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EFFECT OF INTRA-ARTICULAR TRANEXAMIC ACID ON POSTOPERATIVE BLOOD LOSS IN TOTAL KNEE ARTHROPLASTY: A COMPARATIVE STUDY

Orthopaedics

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ABSTRACT

Background: Total knee arthroplasty (TKA) often involves substantial blood loss, leading to transfusion and related risks. Tranexamic acid (TXA) helps reduce bleeding, though the most effective route of administration is still debated. **Objectives:** To evaluate the efficacy of intra-articular tranexamic acid in reducing postoperative blood loss in patients undergoing primary unilateral TKA. **Methods:** A randomized controlled study at SRMS Institute of Medical Sciences (May 2023–October 2024) included 70 patients over 50 years undergoing unilateral TKA. Patients were randomly divided into two groups: treatment group, that received TXA and a control group, that did not. Postoperative hemoglobin levels and blood loss were measured to assess outcomes. **Results:** The treatment group had significantly higher post-operative hemoglobin levels (10.043 ± 1.34 g/dL) compared to control group(9.177 ± 1.21 g/dL; p = 0.006). Mean blood loss was significantly lower in the treatment group (696.58 ± 271.84 mL vs. 1104.48 ± 280.61 mL; p < 0.001). **Conclusion:** Intra-articular tranexamic acid is effective in minimizing postoperative blood loss and transfusion needs in TKA.

KEYWORDS

Tranexamic Acid; Arthroplasty; Blood Loss; Knee Replacement; Hemostasis

INTRODUCTION

Knee osteoarthritis (OA) is the most common form of arthritis in the elderly, often causing disability in individuals over 65 years of age.[1] It is a progressive joint disease affecting the entire knee structure, not just cartilage, and can be primary due to age, obesity, mechanical stress, genetics or secondary to trauma.[2] Clinically, it presents with pain and limited mobility, significantly impairing quality of life. Total knee arthroplasty (TKA) is the preferred surgical option for advanced OA unresponsive to conservative management.[3] Although effective in restoring joint function, TKA is associated with substantial perioperative blood loss. This often necessitates allogeneic blood transfusions, with risks such as infections and transfusion reactions.[4,5,6]

Various strategies are used to reduce TKA-related blood loss, including hypotensive anesthesia, hemodilution, and pharmacological agents like tranexamic acid (TXA).[7] TXA is a synthetic antifibrinolytic that prevents clot breakdown by inhibiting plasminogen activation.[8,9] Since its first use in TKA in 1995, TXA has consistently shown to reduce blood loss and transfusion needs.[10,11,12] Intravenous TXA is widely accepted, but intra-articular administration is gaining attention due to its localized effect and lower systemic exposure.[13]

This study aims to assess the efficacy of per-operative intra-articular TXA in reducing postoperative blood loss in TKA and compare outcomes with patients who did not receive TXA.

MATERIALS AND METHODS

This randomized controlled study was conducted in Department of Orthopaedics at SRMS Institute of Medical Sciences, Bareilly, between May 1, 2023, and October 31, 2024, after receiving ethical clearance from the Institutional Ethics Committee (Ref. No. SRMS IMS/ECC/2023/123. 70 patients over 50 years of age with primary knee osteoarthritis scheduled for unilateral total knee arthroplasty were enrolled. Sampling was done using a simple randomization technique via lottery method, allocating patients into two groups: treatment group received 2 grams of intra-articular tranexamic acid after joint capsule closure, while the control group did not. Exclusion criteria included secondary osteoarthritis, bleeding disorders, abnormal coagulation profiles, cardiorespiratory illness, revision surgeries, malignancy, and allergy to tranexamic acid. All surgeries were performed via a medial parapatellar approach with a tourniquet; drains were not used in the treatment group. Data on demographics and hemoglobin levels were collected pre- and postoperatively day one.

Sample size was determined using G*Power software version 3.1.9.2, based on data from a study by Young-Jun Seol[14] et al. Statistical analysis was performed using IBM SPSS version 22, with significance set at $p < 0.05$. Blood loss was calculated using a formula based on hemoglobin change and patient metrics by Nadler, Sehat, and Gericke.[15,16,17]

Total volume of blood loss (ml) = $100 \times Hb_{loss}/Hb_i$

$Hb_{loss} = BV \times 10 \times (Hb_i - Hb_e)$

BV = estimated total body blood volume in liters

$= 0.3669 \times H^3 + 0.03219 \times W + 0.6041$ (man)

$= 0.3561 \times H^3 + 0.03308 \times W + 0.1833$ (woman)

Where H is the patient's height (m),
W is the body mass (kg),
Hbi is haemoglobin concentration prior to surgery (g/dL),
Hbe is haemoglobin concentration post-operatively (g/dL).'

