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Risk factors for postoperative transfusion in diabetic patients following total shoulder arthroplasty

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Background: Diabetes has been reported as a risk factor for postoperative transfusion following total shoulder arthroplasty (TSA). However, the risk factors specific to diabetic patients that increase their likelihood of postoperative blood transfusion remains understudied. The purpose of the study was to investigate the risk factors that are associated with 30-day postoperative transfusion among diabetic patients who undergo TSA.
Methods: The American College of Surgeons National Surgical Quality Improvement Program database was queried for all patients who underwent TSA between 2015 and 2020. Both patients with and without diabetes were divided into cohorts based on 30-day postoperative transfusion requirement. Bivariate logistic regression was used to compare patient demographics and comorbidities. Multivariate logistic regression, adjusted for all significant patient demographics and comorbidities, was used to identify the characteristics independently associated with postoperative transfusion.
Results: A total of 4376 diabetic patients remained after exclusion criteria, with 4264 (97.4%) patients who did not require postoperative transfusion and 112 (2.6%) patients who did require postoperative transfusion. On multivariate analysis, female gender (odds ratio [OR] 2.43, 95% confidence interval [CI] 1.52-3.89; $P < .001$), American Society of Anesthesiologists ≥3 (OR 2.46, 95% CI 1.10-5.48; $P = .028$), bleeding disorder (OR 2.94, 95% CI 1.50-5.76; $P = .002$), transfusion prior to surgery (OR 12.19, 95% CI 4.25-35.00; $P < .001$), preoperative anemia (OR 8.76, 95% CI 5.47-14.03; $P < .001$), and operative duration ≥129 minutes (OR 4.05, 95% CI 2.58-6.36; $P < .001$) were found to be independent risk factors for postoperative transfusion among diabetic patients. Our nondiabetic cohort included 19,289 patients, with 341 (1.8%) requiring postoperative transfusion. On Multivariate analysis, we found similar risk factors for transfusion to our diabetic population, as well as age ≥75 (OR 1.80, 95% CI 1.37-2.35; $P < .001$) and dependent functional status (OR 2.16, 95% CI 1.40-3.32; $P < .001$) to be independent risk factors for postoperative transfusion among nondiabetic patients.
Conclusion: Female gender, American Society of Anesthesiologists ≥3, bleeding disorder, transfusion prior to surgery, preoperative anemia, and operative duration ≥129 minutes were independently associated with postoperative transfusion following TSA in diabetic patients. These findings encourage physicians to carefully assess patients with diabetes preoperatively to minimize adverse outcomes.

Total shoulder arthroplasty (TSA) is an effective surgical treatment for various degenerative shoulder conditions including rotator cuff arthropathy, glenohumeral osteoarthritis, and inflammatory arthritis.[21] The volume of TSA is rapidly growing, with a 103.7% increase between 2011 and 2017 and a projected increase of 235.2% by 2025.[31] Although complications following TSA are rare, postoperative blood transfusions are commonly reported.[3] Prior studies have found that low hemoglobin and hematocrit levels, older age, cardiac disease, longer operative time, hypertension, and revision surgery are associated with higher rates of postoperative transfusion.[2,14,18,32]

Diabetes has also been reported as a risk factor associated with postoperative transfusion following TSA. Previous studies have demonstrated that insulin-dependent diabetes mellitus is an

Institutional review board approval was not required for this database study as data are deidentified.

