Morbidity and mortality after bilateral simultaneous total knee arthroplasty in a fast-track setting

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Submitted 2015-07-15. Accepted 2015-12-07.

Background and purpose — The safety aspects of bilateral simultaneous total knee arthroplasty (BSTKA) are still debated. In this retrospective single-center study, we investigated early morbidity and mortality following BSTKA in a modern fast-track setting. We also identified risk factors for re-admission within 90 days and for a length of stay (LOS) of more than 5 days.

Patients and methods — 284 patients were selected to receive BSTKA at our institution from 2008 through 2014 in a well-described, standardized fast-track setup (Husted 2012 a, b). All re-admissions within 90 days were identified and mortality rates and time until death were recorded. Transfusion rates and numbers of transfusions were also recorded. Logistic regression analysis was used to identify risk factors for re-admission within 90 days, and also for a LOS of more than 5 days.

Results — 90-day mortality was 0%. 10% of the patients were re-admitted within 90 days. Median time to re-admission was 18 (3–75) days. 153 patients (54%) received postoperative blood transfusions. An ASA score of 3 was identified as an independent risk factor for re-admission within 90 days (OR = 5, 95% CI: 1.3–19) and for LOS of > 5 days (OR = 6, 95% CI: 1.6–21). Higher BMI was a weak risk factor for re-admission within 90 days.

Interpretation — BSTKA in selected patients without cardiopulmonary disease in a fast-track setting appears to be safe with respect to early postoperative morbidity and mortality. Surgeons should be aware that patients with an ASA score of 3 have an increased risk of re-admission and a prolonged length of stay, while patients with higher BMI have an increased risk of re-admission following BSTKA.

Fast-track knee arthroplasty is a cost-efficient and safe treatment method for osteoarthritis of the knee, with excellent patient satisfaction, early functional recovery, and low postoperative morbidity and mortality (Kehlet 2013). Close to one-third of patients scheduled to undergo primary TKA present with bilateral symptoms (Metcalfe et al. 2012). In these cases, the surgeon can choose to either perform a staged procedure or a simultaneous bilateral procedure, depending on comorbidities, the preference of the patient, and so on. The proposed benefits of bilateral simultaneous TKA (BSTKA), including reduced total financial costs and shorter total convalescence period (Odum et al. 2013, Lin et al. 2014), have led to an increased number of simultaneous procedures in recent decades (Hooper et al. 2009, Memtsoudis et al. 2013, Poultsides et al. 2014, Lindberg-Larsen et al. 2015). However, the safety aspects of BSTKA are still debated, as several studies have shown a higher risk of postoperative complications and even higher postoperative mortality after simultaneous procedures than after staged procedures (Restrepo et al. 2007, Stefánsdóttir et al. 2008, Hu et al. 2011, Bolognesi et al. 2013). On the other hand, other authors have reported that BSTKA is safe without any increase in postoperative morbidity and mortality (Hooper et al. 2009, Bini et al. 2014, Lindberg-Larsen et al. 2015).

Comparison of studies on BSTKA is complicated by the use of different inclusion criteria, different patient populations, and different perioperative protocols. Few studies have investigated mortality and morbidity following BSTKA in a fast-track setting (Husted et al. 2011, Hart et al. 2015). Further studies are needed to evaluate the safety aspects of simultaneous procedures performed in a modern fast-track setup, with surgery performed without drains or tourniquet, same-day mobilization, and a short length of stay (LOS).

In this retrospective single-center study, we investigated early morbidity and mortality following BSTKA in a modern fast-track setting. We also identified risk factors for re-admission within 90 days and for a LOS of more than 5 days.

Patients and methods

284 patients were selected to receive BSTKA at our institution from 2008 through 2014 in a well-described, standardized fast-track setup (Husted 2012). All patients presented with painful bilateral knee osteoarthritis, had no known cardiopulmonary comorbidity, and were operated by a consultant specialized in joint replacement surgery. Minimum follow-up was 1 years (range: 1–7.5). Median age was 65 (33–86) years, 53% of the patients (150/284) were female, and mean BMI was 30 (19–50). 26% of the patients had an ASA score of 1, 68% had an ASA score of 2, and 6% had an ASA score of 3.

