its high success rate 10/21 (47.6 %), reasonable recurrence rate TR 4/21 (19%), PR 3/21(14.2%) and moderate failure rate 4/21 (19%).

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P266: Trigeminal neuralgia associated with cerebellopontine angle tumors

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Keywords: Trigeminal Neuralgia, Cerebellopontine Angle, Tumors

Abstract:

Introduction: the symptomatic trigeminal neuralgia (TN) associated with cerebellopontine angle (CPA) tumours can be caused by direct or indirect compression of trigeminal root entrée zone (REZ). Optimal surgical tactic of treatment in such cases is still unclear.

Aim: the aim of this study was to describe the relationships between trigeminal REZ, CPA tumours and vessels in cases of symptomatic TN.

Methods: 30 patients with TN associated with ipsilateral CPA tumours were operated via retromastoid approach in sitting position. All data including neurological signs, pre- and postopetative MRI scans, intra-operative findings and histological findings were analyzed.

Results: There was 18 meningeomas, 8 epidermoids and 4 neurinomas. 17 cases were right-sided and 13 – left-sided. Patients' age at the moment of TN manifestation varied from 23 to 72 years (mean age – 52 years). In all cases we achieved the total removal of tumours with no permanent morbidity nor mortality. The transitory cranial nerves palsy occurred in 3 patients (2 – III CN, 1– IV CN) and completely resolved in 3-4 weeks.

We found 5 types of trigeminal REZ compression. Direct compression of trigeminal root by the tumour (type 1 and 2) was in 23 cases, double compression of root by tumour and SCA (type 3 and 4) was found in 6 cases, and venous compression without contact between trigeminal REZ and tumour in 1 case. In 7 cases microvascular decompression was successfully performed after tumour removal.

Conclusion: the most common cause of TN is direct contact and compression of REZ by CPA tumour. Some cases can be presented with the double compression of TN REZ by tumour and arterial vessel. After removal of CPA tumour in cases of TN the trigeminal REZ must be mandatory examined to evaluate neurovascular relationships. If neurovascular conflict persist, microvascular decompression must be performed to resolve the facial pain.

P267: Cyberknife Radiosurgery for Trigeminal Neuralgia

Authors:

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Keywords: Trigeminal Neuralgia, Image-guided Radiosurgery, Cyberknife

Abstract:

A cohort of 138 patients affected by Trigeminal Neuralgia (TN) was treated by Cyberknife radiosurgery and prospectively followed. Minimum follow-up of this cohort is 36 months.

Patients with typical TN and severe drug-resistant pain underwent image-guided robotic radiosurgery (Cyberknife, Accuray Inc. Sunnyvale, Ca). The treatment was performed in single session using a non-isocentric technique, delivering 60 Gy@80% isodose to a 6 mm retrogasserian target. Clinical re-evaluation was performed at 3, 6, 12, 18, 24 months and then continued on a yearly base.

The median follow-up time was 52.4 months (range, 36-79 months). Significant pain relief was achieved in 129 out of 138 (93.5%) patients, after a median delay of 3 weeks(range 1-6 weeks). 109 patients (78.9%) were completely pain and medication-free (BNI pain class I) 6 months after treatment. 11 out of 138 patients (8%)who failed to achieve pain control after a minimum 6 months observation time underwent a second treatment, which induced pain remission. 24 out of 129 pain-free patients(18,6%) experienced recurrent pain within 3 years from the treatment and underwent retreatment with restoration of analgesia.Peak of recurrent pain was found 12 months after the first procedure (12 patients,50%), while other 7 (29,2%) recurred after 18 months and 5 (20,8%)after 24 months. Overall, 35 patients(25,4%) required a second treatment, either due to primary failure or to recurrent pain.

Actuarial pain control rate (BNI class I-IIIa) after 6, 12, 24, 36 months was, respectively, 93.5%, 85.8%, 79.7%, 76%. Afterwards, it remained stable. Figure 1 shows the actuarial rate of pain control after treatment.

Overall 7 patients (5,1%)developed bothersome hypoesthesia: one patient out of 138 (0.7%) developed bothersome hypoesthesia (BNI grade IV) after a single treatment while 6 out of the 35 patients undergoing retreatment developed BNI grade III hypoesthesia(4,3% of the 138 initial cohort; 17,1% of the 35 patients receiving 2 treatments)

Overall, this is the largest series reporting about Cyberknife radiosurgery for trigeminal neuralgia. The technique here reported, targeting a 6 mm segment of the TN with a prescribed dose of 60 Gy, appears to be a safe and effective treatment for TN, with high pain control rates and an acceptable risk of sensory complications, which are typically found after re-irradiation.



