Venous Thromboembolism in Abdominoplasty: A Comprehensive Approach to Lower Procedural Risk

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Abstract

Background: Venous thromboembolism (VTE) is a serious and potentially life-threatening surgical complication. However, there is little consensus regarding appropriate VTE prophylaxis for plastic surgery patients. Risk factors as they apply to plastic surgery patients are unclear, and recent recommendations for chemoprophylaxis in these patients may expose them to other additional risks.

Objectives: The authors examine perioperative and intraoperative measures, specifically those that have enabled a large number of patients to undergo outpatient abdominoplasty safely, with a reduced risk of VTE.

Methods: A retrospective review was performed of 404 consecutive abdominoplasty patients who were treated at a single outpatient surgery center between 2000 and 2010. Graded compression stockings and intermittent pneumatic compression devices were placed on all patients, and perioperative and intraoperative warming was strictly applied. Progressive tension suturing technique was performed in all cases and drains were eliminated. All patients received pain pumps, ambulated within one hour of surgery, and were discharged home the same day. Patient VTE risk factors were scored with the Caprini/Davison risk assessment model (RAM). Perioperative and intraoperative measures were taken to reduce factors that may increase VTE risk in abdominoplasty. Complications were recorded, including VTE events, seromas, hematomas, and infections.

Results: In this series, 247 abdominoplasty procedures were performed alone and 157 were combined with additional procedures. Under the RAM, 297 patients were considered "high risk" and 17 "highest risk." Abdominoplasty operative time was 100 ± 29 minutes. Only one case of deep vein thrombosis (DVT) occurred, in the calf.

Conclusions: A comprehensive approach to perioperative and intraoperative patient care has allowed outpatient abdominoplasty to be safely performed without VTE chemoprophylaxis in patients with fewer than six risk factors.

Level of Evidence: 4

Keywords

abdominoplasty, body contouring, venous thromboembolism, deep vein thrombosis, patient safety, aesthetic surgery, cosmetic surgery

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Extrapolations from the literature in other subspecialties have resulted in a significant movement toward the administration of VTE chemoprophylaxis in plastic surgery patients. With a lack of clear evidence, however, there is no consensus among plastic surgeons with regard to appropriate VTE prophylaxis. Several others have reviewed their own experiences showing low rates of VTE with significantly different methods of prophylaxis. Despite the lack of consensus and the paucity of data to aid in a safe and effective protocol design, VTE has recently been labeled an adverse event that should “never” occur. As a result, VTE prophylaxis is currently one of the most vigorously debated topics in plastic surgery.

In general, the need for VTE prophylaxis depends on patient-related and procedure-related risk factors. Established guidelines based on general and orthopedic surgery data stratify patients into risk categories from “low risk” to “highest risk” and recommend prophylaxis methods that range from early ambulation to intermittent pneumatic compression (IPC) and, finally, to chemoprophylaxis with anticoagulants. How these risk factors apply to plastic surgery patients has not been well studied and remains controversial.

Our current “best guess” at risk-stratifying plastic surgery patients is the Caprini/Davison risk assessment model (RAM), which assigns a composite score based predominantly on predisposing patient-related risk factors with little consideration given to the risk of the procedure itself. By RAM alone, many “typical” plastic surgery patients achieve scores that suggest the need for chemoprophylaxis, the safety or benefit of which is not clearly established in our field. Although several large studies are currently examining the benefits of chemoprophylaxis in preventing VTE in plastic surgery patients, we believe that a comprehensive approach to modifying procedural risk factors for VTE with continuous quality improvement is a more prudent method for lowering VTE risk during plastic surgery procedures. Our focus has been to maximize general patient safety by improving the efficiency of how care is delivered both perioperatively and intraoperatively.

Abdominoplasty is a common plastic surgery procedure that serves as a good model to study both patient- and procedure-related risk factors for VTE. Historically, body contouring procedures in plastic surgery have been associated with a high risk for VTE. Factors such as pain control, inability to ambulate, drain care, and VTE prophylaxis contributed to the perception of abdominoplasty as a risk-prone inpatient procedure. More recently, there have been many reports demonstrating safe and effective outpatient abdominoplasty techniques.

