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Efficacy Of Tranexamic Acid in Reducing Blood Loss in Primary Total Knee Replacement

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Abstract

Objective: To determine the efficacy of tranexamic acid in reducing blood loss in primary total knee replacement.
Material and Methods: A total of 96 patients having a diagnosis of primary knee osteoarthritis made up the population sample. The Total Knee Replacement patients were separated into two groups. Patients in Group B used Intra venous tranexamic acid, but those in Group A did not use tranexamic acid during the course of the operation or afterwards.
Results: Mean age of the patients recorded in group A 63.79±6.60 (years) and in group B 62.96±7.89 (years). The majority of the patients in both groups were females. After surgery, Group B patients who received tranexamic acid reported less blood loss and less hemoglobin reduction as compared to the control group.
Conclusion: From our study, we conclude that Tranexamic acid used intravenously during total knee arthroplasty considerably lowers postoperative blood loss.
Keywords: Total knee replacement, Tranexamic acid, Efficacy.

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1. Introduction

The possible risk associated with allogeneic blood transfusion, including virus transmission, pathological lesions, and ABO incompatibility, have been revealed in recent years [1]. Clinical clinicians have long wondered about how to prevent blood transfusions since total knee arthroplasty (TKA) is attributed to considerable blood loss. It appears that the most effective method to minimize allogeneic blood transfusion is to reduce peri/postoperative blood loss. To decrease the necessity for allogeneic blood transfusion, multiple strategies were employed including autologous blood transfusion and intraoperative blood sparing [2].

By effectively blocking the lysine-binding site of plasminogen, plasmin, and tissue plasminogen activator, Tranexamic Acid (TXA), a synthetic anti-fibrinolytic drug that resides around 7–10 times more effective than epsilon–aminocaproic acid, inhibits their interaction with fibrin. As a consequence, the proteolytic activity of plasmin on fibrin monomers and fibrinogen is blocked and the conversion of plasminogen to plasmin is significantly delayed [3, 4].

In primary total knee arthroplasty, TXA demonstrated effectiveness in lowering blood loss, haemoglobin decline, and blood transfusion [5]. The intravenous form or the topical intra-articular form was employed in most investigations. Both techniques are equally efficient [6].

Though TXA is quite safe to use, drug allergy with anaphylactic shock has been observed with the intravenous version, despite there being no significant increase in mortality [7]. The topical version presumably raises the risk of sepsis and poses a danger of periprosthetic infection from contaminated needles. Furthermore, it is yet undetermined how topical treatment may impair cementation and the sustainability of the prosthesis. Moreover, it has been established that the oral form is just as effective or even more effective in decreasing blood loss, and blood transfusion followed by total knee replacement. Thus, according to estimates, it is more affordable than intravenous type [8-9].

A study showed that 16% of patients on TXA required blood transfusion, and 39.1% of patients without TXA required transfusion in primary total knee replacement [10].

This study is recommended in consideration of the requirement to reduce bleeding during TKA surgeries to prevent more postoperative complications. Therefore, the goal is to assess if introducing TA to TKA surgery can lower blood loss and haemoglobin levels, consequently shortening hospital stays and reducing the need for transfusions.

2. Materials & Methods

Following approval from the ethics council, 96 patients from the Pakistan Atomic Energy Commission's outside department of orthopaedics in Islamabad who

met the inclusion criteria were included in the study. To take part in the study patients belonging to both gender ages between 50 to 75 years presenting for the total knee replacement were enrolled. Patients having coagulopathy thrombosis or embolism were excluded. Written consent was obtained. Age, gender, diabetes status, hypertension status, and BMI were collected as baseline data at the start of the study. Block randomization was used for randomization. Group A (NON-TXA) has 48 samples, while Group B has 48 samples (TXA).

The same surgical team performed each procedure in the operating room designated for joint replacement procedures. Using an Automatic Digital Tourniquet System, a tourniquet of the proper size was placed in the proximal thigh, and pressure was kept between 350 and 400 mmHg. Before inflating the tourniquet, 250 mg of injectable transamin was administered intravenously to group A. Standard Medial Parapatellar Arthrotomy was used during surgery. Using common jigs, precise bone cuts were produced in the tibia, femur, and patella. Before making the final cuts, the soft tissue balance was examined.

The final implantation of the proper-sized components (Zimmer NexGen Flex or Biomet Vanguard Knee) was carried out methodically using bone cement after the wound had been completely irrigated with normal saline. The field's obvious blood arteries were all coagulated. Three layers of meticulous closure were applied. The tourniquet was inflated and the Jones Dressing was placed. Patients were treated postoperatively by the TKR route. Epidural anaesthesia was used for pain management throughout the first 24 hours. After the dressing was removed on the second postoperative day, joint range of motion (ROM) was initiated. Before the inflation of the tourniquet, patients in group B received Tranexamic acid (250 mg of Inj. Transamin).

