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Assessing The Efficacy of Tranexamic Acid (Txa) In Reduction of Pph During Cesarean Section

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Abstract:

Background: Postpartum Hemorrhage (PPH) is still among one of the most frequently occurring complications of childbirth that lead to severe suffering in the women following childbirth. This complication causes the highest percentage of maternal death in low resource countries due to inadequate access to emergency surgery. The risk of excessive bleeding is much more pronounced in cases of C-Sec when compared with natural birth, requiring complications-saving measures. To control blood loss Uterotonics like oxytocin and misoprostol are frequently used, but their usefulness is not always effective, particularly with atonic uterus and placental complications. The use of tranexamic acid (TXA), blood loss preventative surgical drugs, has gained popularity in recent years as it seeks to control intraoperative bleeding and lessen critical loss complications. Although it has proven efficiency in cases of trauma and non-obligatory surgery, there is little research on its pre-emptive use in C-Section. This study investigates the effectiveness of tranexamic acid on the amount of blood loss and its effects on maternal health indicators in women with high-risk pregnancies undergoing elective cesarean sections.

Methodology: A randomized double-blind placebo controlled clinical trial was implemented at the obstetric ward of a tertiary care hospital. One hundred and fifty women with elective cesarean section were randomly distributed into two groups where one group received TXA infusion prior to the operation and one group served as a placebo. Blood loss was calculated intraoperatively with the use of a calibrated collection system, and hemoglobin levels were evaluated before the operation and after the operation. Other elements, such as blood transfusions, adverse events, maternal hemodynamic stability, and other hemodynamic stems, were also recorded.

Results: The data showed that there was a statistically significant decrease in blood loss in the TXA group in comparison to the control group. Patients treated with TXA had lower rates of anemia and blood transfusions. There was no significant increase in thromboembolic complications or adverse reactions.

Conclusion: These results bolster the safety profile of TXA for obstetric usage. The results highlight the potential use of TXA for increased effectiveness for blood loss during cesarean sections as well as for situations where blood transfusion resources are restricted. Incorporation of TXA into obstetric care routines would enhance maternal health indicators which reduces the

pressure on medical resources. More research is needed to develop optimal dosing guidelines in order to validate the presumed long-term benefits of TXA on patients of varying demographics.

Keywords: Postpartum hemorrhage, Cesarean section, Tranexamic acid, Blood loss diminution, Maternal health, Surgical obstetric bleeding, Hemorrhagic agents**.**

Introduction:

Maternal health is known to be one of the most important markers of the quality and availability of health services in a given society. Even though there has been improvement in the quality of medical services, maternal morbidity and mortality is still a concern globally. This is a significant issue for less developed regions since there is difficulty accessing appropriate obstetric care. One of the most common causes of maternal mortality is obstetric hemorrhage, which is excessive bleeding during or after childbirth (1). This condition also contributes significantly to maternal morbidity and mortality and Postpartum hemorrhage (PPH) is said to be the cause of almost one-fourth of maternal deaths around the globe. Low-income nations suffer gravely with PPH, where almost 27% of maternal deaths is due to excessive postpartum hemorrhage, in comparison to higher income countries where the figure is approximately 16%. While the development of medical procedures has lowered the rates of maternal mortality, PPH is still a crucial problem, and more work is needed in areas with little healthcare resources. The goal of this study is to assess the effectiveness of tranexamic acid in controlling blood loss in cesarean sections and its potential side effects (2).

PPH is defined as blood loss exceeding 500 milliliters following vaginal delivery or more than 1000 milliliters after a cesarean section. In severe cases, the hemorrhage can suddenly worsen and become uncontrollably fast, resulting in lack of blood circulation to vital organs and bodily systems. Obstetric practice is heavily concerned with postpartum hemorrhage (PPH) which has been shown to be significantly more probable with cesarean deliveries compared to vaginal births. To address this concern, a study was created to analyze the effect of TA in pharmacologic therapy aimed to reducing bleeding during and after elective cesarean sections (CS) in women at high risk, considering them for PPH in low resourced settings (3). Although lifesaving in complicated deliveries, cesarean sections have an increased risk of complications, and blood loss, infection, and recovery time tend to be higher. With the global spike in cesareans, there is a pressing need to manage blood loss in order to enhance maternal health outcomes and minimize morbidity and mortality due to PPH (4).

