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Primary Total Knee Arthroplasty Allogenic Transfusion Trends, Length of Stay, and Complications: Nationwide Inpatient Sample 2000–2009

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ABSTRACT

Perioperative blood loss leading to blood transfusion continues to be an issue for total knee arthroplasty (TKA) patients. The US Nationwide Inpatient Sample (NIS) was used to determine annual trends in allogenic blood transfusion rates, and effects of transfusion on in-hospital mortality, length of stay (LOS), costs, discharge disposition, and complications of primary TKA patients. TKA patients between 2000 and 2009 were included (n = 4,544,999) and categorized as: (1) those who received a transfusion of allogenic blood, and (2) those who did not. Transfusion rates increased from 7.7% to 12.2%. For both transfused and not transfused groups, mortality rates and mean LOS declined, while total costs increased. Transfused patients were associated with adjusted odds ratios of in-hospital mortality (AOR 1.16; $P = 0.184$), 0.71 ± 0.01 days longer LOS ($P < 0.0001$), and incurred ($1777 ± 36; $P < 0.0001$) higher total costs per admission.

While total knee arthroplasty (TKA) is a common and successful procedure in terms of improving pain and function, it is not without inherent risks. Blood losses commonly ranging from 1000 to 1500 mL (and sometimes up to 2200 mL) [1] can often require to autologous blood transfusion, which has been estimated to occur at rates as high as 35% to 53% following TKA [2–4]. Overall, national transfusion rates have varied throughout the United States over the last 30 years, increasing from 42 units per 1000 patients in 1979 to 50 units per 1000 patients in 2001 [5–8]. The effectiveness of blood conservation strategies, including lower thresholds for transfusion, postoperative cell salvage, and preoperative autologous blood donation, is not clear. There have been few studies that adequately describe the current trends and rates of transfusion in United States hospitals for elective TKA procedures.

Allogenic blood transfusions have potential consequences associated with their use, including infection (viral [9] and bacterial [10]), immunologic responses [10,11], intravascular hemolysis [10–13], acute lung injury [11,14], transfusion-induced coagulopathy, and mistransfusion [15]. Hemodynamically unstable patients who do not appropriately receive a transfusion are at risk for cerebrovascular accidents and myocardial infarction. Blood management is also an important element in terms of cost, which has increased between 1991 and 2008 and accounts for approximately 2.5% of the overall allocation of hospital cost for primary TKA [16].

The primary purpose of our analysis was to determine the rates and trends of allogenic blood transfusions in patients who received a primary TKA in United States hospitals between 2000 and 2009. Secondary objectives were to identify risk factors for transfusion as well as whether allogenic blood transfusion is associated with increased in-hospital mortality, length of stay (LOS), costs, and complications.

Methods

This national cross-sectional study was a review of the Nationwide Inpatient Sample (NIS) database from 2000 to 2009 [17]. The NIS database is the largest all-payer inpatient care database available in the United States approximating a sample of 20% of non-federal hospitals. The NIS database has grown since 1988, and currently contains information on almost 8 million hospital stays annually from over 1045 hospitals in 46 states that participate in the Healthcare Cost and Utilization Project (HCUP), Agency for Healthcare Research and Quality (AHRQ). Data elements available include patient demographics, insurance status, International Classification of Disease, 9th edition (ICD-9-CM) primary and secondary diagnosis and procedure codes, hospital characteristics, admission and discharge status, LOS, and total charges. These data are de-identified, and the study was deemed exempt by our Institutional Review Board.

Patients who received a primary TKA (ICD-9-CCCM 81.54) from January 2000 through December 2009 were included in the study (n = 4,544,999) (Fig. 1). Exclusion criteria were as follows: age under

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18 years, acute infection of lower extremity, previous arthroplasty, metastatic and bone cancer, fracture(s) of the lower limb, and multiple joint arthroplasties within a single admission (Fig. 1). The total number of weighted patients following these exclusions was 4,215,449. Patients transfused with autologous blood only (ICD-9-CM codes: 99.00, 99.02; n = 285,357) were not included in the analyses, except to compare transfusion trends over time. The remaining n = 3,930,092 patients were then categorized into two groups: (1) those who received a transfusion of allogenic blood [ICD-9-CM procedure codes [18] 99.03 (other transfusion of whole blood), 99.04 (transfusion of packed cells)] alone or in combination with autologous blood (n = 467,448), and (2) those who were not transfused with any blood (n = 3,462,644).

Our primary outcome of interest was annual trends in the rate of allogenic blood transfusion among primary TKA patients. We also examined the effects of blood transfusion among primary TKA patients on in-hospital mortality, hospital LOS, costs, discharge to an extended care facility (rather than home), surgical complications and adverse events. Surgical complications and adverse events were identified using specific ICD-9-CM diagnosis codes, as per previously published algorithms [19] (e.g., pulmonary insufficiency, pulmonary embolism, cardiac, venous thrombosis, etc.). In addition, we also examined the effect of blood transfusion following TKA on pulmonary edema/congestion (ICD-9-CM diagnosis codes 514 and 518.4) and superficial (682.5, 682.6, 998.59) and deep (996.66, 996.67) surgical site infections.

