Can perioperative hemodilution be monitored with non-invasive measurement of blood hemoglobin?

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Background
Trends in non-invasive measurements of blood hemoglobin (Hb) may be useful for identifying the need for transfusion in the perioperative period.

Methods
Crystalloid fluid (5–20 mL/kg) was administered intravenously or by mouth to 30 volunteers and 33 surgical patients in five non-randomized clinical studies where Hb was measured on 915 occasions by non-invasive (Radical-7™) and invasive methodology. The hemodilution curves were compared by volume kinetic analysis and linear regression, with the slope and scattering of the data as key outcome measures.

Results
The slope was 1.0, indicating unity between the two modes of measuring Hb when crystalloid fluid was infused in volunteers; however, only 40–45% of the variability in the non-invasive Hb could be explained by the invasive Hb. Patients undergoing major surgery, who showed the most pronounced hemodilution (median 24 g/L); non-invasive Hb explained 72% of the variability but indicated only half the magnitude of the invasive Hb changes (slope 0.48, P < 0.001 versus the volunteers). Simulations based on volume kinetic parameters from the volunteers showed 25% less plasma volume expansion after infusion when based on non-invasive as compared to invasive Hb, while no difference was found during infusion.

Conclusions
In volunteers the non-invasive Hb had good accuracy (low bias) but poor precision. In surgical patients the non-invasive Hb had good precision but systematically underestimated the hemodilution. Despite severe limitations, the non-invasive technology can be used to follow Hb trends during surgery if supported by occasional invasive measurements to assure acceptable quality of the hemodilution curve.