Tématické sekce sjezdu

Elektromyografie

NEUROMUSCULAR TRANSMISSION DISORDERS IN MILLER FISHER SYNDROME

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Introduction: Miller Fisher syndrome (MFS) is a variant of Guillain-Barré syndrome (GBS). MFS is clinically defined by trias – ophthalmoplegia, ataxia, areflexia. Antibodies against ganglioside GQ1b are bound on the nodal and paranodal sections of oculomotor nerves, sensory nerves (including spinal ganglia) and cerebellum. Ophthalmoparesis is usually severe with prominent fatiguability. In these patients neuromuscular transmission disorders are suspected.

Case report: A 52-year man was admitted to neurological department for progressive external ophthalmoparesis with generalized ataxia. The neurological signs and symptoms developer during 5 days with preceding upper respiratory tract infection. The first diagnosis was MFS. There was very prominent especially oculomotor fatiguability with worsening during the day and after rehabilitation, that neuromuscular transmission was suspected too.

Neurophysiological investigation: Motor conduction studies (including F-waves) were normal, sensory conduction studies with very low amplitude of sensory nerve action potentials. H-reflex was not elicitable. Needle EMG of biceps brachii was normal (14 days after disease onset). Repetitive stimulation (3 Hz) with recording from trapezius with 7 % decrement (4th response) and from nasalis 5.8 %. Axonal stimulated SF EMG with recording by concentric needle electrode from frontalis muscle presented an increased jitter -32.91 µs and 9% blocking - with the stimulation rate 3 Hz. With stimulation rate 10 Hz the jitter decreased to 26.26 µs and without blocking, with 20 Hz stimulation rate was the jitter normal (21.83 µs) and without blocking.

Other investigations: GQ1b antibody level was prominent – 315.7% (norm – up to 9%), antibodies against acetylcholin receptors were not found. MR of brain and thorax were normal.

The patient was treated with a series of plasma exchange. After 14 days he began to walk with crutches and ptosis and

diplopia significantly decreased. 6 weeks later he was able to walk without support and oculomotor function normalized.

Neurophysiological findings in MFS are discussed

Conclusion: In our patient with MFS we diagnosed presynaptic type (axonal) disorder of neuromuscular transmission.

AUTOIMMUNE LOWER MOTOR NEURONE DISORDER – CASE REPORT

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Motor neurone diseases (MND) traditionally include a broad spectrum of neuromuscular disorders. First, we have to mention sporadic forms of ALS (amyotrophic lateral sclerosis) with mixed clinical presentation (syndromes with upper and lower motor neurone signs), then the isolated central type (primary lateral sclerosis, PLS) and at last the isolated peripheral type (primary muscular atrophy, PMA). The existence of familiar hereditary and genetic MND forms is well known, e.g. superoxide dismutase (SOD-1) and dynactin gene muta-tions are known to cause PMA variants also called LMND (lower motor neurone disease).

Selected LMND cases are associated to specific autoantibodies. For example an asymmetric lower motor neurone syndrome with predominant distal involvement is associated to IgM anti–GM1 or to IgM anti–GalNAc-GD1a. Another LMND variant is an asymmetric lower motor neurone syndrome with particular damage of proximal upper extremities muscles (also known as Vulpian-Bernhard syndrome, brachial amyotrophic diplegia or flail arm syndrome) can be associated in 10-20% cases to anti–asialo GM1 autoantibodies. We present a patient's case report with suspected Vulpian-Bernhard syndrome with bilateral non-symmetric cervico-brachial amyotrophy without sensory impairment. The autoimmune aetiology was clearly proven by clinical responsiveness to immunosuppression/immunomodulation therapy mainly to repetitive intravenous human polyclonal immunoglobulin application (IVIG).

ELECTROPHYSIOLOGY STUDY OF DISTAL MEDIAN TO ULNAR NERVE TRANSFER TO RESTORE ULNAR MOTOR FUNCTION - CASE REPORT

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Introduction: Traumatic lesions of ulnar nerve can be responsible for a great loss of hand motor function. Nerve suture of the anterior interosseous nerve, especially the pronator quadratus branch, with deep branch of ulnar nerve can restore ulnar motor nerve´s intrinsic function of the hand and prevent hand clawing. Electrophysiological methods help with diagnosis and guide surgery.

Objectives: We present a patient with recovery of the hand intrinsic functions after interposition nerve grafting. It has been well documented, step by step, by pre-operative, intra--operative and post-operative electrophysiological examinations.

Methods: Electromyography (EMG) was performed before and after the surgery. Ulnar nerve neurography and ulnar nerve cortical somatosensory evoked potentials (SEPs) were examined at both motor and sensory division of ulnar nerve during the surgery.

Results: A 10 year old boy was referred to the neurosurgeon for ulnar nerve cut on his non-dominant arm. Urgent nerve suture was performed. Repeated EMG carried out 6 and 12 months later revealed the evidence of reinnervation potentials in the flexor carpi ulnaris muscle and no recovery in the hand´s intrinsic muscles. Repeated surgical intervention – anterior interosseous to ulnar motor nerve transfer – was recommended. Intraoperative ulnar neurography confirmed complete nerve lesion with no nerve action potential. Ulnar nerve cortical SEPs were recorded to identify sensory division of the nerve and to reduce the misdirected connection of the motor fibres. Surprisingly, cortical SEPs of ulnar nerve were recorded from both motor and sensory division. We explain it by the cross-reinnervation between motor and sensory fibres after the first nerve suture. The motor division had to be identified only by anatomic signs. Post-operative EMG study showed the recovery of action potentials from ulnar intrinsic muscles by median and not by ulnar nerve stimulation. The findings confirmed reinnervation by anterior interosseous nerve. In the post-operative follow-up we detected restored muscle strength (grade IV) of intrinsic muscles, which confirmed successful functional regeneration of the nerve.

Conclusion: The anterior interosseous to ulnar motor nerve transfer is the unique treatment of ulnar nerve injury. Electromyography is commonly used for diagnosis, however, intraoperative electrophysiological methods we used seems to be so far underestimate in routine clinical practice.

NF vyšší nervové činnosti 1

fMRI AND EEG STUDIES OF THE ROLE OF BASAL GANGLIA IN EPILEPSY

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1.   In the fMRI study the impact of epilepsy on the functional brain connectivity (FC) of the BG in two large-scale networks, the default mode network (DMN) and somatomotor network (SMN), was studied in 10 healthy control subjects (HC) and 24 patients with epilepsy. In HC, the BG were functionally negatively correlated with typical DMN regions. This negative correlation as well as the FC between the BG and SMN was significantly lower in patients [3].

2. SEEG studies: The human striatum and pallidum did not generate specific epileptic EEG activity, not even when the seizures were generalized. The visually observed slowing and amplitude increase in the BG was found with the spread of the epileptic activity from the hippocampus to other areas [1]. Significant frequency components of 2-10 Hz, with the maximum in the 5-10 Hz range, were constantly observed in the BG [2]. The frequency of this component slowed by around 2 Hz during seizures. There was a significant ictal increase of power spectral density in all frequency ranges. The changes in the BG were consistent while the seizure activity spread over the cortex, and they partially persisted after the clinical seizure ended. They were inconsistently present in the first period after the seizure onset.

Conclusion: Unlike in HC, in TLE the BG are not correlated with a DMN component, and the FC of the BG is decreased with SMN. The epileptic process reduces the FC between the BG and large-scale brain networks. This may reflect an altered function of the BG in epilepsy.

Based on our SEEG studies, the time course of the oscillatory activities together with the absence of the epileptiform EEG activities in the BG lead us to suggest an inhibitory role of the BG in temporal lobe seizures.. This "filtering effect" of the BG may act as an obstacle to the spread of ictal activity. The BG should be seriously considered as a potential target for neuromodulatory and pharmacological treatment of TLE.

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THE CONTRIBUTION OF INTRACRANIAL EEG TO RESEARCH ON THE EMPATHY FOR PAIN

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In the last decade, a number of functional neuroimaging studies have identified a set of neural structures that are involved in empathy for another person's pain. Bilateral anterior insular cortex and medial/anterior cingulate cortex seem to play a crucial role, but several other brain regions are also co-activated; this includes structures associated mostly with "Theory of Mind" or "mentalizing", including precuneus, ventral prefrontal cortex, superior temporal cortex, and temporo-parietal junction. Electrophysiological pain-empathy responses have been analyzed to investigate the temporal dynamics of neural activity underlying this process. To the best of our knowledge, however, this has been performed with scalp recordings only; pain empathy-related brain potentials have not recorded using intracranial electrodes until now.

In the present study, we investigated intracranial event-related brain potentials (ERPs) from three intractable epileptic patients who underwent preoperatively diagnostic invasive video-EEG monitoring. During the experiment, patients watched 3-second dynamic visual stimuli depicting needle injections into a left hand (N=42), or the same left hand touched by a cue tip (N=42). Intracranial EEGs were recorded using intracerebral and subdural electrodes, investigating in total more than 300 brain sites. The ERPs in each condition (needle and cue tip) were averaged separately off-line, and statistical differences in response amplitudes after painful vs. non-painful stimuli were detected.

In all three subjects, significantly different event-related responses to painful vs. non-painful stimuli were observed in some investigated neural structures, including left-hemispheric temporo-parietal junction, right-sided temporo-occipital junction, and right-sided lateral occipital cortex. In these brain sites, painful needle stimuli evoked more prominent ERPs compared to cue-tip touch. The latency of these intracranial ERPs can be used for direct measurement of local activation with millisecond temporal resolution, and can be compared across different brain structures as well as with the scalp ERPs.

Our pilot data demonstrate the ability of intracranial ERP recordings to contribute to our understanding of pain empathy. More generally, these data provide important insights into more complex social phenomena, and complement widely available functional neuroimaging data which are limited by their reliance on hemodynamic rather than direct neural measurements.

