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Factors influencing unexpected disposition after orthopedic ambulatory surgery

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Abstract

Study Objective—To analyze whether patient characteristics, ambulatory facility type, anesthesia provider and technique, procedure type, and temporal factors impact the outcome of unexpected disposition after ambulatory knee and shoulder surgery.

Design—Retrospective analysis of a national database.

Setting—Freestanding and hospital-based ambulatory surgery facilities.

Measurements—Ambulatory knee and shoulder surgery cases from 1996 and 2006 were identified through the National Survey of Ambulatory Surgery. The incidence of unexpected disposition status was determined and risk factors for such outcome were analyzed.

Main Results—Factors independently increasing the risk for unexpected disposition included procedures performed in hospital-based versus freestanding facilities [odds ratio (OR) 6.83 (95% confidence interval [CI] 4.34; 10.75)], shoulder versus knee procedures [OR 3.84 (CI 2.55; 5.77)], anesthesia provided by nonanesthesiology professionals and certified registered nurse-anesthetists versus anesthesiologists [OR 7.33 (CI 4.18; 12.84) and OR 1.80 (CI 1.09; 2.99), respectively]. Decreased risk for unexpected disposition were found for procedures performed in 2006 versus 1996 [OR 0.15 (CI 0.10; 0.24)] and the use of anesthesia other than regional and general [OR 0.34 (CI 0.18; 0.68)].

Conclusions—The decreased risk for unexpected disposition associated with more recent data and with freestanding versus hospital-based facilities may represent improvements in efficiency, while the decreased odds for such disposition status associated with the use of other than general

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RH: Unexpected admissions after ambulatory surgery

and regional anesthesia may be related to a lower invasiveness of cases. We found an increased risk of adverse disposition in cases where the anesthesia provider was a nonanesthesiology professional. No difference in this outcome was noted when an anesthesia care team provided care.

Keywords

Ambulatory surgery; orthopedic surgery: knee, shoulder; unexpected disposition

1. Introduction

The number of ambulatory surgery services has increased dramatically over the last two decades [1-3]. Among the reasons commonly attributed to this development are changes in the payment structure favoring the shift of less complex cases to an outpatient basis [4]. However, the cost-effectiveness of ambulatory surgeries depends largely on the ability to discharge patients to their customary residence on the same day that the procedure is performed. Thus, unexpected admissions after ambulatory surgery represent a financial burden on hospitals, insurers, and patients alike. To date, few nationally representative studies exist to identify risk factors for this outcome [5], and there are no data on such outcomes and their temporal factors in the orthopedic ambulatory setting.

In this study, we utilized data from the National Survey of Ambulatory Surgery (NSAS) in 1996 and 2006 to determine patient and health care system-related risk factors for overnight admission after ambulatory knee and shoulder surgery. Data such as these allow for the identification and targeting of factors associated with unexpected disposition status after ambulatory orthopedic surgery and increased health care expenditure.

2. Materials and methods

Data collected for the NSAS were obtained from the Centers for Disease Control (CDC). Detailed information regarding the NSAS has been published previously [6]. In brief, the NSAS was conducted by the National Center for Health Statistics in the years 1994 to 1996, then again in 2006, with the goal of compiling nationally representative data on ambulatory surgery procedures performed in both freestanding ambulatory surgery facilities and hospital-based settings. The hospital universe for this database included Medicare-participating, noninstitutional hospitals exclusive of military institutions, Veteran Affairs hospitals, and other federal facilities in the 50 states and the District of Columbia. To be eligible for inclusion in NSAS, patients had to be scheduled for ambulatory surgery with admission and discharge planned on the same day. Patients admitted to the hospital either on an inpatient basis before surgery or through the emergency department were excluded. Information collected in the survey included age, gender, race, type of anesthesia, anesthesia provider, diagnosis codes, and procedure codes [International Classification of Diseases, Ninth Revision, Clinical Modification [ICD-9-CM)].

Although changes were made in the NSAS sampling methodology between 1996 and 2006, both data sets were designed specifically to provide nationally representative weighted data [2]. To maintain consistency, we used weighted data for analysis and variables available in both data sets, thus removing potential bias introduced by these changes. To ensure the reliability of the collected data, a number of steps were taken to maintain the quality and accuracy of data provided in NSAS [6]. Recognizing the utility of this database to answer valuable clinical questions, a large number of studies addressing various aspects across the spectrum of medical specialties, including anesthesia, have been published [5,7-10]. As the

data used in this study are sufficiently deidentified, this project was exempt from review by the Institutional Review Board.

