

Results. Twelve patients were enrolled, and 11 were implanted and randomized. Mean follow-up range is 19 months (range 9–36). Optimal efficacy was not immediate and variable. Two post-lesional effect were identified. From the 8 patients with more than 12 months of follow-up: five are considered as responders (three are totally pain free and two partially). DBS was well tolerated: reversible diplopia, no hormonal or behavioural changes, one sepsis (with re-implantation).

Conclusions. This study confirm the efficacy and safety of chronic hypothalamic DBS for refractory chronic C.H. Neuromodulation hypothesis actions will be discussed.

04. Occipital nerve stimulation in the treatment of chronic cluster headache

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Introduction. Most of patients affected by cluster headache, included in so-called trigeminal autonomic cephalalgias, are controlled by pharmacological therapy, but some refractory chronic cases (around 1%) have to be treated surgically.

Methods. We will show our results in three cases of cluster headache treated by occipital nerve stimulation. We use this procedure when radiofrequency lesions of pterygopalatine ganglion failed (13 cases), and before to perform hypothalamic neurostimulation with deep brain electrodes (one case) when occipital nerve stimulation failed. The patients were asked how much pain they feel using an analogical pain score before and after the procedure, at three and six postoperative months. The surgical procedure was performed under general anaesthesia with patient positioned prone. We implanted subcutaneously a bilateral paddle-style stimulating lead with eight distal electrodes via a retromastoid approach, according to the method described by Oh and co-workers. After surgery, the implanted lead was connected to an external stimulator. If pain relief and paresthesias in the innervation territory of the greater occipital nerve was obtained, an internal stimulator was implanted subcutaneously under brief general anaesthesia in the abdominal region.

Results and conclusions. One patient showed an excellent relief of pain and the other two moderate improvements. For the treatment of cluster headache we use a protocol from less to more complexity. The preliminary results with occipital nerve stimulation showed good results with low risk.

05. Hypothalamic deep brain stimulation for refractory cluster headache: microelectrode recordings

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Introduction. Deep brain stimulation (DBS) of the posterior hypothalamus has been shown to be effective in the treatment of drug-refractory chronic cluster headache. Its mechanisms yet remain unclear.

Methods. Seven patients who fulfilled the published criteria for DBS in chronic cluster headache underwent stereotactic implantation of quadripolar DBS electrodes in the ipsilateral posterior hypothalamus ($x=2$ mm lateral, $y=3$ mm posterior, and $z=5$ mm inferior to the mid-AC-PC line). In five patients microelectrode recordings were performed. In three patients sensory stimulation in the trigeminal and

spinal dermatomes was tested, two patients were investigated for motor responses (passive movement of elbow), autonomic function (counting backwards under stress, cold pack, and bladder filling) and affective responses (pictures with emotional content). Pacemakers were implanted in all instances.

Results. Four out of the seven patients benefitted markedly from chronic DBS. There were no surgical complications. Microelectrode recordings from the target region showed a tonic firing pattern without regular oscillatory activity. The mean neuronal discharge rate was 17 Hz (range 13–35 Hz). There were no neuronal responses to any of the stimuli tested.

Conclusion. Chronic DBS in the posterior hypothalamus yields beneficial results in the majority of patients. Criteria for patient selection have to be refined. The lack of modality-specific modulation of the activity of single neurons in the target area confirms that the posterior inferior hypothalamus is not related to primary or secondary afferent and nociceptive pain processing.

06. Treatment of chronic cluster headache by stimulation of the postero-medial hypothalamus

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Introduction. Cluster headache is the most severe of the primary headaches. Chronic cluster headache is not a life threatening condition but may kill the patients either due to drugs abuse either due to sleep deprivation and severity of pain leading to suicide. The rationale for high frequency stimulation (HFS) of the posteromedial hypothalamus (pHyp) has been based on advanced functional studies that identified the hypothalamus as the origin of Cluster Headache (CH) attacks. We argued to interact with the origin of cluster headache pain bouts rebalancing the allegedly hyperfunctioning hypothalamic neuronal pools.

Patients and methods. Deep brain stimulation (DBS) is the available methodology to modulate a discrete brain volume at a specified target. The previous experience of neurological diseases controlled by focal electrical stimulation as Parkinson's disease, dystonia, tremor, convinced us to attempt pHyp modulation in a compassionate desperate patient affected by chronic CH refractory to any conservative and classical treatment (trigeminal thermizotomy and sphenopalatine ganglion procedures had failed). Fifteen patients affected by chronic cluster headache and ten more patients affected from painful syndrome of the face underwent DBS.

Results and discussion. The mean follow-up is 24 months (range 12 to 62 months). In the whole series, 71% of postoperative days are pain free and intensity and duration of pain bouts is significantly reduced. Chronic high frequency stimulation of the pHyp has been the first direct therapeutic application of functional neuroimaging data in a restorative reversible procedure for the treatment of an otherwise refractory neurological condition.

07. Deep brain stimulation in a patient suffering from short-lasting unilateral neuralgiform headache attacks with conjunctival injection and tearing and right sided essential tremor: a case report

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Background. SUNCT is a rare facial pain syndrome difficult to treat and first cases of successful treatment by DBS implantation in the hypothalamic region have been reported.

