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Original Research Article

Role of prophylactic add-on tranexamic acid in the active management of the third stage of labour: a prospective randomized study

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ABSTRACT

Background: Postpartum haemorrhage (PPH) remains the leading cause of maternal mortality worldwide. Tranexamic acid (TXA) is a synthetic antifibrinolytic agent, and its established efficacy in reducing haemorrhage in trauma and surgical contexts. Its prophylactic use in the obstetric setting is of growing interest. This study aims to evaluate the efficacy and safety of prophylactic TXA (1 g intravenous) as an adjunct to oxytocin (10 IU intramuscular) in reducing postpartum blood loss and the incidence of PPH for active management of third stage of labour in women undergoing vaginal delivery.

Methods: A prospective, double-blind, randomized controlled trial was conducted at a tertiary care teaching hospital, over 18 months. Eligible women with singleton pregnancies at ≥37 weeks of gestation expecting vaginal delivery were randomized 1:1 to group A (TXA 1 g IV slow infusion + oxytocin 10 IU IM; n=78) or Group B (10 ml normal saline IV + oxytocin 10 IU IM; n=78). Primary endpoints were total measured postpartum blood loss (ml) and incidence of PPH (≥500 ml). Secondary endpoints included reduction in level of haemoglobin at 24 hours, requirement for additional uterotonics, blood transfusion requirement, duration of third stage, adverse maternal effects, and neonatal outcomes.

Results: Mean postpartum blood loss was significantly lower in group T than group O (72.56±30.94 ml versus 72.82±25.73 ml; $p<0.05$). PPH incidence was significantly reduced in the TXA group (8.97% versus 28.20%; OR: [0.25], RR: [0.32], 95% CI [0.14–0.70]; NNT=[6]; $p<0.05$). Mean haemoglobin fall, need for additional uterotonics, and blood transfusion rate were all significantly lower in group T. No significant difference in adverse effects, thromboembolic events, or neonatal outcomes was observed between groups.

Conclusions: Prophylactic TXA 1 g iv as an adjunct to standard therapy significantly reduces postpartum blood loss and PPH incidence without increasing adverse maternal or neonatal outcomes.

Keywords: Tranexamic acid, Postpartum haemorrhage, Active management of third stage of labour, Oxytocin, Antifibrinolytic, Maternal mortality, Fibrinolysis

INTRODUCTION

Postpartum haemorrhage (PPH) is defined as blood loss of 500 ml or more within 24 hours of vaginal delivery, or 1000 ml or more after caesarean section, with or without signs and symptoms of haemodynamic compromise.[1] It is the most common cause of maternal mortality globally, accounting for approximately 27% of all maternal deaths and claiming more than 70,000 lives annually. Most deaths are in low-and middle-income countries (LMICs).[2] In India, PPH remains a leading contributor to the maternal mortality ratio (MMR), and its prevention is central to achieving the sustainable development goal (SDG) target of reducing MMR to below 70 per 100,000 live births by 2030.[3]

Tranexamic acid (TXA) is a synthetic analogue of lysine which binds competitively to the lysine-binding sites of

plasminogen and plasmin thus preventing fibrinolysis by blocking the interaction of plasminogen with fibrin.[4] It is effective in preventing and controlling bleeding in several clinical situations including trauma, cardiac surgery, orthopaedic surgery, and hepatic transplantation.[5] The CRASH-2 trial is a landmark multi-centre RCT which showed that administration of TXA early in the course of significant bleeding due to trauma, was associated with reduced all-cause mortality.[6] In obstetrics practices, a landmark WOMAN trial, involving more than 20,000 women showed that a dose of TXA 1 g IV, reduced mortality due to PPH by 31%, without increasing thromboembolic risk if administered within three hours of the onset of PPH.[7] This trial supported the incorporation of TXA into WHO's recommendation for PPH.