2.1 Selection of study sample and statistical analysis

Our study sample consisted of all data in NSAS for the years 1996 and 2006. The two years were chosen so as to assess the impact of temporal changes on the outcome of unexpected disposition status. As our specific focus was on orthopedic surgical procedures, entries with an ICD-9-procedure code indicating knee ligamentoplasty, meniscectomy, and/or arthroscopy as well as shoulder arthroscopy, repair of dislocation, and/or suture of the capsule (81.42-47, 80.6, 80.26, 80.21, 81.82, 81.93, respectively) were included in our analysis. Procedures were then separated into those affecting the knee and the shoulder, respectively. Patient age and gender, health care system type (hospital-based and freestanding facilities), anesthesia type (general, peripheral nerve block, neuraxial anesthesia, and "other", ie, topical, intravenous sedation, and monitored anesthesia care, and others not listed), provider [anesthesiologist, certified registered nurse-anesthetist (CRNA)], and anesthesia care team (ie, anesthesiologist, CRNA, and others) were cross-classified by unexpected disposition status (ie, disposition other than discharge to the patient's primary residence, such as discharge to observation status, discharge to a postsurgical/recovery care facility, hospital admission as an inpatient). We excluded 224 records due to missing entries on disposition status (Fig. 1). An anesthesia category was created if an entry included the specific anesthetic studied. Thus, the 4 categories -- "general", "block", "neuraxial", and "other" -- were not mutually exclusive.

The percentage of procedures performed in each category was tabulated and compared using one-sample Rao-Scott Chi-squared tests. Univariable association analyses using two-sample Rao-Scott Chi-squared tests were followed by multivariable logistic regression to determine whether study characteristics were independently associated with increased risk of unexpected disposition status. Covariates in the regression model included patient age and gender, facility type, procedure type (knee, shoulder), year of the procedure, anesthesia provider, and anesthesia type.

All statistical analyses were performed using SAS version 9.2 (SAS Institute, Cary, NC, USA). To facilitate analysis of data collected in a complex survey design with unequal probabilities of selection, we utilized SURVEYFREQ (SAS Institute) for frequency analysis and SURVEYLOGISTIC (Sas Institute) for multivariable logistic regression. These procedures guarantee consistent estimation of mean and variance parameters by appropriately taking into account the weights attached to the complex survey data [11]. For each covariate, odds ratios (ORs), 95% confidence intervals (CIs), and *P*-values are provided. A P-value < 0.05 was considered significant. The area under the receiver operating characteristic curve (AUC), also referred to as the c-statistic (or concordance index), was used for assessing the model's discriminatory power. A c-statistics of greater than 0.75 was reflective of a well calibrated model [12].

3. Results

During the years of study, an estimated 2,470,978 cases of ambulatory knee and shoulder procedures were performed in the United States. Patient and health care system-related characteristics associated with either procedure are shown in Table 1. The majority of cases were performed in men, those aged between 15 and 64 years, in a hospital-based setting, and by anesthesiologists using general anesthesia as a part of care. The number of cases performed in 2006 versus 1996 was higher for both procedures ($P < 0.0001$). Information on the rates of unexpected disposition by study categories is shown in Table 2. The overall rate

of unexpected admission in our study sample was 3.8% (71,908/1,884,273) for knee and 7.9% (41,152/520,749) for shoulder procedures.

Disposition other than routine discharge to home residence decreased significantly between 1996 and 2006, from 8.5% to 0.6% for knee ($P < 0.0001$), and 21.5% to 4.8% for shoulder procedures ($P < 0.0001$). While unexpected admission rates remained between 2.7% and 4.8% among all age groups for knee procedures, far greater disparities between different age groups of patients undergoing shoulder surgery were seen (40.4% for those < 15 yrs of age and 6.7% for those aged 15-44 yrs). Freestanding facilities had lower unexpected admission rates for either procedure ($P < 0.0001$).

When comparing unexpected disposition status by anesthesia provider, nonanesthesia professionals were associated with significantly higher rates than were anesthesia professionals ($P < 0.0001$ for knee procedures, $P = 0.02$ for shoulder procedures, respectively). Further, those procedures attended by solo anesthesiologists or in an anesthesia care team model had lower rates than procedures performed by CRNAs alone (Table 2).

