JSES International 7 (2023) 855–860

Contents lists available at ScienceDirect

JSES International

journal homepage: www.jsesinternational.org

Increased preoperative aspartate aminotransferase-to-platelet ratio index predicts complications following total shoulder arthroplasty

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ARTICLE INFO

Keywords:
Total shoulder arthroplasty
Liver damage
Cirrhosis
Liver fibrosis
Aspartate aminotransferase-to-platelet ratio index
Complications
Postoperative

Level of evidence: Level III; Retrospective Cohort Comparison Using Large Database; Prognosis Study

Background: This study investigates the association between aspartate aminotransferase-to-platelet ratio index (APRI), a noninvasive measure of liver function, and 30-day postoperative complications following total shoulder arthroplasty (TSA).

Methods: The American College of Surgeons National Surgical Quality Improvement Program database was queried for all patients who underwent TSA between 2015 and 2021. The study population was divided into 4 groups based on preoperative APRI: normal/reference (APRI $\leq$ 0.5), mild fibrosis (0.5 < APRI $\leq$ 0.7), significant fibrosis (0.7 < APRI $\leq$ 1), and cirrhosis (APRI > 1). Multivariate logistic regression analysis was conducted to investigate the connection between preoperative APRI and postoperative complications.

Results: Compared to the reference group, significant fibrosis was independently associated with a greater likelihood of major complications (odds ratio [OR]: 1.82, 95% confidence interval [CI]: 1.11-2.99; $P = .017$), minor complications (OR: 2.70, 95% CI: 1.67-4.37; $P < .001$), pneumonia (OR: 5.78, 95% CI: 2.58-12.95; $P < .001$), blood transfusions (OR: 2.89, 95% CI: 1.57-5.32; $P < .001$), readmission (OR: 1.88, 95% CI: 1.10-3.21; $P = .022$), and non-home discharge (OR: 1.83, 95% CI: 1.23-2.73; $P = .003$). Cirrhosis was independently associated with a greater likelihood of minor complications (OR: 3.96, 95% CI: 2.67-5.88; $P < .001$), blood transfusions (OR: 5.85, 95% CI: 3.79-9.03; $P < .001$), failure to wean off a ventilator (OR: 9.10, 95% CI: 1.98-41.82; $P = .005$), and non-home discharge (OR: 2.06, 95% CI: 1.43-2.96; $P < .001$).

Conclusion: Increasing preoperative APRI was associated with an increasing rate of postoperative complications following TSA.

Total shoulder arthroplasty (TSA) has become a standard surgical treatment option for a wide range of shoulder pathologies, such as glenohumeral arthritis, proximal humerus fractures, rotator cuff arthropathy, and glenoid bone deficiency.[25,34] From 2000 to 2019, the incidence of TSA in the United States increased by 1.527%.[23] With a greater number of chronic comorbidities in advanced age groups, the greater rates of TSA in the older population merit prudent examination of risk factors.[4,28] Previous studies in TSA have explored some such factors, finding that abnormal platelet count and chronic steroid usage correlate with higher rates of postoperative complications.[13,16]

Liver disease is a measurable comorbidity that contributes to an increased risk of perioperative and postoperative morbidity and mortality.[18] Within the field of orthopedics, liver disease has been found to be correlated with surgical complications including blood transfusions, pneumonia, and readmission.[19,20,31,33]

The aspartate aminotransferase (AST)-to-platelet ratio index (APRI), a value calculated from AST and platelet count, has been shown to predict liver fibrosis in patients with liver disease.[15,17] It is simple, cost-efficient, and readily available, as AST and platelet count are routinely tested in preoperative laboratory studies.[17] This study aimed to investigate the association between liver disease, using APRI, and 30-day postoperative complications following TSA.

Institutional review board approval was not required for this study.

