Prevalence of Deep Venous Thrombosis in Patients with Proven Pulmonary Embolism*

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ABSTRACT  Fifty-one patients with proven pulmonary emboli who underwent lower extremity Doppler venous examinations and phlebography were studied. Forty-nine percent of these patients presented with signs or symptoms of lower extremity deep venous thrombosis (edema 31%, pain 37%). Both non-invasive tests were negative for deep venous thrombosis (DVT) in 28/51 patients (55%); both tests were positive in 13/51 patients (25%). In the remaining 10 patients (20%), results were discordant and hence inconclusive. Previous studies in our laboratory document that positive results in both tests have a high correlation with venographic demonstration of lower extremity DVT (sensitivity = 88%) while negative tests strongly indicate the absence of DVT (specificity = 99%). Hence, a majority of patients with documented pulmonary emboli do not have evidence of lower extremity DVT based on standard non-invasive methods. These data suggest that negative or equivocal non-invasive tests should not deter an aggressive diagnostic approach including pulmonary angiography in patients with suspected pulmonary emboli.

Introduction

The association between lower extremity deep vein thrombosis (DVT) and pulmonary emboli (PE) is well known.1,4 Previous studies using non-invasive techniques to demonstrate DVT have reported a prevalence of 90 to 95% in patients with documented pulmonary emboli.5 Such data imply that patients with negative non-invasive tests for DVT should have a very low likelihood of having pulmonary embolism. To evaluate critically this hypothesis, we reviewed the evidence for DVT in all patients with angiographically documented pulmonary embolism treated at the University of Chicago between 1978 and 1982. This report is comprised of 51 such patients who had non-invasive evaluation in the vascular laboratory using Doppler venous ultrasound and phlebography during the same hospital admission.

Materials and Methods

The hospital charts of 113 patients with angiographically confirmed diagnoses of pulmonary emboli were reviewed. Fifty-one of these patients had been evaluated for venous thrombosis in the non-invasive vascular laboratory. Non-invasive studies were performed within 72 hours of documentation of pulmonary embolus in 63% of patients. Only three patients underwent non-invasive evaluation more than seven days before or after angiography.

The non-invasive diagnosis of DVT was made by Doppler venous evaluation and phlebography. Patients were placed supine on an examination table with a 10° elevation of the head of the bed. The legs were partially abducted and externally rotated with a 20° knee flexion. Doppler venous ultrasound examination was performed using a 5.3 MHz continuous wave Doppler instrument as described by Barnes et al.6 Doppler signals were obtained from the posterior tibial, popliteal, superficial femoral, and common femoral veins. Flow was assessed with regard to spontaneity, respiratory variation, and proximal and distal augmentation at each position. The diagnosis of deep venous thrombosis was made by (a) the absence of spontaneous signals or respiratory variation or (b) marked attenuation of compression augmentations.

Phlebography was performed as described by Cranley.7 Recording cuffs were placed around the thorax, mid-thigh, upper thigh, and lower calf and foot after proper positioning and relaxation. Each limb was evaluated with two separate compressions. The first utilized foot compression at 100 mmHg while the second involved lower calf compression at 50 mmHg. Spontaneous respiratory waves and baseline shifts upon compression were specifically noted. Acute deep venous obstruction was diagnosed when respiratory waves were completely absent and baseline shifts were present.

Results

The 51 patients included 24 females and 27 males with an average age of 55 years (range 18–79 years).
Five patients (10%) died during the same admission, although pulmonary embolus was the principal cause of death in only one patient. Twenty-five patients (49%) had physical signs and symptoms consistent with a clinical diagnosis of DVT; 19 patients (37%) had pain and calf tenderness, while 16 patients (32%) presented with leg edema. Three patients had a previous diagnosis of DVT, and six patients had previous documentation of pulmonary emboli. Twenty-six patients (51%) were ambulatory and were admitted from either the emergency room or clinic. The initial chief complaint was compatible with the eventual diagnosis of pulmonary embolus in 65% of patients.

Doppler venous examination of the lower extremities was negative for DVT in 34 patients (67%) and positive in 15 patients (29%). Equivocal or nondiagnostic Doppler studies were noted in 2 patients (4%). Phleborheography was normal (no evidence for DVT) in 29 patients (57%). In 18 patients (33%), it was positive, and in 4 patients (8%) results were considered equivocal or nondiagnostic. Both tests were positive for DVT in only 13 patients (25%). In ten patients (20%) the two tests were in disagreement or one of the tests gave an equivocal result. Both tests were negative for DVT in 28 patients (55%). (See Table I.)

