Pulmonary embolism after insertion of a Greenfield filter

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This report describes a case in which a patient had a Greenfield filter placed at the time of diagnosis of deep vein thrombosis (DVT) when he was asymptomatic for pulmonary embolism. Later in the patient's hospital course, a typical clinical picture of pulmonary embolism developed.

The issues examined in this report include: (1) the incidence of asymptomatic pulmonary embolism; (2) the value of the baseline ventilation perfusion (VQ) lung scan for the diagnosis of DVT; and (3) the value of an echocardiogram in diagnosing pulmonary embolism.

It appears reasonable that patients in whom DVT is diagnosed undergo baseline VQ scanning. This procedure would prevent the misdiagnosis of a new pulmonary embolism while the patient is on anticoagulation therapy and possibly avoid unnecessary invasive diagnostic procedures. The case described demonstrates the usefulness of the echocardiogram and a transthoracic echo in the diagnosis of pulmonary embolism. It also points out the surprisingly high incidence of silent pulmonary embolism in patients in whom DVT is diagnosed.

(Key words: deep vein thrombosis, echocardiogram, Greenfield filter, pulmonary embolism, ventilation perfusion lung scan)

The diagnosis of pulmonary embolism is frequently difficult and challenging. We are increasingly faced with an aging population with complex diseases that predispose to pulmonary embolism. Pulmonary embolism is a direct result of deep vein thrombosis (DVT), and a diagnosis of DVT is of prime importance in accurately diagnosing pulmonary embolism.

As the embolism moves through the right side of the heart, the echocardiogram becomes a potentially valuable tool to diagnose pulmonary embolism, either directly (by visualizing dot) or indirectly (by assessing right ventricular pressure and volume and pulmonary artery pressure).

The following case illustrates the relationship between DVT and pulmonary embolism and the potential role of the echocardiogram. It illustrates the value of looking for pulmonary embolism in the patient with DVT without pulmonary symptoms and the surprisingly high incidence of asymptomatic pulmonary embolism in the setting of DVT.

Report of case

A 74-year-old man with a past medical history significant for glioblastoma, coronary artery disease, type II diabetes mellitus, and atrial fibrillation complained of swelling of the left leg that had been present for approximately 1 month. The swelling had worsened during the past week. He denied having fever, skin lesions, recent trauma, surgery, or history of thrombotic events. He had no complaints related to the right leg. Findings of the review of systems was otherwise negative for symptoms of pulmonary embolism, including cough, dyspnea, hemoptyis, and chest pain.

His past medical history, in addition to that previously cited, included subtotal resection of a glioblastoma followed by cranial irradiation. His radiation therapy was continuing at the time of this presentation. He also had a history of benign prostatic hypertrophy and had undergone transurethral resection of the prostate.

He had a past history of smoking cigars, but he denied tobacco use for at least the past 7 years. He had a past history of heavy alcohol use, but none in the past 12 years.

At physical examination, the patient was elderly appearing and in no acute distress. He was alert and oriented. His temperature was 98.7°F, pulse rate was 92 beats per minute and regular. His blood pressure was 132/90 mm Hg. Respiration were 16/min. Candidiasis of the oral mucosa was noted. Findings of the neck, lungs, and heart examination were normal. The left calf was tender with 1+ pretibial pitting edema. The right leg and both arms were not edematous. Findings of vascular and neurologic examinations were normal.

Laboratory data included normal values for serum sodium, potassium, serum chloride, venous plasma bicarbonate, blood urea nitrogen, and serum creatinine. The blood glucose level was 240 mg/dL. The white blood cell count was 11,300/mm³, with 77% band neutrophils, 13% lymphocytes, 8% monocytes, and 1% basophils. The hemoglobin level was 12.9 g/dL, with a hematocrit of 40.6 mL/dL. Platelet count was 131,000/mm³. Prothrombin time was 13 seconds with a control of 11.8 seconds. Partial thromboplastin time was 26.2 seconds with a control of 29.7 seconds.

The patient's chest x-ray film showed no abnormality,
and the electrocardiogram (ECG) demonstrated normal sinus rhythm and was otherwise normal, except for left atrial enlargement.

Doppler ultrasound examination of the lower extremities was done, demonstrating thrombosis of the left superficial and popliteal veins, with patent veins in the right leg. A diagnosis of DVT of the left leg was made.

Because of the history of intracranial tumor, the patient was considered not to be a candidate for anticoagulation therapy, and a Greenfield filter was placed via the right femoral vein. Its position at the level of L2-3 was confirmed radiographically.

The patient remained stable until 5 days after insertion of the filter, at which time he complained of pain in the right side of the groin. Doppler ultrasound examination of the legs at that time demonstrated not only left superficial femoral and popliteal venous thrombosis, but also right common femoral, superficial femoral, and popliteal thrombosis. The patient still had no pulmonary complaints.

The next day, 6 days after insertion of the Greenfield filter, the patient complained of dyspnea of acute onset. He was tachypneic and tachycardic. Arterial blood gas determination was performed, the patient remained tachypneic and tachycardic. Arterial blood gas determinations at that time revealed the following: pH 7.50; PaO\textsubscript{2} 29 mm Hg; and PaCO\textsubscript{2} 82 mm Hg on 3 L of oxygen. The ECG showed atrial fibrillation. A chest x-ray film at that time was notable for oligemia without any changes from prior studies. Ventilation perfusion (VQ) lung scanning was done, demonstrating multiple, bilateral VQ mismatches, greater on the right side. No baseline VQ lung scan was available for comparison.

