Incidence of deep-vein thrombosis in patients with fractures of the ankle treated in a plaster cast

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Stable fractures of the ankle can be successfully treated non-operatively by a below-knee plaster cast. In some centres, patients with this injury are routinely administered low-molecular-weight heparin, to reduce the risk of deep-vein thrombosis (DVT). We have assessed the incidence of DVT in 100 patients in the absence of any thromboprophylaxis. A colour Doppler duplex ultrasound scan was done at the time of the removal of the cast. Five patients did develop DVT, though none had clinical signs suggestive of it. One case involved the femoral and another the popliteal vein. No patient developed pulmonary embolism. As the incidence of DVT after ankle fractures is low, we do not recommend routine thromboprophylaxis.

In the United Kingdom, most stable fractures of the ankle are treated conservatively in a below-knee plaster cast. It has been suggested that this method of immobilisation may increase the risk of deep-vein thrombosis (DVT) because of inactivation of the ankle pump. Previous studies have indicated that the incidence of DVT ranges between 1.1% and 20% in various injuries of the lower limb treated in a plaster cast. However, the real incidence of DVT in patients with isolated fractures of the ankle treated in this way is not known. Routine thromboprophylaxis for these patients is considered to be standard treatment in some European centres. Our aim was to assess the incidence of DVT in this specific group of patients and to determine whether routine prophylaxis was justified.

Patients and Methods

Our study had the approval of the local research and development department as well as the local ethics committee. Between January and October 2006, 112 patients with an isolated, stable fracture of the ankle were treated by a below-knee plaster cast in our institution. Of these, eight refused to participate in the investigation. During the course of the study, three required operative intervention (examination-manipulation under anaesthesia or internal fixation) and were excluded. One patient, for medical reasons, was started on prophylactic low-molecular-weight heparin (LMWH) and was also excluded. Thus, 100 patients were included in the study. Of these, 51 were males and 49 females with a mean age of 43 years (16 to 74). The fractures were classified according to the criteria of Weber (Table I). The mean body mass index (BMI) of the patients was 28 kg/m² (17.9 to 51) with 41 kg/m² being overweight (BMI > 25 kg/m²) and 24 kg/m² obese (BMI > 30 kg/m²). There were 15 patients on low-dose aspirin (75 mg daily) for cardiovascular or cerebrovascular problems and one was on depot progesterone (implant contraceptive). A total of 29 patients were smokers and continued to smoke during the course of the treatment. The mean duration of treatment in the plaster cast was six weeks (3 to 7) with 72 patients allowed to bear weight fully and nine to bear weight partially. The remaining 19 were kept non-weight-bearing. The patients were reviewed at the end of this period in a dedicated clinic. The plaster cast was removed and union of the fracture was assessed clinically and radiologically. Any symptoms or signs suggestive of DVT were also noted. All patients were assessed for DVT by duplex colour Doppler ultrasonography (Phillips IU22, 8/4 linear array probe; Philips Ultrasound, Bothell, Washington) of the affected limb. The scan was augmented by performance of the Valsalva manoeuvre. The ultrasound examination was considered to be negative if there was normal blood flow in the femoral, popliteal, tibial and peroneal veins, with the vessel lumen fully compressible and completely filled with
Deep-vein thrombosis was diagnosed if the vessel wall was not compressible.

In the past, colour duplex ultrasonography has been considered to be inferior to phlebography in diagnosing asymptomatic DVT. Lapidus et al compared phlebography with colour duplex ultrasonography in 116 patients who had undergone fixation of ankle fractures. Patients with symptomatic DVT were excluded. They concluded that the sensitivity and negative predictive value of colour duplex ultrasonography was 96% and 99%, respectively. They therefore recommended this method as an alternative to phlebography and a screening tool for distal and asymptomatic DVT. Moreover, ultrasonography is safe, reproducible and available in most centres. However, colour duplex ultrasonography is operator-dependent and, therefore, in our study, all scans were performed by an experienced musculoskeletal ultrasound technician (not an author).

The patients who were diagnosed with an above-knee or popliteal DVT received warfarin and Dalteparin for three months. The international normalised ratio (INR) was used to monitor warfarin treatment. Once the INR was more than 2, Dalteparin was stopped and warfarin continued. Those with a below-knee DVT were treated according to the recommendation of the treating orthopaedic consultant (including ACWH). All patients with DVT were re-scanned after one week to assess the progression of the thrombus.

