Assessing Depth of Hypnosis with the NeuroSENSE monitor during Desflurane General Anesthesia – a Randomized Trial

Co-Authors: Matthias Görges, Nicholas West, Erin Cooke, Shanshan Pi, Rollin Brant, Guy A Dumont, J Mark Ansermino, Richard N Merchant
Department of Anesthesiology, Pharmacology & Therapeutics, University of British Columbia (UBC), Vancouver, Canada

Background: Processed electroencephalography (EEG) monitors support depth of hypnosis assessment during anesthesia [1,2]. This randomized study investigated the performance of the NeuroSENSE EEG monitor (NeuroWave Systems Inc., Cleveland Heights, OH) to determine how well its WAV_{CNS} index [3] distinguishes consciousness from unconsciousness during induction and emergence from anesthesia, and whether it correlates with changes in desflurane minimum alveolar concentration (MAC) during maintenance of anesthesia.

Methods: In a prospective clinical trial, following ethics approval and informed consent, EEG was collected from patients using a fronto-temporal bilateral montage. WAV_{CNS} was continuously recorded by the NeuroSENSE monitor, to which the anesthesiologist was blinded. Anesthesia was induced with propofol/remifentanil and maintained with desflurane; randomized changes of -0.4/0/+0.4 MAC target were performed every 7.5 minutes within the 0.8–1.6 MAC range, if clinically acceptable to the anesthesiologist. During emergence from anesthesia, desflurane was stepped down by 0.2 MAC every 5 minutes.

Results: Data from 75 patients aged median (range) 41 years (18-71) were obtained. The WAV_{CNS} distinguished consciousness from unconsciousness, with area under the receiver operating characteristic curve (95% confidence interval) of 99.5% (98.5-100.0) at loss of consciousness and 99.4% (98.5-100.0) at return of consciousness. Bilateral WAV_{CNS} changes correlated with desflurane concentrations, with -8.0/-8.6 WAV_{CNS} units per 1 MAC change in the 0.8-1.6 MAC range during maintenance of anesthesia, and with -10.0/-10.5 WAV_{CNS} units in the 0.4-1.6 MAC range including emergence from anesthesia (Fig 1).

Conclusions: The NeuroSENSE monitor can reliably determine loss and return of consciousness. The WAV_{CNS} correlates with desflurane dosing. At higher doses, the response plateaus as with other EEG monitors [4,5], which suggests limited utility to titrate higher concentrations of anesthetic vapor.

References: [1] Clin EEG Neurosci 2014; 45: 22–32. [2] Anesth Analg 2018; 126: 111–7 [3] IEEE Trans Biomed Eng 2006; 53: 617–32. [4] Clin Monit Comput 2008; 22: 149–58. [5] Acta Pharmacol Sin 2011; 32: 1208–14.

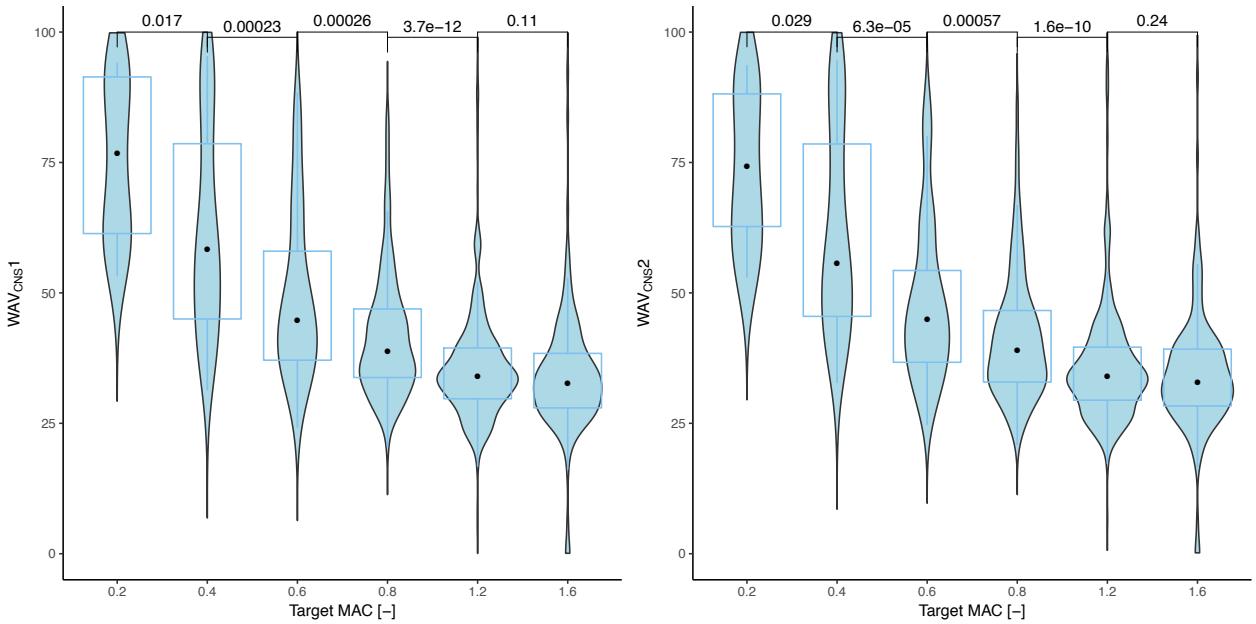

Figure 1: Observed WAV_{CNS} range for each MAC target. Data are shown as hybrid of violin plots, overlaid by boxplots, with statistical comparisons to their next neighbor indicated above; all comparisons, except for the MAC 1.2 vs. 1.6, were statistically significant, due to the large amount of samples included in the analysis.