

## Agreement Between Depth of Anesthesia Monitors Depends on the Patient and Procedure

**Presenting Author:** Marcus Badgeley, MEng, MS4, Icahn School of Medicine at Mount Sinai, New York, USA

**Co-Authors:** Joel Dudley, PhD, Institute for Next Generation Healthcare, Mount Sinai Hospital, New York, USA; Matthew A Levin, MD, Depts of Anesthesiology, Perioperative and Pain Medicine, and Genetics and Genomic Sciences, Icahn School of Medicine, New York, USA

**Introduction:** Anesthesiologists can assess the Depth of Anesthesia (DoA) with gestalt or by monitoring surrogates of DoA. Surrogates include the end-tidal anesthetic concentration (ETAC) and a summary of EEG response, the bispectral index (BIS). ETAC and BIS have different analytes, but similar effectiveness for avoiding intra-operative awareness in the largest randomized clinical trial, B-Unaware [1]. In the B-Unaware trial the median intra-individual ETAC-BIS correlation was -0.16 (interquartile range -0.50, -0.03) [2]. The variable relationship between ETAC and BIS response has been used to suggest the susceptibility to anesthesia. Here we identify patient and procedural determinants of BIS-ETAC concordance.

**Methods:** Adult (age > 18) patients undergoing general anesthesia between 2010 and 2015 in which BIS monitoring was used were included. Exclusion criteria were cardiac surgery, spinal fusions and laminectomies, and cases lacking documented gender and BMI. After removing outlier BIS and ETAC measures, we included only cases with at least 5 minutes of concurrent BIS and ETAC measurements. ETAC was age and equivalent adjusted. BIS and ETAC were sampled q15 seconds.

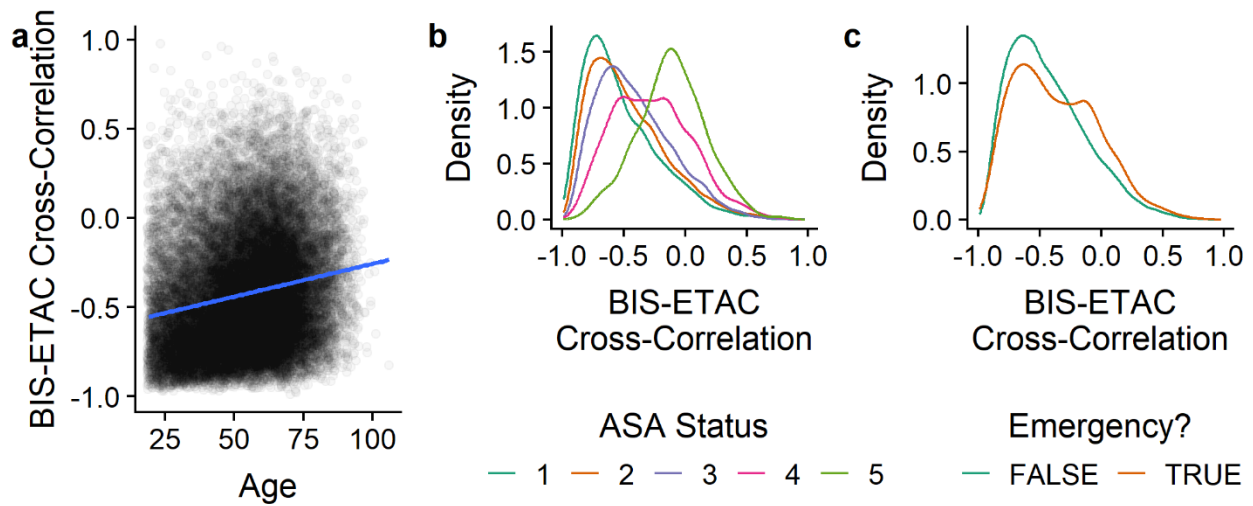
The concordance of BIS and ETAC was measured with the cross-correlation for each case. We then trained multiple linear regression models to predict a case's BIS-ETAC concordance based on patient and procedural factors that were known prior to the operation (age, gender, BMI, race, ASA physical status, attending anesthesiologist, and procedure CPT code). Predictors were assessed for significance with type II ANOVA tests.

**Results:** 31,505 cases met inclusion criteria, with mean anesthesia durations of 214 min (s.d. 126 min) and mean concurrent BIS and ETAC measures for 145 min (s.d. 107 min). The DoA concordance had a wide spread (median -0.48, interquartile range -0.67, -0.22). Multiple linear regression explained 10% of the observed variance in DoA concordance. Patient age and ASA status were the strongest predictors of DoA concordance ( $p=4e-93$  and  $6e-93$ ), and additional significant factors were CPT code ( $p=5e-132$ ), anesthesiologist ( $p=8e-89$ ), patient race ( $p=2e-9$ ), and emergency status ( $p=4e-3$ ).

**Conclusions:** BIS and ETAC monitors provide alternative assessments of DoA. We found a stronger overall BIS-ETAC concordance than prior work, but weaker associations in high risk and emergency cases, and older and lower BMI patients. It is still unclear which monitor is superior for DoA, but knowing when these monitors are redundant or incongruous can guide monitor selection in clinical practice and case selection in clinical trials.

**References:**

- [1] Avidan, Michael S., Lini Zhang, Beth A. Burnside, Kevin J. Finkel, Adam C. Searleman, Jacqueline A. Selvidge, Leif Saager, et al. 2008. "Anesthesia Awareness and the Bispectral Index." *The New England Journal of Medicine* 358 (11): 1097–1108.
- [2] Whitlock, Elizabeth L., Alexander J. Villafranca, Nan Lin, Ben J. Palanca, Eric Jacobsohn, Kevin J. Finkel, Lini Zhang, et al. 2011. "Relationship between Bispectral Index Values and Volatile Anesthetic Concentrations during the Maintenance Phase of Anesthesia in the B-Unaware Trial." *Anesthesiology* 115 (6): 1209–18.



**Figure 1:** a) Association between BIS-ETAC concordance and patient age. Each point represents one case, and the blue line is a linear regression. b&c) Density of BIS-ETAC cross-correlation grouped by (b) ASA physical status level and (c) emergency status.