

Prevention of Venous Thromboembolism in the Plastic Surgery Patient: Current Guidelines and Recommendations

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Over the last five years, there has been a groundswell of interest in the prevention of venous thromboembolism (VTE). An increased level of understanding of the disease process coupled with data documenting the alarmingly high incidence of VTE has prompted a global awareness of the disease. Consequently, prevention of VTE has been targeted by hospitals, both in the United States and abroad, as a top priority to improve patient care. VTE refers to a continuum of disease that begins with deep venous thrombosis (DVT) and can progress to pulmonary embolism (PE). DVT is the more common form of VTE and is often silent, with only 33% of patients presenting with symptoms. As a result, VTE often goes undetected and, if allowed, can progress to PE. This typically delays treatment and results in high rates of morbidity and mortality. The combination of VTE being both difficult to detect and deadly if untreated makes it a disease that is best addressed with preventive rather than therapeutic measures. (*Aesthet Surg J*;29:421-431.)

Over the last five years, there has been a tremendous groundswell of interest in the prevention of venous thromboembolism (VTE). An increased level of understanding of the disease process coupled with data documenting the alarmingly high incidence of VTE has prompted a global awareness of the disease. Consequently, prevention of VTE has been targeted by hospitals, both in the US and abroad, as a top priority to improve patient care. In 2000, of the more than seven million patients discharged from 944 United States acute care hospitals, postoperative VTE was the second most common medical complication, the second most common cause for excess length of stay, and the third most common cause of both excess mortality and financial charges.¹

VTE refers to a continuum of disease that begins with deep venous thrombosis (DVT) and can progress to pulmonary embolism (PE). DVT is the more common form of VTE and is often silent, with only 33 % of patients presenting with symptoms.² As a result, it often goes undetected and, if not treated, can progress to PE. This typically delays treatment and results in high rates of morbidity and mortality. The combination of VTE being

both difficult to detect and deadly if untreated makes it a disease that is best addressed with preventive rather than therapeutic measures.

In 2001, The American Society of Plastic Surgeons estimated that 18,000 cases of DVT might occur in plastic surgery patients annually. Plastic surgery is among the specialties that stand to benefit the most from the prevention of VTE because plastic surgery patients, as a group, may be at higher risk for VTE than typically perceived. Despite this, surgeons' adoption of routine prophylaxis treatment is disappointing. A recent survey conducted by Broughton et al³ found that only 48.7% of surgeons performing facelifts, 43.7% performing liposuction, and 60.8% performing combined procedures consistently use VTE prophylaxis.³

The majority of elective plastic surgery procedures performed in the United States are still performed on white females. It is this group of patients that carries the most common hereditary hypercoagulable disorder. The factor V Leiden gene is found as a heterozygous mutation in 3% to 7% of white females and results in a six-fold increase in the risk of VTE.⁴ This mutation, when combined with other risk factors, such as cancer, travel, or immobilization, exponentially increases the overall risk for VTE. White females are also more likely to use oral contraceptives, hormone replacement therapy, and estrogen receptor antagonists, all of which increase the risk of VTE. When these "silently" high-risk patients undergo seemingly safe outpatient procedures, the potential for fatal complications is far greater than may

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be appreciated. Consequently, these events often generate media coverage nationally and are a frequent source of large-settlement medical malpractice litigation against plastic surgeons.

AMERICAN COLLEGE OF CHEST PHYSICIANS' 2008 GUIDELINES

Every four years, the American College of Chest Physicians (ACCP) convenes to review and revise its guidelines for the prevention of VTE. The goal is to provide evidence-based recommendations (and consensus-based suggestions when evidence is lacking) for the prevention of VTE. The ACCP pools data from various publications in multiple specialties to make these recommendations. The information contained in the eighth edition of the ACCP guidelines⁵ is widely considered to be the definitive source for prophylaxis guidelines. Although plastic surgery as a specialty is not specifically addressed by the ACCP, its evidence-based recommendations for general surgery have been used in this article to create thoughtful guidelines for prevention of VTE in plastic surgery patients.

