

Comparative analysis of blood loss after total knee replacement in tourniquet and non-tourniquet group

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Abstract:

Background: The primary aim of using tourniquet during surgery is to keep the surgical field clean. However the total amount of blood loss by using or not using tourniquet is still controversial

Objective: To compare the mean amount of blood loss in total knee arthroplasty patients with and without tourniquet.

Materials and Methods: It was a randomized controlled trial in the Department of Orthopaedic from July 2015 to June 2016. 120 patients were randomly allocated in tourniquet and non-tourniquet group. All operations were performed under spinal anaesthesia by one surgeon. Those in group A were had TKA under tourniquet after the leg has been exsanguinated. The tourniquet pressure was twice the systolic blood pressure. Patients in group B were not had tourniquet applied to the leg. Mean amount of blood loss was calculated per-operatively using the number of sponges soaked and the volume of blood in suction bottle. Post-operative blood loss was calculated by the volume of blood in drains measured on daily basis for initial 48 hrs.

Results: The mean ages of the patients were 68.40 ± 6.55 in group A and 67.43 ± 5.95 in group B. The mean blood loss of patients in group A was 307.33 ± 36.03 mL while in group B, 425.67 ± 21.04 mL. Statistically the difference between the two groups is significant ($P < 0.05$).

Conclusion: The use of a tourniquet during total knee arthroplasty was effective for reducing blood loss.

Keywords: Total knee replacement, blood Loss, Tourniquet, severe osteoarthritis of knee

Introduction:

Knee pain is the common presenting complaint in the middle-aged and elderly patients, interfering with and limiting the activities of daily living. Pain free and mobile knee joint is essential for good quality of life.^{1,2} In this part of the world, people develop knee pain earlier than those in the developed countries. This reflects our sitting, praying, eating and working habits, which needs a squatting position. The use of Indian indoor toilets, requiring squatting also puts excessive stress and strain on knees in the extreme flexion.^{3,4}

Knee is weight bearing and one of the largest and most complex joint of the body. It is formed

by distal end of femur, proximal end of tibia and posterior surface of patella. It has three compartments named as medial, lateral and patellofemoral. Knee is hinge synovial joint. Its movements not only comprise flexion and extension but also some internal and external rotation.⁵ Knee is affected by a variety of disorders. It is affected most commonly by osteoarthritis, rheumatoid arthritis, gout and post-traumatic arthritis. Osteoarthritis is a disease of synovial joints, and is observed in 40% of 40 year old patient on radiological examination and is the most common reason for total knee replacement. Total knee replacement is mainly indicated for pain especially when combined with deformity and instability.^{6,7}

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The use of a tourniquet is an integral part of a large number of routine orthopaedic operations. Over 25,000 knee arthroplasties are performed in England and Wales every year, mostly under tourniquet. There is still controversy about its use, and the benefits must be weighed against the potential risks. The tourniquet has the obvious advantage of a bloodless field and should, theoretically, provide a better cement bone interface in a cemented arthroplasty.^{8,9,11} Post-operative blood loss may be considerable in reference to calculated blood loss, even if the use of a tourniquet allegedly minimizes intraoperative blood loss.⁹ Total knee arthroplasty results in considerable blood loss. The safest and most effective method of reducing the requirement for blood transfusion is to minimize intra-operative bleeding by the use of a tourniquet.^{8,9,10,11}

The role of the tourniquet is controversial, although it is widely used by orthopaedic surgeons.^{8,9,10,11,12,13} The use of tourniquet is believed to be effective for decreasing intraoperative blood loss and creating a bloodless surgical field, which theoretically would facilitate the cementing technique and other surgical procedures.¹¹ Tai et al reported the mean blood in group I (with tourniquet) was 303 ± 119 mL and in group II (without tourniquet) was 423 ± 197 mL.¹¹ Tourniquet-related soft tissue problem is the related complication.¹¹

Prevention of blood loss is very important consideration when performing total knee arthroplasty. No local study about this device was available. We conducted this study because of the following reasons;

Firstly, because our population is demographically different from western population.^{3,4}

Secondly, this study will serve as primary data source in our population. Thirdly, because the role of tourniquet in blood loss is still controversial.^{8,9,10,11,12,13}

Materials and Method:

