

# Topical Application of Tranexamic Acid in Abdominoplasties Leads to Lower Drainage Volume and Earlier Drain Removal

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**Background:** Tranexamic acid (TXA) is an antifibrinolytic agent that is successfully used in many medical fields to reduce blood loss. In plastic surgery, the systemic administration of TXA has been associated with less hematoma and seroma formation, and consequently, a reduction in the length of hospital stay (LOS). The aim of this study was to evaluate if the topical administration of TXA in patients undergoing abdominoplasty leads to a decrease in the daily drainage volume; earlier drain removal; and possibly, a shorter LOS.

**Methods:** In this single-center, comparative study, 60 patients undergoing abdominoplasty received either topical TXA treatment (n = 30; 1g) or no treatment (n = 30). The primary endpoints were daily drainage volume, time until drain removal, and total LOS. Variables such as sex, age, body mass index, weight of resected skin and underlying fat, and concomitant liposuction were considered in the statistical analysis as covariates.

**Results:** In the TXA group, 54% less total drainage volume was observed ( $P < 0.01$ ). The time until drain removal and LOS were reduced by 23% ( $P < 0.01$ ) and 24% ( $P < 0.01$ ), respectively, compared with the control group. Moreover, it was found that daily drainage volume increased with age.

**Conclusions:** Topical TXA administration reduces daily drainage volume, time until drain removal, and LOS significantly in patients undergoing abdominoplasty. Further studies analyzing the superiority of topical TXA compared with systemic TXA, as well as studies investigating the ideal TXA dosage could deliver further valuable information. (*Plast Reconstr Surg Glob Open* 2025;13:e6799; doi: [10.1097/GOX.0000000000006799](https://doi.org/10.1097/GOX.0000000000006799); Published online 20 May 2025.)

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## INTRODUCTION

Abdominoplasty is one of the most common plastic surgical interventions, considering also its numerous indications, including the aesthetic improvement of body contour, the removal of excess skin postbariatric surgery, and as a harvest site for abdominal flaps (eg, deep inferior epigastric artery perforator [DIEP] flap, mainly for breast reconstruction).<sup>1</sup> In this regard, hematoma and seroma are common complications and may occur in up to 33% of patients.<sup>2</sup> In this type of surgery in particular, which is usually performed on healthy and young patients on an elective basis, these types of complications are feared and should be prevented as far as possible.

Tranexamic acid (TXA) is an antifibrinolytic agent and is widely used nowadays in the fields of trauma, postpartum hemorrhage, and cardiothoracic and orthopedic surgery to minimize blood loss.<sup>3</sup> It acts by decreasing the conversion of plasminogen into plasmin and by directly inhibiting plasmin.<sup>4,5</sup>

Disclosure statements are at the end of this article, following the correspondence information.

The use of TXA has also been extended to plastic and reconstructive surgery in recent years.<sup>6–9</sup> In breast surgery, as well as in aesthetic and body contouring surgery, the intravenous administration of TXA has proven to reduce intra- and postsurgical bleeding and the need for blood transfusions, without increasing thromboembolic risk.<sup>10–12</sup>

In abdominoplasties, in particular, a significant reduction in seroma formation and subsequent postoperative aspiration was found after intravenous TXA administration.<sup>13</sup> In addition, there was a reduction in drainage volume within 24 hours and total fluid production to be drained, a shorter time until drain removal, as well as a shorter length of hospital stay (LOS) in patients undergoing “fleur-de-lis” abdominoplasty and abdominal dermolipectomy with intravenously administered TXA.<sup>14</sup> However, it is to be noted that the systemic administration of TXA in some patients is contraindicated, such as in the event of previous or current thromboembolic events. It has been demonstrated that intravenous TXA concentrations were lower after topical application compared with intravenous administration with equal dosages of TXA,<sup>15,16</sup> resulting in a reduced risk of thromboembolic side effects.<sup>16,17</sup> To date, TXA administration in soft tissue surgery has shown comparable efficacy, irrespective of whether it is administered systemically or topically.<sup>18,19</sup> However, it is currently unclear which method of administering TXA produces the best results due to a lack of data. More specifically, the efficacy of topical TXA application in abdominoplasties has not yet been evaluated. This study aimed to evaluate whether topically administered TXA in patients undergoing abdominoplasty results in a reduced drainage volume; a shorter time until drain removal; and eventually, a shorter LOS compared with surgery without any TXA treatment.