This set of guidelines contains three general recommendations that are applicable to any specialty with regard to prevention of VTE. These recommendations are designed to instruct any institution about an overall strategy for reducing the incidence of VTE:

1. Every hospital should adopt a formal, active strategy that addresses the prevention of VTE;
2. This strategy should be a written policy standardized throughout the institution; and
3. Methods such as preprinted orders and periodic audits should be employed to encourage strict adherence to the guidelines.¹

RISK FACTORS

The key to preventing VTE can be found in understanding who is at risk and why. There are a number of conditions, both preexisting and exposing, that can increase a patient's chances of having a VTE event (Table). Some of these factors can be avoided and some of them cannot, but without specific knowledge, there is no way to account for them.

Most hospitalized patients have at least one risk factor for VTE, while approximately 40% have three or more risk factors. In the absence of thromboprophylaxis, the incidence of confirmed DVT is between 10% and 40% for general surgery patients, and as high as 40% to 60% for postoperative orthopedic patients.⁶ Taking a thorough history is an essential step in identifying risk factors. Previous obstetric complications, such as toxemia, stillbirths, unplanned abortions, or placental insufficiency, are relevant. A history of any of these incidents may alert the clinician to the presence of the antiphospholipid antibody syndrome, which is associated with a high incidence of postoperative VTE. Seemingly innocuous medications like oral contraceptives can also significantly increase a patient's chance of having an event if

Table. Risk factors for venous thromboembolism

Major surgery
Inflammatory bowel disease
Trauma (major or lower extremity)
Nephrotic syndrome
Immobility
Myeloproliferative disorder
Cancer (active or occult)
Obesity
Chemotherapy
Paroxysmal nocturnal hemoglobinuria
Radiotherapy
Central venous catheterization
Age >40 years
Inherited or acquired thrombophilia
Pregnancy and postpartum
Venous compression
Estrogen-containing oral contraceptives
History of venous thromboembolism
Selective estrogen receptor modulators
Acute medical illness
Erythropoiesis-stimulating agents
Hormone replacement therapy

combined with other risk factors. Many young people do not consider contraceptives to be medications, so specific questioning is prudent. Similarly, hormone replacement medications or estrogen receptor modulators can also contribute to an increased risk of VTE.

Risk Stratification

The eighth edition of the ACCP guidelines recommends against individual risk assessment models (RAM), stating that they are cumbersome, hard to keep track of, not likely to be used on a widespread basis, and lack prospective validation.⁴ This marks a significant departure from previous recommendations, where RAM were considered a cornerstone of risk stratification. Caprini et al created a comprehensive RAM that was modified by Davison et al⁷ to be used in plastic surgery. This RAM relied on an appropriate history and physical examination to uncover possible risk factors for VTE. Many of these factors can be elicited by a patient questionnaire that is completed by the patient and returned to the healthcare provider. The assessment can then be completed by the healthcare provider on admission.

Despite the effectiveness and growing acceptance of these tools, the ACCP has decided to support another strategy for risk stratification. Its current recommendation assigns patients to a major target group, each with

specific prophylaxis options, based almost entirely on the procedure being performed; they believe that this represents each patient's principal risk factor. This correlates with most current literature on prevention of VTE, where most studies assign patients to a group based on procedure rather than individual risk factors.

Although ACCP guidelines favor the group approach, they acknowledge that the clinician can deviate from the group recommendations. This caveat is important for plastic surgery. Our group recently published a retrospective cohort study stratifying patients into risk groups using the Caprini model. Specifically, the highest-risk patients were identified and rates of postoperative all-cause mortality, VTE, and hematoma/bleeding events were recorded. These outcomes were compared according to the prophylaxis regimen used. The incidence of VTE in the highest-risk group (score of ≥ 4) was 7.5%, despite the use of some prophylaxis. The authors maintain that these results reveal the importance of risk factors other than the surgery being performed to determine who is truly at risk.⁸

PROPHYLAXIS

Primary prophylaxis is far and away the most useful and cost-effective strategy for reducing the risk of VTE. In all cases, the ACCP recommends proper positioning of the patient on the operating table and early aggressive ambulation. However, it is recognized that many patients cannot be fully ambulatory early after surgery and require additional measures for their prophylaxis. In addition, patients with multiple risk factors require prophylaxis even though they may be ambulating normally. Prophylaxis for the prevention of VTE can be broken down into two main categories: mechanical prophylaxis and chemoprophylaxis. Mechanical prophylaxis refers to devices worn by the patient that reduce venous stasis and therefore prevent VTE. Chemoprophylaxis refers to anticoagulant medications used systemically to prevent VTE.

