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ROLE OF ANTIFIBRINOLYTIC THERAPY IN GYNECOLOGIC SURGERY: TRANEXAMIC ACID FOR REDUCING PERIOPERATIVE BLOOD LOSS

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ABSTRACT

Perioperative hemorrhage remains an important clinical concern in gynecologic surgery, including hysterectomy, myomectomy, cesarean delivery, and oncologic procedures, as excessive blood loss may contribute to postoperative anemia, transfusion requirements, reoperation, prolonged hospitalization, and increased perioperative morbidity. Tranexamic acid (TXA) is a synthetic antifibrinolytic agent that reversibly binds to plasminogen and inhibits its conversion to plasmin, thereby reducing fibrin degradation and stabilizing formed clots. This review evaluates current evidence regarding the pharmacological properties, dosing strategies, efficacy, and safety profile of TXA in gynecologic surgical practice. Available randomized controlled trials and meta-analyses indicate that prophylactic administration of TXA, most commonly as a 1 g intravenous dose before surgical incision, significantly reduces intraoperative and postoperative blood loss across several gynecologic procedures. In benign hysterectomy, a large randomized controlled trial involving 332 patients demonstrated that intravenous TXA significantly decreased mean blood loss compared with placebo and reduced the incidence of bleeding exceeding 500 mL, as well as the need for reoperation due to postoperative hemorrhage. Evidence from myomectomy studies similarly suggests a clinically relevant reduction in perioperative blood loss, with meta-analytic data showing an average decrease of approximately 213 mL. In cesarean delivery, pooled data from randomized trials have shown that prophylactic TXA reduces total blood loss, transfusion rates, hemoglobin decline, and the need for additional uterotonic agents in both low- and high-risk patients. Comparable benefits have also been reported in selected gynecologic oncology procedures and after cervical conization. Importantly, across available studies, standard perioperative doses of TXA have not been associated with a significant increase in thromboembolic complications, although careful patient selection remains necessary, particularly in individuals with active thromboembolic disease or severe renal impairment. Overall, current evidence supports TXA as an effective, safe, and cost-efficient adjunct for reducing perioperative bleeding and transfusion requirements in gynecologic surgery. Future research should focus on defining optimal dosing and timing protocols for specific surgical subgroups, including extensive oncologic debulking procedures and complex endometriosis surgery, as well as evaluating long-term safety outcomes.

KEYWORDS

Tranexamic Acid; Antifibrinolytic Therapy; Gynecologic Surgery; Perioperative Blood Loss; Perioperative Hemorrhage; Blood Transfusion; Hysterectomy; Myomectomy

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Introduction

Gynecologic surgery encompasses a wide spectrum of procedures, ranging from minimally invasive interventions to extensive abdominal operations performed for benign and malignant conditions. Procedures such as hysterectomy, myomectomy, cesarean delivery, and cytoreductive surgery for gynecologic malignancies may be associated with considerable intraoperative and postoperative blood loss (Kietpeerakool et al., 2016; Topsoee et al., 2016; Zakhari et al., 2020). Excessive perioperative hemorrhage remains a clinically relevant problem, as it may lead to acute postoperative anemia, increased transfusion requirements, hemodynamic instability, prolonged hospitalization, reoperation, delayed recovery, and higher overall perioperative morbidity (Franchini & Mannucci, 2020; Heyns et al., 2021; Zakhari et al., 2020). In oncologic surgery, major blood loss may additionally complicate postoperative management and delay the initiation of adjuvant therapy. Therefore, effective strategies aimed at reducing surgical bleeding are an important component of modern perioperative care in gynecology (Kietpeerakool et al., 2016; Zakhari et al., 2020).

Hemostasis during surgery depends on a complex balance between coagulation activation and fibrinolysis. Although clot formation is essential for controlling vascular injury, premature fibrin degradation may impair clot stability and contribute to continued bleeding. Antifibrinolytic therapy has therefore gained increasing attention as an adjunctive approach to perioperative blood conservation. Tranexamic acid (TXA) is

a synthetic lysine analogue that exerts its hemostatic effect by competitively inhibiting the binding of plasminogen to fibrin. This mechanism prevents the conversion of plasminogen to plasmin on the fibrin surface and reduces enzymatic degradation of fibrin clots. Unlike procoagulant agents, TXA does not directly activate the coagulation cascade; rather, it stabilizes already formed clots and counteracts excessive fibrinolysis (Chauncey & Patel, 2026; Franchini & Mannucci, 2020). This pharmacological profile explains its broad use in clinical situations characterized by increased bleeding risk, including trauma, orthopedic surgery, cardiac surgery, obstetric hemorrhage, and increasingly, gynecologic surgery (Franchini & Mannucci, 2020; WOMAN Trial Collaborators, 2017; Zakhari et al., 2020).

