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Safety of Bilateral Total Knee Arthroplasty: Simultaneous Versus Staged at a Week Interval

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Introduction

The decision to perform simultaneous bilateral total knee arthroplasty (TKA) or a staged procedure in patients with severe degenerative arthritis of both knees continues to be controversial. Simultaneous bilateral TKA offers several advantages to the patient, including an operation done under one anesthetic and a single rehabilitation period. Some orthopaedic surgeons recommend against performing bilateral simultaneous TKA and suggest performing the two procedures staged at least a few months apart during two separate admissions. The optimum timeframe between staged procedures continues to be of much debate. Few studies have addressed the safety of staged bilateral TKA one week apart,[1,2] but this time frame may represent a compromise between faster recovery and patient safety.

The primary purpose of this study is to determine if higher risk patients with bilateral knee osteoarthritis selected to have a staged procedure at a one week interval have different rates of complications compared to healthier patients having simultaneous surgery.

Methods

We retrospectively reviewed the department's arthroplasty database for all patients who underwent simultaneous and staged bilateral TKA performed by the two senior authors (CLN and CLI) from 2007-2012. All patients over age 18 who underwent a simultaneous or staged procedure were included in the study. Patients who underwent staged bilateral TKA were admitted following their first procedure. When deemed medically stable, they were transferred to our institution's skilled nursing facility (SNF) to await their second procedure seven days after the first.

Patient demographic data, American Society of Anesthesiologists (ASA) score, preoperative medical comorbidities, and blood transfusions were documented from the medical record. A Charlson Comorbidity Index was calculated for each patient.[2] Inpatient discharge summaries, progress notes, laboratory values, and consultation reports were then reviewed for each patient to identify any perioperative complications during their hospital stay. We classified and stratified each post-surgical complication based on published definitions from the TKA Complications Workgroup of the Knee Society.[3,4] Each complication was graded I to V based on severity as determined by the Workgroup using a modification of the criteria set by Sink et al.[4,5] Grade I complications were excluded while post-operative anemia requiring blood transfusions was documented separately.

We performed an *a priori* power analysis to determine the appropriate sample size before the study. Our primary statistical goal was to determine any significant difference in the rate of complications between simultaneous and staged bilateral TKA. To detect a medium clinically important effect size of 0.30 using a chi-square test with a power of 0.80 and type I error rate of 0.05,[6,7] we would need a sample size of 88 patients in each cohort.

A consecutive series of 235 bilateral TKA patients (470 TKAs) from two surgeons at a single academic institution between 2007 and 2012 were retrospectively reviewed. Of the total, 131 patients (55%) underwent bilateral TKA staged at a one-week interval. There were 69 males (29%) and 166 females (71%) with a mean age of 62.1 years (range 23-87). Patients had a mean Charlson Comorbidity Index of 0.86 (range 0-6) and mean length of stay of 5.69 days (range 3-13). Demographic data of the patient population is presented in Table 1.

Results

Patients who underwent both staged and simultaneous procedures had low overall rates of perioperative complications (6% vs. 13%, $p=0.054$). There was one mortality (grade V) in the staged group that occurred after the second procedure due to a myocardial infarction. The rate of severe complications (grade IV and V) was also low for each group (4 simultaneous patients and 3 staged patients, $p=0.467$). A list of complications and their severity grades from both groups are listed in Table 2.

Patients in the simultaneous group were younger (59.5 vs. 64.2 years, $p<0.001$) and had

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Table 1. Descriptive statistics of all bilateral total knee replacements in the study.

N=235	Mean		Number (%)
Age (years)	62.1	Male	69 (29)
Length of Stay (Days)	5.69	Female	166 (71)
Preoperative Hemoglobin (g/dL)	13	Staged 1 week apart	131 (56)
Blood transfused (units)	1.58	Simultaneous Bilateral	104 (44)
ASA	2.44	Required transfusion	159 (68)
BMI	34.1	Perioperative Complication	31 (13)
Charlson Comorbidity Index	0.83	Hypertension	173 (74)
		Hyperlipidemia	71 (30)
		Diabetes Mellitus	44 (19)
		Coronary Artery Disease	38 (16)
		Chronic Obstructive Pulmonary Disease	16 (7)
		Chronic Renal Insufficiency	10 (4)
		Human Immunodeficiency Virus	4 (2)
		Hepatitis B or C	15 (6)
		Mortality	1 (0.4)

a lower BMI (31.6 vs. 36.0, $p=0.001$) than those in the staged group. Furthermore, patients who underwent simultaneous bilateral TKA had lower ASA scores (2.35 vs. 2.51, $p=0.038$) and a lower mean Charlson Comorbidity Index (0.53 vs. 1.06, $p<0.001$). Comparative data between bilateral simultaneous and staged TKA is detailed in Table 3.

