Review

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Tranexamic acid in rhytidectomy: a scoping review

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Background: Intraoperative and postoperative bleeding is considered one of the most common risks in rhytidectomy. Recently, the use of antifibrinolytic agents in facial plastic and reconstructive surgeries has been evaluated, but their use in rhytidectomy remains a topic of ongoing discussion. Tranexamic acid (TXA) is an antifibrinolytic agent that prevents enzymatic degradation of the fibrin clot by blocking the conversion of plasminogen to plasmin, improves platelet function, and has a direct anti-inflammatory effect. This review covers pertinent literature to elucidate whether the use of TXA in rhytidectomy confers intraoperative and postoperative benefits.

Methods: A systematic literature search was conducted in online databases: PubMed, Google Scholar, Cochrane, Scopus, and Web of Science for all articles on the topic of TXA in facelift published up to and including June, 2023 using the following terms: "TXA," "tranexamic acid," "plastic surgery," "aesthetic surgery," "facelift," "rhytidectomy". They were either searched individually or in combination. All relevant original research articles, of any study design were included and narratively discussed in this review. Studies not carried out in humans and studies centred on the use of TXA in other specialties were excluded. English Language was included.

Results: Eight articles were reviewed in this paper. Through these articles, the authors provided in detail the possible beneficial effects of TXA in facelift patients in evaluating several clinical outcomes: intraoperative blood loss, postoperative drain output, postoperative oedema, ecchymosis, operative time, and surgical field quality.

Conclusion: Although there is still a lack of information on TXA in facelift patients, we are not able to deny the beneficial effects of TXA on this topic. Therefore, further investigations including prospective, case-controlled multi-institutional studies comparing routes of delivery should be performed until reaching, at the end, an evidence-based guideline providing a clear protocol in terms of the administration and dosage of TXA in facelift.

Keywords: facelift, plastic surgery, rhytidectomy, tranexamic acid

Background

Intraoperative and postoperative bleeding is considered one of the most common risks in rhytidectomy, with haematoma complications reported in 1–15% of cases and ~90% occurring within the first 24 h after surgery[1,2]. This complication with its resultant oedema and bruises can lead to permanent pigmentation changes, and extended recovery. In an effort to reduce haematoma risk during facelift, epinephrine is routinely added to the local anaesthetic agent to form "tumescent solution" which decreases bleeding and facilitates dissection[3,4]. On the other hand, those useful prolonged effects of epinephrine could mask the bleeding and thus predispose to "rebound bleeding" which is described as the most common cause of postoperative haematoma following rhytidectomy[5,6]. Moreover, eliminating epinephrine from infiltrating solution has been shown to significantly reduce facelift haematoma rates, so seeking for alternatives would be a necessity. Recently the use of antifibrinolytic agents in facial plastic and reconstructive surgeries has been evaluated, but their use in rhytidectomy remains a topic of ongoing discussion. Tranexamic acid (TXA) is an antifibrinolytic agent that prevents enzymatic degradation of the fibrin clot by blocking the conversion of plasminogen to plasmin, improves platelet function, and has a direct anti-inflammatory effect[2,5]. Despite the potential for TXA to reduce intraoperative blood loss in facelift, up to now, no clear guidelines exist for this specific use. This review covers pertinent literature to elucidate whether the use of TXA in rhytidectomy confers intraoperative and postoperative benefits[4,5].

HIGHLIGHTS

- Tranexamic acid (TXA) is an antifibrinolytic agent, and has a direct anti-inflammatory effect.
- There is a clear benefit in using TXA to decrease intraoperative and postoperative blood loss.
- TXA improves patient outcomes in facelift patients.
- Literature on this topic is still subjective and underpowered.

Methods

Literature search

A systematic literature search was conducted in online databases: PubMed, Google Scholar, Cochrane, Scopus, and Web of Science

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for all articles on the topic of TXA in facelift published up to and including June, 2023 using the following terms: "TXA," "tranexamic acid," "plastic surgery," "aesthetic surgery," "facelift," "rhytidectomy". They were either searched individually or in combination. All relevant original research articles, of any study design were included and narratively discussed in this review. Studies not carried out in humans and studies centred on the use of TXA in other specialties were excluded. English Language was included. Studies that met inclusion and exclusion criteria were separated for full reading, critical appraisal, and data collection. The bibliographic references of the captured articles were examined to search for additional relevant citations.

