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The Spine Journal 15 (2015) 901–909

THE SPINE JOURNAL

Clinical Study

# Allogeneic blood transfusions and postoperative infections after lumbar spine surgery

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Received 5 September 2014; revised 24 December 2014; accepted 3 February 2015

**Abstract**

**BACKGROUND CONTEXT:** Allogeneic blood transfusions have an immunomodulating effect, and the previous studies in other fields of medicine demonstrated an increased risk of infections after administration of allogeneic blood transfusions.

**PURPOSE:** Our primary null hypothesis is that exposure to allogeneic blood transfusion in patients undergoing lumbar spine surgery is not associated with postoperative infections after controlling for patient and treatment characteristics. Second, we assessed if there was a dose-response relationship per unit of blood transfused.

**STUDY DESIGN/SETTING:** This is a retrospective cohort study from a tertiary care spine referral center.

**PATIENT SAMPLE:** A total of 3,721 patients underwent laminectomy and/or arthrodesis of the lumbar spine.

**OUTCOMES MEASURES:** Postoperative infections, pneumonia, endocarditis, meningitis, urinary tract infection, central venous line infection, surgical site infection, and sepsis, within 90 days after lumbar spine surgery were included.

**METHODS:** Multivariable logistic regression analyses were used to assess the relationship of perioperative allogeneic blood transfusion with specific and overall postoperative infections accounting for age, duration of surgery, duration of hospital stay, comorbidity status, preoperative hemoglobin, sex, type of operation, multilevel treatment, operative approach, and year of surgery.

**RESULTS:** The adjusted odds ratio for exposure to allogeneic blood transfusion from multivariable logistic regression analysis was 2.6 for any postoperative infection (95% confidence interval [CI]: 1.7–3.9, p<.001); 2.2 for urinary tract infections (95% CI: 1.3–3.9, p=.004); 2.3 for pneumonia (95% CI: 0.96–5.3, p=.062); and 2.6 for surgical site infection requiring incision and drainage (95% CI: 1.3–5.3, p=.007). Secondary analyses demonstrated no dose-response relationship between the number of blood units transfused and any of the postoperative infections. Because of the low number of endocarditis (1 case, 0.031%), meningitis (1 case, 0.031%), central venous line infection (1 case, 0.031%), and sepsis (14 cases, 0.43%), we abstained from multivariable analysis.

**CONCLUSIONS:** Conscious of the limitations of this retrospective study, our data suggest an increased risk of surgical site infection, urinary tract infection, and overall postoperative infections, but not pneumonia, after exposure to allogeneic blood transfusion in patients undergoing lumbar

FDA device/drug status: Not applicable.

Author disclosures: ***SJJ:*** Grant: Anna Foundation (B), Michael van Vloten Foundation (B), De Drie Lichten Foundation (B), KWF Kankerbestrijding (B). ***YB:*** Nothing to disclose. ***KBW:*** Other: OREF (E, Fellowship Support), AO Spine NA (E, Fellowship Support), Depuy Spine (E, Fellowship Support), K2M, Inc.: (C, Fellowship Support), TranS1 (C, Stock Options). ***TDC:*** Grant: North American Spine Society (D), Gordon and Betty Moore Foundation (B); Personnel Fees: Bio2 (B); Other: OREF (E, Institutional Fellowship Support), K2M (E, Institutional Fellowship Support), AO Spine (E, Institutional Fellowship Support). ***JHS:*** Other: Stryker (B, Consulting fees), Biom'up (B, Consulting fees).

The disclosure key can be found on the Table of Contents and at www.TheSpineJournalOnline.com.

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http://dx.doi.org/10.1016/j.spinee.2015.02.010

spine surgery. These findings should be taken into account when considering blood transfusion and developing transfusion policies for patients undergoing lumbar spine procedures. 

