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Predicting Need for Skilled Nursing or Rehabilitation Facility after Outpatient Total Hip Arthroplasty

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Purpose: Outpatient classified total hip arthroplasty (THA) is a safe option for a select group of patients. An analysis of a national database was conducted to understand the risk factors for unplanned discharge to a skilled nursing facility (SNF) or acute rehabilitation (rehab) after outpatient classified THA.

Materials and Methods: A query of the National Surgical Quality Improvement Program (NSQIP) database for THA (Current Procedural Terminology [CPT] 27130) performed from 2015 to 2018 was conducted. Patient demographics, American Society of Anesthesiologists (ASA) classification, functional status, NSQIP morbidity probability, operative time, length of stay (LOS), 30-day reoperation rate, readmission rate, and associated complications were collected.

Results: A total of 2,896 patients underwent outpatient classified THA. The mean age of patients was 61.2 years. The mean body mass index (BMI) was 29.6 kg/m^2 with median ASA 2. The results of univariate comparison of SNF/rehab versus home discharge showed that a significantly higher percentage of females (58.7% vs. 46.8%), age >70 years (49.3% vs. 20.9%), ASA ≥3 (58.0% vs. 25.8%), BMI >35 kg/m^2 (23.3% vs. 16.2%), and hypoalbuminemia (8.0% vs. 1.5%) (P<0.0001) were discharged to SNF/rehab. The results of multivariable logistic regression showed that female sex (odds ratio [OR] 1.47; P=0.03), age >70 years (OR 3.08; P=0.001), ASA≥3 (OR 2.56; P=0.001), and preoperative hypoalbuminemia (<3.5 g/dL) (OR 3.76; P=0.001) were independent risk factors for SNF/rehab discharge.

Conclusion: Risk factors associated with discharge to a SNF/rehab after outpatient classified THA were identified. Surgeons will be able to perform better risk stratification for patients who may require additional postoperative intervention.

Key Words: Skilled nursing facility, Outpatient, Total hip arthroplasty

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INTRODUCTION

The incidence of total hip arthroplasty (THA) in an outpatient setting is increasing in the United States[1-3]. However, patients must meet certain requirements in order to be discharged home on an outpatient basis. Failure to meet physical therapy (PT) standards for a home discharge, including the capacity for safe ambulation, is a common reason for failure to meet outpatient THA criteria[4]. A portion of patients who undergo THAs who fail to meet PT standards for discharge home will also fail to meet these criteria after a period of inpatient hospitalization. These patients often require additional treatment and nursing attention in either an acute rehabilitation (rehab) center or a skilled nursing facility (SNF)[5]. Several predictors for discharge to a SNF or rehab facility after THA, including increased comorbidity burden, age, male sex, geographic region, and insurance plan type, have previously been identified[6,7].

The role of a SNF has expanded in recent years from long-term residential care to include short-term care for patients with postoperative rehabilitation requirements[8,9]. Many SNFs have attempted to mirror therapeutic protocols used in acute rehab facilities while decreasing cost[10]. In theory, the potential to receive intensive physical and occupational therapy at inpatient facilities would improve patient outcomes. However, mixed results after discharge to SNF have been reported in the literature; some studies have suggested that it can improve functional outcomes while others reported an association with increased complications such as the need for 30-day readmission, reoperation, and medical complications[9-14]. Currently, there is no system that can be used for effective identification of patients who will require and benefit from care in a short-term facility in the postoperative setting[9-14]. This can be particularly problematic for patients with a preoperative outpatient status who had an unplanned hospitalization with discharge to a SNF. It added the risk of postoperative complications and increased cost to providers and hospital systems.

Use of an evidence-based approach for prediction of patients who will require either admission to a rehab facility or admission to a SNF will enable more prudent selection of patients for outpatient THA. This can potentially improve hospital efficiency and cost associated with unplanned facility transfers or readmissions. Therefore, the purpose of this study is to provide better characterization of specific risk factors for prolonged hospitalization and subsequent discharge to a facility in a population of patients who were preoperatively classified to undergo outpatient surgery. According to our hypothesis, despite a preoperative outpatient status, increased age and increased comorbidity burden would lead to an increased rate of discharge to either a SNF or rehab facility.

