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Tranexamic Acid in Aesthetic Facial Plastic Surgery: A Systematic Review of Evidence, Applications, and Outcomes

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Abstract

Background: Tranexamic acid (TXA) is an antifibrinolytic that has become widely used in aesthetic facial plastic surgery, although its efficacy has not been well investigated.

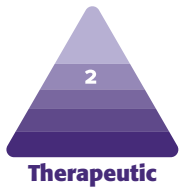
Objectives: To evaluate the existing evidence for use of TXA in aesthetic facial plastic surgery, highlighting routes of administration, dosing, surgical applications, and clinical outcomes.

Methods: Systematic review of primary literature evaluating TXA in aesthetic facial plastic surgery.

Results: Eleven studies met inclusion criteria: 8 prospective randomized controlled trials, 2 retrospective case series/cohort studies, and 1 clinical opinion. Six studies evaluated TXA in rhinoplasty, 4 in rhytidectomy, and 1 in blepharoplasty. Significant reductions in intraoperative blood loss were found in 5 rhinoplasty studies. Three rhinoplasty and 2 rhytidectomy studies found significantly reduced postoperative edema and ecchymosis. One rhinoplasty and 1 rhytidectomy study reported reduced operative time and time to achieve hemostasis. One rhytidectomy study reported reduced postoperative drain output and faster time to drain removal. No studies reported an adverse outcome directly related to TXA.

Conclusions: Existing literature investigating TXA in aesthetic facial plastic surgery is sparse with varying levels of evidence and heterogeneous data. Literature suggests systemic TXA reduces intraoperative blood loss during rhinoplasty, although the clinical significance of this blood loss reduction is unclear. TXA may also reduce postoperative edema and/or ecchymosis in rhytidectomy and rhinoplasty, although the lack of validated grading scales yields insufficient evidence to support this claim. Topical and subcutaneously injected TXA are emerging administration routes in rhytidectomy, with evidence suggesting TXA mixed with tumescent may reduce postoperative drain output, thereby expediting drain removal.

Level of Evidence: 2



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Hemostasis is critical in aesthetic facial plastic surgery. Excessive intraoperative blood loss can lengthen operative times and increase the need for transfusion, both of which add morbidity and increase rates of complications. Postoperative edema and ecchymosis are common sequela of aesthetic facial plastic surgery, which add emotional stress to patients and may prevent social interaction during recovery. Edema and ecchymosis also negatively alter the ability to assess surgical outcomes, both intraoperatively and postoperatively.

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Antifibrinolytics have been used in a variety of surgical fields to reduce the need for transfusions. Arguably, the most widely studied antifibrinolytic is tranexamic acid (TXA). TXA is a synthetic lysine analog that competitively inhibits the activation of plasminogen to plasmin. This temporarily prevents plasmin from dissolving fibrin clots and also blocks plasmin-induced platelet activation, preserving platelets for subsequent clot formation.[1-3] Multiple systematic reviews and meta-analyses have shown that TXA significantly reduces intraoperative bleeding and the need for subsequent transfusion during major surgery without increasing the risk of renal failure or thromboembolic events.[4,5] TXA also has anti-inflammatory effects by inhibiting plasmin formation, as plasmin is responsible for several inflammatory activities.

Despite its known benefits and popularity in cardiac,[6,7] orthopedic,[8-10] and spine surgery,[11] a dearth investigation of TXA exists within the field of plastic surgery except for craniofacial and orthognathic surgery where substantial blood loss is often encountered. Even less information exists within the field of aesthetic facial plastic surgery. Herein, we present a systematic review summarizing the current knowledge and provide clinical recommendations regarding the efficacy of TXA in aesthetic facial plastic surgical procedures.

METHODS

Search Strategy and Study Selection

A systematic review of Pubmed/MEDLINE, Google Scholar, and Embase databases from inception to April 20, 2020, was undertaken in an academic medical setting. This systematic review of published data was deemed Institutional Review Board exempt. A PRISMA checklist can be found in Supplementary Appendix. The population of interest in this study were adult patients undergoing elective aesthetic facial plastic surgery. The intervention considered was the use of TXA. A control group, when present, was a group of patients that received either placebo, such as normal saline, or a standard of care medication that was not TXA. The primary outcome measurements of interest included intraoperative blood loss, postoperative edema and/or ecchymosis, and drain output. Secondary outcome measurements were gathered as revealed by the studies identified. The following search terms were used to identify potential articles: TXA or tranexamic acid and facial plastic surgery or facial aesthetic surgery or rhinoplasty or blepharoplasty or rhytidectomy or facelift or platysmaplasty or neck lift. Only studies published in the English language were included. Two independent reviewers (G.L. and K.L.) screened titles and abstracts to assess eligibility for inclusion. Full texts were then reviewed and inclusion was decided by consensus. When inclusion was uncertain, a third reviewer (J.B.) reviewed the full text to decide inclusion. Any disagreement was resolved through discussion and consensus between the reviews.