RESULTS

In this study, both treatment and control groups had comparable baseline demographics, with no significant differences in age or gender distribution. Hemoglobin loss was significantly lower in the treatment group (mean 83.5582 g/dL (± 39.1774)) compared to the control group (mean 133.9782 g/dL (± 43.830)), with a statistically significant mean difference of 50.420 g/dL ($p < 0.001$). Total blood loss volume was significantly reduced in the treatment group, with a mean difference of 407.905 mL ($p < 0.001$). 10 patients in the treatment group required blood transfusions while 19 in the control group, a difference that was also statistically significant ($p = 0.029$ indicating, more patients received blood transfusions in the control group.

Parameter	Treatment Group (Mean ± SD)	Control Group (Mean ± SD)	p value#
Hb (Pre-operative)	11.803 ± 1.5702	12.011 ± 1.5703	0.580
Hb (Post-operative)	10.043 ± 1.3367	9.177 ± 1.2066	0.006
Hb Loss (g)	83.5582 ± 39.1774	133.9782 ± 43.83	<0.001
Total volume of blood loss (mL)	696.5785 ± 271.84	1104.4835 ± 280.61	<0.001

DISCUSSION

Intra-articular administration of TXA, an antifibrinolytic agent, has been extensively studied for its ability to minimize such blood loss. The present study evaluated the efficacy of intra-articular TXA in reducing blood loss during primary unilateral TKA. Two groups in our study were demographically comparable, with no statistically significant differences in age, sex, BMI, or duration of illness. Most patients were aged between 51–70 years, and females predominated

similar to findings reported by Jang B et al. and Baig MA et al.[7,8] Our results showed that pre-operative hemoglobin levels were similar in both groups (p = 0.580), but post-operative levels were significantly higher in the treatment group (p = 0.006), indicating reduced blood loss with intra-articular TXA use. The control group had more decrease in hemoglobin levels (mean loss: 133.98 ± 43.83 g/dL) compared to the treatment group (83.56 ± 39.18 g/dL) post-operatively, with a statistically significant difference ($p < 0.001$). Transfusion requirement was significantly lower in the treatment group (34.5%) compared to the control group (65.5%), with a p-value of 0.029. This supports the efficacy of TXA in reducing transfusion needs, as also concluded by Jang B et al. and Sabatini et al., who demonstrated equal effectiveness and safety of both topical and intravenous TXA regimens.[7,10] Benoni G et al. supported the prophylactic use of TXA in TKA to reduce transfusion needs without elevating risks of pulmonary embolism or deep vein thrombosis (DVT).[11] These findings align with Jang B et al., Tille E et al., Zhao-Yu C et al.[7,18,19] Gericke et al. and Tille et al. confirmed that the intra-articular application of 2 g TXA was a cost-effective method to reduce perioperative blood loss without increasing complications.[15,18] Gericke et al. omitted drains in treatment group to avoid TXA loss; a strategy we also followed in this study.[15] Wong et al. observed a 20–25% reduction in bleeding with topical TXA.[20]

Lu Q et al. emphasized the importance of blood loss control in TKA to reduce complications, speed up recovery, and enhance patient satisfaction.[21] Themistoklis et al. advocated for personalized, interdisciplinary approaches to optimize perioperative blood management.[22] Overall, our findings reaffirm TXA's role in minimizing blood loss post-operatively in TKA.

Strengths

The study's main strength is its randomized controlled design, which enhances internal validity. Homogeneous patient selection through strict criteria minimized confounders, while objective blood loss measurement using validated formulas ensured data reliability. The intra-articular administration of tranexamic acid allowed for a targeted local effect, and a uniform surgical technique reduced procedural variability.

Limitations

Despite its strengths, the study had limitations, including a modest sample size and single-center design, which may affect generalizability. Long-term thromboembolic outcomes, functional recovery, and postoperative pain were not assessed, limiting the broader evaluation of clinical benefits. Additionally, the optimal route and dosage of tranexamic acid remain uncertain.

CONCLUSION

Intra-articular tranexamic acid significantly reduced postoperative hemoglobin drop, blood loss, and transfusion needs in primary unilateral TKA, proving to be a safe and cost-effective alternative to systemic use. The findings support its role as a key component of perioperative blood management, with potential to enhance surgical outcomes and minimize transfusion-related risks.

