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Complication rates following hip arthroscopy in the ambulatory surgical center

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ABSTRACT

There has been an increase in the number of hip arthroscopy procedures performed in the outpatient setting. The purpose of this study was to query a national database to compare post-operative adverse events between hip arthroscopy procedures performed in hospital based outpatient departments (HOPD) versus ASC's. The Humana Claims Database was queried for all patients undergoing hip arthroscopy performed between 2007 and 2016, using the PearlDiver supercomputer. The study population was divided into two cohorts based on the surgical setting, ASC or HOPD. Complications of interest occurring within 90 days after surgery included Center for Medicare and Medicaid Services (CMS)-reportable complications, readmission, and return to the operating room. Visits to the emergency department after 7 days of surgery was also studied. Univariate comparisons between ASC and HOPD groups were drawn with chi-square tests for categorical variables and t-tests for continuous variables. Logistic regression models were created to determine the association between surgical setting and primary outcomes. Rates of 90-day CMS-reportable complications (2.95% vs 2.17%%; $p = 0.193$), 90-day readmission (4.95% vs 4.25%; $p = 0.370$) and return to the operating room within 90 days (0.07% vs 0.2%; $p = 0.286$) were not significantly different between groups. Rate of visits to the emergency department within 7 days was not statistically different between groups (2.57% vs 3.03%; $p = 0.458$). With the ASC group as reference, no statistically significant association between an outcome and surgical setting was detected after adjusting for confounding factors including comorbidity burden. These findings provide reassurance to providers who perform these procedures in either surgical setting.

1. Introduction

A multitude of patient, surgeon, and facility factors have led to tremendous growth of ambulatory orthopedic surgery.[1] The shift towards an outpatient model of care have demonstrated significant cost savings in the fields of hand surgery, fracture care, among other orthopedic subspecialties.[2–5] Within the scope of outpatient surgical settings, ambulatory surgical centers (ASC) have differentiated themselves from hospital-based outpatient departments (HOPD). ASC's have been associated with improved surgical efficiency due to more experienced surgical teams with greater familiarity for surgeon preferences, faster turnover time, differing staff management practices and even faster regional anesthesia times.[1,6]

These advantages are exceedingly relevant to the field of hip arthroscopy. Unsurprisingly, there has been a concurrent rise in the number of hip arthroscopy procedures performed. One study reported a 25 fold increase in utilization between 2006 and 2013.[7] While hip arthroscopy is generally known to be safe with a low rate of post-operative complications, given its expanding indications including treatment of symptomatic labral tears, femoroacetabular impingement, removal of loose bodies, chondral damage and synovitis, recent attention has been increasingly paid to studying adverse events following hip arthroscopy.[7–12]

A stratified analysis of these outcomes by outpatient surgical setting (ASC vs HOPD) is absent in the literature. Current practices which champion ASC-based orthopedic care are driven largely by surgeon preference and anecdotal evidence of safety and success. The purpose of this study was to query a national database to compare post-operative adverse events between hip arthroscopy procedures performed in HOPD's versus ASC's.

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2. Methods

2.1. Population

The Humana Claims Database was queried for all patients undergoing hip arthroscopy performed between 2007 and 2016, using the PearlDiver supercomputer (PearlDiver Technologies, Fort Wayne, IN). The Humana Claims Database contains medical, prescription, and laboratory claims data from 20.9 million privately-insured and Medicare Advantage patients from 2007 to 2016. Patients were identified by Current Procedural Terminology (CPT) codes, and a breakdown of included CPT codes is provided in Appendix I. Patients with an included CPT-29999 code were only included if the CPT code was concurrently linked to an ICD-9 or ICD-10 code for hip-related pathology within the same record. Only patients undergoing surgery in the ASC or HOPD setting were included. An ASC is defined by Centers for Medicare and Medicaid Service (CMS) as a facility with the sole purpose of providing outpatient surgical services to patients. They are structurally separate from a hospital system and must be administratively and financially independent and distinct from operations of a hospital. A HOPD is owned entirely by the hospital and fully integrated within the hospital financially, administratively, and organizationally; including for quality assurance and medical oversight. Location is treated as part of the main hospital.