THE OCCURRENCE OF ALPHA ACTIVITY DURING CYCLICAL REPETITIVE MOVEMENT

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AIM: Traditionally, electroencephalographic research describes the occurrence of alpha activity on condition of a relaxed state and with closed eyes only. However, some recent studies have detected alpha activity during motor tasks such as cyclical repetitive movement. The aim of our study was to monitor the occurrence, frequency and distribution of scalp alpha activity during qi gong practice both with open and closed eyes.

METHODS: Five volunteers were tested (three men, two women), all with more than twelve month experience with qi gong practice. We selected simple basic movements which all volunteers were familiar with. They were asked to per-

form the given movements for ten minutes with open eyes first, and subsequently for ten minutes with eyes closed. Simultaneously, electroencephalographic activity was recorded with the telemetric 32-channel Nicolet EEG Wireless Amplifier by Natus Neurology Inc. The recorded data of subjects performing movements was then compared with their native EEG recorded before qi gong practice.

RESULTS: During native EEG testing before qi gong practice (in a relaxed resting state with closed eyes) alpha activity was registered with four subjects. In the same fours subjects, alpha activity was also recorded during qi gong practice with closed eyes, and in three subjects also during qi gong practice movements with open eyes. Only with one subject there was beta activity both in the resting and exercising mode (both with open and closed eyes).

CONCLUSION: Many studies have looked into the correlation of brain activity and alpha activity. To sum up, it can be said that there is a negative correlation between alpha activity and cerebral neocortex activity, and positive correlation between alpha activity and the deeper structures of the brain (thalamus, amygdala and insula, anterior cingulum and cerebellum). The results of this pilot study indicate that there is a subcortical steering process for acquired movement stereotypes which are accompanied with a decrease in cerebral neocortex activity and an increase in the activity of certain limbic structures.

HIPPOCAMPAL NEGATIVE EVENT-RELATED POTENTIAL RECORDED IN HUMANS IS NOT TIME-LOCKED TO THE MOTOR RESPONSE EXECUTION

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A hippocampal-prominent event-related potential (ERP) with a peak latency at around 450 ms is consistently observed as

a correlate of hippocampal activity during various cognitive tasks. Some intracranial EEG studies demonstrated that the amplitude of this hippocampal potential was greater in response to stimuli requiring an overt motor response, in comparison with stimuli for which no motor response is required. These findings could indicate that hippocampal evoked activity is related to movement execution as well as stimulus evaluation and associated memory processes. The aim of the present study was to investigate the temporal relationship between the hippocampal negative potential latency (hippocampal slow negativity, hipp SNe) and motor responses. We analyzed ERPs recorded with 22 depth electrodes implanted into the hippocampi of 11 epileptic patients. Subjects were instructed to press a button after the presentation of a tone. All investigated hippocampi generated a prominent negative event-related potential peaking at approximately 420 ms. In 16 from 22 cases we found that the ERP latency did not correlate with the reaction time; in different subjects, this potential could either precede or follow the motor response. Our results indicate that hippocampal slow negativity is not time--locked to the motor response. We suggest that hippocampal evoked activity, recorded in a simple sensorimotor task, is related to the full-value evaluation of stimulus significance within the context of situation.

fMRI 1

MOVEMENT SEQUENCING ABNORMALITIES IN SCHIZOPHRENIA: CHANGES IN CORTICAL ACTIVITY DURING FINGER-TAPPING TASK

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Minor motor and sensory impairments, including movement sequencing, are frequent symptoms in schizophrenia. In

a previous study (Kasparek et al., 2012) we showed abnormal cortico-cerebellar functional connectivity during execution of motor task only in schizophrenia patients (SZP) with sequencing deficit. This suggests that the abnormal connectivity reflects rather symptoms that are domain-specific, than the diagnoses of schizophrenia per se. In order to parse out the differences in brain activity during motor learning that are disease-specific (i.e. common to all SZP relative to healthy controls) versus domain-specific (i.e. specific only to SZP with sequencing deficit), we conducted a new and more detailed analysis of the data from the previous study. We used functional magnetic resonance imaging to examine brain activity during finger-tapping task in 24 SZP and 24 healthy control participants. The task had two experimental conditions, in which participants had to execute blocks of sequenced finger movements (SQ condition) and non-sequenced movements (ALL condition). Prior to the imaging session, outside the scanner the movement sequencing skills were assessed through Neurological Evaluation Scale (NES). Based on the NES scores the patients were subdivided into two groups, those with sequencing abnormalities (SQ+), and those without movement sequencing deficit (SQ-). We performed whole brain analysis to identify regions with higher activation during SQ as compared to ALL blocks and we analyze these results as a function of movement sequencing skill. In the left motor and parietal cortices all patients had higher activation than healthy subjects in both ALL and SQ conditions. However, our analysis revealed that this effect was driven mainly by the SQ- subgroup in motor cortex, and by SQ+ group in parietal cortex. No such differences were seen in the contra-lateral cortices. We conclude that executing a non-sequenced motor task is more demanding for SZP than controls (disease-specific), since they show constantly higher activation in left motor and parietal cortex. Notably, although the overactivation of motor cortex seems to be a good compensating strategy to achieve adequate motor performance, the hyperactivation of parietal cortex seems to be linked to motor deficit symptoms (domain-specific).

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Acknowledgement

LONGITUDINAL FMRI ASSESSMENT IN CHRONIC SPINAL CORD INJURY TREATED BY INTRATHECAL BACLOFEN - PILOT DATA

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Introduction: Spasticity is a frequent disabling sign of upper motor neuron lesion in chronic spinal cord injury (SCI). In severe cases intrathecal baclofen (ITB) is recommended as a choice of effective treatment. Baclofen, being as a strong GABAB agonist, modulates cortical and spinal inhibitory circuits. The aim of this study was to assess longitudinal changes in brain activation after continuous ITB delivery during simple motor tasks performed by functional magnetic resonance imaging (fMRI).

Material and Methods: Two subjects (27 and 35 years-old males, 5.5 years after SCI) with chronic posttraumatic cervical spinal cord injury at C4-5 level underwent ITB pump implantation (Synchromed II, 20ml, Medtronic). Spasticity was assessed by modified Modified Ashworth Scale (MAS, 0 to 4). Both subjects were studied by 1.5T fMRI with three tasks employed: i) finger-tapping and mental movement simulating, ii) finger taping and iii) foot flexion. Tasks were performed before, 12 weeks and one year after ITB pump implantation. Analysis was processed in SPM8 using the FWE corrected threshold ($p < 0.05$).

Results: Both patients were classified as AIS-A and they presented no active movements of lower limbs. In both subjects, MAS score declined in the lower extremities from 4 to 1 before and after ITB implantation, respectively. Before-ITB pump implantation fMRI showed weak activations in all tasks. Post--ITB tasks extensively raised activation in the motor system network, namely the primary sensorimotor cortex and supplementary motor area. In one year follow-up, the activation in foot-flexion mental tasks were detectable only in one of the subjects, with slightly increased volume. One of the most important factors, influencing all the results, is subject motion.

Conclusions: Continuous ITB administration relieving spasticity in SCI patients was associated with increased activation of sensorimotor cortex. ITB treatment may cause distant functional reorganization of sensorimotor network probably by increased GABAB-mediated inhibitory activity at cortical level.

PLASTICITY OF SENSORIMOTOR SYSTEM INDUCED BY SUSTAINED PRESSURE STIMULATION

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Introduction: The aim of this study was to assess functional changes occurring at central nervous system (CNS) in healthy volunteers after sustained pressure stimulation according to Vojta1, a physiotherapeutic method involving induction of a complex motor response, so called reflex locomotion. Although the therapy has been widely used in clinical practice, its underlying neurobiological basis remains a speculation. We hypothesize that the stimulation-driven response induces CNS plasticity at subcortical level detectable by functional magnetic resonance imaging (fMRI), possibly involving specific changes in task-related sensorimotor system activation as well as modulation of resting state networks.

Methods: Two groups of healthy volunteers were included (17 females and 5 males in each group, mean age 24.5 and 24.7 respectively): Group A receiving stimulation at the Vojta right heel zone and Group B receiving control stimulation of the right ankle. All subjects underwent a single fMRI session using a 1.5T Siemens scanner, including 6 experimental runs employing 3 different conditions: rest (6 min); dominant hand finger tapping alternating with rest (6 min); intermittent pressure stimulation applied by an experienced therapist (10 min). Both rest and finger tapping conditions were tested before and after two consecutive stimulation runs. Statistical analysis, including standard pre-processing, nuisance signal regression and group post-hoc contrasts, was carried out using FEAT, and MELODIC followed by Dual Regression, parts of FSL2 5.0. The resulting statistical maps were thresholded at corrected significance level $p < 0.05$.

Results: In finger tapping task, diffuse activation decrease within sensorimotor system was observed in both groups. However, there was significant activation increase mainly in motor nuclei of left thalamus detected only in group A. Additionally, group A showed significant decrease of functional connectivity in the left superior parietal lobule within the bilateral sensorimotor resting-state network.

Conclusions: Our findings provide evidence that stimulation according to Vojta is associated with specific and persistent changes of brain activation, as compared to the control stimulation. The observed changes could represent neurophysiological correlate of Vojta therapy and suggest an important role of subcortical structures.

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Epilepsie 1

PHOTIC STIMULATION IN THE EEG LABORATORY – EUROPEAN ALGORITHM

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Intermittent photic stimulation (IPS) is a common procedure performed in the EEG laboratories in children and adults to detect photosensitivity. In clinical practice, a considerable variability in outcome can be observed which is caused due to many different methodologies used per laboratory. Standardization of this procedure based on scientific and clinical data should permit reproducible identification and quantification of photosensitivity. A survey of IPS methodologies used in different EEG laboratories in the Czech Republic will be presented and compared to the algorithm proposed as a consensus of European experts in this field in 2011.

STATISTICAL PARAMETRIC MAPPING OF REGIONAL GLUCOSE METABOLISM IN MESIAL TEMPORAL LOBE EPILEPSY ASSOCIATED WITH HIPPOCAMPAL SCLEROSIS

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Objective: This study was designed to use statistical parametric mapping (SPM) of preoperative interictal FDG-PET to compare the brain metabolisms of patients with mesial temporal lobe epilepsy/hippocampal sclerosis (MTLE/HS) who underwent resective surgery and controls. Another aim of this study was to analyze potential differences in SPM-PET within the group of MTLE/HS patients in terms of gender, side of HS, histopathological findings, and postoperative outcomes.

