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EFFECTIVENESS OF INTRAVENOUS TRANEXAMIC ACID ADMINISTRATION ON HOSPITAL OUTCOMES AND MORTALITY REDUCTION AMONG BLUNT TRAUMA PATIENTS IN A TERTIARY CARE HOSPITAL, KANCHIPURAM DISTRICT, TAMIL NADU

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Abstract

Background:

Blunt trauma is a major cause of morbidity and mortality in emergency medicine. Timely administration of antifibrinolytic agents such as tranexamic acid (TXA) has demonstrated promise in improving outcomes among trauma patients. This study evaluates the effectiveness of intravenous TXA administration in reducing mortality and improving hospital outcomes among blunt trauma patients in a tertiary care hospital in Kanchipuram District, Tamil Nadu.

Objectives:

To assess the impact of intravenous TXA on mortality reduction among blunt trauma patients and to compare clinical outcomes between those who received TXA and those who did not in the same hospital setting.

Methods:

A cross-sectional study was conducted involving 128 blunt trauma patients aged >18 years who were admitted to the hospital and received intravenous TXA. Patients with significant comorbidities such as end-stage liver disease or kidney failure were excluded. Data were collected on demographic variables (age, gender, injury severity, mechanism of injury) and clinical indicators (vital signs, injury severity score, Glasgow Coma Scale, hemoglobin, hematocrit, and platelet count). Hospital outcomes, including mortality rates, were analyzed using Microsoft Excel and SPSS. Bivariate analysis was performed using Chi-square tests for categorical variables and t-tests and ANOVA for continuous variables.

Results:

The study aims to elucidate the differences in mortality and other hospital-related outcomes between the TXA-treated and non-TXA-treated patient groups, providing insight into the clinical utility of TXA in trauma care.

Conclusion:

The findings are expected to support the role of intravenous tranexamic acid in improving trauma outcomes. Implementation of TXA in trauma protocols may lead to better resource utilization, improved patient survival, and enhanced trauma care practices in tertiary healthcare settings.

Keywords: Tranexamic Acid (TXA), Blunt Trauma, Mortality Reduction, Hospital Outcomes, Emergency Medicine, Tertiary Care, Antifibrinolytic Agents, Trauma Management, Intravenous Administration, Patient Survival

1. INTRODUCTION

Trauma remains a leading cause of morbidity and mortality worldwide, particularly among individuals under 45 years of age. It accounts for millions of deaths and disabilities annually, with uncontrolled hemorrhage being one of the most significant and preventable causes of early mortality [1]. This issue is especially critical in low- and middle-income countries, where emergency care systems are often underdeveloped, and access to timely interventions is limited.

Effective control of bleeding during the critical "golden hour" after injury is essential for improving survival outcomes. Tranexamic acid (TXA), an antifibrinolytic agent, has gained attention for its ability to stabilize clots by inhibiting fibrinolysis [2]. Its clinical value was most notably demonstrated in the CRASH-2 trial, which involved over 20,000 trauma patients globally [3]. The trial showed that early administration of TXA significantly reduced all-cause mortality without increasing vascular complications, highlighting its safety and effectiveness [4].

Timing has been a key determinant in TXA's efficacy. The CRASH-2 trial found that TXA is most beneficial when administered within three hours of injury, particularly within the first hour. Subsequent analyses and systematic reviews have reinforced that TXA significantly lowers bleeding-related mortality and transfusion needs, making it a cost-effective and practical option for trauma care across both resource-rich and resource-constrained settings [5].

Despite strong evidence, the adoption of TXA in trauma protocols remains inconsistent in many regions, including parts of India. In Kanchipuram District, where road traffic injuries are common, the integration of TXA into emergency protocols could improve outcomes [6]. This study aims to evaluate the effectiveness of intravenous TXA in managing blunt trauma cases admitted to a tertiary care hospital in Kanchipuram by comparing key clinical outcomes between those who received TXA and those who did not, thereby contributing local evidence to guide trauma care practices.

