
Validation of the Caprini Risk Assessment Model in Plastic and Reconstructive Surgery Patients

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- BACKGROUND:** The Venous Thromboembolism Prevention Study (VTEPS) Network is a consortium of 5 tertiary referral centers established to examine venous thromboembolism (VTE) in plastic surgery patients. We report our midterm analyses of the study's control group to evaluate the incidence of VTE in patients who receive no chemoprophylaxis, and validate the Caprini Risk Assessment Model (RAM) in plastic surgery patients.
- STUDY DESIGN:** Medical record review was performed at VTEPS centers for all eligible plastic surgery patients between March 2006 and June 2009. Inclusion criteria were Caprini score ≥ 3 , surgery under general anesthesia, and postoperative hospital admission. Patients who received chemoprophylaxis were excluded. Dependent variables included symptomatic deep vein thrombosis (DVT) or pulmonary embolism (PE) within the first 60 postoperative days and time to DVT or PE.
- RESULTS:** We identified 1,126 historic control patients. The overall VTE incidence was 1.69%. Approximately 1 in 9 (11.3%) patients with Caprini score >8 had a VTE event. Patients with Caprini score >8 were significantly more likely to develop VTE when compared with patients with Caprini score of 3 to 4 (odds ratio [OR] 20.9, $p < 0.001$), 5 to 6 (OR 9.9, $p < 0.001$), or 7 to 8 (OR 4.6, $p = 0.015$). Among patients with Caprini score 7 to 8 or Caprini score >8 , VTE risk was not limited to the immediate postoperative period (postoperative days 1-14). In these high-risk patients, more than 50% of VTE events were diagnosed in the late (days 15-60) postoperative period.
- CONCLUSIONS:** The Caprini RAM effectively risk-stratifies plastic and reconstructive surgery patients for VTE risk. Among patients with Caprini score >8 , 11.3% have a postoperative VTE when chemoprophylaxis is not provided. In higher risk patients, there was no evidence that VTE risk is limited to the immediate postoperative period. (J Am Coll Surg 2011;212:105-112. © 2011 by the American College of Surgeons)
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Venous thromboembolism (VTE) is a disorder with short-term mortality and long-term morbidity. VTE has been deemed a major threat to patient safety by policymakers and payers, including the US Surgeon General,¹ the Centers for Medicare and Medicaid Services,² and the National Quality Forum.³ To fully identify VTE risk in surgical patients, recent publications advocate individualized patient risk assessment.⁴⁻⁷ The Caprini Risk Assessment Model (RAM) was derived more than a decade ago, based on a combination of clinical experience and published data.⁸⁻¹⁰ Recently, the Caprini RAM has been validated for 30-day VTE events in a large series of general, urology, and vascular surgery patients.⁵ Revised versions of the model have also been validated in postbariatric body contouring patients⁷ and medical inpatients.^{11,12}

Plastic and reconstructive surgery patients are known to be at high risk for venous thromboembolism after surgery.

Abbreviations and Acronyms

DVT	= deep venous thrombosis
HR	= hazard ratio
LMWH	= low molecular weight heparin
OR	= odds ratio
PE	= pulmonary embolism
RAM	= risk assessment model
VTE	= venous thromboembolism
VTEPS	= Venous Thromboembolism Prevention Study

Symptomatic VTE occurs with high frequency after postbariatric body contouring surgery, including circumferential abdominoplasty (7.7%), abdominoplasty (5.0%), and breast or upper body contouring (2.9%) procedures.⁷ Using the modified Davison-Caprini RAM,¹³ Seruya and colleagues¹⁴ showed a 7.5% VTE incidence in patients stratified to the “highest risk” group. Symptomatic, postoperative VTE occurs in 2.2% of women having flap-based breast reconstruction after mastectomy.¹⁵ However, asymptomatic VTE rates in the flap-based breast reconstruction population may be much higher. A recent study screened asymptomatic women before discharge using duplex ultrasonography and demonstrated that 4% had occult deep venous thrombosis (DVT).¹⁶ In addition, a small case series demonstrated that 16.7% of women may have occult pulmonary embolism (PE) within 3 days of surgery.¹⁷

The Venous Thromboembolism Prevention Study (VTEPS) was funded by the Plastic Surgery Educational Foundation in 2008. The study’s primary objective is to examine the effectiveness of postoperative, prophylactic dose enoxaparin (Lovenox [Sanofi Aventis]) for prevention of symptomatic VTE events in a diverse population of adult plastic and reconstructive surgery patients. The study’s control group is comprised of historic control patients who had plastic and reconstructive surgery but did not receive postoperative heparin, low molecular weight heparin (LMWH), anti-factor Xa medications, or warfarin (collectively referred to as “chemoprophylaxis”).

