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)

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 patients[7] and medical inpatients.[11,12]

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

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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 colleagues[14] 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 $\geq$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