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Original Research

The Effect of Local Tranexamic Acid Administration on Blood Loss and Transfusion in Total Knee Arthroplasty: A Retrospective Study

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ABSTRACT

Objectives: The standard surgical method for primary gonarthrosis in advanced stages is total knee arthroplasty (TKA), despite the risk of bleeding that requires transfusion. Blood transfusions are potentially dangerous. The aim of this study was to determine whether there is a statistical difference in the amount of bleeding and the need for transfusion between patients who received and did not receive perioperative local tranexamic acid in TKA.

Methods: The hospital data system was used to access the data of patients who underwent TKA in our clinic between January 2015 and January 2022 with a diagnosis of gonarthrosis. Patients who underwent TKA and had gonarthrosis as the primary diagnosis were included in the study. They were separated into two groups: A control group (Group C) and a group that received perioperative local tranexamic acid (Group LTXA). The amount of bleeding was compared by taking into account patients' hemogram follow-ups, the amount of blood from their drains, and their transfusion needs during the postoperative period.

Results: The findings demonstrated that TKA patients who received local tranexamic acid administration experienced a significant decrease in perioperative blood loss and needed lesser transfusions.

Conclusion: The findings of our investigation are consistent with other studies and are in favor of the usage of TXA in TKA. To validate our findings and establish the ideal TXA dosage and administration method in TKA, additional research is required.

Keywords: Blood transfusion, hemoglobin, surgical drain, total knee arthroplasty, tranexamic acid

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Total knee arthroplasty (TKA) is an effective treatment for advanced primary gonarthrosis, although it has a high risk of bleeding that needs transfusion. Blood transfusion may be required if there is postoperative acute hemorrhagic anemia. Between one and three blood transfusions are necessary postoperatively for approximately one-third of TKA patients.[1-4] However, blood transfusion carries many risks, including infection and allergic and transfusion reactions.[5] Following TKA, transfusion has been linked to higher rates of mortality and to morbidity, including kidney disease, venous thrombosis, myocardial infarction, heart failure, extended hospital stays, and prolonged rehabilitation.[6] To avoid complications related to transfusion, surgeons aim to reduce perioperative bleeding.

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Tranexamic acid (TXA) is a synthetic lysine amino acid derivative that binds to plasminogen and inhibits the deterioration of fibrin. After its discovery in the 1960s, it began to be commonly used as an antifibrinolytic agent in orthopedic surgery,[7] and the use of tranexamic acid in TKA has increased.[8]

TXA is used locally, systemically, or in combination to decrease blood loss and the need for transfusions after TKA.

The aim of this study was to determine whether there is a statistical difference in the amount of bleeding and the need for transfusion between patients who received and did not receive perioperative local tranexamic acid in TKA.

Methods

This retrospective study included all patients diagnosed with gonarthrosis between January 2015 and January 2022 who met the inclusion criteria: Aged 60–80 years and who underwent primary TKA due to gonarthrosis. Patients with secondary gonarthrosis due to infection, trauma, or rheumatologic or systemic diseases with joint involvement were excluded from the study. Patients who received IV or combined TXA during primary TKA were also excluded from the study. Data about the patients were accessed from the hospital database. The hemogram results of all the patients were evaluated preoperatively and on postoperative days 1 and 3. Surgical drains were applied to all the patients, and the drain volumes were monitored before being removed on the first postoperative day.

All the surgeries were performed using a tourniquet and under spinal anesthesia. One group received local application of 2 g tranexamic acid onto the open wound over the knee joint after cemented TKA. After the application, the incision site was anatomically sutured and the tourniquet was terminated. After 2 h, a drain was clamped and activated. This group was defined as the local tranexamic acid group (Group LTXA). The drain was clamped and turned on 2 h later in the second group, which was not administered tranexamic acid following cemented TKA. This group was identified as the control group (Group C). The inclusion criteria were satisfied by 38 patients in Group C and 39 patients in Group LTXA.

Retrospective analysis of the patient demographics, including age and gender, and the treatments performed in the outpatient clinic, was conducted. Perioperative and postoperative 24-h hemoglobin (Hg) levels were compared. The average amount of blood from the surgical drain after total knee replacement and the significance of the difference in averages between the groups were examined. The relationship between postoperative blood transfusion amounts and tranexamic acid application was also investigated between the groups.

