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NEUROLOGY

Differences in brain metabolism between patients in vegetative state, minimally conscious state and 'locked in syndrome'

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INTRODUCTION:

Patients in a persistent vegetative state (PVS), minimally conscious state (MCS) or locked-in syndrome (LIS) represent a problem in terms of diagnosis, prognosis and management. VS patients are aroused but yet unaware of anything. MCS patients are unable to follow instructions reliably or communicate, but demonstrate reproducible behavioral evidence of awareness of the environment (e.g., visual fixation and episodes of crying precipitated by family voices). Patients with LIS are completely aware but unable to communicate (except by eye blinking or vertical eye movements). At the patient's bedside, the evaluation of possible cognitive function in these patients is extremely difficult because voluntary movements may be very small, inconsistent and easily exhausted. This problem is reflected in their frequent misdiagnosing. Even though functional neuroimaging cannot replace the clinical assessment of patients with altered states of consciousness, it can describe objectively how deviant from normal is the cerebral activity and its regional distribution.

METHODS:

Using PET, we compared the global and regional uptake of [18F]fluorodeoxyglucose in PVS (n=17), MCS (n=3), LIS (n=2) and healthy controls (n=78). All patients were studied awake and drug-free. Data were analyzed using SPM99 (results were considered significant at $p<0.05$ corrected for multiple comparisons).

RESULTS:

Compared to controls (7.1 ± 1.3 mg/100g.min), the mean cerebral metabolic rates for glucose in overall gray matter was 60 % lower in VS (2.9 ± 1.2 mg/100g.min; $p< 0.001$), 40 % lower in MCS (4.2 ± 1.0 mg/100g.min; $p< 0.001$) and within normal limits in LIS (6.8 ± 0.4 mg/100g.min; p = NS). Regions that were significantly most impaired in VS compared to controls were localized in the associative cortices (bilateral prefrontal regions, Broca's area, parieto-temporal and posterior parietal areas and precuneus). Interestingly, the brain area that systematically differentiated our VS from MCS patients was the precuneus. In both LIS patients, there were no voxels that showed a significant decrease in metabolism compared to our 78 control subjects.

DISCUSSION:

The polymodal associative cortices, most dysfunctional in VS, are known to be important in various consciousness-related functions such as attention, memory and language. Within this neural network, the precuneus seems to play a particular awareness-related role in humans. Indeed, this area is one of the most active brain regions in conscious waking (in both healthy controls and LIS patients) and is one of the least active regions in unconscious states such as VS, general anesthesia and slow wave sleep. In all three MCS patients, its activity was significantly above that observed in each VS patient. Given the small number of observations, these results should be viewed as a preliminary record of ongoing research.

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