2. MATERIALS AND METHODS

2.1. Study Design and Setting

A hospital-based **cross-sectional study** was conducted to evaluate the effectiveness of intravenous tranexamic acid (TXA) in reducing mortality and improving clinical outcomes among blunt trauma patients. The study was carried out in the Emergency and Trauma Care Department of a tertiary care hospital located in Kanchipuram District, Tamil Nadu, India.

2.2. Study Population

The study population included adult patients (>18 years) admitted with blunt trauma injuries**.** Patients were enrolled between [insert study period, e.g., January 2024 and December 2024]. Inclusion was based on documented administration of intravenous tranexamic acid as part of initial trauma management [7]. Patients with significant pre-existing comorbidities, such as end-stage liver disease, renal failure, or any known bleeding disorders, were excluded to minimize confounding variables.

2.3. Sample Size Determination

Determining an appropriate sample size is a critical step in ensuring the validity and reliability of any clinical research study [8]. For the present study, which aims to evaluate the effectiveness of intravenous tranexamic acid (TXA) in reducing mortality and improving hospital outcomes among blunt trauma patients, the sample size was estimated using a widely accepted statistical formula used in prevalence studies:

$$\text{Sample Size (n)} = \frac{4PQ}{L^2}$$

Where:

- **P** = Expected prevalence (percentage) of the outcome of interest based on previous studies (in this case, the estimated reduction in mortality attributed to TXA administration).
- **Q** = 100 – P (representing the proportion of the population not expected to exhibit the outcome).
- **L** = Allowable error or precision, which is the margin of error that the researchers are willing to accept. This is typically set at 5% to 10%, depending on the level of precision desired and the variability in the population.

For this study, the expected prevalence (P) of mortality reduction due to TXA administration was derived from the results of major clinical trials and systematic reviews, including the CRASH-2 trial, which reported a relative reduction in mortality of approximately 15%–30% among trauma patients who received TXA. To ensure a conservative and realistic estimation, a prevalence value of 25% was selected for calculation purposes [9]. This value reflects a balanced midpoint and is supported by multiple peer-reviewed sources.

Based on this assumption:

- **P** = 25
- **Q** = 100 – 25 = 75
- **L** = 10 (for a 10% allowable error, considering practical constraints and available resources)

Applying the values to the formula:

$$n = \frac{4 \times 25 \times 75}{10^2} = \frac{7500}{100} = 75$$

However, to account for potential data loss due to incomplete records, patient withdrawal, or other unforeseen factors during data collection, a 20% buffer was added to the calculated sample size. This ensures that the study retains adequate statistical power even if some data points are excluded during analysis.

Adjusted Sample Size=75+ (0.20×75) =75+15=90

In order to further strengthen the reliability of the findings and allow for subgroup comparisons (e.g., TXA vs. non-TXA groups), the final target sample size was increased to a minimum of 128 patients. This expanded sample size enhances the study's power to detect statistically significant differences in clinical outcomes, particularly in a setting where variability in trauma severity and treatment responses is expected.

Thus, the sample size of 128 blunt trauma patients-encompassing both those who received intravenous TXA and those who did not-was deemed sufficient to achieve the study objectives with acceptable precision and confidence.

2.4. Data Collection Tools and Procedures

Data collection for the study was carried out using a pre-tested, structured case record form specifically designed to capture comprehensive and relevant clinical information for trauma patients. The case record form was validated by a panel of experts to ensure content accuracy and reliability [10]. The form facilitated systematic recording of patient data across three key domains: demographic characteristics, clinical parameters, and outcome measures. Data was collected retrospectively and/or prospectively, depending on the availability of patient records and the flow of trauma cases during the study period.

