Title: Longitudinal bedside assessments of high-density EEG and behavioural awareness in disorders of consciousness

Presenting Author: Corinne Bareham

Author(s): Corinne A. Bareham, Department of Clinical Neurosciences, University of Cambridge, Cambridge, United Kingdom, Judith Allanson, Cambridge University Hospitals NHS Foundation Trust, Cambridge, United Kingdom, Neil Roberts, Sawbridgeworth Medical Services, Jacobs & Gardens Neuro Centres, Sawbridgeworth, United Kingdom, Peter J. A. Hutchinson, Department of Clinical Neurosciences, University of Cambridge, Cambridge, United Kingdom, John D. Pickard, Department of Clinical Neurosciences, University of Cambridge, Cambridge, United Kingdom, David K. Menon, Division of Anaesthesia, University of Cambridge, Cambridge, United Kingdom, Srivas Chennu, School of Computing, University of Kent, Canterbury, United Kingdom, Department of Clinical Neurosciences, University of Cambridge, Cambridge, United Kingdom

Abstract:

Recent neuroimaging has shown that neural measures of information exchange and complexity are associated with various consciousness states. This has particular clinical significance for patients with disorders of consciousness (DOC). Despite this, there is a translational gap between the science of consciousness and the development of clinically viable tests of awareness available at the patient's bedside. Moreover, the majority of research with DOC patients is based on cross-sectional studies hindering evaluations regarding long-term outcomes. To bridge this gap, we present findings from a novel longitudinal study of 39 patients, repeatedly assessed systematically using the Coma Recovery Scale – Revised (CRS-R) and resting state high-density EEG (hdEEG) once every 3 months for 2 years, generating 185 assessments. Despite the expected inter-patient variability in CRS-R scores, there was a statistically significant improvement in behaviour over time, beginning approximately 22 months after injury. Moreover, patients with an initial diagnosis of unresponsive wakefulness state, who progressed to the minimally conscious state (MCS), did so at a median of 485 days following onset – later than 12 months at which current guidelines propose permanence. Contrary to current guidelines, we did not observe any influence of aetiology, however, age was a significant predictor with younger patients showing more promising recovery. Progressive increases in arousal contributed exponentially to improvements in behavioural awareness, especially in MCS patients. These findings highlight the importance of indexing arousal when measuring awareness, and the potential for interventions to regulate arousal to aid long-term behavioural recovery in disorders of consciousness. We conducted canonical correlation analysis to determine previously validated spectral and network metrics from hdEEG that best correlated with the patients’ behavioural trajectories. Across all patients, increases in alpha connectivity (dwpli) and clustering coefficients, and decreases in theta power, were most strongly associated with CRS-R trajectories. Linear Mixed Effects Modelling indicated that hdEEG was a valuable addition to CRS-R assessments to predict outcomes and capture the variance between patient’s natural trajectories of recovery. These findings demonstrate that bedside hdEEG complements clinical evaluation, diagnosis and prognosis, with portable, accurate and timely generation of brain-based patient profiles.