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Conscious behavior after traumatic brain injury: Anatomo-functional support and therapeutic prospects

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Objective. Most brain-injured patients with severe and chronic consciousness disorders are in a therapeutic deadlock. This concerns mainly vegetative or neurovegetative patients, and patients in minimally conscious state. Chronic coma is an exceptional condition; certain conditions of akinetic mutism, which are more frequent, can be included in severe and chronic consciousness disorders. The goal is to review the functional connectivity of conscious behaviours and relational arousal, in particular since the introduction of modern clinical imagery.

Description. The connectivity described in this work relies mainly on two magnetic resonance imaging structural studies of the deep brain: a high-resolution atlas (voxel = 250 μm side; 4.7-Tesla) of an human anatomic piece; an extensive study of deep fascicles (diffusion tensor imaging and tractography; voxel = 1.25 \times 1.25 \times 1.5 mm³; 3-Tesla) on 6 healthy subjects. The results show the support of the functional connectivity of consciousness that involves the mesencephalo-pontine tegmentum, the basal ganglia, the hypothalamus and the thalamus. These deep located regions are connected with the cortex through three main paths: thalamic, ganglionic and rostroventral. The thalamic path rises from the tegmentum, uses the central tegmental tract, and reaches the reticular and dorsomedial thalamus; from the thalamus it spreads to the cortex, the limbic system, the striatum and the pallidum. The ganglionic path uses the lenticular nucleus and projects to the cortex. The rostro-ventral path goes through the ventral tegmental area (below the thalamus) and the posterolateral hypothalamus, and then reaches the frontobasal region; this path uses the basal forebrain bundle.

Prospective. The knowledge of structures controlling conscious behaviours can enable to better understand different types of severe and chronic consciousness disorders. This also could allow proposing adjusted therapeutic options including physical medicine, rehabilitation, pharmacology and neuromodulation.