Predictors of Allogeneic Blood Transfusion in Total Hip and Knee Arthroplasty in the United States, 2000–2009

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ABSTRACT

We examined the predictors of allogeneic blood transfusion (ALBT) in primary unilateral total hip arthroplasty (THA) and total knee arthroplasty (TKA), analyzing the Nationwide Inpatient Sample between 2000 and 2009. Multivariate logistic regression analysis was performed. Significant predictors of ALBT in both THA and TKA included older age, female gender, race, weight loss, anemia, Elixhauser Comorbidity Score, hospital caseload, hospital region, and insurance status. No autologous-related blood transfusion was a significant predictor of ALBT in THA, however, not in TKA. We believe that the utilization of ALBT in THA and TKA can decrease by taking these factors into consideration for patient blood management before surgery.

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Total hip arthroplasty (THA) and total knee arthroplasty (TKA) are elective procedures that are usually accompanied by substantial blood loss, which may lead to acute anemia [1]. As a result, many of those patients need to receive allogeneic blood transfusion (ALBT). The 2004 Nationwide Inpatient Sample database analysis by Morton et al [2] demonstrated that hip arthroplasty and knee arthroplasty were among top 10 procedures with the greatest frequency of blood products transfusion. Although transfusion-transmitted disease is no longer an overriding concern in ALBT, risks such as hemolysis, transfusion-related lung injury, and anaphylaxis continue to represent significant concerns [3]. In addition, ALBT is a limited resource. Therefore, continuous effort to prevent ALBT needs to be executed.

Several studies have documented the predictors associated with the need for blood transfusion in THA and TKA [4–11]. Preoperative hemoglobin level is a major predictor for transfusion following total joint arthroplasty [4,7,10,11]. Other associated predictors include blood volume, weight, age, estimated blood loss, aspirin use, female sex, comorbidities, thrombocytopenia and bilateral TKA [12]. However, recent studies reporting the predictors of ALBT in THA and TKA are sparse, particularly on a national level. The purpose of this study was to examine the predictors of ALBT in primary unilateral THA and TKA in the US from 2000 to 2009 by analyzing population-based national hospital discharge data collected for the Nationwide Inpatient Sample (NIS).

Methods

The NIS is the largest all-payer inpatient care database in the US and contains data from approximately 8 million hospital stays from 1000 hospitals each year. These data comprise a 20% stratified sample of all United States community hospitals [13]. Each entry in the database represents a single hospitalization record. Records in the NIS database include discharge and hospital information, which were used to generate national estimates in this analysis.

A retrospective analysis using hospital discharge data from the NIS was performed from 2000 to 2009. The International Classification of Diseases, 9th revision, Clinical Modification (ICD-9-CM) codes was used to identify discharges. Patients who underwent primary THA (ICD-9-CM code: 81.51) and primary TKA (ICD-9-CM code: 81.54) were included in the study. Because ICD-9-CM code 81.51 includes patients who underwent THA for hip fracture, ATYPE 3 (code for elective admission) was included. When the index hospital claim had two ICD-9-CM procedure codes indicating THA (81.51) or TKA (81.54), the event was considered to be a simultaneous bilateral procedure and those patients were excluded. Then, patients were divided into patients who received ALBT (ICD-9-CM code: 99.04) (ALBT group) and those who did not receive ALBT (non-ALBT group).

Patient age, gender, race, comorbidities, autologous-related blood transfusion, hospital size, hospital caseload, hospital region, and payer information, were extracted from the NIS. Age was categorized into the following five groups: "birth–17 years," "18–44 years," "45–64 years," "65–84 years," and "older than 84 years." Race was categorized into "White," "Black," "Hispanic," "others," and "not stated." Comorbidities, previously reported to be predictors for blood transfusion, were

Table 1
Patient Demographics and Hospital Characteristics of Patients Who Underwent THA.

Total Number of Cases	Patients Who Underwent THA 1786373				
	ALBT Group 300216		Non-ALBT Group 1486157		
	WF	%	WF	%	P-Value
Age					<0.001
≤17	182	0.1%	977	0.1%	
18–44	13367	4.5%	99889	6.7%	
45–64	81559	27.2%	596384	40.1%	
65–84	180810	60.2%	741236	49.9%	
≥85	24289	8.1%	47667	3.2%	
Gender					<0.001
Male	86654	28.9%	691160	46.5%	
Female	213554	71.1%	794935	53.5%	
Race					<0.001
White	188599	62.8%	915671	61.6%	
Black	19086	6.4%	60773	4.1%	
Hispanic	6674	2.2%	23517	1.6%	
Others	7098	2.4%	28667	1.9%	
Not stated	78759	26.2%	457529	30.8%	
Comorbidity					
Weight loss	1574	0.5%	2294	0.2%	<0.001
Anemia	84073	28.0%	185614	12.5%	<0.001
Elixhauser Comorbidity Score					<0.001
0	39604	13.2%	359667	24.2%	
1	81870	27.3%	502282	33.8%	
2	82957	27.6%	358351	24.1%	
3	54839	18.3%	175120	11.8%	
4 or more	40945	13.6%	90738	6.1%	
Autologous-related blood transfusion					<0.001
Any	27958	9.3%	157695	10.6%	
None	272259	90.7%	1328461	89.4%	
Hospital size					<0.001
Small	43501	14.5%	217803	14.7%	
Medium	78894	26.3%	350547	23.6%	
Large	177348	59.1%	914486	61.5%	
No information	473	0.2%	3321	0.2%	
Hospital caseload					<0.001
Low ≤74	16315	5.4%	43527	2.9%	
Middle [75-280]	64883	21.6%	240150	16.2%	
High ≥281	219018	73.0%	1202480	80.9%	
Hospital region					<0.001
Northeast	80049	26.7%	347866	23.4%	
Midwest	67360	22.4%	465325	31.3%	
South	119713	39.9%	492165	33.1%	
West	33095	11.0%	180801	12.2%	
Payer information					<0.001
Medicare	199362	66.4%	764494	51.4%	
Medicaid	10437	3.5%	41358	2.8%	
Private	81977	27.3%	632325	42.5%	
Others	7987	2.7%	45739	3.1%	

