



Clinical Study

Effect of liberal blood transfusion on clinical outcomes and cost in spine surgery patients

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Abstract

BACKGROUND CONTEXT: Blood transfusions in spine surgery are shown to be associated with increased patient morbidity. The association between transfusion performed using a liberal hemoglobin (Hb) trigger—defined as an intraoperative Hb level of ≥ 10 g/dL, a postoperative level of ≥ 8 g/dL, or a whole hospital nadir between 8 and 10 g/dL—and perioperative morbidity and cost in spine surgery patients is unknown and thus was investigated in this study.

PURPOSE: This study aimed to describe the perioperative outcomes and economic cost associated with liberal Hb trigger transfusion among spine surgery patients.

STUDY DESIGN/SETTING: This is a retrospective study.

PATIENT SAMPLE: The surgical billing database at our institution was queried for inpatients discharged between 2008 and 2015 after the following procedures: atlantoaxial fusion, anterior cervical fusion, posterior cervical fusion, anterior lumbar fusion, posterior lumbar fusion, lateral lumbar fusion, other procedures, and tumor-related surgeries. In total, 6,931 patients were included for analysis.

OUTCOME MEASURES: The primary outcome was composite morbidity, which was composed of (1) infection (sepsis, surgical-site infection, *Clostridium difficile* infection, or drug-resistant infection); (2) thrombotic event (pulmonary embolus, deep venous thrombosis, or disseminated intravascular coagulation); (3) kidney injury; (4) respiratory event; and (5) ischemic event (transient ischemic attack, myocardial infarction, or cerebrovascular accident).

MATERIALS AND METHODS: Data on intraoperative transfusion were obtained from an automated, prospectively collected anesthesia data management system. Data on postoperative hospital transfusion were obtained through a Web-based intelligence portal. Based on previous research, we analyzed the data using three definitions of a liberal transfusion trigger in patients who underwent

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red blood cell transfusion: a liberal intraoperative Hb trigger as a nadir Hb level of 10 g/dL or greater, a liberal postoperative Hb trigger as a nadir Hb level of 8 g/dL or greater, or a whole hospital nadir Hb level of 8–10 g/dL. Variables analyzed included in-hospital morbidity, mortality, length of stay, and total costs associated with a liberal transfusion strategy.

RESULTS: Among patients with a whole hospital stay nadir Hb between 8 and 10 g/dL, transfused patients demonstrated a longer in-hospital stay (median [interquartile range], 6 [5–9] vs. 4 [3–6] days; $p < .0001$) and a higher perioperative morbidity ($n=145$ [11.5%] vs. $n=74$ [6.1%], $p < .0001$) than those not transfused. Even after adjusting for age, gender, race, American Society of Anesthesiologists class, Charlson Comorbidity Index score, estimated blood loss, baseline Hb value, and surgery type, logistic regression analysis revealed that patients with a nadir Hb of 8–10 g/dL who were transfused had an independently higher risk of perioperative morbidity (odds ratio=2.11, 95% confidence interval, 1.44–3.09; $p < .0001$). Estimated additional costs associated with liberal trigger use, defined as a transfusion occurring in patients with a whole hospital stay nadir Hb of 8–10 g/dL, ranged from \$202,675 to \$700,151 annually.

CONCLUSIONS: Transfusion using a liberal trigger is associated with increased morbidity, even after controlling for possible confounders. Our results suggest that modification of transfusion practice may be a potential area for improving patient outcomes and reducing costs. © 2017 Elsevier Inc. All rights reserved.

Keywords:

Cost saving; Economic; Outcomes; Red blood cells; Surgery; Transfusion

Introduction

Blood loss is a major concern in spine surgery, with an estimated 8%–36% of patients requiring perioperative blood transfusions [1–5]. Blood transfusion promotes oxygen delivery and tissue perfusion during long, complex surgeries, yet carries with it rare but notable risks. Among these risks are acute lung injury, febrile reactions, allergic episodes, infection, and impaired immune response [6–18]. The hemoglobin (Hb) trigger—the Hb value that initiates clinician administration of packed red blood cells (PRBCs)—is frequently used to evaluate physician compliance with existing transfusion guidelines [19,20]. Randomized clinical trials have demonstrated similar or improved outcomes among patients undergoing blood transfusions using a restrictive Hb trigger—defined as an intraoperative Hb level of <10 g/dL, a postoperative Hb level of <8 g/dL, or a whole hospital stay nadir Hb of 8–10 g/dL—versus a liberal Hb trigger (≥ 10 g/dL intraoperatively or ≥ 8 g/dL postoperatively) in cardiac and hip surgery [21–24]. However, the association between transfusion performed using a liberal Hb trigger and perioperative morbidity in patients undergoing spine surgery is not known. In addition, estimation of the costs associated with different Hb triggers has not been previously investigated in patients undergoing spine surgery.

In terms of other non-spine surgical procedures, Ejaz et al. found that more than 1 in 10 patients undergoing hepatic, pancreatic, or colorectal resection were transfused under a liberal trigger, which was associated with worse patient outcomes and increased institutional cost compared with the restrictive trigger group [25]. To the authors' knowledge, no study has examined the associated morbidity and financial impact of liberal transfusions within spinal surgery. We thus aimed to determine the perioperative clinical outcomes and costs as-

sociated with liberal versus restrictive transfusion triggers among spine surgery patients.

Materials and methods

Collected data

The surgical billing database at our institution was queried for inpatients discharged following spinal surgery between 2008 and 2015, yielding 33,043 patients. Patients were stratified into eight groups according to the surgical procedure performed: atlantoaxial fusion, anterior cervical fusion, posterior cervical fusion, anterior lumbar fusion, posterior lumbar fusion, lateral lumbar fusion, other procedures, and tumor-related surgeries (Table 1). Following the exclusion of patients who underwent surgeries other than the abovementioned eight major groupings, 6,931 patients were included for analysis. The present study was approved by our Institutional Review Board (IRB# 00078426).

The surgical database provided data on basic patient characteristics, including the American Society of Anesthesiologists (ASA) status, the Charlson Comorbidity Index (CCI) score, and the total red blood cell (RBC) units given during the hospitalization. Procedure codes and perioperative morbidity data were identified using discharge *International Classification of Diseases, Ninth Revision* (ICD-9) codes. The primary outcome was composite morbidity, which was composed of (1) infection (sepsis, surgical-site infection, *Clostridium difficile* infection, or drug-resistant infection); (2) thrombotic event (pulmonary embolus, deep venous thrombosis, or disseminated intravascular coagulation); (3) kidney injury; (4) respiratory event; and (5) ischemic event (transient ischemic attack, myocardial infarction, or cerebrovascular accident) [26].

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