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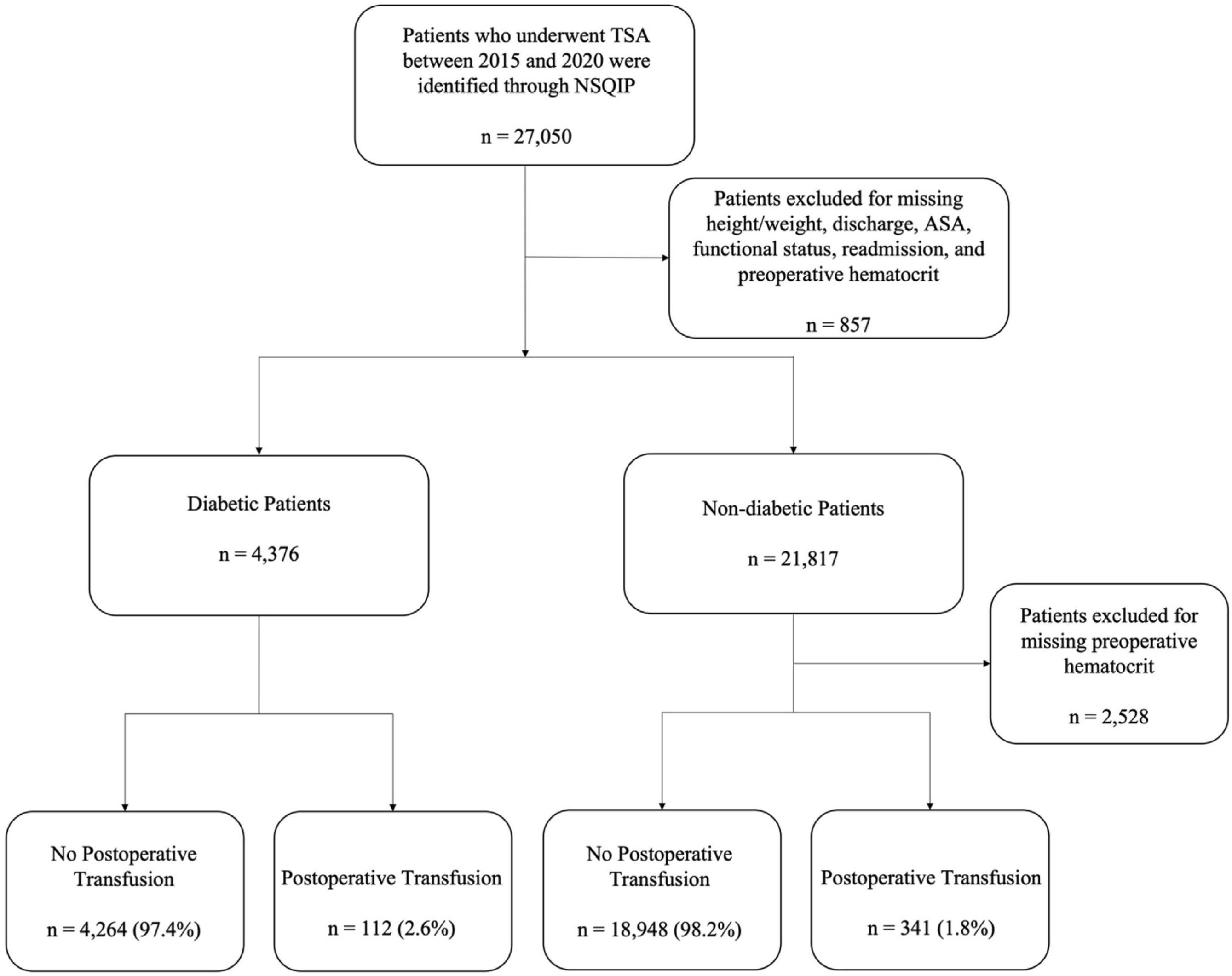

Figure 1 Inclusion and exclusion criteria for postoperative transfusion in diabetic and nondiabetic cohorts. *NSQIP*, National Surgical Quality Improvement Program; *TSA*, Total Shoulder Arthroplasty; *ASA*, American Society of Anesthesiologists.

independent risk factor for transfusion following TSA.[2,17] The number of people with diabetes in the United States increased by 30.6%, from 333 million persons to 435 million persons between 2005 and 2015. One model from the Institute of Alternative Futures predicted a 54% increase in diabetes from 2015 to 2030.[12,25] This increasing prevalence is evident within the orthopedic patient population. A study by Bixby et al[5] documented a rise of diabetic patients undergoing TSA from 12.1% to 17.8% between 2005 and 2018. As these trends continue to increase, along with the growing utilization of TSA, investigating risk factors in diabetic patients may be increasingly important.[1]

Other demographics and conditions, such as female sex, American Society of Anesthesiologists (ASA) classification ≥3, and hematological disorders have been found to be independent risk factors for postoperative transfusion. However, there remains limited literature analyzing the relationship between these factors specific to diabetic patients and postoperative transfusion.[17] These studies may help to understand which diabetic patients are at greater risks for postoperative transfusion. The purpose of this study was to investigate the risk factors that are associated with 30-day postoperative transfusion among diabetic patients who underwent TSA.

