Towards a new passive Brain-computer interface to detect accidental awareness during general anesthesia

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Introduction : Accidental Awareness during General Anesthesia (AAGA) occurs in 1-2% of high-risk practice patients and is responsible for severe psychological trauma, termed post-traumatic stress disorder (PTSD) [1, 2]. Currently, monitoring techniques have a limited accuracy in the prediction or detection of AAGA [3]. Since the first reflex for a patient experiencing AAGA is to move, a passive Brain-Computer Interface (BCI) based on the detection of an intention of movement would be conceivable to alert the anesthetist and prevent this phenomenon [4]. However, the way in which the propofol affects the motor brain activity and is reflected by the electroencephalographic (EEG) signal has been poorly investigated and is not clearly understood.

Methods : We analyzed the EEG signal (128 sensors) of 4 healthy volunteers during several motor tasks and under 3 propofol concentration (0 µg.ml, 0.5 µg.ml, and 1 µg.ml).

Results : The main objective of this study was to investigate how the EEG signal of the motor cortex was modulated with increasing sedation of propofol. Results indicated few variations in terms of ERDs and ERSs for each motor task, suggesting that intention to move can be detected under propofol.
The second goal was to verify that a passive BCI could detect the intention of movement, even when the subject is under propofol. Our results confirm that a state-of-the-art BCI can discriminate MI vs Rest under propofol. Indeed, classification accuracies are better for 3 out of 4 subjects.
We also proposed to use a median nerve stimulation as a routine procedure and classify MNS vs MNS+MI to detect an intention of movement during a general anesthesia. Our results are consistent with those previously announced: the classification is not impacted by propofol sedation, highlighting that this technique can be used to detect accidental awareness during general anesthesia.

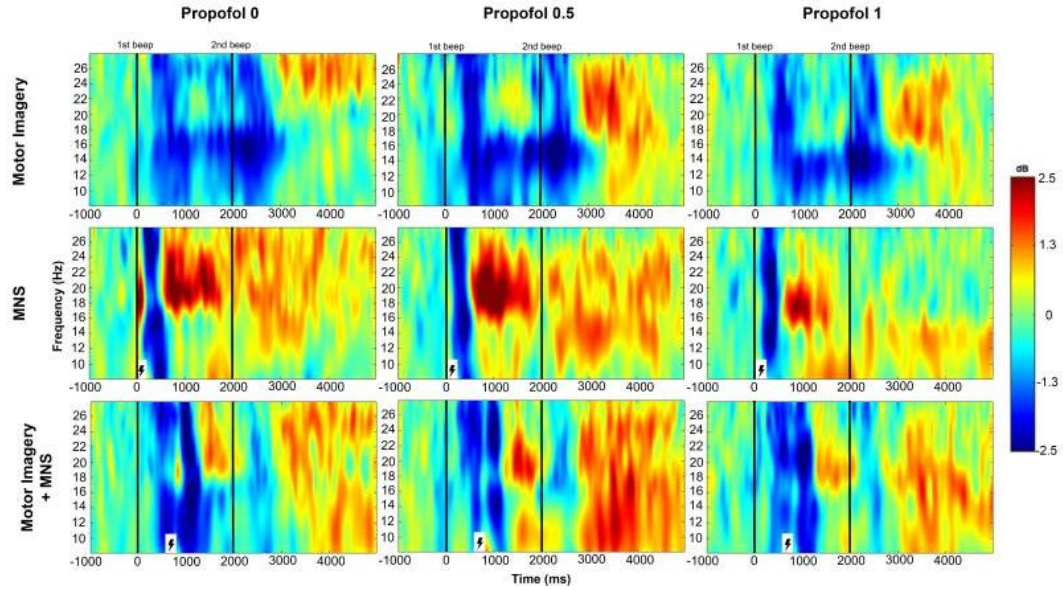

Figure 1 Time-frequency grand average analysis (ERSP) for MI, MNS and MI+MNS motor tasks under 3 propofol concentrations (0 µg.ml, 0.5 µg.ml and 1 µg.ml) for electrodeC3. Black lines indicate when the motor task started and finished. Red color corresponds to a strong ERS and blue to a strong ERD.

References

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