It was a prospective study and randomized controlled trial. 120 patients were selected as consecutive non probability sampling technique in

the Department of Orthopaedic Surgery, Ghurki Trust Hospital, Lahore from July 2015 to June 2016. Sample size of 120 cases, 60 cases in each group; is calculated with 95% confidence level, 80% power of test and taking mean blood loss i.e. 303 ± 119 ml in group I and 423 ± 197 ml in group II. The patients of either sex, age between 50-80 years, having Grade 3 and 4 osteoarthritis and ASA 1 and 2 were included in the study. Patients who were operated previously for any open knee surgery assessed on history, abnormal vascular supply to the leg assessed on distal pulses or with bleeding disorder assessed on labs by measuring platelet count ($<150,000$, deranged), prothrombin time and activated partial prothrombin time were excluded from the study. The approval of this study was taken from Lahore Medical and Dental College/GTTH ethical review committee. Informed consent will be taken. The participants were randomly allocated by random number table to either the tourniquet and non-tourniquet group just before the skin incision. Demographic information, history and examination were completed. All operations were performed under spinal anaesthesia by one surgeon. The patients were received intravenous cefuroxime (1.5g) after induction of anaesthesia and twice postoperatively. Those in group A were had TKA under tourniquet after the leg has been exsanguinated. The tourniquet pressure was twice the systolic blood pressure. Patients in group B were not had tourniquet applied to the leg. Mean amount of blood loss was calculated per-operatively using the number of sponges soaked and the volume of blood in suction bottle. Post-operative blood loss was calculated by the volume of blood in drains measured on daily basis for initial 48 hrs. To apply the tourniquet, empty the limb of blood, either by elevating it for 3-5 minutes or by applying a soft rubber compression bandage. The tourniquet was padded with soft dressing to prevent the wrinkles and blisters that inevitably occurs when the skin is pinched. The tourniquet was applied to the thigh. Finally, tourniquet was not be inflated for longer than 1½ hours in the lower limb to minimize risk. Tourniquet was deflated before closure to identify and to coagulate major

Table 1: Frequency and percentage of genders in both groups.

Gender	Group A (n=60)		Group B (n=60)	
	Number	Percentage	Number	Percentage
Males	26	43.4	28	46.7
Females	34	56.6	32	53.3
Male to female ratio	1:1.3		1:1.2	

Key:

Group A With tourniquet

Group B Without tourniquet

Table 2: Frequency and percentage of age in both groups

Age (years)	Group A (n = 60)		Group B (n = 60)	
	Number	Percentage	Number	Percentage
50 – 60	8	13.4	6	10.0
61 – 70	30	50.0	34	56.7
71 – 80	22	36.6	20	33.3
Mean±SD	68.40±6.55		67.43±5.95	

Key:

SD Standard deviation

Group A With tourniquet

Group B Without tourniquet

Table 3: Comparison of mean blood loss (mL) in both groups

Mean blood loss (mL)	Group A (n = 60)		Group B (n = 60)	
	Number	Percentage	Number	Percentage
250 – 380	27	90.0	7	23.4
381 – 500	3	10.0	23	76.6
Mean±SD	307.33±36.03		425.67±21.04	
P value	0.000			

Key:

SD Standard deviation

Group A With tourniquet

Group B Without tourniquet

bleeding points. All the data were entered on a specified proforma.

The data was analyzed with the help of statistical package for social sciences version 12. Quantitative variables i.e. age and blood loss were presented using mean \pm standard deviation. Qualitative variable i.e. gender was presented using frequency and percentage. Blood loss was calculated per-operatively and post-operatively. $P \leq 0.05$ was taken statistically significant. Data were stratified for age and gender to address the effect modifiers. Post-stratification t-test were applied with p-value ≤ 0.05 as significant.

Results:

A total number of 120 patients, divided into two groups; group A (with tourniquet) and group B (without tourniquet) were included in the study. Each group was comprised of 60 patients. Out of which 26 (43.4%) were males and 34 (56.6%) were females in group A while in group B, there were 28 (46.7%) males and 32 (53.3%) females. Male to female ratios were 1:1.3 in group A and 1:1.2 in group B (Table 1).

The patients shown in table 2 were divided in three age groups. In group A, the first age group, patients aged 50-60 years (8) 13.4%, in second age group, patients aged 61-70 years (30) 50% and in third age group, patients aged 71-80 years (22) 36.6%. While in group B, patients in first age group 50-60 years (6) 10%, second age group, patients aged 61-70 years (34) 56.7% and in third age group, patients aged 71-80 (20) 33.3%. The mean ages of the patients were 68.40 \pm 6.55 in group A and 67.43 \pm 5.95 in group B. (table 2).