Patient demographics (age, gender, race, and insurance status), hospital characteristics [location (rural or urban), region of the United States (northeast, midwest, south and west), teaching status (nonacademic or academic), and bed size (small, medium, or large)] [15], and patient comorbidities were included as covariates in the statistical models. Patient comorbidities were analyzed utilizing the Healthcare Cost and Utilization Project (HCUP) Comorbidity software, which uses ICD-9-CM diagnosis codes to flag the presence of 30 different comorbidities [16]. The covariates were defined as recorded in the discharge summary. Age was grouped into 7 categories representing ten year age brackets (e.g. 40–49) for persons aged 40 to 89, with additional groups for persons under 40 and those over 89.

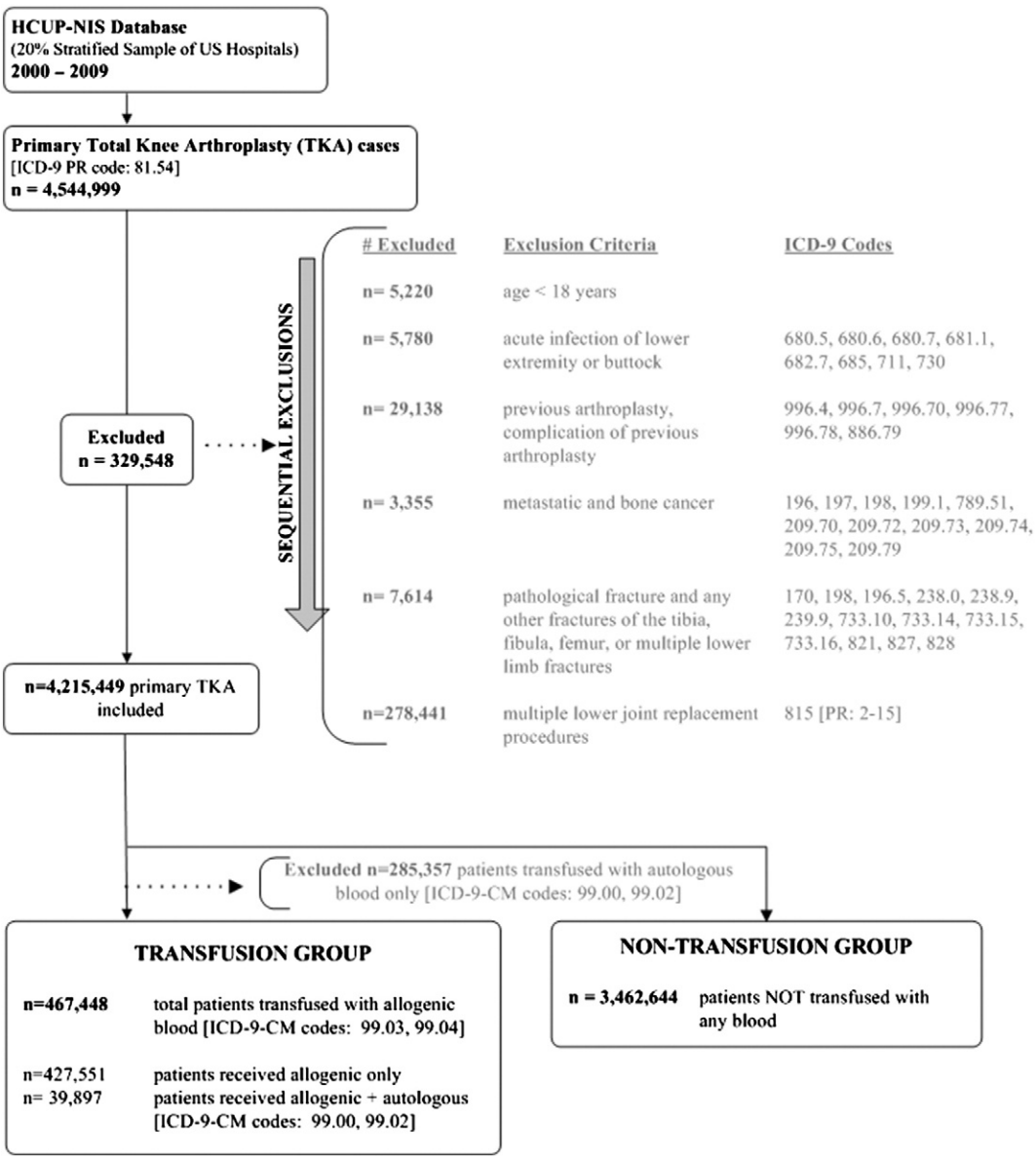

Fig. 1. Diagram showing the number of excluded, transfused, and not transfused cases from the total knee arthroplasty cohort (United States 2000 to 2009).