

# Unplanned Emergency Visits and Admissions After Orthopaedic Ambulatory Surgery in the First 2 Years of Operation of a University Ambulatory Surgery Center

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**Background:** Ambulatory surgeries have increased in recent decades to help improve efficiency and cost; however, there is a potential need for unplanned postoperative admission, clinic visits, or evaluation in the emergency department (ED).

**Purpose/Hypothesis:** The purpose was to determine the frequency, reasons, and factors influencing hospitalizations, return to clinic, and/or ED encounters within 24 hours of ambulatory surgery. The time frame for data collection was the first 2 years of operation of a university sports medicine ambulatory surgery center (ASC). We hypothesized that the percentage of encounters would be low and primarily because of pain or postoperative complication.

**Study design:** Case-control study; Level of evidence, 3.

**Methods:** A retrospective review was performed of all patients undergoing ambulatory surgery at an ASC during the first 2 years of its operation (November 2016 to October 2018). Data including age, sex, Current Procedural Terminology code, procedure performed, American Society of Anesthesiologists classification, body mass index, medical history, and tobacco use were collected. Patients seeking care in the ED, inpatient, or outpatient setting within the first 24 hours after surgery were identified and the reasons for these encounters were categorized into 1 of 3 groups: (1) medical complication, (2) postoperative pain, or (3) other postoperative complication. Logistic regression models were used to assess risk factors for these encounters.

**Results:** A total of 4650 sports medicine procedures were performed at the university ASC during the study period. A total of 35 patients (0.75%) sought additional care within 24 hours of surgery. Medical complications were the primary reason for seeking care ( $n = 16$ ; 45.7%). Patients who sought treatment within 24 hours of surgery tended to be older, had more medical comorbidities, and were more likely to have undergone upper extremity (particularly shoulder) procedures. In the multivariable analysis, patients with higher ASA scores were more likely to seek additional care ( $P < .005$ ) and there was a trend toward increased risk of seeking additional care with upper extremity surgery ( $P = .077$ ).

**Conclusion:** Orthopaedic procedures performed in an ASC result in a relatively low percentage of patients seeking additional care within the first 24 hours after surgery, consistent with other reports in the literature. Upper extremity procedures, particularly those of the shoulder, may carry an increased risk of requiring medical treatment within 24 hours of surgery. Even in the first 2 years of operation of a university-based ASC, low rates of postoperative complications and unplanned admissions can be maintained.

**Keywords:** ambulatory surgery center; emergency treatment; orthopaedic surgery; outpatient surgery; unplanned admission

Outpatient orthopaedic surgeries have increased in popularity as a viable, safe alternative to hospital-based surgery for many conditions. A survey conducted by the U.S. Centers for Disease Control and Prevention in 2009 found that approximately 62% of all surgeries were performed in the outpatient setting, and 43% of these 62% took place in

ambulatory surgery centers (ASCs).<sup>5</sup> The allure of ambulatory surgery is the potential to decrease the burden on the health care system while also liberating patients from unnecessary inpatient observation, fear of the complexities of a large hospital, and the associated costs.

Orthopaedic surgery is commonly performed in the ambulatory setting, including major surgery such as shoulder, knee, and hip arthroplasty in recent years.<sup>3,7,9,13</sup> Outpatient orthopaedic surgeries can lower the cost of surgical procedures as much as 60% compared with inpatient procedures.<sup>4</sup> Despite the economic benefits, the potential for emergency department (ED) visits and admissions in the

postoperative period serve as a potential limiting factor to ambulatory procedures.

Studies have shown that unplanned overnight admissions the day of orthopaedic surgery are in the range of 0.1% to 0.79%.<sup>6,8,10,11</sup> A study by Martin-Ferrero et al<sup>10</sup> further demonstrated that 1.2% of patients were seen in the ED within the first 24 hours of outpatient surgery, with 0.1% requiring hospital admission. Understanding risk factors that lead to admission after planned outpatient surgery is paramount for selecting patients who are healthy enough to undergo surgery at an ambulatory center. Additionally, this may improve preoperative patient education, minimize complications, and decrease costs. The goals of this study were to determine the frequency of seeking care and to determine influential factors for postoperative complications requiring evaluation within 24 hours of ambulatory surgery.

