

Determining consciousness in patients on the edge of awareness

A neuroscience research study breaking new ground – with the support of the Cambridge NIHR/Wellcome Trust Clinical Research Facility

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Background: Evidence of covert cognition has been found prior to recovery of consciousness. Scientists do not know why some patients recover or maintain this capacity whilst other patients do not. The Cambridge Impaired Consciousness Research Group is studying this field.

Aim: The primary objective of the Research Group is to develop a series of objective tests, which eventually form a national standard for the assessment of persons with impaired consciousness. This objective is driven by the knowledge that there currently exists a high rate of misdiagnosis, which is exacerbated by widely varying practices within the health care.

The experimental study 'Sensory and Cognitive Functions in Low Awareness States' (overseen by Professor John Pickard) aims to establish new assessment techniques which could detect (where applicable) 'covert consciousness' in these patients and as a result would lead to more refined diagnoses and enable individually targeted care and treatment.

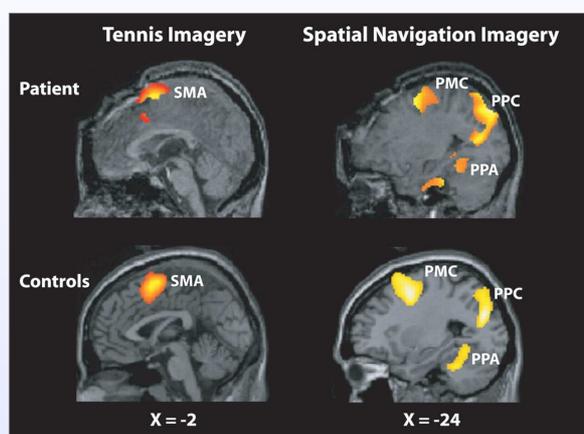


Figure 1: Observation of supplementary motor area (SMA) activity during tennis imagery in patient and healthy volunteers (controls). Parahippocampal gyrus (PPA), posterior parietal-lobe (PPC) and lateral premotor cortex (PMC) while the patient and the same group of volunteers imagined moving around the house (see Owen, Coleman, Boly et al 2007).

A participant might be asked to imagine playing tennis if his/her answer to a question is "yes" and to imagine walking around their home if the answer were to be "no".

Results: Utilising the new techniques the researchers are identifying a number of patients as having covert consciousness.

The study makes a substantial contribution to the understanding of the cerebral activity in low awareness state patients. Careful clinical examination will result in reclassification of the state of consciousness in some of these patients. The new techniques may be useful in establishing basic communication with patients who appear to be unresponsive.

The contribution of the NIHR/Wellcome Trust Cambridge CRF:

To date the CRF has supported 70+ highly dependent patients who require total nursing care (including tube feeding and tracheostomy care) during their study visits and also their families/carers. The study is high intensity and involves a 5 day/4 nights inpatient stay.

The research team is only able to study these patients because of the co-location of the NIHR/WT CRF with the imaging facilities of the Wolfson Brain Imaging Centre with its world-leading scanners (both PET and MR) built as part of the Neurosciences Critical Care Unit.

References:

BBC Panorama (13th November 2012) The Mind Reader: Unlocking My Voice <http://www.bbc.co.uk/programmes/b01ny377> available until 13 Nov 2013

Cruse D, Chennu S, Chatelle C et al (2011) Bedside detection of awareness in the vegetative state: a cohort study, *The Lancet*, Volume 378, Issue 9809, pages 2088 - 2094

Owen AM, Coleman MR, Boly M et al (2007) Using Functional Magnetic Resonance Imaging to Detect Covert Awareness in the Vegetative State *Arch Neurology* Volume 64, Issue 8, pages 1098-1102

Methodology: The study has been running on the Cambridge NIHR/Wellcome Trust Clinical Research Facility (CRF) for the past 12 years. Twice a month, on average, the research team studies patients with severe brain injuries that resulted in them being in a persistent disorder of consciousness.

Patients are transferred to the Cambridge CRF for an initial 5 days (repeat visits tend to be for 3 days) which enables settling in for the participant and extensive testing - at the bedside and in the functional MRI scanner on site.

Testing includes the highly-publicised new techniques (see fig 1) that focus on the visibility of cognitive responses in the brain during clearly-set cognitive tasks during fMRI scanning (Owen AM et al, 2007 and broadcast by BBC Panorama, Nov 2012).

More recently other techniques such as specifically adapted EEG testing have been added to explore bed-side detection of hidden awareness (Cruse D et al, 2011). Changes in the EEG power spectrum after severe brain injury may have prognostic value.



Researcher Srivas Chennu demonstrating the set-up of the EEG test

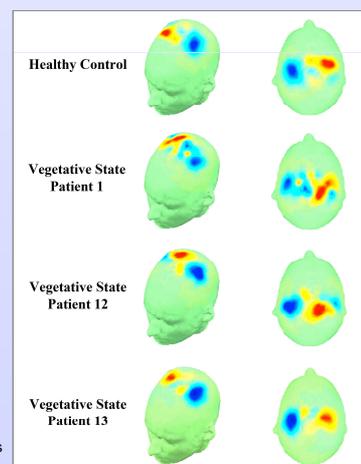


Figure 2: Modulation of the appropriate frequency bands of the EEG signal that are associated with motor imagery in three patients and one healthy control (see Cruse et al 2011)

Contacts

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