e-ISSN: 0975-9506, p-ISSN: 2961-6093

Available online on www.ijpqa.com doi: 10.25258/ijpqa.16.2.103

International Journal of Pharmaceutical Quality Assurance 2025; 16(2); 653-658

Original Research Article

A Retrospective Analysis of Tranexamic Acid vs Placebo and Its Impact on Bleeding in Acute Trauma Patients

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Received: 13-12-2024 / Revised: 18-01-2025 / Accepted: 25-02-2025

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Conflict of interest: Nil

Abstract:

Background: Hemorrhage is a leading cause of preventable death in trauma patients. Tranexamic acid (TXA), an antifibrinolytic agent, has been widely studied for its role in reducing blood loss and improving outcomes in acute trauma cases.

Aim: To compare the efficacy of tranexamic acid versus placebo in reducing bleeding and improving clinical outcomes among patients with acute trauma.

Methods: This retrospective observational study was conducted in the Department of Anesthesia, SKMCH, Muzaffarpur, Bihar, India. The medical records of adult trauma patients admitted between Nov 2022 and October 2023 were reviewed. Patients were divided into two equal groups based on whether they received TXA or placebo within 3 hours of injury. Primary outcomes assessed included total blood loss, hemoglobin drop, and transfusion requirement. Secondary outcomes included mortality, ICU admission, and duration of hospital stay.

Results: Patients receiving TXA showed significantly lower total blood loss and hemoglobin reduction compared to the placebo group. The TXA group also had reduced need for blood transfusions and shorter hospital stays. Mortality and ICU admission were lower in the TXA group, though not statistically significant.

Conclusion: Tranexamic acid administration in acute trauma patients was associated with a meaningful reduction in blood loss, transfusion requirements, and hospital stay duration. Early administration of TXA may offer clinical benefit in trauma management and should be considered as part of early intervention protocols.

Introduction

Hemorrhage continues to be one of the leading causes of preventable mortality among trauma patients, particularly in the initial hours following injury. Effective and timely control of bleeding plays a vital role in reducing morbidity and mortality in acute trauma cases. Trauma-induced coagulopathy, along with massive blood loss, often leads to increased transfusion requirements, hemodynamic instability, and poor clinical outcomes [1,2]. In this context, pharmacological agents that can help stabilize clot formation and reduce fibrinolysis are gaining importance as adjuncts to surgical and supportive care.

Tranexamic acid (TXA) is a synthetic lysine analog that acts by reversibly blocking the lysine binding sites on plasminogen, thereby inhibiting its activation to plasmin, and stabilizing the fibrin clot. The use of TXA in trauma gained global recognition following the CRASH-2 trial, which demonstrated a significant reduction in all-cause mortality when TXA was administered within three hours of injury in bleeding trauma patients. Based on these findings, TXA has been incorporated into trauma management guidelines across various healthcare systems and is now increasingly used as part of damage control resuscitation strategies [3,4].

Despite the evidence supporting the use of TXA, variations in practice patterns continue to exist, especially in resource-limited settings. Furthermore, concerns related to the potential thromboembolic risks and inconsistent findings in different subgroups of trauma patients necessitate further evaluation of its safety and effectiveness [5]. Retrospective analyses from real-world clinical settings can provide important insights into the actual benefits and outcomes associated with TXA, thereby aiding in informed decision-making and guideline implementation at the institutional level [6].

This study aims to conduct a retrospective comparison of the clinical outcomes between trauma patients receiving TXA and those managed with

placebo. The primary focus is on assessing the impact of TXA on blood loss, hemoglobin drop, transfusion requirements, and key outcome parameters such as ICU admission, duration of hospital stay, and mortality. The findings will help reinforce the role of TXA as a cost-effective and readily available pharmacological agent in acute trauma care, especially in high-burden centers catering to critical emergencies.

Aim and Objectives

Aim: To compare the clinical outcomes of tranexamic acid versus placebo in reducing bleeding and improving hemodynamic stability among patients with acute trauma.

Objectives:

1. To evaluate and compare the total blood loss in patients receiving tranexamic acid versus placebo.
2. To assess the drop in hemoglobin levels post-intervention in both groups.
3. To determine the requirement for blood transfusions in the two study arms.
4. To compare the duration of hospital, stay and ICU admission between the two groups.
5. To assess overall mortality in acute trauma patients receiving tranexamic acid versus placebo.
6. To identify the incidence of adverse events such as thromboembolic complications associated with tranexamic acid use.

Materials and Methods

Study Design and Setting: This retrospective observational study was conducted in the Department of Anesthesia, SKMCH, Muzaffarpur, Bihar, India. The medical records of adult trauma patients admitted between Nov 2022 and October 2023 were reviewed. The study aimed to assess and compare the outcomes of patients who received tranexamic acid (TXA) versus those who received placebo within 3 hours of sustaining acute trauma.

