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# Blood Transfusion as a Quality Indicator in Cardiac Surgery

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**I**N 2007, THE SOCIETY OF THORACIC SURGEONS AND THE Society of Cardiovascular Anesthesiologists issued clinical practice guidelines on perioperative blood transfusion and blood conservation in cardiac surgery.<sup>1</sup> In a 2009 follow-up survey of clinicians considered the primary target group of these guidelines, more than two-thirds of respondents indicated some degree of familiarity with the guidelines.<sup>2</sup> However, reported changes in practice resulting from the guidelines were limited, and about half of the respondents indicated that they did not adhere to the recommended reduced hemoglobin cutoff points as transfusion triggers.

Guidelines for blood transfusion have been proposed that attest to the inadequacy of discrete hemoglobin levels as “triggers” for transfusion and acknowledge the necessity of taking other physiologic criteria into account.<sup>1,3</sup> It is generally agreed that transfusion is not of benefit when hemoglobin levels are greater than 10 g/dL and possibly of benefit when hemoglobin levels are less than 6 g/dL. Indications for transfusion in patients with hemoglobin levels within these parameters are often tied to other factors such as existing comorbid conditions and perceived risks of discrete organ ischemia. Another common theme in these guidelines is the limited evidence available to support the recommendations, along with frequent calls for research that could lead to further guidance from level 1 evidence.

In this issue of *JAMA*, 2 articles address distinct but related aspects of blood transfusion. Hajjar et al<sup>4</sup> report results from a noninferiority randomized controlled trial (RCT) comparing 502 patients undergoing cardiac surgery with cardiopulmonary bypass at a single referral center in São Paulo, Brazil, who were assigned to perioperative red blood cell (RBC) transfusion strategies aimed at maintaining hematocrit at or greater than 30% (hemoglobin approximately 10 g/dL) vs 24% (hemoglobin approximately 8 g/dL). The transfusion strategies resulted in transfusion rates of 78% and 47%, respectively. Patients randomized to either group had comparable mortality and morbidity outcomes.

In the other study, Bennett-Guerrero et al<sup>5</sup> analyzed data from more than 100 000 patients undergoing coronary artery bypass graft surgery with cardiopulmonary bypass in 2008 at 798 centers across the United States and observed substantial variation in rates of RBC (7.8%-92.8%), plasma (0%-97.5%), and platelet (0.4%-90.4%) transfusions (range of rates from 408 larger-volume hospitals provided). The variability in transfusion rates persisted after adjusting for a number of patient- and hospital-related factors.

The study by Hajjar et al<sup>4</sup> is a notable addition to the existing body of evidence on the narrow benefits of RBC transfusion and its effect on outcomes in patients without hemorrhage. These studies have suggested that reduction or avoidance of transfusion in cardiac patients is associated with improved outcomes.<sup>6,7</sup> Given the ethical complexities and methodological challenges, to date no RCT has been conducted comparing a transfused group with a nontransfused group.

Transfusion RCTs instead have focused on comparing various transfusion strategies, which may undercut the observed magnitude of differences. Only a minority of patients who are screened and eligible to participate in RCTs agree to do so: 40%, for example, in the TRICC (Transfusion Requirements in Critical Care) study<sup>8</sup> and less than 50% in the study by Hajjar et al.<sup>4</sup> The subsequent lack of differences in outcomes for these trials may be biased by treating physicians accurately determining, a priori, that their enrolled patients would survive participation in the study. Additionally, cell salvage was not used in the study by Hajjar et al,<sup>4</sup> and frequent blood draws performed as part of the study procedures could have contributed to iatrogenic anemia. Moreover, use of relatively fresh, nonleukodepleted blood units in this trial may limit the applicability of the results to other settings. These factors could have contributed to the transfusion rates being relatively high in both study groups. Despite (or because of) these limitations, the trial by Hajjar et al<sup>4</sup> showed that patients undergoing cardiac surgery who received fewer RBC transfusions did as well as those transfused more liberally, with no evidence of ischemia or impaired delivery of oxygen to tissues.

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See also pp 1559 and 1568.

The study by Bennett-Guerrero et al<sup>5</sup> provides a snapshot of transfusion practices in a subset of patients undergoing cardiac surgery across the United States. The data showing highly variable transfusion rates are disconcerting. Yet despite magnitudes of differences between hospitals in terms of RBC transfusion rates, there were no significant differences in mortality rates between the hospitals. The absence of differences in mortality among centers with varying transfusion rates strongly suggests inappropriate transfusions.

Transfusion decisions depend on several factors such as institutional transfusion policies, blood ordering procedures, and availability of blood conservation strategies. Only around 11% of the variation in RBC transfusion rates was explained by hospital characteristics in the study by Bennett-Guerrero et al.<sup>5</sup> Additional patient characteristics included several factors known to affect the probability of RBC transfusion and accounted for only 20% of variability in RBC transfusion rates among the hospitals. With the mortality rates unaffected, it is reasonable to assume that most of the blood ordered in hospitals with high transfusion rates was unjustified, consistent with data from other studies<sup>2,9,10</sup>

Continued inappropriate transfusions among hospitals is a major concern. Transfusions carry risks and are costly, and the supply of blood is limited. Substantial variation in transfusion practices in cardiac surgery was documented in 1991.<sup>9</sup> However, despite subsequent publication of transfusion practice guidelines, substantial variability in transfusion practices persisted.<sup>10</sup> Now, more than a decade later, the study by Bennett-Guerrero et al<sup>5</sup> again documents substantial and unacceptable variation in transfusion practice. Published guidelines have not been effective in reducing this variability in blood transfusion. Institution-level blood management protocols<sup>11</sup> are a preferred approach, including demonstration projects supported at the federal or state level to identify and target specific transfusion practices and patient outcomes. Other potential approaches at the institution level include use of computerized practitioner order entry, which can leverage strategies such as requiring information from treating physicians for transfusion indications in blood product order forms; utilization audits; and benchmarking.

The measures of quality used by the Society of Thoracic Surgeons in the ratings of cardiac surgery programs do not identify or include RBC transfusions as a quality indicator.<sup>12</sup> It may be time for patient blood management to gain status as a performance indicator by accreditation agencies such as the Joint Commission<sup>13</sup> or as a quality indicator by professional organizations such as the Society of Thoracic Surgeons as part of transparency and public rankings for consumers.

The conservation of blood in cardiac surgery was originally stimulated by concerns that blood product inventory would be inadequate to meet the needs of newly developing open heart surgical programs.<sup>14</sup> Subsequently, the recognition of transfusion-related complications, many of which were first described in patients undergoing cardiac surgery, fueled further efforts to limit blood transfusion needs

in this setting.<sup>15</sup> More recently, accurate accounting of the costs of RBC transfusion has led to the realization that alternatives to allogeneic RBC transfusion (eg, autologous blood salvage and reinfusion) may be increasingly cost-effective. Of these 3 motivations for conservative transfusion behavior (blood inventory, blood risks, and blood costs), the primary motivation should be to avoid known (and unknown) risks. The influence of attending surgeons' attitudes has been documented.<sup>16</sup> When evaluating a hemoglobin level, treating physicians must resist the temptation to "first do something" and temper this temptation with a philosophy of "first do no harm" to achieve the optimal balance of providing the best risk-benefit and cost-effective outcomes of transfusion therapy for patients.

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