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Fewer thromboembolic events after implementation of a venous thromboembolism risk stratification tool

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ABSTRACT

Background: Deep venous thrombosis and pulmonary embolus are leading preventable causes of death after surgery. Venous thromboembolism (VTE) prophylaxis management guidelines, with evidenced-based recommendations, are available in the literature. However, over 40% of "at-risk" surgical patients fail to receive appropriate VTE prophylaxis. Decision support–based interventions to reduce venous thromboembolic events were explored.

Methods: A venous thromboembolic risk stratification tool embedded in the electronic medical record, Epic, linking risk category to venous thromboembolic prophylaxis order sets was created, implemented, and analyzed for general surgery patients. Logistic regression analysis was used to compare rates of venous thromboembolic events before and after the intervention, controlling for age, gender, race, body mass index, inpatient status, transfer status, elective/emergent case status, American Society of Anesthesiologists classification, and wound classification.

Results: Venous thromboembolic events in the preintervention and postintervention periods were 55 (1.25%) and 12 (0.64%), respectively ($P = 0.033$). All-cause mortality events decreased after intervention from 49 (1.12%) to 14 (0.75%; $P = 0.187$). Multivariable analyses show that the risk of a venous thromboembolic event after intervention was half (odds ratio = 0.532; 95% confidence interval, 0.284-0.997; $P = 0.049$) as likely compared to that in the preintervention period. From 2012 to 2015, our institution moved from the ninth decile (poor) to the first decile (best) for the incidence of venous thromboembolic events among 760 National Surgical Quality Improvement Program hospitals across the nation.

Conclusions: Postoperative thromboembolic events decreased after implementation of a VTE risk stratification tool, linking risk category to venous thromboembolic prophylaxis order sets, embedded in the electronic medical record, Epic.

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Introduction

Deep venous thrombosis (DVT) and pulmonary embolism (PE) are leading preventable causes of death after surgery.[1] Venous thromboembolism (VTE) prophylaxis management guidelines, with evidenced-based recommendations, are available in the literature.[2] However, over 40% of "at-risk" surgical patients fail to receive appropriate VTE prophylaxis.[3,4] Clinical decision support tools have been effective in reducing VTE events[5-8] but have yet to be tested in electronic medical records (EMRs) using Epic Systems Corporation (Epic) software (Verona, WI).[6] The aim of this study was to evaluate the efficacy of risk-stratified VTE prophylaxis in an EMR in which hard stops to ensure compliance cannot be implemented within select populations. Our hypothesis was that implementing a risk stratification score tied to VTE prophylaxis orders in Epic would result in reduced VTE events.

Methods

A multidisciplinary stakeholder team including nurses, surgeons, residents, hematologists, pharmacists, American College of Surgeons National Surgical Quality Improvement Program (ACS NSQIP) data analysts, and performance improvement specialists met to review data and processes and plan next steps. On closer review of the institution's ACS NSQIP outcome data, VTE events occurred more frequently in older cancer patients, after discharge from the hospital.

We defined VTE as a composite of PE and deep vein thrombosis requiring therapy occurring in 30 d after an operative procedure. Mortality was defined as death from any cause that occurred intraoperatively or within 30 d after an operative procedure.[9] We used ACS NSQIP PE and DVT definitions; criteria for PE included a new diagnosis of a new blood clot in a pulmonary artery with a V-Q scan interpreted as high probability of pulmonary embolism or a positive CT examination, trans-esophageal echocardiogram, pulmonary arteriogram, or any other definitive imaging modality (including direct pathologic examination such as autopsy). Vein thrombosis requiring therapy criteria included the following: new diagnosis of a [new] venous thrombosis (superficial or deep), confirmed by a duplex, venogram, CT scan, or any other definitive imaging modality (including direct pathology examination such as autopsy) and the patient must be treated with anticoagulation therapy and/or placement of a vena cava filter or clipping of the vena cava, or the record indicates that treatment was warranted, but there was no additional appropriate treatment option available.

ACS NSQIP variable definitions have been relatively consistent over time with the 2013 PE definition amended to new diagnosis of new blood clot and July 2016 definition amended to include a PE that occurred during the intraoperative period. In 2013, the vein thrombosis definition was amended to include cases where treatment was warranted but not available and where vein thrombosis was present but the decision-maker refused therapy. In 2014, the ACS NSQIP vein thrombosis criteria clarified that chronic venous thrombosis with evidence of progression postoperatively would be included.

Electronic risk stratification tool

A risk stratification tool was created in the EMR, Epic, linking the patient's risk level to specific VTE prophylaxis order sets, which guides even the least experienced team member to consistently and accurately select appropriate prophylaxis. Each surgical division reviewed current Clinical Practice Guidelines for adult VTE prophylaxis,[10] with a particular focus on weight-based dosing and appropriate extended prophylaxis. VTE prophylaxis medications for moderate, high, and very high-risk categories were delineated. Fondaparinux, available for patients with a history of heparin-induced thrombocytopenia or heparin-induced thrombocytopenia and thrombosis before our intervention, was not included as an option in VTE prophylaxis panels after risk stratification. Conversely, apixaban and heparin were options for patients with creatinine clearance <30 mL/min after risk stratification, and apixaban was not a selection in VTE prophylaxis panels, and heparin was not linked to creatinine clearance before the project. If risk stratification was not performed, all VTE prophylaxis medication options would be available.

The VTE risk assessment tool (Fig. 1) was based on a modified Johns Hopkins Hospital's mandatory decision support tool.[5] In addition to the 13 risk factors included on the Johns Hopkins tool,[11] evidenced-based variables were selected by consensus of an expert clinical panel, including myeloproliferative disorder, nephrotic syndrome, obesity (body mass index [BMI] > 30 kg/m^2), active smoking, major trauma, venous stasis, and a first-degree relative with history of VTE. Using this tool, patients were classified into risk strata based on several factors such as whether patients had cancer or were undergoing a major operation (see Appendix). For instance, cancer and major surgery place a patient at very high-risk and only very high-risk VTE prophylaxis order sets would be available for selection in Epic for these patients. In addition, patients at a very high-risk generated a nursing order for extended prophylaxis education at discharge. However, the recommended prophylaxis can be overridden by disregarding risk stratification.

Implementation phase

Once the risk stratification tool was built in Epic, it was piloted in a subset of surgical patients undergoing colorectal, surgical endocrine, breast, hepatobiliary, and emergency general surgery procedures. Informational sessions were held with surgeons, residents, and pilot-project unit nursing staff. Baseline data and the rationale for change were presented. The risk stratification tool and changes in workflow were reviewed. Clinic staff—nurse practitioners, social workers, and administrative assistants—addressed the preapproval process from insurance companies for patients who would require extended prophylaxis. Change in workflow for inpatient nursing staff included additional patient education, ensuring the timely placement of discharge medication orders, and confirming insurance approval for extended prophylaxis.