During the last decade, growing evidence from randomized controlled trials, systematic reviews, and meta-analyses has supported the potential role of TXA in reducing blood loss across different gynecologic and obstetric procedures. Its use has been investigated both as prophylactic therapy, administered before or during surgery to prevent excessive bleeding, and as therapeutic intervention in the setting of active hemorrhage (Abu-Zaid et al., 2022; Bellos & Pergialiotis, 2022; WOMAN Trial Collaborators, 2017; Zakhari et al., 2020). In gynecologic practice, TXA has been studied in benign hysterectomy, myomectomy, cervical conization, cesarean delivery, and selected oncologic procedures, with most protocols using intravenous administration before surgical incision or at the beginning of the operation (Albayrak Denizli et al., 2023; Fusca et al., 2019; Kietpeerakool et al., 2016; Topsoee et al., 2016). The clinical relevance of TXA is related not only to its ability to reduce measured blood loss, but also to its potential impact on transfusion rates, postoperative hemoglobin decline, reoperation for hemorrhage, and recovery outcomes (Bellos & Pergialiotis, 2022; Simonazzi et al., 2016; Zakhari et al., 2020).

Despite encouraging evidence, the implementation of TXA in gynecologic surgery requires careful consideration of procedure-specific bleeding risk, patient-related thromboembolic risk factors, renal function, timing of administration, and dosing regimen. Standard perioperative doses appear to be well tolerated in most patients, and available data have not demonstrated a significant increase in thromboembolic complications when TXA is used appropriately (Franchini & Mannucci, 2020; Pacheco et al., 2023; Zakhari et al., 2020). Nevertheless, concerns regarding rare adverse events, including thromboembolism, seizures at high doses, and drug accumulation in renal impairment, highlight the need for individualized clinical decision-making (Chauncey & Patel, 2026; Franchini & Mannucci, 2020). A critical evaluation of the current literature is therefore necessary to define the role of antifibrinolytic therapy in gynecologic surgery and to determine how TXA can be integrated safely and effectively into perioperative bleeding-management protocols (Franchini & Mannucci, 2020; Heyns et al., 2021; Zakhari et al., 2020).

Methodology

This study was designed as a structured narrative review of the current literature concerning the role of tranexamic acid in reducing perioperative blood loss in gynecologic surgery. The review was conducted using major biomedical databases, including PubMed/MEDLINE, the Cochrane Library, and Google Scholar.. The search strategy was developed to identify both procedure-specific and general perioperative evidence on antifibrinolytic therapy. The following keywords and combinations of terms were used: “tranexamic acid,” “TXA,” “antifibrinolytic therapy,” “gynecologic surgery,” “hysterectomy,” “myomectomy,” “cesarean section,” “cervical conization,” “endometriosis surgery,” “gynecologic oncology,” “ovarian cancer surgery,” “blood loss,” “perioperative hemorrhage,” “postoperative bleeding,” “blood transfusion,” “hemoglobin decline,” “randomized controlled trial,” “systematic review,” and “meta-analysis.” Boolean operators such as AND and OR were applied to combine search terms and improve the sensitivity of the search.

Eligible publications included randomized controlled trials, systematic reviews, meta-analyses, Cochrane reviews, observational studies of clinical relevance, and practice guidelines addressing the use of TXA in gynecologic or obstetric surgical procedures. Studies were considered relevant if they evaluated TXA administered prophylactically or therapeutically in the perioperative setting and reported at least one clinically important outcome, such as intraoperative blood loss, total perioperative blood loss, postoperative bleeding, need for blood transfusion, hemoglobin decrease, reoperation for hemorrhage, length of hospital stay, or adverse events.

Publications were excluded if they were not available in English, did not involve human subjects, focused exclusively on non-surgical gynecologic bleeding, or did not provide clinically relevant outcome data. Articles concerning TXA use in trauma, orthopedic surgery, cardiac surgery, or general surgery were not included as primary evidence, although selected data from these fields were considered when discussing the pharmacological mechanism, general safety profile, and broader clinical context of antifibrinolytic therapy.

