

The safety of simultaneous bilateral versus unilateral total knee arthroplasty: the experience in a Korean hospital

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ABSTRACT

Introduction: The safety of simultaneous bilateral total knee arthroplasty (SBTKA) remains controversial. This study aimed to compare the postoperative outcomes of SBTKA versus unilateral total knee arthroplasty (UTKA) performed by a single surgeon at a tertiary teaching hospital in Korea.

Methods: 629 female patients with total knee arthroplasty (308 patients for SBTKA and 321 for UTKA) performed under combined spinal epidural anaesthesia (CSE) were selected, and their medical records during admission and follow-up visits for a duration of six months after discharge were reviewed.

Results: Although significantly higher incidences of postoperative confusion and hypoxia during hospitalisation and a longer hospital stay were demonstrated in the SBTKA group, the rates of serious postoperative complications, such as myocardial infarction and deep venous thrombosis, were not different between the groups during the hospital stay and six months afterwards. No death associated with the surgery was encountered in both groups.

Conclusion: It was concluded that SBTKA under CSE may be considered to be relatively safe in Korean female patients.

Keywords: perioperative complications, simultaneous bilateral total knee arthroplasty, total knee arthroplasty, unilateral total knee arthroplasty

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INTRODUCTION

In keeping with an increase in the number of elderly patients with a concomitant increase in the prevalence of degenerative osteoarthritis, total knee arthroplasty

(TKA) is now one of the most common orthopaedic surgeries performed in the elderly. Recently, it has been accepted that simultaneous bilateral total knee arthroplasty (SBTKA) compared to unilateral total knee arthroplasty (UTKA) is a relatively safe and effective treatment for pain relief and the restoration of function, with the added advantages of a shorter hospital stay and consequently decreased overall cost.⁽¹⁻⁴⁾ However, some physicians have noted clinical concerns with SBTKA, because it still carries a potentially higher risk of serious complications, such as myocardial infarction, deep venous thrombosis and pulmonary embolism, especially in elderly patients.^(1,3,5-9) It has been suggested that the surgical volume of TKA,⁽¹⁰⁾ the experience of the surgeon,⁽²⁾ perioperative analgesic technique,⁽¹¹⁻¹⁵⁾ and gender,^(8,10) are related factors that influence the outcomes after TKA. A sizable number of SBTKA and UTKA under combined spinal epidural anaesthesia (CSE) are performed in this institute. Therefore, the aim of the current study was to determine the frequency of early complications and any additional complications for a duration of six months after discharge for female patients undergoing SBTKA or UTKA under CSE at a tertiary teaching hospital in Korea.

METHODS

With the approval of the institutional review board, a retrospective review of the medical records of 629 female patients who were diagnosed with degenerative arthritis and who underwent TKA with CSE by a single experienced surgeon at this tertiary teaching hospital between January 2006 to October 2007 was conducted. The patients, who were all female, were divided into two groups: UTKA group (n = 321) and SBTKA group (n = 308). In order to avoid a gender effect for different responses to major surgery, only female patients were included in this study. All patients received a standard preoperative assessment. Prophylactic antibiotics were administered to all patients one hour prior to incision. Although detailed information about the operative technique was abstracted, the same surgical technique, with extramedullary (EM) guides for both the femoral

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Table I. Demographic and clinical data.

	UTKA (n = 321)	SBTKA (n = 308)	p-value
Age (years)	69.1 ± 6.2	67.7 ± 6.3	0.0038
Height (cm)	151.9 ± 5.4	151.3 ± 5.5	NS
Weight (kg)	62.3 ± 8.6	62.4 ± 8.4	NS
ASA (no.)			
One	93	97	
Two	226	210	
Three	2	1	
Hypotension in ward (no.)	21	75	< 0.0001
Total fluid during OP			
Crystalloid (ml)	639 ± 290	887 ± 367	< 0.0001
Colloid (ml)	466 ± 129	818 ± 262	< 0.0001
Estimated blood loss (ml)			
Day of surgery	763 ± 307	1583 ± 576	< 0.0001
Postoperative Day 1	114 ± 84	198 ± 123	< 0.0001
Haemoglobin (g/dL)			
Preoperative	13.06 ± 1.06	13.02 ± 1.12	NS
At discharge	10.25 ± 1.28	9.49 ± 1.12	< 0.0001
Hospitalisation (days)	8.8 ± 2.3	9.8 ± 6.5	0.0041

NB: Values are mean ± SD or number of patients.

