bone images, notably the amount of labeled pyrophosphate entering the bone. The tin, which functions primarily as a reducing agent (*5*) in a bone-imaging kit, will, if present in excess, coat the red blood cell (*6*). Note that even with the high-ratio kit (less tin) there was a red-blood-cell binding of 69.9%, large enough for concern. Clinically false-positive brain images obtained with pertechnetate were attributed to prior injection of tin-containing radiopharmaceuticals (*7,8*). The tin effect lasts up to 6 days following administration. It is necessary therefore, either that brain imaging precede bone imaging, or that Tc-99m DTPA be used for subsequent brain imaging. Technetium-99m DTPA has been shown to be unaffected by prior injection of a tin-containing radiopharmaceutical.

The identical quality of the bone images and the similar in vitro binding and stability obtained with both high- and low-ratio agents suggest that the amount of tin in the high-ratio agent (0.76 mg/vial) is sufficient to accomplish this goal. It appears reasonable to reduce the amount of tin in reaction vials, especially in the low-ratio (by weight) pyrophosphate/tin bone-imaging kit.

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REFERENCES

1. PEREZ R, COHEN Y, HENRY R, et al: A new radiopharmaceutical for ^{99m}Tc bone scanning. *J Nucl Med* 13: 788–789, 1972 (Abst)

2. PARKEY RW, BONTE FJ, MEYER SL, et al: A new method for radionuclide imaging of acute myocardial infarction in humans. *Circulation* 50: 540–546, 1974

3. MCRAE J, SUGAR RM, SHIPLEY B, HOOK GR: Alterations in tissue distribution of ^{99m}Tc-pertechnetate in rats given stannous tin. *J Nucl Med* 15: 151–155, 1974

4. KHENTIGAN A, GARRETT M, LUM D, et al: Effects of prior administration of Sn(II) complexes on in vivo distribution of ^{99m}Tc-pertechnetate. *J Nucl Med* 17: 380–384, 1976

5. JONES AG, FRANCIS MD, DAVIS MA: Bone scanning: Radionuclide reaction mechanisms. *Semin Nucl Med* 6: 3–18, 1976

6. PAVEL DG, ZIMMER AM, PATTERSON VN: In vivo labeling of red blood cells with ^{99m}Tc: A new approach to blood pool visualization. *J Nucl Med* 18: 305–308, 1977

7. WALKER AG: Effect of Tc-99m-Sn bone scan agents on subsequent pertechnetate brain scans. *J Nucl Med* 16: 579, 1975 (Abst)

8. CHANDLER WM, SHUCK LD: Abnormal technetium-99m pertechnetate imaging following stannous pyrophosphate bone imaging. *J Nucl Med* 16: 518–519, 1975 (Abst)

Imaging Experimental Pulmonary Ischemic Lesions after Inhalation of a Diffusible Radioaerosol—Recent Experience and Further Developments

A concise communication on this subject by Taplin, Chopra, and Elam was published in the *Journal* (*1*). It was stated that inhalation lung imaging with the rapidly diffusible pertechnetate aerosol might suffice to localize regional pulmonary ischemia from emboli without the need for a separate perfusion imaging procedure, and that clinical studies were underway to determine the validity, sensitivity, clinical applicability, and limitations of this new method.

This letter is submitted to review our clinical experience with the TcO_4^- aerosol inhalation lung imaging procedure for detecting emboli as "hot spots" in surrounding areas of lower activity. First of all, the 10-min half-time removal rate from the lungs plus rapid appearance of radioactivity in the stomach posed technical problems. It was difficult to obtain satisfactory lung images in more than two projections during the first 10 min. Secondly, the oxygen driven Blount nebulizer delivered aerosol droplets larger than 5 micrometers in diameter, which caused excessive deposition in the posterior pharynx and major airways, especially in patients who were unable to breathe naturally and with normal tidal volume respiration. Although the first patient with angiographically proved pulmonary embolism showed promising results, one embolized region showed persistently prolonged retention of the aerosol, while other embolized regions cleared normally. More importantly, in two other well-documented pulmonary embolism patients, and another young man with congenital right pulmonary artery atresia, the pertechnetate aerosol was removed from the ischemic and normal areas of lung at the same rates ($T_{1/2}$ values of 8–10 min). These findings, made by one of our colleagues, provided the impetus to learn more of the mechanisms involved in liquid in contrast to gaseous alveolar-capillary membrane diffusion.

It was known from previous radioactive carbon monoxide inhalation studies (*2*), that ^{11}CO gas diffusion was definitely pulmonary arterial blood flow dependent in that its removal rates from better perfused lower lung fields were faster than from the more poorly perfused apical regions in subjects examined in the upright position. It was found, however, that the diffusion of pertechnetate was probably not blood flow dependent because its diffusion rates were faster from the poorly perfused apical regions than from the better perfused basal regions in normal volunteers. These differences between gaseous and liquid diffusion rates led us to study other soluble radioactive materials, with the findings that the molecular weight of the aerosolized agent was important in its rate of diffusion. For example, sodium pertechnetate with a molecular weight of 163 diffuses across the membrane with a half-time of 10 ± 2 min, whereas technetium DTPA with a molecular weight of 492, has a halftime of 45 ± 10 min, and normal human serum albumin (molecular weight 67,000) is much more slowly absorbed with a half-time of approximately 12 hr.

Regarding the search for a "hot spot" imaging procedure for pulmonary embolism detection, these findings were disappointing but they led to the use of Tc-99m DTPA as an improved test agent for routine aerosol inhalation lung imaging. When administered as a high specific activity (10–15 mCi/ml) aerosol in a dose three times that required for the perfusion examination, the airway-ventilation examination can be performed immediately after perfusion imaging using the same radionuclide. By this combined perfusion-aerosol-ventilation procedure, pairs of images may be obtained in as many projections as indicated during a single visit to the nuclear medicine clinic. Furthermore, the aerosol images provide evidence of large and medium size airway obstruc-

tive disease not revealed by either the xenon or krypton gas methods.

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REFERENCE

1. TAPLIN GV, CHOPRA SK, ELAM D: Imaging experimental pulmonary ischemic lesions after inhalations of a diffusible radioaerosol: Concise Communication. *J Nucl Med* 18: 250–254, 1977

2. TAPLIN GV, CHOPRA SK, MACDONALD NS, et al: Imaging small pulmonary ischemic lesions after radioactive carbon monoxide inhalation. *J Nucl Med* 17 866–871, 1976