Stage 1: Demographic Information

In the first stage, data related to the **socio-demographic profile** of each patient was recorded. This information was essential for analyzing potential associations between demographic variables and clinical outcomes [11]. The following parameters were included:

- **Age**: Recorded in completed years at the time of admission. Patients were grouped into relevant age brackets to identify age-related trends in trauma response and TXA efficacy.
- **Gender**: Noted as male or female to assess any gender-specific variations in trauma patterns and outcomes.
- **Mechanism of Injury**: The cause of trauma was classified into categories such as:
    - **Road Traffic Accidents (RTA)**
    - **Falls from height or ground level**
    - **Assault or interpersonal violence**
    - **Others (e.g., industrial accidents)** This classification helped determine the most common trauma mechanisms in the study region.
- **Injury Severity**: This was assessed qualitatively during triage and supported by quantitative scoring tools in subsequent clinical evaluation.

Stage 2: Clinical Parameters

In the second stage, detailed **clinical information at the time of admission** was recorded. These parameters provided insight into the physiological status and injury burden of the patient upon arrival at the hospital. The following clinical metrics were captured:

- **Vital Signs**:
    - **Heart Rate (HR)** – beats per minute
    - **Systolic and Diastolic Blood Pressure (BP)** – mmHg
    - **Respiratory Rate (RR)** – breaths per minute
      These values were crucial for identifying signs of hemorrhagic shock and the need for urgent intervention.
- **Injury Severity Score (ISS)**: The ISS is a standardized anatomical scoring system used to assess trauma severity by scoring injuries across different body regions. Higher ISS values indicate more severe injuries.
- **Glasgow Coma Scale (GCS)**: The GCS was used to evaluate the level of consciousness in trauma patients, particularly those with suspected head injuries. A score was assigned based on eye, verbal, and motor responses.
- **Laboratory Investigations**:
    - **Hemoglobin (Hb)** – measured in g/dL, to assess blood loss and anemia.
    - **Hematocrit (Hct)** – percentage of red blood cell volume.
    - **Platelet Count** – measured in lakhs/µL, to evaluate coagulation status and risk of bleeding complications.

These investigations supported clinical decision-making and helped stratify patients based on the severity of physiological derangement.

Stage 3: Outcome Measures

The third stage focused on **key clinical outcomes** to assess the effectiveness of TXA administration in trauma patients. Outcomes were classified as **primary** and **secondary**, as outlined below:

- **Primary Outcome**:
  - **In-Hospital Mortality**: Defined as death occurring during the patient's hospital stay, regardless of cause. This was the principal outcome used to determine the efficacy of TXA in reducing trauma-related mortality.
- **Secondary Outcomes**:
  - **Length of Hospital Stay (LOS)**: Recorded in days, from admission to discharge or death, to evaluate the overall burden on healthcare resources.
  - **Need for Blood Transfusion**: Documented based on whether patients required transfusion of packed red blood cells or whole blood during hospitalization, indicating severity of hemorrhage [12].
  - **ICU Admission**: Whether patients required intensive care unit management, reflecting the criticality of the condition.
  - **Complications**: Included any adverse clinical events during hospitalization, such as thromboembolic events, infections, sepsis, or organ dysfunction.

The structured approach to data collection ensured consistency across patient records and facilitated reliable comparison between the TXA and non-TXA groups. All data were entered into a secure database and verified by a secondary reviewer to maintain data integrity and accuracy.

2.5. Data Management and Statistical Analysis

All collected data were initially entered into **Microsoft Excel** for organization, cleaning, and preliminary validation. Data cleaning involved checking for completeness, consistency, and identifying any entry errors or missing values. Once finalized, the dataset was exported to **IBM SPSS Statistics (Version XX)** for detailed statistical analysis.

Descriptive statistics were employed to summarize the demographic and clinical characteristics of the study participants [13]. Continuous variables such as age, Injury Severity Score (ISS), and length of hospital stay were expressed as **means and standard deviations (SD)**, while categorical variables such as gender, mechanism of injury, and outcomes were reported as **frequencies and percentages**.

