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Risk factors for admission after shoulder arthroscopy

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Background: Shoulder arthroscopy is a common orthopedic procedure typically performed on an outpatient basis. Occasionally, patients require an unplanned hospital admission. An understanding of the incidence and risk factors for admission after shoulder arthroscopy may assist surgeons in determining which patients may be susceptible to unplanned admission after surgery.

Methods: All consecutive shoulder arthroscopy procedures performed during a 10-year period were reviewed. A 2:1 control-case matching technique was used. Univariate analysis was performed to identify differences between patients admitted after surgery and the control group. Multivariate analysis was performed to identify variables associated with admission.

Results: There were 5598 arthroscopic shoulder procedures performed, with 233 patients (4.2%) requiring admission. The most common reason for admission was respiratory monitoring. Risk factors for admission by multivariate analysis were chronic obstructive pulmonary disease (odds ratio [OR], 2.73; 95% confidence interval [CI], 1.51-4.95), diabetes (OR, 2.11; 95% CI, 1.28-3.48), obstructive sleep apnea (OR, 1.90; 95% CI, 1.13-3.21), age (OR, 1.02; 95% CI, 1.01-1.04), body mass index (OR, 1.04; 95% CI, 1.01-1.07), and operative time (OR, 1.01; 95% CI, 1.00-1.01). Regional with monitored anesthesia care decreased risk compared with general anesthesia and regional with general anesthesia (OR, 0.44; 95% CI, 0.30-0.63).

Conclusion: Chronic obstructive pulmonary disease, obstructive sleep apnea, diabetes, increasing age, increasing body mas index, and increasing operative time were all risk factors for admission after shoulder arthroscopy. The absence of general anesthesia was found to decrease the risk of admission.

Level of evidence: Level III; Case-Control Design; Treatment Study

Keywords: Risk factors; arthroscopy; shoulder; shoulder arthroscopy; admission; complication

Shoulder arthroscopy is a commonly performed procedure, with more than 500,000 shoulder arthroscopy procedures being performed annually in the United States.[7] Arthroscopic shoulder surgery is performed for a variety of indications and is routinely performed on an outpatient basis because it is generally considered a safe, minimally invasive procedure, with reported complication rates as low as 1%.[9,12] On occasion, perioperative complications necessitate an unplanned inpatient admission after shoulder arthroscopy.

Large series using the American College of Surgeons National Surgical Quality Improvement Program (NSQIP) database have reported risk factors for complications within 30 days after shoulder arthroscopy and risk factors for admission for individual arthroscopic procedures, including Bankart repair and anterior cruciate ligament

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Table I Shoulder arthroscopy Current Procedural Terminology codes included in the 5598 total cases

Procedure	CPT code	Frequency of CPT code (No.)	Percent of total CPT codes (%)	Cases including CPT code (%)
Acromioplasty	29826	3700	33	66
Rotator cuff repair	29827	2277	20	41
Débridement limited	29822	1338	12	24
Débridement extensive	29823	998	9	18
Distal claviculectomy	29824	964	9	17
Capsulorrhaphy	29806	654	6	12
Biceps tenodesis	29828	434	4	8
SLAP lesion repair	29807	425	4	8
Loose body removal	29819	222	2	4
Diagnostic arthroscopy	29805	150	1	3
Lysis of adhesions	29825	131	1	2
Partial synovectomy	29820	47	<1	1
Complete synovectomy	29821	21	<1	<1
Total		11,361	100	

CPT, Current Procedural Terminology (American Medical Association, Chicago, IL, USA); *SLAP*, superior labrum anterior-posterior.

reconstruction.[2,3,10,13] A non-NSQIP single-surgeon study by Sultan et al[14] found increasing age, American Society of Anesthesiologists Physical Status Classification, and procedure complexity were significant risk factors for admission after shoulder arthroscopy. Despite these prior studies, a more comprehensive understanding of the reasons for unplanned admission after shoulder arthroscopy is needed.

