

Continuous Noninvasive Hemoglobin Monitoring Reflects the Development of Acute Hemodilution After Consecutive Fluid Challenges.

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BACKGROUND: Consecutive fluid challenges (FCs) are frequently administered to maximize the stroke volume (SV) as part of a goal-directed therapy (GDT) strategy. However, fluid administration may also cause acute hemodilution that might lead to an actual paradoxical decrease in oxygen delivery (DO₂). The aim of this study was to examine whether continuous noninvasive hemoglobin (SpHb) monitoring can be used to detect the development of acute hemodilution after graded fluid administration.

METHODS: In 40 patients who underwent major vascular or gastrointestinal surgery, an FC, consisting of 250 mL colloid solution, was administered. When the SV increased by $\geq 10\%$, the FC was repeated up to a maximum of 3 times. Laboratory-measured hemoglobin concentrations (BHb), SpHb, SV, cardiac output (CO), and DO₂ values were recorded after each FC.

RESULTS: All 40 patients received the first FC, 32 patients received the second FC, and 20 patients received the third FC (total of 750 mL). Out of the 92 administered FCs, only 55 (60%) caused an increase in SV $\geq 10\%$ ("responders"). The first and the second FCs were associated with a significant increase in the mean CO and DO₂, while the mean SpHb and BHb decreased significantly. However, the third and last FC was associated with no statistical difference in CO and SV, a further significant decrease in mean SpHb and BHb, and a significant decrease in DO₂ in these patients. Compared to their baseline values (T₀), BHb and SpHb decreased by a mean of $5.3\% \pm 4.9\%$ and $4.4\% \pm 5.2\%$, respectively, after the first

FC (T1; n = 40), by $9.7\% \pm 8.4\%$ and $7.9\% \pm 6.9\%$ after the second FC (T2; n = 32), and by $14.5\% \pm 6.2\%$ and $14.6\% \pm 5.7\%$ after the third FC (T3; n = 20). Concordance rates between the changes in SpHb and in BHb after the administration of 250, 500, and 750 mL colloids were 83%, 90%, and 100%, respectively.

CONCLUSIONS: Fluid loading aimed at increasing the SV and the DO₂ as part of GDT strategy is associated with acute significant decreases in both BHb and SpHb concentrations. When the administration of an FC is not followed by a significant increase ($\geq 10\%$) in the SV, the DO₂ decreases significantly due to the development of acute hemodilution. Continuous noninvasive monitoring of SpHb does not reflect accurately absolute BHb values, but may be reliably used to detect the development of acute hemodilution especially after the administration of at least 500 mL of colloids.

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