Innovations

Role of Intravenous Tranexamic Acid in Prophylaxis and Treatment of Post Partumhemorrhage

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Abstract

Problem: *Tranexamic acid (TXA) is a heat stable antifibrinolytic, used for the treatment of Postpartum haemorrhage (PPH). Our objective evaluates the efficacy of TXA in preventing PPH in both low and high risk women.* ***Methodology:*** *This observational study with 40 patients each in study and control groups, include term gestation, primigravida, multigravida, multiple pregnancy, placenta previa, abruption placentae, anemia, gestational diabetes, hypothyroidism, polyhydramnios, hypertension complicating pregnancy and other maternal medical disorders. Patients with contraindications to TXA, history of coagulopathy were excluded. TXA 1gm (10ml) in 100ml normal saline was given intravenously over 15minutes prophylactically, 30 minutes before skin incision in cesareansection and at 5 to 6cm cervical dilation in vaginal delivery. In the control group, patients received only AMTSL and if third stage bleeding exceeds 500 ml, therapeutic dose of TXA 1gm given. Amount of bleeding during various intervals were noted. If bleeding continues for more than 30minutes of placental delivery or restarts within 24 hours of first dose, repeat dosage of TXA was given.* ***Findings:*** *Showed statistically significant reduction in intra-partum blood loss (p value-<0.001, chi square value-24.838) and blood loss within 3 hours of placental delivery (p value- <0.001, chi square value-22.792).Requirement of repeat dose of TXA was significantly reduced in study group (p value- <0.001, chi square value -51.330).****Conclusion:*** *Prophylactic administration of TXA helps in reducing both incidence of PPH and the amount of blood loss irrespective of the mode of delivery in both emergency and elective situations among low andhigh risk women effectively.*

Key words: *Post partum haemorrhage, prophylactic intravenous tranexamic acid, therapeutic intravenous tranexamic acid, intrapartum blood loss.*

Introduction

Postpartum hemorrhage (PPH) remains the global leading cause of maternal mortality and morbidity. It is responsible for an estimated 1,40,000 deaths annually and 25% of all pregnancy-related deaths (Say et al., 2014). Post-partum hemorrhage (PPH) is defined as estimated blood loss of more than 500ml after a vaginal birth or 1,000ml after a cesarean section or any blood loss sufficient to compromise hemodynamic instability. The PPH is categorized as either primary or secondary. Primary occurs in the first 24 hours after delivery (early PPH) which is more common and secondary PPH occurs 24 hours to 12 weeks after delivery (late or delayed PPH) (WHO, 2012).

The World Health Organization (WHO) recommends prophylactic uterotonics such as oxytocin to prevent PPH (WHO, 2012; Mavrides et al., 2016), as uterine atony is the most common cause (Geller et al., 2018; Knight et al., 2021). There are several risk factors for PPH, including prolonged labor, multiple pregnancies, previous history of PPH, certain medical conditions such as hypertension and placenta previa, use of forceps or vacuum-assisted birth, and general anesthesia. If left untreated, PPH can lead to severe complications such as shock and even death (Oyelese and Ananth, 2010; Sentilhes et al., 2016; Evensen and Fontaine, 2017). However, PPH is unpredictable and majority of cases occur in the absence of risk factors (WHO, 2012). Main causes of PPH are represented by 4Ts like tone (uterine atonicity) 70%, tissue (retained placental tissue or membranes) 20%, trauma (genital tract trauma, uterine rupture) 10%, and thrombin (maternal coagulation disorder) <1%.

Conservative management of PPH includes uterotonics, uterine massage, bimanual uterine compression, aortic compression. In case of refractory PPH uterine balloon tamponade, surgical compression sutures, step wise devascularisation, uterine artery embolization and hysterectomy can be done. Uterotonicsalone might not effectively prevent PPH secondary to other causes (Oyelese and Ananth, 2010; Evenson and Fontaine, 2017)Management of haemorrhage after CS may range from administration of oxytocics and blood transfusion to more radical measures such as hysterectomy (Munn et al., 2011; Hofmeyr et al., 2005). Following there sults from the World Maternal Antifibrinolytic Trial (WOMAN Trial Collaborators, 2017) the WHO has recommended the use of Tranexamic acid (TXA) for the treatment of PPH (WHO, 2017).

