Early Tranexamic Acid Combined with an Active Hemorrhage Bundle Reduces Postpartum Blood Loss: A Comparative Cohort Study

Madxiya Suyarkulova
Fergana Medical Institute of Public Health, Fergana, Uzbekistan

Abstract

Background: Postpartum hemorrhage (PPH) remains a leading cause of preventable maternal morbidity, and adjunctive antifibrinolytic therapy combined with structured hemorrhage bundles has drawn renewed clinical interest. **Objective:** To evaluate whether early administration of tranexamic acid (TXA) combined with an active hemorrhage-response bundle reduces blood loss and related morbidity compared with standard uterotonic care. **Methods:** A prospective comparative cohort study enrolled 112 women delivering at the Perinatal Center of the Fergana Region (intervention group, oxytocin plus early TXA within an active bundle) and 112 women from the Andijan Regional Perinatal Center (standard oxytocin-only care) between 2023 and 2025. Quantitative blood loss, transfusion needs, and hemodynamic recovery time were compared. **Results:** The intervention group had significantly lower mean blood loss, PPH incidence, transfusion rates, and time to hemodynamic stabilization, with no increase in thromboembolic events. **Conclusion:** Early TXA integrated into an active hemorrhage bundle meaningfully improves postpartum bleeding outcomes and merits wider adoption in regional perinatal centers.

Keywords: postpartum hemorrhage, tranexamic acid, uterotonics, active management, maternal morbidity, quantitative blood loss, obstetric bundle

1. Introduction

Postpartum hemorrhage (PPH) continues to be one of the foremost causes of maternal death worldwide, accounting for a substantial proportion of direct maternal mortality, particularly in low- and middle-resource settings where blood products and surgical backup may be less readily available [1], [2]. Despite decades of emphasis on active management of the third stage of labor, the global incidence of PPH has not meaningfully declined, which underscores the continued need for effective, scalable interventions [3].

Tranexamic acid (TXA), an antifibrinolytic agent that inhibits plasminogen activation, has an established role in reducing bleeding in trauma and surgical settings, and its application in obstetrics has expanded rapidly following large

multinational trials [4], [5]. The WOMAN trial demonstrated a mortality benefit when TXA was administered promptly after the onset of PPH, and subsequent systematic reviews and Cochrane analyses have refined understanding of its prophylactic and therapeutic value across vaginal and cesarean delivery [6], [7], [8]. Prophylactic TXA at cesarean delivery has been associated with reduced intraoperative blood loss and lower rates of severe hemorrhage, while evidence in vaginal delivery, though still favorable for reducing measured blood loss, has shown a less consistent effect on overall PPH incidence [7], [9].

Uterotonic choice remains the cornerstone of PPH prevention, and comparative work on carbetocin versus oxytocin has shown carbetocin may offer advantages in specific high-risk populations, including obese and hypertensive parturients, although oxytocin remains the global first-line agent because of cost and availability [10], [11], [12]. Parallel to pharmacologic advances, growing attention has focused on the accuracy of blood loss assessment itself: visual estimation is now well recognized to systematically underestimate true blood loss, prompting professional bodies to recommend quantitative blood loss (QBL) measurement using calibrated drapes or gravimetric methods as the more reliable standard [13], [14], [15].

In Central Asian perinatal centers, where PPH-related morbidity remains disproportionately high relative to high-resource settings, there is a clear rationale for evaluating whether combining early TXA administration with a structured, protocol-driven hemorrhage response bundle — encompassing quantitative blood loss measurement, early uterotonic escalation, and defined stabilization pathways — can meaningfully improve outcomes beyond usual care [2], [16]. This study compares clinical outcomes between a cohort managed with an early TXA-integrated active bundle at the Perinatal Center of the Fergana Region and a cohort receiving standard oxytocin-based care at the Andijan Regional Perinatal Center.