Early Ambulation and Proper Positioning

Early ambulation and proper positioning on the operating table are logical measures that should be applied to all patients undergoing surgery, regardless of their risk. The goal is to position the patient to maximize venous flow through the legs and to avoid external pressure. Maximum blood flow through the popliteal vein occurs with the knee slightly flexed at 5°. Placing a pillow under the knees will accomplish this. However, one must be careful with this maneuver, because compression of the popliteal vein can reduce blood flow out of the leg. Ambulation should be encouraged as soon as the patient is able, with assistance when necessary. These measures are recommended for all risk groups and are sufficient alone in the low-risk group.

Mechanical Prophylaxis

There are three basic types of mechanical prophylaxis devices: graduated compression stockings (GCS), inter-

mittent pneumatic compression devices (IPC), and venous foot pumps (VFP). The main benefit of these devices is that in addition to reducing the risk of DVT, they function without any increased incidence of bleeding. This makes them an attractive option in plastic surgery, where bleeding is a major concern. All three types of devices have been shown in numerous studies to reduce the risk of DVT in a variety of patient groups.¹

GCS increase venous return by applying constant pressure to the lower extremity. This mechanism of action has been shown in the literature to reduce the incidence of DVT.¹⁰ However, studies on their efficacy are limited in number relative to the other mechanical prophylaxis devices. Only compliance and unusual limb size limit their use. There are no major side effects or strict contraindications with these devices.

IPC and VFP both prevent VTE using the same two distinct mechanisms. First, they reduce stasis by increasing venous return through compression of the legs or feet. Second, pneumatic compression appears to reduce the circulating systemic level of plasminogen activator-1, which in turn increases fibrinolytic activity.¹¹ The decision of which device to use depends on the availability of the device and the clinical indication. If the patient's legs will not fit into the IPC or if surgery is being performed on the calves and knees (eg, liposuction), use of VFP is a more sensible option. The application of either device should be initiated before the induction of anesthesia and should be avoided in patients with peripheral vascular disease or in those who have been immobilized for more than 72 hours. The rationale behind placing the devices before induction is related to the venous pooling that occurs on induction of general anesthesia. Paralyzing agents cause the loss of muscle tone in the legs, where veins can overdistend. Comerota et al¹² have shown that cracks in the endothelium develop, which form the nidus for thrombosis. If the legs are placed in a dependent position, this further increases the extent of dilatation. Furthermore, venous stasis is associated with hypercoagulation related to the retention of metabolic waste products in overdistended veins. Regional anesthesia also results in changes in muscle tone that last for the duration of the anesthesia. Not surprisingly, general anesthesia is associated with higher rates of VTE and should be avoided in high-risk patients if possible.⁹ Use of either ICP or VFP should continue into the postoperative period until the patient is fully ambulatory.

The ACCP currently recommends that mechanical prophylaxis be used in moderate or high-risk patients only when there is a high risk of bleeding, or as an adjunct to chemoprophylaxis in high-risk patients. This marks a significant change from the 2004 recommendations. The ACCP now argues that these devices have not been studied as intensively and are generally less efficacious than the chemoprophylactic agents. However, if one independently examines the literature published since the 2004 guidelines, additional data are available that attest to the value of pneumatic compression. A large meta-analysis

has been published that validates the value of IPC to reduce DVT.¹² The largest multicenter, prospective, double-blind, double-dummy randomized trial involving IPC in abdominal surgery patients with a venographic endpoint has also supported the use of these devices.¹³ The incidence of a positive venogram in patients receiving only pneumatic compression was as low as 5.3%. In light of these new data, this downgrade in the recommended use of IPC is confusing. The latest guidelines do assign a grade 2C to combined IPC and anticoagulants in the highest-risk patients. The guidelines do not differentiate between IPC and GCS. The data do show that the value of IPC is much more robust than data associated with the use of GCS. Mechanical prophylaxis may also be considered in combination with chemoprophylaxis in high-risk patients for double effect. There is evidence to suggest that the combining of mechanical and chemoprophylaxis is more effective than either modality alone, with no increase in risk of bleeding.¹⁴

Chemoprophylaxis

Chemoprophylaxis refers to medications given systemically to decrease the risk of developing VTE. The ACCP currently recommends that all general surgery patients undergoing a “major” surgical procedure receive chemoprophylaxis unless they have a high risk of bleeding. This includes both the moderate and high-risk groups, which are defined by the presence of a major surgical procedure. The definition of a major surgical procedure is deliberately not explained by the ACCP to allow for clinical interpretation. However, the ACCP does describe the risk groups with examples of the types of surgeries involved, as follows:

1. Low risk—Mobile patients undergoing minor surgery
2. Moderate risk—Most general surgery patients, or those undergoing open gynecologic or urologic surgery
3. High risk—Patients undergoing hip or knee arthroplasty or hip fracture surgery, or those with major trauma or spinal cord injury¹

In both the moderate- and high-risk groups, chemoprophylaxis is the recommended treatment, with mechanical prophylaxis reserved only for those patients with a high risk of bleeding and, even then, only until that risk decreases.

The authors of this article recommend that “major surgery” be defined as any operation lasting more than one hour and performed under general or regional anesthesia. This recommendation is based on large trials in general surgery that consisted of patients who fulfilled these criteria.¹⁵⁻¹⁷ Until further evidence is available, it is reasonable to consider that operations under local anesthesia or sedation lasting more than two hours are also considered major surgery. Borow and Goldson¹⁸ have shown that operations lasting more than two hours have a 36.5% incidence of DVT. Based on these data, they concluded that until further evidence is available, it may be prudent to consider these patients to be at risk.

For general surgery patients, the ACCP clearly recommends against the use of aspirin alone as a thromboprophylactic agent for VTE for any patient group. Instead, it recommends the use of low molecular weight heparin (LMWH), low-dose unfractionated heparin (LDUH), the factor Xa inhibitor fondaparinux, and warfarin as options for chemoprophylaxis.¹

Of the recommended chemoprophylactic agents, LMWH and LDUH are by far the most commonly used and best studied of the group. LMWH and LDUH have been shown to be equally effective in preventing DVT in general surgery and orthopedic surgery patients.^{16,17} However, despite their similarities in efficacy, there is controversy in the literature with regard to which of these therapies causes more bleeding. The discrepancy appears to be related to the dose of LMWH used. It has been reported that LMWH has a dose-related effect on bleeding complications. For example, doses of the LMWH enoxaparin that are higher than 3400 units daily are more likely to cause bleeding than the standard 5000 units of LDUH administered every 12 hours.¹⁹ Recently, data have shown that 5000 units of LDUH given every eight hours is associated with more bleeding than when it is administered every 12 hours. LMWH at doses below 3400 units is equivalent to LDUH given every 12 hours in terms of VTE prevention and has a similar incidence of bleeding complications. It now appears that as the dose of either class of drug is increased, both efficacy and bleeding rates increase.

Another advantage of LMWH is that it can be given once daily. It also has greater bioavailability when administered by subcutaneous injection. When appropriate, LMWH should be dose-adjusted to account for renal insufficiency. LMWH is also associated with a significantly lower incidence of heparin-induced thrombocytopenia than LDUH (0.2% vs 2.6%).^{20,21} Although they vary in price, most LMWH formulations are 2 to 10 times more expensive than LDUH.⁸ This cost reflects the medication alone; the manpower costs of administration of twice-daily dosing of LDUH rapidly eliminates this cost differential.

Warfarin is an option for high-risk VTE patients. However, warfarin is complicated by its delayed onset of action and its use requires the frequent monitoring of prothrombin times to avoid bleeding complications. Warfarin also interacts with several other medications via the P-450 pathway, making it a complicated medication to accurately dose. Given these drawbacks and the availability of other effective medications, there is little rationale for the use of warfarin in plastic surgery. The only exception would be a specific contraindication or refusal to use LDUH or LMWH.

Fondaparinux is a selective factor Xa inhibitor. It is listed as an option by the ACCP for both moderate and high-risk patients as an alternative to LMWH. Fondaparinux has been shown to be as effective as LMWH in major abdominal surgery patients and is associated with a similar bleeding profile.¹ This drug has a

17-hour half-life and must be used with caution in patients with a creatinine clearance of < 50 mL /minute. It is contraindicated in those with a creatinine clearance of < 30 mL/ minute. It is not as extensively studied as LMWH and LDUH, but is gaining popularity for use in orthopedic and general surgery patients.

