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Tranexamic Acid in Tumescence for Cervicofacial Rhytidectomies

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Background: Cervicofacial rhytidectomies are one of the most common procedures in the United States. There are many different methods and techniques involved, but all aim to minimize blood loss and procedure time. In our study, we investigated the addition of tranexamic acid (TXA) to tumescent anesthesia during rhytidectomy procedures. Our objective was to analyze the difference in mean procedure time and estimated blood loss in patients undergoing both general and other anesthesia types, with and without the addition of TXA, while maintaining patient safety.
Methods: Seventy-four patients underwent a standard superficial musculoaponeurotic system plication technique rhytidectomy, with 60 patients undergoing general anesthesia and the remaining 14 undergoing other anesthesia types. Forty patients were treated without TXA, whereas the remaining 34 were treated with TXA.
Results: Although the difference was not statistically significant, the addition of TXA resulted in a lower procedure time and estimated blood loss. Within anesthesia type, there was also a slight difference that TXA decreased blood loss and procedure time. We did find that general anesthesia type does significantly impact procedure time and estimated blood loss, when compared with other anesthesia types, independent of TXA use.
Conclusion: The use of tumescent TXA may allow for a faster procedure with less blood loss, although further studies with a larger sample size are needed. *(Plast Reconstr Surg Glob Open 2024; 12:e5540; doi: 10.1097/GOX.0000000000005540; Published online 23 January 2024.)*

INTRODUCTION

Cervicofacial rhytidectomies are one of the most common procedures of the face and neck. Typically, surgeons perform the vast majority of rhytidectomies on an outpatient basis in an office-based surgery setting or at an ambulatory surgery setting. Anesthesia choice (local, conscious sedation, deep sedation, or general anesthesia) depends upon patient and surgeon preference.[1,2]

There are a variety of rhytidectomy techniques, differing in vectors of fixation and amount of dissection.[3] Most surgeons consider the procedures low risk, but there are certain complications that can occur such as excessive bleeding. Excessive intraoperative bleeding can increase surgical time, result in potential hematomas, and can impair the surgeon's vision, which increases the risk of potential nerve injuries.[4] To minimize postoperative bleeding, surgeons have resorted to various measures such as tissue or fibrin glues, pressure dressings, drains, wetting solution infiltrate, and tranexamic acid (TXA).[5]

Hematomas, both major and minor, have a reported occurrence of 0.2%–8%.[5] This event often results in longer recovery times and can lead to a diminution of patient satisfaction.[5]

As mentioned above, TXA is a medication used in minimizing blood loss during facelift procedures. The effectiveness of TXA has been widely accepted across several fields, but the mode of administration differs.[6]

Herein, we describe a technique of tumescent anesthesia that incorporates TXA for rhytidectomy procedures that we propose decreases blood loss and operative times. This method is applicable to patients undergoing local anesthesia, sedation, or general anesthesia.

MATERIALS AND METHODS

The Food and Drug Administration has approved the use of TXA in humans to treat or prevent excessive blood loss from surgery. Advarra institutional review board

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determined that our study met the criteria for health and human services exemption from institutional review board review under category 4: secondary research, for which consent is not required.

Seventy-four patients (nine men, 64 women; average age 62.8, with range from 43 to 81) underwent a rhytidectomy procedure, using a standard SMAS plication technique. From November of 2020 to May of 2022, 60 patients underwent rhytidectomies under general anesthesia and the remaining 14 patients underwent light sedation with versed and fentanyl or oral sedation with alprazolam (hereafter referred to as "other" for anesthesia type).

There were no differences in the groups of patients in each anesthesia group. All patients had no significant co-morbidities other than hypertension. Furthermore, all patients were ASA (American Society of Anesthesia physical status classification system status) I–II. No ASA III patients were included in the group of patients observed. Finally, no patients had evidence of any preexisting bleeding disorders based upon a detailed preoperative evaluation.

In all cases, 180–200 mL of tumescent solution was infiltrated in the subcutaneous plane for the performance of the procedure. In addition to the sedation or general anesthesia, patients underwent infiltration with 10mL of 1% lidocaine with epinephrine 1:100,000 to their incision site and tumescent anesthesia to the subcutaneous tissues of the neck and face with a mixture of 12.5mL of 1% lidocaine, 12.5mL of 0.25% Marcaine, 1mL of 1:1000 epinephrine and 250mL of saline. Before July 2021, patients did not have TXA added to the tumescent solution. Then, starting in July 2021, all patients had 250 mg of TXA added to their tumescent solution for infiltration in a concentration of 1 mg per mL. This concentration was selected to allow for a safe margin for tumescent administration, based upon oral and intravenous dosages supplied by the Food and Drug Administration.[7] A comparable 35 consecutive rhytidectomy patients were selected for review.