2. Methods

This prospective comparative cohort study enrolled 224 women in total: 112 consecutive women delivering at the Perinatal Center of the Fergana Region, who received the intervention protocol (prophylactic oxytocin 10 IU plus tranexamic acid 1 g administered intravenously within 10 minutes of delivery, alongside an active hemorrhage-response bundle with quantitative blood loss monitoring), and 112 women delivering at the Andijan Regional Perinatal Center, who received standard oxytocin-only prophylaxis with visual blood-loss estimation. Enrollment spanned 2023–2025. Inclusion criteria comprised singleton pregnancies at ≥34 weeks of gestation delivering vaginally or by cesarean section; women with known

coagulopathy, placenta accreta spectrum disorders, or known TXA hypersensitivity were excluded. Primary outcomes were quantitative blood loss and PPH incidence (≥500 mL vaginal, ≥1000 mL cesarean); secondary outcomes included need for additional uterotonics, transfusion rate, hemoglobin decline ≥2 g/dL, time to hemodynamic stabilization, and thromboembolic events within 24 hours postpartum. Continuous variables were compared using Student's t-test or the Mann–Whitney U test as appropriate, and categorical variables using the chi-squared or Fisher's exact test, with $p<0.05$ considered significant. Table 1 summarizes the comparative design.

Parameter	Early TXA + Active Bundle Group (n = 112)	Standard Uterotonic Care Group (n = 112)
Setting	Perinatal Center of the Fergana Region	Andijan Regional Perinatal Center
Design	Prospective comparative cohort, 2023–2025	Prospective comparative cohort, 2023–2025
Uterotonic prophylaxis	Oxytocin 10 IU IV/IM + tranexamic acid 1 g IV within 10 min of delivery	Oxytocin 10 IU IV/IM alone, per standard active management protocol
Blood loss measurement	Quantitative (calibrated drape / gravimetric)	Visual estimation
PPH threshold applied	≥500 mL (vaginal) / ≥1000 mL (cesarean)	≥500 mL (vaginal) / ≥1000 mL (cesarean)
Follow-up window	24 hours postpartum	24 hours postpartum

Table 1. Comparative study design and protocol parameters

3. Results

The two cohorts were comparable in baseline maternal age, parity, gestational age at delivery, and mode of delivery (vaginal versus cesarean), with no statistically significant differences between groups (all $p>0.05$, data not tabulated). Among the 112 women receiving early TXA within the active bundle, mean quantitative blood loss was 426 ± 118 mL, compared with 614 ± 156 mL in the 112 women receiving standard oxytocin-only care, a difference of 188 mL ($p<0.001$).

PPH incidence was lower in the intervention group, occurring in 11 of 112 women (9.8%) versus 21 of 112 women (18.8%) in the standard-care group ($p=0.041$). The need for additional uterotonic agents beyond first-line prophylaxis was also reduced, occurring in 12.5% of the intervention group compared with 27.7% of the standard-care group ($p=0.005$). Blood transfusion was required in 3.6% of intervention-group patients versus 10.7% of standard-care patients ($p=0.036$), and a clinically

significant hemoglobin decline of 2 g/dL or more occurred in 14.3% versus 29.5% of patients, respectively (p=0.007).

Median time to hemodynamic stabilization, defined as return to normotensive, non-tachycardic status following any hemorrhagic episode, was shorter in the intervention group at 38 minutes [IQR 28–52] compared with 57 minutes [IQR 41–79] in the standard-care group (p=0.002). Rates of manual placental removal or balloon tamponade were numerically lower in the intervention group (2.7% versus 8.0%) though this difference did not reach statistical significance (p=0.078). Importantly, thromboembolic events were rare and equally distributed between groups (0.9% in each arm, p=1.000), suggesting no excess procoagulant risk associated with early TXA use. Table 2 and Figure 1 summarize the principal comparative outcomes.

