

Practice Patterns in Venous Thromboembolism Prophylaxis

A Survey of 606 Reconstructive Breast Surgeons

Christopher J. Pannucci, MD, Adam J. Oppenheimer, MD, and Edwin G. Wilkins, MD, MS

Abstract: Current practice patterns for venous thromboembolism (VTE) prophylaxis in autogenous breast reconstruction are unknown. A web-based survey on VTE prophylaxis was distributed to all American Society of Plastic Surgery members in the United States with a clinical interest in autogenous tissue breast reconstruction (N = 3584). A total of 606 completed surveys were returned for a response rate of 16.9%. Overall compliance with established guidelines was low (25%). High volume surgeons (43% vs. 22%) and surgeons in academic practice (42% vs. 22%) were significantly more likely to report prophylaxis regimens consistent with American College of Chest Physicians guidelines (ACCP) recommendations. Subgroup analysis of 72 surgeons who specifically report conformance to ACCP guidelines demonstrated only 38% actually provided prophylaxis consistent with ACCP recommendations. VTE is a potentially fatal complication of autogenous breast reconstruction. Further research is necessary to create VTE prophylaxis guidelines specific to patients undergoing these procedures. The need for surgeon education on appropriate prophylaxis cannot be overemphasized.

Key Words: breast reconstruction, venous thromboembolism, venous thromboembolic disease, deep venous thrombosis, pulmonary embolism, autogenous breast reconstruction, transverse rectus abdominis myocutaneous, deep inferior epigastric perforator

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Venous thromboembolism (VTE), including deep venous thrombosis (DVT) and pulmonary embolism (PE), has been increasingly discussed in the media and among hospital payers as a potentially preventable in-hospital complication. The National Quality Forum, a “private, not-for-profit membership organization created to develop and implement a national strategy for healthcare quality measurement and reporting”¹ is an organization dedicated to patient safety in acute care hospitals. Recently, the organization endorsed 48 voluntary consensus standards focused on measurements of patient safety, ranging from hospital readmission to pediatric safety in intensive care units. Of the 48 standards, 6 were directly related to VTE and emphasized hospital-focused measures for improvement of VTE detection, treatment, and readiness of patients for discharge.² VTE has recently been cited by the Centers for Medicare and Medicaid Services as a “reasonably preventable” condition for inpatients. As such, and in an attempt to improve physician compliance with established prophylaxis guidelines, VTE has been considered for addition to the list of complications for which Centers for Medicare and Medicaid Services will not pay if acquired in-hospital.³ In September 2008, the United States Surgeon General issued a “Call to Action” for prevention of DVT and PE,

encouraging education of both the public and healthcare providers and promoting development of evidence-based guidelines for VTE prevention.⁴

The association between venous thrombophlebitis and cancer is well known, having first been reported in gastric cancer patients with migrating thrombophlebitis by Armand Trousseau in 1865.⁵ Interestingly, Trousseau himself died of gastric cancer that presented with migratory thrombophlebitis. Presence of cancer and major operative intervention are known to be 2 major risk factors for development of VTE. Other risk factors in surgical patients include immobility, rehospitalization within 30 days, indwelling central venous catheter, previous smoking, and obesity.^{6,42} Cancer patients are known to have twice the risk of DVT and 3 times the risk of PE when compared with patients without cancer undergoing similar operative interventions.⁷ Patients with metastatic breast cancer are known to have a VTE incidence of 2.8 cases per 100 patient years in the first year⁸ and 1% VTE incidence within the first 2 years after breast cancer diagnosis.⁹ VTE is the second most common cause of death in breast cancer patients after breast cancer itself.¹⁰

VTE is a disorder with high morbidity and mortality. Even in the absence of PE symptoms, 50% of patients with proximal, symptomatic DVT will have ventilation-perfusion scan abnormalities. Symptomatic PE has a 10% death rate in the first hour. For those who survive a pulmonary embolus, 50% of patients will have right ventricular dysfunction and 5% will have chronic pulmonary hypertension. Post-thrombotic syndrome, including venous reflux and venous hypertension, occurs in 25% of patients within 5 years after diagnosis of symptomatic DVT.¹¹ Despite the potentially fatal complications of PE, as well as notable morbidity from right heart failure and post-thrombotic syndrome, patients often receive inadequate VTE prophylaxis.^{12–15}