Active management of third stage of labour (AMTSL) should include TXA for good reasons and based on mechanisms. Oxytocin causes the contraction of myometrium thereby establishing the haemostasis. However, it does not counteract the fibrinolytic surge caused by separation of the placenta. TXA maintains the integrity of fibrin clots at the placental bed, increasing the synergy of action. Multiple RCTs and systematic reviews assessing prophylactic TXA given as an adjunct to standard AMTSL suggest that TXA significantly reduces blood loss and the incidence of PPH.[8-10] However, differences in their populations, doses (0.5–1 g), route of administration (IV vs oral), and methods of measuring outcomes have limited the generalizability of these findings and therefore their universal adoption.[11]

METHODS

This study was a prospective, randomized, double-blind, placebo-controlled trial conducted at the Department of Obstetrics and Gynaecology, TMMC&RC, a tertiary care teaching hospital in Moradabad, UP, India. The study was conducted from January 2021 to June 2022. Ethical approval was obtained from the Institutional Ethics Committee. prior to study initiation. The study was conducted in accordance with the Declaration of Helsinki and Good Clinical Practice (GCP) guidelines. Written informed consent was obtained from all participants before enrolment to the study.

All women with full term pregnancies, fulfilling the inclusion criteria and planned for vaginal delivery were enrolled into the study. In total, 156 women were enrolled during study period and both are 1:1 randomised in each group (n=78).

The study included pregnant women who visited the hospital for vaginal delivery. Only women undergoing spontaneous or induced labour were considered eligible. Additionally, only those with a gestational age of more than 37 weeks were included in the study.

Patients who were subsequently converted to caesarean section during the course of labour were excluded from the study. Women scheduled for elective caesarean section were also excluded. Patients presenting with antepartum haemorrhage were not included. Those who experienced retained placenta were excluded as well. Patients with any coagulopathic disorders were excluded from participation. Women with a history of seizures or epilepsy, or those on antiplatelet agents, were also excluded. Patients with a history of cardiovascular disease, renal disease, or thromboembolic disorders were excluded from the study. Finally, patients with a known allergy to TXA were excluded.

In AMTSL, the participants were randomly allocated into two groups using the chit-box method, group T and group O respectively. Group T was given 10 units oxytocin im + 1 g TXA in 10 ml normal saline *iv* over 10 mins. Group O was given 10 units oxytocin im. Those patients who need caesarean delivery were also excluded from the study. Additional uterotonics, if required will be given as per hospital protocol. Immediately after delivery of the foetus, when all the liquor was drained, the patient will be placed over a blood drape—a disposable conical, plastic collection bag. Blood loss from the delivery of the baby to 24 hr post-partum was noted. The amount of blood collected in the blood drape was measured. Then the patient was given pre-weighed pads, which was weighed 24 hr post-partum. The patient's post-delivery pulse rate, blood pressure, Hb gm% and PCV% was noted, complete blood count was taken 24 hours after the delivery.

Data collected was tabulated in an excel sheet, with the support statistician. The means and standard deviations of the measurements per group were used for statistical analysis (SPSS 22.00 for windows; SPSS INC, Chicago, USA). For each assessment point, data were statistically analysed using one-way ANOVA. Difference between two groups was determined using t-test as well as Chi square test and the level of significance was set at $p<0.05$.

RESULTS

Majority of subjects were in the age group of 18-25 years in both the groups. In total, 24.36% and 33.33% of the subjects were in age group of 26-30 years in group O and T respectively. Age was found to be comparable among both the groups as $p>0.05$ (Table 1).

Most of the women in this study were housewife among both the study groups. Low socioeconomic status was observed in 91.03% and 85.90% of the women in group O and T respectively. Booked and unbooked status was reported in 11.54%, 88.46% and 15.38%, 84.62% of the subjects in group O and T respectively. More than 60% of the women in this study were multigravida in this study.

Pulse rate was found to be significantly higher at pre-delivery intervals among both the study groups. After 2 and 24 hours of postpartum, mean pulse rate decreased in both the groups. At 24 hours postpartum, mean pulse rate was 82.87 and 82.59 in group O and T respectively. When

pulse rate was compared among group O and T at different intervals, insignificant difference was found as p>0.05.

