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Venous Thromboembolic Disease in Trauma and Surveillance Ultrasonography[1]

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Background. **The literature reports a wide variation in the incidence of venous thromboembolic (VTE) disease in trauma patients. The performance of routine surveillance venous duplex ultrasound of bilateral lower extremities is controversial. Furthermore, recent examinations of the national trauma databank registry have suggested that routine duplex surveillance is associated with higher deep venous thrombosis (DVT) detection rates.**

Materials and Methods. **We examined the incidence and risk factors for VTE disease in 2827 trauma patients admitted over a 2-y period to a state-verified level I trauma center. Detailed chart review was carried out for patients with VTE disease. We then evaluated the effects of a routine bilateral lower extremity duplex surveillance guideline on VTE detection in the subset of injury patients admitted to the trauma service.**

Results. **We found an approximately 2% incidence of venous thromboembolic disease in a mostly blunt trauma population. Amongst patients with VTE disease, the most common risk factors were obesity and significant head injury. We then evaluated the 998 patients with injury who were admitted to the trauma service 1 y before and after surveillance guideline implementation. Despite a nearly 5-fold increase in the number of duplex scans, with a substantial increase in cost, we found no significant difference in the incidence of DVT.**

Conclusions. **Our preliminary data argue against the use of routine duplex surveillance of lower extremities for DVT in trauma patients. A larger, prospective analysis is necessary to confirm these findings.**

Key Words: **trauma; DVT; PE; thrombus; venous; pulmonary; embolism; duplex; ultrasound; surveillance.**

INTRODUCTION

Trauma is a risk factor for venous thromboembolic (VTE) disease. The literature suggests a relatively high incidence of VTE disease in trauma patients. However, there is lack of consensus on the exact incidence of VTE disease in trauma patients, and on the best method of VTE prevention [1]. Rates of deep venous thrombosis (DVT) have been reported to range from 0.36% to 90% in trauma patients [2–6]. Reasons for this wide range are myriad, but include the inclusion or exclusion of infrageniculate thrombi and thromboprophylaxis method used.

As trauma and critically ill patients are considered to be at high-risk for DVT and its clinical diagnosis is problematic, many centers have implemented routine duplex surveillance programs of lower extremity veins. It has been suggested that because greater than 50% of patients with typical DVT symptoms do not have DVT and conversely greater than 66% of significant DVT are not clinically recognized, imaging should be routinely performed for DVT detection in surgical intensive care unit patients [6]. To this end, as a level III practice management guideline, the Eastern Association for the Surgery of Trauma (EAST) suggested that serial duplex ultrasound scanning of high-risk asymptomatic trauma patients may be cost-effective and decrease the incidence of pulmonary embolism (PE) [7].

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Similarly, in 2004, an American College of Chest Physicians (ACCP) consensus conference recommended surveillance duplex scans only in high-risk trauma patients who are unable to receive prophylaxis [8]. In a 2008 update, as a grade 1C recommendation, the ACCP recommended screening duplex exams in high-risk patients (i.e., spinal cord injury, lower-extremity or pelvic fracture, or major head injury) who have received suboptimal or no thromboprophylaxis [9]. However, as a grade 1B recommendation, they advised against routine duplex screening for asymptomatic DVT in trauma patients [9].

In turn, evaluation of the National Trauma Databank (NTDB) registry data demonstrated that increased surveillance results in increased DVT detection rates. In 2008, Pierce *et al.* [5] interrogated the NTDB ver. 6.1 registry data and concluded that hospitals with more aggressive lower extremity DVT screening procedures had higher DVT rates. They found that in general, every percentage increase in surveillance rate increased the reported DVT rate by 7% [5]. In 2009, these authors analyzed ver. 6.2 of the National Trauma Data Bank and found that admission to a hospital that routinely screened for DVT was an independent predictor of DVT diagnosis, after controlling for risk factors [10]. Huseynova *et al.* on evaluation of ver. 7.1 of the National Trauma Data Bank came to a similar conclusion [2].

