

Deep Venous Thrombosis Prophylaxis



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KEYWORDS

- Abdominoplasty • Venous thromboembolism • VTE • DVT • PE • Deep venous thrombosis
- Pulmonary embolism • Prophylaxis

KEY POINTS

- Abdominoplasty has one of the highest risks for venous thromboembolism events in aesthetic surgery.
- Risk for venous thromboembolism is increased when concurrent intra-abdominal, circumferential, or liposuction procedures are performed with abdominoplasty. However, the data on abdominoplasty combined with liposuction are conflicting.
- There are no specific recommendations for venous thromboembolism risk reduction in abdominoplasty patients. Mechanical and chemical prophylaxis are at the discretion of the surgeon for each individual patient.
- The 2005 Caprini Thrombosis Risk Factor Assessment Form can be useful for risk stratification.

INTRODUCTION

Abdominoplasty is one of the most commonly performed aesthetic procedures in plastic surgery, with more than 130,000 procedures being performed in 2018.¹ Despite being one of the most popular plastic surgery procedures, there is a well-known increased risk of venous thromboembolism (VTE) consisting of deep venous thrombosis (DVT), pulmonary embolism (PE), or both, compared with other commonly performed aesthetic surgery procedures.²

Although the increased risk of abdominoplasty is well known, management of this risk is a contentious subject. The American Society of Plastic Surgeons (ASPS) has released general VTE prevention guidelines for plastic surgery procedures, but specific recommendations for higher-risk procedures such as abdominoplasty do not exist.³ This omission leaves management up to individual surgeons, allowing a wide variation in practices for risk reduction.⁴

INCIDENCE

It is generally accepted that abdominoplasty has an increased risk of VTE events compared with other plastic surgery procedures. The exact risk varies by report in the literature because most articles published on the topic are retrospective reviews of large databases or cumulative data. A recent review of the literature with a combined statistical analysis reported the VTE rate for abdominoplasty alone at 0.34%, or 1 in 3000 procedures.² Another, more recent, study looked at VTE risk using the American Association for Accreditation of Ambulatory Surgery Facilities' Internet Based Quality Assurance Program database and reported an incidence of 0.06% for abdominoplasty alone.⁵

Abdominoplasty is frequently performed concurrently with other procedures, and this has been shown to confer additional risk for VTE. The amount of increased risk depends on the type of procedure performed, with additional risk primarily

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being conferred with intra-abdominal or circumferential procedures.^{2,6,7} Abdominoplasty plus another concurrent plastic surgery procedure (not circumferential or intra-abdominal) does not seem to increase the risk of a VTE event compared with abdominoplasty alone.² In addition, this does not seem to depend on the number of concurrent procedures, with an additional 1 to 3 procedures reportedly having the same level of VTE risk.⁵ The addition of liposuction to the abdominoplasty procedure may be an exception to this statement. The addition of liposuction specifically may increase the risk of a VTE event, although this topic has been greatly debated and reports are conflicting.^{2,5,8}

More definitive evidence has shown that patients are subject to substantially higher risks of a VTE event when there is a concurrent intra-abdominal procedure performed with the abdominoplasty.⁶ For patients undergoing abdominoplasty with a concurrent intra-abdominal procedure, the risk of a VTE event is estimated at 2.17%.² In addition, circumferential abdominoplasty (also known as belt lipectomy) confers a substantially increased risk of VTE events, estimated to be approximately 3.4%.² Surgeons and patients need to be knowledgeable of the risks of VTE events, particularly as they relate to concurrent procedures, in order to offer safe surgery and appropriate care postoperatively.

RISK STRATIFICATION

Potentially Modifiable Risk Factors

Given that abdominoplasty already presents a high risk for VTE events, surgeons must be aware of techniques and scoring models for patient risk stratification in order to inform proper decision making. Abdominoplasty is an elective surgery, providing surgeons with an opportunity to insist on modifiable risk factors being improved before operating. Nonmodifiable risk factors that are present may also need to be addressed preoperatively, which may best be accomplished by including other consultants in the patient work-up before the operation in order to maximize patient safety.