Methods

The American College of Surgeons National Surgical Quality Improvement Program (NSQIP) database was queried for all patients who underwent TSA between 2015 and 2020. The NSQIP database is fully deidentified, therefore rendering this study exempt from approval by our University's institutional review board. Data in the NSQIP database is obtained from over 600 hospitals in the United States and collected by trained surgical clinical reviewers. The data are periodically audited to maintain high fidelity.

Current Procedural Terminology code 23472 was used to identify patients who underwent TSA, both anatomic and reverse, from 2015 to 2020. Cases for patients younger than 18 years of age or TSA performed for trauma were automatically excluded from the database. Cases were also excluded if any of the following variables had missing information: height, weight, functional health status prior to surgery, discharge destination, ASA classification, and readmission status. Cases were then additionally excluded for no diabetes mellitus and missing preoperative hematocrit values.

Variables collected in this study included patient demographics, comorbidities, surgical characteristics, and 30-day postoperative

Table I
Patient demographics and comorbidities of diabetic patients with and without postoperative transfusion following total shoulder arthroplasty.

Characteristic	No transfusion		Transfusion		*P* value
	Number	Percent (%)	Number	Percent (%)	
Total	4264	100.0	112	100.0	
Diabetes mellitus					.238
Noninsulin	3036	71.2	74	66.1	
Insulin	1228	28.8	38	33.9	
Age					
18-39	7	0.2	0	0.0	.999
40-64	1955	45.8	50	44.6	–
65-74	1030	24.2	9	8.0	**.003**
≥75	1272	29.8	53	47.3	**.015**
Body mass index (kg/m^2)					
<18.5	8	0.2	0	0.0	.999
18.5-29.9	1329	31.2	44	39.3	–
30.0-34.9	1232	28.9	35	31.3	.506
35.0-39.9	881	20.7	17	15.2	.062
≥40.0	807	18.9	16	14.3	.083
Gender					**<.001**
Female	2384	55.9	86	76.8	
Male	1880	44.1	26	23.2	
Functional status					**<.001**
Independent	4133	96.9	101	90.2	
Dependent	131	3.1	11	9.8	
ASA classification					**.001**
1-2	828	19.4	7	6.3	
≥3	3436	80.6	105	93.8	
Current smoker					.908
No	3859	90.5	101	90.2	
Yes	405	9.5	11	9.8	
COPD					**.038**
No	3927	92.1	97	86.6	
Yes	337	7.9	15	13.4	
Congestive heart failure					**<.001**
No	4217	98.9	105	93.8	
Yes	47	1.1	7	6.3	
Hypertension					.191
No	562	13.2	10	8.9	
Yes	3702	86.8	102	91.1	
Disseminated cancer					.171
No	4255	99.8	111	99.1	
Yes	9	0.2	1	0.9	
Open wound/wound infection					.217
No	4233	99.3	110	98.2	
Yes	31	0.7	2	1.8	
Chronic steroid use					.546
No	4059	95.2	108	96.4	
Yes	205	4.8	4	3.6	
Bleeding disorders					**<.001**
No	4111	96.4	97	86.6	
Yes	153	3.6	15	13.4	
Transfusion prior to surgery					**<.001**
No	4252	99.7	104	92.9	
Yes	12	0.3	8	7.1	
Preoperative anemia					**<.001**
No	3230	75.8	24	21.4	
Yes	1034	24.2	88	78.6	
Operative duration (min)					
0-79	1095	25.7	12	10.7	.182
80-128	2099	49.2	36	32.1	–
≥129	1070	25.1	64	57.1	**<.001**

ASA, American Society of Anesthesiologists; *COPD*, chronic obstructive pulmonary disease.
Bold *P* values indicate statistical significance with $P < .05$.

complication data. Patient demographics included age, body mass index (BMI), gender, functional status, ASA classification, current smoking status, and chronic steroid use. Preoperative comorbidities included noninsulin and insulin-dependent diabetes mellitus, chronic obstructive pulmonary disease (COPD), congestive heart failure, hypertension, disseminated cancer, open wound/wound infection, and bleeding disorders. Bleeding disorders includes both patients with hematologic diseases as well as those on chronic anticoagulation therapy. Preoperative lab values included hematocrit. Surgical characteristics included transfusion prior to surgery and operative duration. Postoperative complications that occurred within 30 days included bleeding transfusion.