In this initial analysis of the VTEPS data, we sought to examine VTE incidence and when VTE events occur after plastic surgery. In addition, we examined the ability of the Caprini RAM to risk-stratify plastic and reconstructive surgery patients. Analyses were limited to VTEPS control patients, none of whom received chemoprophylaxis.

METHODS

Study design

VTEPS is being conducted at 5 tertiary care facilities in the United States. VTEPS sites include Regions Hospital (St.


Paul, MN), University of Michigan (Ann Arbor, MI), University of Pittsburgh (Pittsburgh, PA), University of Texas-Southwestern (Dallas, TX), and University of Washington (Seattle, WA). The analyses described here were limited to data from the VTEPS historic control group. Historic control patients were identified using medical record review for all plastic and reconstructive surgery procedures performed at each of the 5 VTEPS sites between March 2006 and June 2009. During this time period, the standard of care for VTE prophylaxis at all VTEPS sites did not include routine chemoprophylaxis. Postoperative chemoprophylaxis was provided to less than 10% of patients based on attending surgeon discretion. Historic control eligibility criteria included moderate to high risk for VTE (Caprini score ≥ 3), operation under general anesthesia, and overnight hospital stay. Control patients did not receive heparin, LMWH, factor Xa inhibitors, warfarin, or other means of prophylactic or therapeutic anticoagulation for 60 days after surgery. This included the patient’s inpatient stay and postdischarge course. Perioperative sequential compression devices were used.

Independent variables

At each study site, medical record review was performed by physician-led teams. Before chart review, each team participated in a standardized training session administered by the VTEPS study coordinators. Retrospective chart review was carried out to identify VTE risk factors per the Caprini RAM (Fig. 1). The factors were used to calculate a risk score based on risk factors present before (eg, medical comorbidities or known thrombophilia) and during (eg, surgery length or central venous line insertion) hospitalization. Additional independent variables included the year the procedure was performed, VTEPS site, patient sex, total number of operations, description of surgical procedure, receipt of chemoprophylaxis, administration of aspirin or clopidogrel, and length of hospitalization.

Dependent variables

Dependent variables of interest were identified using medical record review, including documentation from the operating room, inpatient stay, and outpatient visits. Records were reviewed for 60 days after surgery. Patients who lacked 60-day followup were excluded. Chart review identified symptomatic DVT (including upper and lower extremity DVT), symptomatic PE, or hematoma requiring a second operation. All VTE events required confirmation using objective imaging (lower extremity venous duplex ultrasound, ventilation-perfusion scan, or PE protocol CT scan). Autopsy-proved DVT or PE were considered positive outcomes when they were believed to be the proximate cause of death. Among patients with an outcome of interest, time to VTE and time to