Scoops and criteria

The primary objective of this review is to show the clinical effects of TXA usage in facelift patients in evaluating several clinical outcomes: intraoperative blood loss, postoperative drain output, postoperative oedema, ecchymosis, operative time, and surgical field quality; taking into consideration possible routes of administration to achieve the aforementioned outcomes, besides TXA dosing, and other technical details. We also aimed to review the evolvement of the principals of decision-making regarding the possibility of inserting the recommendation of TXA administration in practical guidelines for facelift patients. The inclusion criteria include: any study design of original research articles, English language, studies with an object of evaluation the role of TXA in facelift patients, and studies on only human subjects.

Results

In this review, we followed the checklist of the "The PRISMA 2020 statement: An updated guideline for reporting systematic reviews"[8]. The selection process is explained by the PRISMA flow diagram (see Fig. 1). The medical literature search identified 177 articles. According to our inclusion criteria, of them, eight articles and reports were eligible for inclusion in this scoping review. The evaluated clinical outcomes while using TXA in rhytidectomy are summarized in (Table 1).

Discussion

Pharmacodynamics of TXA

TXA was first discovered in 1957 in Japan and utilized in the management of postpartum hemorrhageone[1,3,4]. First, TXA is a synthetic derivative of lysine that reversibly blocks the binding sites of plasminogen, thus preventing activation of plasmin which in turn prevents plasmin from degrading the fibrin clot. Second, it improves platelet function. Third, TXA may have an anti-inflammatory effect by blocking plasmin activation of the complement cascade, and reducing the markers of inflammation, including interleukin 6 and creatine-kinase, and other additional mechanisms[2,3,5]. Furthermore, since TXA prevents the formation of plasmin, it inhibits plasmin induced activation of platelets, resulting in a higher circulating platelet count to aid clotting as the surgical procedure progresses. The potential for increased late haemostasis is in contrast to the rebound effects of epinephrine which can increase bleeding after the drug has diffused away. The improvement in haemostasis with TXA has led to its adoption by other surgical specialties including neurosurgery, orthopaedics, obstetrics, cardiothoracic, vascular and trauma[1,3,4]. The safety and efficacy of TXA have been widely evaluated in numerous specialties. TXA is an extremely well-tolerated drug with just few contraindications and side effects listed in the British National Formulary, including some well-tolerated mild gastrointestinal events like diarrhoea, allergic dermatitis, fatigue, and sinusitis. Additionally, the concern that it may increase thromboembolic events was completely dismissed after several published clinical trials that confirmed no increase in stroke, myocardial infarction, pulmonary embolism, or deep vein thrombosis with the utilization of TXA[1,2,5].

TXA is contraindicated in patients on medications that induce blood clotting, such as Factor IX or hormonal contraceptives as these patients are more prone to thromboembolic events. Multiple clinical trials in elective surgical patients showed that TXA reduces the probability of receiving blood transfusion by about one third, and the volume of blood transfused by about 1 unit, with no risk of thromboembolic or other major events. Also, TXA can safely reduce the risk of death in bleeding trauma patients and head-injury-related deaths after a traumatic brain injury[1,4,5].

Literature review/analyzing previous studies

Butz *et al*.[1] in 2016 were the first to report a case series on the use of TXA-soaked pledgets in their series of 57 patients, undergoing a full face and neck rhytidectomy. They reported the novel intraoperative placement of TXA-soaked pledgets under the skin flap after the superficial musculoaponeurotic system plication. Findings of reduced oedema, ecchymosis, and recovery time with faster return to social activity were reported. Overall, one postoperative haematoma occurred that required evacuation (1.7%) and no venous thromboembolic events (VTE) or other systemic complications related to TXA use were reported. The authors recommended the topical TXA use in all rhytidectomy due to its potential to minimize haematoma-related complications and reduce inflammation. On the other hand, the authors failed to objectively determine the optimal dosage of TXA[1].

As a follow-up to that study, Couto *et al*.[2] conducted a prospective study in 2019 on 27 patients who underwent a facelift with anterior approach neck lift and received a subcutaneous injection of TXA-lidocaine-epinephrine solution (1 mg TXA/1 ml of local anaesthetic: 0.5% lidocaine 1:200 000 epinephrine) into the face and neck (60 ml/ side) before skin flap dissection. Although there was no control group, they stated a subjective reduction in bleeding, postoperative drainage output, and a total surgical time saving between 25 and 60 min compared with their patients who receive 0.5% lidocaine with 1:200 000 epinephrine without TXA. There were no complications such as intraoperative or postoperative haematomas, seromas, or VTE. On the other side, the authors considered their results as preliminary, and underpowered aiming to stimulate further similar studies[2].