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https://doi.org/10.1016/j.jseint.2023.06.006

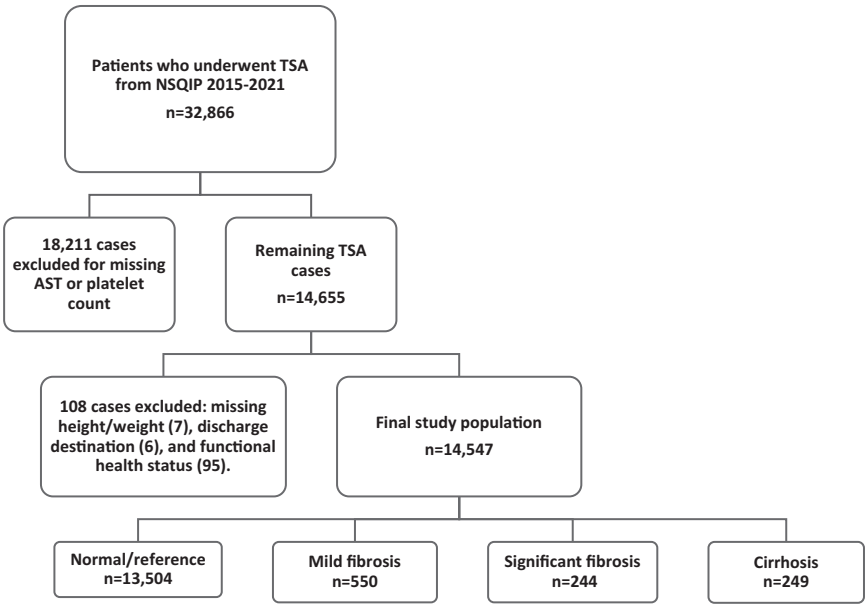

Figure 1 Case selection schematic. *TSA*, total shoulder arthroplasty; *NSQIP*, National Surgical Quality Improvement Program; *ASA*, American Society of Anesthesiologists; *CPT*, Current Procedural Terminology; *AST*, aspartate aminotransferase.

We hypothesize that abnormal APRI values predict more adverse outcomes following TSA.

Materials and methods

We queried the American College of Surgeons National Surgical Quality Improvement Program (ACS-NSQIP) database for all patients who underwent TSA between 2015 and 2021. This study was exempt from approval by our University's institutional review board because the NSQIP database is fully deidentified. Data in the NSQIP database are obtained from over 600 hospitals in the United States and is collected by trained surgical clinical reviewers. The data are periodically audited to maintain high fidelity.

The *Current Procedural Terminology* (CPT) code 23472 was used to identify 32,866 patients who underwent TSA between 2015 and 2021. The exclusion criteria inherent to the NSQIP database exclude all cases for patients younger than 18 years of age. However, 18,211 patients with missing preoperative AST or platelet were excluded, leaving 14,655 patients. A total of 108 patients were excluded for missing height/weight, discharge destination, and functional health status, leaving a total of 14,547 patients to be included in this study. Using 40 as the standard, conventionally accepted upper limit of normal AST, we calculated the preoperative APRI for the remaining patients using the following formula:[15]

$$APRI = \frac{AST \times 100}{Upper\ limit\ of\ normal\ AST \times Platelet\ count\ (in\ thousands)}$$

The remaining study population (Fig. 1) was then indexed into the following 4 cohorts based on their preoperative APRI: normal/reference (APRI $\leq$ 0.5), mild fibrosis (0.5 < APRI $\leq$ 0.7), significant fibrosis (0.7 < APRI $\leq$ 1), and cirrhosis (APRI > 1). APRI cutoff values of 0.5, 0.7, and 1 were chosen because a 2011 meta-analysis of APRI and the staging of liver fibrosis found that these threshold values had sensitivities and specificities of 74% and 49% for some liver damage, 77% and 72% for significant fibrosis, and 76% and 72% for cirrhosis, respectively.[15]

Variables collected in this study included patient demographics, comorbidities, surgical characteristics, and 30-day postoperative complication data. Patient demographics included gender, body mass index, age, smoking status, functional status, American Society of Anesthesiologists (ASA) classification, and preoperative steroid use. Steroid use status was defined as patients who routinely used immunosuppressants or corticosteroids within 30 days preprocedure. Smoking status was defined as cigarette use at any point within the past year before the procedure. Preoperative comorbidities included congestive heart failure, diabetes, hypertension, severe chronic obstructive pulmonary disease, and bleeding disorders. Major and minor complications that occurred within 30 days postoperatively were included in the analysis. Major complications included the following: cardiac arrest requiring cardiopulmonary resuscitation, myocardial infarction, deep vein thrombosis requiring therapy, stroke, unplanned intubation, pulmonary embolism, failure to wean off a ventilator within 48 hours, sepsis, septic shock, deep incisional surgical space infection (SSI), and organ/space SSI, readmission, reoperation, and mortality. Minor complications included the following: pneumonia, urinary tract infection, transfusions within 72 hours after surgery, wound dehiscence, and superficial incisional SSI.

