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Optimization of cardiac output by incremental fluid administration is associated with iatrogenic hemodilution and a paradoxical decrease in oxygen delivery

Blood, haemodilution, Blood, haemoglobin, Oxygen, consumption

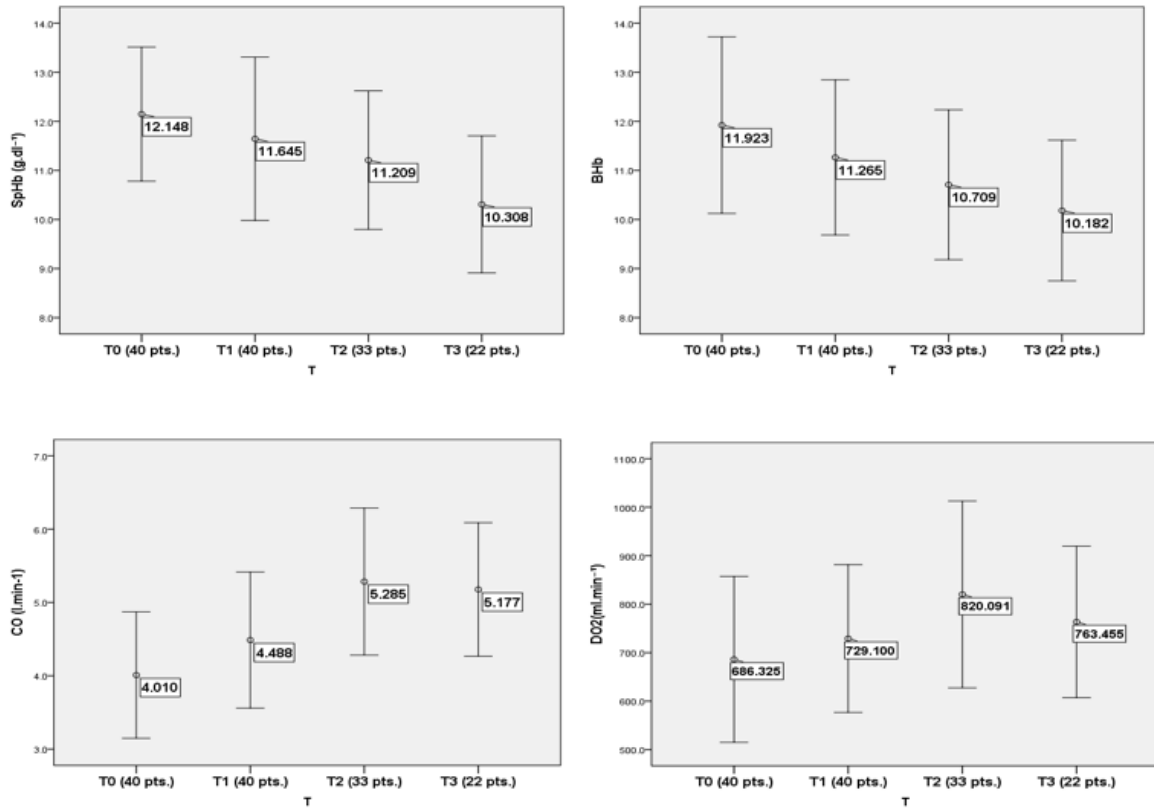
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Background and Goal of Study: Fluid administration causes iatrogenic hemodilution that may lead to avoidable blood transfusions [1]. We examined the effects of incremental fluid loading on the oxygen delivery (DO₂) and on lab (B_{Hb}) and non-invasive (SpHb) hemoglobin levels.

Materials and Methods: After informed consent, 40 adult patients undergoing major gastrointestinal or vascular surgery were included. Oxygen saturation (SpO₂) and SpHb were continuously measured by a Radical-7 Pulse CO-Oximeter (Masimo Inc.). B_{Hb} and PaO₂ were intermittently measured (ABL800 Radiometer). Cardiac output (CO) and stroke volume (SV) were continuously measured by the Vigileo monitor. DO₂ was calculated as $CO \times ((Hb \times 1.38 \times SpO_2) + (PaO_2 \times 0.0031))$. Baseline values were recorded after induction of anesthesia (T₀) and 5 min after the administration of a 250 ml colloid fluid challenge (FC) (T₁). In patients whose SV increased $\geq 10\%$ compared to T₀, another FC was given and all parameters recorded 5 minutes after its completion (T₂). The same protocol was repeated at T₂ and T₃. Student's paired and unpaired tests, Wilcoxon signed rank test and ANOVA were used where appropriate.

Results and Discussion: All 40 patients received one FC (T₁), 33 patients received 2 FC's (T₂), and 22 patients received 3 FC's (T₃). Figure 1 represents the mean \pm SD of SpHb, B_{Hb}, CO and DO₂ during the study and the number of patients studied at each time point. There was a gradual increase in the mean SV between T₀-T₁, T₁-T₂, and T₂-T₃. However, the DO₂ increased significantly only from T₀-T₁, remained unchanged between T₁-T₂, and decreased between T₂ and T₃. There was a statistically significant decrease in mean SpHb and B_{Hb} after each FC. In patients who received 3 FC the SpHb and the B_{Hb} decreased by 1.66 ± 0.67 and 1.7 ± 0.7 g/dL, respectively. This decrease in Hb values explains the observed decrease in the DO₂.



Conclusion(s): Fluid loading in goal-directed therapy may cause a paradoxical decrease in DO₂ due to iatrogenic hemodilution, which is reflected by a real-time decrease in the SpHb trend, similar to the intermittent BHb trend.

References (optional): 1. Perel A. Critical Care (2017) 21:291