All patients received a total knee prostheses—AGC (Biomet), Vanguard (Biomet), NexGen (Zimmer), or PFC Sigma (DePuy Synthes)—using a standard medial parapatellar approach without the use of a tourniquet. The left knee was operated first and surgery was performed sequentially. Cutting guides were applied externally on the tibia and intramedullary on the femur. The standard surgical protocol included spinal analgesia, standardized fluid management, use of preoperative intravenous tranexamic acid (TXA), plugging of the femoral medullary canal, absence of drains, application of local infiltration analgesia (LIA), and use of postoperative compression bandaging. The multimodal opioid-sparing analgesic regime included use of non-steroidal anti-inflammatory drugs, paracetamol, local infiltration anesthesia (LIA applied at the end of surgery only, no catheters), and opioids only upon request.

The patients were transferred from the postoperative recovery unit to the patient ward after a few hours, where immediate mobilization was attempted, allowing full-weight bearing. Physiotherapy was started on the day of surgery and continued until discharge. Rivaroxaban (Bayer, Denmark) was used as oral thromboprophylaxis, starting 6–8 hours postoperatively and continuing on a daily basis until discharge. Mechanical thromboprophylaxis and extended oral thromboprophylaxis were not used. A transfusion protocol was applied with blood transfusions triggered by a 25% decrease in postoperative hemoglobin compared to preoperative values, combined with clinical signs of anemia such as dizziness, shortness of breath, and/or pallor. Patients were discharged when the functional discharge criteria were met, which included being able to undertake independent personal care, being able to walk 70 m with or without crutches, being able to get in and out of bed, and being able to get up independently from a chair or toilet.

LOS was recorded and counted in whole days as the number of postoperative nights in the hospital. All re-admissions within 90 days were identified and the reason for re-admission recorded. Mortality rates and time until death were recorded. Transfusion rates and number of transfusions were also recorded.

Statistics

Comparisons were performed using 2-sample t-test for normally distributed data and a two-sample Wilcoxon rank-sum test for data that were not normally distributed. Proportions were compared using the Pearson chi-squared test. Logistic regression analysis was used to identify risk factors for re-admission within 90 days and for LOS of more than 5 days, while adjusting for age, sex, ASA score, and BMI.

Any p-value less than 0.05 was considered statistically significant. All analyses were performed using SPSS statistics software version 21.

Results

90-day mortality was 0%. 10% of patients were re-admitted within 90 days, with 8% being re-admitted within 30 days. Median time to re-admission was 18 (3–75) days. Surgical site infection treated either with antibiotics alone (n = 2) or with revision (n = 6) was the most common reason for re-admission (Table 1). The proportion of re-admitted patients was not significantly different in between years during the study period (p = 0.9). Median LOS for all patients was 3 (2–30) days. 14% of all patients had a LOS of more than 5 days (data not shown).

54% of patients received blood transfusions postoperatively and 21% received more than 2 units of blood.

Patients with an ASA score of 3 had an OR of 4.9 (95% CI: 1.3–19) for re-admission within 90 days (Table 2) and an OR of 5.8 (95% CI: 1.6–21) for a LOS of more than 5 days (Table 3). Higher BMI was associated with an increased risk of re-admission within 90 days (OR = 1.1, 95% CI: 1.01–1.2) (Table 2).

Table 1. Reasons for 29 re-admissions within 90 days of BSTKA

Reason for re-admission	n
Suspicion of DVT [a]	2
Suspicion of infection [b]	6
Cardiac [c]	4
Thromboembolic [d]	2
Infection [e]	8
Other [f]	7
Total	29

[a] Suspicion of deep-vein thrombosis (DVT), refuted by ultrasound.
[b] Suspicion of infection, refuted by clinical examination and blood sampling.
[c] Patients with chest pains. Cardiac ischemia refuted by blood sampling. 1 patient with atrial fibrillation (medically treated).
[d] 2 patients with DVT confirmed by ultrasound (medically treated).
[e] 6 patients with clinically confirmed infection (treated with surgical revision). 2 patients with superficial site infection (treated with antibiotics).
[f] 2 patients admitted for further mobilization, 1 patient admitted due to wound oozing without suspicion of infection, 1 patient with urinary tract infection, 2 patients with gastric symptoms, and 1 patient with dehydration.

