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Lung Scan Detection of SVC Clot with Collateral Flow to Liver

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We present a case of visualization of a clot in the superior vena cava with collateral flow to the liver during a lung perfusion scan. A digital venogram performed after injection through the right central venous line confirmed the presence of a clot in the superior vena cava with retrograde flow into the azygous venous system.

Key Words: technetium-99m-macroaggregated albumin; lung scintigraphy; SVC clot

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The visualization of organs, other than the lungs, during a lung perfusion study using ^{99m}Tc-macroaggregated albumin was studied. The causes of visualization include: poor radiopharmaceutical tagging, degradation to submicron particle size of injected material, right-to-left cardiac shunts or shunting of material away from the heart after injection (*1,2*). We report on a lung perfusion scan in a patient with a superior vena cava (SVC) obstruction, which showed both hepatic visualization and uptake within the obstructing SVC clot, secondary to a central line placement.

CASE REPORT

An 89-yr-old woman was admitted to the hospital with increasing shortness of breath over a 2-wk period. Significant past medical history included severe cardiovascular disease. Physical examination revealed tachypnea with diffuse ronchi. Bilateral calf tenderness was present.

Arterial blood gases revealed a pH = 7.44, pCO_2 = 37, pO_2 = 112, HCO_3 = 25, O_2 saturation = 96% (the patient was on 3 liters of O_2 via nasal canula). An EKG showed atrial fibrillation. A chest radiograph showed clear lungs and a right central venous line in the superior vena cava (Fig. 1). Doppler ultrasound of the lower extremities revealed a thrombus in the left popliteal vein.

A perfusion scan was performed to rule out pulmonary emboli (Fig. 2); 4 mCi ^{99m}Tc-MAA (98% tagging efficiency) were injected in the right central venous line (there was no other venous access). A ventilation scan was not performed because the patient could not fully cooperate. There was decreased perfusion in the left lung with a large irregular defect in the left mid-lung field. In addition, there was a vertical focus of activity at the tip of the central venous catheter despite several saline flushes, as well as uptake within the quadrate lobe of the liver. A digital venogram performed immediately after the lung scan confirmed the presence of a large SVC clot with collateral flow into the azygous vein (Fig. 3).

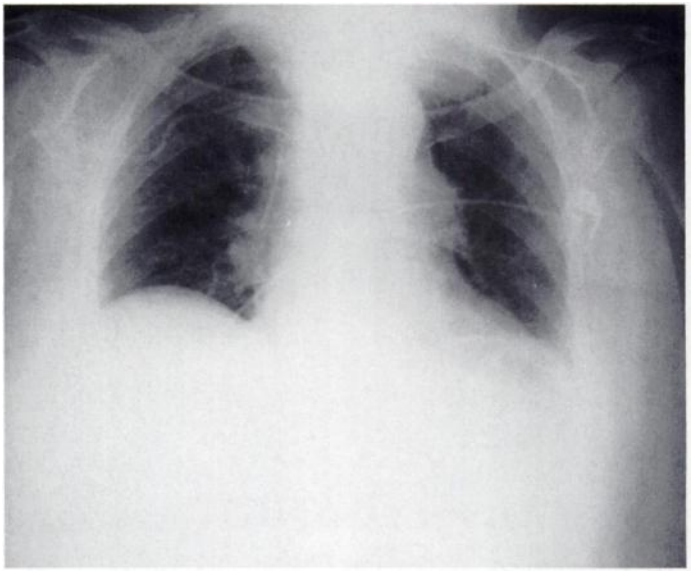

FIGURE 1. Portable chest radiograph showing underaeration, prominent hila and a right central line in the superior vena cava.

DISCUSSION

Occlusion of the SVC may be an acute thrombotic event or may occur gradually. Although malignancy is the underlying cause in 85%-90% (*3*) of superior vena caval occlusions, benign causes include a growing incidence caused by indwelling catheters and fibrosing mediastinitis (*4*). Patients typically present with a violaceous hue and venous distension and edema of the head, neck and upper extremities. Patients may also experience respiratory embarassament, headache and neurological dysfunction (*3*).

Collateral pathways for venous blood return in superior vena caval obstruction include: azygous and hemi-azygous, superior and inferior intercostal, internal mammary, lateral thoracic, epigastric and vertebral veins (*5,6*). A common collateral pathway involves retrograde flow from the innominate veins to the internal mammary veins and the paraumbilical plexus and then thorugh a recanalized umbilical vein into the left branch of

