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Explaining the excess morbidity of emergency general surgery: packed red blood cell and fresh frozen plasma transfusion practices are associated with major complications in nonmassively transfused patients

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Abstract

BACKGROUND: Intraoperative blood product transfusions carry risk but are often necessary in emergency general surgery (EGS).

METHODS: We queried the American College of Surgery-National Surgical Quality Improvement Program database for EGS patients (2008 to 2012) at 2 tertiary academic hospitals. Outcomes included rates of high packed red blood cell (pRBC) use (estimated blood loss:pRBC $<$ 350:1) and high fresh frozen plasma (FFP) use (FFP:pRBC $>$1:1.5). Patients were then stratified by exposure to high blood product use. Stepwise logistic regression was performed.

RESULTS: Of 992 patients, 33% underwent EGS. Estimated blood loss was similar between EGS and non-EGS (282 vs 250 cc, P = .288). EGS patients were more often exposed to high pRBC use (adjusted odds ratio [OR] = 2.01, 95% confidence interval [CI] = 1.11 to 3.66) and high-FFP use (OR = 2.75, 95% CI: = 1.10 to 6.84). High blood product use was independently associated with major nonbleeding complications (high pRBC: OR = 1.73, 95% CI = 1.04 to 2.91; high FFP: OR = 2.15, 95% CI = 1.15 to 4.02).

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CONCLUSIONS: Despite similar blood loss, EGS patients received higher rates of intraoperative blood product transfusion, which was independently associated with major complication.

Emergency general surgery (EGS) patients are known to be at increased risk for death and complications. EGS patients are 5 to 8 times more likely to die than non-EGS (NEGS) patients receiving the same operations electively,[1–4] and as many as 58% of EGS patients will have postoperative complications.[5] After adjusting for differences in baseline patient characteristics and physiologic acuity that might predispose EGS patients to adverse outcomes, EGS patients are still 39% more likely to die and 31% more likely to experience a major postoperative complication than their NEGS counterparts.[1]

Perioperative blood product transfusions have been associated with adverse outcomes.[6–8] Emergency surgery has been identified as an independent risk factor for perioperative blood product transfusions in vascular surgery patients.[7] In the EGS population, patients who receive blood transfusions are at 5.5 times greater odds of experiencing major complications.[9] Although intraoperative blood product transfusions may not be avoidable because of clinical necessity, the thresholds for packed red blood cell (pRBC) transfusion and ratios of fresh frozen plasma (FFP) to pRBCs are modifiable parameters that may affect outcomes.

Much of the literature surrounding intraoperative transfusion practices focuses on the massively transfused trauma patient.[10–13] These findings cannot be generalized to the nonmassively transfused general surgery patient. Intraoperative transfusion practices in EGS have not been well studied. Prior studies of outcomes in EGS have been limited by the absence of intraoperative variables that may be related to clinical indications for transfusion.[1–5,9,14,15]

The objectives of this study were to (1) identify differences in intraoperative transfusion practices between nonmassively transfused EGS and NEGS patients undergoing the same operations and (2) determine if high-intraoperative transfusion rates contribute to adverse outcomes in nonmassively transfused general surgery patients. We hypothesized that EGS patients receive higher rates of intraoperative blood product transfusion than NEGS patients, which contributes to adverse outcomes.

Methods

Study design

After obtaining Institutional Review Board approval, we performed a retrospective cohort study of adult patients (age $\geq$18) in the American College of Surgeons-National Surgical Quality Improvement Project (ACS-NSQIP) database who underwent 1 of 14 procedures common to both EGS and NEGS from January 1, 2008, to December 31, 2012, at 2 academic medical centers (Brigham and Women's Hospital and Massachusetts General Hospital). These procedures were selected based on a summary of clinical conditions encompassing EGS as defined by the American Association for the Surgery of Trauma (Appendix A).[16]

Exclusion criteria were the use of autologous transfusion with cell saver and massive transfusion. We excluded patients who received autologous transfusions to prevent confounding from the different risks associated with autologous vs nonautologous transfusions. In accordance with previously described methods, massive transfusion was defined as the administration of 10 or more units of pRBCs within any contiguous 24-hour period around the operation.[12]

The preoperative patient characteristics and postoperative complications were obtained from ACS-NSQIP. The preoperative variables obtained are listed in Tables 1 and 2.

A chart review was performed to collect intraoperative data. A single evaluator reviewed the intraoperative anesthesia record, the intraoperative nursing record, the surgeon's operative notes, and any laboratory tests drawn between incision time and surgery end time for all patients. The following intraoperative variables were collected: length of operation, start time classification (day vs night), estimated blood loss (EBL), units of pRBCs transfused, units of FFP transfused, volume of crystalloid administered, volume of albumin administered, number of vasopressor medications administered, vital signs (lowest mean arterial pressure, lowest heart rate [HR], and lowest temperature), and laboratory measurements (lowest pH and highest blood glucose). These intraoperative variables were selected based on their previously demonstrated association with postoperative morbidity and mortality or their clinical relevance to transfusion.[17–20]

For all measurements obtained during chart review, all values were considered true values unless they were incompatible with physiology (eg, temperature of 0 °C) or a specific note was mentioned in the record that the value was falsely captured (eg, "probe fell off" when HR was recorded as abnormally low). For estimated values such as blood loss that could potentially differ among records, the order of precedence was as follows: (1) the surgical resident's operative note, (2) the attending surgeon's operative note, and (3) the intraoperative anesthesia record. For intraoperative hemodynamics, recordings on an invasive arterial line took precedence over noninvasive blood pressure cuff measurements. For the administration of vasopressors (to include ephedrine, phenylephrine,