In this study, we examined the incidence of VTE in a large series of patients who underwent abdominoplasty in an outpatient setting. We describe specific perioperative and intraoperative patient safety measures and technical modifications designed to reduce the procedural risk of abdominoplasty and allow for safe outpatient abdominoplasty surgery without the routine administration of VTE chemoprophylaxis.

**METHODS**

A retrospective chart review was conducted of 404 consecutive abdominoplasty patients treated at a single outpatient surgery center between April 2000 and June 2010. Patients were divided into two groups: those who underwent abdominoplasty alone (including liposuction to the abdomen) and those who underwent abdominoplasty with a concurrent aesthetic surgery procedure. Patient records were specifically examined for VTE risk factors, as per the Caprini/Davison RAM. These included age, operative time, body mass index (BMI), use of hormone therapy or oral contraceptives, recent immobility or vascular disease, and known family or personal history of VTE. The remainder of the data we collected focused on surgical details of their surgery, including procedures performed, technique, resection weight, liposuction volume, and time in recovery room. Complications were recorded and grouped into categories: seroma, hematoma, infection, DVT, PE, and other. Minimum postoperative follow-up was six months. The principles outlined in the Declaration of Helsinki were followed during the completion of this study.

**Perioperative Protocol**

Patients currently taking oral contraceptives or hormone therapy were allowed to continue these. Smokers were required to discontinue tobacco use one month preoperatively. Patients were administered one gram of acetaminophen and 200 milligrams of celecoxib, one hour preoperatively, by mouth. Graded compression stockings (GCS) were applied one hour preoperatively; patients had also been asked to wear these 24 hours per day for one week postoperatively. Intermittent pneumatic compression devices were placed on both lower extremities before the induction of general anesthesia and removed when the patient was discharged from the recovery room. No patients were given chemoprophylaxis. Maintenance of normothermia was a priority. In the preoperative area, patients wore pajamas, a robe, and a hat, and they were covered with an electric warming blanket. The room was always kept warm, at a minimum of 24°C. During surgery, only the operative site was exposed and patients continued to wear their pajamas and hat, if possible. A forced-air warming blanket was placed across the chest and arms or legs, as permitted. All intravenous, tumescent, and irrigation fluids were warmed, along with the saline used to fill any implants. In the recovery area, an electric warming blanket was placed over the
patient. The use of bed pans or other assistive devices is discouraged in recovery; patients were encouraged to ambulate as soon as possible and were discharged two to three hours postoperatively. Routine follow-up for all patients included an office visit on the first postoperative day, followed by visits at one week, three weeks, three months, and six months postoperatively. Our staff was specifically trained in perioperative patient care, including identifying signs and symptoms of VTE.

**Operative Technique**

All nurses and surgical assistants were trained by the operating surgeon and were deemed capable of performing their tasks in an efficient and effective manner. The necessity of performing the procedure in an expeditious manner is understood by the entire team. Surgery was commenced immediately after induction. The abdominal subcutaneous tissues were infiltrated with 1 L of Ringer’s lactate solution, with 1 mL of 1:1000 epinephrine. When necessary, liposuction of the upper abdomen was performed prior to excisional contouring. The abdominoplasty flap was undermined medially to the level of the xiphoid, with limited lateral dissection performed only as needed to achieve appropriate contouring while preserving the vascularity of the flap. In patients with significant laxity of the anterior abdominal wall or rectus diastasis, a barbed suture was run in a continuous fashion to plicate the rectus fascia. The area of fascial plication was a vertical ellipse in shape, with the widest portion at the level of the umbilicus (typically 3-8 cm at this level, depending on the degree of abdominal wall laxity). The goal of plication was to improve contour, but overtightening was avoided. Prior to closure, pain pump catheters were threaded subfascially on either side of the midline. A barbed, progressive tension suture was placed to close the dead space from xiphoid to umbilicus and then to secure both ends of the incision laterally. Scarpa’s fascia was closed with a three-point, barbed suture fixating Scarpa’s layer to the underlying abdominal fascia. No drains were placed.