Method. We report the case of a 67 year old patient suffering from SUNCT and essential tremor. The pain was drug resistant and showed no improvement after two glycerol infiltrations of the ganglion gasseri and an occlusion trial of the sphenopalatine artery due to a suspected compression of a trigeminal branch by this vessel. We planned a DBS implantation into the left VIM to control the tremor followed by a second electrode implantation in the centro-median nucleus to relieve the facial pain in a later operation.

Findings. After DBS implantation to the left VIM the patient showed a significant and satisfying relieve of both, the hand tremor and the facial pain syndrome and no second electrode was necessary. Four months after the operation the pain was still significantly improved.

Conclusion. DBS should be considered in the treatment of severe intractable SUNCT. Both pain and tremor were successfully treated by a single electrode placed in the VIM. Since the VIM is not involved in nociceptive pathways, it is possible that abnormal thalamic reorganization occurs in SUNCT, which might explain the success of VIM-DBS for treating pain in this patient.

Movement Disorders I

01. Long-term follow-up after bilateral subthalamic DBS in a series of 73 consecutive Parkinsonian patients

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Introduction. subthalamic DBS has proven its efficacy in controlling motor symptoms of Parkinson's disease. However, debate is arising about possible long-lasting effects of DBS: the results available on the long-term (more than 5 years) follow-up of implanted patients are still controversial. The aim of this study was to retrospectively review the clinical data of patients operated on for bilateral subthalamic DBS at our Institution with more than 5 years of follow-up.

Methods. Seventy-three consecutive patients out of 212 operated from 1998 to 2007 were included in the study. Clinical assessment was performed at baseline, 1 and 5 years postoperatively, by means of UPDRS evaluation in both "on" and "off"-medication. L-Dopa equivalent dosage, surgical and stimulation-related adverse events were also recorded.

Results. Mean age at surgery was 58 years. Mean UPDRS III in "drug-off/stim-on" condition was 42 (± 15) pre-operatively, 19 (± 13) at 1 year follow-up and 29 (± 12) at 5 year follow-up. Baseline L-dopa equivalent dosage was 1,400 mg at baseline, 650 mg at 1 year and 670 mg at 5 year. Twenty patients experienced hypofonia/dysarthria, five had transient eyelid apraxia, three developed depression. One patient had an intracranial haemorrhage, two had infections requiring substitution of the prosthetic materials and one had an extension wire fracture.

Conclusions. Subthalamic DBS is an effective and relatively safe treatment for advanced Parkinson's disease. The beneficial effect is maintained at 5 years, in both UPDRS III improvement and reduction of medications. However, worsening occurs over time, possibly reflecting disease progression.

02. Long term follow-up in patients treated with subthalamic DBS for Parkinson's disease: a target localization study

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Introduction. Subthalamic nucleus DBS represents an effective and proved therapeutic strategy for patients affected from idiopathic complicated Parkinson's disease, but the best strategy of target location is still debated. We present our experience of 62 patients implanted for bilateral STN nucleus DBS with 1 to 7 years follow-up.

Methods. We selected patients through CAPSIT guide-lines. Mean age and mean duration of disease resulted 60 and 8 years, respectively. We obtained MR stereotactic T1 and T2 sequences with Leksell ring. After imaging merging through frame-link[®] software, target coordinates has been calculated based on AC-PC line and morphological direct STN MRI visualization. In all cases we selected final target on the basis of best intraoperative neurophysiological monitoring, and we compared definitive tracks electrode position with clinical outcome. All the patients underwent post-operative MRI.

Results and conclusions. The mean UPDRS III value in OFF medication/OFF stimulation condition was 43.66. The mean UPDRS III value after DBS in ON medication/ON stimulation resulted 13.08 at 6 months follow-up and 14.75 at last follow-up. All the patients reduced more than 50% drugs intake. The only major complication has been a deep hemorrhage with consequent transient emiparesis. Most frequent transient stimulation side effects were paresthesias, dyskinesias, mood depression and weight gain. We report homogeneous clinical outcome despite to the relevant variability of the final electrode position in respect to AC-PC coordinates.

DBS for complicated PD represents a safe and effective treatment, specially for tremor and rigidity symptoms, less effective resulted the control of axial symptoms. We have not experienced protective effect on disease progression.

03. Bilateral subthalamic nucleus stimulation in advanced Parkinson's disease: 5 years follow-up

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Background. The short term benefits of subthalamic nucleus stimulation (STNs) in patients with advanced Parkinson's disease (PD) are well documented. Long-term benefits have to be thoroughly investigated.

Objectives. This study provides a 5-year follow-up of PD patients under chronic STNs.

Method. Thirty consecutive PD patients were prospectively assessed 12, 36, and 60 months after bilateral STN implant. Parkinsonian motor symptoms were evaluated with (on) and without (off) levodopa treatment, with and without bilateral stimulation. Disease-related disability, neuropsychological and mood evolution were comprehensively studied.

Findings. Aborted procedures were 1.5% of all implantations, intracranial haemorrhage 5%, seizures 1.5%, hardware complications 3.3%. At 5 years follow-up, five patients had died and two were lost to follow-up. In the remaining: (1) Parkinsonian motor symptoms (Unified Parkinson's Disease Rating Scale (UPDRS) III) were improved by STNs by 52% ("off" drug) and 68% ("on" drug) with