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Original Research Article

Effectiveness of Topical Tranexamic Acid in Total Knee Replacement: A Case Control Study

Harshit Jain[1], Abhishek Kishore[2], Umang Agrawal[3]

[1], Associate Professor, Department of Orthopaedics, Krishna Mohan Medical College, Mathura
[2]Junior Resident, Department of Orthopaedics, Krishna Mohan Medical College, Mathura
[3]Junior Resident, Department of Orthopaedics, Krishna Mohan Medical College, Mathura

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Corresponding author: Dr. Harshit Jain
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Abstract:

Introduction: Total knee replacement (TKR) is a complex procedure that results in significant blood loss throughout the intraoperative and postoperative phases. The purpose of this trial was to see if tranexamic acid (TXA) could reduce perioperative blood loss and the requirement for blood transfusions in patients undergoing primary TKR.

Materials and Procedures: This study included 60 patients of primary unilateral TKR performed at a tertiary care institute. The patients were divided into two groups of 30 each, at random. Patients in Group A received TXA intraoperatively before to knee closure. Group B acted as the control group, consisting of patients who did not receive TXA. They were both administered 1gm IV TXA. At 24 and 72 hours following surgery, patients were evaluated for postoperative blood loss, haemoglobin reduction, the need for blood transfusion, and any adverse effects of TXA.

Result: The mean decline in postoperative haemoglobin concentration was 0.6 gm/dL (24 hours) and 1.3 gm/dL (72 hours) in group A, with a mean postoperative drain collection of 294.3 40.6 ml (24 hours) and 336 51.3 ml (72 hours). In group B, the mean decline in postoperative haemoglobin was 1.5 gm/dL (24 hours) and 2.3 gm/dL (72 hours), with a mean drain collection of 494 37.7 ml (24 hours) and 502.5 39.7 ml (72 hours) (p 0.001). In group A, four patients required blood transfusions, but 13 patients in group B required blood transfusions (p = 0.0004).

Conclusion: The data from this trial show that using topical TXA preoperatively in TKR considerably lowers post-operative blood loss and the requirement for post-operative blood transfusion without significantly changing patients' liver and renal functions or coagulation profiles.

Keywords: Total Knee Arthroplasty, Tranexamic Acid, Blood Transfusion, Haemoglobin, Perioperative Blood Loss.

Introduction

Osteoarthritis knee is a common disease causing pain and significant disability in population.it is estimated to be 10th leading cause of non-fatal burden in population. [1]. Treatment option include conservative and surgical. Conservative treatment include analgesic , physiotherapy and local injections but they are less effective in the advanced stages of the disease.[2] These days, TKR has become one of the most successful and cost effective surgery in orthopaedics in advance osteoarthritis knee .It drastically reduces pain and improved the quality of life [3].

TKR is a major surgery and hence it is associated with number of postoperative risks to the patient. The possibility of bleeding and the requirement for transfusions are significant surgical complications that must be handled in order to get the best results. [4-5].Blood loss ranging between 1000+-500 ml may occur.[6] A patient who is undergoing TKR can lose up to 2300 ml of blood, which is almost one-third of the total circulating blood volume has also been reported. [7]. Bleeding during total knee arthroplasty can be caused by a variety of variables, including patient characteristics (anticoagulation, cirrhosis, haemophilia, and so on) and surgical technique (bone cuts and soft tissue dissection).

Any surgery transiently activates the fibrinolysis system and the use of local pneumatic tourniquet during surgery may further induce fibrinolysis and hence bleeding. So TKR surgery wherein using tourniquet the risk of bleeding is assumed higher. According to some research, the transfusion rate

following TKR can reach 30%. [5]. Blood loss often leads to post-operative anaemia which necessities blood transfusion. Allogeneic blood transfusion may also increase the risk may lead to undesirable immunologic reaction transmission of disease, postoperative infection and cardiopulmonary complications.

Transfusions also increase rehabilitation time and lengthen hospital stay and the cost of treatment [8, 9]. Controlling blood loss during and after surgery is thus critical to the effectiveness of TKR. Perioperative blood donation, perioperative red cell salvage, purposeful hypotension, and the use of recombinant human erythropoietin have all been examined as ways to prevent perioperative blood loss. From reducing operative blood loss, encouraging results have been obtained by tranexamic acid (TXA) among the various techniques used, till now [11-13].

