CONCLUSION

Submandibular scintigraphy revealed excellent diagnostic ability to predict the prognosis in patients with acute peripheral facial nerve paralysis in its early symptomatic period. Consequently, submandibular scintigraphy should be added as one of the routine tests to predict the prognosis of peripheral facial nerve paralysis and, especially, to determine of the indications for surgical therapy.

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Pulmonary SPECT Imaging and the Stripe Sign

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A patient with high clinical suspicion for pulmonary embolism underwent a diagnostic scintigraphic ventilation/perfusion scan. The planar images revealed an unmatched perfusion defect with a stripe sign in the right middle lobe. A stripe sign is the appearance of normally perfused tissue between the defect and the pleural surface suggesting a nonpleural-based abnormality. SPECT images acquired in the same study period, however, failed to demonstrate normally perfused tissue between the defect and the pleural surface. Previous studies have compared planar ventilation/perfusion studies with stripe sign perfusion defects to pulmonary angiography. The results suggest that stripe sign perfusion defects are generally not due to emboli. However, planar imaging is projectional and may miss pleural contact in some perfusion lesions depending on the projection. In the absence of SPECT data, the significance of the stripe sign may need to be reassessed.

Key Words: pulmonary embolism; pulmonary angiography; ventilation/perfusion scan

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A stripe sign in a ventilation/perfusion (V/Q) scan is the appearance of normally perfused tissue between a lesion and the pleural surface. The presence of a stripe sign may imply that there is a region of normally perfused tissue distal to the defect. In contradistinction, embolic lesions are believed to be pleural based, with the defect contacting the pleural surface. Nonpleural-based lesions with a stripe sign are thought to be less likely due to pulmonary embolism (PE). We report a case of a young woman with a clinical history suggestive of PE. A scintigraphic V/Q study was ordered to evaluate segmental ventilation and perfusion. Planar images revealed a large perfusion lesion with a stripe sign in the right middle lobe on the right posterior oblique (RPO) projection. This defect was not matched with a ventilation abnormality. Using ^{81m}Kr as the ventilation agent, our laboratory performed dual-isotope SPECT acquisitions in all patients who could safely undergo the procedure. This technique eliminates the positioning discrepancies created when the perfusion and ventilation images are acquired separately. Images were visualized in the transaxial, sagital and coronal planes.

The perfusion defect and its ventilation mismatch were well visualized, but a rim of normally perfused tissue could not be identified between the lesion and the pleural surface. This suggests that the limited number of views acquired in planar imaging may fail to locate the point where a perfusion defect contacts the pleural surface. Also, normally perfused tissue adjacent to the lesion, or in the contralateral lung, could mimic a stripe between the defect and the pleural surface. This could be incorrectly interpreted as a less-suspicious, nonpleural-based lesion, and the patient may not get proper treatment. The definition of a stripe sign may need to be reassessed to include the caveat that the stripe must be seen in all of the available perspectives to be labeled a nonpleural-based abnormality. Under these conditions, SPECT imaging should be considered because it is less likely to misrepresent pleural contact in perfusion defects than traditional planar imaging.

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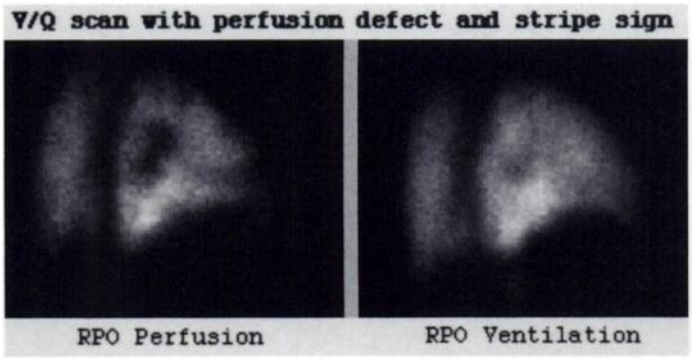

FIGURE 1. Planar perfusion and ventilation images in the RPO projection. A middle lobe perfusion defect is seen with a stripe sign. A subtle abnormality is seen on the ventilation image.

CASE REPORT

Patients

A 42-yr-old woman with a 7-day history of left arm swelling and pleuritic chest pain was presented to the emergency room. The patient had a history of endometriosis for which she had taken oral contraceptives intermittently for 20 yr. She was given a combination pill 1 mo before her evaluation. Physical exam revealed a swollen and tender left upper arm with a circumference 1 in. greater than the right upper arm. Pulse and blood pressure were normal in both arms and oxygen saturation was 96% on room air. The patient denied any cough or hemoptysis. A ventilation/perfusion (V/Q) scan was ordered for suspicion of pulmonary embolism.

The perfusion study was performed using ^{99m}Tc-MAA and was acquired simultaneously with a ^{81m}Kr gas ventilation study. The major abnormality seen in the planar images was a right middle lobe perfusion defect with a stripe sign (Fig. 1). Only a subtle defect was seen on the ventilation images in the same region and the impression was a mismatched perfusion lesion in the right middle lobe with a stripe sign. The SPECT images failed to show normally perfused tissue between the right middle lobe defect and the pleural space (Fig. 2) but showed other unmatched perfusion lesions the right lung. PIOPED criteria applied to these findings would be "high probability for pulmonary embolism" (*1*).

