Blood transfusion in primary total shoulder arthroplasty: incidence, trends, and risk factors in the United States from 2000 to 2009

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Background: Total shoulder arthroplasty (TSA) may be associated with substantial blood loss, and some patients require perioperative blood transfusion. Possible blood transfusion methods include predonated autologous blood transfusion, perioperative autologous blood transfusion, and allogeneic blood transfusion (ALBT). The purposes of the present study were to assess the incidence and recent trends over time of blood transfusion in TSA and analyze patient and hospital characteristics that affect the risk of ALBT.
Methods: This study used national hospital discharge data from the National Inpatient Sample between 2000 and 2009. The data were used to generate the overall blood transfusion rate, and linear regression was used to assess trends in transfusion patterns over time. Logistic regression analysis was performed to analyze which patient and hospital characteristics independently influence the likelihood that a given patient undergoes ALBT.
Results: The overall blood transfusion rate (ie, the proportion of patients who received at least 1 transfusion of any kind) was 6.7%. This rate increased over time, from 4.9% in 2000 to 7.1% in 2009 ($P < .001$). Risk factors associated with ALBT included age, gender, race, insurance status, hospital region, and hospital annual caseload.
Conclusions: The increase in overall blood transfusion rate in TSA found in the present study may be related to factors specific to TSA, such as the introduction of reverse total shoulder arthroplasty during the study period. A variety of patient and hospital characteristics contribute to the risk of undergoing ALBT.
Level of evidence: Epidemiology Study, Database Analysis.
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Keywords: Total shoulder arthroplasty; blood transfusion; National Inpatient Sample

Total shoulder arthroplasty (TSA) may be associated with substantial blood loss, and some patients require a perioperative blood transfusion.[1] Possible blood transfusion methods include predonated autologous blood transfusion (PR-ABT), perioperative autologous blood transfusion (PE-ABT, including intraoperative and postoperative blood collection), and allogeneic blood transfusion (ALBT). A well-known device for intraoperative PE-ABT is the Cell Saver (Haemonetics, Braintree, MA, USA). Combinations of blood transfusion methods are also possible.

Although infectious disease transmission with ALBT is now exceedingly uncommon,[2] the procedure is not entirely benign. ALBT is associated with a risk of allergic reaction, including urticaria and anaphylaxis,[5] and fever, hemodynamic overload, and hemolytic reactions are also possible.[3,4] Moreover, ALBT is a limited resource, so continuous efforts should be made to prevent unnecessary ALBT.

Recent work has reported on trends in blood transfusion utilization in the 2000s for spinal surgery, total hip arthroplasty (THA), and total knee arthroplasty (TKA),[16,19] but no studies have examined the national incidence or current patterns of blood transfusion in TSA. In addition, although several single-center studies have documented patient risk factors for blood transfusion in TSA,[7,8,10,14,15] a large-scale multicenter analysis has not yet been performed. The purposes of the present study were to assess the incidence and recent trends over time of blood transfusion in TSA using a large national database and analyze patient and hospital characteristics that affect the risk of ALBT.

Materials and methods

Data source

This study used national hospital discharge data from the National Inpatient Sample (NIS) between 2000 and 2009. The NIS is the largest all-payer inpatient care database in the United States and contains data from approximately 8 million hospital stays from 1000 hospitals each year. These data comprise a 20% stratified random sample of all community hospitals in the country.[12] Each entry in the database represents a single hospitalization record.

Patient selection

A retrospective analysis using the NIS database was performed for the period from 2000 to 2009. The International Classification of Diseases, 9th Revision, Clinical Modification (ICD-9-CM) codes were used to identify appropriate cases. Patients who underwent primary TSA (ICD-9-CM code 81.80) were included, and those with a diagnosis of shoulder bone infection, malignancy, or pathologic fracture in the bones of the shoulder region (ICD-9-CM codes 171.2, 733.10, 733.11) were excluded. Of note, code 81.80 includes traditional and reverse primary TSA over the time period of the present study. Information about whether these patients received PR-ABT (ICD-9-CM code 99.02), PE-ABT (ICD-9-CM code 99.00), or ALBT (ICD-9-CM code 99.04) was retrieved.

Demographic and health system information

Patient demographics (age, gender, and race), patient payer information, patient comorbidities, hospital size, hospital annual caseload, and hospital region were extracted from the NIS.

Patients were categorized into 5 groups according to age in years: 0-17, 18-44, 45-64, 65-84, and older than 84. Patients were categorized according to race as white, black, Hispanic, other, or not stated. Payer information was categorized as Medicare, Medicaid, private, or other. The presence or absence of anemia as a documented comorbidity was noted, and total comorbidity burden was assessed using the Elixhauser method, which includes a set of 30 medical comorbidities and is a well-established technique for identifying comorbidities from administrative databases.[6] The total comorbidity score was determined for each patient by adding 1 point per comorbidity.

Hospital size was categorized as small, medium, or large using bed number. Annual caseload was defined according to the number of primary TSA procedures performed at each participating institution during each study calendar year and was divided into tertiles. Hospital census region was categorized as Northeast, Midwest, South, or West.

Data analysis

To calculate national estimates using the NIS, discharge weights supplied by the Federal Agency for Healthcare Research and Quality were applied.

The proportion of TSA patients in the total sample receiving PR-ABT, PE-ABT, and ALBT was calculated, and these data were used to generate the overall blood transfusion rate (ie, the proportion of patients receiving at least 1 blood transfusion of any kind). Linear regression was used to assess trends in transfusion patterns over time, and trends for all possible combinations of PR-ABT, PE-ABT, and ALBT were analyzed (ie, ALBT-only, ALBT, PR-ABT, etc.).

Logistic regression analysis was performed to analyze which variables independently influence the likelihood that a given patient undergoes ALBT. Factors included in the regression were age, gender, race, payer information, presence of anemia, Elixhauser comorbidity score, whether the patient underwent autologous-related blood transfusion (ie, PR-ABT or PE-ABT, or both), hospital size, hospital caseload, and hospital region.

Statistical software R 2.15.1 (The R Foundation for Statistical Computing, http://www.r-project.org/foundation/) was used to perform statistical analyses. A P value of .05 was used to define a significant change.

Results

Incidence and trends

A total of 171,118 individuals underwent TSA and met our criteria. The overall blood transfusion rate (ie, the proportion of patients who received at least 1 transfusion of any kind) was 6.7% (11,517 patients; Table I). The PR-ABT rate was 1.1% (1870 patients), the PE-ABT rate was 0.3% (501 patients), and the ALBT rate was 5.5% (9364 patients).