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POSTPARTUM HEMORRHAGE: CURRENT APPROACHES TO TREATMENT AND THE ROLE OF TRANEXAMIC ACID

Abstract

Postpartum hemorrhage remains one of the leading causes of maternal morbidity and mortality worldwide. Despite advances in obstetric care, adverse outcomes are largely attributable to delayed recognition of blood loss, delays in initiating treatment, and inadequate coordination of medical interventions. This article aims to summarize current approaches to the diagnosis and treatment of postpartum hemorrhage, analyze the evidence supporting the use of tranexamic acid, and define its role in current clinical guidelines. A narrative review of international guidelines, randomized controlled trials, and systematic reviews addressing the management of postpartum hemorrhage was conducted. The review examined recommendations issued by the World Health Organization (2023, 2025) and the International Federation of Gynecology and Obstetrics (2022), findings from the WOMAN, E-MOTIVE, WOMAN-2, and TRAAP trials, and a systematic review with an individual patient data meta-analysis of randomized trials published in 2024. Current principles of objective blood loss assessment, early recognition of hemodynamic instability, administration of uterotonics, fluid and transfusion support, and invasive hemostatic interventions are discussed. Particular attention is given to the antifibrinolytic mechanism of action of tranexamic acid, the optimal timing of administration, its efficacy, and safety. The WOMAN trial demonstrated a reduction in bleeding-related mortality with early

administration of the drug, while the 2024 meta-analysis showed a reduced risk of life-threatening bleeding. However, the WOMAN-2 and TRAAP trials did not demonstrate the efficacy of routine prophylactic administration of tranexamic acid in the populations studied. It is concluded that early administration of tranexamic acid as part of comprehensive postpartum hemorrhage management is of considerable clinical importance, whereas its prophylactic use requires strict adherence to current recommendations.

Keywords: postpartum hemorrhage, tranexamic acid, maternal mortality, hemostasis, fibrinolysis, uterotonics, evidence-based medicine, obstetric complications.

Problem statement. Postpartum hemorrhage (PPH) is one of the most serious complications of childbirth and a major cause of maternal mortality worldwide. According to the World Health Organization (WHO), a substantial proportion of maternal deaths are attributable to causes that can be prevented through timely recognition of complications and the provision of appropriate medical care [1, 2]. PPH may occur following vaginal delivery or cesarean section and can rapidly lead to hemodynamic instability, coagulopathy, multiple organ failure, and the need for intensive care.

Traditionally, primary PPH has been defined as blood loss of 500 mL or more within the first 24 hours after childbirth. However, current guidelines emphasize that assessment should consider not only the volume of blood loss but also clinical signs of hypovolemia and changes in the woman’s condition. According to the WHO consolidated guidelines published in 2025, early detection of PPH involves responding to objectively measured blood loss of 300 mL or more accompanied by an abnormal hemodynamic sign, or blood loss of 500 mL or more regardless of whether such signs are present [1]. This approach makes it possible to initiate intervention before severe hypotension or other late manifestations of hemorrhagic shock develop.

The challenge of PPH lies not only in the rapidity of blood loss but also in the difficulty of identifying its underlying cause in a timely manner. Uterine atony, traumatic injuries to the birth canal, retained placental tissue, and coagulation disorders may occur independently or in combination. Consequently, effective management requires diagnostic and therapeutic interventions to be undertaken concurrently, together with readiness to escalate care promptly when necessary [1, 3].

Current strategies for managing PPH involve a combination of objective blood loss assessment, early pharmacological treatment, fluid and transfusion support, and the timely use of mechanical and surgical interventions. Tranexamic acid, an antifibrinolytic agent, plays a particularly important role in this approach. Its efficacy in reducing bleeding-related mortality has been demonstrated in a large international randomized controlled trial [5].

The relevance of this topic stems from the need to synthesize findings from recent studies, distinguish between therapeutic and prophylactic use of tranexamic acid, and define its role in the comprehensive management of women with postpartum hemorrhage.

Analysis of recent research and publications. Current approaches to the management of postpartum hemorrhage (PPH) are based on recommendations issued by the World Health Organization (WHO), the International Federation of Gynecology and Obstetrics (FIGO), the American College of Obstetricians and Gynecologists (ACOG), and the Royal College of Obstetricians and Gynaecologists (RCOG) [1–3, 10, 11]. The 2022 FIGO recommendations emphasize the importance of administering tranexamic acid promptly after the diagnosis of PPH, as well as addressing the underlying cause of bleeding and maintaining hemodynamic stability [3]. In 2023, the WHO separately recommended objective assessment of postpartum blood loss and the implementation of a standardized first-response treatment bundle [4]. In 2025, these approaches were incorporated into the consolidated WHO guidelines for the prevention, diagnosis, and treatment of PPH [1].