TXA is a heat stable antifibrinolytic that has been proven to reduce blood loss and transfusion requirements for various non-obstetric and obstetric elective surgeries in several patient populations (Shaaban et al., 206; Topsoee et al., 2016; Ker et al., 2012; CRAS-2 trial collaborators et al., 2010). TXA, a synthetic derivative derived from lysine, functions by competitively obstructing the binding sites for lysine on plasminogen. Plasminogen possesses five TXA binding sites, with one

having a notably strong affinity and the remaining four exhibiting lower affinity (Grassin et al., 2018).After fetal delivery, TXA arrests bleeding by inhibiting the fibrinolytic system that is activated during placental separation, especially if used early (WOMAN Trial Collaborators, 2017, Gayet et al., 2018).The mother's blood becomes increasinglyprothrombotic in pregnancy (Hellgren, 2003).

Levels ofclot-forming proteins like fibrinogen and coagulation factor VII increase, whereas the activity of fibrinoly ticproteins is reducedbecauseofhigherlevelsofinhibitors.Theplacentaitselfreleases potent inhibitors of fibrinolysis (plasminogen activator inhibitors 1 and 2). Blood levels peak at themoment of birth, falling away rapidly after place ntalseparation (Kruithof et al., 1987).The Royal College of Obstetricians and Gynecologists currently recommends the use of prophylactic TXA only in women at high risk for PPH undergoing caesarean section (CS) (Knight et al., 2021).TRAAP 1 and 2 studies suggested the use of TXA for treatment of PPH to reduce itsrate in vaginal deliveries and cesarean sections respectively, in adjunct to prophylactic oxytocin (Sentilhes et al., 2018; Sentilhes et al., 2021).However, there is limited evidence for definitive recommend dations of prophylactic TXA use in womenofall risk profiles undergoing vaginal deliveries and Cesarean Section (Alam and Choi, 2015; Sentilhes et al., 2015).Thus this study aimed to evaluate the efficacy of Tranexamic acid in preventing Post partumhae morrhage in both low risk and high risk women.

Materials and Methods

This is an Observational study and cross-sectional study, where 40 patients in study group and 40 patients in control group were included. The patient admitted in a tertiary care teaching hospital at Tiruchirappalli during the study period satisfying inclusion criteria were recruited during the period of four months from March to June 2024.

The patients with term gestation, primigravida, multigravida, multiple pregnancy, placentaprevia, abruption, anaemia, gestational diabetes, hypothyroidism, polyhydramnios, hypertension complicating pregnancy and other maternal medical disorders were included. Contraindications to TXA like a known thromboembolic event during pregnancy, history of coagulopathy were excluded.

After obtaining written consent, all patients satisfying inclusion criteria admitted for delivery were included in this study. Detailed history, clinical examination and relevant pre-operative investigations were done. In addition to active management of third stage of labour (AMTSL), all patients in the study group received tranexamic acid 1gm(10ml) in 100ml normal saline intravenously infusion over 15minutes prophylactically, 30 minutes before skin incision in caesarean section and at 5 to 6cm cervical dilation in vaginal delivery. The amount

of bleeding during intrapartum period (immediately up to placental delivery)was assessed.

In case of post-partum haemorrhage, a second dose of 1 gram given intravenously if bleeding continues after 30 minutes of placental delivery or restarts within 24 hours of first dose. The amount of blood loss from placental delivery up to 3 hours was noted (from 3 hours to 24 hours). In the control group, patients will receive only AMTSL as per protocol. If the third stage bleeding exceeds 500 ml and PPH suspected, therapeutic dose of tranexemic acid 1gram was given. The amount of bleeding was noted at similar intervals. Subsequent doses of tranexamic acid given if bleeding persists. Dry and soaked mops and sheets were weighed by a sensitive weighing machine. Blood loss from soaked mops and sheets in case of CS and soaked diapers in case of vaginal delivery was calculated using the formula used by Gai et al.

Blood from mops and sheets = (weight of soaked material - weight of dry material) ÷ 1.05, where 1.05 is the specific gravity of blood at 37˚C.

Amniotic fluid in the suction apparatus was emptied and blood collected immediately after the delivery of placenta was also included to estimate intrapartum blood loss. In the post-partum period, patients were observed clinically and vitals were monitored to identify any excessive bleeding per vaginum. Weight of soaked diapers was noted. Routine care was given and the patients were observed till discharge for secondary post-partum haemorrhage.

Results

In this study, maximum patients are between the age group of 21 and 30 and the age distribution in both groups was similar. More than 50% of the patients were second gravidae and the parity distribution among the groups was relatively similar. The number of patients on study and control groups included for labour induction was 19 and 15 respectively.Difference in mode of delivery in both groups did not have any statistical significance (Table 1).

