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The incidence of deep vein thrombosis and pulmonary embolism after fracture of the tibia: An analysis of the National Trauma Databank

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ABSTRACT

Controversy exists regarding the routine use of chemical prophylaxis in isolated lower extremity fractures. The incidence of VTE in specific fracture locations in the lower extremity is largely unknown, and represents key information necessary to determine the need for prophylaxis. A large cross-sectional study using the National Trauma Databank was performed evaluating for the incidence and risk factors of VTE in isolated tibia fractures. The overall incidence of DVT and PE are extremely low in cases of isolated tibia fractures, which brings into doubt a role for routine use of chemical prophylaxis for these fractures.

1. Introduction

Deep vein thrombosis (DVT) and pulmonary embolism (PE) are known complications after trauma and lower extremity fracture, which carry significant morbidity and mortality.[1] The incidence of venous thromboembolic events (VTE) varies based on the level of injury and inherent patient factors.[2] Multiple studies have investigated the incidence and risk factors associated with VTE (i.e. PE and DVT) after lower extremity fracture.[2–4] The 9th edition of the American College of Chest Physicians guidelines strongly recommends for the use of thromboembolic prophylaxis after major orthopaedic surgery including hip and knee arthroplasty and hip fracture surgery but recommends against the routine use of chemical prophylaxis in patients with isolated injuries distal to the knee.[5]

The decision to give prophylaxis is typically based on patient risk factors and fracture pattern yet controversy exists in many lower extremity fractures. Previous studies have attempted to identify patient risk factors and comorbidities that warrant prophylaxis. Jameson et al. studied the National Health Service hospital database and suggested ankle fracture fixation in patients over 50 as being a risk factor for VTE.[6] After studying the American College of Surgeons (ACS) National Trauma Data Bank (NTDB), Knudson et al., proposed risk factors for VTE, including lower extremity fracture with an Abbreviated Injury Score (AIS) over 3 (i.e. femur fracture or open tibia fracture).[2] Shibuya et al. performed an analysis of the NTDB and showed the incidence of DVT and PE in isolated foot and ankle fractures to be 0.28% and 0.21%, respectively, recommending against routine prophylaxis.[7]

The incidence of VTE in specific fracture locations in the lower extremity is largely unknown, and represents key information necessary to determine the need for prophylaxis. To the best of our knowledge, no large, cross-sectional study has evaluated the incidence of VTE in fractures of the tibia. We hypothesize that the incidence of VTE in all tibial fractures will be low and vary significantly based on fracture location and patient factors.

2. Methods

The National Trauma Data Bank (NTDB) is a registry of data collected from participating trauma centers across the United States. 148,936 patients from the NTDB data set (2009–2011) were identified with tibia and fibula trauma. We excluded patients with any concomitant fractures in addition to that in the tibia or fibula (n = 51,569; Table 1) or those presenting in critical condition (n = 11,291) where critical condition was defined as an injury severity score (ISS) of more than 15. A total of 86,076 patients were eligible for the present analyses.

The NTDB includes data on patient demographics and comorbidities and hospitalization data, including procedures, complications, and trauma types (Table 2). Each injury was assigned an abbreviated injury score for six distinct body regions (head, face, chest, abdomen, extremity, and external). The scores of the three most severely injured body regions were then squared

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Table 1
Inclusion and Exclusion "International Classification of Diseases," 9th revision.

Inclusion
823 Fracture of tibia and fibula
823.0 FX UPPER TIBIA/FIBULA-CL
823.00 Fx tibia upper end closed
823.01 Fx fibula upper end closed
823.02 Fx tibia and fibula upper end closed
823.1 FX UPPER TIBIA/FIBULA-OP
823.10 Fx tibia upper end open
823.11 Fx fibula upper end open
823.12 Fx tibia and fibula upper end open
823.2 FX SHAFT TIB/FIB-CLOSED
823.20 Fx tibia shaft closed
823.21 Fx fibula shaft closed
823.22 Fx tibia and fibula shaft closed
823.3 FX TIBIA/FIBULA SHAFT-OP
823.30 Fx tibia shaft open
823.31 Fx fibula shaft open
823.32 Fx tibia and fibula shaft open
823.40 Fx tibia torus
823.41 Fx fibula torus
823.42 Fx tibia and fibula torus
823.8 FX TIBIA/FIBULA NOS-CLOS
823.80 Fx tibia unspecified closed
823.82 Fx tibia and fibula unspecified closed
823.9 FX TIBIA/FIBULA NOS-OPEN
823.90 Fx tibia unspecified open
823.92 Fx tibia and fibula unspecified open
Exclusion (Any other lower body orthopaedic trauma)
808.0-808.9 Pelvic and Acetabulum Fracture
820.0-820.9 Hip Fracture
821.0-821.39 Femur Fracture
824.0-826.1 Foot and Ankle Fracture

