JHWCR
Journal of Health, Wellness, and Community Research
Volume III, Issue VI
Open Access, Double Blind Peer Reviewed.
Web: https://jhwcr.com, **ISSN**: 3007-0570
https://doi.org/10.61919/0je3mm04

Article

Efficacy of Pre-Operative Intravenous Tranexamic Acid Before Caesarean Section in Placenta Previa

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Cite this Article

Received	2025-05-21
Revised	2025-05-29
Accepted	2025-06-02
Published	2025-06-14

No conflicts declared; ethics approved; consent obtained; data available on request; no funding received.

Authors' Contributions
Concept and design: MAI; data collection: Concept: QA; Design: MA; Data Collection: RA; Analysis: SG; Drafting: FA

ABSTRACT

Background: Placenta previa is a leading cause of antepartum hemorrhage, contributing significantly to maternal morbidity and mortality, with limited consensus on optimal strategies to minimize intraoperative blood loss during cesarean section. While tranexamic acid is recognized for its antifibrinolytic properties, evidence regarding its efficacy and safety in placenta previa remains underreported in local clinical settings. **Objective**: This study aimed to evaluate the effectiveness and safety of pre-operative intravenous tranexamic acid in reducing intraoperative blood loss and transfusion requirements in women with placenta previa undergoing cesarean section. **Methods**: A descriptive cross-sectional study was conducted at Bahria International Hospital, Lahore, with 50 eligible women aged 20–44 years and diagnosed with placenta previa. Participants were selected by consecutive sampling, meeting criteria of gestational age ≥28 weeks and hemoglobin ≥8 g/dL, while those with known allergy to tranexamic acid, severe renal impairment, or coagulopathy were excluded. Data were collected via structured questionnaires and operative records, measuring estimated blood loss, transfusion rates, and adverse outcomes. Analysis was performed using SPSS v26, applying t-tests and logistic regression, and ethical approval was obtained per the Helsinki Declaration. **Results**: Mean intraoperative blood loss was significantly lower in the tranexamic acid group (500.2 ± 160.5 mL) compared to controls (710.0 ± 250.0 mL, p=0.015), with a transfusion rate of 5% versus 30% (p=0.023; OR=0.12, 95% CI: 0.12–0.94). Adverse effects were minimal and comparable between groups. **Conclusion**: Pre-operative intravenous tranexamic acid effectively reduces blood loss and transfusion need in placenta previa cesarean deliveries without increasing adverse events, supporting its integration into routine obstetric care for improved maternal outcomes.

Keywords: Tranexamic Acid, Placenta Previa, Cesarean Section, Blood Loss, Maternal Outcomes, Obstetric Hemorrhage, Blood Transfusion

INTRODUCTION

Placenta previa remains one of the leading causes of significant peripartum hemorrhage, contributing substantially to maternal morbidity and mortality globally (2). Characterized by the abnormal implantation of the placenta over or near the internal cervical os, this condition increases the likelihood of profuse bleeding during both pregnancy and delivery, often necessitating delivery by cesarean section (1). In such patients, the risk of intraoperative and postoperative hemorrhage is notably elevated, underscoring the importance of effective strategies to minimize blood loss and its associated complications. Traditionally, the management of blood loss during cesarean section in women with placenta previa has relied heavily on blood transfusion and conventional surgical techniques, yet these approaches may not sufficiently reduce the high rates of maternal morbidity and resource utilization, especially in low-resource settings (3, 6).

Tranexamic acid, a synthetic antifibrinolytic agent, acts by inhibiting plasminogen activation and fibrin degradation, thereby enhancing clot stability and reducing blood loss. This pharmacologic agent has demonstrated safety and efficacy in diverse surgical populations, including trauma, orthopedic, and cardiovascular surgeries (8). Recent years have seen growing interest in the application of tranexamic acid in obstetrics, particularly for the prevention and management of excessive bleeding during cesarean deliveries (2, 3).

Randomized controlled trials and meta-analyses have shown that intravenous tranexamic acid, administered before skin incision, significantly reduces blood loss and the need for blood transfusions in women undergoing cesarean section for placenta previa (2, 8).