The NSQIP database categorizes diabetes mellitus into three categories: “No,” “Noninsulin,” and “Insulin.” These groups were based on the patient’s treatment regimen for chronic, long-term management within 30 days prior to their procedure. The

Table II
Multivariate analysis of significant patient demographics/comorbidities associated with postoperative transfusion following total shoulder arthroplasty in diabetic patients.

Characteristic	Odds ratio	95% CI	*P* value
Age ≥75	1.32	0.86-2.02	.203
Female gender	2.43	1.52-3.89	**<.001**
Dependent functional status	1.63	0.77-3.45	.200
ASA classification ≥3	2.46	1.10-5.48	**.028**
COPD	1.44	0.76-2.76	.267
Congestive heart failure	2.05	0.73-5.75	.170
Bleeding disorder	2.94	1.50-5.76	**.002**
Transfusion prior to surgery	12.19	4.25-35.00	**<.001**
Preoperative anemia	8.76	5.47-14.03	**<.001**
Operative duration ≥129 min	4.05	2.58-6.36	**<.001**

CI, confidence interval; *ASA*, American Society of Anesthesiologists; *COPD*, chronic obstructive pulmonary disease.
Bold *P* values indicate statistical significance with *P* < .05.

category "No" refers to no diagnosis of diabetes or diabetes controlled by diet alone. "Noninsulin" refers to a diagnosis of diabetes requiring therapy with a noninsulin antidiabetic agent. "Insulin" refers to a diagnosis of diabetes requiring daily insulin therapy. Only cases with non-insulin and insulin-dependent diabetes were included in diabetes cohort.

A total of 27,050 patients who underwent TSA were identified in NSQIP from 2015 to 2020. Cases were excluded as follows: 152 for missing height/weight, 11 for missing discharge destination, 29 for missing ASA classification, 227 for unknown functional health status, 2 for missing readmission status, and 436 for missing preoperative hematocrit. The remaining patients were divided into a diabetic and nondiabetic cohorts, which were then analyzed based on their postoperative transfusion requirements. Of the 4376 patients in the diabetic cohort, 4264 (97.4%) patients did not require postoperative transfusion and 112 (2.6%) patients did require postoperative transfusion (Fig. 1). Of the remaining 19,289 patients without diabetes; 18,948 (98.2%) patients did not require postoperative transfusion; and 341 (1.8%) did require postoperative transfusion (Fig. 1). The risk factors for transfusion in our diabetic cohort were compared to the risk factors for transfusion in a nondiabetic cohort.

All statistical analyses were conducted using SPSS Software (version 29.0; IBM Corp., Armonk, NY, USA). Patient demographics and comorbidities were compared between cohorts using bivariate logistic regression. Multivariate logistic regression including all significantly associated patient demographics and comorbidities was used to identify the characteristics independently associated with postoperative transfusion. Odds ratios (OR) were reported with 95% confidence intervals (CI). The level of statistical significance was set at *P* < .05.

Results

Bivariate analysis was used to identify patient demographics and comorbidities associated with postoperative transfusion in the diabetic cohort, shown in Table I. The characteristics of diabetic patients significantly associated with postoperative transfusion were age ≥75 (*P* = .015), female gender (*P* < .001), dependent functional status (*P* < .001), ASA ≥ 3 (*P* < .001), COPD (*P* = .038), congestive heart failure (*P* < .001), bleeding disorder (*P* < .001), transfusion prior to surgery (*P* < .001), preoperative anemia (*P* < .001), and operative duration ≥129 (*P* < .001). In contrast, patients aged 65-74 had significantly lower rates of transfusion (*P* = .003).

Multivariate analysis, including all significant patient characteristics, was used to identify the characteristics independently associated with postoperative transfusion, shown in Table II. The characteristics of diabetic patients independently associated with postoperative transfusion were female gender (OR 2.43, 95% CI 1.52-3.89; *P* < .001), ASA ≥ 3 (OR 2.46, 95% CI 1.10-5.48; *P* = .028), bleeding disorder (OR 2.94, 95% CI 1.50-5.76; *P* = .002), transfusion prior to surgery (OR 12.19, 95% CI 4.25-35.00; *P* < .001), preoperative anemia (OR 8.76, 95% CI 5.47-14.03; *P* < .001), and operative duration ≥129 minutes (OR 4.05, 95% CI 2.58-6.36; *P* < .001).