UTKA: unilateral total knee arthroplasty; SBTKA: simultaneous bilateral total knee arthroplasty; ASA: American Society of Anaesthesiologist; NS: not statistically significant; OP: operation.

and tibia sides using a locking system between the two, was used. EM guides for both sides were used for the following reasons: (1) When a femoral deformity exists, intramedullary (IM) guides are difficult to apply; (2) If the starting point into the canal is incorrect, the IM rod may come into contact with the femoral cortices; and (3) IM guides insertion can create fatal embolic debris after IM guide insertion. Tourniquet applications were conducted in both groups of patients. The SBTKA was performed sequentially, i.e. at the time of the muscle closure of the first knee, the operator moved on to the other knee, and thus tourniquet times were partially overlapped from the start of the second knee to the completion of the first knee, all of which took approximately 20 minutes.

Anaesthetic care was also standardised for all the patients. Each patient equally received CSE, 0.5% marcaine (Astra Zeneca, Sodertalje, Sweden) intrathecally for surgery, and 2% lidocaine (Huons, Hwaseong, Republic of Korea) and fentanyl (Guju Pharm, Hwaseong, Republic of Korea) epidurally if the patient complained of pain or discomfort during surgery. The postoperative analgesia was maintained by the patient controlled epidural analgesia (PCEA) for three days. Whenever patients requested more analgesics other than PCEA during hospitalisation, pethidine HCl was first administered, followed by ketorolac (Hana Pharm, Hwaseong, Republic of Korea). Postoperative antibiotic therapy, venous thrombosis prophylaxis and passive motion movement for rehabilitation after surgery followed a fixed hospital protocol.

All clinical information for demographic data, preoperative comorbidities, intraoperative events, postoperative outcomes (including the amount of bleeding and transfusion), surgery-related complications, rates of reoperation and mortality during the hospital stay and within six months after discharge, were reviewed and compared between the groups. As a limitation of this retrospective study, the documented preexisting disease and postoperative events, either plausible or obvious, were dependent on the clinical records. Statistical analysis was performed using the SAS/Genetics SAS 9.1.3 (SAS Institute Inc, Cary, NC, USA). For statistical analysis, the Student's *t*-test or Wilcoxon two-sample test for the parametric data and the Fisher's exact test or chi-square test for the proportion of preexisting medical conditions and postoperative complications in the two groups, were used. A p-value of < 0.05 was considered statistically significant.

RESULTS

The patients' height and weight were similar between the two groups, but the average age at the time of surgery in the UTKA group was 1.4 years older than in the SBTKA group ($p = 0.0038$). With regard to intraoperative clinical data, a significantly longer operative time ($p < 0.0001$) and tourniquet time ($p < 0.0001$), a greater amount of total intraoperative crystalloid ($p < 0.0001$) and colloid ($p < 0.0001$) were demonstrated in the SBTKA group. Rates of hypotensive episodes requiring vasopressors and volume replacement were similar during surgery, but

Table II. Preoperative underlying diseases.