Results

Ultrasonography showed that five patients had a DVT (Table II). None had any symptoms or signs of DVT and three were smokers. In two, the DVT involved the peroneal vein, in one the peroneal and the posterior tibial veins, in one the popliteal vein and in one the superficial femoral vein. Of the five patients with DVT, four started treatment with warfarin and Dalteparin (until the INR > 2). A repeat ultrasound scan on the patient with a below-knee DVT, who was not anticoagulated, did not show progression of the thrombus. In summary, the incidence of DVT was 5% (95% confidence interval (CI) 1 to 9). The incidence of popliteal and above-knee DVT was 2% (95% CI 0 to 5). None of the patients had thrombus progression at one week.

Discussion

Deep-vein thrombosis is a significant risk principally because it can lead to fatal pulmonary embolism. Major orthopaedic surgery such as total hip replacement (THR) has a high incidence of DVT (40% to 80%) and pulmonary embolism (clinical pulmonary embolism 4% to 10% and fatal pulmonary embolism 0.2% to 5%). Chemical thromboprophylaxis may therefore be justified. Deep-vein thrombosis has also been implicated as a cause of venous insufficiency, chronic leg swelling, dermatitis and leg ulcers. In patients with total knee replacement (TKR), Muller et al noted that DVT was not a risk factor for leg ulceration and suggested that thromboprophylaxis may not be justifiable on these grounds alone.

The incidence of DVT after injuries to the lower limb which were treated in a plaster cast has been reported to be between 1.1% and 20%. The incidence of venous thromboembolism in the Western population is estimated to be 0.1% per year. Hansson et al found that the cumulative probability of venous thromboembolism by the age of 50 years was 0.5%, and by the age of 80 years, 3.8%. However, the risk of fatal pulmonary embolism without thromboprophylaxis after a fracture of the lower limb is not known. To our knowledge, this is the first study which has assessed the incidence of DVT after isolated fractures of the ankle treated in a below-knee cast.

Jorgensen et al carried out a randomised, controlled trial on patients treated by immobilisation in a plaster cast and noted that the incidence of DVT was 18%. They also noted that a single daily dose of prophylactic tinzaparin (3500 International Units (IU)) was not sufficient to prevent DVT. However, this study did not clarify the nature of the plaster cast (above- or below-knee) and included patients with different injuries. We believe that the nature of the injury, either a soft-tissue injury or fracture, may have a bearing on the incidence of DVT. This has been recognised by Bergqvist and Lowe who suggested that the risk of thrombosis was higher in patients with a tibial fracture than in those with a soft-tissue injury.

Giannadakis et al reported that the incidence of DVT in patients with minor injuries of the lower limb treated in a plaster cast was 1.1% and did not recommend prophylaxis for such patients (Table III). Again, a range of injuries to the lower limb was included in the study, with only 11 patients having an ankle fracture. Moreover, the mean duration of immobilisation in a cast was only 14.4 days (5 to 48) which did not reflect the usual period of immobilisation in patients with ankle fractures. Patients with risk factors such as obesity and smoking were excluded and, as such, the reported incidence was not a true reflection of that seen in the general population.

Kock et al carried out a randomised placebo-controlled trial in patients treated by immobilisation in a cast. They found an incidence of DVT of 4.3% in 163 patients who had been given a placebo compared with 0% in those given LMWH. This study also included patients with varying inju-
ries such as fractures of the foot and soft-tissue injuries of the knee and ankle treated by both a below-knee and an above-knee cylinder cast.

Kujath, Spannagel and Habscheid\(^\text{14}\) found that the incidence of DVT in patients treated in a plaster cast for any condition was 16.5%. The mean duration of plaster immobilisation in their series was 15.8 days. This is not representative of patients treated for a fracture.

Lassen, Borris and Nakov\(^\text{15}\) found that the incidence of DVT was 19% in patients treated in a plaster cast. Again, they included patients with varying diagnoses.

Solis and Saxby\(^\text{16}\) quoted an incidence of DVT of 3.5% in patients undergoing foot and ankle surgery and felt that routine prophylaxis was not warranted. They also found that none of their patients had any clinical signs of DVT. Our findings were similar. We therefore believe that the classic clinical signs of DVT such as tenderness and swelling of the calf are not relevant in an orthopaedic setting involving a fracture of a lower limb.

Routine thromboprophylaxis for all patients with ankle fractures treated in a plaster cast can be expensive, especially for a state-run healthcare system such as the National Health Service (NHS). The cost of 20 mg injections of subcutaneous enoxaparin (Clexane; Aventis Pharma, Kent, United Kingdom)\(^\text{17}\) for six weeks is approximately £135.30 per patient. In our institution, approximately 135 ankle fractures are treated conservatively each year. This would extrapolate to approximately 30 000 ankle fractures in the United Kingdom for the same period, with a cost of £3.97 million for the NHS. Moreover, although LMWH is considered to be safer than heparin itself, side-effects such as bleeding and thrombocytopenia may still pose serious problems for patients.

