participants in National Brain Mapping Center (NBML) using 3T scanner. Usual preprocessing of fMRI and diffusion images and also parcellation to 90 regions (AAL template) were performed using FSL and ExploreDTI. FC and SC matrices were calculated based on time series correlation and number of deterministic tractography streamlines, respectively. After vectorization and concatenation of FC and SC matrices, ICA was applied. To find reproducible components and reliable connectivity, RAICAR (Ranking and averaging independent component analysis by reproducibility) [2] and bootstrap resampling were performed. Reliable connectivity was selected by applying threshold at value corresponding to the 96% confidence interval.

**Results:** We selected the 3 components which best overlapped with well-known functional subnetworks. Fig. 1 shows the functional and structural parts of components in red and blue, respectively. According to Fig. 1.a (red part), brain functional connectivity of the visual system is captured in the first component. The second functional network includes regions in medial prefrontal cortex, anterior cingulate cortex, precuneus etc., which can be interpreted as Default Mode Network (Fig. 1b). Also, functional connectivity in right parietal-frontal part of the brain may encode the right attentional/executive network (Fig. 1c). The corresponding structural networks of functional parts are illustrated as well.

**Discussion/Conclusion:** Three brain functional and their related structural networks are robustly captured with Graph Joint ICA methods since these components are reproducibly seen in two independent datasets. This method provides the capability of finding associated structural connections as the supportive networks for different functional behavior. However, the exact relationship between the relevant SC and FC edges needs further investigation.

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**Changes in functional brain networks during epileptogenesis in a rodent model of temporal lobe epilepsy**

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**Purpose/Introduction:** Temporal lobe epilepsy (TLE) is the most common form of epilepsy in adults. Research has shown that abnormal functional brain networks are involved in the development of epilepsy and in the generation and spread of seizures. In this study, we aim to map changes in functional networks during epileptogenesis in the systemic kainic acid rat model of TLE using resting-state functional MRI and graph theory.

**Subjects and Methods:** Three adult male Sprague–Dawley rats (426 ± 23 g) were included in a pilot study. The animals were intraperitoneally injected with kainic acid (KA) according to the protocol of Hellier et al. (1998) resulting in status epilepticus (SE). Rs-fMRI images were acquired before the KA injections and at 5 time points during the development of epilepsy. At each time point an anatomical image and two resting-state BOLD fMRI images were acquired on a 7T system, while the animals were anesthetized with medetomidine. The fMRI images were corrected for slice timing and motion, normalized, smoothed and band-pass filtered using SPM12. The Pearson correlation coefficient was calculated between the fMRI time series of 40 regions of interest (ROIs) and stored in a correlation matrix. After applying different thresholds to remove the weakest connections, several network measures were calculated using a graph theoretical network analysis toolbox (GRETNA), and plotted as a function of time to visualize how the properties of the functional networks change during epileptogenesis.

**Results:** During the first 3 weeks after the KA injections, the clustering coefficient increases, indicating an increased segregation of the functional network. The characteristic path length increases, indicating a decreased integration, and the small-world coefficient increases, indicating an increase in small-worldness. After these first weeks, there is a decrease in segregation and small-worldness and an increase in integration and the network measures return to their baseline values.
Discussion/Conclusion: In this pilot study we found an increased segregation and small-worldness, and a decreased integration in the functional brain network during the first 3 weeks of epileptogenesis. After these first weeks, the network measures return to their baseline values, even though the epileptogenic process continues. Further research is required to investigate these findings.

References:

Investigation of cognitive impairment in patients with arteriovenous malformations: fMRI study

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Purpose/Introduction: While having arteriovenous malformations (AVM) the incidence of cognitive impairment is 100%. The role of the assessment of cognitive impairment after surgical treatment is high for recovery and quality of life prognosis. The aim of the study was to investigate the organization of cortical areas responsible for the implementation of cognitive functions on endovascular treatment stages using functional MRI.

Subjects and Methods: Patients after surgical treatment of AVM using non-adhesive glue composition ONYX underwent standard neuropsychological diagnostic complex tests, conventional MRI and fMRI. FMRI was performed with the use of Blood Oxygenation Level Dependent technique (BOLD), based on distinctions of magnetic properties of hemoglobin. For fMRI stimuli we used 3 cognitive tests closed to standard MMSE (The Mini Mental State Examination): simple count (simple counting operation in “Active” and stay still in “Baseline”), play of words (patient had to call the words on a given letter in “Active” and stay still in “Baseline”), and visual memory. To assess visual memory we used blocks of 12 not related images for “Baseline” and 13 images with 8 presented before for “Active”. Stimuli were presented 4 times with reduction of repeated images to 6, 4 and 2. Statistical comparison to control group was performed using SPM analysis.

Results: We identified specific brain regions responsible for cognitive functions implementation using functional MRI. In comparison to control group we found functional reorganization of the cerebral cortex. The study showed the overall increase of activated cortical areas and at the same time decrease of Brodmann area (BA) 10 (responsible for cognitive control of executive functions), BA17 and BA18 (secondary visual cortex) activation in memory test. In “play of words” test patients showed the decrease of parahippocampal and insula activation and increase of activated specific cingulate gyrus and medial prefrontal cortex activation. Simple count test showed the increase of BA9, BA46, BA31, BA32 activation (parts of default mode network and responsible for cognitive functions implementation).

Discussion/Conclusion: Using fMRI and extended neuropsychological testing allows to evaluate structural and functional changes in the brain cortex (“brain plasticity”) of AVM patients after surgical treatment.

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