When controlling for all covariates, no patient-related characteristics were associated with increased risk of unexpected disposition status. Factors independently increasing the risk for this outcome included procedures performed in hospital-based versus freestanding facilities, shoulder versus knee procedures, and anesthesia provided by nonanesthesiology professionals and CRNAs compared with anesthesiologists. Decreased risk for unexpected disposition was found for procedures performed in 2006 versus 1996 and the use of anesthesia other than regional and general (Table 3).

4. Discussion

In this study of nationally representative data collected by the CDC and the National Center for Health Statistics, we identified a number of risk factors that are independently associated with increased risk for unexpected disposition status after orthopedic ambulatory surgery. Procedures performed in hospital-based versus freestanding facilities, shoulder versus knee procedures, anesthesia provided by nonanesthesiology professionals and CRNAs versus anesthesiologists increased the risk, while procedures performed in 2006 versus 1996 and those utilizing anesthesia other than general and regional were associated with a decrease in the risk for a disposition other than discharge to the patient's primary residence.

We found no patient-related factors associated with altered risk for unexpected disposition status after ambulatory knee and shoulder procedures. Although previous data on the risk for unexpected admission after ambulatory surgery in general may suggest that extremes in age would affect the risk for adverse disposition [13], we could not confirm this finding in the orthopedic population in this study. Discrepancies in findings may be based partly on different patient characteristics and procedure types included in various studies. For example, in our study sample patients were more likely to be younger (< 65 yrs) than the general ambulatory surgical population studied by Fleisher et al (ie, 86% vs 77%) [13].

It must be noted that, by definition, scheduled ambulatory surgery has the goal of performance of procedure and discharge to the patient's primary residence on the same day. Indeed, this concept is a prerequisite listed for entry into the NSAS [6]. Preselection of patients appropriate for ambulatory surgery occurs [13]. Thus, it is likely that procedure extent (ie, invasiveness and length of surgery) and associated complications may contribute more to the risk of unexpected admissions than patient-related characteristics [13,14]. The fact that shoulder procedures, which may be more complex than ambulatory knee surgeries,

were associated with higher risk for unexpected disposition in our analysis support this argument.

In this study, we determined that freestanding facilities were associated with a lower risk of unexpected dispositions. The finding that patients presenting for surgery in freestanding facilities have, on average, a lower comorbidity burden, and may therefore be considered more carefully selected, has been reported previously [14] and may explain the lower adverse disposition rates in this particular environment found in our analysis. Further, although speculative, it is feasible that disposition to the patient's primary residence is pursued more aggressively as the capacity of freestanding facilities to admit patients for observation may be more limited than for hospital-based settings.

Interestingly, we noted that the type of anesthesia provider significantly affected the odds for unexpected disposition after ambulatory knee and shoulder surgery. While anesthesiologists were associated with the lowest odds, nonanesthesia professionals (which included other specialty physicians) and CRNAs increased the likelihood of unexpected disposition status by approximately seven- and twofold, respectively. In contrast, the anesthesia care team (ie, anesthesiologist and CRNA) performed similarly to a solo anesthesiologist in this analysis. A previous analysis of national data on herniorrhaphies performed in the mid 1990s showed similar results [5].

While a number of studies have identified the optimal anesthetic for various procedures, the range of findings is wide and inconclusive [15,16]. In our analysis, ORs for anesthetic types did not differ in their influencing the risk for unexpected admission except for a reduction with the use of anesthesia techniques other than general and regional anesthesia. It may be argued that with both modern surgical and anesthetic techniques, the choice of anesthetic may have limited influence on the risk for unexpected disposition. Rather, the type of anesthesia used may reflect the surgical invasiveness of a particular procedure [13,14]. The finding of decreased risk of overnight admission with the use of anesthetics other than general and regional may have to be viewed in this context.

The decreased rates and risk of unexpected disposition status after ambulatory knee and shoulder surgery over time found in this study are likely multifactorial, but may include better patient selection, development of discharge pathways, use of better pain management, and shorter-acting anesthetics with fewer side effects [17]. Certainly, the desire of patients and health care systems to avoid the additional financial burden associated with overnight admissions is a factor to be considered when interpreting this trend.