MATERIALS AND METHODS

Approval was obtained from Institutional Review Board (IRB) of Duke University Health System prior to commencement of the study (protocol No. Pro00106640). A query of the national database of the American College of Surgeons National Surgical Quality Improvement Program (ACS-NSQIP) from January 2015 to December 2018 for primary THA with Current Procedural Terminology (CPT) code 27130 was performed. All NSQIP data is de-identified and public for participating institutions. After further stratification, this cohort included THA cases that were preoperatively classified for outpatient status by their institution. Outpatient status, which is determined by each participating institution, can be up to two midnights according to the Center for Medicare/Medicaid Services (CMS). Patients who underwent concurrent procedures and patients who underwent bilateral THA met the exclusion criteria for revision arthroplasty.

The ACS-NSQIP is a nationally validated outcome-based registry; data regarding comorbidity profiles, perioperative events, and 30-day complications including Emergency Department visits and readmissions is collected prospectively[15]. This registry includes data from over 450 high-volume medical centers. Each participating center employs a designated reviewer who is trained in entry of data to the NSQIP registry[16]. Variables regarding preoperative data collected from this database include patient age, sex, body mass index (BMI), and American Society of Anesthesiologists (ASA) classification. The NSQIP registry provides a distinct inpatient or outpatient variable within their reporting. According to their guide for data users, the "inpatient" and "outpatient" classifications are defined as the participating hospital's definition of "inpatient" and "outpatient" status[15]. For the purposes of this study, the NSQIP classification of "outpatient" was used to define outpatient THA.

The functional status was also recorded for all patients. Functional status was sub-categorized as independent, partially dependent, or completely dependent. Independent status was defined as a patient not requiring assistance from another person for performance of any activity of daily living. Partially and completely dependent status is defined as some or total assistance for performance of activities of daily

living. NSQIP morbidity probability was also included for all outpatient cases in each of the listed study years 2015-2018. The morbidity probability is a validated tool for use in risk stratification. A hierarchical regression analysis that represents probability from 0 to 1 that a case will experience a morbid event based on pre-existing conditions is used to determine these probabilities.

Collection of variables regarding postoperative data included operative time, length of hospital stay (LOS), 30-day reoperations, all-cause 30-day readmissions, and both surgical and medical complications. Postoperative surgical complications were defined as transfusion, wound dehiscence, superficial infection, deep infection, and reoperation related to the primary CPT code (27130). Since 2012, new subcategories of unrelated or related 30-day reoperation and readmission have been defined in NSQIP using a diagnosis code linked to the primary procedural CPT code[17].

Mean and standard deviation for continuous variables or counts and percentages for categorical variables were used in summarizing data. A preliminary univariate analysis was performed for comparison of the perioperative variables for the sub-group with discharge to home versus discharge to a SNF or rehab. These variables included age, sex, BMI, albumin, smoking status, ASA, operative time and LOS. A multivariable logistic regression model was created for the dependent outcome of discharge to a skilled nursing or acute rehab facility. The model included baseline demographics and preoperative classification with sex (male and female), age >70 years, BMI >35 kg/m^2, and ASA class 1-4[18,19]. In addition, the available medical-comorbidities were included in each model: diabetes, smoking, functional status, history of chronic obstructive pulmonary disease (COPD), liver disease, congestive heart failure (CHF), hypertension (HTN), renal failure, dialysis, disseminated cancer, wound infection, chronic steroid use or immunosuppressed, weight loss >10%, bleeding or coagulopathy disorder and hypoalbuminemia (defined by albumin <3.5 g/dL). Evaluation of the model was then performed to determine fit with receiver operating characteristics in order to calculate area under the curve. The receiver operating characteristic curve was used for the dependent outcome and the vertical distance of the receiver operating characteristic curve from the point (x, y) on the diagonal line (45° chance line) was maximized in order to establish cut-offs for parameters such as age and BMI. Organization and analysis of data was performed using Wizard (E. Miller, Chicago, IL, USA). Unless otherwise noted, *P*-values<0.05 indicated statistical significance.