An important source of evidence supporting early treatment was the international WOMAN randomized controlled trial, published in 2017. The trial demonstrated a reduction in bleeding-related mortality among women receiving tranexamic acid, particularly when the drug was administered within the first three hours after childbirth [5]. These findings provided the basis for including tranexamic acid in international recommendations for the treatment of PPH.

In 2023, the results of the E-MOTIVE cluster-randomized trial, which investigated the early detection and treatment of PPH, were published in *The New England Journal of Medicine*. The study showed that combining objective blood loss measurement with a standardized first-response treatment bundle substantially reduced the risk of severe bleeding, laparotomy, or death due to bleeding [6]. These findings indicate that treatment effectiveness depends not only on the choice of a specific medication but also on the timeliness and coordination of all components of care.

In 2024, Ker and colleagues published a systematic review and individual patient data meta-analysis of randomized controlled trials involving 54,404 women. The findings demonstrated that tranexamic acid reduced the risk of life-threatening bleeding without a statistically significant increase in thromboembolic events [7]. However, findings from studies investigating prophylactic administration, particularly WOMAN-2 and TRAAP, indicate that the efficacy of tranexamic acid cannot automatically be extrapolated from the treatment of established hemorrhage to routine prophylaxis in all women giving birth [8, 9].

Current literature supports the need for comprehensive PPH management and provides evidence for the early administration of tranexamic acid when bleeding occurs. Nevertheless, important questions remain regarding the optimization of diagnostic algorithms, the timeliness of treatment, and the identification of clinical situations in which prophylactic antifibrinolytic therapy may provide additional benefits.

Purpose of the article. To summarize current approaches to the diagnosis and comprehensive management of postpartum hemorrhage, analyze clinical trial findings regarding the efficacy and safety of tranexamic acid, and define its role in current clinical guidelines.

Presentation of the main material of the study. Early recognition of hemorrhage is one of the key determinants of successful treatment. Visual estimation of blood loss frequently leads to underestimation, particularly when blood accumulates rapidly, mixes with amniotic fluid, or is absorbed by materials used during delivery. Therefore, current guidelines recommend objective measurement of blood loss using calibrated collection devices after vaginal delivery or appropriate quantitative assessment methods during cesarean section [1, 4].

In 2025, the WHO recommended using a blood loss threshold of 300 mL or more accompanied by an abnormal hemodynamic sign, or blood loss of 500 mL or more regardless of whether such signs are present, within the first 24 hours after childbirth for the early detection of PPH [1]. Hemodynamic criteria include tachycardia, decreased blood pressure, and an elevated shock index. However, these indicators must be interpreted in the context of the woman’s overall clinical condition. The absence of marked hypotension does not exclude significant blood loss, as compensatory mechanisms may maintain blood pressure for some time.

The “4 Ts” approach is used to identify the underlying cause of hemorrhage: *Tone* - impaired uterine tone; *Trauma* - trauma to the birth canal; *Tissue* - retained placental tissue; and *Thrombin* - coagulation disorders [3, 10–12]. Uterine atony is the most common cause of PPH; however, several mechanisms may occur simultaneously in an individual patient. Therefore, examination of the birth canal and assessment of uterine contraction and placental tissue should be performed concurrently with the initiation of treatment.

The E-MOTIVE trial confirmed that standardized objective measurement of blood loss combined with a first-response treatment bundle improves clinical outcomes [6].

The trial involved 80 hospitals across four African countries. The primary composite outcome - severe PPH, laparotomy for bleeding, or death due to bleeding -occurred in 1.6% of patients in the intervention group and 4.3% in the usual-care group. These findings highlight the importance of early hemorrhage recognition and coordinated implementation of treatment measures [6].

Current PPH management involves the simultaneous implementation of complementary interventions. The WHO recommends a standardized first-response treatment bundle that includes uterine massage, administration of a uterotonic agent, intravenous tranexamic acid, intravenous fluid therapy, examination of the birth canal, and timely escalation of treatment when necessary [1, 4].

