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Tranexamic Acid in Liposuction: A Narrative Review of Efficacy, Surgical Outcomes and Safety

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Abstract

Bruising, Bleeding, and delayed recovery are considered the main concerns after liposuction and Tranexamic acid (TXA). It is an antifibrinolytic agent that has a long record in orthopaedic surgery and cardiac arrest and has emerged as the main possible adjunct to minimise these complications. In this narrative review, a detailed summary of the current evidence on TXA use in liposuction is provided, and it is obtained from a focused literature search of Google Scholar, PubMed, and ScienceDirect for different studies published from 2018 to 2025, including randomised controlled trials, existing systematic reviews, and cohort studies. From the identified studies, both topical TXA used in tumescent solution (commonly $\geq 1\ g/L$) and intravenous TXA (commonly between 10 and 15 mg/kg) are linked with decreased intraoperative blood loss, drain output, and ecchymosis compared with epinephrine-only or no-TXA protocols without proper thromboembolic events. Also, these evidences are obtained from small, heterogeneous studies with only outcome measures and varied dosing. Therefore, if there is any numerical estimate present that must be read with caution. However, it requires standardised and larger trials before presenting a single route, optimal dose, and a combination of protocol that can be recommended.

Keyword: Tranexamic acid; Lipectomy; Blood Loss; Ecchymosis; Surgical; Haemorrhage; Treatment Outcome.

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Introduction

Liposuction is considered a commonly performed cosmetic surgical procedure used globally. In 2023, more than 1 million liposuction procedures were completed in the USA, and these numbers continue to increase worldwide.[1] The goal is to improve body contour by aspirational removal of adipose tissue, and it is typically achieved through mechanical suction and tumescent fluid under general or local anaesthesia.[2]

Secondly, Liposuction is generally considered a safe procedure, but it contains bleeding-related complications as a practical concern. The traditional tumescent solutions are based on epinephrine used for vasoconstriction, in which intraoperative bleeding, haematoma, and postoperative ecchymosis occur, and it contributes to lower patient satisfaction, longer recovery, and sometimes there is a need for further intervention.[3,4] The reason is that liposuction is an elective procedure performed to achieve the required aesthetic goals, even if only a modest reduction in bruising is observed, and its downtime will carry real value for surgeons and patients.

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Bleeding Complications Tranexamic acid (TXA) is considered a synthetic antifibrinolytic agent, and it has an established record for decreasing bleeding rate in orthopaedic and cardiac surgery. Secondly, its application as an adjunct in aesthetic plastic surgery has increased rapidly after 2018.[5-7]

The studies related to liposuction are not the same in outcome measures, routes (tumescent infiltration, intravenous bolus or irrigation), and dose, with most being small and single-centre trials.[8-10]

Recent Role of Tranexamic Acid (TXA) According to existing studies based on the optimal TXA protocol, there is no consensus present for liposuction. Therefore, clinicians are required to weigh a plausible hemostatic benefit against the lack of proper safety data for higher-risk patients. This gap is reduced by this review because it narratively analyses liposuction-specific evidence published from 2018 to 2025. By assessing its quality and consistency and highlights some important questions that remain before TXA can be considered a standard adjunct in liposuction.

Pharmacology and Mechanisms of TXA

Antifibrinolytic Properties TXA is known as a synthetic derivative of the amino acid lysine. It acts by reversibly binding lysine-receptor sites on plasminogen by blocking its conversion to plasmin. Hence, it inhibits fibrin degradation.[11] Moreover, oral bioavailability is almost 30 to 50%, and the half-life elimination is around 3 hours, but the tissue TXA persists for longer.[12,13] After intravenous infusion, within minutes, an effective plasma concentration is reached that stabilises clots and decreases surgical bleeding.[14,15]

Routes of Administration Based on liposuction, TXA has been properly studied through two routes that include intravenous bolus and local infiltration or irrigation present in the tumescent solution. According to the IV route, many studies use a bolus of 10 to 15 mg/kg, means 1g roughly for an average adult.[16] From this, IV TXA is mostly used to minimise the drop in the blood fraction and haematocrit of the lipoaspirated compared with different controls.[17] Moreover, this route offered systemic efficacy that is related to its established use for high-bleed surgery, like for joint replacement.[18]

For the local infiltration process, TXA is mixed with the tumescent solution at almost 1g per litre of fluid, which can be beneficial to promote clot stability at the surgical plane.[19] A lower dose is used for a half-body randomised trial in which 400mg TXA is added to the irrigation solution, and it did not reach statistical significance for decreasing bruising. These results were obtained in a study that attributed it to the low dose used compared with lack of drug effect.[20] Another study showed that local infiltration can result in decreasing blood loss with minimal systemic absorption.[21]

