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Packed red blood cell transfusion after surgery: are we "overtranfusing" our patients?

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Abstract

BACKGROUND: Data on the hemoglobin (Hb) after transfusion, or the "target," which reflects the "dose" of blood given are not well studied. We sought to examine the incidence and causes of "over transfusion" of red blood cells after surgery.

METHODS: Data on blood utilization including Hb triggers and targets were obtained for patients undergoing colorectal, pancreas, or liver surgery between 2010 and 2013.

RESULTS: A total of 2,905 patients were identified, of which 895 (31%) were transfused (median age 64, interquartile range: 53 to 72; 51% men; median American Society of Anesthesiologists class 3, interquartile range: 3–3; 51% pancreatic, 14% hepatobiliary, 21% colorectal, and 14% other). Among these, 512 (57%) were overtransfused (final Hb target after transfusion $\geq$9.0 g/dL). Among patients who were overtransfused, 171 (33%) were transfused at too high an initial trigger (>8.0 g/dL), whereas 304 (59%) had an appropriate trigger but received $\geq$2 packed red blood cell (PRBC) units, suggesting an opportunity to have transfused fewer units. There was significant variation in overtransfusion among surgeons (range 0% to 80%, $P = .003$).

CONCLUSIONS: Excess use of blood transfusion is common and was due to PRBC utilization for too high a transfusion trigger, as well as too many units transfused.

Almost 14 million units of red cells were transfused in the United States in 2011.[1] Although blood transfusion can be lifesaving, and the risk of viral infectious transmission is lower than ever,[2] transfusion can result in febrile or allergic reactions and transfusion-related acute lung injury[3] and is associated with worsened oncologic[4] and perioperative outcomes, including increased mortality.[5–7] Several landmark randomized controlled trials have tested restrictive transfusion practices in various clinical scenarios, including intensive care, cardiac surgery,[8] joint replacement,[9] and

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gastrointestinal bleeding.[10] These studies have found that maintaining hemoglobin (Hb) levels between 7.0 and 9.0 g/dL resulted in equivalent or improved outcomes compared with more liberal transfusion practice. These results and increased focus on the costs of transfusion[11] have led to attempts to reduce red cell transfusion overuse.

Most guidelines and efforts to reduce transfusion focus on the decision to transfuse—specifically, a transfusion threshold or trigger of 7.0 to 8.0 g/dL Hb.[2,12–14] Equally important but less discussed is the amount of blood to transfuse after the decision to transfuse has been made. There has been some work on limiting the practice of routinely transfusing two units of red cells rather than one in the hemodynamically stable anemic patient.[15,16] However, there has been less focus on the goal Hb or transfusion target after a transfusion. The target Hb range in trials of restrictive transfusion practice is typically set at 9.0 g/dL. Final Hb before discharge can be used as an approximation of the clinician's transfusion target and used as a metric of the appropriate "dosing" of blood.[17,18] Final Hb concentrations above a set level may be considered as an "overtransfusion"—the tranfusion of more blood than necessary to obtain the accepted target goal of 9.0 g/dL. We sought to assess the epidemiology, risk factors, outcomes, and variation by surgeon in overtransfusion after colorectal and hepatobiliary surgery at our institution.

Methods

Patient selection

Patients undergoing major abdominal surgery on the hepatopancreatobiliary and colorectal services for benign and malignant disease at Johns Hopkins Hospital were identified between 2010 and 2013. Demographics, American Society of Anesthesiologists (ASA) class, Charlson comorbidity score, operation type, estimated blood loss (EBL), nadir and final Hb concentration, blood products transfused, inpatient complications, and length of stay (LOS) were collected.

Transfusion data

Transfusion data and Hb levels were obtained from IMPACT online (Haemonetics Corp., Braintree, Massachusetts), a prospective, audited, commercial blood management intelligence portal. Nadir Hb was used to define the transfusion trigger, whereas the final Hb measured, before discharge was used to represent the transfusion target. Hb trigger less than 8.0 g/dL and target less than 9.0 g/dL were considered appropriate based cutoff values established by prospective clinical trial data.[8–10,17] For the purposes of the current analyses, a discharge Hb $\geq$9.0 g/dL was considered an "overtransfusion" as it exceeds the established recommended target for transfusion based on multiple randomized controlled trials.[8–10,17]

Postoperative complications

International Classification of Disease, Clinical Modification, 9th Revision (ICD-9-CM) diagnosis codes acquired from the hospital billing database were used to identify inpatient postoperative 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.

Statistical analysis

Continuous variables were presented as the median with interquartile range (IQR), where appropriate. Categorical variables were displayed as whole numbers and percentages. Baseline characteristics of the study population were summarized by operation type. Chi-squared tests were used for comparing categorical variables. Factors associated with transfusion and outcomes were analyzed using univariable and then multivariable regression models, which were constructed using a knowledge-based approach to variable selection. Modified-Poisson multiple regression models were used for binary outcomes, as these produce easily interpretable risk ratios, as opposed to odds ratios from logistic regression.[19] A multiple linear regression model was used for LOS. A 2-tailed P value of .05 was used as a cutoff for statistical significance. There were no missing data. Analysis was conducted with STATA version 13.1 (StataCorp LP, College Station, TX). The Johns Hopkins University Institutional Review Board approved the study.

Results

Baseline characteristics

A total of 2,905 patients who underwent surgery by 68 surgeons were identified. Overall 1,200 (41%) had pancreas surgery, 491 (17%) had a hepatobiliary operation, 779 (27%) had colorectal surgery, and 435 (15%) had other types of abdominal operation, the most commonly small bowel resections, mesenteric operations, and hernia repairs. Among all patients, 895 (31%) received a red blood cell transfusion during their hospitalization. Specifically, 17.2% of patients received an intraoperative blood transfusion (n = 500), whereas 21.9% received a postoperative blood transfusion (n = 636). Furthermore, 241 patients received both an intraoperative and postoperative blood transfusion. The percentage of patients who received a transfusion varied by operation type: 459 of 1,200 (38%) pancreatic, 122 of 491 (25%) hepatobiliary, 186 of 779 (24%) colorectal, and 128 of 435 (29%) other abdominal