Original Article

Role of Tranexamic Acid in Terms of Reducing Perioperative Blood Loss and Post Operative Transfusion Requirement in Fractures of Proximal Femur

Aamar Munir[1], Saad Mubeen Khalid[2], Nadeem Ahmed Shaikh[3], Syed Tayyab Hasan Naqvi[5], Rana Shahbaz Ahmad[6]

[1,4]Assistant Professor, [2]Postgraduate Resident, [3]Associate Professor, [4]Senior Registrar
Pakistan Air Force (PAF) Hospital / Fazaia Medical College, Air University, Islamabad

Author`s Contribution

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Address of Correspondent
Dr. Aamar Munir
Assistant Professor Pakistan Air Force (PAF) Hospital / Fazaia Medical College, Air University, Islamabad
aamar_munir@hotmail.com

ABSTRACT

Objectives: To assess the effect of perioperative intravenous tranexamic acid (TXA) on the amount of blood lost postoperatively, as well as the requirement of blood transfusions in patients who underwent surgery for proximal femur fractures.

Methodology: A comparative study was conducted at the Department of Orthopedics, Pakistan Air Force (PAF) Hospital, Islamabad, from November 2025 to January 2026. A total of 180 patients aged 18 to 65 years with proximal femur fractures (ASA I to II classification) were included in this study, divided into control and TXA groups. The control group (n = 90) patients who received no TXA, and the TXA group (n = 90) patients who received intravenous TXA perioperatively. Blood loss was measured based on hemoglobin drop and 24-hour drain output. Blood transfusion requirements were recorded according to institutional guidelines. The statistical analysis of the results was performed using SPSS version 25.

Results: The mean postoperative drain output in the TXA group was significantly less than that in the control group (312 ± 74 mL vs. 468 ± 96 mL; $p < 0.001$). Patients receiving TXA also had a lower mean postoperative hemoglobin drop (1.2 ± 0.5 g/dL vs. 2.1 ± 0.6 g/dL; $p < 0.001$). The TXA group had a significantly lower mean number of transfused units per patient (0.38 ± 0.72 vs. 0.89 ± 1.03; $p = 0.001$) and fewer patients needed postoperative blood transfusions (18.9% vs. 38.9%; $p = 0.004$). Thromboembolic or wound-related complications did not differ significantly.

Conclusion: The routine use of perioperative intravenous TXA in clinical practice is supported by the fact that it successfully lowers postoperative blood loss and transfusion requirements in proximal femur fracture surgery without increasing adverse events.

Keywords: Blood Loss, Surgical; Blood Transfusion; Hip Fractures; Orthopedic Procedures; Tranexamic Acid.

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Introduction

One of the most serious orthopedic injuries seen in clinical practice, particularly in older adults, is a proximal femur fracture, which includes femoral neck and intertrochanteric fractures.[1] Worldwide, these fractures are linked to considerable morbidity, functional decline, extended hospital stays, and high health-care costs.[2] Global epidemiological data show that the incidence of hip fractures is highest in older populations, with up to 1.66 million cases reported globally each year and predictions indicating a tripling of cases by 2050 as a result of population aging.[3] Age-standardized rates differ significantly between geographical areas, with North America and Europe reporting higher rates than Asia and Africa.[4]

Although comprehensive national registry data are lacking in Pakistan, hip fractures are a common cause of trauma admissions among the elderly, often linked to underlying osteoporosis and vitamin D deficiency, according to morbidity patterns from tertiary care orthopedic departments.[5] In line with worldwide findings, one hospital-based study reported hip fracture incidence rates that increased with age and mortality rates of up to 20% within a year.[6] Regionally in South Asia and the Middle East, proximal femur fractures are increasing with ageing populations, yet remain under-reported compared with Western regions.[7]