A recent case report\(^\text{11}\) of death from pulmonary embolism in a young patient with an ankle fracture may prompt orthopaedic surgeons to administer thromboprophylaxis to all patients. However, in our series, the overall incidence of DVT after non-operative treatment of an ankle fracture was 5%. In our opinion, this low incidence does not warrant routine thromboprophylaxis. The guidelines issued by the American College of Chest Physicians in 2004 advised against routine prophylaxis for patients with isolated injuries of a lower limb.\(^\text{3}\) Our results agree with this. It is well known that smoking and obesity increase the risk of DVT. Whether providing thromboprophylaxis to this select subgroup of patients would prevent clinically-significant thromboembolism, and whether this policy would be cost-effective, are unknown.

### Table II. Details of the five patients who developed deep-vein thrombosis (DVT)

<table>
<thead>
<tr>
<th>Case</th>
<th>Age (yrs)</th>
<th>Gender</th>
<th>Weight-bearing status*</th>
<th>Site of DVT</th>
<th>Possible predisposing factors</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>67</td>
<td>F</td>
<td>FWB</td>
<td>Peroneal vein</td>
<td>None</td>
<td>Observation</td>
</tr>
<tr>
<td>2</td>
<td>53</td>
<td>M</td>
<td>FWB</td>
<td>Peroneal and posterior tibial veins</td>
<td>BMI 31.6, smoker</td>
<td>Enoxaparin followed by warfarin</td>
</tr>
<tr>
<td>3</td>
<td>18</td>
<td>F</td>
<td>FWB</td>
<td>Superficial femoral vein</td>
<td>BMI 28.3, smoker</td>
<td>Enoxaparin</td>
</tr>
<tr>
<td>4</td>
<td>69</td>
<td>F</td>
<td>FWB</td>
<td>Popliteal vein</td>
<td>BMI 37.3</td>
<td>Enoxaparin followed by warfarin</td>
</tr>
<tr>
<td>5</td>
<td>44</td>
<td>M</td>
<td>FWB</td>
<td>Peroneal vein</td>
<td>BMI 28.4, smoker</td>
<td>Enoxaparin followed by warfarin</td>
</tr>
</tbody>
</table>

* FWB, full weight-bearing
† BMI, body mass index (Kg/m²)

### Table III. Details of previous studies reporting the incidence of deep-vein thrombosis (DVT) without prophylaxis after injury of the lower limb

<table>
<thead>
<tr>
<th>Study</th>
<th>Patients Description</th>
<th>Diagnostic test and Duration</th>
<th>Incidence of DVT without prophylaxis (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kujath et al(^\text{14})</td>
<td>Lower limb fractures and soft-tissue injuries. Nature of cast not mentioned</td>
<td>Ultrasound + phlebography after 15.8 days in cast</td>
<td>16.5 (95% CI(^\text{1}^) not mentioned (n = 127))</td>
</tr>
<tr>
<td>Kock et al(^\text{13})</td>
<td>Lower limb injuries including soft-tissue injuries, sprains, fractures. Included patients with knee cylinder casts and below-knee casts</td>
<td>Ultrasound</td>
<td>4.3 (95% CI not mentioned (n = 163))</td>
</tr>
<tr>
<td>Giannadakis et al(^\text{2})</td>
<td>Minor injuries to foot and ankle; included sprains, fractures (n = 18) and soft-tissue injuries; excluded patients with risk factors</td>
<td>Ultrasound + phlebography after cast removal (14.4 days)</td>
<td>1.1 (95% CI 0 to 4.4 (n = 178))</td>
</tr>
<tr>
<td>Jorgensen et al(^\text{1})</td>
<td>Lower limb injuries; fractures, tendon injuries and soft-tissue injuries. Nature of cast not mentioned</td>
<td>Venography after a mean of 5.5 weeks in cast</td>
<td>18 (95% CI not mentioned (n = 106))</td>
</tr>
<tr>
<td>Lassen et al(^\text{15})</td>
<td>Included tibial, patellar, foot and ankle fractures, tendo Achillis ruptures and post-operative patients</td>
<td>Venography at 5 weeks</td>
<td>19 (95% CI not mentioned (n = 187))</td>
</tr>
</tbody>
</table>

\(^\text{1}\) CI, confidence interval
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References