## MATERIAL AND METHODS

This single-center, comparative study included 60 patients who underwent abdominoplasty. First, the umbilicus was isolated, and thereafter the skin and subcutaneous tissue were detached from the epi-muscular fascia, beginning at the suprapubic crease and reaching more or less laterally to the costal arch and medially to the xiphoid bone. Then the rectus abdominis muscles were reapproximated—if diastasis was present—and the umbilicus reinserted. Finally, the adipo-cutaneous excess was excised caudally to allow for a tension-free layered closure. Surgical dissection was performed using electrocautery; no quilting sutures were used. Two drains (10 Ch) were always placed at the end of the surgical procedure. In the intervention group ( $n = 30$ ), 1 g of TXA diluted with 20 mL of 0.9% sodium chloride was injected through the 2 surgical drains that were kept closed for 20 minutes. The control group consisted of a matched group of 30 patients who underwent the same procedure, but did not receive any topical TXA. Therefore, after the surgical site was closed, the drains were opened immediately. The primary outcomes evaluated were drainage volume, time until drain removal, and LOS. Drainage volume was calculated as the total amount of liquid collected from surgery until drain removal and was measured on a daily

## Takeaways

**Question:** Does topical tranexamic acid (TXA, 1 g) lead to a reduced drainage volume and to an earlier drain removal in patients undergoing abdominoplasty?

**Findings:** In this single-center, comparative study, 60 patients undergoing abdominoplasty received either topical TXA treatment ( $n = 30$ ; 1 g) or no treatment ( $n = 30$ ). In the TXA group, 54% less total drainage volume was observed ( $P < 0.01$ ), and the time until drain removal and length of hospital stay were reduced by 23% ( $P < 0.01$ ) and 24% ( $P < 0.01$ ), respectively, compared with the control group.

**Meaning:** Topical TXA may be considered to reduce drainage volume in abdominoplasty.

basis, that is, every 24 hours, always in the morning. Drains were removed once drainage output had reached approximately 30 mL or less in 24 hours. Patients were discharged from the hospital only after drain removal.

Topical TXA application in abdominoplasties was initiated in 2022 in the hospitals listed in this study, based on the personal experience of the team members. Accordingly, the control group consisted of patients operated on before 2022, and the intervention group consisted of patients operated on after that time. All the patients underwent surgery between June 2020 and September 2023. Variables such as sex, age, body mass index (BMI), weight of resected skin and subcutaneous tissue, and concomitant liposuction were considered in the statistical analysis as possible confounders. The patients were classified into subgroups depending on the type of abdominoplasty they underwent (conventional [ie, without vertical component] versus fleur-de-lis [ie, with vertical component] versus abdominal closure after flap-based breast reconstruction using the DIEP flap) and the type of indication (aesthetic versus postbariatric versus reconstructive, if the donor site was closed after DIEP flap harvest).

All the patients agreed to participate in the study, which was carried out according to the principles of the Declaration of Helsinki. The study was approved by the local ethics committee (BASEC-2022-00964).

## Statistical Analysis

Quantitative data were presented as mean with SD or as median with the 25th and 75th percentiles, as appropriate, and qualitative data as absolute numbers with the corresponding percentages. The different variables between patients receiving TXA and patients not receiving TXA were compared using the Student *t* test, Mann-Whitney test, chi-square test, or Fisher exact test, as appropriate. Due to the nonrandom allocation of patients to treatment (TXA) and control, a multiple linear regression model was used to identify adjusted predictors of LOS and predictors of time until drain removal. To assess the impact of TXA administration on daily fluid drainage from the surgical site, a multivariable linear mixed-effects regression model was used. This regression model with random effects on the intercept accounting for patients enabled adjusted

regression coefficients to be obtained and predictors independently associated with the outcome of interest to be identified. Regression coefficients and the corresponding 95% confidence intervals were presented for all regression models. All statistical tests were performed 2-sidedly, and a *P* value less than 0.05 was considered statistically significant. Statistical analysis was performed using Stata version 17.0 software (StataCorp LP, College Station, TX).

## RESULTS

The patients in the intervention group (*n* = 30) had a mean age of 55 ( $\pm$  9) years, compared with 54 ( $\pm$  11) years in the control group (*n* = 30). The mean weight of resected skin and subcutaneous tissue was 1022 ( $\pm$  819) g in the control group and 1243 ( $\pm$  940) g in the intervention group. Additional liposuction was performed in only 1 patient in the intervention group.