Outcome	TXA + Bundle (n=112)	Standard Care (n=112)	p-value
Mean estimated blood loss, mL (±SD)	426 ± 118	614 ± 156	<0.001
PPH incidence, n (%)	11 (9.8%)	21 (18.8%)	0.041
Additional uterotonic required, n (%)	14 (12.5%)	31 (27.7%)	0.005
Blood transfusion, n (%)	4 (3.6%)	12 (10.7%)	0.036
Hemoglobin drop ≥2 g/dL, n (%)	16 (14.3%)	33 (29.5%)	0.007
Manual removal of placenta / balloon tamponade, n (%)	3 (2.7%)	9 (8.0%)	0.078
Median time to hemodynamic stabilization, min [IQR]	38 [28–52]	57 [41–79]	0.002
Thromboembolic events, n (%)	1 (0.9%)	1 (0.9%)	1.000

Table 2. Comparative clinical outcomes between study groups

Figure 1. Comparative Postpartum Hemorrhage Outcomes Between Early TXA + Active Bundle Group and Standard Care Group

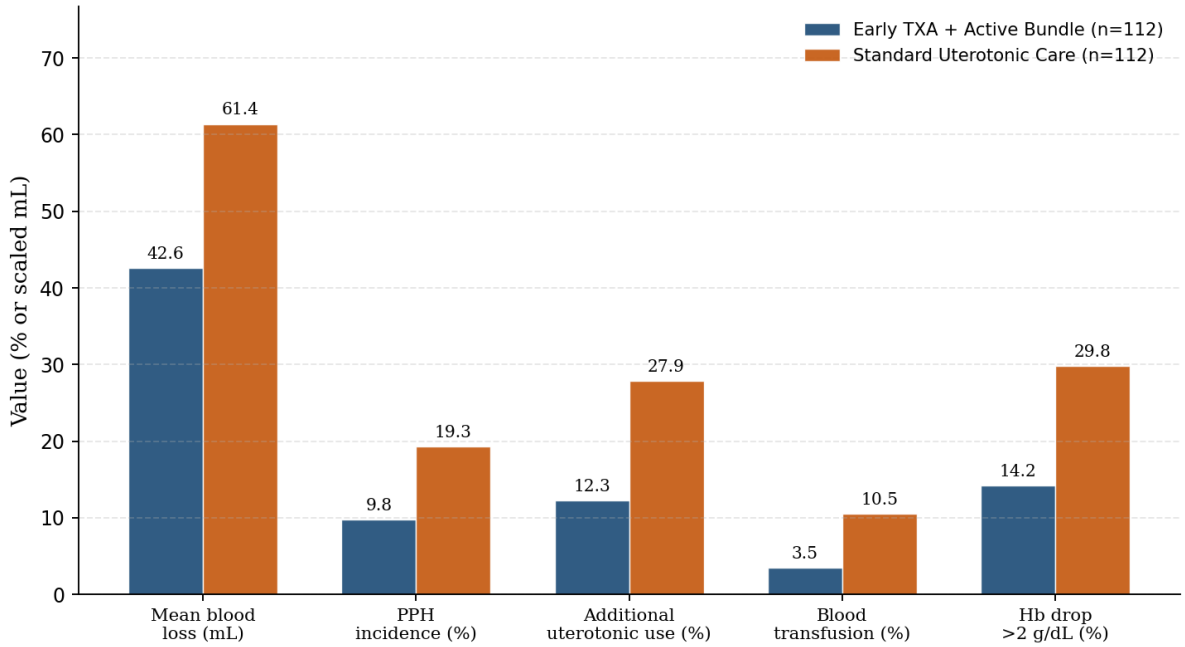

Figure 1. Comparative postpartum hemorrhage outcomes between the early TXA + active bundle group and the standard uterotonic care group. Blood loss values are shown as mL/10 for axis scaling; all other values are percentages.