While analyzing the maternal risk factors among the groups, multiple pregnancy observed top among study groups (57%); whereas in control groups hypothyroidism dominated (62.5%). The other detailed distribution of maternal risk factors among study and control groups was depicted in figure 1. Interstingly, similar type of fetal risk factors observed among study and control groups and having a slight increase noted are macrosomia (55.6%) followed by IUGR (52.9%).

The blood loss in both groups was estimated thereby the study group had lesser than the control group. In study group, 80% of the patients had below 500ml blood loss whereas in control group, 67.5% and 7.5% of patients had 501 to

1000ml and 1001 to 1500ml of blood loss respectively. The difference in proportion was statistically significant with chi square value was 24.838 and p value was<0.001. The detailed description about the blood loss, its volume and duration were tabulated (Table 2).

The response of tranexamic acid on postpartum haemorrhage was assessed and the detailed responses were depicted in table 3. The PPH was significantly reduced in the studygroup (chi square value – 49.371 and p value- <0.001). Prophylactically, the tranexamic acid is very effective as no PPH observed among 30 patients whereas in control group, 24, 10 and 6 patients had atonic PPH, traumatic PPH and retained products respectively (Table 3). The number of repeated dosage of tranexamic acid was significantly reduced in study group(chi square value- 51.330 and p value- < 0.001).

Effect of tranexamic acid on high risk factors of PPH

Abruption: In study group 75% had intrapartum blood loss less than 500ml and only 25% had upto 500ml as against the control group with 0% <500ml, 50% upto 1000ml and 50% 1000ml -1500ml respectively.However the results did not show any statistical significance.

Placenta previa: In study group had significant decreased blood loss after placental delivery till 3 hours compared to other group with p value-0.029 according to Fischer's exact test.

Multiple pregnancy: The study group had statistically significant reduction in intrapartum blood loss with p value-0.047 by Pearson-Chi square test.

Anemia: The study group had statistically significant decreased intrapartum blood loss and blood loss within 3 hours after placental delivery compared to control group (p value-0.039 & 0.021 respectively) by Pearson-Chi square test.

Gestational Diabetes: Comparing both groups, the study group had reduced intrapartum blood loss and reduced blood loss within 3 hours.The difference in proportion is statistically significant with p value-0.003 and 0.013 respectively by Pearson-Chi square test.

Polyhydramnios: In study group, patients with polyhydramnios had significantly reduced blood loss within 3 hours compared to control group with Pearson's Chi square value-4.800 and p value-0.028 and the difference in proportion was statistically significant.

Hypertension complicating pregnancy: The study group had significant decreased blood loss within 3 hours compared to control group with p value-0.029 according to Fischer's exact test.

Macrosomia: In study group, patients who delivered macrosomic baby had statistically significant reduced intrapartum blood loss compared to other group with p value-0.016 by Pearson-Chi square test.

Discussion

In the study group, 80% had intrapartum blood loss of <500ml and 20% had 500 to 1000ml and 0% had 1000 to 1500ml compared to 25%,67.5% and 7.5% respectively. The study with intravenous administration of 10 mg/kg of tranexamic acid 20 min before skin incision at caesarean delivery showed mean blood loss significantly less in the tranexamic acid group compared with the control group for both intra-operative bleeding (262.5±39.6vs.404.7±94.4ml) and post-operative bleeding (67.1±6.5 vs. 141.0±33.9 ml;p 0.001), respectively (Movafegh et al., 2011).The results were consistent with this study.

Asimilar study in Chinaby administer ingtranexamic acid 10 minutes beforeskin incision revealed theinterventionledtolessbleeding2 hours post-operatively, 42.75 ± 40.45 ml in the study groupversus 73.98 ± 77.09 ml in the control group (p = 0.001)but did not show any decrease in post-placental delivery blood loss (Gai et al., 2004).In the present study, we have included both vaginal delivery and cesarean section and we have administered the drug 30 minutes before skin incision in cesarean section and at 5-6 cm cervical dilatation in vaginal delivery and the results showed less bleeding both intrapartum and post partum.

A prospective randomized studyon 90 primiparam others which showed that tranexamic acid significantly reduced blood loss from theend of caesarean section to 2hours post-partum 28.02±5.53 ml blood loss in the tranexamic group versus 37.12 ± 8.97 ml in the control group (p = 0.000). These results were comparable to our study although they studiedonly primipara, whereas our study included all pregnant women irrespective of parity (Sekhavat et al., 2009).

