

Decreasing frontal EEG Alpha Power over Three Surgeries within Seven Months: Accelerated brain aging through progressive frailty?

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Introduction:

An individual's frontal EEG signature during anesthesia usually remains stable between surgeries with a given anesthetic agent, with spectral power in the alpha range only decreasing slowly with age. (1)

Methods:

Frontal EEG was recorded from a 68 year old patient during three cardiac surgeries (1st procedure for coronary artery bypass grafting, 2nd for type A aortic dissection, 3rd for endoaortic graft infection) within a 7 month period, as part of the EPOCAS study (NCT02976584). During this time course the patient's condition declined with noticeable general weakness, especially during aortic graft infection with accompanying sepsis.

Mean end-tidal Isoflurane concentration (%) and mean oscillatory alpha power (dB) were calculated for normothermic artifact free time periods. Furthermore, the end-tidal Isoflurane concentration at which the first 0.75 second isoelectric period of burst suppression in the EEG was observed was determined to evaluate the sensitivity of the brain to the administered anesthetic. (2) The amount of opioid and benzodiazepines was recorded.

In Matlab® (R2016a) mean power spectra (Figure 1) were calculated from two-second (non-overlapping) artefact and burst-suppression free sections of pre and post bypass frontal EEG using the Fast Fourier Transform. Oscillatory alpha power was calculated as the power additional to the underlying broadband noise at the peak frequency within an extended alpha range (7 to 17 Hz).

Results:

Spectral analyses showed a rapid decrease in alpha power (1st surgery: 2.1 dB at 0.95 % Isoflurane, 2nd: 1.75 dB at 0.61 %, 3rd: 0.35 dB at 0.59 %) over the course of 7 months, which was clinically associated with increased frailty, see Figure 1.

References:

Purdon, P.L.: The Ageing Brain: Age-dependent changes in the electroencephalogram during propofol and sevoflurane general anaesthesia. *British Journal of Anaesthesia* (2015), i46–i57

Niu, B.: Minimal alveolar concentration of sevoflurane for induction of isoelectric electroencephalogram in middle-aged adults. *British Journal of Anaesthesia* (2013), 112(1), 72–78

Mitnitski, A.: Assessing biological aging: the origin of deficit accumulation. *Biogerontology* (2013) 14:709–717

Mitnitski, A.: Relative fitness and frailty of elderly men and women in developed countries and their relationship with mortality. *J Am Geriatr Soc* (2005), 53:2184–2189

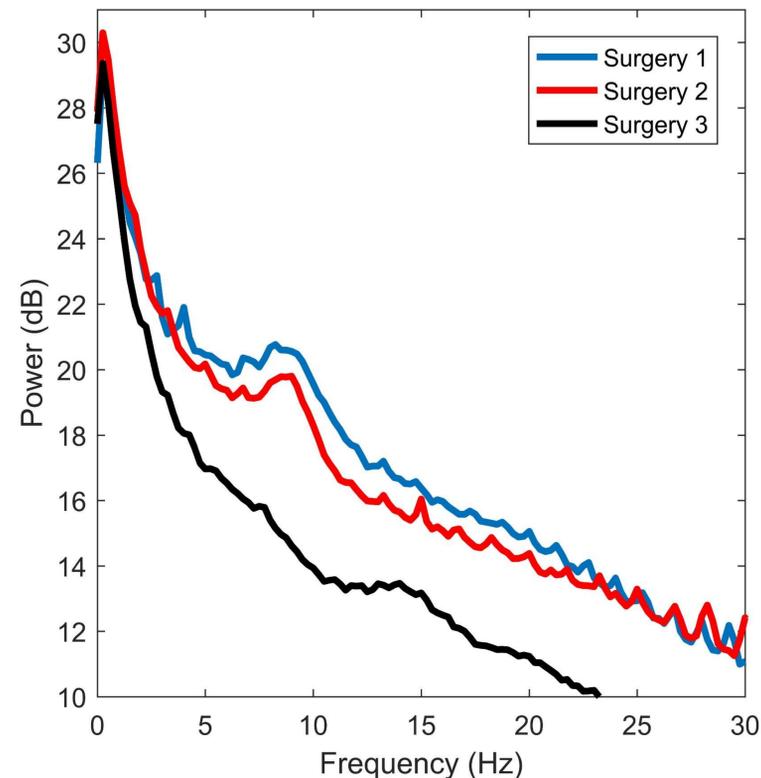


Figure 1: Mean power spectra calculated from artefact and burst suppression free sections of pre and post bypass frontal EEG. Oscillatory alpha power was calculated as the power additional to the underlying broadband noise at the peak frequency within an extended alpha range (7 to 17 Hz).

Conclusion:

The coexistence of decreased frontal EEG alpha oscillation power at 0.6 to 0.9 % of Isoflurane and burst suppression at low volatile anesthetic concentration might be a specific measure of brain ageing induced by ongoing illnesses. (3) It depicts overall patient frailty which presents clinically as increased sensitivity to anesthetics. (4)

During the third procedure the patient had low volatile anesthetic concentrations (0.6 % Isoflurane), with his EEG not showing an alpha oscillation, but rather periods of burst-suppression. The percent of Isoflurane at which the first 0.75 second isoelectric period of burst suppression in the EEG was observed decreased from 1.1 % during the first intervention, to 0.8 % during the second, and then decreased further to 0.5 % during the final case. No change in delta power was observed over the operations. Total doses of Sufentanil and Midazolam were similar.