Our study was limited by a number of factors inherent in the analysis of databases designed for administrative purposes. As such, information on important variables such as clinical details and patient preferences, are not available. In addition, as ambulatory cases tend to be procedure-focused, limited information on comorbidities is available, with the vast majority of entries only including the primary diagnosis necessitating the procedure in the diagnosis fields. Further, no causal relationships can be determined from our data and reasons for our findings must remain speculative. Therefore, our data have to be interpreted in the context of this database construct. And, as is true for any database, we cannot exclude coding bias and collection errors in the NSAS. However, it must be mentioned that a multitude of steps were taken by the National Center for Health Statistics to assure accurate data sampling [6].

Finally, our data are based on only two years of study. Unfortunately, the NSAS was conducted only from 1994-1996 and then again in 2006. We chose to compare only 1996 to 2006 to have the same time frame for each group.

In conclusion, the decreased risk for unexpected disposition associated with more recent data and with freestanding versus hospital-based facilities may represent improvements in efficiency, while the decreased odds for such disposition status associated with the use of other than general and regional anesthesia may be related to a lower invasiveness of cases. However, we found increased risk of adverse disposition in cases in which the anesthesia provider was a nonanesthesiology professional. The odds for unexpected admissions were also higher in cases where CRNAs, not anesthesiologists, provided the anesthesia. No difference in this outcome was seen when an anesthesia care team provided care. As causal relationships cannot be established using our data, investigations to elucidate reasons for our findings are needed.

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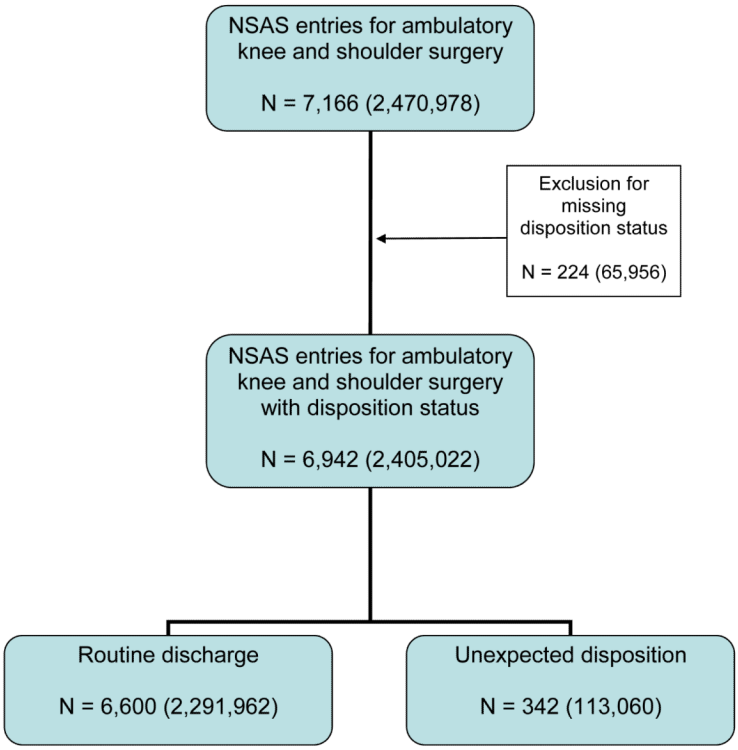

Fig. 1.
Sample selection process. The total numbers (N) represent entries in the National Survey of Ambulatory Surgery (NSAS) database. Numbers in parentheses = the weighted N representing the national sample equivalent.

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Table 1

Percentage of procedures by demographics and their comparison

Variable\procedure type	Category	Knee	*P*-value	Shoulder	*P*-value
Total (N)	unweighted	5,832		1,334	
	weighted	1,941,011		529,967	
Study year (%)	1996	40.4	< 0.0001	18.6	< 0.0001
	2006	59.6		81.4	
Gender (%)	male	54.9	0.0004	57.6	0.0070
	female	45.1		42.4	
Age group (%)	< 15 yrs	1.4	< 0.0001	0.2	< 0.0001
	15-44 yrs	43.4		34.3	
	45-64 yrs	41.2		51.6	
	65-74 yrs	10.6		8.9	
	≥75 yrs	3.4		4.9	
Hospital type (%)	hospital-based facility	66.9	< 0.0001	58.0	0.0058
	freestanding facility	33.1		42.0	
Anesthesia provider	anesthesiologist	55.6	< 0.0001	56.9	< 0.0001
	CRNA	15.3		10.7	
	anesthesiologist/CRNA	21.4		25.7	
	other[a]	7.6		6.6	
Type of anesthesia[b]	general	74.4	< 0.0001	86.3	< 0.0001
	block	5.9	< 0.0001	21.8	< 0.0001
	neuraxial	8.4	< 0.0001	N/A	N/A
	other[c]	24.1	< 0.0001	17.8	< 0.0001

CRNA=certified registered nurse-anesthetist.

