Serum Albumin May Predict Bleeding Transfusion Among Patients Undergoing Total Shoulder Arthroplasty

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INTRODUCTION: Measurement of serum albumin is a common, low-cost test used to assess overall nutritional status, as well as liver, kidney, and heart function. Previous literature has cited its use as a predictor of adverse surgical outcomes, morbidity, and mortality. This study sought to apply these principles to assess the relationship between preoperative serum albumin levels and the need for bleeding transfusion among patients who underwent total shoulder arthroplasty (TSA).

METHODS: A retrospective cohort study was performed using the National Surgical Quality Improvement Program (NSQIP) database of TSA cases occurring between 2012-2021. Inclusion criteria was age ³18 years. Patients were divided into four cohorts based on preoperative serum albumin levels: severe hypoalbuminemia (<3 mg/dL), mild hypoalbuminemia (3-3.49 mg/dL), normal albumin (3.5-4.49 mg/dL) or hyperalbuminemia (³4.5 mg/dL). Bleeding transfusion, the primary outcome, was defined as transfusion of ³1 unit within 72 hours after operative start time, including intraoperatively. Potential confounders included basic demographics (age, sex, race, ethnicity), baseline health status (functional status, ASA classification, BMI, smoking status within one year, history of diabetes, recent immunosuppressive therapy), and procedure characteristics (admission origin, surgical setting, anesthesia modality, preoperative transfusion, emergency procedure designation). Univariate analyses were performed to assess differences between the four cohorts. Multivariable regression analysis, with adjustment for confounding, was performed to assess the relationship between preoperative albumin levels and bleeding transfusion.

RESULTS:

During the study period, 18,044 patients underwent TSA. The normal albumin, mild hypoalbuminemia, severe hypoalbuminemia, and hyperalbuminemia cohorts contained 13,744, 10,055, 248, and 2,997 patients, respectively. The highest proportion of patients in the hypoalbuminemia and normal albumin cohorts had age 70-79 years, female sex, White race, non-Hispanic ethnicity, independent functional status, ASA class 3, obesity, and no smoking, diabetes, or immunosuppressive therapy. However, the greatest proportion in the hyperalbuminemia cohort had age 60-69 years, male sex, and ASA class <3 [Table 1].

On multivariable regression analysis with adjustment for potential confounding factors, compared to patients with normal albumin levels, those with severe (OR 4.43, 95% CI 2.86 to 6.70; p<0.001) and mild (OR 2.17, 95% CI 1.59 to 2.94; p<0.001) hypoalbuminemia had higher risk intra-/postoperative bleeding transfusion following TSA. Conversely, patients with hyperalbuminemia (OR 0.48, 95% CI 0.29 to 0.75; p=0.002) had decreased risk of bleeding transfusion [Table 2].

DISCUSSION AND CONCLUSION: Patients with decreased preoperative albumin levels who undergo TSA have a higher risk of intraoperative or postoperative bleeding transfusion. Further studies characterizing the management of albumin levels preoperatively, as well as supportive strategies for hypoalbuminemic patients during the perioperative period, may help optimize patient outcomes.

Table 1: Univariate Analysis of Patients Undergoing Total Shoulder Arthroplasty and Preoperative Albumin Levels