P268: Longitudinal microstructural footprints of Gamma Knife radiosurgery in trigeminal neuralgia

Authors:

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Keywords: trigeminal neuralgia, Gamma Knife radiosurgery, diffusion tensor imaging, longitudinal study, radiation effect, chronic facial pain

Abstract:

Introduction: Trigeminal neuralgia (TN) is the most frequent human chronic neuropathic facial pain disorder. Gamma Knife radiosurgery (GKRS) is highly successful for surgically-naïve TN patients. Diffusion tensor imaging (DTI) allows magnetic resonance (MR) *in vivo* assessment of white matter microstructure and provides important diffusivity metrics—axial, radial, mean diffusivities (AD, RD, MD), and fractional anisotropy (FA). We previously reported significant focal alterations in diffusivity within GKRS radiosurgical target, implying changes in white matter myelination. Here we aim to use DTI to characterize the longitudinal relationship between trigeminal nerve microstructure and clinical pain relief following GKRS for TN. We hypothesize that GKRS induces a dynamic, time-dependent pattern of microstructural changes in the symptomatic trigeminal nerve.

Methods: 18 GKRS-treated TN patients with high-resolution 3T diffusion and T1 anatomical MR images were retrospectively recruited based on the availability of multiple follow-up MR images including DTI assays. DTI-derived metrics were extracted from four regions of interest—bilaterally from cisternal segment, root entry zone, pontine segment, and the radiosurgical target. Linear mixed effects statistical models were constructed for diffusivities at each region. Diffusivities were compared across time points and between symptomatic and contralateral control nerves. Verbal ratings of pain across time were assessed with 1-way ANOVA at significance of p<0.05.

Results: Pain intensity was significantly reduced from 9±1 to 1±1 at 6-months post-surgery and this reduction persisted to end of follow-up. Microstructural alterations in the target zone appear most pronounced at 12-months post-treatment, with significantly increased RD, MD and decreased FA compared to contralateral control. Beyond 12th month, these alterations were gradually reversed to pre-treatment levels. DTI-metrics were statistically similar at all other regions across time.

Conclusion: Diffusivity analysis demonstrates a temporal disconnect between time-to-pain-relief and time-of-maximal-radiationeffect. This is important for our understanding of GKRS' mechanism of action and its impact on pain. Furthermore, this longitudinal footprint can guide re-treatment decisions in patients non-responsive to initial GKRS by allowing clinicians to infer the extent of radiation effect on the nerve from microstructural diffusivities within the treatment target.

P269: Evaluation of microstructural pain signature revealed through multimodal magnetic resonance imaging

Authors:

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Keywords: neurvascular compression, trigeminal neuralgia, chronic facial pain, diffusion tensor imaging, pain biomarker

Abstract:

Introduction & Aim: Despite uniformly unilateral pain, Trigeminal neuralgia (TN) patients have greater likelihood of bilateral trigeminal neurovascular compression (NVC). This anatomical distinction can allow the identification of specific microstructural signatures associated with the painful, symptomatic side. Diffusion tensor imaging (DTI)—a magnetic resonance imaging tool sensitive to white matter microstructure—was used to identify *in vivo* imaging signatures specific to TN pain, by characterizing symptomatic and asymptomatic trigeminal nerve microstructure in relations to degree of compression in patients with bilateral NVC.

Methods: 3T T1 anatomical, 60-directions diffusion-weighted, and FIESTA images were acquired and aligned to diffusion space for 27 surgically-naïve TN patients. NVCs were graded (I to III) based on FIESTA images. Multi-tensor DTI tractography was used to identify bilateral trigeminal nerves at the pontine segment, root entry zone, and cisternal point of maximal compression. From these regions, DTI-derived microstructural metrics—axial, radial, mean diffusivities, and fractional anisotropy (FA)—were extracted for linear mixed effects statistics between nerve types with significance at p<0.05.

Results: Across all NVC grades, asymptomatic nerves did not demonstrate any diffusivity changes. Symptomatic nerves, however, displayed significant, grade-dependent variations in diffusivities. Compared to contralateral nerves, Grade I symptomatic nerves had higher FA (p<0.01) at the point of maximal compression while Grade III symptomatic nerves had lower FA (p<0.05) at the root entry zone.

