The association of venous thromboembolism chemoprophylaxis timing on venous thromboembolism after major vascular surgery

Danielle C. Sutzko, MD, MS, Patrick E. Georgoff, MD, Andrea T. Obi, MD, Mark A. Healy, MD, MS, *and* Nicholas H. Osborne, MD, MS, *Ann Arbor, Mich*

ABSTRACT

Objective: Venous thromboembolism (VTE) is reported to occur in up to 33% of patients undergoing major vascular surgery. Despite this high incidence, patients inconsistently receive timely VTE chemoprophylaxis. The true incidence of VTE among patients receiving delayed VTE chemoprophylaxis is unknown. We sought to identify the association of VTE chemoprophylaxis timing on VTE risk, postoperative transfusion rates, and 30-day mortality and morbidity in patients undergoing major open vascular surgery.

Methods: Patients undergoing major open vascular surgery (open abdominal aortic aneurysm [oAAA] repair, aortofemoral bypass, and lower extremity infrainguinal bypass [LEB]) were identified using the Michigan Surgical Quality Collaborative (MSQC) between July 2012 and June 2015. The VTE rate was compared between patients receiving early versus delayed VTE chemoprophylaxis. VTE chemoprophylaxis delay was defined as therapy initiation more than 24 hours after surgery. The risk-adjusted association of the chemoprophylaxis timing and VTE development was determined using multivariable logistic regression. Blood transfusion rates, 30-day mortality, and postoperative complications were compared across groups.

Results: A total of 2421 patients underwent major open vascular surgery, including 196 oAAA repair, 259 aortofemoral bypass, and 1966 LEB. The overall incidence of 30-day VTE was 1.40%, ranging from 1.12% for LEB to 3.57% for oAAA repair. Among patients receiving early VTE chemoprophylaxis, the rate of VTE was 0.78% versus 2.26% among those with a delay in VTE chemoprophylaxis ($P = .002$). When accounting for the preoperative risk of VTE, delayed chemoprophylaxis was associated with a significantly higher risk of VTE (odds ratio, 2.38; 95% confidence interval, 1.12-5.06; $P = .024$). The early VTE chemoprophylaxis group was associated with a significantly decreased risk of bleeding compared with those with a delay (14.31% vs 18.90%; $P = .002$). Overall 30-day mortality and postoperative complications were similar with the exception of an associated higher rate of infectious complications in the delayed VTE chemoprophylaxis group, including superficial surgical site infection (6.00% vs 4.06%; $P = .028$), pneumonia (3.25% vs 1.85%; $P = .028$), urinary tract infection (2.95% vs 1.57%; $P = .020$), and severe sepsis (3.05% vs 1.71%; $P = .029$).

Conclusions: Although patients undergoing major open vascular surgery have a low risk of VTE at baseline, there is a significantly greater risk of developing VTE among patients who have a delay in the administration of VTE chemoprophylaxis. Postoperative transfusion rates were significantly lower among patients receiving early chemoprophylaxis. There were no differences in the 30-day mortality and postoperative complications, except for infectious complications. Given these findings, surgeons should consider early chemoprophylaxis in the postoperative setting after major open vascular surgery without contraindication. (J Vasc Surg 2017;■:1-10.)

Venous thromboembolism (VTE) is a common and potentially preventable surgical complication with high morbidity. Although the association between VTE and nonvascular surgical procedures is well-established,[1] less is known about VTE after major vascular surgery. The reported incidence of deep venous thrombosis (DVT) after elective open abdominal aortic aneurysm (oAAA) repair and lower extremity infrainguinal bypass (LEB) varies from 0% to 33%[2-10] in those who do not receive postoperative pharmacologic prophylaxis to 2% to 9% in those who do.[3,5,11-14] The variable reported VTE rate is underscored by inconsistencies in these studies, including the variation in the type, timing, and anticoagulation dose administered, different techniques used to diagnose DVT, and inconsistent below-knee DVT inclusion. Moreover, complications resulting from DVTs, including pulmonary embolism (PE), are not well-described.

The typical vascular surgery patient has multiple risk factors that predispose him or her to VTE, including advanced age, prolonged immobility, and iatrogenic intimal vascular injury. The Caprini Risk Assessment Model has been used to estimate postoperative VTE risk

From the Section of Vascular Surgery, University of Michigan Health System.

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Correspondence: Danielle C. Sutzko, MD, MS, University of Michigan Health System, 1500 E. Medical Center Drive, Frankel Cardiovascular Center, Ann Arbor, MI 48109-5867 (e-mail: horned@med.umich.edu).