	Severe Hypoalbuminemia N = 248	Mild Hypoalbuminemia N = 1,055	Normal Albumin N = 13,744	Hyper-albuminemia N = 2,997	p-value[a]
Basic Demographics					
Age (years)					<0.001
18-59	30 (12%)	121 (11%)	1,706 (12%)	612 (21%)	
60-69	58 (23%)	287 (27%)	4,584 (33%)	1,182 (39%)	
70-79	87 (35%)	399 (38%)	5,497 (40%)	963 (32%)	
≥80	73 (29%)	248 (24%)	1,957 (14%)	240 (8.0%)	
Sex					<0.001
Female	159 (64%)	745 (71%)	7,784 (57%)	1,456 (49%)	
Male	89 (36%)	310 (29%)	5,960 (43%)	1,541 (51%)	
Race					<0.001
White	205 (83%)	912 (86%)	11,951 (87%)	2,625 (88%)	
Black or African American	12 (4.8%)	74 (7.0%)	701 (5.1%)	106 (3.5%)	
Other	1 (0.4%)	14 (1.3%)	227 (1.7%)	59 (2.0%)	
Unknown	30 (12%)	55 (5.2%)	865 (6.3%)	207 (6.9%)	
Ethnicity					0.001
Not Hispanic	198 (80%)	903 (86%)	12,072 (88%)	2,648 (88%)	
Hispanic	23 (9.3%)	65 (6.2%)	657 (4.8%)	142 (4.7%)	
Unknown	26 (11%)	87 (8.2%)	995 (7.3%)	205 (6.8%)	
Baseline Health Status					
Functional Status					<0.001
Independent	215 (87%)	968 (92%)	13,311 (98%)	2,923 (98.7%)	
Dependent	32 (13%)	79 (7.5%)	330 (2.4%)	39 (1.3%)	
ASA Class					<0.001
<3	37 (15%)	242 (23%)	5,364 (39%)	1,525 (51%)	
3	168 (68%)	720 (68%)	7,962 (58%)	1,427 (48%)	
>3	43 (17%)	91 (8.6%)	409 (3.0%)	43 (1.4%)	
BMI					<0.001
Normal Weight (18.5 ≤ 25)	63 (26%)	187 (18%)	2,137 (16%)	502 (17%)	
Underweight (≤18.5)	11 (4.5%)	15 (1.4%)	87 (0.6%)	22 (0.7%)	
Overweight (25 ≤ 30)	66 (27%)	264 (25%)	4,262 (31%)	1,066 (36%)	
Obese (≥30)	106 (43%)	577 (55%)	7,225 (53%)	1,402 (47%)	
Smoking	41 (17%)	138 (13%)	1,371 (10%)	326 (11%)	<0.001
Diabetes					<0.001
No	185 (75%)	772 (73%)	11,148 (81%)	2,486 (83%)	
Oral Agents	30 (12%)	165 (16%)	1,836 (13%)	426 (14%)	
Insulin	33 (13%)	118 (11%)	760 (5.5%)	85 (2.8%)	
Immunosuppressive Therapy	19 (7.7%)	106 (10%)	824 (6.0%)	125 (4.2%)	<0.001
Procedure Characteristics					
Admission Origin					<0.001
Home	215 (90%)	993 (95%)	13,611 (99%)	2,984 (99.8%)	
Institution	24 (10%)	47 (4.5%)	106 (0.8%)	6 (0.2%)	
Setting					<0.001
Inpatient	231 (93%)	947 (90%)	11,469 (83%)	2,394 (80%)	
Outpatient	17 (6.9%)	108 (10%)	2,275 (17%)	603 (20%)	
Anesthesia Modality					0.041
General	238 (96%)	1,026 (97%)	13,406 (98%)	2,928 (98%)	
Regional	7 (2.8%)	16 (1.5%)	165 (1.2%)	23 (0.8%)	
Other	3 (1.2%)	12 (1.1%)	170 (1.2%)	46 (1.5%)	
Preoperative Transfusion	24 (9.7%)	20 (1.9%)	22 (0.2%)	2 (<0.1%)	<0.001
Emergency Case Designation	10 (4.0%)	25 (2.4%)	52 (0.4%)	4 (0.1%)	<0.001
Postoperative Transfusion	52 (21%)	83 (7.9%)	291 (2.1%)	24 (0.8%)	<0.001

[a] Pearson's Chi-squared test; Fisher's exact test; Wilcoxon rank sum test

Table 2: Adjusted Multivariable Regression of Preoperative Albumin Levels and Postoperative Transfusion

Preoperative Albumin Level	OR[a]	95% CI[b]	p-value
Normal albumin	—	—	
Severe Hypoalbuminemia	4.43	2.86-6.70	**<0.001**
Mild Hypoalbuminemia	2.17	1.59-2.94	**<0.001**
Hyperalbuminemia	0.48	0.29-0.75	**0.002**

[a] Odds Ratio [b] Confidence Interval