In a triple random groups, Group T1 (n=30) received 10mg/kg TXA in 20 ml of 5% dextrose intravenously, while T2 group (n=30) received 15mg/kg. Group C (n=30) received a placebo. Mean total blood loss was 527.17±88.666 ml, 376.83±31.961ml and 261.17±56.777 ml in group C, T1, and T2 respectively. Hence, TXA was found to be effective in reducing blood loss and transfusion in anemicparturients undergoing LSCS. 15mg/kg dose of TXA was more efficacious than the 10mg/kg dose and without any undue increase in adverse events. The results were consistent with this study. The study group had statistically significant decreased intrapartum blood loss and blood loss within 3 hours after placental

delivery compared to other group (p value-0.039 & 0.021 respectively) by Pearson-Chi square test. According to WHO data by May 2023, the incidence of anemia among pregnant women was 37%. So in already anaemic women, due to physiological changes both intrapartum and postpartum, even a slightly excessive bleeding may jeopardize her well being (Upasana et al., 2023).

In a systematic review and meta-analysis with 25 articles with 4747 participants, the findings indicated TA resulted in a reduced intra-, postoperative, and total blood loss by a mean volume of 141.25 ml (95% confidence interval [CI] -186.72 to -95.79, P < 0.00001), 36.42 ml (95% CI -46.50 to -26.34, P < 0.00001), and 154.25 ml (95% CI -182.04 to -126.47, P < 0.00001) in CS. TXA administration in vaginal delivery was associated with a reduced intra-, postoperative, and total blood loss by a mean volume of 22.88 ml (95% CI -50.54 to 4.77, P = 0.10), 41.24 ml (95% CI -55.50 to -26.98, P < 0.00001), and 84.79 ml (95% CI -109.93 to -59.65, P < 0.00001) (Chunbo et al., 2017).In addition, TXA could lower the occurrence rate of postpartum hemorrhage (PPH) and severe PPH, and reduce the risk of blood transfusions. Findings indicated that prophylactic intravenous TXA for patients undergoing CS was effective and safe and the results were consistent with our study.

Another study revealed that TXA administration significantly reduced hemoglobin decrease by more than 10%: there was a 35.4% decrease in the TXA group vs. a 59.4% decrease in the non-TXA group, p < 0.0001 and hemoglobin decreased by ≥2 g/dL (11.4% in the TXA group vs. 25.2% in non-TXA group, p < 0.0001), reduced packed red blood cell transfusion (p = 0.0174), and resulted in lower ICU admission rates (p = 0.034) and shorter hospitalization (p < 0.0001). They concluded prophylactic TXA administration during high-risk CS may effectively reduce blood loss, providing a potential intervention to improve maternal outcomes (Yair et al., 2023).

In a randomized controlled study, it was concluded that there was significant reduction in blood loss calculated from placental delivery till end of surgery: 347.17ml in study group versus 517.72ml in control group (p<0.001) and the results were consistent with this study (Dhivya et al., 2016).

Similar baseline socio demographic characteristics in two groups concluded routine prophylactic use of TXA during cesarean section in high-risk women may be encouraged due to following results in their study. The tranexamic acid group when compared to the placebo group showed significantly lower mean blood loss (442.94 ± 200.97 versus 801.28 ± 258.68 ml; p = 0.001), higher mean postoperative hemoglobin (10.39 + 0.96 versus 9.67 ± 0.86 g/dL; p = 0.001), lower incidence of postpartum hemorrhage (1.0% versus 19.0%; p = 0.001), and lower need for use of additional uterotonic agents after routine management of the

third stage of labor (39.0% versus 68.0%; p = 0.001), respectively (Kelvin et al., 2024).

A similar comparable study showed the mean age was similar in 2 groups. Intra-operative mean blood loss was 729.31±172.45 ml in intravenous oxytocin group and 464.86±28.00 ml in intravenous tranexamic acid group. A total of 74.3% women in group 1 and 20% women in group 2 developed postpartum hemorrhage (Monika et al., 2022).It was concluded that tranexamic acid used prophylactically intravenously before skin incision in patients undergoing cesarean section for placenta previa significantly reduces intra-operative blood loss.

Conclusion

From this study we conclude AMTSL along with prophylactic administration of tranexamic acid 1gm intra-venously helps in reducing incidence of intra-partum blood loss and post-partum blood loss significantly. This outcome has been observed irrespective of the mode of delivery. This can be utilized both in high and low risk women irrespective of elective or emergency deliveries.

Limitations

The demographic characteristics among study and control group were almost similar. In both the groups AMTSL was also done along with TXA hence the outcome cannot be completely attributed to the sole efficacy of TXA. Our study was conducted in a small population, which may also be a limitation for the study.