A 54% reduction in the total drainage volume was observed when the groups were compared (261  $\pm$  165 mL

in the intervention group versus 573  $\pm$  438 mL in the control group, *P* < 0.01). The time until drain removal was reduced by 23% (4.4  $\pm$  1.0 d in the intervention group versus 5.7  $\pm$  1.8 d in the control group, *P* < 0.01). Finally, LOS was reduced by 24% (5.2  $\pm$  1.1 d in the intervention group versus 6.8  $\pm$  2.5 d in the control group, *P* < 0.01). Further demographic data and details on the indications of the abdominoplasty procedure and surgical technique are presented in Table 1.

Sex (*P* = 0.31), age (*P* = 0.93), BMI (*P* = 0.95), weight of resected skin and subcutaneous tissue (*P* = 0.69), and liposuction (*P* = 0.35) did not influence the LOS. Topical TXA was shown to significantly reduce LOS in the multiple linear regression results (*P* = 0.02). A breast reconstruction procedure using the DIEP flap as an indication for the abdominoplasty procedure led to a longer hospitalization compared with the other indications and techniques. An overview of the potential predictor variables associated with LOS is provided in Table 2.

**Table 1. Patients' Demographics and Unadjusted Study Outcomes**

Variables	TXA ( <i>n</i> = 30)	No TXA ( <i>n</i> = 30)	<i>P</i>
Age, y, mean $\pm$ SD	55 $\pm$ 9	54 $\pm$ 11	0.94
BMI, kg/m <sup>2</sup> , mean $\pm$ SD	26.2 $\pm$ 4.5	24.65 $\pm$ 4.5	0.15
Sex, no. female	29	29	1.00
History of thromboembolic event, no.	0	2	0.49
Abdominoplasty indication, no.			0.03
DIEP-flap BR	13	23	
Postbariatric	16	6	
Aesthetic	1	1	
Abdominoplasty technique, no.			0.02
DIEP-flap DS closure	13	23	
Conventional	15	7	
Fleur-de-lis	2	0	
Weight of resected skin and subcutaneous tissue, g, mean $\pm$ SD	1243 $\pm$ 940	1022 $\pm$ 819	0.25
Additional liposuction, no.	1	0	1.00
Drainage volume, mL	261 $\pm$ 165	573 $\pm$ 438	<0.01
Time until drain removal, d	4.4 $\pm$ 1.0	5.7 $\pm$ 1.8	<0.01
LOS, d	5.2 $\pm$ 1.1	6.8 $\pm$ 2.6	<0.01

BR, breast reconstruction; DS, donor site.

**Table 2. Potential Predictor Variables Associated With LOS**

Variables	Simple Linear Regression			Multiple Linear Regression		
	RC	95% CI	<i>P</i>	RC	95% CI	<i>P</i>
Sex	-1.6	-4.6 to 1.5	0.31	-1.2	-4.2 to 1.8	0.44
Age	-0.0	-0.1 to 0.1	0.93	0.00	-0.1 to 0.1	0.82
BMI	-0.0	-0.1 to 0.1	0.95			
Topical TXA	-1.6	-2.6 to -0.6	<0.01	-1.3	-2.4 to 0.2	0.02
Abdominoplasty indication						
DIEP-flap BR						
Postbariatric	-1.4	-2.5 to -0.4	0.01	-0.9	-2.0 to 0.3	0.15
Aesthetic	-2.6	-5.5 to 0.3	0.08	-2.4	-5.3 to 0.5	0.10
Abdominoplasty technique						
Conventional						
DIEP-flap DS closure	1.4	0.4-2.5	0.01			
Fleur-de-lis	-1.2	-4.1 to 1.8	0.43			
Weight of resected skin and subcutaneous tissue	0.0	-0.0 to 0.0	0.69			
Liposuction	-2.0	-6.3 to 2.2	0.35			

BR, breast reconstruction; DS, donor site; RC, regression coefficient in days; 95% CI, 95% confidence interval.

With regard to the time until drain removal, sex ( $P = 0.36$ ), age ( $P = 0.36$ ), BMI ( $P = 0.47$ ), weight of resected skin and subcutaneous tissue ( $P = 0.19$ ), and liposuction ( $P = 0.52$ ) had no significant influence, whereas topical TXA significantly correlated with a reduced time until drain removal in the multiple linear regression results ( $P < 0.01$ ). The potential predictor variables associated with the time until drain removal are reported in Table 3.

Sex ( $P = 0.64$ ), BMI ( $P = 0.85$ ), weight of resected skin and subcutaneous tissue ( $P = 0.44$ ), and liposuction ( $P = 0.77$ ) did not significantly influence drainage volume. However, the drainage volume increased significantly with age according to the multiple linear regression results ( $P = 0.02$ ). Topical TXA significantly reduced the amount of fluid drained on a daily basis in the multiple linear regression results ( $P = 0.01$ ). The variables associated with daily fluid drainage are presented in Table 4.