Statistical Analysis

The data analyses of the study were conducted using the "Statistical Package for the Social Science (SPSS) for Windows" statistical software version 23.0 (SPSS, Chicago, IL, USA) on a computer. A probability value of $p<0.05$ was regarded as statistically significant in all analyses. Numerical data were expressed as mean and standard deviation, whereas categorical and ordinal data were expressed as percentages (%). The Shapiro–Wilk test was used to determine whether numerical data have a normal distribution. Student's-t independent and Student's-t paired tests were used to compare groups for numerical measured variables with normal distribution.

Results

Group C consisted of 38 patients, including 32 (84%) females and 6 (16%) males, with an average age of 68 years. Of these, 18 patients underwent TKA due to the right knee osteoarthritis and 20 patients due to the left knee osteoarthritis. A total of 39 patients in the tranexamic acid group (Group LTXA), 30 (77%) were female and 9 (23%) were male, and the mean age was 70.5 years. The group included 19 patients who had TKA for the right knee osteoarthritis and 20 patients who had TKA for the left knee osteoarthritis.

The mean perioperative Hg measurement in Group C was 13.28 g/dL, and it was 10.93 g/dL 24 h after the surgery. In Group LTXA, the mean perioperative Hg was 13.33 g/dL, and it was 11.95 g/dL 24 h after the surgery. Both Group LTXA and Group C showed statistically significant variations between the perioperative and postoperative measures ($p<0.001$) (Table 1).

Table 1. Preoperative and postoperative 24th h mean the level of hemoglobin (Hg)

	Group C (n=38)	Group LTXA (n=39)	p
Preoperative mean Hg level (g/dL)	13.28	13.33	0.000*
Postoperative 24th h mean Hg level (g/dL)	10.93	11.95	0.000*

*p<0.001; Hg: Hemoglobin; n: Number of patients.

In Group C, the average amount of blood from the surgical drain at 24 h postoperatively was 103.03 mL compared with 71.54 mL in Group LTXA. The difference in the volume of blood from the surgical drain was statistically significant. (p<0.001) (Table 2).

In Group C, the mean value of the first 24-h Hg drop was 2.34 g/dL, while in Group LTXA, it was 1.38 g/dL. In Group C, the mean value of the total Hg drop was 3.44 g/dL, whereas in Group LTXA, it was 2.57 g/dL. The first 24-h Hg drop (p<0.001) and total Hg drop (p<0.05) were much greater in Group C than in Group LTXA and were statistically significant (Table 3).

In Group C, 36.8% of the patients did not receive a blood transfusion, 34.2% received one unit of blood, 23.7% received two units, 2.6% received three units, and 2.6% received four units. In Group LTXA, the proportion of patients who did not receive blood transfusion was 89.7%, whereas 7.7% and 2.6%, respectively, received 1 unit and 2 units of blood transfusion. There was a statistically significant relationship between the total amount of transfusion in Group LTXA and Group C (p<0.001) (Table 4).

Discussion

In several studies, tranexamic acid has been used locally, systemically, or in combination to decrease blood loss and the need for transfusions after TKA.[9,10] Local administration of tranexamic acid is as effective as systemic and combined approaches. However, there is no consensus on the route of administration, dose and when it should be administered.[9,11] Concerns about tranexamic acid's possible connection to thromboembolic events arise from how it is administered. Recent research, however, has failed to demonstrate a relationship between these events and the route of administration.[12-18]

The results of this study indicate that the administration of perioperative tranexamic acid locally during TKA can dramatically minimize blood loss and the requirement for blood transfusions. The findings of this study are in accordance with prior studies that demonstrated tranexamic acid's effectiveness in minimizing blood loss during TKA.[15,17,19-21]

The results showed a statistically significant difference between the groups that received local tranexamic acid administration and those that did not in terms of the initial

Table 2. Postoperative 24th h mean surgical drain level (mL)

	Group C (n=38)	Group LTXA (n=39)	p
Mean Surgical drain (ml)	103.03	71.54	0.000*

*p<0.001; ml: Milliliter; n: Number of patients.

Table 3. Postoperative level of hemoglobin (Hg) drop

	Group C (n=38)	Group LTXA (n=39)	p
Postoperative first 24-h Hg drop (g/dL)	2.34	1.38	0.000*
Postoperative total Hg drop (g/dL)	3.44	1.01	0.000*

*p<0.001; Hg: Hemoglobin; n: Number of patients.