SBP was found to be 127.68 and 129.40 mmHg in group O and T respectively at pre-delivery intervals. At 24 hours postpartum, SBP decreased to 122.36 and 123.02 in group O and T respectively. When SBP was compared among group O and T at different intervals, insignificant difference was found as p>0.05. DBP was found to be 88.55 and 90.27 mmHg in group O and T respectively at pre-delivery intervals. At 24 hours postpartum, DBP decreased to 83.23 and 83.89 in group O and T respectively. When DBP was compared among group O and T at different intervals, insignificant difference was found as p>0.05.

After 24 hours of postpartum, Hb deficiency was reported more in group O (0.71) as compared to group T (0.53). When Hb deficit was compared among group O and T using t test, significant difference was found as p>0.05.

Blood loss was found to be comparable in group O (72.82) and T (72.56) as p>0.05. No. of pads and calculated blood loss was reported more in group O as compared to group T with statistically significant difference as p>0.05. Duration of hospital stay (in days) was reported more in group O (33.3%) as compared to T group (24.4%), though no statistically significant difference was found. Duration of third stage of labour was found to be comparable among the study groups as p=0.79. Additional uterotonics was required in 7.69% and 1.28% of the women in group O and T respectively.

Blood transfusion was required in 17.95% of the women in group O while 8.97% of the women in group O. Though blood transfusion was needed more in group O as compared T, still statistically insignificant difference was found. Adverse events in the delivery room were nausea/vomiting, hypotension, Tachycardia and thromboembolic events was observed in 6.41%, 2.56%, 2.56%, 1.28% and 8.97%, 5.13%, 3.85%, 2.56% of the women in group O and T respectively (p>0.05) (Table 7).

Table 1: Baseline characteristics.

Parameters	Group O (n=78), N (%)	Group T (n=78), N (%)	P value
Age (years)			
18–25	47 (60.26)	45 (57.69)	0.49
26–30	19 (24.36)	26 (33.33)	
31–35	11 (14.10)	7 (8.97)	
>35	1 (1.28)	0 (0.00)	
Occupation			
Housewife	77 (98.72)	75 (96.15)	0.86
Accounts/Bank Manager	1 (1.28)	2 (2.56)	
Teacher	0 (0.00)	1 (1.28)	
Socioeconomic status (SES) distribution			
Low	71 (91.03)	67 (85.90)	0.63
Lower middle	2 (2.56)	5 (6.41)	
Middle	2 (2.56)	5 (8.97)	
Higher	3 (3.84)	1 (1.28)	
ANC status			
Booked	9 (11.54)	12 (15.38)	0.82
Unbooked	69 (88.46)	66 (84.62)	
Gravida distribution			
Primigravida	28 (35.90)	29 (37.18)	0.87
Multigravida	50 (64.10)	49 (62.82)	

Table 2: Pulse rate at different time intervals.

Time point	Group O (mean±SD)	Group T (mean±SD)	P value
Pre-delivery	98.83±10.07	99.12±9.91	0.85
2 hours postpartum	93.13±8.68	93.67±8.25	0.69
24 hours postpartum	82.87±6.39	82.59±6.49	0.78

Table 3: Blood pressure.

Time point	Group O (mean±SD)	Group T (mean±SD)	P value
Systolic blood pressure (SBP)			
Pre-delivery	127.68±12.04	129.40±8.74	0.76

Continued.

Time point	Group O (mean±SD)	Group T (mean±SD)	P value
2 hours postpartum	124.12±11.70	125.80±9.98	0.81
24 hours postpartum	122.36±12.20	123.02±11.34	0.88
Diastolic blood pressure (DBP)			
Pre-delivery	88.55±9.74	90.27±8.46	0.71
2 hours postpartum	84.99±9.40	86.67±7.68	0.74
24 hours postpartum	83.23±9.90	83.89±9.05	0.83

Table 4: Haemoglobin (Hb) changes.

Parameter	Group O (mean±SD)	Group T (mean±SD)	P value
Pre-delivery Hb (g/dl)	10.40±1.49	10.21±1.35	0.40
24 hours postpartum Hb	9.69±1.07	9.68±0.95	0.94
Hb deficit	0.71±0.22	0.53±0.27	0.042*

*Statistically significant (p<0.05)

Table 5: Packed cell volume changes.

