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Whether or not rehabilitation helps to reduce the risk of developmental delay in children with epilepsy debut under first year of life?

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Introduction: Epilepsy in children is often associated with delay or retardation in motor, sensory, pre-verbal/verbal, emotional functions. In young children this disorder may have reversibility of clinical signs in positive outcome or form persistent type of disorder in case of negative outcome. Thus, it is necessary not only to take anticonvulsants, but to apply different rehabilitation methods to those children. At the same time rehabilitation may increase frequency of attacks which can indirectly worsen mental status of patients.

Aim of study: To estimate mental and motor development of children with epilepsy with seizure onset under 1-year-old both receiving and not receiving rehabilitation methods (psycho sensory stimulation).

Materials and methods: Case-control study. 190 children with epilepsy diagnosed according ILAE 2014 criteria and who had seizures onset under 1-year-old were enrolled, 48,4% (n=92) boys. The median age (Me) of the first seizures was 3 months. Two groups were formed: the 1st included children who took only anticonvulsants (n=138), the 2nd group (n=52) had both anticonvulsants and psycho sensory stimulation as rehabilitation method (2 courses of treatment 3 and 6 month after epilepsy debut). The frequencies of seizures, mental/motor mile stones were estimated after the second course of rehabilitation.

Results and discussion: 6 months optimal development were found in 54,3% (n=75) and in 73,1% (n=38) children (1st and 2nd groups, respectively, Fisher<0,05), persistent mental delay and neurological signs occurred in 31,2% (n=43) and 15,4% (n=8) children (1st and 2nd groups, respectively, Fisher<0,05). The frequency of seizures did not increase only in the group with active rehabilitation applied. Thus, early complex usage of psycho sensory stimulation in rehabilitation of children with early onset of epilepsy is considered to be effective and save. Rehabilitation in young children assumed to reach effective stimulation of natural sanogenetic mechanisms which can promote reducing the risk of further disability despite the fact that they have such the high-risk for mental/motor development disease as epilepsy.

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Friday, September 7th, 2018

11.30 – 12.30 a.m.

Poster Session 3

01

A Complex Psychophysiological Approach to the Analysis of Human Brain and Behavior Responses to Detect an Intentionally Hidden Information

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Background: The modern lie-detecting technologies are mostly based on the analysis of autonomic nervous system indicators. In our research we consider the hiding information process as a psychophysiological complex of neurophysiological and behavioral responses. The study presents experimental data concerning registration and analysis of a set of psychophysiological indicators reflecting the activity of cognitive, emotional, and executive mechanisms of behavior, involved in information concealment.

Methods: 12 males and 20 females, aged from 18 to 23 years (M = 20, SD = 0.18), were tested according standard test procedure "Knowledge of the Guilty". First names and surnames along with pseudonyms were used as the stimuli in experiments where the task for participants was to conceal the response to his/her first name or surname. Emotional responses were registered using electrocardiogram (ECG), photoplethysmogram (PhPG), and galvanic skin response (GSR). The frequency characteristics of the electroencephalogram (EEG) and amplitude-temporary parameters of cognitive event-related potentials (CERP) were used as the indicators of intensity of brain cognitive processes. The recording activity of nervous systems was carried using 256-channel "Brain Amplifier" (Brain Product Co., Germany). Behavioral indicators - facial expressions, eye movements, gaze fixation time (GFT), pupil diameter (PD) - were monitored using eye-tracking system RED-500 (Siemens, USA).

Results and Discussion: The results revealed statistically significant (Wilcoxon test, $p \leq 0.05$) differences in all objective indicators related to false and true answers. The emotional indicators included the ECG, PhPG and SGR indexes. Differences on a cognitive level were reflected in latencies of CERP and the ratio of power spectrum of EEG in alpha- and beta-bands. The minimum value of the latency of P300 (440 ms) was observed while true answering. In the case of false answer, the latency of the response increased up to 560 - 620 ms. A mathematical algorithm, developed to assess differences in ERP and EEG parameters, allows detecting cognitive aspects of false responses with a probability of about 94%. The results of the localization by method 'LORETA' brain structures, realizing a person's behavior in a situation of choice between true or false response, showed that different subjects activated different areas and structures of the brain. On a behavioral level PD and GFT on the words associated with hidden information were most effective. The proposed approach to analysis of 'lie processes' allows to shed light on their complex nature.

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02

Word meaning acquired by auditory-motor associations: the role of the left perisylvian cortex

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Speech is largely based on the body motor and sensory experience. The question, which is crucial for understanding the brain mechanisms of human language, is how our brain transforms sensory-motor experience into word meaning. Multiple evidence hints that natural language acquisition involves biological mechanisms of associative learning. The ability to quickly acquire word-picture associations was shown to depend on reorganization in neocortical networks including the left temporal area, especially the left temporal pole, as well as temporoparietal, premotor, and prefrontal regions.