All statistical analyses were conducted using SPSS Software version 26.0 (IBM Corp., Armonk, NY, USA). Patient demographics and comorbidities were compared between cohorts using bivariate logistic regression. Multivariate logistic regression, adjusted for all significantly associated patient demographics and comorbidities for the respective cohort, was used to identify associations between preoperative APRI and postoperative complications. Odds ratios (ORs) were reported with 95% confidence intervals (CIs). The level of statistical significance was set at $P < .05$.

Results

Compared to the normal APRI group, the mild fibrosis group was statistically significant for male gender ($P < .001$), ASA $\geq$ 3 ($P < .001$), diabetes ($P < .001$), and bleeding disorders ($P < .001$). Compared to the normal APRI group, the significant fibrosis group was statistically significant for male gender ($P < .001$), age 18-64 years ($P < .001$), ASA $\geq$ 3 ($P = .005$), smokers ($P = .046$), and bleeding disorders ($P < .001$). Compared to the normal APRI group,

Table I
Patient demographics and comorbidities for patients with preoperative normal aspartate aminotransferase-to-platelet ratio index, mild fibrosis, significant fibrosis, and cirrhosis

	Normal (APRI ≤ 0.5)	Mild fibrosis (0.5 < APRI ≤ 0.7)		Significant fibrosis (0.7 < APRI ≤ 1)		Cirrhosis (APRI > 1)	
	Number (%)	Number (%)	*P* value	Number (%)	*P* value	Number (%)	*P* value
Overall	13,504 (100.0)	550 (100.0)		244 (100.0)		249 (100.0)	
Gender			**<.001**		**<.001**		.434
Female	7710 (57.1)	240 (43.6)		104 (42.6)		136 (54.6)	
Male	5794 (42.9)	310 (56.4)		140 (57.4)		113 (45.4)	
Age (yr)			.854		**<.001**		**<.001**
18-39	67 (0.5)	3 (0.5)		3 (1.2)		1 (0.4)	
40-64	3607 (26.7)	157 (28.5)		87 (35.7)		95 (38.2)	
65-74	5662 (41.9)	213 (38.7)		101 (41.4)		95 (38.2)	
≥75	4168 (30.9)	177 (32.2)		53 (21.7)		58 (23.3)	
BMI (kg/m^2)			.318		.656		**.021**
<18.5	6231 (46.1)	256 (46.5)		114 (46.7)		129 (51.8)	
18.5-29.9	100 (0.7)	4 (0.7)		3 (1.2)		3 (1.2)	
30-34.9	3659 (27.1)	161 (29.3)		57 (23.4)		67 (26.9)	
35-39.9	2007 (14.9)	84 (15.3)		35 (14.3)		32 (12.9)	
≥40	1507 (11.2)	45 (8.2)		35 (14.3)		18 (7.2)	
Functional status prior to surgery			.245		.864		.183
Dependent	356 (2.6)	19 (3.5)		6 (2.5)		10 (4.0)	
Independent	13,148 (97.4)	531 (96.5)		238 (97.5)		239 (96.0)	
ASA classification			**<.001**		**.005**		**<.001**
≤2	5298 (39.2)	174 (31.6)		74 (30.3)		64 (25.7)	
≥3	8206 (60.8)	376 (68.4)		170 (69.7)		185 (74.3)	
Smoker			.590		**.046**		**<.001**
No	12,103 (89.6)	489 (88.9)		209 (85.7)		188 (75.5)	
Yes	1401 (10.4)	61 (11.1)		35 (14.3)		61 (24.5)	
Steroid use			.243		.829		.894
No	12,664 (93.8)	509 (92.5)		228 (93.4)		233 (93.6)	
Yes	840 (6.2)	41 (7.5)		16 (6.6)		16 (6.4)	
Comorbidities							
CHF	186 (1.4)	12 (2.2)	.120	4 (1.6)	.729	8 (3.2)	**.018**
Diabetes mellitus	2586 (19.1)	138 (25.1)	**<.001**	57 (23.4)	.099	71 (28.5)	**<.001**
Hypertension	9307 (68.9)	384 (69.8)	.656	172 (70.5)	.599	165 (66.3)	.370
COPD	990 (7.3)	48 (8.7)	.220	24 (9.8)	.140	28 (11.2)	**.021**
Bleeding disorder	339 (2.5)	38 (6.9)	**<.001**	16 (6.6)	**<.001**	30 (12.0)	**<.001**