A large shift has occurred in recent years toward outpatient orthopedic surgery procedures. Studies have demonstrated the safety of these outpatient procedures, leading to increased use of ambulatory surgery centers (ASCs).[4] Fewer available resources are generally available for patients who experience major complications at ASCs, so patients must be selected appropriately to reduce the risk of complications requiring admission.

Understanding risk factors that lead to admission after surgery is important for preoperative patient education, addressing preventable causes for complications, and patient selection for ambulatory surgery centers. This study used data from a single institution to determine individual patient and perioperative risk factors for unplanned admission after elective shoulder arthroscopy. We hypothesized that medical comorbidities and the use of general anesthesia would be risk factors for unplanned admission after shoulder arthroscopy.

Materials and methods

This was a retrospective case-control study to identify reasons and risk factors for unplanned admission after elective shoulder arthroscopy. All arthroscopic shoulder procedures during the 10-year study period from January 2006 to December 2015 were retrospectively identified by Current Procedural Terminology (American Medical Association, Chicago, IL, USA) code. Rotator cuff repair, capsulorrhaphy, biceps tenodesis, and superior labrum anterior-posterior lesion repair were categorized as major procedures, and the remaining procedures were included in the minor category (Table I). For each patient, the electronic medical record (EMR) query included patient demographics (sex, body mass index [BMI], and age), operative variables (major/minor procedure, operative time, and anesthesia type), and comorbidities, including obesity, smoking, chronic obstructive pulmonary disease (COPD), obstructive sleep apnea (OSA), heart failure, peripheral vascular disease, and diabetes. The EMR was retrospectively reviewed to identify the type of anesthesia used for each case (regional with monitored anesthesia care [MAC], regional with general anesthesia, or general anesthesia) and the reason for any postoperative admissions, when available.

An unplanned admission was defined as an unplanned postoperative stay in the hospital on the day of surgery. The cases that resulted in an unplanned admission were identified and included in the case group. A 2:1 control-case matching technique was used in a similar fashion to other recent studies.[1,5,6,8,11,15-17] This methodology is used because admission after elective shoulder arthroscopy is a rare event. Each case was matched with 2 controls that were performed by the same surgeon during a 1-month period. Surgeon and surgery date were chosen because these variables were not included in the risk factor analysis and matching cases according to additional variables would have prohibited their analyses as a risk factor.

A univariate analysis was performed to identify differences between patients in the case group who were admitted after surgery and those in the control group. We used the χ^2 test to compare categorical variables between the case and control groups, except for heart failure, which was compared using the Fisher exact test, and *t* tests were used to analyze continuous variables, except for operative time, which was compared using Wilcoxon rank sum test. A multivariate logistic regression was performed to identify variables associated with admission when all other variables were controlled for.

Results

A total of 5598 elective arthroscopic shoulder procedures were identified during the 10-year study period. The