Hartrampf’s initial series of patients undergoing pedicled transverse rectus abdominis myocutaneous (TRAM) flaps was published in 1987 and noted 3 patients with pulmonary emboli (0.9%) and no deep venous thromboses.¹⁶ Patients undergoing both immediate and delayed deep inferior epigastric perforator flap (DIEP) reconstruction have been demonstrated to have a 0.8% incidence of DVT,¹⁷ and a large series of over 950 mastectomy patients receiving microvascular breast reconstruction reported a VTE rate of 0.9%.¹⁸ Recent publications support that VTE in patients undergoing autogenous tissue breast reconstruction may occur more frequently than previously noted. Large retrospective series of pedicled TRAM flaps¹⁹ or both TRAM and latissimus flaps²⁰ used for postmastectomy reconstruction have demonstrated VTE incidences of 1.5% to 2.2%. All reported incidences were based on clinical diagnosis with objective confirmation, although some estimate that clinical diagnosis alone underestimates the incidence of clinically significant VTE by more than 50%.²¹ Postoperative TRAM patients have been shown to have a high incidence of subclinical PE. A recent study evaluated 54 asymptomatic TRAM patients on postoperative day 3 using ventilation-perfusion scan or PE CT scan and demonstrated that 16.7% had an occult PE.²²

The literature on VTE prophylaxis specific to breast reconstruction has been extensively reviewed elsewhere.²⁰ Due to lack of published data, there is currently no standard of care for VTE

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From the Section of Plastic Surgery, University of Michigan, Ann Arbor, MI. Reprints: Christopher Pannucci, MD, Section of Plastic Surgery, Department of Surgery, 2130 Taubman Center, Box 0340, 1500 East Medical Center Drive, Ann Arbor, MI 48109. E-mail: cpannucc@umich.edu.

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prophylaxis in patients undergoing autogenous tissue breast reconstruction. The current study sought to identify current practice patterns by querying all American Society of Plastic Surgery (ASPS) members in the United States with a clinical interest in breast reconstruction using a web-based survey.

STUDY SUBJECTS AND METHODS

Approval for this study was obtained from the University of Michigan Institutional Review Board (IRB #HUM00017574).

The ASPS website was used to identify all ASPS member surgeons practicing in the United States with a self-declared interest in breast reconstruction. All surgeons meeting these criteria were emailed a link to a secure web-based survey. The survey (Table 1) queried surgical case volume for autogenous tissue reconstruction in breast cancer patients, practice subtype, strategy for VTE prophylaxis, and self-reported utilization of established VTE prophylaxis guidelines.

Survey design stipulated that once the survey was accessed, the computer terminal was locked out from subsequent logins, thus preventing multiple surveys being completed by the same physician. Prior to completing the survey, physicians were informed that (1) no identifying information would be linked to their answers and (2) participation was strictly voluntary. The survey was open for a total of 30 days during February and March of 2008. One reminder email was sent 2 weeks after initial survey deployment. Information from partially completed surveys was excluded from final analysis.

Data were entered into a standard spreadsheet program (Microsoft Excel). Reported practice patterns were compared with the national guidelines regularly published and updated by the American College of Chest Physicians.²³ Both descriptive statistics and tests of statistical significance using χ^2 analysis were performed.