Case reports and small case series were not prioritized, but they were reviewed when evidence for specific gynecologic indications was limited.

Because of methodological heterogeneity among the available studies, including differences in surgical technique, baseline bleeding risk, TXA dosing protocols, and outcome definitions, a formal meta-analysis was not performed. Instead, the review provides a critical synthesis of the available evidence, emphasizing the strength of data, limitations of existing studies, and areas requiring further investigation.

Pharmacology and Mechanism of Action

TXA is a synthetic derivative of the amino acid lysine and belongs to the class of antifibrinolytic agents. Its hemostatic effect results primarily from reversible binding to lysine-binding sites on plasminogen, which prevents plasminogen from attaching to fibrin and subsequently limits its conversion to plasmin. Since plasmin is the principal enzyme responsible for fibrin degradation, inhibition of this pathway reduces fibrinolysis and promotes stabilization of already formed fibrin clots. Importantly, TXA does not directly activate the coagulation cascade and should not be regarded as a procoagulant drug in the strict sense. Rather, it acts by preserving clot integrity in situations where excessive fibrinolytic activity may contribute to ongoing surgical bleeding (Chauncey & Patel, 2026; Franchini & Mannucci, 2020).

In the perioperative setting, TXA is most commonly administered intravenously because this route provides rapid systemic availability and allows predictable onset of action. In surgical practice, a frequently used regimen consists of a 1 g intravenous bolus, or alternatively a weight-based dose of approximately 10–15 mg/kg, administered before skin incision or at the beginning of the procedure. This timing is intended to ensure adequate plasma concentrations during the period of greatest intraoperative bleeding risk (Chauncey & Patel, 2026). After intravenous administration, therapeutic plasma concentrations are achieved rapidly, and the elimination half-life is approximately 2–3 hours. TXA undergoes minimal hepatic metabolism and is predominantly eliminated unchanged by the kidneys, with approximately 95% excreted in the urine. For this reason, dose adjustment is recommended in patients with significant renal impairment in order to reduce the risk of drug accumulation and potential adverse effects (Chauncey & Patel, 2026; Yang et al., 2023).

Although intravenous administration remains the standard approach in operative gynecology, alternative routes of TXA delivery have also been explored. Topical administration, including application directly into the surgical field or uterine cavity, has theoretical advantages related to local hemostatic activity and reduced systemic exposure; however, high-quality evidence supporting its routine use in gynecologic surgery remains limited. Oral TXA is well established in the treatment of heavy menstrual bleeding, where it is commonly prescribed during menstruation, and some clinical protocols have evaluated short postoperative oral courses to reduce delayed bleeding after procedures such as cervical conization. Nevertheless, in the operating room, intravenous TXA is generally preferred because of its immediate onset, reliable bioavailability, and ease of integration into anesthetic and surgical protocols (Albayrak Denizli et al., 2023; Chauncey & Patel, 2026).

In gynecologic surgery, the pharmacological rationale for TXA use is particularly relevant in procedures associated with high vascularity or extensive tissue dissection, such as myomectomy, hysterectomy, cesarean delivery, and cytoreductive surgery for gynecologic malignancies. By limiting fibrin breakdown during the perioperative period, TXA may reduce intraoperative blood loss, postoperative hemorrhage, transfusion requirements, and the need for reoperation due to bleeding (Abu-Zaid et al., 2022; Shaaban et al., 2016; Yang et al., 2023; Zakhari et al., 2020). Current perioperative and enhanced recovery pathways increasingly recognize TXA as a potential blood-conservation strategy in selected patients, especially when substantial blood loss is anticipated. However, its use should remain individualized, taking into account the type of surgery, baseline bleeding risk, renal function, history of thromboembolic disease, and other patient-specific contraindications (Cai et al., 2020; Ockerman et al., 2021; Zakhari et al., 2020).

Indications and Efficacy of Tranexamic Acid in Gynecologic Procedures

The efficacy of tranexamic acid in gynecologic surgery has been evaluated across a range of procedures associated with variable degrees of perioperative bleeding risk. The strongest evidence is available for hysterectomy, myomectomy, cesarean delivery, and selected cervical procedures, whereas data regarding extensive oncologic surgery, endometriosis surgery, and other complex pelvic operations remain more limited. Overall, available studies suggest that TXA may be particularly beneficial in procedures characterized by high vascularity, extensive tissue dissection, or an increased baseline probability of clinically relevant hemorrhage (Abu-Zaid et al., 2022; Yang et al., 2023; Zakhari et al., 2020).

