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Perioperative incidence and locations of deep vein thrombosis following specific isolated lower extremity fractures

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ABSTRACT

Purpose: To determine perioperative incidence and locations of deep vein thrombosis (DVT) in injured and uninjured lower extremities following isolated lower extremity fractures (ILEFs).
Methods: Retrospective analysis of a prospectively collected data of a consecutive patient series with ILEFs who underwent surgical treatment between September 2014 and September 2017 was performed. Patients' bilateral lower extremities were screened for DVT with duplex ultrasonography (DUS) before and after surgery. DVT occurrence was analyzed by location of DVT and fracture site. All patients received pharmacologic thromboprophylaxis while hospitalized. Data on demographics, time to surgery, time of DUS examinations, length of hospital stay and symptomatic pulmonary embolism (PE) was collected.
Results: 1825 patients were included in the study. The incidence of symptomatic PE was 1.6%. All patients were screened with DUS of the bilateral lower extremities in a mean of 3.5 days (range: 0–18 days) after injury, and a mean of 3.6 days (range: 1–11 days) after surgery. Preoperative DUS detected DVT in 547 patients (30.0%), including 3.7% of patients with proximal DVT. 792 patients (43.4%) were found to have a DVT postoperatively, but only 6.2% of patients with proximal DVT. Proximal DVT was detected postoperatively of the represented fractures: 6.5% of the hip, 14.5% of the femoral shaft, 4.5% of the tibial plateau, 4.6% of the tibial shaft, 1.7% of the patellar, and 2.0% of the peri-ankle. Interestingly, the rate of DVT in an uninjured lower limb was significantly higher postoperatively compared to preoperatively (16.4% vs. 4.9%), however, only 0.2% of patients had proximal DVT.
Conclusions: While the perioperative incidence of overall DVT is high following ILEFs, the majority were distal DVT, and the rate of symptomatic PE was low. Femoral shaft fractures were associated with the highest incidence for proximal DVT. The incidence was lower in more distal fractures. The majority of patients diagnosed with DVT postoperatively had already shown symptoms of DVT prior to surgery. DVT can occur in both the injured and uninjured leg, with an obviously higher incidence in the injured leg. The incidence of proximal DVT in an uninjured leg is rare.

Introduction

Venous thromboembolism (VTE), which includes deep venous thrombosis (DVT) and pulmonary embolism (PE), is a principal cause of morbidity and mortality in all hospitalized patients, particularly in the setting of trauma [1]. While the incidence of DVT in orthopaedic trauma has been studied extensively in relation to hip fractures, pelvic fractures, and multiple trauma [2–6], the ILEFs are the most commonly encountered in the clinical practice, and these injuries are known to be risk factors for DVT [3,4,9,15,17]. Multiple studies in the recent literature [3,4,7–11,15,17] have reported the incidence of thromboembolic events with ILEFs after surgery and have concluded that the incidence of DVT is low (range: 2.6–29.4%). DVT sometimes develops immediately after the injury. i.e. before the surgical intervention. However, reports on incidences of DVT prior to surgery is limited. In addition, several studies [7,8,10,11] have not investigated the presence of distal or asymptomatic DVT. Although there is debate on recommendations for the treatment of distal DVT [1], in most cases DVT begins in the calf veins and can also propagate proximally [12]. Detection of

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asymptomatic DVT may allow early treatment to prevent PE or further aggravation. To date, there have been several studies on the relationship between PE and proximal and distal DVT [13,14]. It is generally accepted that proximal DVT is associated with a higher risk for PE and this may result in a more aggressive therapy, thus, it is very important to accurately diagnose and identify the location of DVT. There is a large variation in the rate of DVT per anatomic location of fractures [2–4,11,15–17], however, there is no previous report that provides detailed information with the specific isolated lower extremity fractures.

Few reports exist that specifically identify the incidence and locations of DVT in patients with ILEFs who had surgical treatment. Even organizations like the American College of Chest Physicians do not provide practical recommendations for DVT prophylaxis after ILEFs [18]. At our institution, all patients with fractures routinely receive a DVT screening of the bilateral lower extremities using DUS. Thromboprophylaxis is prescribed during their hospital stay. The primary goal of the study was to determine the preoperative and postoperative incidence of DVT and PE in acute ILEFs. The secondary objective was to investigate locations of DVT, and to find a possible relationship between the incidence and locations of DVT as it relates to fracture location.

Patients and methods

The Institutional Review Board approved this study. All consecutive trauma patients with ILEFs distal to the hip joint (femoral neck, intertrochanteric, femoral shaft, distal femur, patella, tibial plateau, tibial shaft, distal tibial, ankle, calcaneus, and talus fractures) admitted between September 2014 and September 2017 and who underwent surgical treatment were included. Exclusion criteria were: midfoot and forefoot fractures, concomitant injury to the pelvis or acetabulum, history of DVT or PE, medical contraindications to thromboprophylaxis, required additional surgery, required traction postoperatively, mobilization was not possible, admission to an intensive care unit, younger than 18 years, delay in surgery of 3 weeks from the time of injury, open extremity fractures, fractures treated with external fixation, unwillingness to undergo DUS examinations. Patient variables such as age, gender, total length of hospital stay, time to surgery and time of DUS examinations were collected.

