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Trends in Same-Day Bilateral Total Knee Arthroplasty

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ABSTRACT

Between 2000 and 2009 demographics, comorbidity, complications, and 30-day mortality following same-day BTKA (SBTKA) in two high-volume institutions were obtained. Two 5-year periods were created to facilitate trend analysis. The percentage of SBTKA decreased by 36.2% in the latter period. A decline in mean age reflected mainly by a 50% decrease in patients >75 years was observed. The average LOS decreased (5.7 vs. 4.5 days). Overall, selected patients were healthier in the second period. The prevalence of CAD and obesity decreased, whereas hypercholesteremia increased. The overall complication rate decreased by 55.5%; reduction in cardiac adverse events and acute posthemorrhagic anemia was observed. The rate of PE and 30-day mortality was unchanged with time. A need for more selective preoperative screening for potential candidates of SBTKAs is indicated.

Patients who present with symptomatic bilateral degenerative knee disease often desire bilateral total knee arthroplasty (BTKA). For these patients, both knees can be replaced in one-stage or two-stage surgical procedures. In the one-stage approach, both knees are replaced during one anesthetic session, either simultaneously by two surgeons or sequentially by one surgeon. The latter approach replaces a single knee first, with the contralateral knee to be replaced during the same hospitalization under a separate anesthetic, or more commonly, a few months after the first TKA [1].

Faster recovery and rehabilitation, concurrent correction of deformity in both knees, administration of one anesthetic, and lower hospitalization cost are among the advantages of same-day BTKA (SBTKA) compared to two-stage BTKA [1–3]. However, there are still concerns regarding the safety of SBTKA, with several studies indicating that patients who undergo SBTKA may have increased risk of cardiopulmonary complications, pulmonary embolism, and mortality [4–10]. Moreover, SBTKA may not be as cost-effective as expected if patients who undergo SBTKA require higher cost for acute care rehabilitation [11]. There is currently no universally accepted guideline for selecting patients for SBTKA, which makes the decision more challenging for both the surgeon and the patient. Despite these disadvantages, SBTKA is frequently performed in the United States, particularly in high-volume centers.

Trends in the use of SBTKA can be used to understand and predict future use of the procedure and may help determine resource allocation for the care of patients who undergo this procedure. Moreover, epidemiologic studies on the trends of SBTKA provide baseline information for future studies about the predictors of perioperative morbidity and mortality in patients who undergo the procedure, with the aim of minimizing the risks of SBTKA in recent years.

Therefore, the present study was designed and conducted to examine trends in SBTKA in two high-volume orthopedic centers and specifically 1) to investigate if there was a change in demographic and comorbidity of patients undergoing SBTKA over the study period and (2) to determine if there was a difference in the rates of 30-day mortality and perioperative complications following SBTKA by time. Our results would facilitate better definition of selection criteria and guide further decision-making algorithms for SBTKA candidacy.

Materials and Methods

Data Collection

We obtained administrative data for TKA admissions from 2000 to 2009 at two high-volume orthopedic centers (Hospital for Special Surgery, New York, NY; and Rothman Institute of Orthopaedics, Philadelphia, PA). The study was approved by the institutional review board of each institution. We used the *ICD-9-CM* procedure code 81.45 to identify patients who underwent at least one primary TKA between January 1, 2000 and December 31, 2009 [12]. Patients classified as having SBTKA were those who had two primary TKA procedure codes recorded with the same procedure date, as required by discharge coding

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rules. Clinical records for all patients, including death records of in-hospital mortalities, were reviewed. Analysis of temporal change was performed using two 5-year periods (2000–2004 and 2005–2009), which facilitated the trend analysis making the comparison between periods easier. There were no overt changes in the patient selection process at the midpoint of the study period. However, there were changes in the Deep Vein Thrombosis (DVT) prophylaxis and anesthetic protocol. Specifically, more patients were switched to aspirin instead of low-molecular-weight heparin (LMWH) or warfarin for DVT prophylaxis, and there was a shift to neuraxial anesthesia from general anesthesia, in one of the centers (Rothman Institute) throughout the study period. Nevertheless, in the other participating center (Hospital for Special Surgery) there was no change in regard to type of DVT prophylaxis and anesthesia during the study period; warfarin, combined with bridging with LMWH for high-risk patients till INR goals were achieved, and regional anesthesia was utilized in all cases. We examined differences in the incidence of SBTKA, age, gender, race (white, black, other/unknown), and length of stay (LOS) for the two time periods. Comorbidity profiles were evaluated using the Charlson–Deyo Comorbidity Index in addition to several specific conditions of interest: hypertension, diabetes mellitus, hypercholesterolemia, obesity, pulmonary disease, renal disease, and coronary artery disease (CAD). We also examined the rates of procedure-related complications, acute posthemorrhagic anemia, pulmonary insufficiency/acute respiratory distress syndrome (ARDS), pulmonary embolism (PE), and 30-day mortality for the two time periods.

Selection criteria for SBTKA patients were based on the comorbidity profile of the candidates at both institutions. Patients with substantial pulmonary, cardiac, or other serious comorbidities generally underwent staged procedures after receiving medical clearance from an internist. Specifically, coronary artery disease with inducible ischemia, congestive heart failure, advanced chronic obstructive pulmonary disease (COPD), uncontrolled diabetes, peripheral vascular disease, renal failure, morbid obesity, history of venous thromboembolism (VTE) and age >75 years were considered contraindications for SBTKA. However, these exclusion criteria were not meant to dictate but guide a decision-making process regarding eligibility for SBTKA. Therefore, SBTKAs were generally performed on younger and healthier patients. If the preoperative work-up concluded that the patient was not an appropriate candidate for SBTKA, the patient received a unilateral procedure on the more symptomatic side and then underwent TKA of the contralateral side at a later date.