RESULTS

A total of 2,896 patients were categorized as outpatient THA from 2015-2018. The mean age (±standard deviation) of patients was 61.2±11.1 years, and the majority of patients were male (52.6%). The mean BMI was 29.6±5.8 kg/m^2, with median ASA 2 (65.3%). The majority of patients were classified as functionally independent (99.0%) and the low mean morbidity probability was 0.016±0.006 (Table 1). Regarding total perioperative outcomes, the mean operative time was 91.4±35.6 minutes, with a mean LOS of 1.3 ±2.6 days. LOS was greater than 1 because patients can be classified as outpatient for up to two midnights per CMS guidelines. The 30-day readmission rate was 2.3% and the 30-day reoperation rate was 1.3% (Table 2). The most common surgical complication after THA was transfusion (1.8%) and the most common medical complication was a urinary tract infection (0.6%). A complete list of surgical and medical complications after outpatient THA is shown in Table 3.

The results of comparison of perioperative variables between patients who were discharged to home versus those who were discharged to a nursing or rehabilitation facility showed several differences. Regarding non-mod-

Table 1. Baseline Demographics of Outpatient Total Hip Arthroplasty (n=2,896)

Description	Value
Age (yr)	61.2±11.1
Sex	
Male	1,523 (52.6)
Female	1,373 (47.4)
BMI (kg/m^2)	29.6±5.8
Q1, Q3	25.7-33.0
ASA class	
1	210 (7.3)
2	1,890 (65.3)
3	781 (27.0)
4	15 (0.5)
Functional status	
Independent	2,866 (99.0)
Partial/total	23 (0.8)
Morbidity probability*	0.016±0.006

Values are presented as mean±standard deviation, number (%), or range only.
BMI: body mass index, ASA: American Society of Anesthesiologists.
* Calculated with National Surgical Quality Improvement Program regression model based on preoperative medical co-morbidities.

ifiable preoperative variables, a higher percentage of patients over the age of 70 belonged to the group of patients who were discharged to a facility (49.3% vs. 20.9%, *P*<0.0001) and a higher percentage of female patients were discharged to a facility (58.7% vs. 46.8%, *P*=0.005). Regarding modifiable preoperative variables in comparison of facility or rehab versus home discharge, the percentage of BMI >35 kg/m^2 (23.3% vs. 16.2%) and BMI >40 kg/m^2 (6.7% vs. 4.0%) was higher. However, only BMI >35 kg/m^2 showed a significant difference between the two groups (*P*=0.02). A significantly higher percentage of patients with hypoalbuminemia were discharged to a facility compared to those discharged to home (8.0% vs. 1.5%, *P*=0.00001). Although an evaluation of smoking status between the two groups was performed, no significant difference was observed between facility and home discharge groups (17.3% vs. 12.3%, *P*=0.07) and it was not included in the multivariable logistic regression. Postoperatively, a significantly lower operative time was observed for patients who were discharged to home (90.6 minutes) versus facility (105.5 minutes, *P*=0.0001). As expected, the group of patients who were discharged to a facility included a higher percentage of patients with LOS >24 hr (84.7% vs. 24.9%, *P*=0.00001) (Table 4) despite the fact that they were originally classified as outpatient, as described in the methods section.

Further analysis using a multivariable logistic regression was performed in order to evaluate for independent risk factors of facility discharge after outpatient classified THA. This model controlled for age, sex, BMI, ASA, albumin, operative time, functional status, comorbidities including diabetes, HTN, CHF, dialysis, disseminated cancer, wound infection, immunosuppression, >10% weight loss, bleeding disorder, and transfusions. According to the results of the analysis, age >70 years (odds ratio [OR] 3.08; 95% confi-

Table 2. 30-Day Perioperative Outcomes for Outpatient Total Hip Arthroplasty (n=2,896)

Description	Value
OR time (min)	91.4±35.6
LOS (day)	1.3±2.6
LOS 0-1 days	2,091 (72.2)
Readmission	
No	2,829 (97.7)
Yes	67 (2.3)
Reoperation	
No	2,857 (98.7)
Yes	39 (1.3)

Values are presented as mean±standard deviation or number (%).
OR: operating room, LOS: length of stay.