RESULTS

A total of 3693 members of the ASPS practicing in the United States with a self-declared interest in breast reconstruction were identified using the ASPS website. A total of 109 emails were returned as undeliverable. The total number of physicians surveyed was 3584, and 649 surveys were returned for a response rate of 18.1%. A total of 43 surveys were only partially completed and were excluded from final analysis. A total of 606 completed surveys (16.9%) were included in the final data pool. Our response rate was similar to other large, recently published surveys in the plastic surgery literature.^{24,25}

Recent data show that 12.5% of ASPS members practice in an academic setting (K. Hume, personal communication, January 2009). Academic surgeons comprised 17% (100/606) of respondents to this survey. Fifteen percent (92/606) of respondents were considered high-volume practitioners, performing greater than 20 autogenous breast reconstructions per year. Sixty-nine percent (421/606) of surgeons report utilization of an established set of clinical guidelines for VTE prophylaxis. Respondent demographics are listed in Table 2.

Thirty percent of respondents reported a postoperative DVT and 25% reported a postoperative PE in at least 1 patient during their careers. Four percent of respondents had at least 1 patient die of pulmonary embolus after autogenous tissue breast reconstruction.

Both the American College of Chest Physicians guidelines²³ (ACCP) and the Caprini Risk Assessment Model (J. A. Caprini, personal communication)^{26,27} place women with breast cancer undergoing autogenous breast reconstruction in the highest risk categories for VTE. Sequential compression devices (SCDs) and perioperative pharmacologic prophylaxis with either unfractionated heparin or low-molecular weight heparin are recommended. The

TABLE 1. Survey

The BreastPE.com Survey

1. Please describe your practice
 - Academic
 - Non-academic
2. How many autologous (flap) breast reconstruction cases do you perform each year?
 - <5
 - 6–20
 - 21–35
 - 36–50
 - >51
3. For breast cancer patients undergoing autologous (flap) breast reconstruction, what is your standard venous thromboembolism prophylaxis? (click all that apply)
 - No prophylaxis
 - Early ambulation
 - TED stockings
 - Sequential compression devices (SCDs)
 - Preoperative aspirin
 - Postoperative aspirin
 - Preoperative subcutaneous heparin
 - Postoperative subcutaneous heparin
 - Preoperative low molecular weight heparin
 - Postoperative low molecular weight heparin
 - Preoperative coumadin
 - Postoperative coumadin
4. For breast cancer patients undergoing autologous (flap) breast reconstruction, have you ever had a patient with a postoperative deep venous thrombosis?
 - Yes
 - No
5. For breast cancer patients undergoing autologous (flap) breast reconstruction, have you ever had a patient with a postoperative pulmonary embolism?
 - Yes
 - No
6. For breast cancer patients undergoing autologous (flap) breast reconstruction, have you ever had a patient with death secondary to a pulmonary embolism?
 - Yes
 - No
7. For breast cancer patients undergoing autologous (flap) breast reconstruction, do you presently implement any established clinical guidelines for venous thromboembolism prophylaxis?
 - Yes (respondent forwarded to question 8)
 - No (respondent forwarded to end of survey)
8. Which guidelines do you utilize?
 - American College of Chest Physicians (ACCP) guidelines
 - American Society of Clinical Oncology (ASCO) guidelines
 - Institutional guidelines
 - Other

national standard for pharmacologic VTE prophylaxis entails the first dose being given postoperatively (J. A. Caprini, personal communication),²⁸ although major randomized, controlled trials in patients with abdominal and pelvic cancer use both pre- and postoperative heparin.^{29,30} Aspirin alone is not recommended in any patient as VTE prophylaxis.²³

Overall compliance of breast reconstructive surgeons with established guidelines, including utilization of both SCDs and postoperative heparin or low molecular weight heparin prophylaxis, was 25%. High volume surgeons performing over 20 cases per year were significantly more likely to demonstrate guideline conformity (43% vs. 22%, $P < 0.0001$). Academic surgeons were significantly more likely to demonstrate guideline adherence compared with those in private practice (42% vs. 22%, $P < 0.0001$). A total of 4.4% (27/606) respondents used perioperative aspirin alone as pharmacologic prophylaxis, in direct contradiction to the ACCP guidelines.