Statistical Analysis

Comparisons between time groups were performed using *t*-tests for continuous variables (age, LOS) and the chi-square test for categorical variables. Statistical significance was set at $P < 0.05$. All analyses were performed using SAS Software version 9.2 (SAS Institute, Inc., Cary, NC).

Results

The absolute number of BTKAs performed was similar over the two study periods, but the proportion of patients undergoing SBTKA in the second period was 36.2% less than the earlier period (2000–2004: 2400 (20.34%) vs 2005–2009: 2425 (12.98%), $P < 0.001$). Table 1 summarizes the clinical characteristics of SBTKA patients across the two 5-year periods. The proportion of females remained unchanged (61.9% vs 61.1%, $P = 0.566$). A decline in the mean age of patients was observed (65.45 ± 9.54 [13.84–89.82] vs 63.68 ± 8.31 [12.60–92.42] years, $P < 0.001$). This was due to a 50% decrease in the proportion of SBTKA patients 75 years and older in the second period (16.0% vs 7.7%, $P < 0.001$). The average LOS decreased from 5.7 to 4.5 days ($P < 0.001$). Table 2 shows the changes in the comorbidity profiles of SBTKA patients in the two time periods. Overall, patients selected for SBTKA during the second study period were healthier as reflected by the decrease in the Charlson–Deyo Comorbidity Index (0.26 vs 0.22, $P = 0.043$). The prevalence of CAD and obesity decreased from the first to the second study period (CAD: 9.38% vs 6.85%, $P < 0.001$; obesity: 15.71% vs 12.99%, $P = 0.007$). Hypertension was the most prevalent comorbidity in both periods (56.38% vs 55.05%, $P = 0.35$). Hypercholesteremia increased with time (23.08% vs 36.91%, $P < 0.001$). There was a trend toward a decrease for diabetes between the two study periods (9.92% vs 8.33%, $P = 0.055$). The overall perioperative procedure-related complication rate decreased by 55.5% (14.29% in 2000–2004 vs 6.35% in 2005–2009, $P < 0.001$). The rates of perioperative complications for the two study periods are shown in Table 3. Although there were decreases in the rate of the majority of organ-specific complications, these changes were not statistically significant, except for the reductions in cardiac adverse events (1.92% vs 0.66%, $P < 0.001$) and acute posthemorrhagic anemia (7.96% vs 3.79%, $P < 0.001$). Complications affecting the pulmonary system remained relatively unchanged during the latter period of the study. The rate of PE was similar in the two study periods at 1.9% vs 1.8% ($P = 0.79$). The 30-day mortality rate was unchanged with time (0.04% vs 0.04%).

Table 1
Clinical Characteristics of Same-day Bilateral TKA Patients Across the Two 5-Year Periods.

	2000–2004	2005–2009	*P*-value
Total number of TKA patients, *N*	11,796	18,678	N/A
Same-day bilateral TKA, *N* (%)	2400 (20.34)	2425 (12.98)	<0.001
Gender, *N* (%)			
Female	1486 (61.92)	1482 (61.11)	0.566
Male	914 (38.08)	943 (38.89)	
Age, years (mean ± SD)	65.45 ± 9.54	63.68 ± 8.31	<0.001
Age group, *N* (%)			
<75	2016 (84.00)	2238 (92.29)	<0.001
75+	384 (16.00)	187 (7.71)	
Race, *N* (%)			
White	1640 (68.33)	1987 (81.94)	<0.001
Black	154 (6.42)	180 (7.42)	
Other/Unknown	606 (25.25)	258 (10.64)	
Length of stay, days (mean ± SD)	5.69 ± 3.53	4.55 ± 1.54	<0.001

TKA: total knee arthroplasty; N/A: non-applicable; SD: standard deviation.

Discussion

Although arthroplasty of both knees under one anesthetic session (SBTKA) carries several advantages, there is still concern about the safety of this operation and the procedure might be associated with a higher risk of perioperative complications [13,14]. In spite of these concerns, SBTKA is routinely performed, particularly in specialized orthopedic centers. However, there is little information about the epidemiology of SBTKA and the trend of the use of this operation throughout the US. Trends in the use of SBTKA can be used to understand this procedure, predict its future use, and provide baseline

Table 2
Temporal Changes in Comorbidity Profile of Same-day Bilateral TKA Patients by Time.

	2000–2004 ($N = 2400$)	2005–2009 ($N = 2425$)	*P*-value
Comorbidities, *N* (%)			
Hypertension	1353 (56.38)	1335 (55.05)	0.354
Diabetes	238 (9.92)	202 (8.33)	0.055
Hypercholesteremia	554 (23.08)	895 (36.91)	<0.001
Obesity	377 (15.71)	315 (12.99)	0.007
Pulmonary disease	239 (9.96)	212 (8.74)	0.146
Renal disease	6 (0.25)	21 (0.87)	0.004
Coronary artery disease	225 (9.38)	166 (6.85)	0.001
Charlson–Deyo Index, mean ± SD	0.26 ± 0.66	0.22 ± 0.59	0.043