Conflicts of Interest: Nil

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Table 1: Demographic characteristics of study population

Variables	Study Group	Control Group	Remarks
Age in years			
18-20	7 (17.5)	7 (17.5)	Age distribution in both groups were similar
21-25	10 (25)	10 (25)	
26-30	13 (32.5)	13 (32.5)	
31-35	5 (12.5)	5 (12.5)	
≥ 36	5 (12.5)	5 (12.5)	
Parity			
Primigravida	11 (27.5)	10 (25)	Parity distribution among both groups were almost similar
Second gravida	23 (57.5)	20 (50)	
Third gravida	6 (15)	9 (22.5)	
Grand multi	0	1 (2.5)	
Induction of Labour			
No	21 (52.5)	25 (62.5)	Number of patients induced in both groups were almost similar
Yes	19 (47.5)	15 (37.5)	
Mode of delivery			
Vaginal delivery	14 (35)	19 (47.5)	Difference in mode of delivery in both groups; thus no statistical significance
Instrumental delivery	7 (17.5)	7 (17.5)	
Cesarean section	19 (47.5)	14 (35)	

[Figure in parenthesis denoted percentages]

Table 2: Estimation of blood loss in both the groups

Variables	Study Group	Control Group	Remarks
Intrapartum blood loss			
Upto 500 ml	32 (80)	10(25)	Difference in proportion is statistically significant with chi square value - 24.838 and p value - <0.001
501ml -1000ml	8 (20)	27(67.5)	
1001ml – 1500ml	0	3 (7.5)	
After 30 minutes upto 3 hours			
<500ml	37 (92.5)	17 (42.5)	Difference in proportion is statistically significant with chi
>500ml	3 (7.5)	23 (57.5)	

			square value - 22.792 and p value - <0.001
Within 24 hours			
<500ml	40 (100)	36 (90)	Difference in proportion is statistically significant to chi square value-4.211 and p value-<0.04
>500ml	0	4 (10)	

[Figure in parenthesis denoted percentages]

Table 3: Causes of PPH and number of doses of TXA

Variables	Study Group	Control Group
Cause of PPH		
No PPH	30 (75)	0
Atonic PPH	6 (15)	24 (60)
Traumatic PPH	4 (10)	10 (25)
Retained products	0	6 (40)
Number of doses		
1 dose	40 (100)	0
2 doses	4 (10)	33 (82.5)
3 doses	0	3 (7.5)

[Figure in parenthesis denoted percentages]

Figure 1: Distribution of maternal risk factors on study population

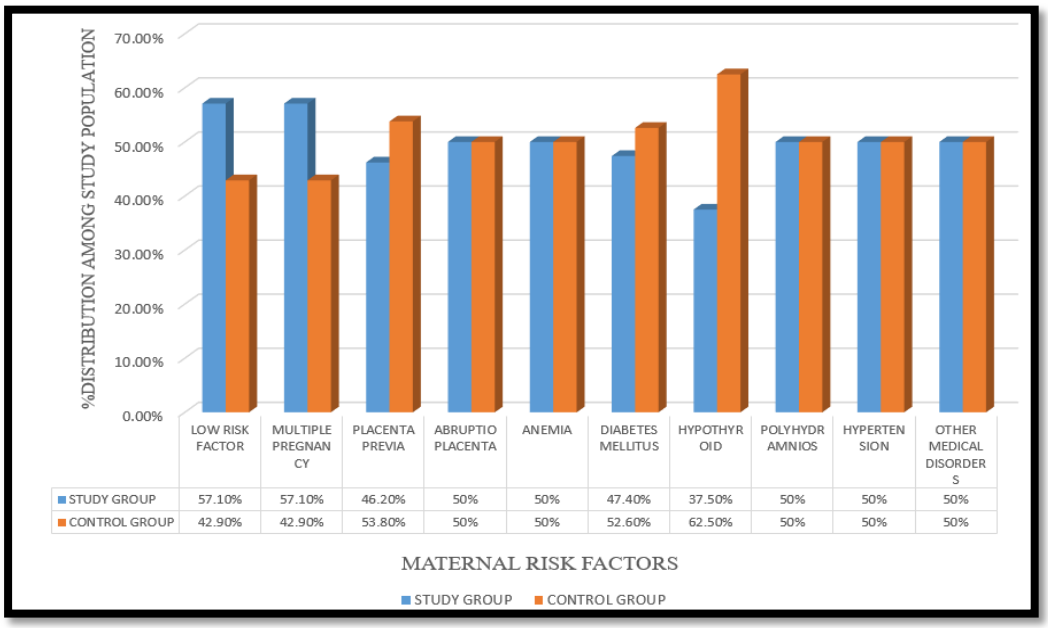

Figure 2: Distribution of fetal risk factors on study population