Patients were all wrapped with a light pressure dressing after their surgical procedure consisting of woven absorbent gauze and compression bandages to hold the dressing in place. Patients were then seen on the first postoperative day and again at day 7 and day 14 for wound checks and suture removal.

Any complications were noted for the patient population, such as hematomas, major and minor, and return to the operating room for bleeding, infections, or excessive bruising (Table 1). Surgical time refers to the duration of the procedure, measured in minutes. After each procedure, blood loss was estimated in milliliter range using numerically labeled suction containers, which was replaced with the average value for subsequent analysis. No irrigation was used over the course of the procedure, and incisional blood loss was minimal.

Table 1. Incidence of Surgical Complication and Hematoma in Patients Undergoing Surgery with and without TXA

	Tranexamic Acid	No Tranexamic Acid
Complication rate	1.35%	0%
Hematoma rate	0%	1.35%

Takeaways

Question: Does the addition of tumescent anesthesia including an antifibrinolytic decrease the amount of blood loss, and hence, operative time?

Findings: The findings in our patient population showed that there was a tendency for lower blood loss and decreased operative time when tranexamic acid was added to the tumescent mixture used for facelift procedures, although not at a statistically significant level.

Meaning: By adding an antifibrinolytic to the tumescent mixture used during facelifting procedures, blood loss and surgical times may be reduced, resulting in fewer complications after the surgical procedure is completed; however, further studies are warranted.

We performed all calculations and analyses in R, version 3.6.2.[8] We used Shapiro-Wilk, Anderson-Darling, Cramer-von Mises, and Kolmogorov-Smirnov tests to assess normality of the residuals of the two response variables (estimated blood loss and procedure length) using the Olsrr package.[9] Data for procedure length was approximately normal, and a natural log transformation were used to achieve approximate normality for estimated blood loss. We ran separate multi-way analysis of variance (ANOVA) for each response variable, with independent variables of sex, use of TXA (yes/no), patient age, anesthesia type (general or other), and patient incidence of high blood pressure (yes/no) included.

RESULTS

We had minimal complications (one patient with a dislocated jaw) and hematoma rates (one patient with a hematoma) in patients. For patients who had TXA administered, there was a 0% hematoma rate and only a 1.35% complication rate. These rates are comparable to the rates of patients without TXA, who had a 1.35% hematoma rate and a 0% complication rate.

Patients who underwent surgery with TXA showed a slight decrease in total procedure time (153.4 ± 6.1 minutes without TXA use versus 144.6 ± 7.6 minutes with TXA use), though this difference was not statistically significant (Fig. 1 and Table 2). Additionally, we found that average

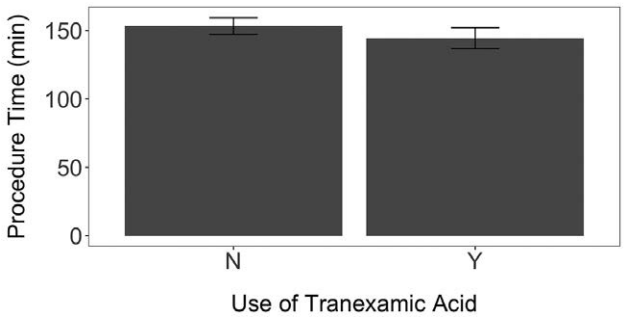

Fig. 1. Mean ± standard error procedure time (min) in patients undergoing rhytidectomies with (Y: yes; n = 34) and without (N: no; n = 40) TXA.

Table 2. Multi-way ANOVA (F-statistics with *P* Values) for Procedural Length Response to Surgical Factors

Variables	*F*	*P*
Age (y)	0.00	0.96
Sex (M/F)	0.86	0.36
TXA (yes/no)	1.06	0.31
High blood pressure (yes/no)	0.41	0.52
Anesthesia type (general/other)	22.85	**<0.001** *

Binary independent variables include sex, use of tranexamic acid, patient incidence of high blood pressure, and type of anesthesia used (general versus other). Value in boldface indicates significant value.
*$P < 0.001$.