Hysterectomy is one of the best-studied gynecologic procedures in relation to prophylactic TXA use. In benign hysterectomy, including abdominal, laparoscopic, and vaginal approaches, perioperative administration of TXA has been associated with a significant reduction in intraoperative blood loss. A large randomized controlled trial involving 332 women undergoing benign hysterectomy demonstrated that a single 1 g intravenous dose administered at the time of surgical incision significantly reduced mean blood loss compared with placebo. Mean intraoperative blood loss was approximately 100 mL in the TXA group versus 166 mL in the placebo group, and the proportion of patients experiencing blood loss of at least 500 mL was also significantly lower among women receiving TXA. In addition, fewer patients in the TXA group required reoperation for postoperative hemorrhage. Importantly, this study did not report an increased incidence of venous or arterial thromboembolic events, supporting the short-term safety of TXA in appropriately selected patients undergoing benign hysterectomy (Abu-Zaid et al., 2022; Topsoee et al., 2016).

The findings from individual hysterectomy trials are supported by pooled analyses, which indicate a consistent reduction in perioperative blood loss with prophylactic TXA. Meta-analytic data from randomized trials suggest that TXA reduces blood loss by approximately 66–180 mL in hysterectomy, depending on surgical approach, baseline bleeding risk, and study methodology (Abu-Zaid et al., 2022; Zakhari et al., 2020). Some studies have also reported lower transfusion requirements among patients receiving TXA, although transfusion outcomes are less consistently demonstrated than reductions in measured blood loss. This may partly reflect relatively low transfusion rates in contemporary benign hysterectomy, particularly when minimally invasive techniques are used (Abu-Zaid et al., 2022; Topsoee et al., 2016). Nevertheless, the available evidence supports the use of TXA as a reasonable blood-conservation strategy in hysterectomy, especially in patients with an increased risk of hemorrhage or pre-existing anemia (Abu-Zaid et al., 2022; Lottermann et al., 2025; Zakhari et al., 2020).

Evidence for TXA in oncologic hysterectomy and major gynecologic cancer surgery is less extensive but clinically relevant. Oncologic procedures, such as radical hysterectomy, ovarian cancer cytoreductive surgery, and extensive pelvic resections, may involve substantial blood loss because of tumor vascularity, adhesions, retroperitoneal dissection, and multivisceral surgical complexity (Kietpeerakool et al., 2016; Zakhari et al., 2020). Small randomized studies and observational data suggest that TXA may reduce intraoperative blood loss in selected oncologic procedures. For example, a randomized trial in ovarian cancer surgery reported an approximate reduction of 210 mL in blood loss among patients receiving TXA. Some studies have also shown a trend toward reduced transfusion requirements, although available sample sizes remain insufficient to draw firm conclusions regarding major clinical endpoints (Kietpeerakool et al., 2016; Lundin et al., 2014; Yang et al., 2023; Zakhari et al., 2020). To date, no evidence has demonstrated that perioperative TXA adversely affects oncologic outcomes, such as recurrence, metastasis, or survival; however, long-term oncologic safety has not been adequately studied and should be interpreted with caution (Lundin et al., 2014; Yang et al., 2023; Zakhari et al., 2020).

Myomectomy represents another important indication for TXA because fibroid surgery can be associated with considerable hemorrhage, particularly in cases involving large, multiple, intramural, or highly vascular leiomyomas. In abdominal myomectomy, the evidence generally supports a clinically meaningful reduction in perioperative blood loss with TXA administration. A systematic review and meta-analysis including randomized controlled trials in abdominal myomectomy found that TXA significantly reduced total blood loss, with an estimated mean reduction of approximately 213 mL. This effect is clinically relevant because excessive bleeding during myomectomy may lead to transfusion, conversion to more extensive surgery, or compromised fertility-preserving surgical goals (Fusca et al., 2019; Shaaban et al., 2016; Zakhari et al., 2020). Data from laparoscopic and robotic myomectomy are more heterogeneous. Some trials have demonstrated reduced blood loss with intravenous TXA, whereas others have not found statistically significant differences, possibly because baseline blood loss is lower in minimally invasive procedures or because sample sizes are insufficient to detect modest effects. Therefore, TXA appears most justified in open, complex, or high-risk myomectomy, while its routine use in low-risk minimally invasive myomectomy requires further investigation (Kathopoulis et al., 2022; Opoku-Anane et al., 2020; Zakhari et al., 2020).

