Upper-Extremity Deep Venous Thrombosis and Pulmonary Embolism*
A Prospective Study

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We prospectively evaluated the prevalence of pulmonary embolism (PE) in 30 consecutive patients with proved deep venous thrombosis (DVT) of the upper extremity. Ten patients (seven male and three female; mean age, 43 years) had primary DVT, and 20 patients (14 male and six female; mean age, 52 years) had catheter-related DVT. Ventilation-perfusion lung scans were routinely performed at the time of hospital admission to all but one patient (one patient was critically ill, and he died four days after DVT diagnosis because of massive PE). Lung scan findings were normal in nine of ten patients with primary DVT, and they were indeterminate in the remaining patient. By contrast, perfusion defects were considered highly suggestive of PE in four patients with catheter-related DVT; two patients had indeterminate lung scans, and 13 patients had normal scans. We conclude that PE is not a rare complication in upper extremity DVT, and that patients with catheter-related DVT seem to be at a higher risk. (Chest 1991; 99: 280-83)

DVT = deep venous thrombosis; PE = pulmonary embolism

Deep venous thrombosis (DVT) of the lower limbs is widely recognized as a leading cause of pulmonary embolism (PE). Using sensitive methods to detect PE, approximately 50 percent of the patients with proved DVT of the lower extremity have been found to have PE.1-7 This unexpectedly high prevalence has been usually underestimated when judged by symptoms alone, because PE may produce no symptom or symptoms that are nonspecific and compatible with many other conditions.

By contrast, upper-extremity venous thrombosis is much less common, and earlier clinical observations suggested that PE occurred rarely.8-10 The literature on this subject is sparse and essentially consists of case reports and retrospective series, and at present (to our knowledge), no studies have been performed specifically to detect asymptomatic PE.

We were interested in this disparity, and we decided to prospectively study a series of patients with upper extremity DVT. The aim of the study was to determine its relation to PE.

Material and Methods

Between January 1985 and March 1990, we identified 30 consecutive patients with DVT of the upper extremity. The diagnosis, which was made in all patients by typical physical findings, was confirmed by venography. The patients were divided into two general groups depending on the cause of the condition. Ten patients (seven male and three female; aged 19 to 72 years; mean age, 43 years) had venous thrombosis arising spontaneously or following exertion: four patients had a traumatic (stress) cause, three patients had a concomitant malignancy, and one patient had a simultaneous acute monoarthroitis in the ipsilateral shoulder, with signs of extrinsic compression (as seen at venography). No predisposing cause was found for the remaining two patients. Additionally, 20 patients (14 male and six female; aged 24 to 80 years; mean age, 52 years) had a catheter-induced DVT. Seven of them had a concomitant malignancy also. Eighteen patients had a central venous catheter (polyvinyl chloride catheters in 13, polyethylene catheters in five) and two patients had peripheral lines.

All patients underwent careful physical examination, and special care was given to any signs or symptoms suggestive of PE (dyspnea, chest pain, etc). Chest roentgenogram and a ventilation-perfusion lung scan were routinely performed during the first 48 hours after diagnosis. All patients were placed on an eight-day regimen of heparin therapy at the time of DVT diagnosis, and then oral anticoagulant therapy was begun.

All lung scans were obtained with a standard gamma camera. Pulmonary perfusion imaging was performed using Tc-99m macroaggregated albumin injected intravenously with the patient supine. Imaging included six standard projections (anterior, posterior, right and left laterals, and right and left obliques). Ventilation imaging was performed with 133Xe. All images were obtained in the posterior projection. The ventilation-perfusion studies were interpreted in accordance with the criteria of Biello et al11 by two staff physicians who had no knowledge of either the clinical history or venogram findings. They examined the perfusion studies to determine whether there are single or multiple perfusion defects, and they noted the sizes of the largest defects to anatomic divisions of the lungs. Then they compared the major perfusion defects with the ventilation defects. When interpretation of the two readers differed, the readers reviewed the case together and came to a consensus opinion.