Conclusion: We show for the first time that microstructural changes in the symptomatic trigeminal nerve directly correlate with NVC—suggesting that symptomatic nerve undergoes important structural changes in TN, ultimately resulting in pain. NVC dynamically (grade-dependently) affects portions of the symptomatic nerve. While initially the zone of maximal compression within cisternal portion of the symptomatic nerve are affected, with increasing NVC, a shift towards the neuraxis occurs and results in likely focal demyelination at the CNS/PNS interface (root entry zone). Microstructural diffusivities can distinguish nerves with pain from those without and provide valuable insights into the pathophysiology of TN. Machine learning solutions constructed from the insights gained here may lead to objective assessment tools of chronic facial pain for TN patients.

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P270: Operative findings and outcome of microvascular decompression for trigeminal neuralgia in patients with multiple sclerosis

Authors:

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Keywords: trigeminal neuralgia, multiple sclerosis, microvascular decompression

Abstract:

Objective: Trigeminal neuralgia (TN) in multiple sclerosis (MS) poses several challenges for treatment. Although these patients often have typical attacks they may not be considered candidates for microvascular decompression (MVD). Optimal treatment in this group of patients is unclear. Here we report on surgical findings and the results of MVD in a series of patients with multiple sclerosis.

Methods: Thirteen patients with typical trigeminal neuralgia and MS underwent MVD. All patients had preoperative magnetic resonance imaging which confirmed radiological findings of MS. All patients were available for regular follow-up. The outcome of intervention was graded according to the Barrow Neurological Institute (BNI) pain score. Mean follow-up was 34 months.

Results: All patients were refractory to medication preoperatively. In the 13 patients a total of 17 MVDs were performed. One patient had a previous MVD and two had previous percutaneous radiofrequency rhizothomies (PRR) in another clinic. There was no surgery-related morbidity or mortality. Intraoperative findings indicated scar tissue at the trigeminal entry zone (11/13 patients), arterial contact (6/13 patients) and vein contact (10/13 patients). Early postoperative pain relief was complete in 12/13 patients, and one patient had partial pain relief. At long term follow-up 8 patients had complete pain relief (BNI I), 4 had partial relief which was controlled with medication (BNI III) and one patient had limited benefit (IV). Of these, in 4 patients a second MVD had been performed because of pain recurrence.

Conclusion: On the long term, 12/13 patients had either complete or partial pain relief (including those who had a second MVD). Intraoperative findings showed neurovascular compression and/or sever scar tissue probably secondary to local inflammation. We conclude, that MVD is a valuable treatment option to control typical TN in patients with MS.

P271: Prospective comparison of long-term pain relief rates after microvascular decompression and radiofrequency ablation for trigeminal neuralgia with initial stereotactic radiosurgery

Authors:

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Keywords: Trigeminal neuralgia, microvascular decompression, radiofrequency ablation, pain relief rates

Abstract:

Objective: So far, none of studies have directly compared microvascular decompression (MVD) and radiofrequency ablation (RFA) on pain control for trigeminal neuralgia (TN) with initial stereotactic radiosurgery (SRS). Using a medium prospective longitudinal database, we aimed to 1) directly compare long-term pain control rates for MVD and RFA for idiopathic TN with initial SRS, and 2) identify predictors of pain control.

Methods: The authors reviewed a prospectively collected database for all patients who underwent treatment for TN between 2012 and 2016 at the Zhongda Hospital Southeast University of China. Standardized collection of data on preoperative clinical characteristics, surgical procedure, and postoperative outcomes was performed. Data analyses were limited to those patients who received MVD or RFA for idiopathic TN with initial SRS.

Results: Of 586 surgical procedures performed for TN at the Zhongda Hospital Southeast University, 125 patients previously underwent initial SRS in other institutes for idiopathic TN, followed by MVD (65) or RFA (60) in our hospital. Patients who received MVD were not younger than those who underwent RFA. The postoperative pain-free rates (Barrow Neurological Institute Pain Intensity score of I) were 97% for MVD (63) and 70% for SRS (42). A subset of patients who had MVD (5) also underwent partial sensory rhizotomy, usually in the setting of insignificant vascular compression. Multivariable regression demonstrated that shorter preoperative recurrence after initial SRS was associated with favorable outcome for MVD.

Conclusion: In this longitudinal study, patients who received MVD had significantly longer pain-free intervals compared with those who underwent RFA for initial SRS. The shorter preoperative recurrence after initial SRS was associated with favorable outcome for MVD. The RFA was unassociated with age groups and should be recommended only for those who feared open craniotomy.

