

Preventing Venous Thromboembolism in Hospitalized Plastic Surgery Patients

Summary: Venous thromboembolism (VTE)—a life- or limb-threatening condition that occurs when a blood clot forms in a deep vein or forms in the vein and passes to the lungs—is a complication of concern in plastic surgery. Thus, the American Society of Plastic Surgeons (ASPS) has developed a practice reference for preventing VTE as well as recording and communicating VTE risks. The document also reviews emerging evidence on VTE prevention and highlights opportunities for future research.

BACKGROUND

Venous thromboembolism (VTE), which occurs when a blood clot forms in a deep vein (deep vein thrombosis, or DVT) or when a clot passes within the veins to the lungs (pulmonary embolus, or PE), is a serious condition that affects millions of people worldwide.

The Centers for Disease Control and Prevention estimates that DVT and PE affect as many as 900,000 people in the United States each year and result in death for up to 100,000.¹ PE alone causes immediate death in about a quarter of the people affected by it.¹ Certain factors increase a patient's risk for developing DVT or PE after surgery.

RATIONALE

In 2008, the Surgeon General's *Call to Action to Prevent Deep Vein Thrombosis and Pulmonary Embolism* prompted the formation of an American Society of Plastic Surgeons (ASPS) task force focused on VTE prevention.² The task force produced evidence-based recommendations and identified best practices in risk assessment, prevention, and patient education.³ Its findings were integrated into the 2011 *Pathways to Preventing Adverse Events in Ambulatory Surgery*, a comprehensive patient safety resource for plastic surgery with a section on VTE.⁴

In 2022, an ASPS task force reviewed the evidence on VTE that has emerged since 2011 and identified a need to update guidance for plastic surgeons on VTE prevention among hospitalized patients and highlight recent research.

► PRACTICE PRINCIPLES

VTE Prevention

These practice principles are based on the best available research on VTE prevention.⁵ **Note:** All data are derived from studies of *inpatient* populations; equivalent data for lower risk cosmetic and ambulatory surgery populations are lacking, and all guidance should be applied with caution. Appendix A provides links to relevant clinical guidelines from other organizations on VTE prevention and management.

Priority was granted to high-quality evidence from randomized controlled trials with patient-important outcomes: symptomatic DVT, PE, and bleeding complications. Evidence from plastic surgery was preferred, but indirect evidence from other surgical specialties was used when direct evidence was not available.

- Perform an individual risk assessment, such as Caprini 2005,⁶ for all inpatient procedures.
- Modify, improve upon, or eliminate identified risk factors when a surgical procedure is not time sensitive.
- Use alternatives to general anesthesia when appropriate and feasible. Consider using monitored anesthesia care, local anesthesia with sedation, or neuraxial anesthesia.
- Use sequential compression devices in all patients undergoing general endotracheal anesthesia. Most guidelines recommend intermittent

Disclaimer: This Practice Reference is for informational and educational purposes only and is not a substitute for a Practitioner's independent medical judgement. The contents are not intended to serve as a standard of care or legal advice. Information and regulations may change over time and Practitioners are solely responsible for complying with current applicable law and standards of care. Practitioners are encouraged to consult legal counsel in the state of practice regarding local standards and responsibilities. p. 1

pneumatic compression over elastic compression stockings.⁵

- Assess benefits and harms of chemoprophylaxis on a case-by-case basis to determine the appropriate course of action. To reduce risk of bleeding, avoid routine use of chemoprophylaxis in patients with lower aggregate risk of VTE. Consider chemoprophylaxis in patients with high procedural or individual risk. Refer to Appendix B for a comparison of recommendations from different VTE guidelines.

Overall VTE risk is a combination of individual and procedural factors.⁷ Preoperative risk-modification strategies should address modifiable patient factors, such as temporary cessation of hormone therapies. Risk-reduction strategies should address both intraoperative techniques, such as using compression devices, maintaining normothermia, and limiting operative time, and postoperative techniques, such as early ambulation and chemoprophylaxis in appropriately selected patients. Chemoprophylaxis is known to reduce the incidence of symptomatic VTE but also confers additional risk of bleeding, making risk stratification an essential component of clinical decision-making. Several instruments have been developed for risk assessment, but the validated Caprini 2005 risk assessment model is generally preferred by plastic surgeons.⁸ Other tools, such as the Padua risk assessment model⁹ or the 2010 Davison-Caprini model,¹⁰ may be less reliable.^{11,12}

The results of an individualized risk assessment should be interpreted with clinical judgement in the context of procedural risk. Mechanical compression and early ambulation are generally appropriate for patients at low risk. Clinicians may consider adding chemoprophylaxis in patients at moderate to high risk of VTE with low risk of bleeding. Absolute risk reduction is highest in patients with Caprini scores above 8.¹³ Hematology consultation may be appropriate in patients simultaneously at high risk of VTE and bleeding.