In November 2006, the trauma service at our state-verified level one trauma center implemented a guideline of routinely performing surveillance duplex scans of bilateral lower extremities in high-risk trauma patients. Given the recent literature demonstrating increased lower extremity DVT detection rates with routine duplex surveillance, we hypothesized that the incidence of lower extremity DVT after implementation of this guideline would increase. Additional specific aims of this study were to elucidate the incidence of VTE events in trauma patients admitted to our hospital, regardless of admitting service, and to examine the incidence of commonly described risk factors in trauma patients with VTE events.

METHODS

Data Collection and Analysis

After obtaining University of Nebraska Medical Center Institutional Review Board approval, we retrospectively queried our trauma registry. This registry, which is captured by the NTRACS ver. 4 database (Digital Innovations, Forest Hill, MD), includes all patients with injury admitted to the hospital. The minimum length of stay in the registry is 1 d, which equates with a stay of up to 24 h. Individual charts of patients with venous thromboembolic events were subsequently examined for comorbid conditions and injury details. In tabulating DVT and PE data, only patients with imaging-proven venous thromboembolic disease were counted. In calculation of statistical values, data were generally rounded to the nearest integer. To provide uniformity to length of stay measurement in patients with VTE, for patients transferred to our trauma center from an outside facility, hospital length of stay included the length of stay at the referring hospital plus the length of stay at our institution. For definition purposes, suprageniculate DVT included popliteal vein DVT. Statistical analysis was carried out using PC SAS ver. 9.2 (SAS, Cary, NC), in consultation with the Biostatistics Department of the College of Public Health, University of Nebraska Medical Center. A t-test was used for continuous data and the χ^2 test was used for categorical data. Fisher's exact test was also used in comparing the percentage of patients admitted to the trauma service with VTE, before and after implementation of the guideline. A test was considered statistically significant if $P \leq 0.05$.

Routine Lower Extremity Venous Duplex Ultrasound Surveillance Protocol

In November 2006, we initiated a guideline whereby high-risk trauma patients admitted to the trauma service, with an expected hospital length of stay $>$ 2 d, undergo routine duplex ultrasound surveillance of bilateral lower extremities for venous thrombosis. Criteria for identifying high-risk trauma patients include age $>$ 55 y, expected immobilization $>$ 3 d, multiple blood transfusions, surgery lasting longer than 2 h, severe head injury, spinal cord injury, major venous injury, complicated pelvic fracture, and lower extremity fracture. Additional criteria for high-risk trauma patients include previous DVT history, obesity, hormone therapy, and current or recent pregnancy. These criteria mirror high-risk criteria identified in the literature [11–13]. This protocol advised that screening should be performed on high-risk patients within the first 2 to 3 d of admission. All trauma service admissions after November 2006 were subject to the above guideline, however, given the above recommendations, the definition of high-risk, and therefore the decision to implement lower extremity surveillance venous ultrasonography was left to the physician's discretion. After the initial screening, weekly ultrasound examinations were done to monitor current DVT status or to continue surveillance in the event of a negative scan. Our protocol has similarities to other surveillance programs, where an initial scan is performed early in high-risk trauma patients, followed by serial surveillance scans [4, 11]. Duplex scanning was performed using linear (3–11 MHz) or sector (3–4 MHz) scan heads. The pelvic veins were not assessed. Data on iliac vein thromboses was gathered separately by computerized tomography (CT) scan and/or ultrasound. DVT prophylaxis standing orders at admission to the trauma service include options for sequential compression devices, subcutaneous heparin (5000 units subcutaneously three times daily), enoxaparin (30 mg subcutaneously twice daily or 40 mg once daily), or no DVT prophylaxis in patients who are ambulating normally. Mechanical and chemical prophylaxis are not mutually exclusive.

RESULTS

In querying our trauma registry, we found that in the 12 mo preceding initiation of routine bilateral lower extremity duplex ultrasound surveillance scanning for DVT (late 2005–late 2006), there were 1342 patients admitted for injury to various services of the hospital. In the 12 mo following initiation of routine surveillance (late 2006–late 2007), there were 1485 patients admitted for injury to several different hospital services. In examining the demographics of the trauma population in late 2005–2006 and late 2006–2007, we noted comparable mean age (49 y and 48 y), gender, hospital length