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Does Seven Days of Postoperative Enoxaparin Increase Bleeding Risk in Abdominal Contouring Surgery? A Single-center Experience

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Background: Venous thromboembolism (VTE) poses a major risk after abdominal contouring surgery, impacting morbidity and mortality. Despite various preventative strategies, surgeons are cautious about using enoxaparin for extended postoperative periods. This study aims to determine if a 7-day postoperative course of enoxaparin increases bleeding risks compared with a single dose of intraoperative unfractionated heparin in patients undergoing abdominal contouring surgery.

Methods: A retrospective cohort analysis was performed on patients who underwent abdominoplasty or panniculectomy from August 2017 to October 2023. Patients were split into 2 groups: Group 1 received 5000 units of intraoperative unfractionated heparin in addition to 7 days of postoperative enoxaparin (40 mg daily); group 2 received only the intraoperative heparin dose. Primary outcomes included bleeding events and VTE incidence. Secondary outcomes were seroma, infection, surgical site dehiscence, necrosis, drain duration, and reoperation rates.

Results: The study included 121 patients (111 women, 10 men), with 61 patients in group 1 and 60 in group 2. The average age was 49 ± 12 years, and the average body mass index was 29.8 ± 5 kg/m². No cases of VTE were reported. Postoperative bleeding occurred in 3 patients (4.9%) in group I and 2 patients (3.3%) in group 2, showing no statistically significant difference ($P = 0.66$). Secondary outcomes also showed no significant differences between the groups.

Conclusions: Our study of 121 patients undergoing either abdominoplasty or panniculectomy demonstrated that administering enoxaparin for 7 days postoperatively is safe and does not increase the risk of bleeding. *(Plast Reconstr Surg Glob Open 2024; 12:e6407; doi: 10.1097/GOX.0000000000006407; Published online 19 December 2024.)*

INTRODUCTION

Over the past decade, there has been a significant surge in the frequency of abdominal contouring surgery performed by plastic surgeons.[1] According to the American Society of Plastic Surgeons procedure statistics report, there were 161,948 abdominoplasty procedures performed in 2022, reflecting a 37% increase from 2019.[2] Venous thromboembolism (VTE), including deep venous thrombosis (DVT) and pulmonary embolism (PE), constitutes a leading cause of morbidity and mortality after body contouring surgery.[3]

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Grazer and Goldwyn[4] reported a 1.1% incidence of DVT and a 0.8% incidence of PE in abdominoplasty. The rate was up to 3.8% in another study by Winocour et al,[5] and 6.8% when abdominoplasty was combined with another intraabdominal procedure, according to Voss et al.[6] Similarly, a study by Koolen et al[7] reported that abdominal contouring procedures carry a greater risk for VTE when combined with hernial repair, observing a VTE rate of 1.1% in combined procedures compared with only 0.3% in abdominal contouring alone.

To mitigate this risk, the current recommendations are to place sequential compression devices in the operating room with the optional use of chemoprophylaxis after surgery.[8] However, there are no definitive guidelines for the type or duration of chemoprophylaxis. Vasilakis et al[9] compared the use of unfractionated heparin versus low-molecular-weight heparin (ie, enoxaparin) for 7 days following abdominal body contouring

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surgery and found no significant difference in the rate of VTE or postoperative bleeding. The inconvenience associated with the use of heparin is the need for continuous daily injections while the patient is recovering at home. Newer oral factor Xa inhibitors enabled shorter hospital stays, with the added benefit of more reliable prophylaxis, and may be more frequently used by plastic surgeons. In a study of 600 patients undergoing abdominal body contouring surgery, the prophylactic use of rivaroxaban for 7 days was associated with a low rate of DVT (0.3%), PE (0.3%), and postoperative bleeding (2.2%).[10] Similarly, the use of fondaparinux, another factor Xa inhibitor, showed a significant reduction in VTE rate compared with the control group, with a nonsignificant increase in the rate of postoperative bleeding.[11] Morales et al[12] found no significant difference in complications between patients who received oral factor Xa inhibitor (ie, rivaroxaban and apixaban) versus those who received low-molecular-weight heparin, although the bleeding rate was marginally higher in the oral factor Xa inhibitor group. Although enoxaparin has a half-life of 3–4.5 hours after a single injection, factor Xa inhibitors tend to have longer half-lives (5–9 hours). In this study, we present our single academic institution experience with the use of 7 days of enoxaparin postoperatively and compare it with no postoperative chemoprophylaxis.

