EDITORIAL VIEW

Transfusion, under-transfusion and over-transfusion

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SUMMARY

The incidence of transfusion has increased day by day due to many factors, including increasing population, enhanced expertise and facilities to operate once inoperable conditions and the willingness of the public to pay high cost of advanced surgical procedures. Trauma services have been well-organized now and victims may have massive transfusion. Many authors have pointed out the need of protocols and guidelines to be followed to avoid transfusion associated risks and complications. Under-transfusion has been preferred to over-transfusion and a need to have a 'Maximum Surgical Blood Order Schedule' has been stressed.

Key words: Blood transfusion; Massive transfusion; Over-transfusion; Under-transfusion; Transfusion-related acute lung injury; TRALI; Transfusion-associated circulatory overload; TACO

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Blood transfusion is in practice for many decades, but it has been associated with some controversies since its start. Before the era of the advent of current cross-matching techniques and before the advanced screening techniques for bacterial and viral contamination, it led to immeasurable morbidity and mortality. Still, the number of transfusions has steadily increased over the last three or four decades throughout the world, a 128% growth rate between 1997 and 2009.[1] The progress in cardiothoracic, neurosurgery and trauma surgery plus establishment of blood banks and transfusion services has played a major positive role in this increase. In the United States, more than 15 million units of RBCs are transfused annually.[2] The Agency for Healthcare Research and Quality (AHRQ) reports that blood transfusion is the most frequently performed procedure for inpatients.[1] Medical research is continuing in search of good and more appropriate protocols and guidelines to regulate transfusion practices, as many researchers have pointed out that the current trend favors inappropriate or unjustified transfusion.[3]

The questions, 'At what point you would start transfusion' and 'how much' must be asked before ordering transfusion. An increased morbidity and mortality has been observed in patients who are transfused at a higher rather than a lower hemoglobin (Hb) threshold.[4-6] Blood may not be needed in every patient with asymptomatic anemia and it may be pharmacologically treatable with folate, vitamin B_{12}, or iron, in which case transfusion can be avoided. In our practice we have noted a persistent Hb level below 10 gm in pregnant ladies of our population. Levels between 7-9 are the most common finding, and blood needed to be transfused very rarely during cesarean sections. This transfusion avoidance strategy can be applied to inpatients as well. A patient who was leading an active life and was completely asymptomatic at a Hb level of 7 gm, will hopefully tolerate a blood loss of 400-500 ml during her cesarean section.

Many international societies and associations have formulated clinical practice guideline for transfusion, recommending a restrictive transfusion strategy, i.e., considering transfusion only at a hemoglobin level of less than 7 to 8 g/dl in hospitalized, stable patients.[7] The Joint Commission has proposed National Patient Safety Goal 16.01.01 "to minimize the overuse of tests, treatments, and procedures to reduce the risk of patient harm."[8]

Although there is a thin line between massive transfusion and over-transfusion, for all practical purposes, the risks associated with blood transfusion are multiplied with both of these. Massive transfusion is usually defined as the use of ten or more bags of blood in a single patient; whereas, over-transfusion can be described as

the practice of transfusing blood or blood products in excess of the actual and genuine needs of the patient. MT may not always be justified in most of the critical situations, when reasonable estimate of blood loss is difficult or impracticable. The anesthesiologists and the surgeons usually depend upon visual estimates for ordering blood and have a tendency to over-transfuse in emergency related confusion.

Over-transfusion still continues on an international level. Although the risk of transfusion-transmitted diseases has greatly reduced, with the following current rates: HIV, 1 transmission in every 2 million units; hepatitis C virus (HCV), 1 in every 2 million units and hepatitis B virus (HBV), 1 in every 200,000 units transfused, bacterial contamination of platelets continues to carry a high risk at 1 in 2,000 units transfused.[9,10] The problem is not confined to transmission of disease only, transfusion-related acute lung injury (TRALI) and transfusion-associated circulatory overload (TACO), both noninfectious conditions, are the two leading causes of fatalities associated with transfusion. The risk of all these increases with every bag of blood transfused. We need to ensure that the indication of blood transfusion for each patient is evidence-based and consistent with current guidelines.