## METHODS

### ASC Criteria

This study utilized data from a single ASC to determine if individual patient characteristics and anatomic surgical location were risk factors for unplanned ED visits and/or hospital admission after elective orthopaedic procedures of the shoulder, elbow, hip, knee, ankle, and foot. The criteria for determining each patient's eligibility for undergoing a procedure at the ASC were created in collaboration between the surgeons, anesthesiologists, perioperative nursing staff, and facility administrators before the opening of the facility. Factors affecting a patient's eligibility include age, body mass index (BMI), American Society of Anesthesiologists (ASA) physical status perioperative risk classification, history of respiratory/heart/renal disease, medication usage, and history of problems with anesthesia (eg, difficult intubation, extended wake time after anesthesia, or personal/family history of malignant hyperthermia). Specific criteria are detailed in Table 1, but the final decision for each patient was left up to the anesthesiologist's discretion.

### Regional Anesthesia

The utilization of regional anesthesia for nerve blockade was determined by a discussion between the anesthesiologist and the patient on the day of surgery. A majority of patients undergoing shoulder procedures elected preoperative interscalene block. Patients undergoing knee surgery chose to undergo postoperative adductor canal block

depending on pain level. Preoperative ankle blocks were utilized for forefoot procedures, whereas preoperative sciatic nerve blocks were used for calcaneal, ankle, or calf procedures. The only postoperative pain catheters utilized at our ASC were indwelling interscalene blocks. To qualify for this, patients had to be undergoing a larger shoulder surgery (rotator cuff repair, Latarjet procedure, capsular release, etc), as it was not offered in routine shoulder arthroscopy. Additionally, contraindications for these catheters included current use of anticoagulants, history of seizures, significant comorbidities, inability to care for the catheter at home, or living a long distance from the ASC and associated hospital. Based on the procedure being performed and patient factors, the ultimate decision to offer an indwelling pain catheter was left to the anesthesiologist's discretion. No other pain catheters or pain pumps were utilized at our ASC.

### Postoperative Pain Management

All but 1 surgeon at our ASC utilized oxycodone for oral postoperative pain management unless an allergy or other sensitivity existed. However, alternatives included hydrocodone-acetaminophen or tramadol based on surgeon and patient preference. Some surgeons used gabapentin in addition to narcotics in the immediate postoperative period. It is important to note that during the data collection period of our study, there was an institution-wide initiative to decrease the prescribed amount of narcotic pain medication postoperatively. Use of local anesthesia intraoperatively was based on surgeon preference and was unable to be assessed in this study.

### Study Population and Identification

After obtaining approval from the institutional review board, a search of electronic medical records identified patients who underwent surgery under general or regional anesthesia in the first 2 years of operation (November 2016 to October 2018) of our ASC. We excluded patients who underwent procedures performed by primary care sports medicine physicians (eg, joint injection, percutaneous tenotomy, percutaneous tendon debridement), as these did not require anesthesia and preoperative testing similar to invasive surgical procedures. Patients who underwent hand and forearm procedures were also excluded, as these procedures were not performed at the ASC until midway through our collection period. There were no arthroplasties

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TABLE 1  
ASC Criteria<sup>a</sup>

Age, y	>18 13-17	Accepted Treating physician has admitting privileges at inpatient hospital Permission from medical director Minimum height 5'0" and weight 100 lb Preoperative anesthesia evaluation BMI <40 Adult must be present in building during procedure
ASA	Class I-II Class III Class IV	Accepted No signs or symptoms of uncontrolled or decompensated conditions No signs or symptoms of uncontrolled or decompensated conditions Anesthesia limited to monitored anesthesia care IV sedation administered by Department of Anesthesia <i>providers</i> only
BMI	<35 or <300 lb <40 or <300 lb  <45 45-55	Procedures requiring prone positioning Procedures requiring lateral or beach-chair positioning Patients aged <18 years regardless of procedure Procedures requiring supine positioning Considered by anesthesia team Must be evaluated by an in-person preoperative medical assessment Patients considered only for procedures requiring minimal sedation No procedure with possibility of conversion to general anesthesia
OSA	>55 Known diagnosis  Positive OSA screening questionnaire	Not accepted Optimized comorbid medical conditions Able to use continue positive airway pressure device in postoperative period Optimized comorbid medical conditions Postoperative pain can be managed predominately with nonopioid analgesia