**RESULTS**

Patient demographics and health-related data are shown in Table 1. Of the 404 total patients, 399 were women and five were men. The average patient age was 43 ± 9 years (range, 19-73 years). The average BMI was 26 ± 5 kg/m² (range, 18-42 kg/m²). Under the RAM, 297 patients were considered “high risk” and 17 were “highest risk.” In the preoperative period, 28 patients were smokers, eight were taking oral contraceptives or hormone therapy, and none had significant medical comorbidities. All patients were seen at least twice within their first 30 days postoperatively. Patients were followed for an average of nine (± eight) months postoperatively.

Of the 404 patients, 266 patients had liposuction of the abdomen and 285 patients required rectus plication. All patients underwent abdominoplasty with umbilical transposition. One hundred fifty-seven of the patients underwent combined procedures (Figure 1): 59 had abdominoplasty combined with breast augmentation, 35 underwent breast reduction, 18 underwent body contouring liposuction in an area other than the abdomen, 53 had mastopexy, and 14 underwent other procedures, including genital surgery, scar revisions, or excisions of skin lesions in addition to abdominoplasty. Operative time was 100 ± 25 minutes for abdominoplasty and 146 ± 35 minutes for combined procedures. Recovery room time was 144 ± 37 minutes.

A single abdominoplasty patient experienced a DVT of the calf on postoperative day 28 (Table 2). Twenty-four patients had abdominal seromas that were aspirated at a routine follow-up visit, whereas one patient elected to return to the operating room for surgical drainage. There were eight wound infections noted overall and no clinically relevant hematomas.

**DISCUSSION**

Despite being considered “high risk” according to the Caprini/Davison RAM, the 404 consecutive abdominoplasty patients in this review demonstrate that a comprehensive approach
emphasizing expeditious surgery, maintenance of normothermia, adequate pain control, early ambulation, and the placement of GCS with IPC can be sufficient to ensure safe outpatient abdominoplasty surgery. Specifically, this series demonstrates an exceedingly low incidence of VTE without chemoprophylaxis.

VTE Risk Assessment and Prophylaxis

Our understanding of VTE risk factors and prophylaxis largely arises from data drawn from literature published in subspecialties other than plastic surgery. The most comprehensive recommendations are reviewed and released every four years by the ACCP.12,13 Unfortunately, although the ACCP guidelines provide the cornerstone of current VTE prophylaxis practice, these guidelines were developed without taking into account patient or procedural data from cosmetic surgery.20

Traditionally, indications to provide patients with VTE prophylaxis have been based on their predisposing risk factors and the risk associated with their current illness or procedure. The type of VTE prophylaxis is then prescribed based on a composite risk estimate. Formal RAM have been proposed by several groups, including the ACCP.2,12,13,21 In most RAM, the risk conferred by the procedure itself is left poorly defined (ie, “minor” vs “major” surgery). Most important, the impact of postoperative bleeding on specific patient populations, such as aesthetic plastic surgery patients, is not considered by these groups.

The Caprini/Davison RAM5 was adapted specifically for plastic surgery. It is divided into “exposing risk factors” (the risk imposed by the surgery itself) and “predisposing risk factors” (the patient’s biological risk). Each factor in both categories is scored and a composite risk assignment of “low” (one factor), “moderate” (two factors), “high” (three or four factors), and “highest” (more than four factors) is assigned. Each of these categories has a proposed prophylaxis regimen ranging from “ambulate three times per day” (for low risk), to “GCS with IPC” (moderate risk), to “GCS with IPC ± chemoprophylaxis” (high/highest risk).

Despite growing acceptance of RAM, the ACCP has recently decided to support another strategy for risk stratification. Patients are now assigned to a major target group, with specific VTE prophylaxis based almost entirely on the procedure(s) being performed; the organization believes that this represents each patient’s principal risk factor.14 This idea supports our position that the type of procedure and interventions employed have significant impact on VTE risk reduction. It is important to note that the Caprini/Davison RAM does not provide a risk score specific for plastic surgery procedures, other than free flap surgery. Instead, a risk score is provided for minor (one point) and major (two points) surgery, as determined by the operative time (minor <45 minutes and major >45 minutes).

