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Original Article

Day of Surgery and Surgical Start Time Affect Hospital Length of Stay After Total Hip Arthroplasty

Aakash Keswani, BA *, Christina Beck, PhD, Kristen M. Meier, MD, MS, Adam Fields, BA, Michael J. Bronson, MD, Calin S. Moucha, MD

Department of Orthopaedic Surgery, Mount Sinai Hospital, New York, New York

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ABSTRACT

Background: The United States spends $12 billion each year on ~332,000 total hip arthroplasty (THA) procedures with the postoperative period accounting for ~40% of costs. The purpose of this study was to evaluate the effect of surgical scheduling (day of week and start time) on clinical outcomes, hospital length of stay (LOS), and rate of nonhome discharge in THA patients.
Methods: Analysis of perioperative variables was performed for patients who underwent THA at an urban tertiary care teaching hospital from 2009 to 2014.
Results: A total of 580 THA patients were included for analysis. LOS was higher for the Thursday/Friday cohort compared to Monday/Tuesday (3.7 vs 3.4 days; $P = .03$). Patients who had a surgical start time after 2 PM had longer LOS compared to patients operated on before 2 PM (3.9 vs 3.5 days; $P = .03$). After controlling for patient comorbidities and THA surgical approach (direct anterior vs posterior), Thursday/Friday THAs were associated with a 3.27 times risk of extended LOS (>75th percentile LOS) compared to Monday/Tuesday THAs ($P < .001$). Additionally, case start before 2 PM was protective and associated with a 0.46 times odds of extended LOS ($P = .01$). LOS reduction opportunity for changing surgical start time to before 2 PM was 0.9 days for high-risk patients (American Society of Anesthesiology class 3/4 and/or liver disease) and 0.2 days for low-risk patients (American Society of Anesthesiology class 1/2).
Conclusion: Patients who underwent THA Thursday/Friday or had start times after 2 PM had significantly extended hospital LOS. Preoperative risk modification along with adjustments to surgical scheduling and/or perioperative staffing may reduce LOS and thus hospital expenditures for THA procedures.

Total hip arthroplasty (THA) is a cost-effective treatment for degenerative joint disease, with as much as 90% of patients reporting return of joint function, pain relief, and improved quality of life [1-4]. Given these success rates, demand for THA has increased dramatically over the past decade. Currently, the United States spends $12 billion each year on approximately 332,000 THA procedures, with an expected increase to 572,000 by 2030 [5]. Because over half of patients undergoing THA are Medicare beneficiaries who often have comorbidities complicating their care, concern exists that such growth will lead to a significant financial burden on the US health care system. [6]. In 2013, Medicare Part A spending for primary THA reached $1.8 billion in the fee-for-service model [6]. Given the urgent need to curtail rising costs, prior successes in voluntary bundled payment demonstrations for primary total joint arthroplasty (TJA), and the relative clinical homogeneity of primary TJA, Medicare recently legislated the Comprehensive Care for Joint Replacement (CJR) model—a mandatory bundled payment demonstration in 67 geographic areas. In this model, hospitals are paid a fixed sum for managing the initial admission, postacute care, and complications in the 90 days postdischarge. With the implementation of CJR starting April 2016, hospitals must identify strategies to improve the value (outcomes divided by cost) of care provided to THA patients [7].

Because postoperative care accounts for approximately 40% of THA episode costs, providers and researchers have focused on strategies to reduce 90-day complication rates, length of stay (LOS), and rate of nonhome discharge (ie, to skilled nursing facilities or inpatient rehabilitation) [8-14]. Institutions that succeeded under

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* Reprint requests: Aakash Keswani, BA, Department of Orthopaedic Surgery, Mount Sinai Hospital, 5 East 98th Street, 9th Floor, NY, NY.

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Medicare's Bundled Payments for Care Improvement—a voluntary bundled payment demonstration for primary TJA—have emphasized the value of care pathway redesign and standardization of protocols (eg, for implant use and setting patient expectations); however, few have focused on the role of scheduling-related operational improvements in achieving these goals [13,15-17]. The purpose of this study was to evaluate the effect of surgical scheduling (specifically, day of week and start time) on clinical outcomes, LOS, and rate of nonhome discharge in THA patients while controlling for patient characteristics, surgical approach (posterior vs direct anterior), and other perioperative factors.

Methods

The institutional review board approved this retrospective study. Medical records for all patients undergoing elective THA by 1 fellowship-trained, experienced orthopedic surgeon at an urban, tertiary care hospital from 2009 to 2014 were reviewed. All patients had the same general selection of implants during the 5-year period including DePuy Summit stems, DePuy Pinnacle shells, and Biolox ceramic heads (typically 36 mm) on highly cross-linked polyethylene. Cases from January 2009 through August 2011 were analyzed using a mini-incision posterior approach (PA) as described by Sculco and Boettner [18] while cases from September 2011 onward were analyzed using direct anterior approach (DAA) using the method described by Berend et al [19]. Both the DAA and PA THA surgeries used a standard table (Maquet Alphastar Pro, Rastatt, Germany). Similar preoperative, intraoperative, and postoperative protocols were used for all of the patient cohorts. There was no difference in perioperative pain protocol between patients done earlier in the week or day (the protocol is fixed in the electronic order set). All patients were seen by a physical therapist on the day of surgery regardless of the time of day or day of week of surgery.

