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Money well spent? A cost and utilization analysis of prophylactic inferior vena cava filter placement in high-risk trauma patients

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ABSTRACT

Background: Inferior vena cava filters (IVCF) for venous thromboembolic prophylaxis in high-risk trauma patients is a controversial practice. Utilization of IVCF prophylaxis was evaluated at a level 1 trauma center. Daily cost of IVCF prophylaxis, time to IVCF, duration between IVCF and chemoprophylaxis, and number of patients needed to treat (NNT) to prevent pulmonary embolism (PE) was calculated.

Methods: A retrospective review of prophylactic IVCF over a 5-year period (2010-2014). Demographic, physiologic, injury, procedural, and outcome data were abstracted from the administrative trauma database. Medicare fees and days without chemoprophylaxis were used to determine daily IVCF cost. NNT was calculated using PE events in a cohort without IVCF.

Results: Over the 5-year period, 146 patients with mean age 56.3 y (SD ± 24.2), 67.8% male, underwent prophylactic IVCF. Predominant mechanisms of injuries were falls (45.9%) and motor vehicle accidents (20.5%) with median Injury Severity Score of 25 (intraquartile range [IQR] 16-29) and head Abbreviated Injury Score of 3 (IQR 3-5). Most common operative interventions required in 24.7% were orthopedic (25.3%) and neurosurgical (21.9%). Median time to IVCF was 78 h (IQR 48-144). Most common IVCF indications were closed head injury (48.6%) and spinal injuries (30.8%). Median time to administration of chemoprophylaxis was 96 h after IVCF (IQR 24-192) in 57.5%. Median IVCF cost was $759/d (IQR $361-$1897) compared with $4.32 for chemoprophylaxis. PE occurred in 0.26% without IVCF. PE did not occur with prophylactic IVCF. Estimated NNT was 379 (95% CI 265, 661).

Conclusions: Prophylactic IVCF placement is a costly practice with relatively low benefit. Anticipated time without chemoprophylaxis and patient criteria should be considered before routine IVCF placement.

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Introduction

Venous thromboembolism (VTE) is a frequent complication of traumatic injury that manifests through dynamic hematologic pathways unique to this patient population. The traditional triad of a hypercoagulable state, stasis, and endothelial damage may be compounded by hypotension, acidemia, and extremity fractures. Protecting patients from fatal pulmonary embolism (PE) while balancing the risk of consequent hemorrhage is a challenge for trauma care providers. The incidence of VTE in the critically injured patient varies widely with pooled data suggesting an 11.8% incidence of deep vein thrombosis (DVT) and 1.5% incidence of PE.[1] Current guidelines recommend mechanical prophylaxis and chemoprophylaxis in high-risk trauma patients.[2] The American College of Chest Physicians (ACCP) provide level 2C recommendations for low-dose unfractionated heparin or low molecular weight heparin (LMWH) over no prophylaxis. However, the preferred chemoprophylaxis for trauma patients is LMWH at a dose of 30 mg every 12 h, though weight-based dosing is becoming increasingly popular.[3,4]

Evolution of hemorrhage in certain injury patterns (i.e., severe traumatic brain injury [TBI] or solid organ injury) complicates the initiation of chemoprophylaxis due to lack of level 1 data in these clinical situations. For those patients, who are not candidates for VTE chemoprophylaxis, insertion of a temporary inferior vena cava filter (IVCF) remains an option. The main goal of prophylactic IVCF is to prevent the development of a fatal PE. Clear guidelines regarding indications for IVCF placement have been established, but often are not applicable to trauma patients due to their unique physiology. Lack of agreement regarding indications for IVCF prophylaxis portends variability of practice when clear evidence-based algorithms are not available. We sought to examine our utilization of prophylactic IVCF in patients admitted to a level 1 trauma center. Specifically, we wished to examine time to IVCF placement, duration between IVCF and chemoprophylaxis, daily cost of IVCF prophylaxis, and number of patients needed to treat (NNT) to prevent VTE.

Methods

This was a retrospective review of high-risk trauma patients undergoing prophylactic IVCF over a 5-year period (2010-2014). For the purposes of this review, the high-risk trauma patient population is defined as trauma patients at the highest risk for a venous thromboembolic event. By assessing average demographics of the IVC filter cohort, it was found that all of these patients met the standard definition of high risk for VTE including Injury Severity Score (ISS) >15, operative intervention, coma, pelvic fractures, and age of 40-59 y.[5] Prophylactic IVCF was defined as those patients who underwent percutaneous IVCF as defined by Current Procedural Terminology code 37,191 without a preoperative diagnosis of DVT or PE. Demographic, physiologic, injury, procedural, and outcome data were abstracted from the administrative trauma database. Requirement to obtain informed consent was waived by the Institutional Review Board, as all data acquired from the administrative database were deidentified. Chart review of the individual electronic medical record was also undertaken to obtain several key variables. Indications for IVCF were obtained using the interventional radiology operative records as recorded in the patient's chart. Time to filter insertion was defined by the amount of elapsed time from patient admission to IVCF insertion. Time to heparin prophylaxis was defined as the amount of time from IVCF insertion to first dose of heparin (low molecular weight or unfractionated) administration. Interruption of heparin prophylaxis was defined as one or more missing doses of prophylactic heparin administration noted in the medication administration record. The daily cost of IVCF prophylaxis was obtained by dividing the 2016 Medicare facility fee for IVCF placement (and removal where indicated) by number of days without chemoprophylaxis. The daily cost of heparin prophylaxis was obtained using the hospital's acquisition wholesale price provided by the pharmacy. The NNT for a prophylactic IVCF to prevent one additional PE was calculated by using the incidence of documented PE in trauma patients admitted during the course of the study who did not undergo prophylactic IVCF placement. The incidence of venous thromboembolic events was compared using the Chi-square test. For the purposes of our analysis, a two-tailed P-value of <0.05 was considered statistically significant. This study was Institutional Review Board approved at Delray Medical Center.

Results

During the course of the 5-year study period, 146 patients (1.8% of all trauma admissions) underwent prophylactic IVCF. Clinically relevant demographic and injury data are presented in Table 1. Patients were predominantly Caucasian males with a mean age of 56.3 y (SD $\pm$ 24.2). The largest cohort of patients had private insurance, followed by Medicare and uninsured payers.

Falls represented the most predominant source of injury followed by motor vehicle accidents. The head and neck region was the most commonly injured area of the body noted by Abbreviated Injury Scores (AIS), with a median ISS of 25 (intraquartile range [IQR] 16-29) indicative of a critically wounded patient population. Ninety percent of patients were admitted to the intensive care unit (ICU) from the trauma bay, while almost 25% of these patients required immediate operative intervention. Orthopedic interventions (25.3%) were most commonly performed, followed closely by neurosurgical procedures (craniotomy 21.9% and spinal instrumentation 20.5%). Abdominal exploration was only required in 7.5% of patients in the IVCF cohort. As can be seen from the demographic characteristics of the comparison cohort, this population had a lower overall injury burden and need for intervention. One third of these patients had an ISS of >15.

The median length of stay (Table 2) for patients with prophylactic IVCF was 14 d (IQR 8-22). The majority of patients were discharged either to a skilled nursing facility or to long-term acute care hospitals (38.3%), followed by acute rehabilitation (35.6%) or home (17.8%). Total hospital mortality was 8.3% (hospice 5.5%, in-hospital 2.8%).