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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	Each Risk Factor Represents 2 Points				
<ul style="list-style-type: none"> <input type="checkbox"/> Age 41-60 years <input type="checkbox"/> Minor surgery planned <input type="checkbox"/> History of prior major surgery (< 1 month) <input type="checkbox"/> Varicose veins <input type="checkbox"/> History of inflammatory bowel disease <input type="checkbox"/> Swollen legs (current) <input type="checkbox"/> Obesity (BMI > 25) <input type="checkbox"/> Acute myocardial infarction <input type="checkbox"/> Congestive heart failure (< 1 month) <input type="checkbox"/> Sepsis (< 1 month) <input type="checkbox"/> Serious lung disease incl. pneumonia (< 1 month) <input type="checkbox"/> Abnormal pulmonary function (COPD) <input type="checkbox"/> Medical patient currently at bed rest <input type="checkbox"/> Other risk factors _____ 	<ul style="list-style-type: none"> <input type="checkbox"/> Age 60-74 years <input type="checkbox"/> Arthroscopic surgery <input type="checkbox"/> Malignancy (present or previous) <input type="checkbox"/> Major surgery (> 45 minutes) <input type="checkbox"/> Laparoscopic surgery (> 45 minutes) <input type="checkbox"/> Patient confined to bed (> 72 hours) <input type="checkbox"/> Immobilizing plaster cast (< 1 month) <input type="checkbox"/> Central venous access 				
<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr style="background-color: black; color: white;"> <th style="padding: 5px;">Each Risk Factor Represents 3 Points</th> </tr> </thead> <tbody> <tr> <td style="padding: 5px;"> <ul style="list-style-type: none"> <input type="checkbox"/> Age over 75 years <input type="checkbox"/> History of DVT/PE <input type="checkbox"/> Family history of thrombosis* <input type="checkbox"/> Positive Factor V Leiden <input type="checkbox"/> Positive Prothrombin 20210A <input type="checkbox"/> Elevated serum homocysteine <input type="checkbox"/> Positive lupus anticoagulant <input type="checkbox"/> Elevated anticardiolipin antibodies <input type="checkbox"/> Heparin-induced thrombocytopenia (HIT) <input type="checkbox"/> Other congenital or acquired thrombophilia If yes: Type _____ *most frequently missed risk factor </td> </tr> </tbody> </table>	Each Risk Factor Represents 3 Points	<ul style="list-style-type: none"> <input type="checkbox"/> Age over 75 years <input type="checkbox"/> History of DVT/PE <input type="checkbox"/> Family history of thrombosis* <input type="checkbox"/> Positive Factor V Leiden <input type="checkbox"/> Positive Prothrombin 20210A <input type="checkbox"/> Elevated serum homocysteine <input type="checkbox"/> Positive lupus anticoagulant <input type="checkbox"/> Elevated anticardiolipin antibodies <input type="checkbox"/> Heparin-induced thrombocytopenia (HIT) <input type="checkbox"/> Other congenital or acquired thrombophilia If yes: Type _____ *most frequently missed risk factor	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr style="background-color: black; color: white;"> <th style="padding: 5px;">Each Risk Factor Represents 5 Points</th> </tr> </thead> <tbody> <tr> <td style="padding: 5px;"> <ul style="list-style-type: none"> <input type="checkbox"/> Elective major lower extremity arthroplasty <input type="checkbox"/> Hip, pelvis or leg fracture (< 1 month) <input type="checkbox"/> Stroke (< 1 month) <input type="checkbox"/> Multiple trauma (< 1 month) <input type="checkbox"/> Acute spinal cord injury (paralysis)(< 1 month) </td> </tr> </tbody> </table>	Each Risk Factor Represents 5 Points	<ul style="list-style-type: none"> <input type="checkbox"/> Elective major lower extremity arthroplasty <input type="checkbox"/> Hip, pelvis or leg fracture (< 1 month) <input type="checkbox"/> Stroke (< 1 month) <input type="checkbox"/> Multiple trauma (< 1 month) <input type="checkbox"/> Acute spinal cord injury (paralysis)(< 1 month)
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<p style="text-align: right; font-size: 1.2em;">Total Risk Factor Score <input style="width: 40px; height: 20px; border: 1px solid black;" type="text"/></p>					

Figure 1. The Caprini Risk Assessment Model. (Adapted from: Caprini JA. Thrombosis risk assessment as a guide to quality patient care. *Dis Mon* 2005;51:70–78, with permission.)

reoperative hematoma in days were identified as additional dependent variables.

Data storage and analysis

A secure, password-protected Website was created through a modification of the American Society of Plastic Surgeons' Tracking Operations and Outcomes for Plastic Surgeons (TOPS) platform (<http://tops.plasticsurgery.org>). The Website was developed and maintained by Outcomes, Inc. Deidentified patient-level data for risk factors and outcomes were uploaded and stored on Outcomes, Inc's secure data server. For analysis purposes, deidentified data were extracted by the American Society of Plastic Surgeons and provided to study personnel in Microsoft Excel spreadsheets.

