Radionuclide Study in Pulmonary Sequestration

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A radionuclide hemodynamic study was helpful in demonstrating blood supply from the aberrant artery in pulmonary sequestration. Two regions of interest were set up in corresponding lower lung fields of a patient suspected of sequestration in the left lower lobe. Following i.v. injection of Tc-99m albumin, radioactivity appeared in the left target area 8–10 sec behind that on the right. This delay is due to the systemic arterial supply to the sequestration, rather than through the pulmonary artery.

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A patient with pulmonary sequestration was given a radionuclide hemodynamic study. This method has proved promising in the diagnosis of pulmonary sequestration.

The patient, a 32-year-old male, exhibited a "tumor shadow" in the left lung on the chest radiograph. He had been well until 3 mo before admission, at which time he noticed night sweating. Other respiratory symptoms such as cough, sputum, fever, and dyspnea did not occur.

On examination the patient appeared well. The routine laboratory examinations and spirogram data were within normal limits.

A posteroanterior radiograph of the chest (Fig. 1a) showed a well-defined mass, approximately 5 cm in diameter, with a band-like shadow close to the medial portion of the diaphragm behind the heart. Hyperlucency around the mass was demonstrated by tomography. The left bronchogram showed no bronchial communication with the hyperlucent lung containing the soft-tissue mass. An angiogram demonstrated an anomalous artery, 1.5 cm in caliber, taking off from the aorta at the 12th thoracic spine and entering the sequestrated lung in the left lower lobe.

At surgery, the "white" sequestrated lung was clearly demarcated from normal lung and was perfused by an anomalous systemic artery in the left lower lobe. A walnut-sized cyst in the sequestrated lung was filled with mucus, and microscopy showed bronchial epithelium in its wall.

Figure 1b shows perfusion images after i.v. injection of 300 mCi of I-131 macroaggregated albumin (MAA) in the supine position. In the left lateral view, a perfusion defect is seen in the posterior basal area of the left lung. Lung contour, the solid line on the figures, was established by lateral chest radiograph.

Figure 2 shows time-activity curves from symmetrical regions of interest in the two lower lung fields as indicated, following a bolus injection of 10 mCi of Tc-99m albumin into the antecubital vein.

In Position 2 (right lower lung) the time-activity curve rises up in 3 sec after the injection and reaches peak value in 10 sec. Activity in the next 35 sec is due to recirculation.

In Position 1 (left lower lung) the peak of the curve lags 8–10 sec behind that in Position 2. This delay is caused because tracer in the aberrant artery must arrive from the aorta, having passed through the pulmonary circulation and left ventricle.

The procedure of Fig. 2 was repeated on this patient 1 mo after operation. The ascending limbs and the peaks of the two curves are almost simultaneous and the radioactivity due to recirculation was similar in both. The new time-activity curve from Position 1 reflects circulation of tracer in the normal lung tissue that filled the Position 1 area after operation.

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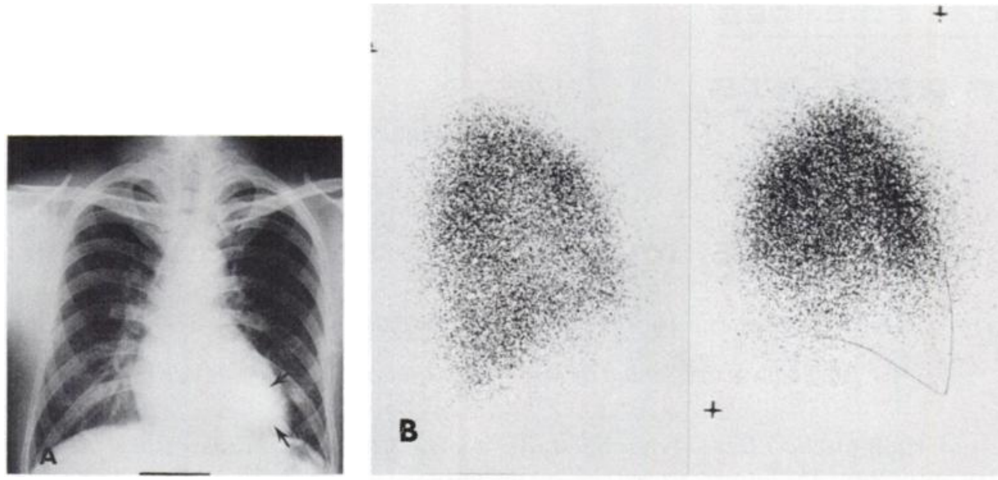

FIG. 1. (A) Chest roentgenogram reveals a well-defined circular shadow, about 5 cm in diameter, behind the heart (arrows). (B) Lung scintigraphy shows perfusion defect to posterior basal region of left lung. Right lateral view is to viewer's left; left lateral view to viewer's right.

DISCUSSION

Pulmonary sequestration is a congenital pulmonary malformation in which a portion of pulmonary tissue is detached from the remainder of the normal lung and receives its blood supply from a systemic artery (*1,2*).

Preoperative diagnosis of this malformation is important in view of the hazards during surgical resection (*3*), but although many cases of this malformation are found in the literature (*4,5*) there are few reports of preoperative diagnosis.

By roentgenogram there are homogeneous masses of water density, localized inflammatory changes, or multiple cystic lesions. A band-like shadow corresponding to the aberrant artery is sometimes demonstrated by tomography extending to the lesion from the subdiaphragmatic region or mediastinum.

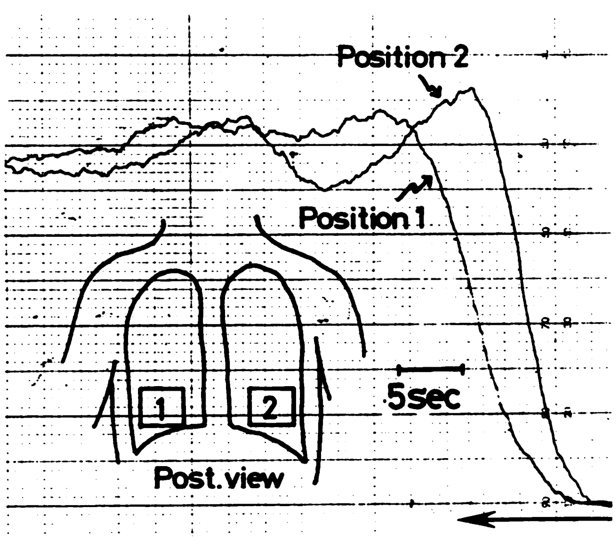

FIG. 2. Time-activity curve following bolus injection of Tc-99m albumin into antecubital vein. See text for details.

The sequestrated lesion is not connected to the normal bronchi of the lung. Therefore, bronchographic contrast material does not usually enter it, and the opacified bronchial tree appears festooned around the sequestration.

The diagnosis of pulmonary sequestration may be suspected when the preceding findings are located in a lower lobe, especially in the posterior basal segment (*6*), but a firm diagnosis can best be achieved by demonstration of blood supply from the systemic circulation to the sequestration.

Alternatively, a hemodynamic study with a radionuclide is attractive as a noninvasive method. A perfusion defect on a lung scintigram with Tc-99m MAA is not always a specific indication of pulmonary sequestration, but this malformation is strongly suspected when the defect corresponds to a posterior basal segment having a cystic appearance by chest radiogram.

In a dynamic study of pulmonary sequestration, the appearance of radioactivity is delayed 8–10 sec in the area of sequestration compared with that of a normally perfused lung field. This delay arises because the radionuclide reaches the aberrant artery through the aorta after the tracer has passed through the pulmonary circulation.

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