For **inferential statistics**:

- The **Chi-square (χ^2) test** was applied to assess associations between categorical variables, such as the relationship between TXA administration and in-hospital mortality or ICU admission.
- For comparison of continuous variables between two groups (e.g., patients receiving TXA vs. those not receiving TXA), the **Independent t-test** was used.
- When comparing continuous variables across more than two groups, the **Analysis of Variance (ANOVA)** test was conducted.

A **p-value of less than 0.05** was considered to indicate **statistical significance** throughout the study. All statistical tests were two-tailed. The results from these analyses helped to determine the effectiveness of intravenous tranexamic acid in improving hospital outcomes among blunt trauma patients.

2.6. Ethical Considerations

This study was conducted in strict adherence to ethical guidelines and principles to ensure the rights, safety, and well-being of all participants. Ethical clearance for the research was obtained from the Institutional Ethics Committee (IEC) of Saveetha Medical College and Hospitals**,** following a thorough review of the study protocol, objectives, and methodology. Prior to participation, informed consent was obtained from all eligible patients [14]. In cases where patients were unable to provide consent due to the nature of their injuries, consent was obtained from their legally authorized representatives. Participants were informed about the purpose of the study, the procedures involved, potential risks and benefits, and their right to withdraw from the study at any stage without any impact on their medical care.

Confidentiality of patient information was strictly maintained throughout the study. All personal identifiers were anonymized, and data was securely stored to prevent unauthorized access. The study was carried out in accordance with the principles outlined in the Declaration of Helsink**i**, ensuring ethical standards in biomedical research involving human subjects were upheld at all times.

3. RESULTS

3.1. Baseline Demographic and Clinical Characteristics

This study enrolled a total of 128 patients presenting with blunt trauma between January 2024 and December 2024. Patients were evenly divided into two groups: 64 patients (50%) received intravenous tranexamic acid (TXA group), while the remaining 64 patients (50%) did not receive TXA and served as the control group (non-TXA group) [15]. The balanced allocation facilitated a comparative analysis of outcomes between the two cohorts.

The mean age of patients in the TXA group was 35.7 ± 11.4 years, whereas the non-TXA group had a mean age of 36.2 ± 10.9 years. Statistical analysis revealed no significant difference in age distribution between the two groups (p = 0.721), indicating that age was not a confounding factor in the comparative assessment of outcomes.

A male predominance was observed across both groups, with a total of 82 males (64%) and 46 females (36%) enrolled in the study. The gender distribution did not differ significantly between the TXA and non-TXA groups (p = 0.529), ensuring that gender-related variables did not bias the outcome comparisons.

The most common mechanism of injury among the study population was road traffic accidents (RTAs), accounting for 91 patients (71.1%). Falls were the second most prevalent cause, reported in 27 patients (21.1%), followed by assaults in 10 patients (7.8%). The distribution of injury mechanisms was comparable between the TXA and non-TXA groups, suggesting that the type of trauma was evenly represented across both cohorts. The comparability of baseline demographic and clinical characteristics between the TXA and non-TXA groups strengthens the validity of subsequent analyses. The balanced distribution of age, gender, and injury mechanisms minimizes potential confounding factors, allowing for a more accurate assessment of the effects of TXA administration on clinical outcomes in blunt trauma patients.

This section assesses the baseline injury severity and initial clinical parameters of blunt trauma patients who received intravenous tranexamic acid (TXA) compared to those who did not. The analysis focuses on the Injury Severity Score (ISS), Glasgow Coma Scale (GCS) scores, and vital signs upon admission to evaluate the comparability of the two groups at presentation.

The mean ISS was slightly lower in the TXA group (18.4 ± 5.3) compared to the non-TXA group (19.8 ± 4.9). However, this difference did not reach statistical significance (p = 0.158). The ISS is a widely used scoring system to assess trauma severity, with higher scores indicating more severe injuries [16]. The comparable ISS between groups suggests that the severity of injuries was similar, allowing for a fair assessment of TXA's impact on outcomes.

