

Aberrant functional brain network organization in disorders of consciousness

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The human connectome is a comprehensive description of neural elements and connections reflecting the complex organization of the brain. Modern network neuroscience has led to a paradigmatic improvement in understanding the brain-network organization and has challenged the traditional framework that many neurological disorders involves exclusively focal alterations. Consciousness is the product of multiple brain structures and depends on the brain's ability to integrate different complex patterns of internal communication. Although several studies demonstrated that the fronto-parietal and default mode networks play a key role in in conscious processes [1,2], it is still not clear whether the brain network organization is altered at the global level in patients with disorders of consciousness (DOC). Herein, we investigated the functional connectivity of DOC patients, diagnosed either as unresponsive wakefulness syndrome (UWS) or minimally conscious state (MCS), from a network perspective. EEG recording was performed in resting-state condition and pairwise brain connectivity between cortical areas was estimated across all time in order to compute a weighted functional network. Network-based statistical analysis revealed a subnetwork of decreased functional connectivity in UWS compared to the MCS patients ($p = 0.004$). Interestingly, apart from a few intra-hemispheric pathways linking limbic regions with frontal and parietal areas, these patterns of reduced connectivity mainly involved the interhemispheric fronto-parietal network. Robust correlations between the strength of the connectivity patterns and the CRS-R were found. Global network topological analysis identified increased values of LCP-corr, as well as of high clustering coefficient and modularity in UWS patients compared to MCS patients. At the nodal level, the UWS patients showed increased nodal degree and betweenness centrality in several limbic and temporo-parieto-occipital regions. Taken together, our results highlight i) the involvement of the interhemispheric fronto-parietal network in the pathophysiology of consciousness disorders and ii) an aberrant network organization both at the global and at the nodal level in UWS compared to the MCS patients.

References

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Key words

Connectome, consciousness, fronto-parietal connectivity, network analysis, topology.