Data analysis was performed using Stata 11 (Stata-Corp LP). A VTE variable, including patients with either DVT or PE, was created. Descriptive statistics that examined DVT, PE, and VTE incidence were generated. For VTE risk analysis, patients were stratified by Caprini score at accepted and published levels (Caprini scores of 3 to 4, 5 to 6, 7 to 8, and >8).^{5,18} Descriptive statistics on VTE rate by stratified Caprini score were generated. Group differences were examined using logistic regression. A value of $p < 0.05$ was considered significant. Kaplan-Meier analysis using stratified Caprini score was performed to examine the number of VTE events over time. Hazard ratios (HRs) were generated. The institutional review board at each VTEPS site approved this study.

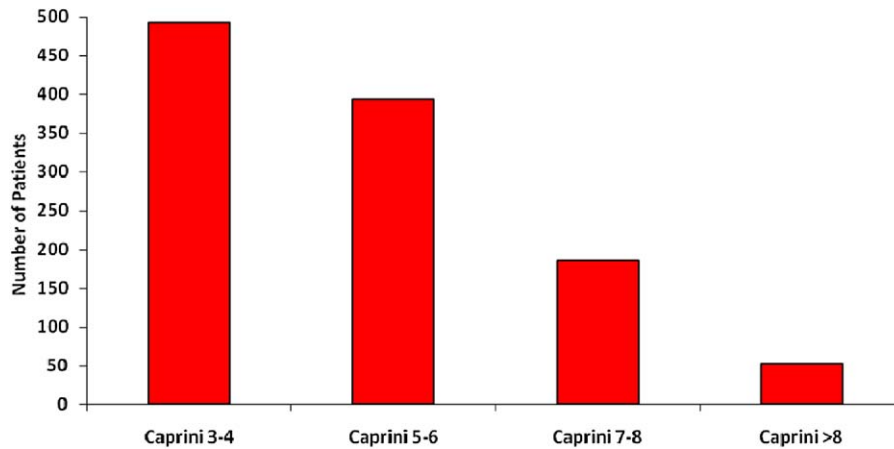


Figure 2. Histogram of Caprini score in plastic and reconstructive surgery patients (n = 1,126).

RESULTS

A total of 1,126 historic control patients were identified from 5 VTEPS network sites. No patient in this series received pre- or postoperative chemoprophylaxis. Most patients (79%) were in the Caprini 3 to 4 or Caprini 5 to 6 groups (Fig. 2).

At 60 days after surgery, the overall VTE incidence was 1.69%. Overall DVT incidence was 1.26% and overall PE incidence was 0.89%. Patients with both DVT and PE comprised 0.44% of the total number of patients. A stratified analysis of VTE by procedure type is shown in Table 1. A univariate analysis examining individual risk factors in patients with and without VTE is presented in Table 2.

VTE incidence increased dramatically with increased Caprini score (Fig. 3). In patients with Caprini score >8, 11.3% had a symptomatic VTE event between postoperative days 0 and 60. Patients with Caprini score >8 were

significantly more likely to develop VTE when compared with patients with Caprini score of 3 to 4 (odds ratio [OR] 20.9, $p < 0.001$), 5 to 6 (OR 9.9, $p < 0.001$), or 7 to 8 (OR 4.6, $p = 0.015$). Additionally, patients with Caprini score 7 to 8 were significantly more likely to develop VTE when compared with patients with Caprini score 3 to 4 (OR 4.5, $p = 0.04$) (Table 3).

Two of 5 sites systematically omitted data on time to VTE. These 2 sites did not provide the postoperative day on which VTE occurred for any patient with VTE at their institution. As required by our Institutional Review Board, data were initially uploaded to our secure, web-based server in a de-identified fashion. Thus, we were unable to re-query the primary data source to obtain time to VTE data for these two sites. All data from these 2 sites were dropped before time series analysis. Kaplan-Meier analysis was per-

Table 1. Venous Thromboembolism Stratified By Procedure Type

Procedure type	Patients, n	Patients with VTE, n (%)
Upper extremity reconstruction	153	0
Breast reconstruction	307	4 (1.3)
Breast reduction	99	1 (1.0)
Cosmetic breast surgery	12	0
Post-bariatric body contouring	26	0
Other body contouring	27	0
Lower extremity reconstruction	47	0
Head and neck reconstruction	198	4 (2.0)
Trunk reconstruction	82	6 (7.3)
Burn reconstruction	16	1 (6.3)
Surgery for decubitus ulcers	96	3 (3.1)
Genitourinary reconstruction	28	0
Facial cosmetic surgery	35	0

VTE, venous thromboembolism.