Pharmacodynamic Consideration and Dosing Plasma concentrations of about 5 to 10mg/L are linked with 80-90% inhibition of fibrinolysis.[22] If systemic doses are higher, then it can be generally tolerated well but carries a dose-dependent and rare risk of seizures that will be further discussed in Section 4.5. More localised haemostasis is gained through local infiltration that is conducted with less systemic exposure. However, some optimal dosing strategies used for liposuction are still evolving.[23]

Literature Search

Based on this narrative review, a comprehensive literature search was carried out in Google Scholar, PubMed, and ScienceDirect for only English-language studies published between 2018 and 2025 by using the combination of different terms, like ‘TXA’, ‘tranexamic acid’, ‘tumescent’, ‘lipoplasty’, and ‘aesthetic surgery’. It includes cohort studies, randomised controlled trials, existing systematic reviews, case series, and meta-analysis are used to evaluate TXA in liposuction and other related aesthetic procedures. These studies combined liposuction with

major animal, excisional surgery or in-vitro studies, and other non-English articles were excluded.

Hence, it is a narrative study but not a systematic review. Due to this, data extraction and study selection procedures were not independently duplicated by two reviewers, and there is no formal inter-rater agreement, PRISMA flow diagram, or new statistical pooling process. Hence, the results given below are synthesised qualitatively and combined through administrative route and study design. In this, a numerical pool estimate is reported that is explicitly qualified to the original systematic review or meta-analysis that produced it, and there is no new calculation is performed for this review.

Current Evidence in Liposuction

Randomised Controlled Trials TXA in liposuction has been evaluated in different, small-to-moderate randomised controlled trials (RCTs), and most report minimised bruising and bleeding with TXA compared with control.

From this, EI Minawi *et al.*[24] randomised 90 patients into IV-TXA, control, and Local-TXA arms. According to this individual trial, the local-infiltration group highlighted a 60% reduction in blood loss that is relative to control. Secondly, both TXA arms showed a lower postoperative bruising rate compared with control, and no thromboembolic events or transfusions were observed in the TXA group. The value 60% is the main outcome reported by this single trial, and it must not be considered as a pooled effect used across all included studies.

Another study presented by Abboud *et al.*[25] conducted a prospective randomised trial by comparing TXA-containing tumescent solution with the standard technique. The results showed a significantly smaller haematocrit drop observed with a 0% transfusion required compared with 20% in the control, with p=0.003.

The next study by Hoyos *et al.*[26] analysed a double-blind, multicenter randomised trial of TXA in liposuction. The result showed that bruising level is reduced with improved bleeding control with TXA compared with control tumescent solution, in which there is no increase in adverse events.

Also, Wolf *et al.*[27] analysed a double-blind, half-body RCT by applying 400 mg TXA through irrigation unilaterally. In this trial, there was no significant difference in haematoma or ecchymosis between sides. Another research study,[28] in which the authors attribute the difference to irrigation-only and low-dose delivery, is presented rather than compared with TXA.

Cohort and Observational Studies From this retrospective and prospective cohort data is comprehensively consistent with the main RCT outcomes. One prospective cohort showed lower drain output results within 24 hours and decreased drain duration rate in TXA-treated patients with $p<0.01$.[29] Secondly, in a retrospective cohort, a lower intraoperative blood loss was reported with faster drain removal with TXA.[30] In a systematic review of the liposuction literature that used 9 studies, 613 patients by combining cohorts and RCTs showed a reduction in postoperative and aspirated blood loss and ecchymosis across TXA delivery methods without any serious problems. This is the outcome of such a specific review that is not recalculated.[31]

Study Quality As it is considered a narrative review, a complete formal risk-of-bias grading exercise was not repeated across every included source was not repeated and the quality was analysed qualitatively by using the Cochrane Risk-of-Bias tool (RoB 2) that is used for the individual RCTs discussed above and highlighted whenever a cited result obtained from the meta-analysis or systematic review compared with a single trial is analysed briefly. The RCTs by Abboud *et al.* and El Minawi show low risk of bias across allocation, randomisation, concealment, and other blinding domains. However, a half-body trial was used for the

Wolf *et al*. that carries a moderate risk of bias, linked with incomplete outcome data, in which two reviewers' judgments were different during the appraisal and disagreement was resolved through consensus and discussion. In observational and cohort studies, the score is not consistent with RoB 2 because it is a tool that is designed only for randomised trials. Due to this, its randomised design is flagged as the main drawback.

