

Original Research Article

Role of tourniquet in post-operative pain after total knee replacement surgery: a case control study

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ABSTRACT

Background: Intraoperative use of tourniquet to double the systolic blood pressure during total knee replacement (TKR) is used commonly for maintaining bloodless field. The aim of this study is to understand the role of tourniquet in post-operative pain after a TKR.

Methods: Using a case-control design we enrolled 20 patients who underwent TKR with intraoperative use of tourniquet and 20 age and gender matched controls who underwent TKR without the use of tourniquet, from November 2014 till May 2016 in the Department of Orthopedics at the A.J. Institute of Medical Sciences, Mangalore. Baseline demographic information was collected for all patients and pain was measured using simplified verbal scale (SVS). Statistical analysis was performed using unpaired t-test and ANOVA.

Results: Average age of cases and controls was 62.8 ± 7.47 and 63.1 ± 7.21 years respectively, with no significant difference between them. The average SVS score on Day 1 was significantly different between the cases and controls, p value 0.0032. On Day 2 and Day 3 SVS scores were not different significant. For cases the mean difference was 0.77 and -1.3 when we compared scores of SVS on Day 2 and Day 1. For control subjects mean difference was 0.939 and 0.760 when we compared SVS scores on Day 3 and Day 1.

Conclusions: We found significantly lower post-operative pain upto Day 3 in patients who underwent TKR without a tourniquet.

Keywords: Total knee replacement, Pain, Complications, Tourniquet

INTRODUCTION

With the advancement in diagnostic and therapeutic procedures, populations are aging and maintaining physical activity in geriatric ages, because of which joint replacement procedures are becoming more common, total knee replacement (TKR) being one of them. Tourniquets have been used for surgical procedures for many years to reduced intra-operative blood loss and improve visibility in the surgical field.¹ Some of the advantages of tourniquets include reduced intra and post-operative blood loss, having a bloodless field of vision and reduced operative time.² However, inconsistent

results have been reported by some authors who have investigated the role of tourniquet on clinical outcome in TKR.³ Few proposed disadvantages of tourniquet application include an increased risk of nerve injury, damage to blood vessels and muscles and post-operative swelling.⁴ Furthermore, the severity of the complications has been found to be associated with high tourniquet pressure and duration of tourniquet times.⁵ After tourniquet deflation, reactive hyper-perfusion can cause swelling and increased soft-tissue tension, which also contribute to pain. Therefore, the use of a tourniquet for TKR is controversial, and it is worrisome because of the sheer number of such procedures being planned and

executed. The benefits of using a tourniquet has to be weighed against the disadvantages to present potential adverse clinical outcomes. This study is aimed to understand the effects of TKR with and without the use of tourniquet with respect to the post-operative pain.

METHODS

Study design and sample population

For this study we included patients who were admitting for undergoing total knee replacement (TKR) surgeries in the Department of Orthopedics at the A.J. Institute of Medical Sciences during the period of November 2014 to May 2016. This study was approved by institutional ethical committee of A.J. Institute of Medical Sciences. During the study period we decided to include 20 patients who would undergo TKR using a tourniquet. This group became the cases and we also included 20 age and gender matched patients who underwent TKR without the use of tourniquets, which became the control group. Inclusion criteria for the study was patients who would undergo either unilateral TKR or staged bilateral TKR, aged more than 50 years and patients with either primary or secondary osteoarthritis of knee. We excluded patients with an established underlying arterial or venous insufficiency, patients undergoing bilateral total knee replacement in single sitting and those undergoing revision surgery of total knee replacement.

Both males and females were being selected. All patients were consented for the surgery and the study. The patients would be admitted and detailed history would be taken and examination would be done. The necessary investigations mentioned below would be performed. All patients underwent standard investigations prior to the surgery, which included blood based investigations and imaging modalities. After obtaining fitness from a physician, patients underwent TKR under spinal anaesthesia followed by epidural analgesia for post-operative pain.

Data collection and analysis

Patients were allocated to each group by random allocation. This was based on random number generator.

The cases group underwent surgery with tourniquet throughout the surgery at a pressure of 350 mmHg. The control group underwent surgery without tourniquet (inflated only for 20 minutes during process of cementing). The surgery was being done with the patient in supine position using the midline longitudinal parapatellar approach with or without tourniquet under absolute sterile conditions. However tourniquet will be inflated in both the study groups during the process of cementing. The implants used were similar in both groups. Cementing was done for both femoral and tibial component. No patient received any pre-operative anticoagulants. All patients were started on post-operative DVT prophylaxis after removal of epidural catheter.

The assessment of pain in our study was by self-reports of pain. Simplified verbal scale (SVS) scoring method was used for pain assessment. Using the SPSS version 23, the demographic data were tested for its distribution through normality tests using D'Agostino & Pearson normality tests. The data were found to be parametric in its distribution. Furthermore, demographic data like age was compared using student's t test. Sex distribution was compared using chi square test between the groups. SVS was presented as numerical mean. The means (SD) were compared using unpaired t test (two tailed). Post-operative drain collection and recovery of range of movements at knee joint on 7th post-operative day were compared using unpaired t-test (independent sample) (two-tailed) between the groups. The intra group variation of pain scores from the baseline to various time intervals was tested utilizing repeated measures of analysis of variance and Turkey's multiple comparison tests, in both the groups and between the groups. p value less than 0.05 was considered as minimum value for statistical significance.