Methods: We analyzed FDG-PET scans from 49 patients with MTLE/HS and 24 control subjects. Using SPM, we analyzed the differences in regional glucose metabolism between the patient and the control groups and within the patient group using multiple variables.

Results: We revealed widespread hypometabolism in the patient group in comparison to the control group in temporal and extratemporal areas on the epileptogenic side (ES). On the nonepileptogenic side (NES), we observed most the hypometabolism in the thalamus and the anterior and middle cingulate gyri (GCA and GCM). In the group of patients with more severe HS (Wyler III/IV), we observed statistically significant hypometabolism in the insula on the ES in comparison to the patients with Wyler I/II HS. In patients with poor postoperative outcomes (ILAE III-V), we found statistically significant hypometabolism in the insula on the ES and the TP on the NES compared to the ILAE I and II group. Patients

with encephalitis/meningoencephalitis and/or febrile seizures in their history showed significant hypermetabolism in the TP either on the ES or the NES and in the middle temporal gyrus on the NES compared to the patients without any insult in their history.

Significance: Our study showed that there are widespread significant changes in metabolism in MTLE/HS patients in comparison to controls, either inside or outside the temporal lobe and mostly ipsilateral to the side of HS. There are significant differences among these patients in terms of postoperative outcomes, degree of HS, and insults in their history.

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QUANTITATIVE EEG ASSESSMENT IN EPILEPTOLOGY – A POSSIBLE WAY TO IMPROVE THE DIAGNOSTICS AND TREATMENT

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Novel and quantitative methods EEG signal analysis are being developed by close multidisciplinary collaborations between epilepsy specialists, biomedical engineers and mathematicians. Quantitative analysis of the long-term monitoring from intracranial electrodes is expected to provide precise and objective results. High performance computational algorithms will be presented, not only from technical point of view, but also to demonstrate that output of these techniques can provide quantitative and clinically relevant diagnostic information. Three types of automatic and semi-automatic al-

gorithms of quantitative EEG analysis will be presented and their benefits for epilepsy surgery planning discussed.

Interictal epileptiform discharges and high-frequency oscillations represent electrographic markers of epileptic tissue. Methods of their automatic detection can substantially facilitate analysis of multi-channel long-term intracranial recordings and extract unbiased meaningful information about spatiotemporal and morphological properties of these markers.

Visual identification of seizure onset zone in intracranial recordings is challenging and prone to bias. Methods of seizure onset identification represent one of the main research directions of intracranial signal processing. It has been demonstrated that introduction of causality measures and network analysis can provide useful information about epileptic network organization. These techniques are capable to identify the seizure onset zone in both ictal and interictal recordings. Application of average Directed Transfer Function and Granger's causality to intracranial recordings demonstrate that seizure onset zone is characterized by the disconnection from the rest of the epileptic network.

Increased information yield and quantitative results lead to increased integration of the above mentioned methods into presurgical diagnosis. These methods of intracranial signal analysis can improve guiding of resective surgery in difficult-to-treat cases and offer surgery to patients formerly classified as not suitable for surgery.

FUNCTIONAL ORGANIZATION OF THE IRRITATIVE ZONE IN NEOCORTICAL EPILEPSY

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Rationale: The irritative zone is an area of the brain generating interictal epileptiform discharges (IEDs) that is used together with other results when planning epilepsy surgery. This zone possesses relatively low diagnostic value due to lack of a specific marker that would identify IEDs generated within the epileptogenic tissue. To increase diagnostic yield of irritative zone, we examined its functional organization.

Methods: Intracranial EEG recordings from 14 patients with refractory neocortical epilepsy were analysed using an algorithm that separates IEDs according to their spatial distribution into clusters. Analysis of cluster properties enabled to determine: 1) activity - percentage contribution to all IEDs in the given recording; 2) origins - the contacts where cluster initiates and 3) active region - the area of the most common propagation.

Results: On average 16,868±16,813 IEDs per patient were analysed. The results demonstrated that in all patients the irritative zone was composed of multiple clusters with an average number of 12.5±4.7 clusters per patient. The strongest cluster generated 43.5±18.9% of all IEDs Average size of active region was 4.5±4.5 contacts and contained 2.2±1.7 origins. Evaluation of the cluster resection with the outcome suggested that the topology of the irritative zone may determine the success of the resection.

Conclusion: This study demonstrates the complex organization and modular nature of the neocortical irritative zone in epilepsy patients. It can be stratified into functional components, each with distinct pathophysiological and clinical significance. The ability to identify the key components of this network and its topology has potential to improve the results of epilepsy surgery.

Varia

DETECTION OF POSTURAL OSCILLATORY MOVEMENT WITHOUT CLINICALLY MANIFESTED TREMOR IN MULTIPLE SCLEROSIS: A PILOT STUDY

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Background: Tremor is an involuntary rhythmic oscillatory movement of a body. It belongs to one of the most prevalent and disabling feature in multiple sclerosis (MS).

Objectives: The types of tremor in MS are still not unified. The aim of our work was to detect which types of oscillatory movements of upper extremities are present in MS without clinical manifestation of the tremor.

Material and Methods: Ten patients with MS (9 women, mean age 37 □ 11years, mean EDSS 3,9 □ 0,8, mean length of the disease 10,2 □ 7,3) and 10 healthy controls participated in this study. Postural tremor was measured with open and closed eyes using an accelerometer LIS 3LV02DQ, ST Micro. The most complex resting signal was measured in upright position, when one arm was hanging freely next to the body and second arm was raised forward. Tremor sensor was placed on the index finger of arm that was raised forward. Frequency, rhythmicity and change of amplitudes were analyzed by spectral analysis.

Results: In healthy subjects with open eyes the spectral analysis showed 3 prevailing frequencies of oscillatory movements: a) 2-3 Hz, b) 7-10 Hz, and c) 12-14 Hz. When eyes were closed, the lowest frequencies disappeared. Oscillatory movement of 7-10 Hz was the most frequent type in MS and significantly differs from healthy subjects. The amplitude of oscillatory movements in MS was profoundly higher than in healthy individuals.

Conclusions: Difference of frequency of oscillatory movements in MS with the most prominent manifestation at 7-10 Hz may correspond to early desinhibition of motor control probably at subcortical level.

REDUCTION OF STUTTERING THROUGH BRONCHODILATATION WITH B2-SYMPATHOMIMETIC DRUG FORMOTEROL

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About 60 million people on the planet suffer from stuttering. Speech fluency disorder caused by stuttering (F98.5) was known already in the ancient civilizations of Egypt, Mesopotamia and China 7000 years ago (1). Despite of this the etiology of stuttering has remained unknown and its causal

treatment has not been possible. According to ICD-10, 10th revision (2), stuttering belongs to „Other behavioral disorders including emotional ones with their beginning in childhood and adolescence" (F98) and is related to Chapter V „Mental and behavioral disorders" (F00-F99). A multi-centric clinical study FORZAK-0503 (3), confirmed (4) hypothetical assumption (5) of the influence of pneumoobstruction of the tracheobronchial tree on the fluency disorder. Poetically spoken, the door opened towards causal reduction of speech disfluency accompanied often by tormentous stuttering (6) then (7). Besides publishing new findings on the etiology of stuttering, it is needed to transfer stuttering under different classification and different identification code within ICD-10 (MKN-10).

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META-ANALYTIC AND RESTING-STATE FUNCTIONAL CONNECTIVITY OF THE CLAUSTRUM

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Introduction: The claustrum anatomy is quite remarkable for its reciprocal connections with almost all regions of the cortex. Although a multimodal integrative and/or synchronising role has been previously suggested, its function remains enigmatic so far. The present study had two main aims: First, we employed the database driven approach to investigate the task-dependent functional connectivity using meta-analytic connectivity modelling (MACM). Second, we performed a complementary resting-state (task-independent) functional connectivity (RSFC) analysis of an sample of healthy subjects.

Methods: The regions of interest (ROIs) for both MACM and RSFC were manually drawn in the left and right claustrum on a standard space template. For MACM, the ROIs were input as seed regions into the BrainMap database (http://BrainMap.Org)1. The significant areas of coactivation were obtained using modified activation likelihood estimation (ALE) algorithm2. For RSFC, a dataset of 50 healthy volunteers (25 males, average age 31.36) was downloaded from the NKI/Rockland sample3. We employed seed-based general linear model analysis, as implemented in FSL v5.0 (http://www.fmrib.ox.ac.uk/fsl)4. The modelled time--series were extracted from the preprocessed data in each ROI. To account for head motion and physiological noise, the model further included several vectors of nuisance signal. Both MACM and RSFC maps were registered to a common MNI152 standard space. Additionally, connectivity of the putamen and insula was subtracted or regressed out in the model to avoid false positives due to partial volume effect and spatial filtering. Next, contrast analysis of resulting maps for the left and right claustrum was performed to detect possible asymmetries. The resulting maps were thresholded at corrected $p < 0.05$.

Results: Both MACM and RSFC have shown similar and mainly symmetrical pattern of connectivity including the contralateral claustrum, ventrolateral thalami, lentiform nuclei, cerebellum, pons, bilateral precentral cortices (BA6), supplementary motor area, insular and frontoparietal opercular cortices. At lower Z threshold, the RSFC maps resembled a combination of several resting-state networks – including task-positive, sensorimotor and salience networks, while excluding mainly rostral frontal and ventral temporal cortices, and so-called default mode network located to posterior cingulate, precuneus cortex, and lateral occipital cortices. Moreover, some striking asymmetries were observed: left claustrum connecting more to the left inferior frontal gyrus (BA44), superior frontal gyrus and left thalamus. On the other hand, the right claustrum showed stronger connections to the right superior and inferior parietal lobule.

Conclusions: Our findings provide novel evidence for the connectivity of the claustrum, suggesting a more specific role in sensorimotor and task-positive systems.