P272: O-ARM-based visualisation and navigation for percutaneous balloon compression in drug-refractory trigeminal neuralgia: a prospective study

Authors:

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Keywords: Trigeminal Neuralgia, Pain Management, Neuronavigation, Three-Dimensional Imaging, Fluoroscopy, Trigeminal Ganglion, Foramen Ovale

Abstract:

Introduction: Percutaneous balloon compression of the trigeminal ganglion is a well-established treatment for medicationrefractory idiopathic trigeminal neuralgia. The main technical challenge associated with this procedure lies with the exact cannulation of the foramen ovale when using standard two-dimensional fluoroscopy. In recent years, O-arm systems have become widely available in neurosurgical practice, allowing online three-dimensional imaging and simultaneous intraoperative navigation. In a prospective study of 12 patients with drug-resistant trigeminal neuralgia we evaluated a novel method of O-armbased three-dimensional navigation and online visualisation to facilitate accurate cannulation of the foramen ovale with subsequent retrogasserian balloon compression.

Methods: This single-centre prospective study included 12 patients (7 female, 5 male) who suffered from drug-resistant idiopathic trigeminal neuralgia. All patients underwent percutaneous balloon compression of the trigeminal ganglion under general anaesthesia. Intraoperative O-arm-based neuronavigation and three-dimensional visualisation was used to ensure exact placement of the Fogarty balloon catheter.

Results: In 11/12 patients the cannula and the Fogarty balloon catheter could be inserted into the foramen ovale at the first attempt; in one patient a single revision step was necessary. In comparison to the standard method using two-dimensional fluoroscopy, time in the OR was increased by a mean of 11 minutes per case (p>0.05). There were no complications related to the novel technique or the duration of the procedure. Postoperatively, there was rapid and complete relief of trigeminal pain in 8/12 patients. In the remaining four patients there was a marked reduction of dysaesthesia.

Conclusion: This study demonstrates that O-arm-based percutaneous cannulation of the foramen ovale with retrogasserian balloon compression is technically feasible and safe. Accurate placement and adequate balloon compression was achieved in all cases. The O-arm can readily be integrated into the theatre setup and allows precise navigation and procedural documentation. We therefore consider the application of O-arm to be a useful tool in the operative treatment of trigeminal neuralgia. In departments where an O-arm is already used for spinal interventions, its additional use in pain therapy should be considered.

P273: Percutaneous trigeminal ganglion balloon compression rhizotomy

Authors:

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Keywords: Trigeminal neuralgia, balloon compression, pain relief

Abstract:

Background: Percutaneous ganglion balloon compression (PBC) is minimally invasive procedure for treatment of trigeminal neuralgia. We are presenting our experiences with this treatment.

Methods: Twenty seven (19 female and 8 male) patients, who presented with classical symptoms of trigeminal neuralgia, were included. Age ranged from 34 to 91 years (median 62 years). 33 procedures were performed. Three patients had 2 procedures on the same side and one patient had 4 procedures – 3 on the same side and 1 on the other side. Duration of the symptoms ranged from 1 year to 30 years (median 5 years). Three patients had previous microvascular decompression (MVD), one alcohol rhyzotomy and one section of the nerve. Procedures were done in general anesthesia. Mullan percutaneous microcompression set was used.

Results: After the procedure pain relief was reported in 25 (93%) patients. In two patients the pain remained the same. Nineteen of the patients (70%) had mild to moderate degree of ipsilateral facial sensory loss. Three patients (11%) developed cheek hematoma which subsided with cold compression. The pain free period ranged from 2 to 74 months (median 15 months). A mean duration of analgesia was longer in patients with ideal pear-shape of balloon at the time of the procedure compared to non-ideal shape (p = 0.01). No major complications occurred in our group of patients.

Conclusions: Percutaneous trigeminal ganglion balloon compression is safe, simple and effective method for temporary pain relief in a selective group of trigeminal neuralgia patients. When repeated it can bring long term pain relief. It should be reserved for patients rejecting or not suitable for MVD.

P274: Volumetric and Morphometric Analyses of the Posterior Cranial Fossa in Patients with Hemifacial Spasm

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Keywords: hemifacial spasm, microvascular decompression, posterior cranial fossa

Abstract:

Background: The posterior cranial fossa of patients with hemifacial spasm tends to be small and shallow. Their vertebrobasilar arteries are often tortuous. We aimed to analyze the anatomical architecture of the posterior cranial fossa and of the vertebrobasilar system using volumetric and morphometric analyses.