2.2. Demographics

The study population was divided into two cohorts based on the surgical setting, ASC or HOPD. Each cohort was then queried for patient age, gender, BMI, race, geographical region (Midwest, Northeast, South, West), year of surgery, insurance type, anesthesia type (use of femoral nerve block or posterior lumbar plexus block), previous intra-articular hip injection, Charlson Comorbidity Index (CCI). The CCI, a validated method to capture comorbidity burden, was created by a scoring system incorporating differentially weighted comorbidities and age classes.[13] Specific to the Humana Claims database, only age groupings by 5-year intervals of life, not the actual age, are available.

2.3. Outcomes

Complications of interest occurring within 90 days after surgery included Center for Medicare and Medicaid Services (CMS)-reportable complications (myocardial infarction, pneumonia, venous thromboembolism, sepsis, post-operative bleeding, wound infection, septic arthritis), readmission, and return to the operating room. Visits to the emergency department after 7 days of surgery was also studied. No standardized complications have been defined for hip arthroscopy. In an attempt to avoid bias by designating specific complications, the authors chose to apply a set of complications publicly reported for joint arthroplasty to assess peri-operative morbidity. The complications included under the umbrella outcome of CMS-reportable described above were identified by appropriate International Classification of Disease 9th and 10th edition (ICD-9, 10) codes. Incidences of these events were compared between patients undergoing hip arthroscopy in the ASC or HOPD setting.

2.4. Statistical analysis

Univariate comparisons between ASC and HOPD groups were drawn with chi-square tests for categorical variables and t-tests for continuous variables. Logistic regression models were created to determine the association between surgical setting and this study's primary outcomes while adjusting for any factors that were significantly different between groups on initial analysis including Charlson Comorbidity Index. For all studies, statistical significance was defined as the p-value less than or equal to 0.05. All statistics were performed in the *R* package (Version 2.13.1).

Table 1
Demographics.

	ASC	HOPD	*P*-value
Total, n	**1012**	**2809**	
Age, y			
10-19	78 (7.71%)	194 (6.91%)	0.14
20-29	102 (10.08%)	269 (9.58%)	
30-39	144 (14.23%)	349 (12.42%)	
40-49	170 (16.80%)	461 (16.41%)	
50-59	200 (19.76%)	504 (17.94%)	
60-69	175 (17.29%)	550 (19.58%)	
70-79	113 (11.17%)	398 (14.17%)	
80-89	29 (2.87%)	76 (2.71%)	
90+	1 (0.10%)	8 (2.85%)	
% Male	395 (39.03%)	1021 (36.35%)	0.13
Race			
White	288 (28.46%)	1125 (40.05%)	< 0.001
African-American	24 (2.37%)	84 (2.99%)	
Hispanic	5 (0.49%)	14 (0.50%)	
Other/Unknown	695 (68.68%)	1586 (56.46%)	

3. Results

A total of 3821 patients undergoing hip arthroscopy were identified, 1012 of whom were in the ASC group and 2809 were in the HOPD group. The HOPD group had a significantly higher mean Charlson Comorbidity Index (1.17 vs 0.91; $p < 0.001$), as well as a higher proportion of patients with diabetes, obesity, and tobacco use (Tables 1 and 2). 54% of the HOPD group had a CCI score of zero compared to 62% of the ASC group, a finding that was significantly different (Table 4). The proportions of all other queried demographic and comorbidity factors were not statistically different between groups.

Rates of 90-day CMS-reportable complications (2.95% vs 2.17%%; $p = 0.193$), 90-day readmission (4.95% vs 4.25%; $p = 0.370$) and return to the operating room within 90 days (0.07% vs 0.2%; $p = 0.286$) were not significantly different between groups (Table 3). Rate of visits to the emergency department within 7 days was not statistically different between groups (2.57% vs 3.03%; $p = 0.458$).

To adjust for potentially confounding factors, logistic regression models were applied which determined the association between surgical setting (ASC vs HOPD) and this study's outcomes of interest. With the ASC group as reference, no statistically significant association was detected in our analysis for CMS-reportable complications (1.41, 0.83–2.60), 90-day readmission (1.26, 0.97–1.49), return to operating room (0.04, 0–1.55), or emergency department visits (1.09, 0.79–1.89)

Table 2
Demographics (continued).

