The Journal of Arthroplasty xxx (2016) 1–5

Contents lists available at ScienceDirect

The Journal of Arthroplasty

journal homepage: www.arthroplastyjournal.org

Original Article

Can We Predict Discharge Status After Total Joint Arthroplasty? A Calculator to Predict Home Discharge

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ARTICLE INFO

Article history:
Received 26 April 2016
Received in revised form
6 July 2016
Accepted 9 August 2016
Available online xxx

Level of Evidence:
III
prognostic

Keywords:
total hip arthroplasty
total knee arthroplasty
total joint arthroplasty
skilled nursing facility
discharge status
calculator

ABSTRACT

Background: Postoperative discharge to a skilled nursing facility after total joint arthroplasty (TJA) is associated with increased costs, complications, and readmission. The purpose of this study was to identify the risk factors for discharge to a location other than home to build a calculator to predict discharge disposition after TJA.

Methods: The American College of Surgeons National Surgical Quality Improvement Program database was queried from 2011 to 2013 to identify patients who underwent primary total hip or total knee arthroplasty. Risk factors were compared between patients discharging home vs a facility. Predictors of facility discharge were converted to discrete values to develop a simple numerical calculator.

Results: After primary TJA, patients discharged to a facility were typically older (70.9 vs 64.3, $P < .001$), female (69.5% vs 55.7%, $P < .001$), had an elevated American Society of Anesthesiologist (ASA) class, and were more likely to be functionally dependent before surgery (3.8% vs 1.1%, $P < .001$). Patient age, preoperative functional status, nonelective THA for hip fracture, and ASA class were most predictive of facility discharge. After development of a predictive model, scores exceeding 40 and 80 points resulted in a facility discharge probability of 75% and 99%, respectively.

Conclusion: In patients undergoing TJA, advanced age, elevated ASA class, and functionally dependent status before surgery strongly predicted facility discharge. Given that facility discharge imposes a significant cost and morbidity burden after TJA, patients, surgeons, and hospitals may use this simple calculator to target this susceptible patient population.

Total joint arthroplasty (TJA) is the most effective treatment for advanced arthritis of the hip and knee, with markedly increased utilization over the last 2 decades [1-4]. Recent predictions estimate an exponential increase in demand over the next several years [5]. The average length of stay for patients undergoing TJA continues to decrease over time [6]. While decreasing inpatient stays may theoretically reduce the total cost of care [7], recent studies have demonstrated that 36% of the total episode of care costs occurs after hospital discharge at skilled nursing and rehabilitation facilities [8]. Therefore, the total cost of care is influenced not only by length of stay, but also by discharge location.

The total number of patients that discharge to a facility other than home varies widely based on the geographic area, ranging from 29% to 83% [8-11]. In addition to the increased costs associated with receiving care at a facility, facility discharge in comparison to home discharge has been associated with increased rate of complications and 30-day readmissions [12-14]. Thus, the cost of facility discharge represents a significant patient risk and cost burden. As the Centers for Medicare and Medicaid Services focuses on decreasing the episodic cost of care for TJA [15], discharge disposition remains an important consideration.

As bundled payment models and other quality-focused reimbursement plans are implemented, discharge to home represents a significant cost savings initiative. Early studies investigating the feasibility of bundled payment models for TJA identified facility discharge as a factor that significantly increases the episodic cost of care [16-18], thus serving as a potential target for cost reduction.

One or more of the authors of this paper have disclosed potential or pertinent conflicts of interest, which may include receipt of payment, either direct or indirect, institutional support, or association with an entity in the biomedical field which may be perceived to have potential conflict of interest with this work. For full disclosure statements refer to http://dx.doi.org/10.1016/j.arth.2016.08.010.

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http://dx.doi.org/10.1016/j.arth.2016.08.010
0883-5403/

We hypothesize that certain patient characteristics increase the probability of facility discharge after TJA and aim to develop a discharge calculator to predict if discharge to facility will be required.

Materials and Methods

The American College of Surgeons National Surgical Quality Improvement Program (NSQIP) was queried for patients undergoing TJA procedures from 2011 to 2013. We identified all patients undergoing total hip arthroplasty (THA) or total knee arthroplasty (TKA) procedures using Current Procedural Terminology (CPT) codes 27130 and 27447, respectively. For patients undergoing THA, we included both elective and fracture THA cases, while only elective cases were included for patients undergoing TKA. Patients who underwent bilateral procedures, revision procedures, simultaneous major ligament reconstruction, American Society of Anesthesiologist (ASA) class of 5, unknown functional status before surgery, or preoperative wound infection or sepsis defined as positive bacterial growth on blood cultures were excluded. Patients having hip arthroplasty after previous surgery (CPT 27132), hemiarthroplasty for hip fracture (CPT 27125), or unicondylar knee arthroplasty (CPT 27446) were also excluded.

