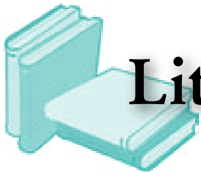

# Literature Reviews

## Intraoperative red blood cell transfusion during coronary artery bypass graft surgery increases the risk of postoperative low-output heart failure.

Surgenor SD, Defoe GR, Fillinger MP, et al. *Circulation* 114;43-48, 2006.

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**Abstract Excerpt**

Should a patient undergoing coronary artery bypass (CABG) surgery on cardiopulmonary bypass (CPB) be transfused if a hemodilutional anemia develops? What would be the clinical impacts of transfusion? In this prospective observational study the relationship between anemia during CPB, red blood cell (RBC) transfusion, and the risk of low-output heart failure (LOF) was examined. Data from 8004 isolated CABG patients was collected from 1996-2004. Exclusion criteria included patients with postoperative bleeding or >3 units of transfused RBC. Three criteria were used to define LOF: the need for intraoperative or postoperative intra-aortic balloon pump (IAPB), re-initiation of CPB, or > 2 inotropes at 48 hours. This study showed that lower nadir hematocrit was associated with increased risk of LOF (adjusted odds ratio 0.90; 95% CI, 0.82-0.92; P=0.016) and the risk of LOF was further increased if patients received RBC transfusions. It was also determined that RBC transfusion was a significant, independent predictor of LOF when adjusted for nadir hematocrit (HCT) (adjusted odds ratio, 1.27; 95% CI, 1.00-1.61; P=0.047). These investigators conclude that a combination of hemodilutional anemia and RBC transfusion increases the risk of LOF but the risk of LOF is even greater when exposed to intraoperative RBC transfusion versus anemia alone.

**Reviewers' Comments**

Is the treatment (blood transfusion) worse than the disease (hemodilutional anemia)? This article by Surgenor and associates. does not resolve this question, but it substantially adds to the evidence from other large, retrospective studies that indicate hemodilutional anemia and RBC transfusion each contribute independently to adverse outcomes following CABG surgery. The size and design of this prospective, observational trial deserves special attention not only for its clinical design, but its ability to demonstrate that the treatment of borderline HCT (18%-25%) during CPB may be worse than anemia itself.

The New England Cardiovascular Disease Study Group includes investigators from eight medical centers that have maintained a registry since 1987 in an attempt to identify and reduce the multiple risks associated with cardiac surgery. Based on their previous work, they designed a trial that divided 8004 CABG patients into quartiles based on their nadir HCT (range <20% to >25%) during CPB. They used multivariable logistic regression analysis (to adjust for all known confounding variables, including nadir HCT) and determined the added risk of RBC transfusion on LOF. The choice of LOF as the primary clinical endpoint was based on the observation that 80% of the variance of surgeon-specific CABG mortality was due to LOF fatality. The discovery that treatment of borderline hemodilutional anemia increases the unadjusted and adjusted incidence of LOF by 82% and 27% respectfully is alarming and suggests that the treatment (1-2 units of RBC) may be doing more harm than good. These findings add plausibility to the notion that increases in the systemic inflammatory response, immunomodulation, and possibly tissue hypoxia (associated with transfusing stored RBC) are responsible, in part, for organ dysfunction observed in these patients. Similar caution will be found in a soon- to-be-published transfusion guideline for cardiac surgery sponsored by the STS/SCA. This evidence-based medicine document states that a RBC transfusion is "reasonable" if the HCT is <18% (during hypothermic CPB) when cerebral oxygen delivery is not at risk or < 21% if significant coexisting disease is present.

Limitations of this study include its non-randomized design, absence of a variable (in the multivariate analysis) that significantly influences the risk of LOF and/or possible lack of concordant findings if markers of neurological and/or renal dysfunction were used. Taken together, however, We believe this study provides not only a strong impetus for performing an appropriately designed clinical trial to study the risk:benefit ratio of treating borderline hemodilutional anemia, but a reasonable design for doing so.