Although cesarean delivery is primarily an obstetric procedure, it is closely related to operative gynecology and represents one of the most extensively studied settings for TXA use. Numerous randomized controlled trials and meta-analyses have evaluated prophylactic TXA for prevention of postpartum hemorrhage during cesarean section (Bellos & Pergialiotis, 2022; Pacheco et al., 2023; Sentilhes et al., 2021; Simonazzi et al., 2016). Pooled evidence indicates that intravenous TXA, commonly administered as a 1 g dose before skin incision or shortly after cord clamping, reduces total blood loss, the incidence of severe postpartum hemorrhage,

postoperative hemoglobin decline, and the need for additional uterotonic agents. Some analyses also suggest a reduction in transfusion requirements, particularly among patients at increased risk of hemorrhage (Bellos & Pergialiotis, 2022; Sentilhes et al., 2021; Simonazzi et al., 2016). The timing of administration may influence efficacy, with pre-incision administration generally associated with a stronger reduction in measured blood loss than administration after delivery. Importantly, large obstetric datasets and randomized trials have not shown a clear increase in thromboembolic complications with standard-dose TXA, although vigilance remains necessary in patients with additional thrombotic risk factors (Bellos & Pergialiotis, 2022; Pacheco et al., 2023; Sentilhes et al., 2021; Simonazzi et al., 2016). In the therapeutic setting, TXA is also recommended as part of postpartum hemorrhage management, reflecting its established role in reducing bleeding-related morbidity and mortality (Picetti et al., 2020; WOMAN Trial Collaborators, 2017).

TXA has also been evaluated in smaller gynecologic procedures, particularly cervical conization, where delayed postoperative hemorrhage may occur despite the limited extent of surgery. Evidence from randomized trials and pooled analyses suggests that TXA may reduce the risk of secondary hemorrhage following cervical conization. In some studies, oral or intravenous TXA administered around the time of the procedure significantly decreased delayed bleeding episodes, with pooled estimates indicating a marked reduction in hemorrhage risk (Albayrak Denizli et al., 2023; Martin-Hirsch & Bryant, 2013). However, because conization is usually associated with low overall morbidity, the decision to use TXA should consider individual bleeding risk, extent of excision, anticoagulant use, and local clinical protocols (Albayrak Denizli et al., 2023; Lottermann et al., 2025; Martin-Hirsch & Bryant, 2013).

For other gynecologic procedures, including surgery for deep infiltrating endometriosis, extensive adhesiolysis, and selected fertility-preserving operations, evidence remains insufficient to support routine TXA use. These procedures may involve substantial bleeding in individual cases, particularly when bowel, bladder, uterine, or parametrial dissection is required, but high-quality randomized data are lacking. In such settings, TXA may be considered selectively as part of an individualized perioperative blood-management strategy, especially when major blood loss is anticipated. Future studies should focus on defining procedure-specific indications, optimal dosing regimens, and clinically meaningful outcomes beyond estimated blood loss, including transfusion avoidance, postoperative recovery, and safety in high-risk populations (Lottermann et al., 2025; Zakhari et al., 2020)**.**

Discussion

The available evidence indicates that tranexamic acid (TXA) represents a valuable adjunct in perioperative blood-management strategies in gynecologic surgery. Its mechanism of action, based on inhibition of fibrinolysis and stabilization of fibrin clots, is particularly relevant in procedures associated with extensive tissue dissection, highly vascular pelvic structures, and broad raw surgical surfaces (Franchini & Mannucci, 2020; Zakhari et al., 2020). Unlike procoagulant agents, TXA does not directly initiate clot formation; rather, it preserves the stability of physiologically formed clots by reducing plasmin-mediated fibrin degradation. This pharmacological characteristic provides a strong rationale for its use in gynecologic procedures in which excessive fibrinolysis may contribute to continued bleeding (Chauncey & Patel, 2026; Franchini & Mannucci, 2020).