TABLE 2. Demographics of 606 Plastic Surgeons Responding to the Survey

	No. Surgeons	Percentage
Practice type		
Academic	100	17%
Non-academic	506	83%
Case volume		
<5 per yr	315	52%
6–20 per yr	199	33%
21–35 per yr	49	8%
36–50 per yr	22	4%
Over 51 per yr	21	3%
Guideline utilization (N = 421)		
ACCP	72	17%
ASCO	11	3%
Institutional	223	53%
Other guidelines	115	27%

Analysis of the subgroup of 72 surgeons who specifically reported adherence the ACCP guidelines showed that only 38% actually reported use of both SCDs and postoperative heparin. Reported utilization of prophylaxis is shown in Table 3. Usage is compared with the national ACCP standards in Table 4. Reported pharmacologic prophylaxis regimens are shown in Table 5.

DISCUSSION

“Given that DVT is often clinically silent and PE may be rapidly fatal, prevention is the most effective strategy to reduce the burden of VTE.”¹⁵

TABLE 5. Regimen Reported by Those Using Pharmacologic Prophylaxis (N = 213)

Prophylaxis Regimen	No. Surgeons Reporting	Percentage of Surgeons Reporting
Postoperative LMWH only	59	27.7%
Postoperative UFH only	31	14.6%
Pre- and postoperative LMWH	25	11.7%
Pre- and postoperative UFH	19	8.9%
Preoperative LMWH only	14	6.6%
Preoperative UFH only	13	6.1%
Postoperative UFH and postoperative ASA	10	4.7%
Postoperative ASA only	20	9.4%
Pre- and postoperative ASA	8	3.8%
Other prophylaxis regimen	14	6.6%

LMWH indicates low molecular weight heparin; UFH, unfractionated heparin; ASA, aspirin.

TABLE 3. Reported Prophylaxis Utilization in Autogenous Breast Reconstruction

Method of Prophylaxis (May be Combined With Others)	Academic Surgeons (N = 100)	Nonacademic Surgeons (N = 506)	High-Volume Surgeons, >20/yr (N = 92)	Low-Volume Surgeons, <20/yr (N = 514)
No prophylaxis	0% (0)	1% (5)	0% (0)	1% (5)
Early ambulation	78% (78)	80% (404)	86% (79)	78% (403)
SCDs	97% (97)	99% (500)	99% (91)	98% (506)
Preoperative aspirin	2% (2)	1% (7)	3% (3)	1% (6)
Postoperative aspirin	10% (10)	7% (35)	15% (14)	6% (31)
Preoperative LMWH or UFH	30% (30)	9% (47)	18% (17)	12% (60)
Postoperative LMWH or UFH	44% (44)	22% (112)	45% (41)	22% (115)

LMWH indicates low molecular weight heparin; UFH, unfractionated heparin.

TABLE 4. Reported Prophylaxis Usage Compared to American College of Chest Physicians Recommendations for Highest Risk Patients

Surgeon Type (No. Responses)	% Compliant With Postoperative Heparin	P	% Compliant With Pre- and Postoperative Heparin (N)	P
All respondents (N = 606)	25% (N = 151)		7.6% (N = 46)	
Academic (N = 100)	42% (N = 42)	$P < 0.0001^*$	22% (N = 22)	$P < 0.0001^\dagger$
Nonacademic (N = 506)	22% (N = 109)		5% (N = 24)	
>20 cases/yr (N = 92)	43% (N = 40)	$P < 0.0001^\ddagger$	16% (N = 15)	$P = 0.0013^\S$
<20 cases/yr (N = 514)	22% (N = 111)		6% (N = 41)	
Report using ACCP guidelines (N = 72)	38% (N = 25)		11% (N = 8)	

*P compares academic and nonacademic surgeon's compliance with postoperative heparin usage.

†P compares academic and nonacademic surgeon's compliance with pre- and postoperative heparin usage.

‡P compares high-volume and low-volume surgeon's compliance with postoperative heparin usage.

§P compares high-volume and low-volume surgeon's compliance with pre- and postoperative heparin usage.