An ultrasound evaluation of the left upper extremity showed a possible thrombus in the midsubclavian region. This finding was confirmed by venography, which demonstrated an extensive clot from the subclavian vein to the forearm. The patient underwent urokinase thrombolysis with a heparin drip, and resolution of the clot was confirmed by daily venograms. She experienced a rethrombosis on day 4 at the hospital when the heparin was discontinued for several hours. A bilateral thoracic outlet syndrome was diagnosed during her admission. Complete clot lysis was achieved by hospital day 9 and lower extremity ultrasound was negative for deep vein thrombosis. A repeat V/Q study showed resolution of the right lung perfusion lesions (Fig. 3). Unfortunately, no pulmonary angiography was performed to confirm the V/Q findings.

DISCUSSION

The stripe sign was first described by Sostman and Gottschalk (*2*) and validated in a retrospective study. The authors proposed the hypothesis that nonpleural-based perfusion defects are not PE. Specifically, "a perfusion defect is considered nonpleural based if it shows a stripe of perfused lung between the defect and the adjacent pleural surface." The hypothesis was validated by reviewing cases where the stripe sign was present, and where the presence or absence of pulmonary emboli in the affected segment was demonstrated by pulmonary angiography.

In the first study by Sostman and Gottschalk (*2*), there were nine

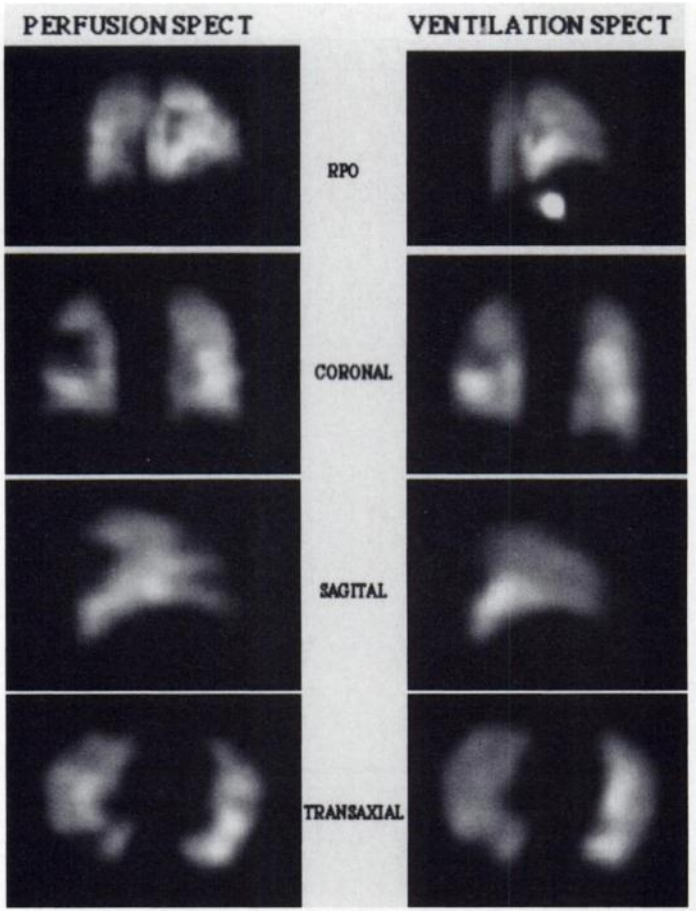

FIGURE 2. The perfusion defect is in contact with the pleural surface in the coronal, sagital and transaxial planes. The ventilation study shows a minimal defect only. The RPO volume rendered view mimics the findings in the planar images.

segments with the stripe sign and a matched ventilation abnormality. None were associated with arteriographic evidence of PE in the same segment. There were six segments with a stripe sign perfusion defect and no ventilation abnormality. Of these, only one was shown to be associated with a PE in the same segment (*2*). The authors later revisited the issue using the data acquired in the PIOPED study (*3*). In that review, however, the ventilation status of the perfusion lesions is not reported. Nevertheless, from a total of 85 segments with the stripe sign, only six were associated with a PE in the same segment or region.

The data suggest that perfusion abnormalities with a stripe sign are generally not embolic in nature. There are two caveats: (a) the PIOPED study and the Sostman and Gottschalk (*1,2*) studies have no general data concerning the segment-by-segment association of mismatched perfusion defects and pulmonary emboli; and (b) that the stripe sign was deemed present if seen in any projection of the planar images. The presence of the stripe sign, however, in any single projection does not necessarily indicate that a layer of perfused lung is present between the defect and the pleural surface.