	ASC	HOPD	*P*-value
Region			
Northeast	7 (0.69%)	33 (1.17%)	< 0.001
Midwest	211 (20.85%)	788 (28.05%)	
South	648 (64.03%)	1643 (58.49%)	
West	146 (14.43%)	345 (12.28%)	
Year			
2007	31 (3.06%)	97 (3.45%)	< 0.001
2008	43 (4.25%)	130 (4.63%)	
2009	67 (6.62%)	209 (7.44%)	
2010	66 (6.52%)	218 (7.76%)	
2011	61 (6.03%)	289 (10.29%)	
2012	93 (9.19%)	316 (11.25%)	
2013	126 (12.45%)	350 (12.46%)	
2014	153 (15.12%)	413 (14.70%)	
2015	207 (20.45%)	429 (15.27%)	
2016	149 (14.72%)	305 (10.86%)	
2017	16 (1.58%)	53 (1.89%)	

Table 3
Comorbidities.

	ASC	HOPD	*P*-value
Charlson Comorbidity Index	0.91 ± 1.68	1.17 ± 2.00	< 0.001
Obesity	183 (18.08%)	699 (24.88%)	< 0.001
Diabetes	170 (16.80%)	634 (22.57%)	< 0.001
Tobacco use	137 (13.54%)	505 (17.98%)	0.001

Table 4
Distribution of Charlson comorbidity index (CCI) scores.

ASC (1012)		% Total	HOPD (2809)		% Total
CCI Score	N		CCI Score	N	
0	625	62%	0	1527	54%
1	185	18%	1	563	20%
2	78	8%	2	265	9%
3	44	4%	3	164	6%
4	30	3%	4	126	4%
5	12	1%	5	47	2%
6	16	2%	6	35	1%
			7	20	1%
			8	20	1%

(Table 5).

4. Discussion

Among 3821 patients undergoing hip arthroscopy identified through a national insurance database, this study did not detect a difference in 90 day CMS reportable complications, readmission, return to operating room, or emergency department visits between patients who had surgery in an ASC and HOPD. The mean CCI score was greater in the HOPD group, as was the proportion of patients with tobacco use, diabetes and obesity. After adjusting for these factors, this study did not identify an association between surgical setting and increased likelihood of any complication of interest. These findings provide reassurance to providers who perform these procedures in either surgical setting.

Longer term complications and outcomes including heterotopic ossification, proximal femur fracture, dislocation, bursitis, and importantly functional outcomes are well defined in hip arthroscopy.[12,14] However, current research on short term outcomes is limited due to difficulty defining pertinent surgery-related adverse events.[7] A previous study focused its attention on 30-day rates of transfusion, venous thromboembolism, and superficial infection following hip arthroscopy. To avoid creating bias through arbitrarily designating specific complications, the authors of this study chose to apply a set of complications publicly reported for joint arthroplasty to assess peri-operative morbidity.[15,16] However, since these set of complications are more likely to occur following total joint arthroplasty, our overall results may underestimate the potential peri-operative complications following hip arthroscopy.

Nevertheless, the relevance of certain complications that are CMS-reportable is echoed in the literature for hip arthroscopy. For example, a recent meta-analysis of 14 studies detected a 2% rate of venous thromboembolism and reported increased age, use of oral contraceptives, increased body mass index, and prolonged traction time as risk factors.[17] Previous studies have been underpowered the understand the true risk of venous thromboembolism among a population undergoing ambulatory hip arthroscopy that is generally deemed low risk.[1] In this study, 90 day venous thromboembolism rates were 0.89% in the ASC group and 1.14% in the HOPD group. These differences were not statistically significant ($p = 0.326$). The data suggests that despite the different comorbidity profile between patients undergoing hip arthroscopy in the ASC and HOPD setting, their peri-operative risk profile is not dissimilar.