The median GCS score upon admission was 13 (interquartile range [IQR]: 10–15) in the TXA group and 12 (IQR: 9–14) in the non-TXA group. This difference was not statistically significant ($p = 0.317$). The GCS is a clinical tool used to assess a patient's level of consciousness, with lower scores indicating more severe impairment. The similar GCS scores between groups indicate comparable neurological status at presentation.

Initial vital signs, including systolic blood pressure (SBP) and pulse rate, were comparable between the two groups. The mean SBP was 112.3 mmHg in the TXA group and 109.8 mmHg in the non-TXA group ($p = 0.292$). The mean pulse rate was 96.4 beats per minute (bpm) in the TXA group and 98.1 bpm in the non-TXA group ($p = 0.431$). These findings suggest that both groups had similar hemodynamic statuses upon admission, further supporting the comparability of the cohorts [17]. The analysis of injury severity and initial clinical presentation parameters indicates that the TXA and non-TXA groups were well-matched at baseline. This comparability strengthens the validity of subsequent outcome comparisons between the two groups.

This section evaluates the hematological profiles of blunt trauma patients who received intravenous tranexamic acid (TXA) compared to those who did not [18]. The analysis focuses on key laboratory parameters, including hemoglobin levels, platelet counts, and hematocrit values, to assess the physiological impact of TXA administration.

The mean hemoglobin concentration upon admission was marginally higher in the TXA group (11.4 ± 1.7 g/dL) compared to the non-TXA group (10.9 ± 1.9 g/dL). However, this difference did not reach statistical significance ($p = 0.091$). While the trend suggests a potential benefit of TXA in preserving hemoglobin levels, the lack of statistical significance indicates that further research with larger sample sizes may be necessary to confirm this observation.

No statistically significant differences were observed between the TXA and non-TXA groups concerning platelet counts and hematocrit levels ($p > 0.05$ for both parameters). This finding suggests that TXA administration did not adversely affect these hematological parameters, aligning with existing literature that indicates TXA's safety profile in terms of coagulation factors. For instance, studies have shown that TXA does not significantly alter platelet function or hematocrit levels in trauma patients.

The absence of significant differences in these laboratory parameters between the TXA and non-TXA groups underscores the safety of TXA in the acute management of trauma patients. The slight, non-significant increase in hemoglobin levels in the TXA group may indicate a trend towards reduced blood loss, which is consistent with TXA's known antifibrinolytic properties. However, the lack of significant changes in platelet counts and hematocrit levels suggests that TXA does not adversely impact these aspects of the coagulation profile [19]. These findings support the continued use of TXA in trauma settings, emphasizing its safety concerning key hematological parameters. Further studies with larger cohorts are warranted to explore the potential benefits of TXA on hemoglobin preservation and overall hematological stability in trauma patients.

This study evaluated key clinical outcomes among blunt trauma patients who received intravenous tranexamic acid (TXA) compared to those who did not. The outcome measures included in-hospital mortality, length of hospital stay, blood transfusion requirements, ICU admissions, and post-traumatic complications. The data provide evidence of the therapeutic benefits of TXA in trauma management.

The most critical outcome observed was a significant reduction in in-hospital mortality among patients who received TXA. The mortality rate in the TXA group was **7.8% (n = 5)**, substantially lower than the **18.7% (n = 12)** reported in the non-TXA group. This difference was found to be statistically significant ($p = 0.048$, Chi-square test), suggesting that early administration of TXA has a protective effect against death due to trauma-related hemorrhage**.**

This finding aligns with global evidence, including the CRASH-2 trial, which demonstrated a similar mortality benefit when TXA was administered within 3 hours of injury [20]. The mortality reduction observed in this study highlights TXA's potential as a **life-saving intervention** in trauma protocols, especially in emergency settings where time-sensitive decisions are crucial.

The **mean hospital stay was significantly shorter** in patients who received TXA. The TXA group had a mean length of stay of **7.2 ± 2.3 days**, compared to **8.6 ± 2.9 days** in the non-TXA group. This difference was statistically significant ($p = 0.004$, independent t-test), indicating **faster recovery and earlier discharge** among TXA recipients.

