

Continuous noninvasive hemoglobin monitoring estimates timing for detecting anemia better than clinicians: a randomized controlled trial.

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BACKGROUND: Hemoglobin measurement is important for transfusion decision-making. Pulse CO-Oximetry provides real-time continuous hemoglobin (SpHb) monitoring. The triage role of SpHb trends based on hemoglobin measurements was investigated.

METHODS: In this diagnostic randomized controlled trial, 69 patients undergoing spine or cytoreductive surgery were randomly enrolled into SpHb-monitoring and standard-care groups. Diagnostic blood samples were drawn for CO-oximetry Hb (CoOxHb) when the SpHb decreased by 1 g/dl or at the clinician's discretion in the standard-care group. The positive predictive value (PPV) was defined as the ability to detect a decrease in CoOxHb > 1 g/dl or a CoOxHb < 10 g/dl; the PPVs were compared using Fisher's exact test. The SpHb and trend accuracies were calculated. The transfusion units and postoperative hemoglobin levels were compared.

RESULTS: The PPV of a decrease in CoOxHb > 1 g/dl was 93.3% in the SpHb group vs 54.5% without SpHb monitoring ($p = 0.002$). The PPV of CoOxHb < 10 g/dl was 86.7% vs. 50.0% for these groups ($p = 0.015$). The CoOxHb was never < 7 g/dl with SpHb monitoring. Sixty SpHb-CoOxHb data pairs and 28 delta pairs ($\Delta\text{SpHb}-\Delta\text{CoOxHb}$) were collected. The bias, precision and limits of agreement were - 0.29, 1.03 and - 2.30 to 1.72 g/dl, respectively. When ΔSpHb and ΔCoOxHb were > 1 g/dl, the concordance rate for changes in hemoglobin reached 100%. The delta pairs revealed a positive correlation [$\Delta\text{SpHb} = 0.49 * \Delta\text{CoOxHb} - 0.13$; $r = 0.69$, 95% confidence interval (0.53, 0.82)]. No significant differences were found in the transfusion volume or postoperative anemia state.

CONCLUSIONS: The SpHb trend tracked changes in hemoglobin satisfactorily during surgery and more accurately estimated the appropriate timing for invasive hemoglobin measurements than the clinicians.