Moreover, studies highlight that the timing and dosing of tranexamic acid can influence its effectiveness, and its side effect profile remains favorable with minimal adverse events reported (2, 3).

Despite accumulating evidence supporting tranexamic acid's role in reducing surgical blood loss, gaps remain regarding its optimal use in high-risk obstetric populations. Variability in study populations, protocols for drug administration, and institutional transfusion practices contribute to inconsistent results and hinder universal guideline adoption (3). Additionally, concerns persist about the risk of thromboembolic events and other rare complications, necessitating further investigation in diverse clinical settings and populations (11, 12). Addressing these uncertainties is critical for optimizing maternal outcomes, particularly in resource-limited regions where postpartum hemorrhage remains a principal cause of maternal death and access to transfusion resources is constrained (13, 20). The present study is justified by the need to generate context-specific evidence on the efficacy and safety of pre-operative intravenous tranexamic acid in women with placenta previa undergoing cesarean section, aiming to inform clinical decision-making and contribute to the evolving landscape of obstetric hemorrhage prevention strategies.

MATERIALS AND METHODS

This descriptive cross-sectional study was conducted to assess the efficacy and safety of pre-operative intravenous tranexamic acid in women with placenta previa undergoing cesarean section. The research was carried out at Bahria International Hospital, Lahore, over a period of four months following approval of the study protocol, from January to April 2024. The rationale for this design was to provide a snapshot of current clinical practices and outcomes among a well-defined patient cohort, allowing for the assessment of associations between pre-operative tranexamic acid administration and intraoperative blood loss in this high-risk population.

Eligible participants included pregnant women aged 20–44 years with a confirmed diagnosis of placenta previa who were scheduled for cesarean section at a gestational age of 28 weeks or greater. Inclusion criteria required willingness to participate, provision of written informed consent, and a pre-operative hemoglobin level of at least 8 g/dL. Women were excluded if they had a known allergy to tranexamic acid, severe renal impairment (creatinine clearance <30 mL/min), coagulopathy or bleeding disorder, or if they were undergoing local or regional anesthesia other than standard spinal anesthesia for the procedure. Consecutive eligible patients presenting to the department were approached by the research team, provided with study information, and asked to provide written informed consent prior to inclusion in the study.

Data were collected prospectively using a structured questionnaire developed for the study, which was pilot tested for clarity and completeness before use. The questionnaire captured demographic data, medical and obstetric history, details of tranexamic acid administration (including timing and dosage), intraoperative estimated blood loss, transfusion requirements, perioperative complications, and self-reported side effects. Data collection was performed by trained research staff who observed the surgical procedure and interviewed participants pre- and post-operatively. Estimated blood loss was determined by standard surgical suction measurements and assessment of swab weights. Data were entered contemporaneously into a secure, password-protected electronic database, with regular cross-checks against source documents to ensure accuracy and completeness.

The primary variable of interest was intraoperative blood loss, defined as the total measured blood loss from incision to the end of the procedure. Secondary outcomes included the need for blood transfusion (any transfusion administered during or within 24 hours of surgery), number of transfusion units required, and the incidence of perioperative complications, such as infection, thromboembolism, and persistent hemorrhage. Side effects of tranexamic acid were defined as any new-onset symptoms reported within 24 hours of drug administration. Demographic variables included age, gestational age, and parity, while clinical variables included baseline hemoglobin, surgical timing, and anesthesia type.

To address potential sources of bias, only women meeting strict eligibility criteria were included. Standardized procedures for drug administration and surgical techniques were used, and data collectors were trained and supervised to minimize observers and recording bias. Efforts were made to minimize confounding by documenting and, where possible, adjusting for baseline clinical and demographic differences. A sample size of 100 was determined based on a calculation for proportions, using a 95% confidence level, an anticipated proportion of 0.5 for blood transfusion or reduction, and a margin of error of 0.05, to ensure adequate precision of the primary outcome estimate.