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EEG 1

AUTOMATED SYSTEM FOR QUANTITATIVE ANALYSIS OF THE EEG BACKGROUND.

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Objectives: This study presents an automated quantitative EEG background analysis system in Microsoft Excel that re- solves certain methodological problems in usual qualitative assessments of properties of the EEG background.

Methods: EEG epochs without extra-cerebral signal artifacts with duration of 2-8 s were subjected to further processing by using an automated analysis system. The trends (identified by the least square method) and the DC offsets (identified by calculating the average value of the data row) were subtracted. The onsets and the ends of the data rows were smoothed by applying the Hanning's window and subjected to Fast Fourier Transform (FFT). The power spectra over the band-pass of 0.5-45Hz were calculated. Both the means of the spectral powers and the spectral powers of the major peaks in the rough delta to gamma spectral bands and in the more detailed narrower sub-bands (by splitting the delta into four; theta into three; alpha into three; beta into four and gamma into 3 sub-bands) were analyzed. In addition to the conventional topographic spectral band analysis, global coefficients of the following indexes were calculated: the ratios of the particular rough spectral powers, the diffused background slowing, the spectral moments and their centers, the topographic spectral gradients and asymmetries in the peaks powers and frequencies. The individual findings were compared with the parameters which were based on provisional database of 76 normal adult EEG (52.16 y.; 15.95; 19-83; mean age; SD; range).

Conclusions: The EEG analysis is based on assessment of the properties of the background and the events. The detec-

tion of events which are blowing out from the background is relatively easy and straightforward. However, an assessment of the background might be sometimes a difficult task even for a trained EEG specialist. This system which is based on the commonly used Excel environment offers several advantages. The main advantage is the possibility of the easy accomplishment according to the needs of the user, and the development of the EEG research.

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CLINICAL EVALUATION VERSUS AUTOMATIC DETECTION OF INTERICTAL EPILEPTIFORM DISCHARGES – WHO CAN WE TRUST?

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Objective. Interictal epileptiform discharges (IEDs) are electrographic hallmark of epilepsy. Information about the spatiotemporal distribution of IEDs in intracranial EEG is utilized to localize epileptogenic zone during the presurgical evaluation and plan the resection. Visual evaluation of long-term multi-channel intracranial recordings is extremely difficult and prone to bias. Clinicians usually assess only high-amplitude (high signal to noise ratio) discharge and low-amplitude IEDs can be overlooked or considered clinically insignificant. The goal of our study was to develop reliable automatic IED detectors to facilitate analysis of long-term recordings and increase the information yield of intracranial recordings.

Methods. Seven intracranial EEG recordings were randomly selected from our database. Samples of five minutes duration from fifteen high-rate IED channels (525 minutes in total) were presented to three experienced EEG specialists for spike labelling. The readers independently reviewed the data and classified IEDs into two groups: obvious and ambiguous. The inter-reader agreement was evaluated and IEDs labelled by at least two readers were considered as a gold standard

(GS). We have developed, tested and optimized novel IED detector using GS datasets and compared its performance with published detectors. Our detecting approach estimates the signal envelope distribution to discriminate IEDs from background activity.

Results. Readers together labelled 6,518 IEDs (53±21% obvious, 47±21% ambiguous). The reader's maximal match was 58% in pair and agreement of all three readers was only 30% (Cohen's kappa 0.14±0.11). Detector's performance was characterized by sensitivity 91±12% and 8±7 false positives per min and per channel. Its performance was 1.4× better than published detector. Examination of false positives revealed that substantial proportion had shape of reminiscent of IEDs, but with lower amplitude. More than 50% false positives were reclassified by readers as IEDs. In addition, regression analysis showed positive relationship between IEDs marked by readers and number of false positives.

Conclusion. The inter-reader agreement in visual IED evaluation is poor. Even experienced readers can identify approximately 40% of IED, especially those with high signal-to--noise ratio. In contrast, automatic detector is 2.5× more sensitive and can identify also low-amplitude IEDs. Areas generating not only high- but also low-amplitude IEDs can be crucial for epileptogenic zone localization.

IOM

PERIOPERATIVE MONITORING OF COGNITIVE FUNCTIONS BY EVENT-RELATED POTENTIALS AND PSYCHOMETRIC TESTS

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Introduction. Postoperative cognitive dysfunction (POCD) is well recognized, but poorly understood syndrome. The role of used anaesthetics remains unclear. Neurophysiologic method – auditory event-related potentials (ERPs) are widely used for assessment of cognitive brain functions.

Objectives. To test the difference in occurrence of POCD between patients undergoing sevoflurane and propofol anaesthesia using standard psychometric tests and ERPs.

Methods. We present results of scheduled interim analysis of the prospective randomized trial after inclusion of 30 pati-

ents undergoing lumbar discectomy. Patients were randomized to receive either sevoflurane (group S; n=18) or propofol anaesthesia (group P ; n=12). Anaesthesia depth was controlled by BIS monitoring. POCD was assessed using modified standard psychometric test battery and ERPs (wave N100 and P3) in defined time-points (preoperatively and postoperatively on day 1, 7 and 40). POCD was defined as a decline of more than one standard deviation in three or more tests.

Results. ERPs analysis of the S group showed increase in the latency (84.9±1.4 vs. 81.4±1, p=0.03) and decrease of the amplitude (6.3±0.6 vs. 8.0±0.8, p<0.001) of the N100 wave on day 1 with normalization on day 7. P3a wave amplitude also in S group showed significant decrease on day 7 (6.2±0.8 vs. baseline 8.4±0.9; p=0.01) lasting till day 40 (6.3±0.9; p=0.004).

POCD using standard tests was diagnosed in 6 patients (33 %) of S group versus 2 (17 %) in P, p=0.41.

Temporary occurrence of new POCD development did not differ between groups (4, 5 and 4 pts. vs. 1, 1 and 0 pts.; on day 1, 7 and 40 in groups S and P respectively; p=0.31). In the S arm a significant decrease in Categorical Verbal Fluency score (CVF) was observed on day 1 (13.7±0.8; p<0.001) and 7 (16.3±1.1; p=0.01) compared to baseline value (22.2±1.5) with normalization on day 40. No differences in other tests were observed.

Conclusions. ERPs analysis showed early auditory sensory impairment and late cognitive decline after sevoflurane use, however these changes were subclinical. POCD occurrence was non-significantly more frequent among patients after sevoflurane anaesthesia, possibly associated with short-term semantic memory impairment assessed by CVF decline.

INTRAOPERATIVE NEUROPHYSIOLOGICAL MONITORING OF BRAIN PERFUSION DURING CARDIAC SURGERY IN PATIENTS WITH ASYMPTOMATIC INTERNAL CAROTID STENOSIS.

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Introduction: Asymptomatic internal carotid (ICA) stenosis is one of documented risk factors of perioperative ischemic stroke (IS) in cardiac surgery. There is no strict consensus in benefit of prophylactic carotid endarterectomy (CEA) in asymptomatic ICA stenosis to reduce intraoperative IS. Median somatosensory evoked potentials (SEP) is reliable tool for intraoperative neurophysiological monitoring (IONM) of brain perfusion during CEA.

Aim of study: Determine safety of median SEP monitoring in intraoperative IS prevention.

Material a Methods: From 1st Jan 2013 to 31st Aug 2014 were enrolled 26 patients (20 males (76.9%), 6 females (23.1%) age range 59-84, average 71.9± 6.47 years). All patients underwent cardiosurgical procedure in extracorporal perfusion (EC) with IONM of cerebral perfusion.

Inclusion criteria: ICA stenosis $\geq$ 50% on one or more sides, asymptomatic > 6 months.

Unilateral stenosis was detected in 10 (38.5%), bilateral in 13 (50.0%), occlusion with contralateral stenosis was in 3 patients (11.5%).

IONM consisted of median SEP and brainstem auditory evoked potentials (BAEP), near infrared spectroscopy (NIRS) were monitored synchronously. Warning and alarm were always directed at anaesthesiologist or perfusionist.

Significant changes were defined as: > 50% of N20/P25 amplitude decrease in SEP and/or "V" wave in BAEP and or "V" latency prolongation > 1 ms. NIRS decrease $\leq$ 40.

Coronary bypass was performed in 22 patients (86.4%), aortic valve replacement in 10 (38.5%), mitral valve replacement in 6(23.1%). Cardiac compartments were opened in 17 cases (65.4%).

Results: SEP amplitude decrease was detected in 5 (19.2%). In 4 of them (80%) was asymmetrical relevant to higher grade of ICA stenosis. Mean arterial pressure (MAP) increase was most effective manoeuvre in all cases. Full SEP restoration (> 50% baseline amplitude) appeared in 3, partial in remaining 2 patients.

Decrease of NIRS was recorded in 4 (15.4%) and always bilateral, symmetrical. Both NIRS and SEP decrease was only marginal, and in 1 case only. BAEP changed nonsignificantly.

No new neurological deficit appeared in 25 (96.2%) within 24 hours. 1 patient could not be clinically evaluated.

3 patients (11.5%) died within 7 days (1- ileus, 2 circulation failure). Perioperative IS was not recorded.

In all surviving 23 patients neither neurological deficit nor TIA/IS within 3 months period after surgery.

Conclusion: Intraoperative brain hypoperfusion in SEP was detected in about 19% of cases. MAP elevation caused in

SEP restitution. No false negative SEP changes were recorded.

No new neurological deficit developed during and after surgery.

NIRS changes were neither consistent with SEP changes nor neurological outcome.

STRUCTURAL CONNECTIVITY OF ELOQUENT SPEECH AREAS DEFINED BY DIRECT CORTICAL STIMULATION MAPPING

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Introduction: The awake intraoperative cortical mapping using direct electric stimulation during neuropsychological testing has become the preferred method to delineate the highly variable speech areas in brain tumour patients. Interestingly, there was no clear relationship observed between the gyrification and the regions involved in various language tasks. In this pilot study, we employed preoperative diffusion tensor imaging (DTI) to test whether eloquent cortex was better predicted by different structural connectivity rather than by its relation to gyrification.

