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Brainstem lesions in permanent vegetative state

Andrea Porzionato[1], Veronica Macchi[1], Carla Stecco[1], Anna Rambaldo[1], Lucia Petrelli[1], Carlo Moreschi[2], Daniele Rodriguez[3] and Raffaele De Caro[1]

[1] Section of Anatomy, Department of Molecular Medicine, University of Padova, Padova, Italy
[2] Section of Legal Medicine, University of Udine, Udine, Italy
[3] Section of Legal Medicine, Department of Molecular Medicine, University of Padova, Padova, Italy

Vegetative state has mainly been associated with widespread damage of cortex, white matter and/or thalamus, whereas brainstem findings are usually absent or include focal, slight and non-haemorrhagic lesions. Functional integrity of the brainstem is considered to be necessary for preservation of sleep/wake cycle (arousal and wakefulness), particularly midline structures of the upper pons and midbrain. Awareness, instead, mainly relies on the integrity of the cerebral cortex, white matter, basal ganglia and thalamus. We present here the neuroanatomical study of a case of post-traumatic permanent vegetative state which is characterized by a quite complex damage also at the level of the brainstem. After a car accident a young woman was referred to Neurosurgical Unit in coma and paraplegia due to head injury and C2 fracture. Spontaneous sleep/wake cycle recovered in the following months. Magnetic resonance, performed one month after the trauma, showed injuries of midbrain, thalamus and left frontal lobe. The patient died more than 15 years after the trauma. Macroscopic examination showed generalized hypotrophy of cerebral hemispheres, cerebellum and brainstem. Partial degeneration of the basal ganglia and severe volumetric reduction of the hemispheric white matter were observed. Wide and bilateral thalamic necrosis and degeneration was found. Transverse sections of the brainstem showed degeneration of the descending and ascending systems of motor and sensitive fibres, and neuronal loss in the inferior olivary complex, pontine nuclei, red nucleus and substantia nigra. In the midbrain, areas of necrosis with reactive astrogliosis extended from the mesencephalic aqueduct towards the interpeduncular fossa, affecting the periaqueductal grey matter, and the dorsal and median raphe nuclei. On the basis of the neuroanatomic description of the damaged areas, we discuss the role of the midbrain reticular activating system and possible plasticity responses in the mechanisms of arousal/wakefulness.

Keywords: Vegetative state, midbrain, trauma, consciousness.