## DISCUSSION

This study showed that topically applied TXA in abdominoplasties results in a significant reduction in drain fluid

production (54%) and time until drain removal (23%), as well as a decrease in the LOS (24%), both in the simple linear and in the multiple linear regression models. Earlier drain removal and earlier patient discharge may not only improve patient comfort, but also reduce the socioeconomic burden on the healthcare system, because patients receiving topical TXA are discharged from the hospital several days earlier. Decreasing the retention time of drains can reduce drain-related side effects or complications, such as pain and infection. In this regard, drainless abdominoplasty using progressive tension sutures to reduce seroma has been described in the literature.<sup>20–23</sup> The use of topical TXA might, therefore, be interesting especially for plastic surgeons not performing this technique. Interestingly, in this study, BMI was not found to influence the outcome measures, whereas advanced age correlated with a higher daily drainage output. In this regard, a correlation between advanced age and increased risk of seroma formation has been previously described in the literature.<sup>24–26</sup> The presence of hypertension, and, therefore, more exudate, diabetes mellitus type 2 as a

**Table 3. Potential Predictor Variables Associated With Time Until Drain Removal**

Variables	Simple Linear Regression			Multiple Linear Regression		
	RC	95% CI	P	RC	95% CI	P
Sex	−1.1	−3.4 to 1.3	0.36	−1.2	−3.4 to 1.0	0.28
Age	0.0	−0.0 to 0.1	0.36	0.0	−0.0 to 0.1	0.23
BMI	0.0	−0.1 to 0.1	0.47			
Topical TXA	−1.3	−2.1 to −0.6	<0.01	−1.2	−2.0 to −0.4	<0.01
Abdominoplasty indication						
DIEP-flap BR						
Postbariatric	−0.6	−1.5 to 0.2	0.16	−0.3	−2.5 to 1.9	0.77
Aesthetic	−1.3	−3.6 to 1.0	0.27	0.7	−0.3 to 1.6	0.17
Abdominoplasty technique						
Conventional						
DIEP-flap DS closure	0.6	−0.2 to 1.5	0.16			
Fleur de lis	−0.7	−3.1 to 1.7	0.57			
Weight of resected skin and subcutaneous tissue	0.0	−0.00 to 0.00	0.19			
Liposuction	−1.1	−4.3 to 2.2	0.52			

BR, breast reconstruction; DS, donor site; RC, regression coefficient in days; 95% CI, 95% confidence interval.

**Table 4. Simple and Multiple Linear Mixed-effects Models for Potential Predictor Variables Associated With Daily Drainage Volume With Random Effect by Patients**

Variables	Simple Linear Regression			Multiple Linear Regression		
	RC	95% CI	P	RC	95% CI	P
Sex	−11.0	−57.4 to 35.3	0.64	−17.7	−61.6 to 26.2	0.43
Age	0.8	0.0–1.6	0.05	1.0	0.2–1.7	0.02
BMI	0.2	−1.7 to 2.0	0.85			
Topical TXA	−28.5	−43.5 to −13.4	<0.01	−22.3	−38.7 to −5.8	0.01
Abdominoplasty indication						
DIEP-flap BR						
Postbariatric	−13.8	−30.9 to 3.3	0.11	−11.5	−29.7 to 6.7	0.21
Aesthetic	−21.5	−67.2 to 24.3	0.36	−10.5	−52.1 to 31.1	0.62
Abdominoplasty technique						
Conventional						
DIEP-flap DS closure	13.5	−3.5 to 30.6	0.12			
Fleur de lis	−11.1	−57.6 to 35.4	0.64			
Weight of resected skin and subcutaneous tissue	0.0	−0.0 to 0.0	0.44			
Liposuction	−9.9	−75.0 to 55.2	0.77			

BR, breast reconstruction; DS, donor site; RC, regression coefficient in days; 95% CI, 95% confidence interval.



comorbidity, and immunologic dysfunction, have been postulated to be some of the causes that may associate increased age with higher seroma risk.<sup>24</sup>

Breast reconstruction using a DIEP flap and abdominoplasty as the donor site closure has been shown to correlate with a longer LOS compared with abdominoplasties performed in postbariatric patients or for aesthetic reasons. In this regard, it must be considered that this prolonged LOS is also due to the reconstructed breast as an additional surgical site and the need for flap monitoring.

