Red Cell Mass Is Not Well Conserved Following Elective Cardiac Surgery Despite Use Of Cell Salvage And Transfusion Guided By Peripheral Hematocrit

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Purpose

Peripheral blood hematocrit (pHct) is commonly used as a measure of red cell volume and to guide transfusion decisions during cardiac surgery. The decrease in pHct accompanying surgery could be due to excessive administration of non-RBC volume expanders or surgical blood loss. We hypothesized that red blood cell volume (RBCV) would be well conserved during surgery – despite marked decreases in pHct – due to cell salvage and transfusion practices. We examined the extent of RBCV loss during surgery and assessed the correlation of pHct with actual RBCV.

Methods

A series of three direct blood volume measurements were performed on 46 patients: (1) before surgery; (2) immediately after surgery; and (3) 2 hours after transfer to the ICU. Total Blood Volume (TBV), Red Blood Cell Volume (RBVC) and Plasma Volume (PV) were measured using the indicator dilution technique via a commercially available, FDA approved semi-automated system (BVA-100 Blood Volume Analyzer, Daxor Corporation).

Results

Despite the use of surgical blood salvage and pRBC transfusions, patients had an average net loss of 648 ± 444 mLs (p<0.0001) of RBCV following cardiac surgery. Since RBCV has a Hct of 100%, this correlates to a surgical blood loss of 1944 ml. Male patients showed an average net loss of 774 ± 432mLs (p<0.0001) while females showed an average net loss of 328 ± 297 mLs (p=0.0035) RBCV. These figures correlate to a surgical blood loss of 2322ml and 984ml respectively. Regression analysis showed only a mild correlation of pHct with RBCV post-surgery (R²=0.49). Normalization of the Hct (which adjusts for abnormally low or high blood volume due to plasma volume derangements) strengthened this correlation (R²=0.96).

Conclusions

Direct blood volume measurement can be used to identify deficits/excesses in RBCV that are not evident from the pHct. Our findings showed a strikingly higher loss of RBCV than was hypothesized, particularly in male patients (2253ml). In patients with blood volume abnormalities – which most of these surgical patients exhibited – the pHct does not provide an accurate estimate of RBCV.