Study of evaluation of tranexamic acid in reducing blood loss and transfusions in Total Knee Replacement surgeries

Dhanraj Game [1] Ashish Somani [2] Kailash Ghorpade [3]

Nitin Ghule[4] Saurabh Dahiphale[5]

1.Junior Resident, Department of Orthopaedics, DBVP Rural Medical College,Loni

2.Professor and Head, Department of Orthopaedics, DBVP Rural Medical College,Loni

3. Professor, Department of Orthopaedics, DBVP Rural Medical College,Loni

4.Professor, Department of Orthopaedics, DBVP Rural Medical College,Loni

5.Junior Resident, Department of Orthopaedics, DBVP Rural Medical College,Loni

Abstract

Background: Total knee replacement (TKR) is associated with significant perioperative blood loss, often necessitating blood transfusion. Tranexamic acid (TXA) is an antifibrinolytic agent used to reduce blood loss.

Aim: To evaluate the effectiveness and safety of tranexamic acid in reducing perioperative blood loss and transfusion requirements in patients undergoing TKR.

Materials and Methods: A prospective observational study including 90 patients undergoing unilateral primary TKR. Intravenous TXA was administered perioperatively. Hematological parameters, estimated blood loss, transfusion requirements, and complications were assessed.

Results: Mean estimated blood loss was 528 ± 148 mL. Blood transfusion was required in 20% of patients. No thromboembolic events were observed.

Conclusion: Tranexamic acid effectively reduces perioperative blood loss and transfusion requirements without increasing complications.

Keywords: Tranexamic acid; Total knee replacement; Blood loss; Blood transfusion

Introduction:

Total knee replacement (TKR) is a widely performed orthopedic procedure for end-stage degenerative knee diseases such as osteoarthritis and rheumatoid arthritis.(1) Although advances in implant design, anesthesia, and perioperative care have improved surgical outcomes, significant intraoperative and postoperative blood loss continues to be a major concern. (2,3) Excessive bleeding can lead to increased morbidity, prolonged hospital stay, delayed rehabilitation, and often the need for allogenic blood transfusion.

Blood transfusions, however, carry risks including transfusion reactions, transmission of infectious diseases, increased cost, and immunomodulatory effects that may negatively impact postoperative recovery. (4,5,6)
Tranexamic acid (TXA), a synthetic lysine analogue, has emerged as a valuable pharmacological agent for reducing surgical blood loss by inhibiting fibrinolysis through reversible blockade of plasminogen activation. Its efficacy has been well documented across various surgical specialties such as cardiac, trauma, obstetrics, and orthopedic procedures. In TKR, TXA can be administered via intravenous, oral, or topical routes, with studies suggesting significant reductions in total blood loss and transfusion requirements without increasing the incidence of thromboembolic events. Given the high surgical volume of TKR and the associated burden of perioperative blood management, evaluating the role of TXA is clinically relevant. (7,8) Our study aims to assess the effectiveness of tranexamic acid in minimizing perioperative blood loss and transfusion needs in patients undergoing TKR and to determine its safety profile in routine orthopedic practice.

Materials and methods :

Our present study was conducted as a prospective observational analysis to evaluate the effectiveness of tranexamic acid in reducing perioperative blood loss and transfusion requirements in patients undergoing total knee replacement (TKR) surgery. A total of 90 patients scheduled for unilateral primary TKR and meeting the inclusion criteria were enrolled after obtaining informed and written consent. Ethical clearance had been secured prior to commencement of data collection.

All surgeries were performed under standardized anesthetic and surgical protocols by experienced orthopedic surgeons. Tranexamic acid was administered intravenously at a predetermined dosage regimen before incision and during the early postoperative period. Patients who received anticoagulants preoperatively or had a history of thromboembolic disorders, coagulopathies, or revision TKR surgeries were excluded. Perioperative blood loss was documented using intraoperative suction measurements, swab weight differentials, and postoperative drain output wherever applicable.

Hemoglobin and hematocrit levels were recorded preoperatively and on postoperative days one and three to assess declines in blood parameters. The need for blood transfusion was determined based on institutional protocols, considering clinical symptoms and laboratory thresholds. Thromboembolic complications, wound-related morbidity, and other adverse events were monitored throughout the hospital stay and during follow-up visits.

All collected data were compiled and analyzed statistically to determine the association between tranexamic acid administration, perioperative blood loss, and transfusion requirements. Descriptive and inferential statistics were applied using appropriate tests of significance, and p-values less than 0.05 were considered statistically significant.