Methods: Four patients (3 males, average age 37) suffering from primary brain tumour underwent pre-operative 3T MRI scanning using a high resolution T1 MPRAGE and a single shell diffusion weighted imaging (DWI) sequence (60 directions, b=1000s/mm2, 2x2x2mm) and intraoperative direct cortical electrical stimulation with a bipolar Ojemann electrode during awake language mapping. After standard preprocessing (FDT in FSL1), probabilistic fiber tracking was performed on DWI data, using 5mm spheres around the intraoperatively defined sites as cortical seeds (PROBTRAC-KX in FSL1). The resulting cortical projections were then projected onto the coregistered and segmented individual cortex (Freesurfer).

Results: A variety of stimulation-positive functional sites was detected and compared to each other, including anomia, counting, speech and motor arrest. The anomia sites were found both in the pars triangularis and pars opercularis of the inferior frontal gyrus. Even opercular anomia sites followed the connectivity pattern of triangular anomia sites and had stronger connections to the rostral parts of the mesial prefrontal cortex and pre-supplementary motor area (pre-

-SMA) than to the precentral gyrus and SMA proper, as opposed to opercular speech or counting arrest sites which also connected more strongly to more posterior parts of the brain, mostly posterior temporal cortex2. Thus, even adjacent sites on the same gyrus that differed in function showed dissociable structural connectivity.

Conclusions: Our results suggest that structure-function relationships are more evident between function and structural connectivity than between function and gyrification.

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Acknowledgement:

Epilepsie 2

PRACTICAL VALUE OF QUANTITATIVE EEG IN EPILEPSY SURGERY PLANNING

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Objective. To assess whether available algorithms of quantitative EEG (qEEG) could practically help in localizing epileptogenic zone (EZ) and modify surgical planning in patients with focal intractable epilepsy.

Methods. We will present a case report of a 7-year-old boy with catastrophic epilepsy caused by focal cortical dysplasia located in the operculo-insular region of the right hemisphe-

re. Due to the challenging localization of the presumed EZ, uncertain surgical borders and expected significant risks of the resection, the patient was stereotactically implanted with oblique depth electrodes. Intracranial EEG (iEEG) signal was analyzed using different qEEG methods. Our originally developed interictal epileptiform discharges (IED) detecting algorithm, which also extracts repetitive propagation patterns, was applied to localize sources of IED. We also used own network connectivity algorithm to analyze ictal (seizure) iEEG activity in detail. Employing results of qEEG analyses, 2D and 3D dynamic reconstructions of both interictal and ictal iEEG epileptiform changes were created and used to guide surgical approach.

Results. Both qEEG algorithms clearly proved the EZ localization in the dorso-caudal insular cortex of the right hemisphere and demonstrated sparing of initially suspected frontal opercular area. The dorso-caudal insular cortex generated 89% of IED; remaining 11% IED originated from the primary motor cortex. Surgical approach was adjusted to this qEEG-based hypothesis. Oblique depth electrodes were preserved intraoperatively to help precise targeting of the lesion. Continuous intraoperative motor-evoked potential monitoring was used to preserve motor functions. The boy has been followed for more than one year postoperatively. He is seizure-free with no motor deficit; with normal cognitive functions.

Conclusions. The case report demonstrates that currently available qEEG methods could help in guiding resective epilepsy surgery in complicated patients indicated for iEEG studies. We suggest our approach could increase patients' chance to obtain seizure-free outcomes without new deficits and thus ultimately improve their quality of life.

INFLUENCE OF DATA PROCESSING PIPELINES ON EEG-FMRI RESULTS IN PATIENTS WITH EPILEPSY

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Simultaneous EEG-fMRI is increasingly used for the noninvasive pre-surgical evaluation of epileptic patients to localize the epileptogenic zone. In this retrospective study of EEG-fMRI data in patients with pharmacoresistant epilepsy, we compared a wide range of data processing strategies using validation with resection masks after successful epilepsy surgery. The aims of this study were to find how various data processing strategies influence EEG-fMRI results, and to identify the best approach for data processing.

Thirteen subjects (9 F, 4 M) with pharmacoresistant epilepsy and good outcome after epilepsy surgery were included in the study. Simultaneous EEG-fMRI data (1.5T scanner) was acquired before the surgery (300 scans per session, TR = 3s). The position of interictal discharges (IED) was marked and used as onsets for event-related regressors in statistical model. SPM8 software was used for data processing. In total, 240 statistical analyses were calculated for each subject comprising all possible combinations of the used variants of preprocessing and GLM settings. The resection mask was created individually for each patient using clinical MR images acquired 3 months after the surgery. Several parameters (e.g. sensitivity, cosine criterion) were calculated for each dataset and processing pipeline to evaluate the concordance between spike-informed EEG-fMRI results and the resection mask. Multivariate statistical analysis was performed in SPSS software.

We found that the preprocessing type (mainly basic pipeline vs. correction for cardiac artifact) does not affect the results. The study revealed two main findings. The first is the optimal processing pipeline – only canonical HRF as a basis function, IED stimulation time series shifted 2 s earlier than positions from EEG description, and massive filtering of artifact (24 movement regressors, signals from white matter and CSF, and global signal). The second finding is related to a more general understanding of the influence of various processing options on results. The superiority of canonical HRF over more flexible basis functions is probably due to our concordance measure, which is based on a single epileptic focus represented with a resection mask, and some type of similarity between the activation map and the mask. The finding of earlier BOLD responses is in concordance with the predominantly prespiking character of the BOLD response presented in previous studies.

IMPORTANCE OF WEAK CONNECTIONS IN FUNCTIONAL NETWORK ANALYSIS OF LEFT TLE

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Brain can be described as a complex network and its structure can be changed in disease [1]. The analysis based on graph theory is a well established tool for quantification of changes in network topology [2,3]; so far the binary representation of connectivity network has been very popular: it preserves a chosen percentage of the strongest connections, thus simplifies analysis and interpretations of results. This approach, however, discards information about weak connections and weighted representation comes into use. We aim to examine differences in results from both approaches.

We used resting state fMRI data from 9 left temporal lobe epilepsy (TLE) patients and 20 controls. We extracted matrices of functional connectivity based on Pearson correlations between representatives from regions defined by AAL atlas [4], in case of binary approach we used 15% of the strongest connections. For both representations we computed path length, clustering coefficient, connectivity strength, and betweenness centrality measures and evaluated group differences by Mann-Whitney U test.

By weighted approach, we observed the significantly (FDR corr.) higher normalized clustering coefficient and higher normalized characteristic path length in patient group that suggest the shift of the network topology toward more regular structure. Together with increased global betweenness centrality, it leads us to an assumption that the patient network forms densely connected clusters that are mutually connected only by a small number of links, whereas the control network exhibits more distributed and balanced pattern of topology. The most striking difference between groups is in connectivity strength which is significantly lower in left TLE group. These results, however, could not be observed in binary representation of connectivity. The increases in characteristic path length and global clustering coefficient were not significant after FDR correction (p-values 0.03 and 0.14) and only a trend towards lattice topology can be concluded. Also just a trend to increased betweenness centrality (p = 0.03) in patient group was seen, no change in connection strength was found.

Our findings support other studies showing that network topology in left temporal lobe epilepsy shifts towards regular structure [3]. This, combined with changes in betweenness

centrality and connection strength, allows us to provide better specification of network topology in left TLE patients. We stress that the difference between groups lies especially in low correlations which is the reason why the analysis based on binary representation failed to find statistically significant changes.

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NF vyšší nervové činnosti 2

THE EFFECT OF REPETITIVE TRANSCRANIAL MAGNETIC STIMULATION ON ATTENTION AND PSYCHOMOTOR SPEED IN PATIENTS WITH MILD COGNITIVE IMPAIRMENT AND EARLY ALZHEIMER'S DISEASE

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Introduction: Repetitive transcranial magnetic stimulation (rTMS) is a noninvasive tool to study and modulate cortical plasticity and brain processes in healthy and diseased brain.

Study objectives

The aim of this study was to investigate the effects of one session of high-frequency rTMS on cognitive functions in

patients with mild cognitive impairment (MCI) and early stages of Alzheimer's disease (AD). Based on our pilot study results (Eliasova et al. 2014) we were particularly interested in modulating attention and psychomotor speed domain by applying rTMS over the right inferior frontal gyrus (IFG) and the right superior temporal gyrus (STG).

Methods: Altogether 20 right-handed patients (11 women, 9 men; age 73.0 ± 6.9 years; 12 mild AD, 8 MCI) participated in the placebo-controlled study. Each patient received 3 sessions of 10 Hz rTMS applied over the IFG, STG and vertex (a control stimulation site). A frameless stereotaxy was used for the coil navigation. A total of 2250 stimuli were delivered per session at 90% intensity of resting motor threshold. The order of stimulation sites was randomized. The Trail making test (TMT) and the Stroop test (ST) were used to evaluate attention and psychomotor speed prior to and immediately after each session. The Wilcoxon paired test and Linear mixed models were used for data analyses.

Results: rTMS of both IFG and STG induced significant improvement in the Word part of the ST (Wilcoxon paired test; p=0.023 and 0.033, respectively), while the IFG stimulation induced additional enhancement in the TMT A and B (Wilcoxon paired test; p = 0.002 and 0.005, respectively). When controlling for placebo effects improvement in the ST (Word part) remained significant after both IFG and STG stimulation.

Conclusions: rTMS of the right IFG and the right STG enhanced psychomotor speed and attention in patients with early stages of AD and may thus have a therapeutic potential that has to be further tested using a multiple-sessions rTMS protocol.

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PREDICTION OF COGNITIVE CHANGES IN PATIENTS WITH PARKINSON'S DISEASE AFTER DBS STN WITH THE USE OF P300 COGNITIVE EVENT RELATED POTENTIAL

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Objective: Deep brain stimulation (DBS) of the subthalamic nucleus (STN) is an effective long-term treatment for motor symptoms in advanced Parkinson's disease (PD). However, it is evident that at least in some patients the change in cognitive functions after STN-DBS may have a clinical importance. Thorough neuropsychological examination is an established part of preoperative assessment of candidates for DBS surgery. We studied whether scalp P300 wave can be used as an additional tool that could improve the selection process and predict the cognitive decline after the procedure.