<sup>a</sup>ASA, American Society of Anesthesiologists; ASC, ambulatory surgery center; BMI, body mass index; IV, intravenous; OSA, obstructive sleep apnea.

performed at our ASC during this time. Data collected for each patient included age, sex, BMI, diagnosis of obstructive sleep apnea, diagnosis of chronic obstructive pulmonary disease (COPD), diagnosis of diabetes, smoking or tobacco use status, ASA classification, and procedure performed. A list of the most common Current Procedural Terminology codes based on surgery category can be found in Appendix Table A1 (available in the online version of this article).

Outcome of Interest

The primary outcome of interest in the study was to identify patients who were seen in either of the 2 health care system's EDs, any outpatient clinic, or were admitted to the hospital within 24 hours of their outpatient surgery. Visits to urgent care facilities and/or facilities outside our health care system were unable to be identified with our electronic medical records search and thus were not included. These patients were identified through an electronic billing search based on surgery date and time and ED or hospital encounter date and time. For all patients meeting the 24-hour criteria, a chart review was performed and the reasons for the encounter (ED visit, outpatient visit, or hospital admission) were identified and recorded. Reasons for encounters were categorized into medical complication, postoperative pain, or other postoperative complication.

Statistical Analysis

Summary statistics, including mean and standard deviation for continuous variables and percentages for categorical

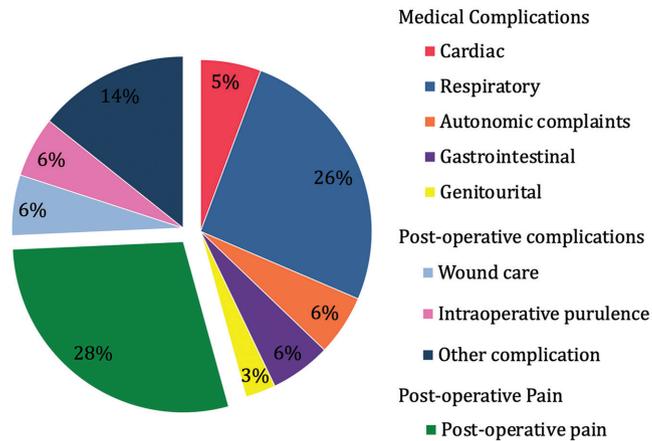
variables, were calculated. Demographic and surgical variables based on whether patients sought additional care within 24 hours of surgery were compared using unpaired *t* tests for continuous variables and Fisher exact tests for categorical variables. The relationship between multilevel categorical variables (ASA classification, smoking status, and location of surgery) were evaluated with univariable logistical regression.

A multivariable logistical regression model was built to evaluate predictors of seeking additional care within 24 hours. Predictor variables included in the model were ASA classification, patient age, patient sex, and upper versus lower extremity surgery. Other patient medical factors, including BMI and the presence of diabetes, COPD, or sleep apnea, were not included in the model, as they are considered when assigning ASA classification. The validity of this decision was assessed by creating a model that included ASA classification as well as these patient factors. In this model, ASA classification was the only statistically significant predictor of patients seeking care within 24 hours. These variables were not included in the final model.