Documentation and Communication

Given the varying approaches to VTE prophylaxis, plastic surgeons should be clear and transparent about their clinical decision-making. ASPS suggests that members consider the following guiding

principles to properly communicate and document their VTE prevention approach.

- Discuss appropriate warning signs and symptoms of VTE with patients and caregivers, and consider giving them this information in written form as well. Be sure to document that you have had these conversations.
- Clearly communicate recommendations regarding modifiable patient risk factors, such as the temporary cessation of hormone therapy, to patients.
- Document results/scores for any preoperative risk assessment tool used.
- Document all judgements made in relation to risk modification and chemoprophylaxis.
- Note all perioperative strategies for risk modification, as well as intra- and postoperative strategies for risk reduction.
- Document whether the patient cannot or refuses to comply with risk modification, chemoprophylaxis, or mechanical prophylaxis. Consider use of an informed refusal form.¹⁴

The Doctors Company, a medical malpractice insurance provider and ASPS partner, offers a continuing medical education course on diagnosing VTE,¹⁵ as well as other resources on communicating risks with patients.

EMERGING EVIDENCE

Although varied chemoprophylaxis strategies are currently in use, evidence is still emerging on specific agents and the ideal timing, dose, and duration of anticoagulation for prophylactic use. Research continues to investigate the following:

- Preoperative versus postoperative administration of anticoagulants
- Enoxaparin versus direct oral anticoagulants (DOACs)
- Appropriate dose and duration
 - Once- versus twice-daily dosing
 - Weight-based dosing
 - Real-time dose adjustments
 - Extended duration chemoprophylaxis

A comparison of existing clinical practice guidelines on VTE prophylaxis demonstrates that there is no consensus on these issues among surgical specialties. Enoxaparin appears most often in the plastic surgery literature, and existing randomized controlled trials report administration 8 to 24 hours after surgery. Observational studies report the use of fondaparinux, rivaroxaban, and apixaban, but no completed randomized trials exist in plastic surgery for these types of chemoprophylaxis.^{16,17} Key considerations in the selection of appropriate agents include oral versus subcutaneous delivery and the availability of reversal agents.

Studies on dose and duration are thus far limited to enoxaparin. Indirect evidence from analyses of anti-factor Xa levels suggests that a daily 40 mg dose may not achieve prophylactic levels in most patients.^{18,19} Research shows that prophylactic enoxaparin may be more effective when delivered twice daily and that weight-based dosing regimens may be useful.²⁰ No high-quality studies are currently available on the ideal duration of chemoprophylaxis in plastic surgery patients.

An alternative approach to VTE in plastic surgery emphasizes early diagnosis and management over prevention. Doppler ultrasound on or around postoperative day 7 can be used in all patients to identify DVT, often before a clot becomes symptomatic. This approach has been used both with and without mechanical compression and other prophylactic strategies.^{21,22}

FUTURE RESEARCH

Considerable uncertainty remains around appropriate VTE prophylaxis in plastic surgery due to the small number of high-quality studies in this patient population. Much of this uncertainty pertains specifically to chemoprophylaxis: high-quality studies on specific drug regimens are lacking, and more research is needed on comparative effectiveness of enoxaparin and the newer class of DOACs.

Additional research is also needed to quantify risk in specific populations. Most existing research is on inpatient populations; equivalent outpatient studies are needed to address risk in ambulatory surgical centers and office-based surgical suites. This is particularly important for high-risk procedures that are increasingly performed on an outpatient basis, such as high-volume liposuction, abdominoplasty, and body contouring. There is also a growing need for data on specific demographic groups, including older patients and patients who have experienced massive weight loss, to inform optimum clinical decision-making.

This document was approved for publication by the ASPS VTE Task Force on October 16, 2023; the ASPS Patient Safety Committee on October 20, 2023; and the ASPS Board of Directors on December 8, 2023.