Timing of Dose. Optimal timing of the first dose of LMWH has been the subject of considerable debate. Several studies found that when given two hours preoperatively, there is a protective effect during surgery and in the immediate postoperative period.^{22,23} However, there is a higher risk of bleeding with preoperative versus postoperative administration.²⁴ The decision on timing of dosage should be based on the risks and consequences of bleeding and, if started postoperatively, the authors recommend administering the dose 12 hours postsurgery. The authors also recommend using IPC before, during, and after the operation.

Duration of Therapy. For patients in the moderate-risk group, the recommendation is that prophylaxis be continued until the patient is discharged from the hospital. No data exist that negate the average seven-day period of prophylaxis used in the clinical trials. Those patients with ongoing risks (including obesity, leg swelling, inflammatory bowel disease, and estrogen or hormonal therapy) should probably be subject to the seven-day period used in the trials because there are no data suggesting that ambulation overcomes the effects of these other risk factors. However, the ACCP also recommends that for high-risk patients—particularly those who have undergone major cancer surgery or have a history of VTE—prophylaxis with LMWH should continue for 28 days. There is evidence to suggest that the extended duration of therapy in this patient group reduces the risk of asymptomatic DVT when compared with LMWH prophylaxis that is discontinued at discharge.¹

CANCER

Cancer is a clear risk for VTE. There is a two-fold risk for surgery and six-fold overall increase for VTE. Although brain, hematologic, and visceral adenocarcinomas have the greatest risk, recent data have shown that head and neck cancers are also problematic for reconstructive patients.⁹ However, cutaneous malignancies have no documented increase risk unless they are associated with distal extremity immobility.

Breast cancer treatment patients present with two confounding risks:

1. There is a two- to five-fold increased risk of VTE in patients on estrogen receptor modulators (eg, tamoxifen); and
2. They have central venous catheters with a 2% to 4% upper extremity VTE risk.

Despite this increased risk, the ACCP recommends that cancer patients undergoing surgical procedures receive prophylaxis that is appropriate for the type of surgery being performed. The only difference is that there is evidence showing that the duration of therapy

should be extended to 28 days for high-risk patients who undergo major surgery for coagulopathic malignancies, such as hematologic and visceral adenocarcinomas.

TRAVEL

As a risk factor, travel is not a unique to plastic surgery, but it is quite relevant. Plastic surgery patients are more likely than other surgery patients to travel in conjunction with their procedures. This includes patients who may be traveling to comprehensive cancer centers for reconstruction and aesthetic patients who travel nationally or for medical tourism. With approximately 1.56 billion flights annually worldwide, there is bound to be some overlap. Kelman et al²⁵ determined that the incidence of VTE with air travel ranges from 1000 to 2000 per million persons for DVT and 500 to 1000 per million persons for PE. However, only 1% to 2% of these episodes of VTE result in death, which is less than would typically be expected. Risk factors include duration of travel greater than five hours with immobility and preexisting conditions, such as oral contraceptive use. The type of vehicle and class of travel are not considered risk factors.²⁵

The ACCP recommends that healthy travelers taking flights longer than eight hours avoid constrictive clothing, maintain adequate hydration, and perform frequent calf muscle contraction exercises. If a traveler has additional risk factors for VTE, then the recommendation includes adding GCS, 15 to 30 mm Hg at the ankle, or a single subcutaneous dose of LMWH before departure. The ACCP specifically recommends against the use of aspirin for VTE prophylaxis in long-distance travelers.¹ No precautions on preoperative travel are recommended in the 2008 ACCP guidelines.

BODY CONTOURING

Of the procedures that are unique to plastic surgery, body contouring seems to have the highest probability of VTE when compared to other plastic surgery procedures. Grazer and Goldwyn²⁶ were the first to identify this when they reported a DVT incidence of 1.1% and PE incidence of 0.8% in abdominoplasty patients. Similarly, Hester et al²⁷ found that when abdominoplasty was combined with other abdominal or pelvic surgical procedures, the incidence of pulmonary embolism was significantly greater. Massive weight loss patients with circumferential body contouring operations are at even greater risk, with a 5.7% to 9.6% incidence of VTE.^{28,29}

The reason for the increased incidence is still largely unknown. Some speculate that putting the patient in the upright position during closure contributes to VTE, while others believe that it is the increase in intra-abdominal pressure with fascia tightening that causes DVT. It has even been suggested that a poorly-placed abdominal binder may contribute to restricting venous outflow. Regardless of the mechanism, these patients warrant thorough consideration with regard to prophylaxis.