Patients and methods: 30 patients with Parkinson's disease who had been implanted with DBS STN were included in the pilot study. They were examined by a neuropsychologist before the DBS and a year after the DBS. The latencies and amplitudes of P300 wave were measured before the operation and again one year after the DBS STN.

Results: We found indirect correlation between latencies of preoperative P300 and neuropsychological status 1 year after the operation. We observed that patients with longer latencies of preoperative P300 tended to have more psychiatric side effects and worse neuropsychological performance one year after the DBS.

Conclusion: Scalp P300 can be proposed as a tool for selection of suitable candidates for the DBS STN surgery in PD.

Key words: Parkinson's disease; DBS; subthalamic nucleus, P300, event-related potentials

ALPHA AND BETA POWER DECREASE DURING ENHANCED COGNITIVE EFFORT IN THE BASAL GANGLIA: AN INTRACEREBRAL RECORDING STUDY.

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Purpose: Cognitive adverse effects may accompany deep brain stimulation (DBS) treatment, as the basal ganglia have influence on widespread neocortical networks. The aim of this study was to investigate how complex motor-cognitive activities are processed in the subthalamic nucleus (STN) and internal globus pallidum (GPi).

Methods: Dystonia patients implanted with GPi-DBS electrodes (n=5), and individuals with Parkinson´s disease (PD) (n=4) or essential tremor (n=1) with STN-DBS electrodes performed two tasks involving the writing of single letters: 1. copying letters from a monitor; and 2. writing of any letter other than that appearing on the monitor. The cognitive load of the second task was increased relative to the first. Intracranial recordings of task-related oscillatory changes were assessed and compared.

Results: Local event-related alpha and beta desynchronization (ERD) were more expressed during the second task while the lower gamma synchronization (ERS) decreased regardless of the basal ganglia structure from which recordings were obtained or the clinical diagnosis. Task-related ERD differences recorded from the language-dominant left hemisphere correlated with a behavioural (RT) measure of cognitive effort. ERD changes declined after levodopa intake in PD patients.

Conclusions: The STN and Gpi participate in cognitive networks. Alpha and beta ERD seems to be essential during processing complex motor-cognitive tasks and increase with enhanced cognitive effort.

Posterová sekce

APPLICATION OF EYE TRACKING IN NEUROSCIENCE

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Introduction: Eye tracking is a technology using cameras to record and analyze eye movements and gaze patterns, therefore providing insight into both cognitive and physiological processing of visual information. Neurological problems frequently affect the way visual information is processed, which then reversely affect the eye movements. While the idea of eye tracking exists for a long time, recent technological advances enable more precise measurement, automated evaluation and make the technology broadly available.

Applications: Specific learning disabilities such as dyslexia are often first diagnosed late due to bad reading skills at school. The eye tracking can be used for screening in preschool age even with children who cannot yet read by easier tasks: e.g. the well known non-verbal Pavlidis task, the gravity effect or by simple smooth stimuli movement tracking. Similarly, schizophrenia is associated with wide spectrum of cognitive impairments. The eye tracking can be used with smooth stimuli movement tracking or also in conjunction with the Rorschach test where it can provide additional information channel for examining psychologist. Other applications of eye tracking include early detection of Alzheimer disease, Autistic spectrum disorder (ASD), and attention deficit hyperactivity disorder (ADHD). Eye tracking is also applicable in the field of assistive technologies where the eye movements serve as output channel, and in other non-medical applications.

Ongoing study: We are currently evaluating a study on early dyslexia detection. Six special schools with preschool classes for children with learning and other disabilities participate in the study. Total of 384 children aging from 6 to 11 years were recorded, of which 33 were diagnosed specifically with dyslexia. Preliminary results suggest differences in the Pavlidis task.

Conclusion: The contribution presents possibilities eye tracking technologies offer for specialized medical examinations and objective evaluation of the measured data. It has been proven in several applications that eye tracking can be successively used both in diagnostic and therapeutical applications. The ongoing study is being made to develop practical application for early dyslexia detection, perform clinical evaluation, and certification of both the method and recording equipment.

DIFFERENCES OF EEG SIGNAL BETWEEN GIFTED AND AVERAGE ADOLESCENTS

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The mental rotation task (Shepard and Metzler, 1971) is a standard cognitive task and a huge amount of research has been done comparing reaction times and error rates between different groups of people. O'Boyle et al. (2005) in their neu-

roimaging study demonstrated that mathematically gifted male adolescents engage different brain structures than those avarage gifted when performing 3D mental rotation.

The purpose of this study was to observe differences between gifted and average adolescents during both 2D and 3D mental rotation task. We recorded and analyzed 16 adolescents (10 boys, 6 girls) with IQ>130 and 10 adolescents with average IQ (<90,110>), all 15 - 18 years old. From the subsequent EEG signal analysis we were able to identify brain structures that discriminates between mathematically gifted and average ability. Together with the EEG signal we measured reaction times and error rates and evaluated them. The significant difference between experimental groups was detected in both reaction times and error rates. After finishing the experiment subjects performed Raven intelligence test and filled out psychological questionnaires (autistic, systematizing and empathizing quotient) and questionnaire with factual, self-evaluation questions and questions about used strategy. Finally, the values from questionnaires were correlated with the EEG signal.

CEREBELLAR ACTIVITY IN CERVICAL DYSTONIA DURING A MOTOR TIMING TASK: AN FMRI STUDY

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Question: Dystonia research has recently started to turn towards a new neural network node presumably playing a significant role in its pathophysiology – cerebellum. Even in the absence of traditional neurology signs of cerebellar dysfunction in most dystonia patients, more subtle indications of cerebellar abnormities may still be found. In preliminary data of our fMRI study, we are presenting compelling evidence of its dysfunction in cervical dystonia patients.

Methods: Functional magnetic resonance imaging has heretofore been performed in 10 patients and 10 healthy individuals during interception of a moving target with simple button pushing – a task, known to engage cerebellum, involving complex predictive motor timing abilities, as the subjects has to react in advance according to the speed of the target to successfully intercept it.

Results: In addition to statistically significantly lower hit ratios than the healthy controls, cervical dystonia patients had substantial differences in activations during the movement estimation and motor timing in preparation for reaction - button pressing: there was lower activation in the ipsilateral cerebellar lobule VI and VII and in contralateral medial prefrontal cortex.

Conclusions: Our results suggest that the cervical dystonia patients suffer from impairment of predictive motor timing – dysfunction presumably directly attributable to changes in cerebellar activation.

fMRI 2

DEALING WITH NOISE IN PSYCHOPHYSIOLOGICAL INTERACTION ANALYSIS

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Background: In some fields of fMRI data analysis, it is apparent that a correct methodology is crucial to achieving meaningful results. This paper provides a first quantitative evaluation of the effects of different preprocessing and noise filtration strategies on the psychophysiological interactions (PPI) – method for analysis of fMRI data [1], where noise management is not yet established.

Materials and Methods: To assess these effects, both real fMRI data and simulated fMRI data were used. Two regions of interest (ROIs) were chosen for the PPI analysis on the basis of their engagement during the task. PPI terms were computed and used in a general linear model (GLM); group-level analyses followed. This first-level PPI analysis pipeline was performed for 32 different preprocessing and analysis settings, which included either data filtration with

RETROICOR [2] or no such filtration; different filtration of the ROI "seed" signal with a nuisance data-driven time series; and the involvement of these data-driven time series in the subsequent PPI GLM analysis [3]. The extent of the statistically significant results was quantified at the group level using simple descriptive statistics.

Conclusion: We conclude that different approaches for dealing with noise in PPI analysis yield appreciably different results. We definitely recommend the usage of RETROICOR. Filtering the ROI signal with data-driven signals and adding these signals to the GLM for assessing the PPI effects is apparently influential, but it is not clear whether their usage improves results in all cases.

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A NOVEL COGNITIVE FMRI TASK TO ASSESS BRAIN MECHANISMS UNDERLYING VISUAL PROCESSING AND ATTENTION

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Introduction: Visual processing and attentional deficits can be found in early Alzheimer's disease (AD).

Study objectives: We aimed at developing a visual cognitive task to study brain mechanisms underlying visual processing in early AD using functional MRI (fMRI). To achieve our goal we developed a novel visual object matching task using conventional and unconventional (spatially rotated) views of object pairs. Here we present the fMRI results of a pilot study performed in healthy subjects (HS).

Methods: Twenty-two right-handed HS (11 men; age 25.3±2.8 years) performed a cognitive task in a 1.5T MR scanner. The task consisted of 60 pairs of emotionally neutral

images and 30 pairs of dots with a symbol placed on the right or left side (a control task). Participants viewed successive paired images, separated by a visual mask. The second image of each pair was either: same (identical) as the first image (canonical condition 1); different in identity (canonical condition 2); same as the first image but spatially rotated (unconventional condition 3); different in identity and spatially rotated (unconventional condition 4). Participants were instructed to respond as quickly as possible by pressing a YES (left) button if the second object of the paired images was the same as the first object (regardless of spatial orientation) or by pressing NO (right) button if they were different. In the control task participants responded with buttons depending on the side of a dot symbol placement. fMRI data were processed using SPM8 and the standard pipeline. The significance level was set to p<0.05 FWE corrected.

Results: At the group level, we found major activation of bilateral temporo-occipital areas, precuneus and inferior frontal gyri during the canonical conditions as compared to the control task. The unconventional conditions revealed additional activation of the posterior parietal areas including the superior parietal lobule and intraparietal sulcus as compared to the canonical conditions.

Conclusion: In the visual object matching task with conventional views of objects we observed major engagement of the ventral visual pathway. The task with spatially unconventional views of objects revealed additional recruitment of the dorsal visual pathway and the dorsal attentional network which is involved in the top-down attentional control of visual processing. Our fMRI paradigm shows promise for assessing task-dependent attentional modulation of visual processing in early AD.

