Thromboprophylaxis in pelvic and acetabular trauma surgery

THE ROLE OF EARLY TREATMENT WITH LOW-MOLECULAR-WEIGHT HEPARIN

N. Steele, R. M. Dodenhoff, A. J. Ward, M. H. Morse

From Frenchay Hospital, Bristol, England

We prospectively studied the outcome of a protocol of prophylaxis for deep vein thrombosis (DVT) in 103 consecutive patients undergoing surgical stabilisation of pelvic and acetabular fractures. Low-molecular-weight heparin (LMWH) was administered within 24 hours of injury or on achieving haemodynamic stability. Patients were screened for proximal DVT by duplex ultrasonography performed ten to 14 days after surgery.

The incidence of proximal DVT was 10% and of pulmonary embolus 5%. Proximal DVT developed in two of 64 patients (3%) who had received LMWH within 24 hours of injury, but in eight of 36 patients (22%) who received LMWH more than 24 hours after the injury (p < 0.01). We conclude that LMWH, when begun without delay, is a safe and effective method of thromboprophylaxis in high-risk patients with major pelvic or acetabular fractures.

Patients with pelvic trauma are at high risk of thromboembolic complications, but effective methods of prophylaxis have still to be accepted and adopted widely in the UK. The incidence of deep vein thrombosis (DVT) after pelvic trauma varies between 35% and 61%.1,2

A variety of thromboprophylactic regimes has been recommended in high-risk trauma patients.1,3-5 Low-dose heparin or intermittent pneumatic compression devices alone are not always effective in preventing DVT6-8 whereas low-molecular-weight heparin (LMWH) agents have been shown to reduce the rate of DVT in high-risk patients with injury to the pelvis or lower limbs.1,3,9,10

Our unit is a tertiary referral centre for the management of patients with pelvic and acetabular fractures. In 1993, we introduced a protocol for prophylaxis for DVT using LMWH started within 24 hours of injury, or on achieving haemodynamic stability together with ultrasound examination using colour-flow duplex scanning of both legs within 14 days of surgery. We undertook a prospective study with the following aims: 1) to assess the use of and compliance with this protocol; 2) to determine the subsequent incidence of proximal DVT and PE in those patients with surgically-treated pelvic and acetabular fractures; and 3) to assess the effect of any delay in the commencement of the LMWH prophylactic regime on the rate of DVT and PE.

Patients and Methods

Between July 1993 and July 1997, a total of 103 consecutive patients with pelvic trauma were treated surgically. There were 83 men and 20 women with a mean age of 37 years (11 to 80); 36 had displaced injuries to the pelvic ring, 57 had acetabular fractures and ten had combined pelvic and acetabular fractures. There were associated injuries in 76% of patients. The mean injury severity score (ISS) was 18 (9 to 54). Thirty-five patients had been admitted directly from our accident and emergency department and 68 had been transferred from district general hospitals within the region. The status of the patient regarding DVT prophylaxis had been determined at the time of the initial referral and the commencement of LMWH prophylaxis recommended before transfer.

All patients with pelvic trauma were treated using a standardised protocol for DVT prophylaxis comprising: 1) the administration of LMWH (Enoxaparin; Rhone-Poulenc-Rorer, Collegeville, Pennsylvania, 40 mg by subcutaneous injection, once daily) within 24 hours of injury or on establishing haemodynamic stability together with ultrasound examination using colour-flow duplex scanning of both legs within 14 days of surgery. We undertook a prospective study with the following aims: 1) to assess the use of and compliance with this protocol; 2) to determine the subsequent incidence of proximal DVT and PE in those patients with surgically-treated pelvic and acetabular fractures; and 3) to assess the effect of any delay in the commencement of the LMWH prophylactic regime on the rate of DVT and PE.

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posterior veins in both legs, if the transfer of the patient from the referring hospital had been delayed by seven days or more; 4) the insertion of an inferior vena cava filter before operation if a proximal DVT was detected; 5) post-operative examination for DVT using bilateral duplex scans at ten to 14 days after surgery and subsequently after a further 14 days if the patient was not mobile by then; and 6) a ventilation-perfusion (VQ) scan if the patient developed clinical signs of PE. Contraindications to immediate prophylaxis for DVT in the protocol were perceived danger of acute unsecured intracranial or intraspinal haemorrhage, haemodynamic instability secondary to continuing haemorrhage and known heparin hypersensitivity.

