The Ventilation Study: Before or After the Perfusion Lung Scan?

One of the putative advantages for the use of Xe-127 in the diagnosis of pulmonary embolism is that one can perform a ventilation study immediately after the patient has had a Tc-99m MAA lung scan (*2,3*). Two of the benefits from this are that:

1. Only those patients with an abnormal perfusion lung scan need have a ventilation study.
2. The perfusion findings enable the ventilation study to be performed in the position most likely to demonstrate the lesion.

It seems, then, that this would be a good thing to do, yet there is no published study, as far as we are aware, that demonstrates the advantage in clinical practice. For this reason we undertook such a study.

We examined all of the lung scans performed in our laboratory since January 1975. Of these 1077 scans, 519 (48%) were normal and thus clearly would not have benefited from a ventilation study.

To determine which position best demonstrated the perfusion defect(s), we examined the abnormal lung scans from a population of 200 patients who had recently had major surgery. The patients had each had a four-view Tc-99m MAA lung scan as part of a separate study on the incidence of postoperative pulmonary emboli. There were 72 abnormal scans and these were examined by an experienced observer to determine which view best demonstrated the perfusion defects. If two views were necessary to demonstrate multiple defects, both views were recorded. The results are given in Table 1. Figure 1 shows one of the nine scans in which two views were necessary to demonstrate multiple lesions.

In the past 2½ yr, 48% of our lung scans were normal, all but a few of these being performed to rule out pulmonary emboli. Clearly, if we had performed the ventilation study before the perfusion lung scan, as was our custom before 1975 when we used Xe-133, we would have performed 512 unnecessary ventilation studies. Many nuclear medicine departments still perform the ventilation study before the perfusion lung scan—see, for example, two recent publications on the subject of ventilation studies (*1,4*).

When a ventilation study is performed before the perfusion lung scan, the posterior view is used exclusively. If we had used a posterior view to study the 72 patients with abnormal lung scans, we would have been unable to evaluate perfusion defects in 20 patients (Table 1).

In nine of these 20 patients, two views were required to evaluate all of the defects. We now do not hesitate to do ventilation studies in more than one view in patients with multiple perfusion defects. This can be done only, of course, when the perfusion scan is performed first.

TABLE 1. VIEW BEST DEMONSTRATING PERFUSION LESION

	View			
Type of lesion	Post	Lat	Ant	Two views
Segmental	12	8	1	
Nonsegmental	40	16	4	
Total	52	24	5	9

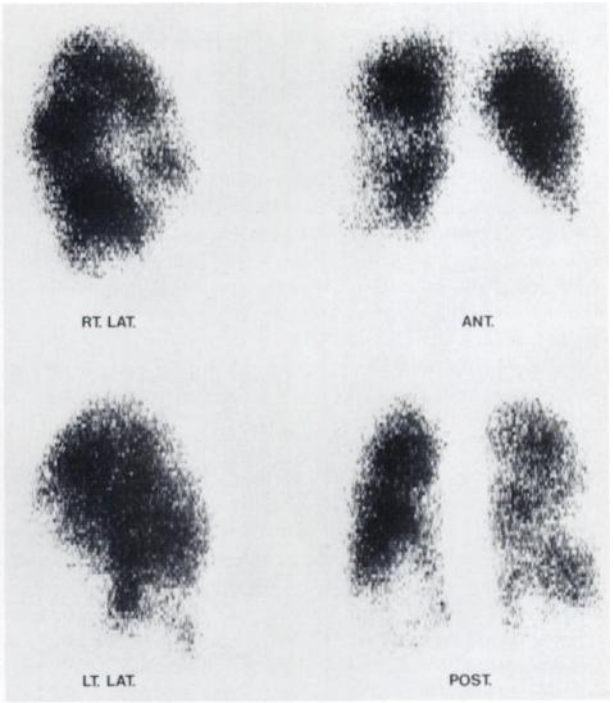

FIG. 1. A four-view Tc-99m MAA lung scan on a patient with chronic obstructive lung disease and pleuritic chest pain. A posterior and a right lateral ventilation study were necessary to evaluate all of the perfusion defects.

Coates and Nahmias (*3*) have shown, in an in vitro lung model, that the resolution of a lung lesion is better with Xe-127 than with Xe-133, no matter where the lesion is placed within the lung. Atkins et al. (*2*) and Coates et al. (*3*) have shown that a Xe-127 ventilation study can be performed after the patient has had a Tc-99m perfusion lung scan. Our study shows that it is important, in clinical practice, to be able to perform the perfusion lung scan first. At present Xe-127 is clearly the agent of choice for ventilation studies.