Table 2. Odds ratio for re-admission within 90 days of BSTKA

Parameter	OR (95% CI)	p-value
Age, years [a]	1.1 (0.99–1.1)	0.09
Female sex	0.93 (0.40–2.2)	0.9
ASA score 2	0.70 (0.25–2.0)	0.5
ASA score 3	4.9 (1.3–19)	0.02
BMI [b]	1.1 (1.01–1.2)	0.04

[a] Age included as a continuous variable.
[b] BMI included as a continuous variable.

Table 3. Odds ratio for a length of stay (LOS) of more than 5 days following primary BSTKA

Parameter	OR (95% CI)	p-value
Age, years [a]	1.0 (0.99–1.1)	0.1
Female sex	1.2 (0.59–2.5)	0.6
ASA score 2	1.2 (0.48–3.1)	0.7
ASA score 3	5.8 (1.6–21)	0.008
BMI [b]	1.0 (0.95–1.1)	0.7

[a] Age included as a continuous variable.
[b] BMI included as a continuous variable.

Discussion

The safety of BSTKA regarding mortality and morbidity is debatable, as several studies have shown higher mortality following simultaneous bilateral procedures than after staged bilateral procedures (Parvizi et al. 2001, Stefánsdóttir et al. 2008) while others have failed to show any differences (Bullock et al. 2003, Lindberg-Larsen et al. 2015). The 3 most recent meta-analyses comparing morbidity and mortality following BSTKA (Restrepo et al. 2007, Fu et al. 2013, Hussain et al. 2013) all concluded that BSTKA carries a higher risk of postoperative mortality. Conclusions on postoperative complications are less sure, as meta-analyses by both Hussein et al. (2007) and Fu et al. (2001) found similar rates of thromboembolic and cardiac complications and also infections, while Restrepo et al. (2007) found a higher risk of cardiac and pulmonary complications following BSTKA than after staged procedures.

Our finding of a 90-day mortality of 0% following BSTKA in a standardized fast-track setting is encouraging, and it is similar to previous reports on early postoperative mortality for bilateral procedures in a fast-track setting, as both Lindberg et al. (2015) and Husted et al. (2011) also reported 0% 90-day mortality following BSTKA, while Poultside et al. (2014) found a 30-day mortality rate of 0.04% in a cohort of 4,825 BSTKA patients. It is important to point out that the study by Husted et al. (2011) included patients who were operated in 2008 (n = 32), thus having a small overlap with the present study. The low mortality rates stand in contrast to the 0.5%

30-day mortality following BSTKA reported by Parvizi et al. (2001), the 0.15% in-hospital mortality reported by Odum et al. (2014), and the 0.3% in-hospital mortality reported by Memtsoudis et al. (2009). One possible explanation for the zero mortality found in our study was the fast-track setup itself, which may have reduced postoperative morbidity and mortality for both total knee arthroplasty patients and total hip arthroplasty patients (Husted et al. 2010a,b, Kehlet 2013, Lindberg-Larsen et al. 2013, 2015).

The 10% re-admission rate within 90 days and the 8% re-admission rate within 30 days found in the present study is comparable to the 7% re-admission rate within 30 days following simultaneous bilateral procedures reported by Lindberg et al. (2015) in a nationwide study, and to the 7% re-admission rate within 30 days following staged bilateral procedures reported by Kheir et al. (2014). Hart et al. (2015) have reported lower 30-day re-admission rates following BSTKA—4% as compared to the 8% value found in the present study, but this might be explained by varying definitions of re-admission between studies, and the possibility of complete follow-up (Husted 2012). A 90-day re-admission rate of 9% following unilateral TKA in a modern fast-track setting has been reported in a recent nationwide study (Jørgensen and Kehlet 2013). This supports the safety aspect of BSTKA, which in our hands has similar re-admission rates to those of unilateral TKA, as the patients receiving 2 unilateral TKAs would have a higher cumulative re-admission rate over time.

Our finding that postoperative infection is the most common cause of re-admission is also in agreement with the findings of both Kheir et al. (2014) and Lindberg et al. (2015). It is interesting that there were no re-admissions due to pulmonary embolism (PE) and only 2 re-admissions (0.7%) due to deep-vein thrombosis (DVT) in our patient cohort, which can be compared with the DVT rate of 0.9% and the PE rate of 1% within 60 days reported by Meehan et al. (2011) and the DVT and PE rates of 1% and 0.8%, respectively, following BSTKA reported by Memtsoudis et al. (2009) in nationwide studies. The 0.7% (2/284) risk of re-admission within 90 days due to thromboembolic events found in our study is lower than the 2% 90-day risk of re-admission due to thromboembolic events reported in fast-track departments in a nationwide study (Glassou et al. 2014). Less comorbidity in patients undergoing BSTKA is the most likely explanation for this difference.

