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Comparisons of Electroencephalographically Derived Measures of Hypnosis and Antinociception During Propofol-Remifentanil Anesthesia

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Background

Nociception-induced arousal or movement during anesthesia, results from ascending sensory signals. Electroencephalogram (EEG) derived measures provide information on cortical activity and hypnosis but are less accurate regarding subcortical activity. The neurophysiologically-based EEG measures of Cortical Input (CI) and Cortical State (CS) have been shown to be prospective indicators of analgesia/anti-nociception and hypnosis respectively.[1] In the current study we have compared CI and an alternate measure of CS, the Composite Cortical State (CCS), with the Bispectral Index (BIS) and another recently developed measure of anti-nociception, the Composite Variability Index (CVI). We aimed to evaluate the extent to which simple combinations of anti-nociceptive and hypnotic measures (rather than each measure individually) could better detect and predict response to stimulation.

Methods

EEG recordings and time series of BIS and CVI from a previously published study,[2] were reanalyzed. In the current study the data from 80 patients each randomized to a target hypnotic level (BIS 50 or BIS 70) and a target remifentanil level (Remi-0, 2, 4 or 6 ng/ml) was included in the analysis. CCS, CI, BIS and CVI were calculated or quantified at baseline and at a number of intervals following the application of the Observer's Assessment of Alertness/Sedation scale (OAA/S) and a subsequent tetanic stimulus. Measures were compared before and after application of the stimuli. Statistical clustering methods were used to evaluate the extent to which simple combinations of anti-nociceptive and hypnotic measures (CCS/CI and BIS/ CVI) could better detect and predict response to stimulation.

Results

Application of the OAA/S stimulus resulted in an increase in CI and CCS, whereas following both stimuli, an increase in all four measures was seen. Pairwise combinations of CI and CCS showed higher sensitivity ($P = 0.006$) and specificity ($P = 0.0159$) in predicting response to tetanic stimulation when compared to CVI and BIS combined.

Conclusions

Combining EEG-derived hypnotic and analgesic quantifiers appears to enable better prediction of patients who are likely to respond to tetanic stimulation.

References

1. Liley et al. Anesthesiology 113 (2):292-304

2. Sahinovic et al. Anesth Analg 119 (2):288-301