Results

A ventilation-perfusion lung scan was performed on 29 patients. No perfusion defects were seen (or low-probability defects) in 22 patients; they were considered as indeterminate in three patients, and major perfusion defects were seen in four patients, highly suggestive of PE (high-probability lung scans) (Fig 1).

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Only one of the four patients with a high-probability lung scan had experienced chest pain and dyspnea; the remaining three patients were asymptomatic. Chest roentgenogram was normal in two patients, but signs of PE were present in two patients (bilateral atelectasis in one patient, pleural effusion and hypoperfusion in another). A repeated lung scan performed eight days after heparin therapy demonstrated a significant improvement of perfusion defects in three of four patients.

No cases of PE were found in patients with spontaneous DVT. Lung scan findings were considered normal in nine patients and indeterminate in one. By contrast, all five patients with PE and two additional patients with an indeterminate lung scan had a catheter-related DVT. On the other hand, no correlation was found between PE and age, sex, concomitant malignancy, correct position of the catheter, infection, or duration of catheter use.

**DISCUSSION**

Upper extremity venous thrombosis is an uncommon condition, accounting for less than 2 percent of all DVTs before 1966, but the relative incidence undoubtedly has risen with the use of central venous catheters and transvenous cardiac pacing. At variance with DVT of the lower limbs, upper extremity venous thrombosis seems to be more common in men, both in primary and secondary forms of DVT (Table 1). Our experience also confirms these findings.

Earlier clinical observations suggested that PE occurred rarely in patients with DVT of the upper limbs. Several authors have questioned the need for anticoagulant therapy in these patients. Certainly, in the several descriptive studies found in the literature, PE occurred rarely: 16 (6.7 percent) of 237 patients (Table 1). In all these studies, however, the diagnosis of PE was sustained only by clinical criteria.

**Table 1—Upper Extremity Deep Venous Thrombosis (DVT)***

<table>
<thead>
<tr>
<th>Authors</th>
<th>Year</th>
<th>Type of Study</th>
<th>No. of Patients</th>
<th>Sex: M/F</th>
<th>Catheter Related</th>
<th>Pulmonary Embolism, No. (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Swinton et al14</td>
<td>1968</td>
<td>Retrospective</td>
<td>23</td>
<td>?</td>
<td>0</td>
<td>1 (4)</td>
</tr>
<tr>
<td>Tilney et al15</td>
<td>1970</td>
<td>Retrospective</td>
<td>48</td>
<td>31/17</td>
<td>15</td>
<td>0</td>
</tr>
<tr>
<td>Ryan et al16</td>
<td>1974</td>
<td>Prospective</td>
<td>8</td>
<td>?</td>
<td>8</td>
<td>3 (37)</td>
</tr>
<tr>
<td>Campbell et al17</td>
<td>1977</td>
<td>Prospective</td>
<td>25</td>
<td>15/10</td>
<td>10</td>
<td>2 (8)</td>
</tr>
<tr>
<td>Prescott and Tikoff18</td>
<td>1979</td>
<td>Prospective</td>
<td>12</td>
<td>11/1</td>
<td>?</td>
<td>1 (10)</td>
</tr>
<tr>
<td>Demeter et al19</td>
<td>1981</td>
<td>Retrospective</td>
<td>16</td>
<td>10/6</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>Donayre et al20</td>
<td>1986</td>
<td>Retrospective</td>
<td>41</td>
<td>31/10</td>
<td>10</td>
<td>5 (12)</td>
</tr>
<tr>
<td>Gutman et al21</td>
<td>1986</td>
<td>Retrospective</td>
<td>25</td>
<td>13/12</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Horvats et al22</td>
<td>1988</td>
<td>Retrospective</td>
<td>33</td>
<td>15/18</td>
<td>13</td>
<td>4 (12)</td>
</tr>
<tr>
<td>Brochner et al23</td>
<td>1989</td>
<td>Prospective</td>
<td>6</td>
<td>3/3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Present study</td>
<td></td>
<td>Prospective</td>
<td>30</td>
<td>21/9</td>
<td>20</td>
<td>5 (15)</td>
</tr>
</tbody>
</table>

