

Considerations for Readmissions in Simultaneous Bilateral Total Knee Arthroplasty

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Abstract

Introduction: Bilateral Total Knee Arthroplasty (BTKA) procedures bestow challenges to patients in their recovery. Studies show that patients undergoing a simultaneous BTKA procedure have a significantly increased need for blood transfusion and postoperative rehabilitation and are at greater risk for complications. These challenges may lead to readmission to the hospital in this particular population. The aim of this study was to examine the differences and demographics of readmitted BTKA patients.

Methods: After gaining approval from our Institutional Review Board, a retrospective review of our hospital's Electronic Medical Records (EMR) was performed for patients who underwent a simultaneous BTKA procedure at Morristown Medical Center (MMC) between August 2018 and September 2020. In total, 328 procedures were identified during this period. Demographic and clinical data was abstracted from the hospital EMR for the identified patients. Readmission events were identified at 30 days, 90 days, and one year postoperatively from the patients billing abstracts. Readmissions were determined following the date of discharge. Basic and univariate statistics for significance were performed using the statistical software Minitab (State College, PA, USA). P-value results ≤ 0.05 were considered significant.

Results: Of the 328 simultaneous BTKA procedures abstracted, 15 patients with at least one readmission event were identified. This readmitted population shared similar demographics with non-readmitted BTKA patients. A greater BMI trended toward statistical significance in readmitted BTKA patients (34.08 v. 31.41; $P=0.093$). ASA scores were found to trend to statistical significance as well. More non-readmitted patients received an ASA score of 2 (73.16% v. 53.33%; $P=0.131$), while more readmitted patients received an ASA score of 3 (40.00% v. 21.73%; $P=0.155$). The only ASA score of 4 assigned was to a readmitted BTKA patient. (6.67% v. 0%; $P=0.046$).

Readmitted BTKA patients exhibited a statistically significant greater median observed length of stay (LOS) than patients who were not readmitted (4 v. 3 days; $P=0.05$). The indexed LOS (determined by a risk stratification algorithm) was expectedly greater and trended toward statistical significance in readmitted patients as well (2 v. 1.5 days; $P=0.178$). There was no significant difference observed in discharge disposition between the two populations.

Introduction

Osteoarthritis is the most common form of arthritis among older people and a frequent cause of physical disability in this population. Specifically, the pooled global prevalence of knee osteoarthritis is 16% [1]. Additionally, diseases such as rheumatoid arthritis and hemophilia can lead to knee destruction, with a reported prevalence of bilateral involvement as high as 19% [2]. For patients with such diseases coinciding with knee destruction,

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total knee arthroplasty has proven to be the treatment of choice as the procedure can restore physical function, relieve pain, and ultimately improve the patient's quality of life [3]. Due to advancements in surgical techniques and prosthetic design, as well as the expansion of eligibility to patients with less severe symptoms, the rate of total knee arthroplasty in the United States has doubled since 2000 [4-6]. Thus, the total number of procedures performed each year now exceeds 640,000 with an estimated cost of 10.2 billion dollars [4,5].

However, patients with symptoms in both knees have the option to undergo bilateral total knee arthroplasty (BTKA) simultaneously. There have been reports in the literature documenting that this procedure is safe and associated with higher patient satisfaction as well as lower costs [7-9]. Yet, many studies have shown higher complication rates related to simultaneous BTKA such as: increased intraoperative blood loss, greater need for perioperative blood transfusion, increased rates of venous thromboembolism, cardiorespiratory complications, neurologic complications, wound breakdown, infection, and mortality [10-13]. Due to the greater effect on cardiovascular and pulmonary systems, simultaneous BTKA are different pathophysiological entities than unilateral total knee arthroplasties [11]. As a result, orthopedic surgeons have avoided patients with cardiopulmonary comorbidities that could lead to increased complications and ultimately hospital readmission [11,14].

To our knowledge, few studies have focused on the risk factors and comorbidities associated with complication rates leading to readmission following a simultaneous BTKA. The purpose of this study is to examine the association between individual patient characteristics such as physical attributes, comorbidities, and ASA scores on patients readmitted following simultaneous BTKA in a three year period at MMC.