A prospective, randomized double-blinded case control series by Cohen *et al*.[4] in 2020 was the first to determine whether intravenous (IV) TXA has an effect on intraoperative bleeding and postoperative ecchymosis and oedema in patients undergoing a deep-plane facelift. This study included 44 patients, as patients in the treatment group (27 patients) received 1 g of IV TXA preoperatively (15 min before skin incision and 4 h postoperatively, while the control group received IV saline). Although there was no difference in intraoperative bleeding, the TXA group

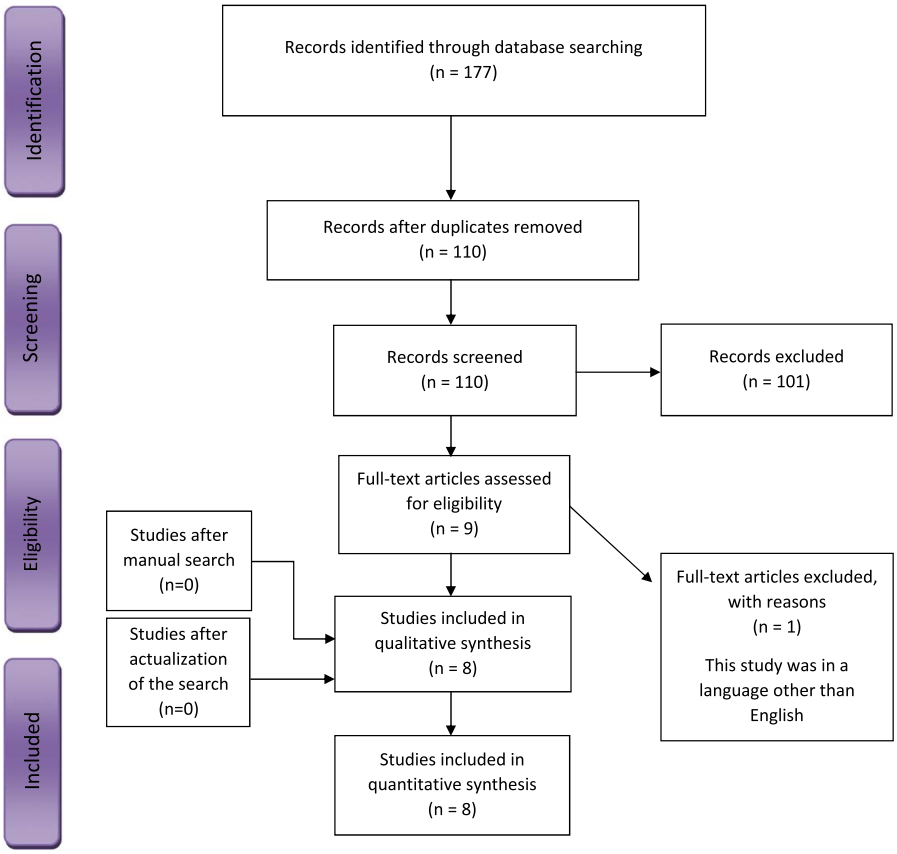

Figure 1. PRISMA 2020 flow diagram explains the selection process.

Table 1

Summarizes the evaluated clinical outcomes while using tranexamic acid in rhytidectomy

Evaluated clinical outcomes	Related studies
Intraoperative blood loss and postoperative drain output	Cohen *et al.*[4]: No significant difference between intravenous TXA and control groups. Schrorder *et al.*[3]: TXA decreased the drain output by 70% during the first postoperative day, the overall intraoperative blood loss, and the required time to drain removal ($P < 0.001$). Kochuba *et al.*[5]: TXA decreased bleeding, and drain output.
Postoperative oedema and ecchymosis	Butz and Geldner[1]: Subjective reduction in postoperative oedema and ecchymosis, although objective grading was not performed Cohen *et al.*[4]: Surgeon-rated postoperative ecchymosis was significantly reduced between TXA and control groups, while no significant difference was reported in patient-rated ecchymosis, patient-rated oedema, or surgeon-rated oedema.
Operative time, and surgical field quality	Couto[2]: The total surgical time was reduced by ~25–60 minutes per patient. Cohen *et al.*[4]: TXA showed a significantly reduced rate of postoperative collections, with 5 patients (29%) in the control group developing serosanguinous collections within the first week after surgery and only 1 patient (4%) in TXA group Schroeder *et al.*[3]: No statistically significant difference in rates of minor haematoma, major haematoma between TXA and control groups Kochuba *et al.*[5]: TXA decreased operating room time Demetrius and colleagues[7]: Time saving in the operating room in TXA group without additional surgical morbidities