Table 4. Distribution of blood transfusion amounts

	Group C (n=38)	Group LTXA (n=39)	p
No need blood transfusion (n) (%)	14 (36.8)	35 (89.7)	
1 unit blood transfusion (n) (%)	13 (34.2)	3 (7.7)	
2 unit blood transfusion (n) (%)	9 (23.7)	1 (2.6)	
3 unit blood transfusion (n) (%)	1 (2.6)	0 (0)	
4 unit blood transfusion (n) (%)	1 (2.6)	0 (0)	
Total blood transfusion (n) (%)	24 (63.2)	4 (10.3)	0.000*

*p<0.001; Hg: Hemoglobin; %: Percentage; n: Number of patients.

24-h hemoglobin drop after surgery and the overall hemoglobin decline throughout the hospital stay.[22,23] The usage of tranexamic acid was linked to a reduced hemoglobin decline, indicating that it might help hasten recovery and reduce hospital stays.[19]

The study's findings revealed that the amount of blood draining from the surgical drain in the group without the application of tranexamic acid (Group C) was significantly higher than that in the group with the application of tranexamic acid (Group LTXA). The effectiveness of tranexamic acid in minimizing blood loss during TKA is in line with previous research.[24-26]

The limitations of this research are the retrospective design, the small sample, the fact that it was performed in a single center and the inclusion of only primary cases of gonarthrosis. Another limitation is that the surgeries were performed by different surgeons. Although they are experienced in TKA, some personal surgical differences may have an effect on blood loss.

Conclusion

The use of perioperative local TXA in TKA can dramatically reduce blood loss, lessen the requirement for blood transfusions, and enhance patient outcomes. However, further research is needed to validate our findings and determine the optimal dosage and administration protocol for TXA in TKA.

Disclosures

Ethics Committee Approval: This article does not contain any studies with human or animal subjects performed by the any of the authors.

Patient informed consent: Informed Consent was obtained.

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References

1. Good L, Peterson E, Lisander B. Tranexamic acid decreases external blood loss but not hidden blood loss in total knee replacement. Br J Anaesth 2003;90:596-9. [CrossRef]
2. Sehat KR, Evans R, Newman JH. How much blood is really lost in total knee arthroplasty?. Correct blood loss management should take hidden loss into account. Knee 2000;7:151-5. [CrossRef]
3. Jansen AJ, Andreica S, Claeys M, D'Haese J, Camu F, Jochmans K. Use of tranexamic acid for an effective blood conservation strategy after total knee arthroplasty. Br J Anaesth 1999;83:596-601. [CrossRef]
4. Hiippala ST, Strid LJ, Wennerstrand MI, Arvela JV, Niemelä HM, Mäntylä SK, et al. Tranexamic acid radically decreases blood loss and transfusions associated with total knee arthroplasty. Anesth Analg 1997;84:839-44. [CrossRef]
5. Bong MR, Patel V, Chang E, Issack PS, Hebert R, Di Cesare PE. Risks associated with blood transfusion after total knee arthroplasty. J Arthroplasty 2004;19:281-7. [CrossRef]
6. Owens J, Otero JE, Noiseux NO, Springer BD, Martin JR. Risk factors for post-operative blood transfusion following total knee arthroplasty. Iowa Orthop J 2020;40:69-73.
7. Okamoto S, Okamoto U. Amino-methyl-cyclohexane-carboxylic acid: amcha. Keio J Med 1962;11:105-15. [CrossRef]
8. Fillingham YA, Ramkumar DB, Jevsevar DS, Yates AJ, Shores P, Mullen K, et al. The efficacy of tranexamic acid in total knee arthroplasty: a network meta-analysis. J Arthroplasty 2018;33:3090-8. [CrossRef]
9. Talmaç MA, Görgel MA, Birsel SE, Sönmez MM, Özdemir HM. The effect of single high-dose preoperative intravenous tranexamic acid administration to reduce blood loss in patients with primary total knee replacement. Sisli Etfal Hastan Tip Bul 2019;53:137-42. [CrossRef]
10. Reale D, Andriolo L, Gursoy S, Bozkurt M, Filardo G, Zaffagnini S. complications of tranexamic acid in orthopedic lower limb surgery: a meta-analysis of randomized controlled trials. Biomed Res Int 2021;2021:6961540. [CrossRef]
11. Marra F, Rosso F, Bruzzone M, Bonasia DE, Dettoni F, Rossi R. Use of tranexamic acid in total knee arthroplasty. Joints 2017;4:202-13. [CrossRef]
12. Wei W, Dang S, Duan D, Wei L. Comparison of intravenous and topical tranexamic acid in total knee arthroplasty. BMC Musculoskelet Disord 2018;19:191. [CrossRef]
13. Gillette BP, Desimone LJ, Trousdale RT, Pagnano MW, Sierra RJ. Low risk of thromboembolic complications with tranexamic acid after primary total hip and knee arthroplasty. Clin Orthop Relat Res 2013;471:150-4. [CrossRef]
14. Kim TK, Chang CB, Koh IJ. Practical issues for the use of tranexamic acid in total knee arthroplasty: a systematic review. Knee Surg Sports Traumatol Arthrosc 2014;22:1849-58. [CrossRef]
15. Shin YS, Yoon JR, Lee HN, Park SH, Lee DH. Intravenous versus topical tranexamic acid administration in primary total knee arthroplasty: a meta-analysis. Knee Surg Sports Traumatol Arthrosc 2017;25:3585-95. [CrossRef]
16. Wu J, Zhou YQ, Deng JH, Han YG, Zhu YC, Qian QR. Ideal intraarticular application dose of tranexamic acid in primary total knee arthroplasty: a prospective, randomized and controlled study. Ann Transl Med 2020;8:1353. [CrossRef]
17. Petersen W, Bierke S, Hees T, Karpinski K, Häner M. Fast track concepts in total knee arthroplasty: use of tranexamic acid and local intra-articular anesthesia technique. Oper Orthop Traumatol [Article in German] 2019;31:447-62. [CrossRef]
18. Tzatzairis TK, Drosos GI, Kotsios SE, Ververidis AN, Vogiatzaki TD, Kazakos KI. Intravenous vs topical tranexamic acid in total knee arthroplasty without tourniquet application: a randomized controlled study. J Arthroplasty 2016;31:2465-70. [CrossRef]