RESULTS

Patient Characteristics

A total of 4841 procedures were performed at our ASC during the study period. Of these, 142 were hand procedures and 49 were percutaneous procedures performed by primary care sports medicine physicians. These 191 procedures were



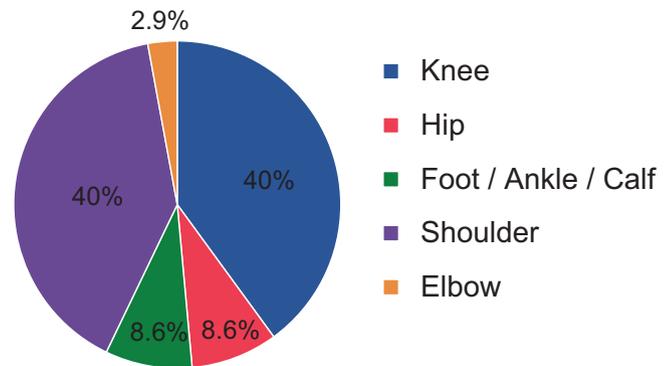
**Figure 1.** Reasons for seeking care.

excluded, leaving a total of 4650 procedures performed at the ASC during the study period. The mean patient age at surgery was 39.4 years, and 55.6% of patients were male. The mean patient BMI was 28.6. The population included 205 patients with diabetes (4.4%), 51 patients with COPD (1.1%), and 213 patients with obstructive sleep apnea (4.6%). There were 3321 nonsmokers (72%), 737 former smokers (15.8%), and 543 current smokers (11.7%). There were 1694 ASA class I patients (36.4%), 2582 ASA class II patients (55.6%), and 379 ASA class III patients (8.0%). Operated joints included 2450 knees (52.7%), 409 hips (8.8%), 512 foot/ankle/calf (11.0%), 1187 shoulders (25.5%), and 92 elbows (2.0%).

### Readmission Statistics

A total of 35 patients (0.75%) required additional care as an outpatient ( $n = 2$ ; 5.7%), inpatient ( $n = 10$ ; 28.6%), or in the ED ( $n = 23$ ; 65.7%) within 24 hours of surgery. Of the patients who sought care in the first 24 hours, 16 (45.7%) were for medical complications (chest pain [ $n = 1$ ], arrhythmia [ $n = 1$ ], respiratory distress [ $n = 9$ ], pancreatitis [ $n = 1$ ], urinary retention [ $n = 1$ ], allergic reaction [ $n = 1$ ], syncope [ $n = 1$ ], and hematemesis [ $n = 1$ ]), 10 (28.6%) were for postoperative pain, and 9 (25.7%) were for other postoperative complications (wound care, swelling, postoperative fever, pulmonary embolism, failure of physical therapy, intraoperative purulence, and corneal abrasion) (Figure 1). Of the 35 patients, 10 (28.6%) were admitted to the hospital. No perioperative mortalities occurred during the study period. Of the 9 patients who sought care within 24 hours after surgery for shortness of breath or respiratory complaints, 4 had shoulder surgery with an intercostal and/or interscalene block.

Of these 35 patients, 5 patients were transferred to the hospital directly from the postanesthesia care unit, and all 5 were admitted. Three of these transfers were for medical reasons (hypoxia [ $n = 2$ ] and premature ventricular contractions with bigeminy [ $n = 1$ ]). The remaining 2 transfers were for intraoperative purulence necessitating intravenous



**Figure 2.** Proportion of patients seeking care by surgical location.

antibiotics ( $n = 1$ ) and inability to return home because of the inability to ambulate postoperatively with crutches/walker ( $n = 1$ ).

### Readmission Risk Factors

Patients readmitted within the first 24 hours of surgery tended to be older, had more medical comorbidities, and were more likely to have upper extremity (particularly shoulder) surgery (Tables 2 and 3, Figure 2). Multivariable logistic regression modeling demonstrated that patients with higher ASA scores were more likely to seek additional care within 24 hours of surgery ( $P < .005$ ), controlling for age, sex, and upper versus lower extremity surgery (Table 4). There was a trend toward increased risk of seeking additional care within 24 hours with upper extremity surgery ( $P = .077$ ) controlling for ASA score, age, and sex.