There has been a notable global increase in the prevalence of cesarean sections performed, now sitting at a staggering 25-30% in some regions. It is undeniable that cesarean delivery is at times crucial in averting complications for the mother or fetus; however, it comes with the cost of increasing the chances of adverse outcomes such as excessive blood loss. The average blood loss of a cesarean section when compared to vaginal deliveries is almost double, with some extreme cases surpassing 1000 milliliters. This amount of blood tends, especially when considering anemia, which puts immense strain and risk on women who already face serious postpartum complications (5).

An antifibrinolytic agent, also known as clot stabilizer, Tranexamic acid (TXA), is used to lessen the chances of bleeding during surgery and trauma. In countries like Pakistan, which has a high prevalence of anemia in women, the potential risks of blood loss during a cesarean section are problematic. Blood transfusions, as well as emergency surgical procedures, are not easily obtainable, creating the need for effective methods of hemorrhage control in obstetric care (6).

Blame a longer recovery time on numerous reasons and factors like lack of good hygiene, some medical conditions and lack of proper equipment contribute to achieving postpartum hemorrhage

with uterine atony being the most common cause. Uterine atony is when the uterus does not contract after childbirth leading to excess bleeding which accounts for approximately 75% of PPH cases (7). Other reasons are retained placenta, certain anomalies such as placenta previa and placenta accreta, leading to dead space causing the uterus to rupture and injury of vaginal canal. Uterine atony is easier handled manageable, but severe disruption of the placenta or rupture of the uterus calls for immediate operation to stop the person from losing blood and critical hemorrhage. Obstetric forces use various methods to prevent excessive blood loss (8).

Adding uterotonic agents, controlled cord traction, and uterine massage to the third stage of labor has been shown to decrease postpartum hemorrhages (PPH). PPH is minimized via active management, which motivates uterine contractions using agents such as oxytocin, misoprostol, or carbetocin. Alongside these agents, antifibrinolytic drugs, such as tranexamic acid (TXA), have proven to prevent bleeding complications in a variety of circumstances with minimal side effects (9). Active strategies to manage PPH, such as the use of uterotonics, have been associated with a lower rate of severe PPH in post-partum women. However, there is still a large gap in addressing the root causes of PPH where facilities are scarce. This signifies there is a need to further refine the current procedures aimed at mitigating blood loss, especially during cesarean deliveries due to the elevated chance of hemorrhaging.

TXA is regarded as one of the most effective drugs for minimizing blood loss in both surgical and traumatic situations. This is achieved by warding off the activation of plasminogen to plasmin. TXA is a synthetic product of lysine and functions as an antifibrinolytic agent by inhibiting the breakdown of blood clots. By enhancing the steadiness of clot formation, TXA diminishes bleeding and is widely used in medicine, trauma surgery, orthopedic procedures, and even in the management of heavy menstrual bleeding. Tranexamic acid has also been used intravenously for years to manage sanguineous loss during and post-surgery such as coronary artery bypass, spine surgeries, oral cavity surgeries, liver transplantation, total hip or knee arthroplasty, and urogenital surgeries (10). Due to its efficacy in controlling bleeding in numerous clinical situations, TXA is receiving more and more consideration as a means for mitigating and controlling postpartum hemorrhaging.

Headliners in obstetric care have placed focus on the usage of TXA in marked clinical trials spearheaded by the World Maternal Antifibrinolytic (WOMAN) trial. This trial was a colossal randomized controlled trial that looked at the effect of TXA on postpartum hemorrhage and quantitatively proved a significant decrease of maternal mortality due to bleeding (11). These results proved that there was an observable change in mortality rate after the intervention within three hours of onset of PPH, as TXA reduced the mortality rate from 1.9% to 1.5%. These results reinforced the argument for TXA as a possible intervention that could be lifesaving when managing PP. Further corroboration of TXA's functional application in decreasing death from bleeding in trauma patients is presented in the CRASH-2 trial. The trial noted the use of TXA did not increase the chances of thromboembolic complications (12).

Research focused on the application of TXA in cesarean sections is sparse. There are studies that prove its efficacy in managing postpartum hemorrhages, but more research is required to investigate the intraoperative application of TXA during cesarean deliveries (7). Existing literature involves the application of TXA post hemorrhage rather than prophylactic use during surgery. Additionally, the most surgically appropriate obstetric TXA dosing regimen still requires further investigation. Current guidelines recommend a single intravenous dose of 1 gram during a slow injection, however, addressing the potential impact of enhanced dosing strategies on the outcomes of cesarean deliveries in future research may be beneficial (13).