After 24 hours, postoperative haemoglobin (Hb) tests were performed on all patients. Through the suction drain that was inserted following TKA, blood loss was assessed after 24 hours.

The sample size was calculated using mean blood loss at 24 hours, 861.7 ± 253.8 ml[8] in the nontranexamic group and 719.0 ± 244.4 ml[8] in the tranexamic group, keeping the power of the test at 80% and confidence interval at 95%, the calculated sample size was 96.

Data were analyzed using IBM SPSS 25. Mean and SD was calculated for numerical data. Frequency and percentages were calculated for categorical data. Numerical data were assessed between both groups using the Independent samples T-test and for categorical data, the Chi-Square test was applied. The level of significance was < 0.05.

3. Results

Total of Ninety-six patients presented for Total Knee Replacement surgery. All the patients were distributed into 2 groups. Patients in Group A did not receive tranexamic acid and patients in Group B received tranexamic acid. The mean age recorded in group A 63.79±6.60 (years) and the mean age in group B was 62.96±7.89 years.

Regarding, gender distribution male patients in Group A 19 (39.6%) and Group B were 21 (43.8%), in group A there were 29 (60.4%) females and in group B there were 27 (56.2%) females. The mean BMI recorded in group A was 27.15±1.39 kg/m^2 and the mean BMI in group B was 26.86±1.80 kg/m^2. In our study, diabetic patients for group A 7 (14.6%) and group B 4 (8.3%). Hypertension was observed 12 (25%) in group A and in group B 9 (18.8%). (Table 1).

Concerning the outcome parameters of our study, we found a noteworthy variance in blood loss in both groups. Group A patients had a total blood loss of 849.40±134.43 ml and group B patients had a total blood loss of 743.52±135.77 ml. Regarding the postoperative haemoglobin after 24 hours we saw a significant increase in group B as compared to group A, the mean score for postoperative haemoglobin in group A was 8.81±1.05 and 10.15±0.93 for group B.

Regarding blood transfusion, we observed that 28.8% of the patients in group A required blood transfusion, and 5 (10.4%) patients required blood transfusion, though the blood transfusion requirement in group B was lower than in group A, the difference observed did not show statistical significance. (Table 2).

5. Discussion

This study found that using TXA intraarticular during primary TKA significantly lowered the blood loss and the necessity for blood transfusions without raising the risk of complications. The majority of blood transfusions are required for orthopaedic surgery overall[11]. They could make up as much as 10% of all transfusions, according to estimates. A transfusion is necessary for about 45% of patients undergoing major surgery because of significant perioperative blood loss[12]. Joint replacement surgery accounts for 39% of these

transfusions. Blood transfusion complications are uncommon but can have serious effects on the patient. Therefore, it is needed to decrease blood loss which ultimately affects the need for transfusions. TXA application appears to be a suitable course of action to do this. TXA can lower the rate of bleeding during orthopaedic surgeries, according to several research[13].

Table-1 Baseline characteristics.

Baseline characteristics		**Group A (Non-TXA)**	**Group B (TXA)**
Age		63.79±6.60	62.96±7.89
Gender	Male	19 (39.6%)	21 (43.8%)
	Female	29 (60.4%)	27 (56.2%)
BMI		27.15±1.39	26.86±1.80
Diabetes		7 (14.6%)	4 (8.3%)
Hypertension		12 (25%)	9 (18.8%)

To establish the efficacy of TA in lowering blood loss and the degree of transfusion in both unilateral and as well as bilateral TKA. Another research[14] showed in 2013, 148 patients underwent bilateral arthroplasty and 180 individuals underwent unilateral arthroplasty. Their research revealed that TA reduced overall blood loss, although the impact on blood transfusion rates may vary depending on the kind of arthroplasty. Blood transfusion rates decreased in individuals having bilateral arthroplasty, but this was not seen in those having unilateral arthroplasty. With 24 patients undergoing unilateral TKA and 26 patients undergoing bilateral TKA, Kakar et al.[15] and Kim et al.[14] showed comparable results. That study similarly came to the contrary finding from Kim et al.[14], who reported the rate of lower blood transfusion among patients undertaking bilateral surgery: TA decreased post-operative blood transfusions in both groups. The dosage and application technique of TA is further factors in its use to lessen bleeding.