After operation, each patient was mobilised within 48 hours, depending on the complexity of the associated injuries, with minimal or partial weight-bearing allowed on the injured side. LMWH prophylaxis was continued until the post-operative duplex scan was performed and the patient was fully mobile on crutches. If a proximal DVT or PE was detected, the patient was treated with the appropriate therapeutic doses of heparin and then with warfarin for three months.

Statistical analysis. The data obtained were collated on a computer database and statistical analysis was performed using the non-parametric chi-squared test, the Mann-Whitney U test and Fisher’s exact test. Values for p of < 0.05 were regarded as significant.

Results
The 35 patients who had been admitted directly to our unit underwent surgical fixation of displaced pelvic fractures after a mean interval of 4.8 days after injury, whereas the 68 transferred from other hospitals after a mean interval of five days (1 to 6), had surgery with a mean delay of 9.4 days which was significantly longer (Mann-Whitney U test, p < 0.001).

Compliance with the protocol. Of the 35 patients admitted directly to our unit, 33 (94%) received prophylaxis with LMWH within 24 hours of injury in accordance with the protocol. The administration of LMWH was delayed in two patients, although in one there was no valid reason for the delay. Of the 68 patients transferred from other hospitals, only 33 (49%) received subcutaneous heparin or LMWH within 24 hours of injury, but all the patients received LMWH on arrival at our unit. In only two of the transferred patients were there recognised contraindications to LMWH.

Pre-operative duplex scanning was performed on nine patients who had been transferred from other hospitals more than seven days after injury. A proximal DVT was detected in one of these patients who had not received LMWH prophylaxis before transfer. This patient required the insertion of a temporary inferior vena caval filter before surgery. In spite of this the patient died from a massive PE immediately after surgery.

<table>
<thead>
<tr>
<th>LMWH within 24 hours (n = 64)</th>
<th>LMWH delayed &gt; 24 hours (n = 36)</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>DVT rate (%)</td>
<td>2 (3)</td>
<td>8 (22)</td>
</tr>
<tr>
<td>PE rate (%)</td>
<td>0 (0)</td>
<td>5 (14)</td>
</tr>
<tr>
<td>Mean ISS</td>
<td>19</td>
<td>17</td>
</tr>
</tbody>
</table>

Post-operative duplex scanning was performed on both legs in 96 patients and venography in two additional patients. Two patients died before the scheduled duplex scans, one being the patient with fatal PE. In the other there was no evidence of DVT or PE at post-mortem examination.

In three patients no post-operative screening for DVT was performed. None of these patients developed symptoms of DVT or PE, but they were excluded from the following analysis of rates of DVT and PE.

Thromboembolic complications. The mortality rate in the series of 103 patients was 2.9% (three patients), the cause of death being PE in one, fulminant sepsis in another, and multiorgan failure in the third. The overall rate of detected thromboembolism was 10% (ten patients) in the 100 patients in whom appropriate post-operative investigations had been performed. Of these ten patients, five developed a symptomatic PE, confirmed on the VQ scan or at post-mortem examination. In one of these patients, a negative duplex scan was performed ten days after surgery but a symptomatic PE developed at 21 days, confirmed on the VQ scan. This patient is assumed to have had a proximal DVT for the purpose of further discussion. The rate of PE was significantly lower in patients who received LMWH within 24 hours of injury (zero) compared with those in whom there was a delay of more than 24 hours (14%; Table I).

There was a significantly lower rate of proximal DVT in patients who were given LMWH within 24 hours of injury (3%) compared with those in the delayed LMWH group (22%), despite the fact that there was no significant difference in the mean ISS between the two groups (Table I). However, the mean ISS was significantly higher in the patients who developed proximal DVT than in those who did not, whereas the time from injury to surgery was not significantly delayed in the former group (Table II).

