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Symptomatic venous thrombo-embolism in low-energy isolated fractures in hospitalised patients

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ABSTRACT

Introduction: In the prevention of venous thrombo-embolic events (VTEs) in isolated low-energy fracture patients, management guidelines are conflicting and prior literature is lacking. We aimed to determine the incidence and factors associated with the development of symptomatic VTE in this patient cohort.
Materials and methods: To identify patients with isolated, low-energy fractures, we studied billing records from all admissions to our tertiary care orthopaedic hospital from 2007 to 2009. We used International Classification of Diseases, 9th Revision codes to identify patients who developed deep vein thrombosis (DVT) and/or pulmonary embolism (PE) during their hospital admission or within 90 days of discharge. We also collected data on socio-demographics, type of injury, fracture treatment, co-morbidities and anticoagulation therapy at time of admission. This study was a retrospective review of a database.
Results: In total, 1701 admissions fit our criteria. Average patient age was 64.27 years and 64.4% were female. There were 479 (28.2%) upper extremity fractures and 1222 (71.8%) lower extremity fractures. Incidence of clinically significant VTE was 1.4%. Of the 24 patients with 25 documented VTE, there were 13 DVTs and 12 PEs, including 2 fatal PEs (0.012%). Nineteen VTEs occurred in association with lower extremity fractures and six with upper extremity fractures; 74% of patients were chemoprophylaxed. Patients with VTE had an average age of 69.5 years and an average body mass index (BMI) of 28 kg m^{-2}. Logistical regression analysis found female sex ($p = 0.05$) and elevated BMI ($p = 0.003$) to be the only significant predictors of VTE.
Conclusions: Clinically significant VTE among patients who sustained isolated, low-energy fractures was found to be low in the setting of standard VTE prophylaxis. Our incidence was consistent with that of patients undergoing total hip arthroplasty. Female sex and increased BMI were statistically significant predictors of VTE.

Introduction

Venous thrombo-embolic events (VTEs), which include deep vein thrombosis (DVT) and pulmonary embolism (PE), are a source of morbidity and mortality among hospitalised populations. Although rare,[1] untreated PE carries a mortality rate of 30% and is related to between 5% and 10% of US inpatient hospital deaths.[2,3] Among orthopaedic patients, increased risk has been identified in those who sustained fractures of the hip, pelvis and spine as well as patients undergoing arthroplasty of the knee or hip. Patients hospitalised for such injuries can carry risk rates as high as 40–60% without VTE prophylaxis.[4,5] Chemoprophylactic therapy has been repeatedly demonstrated to significantly reduce the risk of thrombo-embolic complications following major high-risk procedures, including orthopaedic surgery.[6–11]

Current guidelines for managing VTE risk are contradictory.[12] The American College of Chest Physicians (ACCP) recommends providing guidance for prophylaxis in patients with either moderate or high risk for VTE as well as treatment with low-molecular-weight heparin (LMWH), fondaparinux or dose-adjusted vitamin K antagonists (VKAs) for elective arthroplasty as well as hip fracture surgery.[13] ACCP also recommends prophylaxis for high-risk patients undergoing knee arthroscopy.[4,13] Patients who have surgery durations of under 30 min, are younger than 40 years and undergo repair of minor fractures other than pelvis, hip or femur are considered low risk and are not explicitly recommended for VTE prophylaxis.[14] Since many orthopaedic surgeons consider the risk of bleeding to be significant for patients on therapeutic doses of anticoagulant agents, alternative methods of minimising

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risk have been investigated. The American Association of Orthopaedic Surgeons' (AAOS) guidelines for the prevention of symptomatic PE among patients undergoing total knee arthroplasty suggest the need to stratify risk of both VTE and bleeding complications.[15] Subtle differences between ACCP and AAOS recommendations have led to some inconsistencies in how hospital protocols have been implemented.[16] Furthermore, isolated extremity trauma is conspicuously absent from these guidelines for VTE chemoprophylaxis.

Lower extremity fractures distal to the hip have been studied prior to the adoption of prophylactic recommendations. The incidence for clinically occult DVT has been reported to be 28%, with the highest incidence in patients treated for tibial plateau and femoral shaft fractures. This study found age, time to surgery and longer operating times to be associated with a greater incidence of DVT.[17]

LMWH has been shown to reduce the total incidence of DVT for patients with fractures of the lower extremity treated with surgical fixation, but evidence is inconclusive regarding reduction of risk.[18] Therefore, physicians have been left to rely on anecdotal evidence and clinical judgement when managing post-fracture patients. As a result, adherence to ACCP guidelines and prophylactic protocols varies between individual institutions.[3] The purpose of this study was to identify the incidence of symptomatic VTE in patients who sustain low-energy isolated fractures. A secondary aim was to identify what injury and patient demographic factors are associated with the development of VTE.