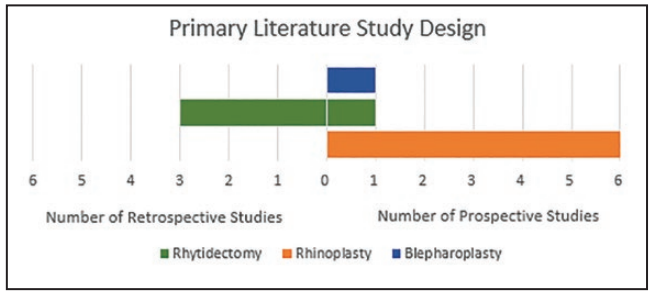

Figure 1. Study designs of primary literature sources.

Data Extraction

The following variables were extracted, when present, from each article and used for comparisons: author, year of publication, journal, country, study design, age of patients, sample size, TXA dosing, surgical procedure performed, control treatment, other comparison treatment (eg, corticosteroids), follow-up time, outcome measurement, study results, and level of evidence (LOE). Data were extracted by 2 independent reviewers (G.L. and K.L) using a data collection spreadsheet (Excel; Microsoft Corp, Redmond, WA, USA) designed a priori.

RESULTS

Eleven studies met inclusion criteria and were evaluated in this review: 8 prospective randomized controlled trials (LOE 2 and 3), 2 retrospective case series/cohort studies (LOE 3 and 4), and 1 clinical opinion (LOE 5) (Figure 1). Four studies were conducted in Iran, 5 in the United States, 1 in Israel, and 1 in Turkey. Both retrospective series were performed in the United States. In 6 studies, the surgical procedure of interest was rhinoplasty, 4 studies focused on rhytidectomy, and 1 study evaluated blepharoplasty. All studies were performed between April 2015 and March 2020 across a variety of journals. The summary of data extraction is found in Table 1.

TXA Dosing and Administration Route

Tranexamic acid dosing and administration routes varied between studies. In the rhinoplasty cohort, all studies utilized systemic administration, either per os (PO) or intravenous (IV). In the rhytidectomy studies, 2 studies

Table 1. Summary of Data Extraction

Source	Surgical intervention	Study type	Sample size	TXA dosing	Primary outcome measurement	Results
Beikaei (Iran, 2015)	Rhinoplasty	Blinded RCT	96 (48 TXA, 48 control)	10 mg/kg IV on anesthesia induction	IOB	Mean (standard deviation) blood loss of 43.3 (11.0) mL with TXA vs 60.3 (9.5) mL in control ($P < 0.001$).
Sakallioğlu (Turkey, 2015)	Rhinoplasty	Blinded RCT	75 (25 TXA, 25 MePred, 25 control)	1 g TXA PO 2 hr preop and 1 g PO q8h postop ×5 days vs 1 mg/kg IV MePred periop.	Photographs on POD1, 2, and 7 analyzed for periorbital edema and ecchymosis	Periorbital edema and ecchymosis lower in TXA and MePred groups vs control ($P < 0.05$). No difference between TXA and MePred groups.
					IOB	Mean intraoperative bleeding lower in TXA group 68 mL vs MePred 98 mL ($P < 0.05$) and control 133 mL ($P < 0.05$).
Eftekharian (Iran, 2016)	Rhinoplasty	Blinded RCT	50 (25 TXA, 25 control)	1 g TXA PO 2 hr before surgery	IOB	Mean (standard deviation) blood loss of 144.6 (60.3) mL in TXA group vs 199.6 (73.1) mL in control ($P < 0.05$).
					Surgical site quality	Mean (standard deviation) satisfaction of surgical site quality in TXA group 3.76/4 (0.52) vs 2.16/4 (0.50) in control ($P < 0.001$).
					Total operating time	Mean (standard deviation) surgery duration in TXA group (2.60 ± 0.53) vs placebo (2.99 ± 0.59) ($P < 0.017$).
Ghavimi (Iran, 2017)	Rhinoplasty	Blinded RCT	50 (24 TXA, 26 control)	10 mg/kg of TXA IV periop	IOB	Mean (standard deviation) intraoperative blood loss of 216 (65) mL with TXA vs 254 (55) mL in control ($P = .013$).
					Hgb and Hct change from preop to POD3	No significant difference in Hgb or Hct change from preop to POD3 between TXA and control groups.
					Periorbital edema and ecchymosis on POD1	Eyelid edema and periorbital ecchymosis improved with TXA, ($P < 0.03$) and ($P < 0.04$), respectively.
					Surgeon satisfaction	Surgeon satisfaction higher in TXA group vs control ($P < 0.03$).
Ghorbani (Turkey, 2018)	Rhinoplasty	Blinded RCT	52 (17 IV TXA, 17 PO TXA, 18 control)	500 mg TXA PO preop, 500 mg TXA IV preop	Photographs on POD3, 5, and 7 analyzed for periorbital edema and ecchymosis	No difference in periorbital edema and ecchymosis on any POD between groups.
					IOB	No difference in intraoperative bleeding between groups.

