Normal Lung Perfusion Scan with Extensive Thromboembolic Disease*


A 50-year-old woman with unexplained pulmonary hypertension had normal findings on six-view lung perfusion scan prior to open lung biopsy. The biopsy demonstrated old organized thrombi. The patient expired and autopsy disclosed extensive thromboembolic disease, both old and new. A six-view lung scan may not distinguish primary pulmonary hypertension from thromboembolic hypertension when diffuse symmetrical thrombi are present. Under such conditions, when invasive diagnostic procedures have an unacceptable morbidity, empiric anticoagulation should be considered.

Normal findings on a well performed multiple view lung perfusion scan effectively excludes the diagnosis of clinically significant pulmonary emboli in acutely ill patients. Furthermore, in the setting of unexplained pulmonary hypertension, normal findings on lung scan distinguish primary pulmonary hypertension (PPH) from thromboembolic hypertension (TEH). We report a patient with autopsy-proven thromboembolic hypertensive pulmonary disease who had normal findings on six-view lung scan shortly prior to death.

CASE REPORT

A 50-year-old woman was admitted for evaluation of unexplained pulmonary hypertension. She was well up until two years earlier when she was treated for hypertension. Over the next two years, she began to experience shortness of breath which was felt to be secondary to hypertensive left ventricular heart failure. Chest roentgenogram demonstrated a small right pleural effusion and revealed moderate cardiac enlargement; electrocardiographic findings were normal, and an echocardiogram demonstrated the left atrium to be 42 mm and the left ventricle, 44 mm. The right ventricle was not adequately visualized. Resting ventricular function disclosed left and right ventricular ejection fractions of 68 and 42 percent, respectively. Right- and left-sided cardiac catheterization showed that the pulmonary-capillary wedge pressure was 12 mm Hg, the pulmonary artery pressure was 78/40 mm Hg, with a mean pressure of 64 mm Hg; the right ventricular pressure was 78/25 mm Hg, and the right atrial pressure was 26 mm Hg; the left ventricular pressure was 105/10 mm Hg, and the systemic arterial pressure was 105/82 mm Hg with a mean pressure of 90 mm Hg. The pulmonary vascular resistance was 1,050 dynes*sec*cm⁻⁵, and the systemic vascular resistance was 1,160 dynes*sec*cm⁻⁵. The cardiac output was 3.9 L/min.

There was no evidence of intracardiac shunt by oxygen saturation blood studies. Her arterial blood gas levels breathing room air at rest revealed: pH, 7.46; partial pressure of carbon dioxide (PaCO₂), 37 mm Hg; and the partial pressure of oxygen (PaO₂), 79 mm Hg. Six-view lung perfusion scan showed a single perfusion defect existing at the right lung base corresponding in both size and location to pleural fluid on the accompanying chest roentgenogram. In view of progressive shortness of breath and worsening signs of right ventricular heart failure, she was readmitted two weeks after the initial evaluation.

The patient had no significant past pulmonary history. She never smoked and denied exposure to inhaled toxic agents. Her only medications included furosemide (Lasix), and potassium supplementation.

On examination, the patient had normal vital signs, was warm and in no respiratory distress. The jugular venous pressure was 14 cm, with visible V waves; no Kussmaul sign was observed. The carotid pulses were ++ without bruits. The lungs were clear. A grade 2 systolic ejection murmur was heard along the lower left sternal border with radiation to the cardiac apex. There was ++ peripheral edema without calf tenderness or other evidence of thrombophlebitis. Results of all routine laboratory blood tests were normal. Pulmonary function test results disclosed a vital capacity 60 percent of predicted, and a carbon monoxide diffusing capacity 57 percent of predicted. A repeat specimen of arterial blood, while the patient was breathing room air, revealed that the PaO₂ was 81 mm Hg, PaCO₂ 34 mm Hg, and pH, 7.44. Roentgenogram demonstrated resolution of the right pleural effusion, and the electrocardiogram was essentially the same as that performed two weeks earlier. Another six-view lung perfusion scan showed normal findings (Fig 1).

In this patient the lung scan was performed immediately after the intravenous injection of 3.0 mCi of ⁹⁹mTc macroaggregated albumin. The radiopharmaceuticals were prepared by a licensed commercial pharmacy (Syncon International Corporation, Garden City, NY). Quality control procedures included microscopic evaluation of particle size. Ninety percent of the particles were between 10 and 90 microns with none greater than 150 microns. The radiochemical

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purity in each case was in excess of 99.8 percent. Six 500,000 count images were acquired on a large field digital camera (Elscent Apex 400) with a low energy all purpose collimator. Each scan consisted of anterior, posterior, left and right lateral, and left and right posterior oblique projections. Each image consisted of 500,000 counts.

In view of the unexplained pulmonary hypertension, open lung biopsy was performed the day after the normal lung scan. Left upper lobe biopsy disclosed medium and small arteries with thickened walls and hypertrophy of the media. There was evidence of old thromboemboli with organization. The patient's immediate postoperative period was complicated by left lower lobe atelectasis and progressive right ventricular heart failure. In spite of aggressive supportive measures, the patient expired on the second postoperative day, three days after the second lung scan. At complete autopsy, fresh emboli were noted in the main pulmonary arteries (Fig 2). The pulmonary vascular lesions, on microscopic examination, were characterized by multiple acute pulmonary thromboemboli and focal organized and recanalized thrombi (Fig 3). There was no evidence of necrotizing arteritis, fibrinoid degeneration, dilatation lesions, or plexiform lesions. There was no thrombotic lesion noted in the veins of the lower extremities or pelvis.