Materials and methods

We conducted a retrospective study of a large cohort of patients admitted to our medical centre (non-trauma centre, academic hospital) over a 3-year period and analysed for potential modifying factors in the setting of standard DVT prophylactic protocols. Hospital billing records from 2007 to 2009 were used to identify patients according to International Classification of Diseases, 9th Revision (ICD-9) code for primary diagnosis on admission (Table 1). Patients were identified and included in the study if their primary diagnosis of admission was consistent with an isolated fracture of the extremity, pelvis or shoulder girdle. Patients younger than 18 years and patients who sustained multiple traumatic injuries were excluded.

Table 1
ICD-9 codes used in the analysis by fracture location.

Fracture location	ICD-9[a]	90-day outcome measures	ICD-9[a]
Pelvis	808	Pulmonary embolus	I26
Clavicle	810	Deep-vein thrombosis (all sites)	180.1–3, 180.8–9
Scapula	811	Death	512–512.9, 514–519.9, 797–799[b]
Humerus	812		
Forearm	813		
Carpal	814		
Hip	820		
Femur	821		
Patella	822		
Tibia/fibula	823		
Ankle	824		
Tarsal/calcaneus	825		

[a] International Statistical Classification of Diseases and Related Health Problems (9th Revision).
[b] Also includes deaths reported in discharge summary but not listed in billing records.

Hospital electronic medical records were used to access treatment information and patient data and socio-demographic information was collected on all identified patients. Information about the fracture location, treatment intervention and other injury was also included for analysis. Previously identified risk factors for VTE were included as study variables including age, sex and body mass index (BMI). Medical and co-morbid conditions including smoking history, diabetes, cancer, hyperlipidaemia, osteoarthritis and pre-existing anticoagulant therapy were used as variables for regression analysis.

Data were collected on patient chemoprophylaxis. No standard VTE prophylaxis was used in patients other than hip and pelvic ring fractures. In these cases only LMWH was prescribed by the orthopaedic service. Patients were considered chemoprophylaxed if they were treated with heparin, LMWH or VKAs. Patients who presented already on anticoagulant therapy for a pre-existing medical condition were considered to be prophylaxed on admission. If they were reversed for an operation they were considered anticoagulated if prophylaxis was restarted post surgery.

All patients who developed clinically symptomatic DVT or PE diagnosed by venous ultrasound or chest computed tomography during or within 90 days of discharge were included in the VTE group and time from initial injury to presentation with clinically significant VTE was collected. Clinically symptomatic DVT was defined as cases identified secondary to pain, swelling or other symptomatic changes necessitating diagnostic testing. These included DVTs at and below the knee. All were found secondary to clinical suspicion. We did not screen for DVT or PE.

Study data were collected and managed using Research Electronic Data Capture (REDCap) electronic data capture tools hosted at our institution.[19] REDCap is a secure, web-based application designed to support data capture for research studies.

Statistical analysis

We determined the incidence of symptomatic DVT, PE and overall VTE. To determine confounding factors, univariate comparisons between the VTE group and the non-VTE group were made based on the demographic data and operative parameters, including age, gender, BMI, DVT prophylaxis, time from initial injury to diagnosis of VTE, location of fracture and co-morbid medical conditions. We used chi-squared test for categorised data and Student's *t*-test for continuous data. For the variables with a p value < 0.1 in the univariate analyses, multivariate logistic regression analyses were performed. The independent variables tested for the multivariate logistic regression analyses include age, gender, etc. as confounding factors; the dependent variable was whether the DVT occurred postoperatively. From the multivariate regression analyses, it was assessed which variables were the risk factors for occurrence of DVT. Statistical analyses were conducted using Statistical Package for the Social Sciences (SPSS) for Windows statistical package (version 17.0; SPSS, Chicago, IL, USA).

Results

Between 2007 and 2009, 1701 adult patients were admitted to our medical centre with the diagnosis of a low-energy, isolated fracture. The mean age of this cohort was 64.27 (18–101) years; 1096 (64.4%) of the patients were female and 605 (35.6%) male. The average BMI was 26 kg m^2. As many as 1222 (71.8%) fractures were in the lower extremity and 479 (28.2%) in the upper extremity. The most common fracture site was the hip (femoral neck, intertrochanteric and subtrochanteric), accounting for 518 (30.5%) fractures. The most common upper extremity fracture was the humerus, with 237 (13.9%) (Table 2).