Takeaways

Question: Does a 7-day postoperative course of enoxaparin 40 mg increase bleeding risks compared with a single dose of intraoperative unfractionated heparin in abdominal contouring surgery?

Findings: This retrospective cohort study analyzed 121 patients undergoing abdominoplasty or panniculectomy, comparing 2 thromboprophylaxis regimens. Results showed no significant difference in bleeding events between the groups, indicating the safety of a 7-day enoxaparin regimen.

Meaning: Administering enoxaparin for 7 days post abdominal contouring surgery is safe and does not increase bleeding risk.

METHODS

Study Design and Population

A retrospective cohort study was conducted at our institution from August 2017 to October 2023. The study evaluated the safety and efficacy of 2 thromboprophylaxis regimens following abdominoplasty or panniculectomy. We included all adult patients aged 18–74 years who underwent these procedures at our institution during the study period. The study protocol was reviewed and approved by the institutional review board. Patients were excluded if they had incomplete medical records or less than 60 days of follow-up; declined to participate in retrospective studies; or received different types of thromboprophylaxis, different durations, or were on long-term anticoagulation therapy for other medical indications.

Thromboprophylaxis Regimens

Perioperative VTE prophylaxis varies among surgeons in our multisurgeon group, tailored to each patient based on the Caprini score, bleeding risk, and individual surgeon preferences. Patient records from the targeted study period were meticulously reviewed to assess the thromboprophylaxis strategies used, resulting in the classification of patients into 2 distinct groups. Group 1 consisted of patients who received an initial dose of 5000 international units of unfractionated heparin subcutaneously at the time of anesthesia induction, followed by a regimen of 40 mg of enoxaparin (Lovenox) administered subcutaneously once daily for 7 days postoperatively. In contrast, group 2 included patients who received only a single dose of 5000 international units of unfractionated heparin subcutaneously during anesthesia induction, without subsequent enoxaparin therapy. As there were no statistically significant differences in patient demographic characteristics between the 2 groups, propensity score matching was unwarranted.

Data Collection

Data were collected retrospectively from our electronic health records. The information extracted included demographic characteristics such as age, body mass index (BMI), ethnicity, and risk factors, including smoking status; diabetes mellitus; dyslipidemia; history of VTE; clotting disorders; and Caprini scores, based on the Caprini risk assessment model (2005). Surgical details recorded included the type of procedure, concomitant liposuction, concomitant breast surgery, any other concomitant procedures (including but not limited to ventral hernia repair, abdominal sacrocolpopexy, buttock lift, and vaginal repair), total anesthesia time (defined as the period from intubation to extubation), whether the patient received intraoperative topical tranexamic acid (TXA), the day of first ambulation, and the duration of hospitalization.

Outcome Measures

Our study's primary outcomes focused on the 60-day incidence of bleeding events and VTE. Bleeding events were defined as hemorrhages with clinical evidence of abdominal hematoma formation, regardless of the management approach. This included assessing whether patients with a hematoma required blood transfusions, based on clinical signs and laboratory results. VTE specifically included PE and DVT. Secondary outcomes included rates of seromas requiring intraoperative surgical or ultrasound-guided drainage, infections needing medical or surgical management, surgical site dehiscence requiring operative management, necrosis requiring operative management, duration of the drain, and overall reoperation. Patient demographic characteristics and clinical outcomes were compared between the 2 groups.