19. Kumar D, Sharma A, Sharma G, Trivedi A. A comparative study of blood loss with and without ınfusion of tranexamic acid in total knee replacement. Cureus 2022;14:e27737. [CrossRef]
20. Kyriakopoulos G, Oikonomou L, Panagopoulos A, Kotsarinis G, Vlachou M, Anastopoulos G, et al. Transfusion rate, hospital stay and cost-effectiveness of intravenous or local administration of tranexamic acid in total hip and knee arthroplasty: a single-center randomized controlled clinical study. Orthop Rev (Pavia) 2019;11:7866. [CrossRef]
21. Craik JD, Ei Shafie SA, Kidd AG, Twyman RS. Can local administration of tranexamic acid during total knee arthroplasty reduce blood loss and transfusion requirements in the absence of surgical drains? Eur J Orthop Surg Traumatol 2014;24:379-84. [CrossRef]
22. Hishimura R, Onodera T, Ohkoshi Y, Okada K, Matsuoka M, Matsubara S, et al. The effect of local injection of tranexamic acid into peri-articular tissue versus drain clamping in total knee arthroplasty: a randomized controlled trial. BMC Musculoskelet Disord;23:111. [CrossRef]
23. Guerreiro JPF, Badaro BS, Balbino JRM, Danieli MV, Queiroz AO, Cataneo DC. Application of tranexamic acid in total knee arthroplasty - prospective randomized trial. Open Orthop J;11:1049-57. [CrossRef]
24. Tille E, Mysliwietz J, Beyer F, Postler A, Lützner J. Intraarticular use of tranexamic acid reduces blood loss and transfusion rate after primary total knee arthroplasty. BMC Musculoskelet Disord 2019;20:341. [CrossRef]
25. 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;20:2494-501. [CrossRef]
26. Lošťák J, Gallo J, Večeřa M, Špička J, Langová K. Local application of tranexamic acid in total hip arthroplasty decreases blood loss and consumption of blood transfusion. Acta Chir Orthop Traumatol Cech [Article in Czech] 2017;84:254-62. [CrossRef]