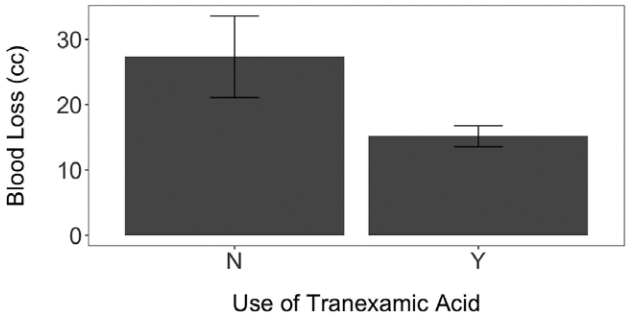

Fig. 2. Mean ± standard error blood loss (mL) in patients undergoing rhytidectomies with (Y: yes; n = 34) and without (N: no; n = 40) TXA.

blood loss was marginally lower in patients undergoing procedures with TXA (15.2 ± 1.6 mL) than patients without TXA (27.3 ± 6.2 mL; Fig. 2 and Table 3). However, this result was not significant as well. When analyzing patients who received the same anesthesia type, there is a slight difference, albeit not significant, that both general anesthesia and the other anesthesia types did have a decrease in estimated blood loss and procedure time with TXA compared with those without TXA. Of note, general anesthesia significantly impacted both total average procedure time and estimated blood loss independent of TXA (Table 4). However, patient age, sex, and incidence of high blood pressure had no significant effect on procedural time or estimated blood loss (Tables 2 and 3).

DISCUSSION

Rhytidectomies remain one of the top five most common cosmetic surgical procedures, often performed in an outpatient setting.[10] In 2020, approximately 234,000 rhytidectomies were performed in the United States. Of those procedures, 92% of patients were women, and the remaining 8% were men.[11] A variety of techniques exist, including subcutaneous facelift, superficial musculoaponeurotic system plication facelift, minimal access cranial suspension lift, deep plane facelift (DPFL), extended superficial musculoaponeurotic system lift, lateral smasectomy, and subperiosteal facelift.[3] Even though these procedures are low risk, certain complications can occur such as bleeding, prolonged edema, alopecia, infection, skin slough, skin loss, numbness, nerve injury, and excessive scarring.[3] Prevention of excessive intraoperative bleeding helps achieve a better outcome while lessening the potential risks of postoperative complications. In addition, intraoperative bleeding can increase the amount of surgical time, as well as result in potential hematomas.[4]

Table 3. Multi-way ANOVA (F-statistics with *P* Values) for Estimated Blood Loss Response to Surgical Factors

Variables	*F*	*P*
Age (y)	2.69	0.10
Sex (M/F)	0.20	0.65
Tranexamic acid (yes/no)	3.20	**0.08** *
High blood pressure (yes/no)	0.91	0.34
Anesthesia type (general/other)	15.29	**<0.001** †

Binary independent variables include sex, use of TXA, patient incidence of high blood pressure, and type of anesthesia used (general versus other). Significant values are shown in boldface.
*$P < 0.1$.
†$P < 0.001$.

Table 4. Mean Procedure Time (Min) and Mean Blood Loss (mL) ± Standard Error of Patients Undergoing Rhytidectomies under General/Other Anesthesia Type with and without Tranexamic Acid

Tranexamic Acid	Anesthesia Type	Procedure Time (± SE)	Blood Loss (± SE)
No	General	164.53 (5.99)	31.02 (7.62)
No	Other	108.88 (6.55)	12.56 (4.03)
Yes	General	153.00 (7.56)	16.95 (1.77)
Yes	Other	105.50 (18.95)	6.83 (0.67)

As such, interest lies in improving the technique and surgical methods to minimize complications and hematomas. Hematomas, both major and minor, are the most common postoperative complication in facelifts.[5] Major hematomas often require a repeat visit to the operative suite to drain the hematoma and achieve hemostasis. Minor hematomas often require frequent aspiration.[12]