Table 1. Continued

Source	Surgical intervention	Study type	Sample size	TXA dosing	Primary outcome measurement	Results
Mehdizadeh (Iran, 2018)	Rhinoplasty	Blinded RCT	61 (15 TXA, 16 Dex, 15 TXA + Dex, 15 Control)	10 mg/kg TXA IV 1 hr preop then q 8 hr postop ×3 doses, 8 mg Dex IV 1 hr preop	Photographs on POD1, 3, and 7 analyzed for periorbital edema and ecchymosis	Periorbital edema and ecchymosis lower in TXA, Dex, and TXA + Dex groups vs control ($P < 0.05$). No difference between TXA, Dex, and TXA+Dex on any POD.
Sagiv (Israel, 2018)	Blepharoplasty	Blinded RCT	24 (12 TXA, 12 control)	Subcutaneous injection – 1 cc of 2% lidocaine with 1 cc of TXA [100 mg/mL] – final TXA concentration = 50 mg/mL	Photographs on POD0-7 analyzed for periorbital edema and ecchymosis	No difference in periorbital edema and ecchymosis on any POD between groups.
					IOB	No difference in intraoperative bleeding between groups.
					Total operating time	No difference in surgical time between groups.
					Cumulative cautery time	No difference in cumulative cautery time.
Butz (USA, 2016)	Rhytidectomy	Clinical observation	57	TXA-soaked pledgets placed subcutaneously after skin flap elevation.[a]	Edema and ecchymosis	Reduced edema and ecchymosis, faster return to work with TXA.
Couto (USA, 2019)	Rhytidectomy	Retrospective case series	27	Tumescent injected into face and neck—150 mg TXA in 150 cc of 0.5% lidocaine with 1:200,000 epinephrine. Final concentration = 1 mg TXA/1 mL	Total operating time	Total surgical time reduced by 25-60 minutes in the TXA group vs historical control.
					Time to achieve hemostasis	Mean (standard deviation; range) time spent achieving hemostasis on both skin flaps combined was 12.9 minutes (±4.2; 7-28 minutes), in the TXA group vs 20-30 minutes on each side in historical control.
Cohen (USA, 2020)	Rhytidectomy	Blinded RCT	44 (27 TXA, 17 control)	1 g TXA IV preop, repeated 4 hr after	IOB	No significant difference in intraoperative bleeding.
					Surgeon and patient-rated postop edema and ecchymosis	Reduction in surgeon-rated postoperative ecchymosis ($P < 0.05$).
					Postoperative fluid collections	Reduction in postoperative hematoma/seroma ($P < 0.01$).
Schroeder II (USA, 2020)	Rhytidectomy	Retrospective cohort study	76 (44 TXA, 32 control)	100 mg TXA to every 10 cc of local anesthetic and tumescent solution. Final concentration 9.1 mg TXA/1 mL	IOB	25% of patients wth IOB <50 cc in control group vs 75% with TXA ($P < 0.001$).