Table 3 showed the mean blood loss of patients in group A was 307.33 \pm 36.03 mL while in group B, 425.67 \pm 21.04 mL. Statistically the difference between the two groups was significant ($P < 0.05$).

Moreover there is no thromboembolic event found in any patient.

Discussion:

The main issue in total knee replacement is the blood loss. Different surgical procedures and techniques had been applied to reduce the blood loss. Such attempts depend on identifying the factors likely to predict the need for transfusion. The opponents for use of a tourniquet cite development of complications such as skin bruising, neurovascular injury, and metabolic disturbance as drawbacks. Young Jun Seol concluded that the preoperative and postoperative single injection of tranexamic acid could be effective in reducing total blood loss and the need for blood transfusion after TKA for patients without any history of thromboembolic disease.¹⁴

while Nilen et al concluded that mini-sub vastus approach, use of saline- adrenaline infiltration, hydrogen peroxide and Feracrylum soaked packs, peri-operative use of tranexamic acid, without using tourniquet and drains, reduces peri-operative bleeding in patients undergoing total knee replacement, thereby reducing the blood transfusion requirement in these patients to almost negligible amount.¹⁵ Francisco MESA-RAMOS et al used Tourniquet and Adrenaline. Intraoperative bathing of the surgical field with adrenaline proved ineffective for reducing blood loss during total knee arthroplasty.¹⁶

Wei Zang in his meta analysis concluded that there is no significant difference either to use tourniquet or not. However with the use of tourniquet there is more thrombo embolic events.¹⁷ Vasconcelos et al in their study concluded that postoperative blood loss in TKA was similar with and without perioperative release of the pneumatic tourniquet for hemostasis.¹⁸

A.Mark et al in their study used tourniquet in some patients and no tourniquet in some patients. They concluded that the use of Tourniquet showed little decrease in loss of blood but there are more morbidities associated with it.¹⁹ Tetro et al found that patients having cemented total knee arthroplasty, the use of a tourniquet during the procedure did not reduce total blood loss.²⁰ Marcos et al found and concluded that releasing the ischemia before closing the operative wound does not have any significant effect on the blood loss through the suction drain or on the post-operative serum hemoglobin levels, in comparison with ending the ischemia after doing for intraoperative blood loss while the elderly and male patients experienced more severe postoperative bleeding. They did not find any difference if tourniquet is released before closure or after closure.²¹

Ashir Ejaz in their randomized study had shown that TKA surgery without a tourniquet results in better functional outcomes, less analgesics requirement, improved knee ROM in the early period of rehabilitation but more blood loss in intraoperative period.²² while Parvizij et al found the use of a tourniquet provides a bloodless field that allows the surgeon to perform the procedure with expediency, less blood loss and optimal visualization.²³ On the other hand Richard E concluded that without using tourniquet, there is no differences in blood loss or transfusion rates, less post-op pain, faster straight leg raise and knee flexion gains, and fewer wound healing disturbances.²⁴

Ta-Wei Tai et al found that the use of a tourniquet during total knee arthroplasty was effective for reducing blood loss and avoiding excessive postoperative inflammation and muscle damage. The use of a tourniquet was related to slightly more postoperative pain but did not affect post-operative recovery.²⁵ while RSA data do not support the use of a tourniquet to improve fixation because tourniquets appear to cause more postoperative pain and less range of motion.²⁶ In conclusion, research suggests that tourniquets confer no appreciable benefit in terms of total blood loss however our current evidence suggests that the risks outweigh the benefits. There are some limitation in our study. Firstly the number of patients were less and we didn't compare it with by using tranexamic acid or adrenaline. Moreover further studies required in our population for better results.

Conclusion:

The use of tourniquet during total knee replacement is effective because it not only makes the field clear for surgeons as well as reduce the amount of blood loss during surgery. The advantages of using it take lead from the disadvantages.

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Role and contribution of Authors:

Dr Hamza Arshad, collected the data and referenes

Dr Ashfaq Ahmed, collected the data, references and wrote the initial writeup.

Dr Latif Khan, collected the data and helped in methodolgoy writing

Dr Saeed Ahmed, collected thereferences and helped in introdu-cition writing.

Dr Shahzad Javed, collected the data and references and helped in the writing of discussion and results

Dr Amer Aziz, collected the references and helped in discusion writing.

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