The median LOS of 3 days found in the present study is similar to LOS figures in previous studies on fast-track total knee arthroplasty (Husted et al. 2011, Jørgensen and Kehlet 2013). This shows that almost all the patients selected can fulfill the functional discharge criteria within just a few days after this major surgical procedure.

We found a high transfusion rate, as more than 50% of patients required postoperative blood transfusions. This finding is not unexpected, as several previous studies have found high transfusion rates following simultaneous bilateral procedures: 95% was found by Stubbs et al. (2005), 55% was

found by Jenny et al. (2013), and 45% was found by Husted et al. (2011). A recent study performed by Kim et al. (2014) did, however, show a much lower transfusion rate of 7% for BSTKA when TXA was administered in multiple doses, indicating the possibility of reducing transfusions more than the blood-saving protocol currently being used at our institution. However, we do not know what role the high transfusion rate reported in our study plays regarding the complication rate and postoperative outcomes, as blood transfusion has been linked to infections (Friedman et al. 2014). Further investigation is therefore required, focusing on intraoperative and total blood loss following BSTKA in order to optimize conservation of blood.

Finally, we found patients with an ASA score of 3 to have an increased risk of re-admission within 90 days and an increased risk of having a LOS of more than 5 days. This is hardly surprising, as similar results have been reported for unilateral procedures (Husted et al. 2010a, Husted 2012). It is, however, surprising that 17 patients (6%) with an ASA score of 3 were offered—and underwent—BSTKA in our study. This contrasts with a recent consensus paper, which stated that only patients with few comorbidities should be offered BSTKA (Memtsoudis et al. 2013). This is supported by our finding that 7 of the 17 patients with an ASA score of 3 were re-admitted within 90 days. However, it is not possible to speculate whether these re-admissions could have been avoided if patients with an ASA score of 3 had undergone a staged bilateral procedure instead.

Obesity is a well-known risk factor for complications following TKA, including increased risk of infections, of prolonged wound drainage, and of thromboembolic complications (Belmont et al. 2014, Thornqvist et al. 2014, Alvi et al. 2015, Si et al. 2015). Thus, our finding that higher BMI was associated with an increased risk, albeit small, of re-admission within 90 days is in agreement with the previous literature (Fabi et al. 2011).

The main limitation of our study was the retrospective design without any control group. The retrospective data collection allowed possible inaccuracies regarding the parameters collected, and the lack of a control group did not allow comparisons and therefore limited our conclusions. The optimal design for evaluating the safety and efficiency of BSTKA would be a randomized controlled study comparing staged and simultaneous procedures. However, such a setup would have a challenging patient inclusion, which is one of the reasons why such trials have not been performed to date (Memtsoudis et al. 2013). Addition of a control group of staged bilateral procedures, as previously done by Husted et al. (2011), would allow comparison of simultaneous with staged procedures. However, such case-control studies with matching of 1 or multiple parameters would still permit selection bias, as the surgeon's choice for performing a staged rather than a simultaneous procedure and vice versa would be unaccounted for. We have therefore presented strictly descriptive data showing safety

aspects with respect to mortality and re-admission following BSTKA in selected patients. Secondly, we only investigated re-admissions and mortality without investigating patient-reported outcomes. However, we have already reported patient satisfaction in another cohort of BSTKA patients from our study population (Husted et al. 2011). Thirdly, ASA score was the only parameter that we included to account for patient comorbidities, and it is known to be associated with great interobserver variability (Mak et al. 2002). Finally, the follow-up for re-admission and mortality was limited to 90 days, which does not allow us to make any conclusions on late surgical complications such as aseptic loosening. However, evaluation of late surgical complications is outside the scope of the current study, and we believe that death more than 90 days after the procedure is unlikely to have been associated with the procedure itself.

In conclusion, BSTKA in selected patients without cardio-pulmonary disease in a fast-track setting appears to be safe regarding early postoperative morbidity and mortality. Surgeons should be aware that patients with an ASA score of 3 have an increased risk of re-admission and prolonged length of stay, while patients with higher BMI have an increased risk of re-admission after BSTKA.

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