Appendix A. Existing VTE Guidance

[American Society of Clinical Oncology, 2023](#): Venous Thromboembolism Prophylaxis and Treatment in Patients With Cancer: ASCO Clinical Practice Guideline Update

[European Society for Medical Oncology, 2023](#): Venous Thromboembolism in Cancer Patients: ESMO Clinical Practice Guideline

[European Association of Urology, 2022](#): Guidelines of Thromboprophylaxis in Urological Surgery

[International Consensus Meeting on Venous Thromboembolism, 2022](#): Recommendations from the ICM-VTE: Hip & Knee

[International Initiative on Thrombosis and Cancer, 2022](#): International Clinical Practice Guidelines for the Treatment and Prophylaxis of Venous Thromboembolism in Patients With Cancer, Including Patients With COVID-19

[American College of Chest Physicians, 2012](#): Prevention of VTE in Nonorthopedic Surgical Patients: Antithrombotic Therapy and Prevention of Thrombosis

[American Society of Hematology, 2019](#): Guidelines for Management of Venous Thromboembolism: Prevention of Venous Thromboembolism in Surgical Hospitalized Patients

[National Institute for Health and Care Excellence, 2019](#): Venous Thromboembolism in Over 16s: Reducing the Risk of Hospital-Acquired Deep Vein Thrombosis or Pulmonary Embolism

[American Society of Breast Surgeons, 2016](#): Consensus Guideline on Venous Thromboembolism (VTE) Prophylaxis for Patients Undergoing Breast Operations

[Canadian Consensus Recommendations, 2015](#): Canadian Consensus Recommendations on the Management of Venous Thromboembolism in Patients With Cancer. Part 1: Prophylaxis.

[American Academy of Orthopaedic Surgeons, 2011](#): Evidence-Based Clinical Practice Guideline on Preventing Venous Thromboembolic Disease in Patients Undergoing Elective Hip and Knee Arthroplasty

Appendix B. Comparison of Selected VTE Guideline Recommendations

The table on the next page compares recommendations, findings, and conclusions from selected guidelines for managing VTE risk.

Note: This table is for reference only; members should read the guidelines or studies cited and decide which approaches make the most sense for a given patient or procedure. The inclusion of these guidelines or recommendations in the table does not constitute an endorsement by ASPS. Please consider the patient populations of focus in each guideline and note the publication date when evaluating their applicability.

The guidelines or studies selected for comparison in the table are as follows:

- Murphy RX Jr, 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. <https://doi.org/10.1097/prs.0b013e318254b4ee>
- Gould MK, Garcia DA, Wren SM, et al. Prevention of VTE in nonorthopedic surgical patients: antithrombotic therapy and prevention of thrombosis, 9th ed: American College of Chest Physicians evidence-based clinical practice guidelines [published correction appears in *Chest*. 2012 May;141(5):1369]. *Chest*. 2012;141(2 Suppl):e227S-e277S. <https://doi.org/10.1378/chest.11-2297>
- 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):709-730. <https://doi.org/10.1097/01.prs.0000475790.54231.28>
- Pannucci CJ, Swistun L, MacDonald JK, Henke PK, Brooke BS. Individualized venous thromboembolism risk stratification using the 2005 Caprini Score to identify the benefits and harms of chemoprophylaxis in surgical patients: a meta-analysis. *Ann Surg*. 2017;265(6):1094-1103. <https://doi.org/10.1097/sla.0000000000002126>

Additional Table Notes:

Abbreviations: CI, confidence interval; ES, elastic stockings; ICU, intensive care unit; IPC, intermittent pneumatic compression; LDUH, low-dose unfractionated heparin; LMWH, low-molecular-weight heparin; OR, odds ratio; RAM, risk assessment model; VTE, venous thromboembolism.

* For all elective procedures in the populations of focus, Murphy 2012 recommends considering risk-reduction strategies such as limiting operating room times, weight reduction, discontinuing hormone replacement therapy, and early mobilization.