THA = total hip arthroplasty; ALBT = allogeneic blood transfusion; WF = weighted frequency; % = percent; any autologous-related blood transfusion = predonated autologous, perioperative autologous, and predonated and perioperative autologous blood transfusion.

Table 2
Patient Demographics and Hospital Characteristics of Patients Who Underwent TKA.

Total Number of Cases	Patients Who Underwent TKA 4270282				
	ALBT Group 476696		Non-ALBT Group 3793586		
	WF	%	WF	%	P-Value
Age					<0.001
≤17	494	0.1%	934	0.0%	
18–44	6189	1.3%	78501	2.1%	
45–64	116015	24.3%	1477548	38.9%	
65–84	321370	67.4%	2136022	56.3%	
≥85	32524	6.8%	97067	2.6%	
Gender					<0.001
Male	116992	24.5%	1408813	37.1%	
Female	359146	75.3%	2373428	62.6%	
Race					<0.001
White	288893	60.6%	2355762	62.1%	
Black	40151	8.4%	173605	4.6%	
Hispanic	24672	5.2%	137649	3.6%	
Others	17760	3.7%	94628	2.5%	
Not stated	105220	22.1%	1031942	27.2%	
Comorbidity					
Weight loss	1759	0.4%	3274	0.0%	<0.001
Anemia	148581	31.2%	420277	11.1%	<0.001
Elixhauser Comorbidity Score					<0.001
0	41992	8.8%	687356	18.1%	
1	113014	23.7%	1205230	31.8%	
2	133742	28.1%	1021584	26.9%	
3	100414	21.1%	554593	14.6%	
4 or more	87534	18.4%	324824	8.6%	
Autologous-related blood transfusion					<0.001
Any	40630	8.5%	288709	7.6%	
None	436065	91.5%	3504877	92.4%	
Hospital size					<0.001
Small	71572	15.0%	562684	14.8%	
Medium	131442	27.6%	947250	25.0%	
Large	272869	57.2%	2273982	59.9%	
No information	813	0.2%	9670	0.3%	
Hospital caseload					<0.001
Low ≤174	30159	6.3%	145140	3.8%	
Middle [175-592]	121906	25.6%	750839	19.8%	
High ≥593	324631	68.1%	2897608	76.4%	
Hospital region					<0.001
Northeast	95570	20.0%	604740	15.9%	
Midwest	92252	19.4%	1108012	29.2%	
South	199035	41.8%	1353204	35.7%	
West	89838	18.8%	727630	19.2%	
Payer information					<0.001
Medicare	340566	71.4%	2151373	56.7%	
Medicaid	15359	3.2%	95495	2.5%	
Private	106704	22.4%	1389559	36.6%	
Others	13545	2.8%	150823	4.0%	

TKA = total knee arthroplasty; ALBT = allogeneic blood transfusion; WF = weighted frequency; % = percent; any autologous-related blood transfusion = predonated autologous, perioperative autologous, and predonated and perioperative autologous blood transfusion.

obtained using the following ICD-9-CM codes: weight loss (260–263, 783.2); anemia (280.0, 280.1–281.9, 285.2, 285.9, 648.2). Comorbidity was also assessed using the Elixhauser method, which is a well-established technique for identifying comorbidities from administrative databases [14]. Total comorbidity score was determined for each case by adding 1 point per comorbidity. Autologous-related blood transfusions were obtained using the following ICD-9-CM codes: pre-donated autologous blood transfusion (99.02), perioperative autologous blood transfusion (99.00). Hospital size (bed number) was categorized into "small," "medium," and "large." Annual hospital caseload was defined according to the number of procedures performed at each participating institution during each study calendar year and divided into tertiles.

Hospital census region was categorized into "Northwest," "Midwest," "South," and "West". Payer information was categorized into "Medicare," "Medicaid," "Private," and "others."

Statistical Analysis

To calculate national estimates using the NIS, discharge weights supplied by the Federal Agency for Healthcare Research and Quality (AHRQ) were applied. Categorical patient data were retrieved. Chi-squared test was used to assess equality of proportions, and Fisher's exact test was used to assess differences of proportions between the ALBT and non-ALBT group. Logistic regression models were used to