Methods

After gaining approval from our Institutional Review Board, a retrospective review of MMC's EMR was performed for patients who underwent a simultaneous BTKA procedure at MMC between August 2018 and September 2020. Patient demographics, comorbidities, and any readmissions within 1 year of surgery due to mechanical complication (periprosthetic fracture or dislocation) or non-mechanical complication (infection, cardiac, neurological, deep vein thrombosis, pulmonary embolism) were all extracted from patient charts. For each BTKA procedure, either a Stryker (Mahwah, NJ) or Zimmer-Biomet (Parsippany, NJ) prosthesis was used.

Inclusion criteria for the study were as follows: patients treated at MMC for simultaneous BTKA, had minimum of three year follow up data, and being 18 years of age or older. Exclusion criteria included: patients undergoing staged BTKA, unilateral TKA, revision TKA and being 18 years of age or younger. Basic and univariate statistics for significance

were performed using the statistical software Minitab (State College, PA, USA). Results were deemed statistically significant if the calculated p-value was less than 0.05.

Demographic data included age, gender, race, ethnicity, height, weight, BMI, ASA score, and length of stay (LOS.) Medical comorbidities such as hypertension, diabetes, chronic obstructive pulmonary disease (COPD), congestive heart failure (CHF), renal disease, osteoarthritis, smoking history, cardiac history, alcohol use, depression and dementia were also recorded. In total, 328 procedures were identified during this period. Readmission events were identified at 30 days, 90 days, and one year postoperatively from the patients billing abstracts.

Results

In total, 328 cases were identified with 313 having no readmission and 15 being readmitted. Of the 313, 148(47.28%) were males and of the 15 8(53.33%) were males. The average age of the patients readmitted was 65.13 years old and the average age of those not readmitted was 63.543. There were significant differences in race or ethnicity between groups as well as payment type as indicated in table 1.

A greater BMI trended toward statistical significance in readmitted BTKA patients (34.08 v. 31.41; P=0.093). ASA scores were found to trend to statistical significance as well. More non-readmitted patients received an ASA score of 2 (73.16% v. 53.33%; P=0.131), while more readmitted patients received an ASA score of 3 (40.00% v. 21.73%; P=0.155). The only ASA score of 4 assigned was to a readmitted BTKA patient. (6.67% v. 0%; P=0.046) as indicated in table 2. Readmitted BTKA patients exhibited a statistically significant greater median observed length of stay (LOS) than patients who were not readmitted (4 v. 3 days; P=0.05). The indexed LOS (determined by a risk stratification algorithm) was expectedly greater and trended toward statistical significance in readmitted patients as well (2 v. 1.5 days; P=0.178). There was no significant difference observed in discharge disposition between the two populations whether patients were discharged home, to hospice, hospital transfer, SAR or SNF as demonstrated in table 3.

When analyzing readmission rates, of the 13 patients that underwent BTKA that were readmitted, 1(6.67%) was readmitted within 30 days for a mechanical complication (p=.046) and 5(33.3%) were readmitted within 30 days for non mechanical readmissions (p<0.001). There were no mechanical or nonmechanical readmissions found at the 60 day interval. Four patients (26.67%) were readmitted with mechanical complications at the 90 day interval p<0.001 and 1(6.67%) with a non mechanical complication (p<0.001). At the 1 year interval, 3 (20%) patients were readmitted with mechanical complications (p<.001) and 4 (26.67%) with non mechanical readmissions (p<.001) as indicated in table 4.

