INTERTICTAL THALAMO-CORTICAL CONNECTIVITY IN FOCAL EPILEPSIES

Dumitru Ciolac[1,2] – lab scientist, Vitalie Chiosa[2] – lab scientist,
Stanislav Groppa[1,2] – academician, PhD, proffesor,
[1]Institute of Emergency Medicine,
[2]Laboratory of Neurobiology and Medical Genetics, State University,
of Medicine and Pharmacy „Nicolae Testemițanu”
dimaciolac@gmail.com, +37379431987

Summary. Intertictal thalamo-cortical connectivity in focal epilepsies

Introduction. Recent extensive studies assigned epilepsy a new pathobiological „label” - a neural network disorder. The emerging structural and functional changes occur within the entire epileptogenic network. Distinct epileptogenic networks of focal epilepsies (FA) remotely can engage the thalamus in the process of synchronization and propagation of seizure activity. Nowadays, little is known about the connectivity between the thalamus and the interconnected cortical regions and the cross-talk between these.

Purpose. The aim of the study was to describe the functional and structural networks underlying the interictal thalamo-cortical connectivity, and to track the causal influences and directional flows within the interconnected areas. Furthermore, to elucidate the role of the thalamus and its subregions in the generation of synchronous long-range activity essential for the propagation and generalization of epileptic activity and to characterize the bands of the cross-talks in the thalamo-cortical pathways.

Methods. Fifteen patients with FA and 15 age- and sex-matched healthy controls underwent 256-channel dense array electroencephalography EEG (dEEG) and 3T Magnetic Resonance Imaging (MRI). The whole-brain cortical thickness (CT) and deep grey matter nuclei volume were derived from MRIs by using FreeSurfer pipeline. The EEG epochs were preprocessed and analyzed using Fieldtrip toolbox and Matlab scripts. Typical interictal spikes with same morphology were marked manually at the time of maximum positivity or negativity. Directed connectivity estimation was achieved by using time-resolved partial directed coherence (TPDC).

Results. Structural abnormalities in both grey and white matter in patients with FE occur over a large number of regions, both within the seizure-generating zone and in regions beyond. Wide-spread areas of cortical gray matter atrophy were depicted within a network involving precentral and postcentral, supramarginal and superior frontal gyri. Additional regions of impaired unilateral grey matter integrity have been detected in the temporal lobe - middle and superior temporal gyri, insula, together with supramarginal gyrus. Patients with FE presented bilateral thalamus volume loss, as well. Regarding thalamo-cortical directed connectivity, a significant breakdown of the effective connectivity from temporal lobe to thalamus and from thalamus to temporal lobe was noted in the theta frequency band, starting ten seconds prior to spike with a maximum at five seconds and a consequent increase over the next five seconds. However, an opposite dynamics in alpha frequency band has been noted. These findings are corroborated by EEG-fMRI studies focusing on pre-spike period which revealed a significant decrease of connectivity immediately before spike between both temporal lobes.

Conclusions. This analysis of structural and effective connectivity in the defining of regional gray matter alterations and pre-spike states of epileptogenic networks, respectively, facilitated the identification of selected cortical/subcortical gray matter atrophy and altered effective connectivity during the period of transition from resting state to interictal spike.

Key words: thalamoctical connectivity, focal epilepsy, directed coonectiviy