*Keywords:* Transfusion; Infection; Lumbar; Surgery; Guideline; Policy; Immunomodulation

## Introduction

Approximately 85 million units of packed red blood cells are transfused annually worldwide [1,2]. However, blood transfusion policies became more restrictive over the past decade [3] as there is growing evidence that allogeneic blood transfusions (i.e., blood from a genetically nonidentical donor) are associated with an increased risk of postoperative infections [4], cancer recurrences, decreased survival in cancer patients [5–7], and other direct transfusion-associated risks (e.g., transfusion-transmissible infections and transfusion errors) [1]. The increased risk of postoperative infections is explained by the immunomodulating effects of allogeneic blood transfusions [4,8–10]. This effect was first hypothesized in 1973 in a study demonstrating improved graft survival of patients who received allogeneic blood transfusion before kidney transplantation [11]. Although the exact mechanism is still unclear [4,12], many subsequent clinical and laboratory studies confirmed the immunosuppressive effect of blood transfusions [9,12].

Blood transfusion is commonly (20–36%) used in spine surgery and aims to improve the oxygen transport capacity of the blood and, therefore, tissue oxygenation [13,14]. The number of units transfused perioperatively is associated with the age of the patient, comorbidities, number of levels instrumented, preoperative hemoglobin, duration of surgery, and complexity of the operation [14–16]. The untoward effects of blood transfusion specifically on surgical site infections after spine surgery have previously been demonstrated in two relatively small case-control studies [17,18]. However, the influence of allogeneic blood transfusion on other postoperative infections, such as urinary tract infection and pneumonia, has not been studied.

Understanding the association of blood transfusion with postoperative infections can help guide future transfusion policies and the management of blood loss during spine surgery. Alternative measures to reduce the need for allogeneic blood transfusions include methods to minimize blood loss, preoperative blood donation, reinfusion, and cell salvage techniques, and the use of erythropoietin and antifibrinolytic agents [17].

This study aims to assess whether perioperative allogeneic blood transfusion is associated with a higher rate of postoperative infections within 90 days after lumbar spine surgery. Our primary null hypothesis is that exposure to allogeneic blood transfusion is not independently associated with specific and overall postoperative infections in multivariable logistic regression analyses accounting for patient and operative treatment characteristics. Second, we assessed if there was a dose-response relationship between the number of blood units transfused and postoperative infections.

## Material and methods

### *Study design and participants*

This retrospective study was approved by the institutional review board, and a waiver of informed consent was granted. We used five Current Procedural Terminology (CPT) codes to identify patients who underwent a laminectomy and/or arthrodesis of the lumbar spine (Appendix 1). Medical record data of patients with one of these CPT codes were retrieved through our Research Patient Data Registry. This is a centralized clinical data registry covering patients from a tertiary care referral center. It comprises diagnostic codes (*International Classification of Diseases, ninth revision* [*ICD9*] code), billing (CPT) codes, demographic information (e.g. sex, date of birth, and race), clinical encounters, transfusion data, laboratory values, and operative and radiology reports.

We included patients older than 18 years who underwent operative treatment between 2001 and 2013 at our institution with one of the five aforementioned CPT codes. Exclusion criteria were cervical or thoracic procedures; clinical follow-up less than 90 days; preexisting infection of the spine; and lumbar spine procedure for a fracture, pseudarthrosis, malignancy, or scoliosis. Presence of a preexisting infection, fracture, pseudarthrosis, malignancy, and scoliosis was based on the operative report. Only the first spine procedure was included when a patient had multiple lumbar spine procedures at our institution.

### *Outcome measures and explanatory variables*

Our primary outcomes were postoperative infections, including pneumonia, endocarditis, meningitis, urinary tract infection, central venous line infection, surgical site infection, and sepsis, within 90 days after lumbar spine surgery. These infections were identified through infection-specific *ICD9* codes (Appendix 2). Medical records of patients with one of these *ICD9* codes were reviewed by two research fellows (SJ, YB), blinded for the explanatory variable allogeneic blood transfusion, to assess if the infection fulfilled the predefined criteria: pneumonia is defined as symptoms clinically consistent with pneumonia and with a positive sputum culture or with empirical start of antibiotics; endocarditis is defined as symptoms, electrocardiography and/or