### DISCUSSION

ASCs have been expanding as a potential means to decrease health care costs and maximize surgical productivity without sacrificing postoperative outcomes. The development of better surgical techniques, more effective postoperative protocols, and close follow-up visits has contributed to this trend.<sup>1,9</sup> However, careful patient selection is imperative to minimize the risk of postoperative complications requiring unplanned ED visits and admissions. Understanding risk factors leading to these encounters can help better define patient selection and set preoperative expectations.

The most important findings of this study are that the risk of presenting to the ED or requiring hospital admission within 24 hours of outpatient surgery at an ambulatory sports medicine surgery center was 0.75%. Many of these visits were for medical complications ( $n = 16$ ; 45.7%), and these visits tended to occur in patients with more underlying medical comorbidities and possibly more often after upper extremity surgery.

Our results are consistent with previous work in this area. In a study of over 10,000 patients undergoing ambulatory orthopaedic surgeries between 1993 and 2012,

TABLE 2  
Patient Characteristics<sup>a</sup>

	Did Not Seek Care in 24 Hours (n = 4615)	Sought Care in 24 Hours (n = 35)	Significance
Age, y	39.3 ± 16.1	43.8 ± 15.8	<i>P</i> = .10
Sex			<i>P</i> = .40
Male	2570 (55.7)	17 (48.6)	
Female	2045 (44.3)	18 (51.4)	
BMI, kg/m <sup>2</sup>	28.6 ± 5.5	30.0 ± 6.6	<i>P</i> = .12
Diabetic	201 (4.4)	4 (11.4)	<i>P</i> = .066
COPD	50 (1.1)	1 (2.9)	<i>P</i> = .32
Sleep apnea	208 (4.5)	5 (14.3)	<b><i>P</i> = .020</b>
Smoking status			<b><i>P</i> = .048</b>
Never	3302 (71.5)	19 (54.3)	
Former smoker	728 (15.8)	9 (25.7)	
Current smoker	536 (11.6)	7 (20.0)	
ASA class			<b><i>P</i> &lt; .001</b>
Class I	1691 (36.6)	3 (8.6)	
Class II	2557 (55.4)	25 (71.4)	
Class III	363 (7.9)	7 (20.0)	
Joint			<i>P</i> = .29
Knee	2436 (52.8)	14 (40.0)	
Hip	406 (8.8)	3 (8.6)	
Foot / ankle / calf	509 (11.0)	3 (8.6)	
Shoulder	1173 (25.4)	14 (40.0)	
Elbow	91 (2.0)	1 (2.9)	
Extremity			<i>P</i> = .055
Lower	3351 (72.6)	20 (57.1)	
Upper	1264 (27.4)	15 (42.9)	

<sup>a</sup>Data are reported as n (%) or mean ± SD unless otherwise indicated. Bold signifies statistical significance. ASA, American Society of Anesthesiologists; BMI, body mass index; COPD, chronic obstructive pulmonary disease.

TABLE 3  
Univariable Logistic Regression Results<sup>a</sup>

	Odds Ratio	95% CI	Significance vs Reference Group
ASA class			
Class I	REF	REF	NA
Class II	5.51	1.66-18.28	<b><i>P</i> = .005</b>
Class III	10.86	2.80-42.83	<b><i>P</i> &lt; .001</b>
Smoking status			
Never	REF	REF	NA
Former smoker	2.15	0.97-4.77	<i>P</i> = .060
Current smoker	2.27	0.95-5.43	<i>P</i> = .065
Joint			
Knee	REF	REF	NA
Hip	1.29	0.37-4.49	<i>P</i> = .69
Foot/ankle/calf	1.02	0.29-3.58	<i>P</i> = .97
Shoulder	2.08	0.99-4.37	<i>P</i> = .054
Elbow	1.91	0.25-14.69	<i>P</i> = .53
Extremity			
Lower	REF	REF	NA
Upper	1.98	1.01-3.89	<b><i>P</i> = .045</b>

<sup>a</sup>Bold signifies statistical significance. ASA, American Society of Anesthesiologists; NA, not applicable; REF, reference group.