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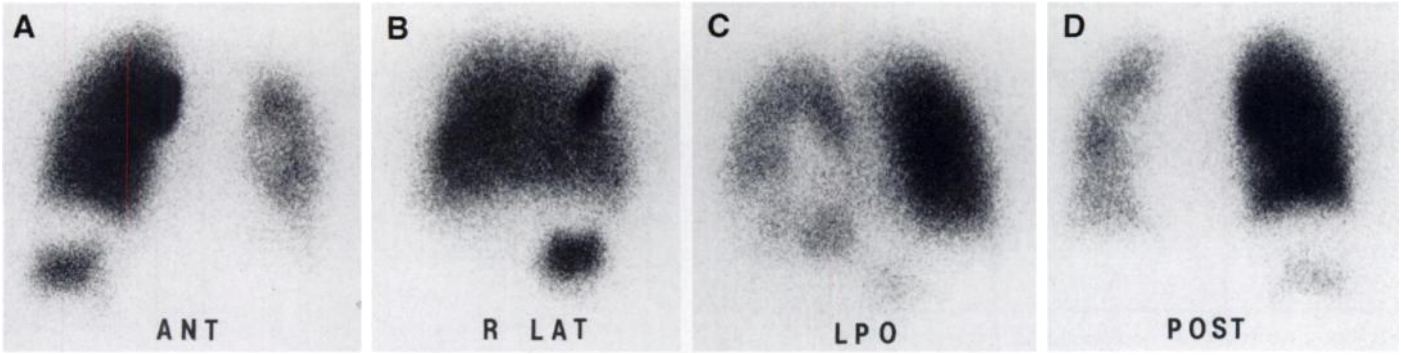

FIGURE 2. Selected images from a lung perfusion scan performed with 4 mCi ^{99m}Tc-MAA show decreased perfusion in the left lung with uptake in the SVC and quadrate lobe of the liver.

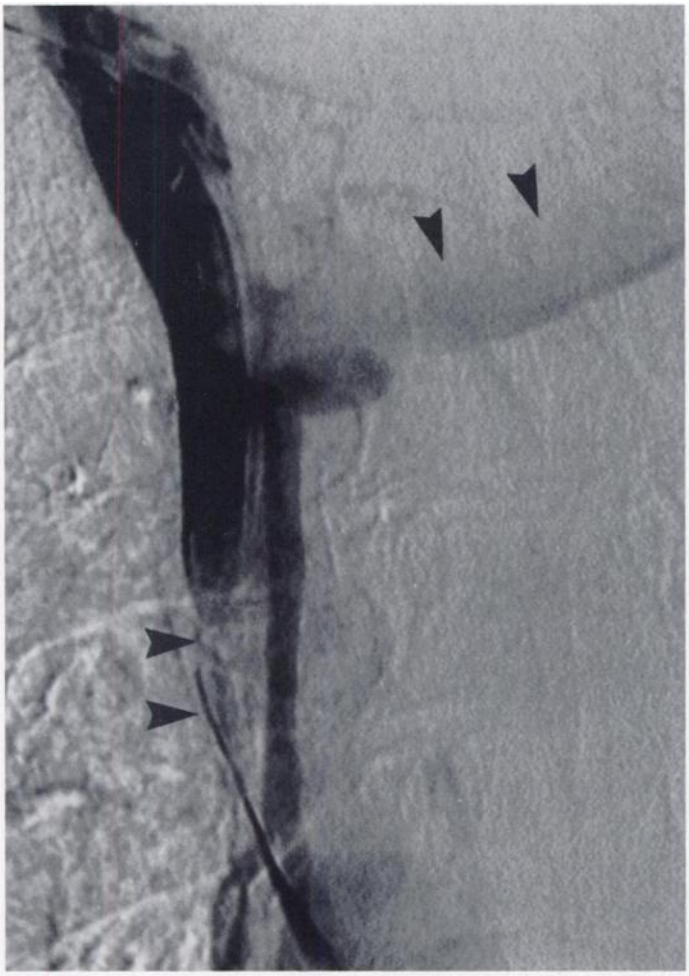

FIGURE 3. Digital venogram after hand injection of 20 cc contrast through the right central venous line confirmed the presence of a clot in the SVC and left innominate vein (black arrowheads) with retrograde flow into the azygous venous system.

the portal vein at the point where it enters the quadrate lobe (*6*). As was seen in our patient, this pattern of collateral flow results in a focal area of increased uptake in the midportion of the liver when ^{99m}Tc-MAA is injected in an upper extremity vein. Other causes of organ visualization on a lung perfusion scan were excluded on the basis of the excellent radiopharmaceutical tag and nonvisualization of other organs such as the kidneys (right-to-left shunt) and spleen (submicron particle degradation) (*2*).

Labeled macroaggregates of albumin have been used to detect clot surfaces (*7*). A combination of factors including adhesion, electrostatic forces and mechanical entrappment allows MAA to detect these clots. The persistent activity involving the distal catheter was felt to be secondary to clot around the catheter and adjacent SVC. This was confirmed on the subsequent venogram.

CONCLUSION

Occlusion of the SVC is frequently encountered in clinical practice. An understanding of the collateral pathways for venous return is essential to correctly interpret the image findings when injecting ^{99m}Tc-MAA into an upper extremity vein. In the present case, lung scintigraphy directly visualized the clot causing SVC obstruction.

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