Table 1: Demographics of BTKA Patients at MMC Aug 2018-Sep 2020

	No readmit n=313	Readmit n=15	p-value
Age, mean (SD)	63.543 (7.753)	65.13 (5.48)	0.299
Sex=male, n (%)	148 (47.28%)	8 (53.33%)	0.646
Race, n (%)			
Asian	11 (3.514%)	0 (0%)	>0.999
Black	8 (2.556%)	1 (6.667%)	0.347
Declined	2 (0.639%)	0 (0%)	>0.999
Other	11 (3.514%)	0 (0%)	>0.999
Unavailable	3 (0.958%)	0 (0%)	>0.999
White	278 (88.818%)	14 (93.333%)	
Ethnicity, n (%)			
Declined	3 (0.96%)	0 (0%)	>0.999
Hispanic Origin Unknown	5 (1.6%)	0 (0%)	>0.999
Non Hispanic Origin	301 (96.17%)	15 (100%)	>0.999
Unavailable	4 (1.28%)	0 (0%)	>0.999
Payer, n (%)			
Medicare	138 (44.09%)	8 (53.33%)	0.483
Private	175 (55.91%)	7 (46.67%)	0.483

Table 2: Body Mass Index, ASA Rating, and Length of Stay observed in BTKA Patients at MMC Aug 2018-Sep 2020

	No readmit n=313	Readmit n=15	p-value
BMI (kg/m²), mean (SD)	31.412 (6.010)	34.08 (5.61)	0.093
ASA, n (%)			
1	16 (5.11%)	0 (0%)	>0.999
2	229 (73.16%)	8 (53.33%)	0.131
3	68 (21.73%)	6 (40%)	0.155
4	0 (0%)	1 (6.67%)	0.046
ASA, median (IQR)	2 (2, 2)	2 (2, 3)	0.015
LOS Observed, median (IQR)	3 (2, 4)	4 (2, 5)	0.05
LOS Index, median (IQR)	1.5 (1, 2)	2 (1, 2)	0.178

Table 3: Discharge Disposition Observed in BTKA Patients at MMC Aug 2018-Sep 2020

Disposition	No readmit n=313	Readmit n=15	p-value
Home - Self Care	73 (23.32%)	4 (26.67%)	0.758
Home Health	150 (47.92%)	7 (46.67%)	>0.999
Hospice	1 (0.32%)	0 (0%)	>0.999
Hospital Transfer	3 (0.96%)	0 (0%)	>0.999
SAR	51 (16.29%)	2 (13.33%)	>0.999
SNF	35 (11.18%)	2 (13.33%)	0.681

Discussion

Given their increased complexity, simultaneous BTKA poses a greater risk of readmission than unilateral TKA procedures. Our findings identified higher BMI and ASA scores were associated with risk of readmission to BTKA patients. Physicians should consider these factors in their selection and preoperative counseling of patients.

The findings of our study, that higher readmission rates following BTKA are associated with greater patient comorbidities, reflects the findings of previously published studies. A recent study by Warren et al. found simultaneous BTKA with medical comorbidities was associated with a threefold higher risk of any complication compared with patients who underwent unilateral total knee arthroplasty

Table 4: Mechanical and Non-Mechanical Readmissions Observed in BTKA Patients at MMC Aug 2018-Sep 2020

	No readmit n=313	Readmit n=15	p-value
30 Day Mech Readmission	0 (0%)	1 (6.67%)	0.046
30 Day Non-mech Readmission	0 (0%)	5 (33.33%)	<0.001
90 Day Mech Readmission	0 (0%)	4 (26.67%)	<0.001
90 Day Non-Mech Readmission	0 (0%)	1 (6.67%)	0.046
1 Year Mech Readmit	0 (0%)	3 (20.00%)	<0.001
1 Year Non-Mech Readmission	0 (0%)	4 (26.67%)	<0.001

[14]. Using an estimated sample of 206, 573; Memtsoudis et al. used nationwide inpatient survey data and found an increasing number of comorbidities was identified as an independent risk factor for major complications and mortality following BTKA [15]. Similarly, the same author published a related article of 4,159,661 discharges of BTKA, unilateral total knee arthroplasty and revision total knee arthroplasty and found the prevalence of procedure related complications and in-hospital mortality was higher in patients with comorbidities undergoing BTKA [11]. Fabi et al. also conducted a study examining unilateral versus bilateral total knee arthroplasty risk factors that increase morbidity. They concluded that age, body mass index and a preexisting pulmonary disorder resulted in increased complications following BTKA [16]. Additionally, despite looking at unilateral total knee arthroplasties, a 2017 study completed by Tay et al. focused on a six year period of octogenarians and found comorbidities had an impact on complication rate [17]. Further, Bovonratwet et al. examined the risk factors for 30-day readmission rate following total hip arthroplasty and concluded patients who are high risk were those with older age and bleeding disorders [18]. Also, Podmore et al. found that comorbidities increase the short term risk of hospital readmission, mortality and revision surgical procedures [19].

