Spectral analysis of passive listening EEG paradigms reveals consistent patterns of activation in severely brain-injured patients

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Background & Motivation

- Language-based EEG paradigms can identify covert cognitive processes in patients with disorders of consciousness (DOC) (Conte, SPN 2015; Markell, SPN 2014).
- Desynchronisation in the alpha frequency band (8-12 Hz) is a marker of auditory attention (Weisz et al., 2011; Banerjee et al., 2011).

Here we attempt to further characterize the modulation of the EEG in response to narrative language as well as the topographic distribution of responses in both healthy controls (HCs) and patient subjects (PSs).

Methods

We recorded the EEG in 15 healthy controls (HCs; age range 23-55) and 16 patient subjects who sustained severe brain injuries. Participants listened to intact (FWD) and backward (Bkwd) speech paradigms. We used the Natus XLTEK system for recordings with 37 individual colloidion-pasted Ag/Cl electrodes in an augmented 10-20 montage at 1-mm inter-electrode distance. All subjects listened to three paradigms: 1) two-backward language paradigm run; 1-6 repeats; 2) multiple paradigms run; 1-6 repeats; 3) three behavioral paradigms: 1) passive listening; 2) personal narratives; 3) motor imagery. In the PSs, acute and chronic traumatic brain injury (TBI) led to decreased activity in the left posterior, parietal, and fronto-central regions. In healthy controls, the majority of significant responses were centered in the centro-parietal and parieto-occipital regions consistent with activation of cortical regions involved in language processing and visual imagery.

Conclusions

- Our results demonstrate the preservation of language processing in a subset of severely brain-injured patients with limited motor output channels.
- In both patient subjects and healthy controls, the majority of significant EEG responses were located in centro-parietal and parieto-occipital regions consistent with activation of cortical regions involved in language processing and visual imagery.
- Evidence of state fluctuations in individual patients suggests the need for repeated testing over multiple testing blocks (see Curley et al., this meeting).

References

Conte, M.M., Fidali, B.C., Markell, H.M., Schiff, N.D. EEG Evidence of Auditory Working Memory and Selective Attention in Disorders of Consciousness, Program No. 405.18, 2015 Neuroscience Meeting Planner. Chicago, IL: Society for Neuroscience 2015 Online