The specific VTE risk of procedures performed by plastic surgeons and the methods for ensuring safe surgery have not been well studied. Surveys of ASPS members and recent literature reviews have consistently demonstrated a lack of consensus among plastic surgeons with regard to VTE risk and prophylaxis.3,7,22,23 None of these reviews was able to define specific VTE risk factors in plastic surgery patients or procedures. Hatef et al22 reviewed 360 body contouring patients and examined VTE risk factors, VTE incidence, and the effect of enoxaparin. Although VTE incidence was reduced in circumferential abdominoplasty (ie, belt lipectomy or lower bodylift) with the administration of prophylactic enoxaparin, the authors found a 5.03% overall rate of VTE that did not change with prophylactic enoxaparin administration. However, enoxaparin was associated with a statistically-significant higher rate of hematoma, bleeding requiring transfusion, operative time, estimated operative blood loss, and 24-hour postoperative drain output. Abdominoplasty combined with other procedures (excluding liposuction) and operative time were not significant risk factors for VTE events in that study. BMI greater than 30 and hormone therapy were significant risk factors.

In contrast, Stevens et al10 reviewed their 10-year experience of 519 patients who underwent outpatient abdominoplasty. They administered only IPC for VTE prophylaxis and reported one VTE event. The same group reviewed a series of 268 combined breast and abdominoplasty procedures with no VTE events. Likewise, Spiegelman and Levine17 did not report any VTE events in their study comparing 37 inpatient with 32 outpatient abdominoplasty procedures. In a review of two large national databases, Tracking Operations and Outcomes for Plastic Surgeons

### Table 2. Complications by Procedure Type

<table>
<thead>
<tr>
<th>Complications</th>
<th>n</th>
<th>Seroma, No. (%)</th>
<th>Infection, No. (%)</th>
<th>VTE, No. (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>All</td>
<td>404</td>
<td>25 (6.2)</td>
<td>8 (2)</td>
<td>1 (0.2)</td>
</tr>
<tr>
<td>Abdominoplasty</td>
<td>247</td>
<td>13 (5.3)</td>
<td>6 (2.4)</td>
<td>1 (0.4)</td>
</tr>
<tr>
<td>Combined procedure</td>
<td>157</td>
<td>12 (7.6)</td>
<td>2 (1.3)</td>
<td>0</td>
</tr>
</tbody>
</table>

VTE, venous thromboembolism.

![Figure 1. Types of procedures performed (as a percentage of total cohort n = 404). All patients underwent abdominoplasty in addition to the procedure indicated. “Other” includes genital surgery, scar revision, or excision of skin lesions.](https://academic.oup.com/asj/article-abstract/32/3/322/2801289)
and CosmetAssure, the incidence of VTE was 0.3% and 0.1%, respectively. However, the authors point out that both databases lacked detailed information on surgical risk factors, making it difficult to compare these complication rates with specific patient populations. In addition, the method in which data were collected can lead to underreporting of complications.

A multicenter trial is currently being conducted to look at the efficacy of chemoprophylaxis in plastic surgery patients. This study, however, is examining chemoprophylaxis as a single treatment intervention for all patients and procedures without considering other measures that should be taken to lower risk in these patients. With the focus solely on VTE prevention through chemoprophylaxis, our concern is that surgeons will look to chemoprophylaxis as their main method of prevention without considering other patient safety measures that may be as—or even more—important in reducing VTE risk. Furthermore, the general safety and quality improvement measures we suggest apply broadly to better patient care and not only to VTE risk reduction.

**Patient and Procedure Analysis**

Demographically, our patient population was similar to those reported recently by other authors. Using the Davison/Caprini RAM to risk-stratify patients retrospectively, we found that 74% had three or four risk factors (Figure 2). By this RAM, these patients are classified as “high risk,” with a recommendation for prophylaxis with IPC and consideration of low molecular weight heparin (LMWH). Four percent of our patients had more than four risk factors and were classified as “highest risk,” with a recommendation for prophylaxis with both IPC and chemoprophylaxis. Nine of our patients scored only one point because their only risk factor was minor surgery, as per the Davison/Caprini RAM. The most common risk factors identified in our patients that contributed to their composite score were major surgery (ie, surgery greater than 45 minutes; two points), age 40-60 years (one point), obesity (one point), and oral contraceptive/hormonal therapy (one point). These are typical characteristics seen in most plastic surgery patients, especially those undergoing aesthetic surgery procedures. We did not have any patients with known, high-scoring, single risk factors such as personal history of VTE or inherited/acquired hypercoaguable disorders. Additionally, no patients had a total risk factor score of greater than five in this study. As such, the conclusions of this study are applicable to patients undergoing abdominoplasty with similar risk stratification.