Sample Size and Study Population: A total of 120 adult patients (aged 18–65 years) were included in the study and were divided into two groups of 60 patients each. Group A included patients who received intravenous TXA (1 gram over 10 minutes, followed by 1 gram over 8 hours), while Group B received a matching placebo as per standard emergency care protocols. Patients were selected based on the availability of complete clinical data and documentation of TXA or placebo administration.

Inclusion Criteria:

- Adult patients aged between 18 and 65 years.
- Diagnosed with moderate to severe acute trauma with active bleeding.
- Received TXA or placebo within 3 hours of injury.
- Hemodynamically stable at admission or stabilized within 1 hour.
- Availability of complete clinical, laboratory, and follow-up data.

Exclusion Criteria:

- Known history of bleeding disorders or anticoagulant therapy.
- Pre-existing thromboembolic disease or active malignancy.
- Pregnancy or lactating females.
- Patients who died within 1 hour of hospital arrival.
- Incomplete or missing medical records.

Data Collection and Parameters Assessed: Demographic details, nature and severity of trauma, timing and dosage of TXA/placebo administration, hemoglobin levels at admission and after 24 hours, estimated total blood loss, number of transfused blood units, ICU admission status, duration of hospital stay, and mortality outcomes were recorded. Adverse events, especially thromboembolic complications such as deep vein thrombosis (DVT) or pulmonary embolism (PE), were also noted.

Outcome Measures: Primary outcomes included total blood loss, hemoglobin drop, and need for blood transfusion. Secondary outcomes included ICU admission, duration of hospital stay, mortality, and incidence of adverse events.

Statistical Analysis: Data were compiled and analyzed using Microsoft Excel and SPSS software version 25.0. Quantitative variables were expressed as mean ± standard deviation (SD) and compared using the Student's t-test. Categorical variables were presented as frequency and percentages, and compared using the Chi-square test. A p-value of <0.05 was considered statistically significant.

Results

This retrospective observational study was conducted on 120 adult trauma patients admitted to the emergency department of SKMCH, Muzaffarpur. The patients were divided equally into two groups: Group A (n=60), who received intravenous tranexamic acid (TXA), and Group B (n=60), who received placebo. Both groups were comparable in terms of demographic variables, including age, gender, and type of trauma. The study evaluated the impact of TXA on total blood loss, hemoglobin drop, blood transfusion requirement, ICU admissions, duration of hospital stay, mortality, and adverse events. Statistically significant differences were observed between the groups in terms of total blood loss, hemoglobin reduction, transfusion requirement, and duration of hospital

stay. The findings support the clinical benefit of early TXA administration in acute trauma care.

Table 1: Distribution of Patients by Age Group

Age Group (years)	Group A (TXA) (n=60)	Group B (Placebo) (n=60)	P-value
18–30	14 (23.3%)	12 (20%)	0.67
31–45	26 (43.3%)	28 (46.7%)	
46–60	20 (33.3%)	20 (33.3%)	

Table 2: Gender Distribution of the Study Population

Gender	Group A (n=60)	Group B (n=60)	P-value
Male	38 (63.3%)	40 (66.7%)	0.71
Female	22 (36.7%)	20 (33.3%)	

Table 3: Type of Trauma Encountered in Each Group

Type of Trauma	Group A (n=60)	Group B (n=60)	P-value
Road traffic accident	39 (65%)	41 (68.3%)	0.68
Fall from height	15 (25%)	13 (21.7%)	
Assault	6 (10%)	6 (10%)	

Table 4: Total Blood Loss in Milliliters (Mean ± SD)

Parameter	Group A (TXA)	Group B (Placebo)	P-value
Total Blood Loss	540 ± 120 ml	710 ± 135 ml	<0.001

Table 5: Hemoglobin Reduction (g/dL) After 24 Hours

Parameter	Group A (TXA)	Group B (Placebo)	P-value
Hb Drop (g/dL)	1.9 ± 0.6	2.8 ± 0.9	<0.001

Table 6: Requirement for Blood Transfusion

Transfusion Required	Group A (n=60)	Group B (n=60)	P-value
Yes	17 (28.3%)	33 (55%)	0.002
No	43 (71.7%)	27 (45%)	

Table 7: ICU Admission Rate in Both Groups

ICU Admission	Group A (n=60)	Group B (n=60)	P-value
Required	9 (15%)	14 (23.3%)	0.23
Not Required	51 (85%)	46 (76.7%)	

Table 8: Duration of Hospital Stay (Mean ± SD in Days)

Parameter	Group A (TXA)	Group B (Placebo)	P-value
Hospital Stay (days)	5.6 ± 1.4	7.2 ± 1.7	<0.001

Table 9: Mortality Outcomes

Mortality Status	Group A (n=60)	Group B (n=60)	P-value
Survived	58 (96.7%)	55 (91.7%)	0.27
Expired	2 (3.3%)	5 (8.3%)	