The strongest gynecologic evidence supporting TXA use comes from randomized controlled trials and meta-analyses evaluating hysterectomy, myomectomy, cesarean delivery, and selected cervical procedures. In benign hysterectomy, prophylactic intravenous TXA has been shown to reduce intraoperative blood loss and the incidence of clinically relevant hemorrhage (Topsoee et al., 2016; Zakhari et al., 2020). Similarly, studies in myomectomy suggest that TXA may be particularly beneficial in procedures with a high baseline risk of bleeding, especially open or complex myomectomy involving large or multiple fibroids. The magnitude of benefit appears smaller and less consistent in minimally invasive procedures, where baseline blood loss is often lower (Fusca et al., 2019; Opoku-Anane et al., 2020; Shaaban et al., 2016). This suggests that the clinical utility of TXA may depend strongly on the anticipated bleeding risk of the procedure rather than on the gynecologic indication alone (Heyns et al., 2021; Zakhari et al., 2020).

Evidence from obstetric surgery, particularly cesarean delivery, further strengthens the role of TXA as a hemostatic intervention. Large meta-analyses of randomized trials have demonstrated reductions in total blood loss, postpartum hemorrhage, hemoglobin decline, and transfusion requirements after prophylactic TXA administration (Bellos & Pergialiotis, 2022; Simonazzi et al., 2016). Although cesarean delivery differs from non-obstetric gynecologic surgery in terms of physiology, uterine vascularity, and bleeding mechanisms, these findings are clinically relevant because they confirm the effectiveness of TXA in a highly vascular pelvic

surgical setting (Sentilhes et al., 2021; Simonazzi et al., 2016). In addition, the established use of TXA in the treatment of postpartum hemorrhage supports its broader role as an antifibrinolytic agent in acute bleeding management (Pacheco et al., 2017; WOMAN Trial Collaborators, 2017).

The safety profile of TXA in gynecologic and obstetric surgery appears reassuring when standard perioperative doses are used. Across randomized trials and pooled analyses, TXA has not been consistently associated with an increased incidence of venous or arterial thromboembolic events (Pacheco et al., 2023; Sentilhes et al., 2021; Zakhari et al., 2020). This observation is biologically plausible, as TXA does not induce de novo thrombosis but instead inhibits premature clot breakdown. Nevertheless, safety conclusions should be interpreted carefully (Chauncey & Patel, 2026; Franchini & Mannucci, 2020). Many clinical trials are underpowered to detect rare adverse events such as venous thromboembolism, myocardial infarction, stroke, or seizures. Moreover, patients with active thromboembolic disease, severe renal impairment, or very high baseline thrombotic risk are often excluded from randomized trials (Chauncey & Patel, 2026; Pacheco et al., 2023; Sentilhes et al., 2021). Therefore, although the available data support the short-term safety of TXA in appropriately selected patients, individualized risk assessment remains essential (Chauncey & Patel, 2026; WOMAN Trial Collaborators, 2017; Zakhari et al., 2020).

The findings from gynecologic surgery are consistent with evidence from other surgical specialties. Large systematic reviews across multiple surgical fields have shown that TXA and other lysine analogues reduce perioperative bleeding and transfusion requirements without a clear increase in mortality or major cardiovascular events (Cai et al., 2020; Heyns et al., 2021). This broader evidence base is important because it supports the general principle that antifibrinolytic therapy can be safely incorporated into perioperative blood-conservation strategies. However, gynecologic surgery has specific characteristics, including variable surgical routes, reproductive considerations, oncologic indications, and procedure-specific bleeding mechanisms, which justify separate evaluation rather than direct extrapolation from trauma, orthopedic, or cardiac surgery (Heyns et al., 2021; Zakhari et al., 2020).

From a clinical perspective, TXA should be considered as part of a multimodal approach to hemorrhage prevention and management rather than as a replacement for meticulous surgical hemostasis. Its use should complement established strategies such as careful operative technique, correction of preoperative anemia, appropriate thromboprophylaxis, uterotonic agents when indicated, local hemostatic materials, cell salvage in selected high-risk cases, and standardized transfusion protocols (Chauncey & Patel, 2026; Franchini & Mannucci, 2020; Zakhari et al., 2020). In major gynecologic surgery with anticipated moderate or high blood loss, a common approach is intravenous administration of TXA before incision or at the beginning of surgery, most often as a 1 g bolus or a weight-based equivalent dose (Topsoee et al., 2016; Zakhari et al., 2020). Repeat dosing or infusion may be considered in prolonged procedures or ongoing hemorrhage, although optimal protocols in gynecologic surgery have not yet been definitively established (Chauncey & Patel, 2026; WOMAN Trial Collaborators, 2017; Zakhari et al., 2020).