TXA is a synthetic analog of the amino acid lysine commonly used to minimize blood loss in a variety of procedures. TXA serves as an antifibrinolytic by reversibly binding four to five lysine receptor sites on plasminogen, therefore decreasing the conversion of plasminogen to plasmin. This process then prevents fibrin degradation and preserves the framework of the fibrin's matrix structure. This action results in improved clotting for the wound bed, allowing for greater fibrin deposition and less bleeding.[6] The effectiveness of TXA has been widely accepted in cardiac, orthopedic, and oral surgery, as well as its use in menstrual blood loss.[6]

TXA continues to gain support for its effectiveness; however, there exists a lack of standardization in administration and dosage. In our study, we propose a technique of utilizing TXA in a tumescent mixture that provides a safe alternative to using drains or tissue/fibrin glue. Although most specialties use TXA in the intravenous or oral form,[13] we have found that it is safe to use TXA intraoperatively by injecting it at the surgical site with the tumescent fluid. The complication rates (Table 1) were comparable between patients who were administered TXA and those who were not. Of the 34 patients who received TXA, there was only one case of a postoperative complication and no

hematomas or excessive bruising. This corroborates with previous studies that adverse outcomes are not directly related to the use of TXA.[14] Further, intravenous administration of TXA periopeatively has even been found to significantly reduce hematoma risk in some procedures.[15] The most effective dosage of TXA in tumescence differs across literature, but in our study, most patients received a dosage of 1 mg of TXA per 1 mL of tumescent solution. Two hundred fifty milligrams of TXA is similar to doses of 1 mg per cc of tumescent solution recommended in the literature.[16] However, Schroeder et al,[17] in their retrospective cohort study on rhytidectomies, used a 9.1 mg of TXA per 1 mL of local and tumescent solution, whereas Cuoto et al,[18] Nayak and Linkov,[19] and Kochuba et al[20] used only 0.75–2 mg per mL TXA in rhytidectomies.[16] Additionally, TXA provides a cost-effective alternative in reducing bleeding volume.[16]

Most of our patients (81%) chose to have their procedures performed under general anesthesia. Our results showed that general anesthesia alone increases procedure time and estimated blood loss. This finding is significant when compared with other anesthesia types, and this difference is independent of TXA use. When looking at solely general anesthesia procedures (without and with TXA), there was a slight decrease in blood loss and procedure time with the addition of TXA. The same finding was found for the other anesthesia types (Table 4). Because our results were not statistically significant, it is only hypothesized that the benefit of using tumescent anesthesia decreased the likelihood of excessive bleeding and complications while maintaining patient safety. However, further studies with a larger controlled population of patients are warranted to make strong conclusions. Furthermore, the use of TXA may increase the safety margin even further than while using tumescent solution alone because no additional complications were noted in this study with the use of TXA, and there was a slight decrease in blood loss intraoperatively, justifying the addition of this medication to the tumescent mixture. This might be even more beneficial in patients who are men and/or have a history of hypertension because the literature suggests that those patients are at a greater risk for bleeding and complications.[3]

We hypothesized that the TXA tumescent mixture would decrease operative times and blood loss. Our results showed that TXA use did decrease procedure time slightly, but was not statistically significant (Fig. 1 and Table 2). Similarly, average blood loss showed a lower average with TXA use (Fig. 2), with TXA having a greater effect on estimated blood loss than procedure time (Table 2 and 3). Once more, this difference was not statistically significant. It is possible that a greater dosage of TXA may lead to further differences in blood loss in operative times when used in conjunction with tumescent solution. However, these results, paired with other investigations on the use of TXA in tumescent mixture suggest the potential efficacy of this method. In a metanalysis study looking at the safety and efficacy of TXA in surgery, it was found that TXA tumescence in rhytidectomies resulted in a reduction in drain output and in operating times.[16] This supports the idea that using TXA in a tumescent solution provides a novel and safe adjunct to performing rhytidectomies. More studies are needed to further test this method as well as provide insight on the most effective dosage including different dosage regimens.

CONCLUSIONS

Tumescent anesthesia is a safe method for assisting in rhytidectomy procedures, for both general anesthesia and other types of sedation. This method of TXA in tumescent anesthesia was found to slightly decrease mean procedure time and average blood loss, but not at a statistically significant level. This study suggests that tumescent TXA may allow for less bleeding, thus leading to fewer complications and less bruising postoperatively. In our hands, the addition of TXA may further augment this process in a safe and cost-effective manner, although additional studies are warranted with larger patient populations to further corroborate these findings.

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DISCLOSURE

The authors have no financial interest to declare in relation to the content of this article.

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