Table 3. Surgical and Medical Complications after Outpatient Total Hip Arthroplasty (n=2,896)

Description	Value
Surgical	
Transfusion	52 (1.8)
Wound dehiscence	1 (0.04)
Superficial infection	17 (0.6)
Deep infection	4 (0.1)
Medical	
Deep vein thrombus	5 (0.2)
Pulmonary embolism	10 (0.3)
Myocardial infarction	2 (0.07)
Cardiac arrest	0 (0)
Stroke	1 (0.04)
Acute kidney injury	1 (0.04)
Urinary tract infection	18 (0.6)

Values are presented as number (%).

Table 4. Comparison of Perioperative Differences between Home and SNF/Rehabilitation Discharge: Univariate Analysis

	Home (n=2,746)	SNF/Rehab (n=150)	*P*-value
Age >70 yr	573 (20.9)	74 (49.3)	0.00001
Sex, female	1,285 (46.8)	88 (58.7)	0.005
BMI >35 kg/m^2	446 (16.2)	35 (23.3)	0.02
BMI >40 kg/m^2	109 (4.0)	10 (6.7)	0.11
Albumin <3.5 g/dL	41 (1.5)	12 (8.0)	0.00001
Smoking	337 (12.3)	26 (17.3)	0.07
ASA ≥3	709 (25.8)	87 (58.0)	0.00001
OR time (min)	90.6 (34.8)	105.5 (45.9)	0.0001
LOS >24 hr	684 (24.9)	127 (84.7)	0.00001

Values are presented as number (%).
SNF: skilled nursing facility, Rehab: rehabilitation, BMI: body mass index, ASA: American Society of Anesthesiologists, OR: operating room, LOS: length of stay.

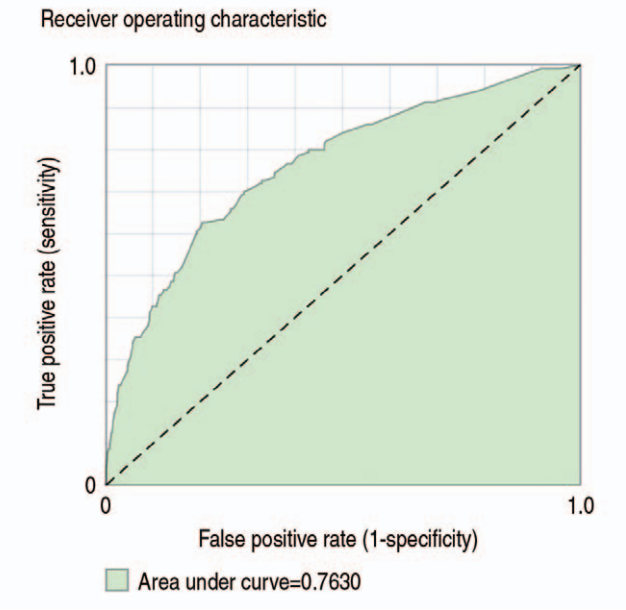

Fig. 1. This is the receiver operating characteristic for the multivariable analysis showing the area under the curve.

dence interval [CI] 2.14-4.44; *P*=0.001), female sex (OR 1.47; 95% CI 1.03-2.10; *P*=0.03), and ASA ≥3 (OR 2.56; 1.75-3.75; *P*=0.001) were identified as independent non-modifiable risk factors. The results showed that albumin <3.5 g/dL (OR 3.76; 95% CI 1.75-8.10; *P*=0.001) was a modifiable risk factor. The receiver operating characteristic of the model showed an area under the curve of 0.7630 (Table 5, Fig. 1).

DISCUSSION

Decreasing the rate of discharge to an acute rehabilitation center or a SNF after total joint arthroplasty is a focal point of attention for implementation of cost reduction strategies and outcome optimization[7-10]. Acute postoperative care after total joint arthroplasty accounts for over $2 billion of healthcare spending in the United States[13,14]. Prudent selection of patients is critical in the effort to minimize the percentage of patients who will require postoperative discharge to a SNF or acute rehabilitation. In addition, considering the disparities regarding patient outcomes following facility dis-

Table 5. Preoperative Risk Factors for SNF Discharge after Outpatient Total Hip Arthroplasty: Multivariable Regression Analysis

	Odds ratio	95% CI	*P*-value
Albumin <3.5 g/dL	3.76	1.75-8.10	0.001
Age >70 yr	3.08	2.14-4.44	0.001
ASA ≥3	2.56	1.75-3.75	0.001
Sex, female	1.47	1.03-2.10	0.03
BMI >35 kg/m^2	1.22	0.80-1.87	0.36

Area under curve=0.7630.
SNF: skilled nursing facility, CI: confidence interval, ASA: American Society of Anesthesiologists, BMI: body mass index.