Table 10: Incidence of Adverse Events (Thromboembolism, Nausea, Vomiting)

Adverse Event	Group A (TXA)	Group B (Placebo)	P-value
Thromboembolism	1 (1.7%)	2 (3.3%)	0.56
Nausea/Vomiting	6 (10%)	9 (15%)	0.41

Table 1 showed no significant difference in age distribution between the TXA and placebo groups. Table 2 confirmed a male predominance in both groups. Table 3 documented that road traffic accidents were the most common trauma type across both arms. Table 4 highlighted that patients in the TXA group had significantly less total blood loss compared to placebo. Table 5 demonstrated a lower drop in hemoglobin values in patients receiving TXA. Table 6 indicated a significantly lower requirement for blood transfusion in the TXA group. Table 7 showed that ICU admissions were less

frequent in the TXA group, although not statistically significant. Table 8 revealed that the duration of hospital stay was significantly shorter in the TXA group. Table 9 displayed a reduced mortality rate in the TXA group compared to placebo, but this difference was not statistically significant. Table 10 showed similar rates of adverse effects, with no significant increase in thromboembolic events among TXA recipients.

Discussion

This retrospective comparative study evaluated the efficacy of tranexamic acid (TXA) versus placebo in the management of acute trauma patients, focusing on key clinical outcomes such as total blood loss, hemoglobin drop, transfusion requirements, ICU admissions, hospital stay duration, mortality, and adverse events. The findings suggest that TXA administration within 3 hours of trauma significantly reduces blood loss and transfusion needs while also improving overall clinical outcomes [7,8].

The demographic profiles of the study groups were similar with respect to age, gender distribution, and type of trauma, ensuring comparability. Road traffic accidents remained the leading cause of injury, in line with global epidemiological trends, especially in younger and middle-aged populations [9].

A significant reduction in total blood loss was observed in patients receiving TXA compared to those who received placebo [10]. This aligns with the findings from the CRASH-2 trial and other subsequent studies which demonstrated the antifibrinolytic effect of TXA in stabilizing clots and preventing further hemorrhage. The reduction in hemoglobin drop among the TXA group supports its role in limiting ongoing blood loss and improving hemodynamic parameters during the critical early phase of trauma care [11,12].

The transfusion requirement in the TXA group was markedly lower, highlighting its utility in minimizing the need for blood products, which is particularly important in resource-limited settings. Fewer transfusions not only reduce the risk of transfusion-related complications but also lessen the burden on blood banks and healthcare resources. These findings are in agreement with studies conducted in both civilian and military trauma populations, reinforcing TXA's cost-effectiveness and clinical benefit [13,14].

Hospital stay duration was also significantly reduced in the TXA group. Early hemostatic control and reduced transfusion needs may contribute to faster recovery and discharge readiness. Though ICU admission rates and mortality were lower in the TXA group, these differences were not statistically significant. However, a trend toward improved outcomes indicates the potential for broader benefit with larger sample sizes or multicenter trials [15,16].

Importantly, TXA use was not associated with a higher incidence of thromboembolic events. Concerns have been raised regarding possible prothrombotic risks, especially in trauma patients with underlying comorbidities. In this study, the low rate of thromboembolic complications across both groups suggests that TXA is safe when used within the appropriate therapeutic window [17,18].

The retrospective nature of the study presents certain limitations, including reliance on the accuracy of medical records, potential selection bias, and lack of control over exact timing and dosing consistency. Furthermore, the single-center setting may limit generalizability to other trauma care environments. Despite these limitations, the study provides valuable real-world evidence on the efficacy and safety of TXA in acute trauma management [19,20].

This study supports the early use of tranexamic acid in trauma patients for reducing blood loss, transfusion requirements, and length of hospital stay. Incorporating TXA into standard trauma protocols may improve clinical outcomes and resource utilization, especially in high-volume emergency settings. Further prospective and multicenter studies are warranted to confirm these findings and establish definitive clinical guidelines.

Conclusion

The retrospective analysis demonstrates that early administration of tranexamic acid in patients with acute trauma is associated with significant clinical benefits, including reduced total blood loss, a smaller decrease in hemoglobin levels, and a decreased need for blood transfusion. Additionally, patients receiving TXA experienced shorter hospital stays and a lower frequency of ICU admissions, with a trend toward reduced mortality, although not statistically significant. The safety profile of TXA remained favorable, with no substantial increase in adverse events, particularly thromboembolic complications. These findings support the inclusion of TXA as a standard component of early trauma management, particularly in resource-limited and high-volume emergency settings. Widespread implementation of TXA protocols can contribute to improved patient outcomes, optimized use of blood products, and decreased healthcare burden. However, further prospective, multicenter studies are needed to validate these results and refine clinical guidelines for its use across various trauma subpopulations.

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