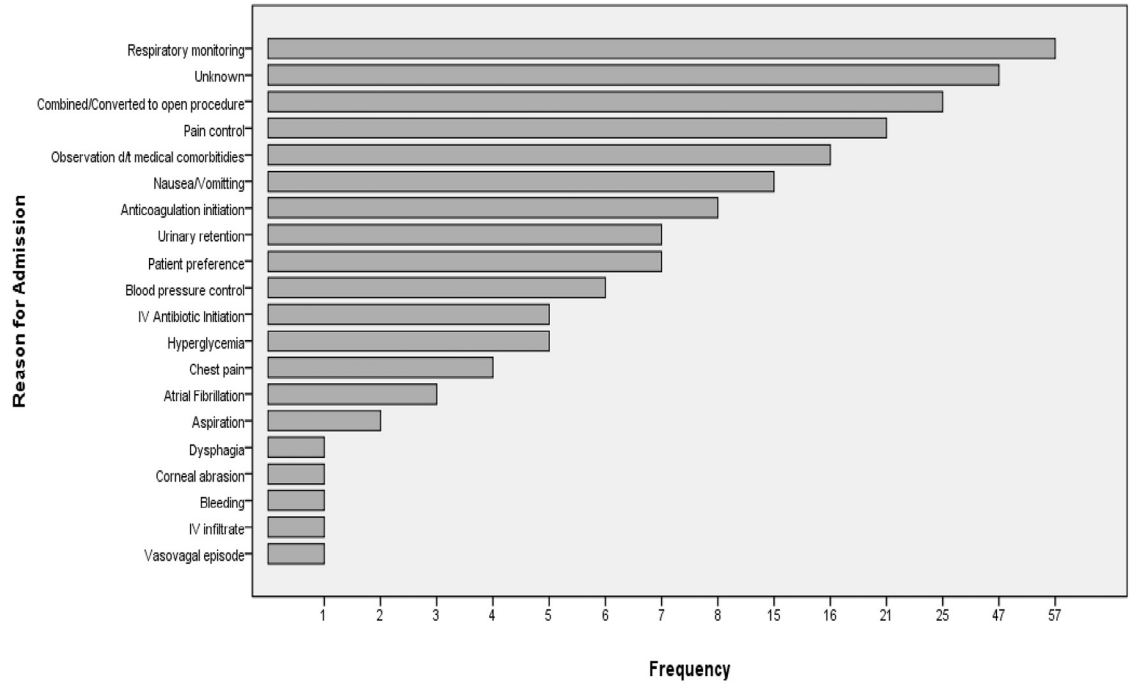

Figure 1 Reasons for unplanned admissions after shoulder arthroscopy. *IV*, intravenous.

operations were performed by 18 different surgeons. Among the 5598 cases, 11,361 Current Procedural Terminology codes were recorded (Table I). Of the cases recorded, the most common procedures performed were acromioplasty (3700 [66%]), rotator cuff repair (2277 [41%]), and limited débridement (1338 [24%]). We identified 233 patients who were admitted after their elective surgery, for an unplanned admission rate of 4.2%. The 5 most common reasons for admission (Fig. 1) included respiratory monitoring (57 [24%]), requirement of an unplanned open procedure (25 [11%]), pain control (21 [9%]), anesthesiologist-initiated observation due to medical comorbidities (16 [7%]), and nausea/vomiting (15 [6%]; Fig. 1). The documentation in the EMR for 47 patients was insufficient to determine the reason for admission.

Demographic and potential risk factors for admission were analyzed between the admission and control groups (Tables II and III). When patient demographics were analyzed, univariate models suggested BMI (odds ratio [OR], 1.07; 95% confidence interval [CI], 1.05-1.10) and age (OR, 1.03; 95% CI, 1.02-1.04) were risk factors for admission, with the OR representing the increased risk for a single-unit increase (age, 1 year; and BMI 1 unit). Sex (OR, 0.71; 95% CI, 0.52-0.98) was not statistically significant. In a multivariate analysis, BMI (OR, 1.04; 95% CI, 1.01-1.07) and age (OR, 1.02; 95% CI, 1.01-1.04) continued to be correlated with increased risk of admission when other relevant factors were controlled for.

When operative variables were analyzed, univariate models suggested operative time (OR, 1.01; 95% CI, 1.00-1.01) was a risk factor for admission, with the OR representing the increased risk from each additional minute of operative time. In addition, regional with MAC (OR, 0.36; 95% CI, 0.22-0.59) decreased the risk of postoperative admission. Major procedures (OR, 0.98; 95% CI, 0.71-1.34) and regional with general anesthesia (OR, 0.89; 95% CI, 0.56-1.42) were not statistically significant. In a multivariable analysis, operative time (OR, 1.01; 95% CI, 1.00-1.01) continued to be correlated with the risk of admission, and regional with MAC had a decreased risk for admission compared with regional with general anesthesia or general anesthesia (OR, 0.44; 95% CI, 0.30-0.63) when other relevant factors were controlled for.