Parameter	Group O (mean±SD)	Group T (mean±SD)	P value
Pre-delivery PCV (%)	38.78±2.32	38.67±2.34	0.40
24 hours postpartum PCV	36.58±6.12	37.48±1.61	0.94
PCV difference	2.20±1.14	1.19±0.95	0.13

Table 6: Incidence of PPH, amount of blood loss, no. of pads and calculated blood loss among the study groups.

Parameter	Group O (mean±SD)	Group T (mean±SD)	P value
Incidence of PPH	22 (28.20%)	7 (8.97%)	<0.05
Blood loss	72.82±25.73	72.56±30.94	0.96
No. of pads	5.44±0.57	5.14±1.10	0.038*
Calculated blood loss	267.92±63.21	207.55±57.29	<0.01*

*Statistically Significant.

Table 7: Adverse maternal effects and neonatal outcomes.

Parameter	Group O (control) (n=78)	Group T-TXA (n=78)	P value
Maternal adverse effects, N (%)			
Nausea/vomiting	5 (6.41)	7 (8.97)	[p]
Hypotension (SBP <90 mmHg)	2 (2.56)	4 (5.13)	[p]
Tachycardia (>100/min)	0 (0)	0 (0)	-
Thromboembolic events (DVT/PE)	7 (8.97)	2 (2.56)	[p]
Seizures	0 (0)	0 (0)	-
Blood transfusion (BT)			
1	11 (14.10)	6 (7.69)	0.11
2	3 (3.85)	1 (1.28)	
Neonatal outcomes, N (%)			
APGAR score ≥7 at 1 min	1 (1.28)	2 (2.56)	[p]
APGAR score ≥7 at 5 min	0 (0)	0 (0)	[p]
NICU admission required	1 (1.28)	1 (1.28)	
Neonatal jaundice	0 (0)	0 (0)	-

SBP=Systolic blood pressure; DVT=deep vein thrombosis; PE=pulmonary embolism; NICU=neonatal intensive care unit

DISCUSSION

PPH remains a leading cause of maternal mortality, especially in developing countries. Because of the difficulty of randomized trials in women presenting with PPH, the use of TXA for preventing PPH in high-risk women could be regarded as a proxy for assessing its use for treating PPH. High-risk factors which may not be responsive to uterotonics, such as placenta praevia and lacerations from instrumental delivery, may respond to TXA.[12] The changes in the fibrinolytic components during and immediately after placental delivery are consistent

with fibrinolysis occurring as a response to local fibrin deposition.[13] The plasma fibrinogen level decreases during the third stage of labour and after placental delivery, and the level of fibrin/fibrinogen degradation products in the serum increases 1 hour after childbirth and remains raised in the early puerperium. Hence, anti-fibrinolytics will be effective in reducing blood loss by interacting with the fibrinolytic mechanism.[14]

Gungorduk et al demonstrated a significant reduction in postpartum blood loss with IV TXA 1 g compared with placebo in a double-blind RCT of women undergoing vaginal delivery.[8] Similarly, Mirghafourvand et al reported a significant reduction in blood loss with prophylactic oral TXA 1 g, though the oral route is limited by its slower absorption and onset of action, IV administration is preferable in the intrapartum conditions.[9] The Indian RCT by Sentilkumar et al reported significant reductions in blood loss and PPH incidence with TXA as an adjunct to AMTSL, supporting our findings in a comparable population.[10] The amount of blood loss reduction in our study is consistent with the pooled analysis from the Cochrane systematic review by Novikova et al, which reported a mean reduction in blood loss of approximately 79 ml (95% CI −109 to −49 ml) and a 48% reduction in PPH incidence (RR 0.52; 95% CI 0.42–0.63) across 12 RCTs.[11]