Thromboprophylaxis regimen consisting of chemical (Low molecular weight heparin (LMWH)) and mechanical methods (pneumatic compression with foot pump) was applied for each patient before and after surgery. The pneumatic compression was stopped if DVT was diagnosed. LMWH was applied subcutaneously (4100 IU once daily) in all patients during their hospital stay. LMWH was stopped at least 12 h prior to surgery and restarted 12 h after surgery. All patients who developed proximal DVT were treated with anticoagulation therapy (LMWH calcium, 4100 IU every 12 h.) during their hospital stay followed by rivaroxaban for 3 months [18].

A vascular ultrasonography technician performed DUS of bilateral lower extremities before and after the surgery. All scans examined the deep veins of the lower extremity from the common femoral vein to the ankle. The criteria of positivity for VTE included noncompressibility, presence of intraluminal defect or absent or nonphasic Doppler signal, lack of respiratory variation in above knee segments, and inadequate flow augmentation to calf and foot compression maneuvers [23]. All DUS examinations were performed with Philips IU 22 duplex scanners (Royal Phillips Electronics, Amsterdam, The Netherlands). Bandages commonly were removed for this examination as needed. DVT was defined as proximal if localized in the popliteal vein or proximally. Distal DVT was defined as thrombosis distal to popliteal vein. Patients who had DVT in both distal and proximal veins were classified in the proximal DVT group. Symptomatic PE was defined as clinically suspected PE confirmed by positive spiral computed tomography pulmonary angiogram, or sudden death [24].

The Statistical Package for Social Sciences (SPSS) software version 19 (SPSS, Chicago, IL, USA) was used to perform statistical analyses. Data were presented as means and standard deviations. Comparisons were performed using the chi-square test. A statistical significant difference was accepted for p-values of < 0.05.

Results

During the study period, 1825 patients met the inclusion criteria. The mean age and standard deviation at injury was 62.8 ± 19.5 years (range: 18–102 years). The gender distribution was as follows: 879 males (48.2%) and 946 females (51.8%). The preoperative DUS were performed at a mean of 3.5 ± 3.0 days (range: 0–18 days) after injury. The postoperative screening was performed at a mean of 3.6 ± 1.5 days (range: 1–11 days) after surgery. The time from injury to surgery was 4.6 ± 2.5 days (range: 0–21 days), and hospital stay was 8.6 ± 2.5 days (range: 5–25 days).

Location of fracture was femoral neck in 528 patients (28.9%), intertrochanteric in 552 patients (30.2%), femoral shaft in 159 patients (8.7%), tibial plateau in 176 patients (9.6%), tibial shaft in 152 patients (8.3%), patellar in 59 patients (3.2%), peri-ankle in 199 patients (10.9%) (Table 1).

Preoperative DUS detected DVT in 30.0% of patients, with proximal DVT in 3.7% of all patients and distal DVT in 26.2% of all patients. Postoperatively, 43.4% of patients were found to have a

Table 1
The perioperative incidence and locations of DVT per ILEF types.

Lower extremity fractures	No. Patients(%)	No.preoperative(%)		No.postoperative(%)	
		Proximal	Distal	Proximal	Distal
Femoral shaft fractures	159(8.7%)	19(11.9%)	45(28.3%)	23(14.5%)	65(40.9%)
Tibial plateau fractures	176(9.6%)	6(3.4%)	36(20.5%)	8(4.5%)	72(40.9%)
Tibial shaft fractures	152(8.3%)	6(3.9%)	35(23.0%)	7(4.6%)	39(25.7%)
Patellar fractures	59(3.2%)	1(1.7%)	8(13.6%)	1(1.7%)	14(23.7%)
Hip fractures	1080(59.2%)	32(3.0%)	326(30.2%)	70(6.5%)	456(42.2%)
Femoral neck fractures	528(28.9%)	14(2.7%)	148(28.0%)	44(8.3%)	234(44.3%)
Intertrochanteric fracture	552(30.2%)	18(3.3%)	178(32.2%)	26(4.7%)	222(40.2%)
Peri-ankle fractures	199(10.9%)	4(2.0%)	29(14.6%)	4(2.0%)	33(16.6%)
Distal tibial fractures	76(4.2%)	2(2.6%)	13(17.1%)	2(2.6%)	14(18.4%)
Ankle fractures	86(4.7%)	2(2.3%)	13(15.1%)	2(2.3%)	14(16.3%)
Calcaneal Fractures	30(1.6%)	0(0.0%)	3(10.0%)	0(0.0%)	4(13.3%)
Talus fractures	7(0.4%)	0(0.0%)	0(0.0%)	0(0.0%)	1(14.3%)
Total	1825(100.0%)	68(3.7%)	479(26.2%)	113(6.2%)	679(37.2%)

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