**DISCUSSION**

Until the results of the open lung biopsy were known, our patient had unexplained pulmonary hypertension. The diagnosis of such hypertension often rests on the ability to distinguish PPH from TEH.\(^4\) In view of differences in therapy and outcome for the two, attempts at making an accurate diagnosis are necessary.\(^4\) Acknowledging the risks of pulmonary angiography and open lung biopsy, lung perfusion scanning is the procedure of choice to initially distinguish PPH from TEH.\(^5\) Accordingly, a normal or low proba-

**FIGURE 1.** Six-view lung perfusion scan with normal findings.

**FIGURE 2.** Gross photograph of dissected right pulmonary artery and branches demonstrates obstructing embolus of lower lobe branch (arrow) and remnants at points of attachment of reabsorbed emboli of the main pulmonary artery (V). Our patient's normal lung scan result, and yet, extensive thromboembolic disease, is therefore worthy of comment.

Normal lung scan with pulmonary thromboemboli proved by angiocardiography has been reported in the past in two patients who were felt to have delayed obtaining the scan after the initial symptoms, with ultimate angiographic evidence of thromboemboli.\(^3\) The limitation of the number of views performed during a perfusion scan has also been cited.
as a reason for a normal finding on scan, with angiographically proven pulmonary emboli. Most recently, normal findings on four-view ventilation-perfusion lung scan were reported with an angiographically proven thromboembolism obstructing 80 percent of the right main pulmonary artery. The explanation for this finding was that dye was observed to flow around the obstruction during performance of the angiogram, as probably did the macro spheres during the scan.

Our patient also demonstrates that in spite of a normal appearing six view lung scan, extensive thromboembolic disease can be present. We believe there are two explanations for this finding. Our patient had diffuse symmetrical small artery obstruction throughout both lungs. This possibly accounted, in part, for the normal, even distribution of the labelled macro spheres. Secondly, some of the clots at autopsy were not only organized, but also recanalized, therefore allowing the labelled macro spheres to flow through. The observation of macro recanalized clots, with distal blood flow, has recently been described using fiber optic angiography.

We believe that extensive thromboembolic disease, as in our patient, may be more prevalent than appreciated. Patients with normal lung scan results and unexplained pulmonary hypertension may be presumed to have PPH and are thus candidates for vasodilator therapy. It is possible that thromboembolic disease exists, even though an apparent "misleading" response to vasodilator therapy is noted, as has been reported in thromboembolic disease. Accordingly, empiric anticoagulation has been suggested, as thrombosis may be part of the natural history of PPH.

In conclusion, we present a patient with unexplained pulmonary hypertension who had a normal perfusion scan and yet extensive organized clots throughout both lungs at autopsy. The symmetrical distribution of the defects, coupled with recanalization of the clots, may explain the normal scan findings with such diffuse disease. Diagnosis of thromboembolic disease may be difficult to make under these circumstances when more invasive procedures are discouraged because of associated risks. Under appropriate conditions, when it is impossible to distinguish TEH from PPH, the benefits of empiric anticoagulation therapy should be entertained, comparing such therapy to its own acknowledged risks.

REFERENCES

Radiation Necrosis Causing Failure of Automatic Ventilation during Sleep with Central Sleep Apnea*

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A patient operated upon for a midline cerebellar hemangio-blastoma developed failure of automatic respiration during sleep, together with central sleep apnea syndrome, approximately two years after receiving radiation therapy to the brain. Clinical and CT scan findings were compatible with a diagnosis of radiation necrosis as the cause of his abnormal respiratory control.

Disturbances in the central control of respiration may take various forms. We report a case of failure of automatic respiration during sleep, together with periods of sleep apnea of central origin, which developed approximately two years after radiation therapy to the brain. To the best of our knowledge, there is no similar report.

CASE REPORT

A 32-year-old man was first admitted in May, 1983 with a two-month history of headache, giddiness and ataxia. CT scan of the brain showed a well-defined, rounded hypodense mass in the vermis of the cerebellum with some nodular enhancement following contrast administration. The patient was operated on and the tumor was partially excised; histologic diagnosis of capillary hemangio-blastoma of the cerebellum was made.

Subsequently, the patient received a course of radiation to the brain—6000 rads delivered in 30 fractions over a daily tumor dose of 200 rads using the three-field technique. The patient's tolerance and response were very good and another CT scan showed complete regression of the tumor.

He remained asymptomatic until January 1, 1985 after which he began to develop progressive difficulty in swallowing and speech, a nasal twang, nasal regurgitation, and tingling and numbness in all his limbs. On physical examination he was noted to be of slight build. CNS examination revealed bilateral nuclear ninth, tenth and twelfth cranial nerve palsies with gross loss of posterior column sensitivity in

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