EEG paradigms as a supplemental tool to behavioral assessments of DOC

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Conclusions

● EEG paradigms are promising tools for the diagnosis of CMD in DOC patients.

● Neuroimaging could complement standard clinical tools to eliminate misdiagnosis.

● Such paradigms can be used to assess the validity of novel clinical instruments.

Preliminary findings

● An SMR EEG paradigm could identify CMD in DOC patients.

● Evoked EEG during multisensory integration suggests awareness-dependent modulation.

Background

● Disorders of consciousness (DOC) are common after brain injury.

● Diagnosis/prognosis in acute phase of DOC are critical for informed life decisions.

● Current validated clinical scales, like the Coma Recovery Scale - Revised (CRS-R) do not take into account motor and drive deficits, potentially underestimating awareness, like in case of Cognitive-Motor Dissociation (CMD).

● The Motor Behaviour Tool (MBT) is a novel clinical scale designed to alleviate this caveat.

● Neuroimaging and brain-computer interface (BCI) have also been proposed to improve the diagnosis and prognosis of these patients.

Objectives

● Investigate the diagnostic and prognostic value of two electroencephalography (EEG)-based paradigms in DOC patients, i.e., allow classification of patients into coma, Unresponsive Awareness Syndrome (UWS) or Minimally Conscious State (MCS).

● Employ the independent neuroimaging evidence to assess the added value of the MBT instrument over CRS-R.

Methods

● Patients

   • Acute DOC (< 3 weeks from injury)

   • Acute Neuro-Rehabilitation Unit, CHUV

● Experimental apparatus

   • Sensorimotor rhythm (SMR) paradigm

     • 15 motor attempt + 15 "rest" trials per run, randomized, auditory cue.

     • Functional Electrical Stimulation (FES)-actuated hand extension movement, only after motor attempt trials.

   • Peri-personal space (PPS) paradigm

     • Random FES-driven tactile, auditory and multi-modal (audio-tactile) stimuli.

     • Stimuli randomized inside (near) or outside (far) the patient’s PPS (actionable space).

● Concurrent CRS-R and MBT clinical testing.

● Neuroimaging analysis

   • Above-chance SMR classification.

   • Non-linear addition of within-PPS sensory stimuli in evoked potentials.

Results

● Patient A

   • CRS-R: UWS

   • MBT: UWS/CMD

   • SMR EEG: Above chance accuracy.

● Patient B

   • CRS-R: UWS

   • MBT: UWS

   • SMR EEG: Chance level accuracy.

● SMR paradigm confirms MBT tool about CMD diagnosis and complements CRS-R.

● PPS paradigm suggests awareness-dependent modulation in 8 DOC patients.

● Average evoked EEG potentials over 8 patients.

● Audio-tactile sensory integration within-PPS (solid line) significantly different from outside-PPS (dashed line) ~100 and ~350 msec.

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