Surgical fixation or arthroplasty is the standard approach for proximal femur fractures.[8] However, significant perioperative blood loss and resultant allogenic transfusion remain prominent challenges, with transfusion rates reported as high as 30%–60% in some cohorts.[9] Blood loss contributes to postoperative anemia, delayed rehabilitation, extended hospital stays, and transfusion-related complications.[10]

Tranexamic acid (TXA), a synthetic antifibrinolytic agent, has been widely studied in elective orthopedic surgeries and increasingly in trauma settings for its potential to reduce surgical bleeding and transfusion requirements.[11] Systematic reviews and large cohort studies demonstrate that TXA reduces the need for blood transfusion without significantly increasing thromboembolic complications.[12] Locally, a study from Pakistan showed significantly lower transfusion frequency with preoperative TXA in intertrochanteric fractures.[13]

Given the high burden of perioperative blood loss in proximal femur fracture surgery and the promising evidence for TXA, this study aims to evaluate the role of TXA in reducing perioperative blood loss and postoperative transfusion requirement in these fractures. The objective was to compare the mean postoperative blood loss and postoperative blood transfusion requirements between patients undergoing surgery for proximal femur fractures receiving intravenous peri-operative TXA and those not receiving TXA.

Methodology

This comparative study was conducted at the Department of Orthopedics, Pakistan Air Force (PAF) Hospital, Islamabad, Pakistan, from November 2025 to January 2026. Ethical approval was obtained from the Institutional Ethical Review Board of PAF Hospital Islamabad (Approval No. PAF/251029), and the study was conducted in accordance with the Declaration of Helsinki. Written informed consent was obtained from all participants prior to enrollment.

Sample size was determined using the WHO calculator, based on a confidence level of 95%, alpha error of 5%, and study power of 80%. The anticipated proportion of postoperative blood transfusion was taken as 0.175 in the TXA group and 0.367 in the control group.[14] The calculated total sample was 180 patients with 90 patients allocated to each group.

Patients aged between 18 and 65 years with radiologically confirmed proximal femur fractures (including femoral neck and intertrochanteric fractures) requiring surgical intervention were included. Only patients classified as American Society of Anesthesiologists (ASA) physical status I or II were enrolled. Exclusion criteria included pathological fractures, polytrauma, known bleeding or coagulation disorders, history of thromboembolic disease, chronic anticoagulant use, renal impairment, allergy to TXA, revision surgeries, and patients with ASA class III or above.

Participants were divided into two groups. The TXA group received intravenous TXA at a dose of 15 mg/kg administered 15–20 minutes prior to skin incision. The control group did not receive TXA. Surgical procedures, including fixation or arthroplasty, were performed according to standard departmental protocols by consultant orthopedic surgeons. To reduce confounding, anesthetic technique, perioperative fluid management, and postoperative care were standardized for both groups.

The mean postoperative blood loss and requirement for postoperative blood transfusions were the main outcomes. The total drain output during the first 24 hours following surgery, expressed in milliliters, was used to calculate postoperative blood loss. Hemoglobin levels were also measured prior to surgery and 24 hours afterward, and the hemoglobin drop was noted as a secondary measure of blood loss. Hemoglobin levels less than 8 g/dL in asymptomatic patients, hemoglobin levels less than 9 g/dL in patients exhibiting clinical symptoms of anemia (tachycardia, hypotension, dyspnea), or the attending physician's judgment based on hemodynamic instability were the predetermined institutional triggers for the administration of blood transfusions. Each patient's total number of packed red blood cell transfusions was noted.

Length of hospital stay, postoperative complications (such as thromboembolic events, wound complications, and infections), and TXA-related adverse drug reactions were secondary outcomes. Throughout their hospital stay, patients were clinically observed for indications of pulmonary embolism and deep vein thrombosis.

SPSS version 25 was used for data entry and analysis. The Shapiro-Wilk test was used to determine the normality of continuous variables, which were then expressed as mean ± standard deviation. Continuous variables were analyzed using independent sample t-tests and categorical data as frequencies and percentages were analyzed using chi-square tests. The p-values of ≤ 0.05 were considered statistically significant. In addition, when applicable, effect sizes and 95% confidence intervals were reported to enhance the clinical interpretation of the results.