Table 2. Univariate Analysis Examining Individual Risk Factors in Patients With and Without Venous Thromboembolism

Risk factor	Without VTE	With VTE	p Value
Patients, n	1,107	19	
Age (y), mean	48.2	54.2	0.083
Female, %	64.8	63.2	0.864
BMI > 25, %	66.5	79.0	0.252
BMI > 40, %	8.3	10.5	0.727
Prior surgery within 1 mo, %	11.9	47.4	<0.001
OR time, mean	3.5	3.8	0.621
History of VTE	2.5	0	0.481
Family history of VTE, %	0.53	5.26	0.008
Cancer (present or previous), %	37.6	36.8	0.946
Central venous access, %	11.3	47.4	<0.001
Women, n	734	12	
Oral contraceptive use, %	9.1	16.7	0.371

VTE, venous thromboembolism; BMI, body mass index.

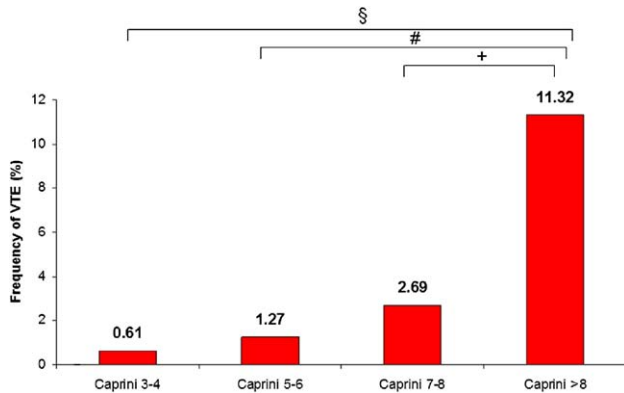


Figure 3. Rates of venous thromboembolism (VTE) in the first 60 postoperative days by stratified Caprini score (n = 1,126). OR, odds ratio; § compares Caprini>8 to Caprini 3-4, OR 20.85, p<0.001; # compares Caprini>8 to Caprini 5-6, OR 9.93, p<0.001; + compares Caprini>8 to Caprini 7-8, OR 4.62, p=0.015.

formed on 1,087 patients from the remaining 3 sites. Patients with Caprini score >8 had significantly increased hazard for VTE when compared with patients with Caprini score 3 to 4 (HR 48.6, p < 0.001), 5 to 6 (HR 9.3, p = 0.001), or 7 to 8 (HR 3.6, p = 0.041) (Table 4). In patients with Caprini score 7 to 8 and >8, VTE events occurred across the 60-day follow-up period (Fig. 4).

DISCUSSION

Our data demonstrate that the Caprini RAM is a useful and effective tool to stratify plastic and reconstructive surgery patients for VTE risk. For patients with higher Caprini scores, a significantly greater likelihood of VTE events was observed. Approximately 1 in 9 patients (11.3%) with Caprini score >8 had a VTE event within 60 days after surgery. Particularly among patients with Caprini score 7 to 8 or >8, there was no evidence that VTE risk is limited to the immediate postoperative period.

Venous thromboembolism in plastic surgery patients

Venous thromboembolic events carry the risk of both morbidity and mortality. Patients presenting with symptomatic

Table 4. Sixty-Day Hazard for Venous Thromboembolism Stratified by Caprini Score

Score	Caprini 5-6	Caprini 7-8	Caprini >8
Caprini 3-4	5.2 (0.6-46.7) p = 0.139	13.3 (1.6-114.1) p = 0.018	48.6 (5.7-416.0) p < 0.001
Caprini 5-6	—	2.6 (0.7-9.5) p = 0.162	9.3 (2.5-34.7) p = 0.001
Caprini 7-8	—	—	3.6 (1.1-12.6) p = 0.041

Data are presented as hazard ratio (95% CI).