However, multiple studies demonstrated that there is no difference in complication rates between BTKA compared with unilateral TKA. Hart et al. utilized The National Surgical Quality Improvement Program and examined the 30-day complication rates of patients who underwent BTKA (n=1,771) and unilateral TKA (n=6,790) over a three year period. They found a low number of readmissions and major complications following BTKA [20]. Zeni et al. also found no difference in complication rate following BTKA and unilateral TKA. Despite the limitation of a small sample size, no subjects in the study reported or had serious postoperative complications [21]. Additionally, Ritter et al. conducted a survival analysis of 6,200 TKAs (simultaneous BTKA=2050, UTKA=1796, staged BTKA=152), and found no significant difference regarding prosthetic failure, cardiac complications and the rates of death in the three groups [22]. Yet, it was found the unilateral group had significantly lower Knee Society scores that simultaneous BTKAs [22].

Despite it not being the primary focus of this present study, the debate between simultaneous, and staged BTKA must also be discussed. Benefits of BTKA include decreased overall hospital stay, length of stay, less anesthesia time, decreased overall rehabilitation and decreased cost to the patient and health care system compared with unilateral TKA [23-26]. Yet, several studies have demonstrated the increased risk of complications following BTKA. Liu et al. conducted a systematic review in 2019 assessing the clinical outcome associated with simultaneous BTKA and stage BTKA. They found simultaneous BTKA was associated with higher rates of mortality, pulmonary embolism, and deep vein thrombosis compared with staged BTKA [27]. Although it was determined simultaneous BTKA had a lower risk of deep infection and respiratory complications [27]. Dong et al. also conducted a meta analysis comparing simultaneous and staged BTKA that concluded simultaneous BTKA was associated with higher rates of mortality, blood transfusion, and pulmonary embolism [13]. However, the studies included were published before 2000. In contrast, several published studies have found simultaneous BTKA does not increase risk of complications such as death, cardiac complications, neurological complications, or revision compared with staged BTKA [28-31]. It has also been documented in the literature that simultaneous BTKA is as safe as the staged BTKA based off a systematic review conducted by Malahias et al. that compared 19 articles that demonstrated there was no significant difference in mortality rate, cardiac complications, revision rate, thromboembolic events, and functional outcomes [32].

The authors acknowledge the present study has several limitations. As a retrospective review of patient records, it includes all inherent biases associated with retrospective studies. Given the lack of blinding and randomization, each surgeon and patient was allowed to decide together whether to perform a simultaneous BTKA or staged BTKA at their discretion. This preference was influenced by the surgeon's habit and training, pre-operative assessment of cartilage on radiographic findings, and the patient's medical history that could leave them predisposed to postoperative complications. Our study also did not control for the stem model. It is possible different surgeons used different prosthetic designs of their respective BTKA. Finally, we observed low rates of

readmission in our sample population over a three-year period of follow up, limiting the power of our analysis. This may be reflected in our data analysis trending towards statistical significance. Based on our findings, higher BMI and ASA scores were associated with risk of readmission to BTKA patients. Further studies in the United States may require large, registry based efforts to reveal small effect sizes.

Conclusion

The use of simultaneous BTKA as a procedure for the treatment of conditions such as osteoarthritis, and rheumatoid arthritis is still debated in the literature. This is due to the controversy that simultaneous BTKA has been associated with higher complication rates post operatively. Among patients that underwent BTKA at a large United States regional trauma center in a three year period, patients that had higher BMI and ASA scores were associated with higher risk of readmission following the procedure. These findings suggest the United States surgeons should consider the benefits and disadvantages of BTKA for each individual case. However, a prospective, randomized control study would still be required to further demonstrate hospital readmission rate following BTKA is associated with higher BMI and ASA scores.

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