RESULTS

During the study period, we enrolled 20 patients who underwent TKR with tourniquet. Twenty age and gender matched control patients who underwent TKR without the use of tourniquet was also included in the study. Average age of cases and controls was 62.8 ± 7.47 and 63.1 ± 7.21 years respectively, with no significant difference between them (Table 1).

Table 1: Baseline characteristics of patients enrolled in the study.

	Cases (tourniquet)	Controls (without tourniquet)	P value*
Number of patients	20	20	
Average age (Standard Deviation)	62.8 (7.47)	63.1 (7.21)	0.89
Gender distribution			
Males	5	6	>0.999
Females	15	14	
Simplified verbal scale score			
Day 1	2.65±0.48	2.2±0.41	0.0032
Day 2	3.4±0.59	3.15±0.74	0.249
Day 3	1.35±0.48	1.45±0.51	0.530

*p value <0.05 taken as statistically significant

Table 2: Comparison of simplified verbal scale (SVS) to baseline score in the two groups.

Comparison of SVS scores to baseline	Cases (tourniquet)		Controls (without tourniquet)	
	Mean difference (95% CI*)	P value [#]	Mean difference (95% CI)	P value [#]
SVS Day 2 vs. SVS Day 1	0.7711 (0.385 -1.156)	<0.001	0.939 (0.519-1.359)	<0.001
SVS Day 3 vs. SVS day 1	-1.3 (-1.68—0.919)	<0.001	0.760 (-1.18-0.340)	<0.001

*CI: confidence interval; [#]p<0.05 statistically significant.

Out of 20 cases 5 were males and out of 20 controls 6 were males. So the cases and controls were age and gender matched. Pain assessment was done using the simplified verbal scale which was scored on Day 1, Day 2 and Day 3. The average SVS score on Day 1 was significantly different between the cases and controls, p value 0.0032 (Table 1). On Day 2 and Day 3 SVS scores were not different significant. When we compared the SVS scores on Day 2 and Day 3 with Day 1, we found the mean difference to be statistically different for both cases and controls (Table 2). For cases the mean difference was 0.77 and -1.3 when we compared scores of SVS on Day 2 and Day 1. For control subjects mean difference was 0.939 and 0.760 when we compared SVS scores on Day 3 and Day 1.

DISCUSSION

The characteristics of both the patient groups were similar with respect to the demographic profile and surgical approach, the duration of surgery and tourniquet pressure applied. The surgery was conducted by senior and experienced surgeons in both groups, which would remove systematic bias to a large extent. The implants used were also similar in both groups and none of the patients in the study received any pre-operative anticoagulants. Patients under went total knee replacement under spinal anaesthesia followed by epidural analgesia for post-operative pain. Tourniquet use has been proposed to be associated with reduced intraoperative and early postoperative blood loss, however despite the presence of an adequate anaesthesia, tourniquet inflation may itself contribute to pain.⁶ There is scarce literature which addresses tourniquet related pain in patients undergoing TKR. Thigh pain with the use of tourniquet has been reported a common early post-operative complication. Worland et al observed a higher incidence of tourniquet related pain in group having tourniquet pressure of 350 mm Hg compared to those having tourniquet pressure of 100 mm Hg above systolic blood pressure on post operative day 1, 2 and 3 whereas there was negligible difference after 3rd post operative day till 2 weeks.⁷ Using lower tourniquet pressure has been suggested to reduce the risk of post-operative pain. Olivecrona et al demonstrated that the limb-occlusion-pressure method reduces the pressure needed for tourniquet without compromising the quality of the bloodless field.⁸ However, in this randomized study,

lower tourniquet pressure did not result in lower postoperative pain.

It has been proposed that recession of neuraxial block causes unblocking of unmyelinated C fibers. This tourniquet related pain can be controlled by adding narcotic analgesics to anaesthesia.⁹ Release of metabolites after tourniquet release, along with decrease in vascular resistance and mean arterial blood pressure also contribute towards causing pain.¹⁰ Studies have demonstrated that levels of metabolites like malondialdehyde, inducible nitric oxide synthase and NO metabolites nitrate in the muscle increase when a tourniquet was used in TKA.¹¹ Biopsy findings by Bao et al showed massive neutrophil infiltration in patients undergoing TKA surgery with a tourniquet.¹² Furthermore, Ledin et al observed significantly less pain and 11 degrees more flexion at 2 years in patients who were operated without a tourniquet.¹³

CONCLUSION

We compared the effect of tourniquet in patient undergoing total knee replacement. We observed that the postoperative thigh pain assessed upto 3rd post operative day was significantly lower in patient under going surgery without tourniquet. This being a single centre case control study, the results are not generalizable to other populations. We need multi-centric randomized trials in future to better understand the role of tourniquets in post operative pain after TKR surgeries.

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Ethical approval: The study was approved by the institutional ethics committee

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