Impact of Albumin on Total Shoulder Arthroplasty Outcomes

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Introduction

Malnutrition has been associated with adverse outcomes and higher perioperative complications in orthopaedic procedures (1). Specifically, albumin as a serological marker of malnutrition has shown to be predictive of surgical site infection and mortality risk following joint arthroplasty (2,3). A 2020 systematic review found elective total joint arthroplasty in low albumin patients to be associated with a 93% increase in all measured complications (4). Previous studies have reported the effects of hypoalbuminemia, defined as a serum albumin less than 3.5 g/dL, in total shoulder arthroplasty (TSA) patients with significantly increased rates of complications, readmission, and mortality (5,6). More recently, Flamant et al. reported malnutrition to be associated with increased incidence of extended length of stay and discharge to rehab or skilled nursing facilities in 421 primary and 71 revision elective shoulder arthroplasty cases from a multi-institutional study (7). The project of interest aims to further elucidate hypoalbuminemia as a risk factor for specific TSA complications.

Kishawi et al. subdivided hypoalbuminemic patients into quartiles and found those with lower albumin levels had a greater rate of postoperative complications including surgical site infection and return to the operating room within 30 days (8). In this study, we will utilize a stratum-specific likelihood ratio (SSLR) analysis to further define thresholds for the influence of preoperative serum albumin level on TSA complications. We hypothesize that lower value-based thresholds, specifically serum albumin levels of less than 3.5 g/dL, will be significantly associated with an increased risk for post-operative complications following TSA. With trends demonstrating TSA to increase in popularity (9,10) alongside revision TSA (11) which have a higher overall complication rate (12), this study can serve to guide surgeons and highlight the potential application of screening serum albumin levels as preoperative risk stratification for improving patient outcomes. Ultimately, understanding the effects of hypoalbuminemia on perioperative complications can aid in appropriate selection of TSA patients for surgical intervention and risk counseling preoperatively.

Methods

A total of 151,738 patients were queried from data provided by the American College of Surgeons maintained National Surgical Quality Improvement Program (ACS-NSQIP) database between the years of 2005 to 2018. Exclusion criteria were if patients had a missing or unknown serum albumin concentration and patients less than 18 years old.

Patients who had undergone primary TSA (Current Procedure Terminology CPT code 23472) were stratified by preoperative serum albumin levels from 1 to 4 g/dL at a 0.1 g/dL interval and categorized based on the presence or absence of infection and revision. SSLR analysis was conducted to elucidate meaningful thresholds for the influence of preoperative serum albumin levels on these TSA outcomes. Bivariate analysis assessed differences in demographics and comorbidities between the found intervals. A multivariate logistic regression assessed the influence of a preoperative serum albumin level below the significant threshold on subsequent infection or revision.

Results

Table 1. Patient Demographics and Medical Comorbidities of Patients

Variables	Albumin 3.1-4 (n = 6,127)	Albumin 1-3 (n = 279)	P-Value
Demographics			
Age (years)	70.57	72.93	<0.001
Sex (F/M) (%)	61.6/38.4	64.9/35.1	0.278
BMI	31.73	29.69	<0.001
Race (%)			0.142
American Indian	0.6	0.0	
Asian	0.5	0.4	
Black or African American	6.6	6.5	
Hispanic	4.3	7.6	
Native Hawaiian	0.1	0.0	
White	88.0	85.6	
ASA (%)			<0.001
I or II	34.6	16.5	
III or IV	65.4	83.2	
Medical Comorbidities (%)			
Smoking	10.8	16.1	0.006
COPD	9.1	14.7	0.002
Hypertension	70.8	73.5	0.327
Congestive Heart Failure	1.0	3.9	<0.001
Dialysis	0.8	2.5	0.003
Steroid Use	7.1	9.7	0.099
Weight Loss	0.3	1.4	<0.001
Preoperative Transfusion	0.3	6.1	<0.001
Bleeding Disorder	3.7	7.5	0.001
Diabetes	21.0	23.7	0.292
Dyspnea	9.9	15.0	0.019
Dependent Functional Status	3.1	10.8	<0.001

BMI, body mass index; ASA, American Society of Anesthesiologists; COPD, chronic obstructive pulmonary disease.

SSLR analysis indicated meaningful thresholds for the influence of preoperative serum albumin levels on subsequent revision at the 1-3 and 3.1-4 g/dL intervals. This was obtained by calculating the associated likelihood ratio and 95% upper and lower confidence intervals (CI) and merging thresholds into progressively larger intervals until a significant difference in risk ratios between the adjacent groups was found. No significant intervals were found for perioperative infection rate. The 1-3 g/dL and 3.1-4 g/dL intervals were then subject to bivariate analysis (Table 1) to look for differences in demographics and comorbidities between the two groups with variables having a p<0.2 controlled for in the multivariate analysis. Multivariate analysis found that patients in the 1-3 group had increased odds (OR 1.723, 95% CI 0.829-3.579) of undergoing revision compared to the 3.1-4 group, but the result was not statistically significant (p=0.145).

Discussion

Low preoperative serum albumin levels have been associated with increased rates of complication following TSA (5,6). Through SSLR analysis, this study found that patients having an albumin level between 1-3 g/dL had an increased likelihood for revision than patients with an albumin level between 3.1-4 g/dL. Multivariate analysis found that patients in the 1-3 g/dL group had higher odds of requiring revision surgery but this result was not significant (p>0.05). A limitation of this study was the sample size as fewer patients within the ACS-NSQIP database underwent a subsequent revision (n=113) as compared to those who did not get a revision (n=6280). Future studies can sample a wider group of patients with provided preoperative serum albumin levels to further elucidate low albumin as a risk factor for TSA complications.

Acknowledgements

References

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