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Who Should not Undergo Short Stay Hip and Knee Arthroplasty? Risk Factors Associated with Major Medical Complications Following Primary Total Joint Arthroplasty

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Introduction

Improved anesthesia and rehabilitation protocols have made outpatient or short stay (less than 24 hours) total hip arthroplasty (THA) and total knee arthroplasty (TKA) possible.[1] However, the optimal candidate for either outpatient or short stay THA or TKA remains to be defined. Furthermore, hospitals and surgeons are wary of the financial and safety impact of readmissions following short stay THA/TKA.[2,3] Nausea, bleeding, urinary retention, and pain can all result in early readmissions.[3] Therefore, the purpose of this study is to identify which risk factors would preclude patients from undergoing short stay THA/TKA. We sought to identify the medical comorbidities associated with an increased risk of complication and develop a predictive model to identify patients who should not be considered for either outpatient or short stay joint arthroplasty.

Materials and Methods

We retrospectively reviewed a consecutive series of 1012 patients who underwent primary total hip and knee arthroplasty at a single high volume academic institution from February 2013 to December 2013. Medical comorbidities, demographics, and timing of postoperative in-hospital complications were documented for each patient. Each post-surgical complication was classified and stratified based on published definitions by Sink, et al.[4] Grade I complications involving no intervention were excluded from the study. A subgroup of patients who experienced a later in-hospital complication after 24 hours post-operatively was identified. Length of stay, rates of return to the operating room, and readmission at 90 days were also noted. We chose 24 hours postoperatively as a cutoff because we only wanted to look at later in-hospital complications, as urgent complications prior to 24 hours postoperatively would be identified by most short stay TJA protocols.

Results

Of the 1012 consecutive primary THA and TKA patients included in the study, 70 patients (6.9%) experienced a perioperative complication during their index hospital admission. Fifty-nine (84%) of these complications occurred greater than 24 hours post-operatively.

When comparing the patients who experienced a complication after 24 hours postoperatively and those who did not, there was no statistical difference in BMI (31.8 vs 32.8 kg/m^2, $p = 0.425$), surgical procedure (36% vs. 35% THA, $p = 0.857$), or incidence of diabetes mellitus (18% vs. 18%, $p = 0.989$). Patients experiencing a complication after 24 hour postoperatively were more likely to be older (mean age 63.6 vs. 60.1 years, $p = 0.045$), and have a history of chronic obstructive pulmonary disease (COPD), congestive heart failure (CHF), or coronary artery disease (CAD) (all $p < 0.001$). Results comparing the two groups are listed in Table 1.

Based on multivariate analysis, independent risk factors for in-hospital complications included COPD (adjusted OR 4.16, 95% CI 1.86 − 9.32), CHF (adjusted OR 9.71, 95% CI 4.55 − 20.71), CAD (adjusted OR 2.80, 95% CI 1.38 − 5.69), and liver cirrhosis (adjusted OR 8.43, 95% CI 1.63 − 43.59). Results of univariate and multivariate analyses are detailed in Table 2.

We then performed a forward, stepwise, multiple logistic regression analysis to generate a model to identify the ideal patient for outpatient or short-stay primary TJA. Results of this analysis are shown in Table 3. A 6-point risk score was created appropriately weighting these independent variables including COPD, CHF, cirrhosis, and CAD. Patients with a score of zero had a probability of complications after 24 hours postoperatively of 3.1% (Figure 1). The receiver operating characteristic curve demonstrated a good fit of this model with area under curve of 0.738.

Table 1. Comparison of patients who experienced a complication after 24 hours postoperatively and those who did not.

	Complication > 24 hours post-operatively (n = 59)	No Complications after 24 hours (n = 953)	p value
Age (years)	63.6	60.1	0.045
BMI (kg/m^2)	31.8	32.8	0.425
Total Length of Stay (days)	6.95	3.12	< 0.001
Risk Score	1.22	0.21	< 0.001
Hip Arthroplasty	21 (36)	329 (35)	0.867
Age > 75 years	10 (20)	90 (11)	0.061
BMI > 35 kg/m^2	19 (35)	277 (35)	0.607
COPD	11 (18)	47 (5)	< 0.001
CAD	19 (32)	78 (8)	< 0.001
CHF	18 (31)	28 (3)	< 0.001
Intraoperative Vasopressors	30 (51)	350 (37)	0.03
Chronic Kidney Disease	16 (27)	128 (13)	0.004
Diabetes	11 (18)	177 (18)	0.989
Cirrhosis	3 (9)	5 (1)	0.036
90-day Readmission	16 (27)	53 (6)	< 0.001
Return to OR	7 (12)	38 (4)	0.044

Table 2. Univariate and multivariate logistic regression analysis to identify independent risk factors for in-hospital complications after 24 hours postoperatively.