Planar imaging typically includes only four to six views in most laboratories including anterior/posterior, left posterior oblique/RPO and, occasionally, anterior oblique images. This strategy provides only three to four images of each lung, which may not give enough information to accurately evaluate perfusion defects for pleural contact. If the lesion contacts the pleural surface in any single projection, it is a pleural-based lesion. The limited number of views acquired in planar imaging may fail to locate the point where a perfusion defect contacts the pleural surface. A stripe sign

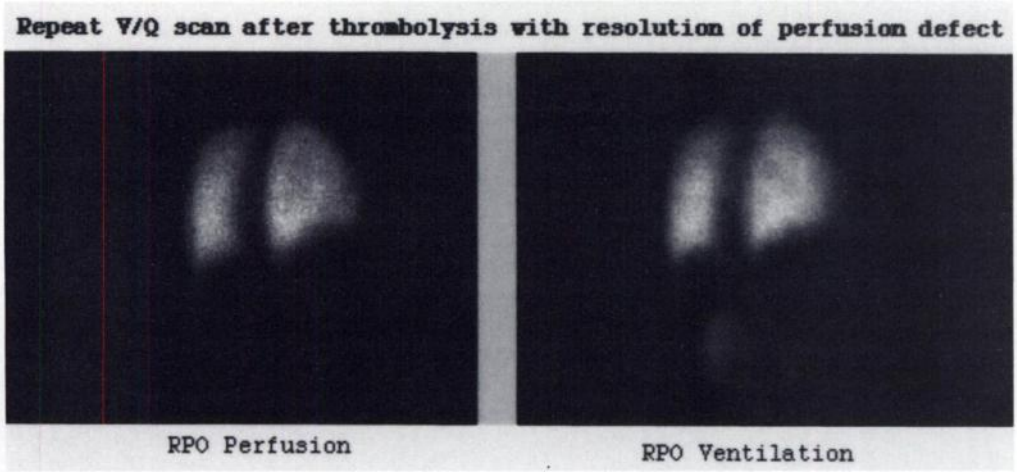

FIGURE 3. A repeat V/Q study after thrombolysis showing resolution of the right middle lobe perfusion abnormality.

could also be mimicked by normally perfused tissue in segments adjacent to the lesion or in the contralateral lung. This may be incorrectly interpreted as a less-suspicious, nonpleural-based lesion, and the patient may not get proper treatment. Under these circumstances, SPECT imaging is less likely to misrepresent pleural contact in perfusion lesions and should be considered when performing V/Q studies.

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Early Detection of Bleomycin-Induced Lung Injury in Rat Using Indium-111-Labeled Antibody Directed Against Intercellular Adhesion Molecule-1

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We have investigated whether an ^{111}In-labeled mouse monoclonal antibody to rat intercellular adhesion molecule-1 (^{111}In*aICAM-1) could detect lung injury early in rats treated with bleomycin. **Methods:** Rats received an intravenous injection of either ^{111}In*aICAM-1 or ^{111}In-labeled normal mouse IgG (^{111}In*nmIgG) and were imaged and killed 24 hr later. Lung injury was induced by an intratracheal injection of bleomycin 4 or 24 hr before the rats were killed. After death, tissue was removed and activity was measured, lungs were cryostat-sectioned to detect the presence of ICAM-1 by immunofluorescence, and the up-regulation of LFA-1α was examined on blood polymorphonuclear leukocytes (PMNs) using fluorescence-activated cell-sorter (FACS) analysis. **Results:** In rats injected with ^{111}In*aICAM-1, the percent injected dose/organ in lungs both at 4 and 24 hr postbleomycin increased significantly compared to the values in either uninjured rats or rats that received ^{111}In*nmIgG. At 4 and 24 hr postinjury, the target-to-blood (T/B) ratio was 8/1 and 6/1, respectively. For ^{111}In*nmIgG, the T/B ratio at 4 hr was 0.5/1 and 0.4/1at 24 hr. In ^{111}In*aICAM-1 rats injured at 4 or 24 hr, images could easily be distinguished from uninjured rats. All images of ^{111}In*nmIgG rats showed only cardiac blood-pool and liver activity with little lung activity. Lung ICAM-1 immunofluorescence intensity increased in the bleomycin-treated samples compared to uninjured lungs. Expression of LFA-1α on PMNs increased 19% and 210% at 4 hr and 24 hr postinjury, respectively, compared to control values. **Conclusion:** Biodistribution and imaging data demonstrate that ^{111}In*aICAM-1 can detect early acute bleomycin-induced lung injury. Immunofluorescence and FACS data suggest that ^{111}In*ICAM-1 uptake is a specific process. This antibody has potential as an early radionuclide detector of acute inflammations.

Key Words: antiadhesion molecule antibody; acute respiratory distress syndrome; inflammation; ICAM-1

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Indium-111 or ^{99m}Tc-labeled autologous white blood cells (WBCs) and ^{67}Ga-citrate are commonly used radiopharmaceuticals that are effective indicators of inflammatory processes in a variety of clinical settings (*1,2*). However, these agents are not without their limitations such as the time-consuming preparation and exposure to blood-borne pathogens with labeled WBCs, and low specificity and high bowel activity with ^{67}Ga. To supplant or be an adjunct to these radiopharmaceuticals, a

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