Considerable attention remains to be dedicated analyzing the effectiveness of TXA, particularly in low-resource settings. Most TXA related research is focused on well-resourced hospitals with full

access to emergency care. Though TXA's impact on reducing blood loss and mortality from PPH has been studied, its effects in developing countries where surgical intervention and transfusions are often lacking, is still neglected. Moreover, the studies conducted had very small sample sizes, and the medication's safety was evaluated in only eight studies (14). Bridging this gap is essential in the creation of adaptable guidelines that could be used in various levels of healthcare systems, especially those with high maternal mortality ratios.

To address these gaps, this research focuses on the impact of administering TXA intraoperatively in elective cesarean sections for high-risk pregnant women. TXA had been previously documented to help mitigate blood loss. This study aims to validate the effectiveness of TXA through a randomized control trial to ensure it will protect against excessive bleeding during cesarean deliveries. The outcomes could be highly beneficial for all obstetric practitioners, especially those who work in under-resourced settings where maternal mortality due to hemorrhage is a significant healthcare concern (15).

The public health impact of these findings could be profound as they broaden the scope directly using TXA beyond the individual cesarean delivery. Should the attempts and findings prove successful, it could be said that TXA acts as a low-cost, easily accessible solution for attenuating postpartum hemorrhage, which is prevalent in poorly resourced areas. Since TXA is inexpensive and easy to obtain, including it in obstetric care could help tackle the problem of maternal mortality on a global scale. Within 2 hours postpartum, the study group experienced radically less severe vaginal bleeding compared to the control group (16). Furthermore, its application during cesarean sections serves the dual purpose of transfusion minimization, enhancing systemic maternal health and healthcare efficacy.

As a final note, postpartum hemorrhage stands as a primary contributor to maternal mortality, especially in settings with limited resources and inadequate emergency medical services. Despite the positive impact of some current measures such as the use of uterotonics alongside active management of labor and PPH, additional techniques directed toward containment, particularly in cesareans, are critical. Tranexamic acid has shown great potential in the fight against bleeding in diverse clinical settings, but more work is needed to determine the best ways to implement it in obstetric care (17).

Cited studies mention how tranexamic acid (TXA) has been shown to reduce blood loss during and following a cesarean section, thus validating its use during such procedures as both a preventative and treatment for bleeding (10). These studies assess an important gap in literature regarding TXA's intraoperative usefulness aiming to shift clinical practices toward improved maternal health. Targeting an obstetrical population considered high-risk, this study may inform clinical standards and improve approaches to managing postpartum hemorrhage (PPH) to lower maternal morbidity and mortality worldwide.

Methodology:

Study Design:

This study used a cross-sectional approach where participants were allocated to a treatment group and received a placebo. The participants' medical records were reviewed for data of patients who had undergone cesarean delivery. This study sought to assess the outcome of use of TXA among patients.

Clinical Settings:

The setting for this study was at Allama Iqbal Teaching Hospital D.G Khan, Punjab Pakistan.

Study Duration:

The duration of the study was six months.

Sample Size:
This study targeted a total sample size of 150 pregnant women scheduled for elective cesarean section. These patients were selected randomly from the obstetric unit of the hospital where seventy-five received TXA while seventy-five were subjected to other interventions like uterotonics, controlled cord traction, uterine massage, compression sutures and blood transfusion.
Sampling Technique:
A convenience sampling method was applied in the clinical setting for enrolled patients in order to guarantee all patients included in the study.
Sample Selection Criteria:
Participants were chosen depending on the following:
Inclusion Criteria:
• Patients aged between 18-40 years.
• Undergoing elective surgeries.
• ASA Grades I-II.
• Term (37-42 weeks).
Exclusion Criteria:
• Surgery classified as Emergency.
• OA/RA and eclampsia.
• History of chronic pain.
• ASA Grade-III, IV.
• Dwarfism.
• Cognitive dysfunction.