Each THA patient's electronic medical record was reviewed to collect demographic data (age, gender, procedure etiology, body mass index, smoking history, depression/anxiety history), comorbidities (cardiac disease, hypertension, diabetes, chronic obstructive pulmonary disorder, asthma), renal disease, liver disease (cirrhosis, hepatitis B or hepatitis C), immunosuppression (for patients with human immunodeficiency virus, transplant, or autoimmune disorders with confirmed prescription of immunosuppressants), and American Society of Anesthesiology (ASA) class. Perioperative variables included day of the week, operative time, anesthesia time, LOS, and discharge disposition. Postoperative variables included 30-day readmission and 30-day revision.

Patients were sorted into groups based on day of the week surgery was performed (Monday/Tuesday vs Thursday/Friday) and surgical start time (before 2 PM vs after 2 PM). Patients without confirmed 30-day follow-up were removed from analysis as appropriate. LOS was rounded to the half-day for analysis. Statistical analysis was conducted using SAS (version 9.3) with a 2 tailed alpha of 0.05. Categorical analysis was conducted with chi-square and Fisher exact test where appropriate. Continuous variables were analyzed using Student *t* test or Mann-Whitney *U* test after testing for normality and equal variance. Multivariate logistic regression models only included predictors which yielded a *P* value of .20 or less from bivariate analysis. All variables were assessed for confounding and interaction where appropriate. Final models were assessed for goodness of fit using the Hosmer-Lemeshow test.

Exploratory analysis comparing average LOS among patient groups was performed to assess potential LOS reduction opportunity in our cohort. Patients were divided into groups based on (1) number of significant clinical risk factors for extended LOS (>75th percentile LOS) and (2) day/time of surgery. Average LOS was compared for patients operated on earlier (Monday or Tuesday) vs later in the week (Thursday or Friday), and for those with surgery start time before vs after 2 PM to calculate a potential LOS reduction opportunity. Patients with an LOS greater than 2 standard deviations of the mean were excluded from analysis to minimize the effect of outliers.

Results

A total of 580 THA patients were included for analysis, of which 307 received DAA and 273 PA. Patients were divided into groups based on day of week (Monday/Tuesday vs Thursday/Friday) and time of day (before 2 PM vs after 2 PM) the surgery was performed. Patient demographics were generally consistent across these groups (Table 1); however, those operated on after 2 PM were more likely to have a body mass index greater than 40 ($P = .003$) and chronic obstructive pulmonary disease ($P = .03$) compared to those operated on before 2 PM. Additionally, Monday/Tuesday THAs had a shorter anesthesia time (139 minutes) compared to Thursday/Friday THAs (144 minutes; $P = .01$). No other patient or operative characteristics were significantly different between the groups.

Bivariate analysis demonstrates LOS was significantly ($P = .03$) higher for the Thursday/Friday cohort (3.7 days) compared to Monday/Tuesday (3.4 days; Table 2). Furthermore, patients who had a surgical start time after 2 PM had a longer LOS (3.9 days) compared to patients operated on before 2 PM (3.5 days; $P = .03$). Rates of extended LOS (>75th percentile LOS) were higher among Thursday/Friday vs Monday/Tuesday patients (26% vs 9.2%; $P < .001$), and among patients with surgery starting after vs before 2 PM (27% vs 15%; $P = .01$). There were no differences in discharge destination or adverse outcomes, including 30-day readmission and revision, across all groups.

After controlling for patient characteristics, comorbidities, and THA surgical approach, procedures performed on Thursday/Friday were associated with a 3.27 times risk of extended LOS compared to Monday/Tuesday operations ($P < .001$; Table 3). In the same analysis, case start before 2 PM was protective and associated with a 0.46 times odds of extended LOS ($P = .01$). Liver disease (odds ratio [OR] = 3.15; $P = .04$), ASA class 3/4 (OR = 2.10; $P = .003$), and DAA compared to PA (OR = 0.56; $P = .01$) were also significant predictors.

Exploratory analysis was performed by stratifying patients based on the significant risk factors for extended LOS identified in Table 3 and comparing average LOS among them. First, patients were divided into 2 groups: those with ASA class 3/4 or with liver disease (high risk) and those with ASA class 1/2 without liver disease (low risk; Table 4). High-risk patients operated on after 2 PM had a longer LOS regardless of day of the week (Monday/Tuesday, 3.7 days; Thursday/Friday, 5.2 days) compared to patients with an earlier start time (Monday/Tuesday, 3.5 days; R/F 4.0 days). Regardless of time of surgery, high-risk patients operated on Thursday/Friday as opposed to Monday/Tuesday had longer LOS (before 2 PM, 4.0 vs 3.5 days; after 2 PM, 5.2 vs 3.7 days). These results indicate a 0.7-day LOS reduction opportunity per high-risk patient if the surgery was performed earlier in the week, and a 0.9-day decrease in LOS if the operation started before 2 PM. Low-risk patients reveal a similar trend where, regardless of day of the week, they had longer LOS than those operated on after 2 PM (Monday/Tuesday, 3.5 vs 3.3 days; R/F 3.5 vs 3.3 days). For lower risk patients, this suggests a 0.2-day LOS reduction opportunity per patient if surgery was performed before 2 PM.

Discussion

Given the increase in demand for THA and Medicare's CJR mandating bundled payments for primary THA, the care team