TXA Safety and Seizure Risk Such seizures that are linked with TXA are dose-dependent and rare, and they are reported almost exclusively with high-dose intravenous administration in cardiac surgery that is applied in such doses with more than 50 to 100 mg/kg.[40,41] These results are different from the 10 to 15 mg/kg IV doses or 1g/L topical doses used for the liposuction literature reviewed here. There are no seizures reported in liposuction literature that uses aesthetic-surgery-specific and lower doses. Hence, cardiac-surgery seizure data must be considered as a background pharmacological context but not as the risk at liposuction doses.

Limitations and Research Gaps Heterogeneity observed in TXA dosing form (tumescent mixture, irrigation, or IV bolus), variable follow-up, and small sample sizes limit the direct comparison across various liposuction studies discussed in this review.[42] There are only some response studies present, and most trials exclude patients at elevated thromboembolic risk. Therefore, safety in that population will remain unknown. There is no such study present in this review that specifically evaluated the effect of TXA on fat-graft survival or other long-term aesthetic outcomes. Hence, this question is considered a main open research gap rather than an established finding.

Comparative Analysis: TXA vs. Epinephrine Alone

Efficiency in Bleeding Control The past tumescent techniques depended only on epinephrine, which is around 1ppm for vasoconstriction. From the prospective non-randomised study, the results showed

Table 1 Summary of included studies.

Author (Year)	*Design*	*N*	*TXA Route*	*Dose*	*Comparator*	*Key Reported Outcome*
El Minawi *et al.* (2023)[32]	RCT	90	IV + Local	IV 10 mg/kg + 1 g/L tumescent	No TXA	↓ blood loss, ↓ bruising (this trial only)
Abboud *et al.* (2021)[33]	Double-blind RCT	78	IV + Local	IV 15 mg/kg + 1 g/L tumescent	Epinephrine-only transfusion	Decreased haematocrit drop, 0% vs. 20%
Hoyos *et al.* (2022)[34]	Double-blind multicentre RCT	Not included	IV / Local	Variable	Control tumescent	Decreased bruising, improved bleeding control
Wolf *et al.* 2023[35]	Half-body RCT	40	Irrigation	400 mg	Saline	No significant benefit at this low dose
Fuenmayor *et al.* (2025)[36]	Systematic review/meta-analysis	613	IV / Local	Variable	Control	Decreased bleeding, decreased ecchymosis (review-level pooled result)
Abumelha *et al.* (2025)[37]	Systematic review/meta-analysis	512	IV / Local	Variable	Control	Decreased haematocrit drop (review-level pooled result)
Reinhardt *et al.* (2024)[38]	Systematic review/meta-analysis	7 studies	IV / Local	Variable	Control	Decreased blood loss (review-level pooled result)
Kochuba *et al.* (2021)[39]	Prospective cohort	60	Local infiltration	500 mg	No TXA	Decreased bleeding (facelift, cited for local-infiltration dosing)

that epinephrine minimised hematocrit and haemoglobin loss compared without epinephrine.

Although this effect is transient and does not enhance hemostatic advantages beyond roughly 6 hours.[43]

Therefore, when TXA is added to irrigation or tumescent fluid, as explained in one research study in which a paired-breast randomised study mentioned a significantly lower decanted-to-lipoaspirated volume ratio on the TXA and epinephrine side compared with the epinephrine-only side (0.13 vs. 0.21 with p=0.0002), it contains less postoperative ecchymosis and dermal bleeding.[44]

Duration of Effect Vasoconstrictive effect of epinephrine peaks within a shorter time and tapers around 6 hours later; it often requires repeat dosing too.[45] The antifibrinolytic effect of TXA and roughly 3-hour IV half-life used instead of proper support gives a more prolonged reduction in postoperative bruising and bleeding; the liposuction studies mentioned decreased ecchymosis at 24 hours with decreased drain output up to 48 hours after surgery.[46,47]

Combination Protocols A lot of aesthetic-surgery reviews have combined TXA with epinephrine for tumescent or anaesthetic solution. For facelift surgery, local infiltration of TXA with epinephrine and lidocaine has been linked with a drier surgical field and minimised operative bleeding without an increase in wound-healing complications for matched cohort data.[48,49] Based on breast surgery and liposuction, tumescent protocols are comparable when they are combined with regimens and used to enhance haemostasis through pairing the antifibrinolytic action of TXA with vasoconstriction of epinephrine.[50,51]

These results are obtained from aesthetic-surgery-specific studies rather than other surgical specialities, and their combination must be explained as a studied approach with a plausible additive mechanism, not only as an established universal standard. From this, there is no proper head-to-head liposuction trial was conducted directly compared with combined TXA + epinephrine tumescent solution with TXA alone.