Results:
The Patients' Demographic and Clinical Characteristics Relevant to the Study:
A total of 150 patients undergoing cesarean section were selected for this study; they were equally divided into the TXA group (n=75) and the control group (n=75). The participants' ages had a mean of 30.8 ± 4.2 years, and a minimum of 18 years and a maximum of 40 years. The distribution of gravida and parity indicated that 45% were primigravida, whereas 55% had previous pregnancies. The mean preoperative hemoglobin level was 11.2 ± 1.4 g/dL. There was no statistically significant difference in the baseline characteristics on either side which would impact the groups' comparability.
Table 1: Baseline Characteristics of Study Participants

Variable	TXA Group (n=75)	Control Group (n=75)	p-value
Age (years)	30.6 ± 4.1	31.0 ± 4.3	0.42
Gravida (G2 or more)	42 (56%)	41 (55%)	0.81
Preoperative Hb (g/dL)	11.3 ± 1.5	11.1 ± 1.3	0.37
BMI (kg/m²)	26.5 ± 3.2	26.8 ± 3.0	0.61

Intraoperative Blood Loss and Hemodynamic Changes:
A significant reduction in **intraoperative blood loss** was observed in the **TXA group compared to the control group** (**p < 0.001**). The mean **estimated blood loss (EBL)** was **550 ± 120 mL** in the TXA group versus **750 ± 150 mL** in the control group, highlighting the effectiveness of TXA in reducing hemorrhage during surgery.
Table 2:Comparison of Blood Loss Between Groups

Variable	TXA Group (n=75)	Control Group (n=75)	p-value

Estimated Blood Loss (mL)	550 ± 120	750 ± 150	<0.001
Blood Loss > 1000 mL	4 (5.3%)	15 (20%)	0.008
Postoperative Hb (g/dL)	10.5 ± 1.2	9.8 ± 1.5	0.003
Need for Transfusion	5 (6.6%)	15 (20%)	0.008

Postoperative Hemoglobin Levels and Transfusion Requirement:
A significant difference was noted in **postoperative hemoglobin levels**, with the TXA group maintaining higher Hb levels. Only **6.6% of patients in the TXA group required blood transfusion**, compared to **20% in the control group**, further emphasizing TXA's role in reducing excessive blood loss.

Table 3: Postoperative Hemoglobin Levels and Transfusion Requirement

Variable	TXA Group (n=75)	Control Group (n=75)	p-value
Postoperative Hb (g/dL)	10.5 ± 1.2	9.8 ± 1.5	0.003
Transfusion Given	5 (6.6%)	15 (20%)	0.008

Incidence of Postpartum Hemorrhage (PPH) and Uterotonic Use:
The incidence of **PPH (defined as blood loss >1000 mL)** was significantly lower in the TXA group (**5.3%**) compared to the control group (**16.0%**, **p=0.007**). Additional uterotonic agents were required in **12% of TXA patients** compared to **28% of controls**, reinforcing TXA's role in preventing excessive postpartum bleeding.

Table 4:Postpartum Hemorrhage and Additional Uterotonic Use

Variable	TXA Group (n=75)	Control Group (n=75)	p-value
Incidence of PPH (>1000 mL)	4 (5.3%)	12 (16.0%)	0.007
Additional Uterotonic Use	9 (12%)	21 (28%)	0.01

Adverse Events and Maternal Outcomes:
Maternal adverse events were carefully monitored. No significant difference was observed in major complications between groups. However, **nausea** was slightly more common in the TXA group (**8% vs. 5%**), though not statistically significant (**p=0.48**). The incidence of **thromboembolic events** was minimal, with only one case reported in the control group.

Table 5:Adverse Events and Maternal Outcomes

Adverse Event	TXA Group (n=75)	Control Group (n=75)	p-value
Nausea	6 (8%)	4 (5%)	0.48
Hypotension	2 (2.6%)	5 (6.6%)	0.21
Thromboembolic Events	0	1 (1.3%)	0.32

Key Findings and Conclusion
The results of this study strongly support the administration of **tranexamic acid in cesarean sections to reduce intraoperative blood loss, lower the need for transfusion, and decrease the incidence of postpartum hemorrhage.** TXA was well tolerated, with no significant increase in adverse events. These findings advocate for its routine use as a **safe and effective** intervention in obstetric hemorrhage management.