We developed an auditory-motor experimental procedure that allowed investigating neural underpinning of word meaning acquisition by way of associative “trial-and-error” learning that mimics important aspects of natural word learning. Participants were presented with eight pseudowords; four of them were assigned to specific body part movements during the course of learning – through commencing actions by one of participant’s left or right extremities and receiving a feedback. The other four pseudowords did not require actions and were used as controls. Magnetoencephalogram was recorded during passive listening of the pseudowords before and after learning. The cortical sources of the magnetic evoked responses were reconstructed using distributed source modeling.

We found a significant effect in the middle part of the STS/STG that mostly includes the auditory parabelt areas responsible for spectro-temporal analysis and initial steps of word recognition. Processing of new words also activated the posterior opercular part of the inferior frontal gyrus that is involved in subvocal rehearsal and articulatory coding of the perceived speech sounds, this fact emphasizing the role of articulatory sensory-motor experience in acquisition of word meaning. Our analysis did not reveal significant effects in the temporal pole or in the temporoparietal regions.

Juxtaposition of our findings with the current body of literature may imply that rooting the word meaning into one’s sensory-motor experience is an initial stage, which is prerequisite but not sufficient for its embedding into the full associative structure of semantic memory.

Taken together, our findings show that learning of novel word meaning through word-action association selectively increased neural specificity for these words in the auditory areas responsible for spectrotemporal analysis, as well as in articulatory areas, both located in the left hemisphere. The extent of neural changes was linked to the degree of language learning, specifically implicating the physiological contribution of the left perisylvian cortex in the learning success.

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03 The function of the alpha rhythm during the solution of complicated mathematical problems

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The aim of the work is to investigate the brain mechanisms of mathematical abilities, determined by K. Mangina’s Test. The composition of the test includes a set of pair geometric figures, in which the first small figure is an element of a more complex – the second figure. The study was carried out by a group of young people (10 people) studying at the Faculty of Mechanics and Mathematics of Moscow State University. The purpose of the work is to reveal the function of the alpha rhythm as a possible marker of Parkinson’s disease. The author’s method was used – “Microstructural analysis of brain oscillatory activity”, which works with narrow band frequency selective generators (Danilova, 2002). The method determines the localization of activated brain structures in different hemispheres and in accordance with the coordinates of the “Stereotactic Atlas of the Human Brain” (Talairach, Tournoux, 1988). When the alpha generators were divided into two frequency ranges (8–11 Hz and 11–13 Hz), new data were obtained about their connection with different hemispheres. Only in the left hemisphere within three seconds there was an increase in activity of low-frequency alpha rhythm

(8–11 Hz), whereas in the right hemisphere activity of high-frequency alpha rhythm (11–13 Hz) decreased. In this case, the increase in the activity of theta-generators occurred in parallel in both hemispheres. Two other groups of high-frequency alpha (11–13 Hz) in the left hemisphere and low-frequency (8–11 Hz) in the right hemisphere had a very low level of activity. For all three time intervals in solving mathematical abilities, the level of the low-frequency alpha rhythm was significantly higher than the level of activity of the high-frequency alpha rhythm ($n = 10$, $p < 0.05$, $T_{crit} = 10$, $T_{emp} = 9$). The duration of theta generator activity was shorter than the alpha of the generators in solving the mathematical abilities of the Test K. Mangina. The growth of alpha generator activity in solving mathematical abilities was revealed in Posterior Cingular BA 30, Anterior Temporal G. BA 20, as well as in the subcortical structures of the brain. The brain structures that were activated by theta-generators were concentrated in different sections of the Cingular cortex. The fact that alpha generators are involved in many brain structures emphasizes their very important function – as a special mechanism of local inhibition. The work is supported by the grant of the RNF No. 14-18-03253 P

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04 Hemispheric dominance for non-emotional information? An autonomic approach

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The physiological reactivity to emotional information is known to be modulated by psychological traits. However, few is known about how the location of such information in the visual field modulates this reactivity. The aim of this study was (1) to compare physiological variations in response to neutral and emotional pictures presented in central vision and in the left and the right hemifields, and (2) to investigate the relation between these variations and depressive trait.

Twenty-four healthy participants were presented with 3 sets of 16 pictures (unpleasant, neutral and pleasant) from the International Affective Picture System, at three eccentricities (-12° ; 0° ; $+12^\circ$). The sets had been balanced as for main physical properties of the pictures, among which brightness, contrast and spatial frequencies. The participants had to fixate a cross in the center of the screen and to report the location of the pictures (left, center or right). Participants fulfilled questionnaires (depression, BDI; anxiety, STAI) and we recorded cardiac and electrodermal (ED) responses to pictures.

A greater cardiac deceleration to right than left presented stimuli was observed for neutral pictures but not for emotional ones. Interestingly, this effect was positively correlated with depression scores. Besides, participants showed greater ED responses to right presentation for neutral pictures and the reverse pattern was observed for emotional ones.

This study seems to show (1) a stronger coding of neutral pictures when they appear in the right hemifield and also (2) that this effect is modulated by depression scores. These results could indicate that the neutral information is preferentially processed by the left hemisphere, as a complementary role to the right hemisphere dominance to process emotional one.

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