[a] Includes nonanesthesiologist physicians and other combinations of providers not covered by the listed categories.

[b] The 4 categories are not mutually exclusive and were considered as 4 separate variables in the analysis.

[c] Includes procedures with entries for intravenous sedation, monitored anesthesia care, topical anesthesia, and other anesthesia not captured in the list of categories.

Table 2

Unexpected dispositions within each category and association analysis

Variable\procedure type	Category	Knee	*P*-value	Shoulder	*P*-value
Total (N)	unweighted	5,647		1,295	
	weighted	1,884,273		520,749	
Study year (%)	1996	8.5	< 0.0001	21.5	< 0.0001
	2006	0.6		4.8	
Gender (%)	male	3.3	0.0837	7.6	0.7386
	female	4.4		8.3	
Age group (%)	< 15 yrs	4.7	0.0472	40.4	0.1007
	15-44 yrs	4.8		6.7	
	45-64 yrs	2.7		7.0	
	65-74 yrs	4.2		12.9	
	≥ 75 yrs	3.1		15.6	
Hospital type (%)	hospital-based facility	5.4	< 0.0001	12.8	< 0.0001
	freestanding facility	0.6		1.2	
Anesthesia provider (%)	anesthesiologist	2.9	< 0.0001	5.6	0.0200
	CRNA	4.0		10.0	
	anesthesiologist/CRNA	2.7		7.5	
	other[a]	14.0		18.9	
Type of anesthesia[b] (%)	general	4.2	0.0412	8.1	0.6042
	block	3.7	0.9452	4.1	0.0568
	neuraxial	4.6	0.4765	N/A	N/A
	other[c]	2.3	0.0096	5.0	0.1713

CRNA=certified registered nurse-anesthetist.

[a] Includes nonanesthesiologist physicians and other combinations of providers not covered by the listed categories.

[b] The 4 categories are not mutually exclusive and were considered as 4 separate variables in the analysis.

[c] Includes procedures with entries for intravenous sedation, monitored anesthesia care, topical anesthesia, and other anesthesia not captured in the list of categories.

Table 3

Risk factors for unexpected disposition (multivariate regression analysis)

Variable	Category	Odds ratio estimates	95% Confidence intervals		*P*-value
Gender (reference: female)	Male	0.74	0.53	1.02	0.0694
Age group (reference: 15-44 yrs)	< 15 yrs	1.38	0.47	4.02	0.5559
	45-64 yrs	0.89	0.62	1.27	0.5177
	65-74 yrs	1.16	0.67	2.01	0.6084
	≥ 75 yrs	1.64	0.63	4.25	0.3105
Hospital type (reference: freestanding facility)	Hospital	6.83	4.34	10.75	< 0.0001
Anesthesia provider[b] (reference: anesthesiologist)	Other[a]	7.33	4.18	12.84	< 0.0001
	CRNA	1.80	1.09	2.99	0.0229
	Anesthesiologist/CRNA	1.13	0.73	1.77	0.5787
Type of anesthesia[c] (reference: absence of particular anesthetic)	General	1.56	0.77	3.16	0.2158
	Peripheral nerve block	0.85	0.33	2.22	0.7401
	Neuraxial	0.94	0.37	2.37	0.8945
	Other[d]	0.34	0.18	0.68	0.0019
Procedure type (reference: knee)	Shoulder	3.84	2.55	5.77	< 0.0001
Study tear (reference: 1996)	2006	0.15	0.10	0.24	< 0.0001

CRNA=certified registered nurse-anesthetist.

[a] Includes nonanesthesiologist physicians and other combinations of providers not covered by the listed categories.

[b] Due to missing responses for “anesthesia provider”, the number of entries included in the multivariable model was reduced to 6,495 (2,289,326). The concordance index for the fitted model was 0.8.

[c] The 4 categories of “type of anesthesia” are not mutually exclusive and are considered 4 separate variables in the analysis.

[d] includes procedures with entries for intravenous sedation, monitored anesthesia care, topical anesthesia, and other anesthesia not captured in the list of categories.