

Evaluation of Noninvasive Hemoglobin Measurements on High Risk Surgical Patients.

Richard KM, Quill T.J., Surgenor S.D., Trummel J.M., Koff M.D. *Proceedings of the 2010 Annual Meeting of the American Society Anesthesiologists*. Abs. A187.

Background

Studies have shown that total hemoglobin measured via noninvasive pulse CO-Oximetry (SpHb) is accurate when compared to drawn samples (on healthy volunteers) of blood measured using a laboratory CO-Oximeter (tHb). Little data is available utilizing this technology in patients with significant co-morbidities during high-risk surgical procedures.

Methods

After IRB approval and informed patient consent, 11 patients of ASA class 3-4 undergoing elective vascular, neurosurgical or general surgical procedures requiring an arterial line for standard of care monitoring were prospectively enrolled in an observational trial. Two Masimo Rainbow Adult Resposable probes (Rev E) were attached to the middle or ring finger on both right and left hands of each patient according to manufacturer instructions. The probes were covered with ambient shields to prevent optical interference. Continuous SpO₂, SpHb, perfusion index, pulse rate and signal quality index were recorded and downloaded to a laptop computer for analysis. The SpHb values were compared with tHb values obtained from intra-operative blood samples drawn via arterial line and analyzed by laboratory Co-Oximetry. Bias, precision and accuracy root mean square (A_{RMS}) were calculated. Bland Altman analysis was plotted.

Results

A total of 39 tHb measurements were collected, 13 of which were excluded due to device low signal quality or errors in data collection software. The 26 remaining tHb values were paired with 44 total SpHb values measured from left and/or right hands at the corresponding intra-operative time point. Values measured from the left vs right hands showed identical mean bias of -0.5 g/dL with precision of 1.1 and 0.9 g/dL, respectively. A_{RMS} were 1.2 g/dL for the left and 1.0 g/dL for the right. Figure 1 shows the correlation of SpHb versus laboratory hemoglobin; R^2 was 0.55. Bland-Altman analysis (Figure 2) indicated that the 95% limits of agreement between the two methods ranged from -2.6 to 1.6 g/dL with one data point lying outside these limits.

Conclusions

Noninvasive hemoglobin measurement from Pulse CO-Oximetry (SpHb) provides clinically acceptable accuracy (within 1 g/dL) compared to laboratory CO-Oximetry (tHb) measurements measured during high risk surgical procedures in patients with co-morbid conditions (ASA 3-4). Accuracy did not depend upon the site of measurement. This technology appears valuable to trend high-risk surgical patients directly in the operative environment and may reduce serial and invasive hemoglobin measurements and tests. This non-invasive technology may also add value to care and reduce laboratory

costs in many other clinical locations and scenarios (ICU, PACU, Jehovah's Witness patients, pediatrics, etc.).

Figure 1

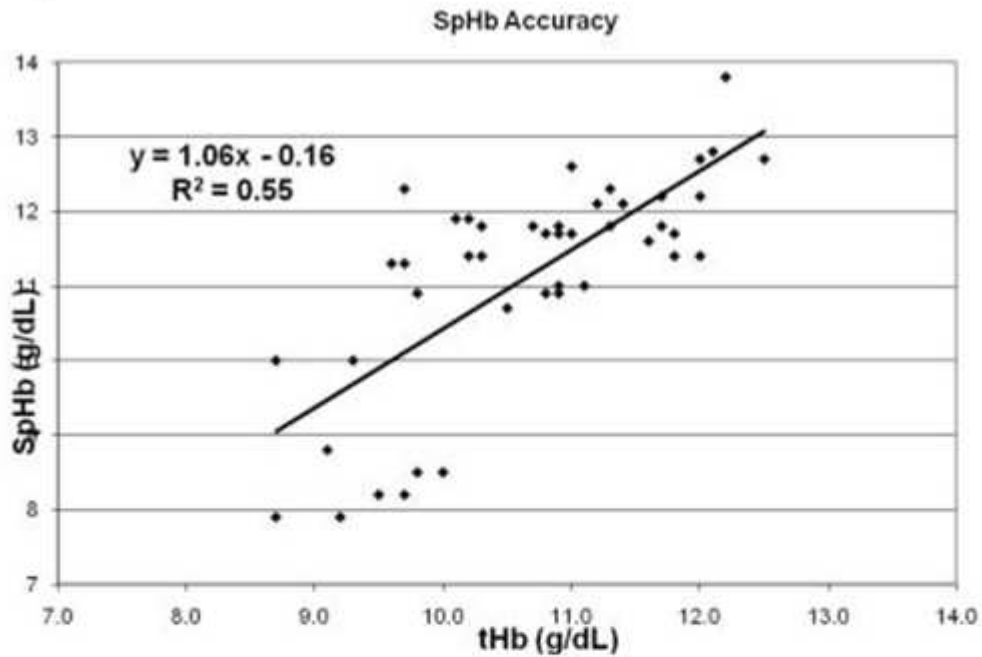


Figure 2