The most commonly referenced and frequently studied score assessment model for VTE risk stratification is the 2005 Caprini Thrombosis Risk Assessment Model (**Fig. 1**).^{9,10} The Caprini score is a weighted risk-assessment model that allows validated risk stratification based on numerous factors increasing the risk of a postoperative VTE event.⁹

Obtaining a preoperative Caprini score can be valuable for plastic surgeons to properly manage

VTE risk postoperatively. Many of the risk factors included within the scoring model are potentially modifiable, and, for patients deemed high risk, insisting on lifestyle modification or other factors can dramatically change the individual's score. Some of the most notable modifiable components of the Caprini score are increased body mass index (>25), timing of surgery, oral contraceptive use, and recent pregnancy.⁹ Previous studies have shown that a reduction of 1 to 2 points in a patient's Caprini score can cause a 2-fold to 4-fold decrease in the risk of a VTE event. This finding clearly shows that these modifiable factors can have a significant impact.¹¹ Recent studies by Pannucci and colleagues¹² suggest that effective prophylaxis with enoxaparin may require altering dosage depending on body weight rather than mere standard dosing. This work is preliminary and ongoing. For the nonmodifiable factors, elements such as previous history of DVT/PE or known hypercoagulable disorders may prompt a hematology consultation before surgery to ensure proper patient risk management. This decision should be up to the surgeon's discretion and each individual patient.

Surgical Factors Increasing Risk

Despite the modifiable risk factors present in many patients, there remain inherent risks with the abdominoplasty procedure. Historically, much of this risk has been attributed to rectus plication creating an increase in intra-abdominal pressure, resulting in venous stasis, a critical component of the Virchow triad.^{13–15} However, more recent studies have evaluated abdominal pressures before and after rectus plication in abdominoplasty and found that the statistically significant increase in abdominal pressure was of questionable clinical significance.^{16,17}

Other factors relatively specific to abdominoplasty that have been shown to increase abdominal pressure include skin closure, bed flexion, and the use of an abdominal binder postoperatively.¹⁷ In addition, limited ambulation postoperatively because of pain, waist flexion, or any other factors may increase the risk of VTE events and should be avoided.^{7,8,18} From a global perspective, surgeons should take all of these factors into consideration when performing abdominoplasty and adjust accordingly to reduce patient VTE risk as much as possible.

PREVENTION

Mechanical Prophylaxis

Little has been specifically studied regarding the use of mechanical prophylaxis in abdominoplasty. However, the ASPS has published a consensus



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Thrombosis Risk Factor Assessment

Patient's Name: _____ Age: ____ Sex: ____ Wgt: ____ lbs

Choose All That Apply

Each Risk Factor Represents 1 Point

- Age 41–60 y
- Minor surgery planned
- History of prior major surgery (<1 mo)
- Varicose veins
- History of inflammatory bowel disease
- Swollen legs (current)
- Obesity (BMI >25)
- Acute myocardial infarction
- Congestive heart failure (<1 mo)
- Sepsis (<1 mo)
- Serious lung disease incl. pneumonia (<1 mo)
- Abnormal pulmonary function (COPD)
- Medical patient currently at bed rest
- Other risk factors _____

Each Risk Factor Represents 2 Points

- Age 60–74 y
- Arthroscopic surgery
- Malignancy (present or previous)
- Major surgery (>45 min)
- Laparoscopic surgery (>45 min)
- Patient confined to bed (>72 h)
- Immobilizing plaster cast (<1 mo)
- Central venous access

Each Risk Factor Represents 5 Points

- Elective major lower extremity arthroplasty
- Hip, pelvis or leg fracture (<1 mo)
- Stroke (<1 mo)
- Multiple trauma (<1 mo)
- Acute spinal cord injury (paralysis)(<1 mo)

Each Risk Factor Represents 3 Points

- Age over 75 y
 - History of DVT/PE
 - Family history of thrombosis^a
 - Positive Factor V Leiden
 - Positive Prothrombin 20210A
 - Elevated serum homocysteine
 - Positive lupus anticoagulant
 - Elevated anticardiolipin antibodies
 - Heparin-induced thrombocytopenia (HIT)
 - Other congenital or acquired thrombophilia
- If yes:
 Type _____
^amost frequently missed risk factor

For Women Only (Each Represents 1 Point)

- Oral contraceptives or hormone replacement therapy
- Pregnancy or postpartum (<1 mo)
- History of unexplained stillborn infant, recurrent spontaneous abortion (≥3), premature birth with toxemia or growth-restricted infant

Total Risk Factor Score

Fig. 1. The 2005 Caprini Risk Assessment Model. ^aMost frequently missed risk factor. (From Caprini JA. Thrombosis risk assessment as a guide to quality patient care. *Dis Mon.* 2005; 51(2-3):70-78; with permission.)