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in a large surgical cohort of patients that encompassed a myriad of general and surgical subspecialties.[15-17] However, no vascular surgery-specific risk assessment tool exists. In high-risk patient populations, defined as a Caprini score of five or greater, the American College of Chest Physicians guidelines recommend that VTE chemoprophylaxis with low-molecular-weight heparin (LMWH) or low-dose unfractionated heparin be administered in the absence of contraindications (grade 1B evidence).[18] In regard to major vascular surgery, the available VTE prophylaxis guidelines are limited in number and specificity,[19-22] and surveys of vascular surgeons show wide discrepancies in the postoperative chemoprophylaxis use.[18,23-25] These discrepancies exist not only for the use of chemoprophylaxis, but for the timing of use as well. This may in part be explained by two important factors: the near universal intravenous intraoperative use of heparin and the potential postoperative bleeding risk with a new vascular anastomosis.

Given the variation in reported VTE incidence after major vascular surgery and in postoperative VTE prophylaxis timing, we sought to (1) determine the VTE incidence after oAAA repair, aortobifemoral bypass (AFB), and LEB among a statewide quality collaborative, (2) examine the relationship between early versus delayed postoperative VTE chemoprophylaxis and VTE events, and (3) determine if there is a difference in blood transfusion rates and 30-day complications for patients receiving early versus delayed VTE chemoprophylaxis. We hypothesized that VTE rates would increase with delay in chemoprophylaxis and overall bleeding rates would be low.

ARTICLE HIGHLIGHTS

- **Type of Research:** Retrospective analysis of the Michigan Surgical Quality Collaborative (MSQC) database
- **Take Home Message:** Analysis of outcome of 2421 major vascular operations from the MSQC database revealed a 1.40% incidence of 30-day venous thromboembolism, significantly less (0.78%) when chemoprophylaxis was started within 24 hours than in those with delayed chemoprophylaxis (2.26%; $P = .024$).
- **Recommendation:** The authors suggest early (<24 hour) chemoprophylaxis after major open vascular operations, particularly in patients with risk factors for deep vein thrombosis who have no contraindications to chemoprophylaxis.

METHODS

Data source. The Michigan Surgical Quality Collaborative (MSQC) is a statewide hospital collaborative dedicated to overall surgical quality improvement. Currently MSQC includes 73 participating hospitals. The collaborative captures data on 306 different *Current Procedural Terminology* (CPT) codes arranged into 14 broadly defined procedure groups including general surgery, vascular surgery, and hysterectomy procedures. MSQC data are abstracted in a hybrid approach by trained Surgical Clinical Quality Reviewers (SCQRs). The hybrid approach includes the SCQR providing the full list of eligible cases from which a sample is to be drawn. These cases are then stratified into procedural groups followed by simple random sampling to select the cases for data abstraction. The data abstraction process is then performed by the SCQR. The SCQR performs a comprehensive chart review for the specific data points in the data dictionary. This process includes review of preoperative history and physical, operative reports, postoperative progress notes, laboratory results, radiologic studies and reports, and discharge summaries. In regard to specific variables that are important in our study (ie, VTE chemoprophylaxis, type, and timing), SCQR record the initial start time and date of administration by chart review. For complete information on MSQC, data sampling and abstraction procedures please see www.msqc.org. The use of MSQC data was granted through a standard institutional review board approval and a data user agreement through the MSQC compliance office. All patient information was deidentified and did not require informed consent.

Patient selection. Patient selection is demonstrated in the Fig. Patients over 18 years old who underwent oAAA, AFB, and/or LEB from July 2012 to June 2015 were included in the analysis. CPT codes were used to select these operations (Supplemental Table I, online only). Urgent, emergent, and elective cases were included. The following procedures were excluded: endovascular abdominal aortic aneurysm repair, ruptured abdominal aortic aneurysm repair, extra-anatomic bypass (ie, axillary to femoral bypass), and mesenteric bypasses. We also excluded 1 patient for incomplete data, 168 patients who had a documented contraindication to anticoagulation, and 24 patients who died the day of the procedure and thus did not have the opportunity to develop a VTE event. Finally, we excluded 871 patients who did not receive VTE chemoprophylaxis, because our main question was timing of VTE chemoprophylaxis. This resulted in 2421 patients who underwent major open vascular surgeries and received VTE chemoprophlaxis at some time during the postoperative period. We then separated the procedures into two groups, those who had no delay in VTE chemoprophylaxis (58.0%), which we defined as administration of chemoprophylaxis within 24 hours of the operation, and those who had a delay in VTE chemoprophylaxis (42.0%), which we defined as administration more than 24 hours after the operation.