Being synthetic amino acid, tranexamic acid functions by competitive inhibition of plasminogen conversion into plasmin, thus promoting clot stabilization [14, 15]. Following total knee arthroplasty, tranexamic acid has established itself as an efficient antifibrinolytic aid in reducing blood loss and transfusion hazards. Furthermore, it has not been linked to an increase in thromboembolic consequences. There are several points of view on how TXA has been used in TKR. Tranexamic acid can be given intravenously, topically, or orally by surgeons. Though the bulk of trials utilising tranexamic acid in total knee arthroplasty settings have focused on the intravenous route, topical spraying of TXA has been shown to be equally efficacious while being safer in terms of post-operative issues such as DVT.

The existing evidence on the efficacy of this topical application was mixed, with some studies claiming no difference in blood loss between IV and IA routes [16], others showing a significant difference and advocating intra-articular application [17-21], and still others reporting intravenous route to be better and associated with significantly lower operative blood loss.

We conducted a prospective case-control study to determine the efficacy of topical perioperative TXA in reducing perioperative and postoperative blood loss in TKR, to determine the need for allogeneic blood transfusion in TKR patients, and to learn about any adverse effects of TXA on liver and renal functions and coagulation profile.

Materials and Methods

From November 2021 to November 2023, this study was conducted at KM Medical College in Mathura with the approval of the institutional ethical committee and previous written informed permission from the patients. The study included 60 consecutive patients of primary unilateral TKR performed in the orthopaedic department during the study period, regardless of age, gender, prosthesis type, or surgical technique. The study excluded cases of revision TKR, patients with a known history of a bleeding condition, deep vein thrombosis (DVT), pulmonary embolism, or anticoagulant therapy. Patients receiving TKR for trauma or tumour, as well as those with a history of renal failure or liver disease, were also excluded. This prospective case-control research included patients who met the above criteria. All of the patients in the study are of the same ethnicity (Indian).

The patients were divided into two groups of 30 each, at random. Patients in Group A had undergone primary TKR and were given 1 gramme TXA in a 10 ml solution locally in the knee 5 minutes before closure. Both patients received 1gm IV TXA. Patients in Group B had undergone primary TKR without the use of TXA. The surgeries were carried out in a routine manner. The medial parapatellar technique was employed on all patients in both groups, and cemented fixed bearing metal back implants were used. TXA was syringe sprayed onto the specified six areas after the prosthesis was implanted and cemented, which included the posterior capsule, quadriceps tendon, medial, lateral pockets of arthotomy, patellar tendon, and exposed femur and tibia surfaces. In all patients, a tourniquet was employed, which was inflated prior to the incision and deflated at the moment of closure. In both groups, the wound over drain was closed and the tourniquet was released in the same manner. Rivaroxaban 10mg od tablet was started for all patients on POD1 for DVT prevention. A physiotherapist monitored all patients postoperatively, and a recorded regimen was adopted in all cases.

Blood loss was estimated during surgery by counting the number of swabs wet, and in the postoperative period by measuring drain collection at 24- and 72-hour intervals before drain removal in both groups. Preoperative haemoglobin and coagulation profiles such as bleeding time (BT), clotting time (CT), prothrombin time (PT), and international normalised ratio (INR) were measured in groups, as well as 24 and 72 hours postoperatively. In our study, allogeneic blood transfusion was recommended when a patient's haemoglobin level fell below 7.0 mg/dl.

Results

Statistical analysis was executed using SPSS for windows. The nature of the hypothesis was 2 tailed, and a p value >.05 was considered statistically significant for all comparisons. To assess the differences between groups, the Student's t-test or 2 tests was utilised.

Group A compromises of 30 patients (mean age 62.7 ±7) 58% of females whom the tranexamic acid was given intraoperative.

Group B compromises of 30 patients (mean age 61. ±6.) 60% of females whom the tranexamic acid was not given intraoperatively. There is no significant difference in demographic profile ($p>0.05$) of both group. There were also no significant differences in the, preoperative hematologic values and operative time among the 2 groups.

