

Accuracy of Noninvasive Hemoglobin Measurements by Pulse CO-Oximetry in Hemodilution Subjects

Allard M, et al. *Anesthesiology*. 2009; A184.

Background

Noninvasive and continuous hemoglobin measurement offers advantages in the assessment of acute and chronic anemic states in several clinical settings. The purpose of this study was to evaluate the accuracy of noninvasive total hemoglobin measurements from pulse CO-Oximetry (SpHb) as compared with drawn samples of blood measured using a laboratory CO-Oximeter (tHb) in normal healthy subjects undergoing hemodilution.

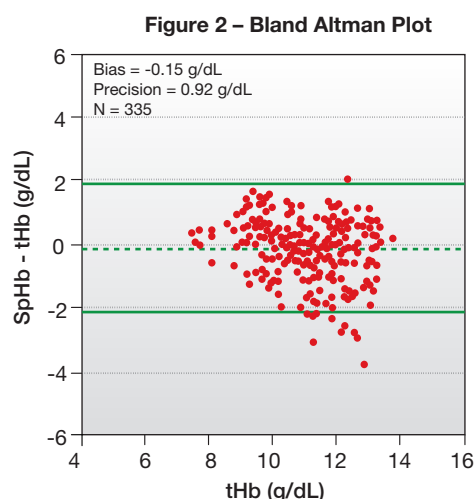
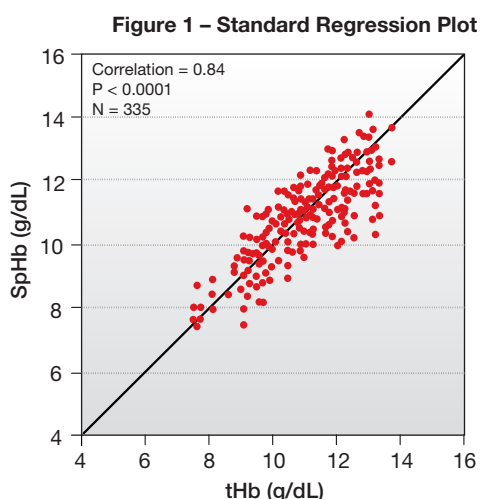
Methods

Peripheral intravenous lines (upper extremity) and intra-arterial lines (radial) were inserted into 20 healthy adult subjects. For continuous measurement of SpO₂, SpHb, perfusion index, pulse rate, and signal quality index, all subjects wore up to 3 Rainbow Adt noninvasive hemoglobin sensors (sensor version A) on one or both hands connected to a Masimo Radical-7 Pulse CO-Oximeter. Optical interference was prevented by covering the sensors with optical shields. Data from the pulse CO-Oximeter was continuously downloaded onto a laptop computer. For the hemodilution procedure, approximately one unit of blood was drawn from each subject through the arterial line while isolyte intravenous fluid was given to compensate for the decrease in intravascular volume and further reduce hemoglobin. Subjects received isolyte until they reached a 30% reduction in hemoglobin or a maximum of 30 ml/kg of intravenous fluid. During isolyte infusion, arterial tHb samples were drawn after each 500 mL of fluid administered and immediately analyzed for total hemoglobin by laboratory CO-Oximetry. The bias, precision, and accuracy root mean square (A_{RMS}) were calculated and the Bland Altman analysis plotted.

Results

A total of 165 tHb measurements were collected with 335 paired SpHb measurements. 8 SpHb measurements were excluded from the analysis (2.4%) because of device low signal quality. The average drop in tHb during phlebotomy/hemodilution was 2.4 +/- 0.8 g/dL. Laboratory CO-Oximetry tHb values ranged from 7.5 to 13.8 g/dL. The correlation of SpHb to tHb measurements was 0.84 ($p < 0.001$) with a bias of -0.15 and precision (1 SD) of 0.92 g/dL. Regression analysis indicated that SpHb measurement accuracy was unaffected by perfusion index levels.

Continuous Noninvasive Hemoglobin Measurement (SpHb) vs. Invasive Laboratory Hemoglobin (tHb), g/dL



Conclusions

Noninvasive hemoglobin measurement from Pulse CO-Oximetry provides clinically acceptable accuracy compared to tHb from laboratory CO-Oximetry in normal subjects undergoing hemodilution and may offer an acceptable alternative to invasive hemoglobin tests in many clinical scenarios.