In our nondiabetic cohort, bivariate analysis was used to identify patient demographics and comorbidities associated with postoperative transfusion, shown in Table III. We identified age ≥75 (*P* < .001), BMI ≤ 18.5 (*P* < .001), female gender (*P* < .001), dependent functional status (*P* < .001), ASA classification ≥3 (*P* < .001), COPD (*P* = .008), congestive heart failure (*P* < .001), disseminated cancer (*P* < .001), open wound/wound infection (*P* = .050), chronic steroid use (*P* = .018), bleeding disorders (*P* < .001), transfusion prior to surgery (*P* < .001), preoperative anemia (*P* < .001), and operative time <80 and ≥ 129 minutes (*P* < .001) to be associated with increased risk of transfusion in our nondiabetic cohort.

Multivariate analysis, adjusted for all significant demographics and comorbidities was used to identify independent risk factors for postoperative transfusion in our non-diabetic cohort, shown in Table IV. The characteristics we identified to be significantly associated with postoperative transfusion were age ≥75 (OR 1.80, 95% CI 1.37-2.35; *P* < .001), BMI <18.5 (OR 1.58, 95% CI 0.79-3.15; *P* < .001), female gender (OR 2.58, 95% CI 1.98-3.36; *P* < .001), dependent functional status (OR 2.16, 95% CI 1.40-3.32; *P* < .001), ASA classification ≥3 (OR 1.69, 95% CI 1.29-2.21; *P* < .001), bleeding disorders (OR 3.46, 95% CI 2.28-5.27; *P* < .001), transfusion prior to surgery (OR 3.22, 95% CI 1.47-7.08; *P* = .004), preoperative anemia (OR 8.97, 95% CI 7.02-11.47; *P* < .001), and operative time ≥129 minutes (OR 3.09, 95% CI 2.41-3.96; *P* < .001).

Discussion

Our study investigated the risk factors of diabetic patients for postoperative transfusion following TSA. Overall, the transfusion rate among the diabetes patients was found to be 2.6% (Fig. 1). Our results demonstrated that female gender, ASA ≥3, bleeding disorders, transfusion prior to surgery, preoperative anemia, and operative duration ≥129 minutes were independent risk factors for transfusion within the diabetic population. In the nondiabetic cohort, we found similar risk factors for postoperative transfusion following TSA. However, younger patients in the diabetic cohort were significantly associated with increased risk of postoperative transfusion when compared to the nondiabetic cohort.

Diabetes is a common chronic medical condition that affects an increasing proportion of the US population, with 37.3 million Americans (11.3% of population) diagnosed with diabetes. Another 96 million Americans (38% of population) are classified as prediabetic.[20] Recent trends have shown a significant increase in the proportion of patients with diabetes undergoing TSA, from 12.1% to 17.8% between 2005 and 2018.[5] Diabetes has also been suggested to accelerate the development of osteoarthritis, which could influence the volume of diabetic patients seeking arthroplasty.[15] Therefore, as an increasing number of diabetic patients seek orthopedic surgery, it may be important to better understand how certain factors in the diabetes population can influence adverse outcomes.

Diabetes is known to damage multiple organ systems, and the well documented complications such as neuropathy, nephropathy, and peripheral artery disease have been shown to adversely impact orthopedic surgical outcomes.[34] For example, peripheral neuropathy can lead to gait disturbances that increase fall risk. Vascular disease and poor glycemic control can negatively impact wound

Table III
Patient demographics and comorbidities of non-diabetic patients with and without postoperative transfusion following total shoulder arthroplasty.