Surgical Protocol

All procedures were performed under general anesthesia. According to our protocol, each patient used a sequential compression device on both calves before the induction of anesthesia, as well as intraoperatively and postoperatively. The duration of use depended on the patient's risk factors for DVT, types of combined procedures, and mobility. Patients were also instructed to limit their activities to daily living levels during the first week, resume low-impact activities by the second week, avoid baths or submerging the surgical incision sites in water for 48 hours, and wear an abdominal binder for approximately 6 weeks. The drain was removed once the daily output was less than 30 mL of serosanguineous fluid over 24 hours for 2 consecutive days. Topical TXA at a 4% concentration, consisting of 3 g of TXA mixed with 75 mL of NaCl 0.9%, was applied using a spray on the surgical site.

Statistical Analysis

Data were analyzed using SPSS Statistics version 28 (IBM Corp.). Continuous variables were tested for normality using the Kolmogorov–Smirnov test. Normally distributed data were analyzed using the independent *t* test, whereas nonnormally distributed data were analyzed using nonparametric tests (Mann-Whitney U test). Categorical data were analyzed using the chi-square test or Fisher exact test, as appropriate. Logistic regression analysis was used to assess the impact of patient characteristics, including smoking status, comorbidities (diabetes, hypertension, clotting disorders, previous VTE cases), dyslipidemia, type of procedure, whether the patient received topical TXA, breast procedures, concomitant liposuction, or other concomitant procedures on the risk of developing primary outcomes.

Results from primary and secondary outcomes comparison and from logistic regression were considered statistically significant at a *P* value of less than 0.05. However, for comparisons involving patient demographics and operation characteristics, a Bonferroni correction was applied to adjust for multiple comparisons, setting the significance threshold at 0.005.

RESULTS

Our study included a total of 121 patients: 61 patients received postoperative chemoprophylaxis (group 1) and 60 did not (group 2). The average age of participants was 49 ± 12 years, with an average BMI of 29.8 ± 5 kg/m². There were 111 women (91.7%) and 10 men (8.3%) in the cohort. Among the total population, 114 (94.2%) were White, 3 (2.5%) were African American, and 4 (3.3%) represented other populations (eg, American Indian and Latino). The patients in the treatment groups were matched in terms of characteristics and risk factors. There were no statistically significant differences between the groups in age, BMI, gender, Caprini score, smoking status, history of hypertension, diabetes mellitus, dyslipidemia, clotting disorders, and previous VTE incidents ($P > 0.005$) (Table 1; Fig. 1).

In regard to operative characteristics, abdominoplasty was performed in 38 patients (62.3%) in group 1 and 24 patients (40%) in group 2 ($P = 0.01$), which is not statistically significant after applying the Bonferroni correction. Panniculectomy was performed in 23 patients (37.7%) in group 1 and 36 patients (60%) in group 2 ($P = 0.014$). Flank liposuction was performed in 28 patients (45.9%) from group 1 and 22 patients (36.7%) from group 2 ($P = 0.3$). Concomitant breast surgery took place in 19 patients (31.1%) from group 1 and 12 patients (20%) from group 2 ($P = 0.16$). Other concomitant procedures were performed on 19 patients (31.1%) in group 1 and 19 patients (31.7%) in group 2 ($P = 0.95$). The median length of anesthesia was longer in group 1, at 6.2 hours

