Identifying Variations in Blood Use Based on Hemoglobin Transfusion Trigger and Target among Hepatopancreaticobiliary Surgeons

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BACKGROUND: Transfusion practice among surgeons varies despite several trials supporting the restrictive use of blood products. We sought to define the variation in surgeon transfusion hemoglobin (Hb) triggers and targets among patients undergoing hepatopancreaticobiliary (HPB) procedures, as well as assess perioperative outcomes among patients receiving transfusions under a restrictive vs liberal transfusion strategy.

STUDY DESIGN: Using prospectively collected data, variations in transfusion Hb triggers, targets, and overall use of blood were examined among 1,554 patients undergoing an HPB procedure by 1 of 11 surgeons at Johns Hopkins Hospital between 2009 and 2013. Perioperative outcomes were compared among patients treated with a restrictive (Hb $<$ 8 g/dL) vs liberal (Hb $\geq$ 8 g/dL) transfusion strategy.

RESULTS: Among the 1,554 patients included in the cohort, 504 (32.4%) received at least 1 transfusion of red cells. Patients who received a transfusion were older and had more medical comorbidities (both $p < 0.001$). Among 620 patients who met inclusion for blood use analysis, 344 (55.5%) received a transfusion using a restrictive trigger, 160 (25.8%) with a liberal trigger, and 116 (18.7%) patients had an Hb $<$ 8 g/dL but did not receive a transfusion. The mean transfusion Hb trigger was 7.7 $\pm$ 1.1 g/dL and the mean target was 9.3 $\pm$ 1.1 g/dL. Patients transfused with a higher Hb trigger were older, male, white, and had more medical comorbidities and higher intraoperative estimated blood loss (all $p < 0.05$). Hemoglobin transfusion triggers varied among different surgeons ($p < 0.001$). Perioperative mortality, complications, and length of stay did not differ between those treated with a restrictive vs liberal transfusion strategy ($p > 0.05$).

CONCLUSIONS: Nearly 1 in 3 patients undergoing an HPB procedure received a blood transfusion in the perioperative period. Transfusion use, indication ("trigger"), and dose ("target") varied among surgeons. The use of a restrictive transfusion strategy did not affect perioperative outcomes. (J Am Coll Surg 2014;219:217–228. © 2014 by the American College of Surgeons)

According to the most recent data published by the Department of Health and Human Services, approximately 5 million hospitalized patients received transfusions of nearly 14 million units of red blood cells in the United States in 2011.[1] Of these patients, surgical patients receive a large proportion of blood components in most hospitals. Patient blood management programs have been introduced in many institutions in order to identify overuse of blood products and to minimize unnecessary or nonindicated transfusions. However, implementation and adoption of transfusion protocols differ nationwide, with varying degrees of success.[2] Compliance with evidence-based blood transfusion practice remains an area of potential improvement.

Although transfusion-related reactions are rare and are estimated at well below 1%, several transfusion-related risks exist, including febrile reactions, severe allergic episodes, and transfusion-related acute lung injury.[3,4] Several studies have also found an association between blood transfusions and worse immediate and long-term postoperative outcomes.[5-10] The need for blood transfusion has been noted to have a detrimental effect on immediate and long-term

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Abbreviations and Acronyms

ASA = American Society of Anesthesiologists
EBL = estimated blood loss
Hb = hemoglobin
HPB = hepatopancreaticobiliary
IQR = interquartile range
OR = odds ratio

outcomes after surgery, likely due to an immunosuppressive effect.[11] Kooby and associates[12] showed these adverse outcomes to have a dose-related effect, with worse outcomes in patients requiring multiple units of blood. Numerous trials and meta-analyses have subsequently shown that the liberal use of transfusions results in equal and/or worse outcomes as compared with more restrictive use.[13-16] Based on these data, multiple national groups have issued evidenced-based recommendations supporting the restrictive use of blood transfusion, with most recommending against blood transfusion in patients with hemoglobin (Hb) levels >7 g/dL or 8 g/dL in most situations.[17-20]