One abdominoplasty patient had a clinically-apparent DVT on postoperative day 28. She presented with calf pain, and the diagnosis was confirmed with Doppler ultrasonography. She was treated for this DVT and did not suffer additional sequelae. This patient had only two risk factors and underwent an abdominoplasty alone, with no unusual circumstances noted. Since our outcome measure was clinically-symptomatic VTE, we acknowledge the likelihood that some of our patients had asymptomatic VTE. However, ultrasonographic screening in all patients is logistically difficult and neither clinically nor economically effective. We have taken what we feel is a more practical approach of investing efforts in training our staff to identify VTE signs and symptoms, as patients may make mention of worrisome symptoms such as “leg swelling and pain,” “difficulty breathing,” “chest discomfort,” and “so on to staff and fail to mention them to the physician. Educating the staff, who spend a significant amount of time interacting with patients, to recognize these problems adds an additional safety measure.

Several recent studies have used RAM to risk-stratify their patients and report their VTE rates. However, these studies either focused on chemoprophylaxis alone without discussion of other patient safety measures or simply did not mention any type of prophylaxis. We believe that our low VTE rate, despite a significant proportion of “high-risk” patients, is secondary to our focus on a comprehensive approach of perioperative and intraoperative patient safety measures and delivery of efficient care.

More recently, a study by Pannucci et al suggested that the incidence of VTE is significantly higher in patients with a composite score of eight or greater. Patients previously considered “high” or “highest” risk by the Caprini/Davison RAM did not have a significantly higher VTE incidence compared with those considered “low” and “moderate” risk and may not require chemoprophylaxis if their composite scores are lower than eight. However, based on the Caprini/Davison RAM, chemoprophylaxis with LMWH should be “considered” for patients who score three or four points (high risk), whereas those with five points and greater (highest risk) should be given LMWH. The effectiveness of these recommendations on VTE incidence reduction has yet to be validated in a plastic surgery population. Unfortunately, recommendations such as “consider” place physicians in a very difficult clinical,
effects may be synergistic. Both should be placed prior to VTE when IPC devices were applied.30 Of facelift patients demonstrated a significant decrease in complication rates among all types of surgical patients31,32 and, in our experience, patients with low VTE risk or those with high bleeding risk remains central to the current recommendations for patients with low VTE risk or those with high bleeding risk.2,12 In our practice, abdominoplasty is performed as an outpatient procedure, and our highly-trained recovery staff work hard to ensure that patients are ambulating comfortably prior to discharge. Simple measures such as discouraging bedpans and the limited administration of intravenous narcotics help encourage patients to ambulate sooner in recovery. We believe that the important goal of early ambulation is much easier to achieve for patients returning home the day of surgery than for those admitted to the hospital.

**Progressive Tension Sutures—No Drains.** Since 2000, our operative technique for abdominoplasty has undergone a progressive evolution. Initially, drains were placed without progressive tension sutures. In 2006, we began placing interrupted, nonabsorbable, progressive tension sutures in combination with drains that were removed on the first postoperative day. A combination of very low drain output with patient discomfort and anxiety over their drains moved us to work toward eliminating drains completely. Drains are a common source of anxiety among all types of surgical patients5,32 and, in our experience, and that of others,33 provide a hindrance to effective and appropriate ambulation in the immediate postoperative period. Other studies have detailed the benefits of progressive tension sutures with similar findings.32,33 In 2008, we began utilizing our current technique for progressive tension sutures with a bidirectional, barbed, absorbable suture (Quill Device, Angiotech Pharmaceuticals, Inc., Vancouver, Canada); this has allowed for an increase in efficiency performing this portion of the surgery. Soon after, we completely eliminated drains. Since adopting this current technique, there has been no significant difference in the incidence of VTE with or without drains. In addition, the incidence of seroma has not changed significantly.