RESULTS

Table 1. Demographic Profile of Study Participants (n = 90)

Variable	Category	Number (%)	Mean ± SD	Range
Age (years)	50–59	28 (31.1)		
	60–69	39 (43.3)	**64.2 ± 7.8**	50–82
	70–79	19 (21.1)		
	≥80	4 (4.5)		
Gender	Male	38 (42.2)		
	Female	52 (57.8)		
BMI (kg/m²)	—	—	**26.1 ± 3.4**	19.8–34.6
Height (m)	—	—	**1.62 ± 0.09**	1.45–1.80
Weight (kg)	—	—	**68.4 ± 8.6**	52–88

Table 2. Baseline Hematological Parameters (Preoperative)

Parameter	Category	Number (%)	Mean ± SD
Hemoglobin (g/dL)	<10	6 (6.7)	
	10–11.9	28 (31.1)	**12.4 ± 1.2**
	≥12	56 (62.2)	
Hematocrit (%)	<30	5 (5.6)	
	30–35	31 (34.4)	**36.8 ± 3.6**
	>35	54 (60.0)	
RBC Count (million/µL)	—	—	**4.36 ± 0.48**

Table 3. Perioperative Hematological Change, Blood Loss, and Transfusion Requirement

Parameter	Time Point/Category	Result (Mean ± SD)	Number (%)
Hemoglobin (g/dL)	Preoperative	12.4 ± 1.2	—
	POD-1	10.8 ± 1.1	—
	POD-3	11.2 ± 1.0	—
Hematocrit (%)	Preoperative	36.8 ± 3.6	—
	POD-1	32.1 ± 3.3	—
	POD-3	33.5 ± 3.1	—
RBC Count (million/µL)	Preoperative	4.36 ± 0.48	—
	POD-1	3.72 ± 0.41	—
	POD-3	3.89 ± 0.38	—
Estimated Blood Loss (mL)	<500	—	41 (45.6)
	500–750	—	32 (35.6)

	>750	—	17 (18.8)
	Mean ± SD	**528 ± 148 mL**	—
Transfusion Requirement	Required	—	18 (20.0)
	Not required	—	72 (80.0)
Units Transfused	Mean units/patient	**1.28 ± 0.46**	—

Table 4. Postoperative Outcomes and Complications

Parameter	Category	Number (%)	Mean ± SD
Length of Hospital Stay (days)	≤5	46 (51.1)	
	6–7	31 (34.4)	**5.8 ± 1.6**
	>7	13 (14.5)	
Complications	None	81 (90.0)	
	Wound hematoma	4 (4.4)	
	Superficial infection	3 (3.3)	
	Delayed wound healing	2 (2.2)	
	DVT/TEE	0 (0.0)	
Overall Outcome	Excellent	52 (57.8)	
	Good	27 (30.0)	
	Fair	9 (10.0)	
	Poor	2 (2.2)	

Discussion:

The present study evaluated the role of tranexamic acid (TXA) in minimizing perioperative blood loss and transfusion requirements in patients undergoing total knee replacement (TKR) surgery. The findings demonstrated an overall favorable clinical profile with reduced blood loss, limited transfusion needs, and a low incidence of postoperative complications. The demographic profile indicated that the majority of patients belonged to the 60–69 years age group, consistent with known epidemiology of degenerative knee disorders requiring arthroplasty. Females constituted a higher proportion of the cohort, reflecting both the gender-specific prevalence of osteoarthritis and health-seeking patterns reported in literature.

Preoperative hematological parameters revealed generally adequate hemoglobin and hematocrit levels, indicating that most patients entered surgery without significant anemia. (9,10)

This baseline adequacy may have contributed to reduced transfusion triggers postoperatively. A decline in hemoglobin, hematocrit, and RBC counts was noted on postoperative day one, followed by partial recovery by postoperative day three. This pattern aligns with the expected physiological response to surgical trauma and perioperative hemodilution. Importantly, the magnitude of postoperative hematological decline in the present study was moderate and did not translate into a high transfusion burden. (11,12,13)

Estimated intraoperative blood loss showed that nearly half of the patients experienced less than 500 mL of loss, while only a minority exceeded 750 mL. The mean blood loss of 528 ± 148 mL in the present

study compares favorably with previously reported values in TKR without TXA use, which range between 800 and 1500 mL. The reduction observed reinforces the anti-fibrinolytic action of TXA, which is well documented to inhibit plasminogen activation and stabilize clot formation at surgical sites. Transfusion requirements were limited to 20% of the cohort, and patients requiring transfusion generally needed only one unit. This reduced transfusion burden translates into potential cost savings, minimized transfusion-related risks, and accelerated postoperative rehabilitation. (14,15)

The safety profile of TXA was reaffirmed by the low incidence of postoperative complications. No cases of deep vein thrombosis (DVT) or thromboembolic events were reported, addressing a key concern frequently debated in the literature. Wound-related complications were minor and occurred in a small subset of patients. Favorable clinical outcomes were reflected in the postoperative recovery trajectory, with more than half of the patients demonstrating excellent outcomes and 30% achieving good outcomes. Hospital stay averaged 5.8 ± 1.6 days, suggesting that TXA may indirectly facilitate earlier mobilization and discharge by preserving perioperative hemoglobin levels and reducing physiological stress.

Conclusion:

The findings of this study are consistent with contemporary evidence supporting TXA as a safe and effective adjunct in orthopedic surgery, particularly in high blood-loss procedures such as TKR. Although the study lacks a direct comparison group, the internal trends strongly support the clinical utility of TXA. Future research incorporating randomized controlled designs, larger sample sizes, and subgroup analyses based on dosing routes (intravenous vs topical vs oral) may further refine optimal TXA usage. Overall, the results substantiate TXA as a valuable component of modern perioperative blood management in TKR, contributing to improved patient outcomes and reduced healthcare burden.

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