Table 3. Sixty-Day Odds for Venous Thromboembolism Stratified by Caprini Score

Score	Caprini 5-6	Caprini 7-8	Caprini >8
Caprini 3-4	2.1 (0.5-8.8) p = 0.312	4.5 (1.1-19.1) p = 0.040	20.9 (5.1-86.1) p < 0.001
Caprini 5-6	—	2.2 (0.6-7.5) p = 0.231	9.9 (2.9-33.8) p < 0.001
Caprini 7-8	—	—	4.6 (1.4-15.8) p = 0.015

Data are presented as odds ratio (95% CI).

PE have a 10% death rate within 1 hour. Of patients who survive, 50% demonstrate evidence of right ventricular dysfunction. An additional 5% will eventually develop chronic pulmonary hypertension.¹⁹ Between 4% and 7% of plastic surgeons report a patient death from postoperative PE.^{20,21} DVT can damage venous valves, which can result in venous reflux and the post-thrombotic syndrome. Severe PTS occurs in approximately 10% of patients with symptomatic DVT¹⁹ and manifest as a chronically swollen, tender, and ulcerated extremity. Post-thrombotic syndrome is a major predictor of poor quality of life after DVT.²²

Plastic surgeons underuse chemoprophylaxis in high-risk patients and may fail to recognize risk factors when present.²⁰⁻²⁴ Others may recognize risk factors but fail to actively modify them before surgery.²⁵ Plastic surgeons commonly cite risk of re-operative hematoma and lack of evidence in the plastic surgery literature as reasons for not providing chemoprophylaxis.²¹ Recently, plastic surgeons have been inundated with information on postoperative thromboembolic complications. Multiple recent publications have defined VTE incidence and risk factors in plastic surgery patients.^{7,14,15,17,26-33} Barriers to surgeons providing chemoprophylaxis and methods to minimize VTE risk have been discussed in several letters to the editor.³⁴⁻³⁶ A modified version of

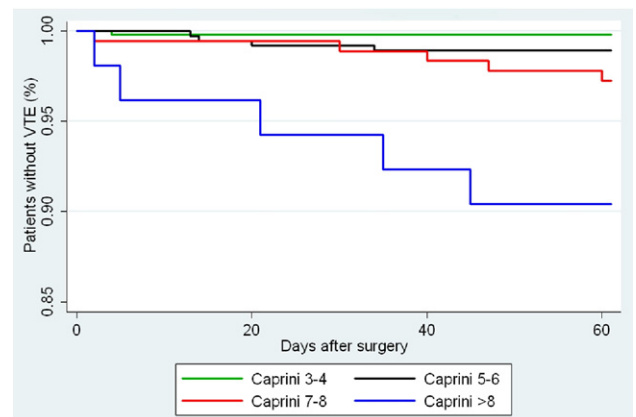


Figure 4. Survival analysis examining time to venous thromboembolism (VTE) by stratified Caprini score (n = 1,087).

the Caprini RAM has been validated in postbariatric body contouring patients.⁷ However, no RAM had previously been validated in a broad range of adult plastic and reconstructive surgery patients.

Validation of the Caprini Risk Assessment Model

Earlier versions of the Caprini RAM⁹ placed all patients with a score ≥ 5 into the same “highest risk” group. This designation was challenged by a recent publication by Bahl and colleagues⁵ from the University of Michigan. In a series of more than 8,000 general, urology, and vascular surgery patients, widely variable VTE rates were seen among patients previously lumped into the same “highest risk” category. Observed differences in VTE incidence among patients with Caprini score of 5 to 6 (1.3%), 7 to 8 (2.6%), and >8 (6.5%) were statistically significant. As a result, recent modifications of the Caprini RAM recognize patients with Caprini score >8 as a separate, “super high risk” group. Extended-duration chemoprophylaxis for 30 days after surgery is recommended for this “super high risk” patient subgroup.^{18,37}

Superficially, the study design for VTEPS and Bahl and colleagues⁵ analyses appear similar. Both used the Caprini RAM to retrospectively risk-stratify surgical patients, and they then examined VTE incidence by stratified Caprini score. However, the observed VTE incidence by stratified Caprini score was notably different between the VTEPS and Bahl patient populations. VTE incidence among “super high risk” patients included in VTEPS approached twice the incidence seen in Bahl’s patient population (11.3% vs 6.5%).