Underlying medical condition	UTKA (n = 321)	SBTKA (n = 308)	p-value
Cardiovascular disease			
Angina	20	10	NS
Arrhythmia	33	36	NS
Congestive heart failure	1	2	NS
Hypertension	171	168	NS
Other condition	24	18	NS
Pulmonary disease			
COPD	8	6	NS
Other condition	1	2	NS
Endocrine disease			
Diabetes mellitus	57	48	NS
Thyroid disease	9	12	NS
Adrenal disease	5	4	NS
Neurological disease			
Stroke	15	5	0.029
Other conditions	4	1	NS
Hepatic disease	5	4	NS
Chronic renal failure	3	2	NS
Psychologic disease	2	0	NS
Rheumatologic disease	2	1	NS
Total no. of patients with underlying medical conditions	234	228	NS

UTKA: unilateral total knee arthroplasty; SBTKA: simultaneous bilateral total knee arthroplasty; NS: not statistically significant; COPD: chronic obstructive pulmonary disease.

significantly higher in the SBTKA group after surgery ($p < 0.0001$). Blood loss on the day of surgery ($p < 0.0001$) and on postoperative Day 1 ($p < 0.0001$) was greater in the SBTKA group, and thus more blood transfusions were required (an average of 2.2 units of bank blood transfusion in 113 patients with SBTKA vs. 1.8 units in 12 patients with UTKA) ($p < 0.0001$) in addition to autologous transfusion in 156 patients in the SBTKA group and 200 patients in the UTKA group. Haemoglobin levels at discharge were 9.49 g/dL and 10.25 g/dL in the SBTKA and UTKA groups, respectively, and these differences were found to be significant ($p < 0.0001$). The hospitalisation period in the SBTKA group was only one day longer than in the UTKA group, and this was significantly different ($p = 0.0041$) (Table I).

Although there was no difference with respect to the total number of patients having one or more preexisting medical conditions between the SBTKA (74%) and UTKA (73%) groups, the latter had significantly more preexisting episodes of stroke than the SBTKA group (15 patients vs. 5 patients, $p = 0.029$) (Table II). The prevalence of postoperative complications until discharge was significantly higher in the SBTKA group, with an overall 137 complications in 115 patients (37%) and 54 complications in 47 patients (15%) in the SBTKA and UTKA groups, respectively ($p < 0.0001$), and no difference after discharge (14 vs. 13 patients). The only outcomes that were significantly different between the

groups during hospitalisation were the higher rates of postoperative confusion (14 vs. 5 patients, $p = 0.029$) and postoperative hypoxic episodes (99 vs. 35 patients, $p < 0.0001$) in the SBTKA group. A hypoxic episode was defined as less than 90% of peripheral oxygen saturation with room air, and occurred mostly within 24 hours post surgery. Analysis of the rates for wound infection, severe pain and revision operation did not reveal any difference during hospitalisation and within six months after discharge. Anaesthesia-related sequelae, such as epidural haematoma and epidural infection, did not occur in any patient.

The prevalence of serious complications, such as myocardial infarction, deep venous thrombosis and stroke, between the SBTKA and the UTKA groups was not statistically different during hospitalisation and within six months after discharge. The two patients in both groups who presented with postoperative myocardial infarction during their hospital stay had preexisting cardiac diseases; one patient in the UTKA group had preexisting hypertension and angina symptoms in addition to diabetes mellitus; the other patient in the SBTKA group had preexisting aortic valve regurgitation and congestive heart failure. No patient in either group presented with clinically-relevant new myocardial infarction within six months after discharge. Deep venous thrombosis occurred in two patients in the SBTKA group during hospitalisation. However, delayed

Table III. Postoperative complications.

Complications	UTKA (n = 321)	SBTKA (n = 308)	p-value
Cardiovascular			
Myocardial infarction	1	1	NS
Angina	3	3	NS
Arrhythmia	4	7	NS
Heart failure	1	0	NS
Deep vein thrombosis			
During hospitalisation	0	2	NS
After discharge	6	2	NS
Pulmonary oedema	1	1	NS
Neurologic stroke			
During hospitalisation	1	1	NS
After discharge	0	1	NS
Confusion	5	14	0.029
Liver function abnormality	1	6	NS
Gastric haemorrhage	1	1	NS
Hypoxia	35	99	< 0.0001
Wound infection			
During hospitalisation	0	3	NS
After discharge	3	7	NS
Revision operation			
During hospitalisation	1	0	NS
After discharge	1	3	NS
Total complications			
During hospitalisation	47	115	< 0.0001
After discharge	10	13	NS

UTKA: unilateral total knee arthroplasty; SBTKA: simultaneous bilateral total knee arthroplasty; NS: not statistically significant

onset of deep venous thrombosis occurred more in the UTKA group within the six-month period of follow-up visits. Patients who had deep venous thrombosis were treated with heparin and warfarin, and none experienced pulmonary embolism (Table III). There was no death related to surgery or anaesthesia. One patient in the UTKA group died of metastatic cancer after discharge.