When potential risk factors were analyzed, univariate models suggested OSA (OR, 3.65; 95% CI, 2.35-5.71), COPD (OR, 3.01; 95% CI, 1.77-5.17), and diabetes (OR, 3.66; 95% CI, 2.35-5.76) were risk factors for admission, whereas peripheral vascular disease (OR, 2.58; 95% CI, 1.00-6.84), heart failure (OR, 6.09; 95% CI, 0.8-123.5), and smoking (OR, 0.90; 95% CI, 0.58-1.37) were not statistically significant. In a multivariable analysis, OSA (OR, 1.90; 95% CI, 1.13-3.21), COPD (OR, 2.73; 95% CI, 1.51-4.95), and diabetes (OR, 2.11; 95% CI, 1.28-3.48) continued to be correlated with the increased risk of admission when other relevant factors were controlled for.

Further modeling of BMI and operative time (Table IV) showed that the statistically significant effects of BMI and operative time persisted when the data were segmented for overweight and obese BMI classifications, >24.9 kg/m^2 and >29.9 kg/m^2 (OR, 1.11 and 1.13), respectively, and operative time greater than 60 and 90 minutes (OR, 1.01 and 1.01).

Table II Demographic and potential risk factors to hospital admission after surgery

Variable	Admission (n = 233)	Control (n = 468)	*P* value
Demographics			
Female sex, %	47.2	39.1	.04
Body mass index, mean kg/m^2	32	28	<.001
Age, mean yr	52	48	<.001
Age category, No. (%)			
<40 yr	33 (14)	126 (27)	<.001
40-65 yr	161 (69)	294 (63)	
≥65 yr	39 (17)	48 (10)	
Operation length			
Time, mean (range), min	77 (55-91)	70 (54-91)	.003
Time >90 min, No. (%)	84 (36)	121 (26)	.01
Anesthesia category, No. (%)			
Regional with general anesthesia	121 (52)	172 (37)	<.001
Regional with MAC	70 (30)	243 (52)	
General anesthesia	42 (18)	53 (11)	
Potential risk factors, No. (%)			
Obesity	119 (51)	156 (33)	<.001
Smoking	37 (16)	81 (17)	.71
COPD	35 (15)	26 (6)	<.001
Obstructive sleep apnea	58 (25)	39 (8)	<.001
Heart failure	3 (1)	1 (0)	.11
Peripheral vascular disease	10 (4)	8 (2)	.07
Diabetes	57 (24)	38 (8)	<.001
Major procedure	128 (55)	260 (56)	.94

MAC, monitored anesthesia care; *COPD*, chronic obstructive pulmonary disease.

Table IV Further modeling of body mass index and operative time

Variable	Odds ratio (95% CI)	*P* value
Body mass index		
Overall	1.07 (1.05-1.10)	<.0001
>24.9 kg/m^2 (overweight and obese)	1.11 (1.07-1.14)	<.0001
>29.9 kg/m^2 (obese)	1.13 (1.08-1.19)	<.0001
Operative time		
Overall	1.01 (1.00-1.01)	<.001
>60 min	1.01 (1.00-1.01)	<.001
>90 min	1.01 (1.00-1.01)	.04

CI, confidence interval.

Discussion

Orthopedic surgeons perform the vast majority of arthroscopic shoulder procedures on an outpatient basis. Although uncommon, some elective procedures require a postoperative admission. This study reviewed 5598 shoulder arthroscopies at a single institution over a 10-year period and found that 4.2% of patients required an unplanned postoperative admission. The most common reasons for postoperative admission were respiratory monitoring (24%), requirement of an unplanned open procedure (11%), pain control (9%), anesthesia-initiated observation due to medical comorbidities (7%), and nausea/vomiting (6%).