Despite these recommendations, transfusion practice among surgeons remains varied.[2] Overall blood use has previously been used as a measuring stick to assess surgeon skill and performance. This approach, however, can be flawed because it does not account for variations in procedures or patient populations. Rather, improvements in blood use may be better assessed using a clinician's "trigger" for transfusion (ie, the level of Hb that prompts a transfusion). Data on when a surgeon "triggers" the use of a blood transfusion may better allow for evaluation of compliance with evidenced-based recommendations.[21] Another quality measure of blood use is the assessment of the Hb target, which is the resulting Hb concentration after the transfusion is completed. The Hb target, in effect, is an assessment of whether the "dose" of blood was appropriate.[21] Given that hepatopancreaticobiliary (HPB) surgery is traditionally a subspecialty that uses blood bank resources, and given the perceived heterogeneity in blood transfusion practice among surgeons, we sought to define the variation in Hb triggers and targets among patients being treated by surgeons at a large HPB center. In addition, we sought to identify possible patient- and surgeon-specific factors that may be associated with underlying variation. Finally, we compared perioperative outcomes among patients receiving blood transfusions under a restrictive vs liberal transfusion trigger after undergoing an HPB surgical procedure.

METHODS

Surgeon and patient selection and data collection

Patients undergoing major pancreatic and liver operations between 2009 and 2013 at Johns Hopkins Hospital were identified through International Classification of Diseases (ICD-9) procedure codes (52.96, pancreatic anastomosis; 52.7, Whipple procedure; 52.6, total pancreatectomy; 52.59, partial pancreatectomy; 52.51, proximal pancreatectomy; 52.52, distal pancreatectomy; 51.37, bile duct/gastrointestinal anastomosis; 50.3, hepatic lobectomy; 50.22, partial hepatectomy). Surgeon characteristics were collected in a deidentified fashion, and data on fellowship training, overall and HPB operative yearly caseload, and number of years in practice were obtained. Standard patient demographic and clinicopathologic data were also collected, including age, sex, race, Charlson comorbidity index scores, and American Society of Anesthesiologists (ASA) status. Discharge ICD-9 diagnosis codes were used to identify in-hospital perioperative complications, which included transient ischemic attack, cerebrovascular attack, myocardial infarction, ventilator-associated pneumonia, urinary tract infection, surgical site infection, sepsis, drug resistant infection, *Clostridium difficile* infection, deep vein thrombosis, pulmonary embolism, and disseminated intravascular coagulation. Perioperative mortality was defined as death in the hospital or within 90 days from the date of surgery.[22]

Transfusion data and Hb levels were obtained through IMPACT online (Haemonetics Corp), a comprehensive proprietary blood management intelligence portal integrating patient and case clinicopathologic data, operative data, and laboratory data.[21] All data in this system are collected prospectively, updated monthly, and are under institutional quality review to verify accuracy. For purposes of this study, only packed red blood cell transfusion was analyzed. First, lowest, and last recorded Hb measurements during the entire hospitalization are identified and recorded by the database. For the purpose of this study, the Hb trigger was defined as the lowest measured Hb during the patient's hospitalization. For analysis of Hb target, we used the last measured Hb before hospital discharge.[21] Based on the most commonly cited large randomized controlled trials analyzing transfusion triggers, a restrictive transfusion strategy was defined as any patient with the lowest recorded Hb < 8 g/dL.[13,14,16,23,24] In contrast, a liberal trigger was defined as those patients who received a transfusion with a lowest recorded Hb ≥ 8 g/dL. Patients with Hb ≥ 8 g/dL who did not receive a transfusion were excluded from analysis to avoid overestimating the true Hb trigger.

Statistical analysis

Continuous variables were presented as the median and 25th to 75th percentile interquartile range (IQR). Categorical variables were displayed as whole numbers and percentages. Fisher's exact test or chi-square test was