Table 1. Continued

Source	Surgical intervention	Study type	Sample size	TXA dosing	Primary outcome measurement	Results
					POD1 drain output	Mean POD1 drain output 50.4 cc in control vs 14.8 cc in the TXA group ($P < 0.001$).
					Days to drain removal	Mean 1.8 days in control group vs 1.2 days in the TXA group ($P = 0.001$).
					Percentage of drains removed POD1	34.4% of drains removed POD1 in control group vs 77.3% in the TXA group ($P < 0.001$).
					Percent POD1 drain output <25 cc	21.9% of POD1 drain output <25 cc in control vs 95.5% with the TXA group ($P < 0.001$).

Dex, dexamethasone; Hct, hematocrit; Hgb, hemoglobin; Hr, hour; IOB, intraoperative blood loss; IV, intravenous; MePred, methylprednisolone; Periop, perioperatively; PO, per Os; POD, postoperative day; Postop, postoperatively; Preop, preoperatively; RCT, randomized controlled trial; TXA, tranexamic acid. [a]No information was reported on the amount/concentration of TXA used.

investigated injectable TXA mixed with tumescent solution (lidocaine and saline), 1 used IV administration, and 1 topically through TXA-soaked pledgets. The blepharoplasty study utilized subcutaneous injectable TXA mixed with lidocaine with epinephrine.

Intraoperative Blood Loss and Postoperative Drain Output

Eight studies measured intraoperative blood loss, 5 of which assessed the use of TXA in rhinoplasty patients,[12-16] 2 in rhytidectomy,[17,18] and 1 in blepharoplasty.[19] Intraoperative bleeding was measured using relatively standard means across studies by measuring the weight of blood-soaked gauze and sponges, although 1 study implemented a subjective assessment of blood loss.[17] Within the rhinoplasty studies, 4 out of 5 studies found that TXA administration significantly reduced intraoperative bleeding relative to control groups. The 1 rhinoplasty study that did not report improvements in intraoperative blood loss analyzed a low dose of systemic TXA. No significant reduction in intraoperative blood loss was appreciated in the blepharoplasty study. Among the 2 rhytidectomy studies that evaluated intraoperative bleeding, one group saw no difference between IV TXA and control groups, whereas the other found that the addition of TXA to their injectable tumescent solution increased the percentage of patients with <50 cc of blood loss from 25% to 75% ($P<0.001$). This study additionally evaluated postoperative drain output as a primary outcome measurement. With the addition of TXA to their injectable tumescent solution, POD1 drain output reduced from 50.4 cc in the control group to 14.8 cc ($P<0.001$), average day of drain removal was reduced from 1.8 days in the control group to 1.2 days ($P=0.001$), the percentage of drains removed on POD1 was increased from 34.4% in the control group to 77.3% ($P<0.001$), and the percentage of POD1 drain output <25 cc was increased from 21.9% in the control group to 95.5% ($P<0.001$).

Postoperative Edema and Ecchymosis

Seven studies measured postoperative periorbital edema and ecchymosis—4 rhinoplasty,[12,14,16,20] 1 blepharoplasty,[19] and 2 rhytidectomy studies.[17,21] Analysis was performed through in-person physical examination, by blinded review of postoperative photographs taken in office by professionals, or by review of photographs the patients themselves as outpatients. One rhytidectomy study implemented a patient-rated grading scale for postoperative edema and ecchymosis. In the rhinoplasty studies, most data points were taken on postoperative day (POD) 1 and POD 7, while some studies additionally measured edema and ecchymosis on POD 2, 3, and 5. In the blepharoplasty study, photographs were analyzed on POD 0-7. In all rhinoplasty studies, periorbital edema and ecchymosis were graded individually on a scale from 0 to 4 for both the upper and lower lids in the following manner: − 0, None; (+) 1, to the medial canthus; (+) 2, extending to the pupil; (+) 3, past the pupil; and (+) 4, to the lateral canthus. In the blepharoplasty study, periorbital edema and ecchymosis were graded individually on a scale from 0 to 4 for both the upper and lower lids with 1 point for each of the following:

ecchymosis in up to one half of the upper eyelid area; ecchymosis in more than one half of the upper eyelid area, in the lower eyelid; and ecchymosis outside the eyelid area.