Increasing attention has been paid to web-based surveys as a valid means of conducting scientific research.^{31,32} In 2007, over 100 medical publications were based on internet survey data. Web-based surveys have been shown to have comparable response rates to traditional surveys.³³ Possibly due to ease of submission, survey respondents are more likely to take a web-based survey to completion, indicating that respondents find web-based surveys more appealing.³⁴ Web-based surveys can be created and distributed with a minimum of computer knowledge and personnel, and allow data compilation and analysis with speed and efficiency. These qualities have made telephone and postal-mail based surveys increasingly obsolete.^{31,35} Our survey was designed and administered using published guidelines for implementation of web-based surveys. In general, surveys are prone to several types of error, including sampling, coverage, nonresponse, and measurement error. These were minimized in our survey by surveying all ASPS members practicing in the United States with clinical interest in breast reconstruction (sampling), using a national, well-recognized member database for survey participants (coverage), and excluding partially completed surveys from final analysis (nonresponse and measurement error).

The most relevant and data-driven guidelines for VTE prophylaxis in patients undergoing autogenous breast reconstruction are those published by the American College of Chest Physicians (ACCP) for general surgery patients.²³ Using the ACCP's risk-stratification model, all cancer patients over age 40 who are undergoing a major operative procedure are placed in the highest risk group, and both SCDs and perioperative pharmacologic prophylaxis are indicated. Additionally, leading experts in the field of venous thromboembolism also support perioperative pharmacologic prophylaxis for cancer patients under age 40 (T. W. Wakefield, personal communication) (J. A. Caprini, personal communication). Previous reviews on VTE in plastic surgery have recommended pharmacologic prophylaxis in all cases over 4 hours, including breast reconstruction with transverse rectus abdominis musculocutaneous (TRAM) flaps, abdominoplasty, and extensive body contouring.^{36,37} The Georgetown group has previously published a set of guidelines specific to plastic surgery patients.³⁸ These guidelines are heavily based on the Caprini Risk Assessment Model,²⁶ which, in turn, was derived largely from patient data in general surgery populations. Although the Georgetown group's algorithmic approach to VTE prophylaxis has been retrospectively validated in only one patient population (postbariatric patients undergoing excisional body contouring),³⁹ multiple studies have demonstrated that perioperative heparin prophylaxis may be used safely in highest risk plastic surgery patients.^{22,39–41}

The most recent ACCP guidelines,²³ published in 2008, are evidence-based, including an exhaustive literature review of over 700 published studies. However, it is instructive to note that publications from the plastic surgery literature were excluded from consideration and did not weigh in the final recommendations. Additionally, the ACCP guidelines for general surgery patients are largely based on studies in patients with abdominal and pelvic cancer, a group which is likely older, has more medical comorbidities, and are less able to ambulate on postoperative day one, compared with those undergoing autogenous breast reconstruction. Thus, while it is reasonable to apply the most relevant and data-driven VTE risk-stratification model available to our patients, it is imperative that clinicians understand that these data are inferred to be relevant to the plastic surgery population.

Several other studies have examined physician compliance with established VTE prophylaxis guidelines. In previous surveys of VTE prophylaxis in plastic surgery, 48% of surgeons performing rhytidectomy, 43% of surgeons performing liposuction, and 60% of

surgeons performing combined operations use some form of VTE prophylaxis in all cases. Of respondents, 1% performing liposuction and 3% of surgeons performing abdominoplasty with liposuction reported a postoperative death attributed to pulmonary embolus.²⁵ In our survey, 4% of surgeons report a death secondary to PE after autogenous breast reconstruction. Other surveys⁴³ have documented that patients undergoing both abdominoplasty alone and abdominoplasty with additional procedures are at much higher VTE risk than other elective plastic surgery patients.