Methods: We retrospectively reviewed the images of the computed tomography and magnetic resonance imaging in 60 patients with hemifacial spasm (Age 21-80) and in age-matched healthy controls. The volume and shape of the posterior cranial fossa were measured using a stereological volumetry. Vascular tortuosity was analyzed on magnetic resonance imaging results. These measurement results were statistically compared between the hemifacial spasm and control groups.

Results: The young adult patients with hemifacial spasm had smaller posterior cranial fossa than controls. The vertebrobasilar arteries in the elderly adult patients with hemifacial spasm were more tortuous than controls.

Conclusion: Young hemifacial spasm patients tend to have smaller posterior cranial fossa. Elder such patients tend to have tortuous vertebrobasilar arteries. Such characteristics should be considered in surgical management of hemifacial spasm.

P275: Pattern of brain white matter connectivity is predictive of trigeminal neuralgia

Authors:

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Keywords: white matter connectivity, trigeminal neuralgia, multivariate pattern, machine learning

Abstract:

Objective: There is increasing interest in studying structural brain alterations in neuropathic pain. Analysis of structural brain images has been commonly used to detect group differences based on single or clusters of voxels. However, multivariate pattern analysis can capture specific spatial patterns that can be used as possible biomarkers to predict individual-level disease state. This is likely more relevant since the neuroanatomy of pain involves clusters or networks of sites. Our study investigates the possibility of predicting symptomatic trigeminal neuralgia (TN) based on brain structural connectivity patterns.

Methods: T1 and diffusion weighted imaging (1 b=0 and 60 directions with b=1000 s/mm²) from 23 right-sided TN patients (R-TN, 48.91±13.10Y,15F) and 23 healthy controls (HCs, 47.61±11.47Y, 15F) were used to construct whole-brain white matter networks. Probabilistic tractography was performed using Mrtrix3. Normalized streamline count (NSC), defined as the number of streamlines between each pair of ROIs given 1 million streamlines at the whole-brain level, was generated for each subject between 84 regions of interest (ROIs). These 3486 NSC are used as features in a linear support vector machine (SVM) classification to distinguish R-TN patients from HCs with a leave-one-out cross-validation (LOOCV) approach. The important features were also used to estimate their correlations with duration of TN pain.

Results: Prediction of symptomatic TN from HC based on our machine-learning paradigm was 88.00% accurate (91.30% sensitivity, 91.30% specificity). Feature weights indicated that classification was driven by lower streamline counts in the posterior left hemisphere and between hemispheres, and higher counts in the right parietal and occipital regions. Part of the lower NSCs were associated with longer pain duration.

Conclusions: Machine learning algorithms of structural connectivity pattern accurately distinguish TN from controls. This pattern includes reduced fiber connections between regions related to affective and associative dimensions of pain in TN patients, and enhanced fiber connections of regions related to both somatosensory and higher order cognitive functions. Furthermore, this pattern relates to duration of pain, suggesting the likely dynamic nature of these changes. This study highlights the role of unique structural changes in TN and structural brain imaging towards a more objective definition of neuropathic pain disorders.

P276 : Can MRI replace stereotactic biopsy for glioblastomas?

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Abstract :

Introduction: Diagnostic histopathology is gold-standard in the diagnosis of intracranial lesions and forms the basis for the therapeutic approach. Thereby the stereotactic brain biopsy is an important and reliable method. However, morbidity and mortality are reported between 0 and 6% (1-6). This leads to the question, whether imaging diagnosis such as MR can replace invasive diagnostic procedures.

Methods: In a retrospective analysis we compared the radiological MR - diagnosis with the histopathological diagnosis, to determine their correlation. Between 2000 and 2011 a total of 168 patients underwent stereotactic brain biopsies at the Department of Neurosurgery of the University Hospital of Graz. There were 98 male and 70 female patients between the ages of 15 and 84. In addition, we recorded some general information, past medical history, medication and Karnofsky- Performance-Score, as well as location and type of the lesions and the outcome of the operation.

Results: There was a compliance of the preoperative radiological diagnosis and the histological diagnosis in 82%, n=137, of the cases. In 18%, n=31, of the cases the two diagnosis did not show any consistency. Perioperative complications occurred in 19 patients. The morbidity rate was 5% and the mortality rate 3,5%.

Conclusions: Compared to other studies with similar topics, this correlation rate presented a good result (2, 5-8). However, the histological diagnosis remains gold- standard as this histological confirmation is still necessary to choose the accurate treatment. Stereotactic brain biopsy is a reliable and safe procedure.

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