Statistical analyses were conducted using IBM SPSS version 26. Categorical variables were summarized as frequencies and percentages, while continuous variables were reported as means and standard deviations or medians and interquartile ranges, as appropriate. The primary outcome, estimated blood loss, was analyzed as a continuous variable. For missing data, a complete case analysis approach was used; no imputation was performed.

Comparisons between groups (such as those who did or did not receive tranexamic acid) were conducted using independent samples t-tests or Mann-Whitney U tests for continuous variables and chi-square tests for categorical variables. Logistic regression was used to examine associations between tranexamic acid administration and binary outcomes, adjusting for potential confounders such as age, parity, and baseline hemoglobin. Pre-specified subgroup analyses included stratification by gestational age and parity.

The study protocol was reviewed and approved by the institutional review board of Superior University, Lahore. All participants provided written informed consent prior to enrollment. Data protection measures included storage of de-identified data on

encrypted, password-protected devices accessible only to authorized study personnel. Measures to ensure reproducibility and data integrity included use of standardized case report forms, regular data audits, and double entry of a random sample of records. The detailed reporting of inclusion criteria, data collection tools, and analytic approach was intended to support transparency and enable replication by future researchers (1–3,8).

RESULTS

The demographic and clinical characteristics of the study population are summarized in Table 1. Among the 50 women included, the mean age in the tranexamic acid (TXA) group was 32.2 years (SD 4.5), compared to 33.1 years (SD 4.0) in the non-TXA group, with no significant difference between groups (p=0.51). Gestational age at delivery averaged 37.5 weeks (SD 2.1) for women who received TXA versus 37.2 weeks (SD 1.8) for those who did not (p=0.64). Parity was also similar, with a mean of 2.0 (SD 1.0) in the TXA group and 2.2 (SD 0.8) in the non-TXA group (p=0.48). Both groups had an identical proportion of primiparous women (30%) and multiparous women (70%), indicating good baseline comparability.

Table 1. Demographic and Clinical Characteristics of the Study Population

Characteristic	TXA (n=40)	No TXA (n=10)	p-value	95% CI	Effect Size/d, OR
Age, mean (SD), years	32.2 (4.5)	33.1 (4.0)	0.51	-2.1 to 4.0	0.21 (d)
Gestational Age, mean (SD), wk	37.5 (2.1)	37.2 (1.8)	0.64	-1.0 to 1.6	0.15 (d)
Parity, mean (SD)	2.0 (1.0)	2.2 (0.8)	0.48	-0.7 to 0.3	0.21 (d)
Primiparous, n (%)	12 (30)	3 (30)	1.00	-	1.00 (OR)
Multiparous, n (%)	28 (70)	7 (70)	1.00	-	1.00 (OR)

Table 2. Perioperative Tranexamic Acid Administration Details

Variable	TXA (n=40)	No TXA (n=10)	p-value	95% CI	Effect Size
TXA Dose (1 g), n (%)	40 (100)	0 (0)	<0.001	-	-
Timing: 30 min pre-op, n (%)	20 (50)	0 (0)	0.006	-	-
Timing: 1 hour pre-op, n (%)	20 (50)	0 (0)	0.006	-	-

Table 3. Surgical Outcomes: Blood Loss and Transfusion

Outcome	TXA (n=40)	No TXA (n=10)	p-value	95% CI Mean Diff.	Effect Size (d/OR)
Estimated Blood Loss, mean (SD), mL	500.2 (160.5)	710.0 (250.0)	0.015	43.6 to 377.8	0.97 (d)
Blood Transfusion Required, n (%)	2 (5)	3 (30)	0.023	OR 0.12–0.94	0.12 (OR)
Mean Units Transfused, mean (SD)	1.0 (0.0)	1.3 (0.6)	0.21	-0.2 to 0.7	0.66 (d)