ASPS Guideline* <i>Murphy 2012</i>		CHEST Guideline <i>Gould 2012</i>		AAPS Consensus Conference <i>Pannucci 2016</i>	Meta-Analysis <i>Pannucci 2017</i>
Population					
Inpatient plastic surgery patients	Outpatient plastic surgery patients	General surgery patients with low risk of bleeding	General surgery patients with high risk of bleeding	Plastic surgery patients	Heterogeneous surgical patients, including plastic surgery and surgical ICU
Recommendation for All Patients in Population					
<ul style="list-style-type: none"> Complete a 2005 Caprini RAM or a comparable risk assessment tool 	<ul style="list-style-type: none"> Consider completing a 2005 Caprini RAM or a comparable risk assessment tool 	<ul style="list-style-type: none"> “Risk stratification for VTE is challenging but essential and requires consideration of both patient- and procedure-specific risk factors. Although several models for risk stratification exist, all have important limitations.” 		<ul style="list-style-type: none"> Risk-stratify all patients using a 2005 Caprini score Use non-general anesthesia when appropriate Use IPC in plastic surgery patients Do not add routine chemoprophylaxis to IPC in the general non-risk-stratified plastic surgery population 	—
Recommendation by Caprini Score					
1	<ul style="list-style-type: none"> No recommendations 	<ul style="list-style-type: none"> Use mechanical prophylaxis, preferably with IPC, over no prophylaxis 		<ul style="list-style-type: none"> No recommendations concerning chemoprophylaxis 	<ul style="list-style-type: none"> No data
2					
3	<ul style="list-style-type: none"> Consider the option to use post-operative LMWH or unfractionated heparin Consider use of mechanical prophylaxis throughout the duration of chemical prophylaxis for non-ambulatory patients 	<ul style="list-style-type: none"> Use LMWH, LDUH, or mechanical prophylaxis, preferably with IPC, over no prophylaxis 	<ul style="list-style-type: none"> Use mechanical prophylaxis, preferably with IPC, over no prophylaxis 	<ul style="list-style-type: none"> No recommendations concerning chemoprophylaxis 	<ul style="list-style-type: none"> 0.7% incidence of VTE without chemoprophylaxis VTE not significantly reduced with chemoprophylaxis (OR 1.31, 95% CI 0.51–3.31, p=0.57)
4					
5		<ul style="list-style-type: none"> Use pharmacologic prophylaxis with LMWH or LDUH over no prophylaxis Use low-dose aspirin, fondaparinux, or mechanical prophylaxis (preferably with IPC) be over no prophylaxis in patients in whom heparin is contraindicated 	<ul style="list-style-type: none"> Use mechanical prophylaxis, preferably with IPC, over no prophylaxis until the risk of bleeding diminishes and pharmacologic prophylaxis may be initiated 		<ul style="list-style-type: none"> 1.8% incidence of VTE without chemoprophylaxis VTE not significantly reduced with chemoprophylaxis (OR 0.96, 95% CI 0.60–1.53, p=0.85)
6					
7					
8					
≥9		<ul style="list-style-type: none"> Use extended-duration pharmacologic prophylaxis (4 weeks) with LMWH over limited-duration prophylaxis 		<ul style="list-style-type: none"> Consider chemoprophylaxis on a case-by-case basis in patients with a Caprini score >8 	<ul style="list-style-type: none"> 10.7% incidence of VTE without chemoprophylaxis VTE significantly reduced with chemoprophylaxis (OR 0.41, 95% CI 0.26–0.65, p=0.0002)

Disclaimer: This Practice Reference is for informational and educational purposes only and is not a substitute for a Practitioner’s independent medical judgement. The contents are not intended to serve as a standard of care or legal advice. p. 6

REFERENCES

- ¹ Centers for Disease Control and Prevention. Data and statistics on venous thromboembolism. Last reviewed June 28, 2023. <https://www.cdc.gov/ncbddd/dvt/data.html>
- ² Office of the Surgeon General (US); National Heart, Lung, and Blood Institute (US). *The Surgeon General's Call to Action to Prevent Deep Vein Thrombosis and Pulmonary Embolism*. 2008. <https://www.ncbi.nlm.nih.gov/books/NBK44178/>
- ³ American Society of Plastic Surgeons. *Evidence-based Practices for Thromboembolism Prevention: A Report from the ASPS Venous Thromboembolism Task Force*. July 2011. https://www.plasticsurgery.org/documents/medical-professionals/health-policy/key-issues/ASPS_VTE_Report.pdf
- ⁴ American Society of Plastic Surgeons; The Doctors Company. *Pathways to Preventing Adverse Events in Ambulatory Surgery*. 2011. <https://www.plasticsurgery.org/Documents/Health-Policy/Patient-Safety/patient-safety-2011-adverse-events-ambulatory-surgery.pdf>
- ⁵ 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):709-730. <https://doi.org/10.1097/01.prs.0000475790.54231.28>
- ⁶ Caprini JA . Thrombosis risk assessment as a guide to quality patient care. *Dis Mon*. 2005;51:70-78. <https://doi.org/10.1016/j.disamonth.2005.02.003>
- ⁷ Iorio ML, Venturi ML, Davison SP. Practical guidelines for venous thromboembolism chemoprophylaxis in elective plastic surgery. *Plast Reconstr Surg*. 2015;135(2):413-423. <https://doi.org/10.1097/prs.0000000000000908>
- ⁸ White AJ, Kanapathy M, Nikkhah D, Akhavan M. Systematic review of the venous thromboembolism risk assessment models used in aesthetic plastic surgery. *JPRAS Open*. 2021;30:116-127. <https://doi.org/10.1016/j.jpra.2021.07.010>
- ⁹ Barbar S, Noventa F, Rossetto V, et al. A risk assessment model for the identification of hospitalized medical patients at risk for venous thromboembolism: the Padua Prediction Score. *J Thromb Haemost*. 2010;8(11):2450-2457. <https://doi.org/10.1111/j.1538-7836.2010.04044.x>
- ¹⁰ Caprini JA. Risk assessment as a guide to thrombosis prophylaxis. *Curr Opin Pulm Med*. 2010 Sep;16(5):448-52. <https://doi.org/10.1097/MCP.0b013e32833c3d3e>
- ¹¹ Pannucci CJ, Barta RJ, Portschy PR, et al. Assessment of postoperative venous thromboembolism risk in plastic surgery patients using the 2005 and 2010 Caprini Risk score. *Plast Reconstr Surg*. 2012;130(2):343-353. <https://doi.org/10.1097/prs.0b013e3182589e49>
- ¹² Zhou H, Hu Y, Li X, et al. Assessment of the risk of venous thromboembolism in medical inpatients using the Padua prediction score and Caprini risk assessment model. *J Atheroscler Thromb*. 2018;25(11):1091-1104. <https://doi.org/10.5551/jat.43653>