Sultan et al[14] previously examined risk factors for unplanned overnight admissions after shoulder arthroscopy in a non-NSQIP, single-surgeon series of 242 patients and found the rate of unplanned admission was 18.0%. The most common reasons for admission were identified as "abnormal postoperative observations," "pain," and "wound ooze." Our study features a significantly larger sample size and also enabled

Table III Modeling of potential risk factors to hospital admission after surgery

Variable	Univariate		Multivariable	
	Odds ratio (95% CI)	*P* value	Odds ratio (95% CI)	*P* value
Obstructive sleep apnea	3.65 (2.35-5.71)	<.001	1.90 (1.13-3.21)	.016
COPD	3.01 (1.77-5.17)	<.001	2.73 (1.51-4.95)	.001
Body mass index	1.07 (1.05-1.10)	<.001	1.04 (1.01-1.07)	.003
Regional with MAC	0.36 (0.22-0.59)	<.001	0.44 (0.30-0.63)	<.001
Diabetes	3.66 (2.35-5.76)	<.001	2.11 (1.28-3.48)	.003
Age (yr)	1.03 (1.02-1.04)	<.001	1.02 (1.01-1.04)	.001
Operative time (min)	1.01 (1.00-1.01)	<.001	1.01 (1.00-1.01)	.004
Female sex	0.71 (0.52-0.98)	.036	—	—
Peripheral vascular disease	2.58 (1.00-6.84)	.049	—	—
Heart failure	6.09 (0.8-123.5)	.119	—	—
Regional with general anesthesia	0.89 (0.56-1.42)	.617	—	—
Smoking	0.90 (0.58-1.37)	.634	—	—
Major procedure	0.98 (0.71-1.34)	.876	—	—

CI, confidence interval; *COPD*, chronic obstructive pulmonary disease; *MAC*, monitored anesthesia care.

the identification of reasons for admission through retrospective review. Our rate of unplanned admission was lower than that of their study and may more closely resemble the true incidence of this event.

DeFroda et al[3] published a NSQIP-based analysis investigating the rate of admission after arthroscopic Bankart repair with a rate of admission of 7.6%, which is more in line with our finding. One of the limitations of using the NSQIP database is that specific reasons for admission cannot be identified. Because we used a large single-institution cohort, we were able to analyze specific reasons for postoperative admission. This information is more specific and potentially helpful for practitioners performing arthroscopic shoulder surgery.

In our study, COPD, OSA, diabetes, increasing patient age, increasing BMI, and increasing operative time were all individually found to be risk factors for unplanned admission after shoulder arthroscopy. The increased risk associated with patient age is similar to previously published studies.[3,14] Our study did not identify performing major vs. minor procedures as a risk factor for admission, which contrasts with previous findings that performing a rotator cuff repair, a major procedure, was a risk factor for admission.[14] Our findings add to an existing body of literature suggesting that patients with increasing age, operative time, and COPD are at increased risk for perioperative complications, readmission, and now—unplanned postoperative admission. Unlike these previous studies, we found diabetes and OSA were risk factors for postoperative admission; however, smoking was not a significant risk factor for admission.[3,14] In our analysis, increasing BMI and operative time were risk factors for admission for each unit increase of BMI and minute increase in operative time. Further analysis showed this overall effect persisted when isolated for overweight and obese BMI subsets as well as operative time greater than both 60 or 90 minutes, so cutoff values could not be identified.

There is no consensus about whether general, regional, or combined general and regional anesthesia is preferable for arthroscopic shoulder procedures. This study compared types of anesthesia—general anesthesia, regional with general anesthesia, and regional anesthesia with MAC—and found that the absence of general anesthesia was protective, decreasing the risk of admission after arthroscopic shoulder surgery. This suggests that general anesthesia should be avoided for shoulder arthroscopy, when possible, to decrease the risk for postoperative admission. General anesthesia necessitates manipulating and securing a patient's airway with an endotracheal tube or laryngeal mask airway, and respiratory monitoring was the most common reason for postoperative admission in this study. Although a direct correlation cannot be made based on the data available in this study, avoidance of general anesthesia for arthroscopic shoulder surgery is now preferred at our institution. Further research is necessary to determine whether the use of a regional anesthetic alone for these types of procedures limits postoperative admission. In contrast to prior studies, our study did not investigate the role of American Society of Anesthesiologists grade.

