Quantitative Review and Comparison of Noninvasive Hemoglobin Accuracy and Trend Ability

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Introduction

Multi-wavelength pulse spectrophotometric noninvasive measurement of total hemoglobin in arterial blood has been recently introduced as a tool for making perioperative transfusion decisions. The Radical-7® Pulse CO-Oximeter (Masimo Corp.; Irvine, CA) is a fingertip sensor that provides continuous hemoglobin (SpHb) measurements. Several clinical studies have assessed accuracy, precision and trend ability of this technology. The objective of our study is to critically review published data on the Radical-7® Pulse CO-Oximeter.

Methods

We performed a quantitative review of studies assessing accuracy, precision and trend ability. We performed a Medline search to identify articles that compared SpHb to total hemoglobin (tHb). Fifteen trials, published from December 2010 to February 2013, were identified.

Results

Twenty groups of subjects were analyzed from fifteen trials, group size ranging from 12 to 91 patients. Total number of patients studied was 616, providing 3701 simultaneous comparisons. Bias describes whether there is a systematic deviation between tHb and SpHb. The mean bias was 0.062 ± 0.93 g/dl, ranging from -1.7 to 1.8 g/dl, with a median of 0.025 g/dl. The variation in the limits of agreement refers to precision. The mean ± SD of the lower and upper limits of agreement were -2.33 ± 1.07 and 2.63 ± 1.65, respectively. Six studies evaluated trend ability, plotting the difference of SpHb and tHb values between consecutive time points using a four-quadrant plot technique. This showed directionality of the trend with a central exclusion zone of 1 g/dl applied. The concordance rate (the number of data points that are in the 2 quadrants of agreement) was done in three studies (93% by Park et al, 94% by Colquhoun, and 95% by Marques) and calculated for another three by inspecting their figures (80% by Frasca, 80% by Applegate, and 57% by Vos).

Conclusion

There appears to be a strong ability for this technology to demonstrate data trends versus accuracy, which has been the primary focus of most studies. The combined use of laboratory tHb value and SpHb trends may provide the needed accuracy, and timeliness to optimize transfusion decisions.