A transthoracic echocardiogram showed normal left ventricular size and function along with left ventricular hypertrophy. It also showed right atrial and right ventricular enlargements with normal right ventricular function. Linear echoes that were consistent with venous thrombosis in transit were seen in the inferior vena cava.

Transesophageal echocardiography was also done, which demonstrated, in addition to the foregoing findings, linear soft tissue casts in the inferior vena cava and main pulmonary artery without cardiac masses. This finding was also thought to be consistent with thrombosis in transit. The patient was then started on systemic anticoagulation therapy.

The remainder of the patient's hospital course was without incident except for occasional self-limited episodes of atrial fibrillation. He was maintained on appropriate heparin therapy, and warfarin sodium therapy was begun. He was discharged on warfarin therapy, with an international normalized ratio (INR) of 2.3.

**Discussion**

This case raises several interesting issues, including:
- The incidence of asymptomatic pulmonary embolus at the time of presentation of deep venous thrombosis (DVT); and
- the value of baseline VQ lung scan at the time of diagnosis of DVT; and
- the value of echocardiograms, including a transesophageal echocardiogram as an adjuvant in the diagnosis of pulmonary embolism.

In the patient described, the most likely etiology for pulmonary embolism diagnosed after placement of the Greenfield filter is asymptomatic pulmonary embolism before filter placement or embolism to the right side of the heart before filter placement with subsequent pulmonary embolism. The other possible source would be a clot propagation proximally from the Greenfield filter, an entity described previously. The rarity of such an event is well documented. Studies by Kistner et al and Lemone, Plate et al, and Huisman et al document the surprisingly high incidence of silent pulmonary embolism in patients in whom DVT is diagnosed, varying from 22% to 55% of patients in these studies.

Monreal et al assembled a larger group of patients and studied this same issue, yielding an incidence of pulmonary embolism of roughly 30% in patients with DVT asymptomatic for pulmonary embolism. Monreal et al also noted that signs or symptoms of pulmonary embolism developed in 5% of their study population after the initiation of anticoagulation therapy without a change on the VQ lung scan from baseline. This 5% represents a population that might have been considered a failure of anticoagulation therapy in the absence of a baseline VQ lung scan.

It appears reasonable that baseline VQ lung scanning be done in patients with diagnosed DVT. This procedure would prevent the misdiagnosis of new pulmonary embolism while patients are on anticoagulation therapy. The avoidance of such misdiagnosis would prevent unnecessary invasive diagnostic procedures and unnecessary changes in therapy.

The case described here also illustrates the usefulness of the echocardiogram in the diagnosis of pulmonary embolism. Cases documenting the use of transthoracic echocardiography to identify intracardiac thromboembolism associated with pulmonary embolism include those by Starkey and de Bono and Kumar and Gallagher.

Starkey and de Bono describe a woman with a coiled thromboembolism lodged in a probe-patient foramen ovale, first noted by transthoracic echocardiogram and confirmed on autopsy, associated with fatal pulmonary embolism.

Kumar et al report three cases. The first was of a man with a mobile right atrial mass seen by echocardiography, presumably embolus, associated with fatal pulmonary embolism. The second case describes a man with a tubular mass extending from the right atrium to the right ventricular outflow tract, associated with symptomatic, nonfatal pulmonary embolism. The third case involved a young woman with surgically confirmed right atrial thrombus, associated with signs and symptoms of pulmonary embolism. In general, echocardiographic signs of pulmonary embolism include high ventricular pressure, pulmonary hypertension, and tricuspid insufficiency as well as actual visualization of the thrombus in the right atrium, right ventricle, or pulmonary artery.
Our report describes transthoracic echocardiographic findings of an inferior vena cava thrombus in transit associated with pulmonary embolism. Additionally, transesophageal echocardiography confirmed the transthoracic findings and additionally noted thrombus in transit in the main pulmonary artery without intracardiac mass. The use of transesophageal echocardiography to aid in diagnosis of pulmonary embolism has not been well described, but the modality appears to be highly sensitive.

The role of echocardiography, either transthoracic or transesophageal, in diagnosis of pulmonary embolism is limited by the transitory nature of thromboembolism as it passes through the inferior vena cava and right side of the heart to the pulmonary circulation. However, in those cases in which the echocardiogram identifies an intracardiac or intravascular mass suggestive of thromboembolism or echocardiographic findings of right ventricle overload or pulmonary hypertension occur in the absence of prior disease of the right side of the heart, the diagnosis of pulmonary embolism is extremely likely and can be made in association with other signs and symptoms typical of pulmonary embolism. Normal findings on an echocardiogram should not be used to rule out a pulmonary embolism.

Comment
We have presented a report of a case in which a patient with diagnosed DVT had a Greenfield filter placed at a time when he was asymptomatic for pulmonary embolism. Later in his hospital course, a typical clinical picture of pulmonary embolism developed, and the diagnosis was made in part with the identification of inferior vena cava and pulmonary artery thromboembolism demonstrated by transthoracic and transesophageal echocardiography. Additionally, the previously documented high incidence of silent pulmonary embolism with DVT suggests benefit in routinely obtaining VQ lung scans in those patients in whom acute DVT is diagnosed.

References