Table 6. Summary of Current Literature Analyzing Risk Factors for Discharge to SNF or Rehabilitation Facility

Study	No. of patients	Database	Inpatient/ outpatient
Schwarzkopf et al.[6] (2015)	14,326 (THA)	California State Database	Inpatient
Soley-Bori et al.[7] (2017)	110,643 (THA and TKA)	Truven Health Analytics MarketScan Database	Inpatient
Keswani et al.[21] (2016)	106,360 (THA and TKA)	National Surgical Quality Improvement Program Database	Inpatient
Shah et al.[22] (2017)	3,120 (nonelective primary THA)	National Surgical Quality Improvement Program Database	Inpatient
Halawi et al.[23] (2015)	372 (THA and TKA)	Institutional Database	Inpatient
Sharareh et al.[24] (2014)	100 (THA and TKA)	Institutional Database	Inpatient
Rondon et al.[25] (2018)	2,281 (TKA)	Institutional Database	Inpatient
Ponnusamy et al.[26] (2017)	138,842 (THA)	Medicare Provider Analysis and Review Database	Inpatient
Mehta et al.[20] (2019)	93,493 (THA)	Pennsylvania Health Care Cost Containment Council Database	Inpatient

SNF: skilled nursing facility, THA: total hip arthroplasty, TKA: total knee arthroplasty.

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charge in the literature, prompt identification of patients who will benefit from this additional intervention is of foremost importance[12-14]. Several predictors have previously been identified in the current literature as factors that contribute to discharge to a SNF or rehab facility after inpatient surgery: increased comorbidity burden, age, male sex, region, and type of insurance plan (Table 6)[6,7,20-26]. Our cohort from the NSQIP database provides an addition to this literature with identification of additional risk factors for discharge to a facility in THA patients who were classified under an outpatient status at the time of surgery. This could be helpful in identifying patients who are more suited for outpatient THA versus patients who may require an inpatient stay after THA with subsequent discharge to a care facility.

The findings of this study demonstrated that the likelihood of requiring either SNF or discharge to a rehabilitation facility is significantly higher for patients with age >70 years, female sex, hypoalbuminemia (albumin <3.5 g/dL), and ASA score ≥3. Our results agree with those reported in previous literature evaluating risk factors for non-home discharge after THA utilizing other databases. In an analysis of the 2010 California Hospital Discharge, Schwarzkopf et al reported that the likelihood of non-home discharge was greater for patients with more comorbidities, older age, and female sex[6]. While these findings are consistent with our results, they also reported that Medicaid insurance payer status and African American or Asian race were the strongest predictors for non-home discharge[6]. Mehta et al.[20], who added to this finding using the Pennsylvania Health Care Cost Containment Council Database, reported an association of African American race with higher rates of discharge to a rehabilitation facility. The potential mechanisms behind these associations remain controversial, however, proposed causal factors include proportion of patients below the poverty line and increased comorbidity burden, differing patient preoperative expectations, and perceived levels of at-home social support[27,28]. The orthopaedic literature includes significant bias, and this may represent a finding that could be rooted in bias[29]. Better characterization and reduction of this health disparity should be the aim of future research.

