

Multiple Pathways of EEG Spectral Pattern Progression with Anesthetic Agent Reduction

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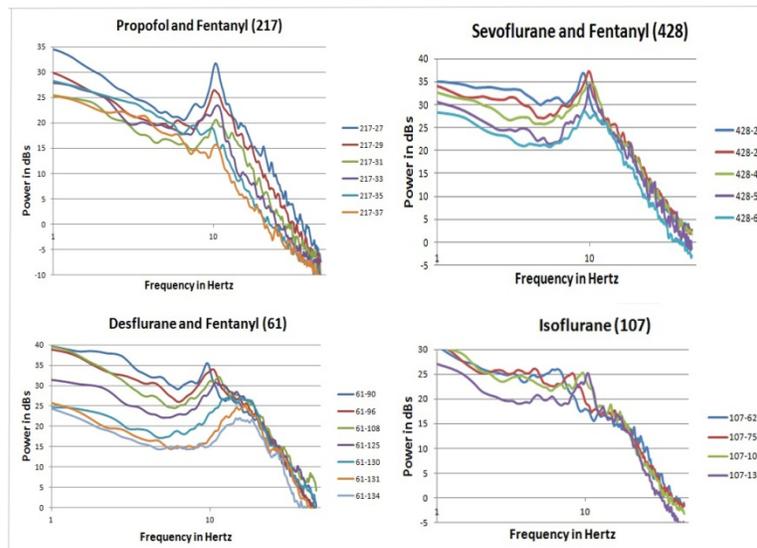
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Introduction: It has been suggested that EEG derived algorithms such as the Bispectral Index™ can be used to monitor the “depth of anesthesia” or the “hypnotic effect” of an anesthetic for several purposes. The underlying assumption is that anesthesia is a depression or inhibition of neural activity which leads to consistent changes in the amplitudes of the different frequencies in the EEG signal. If this were true, a series of EEG spectra over a wide range of anesthetic agent concentrations would vary consistently in some manner for all subjects.

Method: Log-log presentations were used to examine the series of EEG spectra over the course of surgery and emergence from more than one hundred patients. They were examined visually to determine if there was more than one pattern (or “pathway”) to the changes.

Results: Evaluating the series of EEG spectra discovered several pathways. Case 217 had a loss of amplitude at all frequencies and no shift in the frequency of the peak at 10 Hertz. Case 428 had a loss of amplitude at frequencies below the peak. Case 61 had a shift of the frequency of the 10 hertz peak to higher frequencies and a loss of amplitude at frequencies less than the peak. Case 107 had a shift of the peak from 7 to 10 Hertz with no loss of amplitude until the last spectrum and always had a “plateau” out to 20 Hertz. In some other cases (not shown) the 20 Hertz plateau developed into a peak distinct from the 10 Hertz peak.

Conclusion: A universal quantitative EEG algorithm based on spectral analysis as used in several commercial EEG “depth of anesthesia” monitors would likely be inaccurate for many individuals. Accuracy for an individual would require a method that identifies both the pathway and the location on the pathway. Patient factors and choice of anesthesia technique appear to determine which pathway occurs.



The figure above shows four different progressions of spectra as the hypnotic agent component of the anesthetic is reduced.