DISCUSSION

Recently, SBTKA under single anaesthetic has become an attractive option for patients requiring both knee replacements. Compared to UTKA, SBTKA is more affordable because of the shorter period of postoperative rehabilitation and hospital stay.⁽²⁻⁴⁾ However, the choice of SBTKA instead of staged TKA or UTKA remains controversial. Although some studies have suggested a higher risk of cardiac morbidity, pulmonary embolism, deep vein thrombosis and mortality after SBTKA compared to UTKA,^(1,3,5-9) there have also been supportive studies that have demonstrated no definite higher perioperative complications for SBTKA compared to UTKA.^(2,4) In studies with increased frequencies of serious complications after SBTKA, older patients and patients with preoperative medical conditions were at a greater risk.^(5,7) Previous studies suggesting that SBTKA is a relatively safe procedure had a small number of

patients.^(2,4) Our study demonstrated that, compared with UTKA, SBTKA is relatively safe in terms of postoperative complications. Only minor complications, such as confusion and transient hypoxia, remained significantly higher in the SBTKA group compared to the UTKA group during the hospital stay. There were no postoperative complications in the SBTKA group within six months after discharge. In contrast to previous reports,^(2,4) our study had a large study sample with a similar number of patients in each group.

Similar to previous studies, the patients in the SBTKA group had a substantially shorter total hospital stay. In the current study, it is estimated that second-stage TKA would double the length of hospital stay (mean 9.8 and 8.8 days in 308 patients from the SBTKA and 321 patients from the UTKA groups, respectively). All patients were discharged directly home safely. With respect to preoperative medical conditions, there was no difference between the groups except for the significantly lower episode of stroke in the SBTKA group vs. the UTKA group, with an average age of 68 and 69 years at the time of surgery, respectively. When performing SBTKA under one anaesthetic, serious medical episodes may deter surgeons from proceeding with SBTKA in these patients.

In the analysis of postoperative complications,

a significantly higher proportion of patients in the SBTKA group (37% vs. 17%) showed surgery-related complications during hospitalisation, but there was no difference between the two groups within six months after discharge (3% vs. 2.8%). As for minor and self-limited complications, episodes of postoperative hypoxia and confusion were significantly higher in the SBTKA group, as in previous studies.^(1,3,4) Hypoxic episodes occurred mostly within 24 hours after surgery and subsided with oxygen supplementation. The higher rate of postoperative confusion after SBTKA was likely due to the lower haemoglobin levels and the systemic dissemination of fat emboli.^(1,4,6) Kim has reported that the higher incidence of fat embolism after SBTKA vs. UTKA was determined with histological slides.⁽⁶⁾ Although no generalised fat emboli syndrome was found in the current study, postoperative neurological manifestations, such as confusion together with hypoxic episodes, could be attributed to fat emboli. The two patients who showed a focal neurological deficit associated with postoperative confusion were discharged without sequelae in this study.

As a significant cause of morbidity and mortality after TKA, the risk of cardiac complications, including myocardial infarction, is of great concern. Although it is generally accepted that there is a potentially higher risk of cardiac complications in SBTKA vs. UTKA, especially in the older age group,^(1,5,7-9) due to the inability to manage fluid shift after the TKA procedure, postoperative myocardial infarction was noted in one patient during the hospital stay, and none within six months after discharge in both groups in this study. It was found that the occurrence of myocardial infarction after TKA in this study was associated with various preoperative underlying cardiac conditions rather than the patient's age (71 and 69 years in the SBTKA and UTKA groups, respectively). Other studies have also suggested that the patient's preoperative cardiovascular medical condition is a strong predictor of postoperative cardiovascular complications after SBTKA.^(5,7)