Fifty patients who needed unilateral TKA were the subject of the study by Roy et al.[16], which assessed the effectiveness of intraarticular topic TA in minimizing blood loss in contrast to the control group. Additionally, a decrease in blood transfusions among TKA patients who had received TA was observed. Haemoglobin level declines were the metrics considered in this investigation. In a randomized clinical trial with 99 patients, Pachauri et al.[17] evaluated the effectiveness of TA in postoperative TKA and found that haemoglobin levels decreased significantly.

The mean postoperative haemoglobin level in this trial indicated a negligible drop when using TA. Contrarily, those who didn't take the medication had large drops in serum haemoglobin levels and needed blood transfusions. After a procedure with a high risk of bleeding, maintaining haemoglobin levels has a significant impact on reducing the need for blood transfusions and related consequences.[18] This hypothesis is supported by the research, which also highlights the value of routine TA use in TKA procedures.[19]

Tan J et al[20]. reported that hypertension, dyslipidemia, cerebrovascular accident, obesity, diabetes mellitus, and congestive heart failure, are the most frequent comorbidities among patients referred for TKA. This study supports these findings by demonstrating that, in agreement with the rate of chronic infections among the population above 60 years, hypertension is the most common comorbid among the population, after diabetes mellitus.

Table-2 Comparison of blood loss, haemoglobin, and transfusion required between both groups.

Parameters	Group A (Non-TXA)	Group B (TXA)	P value
Blood loss (24 hours)	849.40±134.43	743.52±135.77	0.0001
Postoperative haemoglobin (24 hours)	8.81±1.05	10.15±0.93	0.0001
Transfusion required	10 (28.8%)	5 (10.4%)	0.16

To arrive at a precise conclusion while deciding the most efficient application strategy, various investigations involving the comparison of various TA application strategies need to be done. Recent research has, however, repeatedly shown that TA lessens bleeding and the requirement for blood transfusions after TKA procedures.[21, 22]

5. Conclusion

From our study, we conclude that Tranexamic acid used intravenously during total knee arthroplasty considerably lowers postoperative blood loss. The Results of this study depict a decrease in total blood loss, and a reduction in haemoglobin levels and blood transfusion.

CONFLICTS OF INTEREST- None

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Contributions:

M.I.Y, K.H - Conception of study

F.R, S.N.J - Experimentation/Study conduction

M.S.M, S.I -Analysis/Interpretation/Discussion

M.I.Y, M.S.M, S.N.J - Manuscript Writing

M.I.Y - Critical Review

F.R, K.H - Facilitation and Material analysis

References

[1] Song K, Pan P, Yao Y, Jiang T, Jiang Q. The incidence and risk factors for allogenic blood transfusion in total knee and hip arthroplasty. J Orthop Surg Res. 2019;14(1):1-6. DOI: 10.1186/s13018-019-1271-7.

[2] Pawaskar A, Salunke AA, Kekatpure A, Chen Y, Nambi GI, Tan J, et al. Do autologous blood transfusion systems reduce allogeneic blood transfusion in total knee arthroplasty? Knee Surg Sports Traumatol. Arthrosc. 2017;25(9):2957-66. DOI: 10.1007/s00167-016-4286-4.

[3] Pechlivani N, Kearney KJ, Ajjan RA. Fibrinogen and Antifibrinolytic Proteins: Interactions and Future Therapeutics. Int J Mol Sci. 2021;22(22):12537. DOI:10.3390/ijms222212537

[4] Li MM, Kwok JY, Chung KY, Cheung KW, Chiu KH, Chau WW, et al. Prospective randomized trial comparing efficacy and safety of intravenous and intra-articular tranexamic acid in total knee arthroplasty. Knee Surg Relat Res. 2020;32(1):1-6. DOI:10.1186/s43019-020-00007-2

[5] Ye W, Liu Y, Liu WF, Li XL, Fei Y, Gao X. Comparison of efficacy and safety between oral and intravenous administration of tranexamic acid for primary total knee/hip replacement: a meta-analysis of randomized controlled trial. J Orthop Surg Res. 2020;15(1):1-1. DOI:10.1186/s13018-020-02115-1

[6] Prakash J, Seon JK, Park YJ, Jin C, Song EK. A randomized control trial to evaluate the effectiveness of intravenous, intra-articular and topical wash regimes of tranexamic acid in primary total knee arthroplasty. J Orthop Surg Res. 2017;25(1):2309499017693529. DOI: 10.1186/s13018-017-0678-6

[7] Duncan CM, Gillette BP, Jacob AK, Sierra RJ, Sanchez-Sotelo J, Smith HM. Venous thromboembolism and mortality associated with tranexamic acid use during total hip and knee arthroplasty. J Arthroplasty. 2015;30:272-6. DOI:10.1016/j.arth.2014.09.019