Three out of 4 rhinoplasty studies revealed significantly reduced postoperative edema and ecchymosis in the TXA groups relative to controls. Sakallioğlu et al[16] found that although periorbital edema and ecchymosis were reduced in the TXA group relative to placebo, this was not significantly different from the reduction in edema and ecchymosis found in a third group of patients who received only methylprednisolone IV perioperatively. Further, Mehdizadeh et al[20] found similar results to Sakallioğlu et al,[16] wherein TXA significantly reduced postoperative periorbital edema and ecchymosis relative to placebo, but that this reduction was not significantly different from the reduction found in a group that received perioperative dexamethasone IV, or from a fourth group that received both perioperative dexamethasone and TXA. In the blepharoplasty study, Sagiv et al[19] found no difference in periorbital edema and ecchymosis on any postoperative between TXA and control groups. Cohen et al[17] asked patients to subjectively rate their lower facial/neck bruising and swelling on a scale of 1 (mild), 2 (moderate), or 3 (severe) on each postoperative visit 1, 6, and 9. These were then averaged to create a single value for each patient. Surgeon assessment scores of each patient were similarly recorded and photograph documentation was performed. In their study, surgeon-rated postoperative ecchymosis was significantly reduced between TXA and control groups, while no significant difference was realized in patient-rated ecchymosis, patient-rated edema, or surgeon rated-edema. In their rhytidectomy study, Butz and Geldner[22] noted a subjective reduction in postoperative edema and ecchymosis, although objective grading was not performed, and the postoperative time interval was not described. No controls for anticoagulation or other confounding factors were performed.

Operative Time, Cautery Time, Surgical Field Quality, and Complications

Five studies compared additional variables such as total operative time, cumulative cautery time, and surgical field quality between intervention groups. Sagiv et al[19] found no difference in operative time or cumulative cautery time in blepharoplasty patients who were injected with local anesthetic containing TXA or those without. Eftekharian and and Rajabzadeh[15] found that patients undergoing rhinoplasty who received systemic TXA before surgery had significantly shorter surgery duration than those who received placebo, and that the surgeon was significantly more satisfied with the surgical field quality. Couto et al[21] retrospectively analyzed patients who underwent either extended superficial aponeurotic system (SMAS) or SMAS plication facelift procedures with concomitant neck lift following tumescent injection of 1.5 mL TXA (100 mg/mL) in 150 cc of 0.5% lidocaine with 1:200,000 epinephrine, and compared them to historical controls who received a standard tumescent without TXA. The study found that time spent achieving hemostasis on the right, left, and the 2 sides of the face combined was 6.5 minutes (±2.7; range, 1-15 minutes), 6.3 minutes (±2.1; range, 3-13 minutes), and 12.9 minutes (±4.2; range, 7-28 minutes), respectively. Previously, the senior author would spend 20-30 minutes gaining hemostasis on each side, and thus the total surgical time was reduced by approximately 25 to 60 minutes per patient. No complications were reported in any study that were directly attributed to the use of TXA. In the randomized trial conducted by Cohen et al,[17] the TXA cohort 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 the TXA group ($P < 0.05$). Schroeder and Langsdon[18] reported no statistically significant difference in rates of minor hematoma, major hematoma, Nitro-bid (Savage Laboratories, Melville, NY) use, or thromboembolic events between TXA and control groups.

DISCUSSION

The current body of literature investigating TXA in aesthetic facial plastic surgery is sparse. Our systematic review identified 11 primary sources of investigation, most of which evaluated the use of TXA in rhinoplasty. The LOE among the rhinoplasty studies was high, with each study representing an evidence level 1 or 2 randomized control trial. Beikaei et al,[13] Sakallioğlu et al,[16] Eftekharian and Rajabzadeh,[15] and Ghavimi et al[12] all reported significant reductions in intraoperative blood loss with the use of TXA relative to controls. Each of these groups used systemic doses of 1 g PO or 10 mg/kg IV before surgery, which is consistent with the current US Food and Drug Administration guidelines for IV dosing (10 mg/kg, repeated 3 to 4 times daily as needed).[1,23]

While statistically significant reductions in blood loss were realized in the rhinoplasty studies, the mean reduction between the studies was 44 mL, which is not likely to be clinically significant in an otherwise healthy adult patient undergoing elective rhinoplasty. This is supported by Ghavimi et al[12] who found no significant difference in postoperative Hgb and Hct measured 3 days following surgery, despite patients in their study showing a statistically significant difference in intraoperative bleeding between TXA and control groups. Nevertheless, controlling intraoperative bleeding may play a greater role in improving visualization

and allowing the surgeon to conduct a meticulous dissection technique, although this was not quantitatively measured in any study. Thus, the argument for the use of TXA to control intraoperative bleeding in cases, where the overall blood loss is already low (relative to total blood volume) may be justifiable—particularly in surgery such as rhinoplasty where the surgical field anatomically is confined. Eftekharian and Rajabzadeh[15] also reported that the quality of the surgical field was significantly improved with the use of TXA, although this was measured qualitatively using a non-validated grading scale. The only study that did not report a statistically significant reduction in intraoperative bleeding with the use of TXA investigated a lower dose preoperatively (500 mg) than other studies,[14] indicating that larger doses may be required to achieve the desired effect in this population.