The results of this study have several possible implications. Surgeons, anesthesia providers, and patients should be aware of these risk factors and how they influence the need for postoperative admission. In addition, surgeons should make effort to minimize the operative duration of their procedures, when clinically appropriate, to decrease the risk of unplanned admission. Patients should be carefully screened and evaluated for the aforementioned risk factors before surgery. The presence of these risk factors may guide orthopedic and anesthesia providers to schedule a particular patient in a hospital-based surgical suite vs. an ASC. Electing to perform shoulder arthroscopy on an at-risk patient in a hospital-based surgical suite may significantly decrease the perioperative health care costs that could be associated with monitoring and transportation from an ASC to a nearby hospital. In a similar fashion, these risk factors may help identify patients at risk for postoperative admission as compensation continues to move toward expanded bundled payment models.

This study has several important limitations. First, the retrospective nature of the study limited data collection because the only source of data was the medical record. As a result, an attributable reason for admission after shoulder arthroscopy could not be identified in 47 patients due to incomplete medical records. Incomplete medical records also limited our ability to analyze other variables of interest, including operative room positioning, pain control methods, regional anesthesia techniques, and the specific discharge criteria used in each case.

Second, this series included patients of multiple surgeons. In this study, requirement of an unplanned open procedure represents a conversion to open or minimally invasive open procedure, such as a rotator cuff repair, which was an operative technique used by several of the surgeons included in this analysis early in the study period (years 2006-2012) when the surgeon did not feel an arthroscopic procedure was appropriate after intraoperative evaluation. There were 19 patients who required an unplanned open procedure in this analysis that were converted open rotator cuff repair, which represents 8% of the overall 233 unplanned admissions. The 2:1 case-control matching technique, which controlled for surgeon and time period, was used to reduce any bias with regard to surgeon-related differences in surgical technique or postoperative protocol.

Third, the choice to admit a patient postoperatively was at the discretion of the surgeon or the anesthesia provider, or both, and individual bias may thus have affected the rate of admission after surgery. This bias likely increased the overall rate of unplanned admission in this analysis.

Fourth, this analysis draws important conclusions on reasons for unplanned postoperative admissions that occur on the day of surgery; however, we were not able to draw any conclusions regarding delayed or late admissions after shoulder arthroscopy. Despite these limitations, we were able to

identify several specific risk factors for admission after arthroscopic shoulder surgery.

Conclusion

COPD, OSA, diabetes, increasing age, increasing BMI, and increasing operative time were all individually found to be risk factors for unplanned admission after shoulder arthroscopy. The absence of general anesthesia decreased the risk of admission after shoulder surgery. Patients, particularly those considering shoulder arthroscopy at an ASC, should be carefully screened for risk factors so health care providers are properly prepared for the risk of unplanned admission after surgery. Orthopedic surgeons, anesthesia providers, and patients should be aware of these risk factors and consider whether a given patient's operation should be performed at an ASC or at a hospital-based outpatient surgery center.