Disclaimer: This Practice Reference is for informational and educational purposes only and is not a substitute for a p. 7
Practitioner's independent medical judgement. The contents are not intended to serve as a standard of care or legal
advice. Information and regulations may change over time and Practitioners are solely responsible for complying with
current applicable law and standards of care. Practitioners are encouraged to consult legal counsel in the state of prac-
tice regarding local standards and responsibilities.

- 13 Pannucci CJ, Dreszer G, Wachtman CF, et al. Postoperative enoxaparin prevents symptomatic venous thromboembolism in high-risk plastic surgery patients. *Plast Reconstr Surg*. 2011;128(5):1093-1103. <https://doi.org/10.1097/prs.0b013e31822b6817>
- 14 Cahill RF. Informed refusal. The Doctors Company. February 2022. <https://www.thedoctors.com/articles/informed-refusal/>
- 15 The Doctors Company. *Spotlight on Diagnosing PE/DVT (The Doctor's Advocate CME)*. <https://thedoctors.rivent.com/a/35838P3WyRzE>
- 16 Morales R Jr, 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):440-449. <https://doi.org/10.1093/asj/sjv243>
- 17 Sarhaddi D, Xu K, Wisbeck A, et al. Fondaparinux significantly reduces postoperative venous thromboembolism after body contouring procedures without an increase in bleeding complications. *Aesthet Surg J*. 2019;39(11):1214-1221. <https://doi.org/10.1093/asj/sjz184>
- 18 Pannucci CJ, Rockwell WB, Ghanem M, Fleming KI, Momeni A, Agarwal J. Inadequate enoxaparin dosing predicts 90-day venous thromboembolism risk among plastic surgery inpatients: an examination of enoxaparin pharmacodynamics. *Plast Reconstr Surg*. 2017;139(4):1009-1020. <https://doi.org/10.1097/prs.0000000000003159>
- 19 Pannucci CJ, Hunt MM, Fleming KI, Prazak AM. Weight-based dosing for once-daily enoxaparin cannot provide adequate anticoagulation for venous thromboembolism prophylaxis. *Plast Reconstr Surg*. 2017;140(4):815-822. <https://doi.org/10.1097/prs.0000000000003692>
- 20 Pannucci CJ, Fleming KI, Agarwal J, Rockwell WB, Prazak AM, Momeni A. The impact of once- versus twice-daily enoxaparin prophylaxis on risk for venous thromboembolism and clinically relevant bleeding. *Plast Reconstr Surg*. 2018;142(1):239-249. <https://doi.org/10.1097/prs.0000000000004517>
- 21 Swanson E. Prospective study of doppler ultrasound surveillance for deep venous thromboses in 1000 plastic surgery outpatients. *Plast Reconstr Surg*. 2020;145(1):85-96. <https://doi.org/10.1097/prs.0000000000006343>
- 22 Seruya M, Venturi ML, Iorio ML, Davison SP. Efficacy and safety of venous thromboembolism prophylaxis in highest risk plastic surgery patients. *Plast Reconstr Surg*. 2008;122(6):1701-1708. <https://doi.org/10.1097/prs.0b013e31818dbffd>