[8] Sadigursky D, Andion D, Boureau P, Ferreira MC, Carneiro RJ, Colavolpe PO. Effect of tranexamic acid on bleeding control in total knee arthroplasty. Acta Ortopédica Brasileira. 2016 May;24:131-6. DOI: 10.1590/1413-785220162404159047

[9] Irwin A, Khan SK, Jameson SS, Tate RC, Copeland C, Reed MR. Oral versus intravenous tranexamic acid in enhanced recovery primary total hip and knee replacement: results of 3000 procedures. Bone Joint J. 2013;95:1556-61. DOI:10.1302/0301-620X.95B11.32001

[10] Aslam KS, Niazi AK, Nabi O. Efficacy of tranexamic acid in reducing blood loss in total knee replacements. J Pak Med Assoc. 2015;65(3):210-14 DOI: 10.1542/peds.2014-0131B

[11] Slover J, Lavery JA, Schwarzkopf R, Iorio R, Bosco J, Gold HT. Incidence and Risk Factors for Blood Transfusion in Total Joint Arthroplasty: Analysis of a Statewide Database. J Arthroplasty. 2017;32(9):2684–2687.e1. DOI: 10.1016/j.arth.2017.04.020

[12] Shander A, Hofmann A, Ozawa S, Theusinger OM, Gombotz H, Spahn DR. Activity-based costs of blood transfusions in surgical patients at four hospitals. Transfusion. 2010;50(4):753–65. DOI:10.1111/j.1537-2995.2009.02247.x

[13] Stanworth SJ, Cockburn HAC, Boralessa H, Contreras M. Which groups of patients are transfused? A study of red cell usage in London and Southeast England. Vox Sang. 2002;83(4):352–7. DOI:10.1159/000065630

[14] Kim TK, Chang CB, Kang YG, Seo ES, Lee JH, Yun JH, et al. Clinical value of tranexamic acid in unilateral and simultaneous bilateral TKAs under a contemporary blood-saving protocol: a randomized controlled trial. Knee Surg Sports Traumatol Arthrosc. 2014;22(8):1870-8. DOI: 10.1007/s00167-013-2426-7

[15] Kakar PN, Gupta N, Govil P, Shah V. Efficacy and safety of tranexamic acid in control of bleeding following TKR: a randomized clinical trial. Indian J Anaesth. 2009;53(6):667-71. DOI:10.4103/0019-5049.146676

[16] Roy SP, Tanki UF, Dutta A, Jain SK, Nagi ON. Efficacy of intra-articular tranexamic acid in blood loss reduction following primary unilateral total knee arthroplasty. Knee Surg Sports Traumatol Arthrosc. 2012;20(12):2494-501. DOI:10.1007/s00167-011-1494-y

[17] Pachauri A, Acharya KK, Tiwari AK. The effect of tranexamic acid on hemoglobin levels during total knee arthroplasty. Am J Ther. 2014;21(5):366-70. DOI:10.1097/MJT.0b013e318292d18e

[18] Delanois RE, Mont MA. Does tranexamic acid reduce blood loss in total knee arthroplasty? Commentary on an article by X. Aguilera, MD, et al.:"Efficacy and safety of fibrin glue and tranexamic acid to prevent postoperative blood loss in total knee arthroplasty. A randomized controlled clinical trial". J Bone Joint Surg Am. 2013;95(22):e179. DOI: 10.2106/JBJS.M.00836

[19] Chimento GF, Huff T, Ochsner JL Jr, Meyer M, Brandner L, Babin S. An evaluation of the use of topical tranexamic acid in total knee arthroplasty. J Arthroplasty. 2013;28(8 Suppl):74-7. DOI: 10.1016/j.arth.2013.05.023

[20] Tan J, Chen H, Liu Q, Chen C, Huang W. A meta-analysis of the effectiveness and safety of using tranexamic acid in primary unilateral total knee arthroplasty. J Surg Res. 2013;184(2):880-7. DOI: 10.1016/j.jss.2013.04.017

[21] Poeran J, Chan JJ, Zubizarreta N, Mazumdar M, Galatz LM, Moucha CS. Safety of tranexamic acid in hip and knee arthroplasty in high-risk patients. Anesthesiol. 2021;135(1):57-68. DOI: 10.1097/ALN.0000000000003723

[22] Fan D, Ma J, Liu X, Zhang L. Peri-articular administration of tranexamic acid is an alternative route in total knee arthroplasty: a systematic review and meta-analysis. J Orthop Surg Res. 2022;17(1):1-21. DOI:10.1186/s13018-021-02820-9