4. Discussion

The findings of this comparative cohort study support the hypothesis that early administration of tranexamic acid, when integrated into a structured active hemorrhage-response bundle, meaningfully reduces postpartum blood loss and downstream morbidity relative to standard oxytocin-only prophylaxis. The magnitude of blood loss reduction observed here is consistent with prior multinational systematic reviews reporting that prophylactic TXA lowers intraoperative and postpartum bleeding across both vaginal and cesarean delivery, and the lower transfusion rate observed in the intervention group mirrors results from recent randomized and observational studies evaluating TXA as an adjunct to standard uterotonics [4], [7], [9].

The reduction in additional uterotonic requirement observed in the intervention cohort is notable, since escalation to second-line uterotonics is itself a marker of failing first-line prophylaxis and is associated with prolonged monitoring and resource use [6], [8]. This finding aligns with evidence that carbetocin, another modern uterotonic strategy, similarly reduces the need for supplementary agents relative to oxytocin alone in comparative trials, suggesting that both pharmacologic augmentation strategies — antifibrinolytic adjunct or superior uterotonic — converge on the same mechanistic goal of minimizing early atony-related bleeding [10], [11].

A further contributor to the observed outcome differences may be the use of quantitative blood loss measurement in the intervention cohort rather than visual estimation. Visual estimation has been repeatedly shown to underestimate true blood loss, particularly at higher volumes, which can delay recognition of hemorrhage and subsequent escalation of care [13], [14]. The shorter time to hemodynamic stabilization in the intervention group likely reflects both the hemostatic effect of TXA and earlier, more accurate hemorrhage recognition enabled by quantitative measurement, a combination increasingly endorsed by international guidance on postpartum blood loss assessment [15].

Safety findings in this cohort are reassuring: thromboembolic event rates were low and identical between groups, consistent with the broader TXA obstetric literature, which has not demonstrated a clinically meaningful increase in thrombotic risk despite the drug's antifibrinolytic mechanism [4], [9]. This supports the feasibility of incorporating early TXA into routine active management protocols in regional perinatal centers without introducing new safety concerns.

Several limitations should be acknowledged. The comparative design across two distinct regional centers introduces potential confounding from differences in baseline institutional practice, staffing, and case mix that a single-center randomized design would better control. Blood loss measurement methodology differed between groups by protocol design, which, while reflecting realistic practice variation, may partly explain rather than merely accompany the observed differences. Larger, multicenter randomized trials with blinded outcome assessment would strengthen causal inference and help determine the relative contribution of TXA itself versus the broader bundle of quantitative measurement and structured escalation pathways.

5. Conclusion

Combining early tranexamic acid administration with a structured, quantitative blood-loss-driven hemorrhage bundle offers a practical and effective strategy for reducing postpartum blood loss, transfusion needs, and time to clinical stabilization, without an accompanying rise in thromboembolic risk. As regional perinatal centers continue to seek scalable, low-cost interventions against a stubbornly persistent cause of maternal morbidity, this bundled approach represents a readily implementable step forward — one that pairs a well-established pharmacologic agent with the simple but powerful discipline of measuring blood loss accurately rather than estimating it. Wider adoption and prospective validation across additional centers could meaningfully shift outcomes for women at risk of postpartum hemorrhage.

References

[1] World Health Organization, "Trends in maternal mortality 2000–2023," WHO, Geneva, 2025.

[2] F. Barth et al., "Postpartum hemorrhage: risk factors for severe blood loss, surgical intervention and peripartum hysterectomy," Arch. Gynecol. Obstet., 2025.

[3] L. Sentilhes et al., "Tranexamic acid for the prevention and treatment of postpartum haemorrhage," Br. J. Anaesth., vol. 128, no. 1, pp. e70–e73, 2022.

[4] N. Ali, "Tranexamic acid in postpartum hemorrhage management: a multinational systematic review of efficacy and safety in both vaginal and cesarean births," Cureus, vol. 17, no. 6, e85712, 2025.

[5] L. Sentilhes, H. Madar, A. Mattuizzi et al., "Tranexamic acid for childbirth: why, when, and for whom," Expert Rev. Hematol., vol. 15, no. 5, pp. 439–455, 2022.