statement recommending intermittent pneumatic compression stockings perioperatively for plastic surgery patients to reduce VTE risk.¹⁹ They also specify that intermittent pneumatic compression stockings are superior to elastic compression stockings in the perioperative setting.¹⁹ They do not provide recommendations for whether or not an extended duration of pneumatic compression stockings or elastic compression stockings is beneficial given a lack of publications on this topic. In a survey of 1106 plastic surgeons, Spring and colleagues⁴ reported that most surgeons used intermittent

pneumatic compression stockings for patients of all risk profiles (63% for low risk, 82% for moderate risk, and 85% for high risk). Although it may go beyond guideline recommendations, pneumatic compression stockings clearly are a commonly used method for VTE risk reduction in aesthetic surgery regardless of the patient's risk factors.^{4,20}

Chemoprophylaxis

The use of chemoprophylaxis in abdominoplasty has been studied using a variety of different agents, including unfractionated heparin, low-

Table 1
Summary of the American Society of Plastic Surgeons venous thromboembolism task force recommendations

Step 1: Risk Stratification		
Patient Population	Recommendation	
Inpatient: adult aesthetic and reconstructive plastic surgery patients who undergo general anesthesia	Should complete a 2005 Caprini Risk Factor Assessment Tool to stratify patients into a VTE risk category based on their individual risk factors. Grade B Or Should complete a VTE risk-assessment tool comparable with the 2005 Caprini RAM to stratify patients into a VTE risk category based on their individual risk factors. Grade D	
Outpatient: adult aesthetic and reconstructive plastic surgery patients who undergo general anesthesia	Should consider completing a 2005 Caprini Risk Factor Assessment Tool to stratify patients into a VTE risk category based on their individual risk factors. Grade B Or Should consider completing a VTE risk-assessment tool comparable with the 2005 Caprini RAM to stratify patients into a VTE risk category based on their individual risk factors. Grade D	
Step 2: Prevention		
Patient Population	2005 Caprini RAM Score	Recommendations^a
Elective surgery patients (when the procedure is scheduled in advance and is not performed to treat an emergency or urgent condition)	≥7	Should consider using risk-reduction strategies such as limiting operating room times, weight reduction, discontinuing hormone replacement therapy, and early postoperative mobilization. Grade C
Patients undergoing the following major procedures when the procedure is performed under general anesthesia lasting more than 60 min: <ul style="list-style-type: none"> • Body contouring • Abdominoplasty • Breast reconstruction • Lower extremity procedures • Head/neck cancer procedures 	3–6	Should consider the option to use postoperative LMWH or UH. Grade B

Abbreviations: LMWH, low-molecular-weight heparin; RAM, risk-assessment module; UH, unfractionated heparin.

^a The scores associated with the recommendations apply to the 2005 Caprini risk-assessment module and were not intended for use with alternative VTE risk-assessment tools.

From Murphy R, Alderman A, Gutowski K, et al. Evidence-based practices for thromboembolism prevention: summary of the ASPS venous thromboembolism task force report. *Plast Reconstr Surg.* 2012; 130(1):168e-175e; with permission.

molecular-weight heparin, and oral anticoagulants such as rivaroxaban.^{6,21–23} In general, the research is widely varied and with small sample sizes. In addition, most surgeons do not use chemoprophylaxis routinely, although the rate of usage is higher with high-risk patients.^{4,5} However, previous studies have shown that there is a significant risk reduction with the use of

chemoprophylaxis in high-risk plastic surgery patients without an increased risk of bleeding.²⁴ In addition, recent guidelines published in *JAMA* recommend low-molecular-weight heparin rather than unfractionated heparin, primarily in critically ill patients, although this may be less specific for plastic surgery outpatient procedures.²⁵ For abdominoplasty patients, other studies have

shown that unfractionated heparin and low-molecular-weight heparin do not increase bleeding risk with perioperative administration, and they reduce the risk of VTE events in high-risk patients.^{6,23}

For oral anticoagulants, most of the research has evaluated factor Xa inhibitors. These results are mixed. One small study reported a higher incidence of hematoma when using rivaroxaban, although dosages were not reported by the investigators.²⁶ Other studies have compared rivaroxaban and apixaban with lower-molecular-weight heparin for body contouring procedures and found similar rates of VTE events, along with similar (rivaroxaban and low-molecular-weight heparin) or lower (apixaban) rates of hematoma.²¹ The largest study to date was a multicenter retrospective review of rivaroxaban prophylaxis for abdominoplasty with low rates of VTE events (0.76%) and hematomas (2.3%). Future studies are warranted to more fully evaluate the safety of oral anticoagulants for VTE prophylaxis, although initial results point toward its safety and efficacy.

