

ANESTH ANALG 2011; 112(SCA Suppl);1-102

SCA15**The Impact of Extracranial Contamination on NIRS measurements of regional cerebral oxygen saturation: a comparison of three different cerebral oximeters**

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Objective: Near-Infrared spectroscopy (NIRS) is a non-invasive technology allowing for the measurement of regional cerebral oxygen saturation (rSO₂). Increasing evidence points to a variably robust relationship between intraoperative cerebral oxygen desaturation and significant adverse perioperative outcomes. There are currently three NIRS devices available for clinical use; the Fore-Sight (CAS Medical), the INVOS (Somanetics) and the Equanox (Nonin). Although these monitors are increasingly being used in many clinical settings, inter-device technologic differences suggest potential variation in the ability to accurately acquire (and spatially resolve) brain oxygenation signals. The primary objective of this study was to determine if NIRS-derived rSO₂ measurements accurately account for oxygen saturation contamination from extracranial (i.e. scalp) tissue.

Methods: After institutional approval and informed consent, volunteers (n = 12) were recruited to participate in this study. Each of the 3 NIRS devices was randomly applied to one side of the subject's forehead with a surface pulse oximeter (that recorded superficial extracranial tissue saturation) placed on the contralateral side. Below these sensors, a circumferential pneumatic head cuff was placed. After the recording of baseline rSO₂ measurements, the head cuff was inflated until a loss of pulse oximeter signal indicated no flow in the extracranial tissue. Once this state of extracranial tissue hypoxia was obtained, rSO₂ measurements were recorded at two and five minutes post-inflation. The head cuff pressure was then released allowing the extracranial tissue to be reperfused. A one minute post-reperfusion measurement was also recorded. This procedure was repeated in triplicate with each of the NIRS devices. Changes from baseline in rSO₂ among the 3 devices were compared using a Student's t test.

Results: The induction of extracranial hypoxia resulted in a significant reduction in rSO₂ measurements in two of the three NIRS devices studied. At five minutes post-inflation of the pneumatic head cuff, the rSO₂ measurements were significantly lower than baseline with both the INVOS and Fore-Sight (16.6 ± 9.6%, p = 0.0014; and 11.8 ± 5.3%, p = 0.0002, respectively), but not the Equanox (6.8 ± 6.0%, p = 0.1065). There was no difference between the INVOS and the Fore-Sight with respect to the magnitude of extracranial contamination, but both were significantly worse compared to the Equanox (Figure 1).

Conclusions: Extracranial contamination appears to significantly affect NIRS measurements of cerebral oxygen saturation in at least two of the three commercially available cerebral oximeters. Although the clinical implications of this inaccurate spatial resolution require further study, it appears that the oxygen saturation measurements from most cerebral oximeters do not solely reflect that of the brain alone.

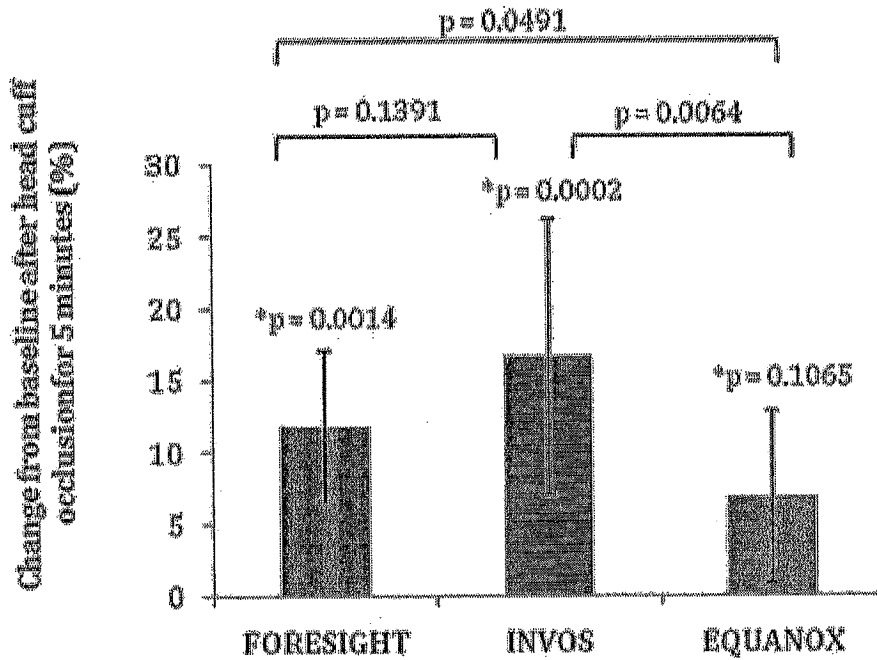


Figure 1. Percent change from baseline cerebral saturation after head cuff occlusion for five minutes for the different NIRS devices studied. *p value compared to baseline saturation measurement.