APRI, aspartate aminotransferase-to-platelet ratio index; *BMI*, body mass index; *ASA*, American Society of Anesthesiologists; *CHF*, congestive heart failure; *COPD*, chronic obstructive pulmonary disease.
Bold *P* values indicate statistical significance with $P < .05$.

the cirrhosis group was statistically significant for people aged 40-64 years ($P < .001$), body mass index <18.5 and 18.5-29.9 ($P = .021$), ASA ≥ 3 ($P < .001$), smokers ($P < .001$), and congestive heart failure ($P = .018$), diabetes ($P < .001$), chronic obstructive pulmonary disease ($P = .021$), and bleeding disorders ($P < .001$) (Table I).

Compared to the normal APRI group, abnormal APRI groups were found to have an association with the following 30-day postoperative complications: major complications, minor complications, overall complications, septic shock, pneumonia, blood transfusions, failure to wean off a ventilator within 48 hours, readmission, and non-home discharge (Table II). Specifically, the mild fibrosis group was associated with minor complications ($P = .001$), septic shock ($P = .030$), failure to wean off ventilator ($P < .001$), and non-home discharge ($P = .016$). The significant fibrosis group was associated with major complications ($P = .008$), minor complications ($P < .001$), overall complications ($P < .001$), pneumonia ($P < .001$), blood transfusions ($P < .001$), readmission ($P = .010$), and non-home discharge ($P = .045$). The cirrhosis group was associated with minor complications ($P < .001$), overall complications ($P < .001$), pneumonia ($P = .018$), blood transfusions ($P < .001$), failure to wean off ventilator ($P = .005$), and non-home discharge ($P < .001$). In general, the overall complication rate increased as APRI increased from the normal group to the mild fibrosis group to the significant fibrosis group to the cirrhosis group (6.4%, 8.0%, 12.7%, 17.3%, respectively). Minor complications (3.3%, 5.8%, 8.2%, 14.1% respectively), blood transfusions (1.8%, 2.9%, 4.9%, 12.0%, respectively), and non-home discharge (9.0%, 12.0%, 12.7%, 16.1%, respectively) followed the same pattern.

After controlling for all significant patient demographic and comorbidity factors, an adjusted multivariate regression analysis was conducted (Table III). Compared to the normal platelet group, the mild fibrosis group was independently associated with a greater likelihood of minor complications (OR: 1.76, 95% CI: 1.21-2.57; $P = .003$), failure to wean off a ventilator (OR: 7.05, 95% CI: 2.22-22.39; $P < .001$), and non-home discharge (OR: 1.44, 95% CI: 1.09-1.89; $P = .009$). The significant fibrosis group was independently associated with a greater likelihood of major complications (OR: 1.82, 95% CI: 1.11-2.99; $P = .017$), minor complications (OR: 2.70, 95% CI: 1.67-4.37; $P < .001$), overall complications (OR: 2.08, 95% CI: 1.41-3.07; $P < .001$), pneumonia (OR: 5.78, 95% CI: 2.58-12.95; $P < .001$), blood transfusions (OR: 2.89, 95% CI: 1.57-5.32; $P < .001$), readmission (OR: 1.88, 95% CI: 1.10-3.21; $P = .022$), and non-home discharge (OR: 1.83, 95% CI: 1.23-2.73; $P = .003$). The cirrhosis group was independently associated with a greater likelihood of minor complications (OR: 3.96, 95% CI: 2.67-5.88; $P < .001$), overall complications (OR: 2.51, 95% CI: 1.76-3.57; $P < .001$), blood transfusions (OR: 5.85, 95% CI: 3.79-9.03; $P < .001$), failure to wean off a ventilator (OR: 9.10, 95% CI: 1.98-41.82;

Table II
Bivariate analysis of 30-day postoperative complications in patients with preoperative normal aspartate aminotransferase-to-platelet ratio index, mild fibrosis, significant fibrosis, and cirrhosis