and summed to create a composite score of severity. ISS is correlated with mortality, morbidity, and hospitalization time and is part of the NTDB data set. Obesity in the NTDB was defined as a body mass index (BMI) of 40 kg/m^2 or greater. The Common Procedural Terminology (CPT) codes were used to classify procedures in the NTDB into six categories based on treatment of the tibia fracture including: closed reduction with fixation, open reduction with or without fixation, closed reduction without fixation, immobilization without manipulation, soft tissue only procedures (e.g., wound debridement), other, and unspecified procedures (Table 3). Our inclusion criteria for this study were 1) fracture of the tibia/fibula with no other documented fractures; and 2) ISS less than 15. We excluded patients with 1) multiple fractures; 2) isolated ankle fractures; 3) procedure code listed as "other"; 4) patients without valid complication codes; 5) more severe concomitant injuries (ISS greater than or equal to 15).

2.1. Statistical analysis

Rates of DVT and PE in patients with tibia and fibula trauma and the association of DVT or PE with other hospital complications were calculated using a chi-square test or Fisher's exact test, as necessary. Logistic regression models were used to calculate adjusted odds ratios (ORs) and 95% confidence intervals (CIs).

Factors were selected based on independent associations with deep vein thrombosis (DVT) or pulmonary embolism (PE) in bivariate analyses. Any factor with a p value <0.02 and a frequency of >.01% of the population was included. Gender, age, ISS and the following comorbidities were included in all analyses: hypertension, smoking history, diabetes, impaired sensorium, obesity, and bleeding disorder. DVT models were additionally adjusted for alcoholism. PE models were additionally adjusted for respiratory disease. Angina and the immobilization procedures were associated with DVT but were rare and were not included in the analysis.

Table 2
Variables used in analysis.

Demographies
Age (1 year increments)
Gender (Male/female)
Injury Severity Score (continuous, <15)
Length of hospital stay (minutes)
Comorbidities
Hypertension requiring medication
Current smoker
Diabetes mellitus
Respiratory Disease
Alcoholism
Impaired sensorium
Obesity (Body mass index >40 kg/m2)
Bleeding Disorder
Congestive heart failure
History of Cerebrovascular Accident
Myocardial infarction within 6 months
Functionally dependent health status
Dialysis
Disseminated cancer
Steroid Use
Angina within 1 month
Esophageal varices
Peripheral vascular disease
Chemotherapy for cancer within previous 30 days
Ascites within 30 days
Fracture
Fracture types (see Table 1)
Open/Closed Fracture
Procedure
Use of pharmacological DVT prophylaxis
Surgical or non-surgical procedure (See Table 3)
Complication
Extremity compartment syndrome
Pneumonia
Drug or alcohol withdrawal syndrome
Deep vein thrombosis
Acute renal failure
Acute respiratory distress syndrome
Pulmonary embolism
Decubitus ulcer
Organ/space surgical infection
Cardiac arrest with Cardiopulmonary resuscitation
Unplanned intubation
Superficial surgical infection
Myocardial infarction
Deep surgical site infection
Graft
Stroke/Cerebrovascular accident

Table 3
Categories of tibia and fibula fracture procedures using Common Procedural Terminology (CPT) Codes.

Closed reduction with fixation
93.54 Application of splint
93.56 Application of pressure dressing
93.59 Other immobilization, pressure, and attention to wound
79.16 Closed reduction of fracture with internal fixation, tibia and fibula
79.46 Closed reduction of separated epiphysis, tibia and fibula
Open reduction with or without fixation
79.26 Open reduction of fracture without internal fixation, tibia and fibula
79.36 Open reduction of fracture with internal fixation, tibia and fibula
79.56 Open reduction of separated epiphysis, tibia and fibula
Closed reduction without fixation
79.06 Closed reduction of fracture without internal fixation, tibia and fibula
Immobilization, special dressing
93.50 Other immobilization, pressure, and attention to wound
93.51 Application of plaster jacket
93.53 Application of other cast
Soft tissue procedures, such as wound debridement
79.66 Debridement of open fracture site, tibia and fibula
Other and unspecified procedures
79.96 Unpecified operation on bone injury, tibia and fibula