

Clinical Interpretation of Noninvasive Hemoglobin (SpHb) Revised: Single Capillary-Bed rather than Arterial Hemoglobin.

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Background and Goal of Study

Introduction of noninvasive monitoring of hemoglobin, SpHbTM (Radical-7, Masimo Corp., Irvine, US) followed by controversial reports of accuracy. The reference method was laboratory analysis of venous or arterial blood. Radical-7 has a venous SpHb modes, where venous is mathematically derived from arterial. However, in previous study, arterio-venous dilution difference found positive at the end of 15 ml/kg crystalloid bolus, but progressively negative during next 20 minutes¹. This is attributable to reflux interstitial fluid which diluted venous blood. Our objective was to evaluate arterio-capillary dilution difference (acDD) in a stepwise 15 m crystalloid infusion. Hypothetically, if SpHb is affected by transcapillary fluid shift, acDD will be negative after 20min. following last bolus.

Materials and Methods

Prospective clinical trial was conducted preoperatively in 36 ASA-II elective orthopedic surgery patients. After overnight fast they received three 5 ml kg⁻¹ boluses of acetated Ringer's solution separated by periods of 5min. without fluid. Radial art samples were drawn and SpHb was recorded simultaneously at 5 data points - before 1st bolus, after each 5 min. period following 3rd bolus, after 20min. following 3rd bolus. Blood was analyzed in laboratory (COULTER® LH750; Beckman Coulter, Inc. USA). Arterial and capillary dilutions were calculated from fractional change of arterial hemoglobin and SpHb, respectively.

Results and Discussion

144 arterial and capillary estimates of stepwise plasma dilutions were calculated from 180 simultaneous measurements of arterial Hb and SpHb at 5 data points. The acDD was negative after 20min. following last bolus. Noninvasive Hb could have been affected by transcapillary fluid shift because acDD was positive in 1st step (rehydration?), negative in 3rd (overhydration?) and most negative after next 20 min. (redistribution?). Anatomy of noninvasive measuring site (derma) suggests that measurements are made in the vicinity of a single bed. Theoretically, SpHb can be a surrogate of metarteriolar (arterial) and capillary Hb since capillaries are also pulsating due to vasomotion.

Conclusion

Noninvasive hemoglobin (SpHb) was probably affected by transcapillary fluid shifts in capillaries under the probe.

References

1. Svensen et al. *Anesth Analg* 2009;108:128-33.