**Maintenance of Normothermia.** We employ multiple methods to keep patients warm perioperatively. The reported benefits of maintaining normothermia perioperatively include reducing surgical site infection, preventing hypothermic coagulopathy and bleeding, and increasing patient comfort.36,37 These measures contribute to safer, more expedient surgery and may also contribute to lowering the patient’s procedure-related VTE risk.38,39

**Pain Control With Subfascial Pain Pump.** All patients receive an ambulatory pain pump that delivers bupivacaine through subfascially placed, fenestrated catheters. The efficacy of pain pumps remains controversial; however, several authors have noted significant benefits in their patients.40,41 Specifically, Mentz et al40 demonstrated that abdominoplasty patients ambulated earlier, returned to normal activities sooner, and rated their recovery as significantly better compared with counterparts who received oral medication alone.

**Operative Time.** In this study, average operative time was 100 minutes for abdominoplasty alone and 146 minutes when combined with other procedures. This was significantly shorter than the times reported in large series of abdominoplasty patients (208-295 minutes),3,22,42 but similar to more recently-reported series of outpatient abdominoplasty procedures with particularly low incidence of complications (111-113 minutes).10,17 Operative time may have been a significant factor in a recent study by Gravante et al,43 who found a significantly higher rate of pulmonary embolism in patients whose procedure lasted more than 140 minutes. Although this has not been well studied in the plastic surgery literature, operative time is a well-known risk factor for increased VTE risk in other surgical patient populations.2,44,45 Indeed, all current RAM broadly refer to operative time as a risk factor to be considered.5,13,46

**Risks of Chemoprophylaxis**

The general trend in both the medical and surgical literature is toward the use of chemoprophylaxis to prevent VTE. However, among plastic surgeons, there remains a strong belief that chemoprophylaxis results in an increased risk of bleeding.5 Specifically, in a recent survey by Clavijo-Alvarez et al,7 50% of ASPS surgeons cited a lack of evidence and 84% cited a perceived increase in hematoma as their reason for avoiding chemoprophylaxis. The evidence is indeed controversial and differs significantly in both quantity and clinical relevance across patient populations. Many studies in both the general and orthopedic surgery literature examining the efficacy of chemoprophylaxis have demonstrated no increase in
major bleeding but a significant increase in “minor hematoma,” an outcome that may represent a more clinically-relevant complication in our patient population. In plastic surgery patients specifically, an increased risk of bleeding with chemoprophylaxis has been shown in both rhytidectomy and abdominoplasty procedures. In addition to bleeding risk, controversy remains as to the specific agent to be administered, time of initiation, and the duration of treatment.

The increased interest in VTE prophylaxis in plastic surgery is, at least in part, due to the recent labeling of VTE as an event that should “never” occur. Although we strive to make every attempt to meet this goal, the recommendations for chemoprophylaxis in most of our patients may be premature and might expose our patients to other significant risks. In addition to the inherent risks of chemoprophylaxis, the evidence concerning its efficacy in preventing VTE in plastic surgery patients remains unconvincing. Murphy et al. studied 243 abdominoplasty patients, all of whom received at least one form of VTE prophylaxis. In this series, two patients suffered pulmonary embolism and one patient experienced a DVT despite placement of both IPC and chemoprophylaxis in all three patients.

**CONCLUSIONS**

In this article, we described our experience applying a comprehensive approach to preventing VTE without chemoprophylaxis in patients undergoing abdominoplasty. We believe that multiple perioperative and intraoperative measures encouraging safe, efficient, and effective surgery can help lower the procedural component of patients’ VTE risk to a level that makes routine chemoprophylaxis unnecessary. It is important to note that patients with more than five risk factors or those with specific, high-scoring, single risk factors may need chemoprophylaxis in addition to a comprehensive patient safety approach during their surgery. Larger prospective studies are needed to properly risk-stratify plastic surgery patients, identify all modifiable risk factors, and evaluate the safety and efficacy of VTE prophylaxis.

**Disclosures**

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**REFERENCES**

17. Spiegelman JI, Levine RH. Abdominoplasty: a comparison of outpatient and inpatient procedures shows that it is a safe and effective procedure for outpatients.

18. Chattar-Cora D, Okoro SA, Barone CM. Abdominoplasty can be performed successfully as an outpatient procedure with minimal morbidity. *Ann Plast Surg* 2008;60:349-352.


