

Details of an EEG Spectra Pathway with Propofol and Opioid TIVA

Presenting Author: Christopher M. Scheib MD

Co-Author: William Hefner VAMC

Introduction: Propofol plus an opioid such as fentanyl is one example of a category of anesthesia protocols known as “total IV anesthesia” (TIVA). A common progression of EEG spectra from high to low concentration of propofol (“pathway”) is illustrated with one case below.

Method: The EEG signal was previously recorded with a BIS™ monitor. A custom program based on LabView™ was used to generate the spectra and the alpha peak and theta trough parameters. A pharmacokinetic model was used to calculate the effect site concentrations.

Results: The change in EEG spectra shape and amplitude from high to low propofol concentration is biphasic. The initial change in the alpha peak is an increase in power as the propofol concentration declines. Further reduction in the concentration results in the power of the alpha peak declining. This implies that a spectrum with the maximum alpha peak power can be used as a reference point. There are other changes in the shape of the EEG spectra during this process. The sections of the spectra above and below the alpha peak frequency often form a straight line on a log-log presentation. These two segments can be referred to as the “high frequency segment” and the “low frequency segment”. EEG spectra from an anesthetic agent concentration above the maximum alpha peak power reference spectrum have a low frequency segment that is steeper than the low frequency segment of the reference spectrum and a high frequency segment that is less steep than the corresponding segment of the reference spectrum. This is illustrated in the top left section of the figure. As the concentration of propofol is reduced below the level of the maximum alpha peak, the power at every frequency point from below and including the alpha peak is reduced. This is illustrated in the upper right section of the figure. Further reduction of propofol results in a loss of power at all frequencies. The apparently straight lines in the log-log spectra, the peak at 10 Hertz (alpha peak) and the trough at 7 Hertz (theta trough) are shape features and can be tracked to help locate an individual spectrum on the pathway. The values for the peak and trough parameters relative to the calculated effect site propofol concentration for case 217 are shown in the bottom right section of the figure.

Conclusions: The EEG spectrum in the sequence with the maximum alpha peak power can be used for a reference spectrum in the pathway. The EEG spectra were most affected by the estimated effect site propofol concentration. As long as the estimated effect site fentanyl concentration met a minimum value it did not appear to affect the pathway.