Results

A total of 180 patients who underwent surgical management of proximal femur fractures were included as part of the final analysis: of these participants, 90 were assigned to a tranexamic acid (TXA) group, and 90 to the control group. No violations of the protocol or dropouts were noted.

Clinical and demographic characteristics for the TXA and control groups were comparable prior to treatment (Table I). Assessment of baseline clinical characteristics (age, gender distribution, type of fracture, ASA classification and preoperative hemoglobin level) revealed no statistically significant differences between the two treatment groups. Similarly, no statistically significant differences were observed among the surgical procedures that these patients underwent.

Patients receiving intravenous TXA had significantly less post-operative blood loss than control patients when measured by the amount of blood collected in a drainage bag during the first 24 hours postoperatively. The mean change in postoperative hemoglobin level at 24 hours was also smaller in the TXA than in the control group, indicating that the TXA group experienced less blood loss due to surgery (Table II).

In terms of transfusion outcomes, compared to the control group, a much smaller percentage of patients in the TXA group needed postoperative blood transfusions. Additionally, the TXA group had a significantly lower mean number of packed red blood cell units transfused per patient. These results show that perioperative TXA administration reduces the transfusion burden in a way that is clinically significant (Table III).

Table I: The study participants' baseline clinical and demographic characteristics

Variable	TXA group (n = 90)	Control group (n = 90)	p-value
Age (years), mean ± SD	54.2 ± 8.9	55.1 ± 9.3	0.48
Male, n (%)	58 (64.4)	55 (61.1)	0.65
Female, n (%)	32 (35.6)	35 (38.9)	
ASA I, n (%)	41 (45.6)	39 (43.3)	0.76
ASA II, n (%)	49 (54.4)	51 (56.7)	
Femoral neck fracture, n (%)	46 (51.1)	49 (54.4)	0.66
Intertrochanteric fracture, n (%)	44 (48.9)	41 (45.6)	

Table II: Comparison of postoperative blood loss and hemoglobin changes

Outcome	TXA group (n = 90)	Control group (n = 90)	p-value
Postoperative drain output (mL), mean ± SD	312 ± 74	468 ± 96	<0.001
Postoperative Hb at 24 h (g/dL), mean ± SD	10.9 ± 1.2	9.8 ± 1.4	<0.001
Mean Hb drop (g/dL), mean ± SD	1.2 ± 0.5	2.1 ± 0.6	<0.001
Preoperative Hb (g/dL), mean ± SD	12.1 ± 1.3	12.0 ± 1.4	0.59

Table III: Transfusion requirement and secondary outcomes

Variable	TXA group (n = 90)	Control group (n = 90)	p-value
Patients requiring transfusion, n (%)	17 (18.9)	35 (38.9)	0.004
Units transfused per patient, mean ± SD	0.38 ± 0.72	0.89 ± 1.03	0.001
Length of hospital stay (days), mean ± SD	5.2 ± 1.4	6.4 ± 1.7	<0.001
Thromboembolic events, n (%)	1 (1.1)	2 (2.2)	0.56
Wound complications, n (%)	3 (3.3)	4 (4.4)	0.70

The TXA group's mean hospital stay was shorter than that of the controls, according to secondary outcomes. Complications following surgery were rare and similar in all groups. The incidence of thromboembolic events, wound complications, and adverse drug reactions did not differ statistically significantly, indicating that TXA use

was not linked to an increased risk of complications following surgery (Table III).

Discussion

The current study shows that in patients having surgery for proximal femur fractures, peri-operative intravenous TXA dramatically lowers postoperative blood loss and the requirement for blood transfusions. Compared to controls, patients receiving TXA had significantly lower postoperative drain output, a smaller postoperative hemoglobin drop, and a significantly lower percentage of patients needing allogenic blood transfusions. Crucially, TXA administration was not associated to a higher risk of wound-related complications (3.3%) or thromboembolic complications (1.1%), indicating its safety in ASA I–II patients.