Table 1. Patient Demographics

	Group 1, N = 61	Group 2, N = 60	*P*
Mean age (SD), y	48 (11)	51 (13)	0.20
Sex			0.5
Male	4 (6.6%)	6 (10%)	
Female	57 (93.4%)	54 (90%)	
Mean BMI (SD), kg/m²	28.7 (4.6)	29.7 (5.4)	0.05
Average Caprini risk assessment (SD)	5 (1)	5 (1)	0.79
Range of Caprini score	2–9	2–8	
Caprini score stratified risk			
Low Caprini score (≤4) (%)	17 (27.9%)	22 (36.7%)	
Medium Caprini score (5–6)	34 (55.7%)	25 (41.7%)	
High Caprini score (≥7)	10 (16.4%)	13 (21.7%)	
History of VTE event	2 (3.3%)	2 (3.3%)	0.98
Hypertension	13 (21%)	18 (30%)	0.27
Diabetes mellitus	9 (14%)	13 (21%)	0.32
Dyslipidemia	33 (54%)	27 (45%)	0.31
Smoking			
Active	1 (1.6%)	1 (1.7%)	0.99
Former	4 (6.6%)	13 (21.7%)	
Never smoker	56 (91.8%)	46 (76%)	
Hypercoagulable disorder	0 (0%)	2 (3.3%)	0.15

(interquartile range [IQR] = 4.5–7.9), compared with 4.7 hours (IQR = 3.7–5.7) in group 2 ($P < 0.001$). This difference can be explained by the higher number of concomitant breast procedures in group 1 compared with group 2.

In terms of postoperative care, 60 patients (98.4%) in group 1 received topical TXA compared with 46 patients (76.7%) in group 2, with the difference being significant ($P < 0.001$). The median time to ambulation was 1 day (IQR = 1–1) for group 1 and 0 days (IQR = 0–1) for group 2 ($P = 0.118$). Both groups had a median hospital stay of 1 day ($P = 0.05$). Operative characteristics are detailed in Table 2.

As for the outcomes, no VTE cases were reported in either group. Hematoma incidence was 3 cases (4.9%) in group 1 and 2 cases (3.3%) in group 2 ($P = 0.66$). The need for blood transfusions among patients with hematomas was reported in 2 cases in group 1 (3.2%) and 1 case in group 2 (1.7%) ($P = 0.54$). Operative hematoma evacuation was necessary in 2 cases (3.2%) in group 1 and in 1 case (1.7%) in group 2 ($P = 0.54$). Infection was reported in 1 case in group 1 (1.6%) and 3 cases in group 2 (5%) ($P = 0.3$). Seroma was observed in 1 case in group 1 (1.6%) and 4 cases in group 2 (6.4%) ($P = 0.24$). Dehiscence occurred only in 1 case (1.7%) in group 2 ($P = 0.31$). Neither group 1 nor group 2 exhibited skin necrosis. The median number of days with drains was reported as 14 days (IQR = 9–19) for group 1 and 12 days (IQR = 7.5–16.5) for group 2. This difference was also not statistically significant ($P = 0.33$). This highlights that there were no significant differences in the primary and secondary outcomes between the 2 treatment groups. (Table 3 and Figure 2 summarize the 60-day incidence of complications for both treatment groups).

Logistic regression showed that among all the variables studied, only the presence of concomitant breast procedures significantly predicted the occurrence of abdominal hematoma, with a coefficient of 3.487 ($P = 0.034$) and an odds ratio of 32.6, indicating a substantial increase in the likelihood of hematoma occurrence in patients undergoing breast procedures. Although diabetes, dyslipidemia, and the concomitance of other invasive procedures showed high odds ratios (8.2, 4.5, and 9.2, respectively), they were not statistically significant, indicating a potential but not definitive impact on the outcome. Other variables did not demonstrate either high odds ratios or statistically significant associations.