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COULD IT BE POSSSIBLE TO DISTINGUISH BENDING AND CROSSING FIBERS IN DIFFUSION MRI DATA?

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After diffusion tensor imaging (DTI) model [1], several approaches which are able to detect two or more crossing fibers in diffusion MRI (dMRI) data have been invented (e.g. Q--ball imaging, ball and stick model) [2], [3]. After that, some fiber bundles which had not been seen with DTI model were suddenly observed (e.g. in corpus callosum). Although it brought an improvement it seems that about 50% of detected fiber bundles are false positive results after tractography [4]. One crucial problem is that tractography cannot decide if the bundles are crossing or bending because models are not estimating bending-tensor. For 2 crossing fibers, the tractography algorithm can trace from one point to three different places. For 2 bending fibers, there is only one possible way. We would like to introduce how the difference between dMRI data coming from crossing or bending fibers could be detected. Imagine a population of water molecules in the centre of crossing or bending and some applied gradient of diffusion measurement. For crossing fibers, the population of molecules can diffuse in all directions of fiber spreading, thus the phase of molecules can be affected by the whole gradient range. Contrary for one bending fiber, the population can diffuse only in directions of the fiber, thus the phase can be affected only by the narrower gradient range. It applies simi-larly for second bended fiber. From this point of view, phase distributions should differ for crossing and bending fibers respectively also resulting dMRI data should differ. For this statement testing, the dMRI data simulator which generates dMRI data based on Brownian motion of water molecules inside and outside axons per one voxel volume was created. Although there is several technical problems and aspects (e.g. periodic character of gradient space phase distribution) we are looking for sequence settings of dMRI measurement where the dMRI data would be statistically significantly different for crossing and bending fiber geometries.

Acknowledgement

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Workshop: Automatická klasifikace EEG grafoelementů

AUTOMATIC CLASSIFICATION OF EEG GRAPHOELEMENTS (WORKSHOP)

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Outline

1. Motivation, why and which types of EEG graphoelements to classify automatically

2. Discriminative features extraction

   a. Multichannel adaptive segmentation of non-stationary signals

   b. Heuristic features extraction based on physician's point of view

   c. Extraction, selection, reduction and features standardization

   d. Application of PCA - Principal Component Analysis and ICA- Independent Component Analysis (artefacts rejection]

3. Supervised and non-supervised learning classical and fuzzy.

   a. Statistical pattern recognition, k-NN, k-means

   b. Artificial neural networks, multilayer perceptron

   c. Fuzzy sets for improving the homogeneity classes of EEG segments (fuzzy c-means, fuzzy k-NN)

4. Semi-automatic extraction of prototypes from original EEG recordings, pre-processing by cluster analysis in the learning phase (prototypes gathering), involving of expert into the process of etalons extraction

5. Graphic visualization of results

   a. Color identification of significant graphoelements

   b. Temporal profiles - graphs of segments membership in EEG classes in the course of time

c. Automated processing of neonatal temporal profiles (sleep stages detection)

d. Statistical diagrams of percentual EEG graphoelements occurrence

6. Applications, case studies

a. Automatic detection and classification of epileptic graphoelements for long-term EEG monitoring

b. Automatic detection of sleep stage changes in neonatal EEG, statistics of quiet and active sleep

c. Practical examples of etalons extraction

NF „Resting State"

FMRI FOR STUDY OF BRAIN RESTING STATE NETWORKS IN PATIENTS WITH DEGENERATIVE BRAIN DISEASES

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Resting-state networks (RSNs) are characterized by organized basal activity during rest and by low-frequency signal fluctuations that can be studied by fMRI. To date, several RSNs have been consistently reported, including the task-positive networks (e.g., the primary motor, visual and auditory network, the left and right fronto-parietal RSNs, and the extrastriate visual RSN) and the default mode network (DMN). Functional connections of these RSNs tend to be strongly related to structural white matter connections, suggesting the existence of an underlying structural core of functional connectivity networks in the human brain. Several hundred studies are now available that address integrity of resting connectivity in patients with Alzheimer's disease (AD) and mild cognitive impairment (MCI), as well as preclinical at-risk subjects. Most studies focus on the default mode network (DMN), a system of specific brain areas showing strong connected resting activity that attenuates during goal-directed behavior. The extent of intrinsic brain activity tends to be

strongly correlated with cognitive processes and is specifically disrupted in AD and MCI patients and at-risk subjects, with changes seeming to evolve during the transition between the disease stages.

Regarding Parkinson's disease (PD) and PD with cognitive impairment the data on changes in the DMN and other RSNs remain rather conflicting and are probably related to the phenotypic and pathological heterogeneity of the disease. The DMN disturbances in PD may be linked both to the dopamine deficiency (that can be at least partially reversed by dopaminergic medication) and to cognitive dysfunctions. The lecture will focus on the DMN and other RSNs results as assessed by fMRI, particularly in PD and early AD. The impact of dopaminergic and cholinergic medication will also be discussed.

INTER-AREAL FRONTAL LOBE COMMUNICATION DURING REST: A DEPTH EEG CONNECTIVITY STUDY

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Purpose: This study investigated functional connectivity in the human limbic system, frontal and temporal lobe and their relationship in pharmacoresistant patients with temporal lobe epilepsy (TLE). We worked with interictal recordings in resting state and investigated whether there exists a relationship between specific brain structures and frequency bands.

Methods: We studied five pharmacoresistant patients with TLE, who were candidates for surgery and had established deep electrodes in the pre-surgery examination (the detection of epileptic zone). The deep electrode recordings from epileptic zones

and non-epileptic structures of the brain we divided into eleven areas based on their anatomical locations which are cross correlated with each other and we identified the relationship between them. We worked with interictal recordings in resting state. We considered a significant correlation to be a correlation value bigger than +/-0.5 and lasts longer than 30 percent of 10-minute interval. We complemented correlation with graphs (tentative graphical views of correlations) and coherence.

Results: In the tested structures the link occurred predominantly in alpha. It was shown that there exist the relationship between specific structures and particular frequency bands. We also discovered that this relationship wasn't affected by epilepsy.

Conclusions: Interareal communication within the frontal lobe during rest appears to be structured and complex. The resting state comprises ongoing communications on various levels: the whole brain, interlobar, regional and subregional levels. The hub structures known to assure the large scale communication in the RSNs have the hub properties also in interlobar and regional interactions. While the very slow oscillation on the brain level have been largely studied by the RSN fMRI, the more rapid lobar and sublobar communications are not well understood and need further research.

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COMPARISON OF CANONICAL CORRELATION ANALYSIS AND PEARSON CORRELATION IN RESTING STATE FMRI IN PATIENTS WITH PARKINSON'S DISEASE

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Introduction: In many fMRI studies of functional connectivity, researchers need to select representative signal of region of interest (ROI). Usual approach is to compute mean or first eigenvector of ROI voxels and use it to calculate Pearson correlation (PC). In this abstract we compare this usual practice with extended technique using more eigenvectors and canonical correlation analysis (CCA).

Methods: We used resting-state data from 18 PD patients, two sessions for each subject, first in off state, second in on state (after L-dopa medication). Dataset was acquired using 1.5T MR scanner Siemens Symphony, 150 scans, TR=3.0 s. Data were preprocessed in SPM8 - unwarped, slice timing corrected, spatially normalized and smoothed using 5mm kernel. Masks of individually segmented gray matter were applied. Then we used AAL parcelation and performed PCA on each region. First eigenvectors were used for PC analysis and every eigenvector above 10% explained variability entered CCA. To find AAL regions influenced by medication, t-tests were performed on differences between first and second session both using PC and CCA coefficients.

Results: CCA identified 107 and PC 206 significant changes in correlation between AAL regions (p<0.05 uncorrected). Only 5 significant changes were identical for CCA and PC. Mean CCA correlation was 0.58, mean PC correlation was 0.22.

Conclusion: PC and CCA are statistical methods quantifying information about similarity of signals. Although CCA is not commonly used in fMRI, we performed it as extension of PC, because we want to exploit more variability from data than PC can. Mean CCA correlation on group level is significantly higher than PC correlation. CCA evaluates greatest correlation obtained by linear combination of eigenvectors between every two regions. Therefore CCA contains stronger correlations than PC. Statistically significant results are evidence that CCA is able to find differences between datasets albeit on uncorrected level. These differences can represent effect of L-dopa medication on functional connectivity network. CCA could reveal information, that remains hidden for PC analysis and for assessment of functional connectivity it could be useful to combine information from both methods – CCA and PC.

EEG 2

INITIATIVES AND PROJECTS FOR COLLABORATION IN NEUROINFORMATICS

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Sharing of electrophysiology data, related metadata, processing methods and workflows is one of the crucial tasks in neuroinformatics. International Neuroinformatics Coordinating Facility (INCF) develops and maintains computational infrastructure for neuroscientists and INCF Programs address infrastructural issues of high importance to the neuroscience community. The INCF program "Standard for data sharing – Electrophysiology Task Force" deals with collection of requirements for developing the data format that could be accepted and widely shared within the community. To enable collaboration through the sharing of neuroscience data, INCF also introduced the INCF Dataspace that associates data sources in a distributed system based on iRods solution.

The Czech National Node for Neuroinformatics (CNNN) is currently focused on two main topics. The first one deals with higher reliability of interactions of human subjects, artificial systems and their alliances. Theoretical knowledge is applied in transportation area; relations between the components of the EEG alpha rhythm and attention levels of relevant subjects are investigated. The Node also continues in building of complex hardware and software infrastructure for research in electrophysiology. A catalog server connected to INCF Dataspace and a node server for EEG/ERP domain (a subnode of the catalog server) were established. The Node members also work in an international group developing the Ontology for describing Experimental Neurophysiology (OEN).

The EEG/ERP Portal (EEGBase) is a web-based system that enables researchers to store, manage, share, and process data and metadata from EEG/ERP experiments [1]. The portal also enables users to work in research groups, define metadata, and run methods for discrete signal processing. Users may have different roles in the system and the related level of authority. The EEG/ERP Portal was registered as a neuroscience resource within the Neuroscience Information Framework (NIF); direct access to the services implemented in the EEG/ERP Portal is ensured through the NIF interface. Off-line and mobile versions of the portal are also available.