Characteristic	No transfusion		Transfusion		*P* value
	Number	Percent (%)	Number	Percent (%)	
Total	18,948	100.0	341	100.0	
Age					
18-39	105	0.6	2	0.6	.506
40-64	7801	41.2	92	27.0	–
65-74	5260	27.8	52	15.2	.312
≥75	5782	30.5	195	57.2	**<.001**
Body mass index (kg/m^2)					
<18.5	151	0.8	12	3.5	**<.001**
18.5-29.9	9685	51.1	236	69.2	–
30.0-34.9	4956	26.2	60	17.6	**<.001**
35.0-39.9	2437	12.9	15	4.4	**<.001**
≥40.0	1692	8.9	18	5.3	**<.001**
Gender					**<.001**
Female	10,585	55.9	259	76.0	
Male	8363	44.1	82	24.0	
Functional status					**<.001**
Independent	18,599	98.2	309	90.6	
Dependent	349	1.8	32	9.4	
ASA classification					**<.001**
1-2	8869	46.8	87	25.5	
≥3	10,079	53.2	254	74.5	
Current smoker					.342
No	16,971	89.6	300	88.0	
Yes	1977	10.4	41	12.0	
COPD					**.008**
No	17,696	93.4	306	89.7	
Yes	1252	6.6	35	10.3	
Congestive heart failure					**<.001**
No	18,850	99.5	334	97.9	
Yes	98	0.5	7	2.1	
Hypertension					.218
No	7062	37.3	116	34.0	
Yes	11,886	62.7	225	66.0	
Disseminated cancer					**<.001**
No	18,904	99.8	336	98.5	
Yes	44	0.2	5	1.5	
Open wound/wound infection					**.050**
No	18,896	99.7	338	99.1	
Yes	52	0.3	3	0.9	
Chronic steroid use					**.018**
No	17,991	94.9	314	92.1	
Yes	957	5.1	27	7.9	
Bleeding disorders					**<.001**
No	18,523	97.8	307	90.0	
Yes	425	2.2	34	10.0	
Transfusion prior to surgery					**<.001**
No	18,923	99.9	329	96.5	
Yes	25	0.1	12	3.5	
Preoperative anemia					**<.001**
No	16,055	84.7	102	29.9	
Yes	2893	15.3	239	70.1	
Operative duration (min)					
0-79	4840	25.5	42	12.3	**.014**
80-128	9586	50.6	129	37.8	–
≥129	4522	23.9	170	49.9	**<.001**

ASA, American Society of Anesthesiologists; *COPD*, chronic obstructive pulmonary disease.
Bold *P* values indicate statistical significance with $P < .05$.

healing and surgical recovery.[34] Additionally, patients with diabetes are more likely to be older and have a higher BMI, which can also contribute to poor postoperative outcomes.[33] Furthermore, surgery and trauma are known to alter carbohydrate metabolism due to prolonged periods of stress, leading to increased insulin resistance. Diabetes exacerbates this hyperglycemic state and has therefore been correlated with adverse in-hospital events.[34]

Diabetic patients have been reported to be at increased risk for postoperative blood transfusion after orthopedic surgery.[10,24,27,30] Following total elbow arthroplasty, diabetes has been found to be significantly associated with increased rates of postoperative transfusions and increased length of stay.[24,30] Studies on total hip and knee arthroplasty (THA and TKA, respectively) have found insulin-dependent diabetes to be an independent risk factor for postoperative transfusions.[10,27] Klasan et al[16] suggested that these transfusions subsequently increase the risk of complications and infections following THA and TKA, further heightening the pre-existing risk that diabetic patients have for infection and poor healing postoperatively. Following TSA, diabetes has been associated with higher risk of postoperative blood transfusion, stroke, sepsis, wound complications, and extended length of stay.[8]

Table IV
Multivariate analysis of significant patient demographics/comorbidities associated with postoperative transfusion following total shoulder arthroplasty in non-diabetic patients.

Characteristic	Odds ratio	95% CI	*P* value
Age ≥75	1.80	1.37-2.35	**<.001**
BMI <18.5	1.58	0.79-3.15	.194
Female gender	2.58	1.98-3.36	**<.001**
Dependent functional status	2.16	1.40-3.32	**<.001**
ASA classification ≥3	1.69	1.29-2.21	**<.001**
COPD	1.07	0.73-1.58	.747
Congestive heart failure	2.30	0.98-5.38	.055
Disseminated cancer	2.48	0.87-7.10	.090
Open wound/wound infection	1.01	0.29-3.56	.983
Chronic steroid use	1.11	0.72-1.71	.628
Bleeding disorders	3.46	2.28-5.27	**<.001**
Transfusion prior to surgery	3.22	1.47-7.08	**.004**
Preoperative anemia	8.97	7.02-11.47	**<.001**
Operative time ≥ 129 min	3.09	2.41-3.96	**<.001**

CI, confidence interval; *BMI*, body mass index; *ASA*, American Society of Anethesiologists; *COPD*, chronic obstructive pulmonary disease.
Bold *P* values indicate statistical significance with *P* < .05.

