Accuracy of Noninvasive and Continuous Hemoglobin Measurement by Pulse CO-Oximetry during Preoperative Phlebotomy.

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Background

In recent years, the continuous noninvasive hemoglobin measurement has been offered by devices using advanced pulse oximetry technology. Accuracy has been established in healthy adults as well as in surgical and intensive care unit patients but not in the setting of acute hemorrhage. In this study, we evaluated the accuracy of such a device in the clinical setting of preoperative phlebotomy thereby mimicking a scenario of acute blood loss.

Methods

This prospective study included patients undergoing surgical repair of congenital heart disease (CHD) for whom preoperative phlebotomy was planned. Blood was removed after the induction of anesthesia and prior to the start of the surgical procedure. Replacement with crystalloid was guided by hemodynamic variables and cerebral oxygenation measured by near-infrared spectroscopy. Hemoglobin was measured by bedside whole blood analysis (total hemoglobin [tHb]) before and after phlebotomy, and concurrent measurements from the pulse co-oximeter (noninvasive, continuous, or spot-check testing of total hemoglobin [SpHb]) were recorded.

Results

The study cohort included 45 patients ranging in age from 3 months to 50 years. Preoperative phlebotomy removed an average of 9.2 mL/kg of blood that was replaced with an average of 7.2 mL/kg of crystalloid. The pre- and postphlebotomy tHb values were 13.0 ± 1.9 and 12.4 ± 1.8 g/dL, respectively. The absolute difference between the tHb and SpHb (▵Hb) was 1.2 ± 0.1 g/dL. Bland-Altman analysis revealed a bias of 0.1 g/dL, a precision of 1.5 g/dL, and 95% limits of agreement of -2.8 to 3.1 g/dL. In 52.2% of the sample sets, the SpHb was within 1 g/dL of the actual hemoglobin value (tHb), and in 80% of the sample sets, the SpHb was within 2 g/dL. No variation in the accuracy of the deviation was noted based on the patient's age, weight, or type of CHD (cyanotic versus acyanotic).

Conclusion

The current study demonstrates that the accuracy of continuous, noninvasive hemoglobin measurement was not affected by acute blood loss simulated by preoperative phlebotomy. Although the device provided a clinically acceptable correlation with the actual hemoglobin value and offers the value of a continuous trend monitor, given the precision of the device, it does not appear that actual transfusion decisions can be based on the device alone.