In cases of uterine atony, the initial priority is to restore effective uterine contraction, which helps compress the blood vessels at the placental bed and reduce blood loss. Intravenous oxytocin is recommended by the WHO as the first-line medication for treating PPH. If oxytocin is ineffective or unavailable, other uterotonic agents may be used according to the clinical circumstances, contraindications, and applicable protocols [1, 3, 10]. It is important to recognize that uterotonics do not treat traumatic injuries to the birth canal, retained placental tissue, or coagulopathy. Therefore, treatment must also address the specific underlying cause of hemorrhage.

In cases of substantial blood loss, venous access must be established, hemodynamic status assessed, intravenous fluid therapy initiated, and blood components prepared when indicated. The WHO recommends isotonic crystalloid solutions for initial intravenous resuscitation [1]. The volume of fluid administered should be guided by the severity of blood loss and the patient’s clinical response, ensuring that fluid administration does not delay necessary transfusion support.

In patients with severe or prolonged hemorrhage, it is important to monitor hemoglobin levels, platelet count, prothrombin time, activated partial thromboplastin time, and fibrinogen concentration. Hypofibrinogenemia may accompany massive

obstetric hemorrhage and requires timely detection and correction in accordance with local protocols [3, 10, 11].

If pharmacological interventions fail to control the bleeding, mechanical or surgical hemostasis should be initiated without delay. Depending on the cause and severity of hemorrhage, available options include uterine balloon tamponade, compression sutures, vessel ligation, uterine artery embolization, or hysterectomy [3, 10, 11, 14]. The choice of method depends on the clinical circumstances, available resources, and the experience of the healthcare team. Waiting for additional medications to take effect should not delay necessary surgical intervention.

Tranexamic acid is a synthetic antifibrinolytic agent that inhibits the interaction of plasminogen with fibrin and reduces the breakdown of an established blood clot. Unlike uterotonics, it does not stimulate uterine contractions but promotes the stabilization of fibrin clots. Thus, its action complements other therapeutic interventions but does not replace control of the bleeding source, restoration of circulation, or surgical hemostasis [3, 5].

The pathophysiological rationale for using tranexamic acid is based on the potential increase in fibrinolytic activity during severe hemorrhage, which contributes to the breakdown of formed blood clots. Inhibition of this process helps stabilize the hemostatic clot. However, the drug does not correct uterine atony, remove retained placental tissue, or mechanically close a damaged blood vessel. Therefore, tranexamic acid is used as part of comprehensive PPH management.

An important milestone in evaluating the efficacy of tranexamic acid was the international, randomized, double-blind, placebo-controlled WOMAN trial, the results of which were published in 2017 [5]. The study included 20,060 women with postpartum hemorrhage following vaginal delivery or cesarean section. Participants were randomized to receive tranexamic acid or placebo in addition to standard care.

In the overall study population, death due to bleeding occurred in 155 of 10,036 women (1.5%) in the tranexamic acid group and 191 of 9,985 women (1.9%) in the

placebo group. The relative risk was 0.81 (95% confidence interval [CI], 0.65–1.00; p = 0.045), corresponding to an approximately 19% relative reduction in the risk of death due to bleeding [5].

The findings of the analysis according to the timing of drug administration were particularly important. Among women who received tranexamic acid within the first three hours after childbirth, death due to bleeding

In 2024, Ker and colleagues published a systematic review and individual patient data meta-analysis of randomized controlled trials investigating the use of tranexamic acid to reduce postpartum bleeding in *The Lancet* [7]. The analysis included data from 54,404 women across five trials. The primary outcomes were life-threatening bleeding and thromboembolic events.

Life-threatening bleeding occurred in 178 of 27,300 women (0.65%) in the tranexamic acid group and 230 of 27,093 women (0.85%) in the placebo group. The pooled odds ratio was 0.77 (95% CI, 0.63–0.93; p=0.008), indicating a statistically significant reduction in the risk of life-threatening bleeding [7].

Thromboembolic events were rare, occurring in 50 of 26,571 women (0.2%) in the tranexamic acid group and 52 of 26,373 women (0.2%) in the placebo group. No statistically significant difference was found between the groups (OR, 0.96; 95% CI, 0.65–1.41; p = 0.82) [7]. However, the absence of a statistically significant difference does not imply that the risk is completely absent in all clinical situations.

The authors did not recommend administering tranexamic acid to all women during childbirth but noted that its use before a formal diagnosis of PPH may be considered in women at high risk of death [7]. This conclusion should be interpreted alongside current WHO recommendations, which do not support routine prophylactic administration of tranexamic acid during vaginal birth [1].