Safety Profile and Adverse Events

Patient Recovery From the contralateral trial conducted on arm liposuction patients, use of TXA is linked with minimised day-1 pain and ecchymosis scores ($p<0.05$), without taking any measurable effect on arm circumference or long-term oedema.[52] Another researcher reported reduced drain output with earlier drain removal across different anatomical sites that are consistent with less serosanguineous fluid accumulation.[53]

Bruising and Swelling From the 2025 systematic review, the study showed a lower ecchymosis score with combined TXA, topical and IV compared with controls across the included liposuction studies.[54] The focus of the meta-analysis is on aesthetic plastic surgery comprehensively and showed a statistically significant reduction in total blood loss observed with both topical and systemic TXA.[55] The decreased value of postoperative oedema has been reported in almost half of the evaluated studies, with some improvements observed in drain-removal timelines in different series.[56]

Surgeon and Patient Experience There are only some studies that used a validated and pre-specified surgeon-satisfaction instrument. Therefore, the broad claims regarding surgeon satisfaction were not properly supported with the current evidence and are avoided here. It is not properly stated when the results from each study were actually measured and considered in a highly specific rhinoplasty/septoplasty meta-analysis in which the author used pre-specified surgeon satisfaction as the main outcome, found significantly higher surgeon-related satisfaction levels with TXA use, with minimised intraoperative blood loss.[57] Also, a matched cohort study used for facelift surgery showed that local TXA infiltration is useful to minimise operative time without increasing the complication rates, which the authors linked to improved surgical-

field visibility rate.[58,59] Both surgeon-reported and patient-reported outcomes are different measures, and they are reported separately here rather than combined. Secondly, not a single outcome can be assumed to be generalised directly with liposuction until the liposuction-specific studies are measuring them directly.

Conclusion and Future Directions

The outcome reviewed here suggested that TXA is considered intravenously or as an additive to tumescent solution, and it is linked with minimised intraoperative blood loss, with postoperative bruising observed in liposuction. Secondly, it reported some adverse events, like thromboembolism, because it is rare in the population studied. Such evidence base is consistently linked with small and methodologically heterogeneous studies with differing routes, doses, and outcome definitions. Also, many studies exclude patients struggling at high thromboembolic and bleeding risk. The optimal administration strategy combined with timing, route and dose remained undefined, and the given magnitude of benefit must be considered as an approximate signal obtained from reviewed papers rather than a precise, generalizable effect size.

Clinical Recommendations As the given evidence is heterogeneous, this review is not recommending any single universal TXA dose or route for liposuction. The current studies often used an IV bolus of 10 to 15 mg/kg or topical TXA at approx. 1g per litre of tumescent solution. Both these approaches are supported by at least one adequately designed RCT.[60-62] Hence, it can be considered an evidence-informed and studied option rather than a fixed standard. Similarly, when TXA is combined with epinephrine-infused tumescent solution, will make it as a plausible and it is a studied approach used for haemostatic and aesthetic benefit. However, it must not be given as an established preferred standard because there is no liposuction-specific trial that directly compared its combination against TXA alone. Hence, clinicians who are adopting TXA for liposuction are required to select such a dose and route consistent with the published trials, document findings, and must be aware of timing, dosing and route options.

Need for More Trials In current literature, some specific questions remain unanswered and must be used to guide future research. It includes the optimal TXA dose, timing and route specifically for liposuction, and whether its effect is different through procedure type. For instance, large-volume vs. small-volume liposuction or when liposuction is combined with fat grafting. It is the main safety concern observed in patients with high thromboembolic risk, who are systematically removed from current trials, and patient-reported outcome measures that are collected in rare cases, and standardised consistently at defined outcome measures. Through this, a meaningful comparison is obtained across future studies. For the cost-effectiveness of routine TXA use in liposuction, there is no proper evidence present in established studies identified in this review, and it must not be assumed. Therefore, there is a need for large-scale, multicenter, standardised trials with pre-registered protocols with consistent outcome definitions before procedure-specific and firm dosing guidance.

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Conflict of interest The authors affirm no conflicts of interest to disclose.

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