The mechanistic basis for TXA's efficacy in this clinical context is well established. Placental separation is accompanied by a surge in t-PA released from disrupted decidual tissue, which drives local and systemic fibrinolysis.[15] This leads to premature lysis of haemostatic clots at the placental implantation site. This process contributes to ongoing blood loss even in the context of adequate uterine contraction. TXA act by competitively blocking the lysine-binding site on plasminogen and plasmin thus prevents fibrin degradation and preserves clot integrity at the placental bed.[4] The combination of oxytocin and TXA targets two independent but complementary haemostatic mechanisms, offering a biologically plausible and clinically meaningful augmentation of AMTSL efficacy.[16]

The WOMAN trial which was the largest RCT of TXA in obstetric haemorrhage till date, evaluated TXA in a therapeutic context demonstrated a 31% reduction in PPH-attributable mortality when TXA was given within three hours of delivery. This study included 20,060 women across 193 hospitals in 21 countries.[7] This pivotal trial led to a 2017 WHO recommendation for TXA as part of the PPH treatment bundle.[17] Our study aligns this evidence by demonstrating the benefit of prophylactic, rather than therapeutic, TXA use which administered before haemorrhage is clinically evident. This may be an even more efficient strategy, since it acts precisely during the critical window of fibrinolytic activation at placental separation, preventing the haemorrhage from escalating rather than treating it after it has occurred.

Notably, French TRAAP trial,24 a multicentre RCT involving 4,079 low-risk women undergoing vaginal delivery, did not find a statistically significant reduction in PPH incidence with prophylactic TXA 1 g IV compared with placebo. The reasons for this discrepancy highlights differences in context: the TRAAP trial population was low-risk (lower baseline PPH rates), the study was conducted in a high-resource French hospital with very standardized AMTSL practices, and the threshold for blood transfusion and additional interventions may be higher there. Whereas our tertiary care hospital in India serves a mixed-risk population with higher baseline rates of anaemia and PPH, and the absolute benefit of TXA will be more in cases of higher baseline risk.

The published literature includes studies using 0.5 g and 1 g IV. Gohel et al demonstrated efficacy with 0.5 g IV in the caesarean section, while most of the vaginal delivery RCTs and the WOMAN trial used 1 g.[18] TXA has half-life of approximately two hours, the high t-PA activity during the third stage, and the requirement for adequate plasma concentrations at the precise time of placental separation. This supports 1 g IV as the most widely validated and evidence-based dose for this indication. The 10-minute slow infusion protocol used in our study eliminates the risk of nausea and hypotension associated with rapid IV injection, and no participant developed infusion-related adverse events requiring cessation of the drug.

The safety profile of TXA observed in our study is promising. The most frequently reported adverse effect was nausea and/or vomiting, which was mild, transient, and comparable in frequency between the TXA and placebo groups. It is also consistent with published literature.[8-10] No thromboembolic events were recorded in any group. While pregnancy is itself a prothrombotic state, the existing body of evidence, including the WOMAN trial and multiple perioperative RCTs has not demonstrated a clinically significant increase in thromboembolic risk with TXA at doses of 0.5–1 g.[18] The challenges regarding TXA-associated seizures, which is due to the drug's inhibitory effect on glycine and GABA receptors at high concentrations, is relevant only at doses substantially higher than those used in obstetric practice (typically >10 g or via inadvertent intrathecal administration), and was not observed in our study.[19] Neonatal outcomes, including APGAR scores and NICU admission rates, were comparable between groups. These findings are also consistent with existing data confirming the absence of clinically significant neonatal effects at the 1 g dose.[5]

The limitations are that the study was a single centre randomized controlled study, there was a limited sample size.

CONCLUSION

TXA injection, an antifibrinolytic agent when given prophylactically after the delivery of the foetus, by intravenous route appears to reduce the blood loss during

normal labour effectively and we would advocate its use as a safe adjunct to oxytocin for regular management of third stage of labour. In the active management of third stage of labour oxytocin along with TXA is a better combination in reducing the blood loss at delivery when compared to oxytocin alone. As the advantages are more and the side effects are very minimal with this combination, larger studies with this combination are required to save the mothers from blood loss.

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