There is significant difference in post-operative blood loss, measured by drain output in 24 and 72 hours ($p<0.050$) of both group. {Table 1}

Table 1:

Post-operative Drain	Group A	Group B
24 hr.	294.3 ml ± 40.6	494 ± 37.7
72 hr.	336 ml ±51.3	502.5 ± 39.7

We also observed that 100% patients of group A, the drain was removed after 72 hours while in group B, drain was removed only in 40% (N=24) of patients. Also, preoperative haemoglobin levels were almost identical in both the groups; however there is significant drop in post op haemoglobin in group B as compared to group A, as evident in Table 2.

Table 2:

HB	Group A	Group B
At 24 Hr.	11.2 ± 1.1	10.3 ± 1.4
At 72 Hr.	10.7 ± 0.9	8.9 ± 0.8

In group A 75% of patients had haemoglobin >10 gm. /dl at 72 hours postoperatively, while in group B only 25% had haemoglobin > 10 gm. /dl at 72 hours. Post operatively in group A, Only 5 patients needed a blood transfusion while in group B 90% (N=27) patients received blood transfusion.

Adverse events were recorded in 6 patients.2 of them underwent revision surgery following prosthetic joint infection, both of them belong to group B. 2 patients developed VTE, 1 of each from both group. Other 2 patients developed minor adverse reaction which was resolved by therapeutic measures.

Therapeutic efficacy of TKA was evaluated by KSS (knee society score) scores of patient. It included knee score (pain, stability and ROM) and functional score (walking distance and stairs climbing). Higher the score, the better the outcome. In our study, we found no significant difference in KSS scoring of both group. ($P> 0.05$)

Discussion

In group A we have 30 patients whom we gave intraarticular TXA in addition to IV TXA while in group b we have 30 patients whom we gave only intravenous TXA. We have included 60 cases as sample size in our study which is line with other studies. Mean age of our sample is 44.8 years which is also close to other similar studies. Majority of participants in our study are female which is also the case in other studies. In both groups we have used 1 g intravenous TXA preoperatively before the inflation of tourniquet. We gave 1 g of TXA topically before closure of surgery after the cementation and settlement of implant. We used needle spray technique and sprayed the drug at standard six pockets where we assumed theoretically to have high blood loss.

Preoperative Hb in our study is 11.2gm% which is in line with other study. Mean duration of surgery in our study is 1hr which is similar to other studies. Post-operative blood loss in our surgery measured by calculating the drain amount at 24 and 72 hours. Mean blood loss of group A is 494 ± 37.7 ml and that of group B is 502 ±39.7 ml we can compare our result from other study in table Postoperative Hb in GROUP A after 72 hours is 10.7 ± 0.9 gm. % and in GROUP B is 8.9 ± 0.8 gm. % in our study 2 of the patients in Group B in our study developed infection which can be accounted for more blood loss during surgery. VTE was developed in 2 patient; 1 in each group. Hence we cannot comment on superiority of TXA in view of patient safety in group where we additionally gave TXA topically.

In our study we did not find any advantage of intraarticular TXA compared to intravenous group with respect to overall functional result of TXA as KSS score in both studies was not significantly differ.

Table 3:

Author	Year	Number of Patients	Protocol	Outcomes evaluated
My Study	2022	60	IA 1 g TXA in 10 ml NS	There is great decrease in post-operative blood loss in TKR
Carvalho et al	2015	125	IA in 1.5 & 3.0 in povidone-iodine solution	Mean post-operative hb levels blood loss safety
Gomez-Barrena et al	2014	78	IA 3 g in 100 ml saline and two 15 mg/kg IV doses (before tourniquet release and after three hours	Drain blood loss at 24 and 48 hours, transfusion rate
Yang et al	2015	80	IA 500 mg in 20 ml saline	Blood loss, transfusion rate, safety

Conclusions

Total knee replacement is a rewarding and proven surgery in advanced stage of knee osteoathritis. But it can be crippling for the surgeon and patients, on account of its some of postoperative complications. Post operating blood loss is one of such complication. The data from this study conclude that the use of Intra-articular TXA in TKR significantly reduces perioperative blood loss and reduces the need for blood transfusion in patients undergoing TKR without increasing any thromboembolic complications like DVT.

Postoperatively, significantly less reduction in haemoglobin level 10 of 11 and less requirement of blood transfusion was observed in the individuals who received Intra-articular TXA. The role of TXA is undisputedly proven effective to minimise the post-operative blood loss and its associated complications as evident in various studies. But the matter which is still the controversy is the route of administration, dose of TXA to be given.

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