Martin-Ferrero et al<sup>10</sup> reported an ED visit rate of 1.21% in the first 24 hours postoperatively. The most common reasons for these visits were pain and bleeding. They demonstrated an unplanned overnight admission rate of 0.1%

and identified advanced age, ASA status of III, and lengthy surgery as risk factors. Interestingly, this study only included patients with a stable family environment, a telephone, a designated caregiver during the first 48-hour

TABLE 4  
Multivariable Logistic Regression Results<sup>a</sup>

	Odds Ratio	95% CI	Significance vs Reference Group
ASA class			
Class I	REF	REF	NA
Class II	6.25	1.76-22.21	<b>P = .005</b>
Class III	12.67	2.83-56.75	<b>P &lt; .001</b>
Age			
1-year increase in age	0.99	0.96-1.01	P = .34
Sex			
Male	REF	REF	NA
Female	1.29	0.66-2.54	P = .46
Extremity			
Lower	REF	REF	NA
Upper	1.89	0.93-3.81	P = .077

<sup>a</sup>Bold signifies statistical significance. ASA, American Society of Anesthesiologists; NA, not applicable; REF, reference group.

period, and easy access to a nearby hospital. The difference in our results may be attributed to the absence of hand procedures in our analysis, whereas hand surgeries represented approximately 52% of their reported cases.

Other studies have also shown an increase in unplanned additional care being sought after upper extremity surgery.<sup>7,13</sup> Navarro et al,<sup>12</sup> in a study of 1306 outpatient rotator cuff repairs (729 male and 577 female patients; average age, 60 years) had a 6.9% return to ED or urgent care within 7 days of surgery. This return rate for rotator cuff repairs was nearly double that of other procedures (3.9% return rate). Of the patients who returned, 2.6% had an avoidable diagnosis (constipation, nausea or vomiting, pain, and urinary retention), with pain being the most common diagnosis in 68.6% of patients. The authors have attempted to optimize multimodal pain control to decrease the number of unplanned visits postoperatively.

Christian et al<sup>2</sup> conducted a study over a 10-year period of 5598 shoulder arthroscopy surgeries and assessed the rate and risk factors leading to unplanned postoperative admission. They recorded an unplanned admission rate of 4.2%, which is significantly higher than those reported for all orthopaedic ambulatory procedures.<sup>8,10</sup> They identified risk factors of COPD, obstructive sleep apnea, diabetes, age, BMI, and operative time.

The strengths of this study include the large patient population and variety of surgeries and surgeons, which makes it reproducible. The limitations include the fact that no arthroplasty, hand, or forearm procedures were included, which could affect the number of patients seeking care within 24 hours after surgery. This limits the study's generalizability, given that these patients can make up a significant portion of outpatient procedures at other ASCs. We were unable to assess postoperative visits to urgent care facilities or facilities outside of our health care system, which could have led to patients not being captured within this study. Given the retrospective nature of the study, we were unable to control for regional anesthesia considerations and postoperative narcotic use. The next steps for this study would be to expand the postoperative time frame to include patients seeking care beyond

24 hours to assess other complications that may occur in the early postoperative course.

Utilizing an ASC is an effective option to help decrease the burden of inpatient surgery on the health care system. Care must be taken in patient selection, and medical optimization of patients with a higher ASA classification should be considered. Postoperative protocols and multimodal pain regimens may even further help to decrease the burden of unplanned visits. Orthopaedic procedures performed in a university ASC appear to be safe with a relatively low percentage of patients seeking additional care within the first 24 hours after surgery, consistent with other reports in the literature.

## CONCLUSION

Orthopaedic procedures performed in an ASC result in a relatively low percentage of patients seeking additional care within the first 24 hours after surgery, consistent with other reports in the literature. Upper extremity procedures, particularly those of the shoulder, may carry an increased risk of requiring medical treatment within 24 hours of surgery. Even in the first 2 years of operation of a university-based ASC, low rates of postoperative complications and unplanned admissions can be maintained.

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