The effect of TXA on postoperative edema and ecchymosis was measured in 4 of the 6 existing rhinoplasty studies. Three out of 4 rhinoplasty studies found that TXA significantly reduced postoperative periorbital edema and ecchymosis relative to placebo, although Sakallioğlu et al found that the reduction was not significantly different from patients who received IV methylprednisolone preoperatively. Adding to this, Mehdizadeh et al[20] found dexamethasone and TXA, separately or in combination, showed no statistically significant difference in decreasing periorbital edema or ecchymosis on POD 1, 3, or 7, although one may have expected an additive effect. Ghorbani et al,[14] whose group evaluated the effectiveness of low-dose TXA, also found no difference in postoperative edema and ecchymosis compared with placebo. Taken together, these findings indicate that TXA can significantly reduce postoperative periorbital edema and ecchymosis following rhinoplasty, although this benefit may not be substantially different than perioperative steroids. It is important to note that while the edema and ecchymosis grading scales used were consistent across these studies, the scales themselves are not externally validated.

In the only study to evaluate TXA in blepharoplasty, Sagiv et al[19] found that subcutaneous injection of 1 cc of 2% lidocaine with 1 cc of TXA [100 mg/mL] did not significantly reduce periorbital edema on any POD 0-7 relative to controls. The authors did, however, note a trend toward significance in the TXA group on POD 7, and the argument could be made that the study was underpowered to derive statistical significance. Additionally, many of the postoperative photographs used to assess for edema and ecchymosis were obtained by patients on their mobile devices, which although may have been convenient for patients, introduces significant variability and bias. Furthermore, this study did not indicate how many patient photographs were sent by the patients and how many of those were evaluated, calling into question a potential selection bias on behalf of the reviewers.

Perhaps, a more convincing use case for TXA in aesthetic facial plastic surgery is rhytidectomy, where intraoperative blood loss and postoperative edema and ecchymosis are realized to a greater degree than following rhinoplasty or blepharoplasty, and where the frequent use of postoperative drains allows for greater quantification of effect. Among the 4 rhytidectomy studies, 2 groups retrospectively evaluated the effect of TXA mixed with injectable tumescent. Couto et al[21] found that 1.5 mL of TXA (100 mg/mL) mixed into a tumescent solution of 150 cc of 0.5% lidocaine with 1:200,000 epinephrine injected subcutaneously into the face and neck before rhytidectomy resulted in a significant reduction in time to achieve hemostasis as well as in total operative time. One explanation for this phenomenon may be the interplay of TXA with epinephrine. While epinephrine is a potent vasoconstrictor, its effect is temporary and reversable. As such, it is possible that the epinephrine effect may still be present at the time of wound closure, particularly for the rapid surgeon. In these situations, a transected vessel that would otherwise require hemostasis may go unnoticed before the wound is closed, and once the epinephrine effect has worn off, rebound bleeding may occur. Rebound bleeding has been reported to be a common cause for postoperative facelift hematoma,[21] and eliminating epinephrine from infiltrating solution has been shown to significantly reduce the facelift hematoma rate.[24,25] Rebound bleeding may also be the mechanism by which second side closures in rhytidectomy typically last longer and require more hemostasis than the first side, as there has been more time for the vasoconstrictive effect of epinephrine to dissipate. Nevertheless, Couto et al[21] found no statistical difference between time to close either side of the face, indicating that the rebound bleeding seen with epinephrine is possibly negated by the addition of TXA. No significant difference in hematoma rates was seen with the addition of TXA in their series. Clearly, the extent to which the combination of TXA and epinephrine contributes to intraoperative hemostasis requires further investigation.