Smoking was previously identified as a risk factor associated with a variety of adverse outcomes after total joint arthroplasty[30,31]. Findings of our study indicate a trend toward significance of smoking as a risk factor for SNF placement, however, this did not reach significance and therefore was not determined to be an independent risk factor, thus it was not included in the multivariable logistic regression. Likewise, after conduct of multiple arthroplasty studies, higher ASA scores and hypoalbuminemia were reported to serve as surrogate markers associated with poor outcomes[32,33]. It is also important to note that higher BMIs and longer surgical times were reported for the facility/rehab discharge group, supporting the suggestion that increased co-morbidities could predict discharge to a facility[34]. This finding also indicates possible confounders in this study with these differences in cohorts. Based on our findings, awareness of the fact that these potentially modifiable factors are associated with a higher risk for non-home discharge after THA in outpatient settings is important for surgeons. Based on these risk factors, surgeons can provide an evidence-based approach for preoperative counseling and overall selection of patients for outpatient THA. It is also important to note that decisions regarding patient discharge are made by a multidisciplinary team. In the effort to achieve the best and safest outcome, physical and occupational therapy as well as the patient's family and living situation can have an influence with regard to where the patient should be discharged after surgery. Cooperation between the surgeon and these other care teams is important in determining whether a patient is a good candidate for outpatient surgery.

The literature regarding discharge to a facility after total knee arthroplasty can also serve to provide further validation of these risk factors. Many of these variables are consistent with those identified for THA and therefore merit discussion. For example, related to our findings showing correlation of elevated BMI with non-home discharge, Yao et al.[35] reported that use of tobacco and diabetes were predictive variables in a TKA cohort. Insurance status is an additional factor associated with increased non-home discharge after total knee arthroplasty[14,36]. While this could be applied for inpatient-based surgery, there are limitations in applying data regarding insurance claims to outpatient cohorts and discharge to a facility. One advantage of this study is that our cohort did not have insurance-related restrictions for facility or rehab discharge based on a required number of mid-night hospital stays. Thus, we were able to perform an evaluation to determine which patients required discharge to a facility independent of their insurance status.

A descriptive analysis of several complications observed after outpatient THA is also included (Table 3). Our findings indicate that complication rates within a 30-day window are low among THA cases managed in the outpatient setting. Serious adverse events such as stroke (0.04%), myocardial infarction (0.07%), and cardiac arrest (0%) are reported in less than 0.1% of patients. Postoperative transfusion (1.8%), urinary tract infection (0.6%), and pulmonary embolism (0.3%)

are reported at relatively higher rates, thus the aim of many studies is to reduce the incidence of these complications after total joint arthroplasty[37-39]. Despite relatively low absolute risk, providers must be especially cognizant of patients who are discharged to either a SNF or rehab facility, considering that documented rates of complications are higher in this population[40].

This is the first study to utilize the National Surgery Quality Improvement Program (NSQIP) for evaluation of risk factors for discharge to either a SNF or rehab facility after an outpatient THA. In addition, the utility of the NSQIP database in THA with hospital-verified surgical data, in contrast to claims-based data, was demonstrated[41]. Considering the magnitude of the NSQIP, a robust sample size of 2,896 patients was evaluated in this study. Using the NSQIP database, analysis of specific perioperative risk factors such as operative time and ASA classification can also be performed, enabling performance of a comprehensive regression analysis.

Despite these strengths, our study has limitations, including those inherent to a large scale, nationally representative database such as the NSQIP. As such, the clinical significance of the results may not correspond to their statistical significance[42]. In addition, the NSQIP classification of "inpatient" versus "outpatient" status was determined by specific participating institutions. Institutions included in the registry may have a different definition of admission status which could bias the results. As a further limitation of the NSQIP database, orthopaedic surgery specific data points and social factors for planning of patient discharge were not included in our analysis. For example, assessment of orthopaedic specific complications (intraoperative fracture, mal-positioned implant) and orthopaedic specific preoperative risk factors (history of prior hip procedures, severity indices for hip osteoarthritis) was not possible. As a final limitation, complications occurring within a 30-day window after surgery are documented in the NSQIP database. Conduct of future studies for prospective evaluation of acute rehab and discharge to a SNF after outpatient total joint arthroplasty may be warranted for assessment of potential differences in long-term outcome.

CONCLUSION

Utilizing a nationally representative database, the aim of our study is to identify patient demographics and risk factors associated with discharge to nursing or rehab facilities following outpatient THA. By attaining greater understanding of these factors, surgeons will be able to perform better risk stratification for their patients in order to determine which patients may be fit to undergo outpatient THA.

CONFLICT OF INTEREST

The authors declare that there is no potential conflict of interest relevant to this article.

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