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Rapid Miniaturized Chromatographic Quality-Control Procedures for Tc-99m Radiopharmaceuticals

To those of us in nuclear pharmacy responsible for the preparation of Tc-99m radiopharmaceuticals, a simple and rapid chromatographic system is a valuable tool for the daily quality control of radiopharmaceuticals before the patient doses are dispensed. The technique recently presented by Zimmer and Pavel (*1*) is indeed simple and rapid and, as such, is representative of the "state of the art" in Tc-product quality control. However, some of the procedures described for the development and evaluation of the system need clarification.

Figure 1 illustrates the 1 cm × 6 cm strip as described by Zimmer and Pavel. The solid lines at 1, 3, and 5 cm are the origin (or.), center line (c) and solvent front (sf), respectively. The dotted lines show where the strip was "cut into eight equal segments: four below the center line and four above." The cross-hatched area represents the colored tape added to each strip for identification.

According to Fig. 1, if the radioactivity remained at the origin during chromatographic development, as expected for particulate radiopharmaceuticals, then the maximum activity would be counted in Segment 2, rather than Segment 1, as reported. No activity would be counted in Segment 1 unless the applied spot was quite large (>5 mm dia.) or the activity migrated before the strip was dried—highly unlikely for insoluble particles. Similarly, if development was stopped when the solvent front reached the 5 cm pencil line, no activity at all would be counted in Segment 8. As much as 96.9% of the radioactivity was reported in Segment 8 for the soluble Tc-complexes on ITLC-SG paper developed with normal saline. Although the precise segmental positioning of the activity appears to be in error as reported, no error results when the strips are cut at the center line and each half is counted separately.

Examination of the segmental distribution of radioactivity for Tc-99m Sn pyrophosphate on 31 ET paper developed in acetone revealed 21% of the activity in Segments 5–8, indicating 21% free pertechnetate. The authors, however, commented that these "unusually high values for the hydrolyzed reduced Tc-99m fraction in Tc-99m pyrophosphate" were consistent with those obtained from commercial chromatography kits. The data reported using ITLC-SG paper and normal saline showed only 1.3% of the activity as hydrolyzed reduced Tc-99m. Accordingly, one could easily question the amount of available stannous tin in the pyrophosphate kit(s) used in the chromatographic study.

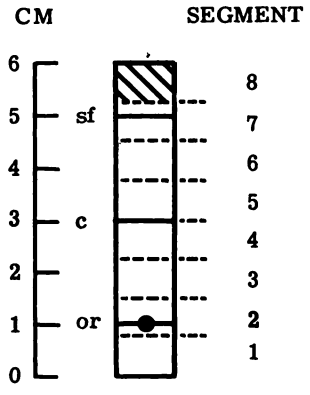

FIG. 1. Diagram of chromatographic strip.

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Reply

We welcome the comments made by Dr. Mock regarding the miniaturized chromatography system developed in our laboratory. Indeed, the statement regarding the cutting of the strips for counting does need some clarification. As illustrated in Fig. 1, the strips were cut into eight equal segments: four below and four above the center pencil line. However, the strips were cut in such a manner that the initial strip section (strip section number 1) encompassed the origin (0.3 cm below the bottom pencil line) and the last strip (strip section number 8) encompassed the solvent front (0.3 cm above the top pencil line).

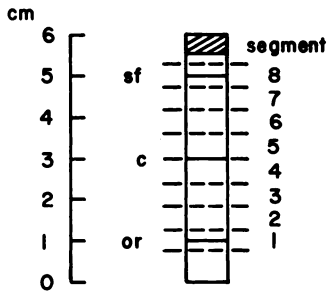

FIG. 1. Diagram of chromatographic strip.

Regarding the results of the chromatographic evaluation of Tc-99m-Sn-pyrophosphate, there is indeed a free pertechnetate level of 21% in the example given, using 31ET paper chromatography. This value has nothing whatsoever to do with the hydrolyzed reduced Tc-99m level and can only be determined using ITLC-SG paper and normal saline. The comments regarding "unusually high values for hydrolyzed reduced Tc-99m fraction in Tc-99m pyrophosphate" refer to commercial chromatography kits, which do not use ITLC-SG paper chromatography. In this case there is an overestimation of the amount of hydrolyzed reduced Tc. The phenomenon has been observed not only by us, but also by other investigators including Colombetti et al. (*1*).

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1. COLOMBETTI LG, MOERLIEN S, PATEL GC, et al: