Title: Improved estimation of total blood volume can provide a reliable prediction of dilutional hematocrit and oxygen delivery during cardiopulmonary bypass

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Abstract:

Background: Adequate indexed oxygen delivery (iDO2) during cardiopulmonary bypass (CPB) for open heart surgery is crucial to protect organ function, improved outcome and reduced hospital stay. To prepare for optimal oxygen delivery during CPB, accurate prediction of dilutional hematocrit (Hct) and iDO2 is essential, which is dependent on a reliable estimation of total blood volume (TBV). In this study, we evaluated and improved the accuracy of TBV estimation and its effect on the predicted versus measured Hct and iDO2 during CPB.

Methods: We performed a retrospective study of 113 patients who underwent cardiac surgery to compare four conventional methods of estimating TBV and accuracy of the predicted versus measured Hct and iDO2: 1) weight based 1; 70ml/kg for all patients, 2) weight based 2; 70ml/kg for males and 65 ml/kg for females, 3) Allen’s formula, and 4) Nadler’s formula

Results: TBV estimated by Allen’s formula predicts the dilutional Hct better than the other three. However, all four methods overestimate pre-operative TBV when Hct is low and underestimate when Hct is high. We found that TBV is dependent on Hct in addition to body size and gender. Based on our analysis, we developed an improved formula to predict reliable TBV.

Conclusion: Unreliable estimation of TBV is a major reason of inaccurate prediction of dilutional Hct and iDO2. TBV has been calculated based on the body size and gender of an individual. However, we found that two individuals with the same body size and gender can have different TBV depending on Hct (5% TBV/Hct difference). We devised a formula of TBV estimation including Hct, which likely predicts dilutional Hct and iDO2 more accurately.