The Spine Journal 16 (2016) 951–961

Clinical Study

Are allogeneic blood transfusions associated with decreased survival after surgical treatment for spinal metastases?

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Received 27 October 2015; revised 8 March 2016; accepted 21 March 2016

Abstract

BACKGROUND CONTEXT: Perioperative allogeneic blood transfusions have been associated with decreased survival after surgical resection of primary and metastatic cancer. Studies investigating this association for patients undergoing resection of bone metastases are scarce and controversial.

PURPOSE: We assessed (1) whether exposure to perioperative allogeneic blood transfusions was associated with decreased survival after surgery for spinal metastases and (2) if there was a dose-response relationship per unit of blood transfused. Additionally, we explored the risk factors associated with survival after surgery for spinal metastases.

STUDY DESIGN/SETTING: This is a retrospective cohort study from two university medical centers.

PATIENT SAMPLE: There were 649 patients who had operative treatment for metastatic disease of the spine between 2002 and 2014. Patients with lymphoma or multiple myeloma were also included. We excluded patients with a revision procedure, kyphoplasty, vertebroplasty, and radiosurgery alone.

OUTCOME MEASURES: The outcome measure was survival after surgery. The date of death was obtained from the Social Security Death Index and medical charts.

METHODS: Blood transfusions within 7 days before and 7 days after surgery were considered perioperative. A multivariate Cox proportional hazard model was used to assess the relationship between allogeneic blood transfusion as exposure versus non-exposure, and subsequently as continuous value; we accounted for clinical, laboratory, and treatment factors.

RESULTS: Four hundred fifty-three (70%) patients received perioperative blood transfusions, and the median number of units transfused was 3 (interquartile range: 2–6). Exposure to perioperative blood transfusion was not associated with decreased survival after accounting for all explanatory variables (hazard ratio [HR]: 1.03; 95% confidence interval [CI]: 0.80–1.31; p=.841). Neither did we find a dose-response relationship (HR: 1.01; 95% CI: 0.98–1.04; p=.420). Other factors associated with worse survival were older age, more severe comorbidity status, lower preoperative

FDA device/drug status: Not applicable.

Author disclosures: ***NRPP:*** Nothing to disclose. ***RBB:*** Nothing to disclose. ***SJJ:*** Grant: Anna Foundation (B), De Drie Lichten Foundation (B), KWF Kankerbestrijding (B), Michael van Vloten Foundation (B). ***MBH:*** Nothing to disclose. ***FJH:*** Nothing to disclose. ***MLF:*** Nothing to disclose. ***JHS:*** Nothing to disclose.

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

Dr Janssen has received funding from Stichting Anna Fonds, Stichting Michael van Vloten Fonds, Stichting de Drie Lichten, and the KWF Kankerfonds during the conduct of the study. The other authors have nothing to disclose.

This study was approved by our institutional review board.

This research was performed at Massachusetts General Hospital, Boston, MA, USA/Brigham and Women's Hospital, Boston, MA, USA.

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http://dx.doi.org/10.1016/j.spinee.2016.03.043

hemoglobin level, higher white blood cell count, higher calcium level, primary tumor type, previous systemic therapy, poor performance status, presence of lung, liver, or brain metastasis, and surgical approach.

CONCLUSIONS: Perioperative allogeneic blood transfusions were not associated with decreased survival after surgery for spinal metastases. More liberal transfusion policies might be warranted for patients undergoing surgery for spinal metastasis, although careful consideration is needed as other complications may occur.

Keywords: Allogeneic blood transfusion; Bone metastases; Mortality; Spinal metastases; Spine; Survival

Introduction

Blood transfusions are administered in 8% to 36% of the patients undergoing spinal surgery, and oncologic spinal surgery has been associated with even higher transfusion rates and volumes [1–4]. Perioperative allogeneic blood transfusion has been associated with an increased risk of tumor recurrence and decreased survival after surgical resection of primary malignancies (eg, colon, breast, and bladder) [5–7]. The association of decreased survival with perioperative blood transfusions has also been demonstrated in patients undergoing surgery for metastatic disease [8–11]. Although the mechanism is not fully understood, it is hypothesized that allogeneic blood transfusion decreases host versus tumor surveillance through immunosuppression [12].

Janssen et al. [13] demonstrated that exposure to perioperative allogeneic blood transfusions in patients undergoing surgery for long-bone metastatic fractures does not decrease survival per se, but the study did demonstrate a dose-response relationship; the risk of death increased by 7% per unit of blood transfused. However, this finding was contrasted by Clausen et al., who found that transfusion of 1 to 2 units was associated with increased 12-month survival in patients undergoing surgery for spinal metastases [14].

We, therefore, sought to assess whether perioperative allogeneic blood transfusions were associated with decreased survival after surgery for spinal metastases. Specifically, we evaluated if exposure to allogeneic blood transfusion within 7 days of surgery for spinal metastases was associated with decreased survival while accounting for confounders. Second, we assessed a dose-response relationship per unit of blood transfused while accounting for confounders. Additionally, we explored other factors associated with survival after surgery for spinal metastases.

Materials and methods

Study design and participants

Our institutional review board approved a waiver of consent for this retrospective study. Patients who had surgery for metastatic disease of the spine—cervical, thoracic, and lumbar vertebrae—between January 2002 and January 2014 in two affiliated tertiary referral centers were included. We also included patients with multiple myeloma and lymphoma [15]. Exclusion criteria were patients undergoing revision surgery, radiosurgery, vertebroplasty, or kyphoplasty alone. We only included the first procedure if patients underwent multiple procedures to respect the statistical rule of independence [16].

The surgeon decided upon the operative approach based on the estimated survival, primary tumor type, location and size of the metastatic lesion, degree of neurologic compromise, and the level of pain and disability.

Outcome measures and explanatory variables

Survival after surgery was our primary outcome measure. We used the Social Security Death Index and medical charts to determine the date of death [17]. We considered March 18, 2015 as the final follow-up moment for assessment of the outcome measure. By this final follow-up moment, 509 patients (78%) were deceased, with a median follow-up of 11 months (interquartile range [IQR]: 3–33 months) (Fig. 1).

All allogeneic blood transfusions within 7 days before and 7 days after surgery were considered perioperative and were extracted from the hospital's blood bank records. We included all packed allogeneic red blood cells—leukoreduced and non-leukoreduced. One red blood cell unit contains about 300 to 360 mL of whole blood, with a hematocrit value ranging from 55% to 58%. The blood transfusion thresholds following guidelines at one hospital were hematocrit of <24% (patients 40 years or younger), <27% (40–60 years of age), or <30% (60 years or older). The blood transfusion thresholds following guidelines at the other hospital were hematocrit of <21% (normovolemic and non-bleeding patients), <26% (patients with cancer or with preoperative anemia, or pregnant women), or <30% (patients with acute coronary syndrome or major thoracic surgery).

Data for the following explanatory variables were extracted from medical records: age at time of surgery, sex, comorbidity status, body mass index in kg/m^2, primary tumor type, ECOG (Eastern Cooperative Oncology Group) performance status, pathologic fracture status, number of bone and visceral metastases, previous radiation therapy, previous systemic therapy, preoperative embolization, preoperative ASIA (American Spinal Injury Association) impairment scale, surgical approach, operative treatment, number of spinal levels operated on, year of surgery, hospital, estimated blood loss, anesthesia time, duration of hospital stay, preoperative hemoglobin level (g/dL), preoperative creatinine (mg/dL), preoperative platelet count (1,000/mm^3), preoperative white