	Normal (APRI ≤ 0.5)	Mild fibrosis (0.5 < APRI ≤ 0.7)		Significant fibrosis (0.7 < APRI ≤ 1)		Cirrhosis (APRI > 1)	
	Number (%)	Number (%)	*P* value	Number (%)	*P* value	Number (%)	*P* value
Major complications	532 (3.9)	21 (3.8)	.886	18 (7.4)	**.008**	15 (6.0)	.098
Minor complications	440 (3.3)	32 (5.8)	**.001**	20 (8.2)	**<.001**	35 (14.1)	**<.001**
Overall complications	866 (6.4)	44 (8.0)	.139	31 (12.7)	**<.001**	43 (17.3)	**<.001**
Sepsis	20 (0.1)	0 (0.0)	.998	1 (0.4)	.320	1 (0.4)	.330
Septic shock	9 (0.1)	2 (0.4)	**.030**	0 (0.0)	.999	1 (0.4)	.088
Pneumonia	64 (0.5)	5 (0.9)	.160	7 (2.9)	**<.001**	4 (1.6)	**.018**
Reintubation	31 (0.2)	3 (0.5)	.152	1 (0.4)	.568	2 (0.8)	.086
Urinary tract infection	99 (0.7)	7 (1.3)	.157	1 (0.4)	.561	3 (1.2)	.395
Stroke	22 (0.2)	0 (0.0)	.998	0 (0.0)	.998	1 (0.4)	.377
Cardiac arrest	8 (0.1)	1 (0.2)	.290	0 (0.0)	.999	0 (0.0)	.999
Myocardial infarction	32 (0.2)	0 (0.0)	.998	1 (0.4)	.589	0 (0.0)	.998
Blood transfusions	249 (1.8)	16 (2.9)	.074	12 (4.9)	**<.001**	30 (12.0)	**<.001**
Deep vein thrombosis	44 (0.3)	0 (0.0)	.998	2 (0.8)	.201	0 (0.0)	.998
Pulmonary embolism	34 (0.3)	1 (0.2)	.748	0 (0.0)	.998	0 (0.0)	.998
Failure to wean off ventilator	13 (0.1)	4 (0.7)	**<.001**	0 (0.0)	.999	2 (0.8)	**.005**
Deep incisional SSI	11 (0.1)	1 (0.2)	.442	0 (0.0)	.999	0 (0.0)	.999
Superficial incisional SSI	37 (0.3)	4 (0.7)	.063	0 (0.0)	.998	2 (0.8)	.138
Organ/space SSI	33 (0.2)	1 (0.2)	.771	0 (0.0)	.998	1 (0.4)	.624
Wound dehiscence	10 (0.1)	0 (0.0)	.999	1 (0.4)	.103	0 (0.0)	.999
Readmission	426 (3.2)	18 (3.3)	.877	15 (6.1)	**.010**	12 (4.8)	.141
Reoperation	193 (1.4)	9 (1.6)	.689	5 (2.0)	.423	6 (2.4)	.205
Non-home discharge	1212 (9.0)	66 (12.0)	**.016**	31 (12.7)	**.045**	40 (16.1)	**<.001**
Mortality	22 (0.2)	2 (0.4)	.277	1 (0.4)	.367	1 (0.4)	.377

APRI, aspartate aminotransferase-to-platelet ratio index; *SSI*, surgical space infection.
Bold *P* values indicate statistical significance with $P < .05$.

Table III
Multivariate analysis of 30-day postoperative complications in patients with preoperative normal aspartate aminotransferase-toplatelet ratio index, mild fibrosis, significant fibrosis, and cirrhosis.

	Mild fibrosis (0.5 < APRI ≤ 0.7)	Significant fibrosis (0.7 < APRI ≤ 1)	Cirrhosis (APRI > 1)
	OR, 95% CI; *P* value	OR, 95% CI; *P* value	OR, 95% CI; *P* value
Major complications	-	1.82, 1.11-2.99; **.017**	-
Minor complications	1.76, 1.21-2.57; **.003**	2.70, 1.67-4.37; **<.001**	3.96, 2.67-5.88; **<.001**
Overall complications	-	2.08, 1.41-3.07; **<.001**	2.51, 1.76-3.57; **<.001**
Septic Shock	4.48, 0.92-21.81; .064	-	-
Pneumonia	-	5.78, 2.58-12.95; **<.001**	2.44, 0.83-7.18; .104
Blood transfusions	-	2.89, 1.57-5.32; **<.001**	5.85, 3.79-9.03; **<.001**
Failure to wean off ventilator	7.05, 2.22-22.39; **<.001**	-	9.10, 1.98-41.82; **.005**
Readmission	-	1.88, 1.10-3.21; **.022**	-
Non-home discharge	1.44, 1.09-1.89; **.009**	1.83, 1.23-2.73; **.003**	2.06, 1.43-2.96; **<.001**

APRI, aspartate aminotransferase-to-platelet ratio index; *OR*, odds ratio; *CI*, confidence interval.
Dashes represent associations not significant in bivariate analysis and were not included in multivariate analysis. Bold *P* values indicate statistical significance with $P < .05$.