The increased risk of deep venous thrombosis and pulmonary embolism in association with SBTKA is a serious concern. Interestingly, the data for the prevalence and timing of clinically significant venous thromboembolism after SBTKA and UTKA was mixed. In the current study, two patients presented with deep venous thrombosis during hospitalisation in the SBTKA group, and none in the UTKA group. In contrast, deep venous thrombosis occurred in one and six patients during the six-month follow-up visits in the SBTKA and UTKA groups, respectively. The prevalence of

thromboembolic disorder was higher after SBTKA vs. UTKA in some studies,^(3,8) while the prevalence of deep venous thrombosis was similar,⁽⁷⁾ or lower in other studies.^(1,9) The exact mechanism of the low prevalence of deep venous thrombosis after SBTKA vs. UTKA is not clear. In addition, venous thromboembolism after TKA occurred mostly during hospitalisation.^(3,8) Thromboembolism after TKA may happen well after the discharge as a late-onset complication.⁽¹⁶⁾ The patients who had deep venous thrombosis were diagnosed by their clinical signs, confirmed by using compressive duplex ultrasonography, and treated with heparin and warfarin, but they were not linked with pulmonary embolism in this study. However, it should be noted that the clinically insignificant small size of pulmonary emboli might have not been detected in routine practice.

The results of this study showed that the six-month mortality rates were 0%, and the prevalence of serious complications, such as myocardial infarction or deep venous thrombosis, was very low and not statistically different between the two groups until six months after surgery. Our findings were specifically obtained from female patients only in order to avoid gender-specific effects on postoperative complications. According to previous studies,^(8,10) the rates of myocardial infarction, mortality and wound infection after TKA are different for the genders. The putative reasons for the lower rates of serious complications such as myocardial infarction and deep venous thrombosis, and for the absence of pulmonary embolism after TKA in this study, may be ascribed to the surgical volume of the institution, the experience of the surgeon, the anaesthetic technique used and postoperative pain control.

The relationship between surgical volume and outcomes following TKA⁽¹⁰⁾ and total hip arthroplasty⁽¹⁷⁾ has been previously suggested. SooHoo et al⁽¹⁰⁾ have indicated that surgical volume is one factor that predicts the rates of complications, infection, pulmonary embolism and mortality following TKA, and that the larger size is associated with fewer complications. Approximately 1200 cases of TKA are performed in our hospital by three TKA teams per year compared to one-quarter of that number for SBTKA. The rates of perioperative complications and patients' satisfaction following TKA are also related to the level of experience of the surgeon.⁽²⁾ As a tertiary teaching hospital, it is therefore important for our institution to evaluate the outcomes of SBTKA vs. UTKA.

All cases of TKA included in the current study were conducted using the CSE technique. Anaesthetic methods may also affect the outcomes of surgery. Neuraxial block

has been reported to maintain a haemodynamically-stable response to some extent, even in compromised patients, which has reduced perioperative cardiac morbidity and pulmonary embolism.^(13,15) Therefore, the practice of using CSE in patients undergoing TKA results in better postoperative outcomes.^(11,12,14) In addition, the epidural analgesic technique vs. intravenous pain control was shown to be a better choice in controlling postoperative pain and facilitating rehabilitation in TKA patients.⁽¹¹⁾ As with previous studies,^(18,19) no serious complications, such as epidural infection or haematoma associated with the spinal or epidural procedure, were encountered.

As a retrospective study, the limitation of the current study is that the outcomes, in terms of significant complications from SBTKA vs. UTKA, were completely dependent on the accuracy of the medical records. Despite the limitations, the current analysis of postoperative complications of SBTKA vs. UTKA may be a useful reference for further investigations in this area. In conclusion, SBTKA is not an independent risk factor compared to UTKA in advanced surgical and anaesthetic techniques and proper postoperative pain control.

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