The Accuracy of Noninvasive Hemoglobin Monitoring Using the Radical-7 Pulse CO-Oximeter in Children Undergoing Neurosurgery.

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Background

The most common method for determining the hemoglobin concentration is to draw blood from a patient. However, the Radical-7 Pulse CO-Oximeter (Masimo Corporation, Irvine, CA) can noninvasively provide continuous hemoglobin concentration (SpHb). In our study we compared noninvasive measurements of SpHb with simultaneous laboratory measurements of total hemoglobin in arterial blood samples taken from children (tHb).

Methods

Arterial blood samples were analyzed using a laboratory CO-oximeter, and SpHb was simultaneously recorded in pediatric patients undergoing neurosurgery. When patients met the criteria for hypovolemia, 10 mL/kg of colloids or red blood cells were administered over 10 minutes. SpHb and tHb data were collected before and after intravascular volume resuscitation. The relationship between SpHb and tHb was assessed using a 4-quadrant plot, linear regression, mixed-effect model, and modified Bland-Altman analyses.

Results

One hundred nineteen paired samples were analyzed. The correlation coefficient between SpHb and tHb was 0.53 ($P < 0.001$), whereas that of change in SpHb versus change in tHb was 0.75 ($P < 0.001$). The average difference (bias) between tHb and SpHb was 0.90 g/dL (95% confidence interval [CI], 0.48-1.32 g/dL) and 1 standard deviation of the difference (sd) was 1.35 g/dL. The concordance rate (a measure of the number of data points that are in 1 of the 2 quadrants of agreement) determined using a 4-quadrant plot was 93%. The correlation coefficient between SpHb and tHb after intravascular volume resuscitation was 0.58 ($P < 0.001$), whereas that of changes in SpHb and tHb was 0.87 ($P < 0.001$). The bias immediately after volume resuscitation was 1.18 g/dL (95% CI, 0.81-1.55 g/dL), and sd was 1.28 g/dL with a concordance rate of 94.4%. The bias was -0.03 g/dL when tHb was ≥11 g/dL, which was significantly lower in comparison with biases when tHb <9 g/dL (1.24 g/dL) and tHb was 9-11 g/dL (1.17 g/dL) ($P = 0.004$).

Conclusion

The Radical-7 Pulse CO-Oximeter can be useful as a trend monitor in children during surgery even immediately after intravascular volume expanders are administered. However, it is advisable to confirm the baseline hemoglobin level and to consider the influence of tHb level on the bias. In addition, one should be cautious with regard to using SpHb alone when making transfusion decisions.