Schroeder and Langsdon[18] also retrospectively evaluated injectable TXA in rhytidectomy. They both found that adding 100 mg TXA to every 10 cc of local anesthetic and tumescent solution (final concentration of 9.1 mg/mL) resulted in a significant decrease in average POD1 drain output ($P<0.001$), reduced time to drain removal ($P=0.001$), and increased percentage in patient's whose drains were deemed safe for removal on POD1 ($P<0.001$). No statistically significant difference in the rates of minor hematoma, major hematoma, Nitro-bid use, or thromboembolic events was noted between the groups. While the retrospective nature of this study has an inherent bias, the objectivity of the data collected, and analysis performed produce a compelling argument for the use of TXA in tumescent

solution. Furthermore, not only is a reduction in POD1 drain output from 50.4 cc in the control group to 14.8 cc in the TXA clinically significant, but also the increase in POD1 drain removal from 34.4% in the control group to 77.3% in the TXA group is (although not directly measured in this study) likely correlated with increased patient satisfaction, which is paramount to the physician–patient relationship. Notably, the concentration of TXA in their study was substantially higher than that used by Couto et al.[21]

Intravenous TXA in rhytidectomy patients was recently evaluated by Cohen et al[17] in a randomized, blinded, placebo-controlled trial. In their study of 44 patients, surgeon-rated postoperative ecchymosis was significantly reduced with the administration of 1 g TXA IV preoperatively and again 4 hours later. No significant differences were realized in patient-rated ecchymosis, patient-rated edema, surgeon rated-edema, or intraoperative bleeding. Despite these findings, inadequate patient standardization between groups, subjective grading of intraoperative bleeding, and lack of validated objective grading systems for postoperative edema and ecchymosis in rhytidectomy patients limit the consistency of outcome measurements in this study and call into question the clinical reliability of their conclusions. Systemic TXA did objectively reduce the rate of postoperative serosanguinous fluid collections from 29% in the control group to 4% with TXA ($P < 0.05$), although a nearly 29% fluid collection rate in the control group is far above the 4% rate quoted in the literature following deep plane rhytidectomy.[26]

Butz and Geldner[22] were the only group in the rhytidectomy cohort to evaluate the effect of topical TXA on edema and ecchymosis. In their series of 57 patients, they found subjective improvements in postoperative edema and ecchymosis when TXA was applied to the undersurface of elevated skin flaps during SMAS plication rhytidectomy. After the SMAS plication was performed and hemostasis obtained using bipolar cautery, TXA-soaked pledgets were placed under the skin flap while the contralateral rhytidectomy flaps were being raised. This was repeated on the contralateral side while the initial side was closed. The authors reported that patients had less ecchymosis after surgery and returned to work faster, although the LOE was quite low, as the concentration of TXA applied to the pledgets was not reported, and the duration of application was not standardized. This study is also limited by the lack of a validated measurement tool for quantifying edema and ecchymosis following rhytidectomy.

This systematic review is limited by the data provided within each primary investigation source. Heterogenous data across these studies, including TXA dosages, TXA concentrations, and outcomes measured, prevented effective meta-analysis. This systematic review was also limited to studies published in the English language, and as such there may be additional primary literature evaluating TXA which was not analyzed. Overall, this review provides the most comprehensive and up-to-date evaluation of primary investigation into the effects of TXA in aesthetic facial plastic surgery with the intention of guiding surgeons toward data-driven surgical practices.

CONCLUSIONS

This systematic review summarizes the primary literature and highlights the current evidence evaluating TXA in aesthetic facial plastic surgery. The current evidence suggests that administration of TXA in standard doses of either 10 mg/kg/dose or 1 g either IV or PO preoperatively or perioperatively during rhinoplasty leads to a significant reduction of intraoperative blood loss. While this reduction in blood loss is likely not hemodynamically significant, it may have the benefit of reducing operative time by enhancing hemostasis and improving surgical site quality. The literature suggests that TXA significantly reduces postoperative edema and ecchymosis following rhinoplasty and rhytidectomy, although its effect may not differ from that of systemically administered corticosteroids, and the lack of validated edema and ecchymosis grading scales for rhytidectomy limits these conclusions. Topical and subcutaneously injected TXA in blepharoplasty and rhytidectomy are emerging routes of administration, although more data are needed to objectively evaluate their efficacy in these settings. The most compelling evidence for the use of TXA in rhytidectomy exists in administering TXA with injectable tumescent, although the quality level of this evidence is marginal. This review also demonstrates the variance dosing when using TXA subcutaneously and highlights the need for further investigation to elucidate the ideal concentration for maximum benefit while ensuring a low-risk profile.

Supplementary Material

This article contains supplementary material located online at www.asjopenforum.com.

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