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References

1. Arsoy D, Woodcock JA, Lewallen DG, Trousdale RT. Outcomes and complications following total hip arthroplasty in the super-obese patient, BMI > 50. J Arthroplasty 2014;29:1899-905. http://dx.doi.org/10.1016/j.arth.2014.06.022
2. Bokshan SL, DeFroda SF, Owens BD. Risk factors for hospital admission after anterior cruciate ligament reconstruction. Arthroscopy 2017;33:1405-11. http://dx.doi.org/10.1016/j.arthro.2017.02.002
3. DeFroda SF, Bokshan SL, Owens BD. Risk factors for hospital admission following arthroscopic Bankart repair. Orthopedics 2017;40:e855-61. http://dx.doi.org/10.3928/01477447-20170719-04
4. Goyal KS, Jain S, Buterbaugh GA, Imbriglia JE. The safety of hand and upper-extremity surgical procedures at a freestanding ambulatory surgery center: a review of 28,737 cases. J Bone Joint Surg Am 2016;98:700-4. http://dx.doi.org/10.2106/JBJS.15.00239
5. Hansen LE, Stone GL, Matson CA, Tybor DJ, Pevear ME, Smith EL. Total joint arthroplasty in patients taking methadone or buprenorphine/naloxone preoperatively for prior heroin addiction: a prospective matched cohort study. J Arthroplasty 2016;31:1698-701. http://dx.doi.org/10.1016/j.arth.2016.01.032
6. Haughom BD, Plummer DR, Hellman MD, Nho SJ, Rosenberg AG, Della Valle CJ. Does hip arthroscopy affect the outcomes of a subsequent total hip arthroplasty? J Arthroplasty 2016;31:1516-8. http://dx.doi.org/10.1016/j.arth.2016.01.008
7. Jain NB, Higgins LD, Losina E, Collins J, Blazar PE, Katz JN. Epidemiology of musculoskeletal upper extremity ambulatory surgery in the United States. BMC Musculoskelet Disord 2014;15:4. http://dx.doi.org/10.1186/1471-2474-15-4
8. Krych AJ, Sousa PL, Morgan JA, Levy BA, Stuart MJ, Dahm DL. Incidence and risk factor analysis of symptomatic venous thromboembolism after knee arthroscopy. Arthroscopy 2015;31:2112-8. http://dx.doi.org/10.1016/j.arthro.2015.04.091
9. Marecek GS, Saltzman MD. Complications in shoulder arthroscopy. Orthopedics 2010;33:492-7. http://dx.doi.org/10.3928/01477447-20100526-15
10. Martin CT, Gao Y, Pugely AJ, Wolf BR. 30-day morbidity and mortality after elective shoulder arthroscopy: a review of 9410 cases. J Shoulder Elbow Surg 2013;22:1667-75, e1661. http://dx.doi.org/10.1016/j.jse.2013.06.022.
11. Noback PC, Jang ES, Cuellar DO, Seetharaman M, Malagoli E, Greisberg JK, et al. Risk factors for achilles tendon rupture: a matched case control study. Injury 2017;48:2342-7. http://dx.doi.org/10.1016/j.injury.2017.08.050
12. Owens BD, Williams AE, Wolf JM. Risk factors for surgical complications in rotator cuff repair in a veteran population. J Shoulder Elbow Surg 2015;24:1707-12. http://dx.doi.org/10.1016/j.jse.2015.04.020
13. Shields E, Thirukumaran C, Thorsness R, Noyes K, Voloshin I. An analysis of adult patient risk factors and complications within 30 days after arthroscopic shoulder surgery. Arthroscopy 2015;31:807-15. http://dx.doi.org/10.1016/j.arthro.2014.12.011
14. Sultan J, Marflow KZ, Roy B. Unplanned overnight admissions in day-case arthroscopic shoulder surgery. Surgeon 2012;10:16-9. http://dx.doi.org/10.1016/j.surge.2010.11.033
15. Viste A, Abdel MP, Ollivier M, Mara KC, Krych AJ, Berry DJ. Prior knee arthroscopy does not influence long-term total knee arthroplasty outcomes and survivorship. J Arthroplasty 2017;32:3626-31. http://dx.doi.org/10.1016/j.arth.2017.06.052
16. Werner BC, Higgins MD, Pehlivan HC, Carothers JT, Browne JA. Super obesity is an independent risk factor for complications after primary total hip arthroplasty. J Arthroplasty 2017;32:402-6. http://dx.doi.org/10.1016/j.arth.2016.08.001
17. Zou RH, Wukich DK. Outcomes of foot and ankle surgery in diabetic patients who have undergone solid organ transplantation. J Foot Ankle Surg 2015;54:577-81. http://dx.doi.org/10.1053/j.jfas.2014.10.003