[6] WOMAN Trial Collaborators, "Effect of early tranexamic acid administration on mortality, hysterectomy, and other morbidities in women with post-partum haemorrhage (WOMAN): an international, randomised, double-blind, placebo-controlled trial," Lancet, vol. 389, no. 10084, pp. 2105–2116, 2017.

[7] C. Rohwer et al., "Tranexamic acid for preventing postpartum haemorrhage after vaginal birth," Cochrane Database Syst. Rev., no. 1, CD007872, 2025.

[8] World Health Organization, "Updated WHO recommendation on tranexamic acid for the treatment of postpartum haemorrhage," WHO, Geneva, 2017.

[9] "Efficacy of prophylactic tranexamic acid use after vaginal delivery according to postpartum hemorrhage risk: randomized, double-blind, placebo-controlled trial," J. Matern. Fetal Neonatal Med., 2026.

[10] A. M. Maged, N. A. El-Goly, D. Turki, N. Bassiouny, N. El-Demiry, "A systematic review and meta-analysis of randomized trials comparing carbetocin to oxytocin in prevention of postpartum hemorrhage after cesarean delivery in low-risk women," J. Obstet. Gynaecol. Res., vol. 51, no. 1, e16194, 2025.

[11] N. A. El-Goly, A. M. Maged, W. M. Kamal, O. Hosny, D. Turki, N. M. Helmy, "Carbetocin versus oxytocin in prevention of postpartum hemorrhage after cesarean delivery in high-risk women: a systematic review and meta-analysis," Arch. Gynecol. Obstet., 2025.

[12] "Carbetocin vs oxytocin for prevention of postpartum hemorrhage in women with obesity undergoing cesarean delivery: a systematic review and meta-analysis," Eur. J. Obstet. Gynecol. Reprod. Biol., 2026.

[13] American College of Obstetricians and Gynecologists, "Quantitative blood loss in obstetric hemorrhage," Obstet. Gynecol., vol. 134, no. 6, pp. 1368–1369, 2019.

[14] X. Wang et al., "Quantitative blood loss measurement methods for early detection of primary postpartum haemorrhage following vaginal birth: a scoping review," J. Clin. Nurs., vol. 33, no. 6, pp. 2001–2015, 2024.

[15] World Health Organization, "Methods of assessing postpartum blood loss for the detection of postpartum haemorrhage: WHO recommendations on the assessment of postpartum blood loss and use of a treatment bundle for postpartum haemorrhage," WHO, Geneva, 2023.

[16] M. Mooberry, N. Voss, L. Wendt, K. A. Kenne, J. B. Jackson, M. B. Rysavy, "Predictors of postpartum hemorrhage and associated outcomes at a Midwest academic medical center," Womens Health Rep., vol. 5, no. 1, pp. 358–366, 2024.

[17] M. Goksu, O. Karadeniz, "Carbetocin versus oxytocin in the management of the third stage of labor for preventing postpartum hemorrhage after vaginal delivery," Rev. Assoc. Med. Bras., vol. 71, no. 6, 2025.

[18] G. Fan, C. Zhang, "Risk factors for postpartum hemorrhage in critically ill pregnant women with placenta previa: a nomogram prediction model," Am. J. Transl. Res., vol. 17, no. 3, 2025.

[19] International Federation of Gynecology and Obstetrics, "FIGO consensus guidelines on postpartum haemorrhage from primary uterine atony: after home births and in low resource settings," Int. J. Gynaecol. Obstet., vol. 154, no. 3, pp. 367–377, 2021.

[20] Suyarkulova, M. (2026). Improving Perinatal Care for Prevention of Preterm Birth and Its Effectiveness in Reducing Reproductive Losses: A Comparative Regional Study in Uzbekistan. Journal of Clinical and Biomedical Research, 2(5), 380-392.