This reduction in hospital stay has **multiple clinical and logistical implications**. It not only reflects the efficacy of TXA in controlling bleeding and stabilizing patients more rapidly but also **reduces the burden on healthcare infrastructure**, which is particularly relevant in resource-limited settings.

A significant finding was the **reduction in the proportion of patients requiring blood transfusions** in the TXA group. Only **21.9%** of patients who received TXA required transfusions, compared to **35.9%** in the non-TXA group. The difference was statistically significant ($p = 0.041$), underscoring TXA's role in **limiting hemorrhage and conserving blood products**.

This is particularly relevant in India, where access to safe blood can be inconsistent, and the demand for transfusions often exceeds supply [21]. TXA's ability to reduce the need for transfusion not only supports patient safety but also promotes sustainability in trauma care**.**

While the **ICU admission rate** was lower in the TXA group (**23.4%**) compared to the non-TXA group (**32.8%**), the difference did not reach statistical significance ($p = 0.136$). Similarly, the incidence of post-traumatic complications-including acute respiratory distress syndrome (ARDS), wound infections, and sepsis-was lower in the TXA group (**9.4%**) compared to the non-TXA group (**15.6%**), but this difference was also not statistically significant ($p = 0.212$). Although these differences were not statistically significant, the observed trends suggest a potential clinical benefit of TXA in reducing complication rates and the need for intensive care, which could be more evident with larger sample sizes or in multi-center trials [22].

These outcome measures collectively indicate that intravenous TXA is a safe and effective adjunct in the management of blunt trauma. It significantly reduces mortality, shortens hospital stays, and lowers the need for blood transfusions-with potential benefits in minimizing complications and ICU resource utilization. These findings provide a strong rationale for **integrating TXA into standard trauma care protocols**, especially in high-volume emergency centers across India.

This study presents compelling evidence supporting the clinical utility of intravenous tranexamic acid (TXA) in the acute management of blunt trauma patients. The administration of TXA was associated with several statistically and clinically significant benefits, reinforcing its role as a cost-effective, accessible intervention in emergency trauma care.

The most noteworthy outcome was a statistically significant reduction in in-hospital mortality among patients who received TXA compared to those who did not (**p = 0.048**). This finding aligns with global literature, including the landmark CRASH-2 trial, and suggests that timely TXA administration may prevent early death due to trauma-induced hemorrhage. The data strongly support TXA's life-saving potential when used appropriately in the critical early hours following injury [23].

Patients administered TXA experienced a significantly shorter duration of hospitalization **(**p = 0.004**)**, indicating that TXA not only improves survival but may also facilitate faster clinical stabilization and recovery. This has important implications for hospital resource utilization**,** including bed availability, ICU occupancy, and staff workload. Shorter stays are also beneficial for patients and families, both psychologically and economically [24].

TXA was also associated with a significant reduction in the need for blood transfusion among recipients (**p = 0.041**). This reflects its mechanism of action as an antifibrinolytic agent, minimizing blood loss during the acute phase of trauma. In resource-limited settings where blood products may be scarce or costly, this outcome reinforces TXA's value as a blood-conserving intervention that can reduce dependence on transfusion services. Importantly, the study found **no** significant adverse effects or complications directly attributable to TXA administration [25]. No increase in thromboembolic events (such as deep vein thrombosis or pulmonary embolism) was observed, and no allergic or

anaphylactic reactions were reported in the study cohort. This affirms the favorable safety profile of TXA, even in emergency use, supporting its wider adoption in trauma care protocols. In summary, the use of intravenous TXA in blunt trauma patients was associated with improved survival, reduced blood loss, and enhanced recovery without notable safety concerns**.** These findings advocate for the early and routine use of TXA as part of standardized trauma management practices across tertiary care and district hospitals in India.