Plastic surgery patients are not necessarily at increased risk for VTE events when compared with general, urology, and vascular surgery patients. The differences in observed VTE incidence between the 2 studies may be explained by differences in study methodology. First, the VTEPS dataset contains 60-day patient follow-up, compared with 30-day outcomes in the Bahl study. Second, VTEPS methodology used manual chart review to identify VTE events; this method may be more robust than using hospital billing data. Finally, 32% of Bahl’s Caprini >8 group received LMWH prophylaxis. In contrast, this analysis of the VTEPS database specifically excluded patients who received chemoprophylaxis.

Late venous thromboembolism risk

For patients with Caprini score 7 to 8 and >8 , VTE risk was not limited to the immediate postoperative period. Our results echo recently published data from the UK’s Million Women Study.³⁸ The Million Women Study demonstrated that in middle-aged women, VTE risk may remain substantially elevated for at least 90 days after surgery. Published

guidelines for total hip or knee replacement and hip fracture surgery support postdischarge chemoprophylaxis for up to 5 weeks after surgery.³⁹ Similar recommendations for extended duration chemoprophylaxis have been made in selected groups of medical patients⁴⁰ and general surgery patients.^{18,41-43} The Enoxaparin and Cancer (ENOXACAN II) study was a randomized control trial examining 7 versus 28 days of LMWH for VTE prevention after surgery for intra-abdominal or pelvic malignancy. Extended-duration prophylaxis significantly reduced VTE events at 30 and 90 days after surgery.⁴³ Interestingly, plastic surgery patients have demonstrated excellent compliance with outpatient LMWH injections for VTE prophylaxis. A small case series of postdischarge subcutaneous LMWH prophylaxis has shown $>90\%$ medication compliance.¹⁴

Limitations

Our analysis is limited by several factors. The VTEPS data were identified and uploaded in a retrospective manner. Risk factors were identified using physician review of the medical record. So, inadvertent omissions from the dictated medical record may have resulted in underestimation of a patient’s Caprini risk score.

Multiple physicians and physician-led teams at 5 separate VTEPS sites identified and uploaded data to the study’s central Website. Sites contributed variable numbers of patients to the 2 study cohorts (historic control and clinical protocol). Intersite variability in data collection may have been present. Before undertaking VTEPS, we attempted to control for this confounder. Each individual involved in data collection was provided with explicit, written study protocols. All individuals who collected VTEPS data participated in a standardized training session, administered by study personnel. Data were retrospectively checked by VTEPS core investigators for completeness. Ongoing feedback was provided to each VTEPS site. Incomplete data were dropped from the analysis.

Medical record review was conducted at each VTEPS site. Patients who had a VTE event diagnosed and/or treated at another hospital may not be represented in the VTEPS database. Literature published after our study protocol was designed and implemented supports elevated VTE risk for at least 90 days after surgery.³⁸ However, patients whose VTE event occurred after postoperative day 60 are not included in our database. Clinical diagnoses of DVT and PE are known to be unreliable. Clinical examination alone is known to underestimate true incidence of VTE.⁴⁴⁻⁴⁸ We did not screen patients for asymptomatic VTE, as has been done in other high risk surgical groups.^{16,17,49,50} As a result of these factors, the VTEPS database likely under-represents the true incidence of VTE after plastic surgery.

In conclusion, the Caprini RAM effectively risk-stratifies plastic and reconstructive surgery patients for perioperative VTE risk. Among patients with Caprini score >8 , 11.3% have a postoperative VTE when chemoprophylaxis is not provided. In patients with Caprini score 7 to 8 or Caprini score >8 , there was no evidence that VTE risk is limited to the immediate postoperative period. Future goals of the VTEPS study will include examination of both VTE and re-operative hematoma rates between patients who receive and do not receive post-operative, prophylactic dose enoxaparin.

Author Contributions

Study conception and design: Pannucci, Hamill, Hume, Hoxworth, Fisher, Rubin, Pusic, Wilkins

Acquisition of data: Pannucci, Bailey, Fisher, Dreszer, Zumsteg, Jaber

Analysis and interpretation of data: Pannucci, Pusic, Wilkins

Drafting of manuscript: Pannucci, Wilkins

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