TXA, tranexamic acid.

showed a significantly reduced rate of postoperative collections. Also, the patients who received TXA were consistently rated as having less postoperative oedema and ecchymosis. 4% of patients in the TXA group experienced a sub-mental fluid collection. Consequently, the authors conducted that IV use is safe and reduces postoperative ecchymosis and fluid collections. One the other side, Wan *et al.*[6] in their letter to the editor in 2020 suggested that the primary effect of the intravenous TXA in reducing intraoperative blood loss had not been achieved in Cohen study, so thinking about other routes of administrations should be a priority[6].

Then, Schroeder *et al.*[3] in 2020 designed a retrospective cohort study to determine whether local TXA reduced intraoperative bleeding and postoperative drain output in 76 patients undergoing deep-plane rhytidectomy with platysmaplasty. The authors reported the use of 100 mg of TXA in every 10 ml of lidocaine-epinephrine solution compared to a control group without TXA. They stated that TXA decreased the drain output by 70% during the first postoperative day, the overall intraoperative blood loss, and the required time to drain removal ($P < 0.001$). No statistically significant differences were observed in haematoma or thromboembolic event rates. Although they reported one case of thromboembolic event, this was not statistically significant as mentioned before.

After that, a prospective, case-control study was conducted by Kochuba *et al.*[5] in 2020. This study included 39 patients undergoing facelift surgery alone or in combination with other facial rejuvenation procedures. All patients were injected subcutaneously with 1 or 2 mg/ml TXA plus 0.5% lidocaine/1:200 000 epinephrine solution prior to dissection (60 ml/side). No significant difference was noted in total time to haemostasis between administration of 1 mg or 2 mg of TXA ($P = 0.93$). But, they stated that in the 2 mg TXA group, mean time required for haemostasis on the left (first side) versus right side was found to be significant ($P < 0.03$). The authors concluded that TXA was shown to be safe and to decrease bleeding, operating room time, and drain output compared with traditional local anaesthesia with epinephrine. Moreover, none of the patients experienced postoperative haematoma, seromas, or clinical VTE.

And finally, Demetrius *et al.*[7] designed a retrospective, single-surgeon case-control study, published in 2022. All patients underwent facelift surgery alone or in combination with fat transfer and perioral chemical peel. All patients received subcutaneous infiltration of 0.5% lidocaine/1:200 000 epinephrine with or without 1 or 2 mg/ml TXA. Mean surgical time in the no-TXA group was 21 minutes longer than in the TXA group ($P = 0.016$). Eight percent of patients in the no-TXA group experienced minor complications versus 11% of patients in the TXA group. No patients experienced major complications. This study added to the objective body of evidence supporting TXA usage in facelift surgery by documenting time saved in the operating room without additional surgical morbidities[7].

TXA dosing and administration routes

TXA dosing and administration routes varied between studies in facelift. So far, four studies investigated subcutaneous injectable TXA mixed with tumescent solution[2,3,5,7], one study used IV administration[4], and one study topically through TXA-soaked pledgets[1]. There is a little general consensus on the optimal dose of TXA; however, 10 mg/kg has been shown to inhibit 80% of plasminogen conversion to active plasmin, the TXA remaining active for more than 17 h. Concerning dosing, the suggested doses were mentioned previously in detail by authors[1–7].

Conclusion

This scoping review summarizes the current literature on TXA in facelift. Although there is still a lack of information on TXA in facelift patients, there is a clear benefit in using TXA to decrease intraoperative and postoperative blood loss. Most of the studies noticed a decrease in oedema and ecchymosis in the postoperative period and the potential anti-inflammatory response, which eventually improves patient outcomes in facelift patients. Numerous routes of delivery including intravenous, topical, and local infiltration in tumescent solution are studied.

Consequently, TXA is often recommended for facelift procedures as it can help reduce bleeding and bruising during and after the surgery. But, actually, the literature on this topic is often subjective and underpowered, and although the aforementioned advantages justify its use, further investigations including prospective, case-controlled multi-institutional studies comparing routes of delivery are needed to standardize its optimal administration route and dosage.

Ethical approval

Not applicable.

Consent

Not applicable.

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Author contribution

A.S.: manuscript preparation in all phases. N.A.: manuscript preparation in most phases. M.A.A.: revised the final version of the manuscript critically.

Conflicts of interest disclosure

The authors declare that they have no conflicts of interest.

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