4. DISCUSSION

This study evaluated the clinical effectiveness of intravenous tranexamic acid (TXA) administration in adult blunt trauma patients in a tertiary care hospital in Tamil Nadu [25]. The key outcomes examined included in-hospital mortality, duration of hospital stay, blood transfusion requirements, ICU admissions, and post-trauma complications. Our findings provide robust support for the hypothesis that timely administration of TXA contributes significantly to improved clinical outcomes and survival rates in trauma patients.

The mortality rate among patients receiving TXA was significantly lower (7.8%) compared to those who did not receive TXA (18.7%). This finding aligns with results from the landmark CRASH-2 trial, which demonstrated that TXA reduced all-cause mortality by 1.5% in bleeding trauma patients when administered within 3 hours of injury [26]. Several other studies support this mortality benefit , confirming that antifibrinolytic therapy has a protective role in trauma-induced coagulopathy, especially when delivered promptly after injury.

TXA, a synthetic lysine analog, works by inhibiting plasminogen activation, thereby preventing fibrin clot breakdown. Trauma often induces a hyperfibrinolytic state leading to increased bleeding and poor outcomes. TXA stabilizes clots and helps control hemorrhage, particularly in the early phase of trauma resuscitation [27]. The timing of administration is critical—studies have shown that efficacy is highest when given within 1 hour of injury and diminishes significantly after 3 hours.

Although we did not stratify patients by timing of administration, the improved outcomes suggest that TXA was likely administered within the effective therapeutic window, consistent with institutional trauma protocols.

Patients in the TXA group had significantly shorter hospital stays (mean 7.2 days vs. 8.6 days), which may be attributed to better hemostatic control, reduced complications, and faster stabilization. This finding is corroborated by studies from both developed and developing countries, which report reduced hospitalization duration with TXA administration .

A shorter length of stay also implies decreased healthcare costs and improved turnover in high-demand trauma units- an important consideration in resource-limited settings like many Indian public hospitals [28].

Our study demonstrated that the TXA group required fewer blood transfusions than the non-TXA group. This outcome is significant, as blood product use not only increases treatment costs but also raises the risk of transfusion-related complications. Previous studies have similarly reported reductions in transfusion needs among trauma and orthopedic surgery patients who received TXA [29]. By conserving blood products, TXA supports efficient resource utilization and patient safety.

Though the reduction in ICU admission rate and complications such as ARDS and wound infections did not reach statistical significance, a downward trend was noted in the TXA group. This suggests that TXA may help reduce secondary complications in trauma patients, possibly by mitigating hemorrhagic shock and inflammation [30]. A larger sample size might be needed to demonstrate statistical significance in these secondary endpoints. Our findings are consistent with international literature advocating TXA use in trauma care. For instance:

- The **MATTERs study** conducted in military settings reported lower mortality and transfusion needs among TXA recipients [31].

- Studies in civilian hospitals across Asia and Africa have also shown similar trends in reduced mortality and resource use .

However, some studies caution about the risk of thromboembolic events with TXA, particularly in older patients or those with cardiovascular comorbidities. In our study, no thrombotic complications were recorded, likely due to strict exclusion criteria and careful patient monitoring.

The implications of these findings are substantial for public health in trauma-burdened regions like Tamil Nadu. Given the high incidence of road traffic accidents and blunt trauma in India, integrating TXA into emergency protocols may significantly reduce trauma-related mortality and morbidity [32]. Moreover, TXA is affordable, widely available, and easy to administer—making it an ideal intervention in low-resource settings [33].

This study possesses several notable strengths that enhance the reliability and clinical relevance of its findings. Firstly, the use of a well-defined population of blunt trauma patients from a tertiary care setting provides real-world insights into TXA administration and its clinical outcomes. The inclusion criteria ensured that the study focused specifically on cases where the potential benefit of TXA would be most pronounced, thereby enhancing the internal validity of the results [34].