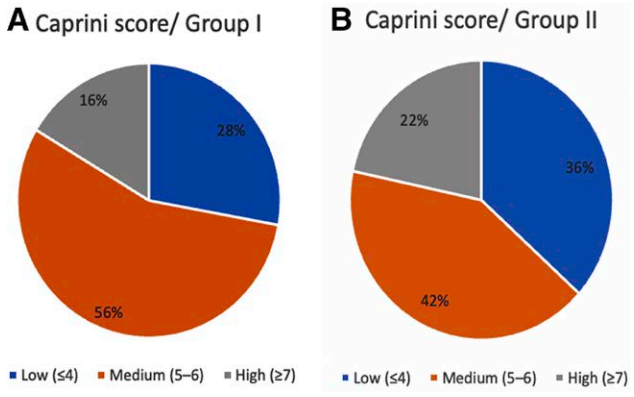

Fig. 1. A, Distribution of Caprini scores in Group 1, categorizing patients into three risk levels for VTE: low risk (Caprini score ≤ 4), medium risk (Caprini score 5–6), and high risk (Caprini score ≥ 7). B, Distribution of Caprini scores in Group 2, following the same categorization.

DISCUSSION

Abdominal contouring procedures are popular elective cosmetic procedures aimed at reshaping the anterior abdomen and waistline. Whether performed alone or as part of other procedures such as breast or other body contouring procedures, optimizing safety is a priority for plastic surgeons.[13] A fine balance between preventing postoperative VTE without increasing the risk of bleeding and consequent wound complications must be achieved.[14]

A study by Ali et al[15] has developed a risk model predicting readmission after panniculectomy and identified DVT as a significant postoperative complication. In our previous published series of 238 patients who underwent panniculectomy with intraoperative unfractionated heparin, the incidence of postoperative VTE was 2.1%.[16] Other studies showed that the incidence could reach 6.8% when abdominoplasty is combined with another complex procedure.[6] Therefore, additional, prolonged chemoprophylaxis may be considered.[8]

In our retrospective cohort single-institution study, the results highlight the safety and efficacy of the 7-day postoperative enoxaparin regimens following abdominoplasty or panniculectomy, showing no significant differences in primary or secondary outcomes compared with the intraoperative unfractionated heparin treatment group. Thromboprophylaxis with enoxaparin can be used

Table 2. Operation Characteristics by Treatment Group

Procedure	Group 1, N = 61	Group 2, N = 60	*P*
Abdominoplasty	38 (62.3%)	24 (40%)	0.01
Panniculectomy	23 (37.7%)	36 (60%)	0.014
Liposuction	28 (45.9%)	22 (36.7%)	0.3
Concomitant breast surgery	19 (31.1%)	12 (20%)	0.16
Other concomitant surgical procedures	19 (31.1%)	19 (31.7%)	0.95
Length of anesthesia (h), median (IQR)	6.2 (4.5–7.9)	4.7 (3.7–5.7)	<0.001
Receiving TXA	60 (98.4%)	46 (76.7%)	<0.001
Length of hospital stay (d), median (IQR)	1 (1–1)	1 (0.5–1.5)	0.05

Table 3. Sixty-day Incidence of Complications

	Group 1, N = 61	Group 2, N = 60	*P*
VTE	0 (0%)	0 (0%)	
Hematoma	3 (4.9%)	2 (3.3%)	0.66
Requiring blood transfusion	2 (3.2%)	1 (1.7%)	0.54
Operative evacuation	2 (3.2%)	1 (1.7%)	0.54
Infection	1 (1.6%)	3 (5%)	0.3
Seroma	1 (1.6%)	4 (6.7%)	0.16
Dehiscence	0 (0%)	1 (1.7%)	0.31
Necrosis	0 (0%)	0 (0%)	
Duration of drain (d), median (IQR)	14 (9–19)	12 (7.5–16.5)	0.337