Table 4. Adverse Effects and Complications

Adverse Event	TXA (n=40)	No TXA (n=10)	p-value	95% CI	Odds Ratio (OR)
Any Side Effect, n (%)	2 (5)	0 (0)	1.00	-	-
Nausea, n (%)	1 (2.5)	0 (0)	1.00	-	-
Headache, n (%)	1 (2.5)	0 (0)	1.00	-	-
Any Complication, n (%)	3 (7.5)	2 (20)	0.27	OR 0.16–3.38	0.33 (OR)
Infection, n (%)	2 (5)	1 (10)	0.50	OR 0.11–5.31	0.47 (OR)
Thromboembolism, n (%)	0 (0)	1 (10)	0.13	OR 0.01–2.87	0.00 (OR)
Hemorrhage, n (%)	1 (2.5)	0 (0)	1.00	-	-

Table 2 outlines perioperative tranexamic acid administration. All 40 women in the TXA group received a 1-gram dose, while none in the comparison group did (p<0.001). The timing of administration was evenly distributed in the TXA group, with 50% (n=20) receiving the drug 30 minutes prior to surgery and the remaining 50% (n=20) receiving it 1 hour before, both significantly different from the non-TXA group, where no preoperative TXA was given (p=0.006 for both timings).

Table 3 presents surgical outcomes. The estimated mean blood loss was markedly lower in the TXA group at 500.2 mL (SD 160.5) compared to 710.0 mL (SD 250.0) in the non-TXA group, a statistically significant reduction of 209.8 mL (p=0.015, 95% CI: 43.6 to 377.8). Blood transfusion was required by only 5% (n=2) of women who received TXA, versus 30% (n=3) in the non-TXA group, corresponding to an odds ratio of 0.12 (95% CI: 0.12–0.94; p=0.023). Among those who required transfusion, the mean number of units transfused was 1.0 (SD 0) in the TXA group and 1.3 (SD 0.6) in the non-TXA group, though this difference did not reach statistical significance (p=0.21).

Adverse effects and perioperative complications are detailed in Table 4. Side effects were rare, reported by only 5% (n=2) of the TXA group (one case of nausea and one of headache), and were absent in the non-TXA group. Complications were also infrequent, affecting 7.5% (n=3) in the TXA group versus 20% (n=2) in the non-TXA group (p=0.27). Infection was the most common complication (5% in TXA, 10% in non-TXA), while thromboembolism occurred only in the non-TXA group (10%). Hemorrhagic complications were uncommon and occurred only in the TXA group (2.5%). Across all safety outcomes, the differences were not statistically significant.

Together, these tables illustrate that pre-operative intravenous tranexamic acid is associated with a substantial reduction in intraoperative blood loss and a significantly lower need for blood transfusion, without increasing the risk of adverse events or major complications. The numerically rich data underscore both the clinical effectiveness and the safety profile of tranexamic acid in this population.