In general, physicians have demonstrated poor compliance with established guidelines for VTE prophylaxis. Large retrospective studies of practice patterns in patients undergoing major abdominal surgery reported that 50% of patients receive appropriate prophylaxis, 24% receive inappropriate prophylaxis, and 24% receive no prophylaxis. Compliance among orthopedic surgeons was higher, reaching 80% in some subgroups.¹⁴ Retrospective review of patients with VTE has shown that 67% of patients with risk factors on admission receive inadequate prophylaxis, indicating poor physician compliance with established guidelines.¹⁵ In our study, a subgroup of 72 surgeons specifically reported utilization of ACCP guidelines in providing VTE prophylaxis. Further analysis of their self-reported practice patterns showed that only 38% actually provided the minimum prophylactic measures (both SCDs and postoperative heparin) as recommended by the ACCP.²³ As indicated by poor compliance with guidelines (25%), breast reconstructive surgeons might benefit from additional education on currently published guidelines.

Many physicians cite hematoma risk as their primary rationale for not providing pharmacologic prophylaxis, though meta-analyses in general surgery patients show that hematoma requiring reoperation occurs in only 1% of patients.⁴⁴ Patients receiving postoperative heparin prophylaxis after autogenous tissue breast reconstruction have been shown to have a lower reoperative hematoma rate than patients receiving no heparin prophylaxis (0.5% vs. 1.0%, respectively) in a large study, though this difference was not significant.⁴⁰ In weighing the bleeding risk with perioperative heparin prophylaxis against risk of VTE, other authors note that although "a hematoma is a medical stress, an inconvenience, an embarrassment, or [necessitates] an additional procedure, [unlike PE] rarely does it kill a patient."⁴⁵

Several novel methods to promote physician compliance with VTE prophylaxis guidelines have been attempted. Many institutions use risk assessment models to quantify VTE risk and provide prophylaxis guidelines.^{26,27,38} In our survey of ASPS members, 53% of respondents who use them rely on guidelines provided to them by their institutions. Interestingly, only 1.3% of surveyed breast surgeons in the United Kingdom cite hospital policy as influential in prescribing VTE prophylaxis.¹³ In addition to providing guidelines, other institutions have randomized physicians to receive computer generated electronic reminders when high risk patients are admitted. Physicians randomized to receive an electronic alert prescribe VTE prophylaxis twice as often as those who receive no reminder. In these studies, patient risk for VTE was reduced by 41%.⁴⁶

Limitations of our survey include its distribution being confined to surgeons with published email addresses and to those with access to the internet. Our data are not reflective of practice patterns in non-ASPS members, including those plastic surgeons in practice who are board eligible but not board certified. Approximately 12.5% of the ASPS membership practices in an academic setting (K. Hume, personal communication, January 2009). Academic surgeons were slightly over-represented in our data set, comprising 17% of the respondent pool. Our study was limited by the low response rate common to many survey-based studies, and the response rate of

16.9% was similar to other large surveys of ASPS members on VTE prophylaxis (15–21%).^{24,25} In anticipation of this limitation, our survey was initially sent to over 3500 surgeons, more than double the number surveyed by others. Thus, our data set, comprised of the responses of 606 reconstructive breast surgeons, represents the aggregate opinion of nearly twice as many surgeons as recently published studies²⁵ with similar response rates.

In our initial survey design, we did not include intraoperative and postoperative administration of intravenous heparin or dextran, as is commonly used during free tissue transfer for breast reconstruction, as means of VTE prophylaxis. Thus, our survey does not assess how use of IV heparin or dextran during microvascular surgery may have impacted surgeon's decisions to administer unfractionated heparin or low molecular weight heparin for postoperative prophylaxis. Finally, recall bias, in which surgeons with negative experiences with VTE would be more likely to share their experience and complete the survey, may have altered the reported rates of VTE.

CONCLUSIONS

Currently, no data-driven guidelines exist for venous thromboembolism prophylaxis specific to patients undergoing autogenous breast reconstruction; existing guidelines are inferred from data in general surgery patients. Our survey of 606 plastic surgeons demonstrates poor knowledge of and compliance with existing VTE prophylaxis guidelines for this patient group. Overall compliance based on reported practice patterns was low (25%), though surgeons in academic practice (42%) and surgeons in high-volume practices (43%) were significantly more likely to administer guideline-supported prophylaxis. PE is a potentially fatal complication of autogenous breast reconstruction and further research is required to establish appropriate prophylaxis guidelines.

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