The study's reduction in blood loss is both mechanistically and biologically consistent with TXA's antifibrinolytic action. TXA stabilizes fibrin clots and reduces the hyperfibrinolytic response brought on by trauma and surgical manipulation of cancellous bone in proximal femur fractures by competitively inhibiting the conversion of plasminogen to plasmin.[15] According to recent study, fibrinolytic activation peaks in the early perioperative phase following hip fracture surgery, which makes prompt TXA administration especially beneficial for lowering hemoglobin decline and postoperative bleeding.[16]

The results of this study align with a number of recent trials and meta-analyses. Intravenous TXA significantly reduced postoperative blood loss and transfusion rates in hip fracture patients without raising the risk of thromboembolism, according to a large trial by Khatib et al.[17] Similarly, after using TXA for fragility hip fractures, a multicenter study by Lasocki et al found a nearly 40% relative reduction in transfusion requirements.[18] TXA significantly lowers transfusion rates and peri-operative blood loss while maintaining a favorable safety profile, according to a recent meta-analysis by Liu et al that included over 10,000 hip fracture patients.[19]

Meng et al and Zhang et al separately found that elderly patients receiving intertrochanteric fracture fixation with TXA had significantly lower postoperative hemoglobin drop and transfusion rates in Asian populations.[20,21] These results closely resemble those of this study and imply that the effectiveness of TXA is constant among various ethnic and geographic groups. Notably, compared to topical or delayed dosing techniques, intravenous TXA delivered before to incision offers the best blood-sparing advantages, according to a network meta-analysis by Bloom et al.[22]

In resource-constrained environments like Pakistan, where blood supply, transfusion-related costs, and transfusion-associated problems continue to be significant issues, the transfusion reduction seen in this study is clinically significant. Secondary outcome studies indicate that reduced transfusion exposure may result in a decreased risk of infection, better postoperative recovery, and a shorter hospital stay. Recent cohort studies from Europe and East Asia have revealed similar decreases in hospital stay duration.[23]

TXA's usage in trauma patients has long been restricted due to safety concerns, including thromboembolic risk. Its safety in hip fracture surgery is, nevertheless, supported by current high-quality research.[24] TXA usage did not raise the incidence of deep vein thrombosis, pulmonary embolism, or myocardial infarction, according to a population-based cohort study by Dastrup et al comprising over 50,000 patients.[25] These results are consistent with this study findings, which showed that thromboembolic events were uncommon and similar across groups.

When considered collectively, the results of this study support the increasing amount of current research that supports the usual use of intravenous TXA in proximal femur fracture surgery. With potential advantages for patient outcomes and healthcare resource use, TXA is an affordable, safe, and simple strategy to lower peri-operative blood loss and transfusion load in Pakistani orthopedic surgery.

LIMITATIONS: There are several limitations of this study. Despite the fact that baseline characteristics were similar across groups, the non-randomized, single-center design may restrict generalizability and create possible selection bias. Drain output and early hemoglobin changes were used to estimate postoperative blood loss, which might not adequately account for occult blood loss. Furthermore, examination of long-term problems or functional outcomes was not possible because outcomes were only evaluated during the in-hospital period. Lastly, the inclusion of ASA I–II patients between the ages of 18 and 65 may restrict the application to higher-risk, older groups that frequently experience proximal femur fractures.

Conclusion

In patients having surgery for proximal femur fractures, peri-operative intravenous TXA dramatically lowers postoperative blood loss and the need for blood transfusions without raising the risk of thromboembolic or wound-related complications.

TXA is a safe, effective and cost-effective means of conserving blood in settings with limited resources; therefore, if routinely incorporated into peri-operative protocols for surgery to treat proximal femur fractures, TXA can lead to better outcomes for patients while improving the utilization of healthcare resources.

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