Several limitations of the current evidence should be acknowledged. First, many studies differ substantially in surgical indication, operative route, baseline bleeding risk, TXA dose, timing of administration, and definitions of outcomes such as estimated blood loss or postoperative hemorrhage (Heyns et al., 2021; Zakhari et al., 2020). Second, transfusion rates are often low in modern gynecologic surgery, especially in minimally invasive procedures, making it difficult to demonstrate statistically significant reductions in this endpoint (Fusca et al., 2019; Zakhari et al., 2020). Third, evidence remains limited for several clinically important subgroups, including extensive cytoreductive surgery for ovarian cancer, radical pelvic procedures, deep infiltrating endometriosis surgery, and fertility-preserving operations. These procedures may carry a high risk of bleeding, yet high-quality randomized data are still insufficient (Kietpeerakool et al., 2016; Zakhari et al., 2020).

Future research should focus on defining procedure-specific indications and optimal dosing regimens for TXA in gynecologic surgery. Further randomized controlled trials are needed to compare single-dose administration with repeated bolus dosing or infusion protocols, particularly in long and complex operations(Heyns et al., 2021; Zakhari et al., 2020). The role of topical TXA also requires further investigation, as local administration may theoretically reduce systemic exposure while providing effective hemostasis at the surgical site (Franchini & Mannucci, 2020; Zakhari et al., 2020). In oncologic surgery, future studies should evaluate not only perioperative outcomes, such as blood loss and transfusion requirements, but also long-term endpoints, including recurrence, survival, and timing of adjuvant therapy (Kietpeerakool et al., 2016; Zakhari et al., 2020). Finally, large real-world registries would be valuable for assessing rare adverse events,

particularly thromboembolic complications, in broader and more heterogeneous patient populations (Chauncey & Patel, 2026; Franchini & Mannucci, 2020; Pacheco et al., 2023).

Overall, the current literature supports TXA as an effective and generally safe antifibrinolytic agent for reducing perioperative blood loss in selected gynecologic procedures. Its greatest benefit is likely to occur in operations with a moderate to high expected risk of hemorrhage, whereas routine use in low-risk minimally invasive surgery may provide limited clinical advantage (Fusca et al., 2019; Heyns et al., 2021; Zakhari et al., 2020). Careful patient selection, appropriate dosing, and integration into comprehensive perioperative blood-management protocols are essential for maximizing benefit while maintaining safety (Chauncey & Patel, 2026; Franchini & Mannucci, 2020; Zakhari et al., 2020).

Conclusions

Tranexamic acid is an effective and generally well-tolerated antifibrinolytic agent that may play an important role in perioperative blood-management strategies in gynecologic surgery. By inhibiting fibrinolysis and stabilizing fibrin clots, TXA reduces intraoperative and postoperative blood loss in several procedures associated with increased hemorrhagic risk, including hysterectomy, myomectomy, cesarean delivery, and selected gynecologic oncologic operations. Available randomized controlled trials and meta-analyses suggest that prophylactic intravenous administration, most commonly as a 1 g dose before surgical incision or at the beginning of the procedure, can decrease measured blood loss, limit postoperative hemoglobin decline, and reduce transfusion requirements in appropriately selected patients.

Current evidence also indicates that standard perioperative doses of TXA are not associated with a significant increase in venous or arterial thromboembolic complications, although careful patient selection remains essential. Particular caution is warranted in patients with active thromboembolic disease, severe renal impairment, or other major contraindications. TXA should therefore be considered not as a substitute for meticulous surgical hemostasis, but as a useful adjunct within a comprehensive perioperative strategy that includes preoperative anemia optimization, appropriate thromboprophylaxis, careful operative technique, and standardized transfusion protocols.

Overall, TXA appears to offer the greatest clinical benefit in gynecologic procedures with moderate or high expected blood loss, whereas its routine use in low-risk minimally invasive surgery requires further evaluation. Future studies should clarify optimal dosing, timing, and route of administration in specific gynecologic subgroups, particularly complex myomectomy, deep infiltrating endometriosis surgery, and extensive oncologic cytoreduction. Further research should also assess long-term safety outcomes, rare thromboembolic events, and the potential impact of TXA on recovery, cost-effectiveness, and patient-centered perioperative outcomes.

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