RECOMMENDATIONS

We have carefully reviewed the recommendations contained in the eighth edition of the ACCP guidelines⁵ and adapted them for application in plastic surgery. The previous ACCP data showed that the incidence of DVT in the moderate-risk group varied significantly (between 10% and 40%). Within the current ACCP moderate-risk group, patients with two to four risk factors are bunched together, representing a spectrum of VTE incidence from 10% to 40%. We suggest that the approach to the patient with a 10% risk might be far different than the one with a 40% risk. Furthermore, the decision to downgrade IPC and recommend that everyone at risk receive an anticoagulant will result in increased bleeding complications. This, in turn, would result in noncompliance and is therefore a useless model. There is ample evidence in the literature (including recent studies) that suggests that at least some of these patients would do just as well with IPC.

Another challenge in this process was interpreting the deliberately vague terms describing “minor” and “major” surgery and adapting them into a useful tool. The authors have chosen to use the historical inclusion criteria of clinical DVT trials, considering patients with operations lasting more than one hour under regional or general anesthesia to be major. Similarly, we suggest that until further data are available, patients who are under sedation for more than two hours should be considered to have had major surgery. The ACCP uses the terms “minor” and “major” to separate patients into low-risk and moderate-risk groups, respectively. These terms are purposely left undefined to allow for clinical interpretation, which we are providing in the interests of patient safety. Clinical outcomes studies will eventually refine our thoughts, because randomized controlled clinical trials in all of these situations are unlikely.

The ACCP defines low-risk patients as mobile patients who are undergoing minor surgery. There are no specific thromboprophylaxis recommendations for low-risk patients. Moderate-risk patients are described as those having a major general, open gynecologic, or urologic surgery. The ACCP recommendations for these patients are exclusively chemoprophylactic in the form of LMWH, LDUH, or fondaparinux. The only exception for mechanical prophylaxis is if the patient has a high bleeding risk. Because the guidelines lump a broad patient group together representing a potential VTE incidence of between 10% and 40% in those without prophylaxis, we suggest using the 2004 guidelines for this group. They show that those individuals with two risk factors have a 10% to 20% incidence of DVT and would be equally protected by IPC without any increased risk of bleeding. There are no studies that refute the 2004 recommendations for this group and, indeed, several studies further support those 2004 conclusions.^{14,15}

In plastic surgery, where bleeding can be a major problem, the surgeon should use IPC both before and during the operation and in the early postoperative period. When it is deemed appropriate, anticoagulation

should then be commenced. We would also suggest that patients with ongoing risk be treated for the traditional seven days, as has been done in the vast majority of clinical trials. Cancer patients, those with a history of VTE, and those with multiple risk factors should probably receive 28 days of prophylaxis with LMWH.

High-risk patients are defined as patients who are having a major orthopedic procedure or those with major trauma. The recommendations for these patients are also exclusively chemoprophylactic, in the form of LMWH, fondaparinux, or warfarin. Mechanical prophylaxis is only recommended in this high-risk group if the patient is at high risk of bleeding or if the mechanical prophylaxis is used in conjunction with a chemoprophylactic agent.

We suggest that the distinction between plastic surgery in the inpatient or outpatient setting should not be the sole criterion for determining whether the operation is major or minor. Patients who need to be admitted to the hospital after a plastic surgery procedure will all require prophylaxis and would fall into either the moderate- or high-risk groups. The length of the procedure or the use of general or regional anesthesia should be a major determining factor. If the procedure lasts for more than one hour under general or regional anesthesia, or two hours under sedation, then mechanical prophylaxis is recommended in the form of either ICP or VFP. Both the type of anesthesia and the duration of surgery have been shown to increase the risk of VTE in surgery patients.²⁴⁻²⁶ No specific prophylaxis is recommended for low-risk patients.

The distinction between moderate- and high-risk patients is based on the number of risk factors. High-risk patients are defined as patients having inpatient surgery who have more than four risk factors. Moderate-risk patients have four or fewer risk factors. Our recommended prophylaxis for moderate-risk patients with three to four risk factors is 30 mg of LMWH daily, starting 12 hours postoperatively. The lower dose has been associated with fewer bleeding complications. For high-risk patients, the recommendation is 40 mg daily in combination with ICP or VFP. For both moderate- and high-risk patients, mechanical prophylaxis is recommended as a stand-alone therapy only if there is a high risk of bleeding. The mechanical method should include IPC whenever possible because the data supporting the use of IPC are the most thoroughly studied. We also suggest that the moderate-risk group should be further divided into those with zero to two risk factors and those with three to four risk factors; therapy should be provided for the length of the hospitalization in those with lesser risk. Higher-risk patients in the moderate-risk group (ie, those with three or four factors) should receive the traditional seven-day course of prophylaxis. Proper positioning of the patient during surgery and early ambulation is recommended in all groups.