	Univariate Analysis			Multivariate Analysis		
Risk Factor	**Odds Ratio**	**95% Confidence Interval**	**p value**	**Odds Ratio**	**95% Confidence Interval**	**p value**
Age > 75	1.73	0.88 – 3.45	0.113	1.15	0.53 – 2.59	0.713
BMI > 35	0.52	0.23 – 1.16	0.111	0.52	0.22 – 1.23	0.136
Hip Arthroplasty	1.05	0.61 – 1.82	0.867	0.96	0.51 – 1.81	0.902
COPD	4.42	2.16 – 9.06	< 0.001	3.98	1.74 – 9.07	0.001
CAD	5.33	2.94 – 9.64	< 0.001	2.71	1.32 – 5.57	0.007
CHF	14.5	7.42 – 28.33	< 0.001	9.27	4.20 – 20.44	< 0.001
Intraoperative Vasopressors	1.78	1.05 – 3.02	0.032	1.45	0.80 – 2.65	0.22
Chronic Kidney Disease	2.39	1.31 – 4.39	0.004	1.10	0.52 – 2.31	0.799
Diabetes	1.00	0.51 – 1.98	0.989	0.90	0.42 – 1.94	0.79
Cirrhosis	5.62	1.48 – 21.33	0.011	8.06	1.85 – 35.11	0.005

Discussion

As the drive to decrease the length of stay following primary THA/TKA continues to strengthen, concerns regarding patient safety and the financial impact of unexpected readmissions due to early discharge remain.[5] While some studies have shown no difference between the readmission rates in patients undergoing outpatient THA/TKA compared to controls,[6] the patient characteristics best suited for these types of procedures remain undefined. Therefore, we examined the timing and severity of complications as well as ultimate interventions in

Table 3. Forward, stepwise, multiple logistic regression analysis to generate a model to identify the ideal patient for outpatient or short-stay primary TJA. A weighted 6-point score was generated.

Risk Factor	Weighted Score	Odds Ratio	95% Confidence Interval	p value
CHF	2	9.71	4.55 – 20.71	< 0.001
Cirrhosis	2	8.19	1.97 – 34.15	0.004
COPD	1	4.16	1.86 – 9.32	0.001
CAD	1	2.8	1.38 – 5.69	0.004

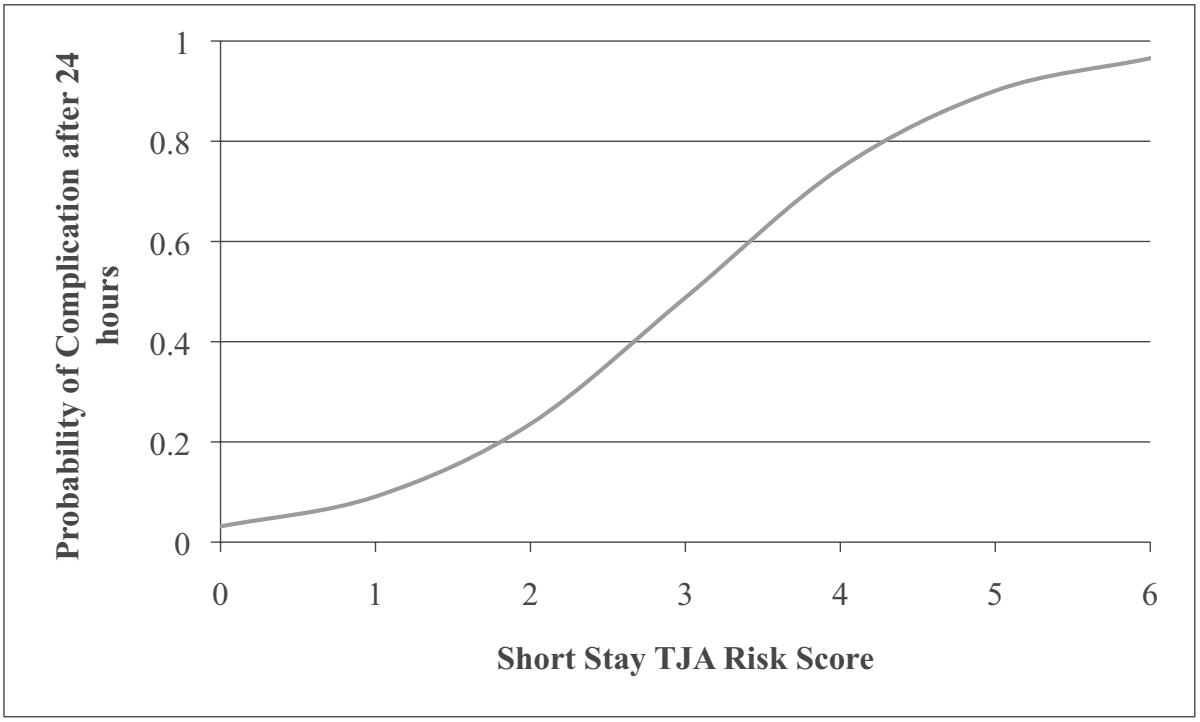

Figure 1. Probability of complications after discharge 24 hours postoperatively based upon risk score.

a large group of consecutive, unselected patients undergoing primary THA or TKA.