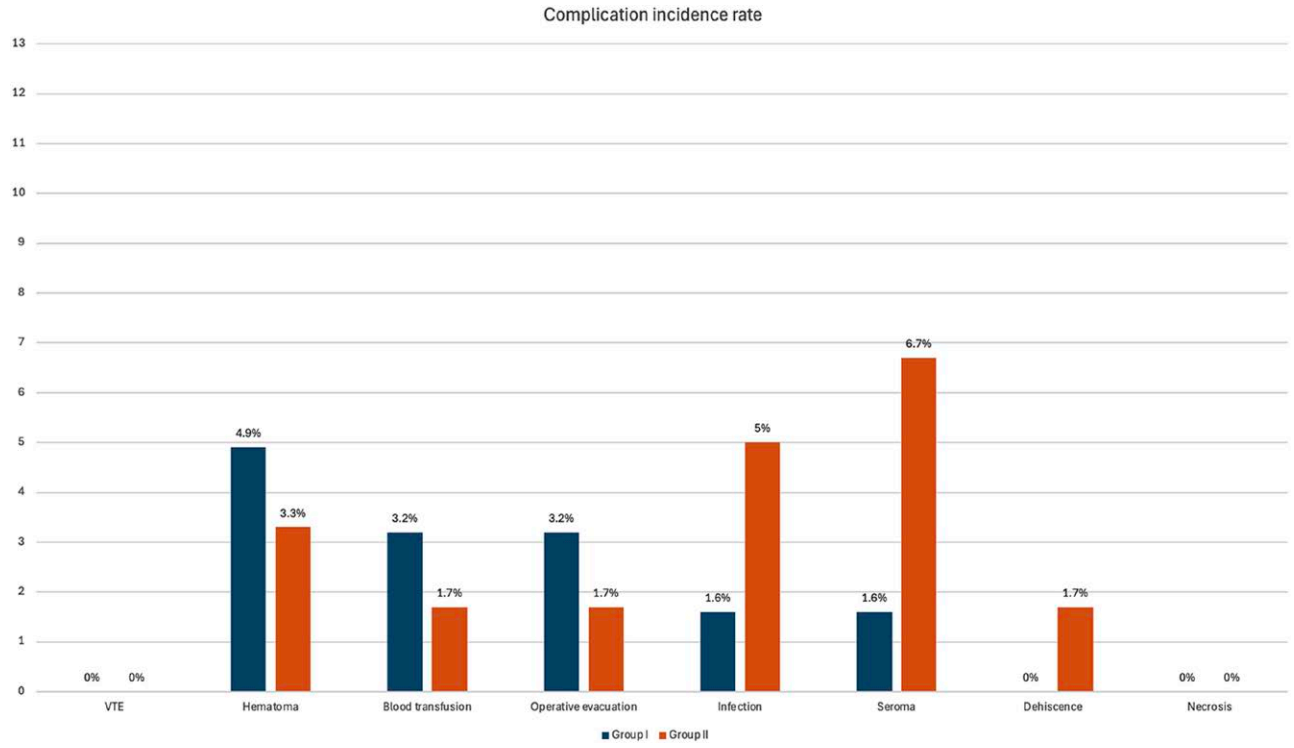

Fig. 2. Difference in incidence rates for each complication between both treatment groups.

to reduce the risk of VTE without significantly increasing the risk of postoperative bleeding. Additionally, our logistic regression analysis indicates that among various predictors, only breast procedures significantly increased the risk of hematoma. This outcome could be due to increased operative time and overall theoretical risk. This finding is supported by a systematic review by Michot et al,[17] which showed that concomitant breast surgery with abdominoplasty increases overall morbidity.

Several studies have investigated the safety profile of multiple chemoprophylaxis regimens following body contouring surgery.[18,19] Campbell et al[8] compared the use of enoxaparin for 2 days postoperatively with intraoperative heparin and found no significant differences in the overall incidence of complications between the 2 groups (19% versus 14% respectively, $P = 0.503$). On the other hand, Hatef et al[3] compared the use of enoxaparin for 6 days in 137 patients who underwent abdominoplasty surgery with 221 patients treated with sequential compression device. They found that although the enoxaparin group showed a statistically significant decrease in VTE rates, it exhibited a higher incidence of bleeding at 7.3% compared with 0.5% in the non-enoxaparin group ($P < 0.001$).[3]