$P = .005$), and non-home discharge (OR: 2.06, 95% CI: 1.43-2.96; $P < .001$).

Discussion

Using a large national database, we investigated APRI as a predictor for 30-day postoperative complications following TSA. We found that cohorts associated with increasing APRI had a greater number of overall complications. APRI associated with cirrhosis was an independent predictor of minor complications, overall complications, blood transfusions, failure to wean off a ventilator, and non-home discharge.

In the past decade, the incidence of TSA procedures has grown exponentially.[30,34] The use of reverse TSA for pathologies not amenable to anatomic TSA is the main reason for this growth, such as fractures, rotator cuff arthropathy, and severe bone loss.[30] Significant comorbidities and complications are frequently associated with the geriatric population. For this reason, employing measures like APRI preoperatively has the potential to both promote positive patient outcomes and reduce the costs associated with postoperative complications.[24,30]

Liver damage has been frequently associated with perioperative and postoperative morbidity and mortality.[18] Hepatic function is critical for the metabolic clearance of nutrients and drugs, neutralization of toxins, bile secretion, and synthesis of serum proteins and coagulation factors.[9] Liver pathology has the potential to promote fibrosis and cirrhosis, which impairs each of these important processes. Clinical manifestations of these disturbances include hypertension from disease-related fibrotic and nonfibrotic resistance to portal blood flow.[29] Portal hypertension causes circulation to become hyperdynamic, such that it is highly susceptible to the hemodynamic changes elicited by the surgical circumstances of hemorrhage, anesthesia, and hypotension. These disruptions risk ischemia and further damage to the liver.[9] Hemostasis is further altered by the coagulopathies experienced by those with liver disease, as a consequence of the altered formation of coagulants

and anticoagulants.[18] Therefore, increased peri- and postoperative bleeding complications are seen in patients with liver damage.[6,18]

A notable growth in the global burden of liver disease and advancements in its management means that the expected population of those with liver disease that undergo surgery has also grown.[3,10,21] Our data revealed that the patients with APRI indicative of liver damage were more likely to be associated with male gender, of ASA classification ≥3, and diagnosed with diabetes and bleeding disorders. These findings support the literature, in which men have a higher incidence of cirrhosis and common causes of liver damage such as nonalcoholic fatty liver disease.[14,26] Similar to our findings, another study investigating cirrhosis patients undergoing liver transplantation found that 90% of patients whose liver damage progressed to cirrhosis had an ASA classification ≥3.[32] In addition, the role of diabetes in liver damage is well documented.[7,22] A study on cirrhosis and diabetes noted that around 30% of patients with liver cirrhosis were also diabetic, comorbidity that was controlled for in our multivariate analysis.[7]

We found independent associations between the significant fibrosis and cirrhosis APRI groups with postoperative transfusions. Patients with liver damage have a greater risk of bleeding complications as a result of hemostatic disturbances secondary to decreased synthesis of coagulation factors and thrombocytopenia.[1] Our data support the preexisting literature findings that more bleeding complications occur in orthopedic joint replacement patients with liver dysfunction and damage.[20,31] A study of total knee arthroplasty (TKA) in cirrhosis patients reported that among the 44% higher complication rate of cirrhosis patients, significantly more blood loss was a common postoperative occurrence.[31] Similarly, a recent analysis of total hip arthroplasty (THA) outcomes found that increased perioperative bleeding, although not life-threatening, was more common among patients with liver damage.[20]

We found the mild fibrosis and cirrhosis APRI groups to be independently associated with failure to wean off a ventilator within 48 hours postoperatively. Our findings are consistent with a study of cirrhosis patients undergoing anesthesia for various surgeries, in which there was an 8% incidence of ventilatory dependence greater than 24 hours in cirrhosis patients compared to non-cirrhosis patients.[35] This may be a result of the increasing portal hypertension or resultant portosystemic shunting seen in liver cirrhosis, as the intrapulmonary vasculature has been found to dilate and predispose to respiratory complications.[2]