<table>
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<td>4(8%)</td>
<td>2(4%)</td>
<td>28(55%)</td>
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Table I

Doppler venous examinations (Dop) and phleborheography (PRG) performed on each of 51 patients with documented PE.

+ = positive
- = negative
E = equivocal

Discussion

Other investigators have demonstrated a high correlation between fatal pulmonary emboli and lower extremity deep venous thrombosis.1-4 Autopsy studies suggest that more than 90% of pulmonary emboli originate from thrombi in the deep veins of the lower limbs or pelvis.5 In a particularly meticulous study, Havig performed autopsies in 261 selected patients in which he completely dissected the veins of the lower extremity and pulmonary arteries.6 Pulmonary emboli of varying clinical import were documented in 145 of these patients. Grossly visible thrombi were demonstrated in the inferior vena cava or lower extremity in all but 26 of these patients.

This pathologic evidence has led several investigators to study the relationship between non-invasive diagnosis of DVT and pulmonary embolus. Sasahara found that 95% of patients with pulmonary emboli had deep venous thrombosis confirmed by impedance plethysmography (IPG).7 He recommended this study as the principal diagnostic aid in screening patients with suspected pulmonary embolism. Hirsh further suggests that the association between lower extremity deep venous thrombosis and pulmonary embolus is so strong that when pulmonary angiography is not available or contraindicated, the non-invasive diagnosis or venographic demonstration of DVT can, in effect, confirm the clinical diagnosis of pulmonary embolus.8

Chelly and colleagues disagreed with this approach.9 They performed Doppler venous examinations in 79 patients with angiographically proven pulmonary emboli. In validation studies in their laboratory, Doppler examinations were more than 86% sensitive for the detection of DVT in the thigh. Interestingly, 61 of the 79 patients (77%) demonstrated normal venous flow patterns contradicting a diagnosis of DVT. They concluded that Doppler venous examination alone, while accurate in the diagnosis of thigh DVT, cannot exclude the presence of clinically important thrombi in the calf or pelvic veins.

Our results are comparable to Chelly et al. No lower extremity deep venous thrombosis was demonstrated in 55% of our patients with proven pulmonary emboli. In fact, only 25% of patients had a definite diagnosis of DVT confirmed by positive Doppler venous and plethysmographic studies. The reliability of this data is supported by a previous study in our laboratory10 in which this combination of non-invasive tests was compared to venography in 119 patients. Doppler ultrasound examination for DVT by an experienced technician offered a sensitivity of 78% and specificity of 93% when compared to venograms. The combination of Doppler venous examination and PRG further increased sensitivity and specificity which remain at 88% and 99% in our laboratory. It is noteworthy that these calculations included calf vein thrombi which remain the most difficult abnormality to detect. While it is possible the IPG is a more accurate study, in collective reviews the accuracy of PRG equals or exceeds that of IPG.4,6,7,11

Another potential source of error may be the temporal relationship between non-invasive testing, the onset of symptoms, and documentation with pulmonary angiography. This is of concern because non-invasive tests begin to normalize within 48-72 hours of documented DVT.12 Unfortunately, the timing of our tests was at the discretion of the primary physician; tests were ordered more frequently to define the source of the emboli rather than to make treatment decisions. Nonetheless, positive non-invasive tests for DVT were no more frequent in patients studied within 24 hours of documented PE (33%) than in those studied four to five days after angiography (25%).

Two alternate explanations can explain contradictions between our findings and autopsy studies. First, patients suffering fatal pulmonary emboli may have a much higher incidence of lower extremity DVT than those presenting with pulmonary emboli of less morbidity. Thrombi originating in pelvic veins or other
sites undetectable by lower extremity non-invasive examinations may be more frequently responsible for such nonfatal events. Normal non-invasive studies despite documented emboli could also be explained by migration of clot from the ilio-femoral system restoring relatively normal flow in the deep veins.

Conclusion

Previous reports document a high correlation between pulmonary emboli and deep venous thrombosis of the lower extremities. DVT could not be documented in the majority of our patients with PE. This data suggests that non-invasive studies cannot be used to screen patients with suspected PE; negative or equivocal non-invasive tests should not deter an aggressive diagnostic approach, including pulmonary angiography.

References