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REFERENCES

1. Hunter DJ, Felson DT. Osteoarthritis. BMJ. 2006 Mar 18;332(7542):639–42. doi:10.1136/bmj.332.7542.639. PMID: 16543327; PMCID: PMC1403209.
2. Hsu H, Siwiec RM. Knee Osteoarthritis [Internet]. In: StatPearls [Updated 2023 Jun 26]. Treasure Island (FL): StatPearls Publishing; 2025 Jan–. Available from: https://www.ncbi.nlm.nih.gov/books/NBK507884/
3. Varacallo M, Luo TD, Mabrouk A, et al. Total Knee Arthroplasty Techniques [Internet]. In: StatPearls [Updated 2024 May 6]. Treasure Island (FL): StatPearls Publishing; 2024 Jan–. Available from: https://www.ncbi.nlm.nih.gov/books/NBK499896/
4. Prasad N, Padmanabhan V, Mullaji A. Blood loss in total knee arthroplasty: an analysis of risk factors. Int Orthop. 2007;31:39–44.
5. Banerjee S, Issa K, Kapadia BH, et al. Intraoperative nonpharmacotherapeutic blood management strategies in total knee arthroplasty. J Knee Surg. 2013;26:387–93.
6. Cushner FD, Friedman RJ. Blood loss in total knee arthroplasty. Clin Orthop Relat Res. 1991;(269):98–101.
7. Jang B, Kao M, Bohm MT, et al. Intra-articular injection of tranexamic acid to reduce blood loss after total knee arthroplasty. J Orthop Surg (Hong Kong). 2014 Aug;22(2):146–9. doi:10.1177/230949901402200205. PMID: 25163943.
8. Baig MA, Kommera S. Evaluation of tranexamic acid in reducing blood loss and transfusions in total knee replacement. Int J Res Orthop. 2019;5:899–903.
9. Liu D, Dan M, Martinez Martos S, Beller E. Blood management strategies in total knee arthroplasty. Knee Surg Relat Res. 2016;28:179–87.
10. Sabatini L, Atzori F. Topical intra-articular and intravenous tranexamic acid to reduce blood loss in total knee arthroplasty. Ann Transl Med. 2015 May;3(Suppl 1):S18. doi:10.3978/j.issn.2305-5839.2015.02.25. PMID: 26046063; PMCID: PMC4437955.
11. Benoni G, Fredin H. Fibrinolytic inhibition with tranexamic acid reduces blood loss and blood transfusion after knee arthroplasty: a prospective, randomised, double-blind study of 86 patients. J Bone Joint Surg Br. 1996;78:434–40.
12. Benoni G, Carlsson A, Petersson C, Fredin H. Does tranexamic acid reduce blood loss in knee arthroplasty? Am J Knee Surg. 1995;8:88–92.
13. Hynes M, Calder P, Scott G. The use of tranexamic acid to reduce blood loss during total knee arthroplasty. Knee. 2003;10:375–7.
14. Young-Jun Seol, MD, Jong-KeunSeon, MD, Seung-Hun Lee, MD et al. Effect of Tranexamic Acid on Blood Loss and Blood Transfusion Reduction after Total Knee Arthroplasty,Knee Surg Relat Res 2016 Sep; 28(3): 188-193 https://doi.org/10.5792/ksrr.2016.28.3.188.
15. Gericke E, De Beer J, Deacon M, Marais LC. Percutaneous intra-articular tranexamic acid following total knee arthroplasty without drainage to reduce blood loss. SA Orthop J. 2020;19:74–8.
16. Nadler SB, Hidalgo JH, Bloch T. Prediction of blood volume in normal human adults. Surgery. 1962 Feb;51(2):224-32. PMID: 21936146.
17. 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. doi: 10.1016/S0968-0160(00)00047-8.
18. 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 Jul 27;20(1):341. doi:10.1186/s12891-019-2715-9. PMID: 31351459; PMCID: PMC6661102.
19. Zhao-Yu C, Yan G, Wei C, Yuejv L, Ying-Ze Z. Reduced blood loss after intra-articular tranexamic acid injection during total knee arthroplasty: a meta-analysis of the literature. Knee Surg Sports Traumatol Arthrosc. 2014 Dec;22(12):3181–90. doi: 10.1007/s00167-013-2814-3. Epub 2013 Dec 19. PMID: 24352523.
20. Wong J, Abrishami A, El Beheiry H, et al. Topical application of tranexamic acid reduces postoperative blood loss in total knee arthroplasty: a randomized, controlled trial. J Bone Joint Surg Am. 2010;92:2503–13.
21. Lu Q, Peng H, Zhou GJ, Yin D. Peri-operative blood management strategies for total knee arthroplasty. Orthop Surg. 2018 Feb;10 (1):8–16. doi:10.1111/os.12361. PMID: 29424017; PMCID: PMC6594499.
22. Themistoklis T, Theodosia V, Konstantinos K, Georgios DI. Perioperative blood management strategies for patients undergoing total knee replacement: Where do we stand now? World J Orthop. 2017 Jun 18;8(6):441–54. doi:10.5312/wjo.v8.i6.441. PMID: 28660135; PMCID: PMC5478486.