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EDITORIAL COMMENTARY

Blood transfusion balance: Too much, not enough, or just right

Victor A. Ferraris, MD, PhD

See related article on pages 3084-9.

The decision to administer a perioperative blood transfusion involves a balance between the risks of receiving an allogeneic donor unit and the benefits of volume replacement and improved oxygen-carrying capacity. Every experienced surgeon has a patient whose life was saved by a blood transfusion. On the other hand, an overwhelming amount of evidence suggests that perioperative blood transfusion translates into adverse surgical outcomes in some circumstances. In their study published in this issue of the *Journal*, Likosky and coauthors¹ evaluated a subgroup of patients undergoing elective coronary artery bypass grafting (CABG) who received a so-called discretionary transfusion of packed red blood cells (PRBCs). They used a subset of the Society of Thoracic Surgeons adult cardiac surgical database from

5 regional collaboratives in the Cardiac Surgery Quality Improvement (IMPROVE) network to identify 2 groups of patients: 1 group receiving 1 or 2 units of PRBCs and 1 with no transfusions. The study cohort was at low risk of operative mortality, but independent of this risk there was significant variation in the transfusion of 1 or 2 PRBC units across regions.

Patients with low operative risk are least likely to benefit from transfusion. For trauma patients, the association of transfusion with all-cause mortality appears to vary according to the predicted risk of death. Transfusion may reduce mortality in patients at high predicted risk of death but increase mortality in those at low risk (Figure 1).²

Similarly, we found a dose-dependent relationship between blood transfusion and morbidity and mortality in patients undergoing noncardiac thoracic operations.³ Further, we queried the American College of Surgeons National Surgical Quality Improvement Program database, which contains patients undergoing mostly general surgical procedures, for data entered between 2010 and 2012 to identify mortality and morbidity differences in patients receiving blood transfusion within 72 hours of the operative procedure and those who did not receive any blood. We calculated the relative risk of development of a serious complication or of operative mortality in propensity-matched patients with equivalent risks of receiving a blood transfusion. There was an astounding

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FIGURE 1. Odds ratio of death in trauma patients receiving transfusion compared to no transfusion segregated by mortality risk category. *CI*, Confidence interval. (Used with permission from Perel P, Clayton T, Altman DG, Croft P, Douglas I, Hemingway H, et al. Red blood cell transfusion and mortality in trauma patients: risk-stratified analysis of an observational study. *PLoS Med.* 2014;11:e1001664.)

FIGURE 2. Odds ratios of operative morbidity and mortality associated with transfusion in propensity matched cohorts with equal transfusion-risk. (Used with permission from Hochstetler M, Ferraris VA, Martin JT, Mahan A, Saha SP; unpublished data.)

difference in transfusion-related outcomes that depended on the predicted preoperative risk of death or serious morbidity. We found that high-risk patients do not have significant risk associated with blood transfusion, whereas the patients at lowest risk have between an 8- and 10-fold excess risk of adverse outcomes when they receive a blood transfusion (Figure 2).

Likosky and coauthors¹ studied a cohort of low-risk patients undergoing CABG. One might speculate that in the spectrum of patients undergoing cardiac operations this cohort would be least likely to benefit from PRBC transfusion. Likosky and coauthors¹ carefully avoided measuring surgical outcomes in transfused and nontransfused patients. I am not sure why. In their Discussion section, Likosky and coauthors¹ point out that other

investigators have identified adverse CABG-related outcomes in transfused patients, but one wonders why they themselves did not evaluate the relationship between transfusion and morbidity or mortality in their study group. The important feature of their work is the accumulation of regional data and the collaboration among participating sites. The overarching questions remains mostly unanswered. Did transfusion of small amounts in their patient cohort translate into adverse outcomes? Were patients in the regional group of high transfusion burden placed at increased operative risk by receiving the blood product?

Perhaps the most important observation in the article by Likosky and coauthors¹ is the finding that regional variation in transfusion practice exists despite a regional IMPROVE

network dedication to quality improvement. It is not surprising that there are regional variations. Others have found wide geographic variations in blood transfusion.⁴ Likosky and coauthors¹ point out that many cultural factors track with transfusion practice. Hospital culture, surgeon culture, and now geographic culture may all contribute to variations in transfusion rates. It is possible that the least important cultural factor is surgeon behavior.⁵ Several pieces to the puzzle are missing. What is the impact of cultural transfusion practice on surgical outcomes? Is geographic variation in transfusion practice amenable to intervention? Is it even possible to alter practice patterns not related to surgeon behavior? Do patients undergoing higher-risk procedures than elective first-time CABG show similar variations in transfusion behavior? Perhaps most importantly, how do surgeons identify those patients who will benefit from transfusion while withholding transfusion from those who are potentially harmed by it?

One hopes that regional collaboratives like the IMPROVE network can answer some of these questions.

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