A programmable hardware stimulator that allows users to create various experiments and use the combined stimulation (acoustic and visual) was designed and developed. The stimulator is portable and can be connected to conventional equipment.

Acknowledgments:

[1] EEG/ERP Portal (EEGBase). (2014). Available online at: http://eegdatabase.kiv.zcu.cz/

NON-LINEAR ANALYSIS OF NEWBORN EEG

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Introduction: Electroencephalography (EEG) is the measurement of brain electrical activity by means of electrodes positioned on the scalp, which has many important applications in medicine. From one side, visual inspection of EEG signal by neurologists is time consuming, tedious, based on the previous experience and subjective. From the other side, automated classification of EEG signals is very difficult task, as these signals can be noisy and especially when they are recorded during a long time period. In most cases, the agreement of an automatic method with visual analysis is a basis criterion for its acceptance. Today, as well as in the previous decade, a variety of signal processing techniques is being applied on EEG data.

Methods: In this contribution we present briefly a comprehensive methodology for automatic recognition of behavioral states in neonatal sleep EEG. The methodology is based on segmentation, comprehensive feature extraction and classification of signal segments by supervised learning techniques. The attention was focused on data representation stage in the multistage processing system, namely representation of signal by extracted features. This stage is very important in the analysis of EEG signals in the computational data processing, as it directly affects the classification accuracy. Specifically extracted nonlinear features, whose classification potential was tested, were Hurst exponent and approximate entropy, calculated both for the raw signal and signal after the application of wavelet transform. The methodology was optimized for EEG signal processing in the field of sleep studies in newborns and verified on real clinical neonatal data.

Conclusions: Based on the obtained results, it can be concluded that the Hurst exponent can be used in the field of neonatal sleep EEG analysis, as it can differentiate well between quiet and active sleep stages. The combination of wavelet transform and approximate entropy were used for the first time in the proposed system for the classification of sleep stages in newborns. The results show that this approach can be used for neonatal sleep EEG analysis, as it provides high classification accuracy. Thus this work provides a reference for enhancing the differentiation of individual neurological states and for the improvement of existing approaches.

METHODS OF HIGH FREQUENCY OSCILLATIONS DETECTION: ADVANTAGES AND DISADVANTAGES

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Background: High frequency oscillations (HFOs) represent new electrographic marker of epileptogenic tissue and they are considered as a surrogate marker of seizure onset and epileptogenic zones. HFOs are recorded mainly in intracranial recordings. Visual analysis of HFOs in long-term recordings is extremely difficult due to the low signal-to-noise ratio of HFOs. Successful integration of HFOs into presurgical evaluation requires development of reliable methods of automatic HFO detection and quantification. We aimed to examine performance of three new HFO detecting algorithms and compared their performance with published detectors.

Methods: We implemented three published detectors which utilize RMS, line length or Hilbert transform approach to detect HFOs. We have developed additional three types of detectors which utilize short time energy estimation, Hilbert envelope and Bayesian evidence. All HFO detecting algorithms were applied to gold standard datasets and their performance quantified.

Results: Line length and Hilbert detectors detected the highest number of HFOs. The lowest number of the detections was achieved by RMS and energy estimating detectors. According to the results, the detectors can be divided into two groups. One group is characterized by high sensitivity. These algorithms detect nearly all the labeled HFOs events, but suffer from the high false positive detection rate. Second group of detectors have high positive prediction value but lower sensitivity. Our Hilbert envelope detector demonstrated the best performance of all evaluated detectors.

Conclusions: To improve the performance of detectors with high sensitivity will require to develop additional post-processing steps to remove the majority of false detections. Meanwhile detectors with low sensitivity will detect only high-amplitude HFOs. Future selection of the most appro-

priate algorithm for HFO detection in intracranial recordings will require detail understanding of the clinical significance of low-amplitude HFOs and major sources of false positive detections.

NF vyšší nervové činnosti 3

FALSE VISUAL MISMATCH NEGATIVITY

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Recording of the visual mismatch negativity (vMMN) requires building of a visual temporal regularity using standard stimuli and afterwards interrupting of such regularity by a deviant stimulus. However, for the veridical vMMN it is necessary to control subject's attention by a task, because the attentional modulation might elicit a similar event related response (ERP) as the vMMN. In this contribution we point out an important and unexpected interaction between the attentional task and the regularity violation.

We presented standard/deviant stimuli (a moving grating) in periphery of the visual field and targets/non-targets (numbers) stimuli in the central part of the visual field. Targets were presented randomly with preceding 2, 3 or 4 non-target stimuli (so the time between targets was randomly selected in the interval of 2460 to 4100 ms. Subjects (aged 21–61 years, 3 females) pressed a button when they spot the target. To make the recording session as short as possible the target was presented immediately (400 ms) after each deviant; this way deviants were unpredictable and also uninterrupted by a slow response to the target. ERPs were recorded from 68 unipolar electrodes, (four EOG channels) with the right earlobe as a reference.

In results we observed a statistically significant vMMN-like response in the interval of 150 to 250 ms. This response, however, exhibited unexpected features, as its localisation was in the central area with prevalence to the left hemisphere (all subjects responded by the right hand) and it was absent in recordings where the subjects' response was not required. Further, we observed difference in a linear trend of the ERPs to standard/deviant stimuli. All these signs supported evidence that the vMMN-like potential was a false vMMN created by superposition of a preparatory potential for the target detec-

tion (the early readiness potential – Bereitschafts Potential) and the deviant response.

The presented stimulation scheme with a randomised appearance of the deviant stimulus and the attentional task caused the false vMMN because the subjects' expectation of the target stimulus resulted in the readiness potential, which precedes the behavioural response even couple of seconds before subjects' reaction. Due to a suboptimal design, this preceding response was superimposed in a greater extent over the deviant response than over the standard one.

The linear character of the readiness potential, however, allows its extraction from the ERP and identification of the veridical vMMN (Kremláček J, et al. Visual mismatch negativity in the dorsal stream is independent of concurrent visual task difficulty. Front Hum Neurosci 2013;1–7).

IS NUCLEUS SUBTHALAMICUS INVOLVED IN THINKING? SEPARATION OF CONSCIOUS AND SUBCONSCIOUS COGNITION COMPONENT IN THE SUBTHALAMIC NUCLEUS USING P300 AND MMN PROTOCOLS.

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Introduction: P300 wave is considered a correlate of cognitive process and an oddball paradigm is used for its recording. MMN (Mismatch negativity) is considered a correlation of automatic sensory memory on a subconscious level and also a reflection of subconscious primitive sensory intelligen-

ce. When the MMN is recorded the same protocol as P300 paradigm is used, only with the difference that the proband pays no attention to the stimuli. The aim of this study was to compare evoked potentials from the P300 paradigm against MMN paradigm, both recorded in the subthalamic nucleus (STN) and thus electrophysiologically isolate conscious cognition component in this structure.

Methods: We included 3 patients (2 of whom were women) with Parkinson's disease and recorded the evoked potentials using protocols P300 and MMN during installation of DBS (Deep brain stimulation). The average age of the patients was 59 ± 8 years, disease duration 9 ± 3 years. The electrodes were implanted into the STN bilaterally and each wore four contacts on the left and on the right side (L1,2,3,4 and R1,2,3,4). We were interested in local potentials – in signal from the connection of contacts to each other on one intracerebral electrode (on each side 3 bipolar montages were monitored: L1-2, L2-3, L3-4, R1-2, R2-3, R3-4). We were interested in the latency of 200 to 400 ms - thus in the area of cognitive responses P300.

Results: When the averaged signal of infrequent stimuli between P300 and MMN paradigm was compared a significant difference between them in each left and right electrode at least in one montage was found. The same we found when comparing averaged frequent answers. There was also a statistically significant difference between the evoked potentials obtained during P300 paradigm and MMN paradigm.

Conclusion and Discussion: The difference between evoked potentials of MMN and P300 protocols in latency of 200-400 ms suggests that STN is involved in conscious cognitive processes at the time of stimuli application. Thus the thinking – at a given time – is not a function of the brain cortex only. What component of the cognitive processes STN does represent cannot be exactly specified. Although oddball paradigm is very simple, during this paradigm the patient uses a variety of cognitive functions – attention, executive function, working memory, calculation and proper level of motivation is necessary too.

Workshop: Automatická klasifikace EEG grafoelementů

AUTOMATIC CLASSIFICATION OF EEG GRAPHOELEMENTS (WORKSHOP)

Vladimír Krajča, Svojmil Petránek, Jitka Mohylová, Hana Schaabová, Václava Sedlmajerová

Outline

1. Motivation, why and which types of EEG graphoelements to classify automatically

2. Discriminative features extraction

   a. Multichannel adaptive segmentation of non-stationary signals

   b. Heuristic features extraction based on physician's point of view

   c. Extraction, selection, reduction and features standardization

   d. Application of PCA - Principal Component Analysis and ICA- Independent Component Analysis (artefacts rejection]

3. Supervised and non-supervised learning classical and fuzzy.

   a. Statistical pattern recognition, k-NN, k-means

   b. Artificial neural networks, multilayer perceptron

   c. Fuzzy sets for improving the homogeneity classes of EEG segments (fuzzy c-means, fuzzy k-NN)

4. Semi-automatic extraction of prototypes from original EEG recordings, pre-processing by cluster analysis in the learning phase (prototypes gathering), involving of expert into the process of etalons extraction

5. Graphic visualization of results

   a. Color identification of significant graphoelements

   b. Temporal profiles - graphs of segments membership in EEG classes in the course of time

   c. Automated processing of neonatal temporal profiles (sleep stages detection)

   d. Statistical diagrams of percentual EEG graphoelements occurrence

6. Applications, case studies

   a. Automatic detection and classification of epileptic graphoelements for long-term EEG monitoring

   b. Automatic detection of sleep stage changes in neonatal EEG, statistics of quiet and active sleep

   c. Practical examples of etalons extraction