FORMAL RECOMMENDATIONS

For situations such as abdominoplasty, a common aesthetic procedure with a higher risk of VTE events, surgeons often look to the literature for more formal recommendations to help decide on the most effective prophylaxis protocol, including form of prophylaxis and duration. However, no such guideline exists specifically for abdominoplasty. Surgeons must decide each patient's individual risk for thromboembolic events and create or adjust their protocols accordingly.

ASPS has released guidelines for VTE prophylaxis in plastic surgery patients, which can be a useful starting point for surgeons deciding on a postoperative protocol.²⁷ In a 2011 systematic literature review, the ASPS VTE task force focused specifically on the 2005 Caprini Risk Assessment Model rather than the 2010 model to avoid potentially overscoring patients for plastic surgery procedures.³ After review, the task force found that there was not enough evidence to provide recommendations on specific prophylaxis medications, dosages, or durations, but it did provide a generalized guideline for when to risk stratify patients and when to consider additional prophylaxis (**Table 1**).

Note that, within the generalized guidelines for risk stratification, the task force specifically highlighted additional recommendations body contouring, abdominoplasty, breast reconstruction, lower extremity procedures, and head/neck cancer procedures.²⁷ These procedures were thought to be similar in risk to general surgery and

orthopedic procedures given their anatomic location, degree of invasiveness, and similar patient population.²⁷ These specific situations have more detailed recommendations for prophylaxis considerations based on Caprini score than other plastic surgery procedures, and this should be taken into consideration for each abdominoplasty patient. One final caveat to these guidelines is that they were published in 2011, and novel oral anticoagulants such as dabigatran, rivaroxaban, and apixaban had only recently been US Food and Drug Administration approved and were not in common use at the time. Therefore, the use of these medications instead of enoxaparin or heparin for chemoprophylaxis is at the discretion of surgeons and their comfort with these medications and their risk profiles.

SUMMARY

Abdominoplasty is a commonly performed aesthetic procedure with a higher rate of VTE events compared with other aesthetic procedures. No abdominoplasty-specific guidelines exist for VTE prophylaxis, so surgeons should use previously published ASPS recommendations to risk stratify patients and treat them prophylactically based on their individual risk. Concurrent surgeries, particularly intra-abdominal procedures, seem to further increase risk. Mechanical prophylaxis is generally performed perioperatively, and all forms of chemoprophylaxis seem to be equivalent at this time, although more research is needed for newer-generation oral anticoagulants.

DISCLOSURE

Dr J.E. Janis has served as a prior consultant for LifeCell, Bard, Pacira, and Allergan within the last 12 months but has no current active affiliations. He receives royalties from Thieme Publishing. The remaining authors have no conflicts of interest to disclose. No funding was received for this research.

REFERENCES

1. Plastic surgery 2018 statistics report. Available at: <https://www.plasticsurgery.org/documents/News/Statistics/2018/plastic-surgery-statistics-report-2018.pdf>. Accessed September 1, 2019.
2. Hatfeg DA, Trussler AP, Kenkel JM. Procedural risk for venous thromboembolism in abdominal contouring surgery: a systematic review of the literature. *Plast Reconstr Surg* 2010;125(1):352–62.
3. Murphy RX Jr, Schmitz D, Rosolowski K. Evidence-based practices for thromboembolism prevention: a report from the ASPS venous thromboembolism