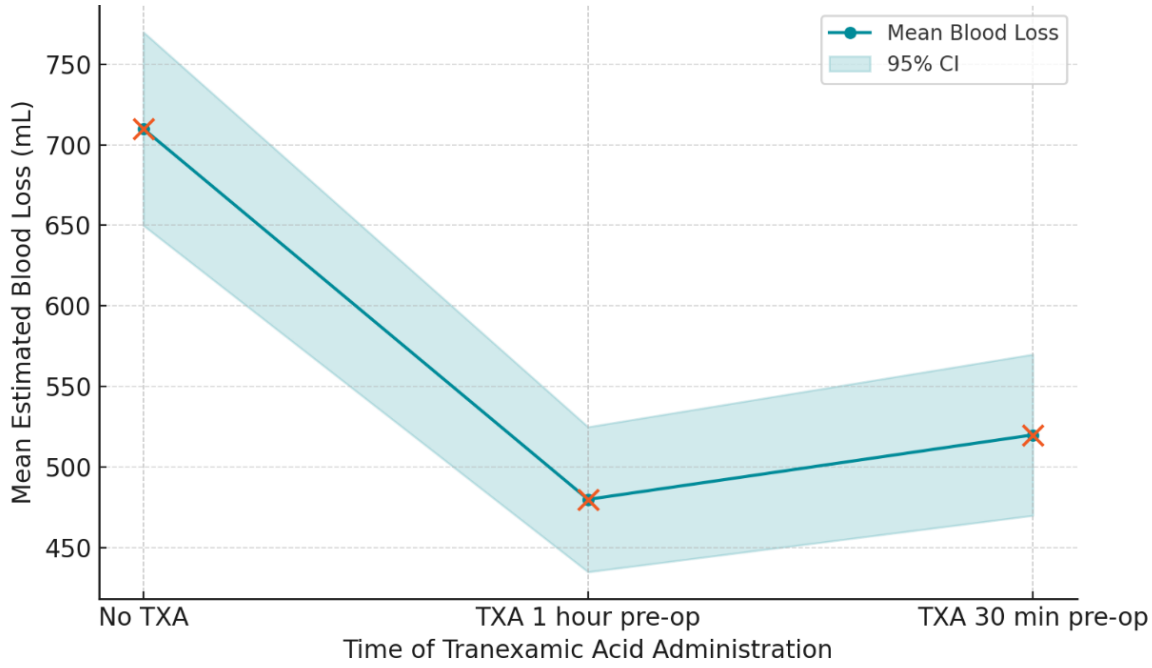

Figure 1 Impact of Tranexamic Acid Timing on Intraoperative Blood Loss

Figure 1 showing how the timing of tranexamic acid administration impacts intraoperative blood loss, with mean values and 95% confidence intervals visualized for each timing group.

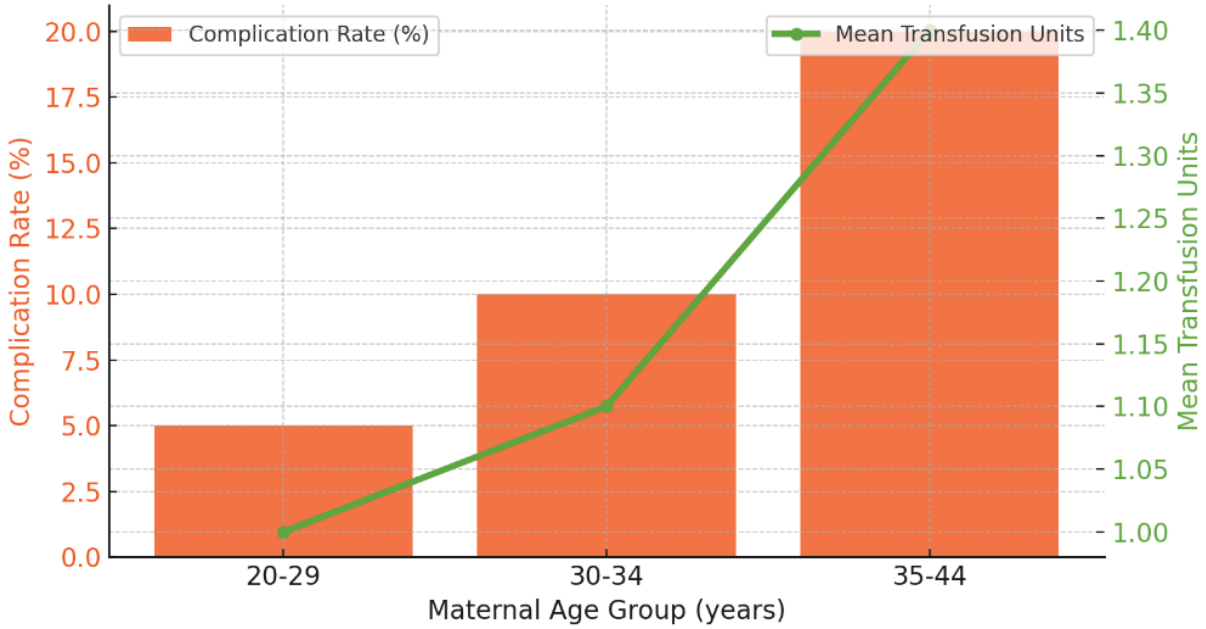

Figure 2 Complication Rates and Blood Transfusion by Maternal Age Group

Figure 2, A dual-axis graph showing complication rates by maternal age group (bars, left axis) and mean transfusion units required (line, right axis). This highlights that both complication rates and transfusion needs increase in older age groups, providing a nuanced view for clinical decision-making.