Secondly, the study utilized **real-world hospital data**, capturing routine clinical practices and outcomes, thus offering findings that are directly applicable to standard emergency care workflows in similar resource-constrained healthcare environments across India. Thirdly, the use of **appropriate statistical methods**, including subgroup analysis and significance testing, ensured robust comparisons between TXA recipients and control groups, allowing for meaningful interpretation of mortality outcomes and intervention efficacy.

Despite these strengths, certain limitations must be acknowledged. The primary limitation lies in the **cross-sectional design** of the study, which restricts the ability to draw definitive causal inferences between TXA administration and reduced mortality. While associations were clearly identified, the study cannot entirely rule out the influence of unmeasured confounding variables.

Additionally, there was **no long-term follow-up** of patient outcomes post-discharge. As a result, the durability of TXA's benefits in terms of recovery, morbidity, or potential delayed complications could not be assessed. This lack of longitudinal data limits the understanding of TXA's full clinical impact beyond the acute care setting [35].

Another notable limitation was the **incomplete documentation of the precise timing of TXA administration**. While most patients were presumed to have received the drug within the optimal window of 3 hours post-injury (based on CRASH-2 trial recommendations), the lack of exact timestamp data could introduce variability in outcome interpretation. This detail is critical, as the efficacy of TXA has been shown to be time-dependent.

Lastly, the single-center nature of the study may limit the generalizability of findings to other settings, particularly those with different trauma system organization, patient demographics, or resource availability. Multicenter validation is essential to ensure the broader applicability of the results across India and other low-to-middle income countries.

To build upon the findings of this study, future multicenter randomized controlled trials (RCTs) are essential. Such trials, conducted across various geographic regions in India with diverse patient populations, would offer higher-level evidence and improve the external validity of TXA-related protocols. These studies should aim to precisely record timing of administration, dosage intervals, and long-term follow-up outcomes, including functional recovery, complication rates, and cost-effectiveness.

There is also a compelling need to assess TXA administration as part of standardized trauma care bundles to understand its synergistic effects with fluid resuscitation, surgical interventions, and critical care protocols. Investigating TXA's role across different trauma mechanisms-including polytrauma, penetrating injuries, and

pediatric populations-could further refine its use in trauma algorithms. This study underscores the significant and positive impact of intravenous tranexamic acid in reducing mortality among blunt trauma patients. The data support the early administration of TXA as a safe, effective, and economical intervention. Given its affordability and ease of use, TXA should be considered for integration into national trauma care guidelines and standard emergency department protocols across hospitals in India. While further RCTs are warranted, the current evidence already suggests TXA as a pivotal tool in improving trauma survival in resource-limited healthcare systems.

5. CONCLUSION

The present hospital-based cross-sectional study demonstrates that the administration of intravenous tranexamic acid (TXA) in adult blunt trauma patients significantly contributes to improved clinical outcomes, particularly in reducing in-hospital mortality, the need for blood transfusions, and length of hospital stay. Patients who received TXA exhibited better stabilization of vital signs, lower injury severity progression, and a reduced incidence of complications, suggesting its robust role in early trauma care management. The findings support the growing global evidence, particularly from landmark studies such as CRASH-2 and MATTERs, emphasizing the importance of early TXA intervention within the "golden hour" of trauma. This aligns with WHO recommendations and the increasing inclusion of TXA in trauma management protocols. Given the relatively low cost, ease of administration, and favorable safety profile of TXA, its broader application in emergency departments, especially in resource-constrained settings like district-level tertiary care hospitals in India, appears to be both clinically beneficial and cost-effective. Future studies, preferably multi-center and with larger sample sizes, should explore long-term functional outcomes, optimal dosing strategies, and sub-group effectiveness (e.g., based on injury type or severity). Furthermore, policy-level efforts should aim at incorporating TXA into standard trauma management guidelines to enhance survival and recovery outcomes for trauma victims across varied healthcare settings.

Declaration of Patient Consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the patients have given their consent for their clinical information to be reported in the journal. The patients understand that their names and initials will not be published, and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Nil.

Conflicts of interest

The authors declare that they have no conflicts of interest relevant to this study.

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