Our overall complication rate of 6.9% in this cohort is comparable to published rates of morbidity following primary THA/TKA.[7,8] Additionally, our results also show that the majority of these major medical complications occur past 24 hours, with the majority of these complications being cardiopulmonary in nature. It would be particularly concerning if these complications occurred outside the hospital setting. Parvizi, et al evaluated a consecutive series of 1636 patients undergoing unilateral THA or TKA and reported one death and 104 major life threatening complications, of which 90% occurred within the first 4 days of the index surgery (the time frame of a typical hospital stay).[9]

We sought to eliminate any confounding variables by using a multivariate logistic regression analysis to identify independent risk factors for the development of complications following THA/TKA. While chronic obstructive pulmonary disease (COPD), congestive heart failure (CHF), coronary artery disease (CAD), and cirrhosis were not surprisingly associated with complications, interestingly, age, body mass index (BMI), diabetes, and chronic kidney disease were not independent risk factors. These results are not completely consistent with prior published reports. Parvizi and colleagues reported that old age, increased body mass index and ASA score were associated with complications.[9] Patients with these risk factors should therefore not be recommended to have short stay THA/TKA.

Finally, we developed an easy-to-use 6-point scale with good predictive accuracy (AUC = 0.738) that orthopedic surgeons can use to determine a patient's candidacy for short stay total joint arthroplasty (TJA). However, this model is not fully predictive and there are other factors such as operative time or intraoperative events that can affect events postoperatively. Our model is intended for preoperative use in order to help facilitate and determine perioperative resources such as bed

management, hospital vs. ambulatory surgery utilization, and patient guidance. The threshold for risk should be adjusted according to institutional or individual preference.

This study has several strengths and limitations. We did not quantify the severity of medical comorbidities such as CAD, COPD, obesity, or diabetes mellitus. These were considered binary variables and thus may affect the final analysis. However, our data represents the detailed data set for a large, consecutive number of unselected patients undergoing primary THA/TKA. The sample size exceeded our power analysis and therefore minimizes type II error. We also did not take into account intraoperative factors such as operative time or blood loss, and we did not assess readmissions at 30 or 90 days. While this can bias our analysis, the intent of this study was to determine who would be a candidate for short stay TJA (less than 24 hours), not to predict the need for readmissions. Future prospective studies are necessary to validate these findings. The strengths of this study include the large sample size, the unselected nature, and the detailed documentation analysis of patient comorbidities. Patients with a history of COPD, CHF, CAD, and cirrhosis are at higher risk for developing a late in hospital complication following primary THA/TKA. Most postoperative complications occur beyond 24 hours. Thus, patients with these risk factors should not undergo short stay or outpatient primary TJA.

References

1. Cross MB, Berger R. Feasibility and safety of performing outpatient unicompartmental knee arthroplasty. *Int Orthop* 38(2):443-447 (2014).

2. Lovald ST, Ong KL, Malkani AL, et al. Complications, mortality, and costs for outpatient and short-stay total knee arthroplasty patients in comparison to standard-stay patients. *J Arthroplasty* 29(3):510-515 (2014).

3. Berger RA, Kusuna SK, Sanders SA, et al. The feasibility and perioperative complications of outpatient knee arthroplasty. *Clin Orthop Relat Res* 467(6):1443-1449 (2009).

4. Sink EL, Leunig M, Zaltz I, et al. Reliability of a complication system for orthopaedic surgery. *Clin Orthop Relat Res* 470:2220-2226 (2012).

5. Kehlet H. Fast-track hip and knee arthroplasty. *Lancet* 381(9878):1600–1602 (2013)

6. Kehlet H, Wilmore DW. Evidence-based surgical care and the evolution of fast-track surgery. *Ann Surg* 248(2):189–198 (2008).

7. Pugely AJ, Callaghan JJ, Martin CT, et al. Incidence of and risk factors for 30-day readmission following elective primary total joint arthroplasty: analysis from the ACS-NSQIP. *J Arthroplasty* 28(9):1499-504 (2013).

8. Yoshihara H, Yoneoka D. Trends in the incidence and in-hospital outcomes of elective major orthopaedic surgery in patients eighty years of age and older in the United States from 2000 to 2009. *J Bone Joint Surg Am* 96(14):1185-1191 (2014).

9. Parvizi J, Mui A, Purtill JJ, et al. Total joint arthroplasty: when do fatal or near-fatal complications occur? *J Bone Joint Surg Am* 89(1):27-32 (2007).