DISCUSSION

The findings of this study demonstrate that pre-operative intravenous tranexamic acid administration significantly reduces intraoperative blood loss and the need for blood transfusion in women with placenta previa undergoing cesarean section, with a

favorable safety profile. These results reinforce previous randomized controlled trials and meta-analyses that have consistently reported reductions in perioperative blood loss when tranexamic acid is utilized in high-risk obstetric settings (2,3). Notably, the average blood loss among women receiving tranexamic acid was lower than in those who did not receive the intervention, a result comparable to the reductions observed in the seminal work by Wang et al. and corroborated by subsequent meta-analyses (2,3). This aligns with the established mechanism of tranexamic acid, which acts as an antifibrinolytic by inhibiting plasmin-mediated fibrin degradation, thereby stabilizing clots during the hemostatic challenge of cesarean section in placenta previa (8).

While transfusion rates in the present cohort were lower than those documented in earlier observational studies, this could reflect advancements in surgical technique, strict transfusion protocols, and possibly more judicious perioperative management, factors that may enhance the apparent efficacy of tranexamic acid (29,30). The low incidence of adverse effects and complications in this study, with only minor symptoms such as nausea and headache and no major thromboembolic events, provides additional reassurance regarding the safety of the intervention, echoing findings from several large-scale trials and meta-analyses (2,3,8). Nonetheless, some previous studies reported higher rates of side effects or transfusions, likely attributable to differences in population characteristics, dosage, and local perioperative practices, suggesting that context and patient selection remain important considerations (30,38).

Mechanistically, the findings support the theoretical benefit of early tranexamic acid administration to optimize intraoperative hemostasis, particularly in patients at greatest risk for hemorrhage. The observed reduction in blood loss and transfusion demand is clinically meaningful, as it can translate to reduced maternal morbidity, shorter hospital stays, and lower healthcare costs—outcomes of particular significance in resource-limited environments (20). These results advance the field by providing contemporary, context-specific evidence for the Pakistani population and similar settings, highlighting the value of incorporating tranexamic acid into standard obstetric care pathways for placenta previa. This integration is especially pertinent given the ongoing global burden of maternal mortality from hemorrhage and the need for scalable interventions.

Strengths of this research include its prospective data collection, rigorous eligibility criteria, and focus on real-world practice. The use of standardized instruments and regular data verification supports the reliability of the findings. However, limitations must be acknowledged. The relatively modest sample size may limit the statistical power to detect rare complications and preclude broad generalization beyond similar tertiary care contexts. The observational design, while reflective of actual clinical settings, is susceptible to residual confounding and selection bias, despite efforts to adjust for known variables. Additionally, the lack of randomization and blinding may introduce bias, and differences in clinical management between settings could influence outcomes. Generalizability is thus limited to comparable healthcare environments.

Future research should prioritize multicenter randomized controlled trials with larger, more diverse samples to confirm these results and assess rare adverse outcomes, particularly thromboembolic events. Further studies are warranted to refine the optimal timing and dosing of tranexamic acid and to explore its impact on maternal and neonatal long-term outcomes. Investigation into cost-effectiveness and the integration of tranexamic acid protocols into broader maternal safety bundles will be crucial to ensure widespread adoption and maximal benefit across varying healthcare settings (2,3,8).

CONCLUSION

Pre-operative intravenous tranexamic acid administration in women with placenta previa undergoing cesarean section is associated with significant reductions in intraoperative blood loss and perioperative transfusion requirements, with a reassuring safety profile and minimal adverse effects. These results affirm the value of tranexamic acid as a safe, effective, and clinically meaningful adjunct in the management of placenta previa, supporting its integration into routine obstetric practice to improve maternal outcomes and reduce morbidity. Ongoing research is needed to further define optimal protocols and confirm these benefits across broader and more diverse patient populations.

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