In addition, a study by Sforza et al[20] highlighted the importance of a holistic approach to VTE prophylaxis after abdominoplasty. This approach included several preoperative measures, such as smoking cessation, stopping hormone replacement therapy, maintaining a BMI less than 40 kg/m^2, using compression stockings, and administering enoxaparin. Among the 1078 patients who followed this protocol, there were no recorded cases of DVT or bleeding. This suggests that a comprehensive, procedure-specific approach can significantly reduce the risk of DVT in abdominoplasty surgery. Similarly, Mustoe et al[21] highlighted the role of conscious sedation in reducing postoperative thromboembolic complications compared with general anesthesia. Based on anecdotal observations, the senior author reported never encountering cases of

DVT with patients under conscious sedation. They justified this by noting that under conscious sedation, the preservation of calf muscle pump action and thermoregulatory reflexes eliminates the need for warming blankets or chemoprophylaxis.[21]

Other studies in the literature have examined the safety and efficacy of various types of thromboprophylaxis following abdominal contouring surgery. For example, Vasilakis et al[9] reported that 7 days of rivaroxaban for postoperative abdominal contouring surgery resulted in fewer cases of VTE complications postoperatively compared with intraoperative unfractionated heparin, with no statistically significant difference in bleeding rates. Similarly, Hunstad et al[22] conducted a retrospective case series involving 132 patients who underwent abdominoplasty and received 10 mg of rivaroxaban daily for 7 days. Their outcomes showed that only 1 patient had a symptomatic VTE event (0.76%), and 3 patients developed hematoma (2.3%). The authors noted that this result was comparable to the postabdominoplasty hematoma incidence (3%) reported in the literature.[23] The study conducted by Dini et al[24] revealed an unexpected tragic outcome while exploring the effects of oral rivaroxaban compared with a placebo in patients who underwent abdominoplasty. This randomized control trial included 40 patients who were administered either 10 mg of oral rivaroxaban or a placebo once daily for a duration of 10 days following an abdominoplasty procedure. However, the trial was prematurely terminated due to a significantly high incidence of severe hematoma complications. Notably, 6 of the 27 patients who underwent the surgery developed large hematomas, an issue exclusively observed in the group receiving rivaroxaban. These findings prompted a re-evaluation of the safety protocols associated with the use of rivaroxaban in the context of surgical recovery.[24]

Overall, our study demonstrates that chemo thromboprophylaxis methods can be both effective and safe for patients undergoing abdominal contouring surgery. However, the complexity of choosing the optimal approach remains, as evidenced by varying studies in the literature that report different methods and outcomes. Therefore, larger multicenter studies are still essential to provide a definitive judgment on the most effective and safest prophylactic strategies. Such research would help standardize practices and potentially lead to unified guidelines that could universally improve patient outcomes in cosmetic surgery.

Limitations

This study is subject to several limitations, including its retrospective design, which limits control over confounding variables and introduces potential selection and recall biases. The lack of randomization and the study's single-center nature may affect the generalizability of the findings. Furthermore, the sample size did not meet the 80% power analysis threshold, making it insufficient for detecting small but clinically significant differences. Additionally, although significant associations were observed with breast procedures, the effects of other procedures did not reach statistical significance, pointing to potential limitations due to the sample size. Besides, the absence of VTE events in our study suggests that a larger sample is needed to detect any significant differences in VTE rates. Finally, data collected from electronic health records may introduce information bias, and potential noncompliance with postoperative instructions or loss to follow-up among patients could skew the results.

CONCLUSIONS

In this study of 121 patients undergoing abdominoplasty or panniculectomy with or without a 7-day postoperative enoxaparin thromboprophylaxis regimen, there was no observed increase in the rate of bleeding among the 7-day chemoprophylaxis group. Although the study was not powered to detect significant effects on the rate of VTE, the data collected can be valuable for future systematic reviews that aim to explore VTE risks associated with abdominal contouring surgery.

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DISCLOSURE

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

ETHICAL APPROVAL

The study protocol received approval from our institutional review board under the reference number 23-010860.

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