Complications of LMWH. There were no complications, such as prolonged wound oozing, excessive bruising or bleeding, associated with the use of LMWH. A major blood transfusion, in excess of 20 units, was required in three patients, two of whom were resuscitated and became haemodynamically stable before LMWH was begun. The third patient died after transfusion of over 100 units, without receiving LMWH.
Table II. Time of delay to surgery and the ISS in the subgroups of patients who developed proximal DVT compared with those patients without DVT

<table>
<thead>
<tr>
<th>Delay to surgery (days)</th>
<th>DVT</th>
<th>No DVT</th>
<th>p value*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean ISS</td>
<td>27</td>
<td>18</td>
<td>0.002</td>
</tr>
</tbody>
</table>

* Mann-Whitney U test

Discussion

The incidence of proximal DVT defined as thrombosis affecting the popliteal or more proximal veins, with or without evidence of calf vein thrombosis in patients with pelvic trauma is 23% to 33%, with symptomatic PE occurring in 2% to 10% of patients, and fatal PE in 0.5% to 2%. In our study, using a protocol based on prophylaxis with LMWH started within 24 hours of pelvic injury, the incidence of proximal DVT was 10%. This is comparable with the reported rate of DVT of 6% pre-operatively and 3% post-operatively in a similar population of patients undergoing a combination of pre-operative duplex screening, the use of intra- and post-operative sequential leg compression devices, and post-operative treatment with warfarin. Our findings support the alternative use of a LMWH regimen for DVT prophylaxis which is well tolerated by patients and requires no formal monitoring of anticoagulation levels. LMWH appears to be an effective thromboprophylactic agent, not associated with an increased risk of bleeding complications.

It is noteworthy that there was a markedly lower rate of proximal DVT in those patients who received LMWH within 24 hours of injury compared with those in whom prophylaxis had been delayed. There was a sevenfold difference between these two groups (3% vs 22%, p < 0.01). Our results confirm previous findings that patients with more severe injuries (higher ISS scores) were at increased risk of developing DVT. However, the difference in the rates of DVT in patients receiving either early or delayed LMWH prophylaxis cannot be accounted for by the severity of injury, or any delay in the time from injury to operation, because these were similar in the two groups. Our study does not show a causal link between delay in administration of LMWH and increased risk of thromboembolism. The proportion of patients receiving early LMWH prophylaxis was certainly greater in patients admitted directly to our hospital compared with those transferred from elsewhere, and there may have been other factors or differences in treatment acting as confounders which we have not identified.

In ten of our patients who did develop a proximal DVT, five had a symptomatic PE, one of which was fatal. This highlights the importance of the early detection and treatment of DVT. The use of serial duplex ultrasonography is recommended in clinical practice as a cost-effective, non-invasive screening method for proximal DVT in high-risk trauma patients while it is recognised that it has a lower sensitivity than venography in screening asymptomatic patients.

Pelvic magnetic resonance imaging venography has also been recommended in patients with acetabular fractures, but magnetic resonance imaging venography and also contrast-enhanced CT, have been shown often to give false-positive rates for DVT and cannot be recommended for routine screening in pelvic and acetabular trauma.

The provision of simple guidelines for the initial management of patients with major pelvic or acetabular fractures has been recommended to referring hospitals in order to correct potential deficiencies in their care before transfer to a specialist pelvic trauma unit. Our study highlights the need to urge prompt administration of LMWH or other effective thromboprophylaxis. Evidence-based guidelines for the prevention of venous thrombosis in trauma patients have been published recently supporting the use of LMWH. However, the immediate use of LMWH in cases of spinal injury and in patients with intracranial haemorrhage remains controversial. We recommend the use of our protocol administering LMWH within 24 hours of injury or, if the patient is haemodynamically unstable, delaying its administration until 24 hours after the patient’s condition has stabilised. We now recommend one minor modification to our protocol; namely the performance of pre-operative duplex scanning on all patients when there is a delay of more than three days from injury to surgery, as recommended by Montgomery et al, in order to detect and treat DVT of early onset.

We conclude that LMWH is a relatively safe and effective method of thromboprophylaxis in patients with major pelvic or acetabular fractures.

No benefits in any form have been received or will be received from a commercial party related directly or indirectly to the subject of this article.

References