The anesthesiologists are well aware that stored blood cells undergo multiple biochemical, functional, and structural changes, a condition referred to as the RBC *storage lesion,* and that 2,3-diphosphoglycerate (2,3-DPG) decreases in these, shifting the oxyhemoglobin dissociation curve to the left, making these less efficient in delivering oxygen to the tissues. Stored cells have insufficient nitric oxide (NO) bioavailability, which also results in vasoconstriction and decreased oxygen delivery.[11] Transfusing RBCs, stored for more than 2 weeks, have been associated with a statistically significant risk of postoperative complications, including increased mortality, prolonged ventilator support, increased renal failure, and sepsis.[12]

It is reasonable to assume that the incidence of transfusion errors will be increased with massive transfusion or over-transfusion. Most of these are caused by patient caregivers outside the laboratory and a lesser number by the hospital transfusion service. Surprisingly, phlebotomy has been found to account for 13% of all transfusion-associated errors.[13] A study reviewing 4,000 transfusion audits from the College of American Pathologists Q-Probe data revealed that in 25% of transfusions, the transfusionist failed to confirm patient identification.[14] Missed identification may lead to mistransfusion. Mistransfusion, the transfusion of a unit of blood to the wrong patient, is the leading cause of mortality associated with transfusion. Using data from the New York State Department of Health errors database, Linden and colleagues reported that the risk of mistransfusion was one in every 12,000 procedures.[15] ABO-incompatible mistransfusions occur at a rate of 1 in every 33,000 procedures, with 1 in every 600,000 resulting in death.[15] The Joint Commission has had patient identification as the number one National Patient Safety Goal (NPSG) for many years. In the 2012 National Patient Safety Goals, TJC has added NPSG 01.03.01 to eliminate transfusion errors related to patient misidentification.[16]

Under-transfusion may be defined as transfusing blood in a volume less than that estimated to be required for a particular patient. Careful estimation of the intraoperative blood loss will guide us towards projected Hb after all that hemodilution by crystalloids and/or colloids. Blood loss may be justified to be fully compensated in neonatal and pediatric surgery, many anesthesiologists will rely upon their visual assessment and transfuse if absolutely essential. Postoperative Hb estimate may be a better guide to replace blood loss. Under-transfusion has many advantages; less risk of spread of blood related infections, less risk of transfusion errors, avoidance of TRALI and TACO, and less financial burden on the patient. It will be tolerated by many patients except patients of cardiovascular disease. Anemia is the worst enemy of cardiac patients due to associated circulatory overload. A study about perioperative cardiac morbidity in 1990 stated that of the 25 million patients undergoing noncardiac surgery each year in the United States, approximately one third, or 8 million are at risk for cardiac morbidity or mortality.[17] Many of these patients will also be anemic, whether due to acute blood loss (surgery or trauma) or chronic conditions such as renal failure or cancer. Attempts to limit the volume of allogeneic blood transfused have focused on tolerance of lower hemoglobin levels, but such a practice may increase risk in these patients. No doubt, in the perioperative period, the most commonly cited risk factors for adverse cardiac outcomes are gender, age, urgency of operation, and the presence of existing congestive heart failure, diabetes or significant cerebral vascular occlusive disease.[18]

Patients without coronary artery disease, have a tremendous ability to compensate for decreases in coronary arterial oxygen content; patients with coronary artery disease have a limited ability to compensate for or to tolerate uncompensated decreases in myocardial oxygen delivery, and there is a narrow window of Hb or hematocrit values at which these patients do the best. Hematocrit values below 28% or above 35% appear to be associated with increasing risk of morbidity and mortality whether in chronic or

acute anemia.

Jehovah's Witnesses have provided great opportunity to the researchers to study the effects of anemia and the tolerance of blood loss during trauma or surgery. In a study of 125 such patients undergoing surgery, both intraoperative blood loss and perioperative Hb levels were found to be independent predictors of postoperative mortality (rising from 6% at Hb levels of >8 g/dl to 61% at Hb levels of <6 g/dl).[19] Another study provided contradictory evidence, citing children of Jehovah's Witnesses with HB levels of 3 g/dl tolerating bypass without difficulty18. A final study of the association between anemia and mortality in Jehovah's Witnesses reported that blood loss of >500 ml during surgery was a more important risk factor than was preoperative Hb.[20]

There is little clinical evidence that permits prediction of the critical Hb or hematocrit at which ischemia will develop in any given patient.

To control the over-judicious crossmatch orders, and over-transfusion, strict blood utilization criteria need to be enforced in every hospital. The common practice of ordering two units of blood has to be changed in favour of ordering a single unit at a time, and type and crossmatch orders need to be abandoned in favor of type and screen. Some departments insist that crossmatch orders must mention documented clinical. A periodic review of the existing protocols and the practices is recommended for maximum optimization. The protocols may differ from time to time within a single institution or from institution to institution. The study by Thabah R et al[21] in this issue of the journal emphasizes the need of proper assessments of the requirement of blood and blood products in every institution. Protocols need to be made and adhered to.

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