The specific comorbidities that place diabetic patients at increased risk for transfusion are minimally documented. Our study found female gender within diabetic patients to be an independent risk factor for postoperative transfusion. Other orthopedic studies, including those on TSA, TKA, and THA, have also found female gender to be predictive of postoperative transfusion.[6,13,17,29] These prior studies suggest that the lower baseline hemoglobin within the female population increases the likelihood of needing postoperative transfusion.[17] In the general population, female patients have lower hemoglobin levels likely secondary to menstrual losses, abnormal uterine bleeding, and pregnancy.[4] Furthermore, a study by Solomon et al[28] found that the prevalence of anemia in female diabetic patients was nearly three times greater than that of male diabetic patients.

We also found ASA class ≥3, bleeding disorders, transfusion prior to surgery, and preoperative anemia to be characteristics of diabetic patients that were independently associated with postoperative transfusion. In agreement with our results, prior studies have found ASA class ≥3 to be a risk factor for postoperative transfusion following TSA and THA.[3,7,17,23] It is also well known that preoperative hemoglobin and hematocrit levels are reliable predictors of postoperative transfusion needs.[9,11,23] Padegimas et al[22] reported that patients with a hematocrit level less than 39.6% have an increased risk for postoperative transfusion. Diabetic patients are also more likely to be anemic than nondiabetic patients, influenced by kidney disease, inflammation, nutrition, drugs, concomitant autoimmune disorders, and hormonal changes.[19] A cross-sectional study on anemia in adult diabetic patients found an overall prevalence of 19%.[28] As stated previously, diabetes can lead to multiple organ system damage, which can result in nephropathy.[34] Nephropathy can lead to decreased erythropoietin production and the development or worsening of anemia.[19] For these reasons, patients with diabetes are often predisposed to preoperative anemia, increasing their likelihood of requiring transfusion.

Lastly, our study found operative duration longer than 129 minutes to be an independent risk factor for postoperative transfusion in diabetic patients. Prior studies have demonstrated prolonged operative time and increased intraoperative blood loss to be risk factors for postoperative transfusion following arthroplasty.[11,29] Additionally, longer operative times likely result in higher volumes of blood loss. A study by Burns et al[6] on blood transfusion rates following TSA found that estimated blood loss greater than 300 mL intraoperatively was predictive of postoperative transfusion. Since anemia is more common in diabetes patients, it is reasonable that extended operation time and increased blood loss would increase the likelihood of transfusion.

When comparing our results to a non-diabetic patient population, we found similar risk factors for postoperative transfusion following TSA. Of note, in contrast to the nondiabetic cohort, ages 65-74 among diabetic patients were significantly associated with increased risk of transfusion. This suggests that although similar risk factors exist, diabetic patients may be at higher risk of postoperative transfusion at a younger age when compared to the general population. As stated above, this could be related to the higher likelihood of anemia and other comorbidities among diabetic patients, making them higher risk surgical candidates that are more likely to require postoperative transfusion. Furthermore, many prior orthopedic studies have clearly demonstrated increased risk of postoperative transfusion in diabetic patient populations.[10,24,27,30] Therefore, special preoperative care still needs to be given to the diabetic population, as their disease may make them more likely to possess these risk factors.

This study was limited to the information that is available through the NSQIP database. Our data were limited to 30-day postoperative complications. Therefore, we could only report on the short-term influences of the comorbidities studied. Blood transfusion after this interval was not included. Additionally, factors that have been found to be associated with transfusion rates in other studies including patient insurance status, hospital region, and annual hospital caseload were unable to be analyzed.[26] Since we were unable to analyze the effects of perioperative medications, such as tranexamic acid, to decrease the risk of postoperative bleeding, further research should be directed the efficacy of these management options. Despite these limitations, we used a large national database to analyze the associations between comorbidities within diabetic patients and postoperative transfusion following TSA. Moreover, this is the first study to investigate specific risk factors among diabetes patients leading to postoperative transfusion, expanding upon prior studies that associate diabetes with postoperative transfusion.

Conclusion

Female gender, ASA ≥ 3, bleeding disorder, transfusion prior to surgery, preoperative anemia, and operative duration ≥129 minutes were independently associated with postoperative transfusion following TSA in diabetic patients. When compared to nondiabetic patients, diabetic patients may be at increased risk of postoperative transfusion from a younger age. As the utilization of TSA and the prevalence of diabetes continue to increase, it is important to understand how certain risk factors may increase the likelihood of adverse outcomes within higher risk populations. This knowledge can guide physicians to council diabetic patients on preoperative management to minimize risks prior to surgery.

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