*Most reports on upper extremity venous thrombosis are retrospective studies or case reports. The condition seems to affect male subjects more commonly. In recent years, catheter-related DVT have been increasingly frequent. Pulmonary embolism seems to be more common in those series with a larger proportion of catheter-related DVT.*

**FIGURE 1.** A 22-year-old woman was admitted to the hospital because of acute pancreatitis; sudden edema and tenderness on the right arm developed (ipsilateral to a polyvinyl chloride catheter). Contrast venography showed a subclavian venous thrombosis. She had never experienced dyspnea or pleuritic chest pain, but multiple perfusion defects were seen on lung scan, highly suggestive of pulmonary embolism. A repeated lung scan performed eight days later showed marked improvement.

The remaining patient, a 72-year-old man admitted to the hospital because of pulmonary tuberculosis with high fever and marked respiratory symptoms, developed right arm edema, with tenderness and a palpable cord on the same side as the polyvinyl chloride catheter. Axillary vein thrombosis was diagnosed by venography, but lung scan was not performed because the patient was critically ill. Heparin therapy was started at therapeutic doses, but the patient died four days later. Autopsy revealed multiple recent pulmonary thromboemboli in various stages of organization, as well as a thrombus attached to the catheter.
Now it is well established that PE most often is asymptomatic; at present, no studies have been performed specifically to detect asymptomatic PE in patients with upper extremity DVT.

The many limitations of lung scan in the identification of PE have been discussed extensively in the literature, but it is difficult to endorse pulmonary angiography to asymptomatic patients as an alternative to scanning. We agree with Moser and LeMoine\(^6\) in that lung scan is a sensitive and reliable tool in this context, and thereafter an acceptable noninvasive alternative. In our experience, all cases of lung scan-detected PE were in patients with catheter-related venous thrombosis. It was found in five of 20 patients with catheter-induced DVT, and this frequency (25 percent) closely resembles our own experience in patients with lower limb DVT.\(^7\) These findings may explain the low incidence of PE in the earlier series of patients with DVT of the upper extremity: in these series, most patients had primary (non-catheter related) forms of DVT. As summarized in Table 1, the percentage of patients with PE is higher in the more recent series, with a higher proportion of patients with secondary forms of DVT. Swinton et al,\(^8\) in 1968, suggested that PE was more frequent and severe in patients with secondary thrombosis. In addition, most case reports of PE associated with upper extremity DVT were done in patients with central vein catheters.\(^8\),\(^9\) However, only a prospective study using sensitive and objective methods for the diagnosis of PE can confirm this association.

Although in our study all the patients had venographically documented DVT of the upper extremity, it is possible that the source of emboli could have been from the lower extremity. No one patient in this series had clinical symptoms suggesting DVT in lower limbs, and we considered it unnecessary (for ethical reasons) to perform roentgenographic ascending venography to rule out silent DVT. However, a noninvasive method was performed in the latter ten patients: real-time ultrasound was performed on lower limbs, and no one case of DVT was detected. In any case, its sensitivity is low in asymptomatic patients.\(^10\)

Certainly, although PE most commonly results from DVT involving the lower limbs, other sources must be considered, particularly when there is no evidence of thrombosis in the lower extremities. According to the Hull et al\(^11\) experience, the frequency of a negative venogram associated with PE by pulmonary angiography was 30 percent. Possible explanations include embolization of all thrombi to the pulmonary circulation so that none are obvious in the lower extremity. It is also possible that the embolism was derived from a source other than the deep veins of the legs. According to our experience, if these patients have an intravenous catheter inserted, the possibility of DVT of the upper extremity must be ruled out.

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