A fundamental distinction must be made between treating established PPH and administering tranexamic acid prophylactically after childbirth. The WOMAN-2 trial evaluated the efficacy of prophylactic tranexamic acid in women with moderate or

severe anemia following vaginal delivery [8]. More than 15,000 participants were enrolled and randomized to receive either tranexamic acid or placebo. Clinically diagnosed PPH occurred in 530 of 7,579 women (7.0%) in the tranexamic acid group and 497 of 7,487 women (6.6%) in the placebo group. The relative risk was 1.05 (95% CI, 0.94–1.19), indicating no statistically significant reduction in the risk of PPH [8].

The TRAAP trial investigated the prophylactic administration of 1 g of tranexamic acid after vaginal delivery in addition to prophylactic oxytocin [9]. Blood loss of at least 500 mL occurred in 8.1% of women in the tranexamic acid group and 9.8% in the placebo group. The difference was not statistically significant (RR, 0.83; 95% CI, 0.68–1.01; p=0.07) [9].

The WOMAN-2 and TRAAP findings indicate that the benefits of tranexamic acid demonstrated in the treatment of PPH cannot automatically be extrapolated to its routine prophylactic administration in all women after childbirth. The WHO consolidated guidelines published in 2025 do not recommend routine prophylactic use of tranexamic acid during vaginal birth [1]. This position is based on the lack of convincing evidence of additional clinical benefit compared with standard preventive measures and the inability to completely exclude potential thromboembolic risks.

According to WHO and FIGO recommendations, tranexamic acid should be administered as early as possible after the clinical diagnosis of PPH, but no later than three hours after childbirth [1, 3]. The recommended regimen is 1 g administered intravenously over approximately 10 minutes. If bleeding continues after 30 minutes or recurs within 24 hours of the initial dose, a second 1 g intravenous dose may be administered in accordance with clinical guidelines [3, 5].

The timing of administration is critical: treatment should not be delayed until all other interventions have been completed or laboratory results become available. At the same time, administration of tranexamic acid must not delay uterotonic therapy, circulatory resuscitation, or surgical hemostasis when indicated [1, 3].

The WOMAN trial and the 2024 meta-analysis did not demonstrate a statistically significant increase in the incidence of thromboembolic events in the tranexamic acid groups [5, 7]. Nevertheless, contraindications, comorbidities, the risk of thrombotic complications, and the prescribing information for the specific medicinal product must be considered before administration. Drug safety should be assessed in the context of the individual clinical situation, as the absence of a statistically significant difference in large trials does not guarantee zero risk for every patient.

Further reductions in maternal morbidity and mortality require not only access to effective medications but also improvements in the organization of obstetric care. Priority measures include implementing objective blood loss measurement, standardized early-response algorithms, regular staff training, ensuring the availability of uterotonics and tranexamic acid, providing timely transfusion support, and maintaining readiness to perform surgical hemostasis when necessary [1, 4, 6].

Assessing the effectiveness of implementing recommendations in routine clinical practice is also essential. Even when evidence-based protocols are available, outcomes may remain unsatisfactory if diagnosis is delayed, medications are unavailable, or coordination among team members is inadequate. Therefore, a modern model of care should combine clinical interventions with organizational measures designed to minimize delays at every stage of management.

Further research should clarify the optimal strategies for using antifibrinolytic therapy in specific high-risk populations, evaluate its effects on different clinical endpoints, and identify the most effective ways to integrate tranexamic acid into comprehensive treatment algorithms. Particular attention should be paid to distinguishing the indications for therapeutic and prophylactic use of the drug to ensure that clinical decisions are consistent with the available evidence.

Conclusions. Postpartum hemorrhage remains an obstetric emergency, and successful management depends on early diagnosis, rapid identification of the

underlying cause, and the comprehensive use of pharmacological, fluid and transfusion support, and surgical interventions.

Tranexamic acid is an important component of postpartum hemorrhage management. Its early administration, preferably within the first three hours after childbirth, helps reduce the risk of death due to bleeding. However, the drug does not replace uterotonic therapy or other necessary therapeutic interventions.

Thus, optimizing the management of postpartum hemorrhage requires the timely administration of tranexamic acid when bleeding occurs, the implementation of standardized response algorithms, and improvements in the organization of obstetric care. Routine prophylactic administration of tranexamic acid during vaginal birth is not recommended.

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