At the time of this study, the NSQIP database included more than 700 hospitals throughout the United States committed to quality improvement, including both teaching and nonteaching institutions [19]. Robust data are collected, including patient demographics, comorbidities, surgical procedures performed, operative variables, and 30-day medical and surgical complications. The NSQIP database has been utilized in multiple orthopedic studies to compare short-term complications [20-22]. Through a combination of telephone communication, surgeon contact, and review of the medical records, a high level of data reliability and accuracy is maintained, with reported disagreement rates of 2% [23].

For the present study, discharge destination was the primary variable of interest. Using the variables provided by the NSQIP database, we compared patients discharging home to patients discharging to a facility, including a skilled care facility, rehabilitation facility, separate acute care facility, facility which was not home, or an unskilled facility that was not home. Patients who expired during the hospital admission or for whom discharge destination was unknown were excluded.

Statistical Analysis

An initial univariate analysis, including Student *t* test and chi-square analysis for continuous and categorical variables, respectively, was performed to identify patient factors associated with facility discharge. All variables with a univariate *P* value <.1 were included in a multivariate logistic regression model to determine risk factors for facility discharge using methods previously described by Hyder et al [24]. To account for the influence of multiple variables, specifically age, elective surgery status, functional status before surgery, living location before surgery, and ASA class, each variable value was assigned a score [24]. A total score was then calculated for each patient using the individual values assigned to each variable of interest. A receiver operator characteristic curve was created to predict facility discharge with a model discrimination c-index of 0.7. The probability of facility discharge could then be determined for each individual patient preoperatively based on input of facility discharge predictors into the created discharge destination calculator.

Source of Funding

No source of internal or external funding was used to support this research study. This study was deemed exempt by the Institutional Review Board at the University of Iowa and was HIPAA (Health Insurance Portability and Accountability Act) compliant.

Results

Of the 108,396 patients identified in the NSQIP database undergoing TJA, 107,300 patients were identified that met our inclusion and exclusion criteria. In total, 74,252 patients (69.2%) discharged home after surgery while 33,048 patients (30.8%) discharged to a facility. Patients who discharged to facility were generally older (70.9 vs 64.3, $P < .001$), female (69.5% vs 55.7%, $P < .001$), had elevated ASA class (1 and 2 vs 3 and 4, $P < .001$), and were more likely functionally dependent before surgery (3.8% vs 1.1%, $P < .001$; Table 1). The 30-day mortality rate was more than 10 times higher in patients discharged to a facility as compared with home (3.9% vs 0.3%, $P < .001$). In addition, the rate of any 30-day complication was 3 times higher in patients discharged to a facility as compared with home (25.5% vs 8.2%, $P < .001$).

Multivariate logistic regression analysis identified increased patient age, nonelective THA for fracture, dependent functional status, living location other than home before surgery, and elevated ASA class as predictors of postoperative facility discharge (Table 1).

Table 1
Characteristics of Total Joint Arthroplasty Patients by Discharge Location.

Characteristic	Home	Facility[a]	*P* Value
Total, n (%)	74,250 (69.2)	33,050 (30.8)	
Patient			
Age, y (SD)	64.25 (10.28)	70.93 (10.32)	<.0001
Sex, male, n (%)	32,820 (44.28)	10,084 (30.55)	<.0001
ASA classification, n (%)			<.0001
I	2942 (3.96)	363 (1.10)	
II	42,768 (57.60)	14,100 (42.66)	
III	27,678 (37.28)	17,568 (53.16)	
IV	862 (1.16)	1019 (3.08)	
Functional status, n (%)			<.0001
Independent	73,413 (98.87)	31,735 (96.02)	
Some assistance	815 (1.10)	1247 (3.77)	
Full assistance	22 (0.03)	66 (0.21)	
Location before admission, n (%)			<.0001
Home	74,078 (99.77)	32,524 (98.42)	
Nursing home	30 (0.04)	323 (0.98)	
Transfer	142 (0.19)	203 (0.61)	
Surgery			
Elective surgery, yes, n (%)	73,129 (98.49)	31,842 (96.34)	<.0001
Emergency surgery, yes, n (%)	241 (0.32)	262 (0.79)	<.0001
Surgical type, n (%)			<.0001
THA (n, 42,663)	30,597 (71.72)	12,066 (28.28)	
TKA (n, 16,237)	43,653 (67.54)	20,984 (32.46)	
Outcomes			
Predicted risk of death, %			
Mean (SD)	1.1 (3.2)	10.5 (15.9)	<.0001
Median (IQR)	0.3 (0-0.9)	3.9 (1.4-11.7)	<.0001
Predicted risk of morbidity, %			
Mean (SD)	11.8 (10.1)	29.0 (17.7)	<.0001
Median (IQR)	8.2 (4.4-16.0)	25.5 (15.5-39.8)	<.0001

SD, standard deviation; ASA, Association of Anesthesiologists; THA, total hip arthroplasty; TKA, total knee arthroplasty; IQR, interquartile range.
[a] Discharge to skilled nursing facility or acute rehabilitation facility.