

# Blood loss in total knee arthroplasty with and without tourniquet

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## Abstract

**Introduction:** Total knee arthroplasty (TKA) is a commonly used surgical intervention utilized for patients suffering from arthritis. The present study evaluated the blood loss in TKA, with and without pneumatic tourniquet and to assess the effect of tourniquet release on the overall pain and the functional outcome.

**Methodology:** This prospective study was conducted from July 2015 till September 2017 in which patients who were admitted for TKA were included. The patients were divided into two groups of 30 patients each, one group scheduled to undergo TKA with tourniquet while the other group without tourniquet. Blood loss in the drain, haemoglobin levels, pain (using visual analogue scale) and function outcome using Knee Society Score was noted and compared between the two intervention groups.

**Results:** Significantly lower blood loss was observed in the patients who underwent TKA with tourniquet as compared to those who underwent TKA without a tourniquet at the three time points. Between group comparison revealed no significant difference in the haemoglobin levels. Pain score were similar in the patients in the two groups. KSS between the patients in the two intervention groups was not significantly different at different time points. None of the patients had complication of thromboembolism or need for blood transfusion.

**Conclusions:** Tourniquet resulted in decreased blood loss. Further randomized, multi-centric studies are required to better understand the role of tourniquet in patients undergoing TKA.

**Keywords:** arthroplasty; hemostasis; knee; blood loss

## Introduction:

Total knee arthroplasty (TKA) is a commonly used surgical intervention utilized for patients suffering from arthritis. It is an efficacious surgical procedure which improves patient's quality of life, decreases the pain and elevates the functional capability of the patients [1]. TKA is an important cause of blood loss during surgeries and many studies have shown a high rate of transfusions in these surgeries [2]. Transfusions themselves are associated with multiple complications, and are

associated with an increased length of hospital stay, increased chances of infections and increase chances of contracting blood borne diseases with these blood transfusions. The use of tourniquet allows the orthopedic surgeon to have a blood-less operative field and also results in an improved cementation technique. However, the timing of tourniquet removal as the best option in preserving blood stock levels is a controversial topic, with varying point of views in literature. Newman et al found that there was less blood loss

when the tourniquet was released after the suture and pressure dressing [3], while Page et al found better results in patients with perioperative release of tourniquet [4]. However, many authors have refuted the effect of

tourniquet on blood loss during TKA. Limited literature is available from Indian settings which has studied the effect of tourniquet on blood loss. The present study is aimed to evaluate the total blood loss in patients undergoing TKA, with and without pneumatic tourniquet release for hemostasis. We will also assess the effect of tourniquet release on the overall pain profile of the patients undergoing TKA, and the functional outcome in the patients.

## Methodology:

### Study design and sampling:

This prospective study included patients who were admitted for TKA from July 2015 till September 2017. Based on the patient load from previous years, a convenient sample of 60 was chosen. Patients above the age of 40

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	Intervention group		p value
	Patients undergoing TKA with tourniquet (n=30)	Patients undergoing TKA without tourniquet (n=30)	
Age (in years)	58.16 ± 7.8 (range 45-73)	67.0 ± 8.77 (range 42-80)	-
Gender distribution			
Males	08 (27%)	10 (34%)	-
Females	22 (73%)	20 (66%)	
Blood loss (in ml)			
0 to 24 hours	398.6 ± 15.26	422.13 ± 23.23	<0.001
24 to 48 hours	109.43 ± 7.82	114.93 ± 10.61	0.02
Total	507.7 ± 20.39	540.4 ± 29.98	<0.001
Hemoglobin (in gm%)			
Baseline	13.23 ± 0.54	13.29 ± 0.54	0.66
At 24 hours post-operatively	12.55 ± 0.56	12.56 ± 0.55	0.94
At 48 hours post-operatively	11.93 ± 0.47	11.94 ± 0.55	0.93
Visual analogue scale score			
Pre-operative	7.43 ± 0.85	7.53 ± 0.97	0.67
At 24 hours post-operatively	6.06 ± 0.63	6.07 ± 0.63	0.42
At 7 days post-operatively	2.8 ± 0.55	2.93 ± 0.6	0.71
At 15 days post-operatively	1.76 ± 0.5	1.86 ± 0.57	0.47
At 1 month post-operatively	1.23 ± 0.43	1.2 ± 0.4	0.52
Values are either mean ± standard deviation or number (percentage)			

years, of either gender, willing to participate in the study were included. Eligible patients were approached and explained the purpose of the study. A separate written consent was obtained from the patients, failing which the patients were excluded from the study. Refusing to participate in the study did not affect the management of the patients in any way. The study was approved by the institutional ethics committee. The patients were divided into two groups of 30 patients each, one group scheduled to undergo TKA with tourniquet while the other group without tourniquet. A detailed history was taken and relevant investigations and examinations were done. All the patients were operated by the same surgical team, by the same TKA procedure, and the pre and post-operative data were gathered by the investigator and team and noted down in a case report form.