Univariate logistic regression analysis of the study population revealed a statistically significant correlation between lower preoperative hemoglobin and higher rates of blood transfusion in both the staged ($p=0.001$) and simultaneous group ($p=0.004$). There was no significant correlation with BMI ($p=0.972$) or Charlson Comorbidity Index ($p=0.352$) and rates of complications among the whole study population. While the simultaneous group had a higher preoperative hemoglobin (13.3 vs. 12.7 g/dL, $p=0.007$), there was no statistical difference in the number of patients who received a blood transfusion (71% vs. 65%, $p=0.307$) or in the mean number of units of blood transfused (1.74 vs. 1.45, $p=0.222$).

Table 2. List of complications and grades of severity. Grade I complications were excluded from the study.

Staged bilateral TKA (n=8)	Simultaneous bilateral TKA (n=14)
3 patients - Delirium requiring close monitoring and antipsychotics (grade II)	3 patients - Delirium requiring close monitoring and antipsychotics (grade II)
Bradyarrythmia requiring cardiology consultation and close follow-up (grade II)	Persistent bleeding in hemophiliac requiring factor infusion (grade II)
Atrial fibrillation requiring medical treatment and prolonged index admission (grade III)	Seizure requiring treatment and outpatient monitoring (grade II)
2 patients - Hypoxia requiring ICU transfer (grade IV)	Peroneal nerve palsy requiring orthotics which resolved (grade II)
Death from acute myocardial infarction (grade V)	Pulmonary Embolism requiring anticoagulation and prolonged admission (grade III)
	2 patients - Hypoxia requiring intervention and prolonged admission (grade III)
	Readmission for sepsis unrelated to TKA (grade III)
	3 patients - Hypoxia requiring ICU transfer (grade IV)
	Pulmonary Embolism requiring ICU transfer (grade IV)

Table 3. Comparison of patients undergoing simultaneous bilateral TKA and those staged one week apart.

Patient Data	Staged (n=131)	Simultaneous (n=104)	p value
Age (years)	64.2	59.5	<0.001
Length of Stay (Days)	7.2	3.8	<0.001
Preoperative Hemoglobin (g/dL)	12.7	13.3	0.007
Blood transfused (units)	1.45	1.74	0.222
ASA	2.51	2.35	0.038
BMI	36.0	31.6	0.001
Charlson Comorbidity Index	1.06	0.53	<0.001
Male (%)	30 (23)	39 (38)	0.014
Required transfusion (%)	85 (65)	74 (71)	0.307
Perioperative Complication (%)	12 (9)	19 (18)	0.040
Hypertension (%)	105 (80)	68 (65)	0.011
Hyperlipidemia (%)	39 (30)	32 (31)	0.868
Diabetes Mellitus (%)	38 (29)	6 (6)	<0.001
Coronary Artery Disease (%)	26 (20)	12 (12)	0.085
COPD (%)	14 (11)	2 (2)	0.008
Chronic Renal Insufficiency (%)	8 (6)	2 (2)	0.192
HIV (%)	2 (2)	2 (2)	1
Hepatitis B or C (%)	6 (5)	9 (9)	0.283
Mortality (%)	1 (1)	0 (0)	1

Discussion

Staged bilateral TKA is an option for patients with advanced degenerative joint disease of both knees who desire a single rehabilitation period, and who have medical comorbidities putting them at high risk during simultaneous bilateral TKA. There were several limitations to our study, however. A selection bias exists in the decision to proceed with simultaneous bilateral TKA. Surgeons are much more likely to select younger, healthier patients to undergo a simultaneous operation. Our data confirm this, as the simultaneous group was younger and had lower ASA scores, Charlson Comorbidity Indices, and BMI. Despite being older and having more medical comorbidities, patients who underwent staged bilateral TKA had lower complication rates, which approached statistical significance (p=0.054). While our study identified perioperative complications during the index hospital admission, we did not have long-term follow-up to identify many of their adverse events including osteolysis, bearing surface wear, or periprosthetic fracture. Our data are consistent with prior smaller series demonstrating a low complication rate with a staged bilateral procedures one week apart.[1,8]

Conclusion

Staging bilateral TKA one week apart has low complication rates and is a viable option for patients with advanced degenerative disease and deformities of both knees who desire a single rehabilitation period. Staged procedures are particularly attractive for those with medical comorbidities precluding a simultaneous operation.

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