Initially, TXA was used predominantly in traumatology, gynecology, and cardiothoracic surgery because of its ability to significantly reduce the risk of major hemorrhage.<sup>27–29</sup> Nowadays, the indications of both systemic and topical administration of TXA have also increased in elective surgery,<sup>3,30</sup> because there is increasing evidence of its beneficial effects on the prevention of bleeding and reduction of seroma formation.<sup>3,10,12,29–31</sup> Accordingly, the systemic and topical administration of TXA have also been tested in different kinds of procedures often performed by plastic surgeons, including body contouring or breast surgery.<sup>7,8,10,31–33</sup> In this regard, Ausen et al<sup>9</sup> described a significant reduction in drain fluid production (33%) in patients undergoing mastectomy, in a comparison of patients receiving 500mg of topical TXA and patients receiving 0.9% sodium chloride (placebo). Rifkin et al<sup>34</sup> evaluated the systemic administration of 1g of TXA both before and at the end of surgery in 851 patients undergoing gender-affirming mastectomies. The authors observed a significantly reduced rate of hematoma and seroma formation.<sup>34</sup> Yao et al<sup>35</sup> compared the topical application of 1g of TXA before wound closure to the use of saline solution only in 98 patients undergoing reduction mammoplasty, finding no significant reduction in hematoma formation or drainage output. The different findings of these studies may suggest the superiority of intravenous TXA administration. In fact, a meta-analysis performed by Liechti et al,<sup>12</sup> including 1139 patients, showed that perioperative intravenous TXA administration (studies reporting different doses from 1000 to 2000 mg or 15 mg/kg to 1000 to 3000 mg/d over 24 h and up to 5 d postoperatively) reduced hematoma and seroma formation compared with no TXA administration at all.

Elena Scarafoni<sup>36</sup> demonstrated the benefits of TXA in reducing perioperative blood loss, regardless of its administration route (intravenous, topical, subcutaneous, and oral) in a systematic review. Furthermore, they were able to show that there was no increase in thromboembolic risk.<sup>36</sup> Mess and Stephanos<sup>37</sup> retrospectively observed 4 thromboembolic events (1 deep vein thrombosis and 3 pulmonary embolisms) in 98 cases undergoing abdominoplasty with the concomitant use of TXA and, therefore, advised caution with its use. However, this study had no control group and was retrospective, so the prevalence of a thromboembolic event without TXA is not known.<sup>37</sup> Nowadays, there is in any case a lack of evidence showing an increased thromboembolic risk following TXA application in abdominoplasties, particularly regarding the application route.

The limitations of this study consist, first of all, in not being a double-blinded, randomized controlled trial, that

is, the study is retrospective, and, second, in there being a limited number of patients per group, in general, and per subgroup, in particular. Nevertheless, the effect of TXA was evaluated with specific statistical models that provide reliable and adjusted estimates to have comparable study populations. Finally, a further limitation is the heterogeneity of the subgroups, which is an important confounder. For instance, the abdominoplasty-like donor site closure of the DIEP flap is hardly comparable to an aesthetic abdominoplasty in terms of hospitalization length, because flap monitoring and surgical site at the breast may lengthen the hospitalization. However, drainage volume and time until drain removal can be evaluated independently.

In summary, the role of TXA in plastic surgery, in general, and in abdominoplasties, in particular, is not yet well defined. On the one hand, there is no clear consensus on the dosage of TXA, and there are no studies on large cohorts regarding the advantages of systemically or topically administered TXA, even though comparable effects have been suggested.<sup>18,19</sup> On the other hand, different outcomes are reported in this regard, taking into consideration that all these studies also report on different abdominoplasty techniques.<sup>13,14</sup> The results demonstrated in this study consider the fact that patients underwent conventional abdominoplasty, fleur-de-lis abdominoplasty, or abdominoplasty following the closure of the abdominal DIEP-flap donor site, resulting in a very small number of patients per group. Therefore, larger prospective randomized controlled trials comparing different TXA administration methods and dosages should be carried out, taking into consideration the type and method of surgery.<sup>18,19,38</sup>

## CONCLUSIONS

The findings of this study show that singular administration of topical TXA significantly reduces drainage volume, time until drain removal, and consequently, LOS in patients undergoing an abdominoplasty. Accordingly, this may have an impact on patient comfort and the socioeconomic burden. However, currently, there is no consensus regarding the application method, the ideal TXA dosage, and postoperative continuation of TXA administration, and therefore, further studies are required to better assess the efficacy and safety of TXA.

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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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