Readmission following hip arthroscopy is burdensome to both the patient and healthcare system and is not yet fully understood. Hartwell et al. identified a 30-day readmission rate of 1.3% but was unable to stratify readmission events by surgical setting.[10] Similarly, a review of a statewide database reported a 90-day readmission rate of 1.6%.[8] This study reported 90-day readmission rates in the ASC and HOPD setting that were greater than what has been demonstrated in studies of hip arthroscopy as well as knee and shoulder arthroscopy.[18,19] The authors hypothesize that these differences can at least in part be explained by the greater rate of comorbidities, namely diabetes and obesity, in our study population relative to those of prior studies. CCI score has been shown to be associated with readmission following orthopedic surgery.[20] 11% of the patients in this study had a CCI score greater or equal than 3. Further investigation into other relevant factors including operative time and other surrogates of case complexity may also be warranted. It has been shown that existing literature on hip arthroscopy may fail to reflect the outcomes standard-volume orthopedic practices and thus underestimate the true rate of complications.[12] Lastly, it is worth mentioning that large differences can exist among databases secondary to variations in coding, patient attrition, among other reasons.[21]

Visits to the emergency department after ambulatory surgery may significantly contribute to post-surgical care utilization and is not well understood.[22] There is theoretical concern that underaddressed or evolving post-operative issues such as pain control, nausea, difficult mobilization in the recovery unit of an ASC may lead to presentation to the emergency department. In this study, we did not find a difference between emergency department visits within 7 days of surgery between groups. Rates of emergency department visits in this study are comparable to previously reported rates in the literature of other outpatient orthopedic procedures except for that of rotator cuff repair, which is known to have a higher rate.[22] Reported risk factors in the literature include public insurance status and previous visit to the emergency department within 6 months prior to surgery.[23] Prospective investigation may help further clarify the relationship between surgical setting and use of emergency or urgent care resources in the peri-operative period.

As employers and insurers are establishing contribution limits that incentivize patients to select lower priced free-standing facilities for acute treatments such as arthroplasty and arthroscopy, the ambulatory surgical center may be a superior economical choice in hip arthroscopy

Table 5
Univariate and multivariate analysis of outcomes.

	ASC	HOPD	*P*-value	OR [95% CI][a]	*P*-value
Total, n	1012	2809			
90-day CMS-reportable complications	22 (2.17%)	83 (2.95%)	0.193	1.42 [0.83–2.60]	0.228
90-day Readmission	43 (4.25%)	139 (4.95%)	0.370	1.26 [0.97–1.49]	0.291
Return to Operating Room	2 (0.20%)	2 (0.07%)	0.286	0.04 [0.00–1.55]	0.161
7-day Emergency Department Visits	26 (2.57%)	85 (3.03%)	0.458	1.09 [0.79–1.89]	0.756
90-day Venous Thromboembolism	9 (0.89%)	32 (1.14%)	0.508	1.62 [0.67–4.83]	0.326

[a] Represents odds ratios and confidence intervals of multivariate analysis of outcomes with the ASC group as reference.

for patients. The ability to draw this conclusion is impacted by this study's limitations. First, peri-operative morbidity was assessed with a set of publicly reportable complications after total joint arthroplasty. This approach, while employed to reduce bias, may underestimate the true peri-operative risk following hip arthroscopy, namely of intra-complications including traction and neurovascular injuries, labral and chondral injury and fluid extravasation. However, previous studies on adverse events following hip arthroscopy have studied such outcomes as transfusion, infection, and thromboembolism all of which are included in CMS-reportable complications. Second, data on surgeon factors such as hip arthroscopy case volume or fellowship training and anesthesiologist experience which are likely to influence complications and post-operative recovery was unavailable in this study. Lastly, variations in coding in this study of an insurance database may impact the validity of our results.

5. Conclusion

This study did not detect a difference in 90 day CMS reportable complications, readmission, return to operating room, or emergency department visits between patients who had surgery in an ASC and HOPD. These findings provide reassurance to providers who perform these procedures in either surgical setting.

Author contribution statement

All authors made substantial contributions to research design, data analysis and acquisition, drafting the paper or revising it critically, and all authors have approved this submitted version of the manuscript.

Declaration of competing interest

The authors do not have any competing interests relevant to this manuscript to disclose.

Appendix 1

CPT Codes for Inclusion
29915
29916
29860
29861
29862
29863
29999[a]

[a]Patients with this code only included if they had a concurrently linked ICD code for hip-related pathology.

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