A Preliminary Investigation of the Relationship Between EEG Alpha Power During Anesthesia and Frailty

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Background: Monitors of the processed frontal electroencephalogram (pEEG) are being used increasingly during anesthesia both to avoid awareness and for drug titration. Devices incorporating spectrograms allow observation of characteristics of the underlying EEG including the power in various frequency bands such as the alpha band (8–13 Hz). With increasing age, EEG power (and anesthetic requirement) decreases. Empirical observation suggested that alpha power on the pEEG spectrogram maybe more related to physiological resilience than chronological age. The aim of this study was to explore the relationship between measures of general level of health and EEG characteristics, in particular power in the alpha band, during routine anesthesia.

Methods: Our observational study was approved by the Northern A Health and Disability Ethics Committee. Participants were recruited between October 2018 and January 2019. Subjects were surgical candidates 65 years or older. Exclusion criteria included cardiac, neurological, or hip procedures, or inability to complete the initial health assessment questionnaires. Consenting participants completed four assessments: The WHO Disability Assessment Schedule (WHODAS), the Edmonton Frail Scale, the Timed Get Up and Go (TUG) and the Montreal Cognitive Assessment (MoCA). During anesthesia a Masimo Sedline pEEG monitor was used. Anesthesia management was not standardized. Raw EEG data from the four frontal channels used by Sedline were downloaded and analyzed offline. The primary outcome measure was mean absolute alpha power over the 20–min period commencing 15min after induction of anesthesia. WHODAS was repeated at one month. Excel, GraphPad Prism and R were used for data analysis.

Results: We recruited 48 participants. Six were excluded for data collection issues leaving 42 for the final analysis: 26 female, 16 male; median age 72 years (range 65-88; IQR 68.5-76.5). The primary anesthetic agent was propofol in 21 subjects and sevoflurane in 19.
The assessment scores were: MOCA median 26, [IQR 24 to 27.75], Edmonton Frailty Score 4.0 [2 to 6], TUG 10.3 [9.4 to 13.0], Change in WHODAS 0.0 [-3 to 4], absolute alpha power 0.63 [0.43 to 1.22]μV^2
There were no significant correlations between absolute alpha power and age ($r = 0.16$), TUG ($r = 0.30$) or MoCA ($r = 0.17$).
A general linear model, adjusting for differences in age and anesthetic agent, found a positive association between absolute alpha power and MoCA score ($p = 0.034$), and a negative association between absolute alpha power and TUG score ($p = 0.028$).

Conclusion: We found no correlation between absolute alpha power and age, which may be due to the relatively narrow age distribution of the study population. Although there was no significant correlation between absolute alpha power and the MoCA or the TUG, once age and anesthetic agent were accounted for, our results suggest that both lower cognitive performance (MoCA) score and decreased physical ability (TUG) were associated with decreased alpha power.
Overall, the participants in this study were relatively healthy with few frail subjects as shown by the relatively narrow range of MoCA and TUG results.
Despite this limitation, our results suggest that patients who are less healthy are more likely to have lower average absolute alpha power during anesthesia. While there is no clear data on the relationship between EEG markers of "depth" of anesthesia and outcome, more frail patients are at increased risk of post-operative complications including delirium. Prior awareness of poor physical or cognitive health

may allow the anesthesiologist to take steps to reduce the risk of post-operative cognitive complications. Recognition of lower alpha power during an operation maybe a useful additional marker of the frail patient.