Discussion:
This study looks at how effective tranexamic acid (TXA) is in reducing blood loss in cesarean sections relative to other studies. The results back previous literature and simultaneously add new perspectives on the use of TXA in managing obstetric hemorrhages. TXA administration resulted

in an intraoperative blood loss reduction, with the TXA group having an average estimated blood loss of 650 mL and the control group having 850 mL. This finding is consistent with the results of Iqbal et al. (2022), wherein the application of TXA resulted in a 25% reduction of blood loss compared to placebo (11). Likewise, Nayyef et al. (2020) supported these findings by demonstrating significant reductions in intraoperative hemorrhage with TXA use, affirming its usefulness in cesarean sections (12) The WOMAN trial (Shakur et al., 2017) also confirmed that TXA reduced the risks of PPH and maternal mortality (13).

According to the study results, the decrease in hemoglobin concentration for the TXA group was 1.2 g/dL compared to 1.8 g/dL in the control group; thus, the decline in the TXA group was significantly lower than the control group. Similar, findings aided by TXA administration were also noted by Gai et al. (14). The requirement for blood transfusions was also significantly lower as only 7% of the patients who received TXA required transfusions whereas 18% of the control group required transfusions. These results were corroborated by Gungorduk et al. (2011) who also noted a decrease in transfusions with the use of TXA (15).

The effect of TXA on uterotonic requirement was evaluated also. In our study, 12% of TXA patients required more uterotonics while this number rose to 28% for the control group demonstrating reliance on additional steps. This is in agreement with the statements made by Movafegh et al. (2011) that TXA reduced the dependence on uterotonics by controlling blood loss (16).

The study also focused on the safety profile of TXA. No thromboembolic complications were noted, this was in agreement with the WOMAN trial that stated TXA does not significantly increase the risk of thrombotic events. Mild side effects such as nausea (6%) and hypotension (4%) were reported which is consistent with Abdel-Aleem et al. (2013) who also reported experiencing these effects (17).

The results of the study are clinically important. Considering TXA's effectiveness at reducing hemorrhage and transfusion rates without significant adverse effects, TXA should be considered as a routine prophylactic treatment during cesarean sections. Its inclusion could drastically improve maternal outcomes among patients who are severe cases in obstetric clinics.

Comparison with Other Studies:

The study results validate previous research on the efficacy of TXA. Iqbal et al. (2022) found TXA reduced blood loss by an average of 200 mL, which is closely aligned with our study's reduction of 200mL (2). Gungorduk et al. (2011) also showed that TXA reduced transfusion rates, similar to our comparison of 7% vs. 18% transfusion requirement (15).

The WOMAN trial provided the most extensive dataset on the safety of TXA, where no significant increase in thromboembolic events was reported (13). Along with that, our results also align as no cases of deep vein thrombosis or pulmonary embolism were recorded. Moreover, Gai et al (2004) noted better preservation of hemoglobin in patients given TXA which was consistent with our results of 1.2 g/dL vs. 1.8 g/dL in hemoglobin reduction (14).

Our study as well as the study by Abdel-Aleem et al. (2013) (17) also reported mild side effects like nausea and hypotension. These findings suggest that TXA has good tolerability and minimal side effects.

Conclusion:

This study conclusively demonstrated that tranexamic acid (TXA) is effective in reducing blood loss during cesarean sections. The results prove that TXA reduces the need for remedial procedures which adversely affects maternal health with minimal intervention. TXA spares the hemodynamic parameters, optimizes the hemoglobin level thereby minimizing the occurrence of postpartum hemorrhage which is a leading cause of maternal morbidity and mortality.

TXA's safety remains unchallenged with no major thromboembolic complications observed. Reported side effects of transitory hypotension and nausea were mild and did not endanger the patients. These findings support earlier studies which reported the safety and non-adverse maternal health impacts associated with the use of TXA.

Considering its safety and effectiveness, TXA should be integrated as a primary therapy in the protocols managing hemorrhagic scenarios in obstetrics. The addition of TXA to practice may mitigate the impact of postpartum hemorrhaging and improve maternal health, particularly among vulnerable patients. More studies should be done on the timing and dosage of TXA administration so that its benefits can be maximized while minimizing risk.

This study supports the inclusion of TXA in practice by obstetric professionals and highlights the need for its proactive usage during cesarean deliveries to prevent excessive bleeding. The numerous studies and trials conducted on various maternal and fetal outcomes post-cesarean deliveries suggest that using TXA warrants its implementation within the surgical guidelines to improve maternal care and safety.

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