We also found that greater APRI scores correlated with discharge to a non-home location. This pattern may be attributed to the higher rate of postoperative complications observed in these groups, including bleeding complications and ventilatory dependence. In patients undergoing THA or TKA, cirrhosis is also significantly associated with more frequent non-home facilities. In general, the rate of overall complications following TSA was significantly higher in patients with increasing degrees of liver damage as predicted by APRI. This finding is consistent with preexisting literature studying orthopedic surgeries in patients with liver dysfunction and damage.[20,31] The gold standard to diagnose liver damage is biopsy. However, it is limited by the risk of complications inherent to its invasive nature, with studies showing 1.1%-3.2% of biopsies reporting adverse events.[11,27] Several noninvasive serum markers related to fibrosis, such as extracellular matrix management enzymes, are nonspecific to hepatic damage.[17] Furthermore, specific panels like the FibroTest, which tests total bilirubin, apolipoprotein A_1, and a_2-macroglobulin among other markers, are expensive.[17] The APRI possesses a moderate degree of accuracy in predicting liver fibrosis with increasing value.[15] In a study of patients with chronic hepatitis C, APRI correctly identified significant fibrosis in 71.3%, advanced fibrosis in 76.2%, and cirrhosis in 76.2% of patients.[15,17] Although APRI does not possess the same accuracy as liver biopsy, APRI provides a fast, noninvasive, and convenient screening tool for patients. This is not to suggest that APRI is sufficient in stratifying patients with liver disease, but rather that patients with an elevated APRI may benefit from a multidisciplinary approach in preoperative optimization.

Our study found that APRI scores may serve as an effective predictor for postoperative complications following TSA. Along with a negative patient experience, postoperative complications have been shown to have an impact on hospital finances.[12] Therefore, the use of APRI to predict liver damage may also help to improve preoperative risk assessment, patient experience, and cost optimization in TSA.

To our knowledge, this is the first study to describe the relationship between APRI and complications following TSA. There are several limitations of this study. Although the ACS NSQIP database is a useful national database for the analysis of comorbidities and postoperative complications, the data are limited by a 30-day postoperative period. This prevents the investigation of long-term outcomes and complications from TSA that may occur after this period. In addition, while studies have found that APRI can predict liver cirrhosis and fibrosis with a respectable degree of accuracy, the evidence is mixed, depending on the specific etiology responsible for liver damage.[5,8,15] APRI may be less effective when identifying degrees of fibrosis in patients with a coinfection of HIV (human immunodeficiency virus) and HCV (hepatitis C virus), in patients with autoimmune hepatitis, or in patients with chronic hepatitis B.[5,8,15,17]

While we did not identify complications specific to the shoulder, our findings provide further support that patients with liver disease are at increased risk for postoperative blood transfusion, as previously shown in THA and TKA. Of note, we did not find increased rates of SSI or reoperation, indicating that liver disease is not a contraindication for TSA. Given the increased risk of blood transfusion in patients with liver disease, it may be of interest for further studies to identify the reasons leading to transfusion, such as preoperative anemia, bleeding during the shoulder approach, or other reasons.

Conclusion

Among those with predicted liver damage, the overall rate of complication following TSA was found to increase with greater APRI scores. Compared to normal APRI, APRI associated with any degree of liver damage was found to be independently associated with a greater likelihood of minor complications, remaining on a ventilator after 48 hours, and non-home discharge. Specifically, APRI associated with mild fibrosis was an independent predictor of minor complications, failure to wean off a ventilator, and non-home discharge. APRI associated with significant fibrosis was an independent predictor of major complications, minor complications, overall complications, pneumonia, blood transfusions, readmission, and non-home discharge. APRI associated with cirrhosis was an independent predictor of minor complications, overall complications, blood transfusions, failure to wean off a ventilator, and non-home discharge. As the prevalence of TSA grows, these results suggest careful consideration of noninvasive predictors of liver damage as preoperative risk factors to reduce postoperative adverse events, minimize hospital stay, and promote favorable patient outcomes.

Disclaimers:

Funding: No funding was disclosed by the authors.

Conflicts of interest: The authors, their immediate families, and any research foundation with which they are affiliated have not received any financial payments or other benefits from any commercial entity related to the subject of this article.

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