### Operative technique:

	Intervention group		p value
	Patients undergoing TKA with tourniquet (n=30)	Patients undergoing TKA without tourniquet (n=30)	
Pre-operative	35.03 ± 6.79	36.13 ± 5.92	0.5
At 15 days post-operatively	38.23 ± 6.41	38.9 ± 5.6	0.59
At 1 month post-operatively	49.2 ± 6.36	49.23 ± 6.92	0.72
At 3 months post-operatively	71.36 ± 5.79	70.94 ± 5.38	0.47
Values are either mean ± standard deviation or number (percentage)			

Midline skin incision was made in the knee-flexion position to allow subcutaneous tissue to fall medially and laterally, improving operative exposure. The skin incision was made long enough to avoid excessive skin tension during retraction, which can cause skin necrosis. Medial parapatellar approach was taken for all standardretinacular incision. The medial skin flap was kept as thick as possible by dissecting superficial to the extensor mechanism. The retinacular incision was extended proximally, continuing it around the medial side of patella. The medial side of the knee was exposed by elevating the anteromedial capsule and the deep medial collateral ligament subperiosteally. The knee was extended, and the patella everted to allow the routine release of lateral patella-femoral plicae. The knee was later flexed, the anterior cruciate ligament removed along with the medial and the lateral menisci. This removal was done along with the osteophytes which led to component malposition or soft tissue imbalance. With posterior cruciate ligament substitution or retention, tibia was subluxated and externally rotated. The lateral tibial plateau was exposed by partial infrapatellar fat pad excision, and the everted extensor mechanism was retracted. The patellar tendon attachment to the tibial tubercle was taken care of during manoeuvres which may cause tension to the extensor

mechanism. For bone surface preparation proper sizing of the individual components, alignment of the components for restoring the mechanical axis, re-creation of equally balanced soft tissues and the gaps in flexion and extension along with optimal patellar tracking were considered.

### Data Collection and Data Analysis:

Using a pre-designed case report form blood loss in the patients undergoing TKA in both the groups were assessed post-operatively by measuring the blood in drain between 0-24 hours and 24-48 hours. Hemoglobin levels of all patients were also noted at baseline pre-operatively and then post-operatively at regular intervals. Pain experienced by the patients was assessed using the standard visual analogue scale (VAS) scores, scored between 1-10, where higher score indicating more pain. This was done pre-operatively, and post-operatively at 24 hours, 1 week, 15 days and one month. Functional outcome of all patients was assessed with the functional Knee Society Score (KSS), scored out of 100 [5]. This was done pre-operatively, and post-operatively at 15 days, 1 month and 3 months post TKA. Quantitative data were expressed as mean and standard deviation and qualitative data as number and percentages. Quantitative and qualitative variables were compared between the two intervention groups using the t-test and chi-square respectively. All the results were considered to be significant at the 5% critical level.

### Results:

Table 1 describes the distribution of baseline characteristics of the patients included in the study. Of the 60 patients included in the study, 30% of the patients were males and 70% were females. All patients were equally divided in the two intervention groups.

Mean of the patients who underwent TKA with tourniquet was  $58.16 \pm 7.8$  years and those without tourniquet was  $62.0 \pm 8.77$  years. Loss of blood was assessed in patients in both the intervention groups at different time points. Significantly lower blood loss was observed in the patients who underwent TKA with tourniquet as compared to those who underwent TKA without a tourniquet at the three time points (Table 1). Hemoglobin levels for patients in both the intervention groups at various time points are as described in Table 1. Intra group analysis found a significant difference in the haemoglobin levels at various time points, in the same group for both with and without tourniquet procedure ( $p < 0.05$ ). Between group comparison at a time-point revealed no significant difference in the haemoglobin levels ( $p > 0.05$ ). Comparison of VAS pain score at different time points revealed no significant difference between the patients in the two groups. Though intra-group analysis revealed a significantly decreasing VAS pain score with regular follow up time points. KSS between the patients in the two intervention groups was not significantly different at different time points. None of the patients had complication of thromboembolism or need for blood transfusion.

### Discussion:

TKA is a common surgical intervention used to treat patients with arthritis with high efficacy and better functional outcome. However, due to blood loss associated with the condition, the

surgery is also associated with multiple blood transfusions, which themselves are associated with numerous complications and increase hospital stay. The use of tourniquet while performing TKA was designed to avoid the need of blood transfusions in the patients. The present study compared the blood loss, hemoglobin levels, pain experienced and functional outcome of patients undergoing TKA with and without tourniquet. Benefit of tourniquet in reducing blood loss TKA remains controversial. While Harvey et al reported a decreased average blood loss in TKA [6], Tetro et al demonstrated an increased blood loss with the use of tourniquet [7]. To make things more inconclusive, Abdel-Salam et al observed no difference in operation time and blood use with or without the use of tourniquet [8]. Present study found decreased overall blood loss in patients with the use of a tourniquet, though haemoglobin levels of the patients were not statistically different in the two intervention groups. Operation time was not measured in our study. A meta-analysis by Tai et al showed that patients operated with a tourniquet had less total measured operative blood loss [9]. However, with the recent concept of "calculated blood loss", it is now understood that the total measured blood loss represents only a fraction of the actual blood loss. Gross' method has been suggested for calculating the actual blood loss in such patients [10]. Previous studies indicate that much more accurate estimation of true blood loss can be made by using this formula [11]. Sehat et al demonstrated that there is a substantial

amount of unmeasured blood loss in TKA [12]. Though, Tai et al in their meta-analysis found that intraoperative and total measured blood loss were significantly less in the tourniquet group than in the non-tourniquet group, but pooled data showed no significant difference. This finding shed light on the fact that blood loss during TKA cannot be assessed accurately using routine methods and surgeons can underestimate the blood loss. The major limitation of our study is the small sample size. Secondly, blood loss can vary with the operative technique used. Ours being a single centre study, the results might not be generalizable to other surgical centres.

### Conclusion:

Conflicting evidence regarding the use of tourniquet in TKA in published literature makes the issue controversial, but the technique is widely used by surgeons. Our study found significantly decreased blood loss with the use of tourniquet but there was no significant difference in the haemoglobin level. Additionally, post-operative pain and functional outcome were also comparable in both the tourniquet and non-tourniquet group. It is therefore suggested that tourniquet should be avoided in patients with high risks of thromboembolism. Further randomized, multi-centric studies are required to better understand the role of tourniquet in patients undergoing TKA.

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