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Resting state networks and brain functional connectivity under ECT

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Introduction: Electroconvulsive therapy (ECT) is highly effective in patients with depression. There is evidence that ECT impacts on neuronal networks considered to play an important role in the neurobiology of depression. Electroencephalography (EEG) offers a unique tool to noninvasively investigate brain electric activity and neuronal processes including functional connectivity.

Objectives: To investigate neuronal processes and connectivity in sensor and source space before and under ECT using resting state EEG.

Methods: EEG recordings of 20 severely depressed patients (51.3±10.7y.) were investigated before and after completion of right unilateral ECT. EEG power and sLORETA analyses were calculated from artifact-free epochs; spectrotemporal dynamics were analyzed in sensor and source space.

Results: Data revealed significantly increased delta and theta power in frontal sensor EEG electrodes, whereas EEG significantly connectivity decreased in both sensor and source space. sLORETA analyses indicated sources of current density increases in inferior frontal, superior frontal, insular, and temporal cortices. Statistical non-parametric mapping showed increased delta activity in middle frontal gyrus (xyz=35,35,-10; BA47, $p<0.01$), inferior frontal gyrus (xyz=35, 30, -15; BA 11, $p<0.01$), insular cortex (xyz=30,25,0; BA13, $p<0.05$) and superior temporal gyrus (xyz=45,25,20; BA38, $p<0.05$).

Conclusion: ECT is associated with changes in both brain electric activity and EEG connectivity in frontal brain regions, a key anatomical region in the pathophysiology of depression. Low frequency power increases and EEG connectivity decreases may be a neurophysiological correlate of the mechanisms of action of ECT.

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