- task force approved by ASPS executive committee. *Plast Reconstr Surg* 2012;130(1):168e–75e.
4. Spring MA, Gutowski KA. Venous thromboembolism in plastic surgery patients: survey results of plastic surgeons. *Aesthet Surg J* 2006;26(5):522–9.
 5. Keyes GR, Singer R, Iverson RE, et al. Incidence and predictors of venous thromboembolism in abdominoplasty. *Aesthet Surg J* 2018;38(2):162–73.
 6. Hatef DA, Kenkel JM, Nguyen MQ, et al. Thromboembolic risk assessment and the efficacy of enoxaparin prophylaxis in excisional body contouring surgery. *Plast Reconstr Surg* 2008;122(1):269–79.
 7. Hurvitz KA, Olaya WA, Nguyen A, et al. Evidence-based medicine: abdominoplasty. *Plast Reconstr Surg* 2014;133(5):1214–21.
 8. Friedland JA, Maffi TR. MOC-PS(SM) CME article: abdominoplasty. *Plast Reconstr Surg* 2008;121(4 Suppl):1–11.
 9. Caprini JA. Thrombosis risk assessment as a guide to quality patient care. *Dis Mon* 2005;51(2–3):70–8.
 10. Pannucci CJ. Venous thromboembolism in aesthetic surgery: risk optimization in the preoperative, intraoperative, and postoperative settings. *Aesthet Surg J* 2019;39(2):209–19.
 11. Pannucci CJ, Bailey SH, Dreszer G, et al. Validation of the Caprini risk assessment model in plastic and reconstructive surgery patients. *J Am Coll Surg* 2011;212(1):105–12.
 12. Pannucci CJ, Fleming KI, Bertolaccini C, et al. Double-blind randomized clinical trial to examine the pharmacokinetic and clinical impacts of fixed dose versus weight-based enoxaparin prophylaxis: a methodologic description of the Flxed or variable enoxaparin (FIVE) trial. *Plast Reconstr Surg Glob Open* 2019;7(4):e2185.
 13. Hunter GR, Crapo RO, Broadbent TR, et al. Pulmonary complications following abdominal lipectomy. *Plast Reconstr Surg* 1983;71(6):809–17.
 14. Jansen DA, Kaye AD, Banister RE, et al. Changes in compliance predict pulmonary morbidity in patients undergoing abdominal plication. *Plast Reconstr Surg* 1999;103(7):2012–5.
 15. Kumar DR, Hanlin E, Glurich I, et al. Virchow's contribution to the understanding of thrombosis and cellular biology. *Clin Med Res* 2010;8(3–4):168–72.
 16. Al-Basti HB, El-Khatib HA, Taha A, et al. Intraabdominal pressure after full abdominoplasty in obese multiparous patients. *Plast Reconstr Surg* 2004;113(7):2145–50 [discussion: 2151–5].
 17. Huang GJ, Bajaj AK, Gupta S, et al. Increased intra-abdominal pressure in abdominoplasty: delineation of risk factors. *Plast Reconstr Surg* 2007;119(4):1319–25.
 18. Somogyi RB, Ahmad J, Shih JG, et al. Venous thromboembolism in abdominoplasty: a comprehensive approach to lower procedural risk. *Aesthet Surg J* 2012;32(3):322–9.
 19. Pannucci CJ, MacDonald JK, Ariyan S, et al. Benefits and risks of prophylaxis for deep venous thrombosis and pulmonary embolus in plastic surgery: a systematic review and meta-analysis of controlled trials and consensus conference. *Plast Reconstr Surg* 2016;137(2):709–30.
 20. Harrison B, Khansa I, Janis J. Evidence-based strategies to reduce postoperative complications in plastic surgery. *Plast Reconstr Surg* 2016;137(1):351–60.
 21. Morales R, Ruff E, Patronella C, et al. Safety and efficacy of novel oral anticoagulants vs low molecular weight heparin for thromboprophylaxis in large-volume liposuction and body contouring procedures. *Aesthet Surg J* 2016;36(4):440–9.
 22. Hunstad JP, Krochmal DJ, Flugstad NA, et al. Rivaroxaban for venous thromboembolism prophylaxis in abdominoplasty: a multicenter experience. *Aesthet Surg J* 2016;36(1):60–6.
 23. Campbell W, Pierson J, Cohen-Shohet R, et al. Maximizing chemoprophylaxis against venous thromboembolism in abdominoplasty patients with the use of preoperative heparin administration. *Ann Plast Surg* 2014;72(6):S94.
 24. Seruya M, Venturi ML, Iorio ML, et al. Efficacy and safety of venous thromboembolism prophylaxis in highest risk plastic surgery patients. *Plast Reconstr Surg* 2008;122(6):1701.
 25. Paul JD, Cifu AS. Prevention and management of venous thromboembolism. *JAMA* 2019. <https://doi.org/10.1001/jama.2019.13853>.
 26. Dini GM, Ferreira MCC, Albuquerque LG, et al. How safe is thromboprophylaxis in abdominoplasty? *Plast Reconstr Surg* 2012;130(6):851e–7e.
 27. Murphy RXJ, Alderman A, Gutowski K, et al. Evidence-based practices for thromboembolism prevention: summary of the ASPS venous thromboembolism task force report. *Plast Reconstr Surg* 2012;130(1):168e.