We recommend that any patient undergoing an abdominoplasty or any other truncal body contouring procedure other than liposuction be carefully screened for risk. The choice and duration of prophylaxis should be based on individual risk assessment, length of surgery,

and type of prophylaxis. Patients undergoing body contouring in the inpatient setting or combined with intra-abdominal or pelvic procedures will almost always fall into the high-risk group and will require appropriate prophylaxis. We have combined our recommendations with the ACCP data and consolidated it into a one-page order form to facilitate use in the clinical setting (Appendix).

The recommendations provided in this paper are not the result of specific level I plastic surgery data and we recognize this weakness, but we are encouraged by our recent work linking high scores to significant VTE rates in plastic surgery patients. More studies are needed to validate our data and further the plastic surgery community's knowledge about the incidence and prevention of VTE.

CONCLUSIONS

Appropriate risk assignment and prophylaxis for the prevention of VTE in plastic surgery remains a challenging topic. However, it is imperative that each practitioner adopt an easy-to-use system for his or her practice. Data such as those contained in the ACCP guidelines and risk assessment tools such as the one presented in the Appendix will help assist plastic surgeons to accurately assess and prophylactically treat their patients for VTE. ▀

DISCLOSURES

The authors have no financial interest in and received no compensation from manufacturers of products mentioned in this article.

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Appendix

VDC ORDER FORM

Risk Factors

Major Surgery	Erythropoiesis-Stimulating Medications
Trauma	Paroxysmal Nocturnal Hemoglobinuria
Immobility of Lower Extremities	Medications
Cancer (excluding skin)	Myeloproliferative Disorders
Cancer Therapy (Chemo/Radiation)	Obesity
Venous Insufficiency	Central Venous Access
Hx or Family Hx of VTE	Thrombophilia
Age > 40 yrs	Nephrotic Syndrome
Pregnancy/Postpartum	Inflammatory Bowel Disease
Oral Contraceptives (w/ Estrogen)	Acute Medical Illness
Hormone Replacement Therapy	Selective Estrogen Receptor

Risk Group Definitions

LOW RISK: Healthy patients having outpatient surgery
MODERATE RISK: Patients with zero to four risk factors surgery requiring admission and recovery in the hospital. Abdominoplasty patients.
HIGH RISK: Patients with more than four risk factors having surgery requiring admission and recovery in the hospital. Body contouring patients combined with other intra-abdominal or pelvic procedures.

Thromboprophylaxis Orders

Low Risk	General or regional anesthesia procedure lasting < 1 hr or Sedation procedure < 2 hr	Proper positioning and early ambulation <input type="checkbox"/>
	General or regional anesthesia procedure lasting > 1 hr or Sedation procedure > 2 hr	IPC or VFP <input type="checkbox"/>
Moderate Risk	Normal risk of bleeding and 3-4 risk factors	Enoxaparin 30 mg SQ daily. First dose given 12 hrs post-op <input type="checkbox"/>
	High risk of bleeding or 0-2 risk factors	IPC or VFP <input type="checkbox"/>
High Risk	Normal risk of bleeding	Enoxaparin 40 mg SQ daily and IPC or VFP. First dose given 12 hrs post-op <input type="checkbox"/>
	High risk of bleeding	IPC or VFP <input type="checkbox"/>

- IPC (Intermittent Pneumatic Compression Devices), VFP (Venous Foot Pumps), SQ (Subcutaneous)
- Mechanical thromboprophylaxis should be switched to anticoagulant thromboprophylaxis when high bleeding risk decreases
- Foot pumps should be used only when the use of IPC is not feasible
- Drug choice is based on hospital formulary restrictions
- Graduated compression stockings may be used with IPC but are not recommended as a sole method of prophylaxis

Signature/Credentials/ID Code: _____

Pager: _____ **Date:** _____ **Time:** _____