INHALATION LUNG SCANNING USING CARRIER-FREE ^{113m}In

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Dual-isotope techniques (*1*) or the use of certain radioactive gases (*2*) permit estimates of both pulmonary perfusion and ventilation to be carried out simultaneously in the same study. However, the inconvenience involved in the preparation of radionuclide-labeled pharmaceuticals and the expense and difficulty in handling radioactive gases prompted us to investigate simpler methods of obtaining inhalation studies of good quality.

We have previously described a method using technetium in the pertechnetate form which yields information of high quality (*3,4*). However, it is not possible to perform perfusion and inhalation studies simultaneously if one also desires to use a technetium-labeled compound (e.g. macroaggregated albumin, MAA, or macroaggregated ferrous hydroxide, MAFH) for the perfusion study. To overcome this, we have recently used carrier-free indium in a nebulized spray generated by the same simple nebulizing system we employ for pertechnetate inhalation studies.

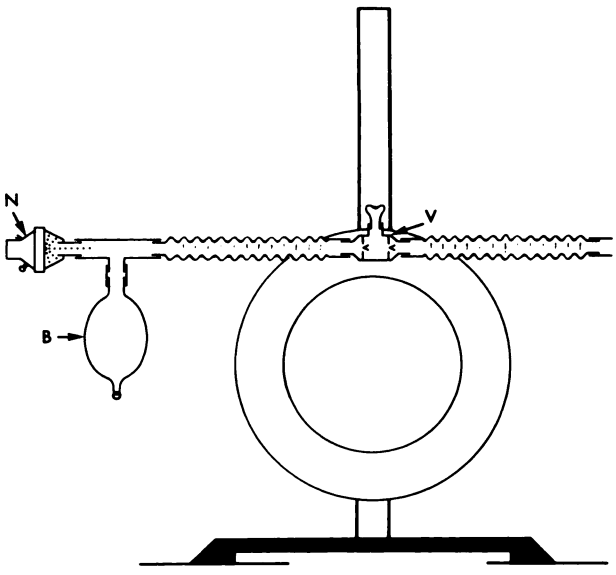

FIG. 1. Diagrammatic representation of simple inhalation system employed. It consists of Bird® Micronebulizer (N) to which air is supplied at rate of 14 liter/min, reservoir bag (B) on which subject breathes via 20-in. length of corrugated tubing and low resistance valve (V) while seated before head of gamma camera.

METHOD

The system (Fig. 1) consists of a Bird® micronebulizer through which a stream of air is passed at the rate of 14 liter/min to a 5-liter reservoir bag. Sterile ^{113m}In is eluted from a ^{113}Sn-containing generator using 0.05 *N* hydrochloric acid. This is added to the nebulizer without the addition of buffer in a concentration of 10–15 mCi in 5 ml. The subject inhales the nebulized spray from the 5-liter reservoir via a 20-in. length of corrugated rubber tubing (i.d. 1 in.) to the end of which is attached a mouthpiece fitted with a non-return valve. Exhaled material is removed by a large-bore, low-resistance tube. The study is generally carried out with the subject seated before the head of a gamma camera (Nuclear-Chicago Pho/Gamma III fitted with a diverging collimator. Inhalation of the indium causes no discomfort. Of the activity added to the nebulizer, 10–15% is detectable in the patient's lungs. Counts may be accumulated during inhalation or after inhalation ceases because the ^{113m}In is not cleared rapidly from the lungs. A counting rate of about 15 kcpm is obtained after 5-min inhalation. Rectilinear scanning of the lungs after inhalation produces equally satisfactory results.

Unlike technetium in the pertechnetate form which is rapidly removed from the lungs when inhalation ceases (*3–5*), the indium appears to remain in situ for some time. Its ultimate fate is presently being examined.

The nebulizing system used produces particles which reach the lower airways with negligible deposition in the trachea and main bronchi. The use of

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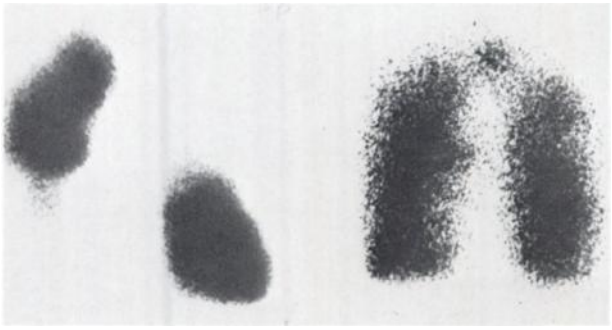

FIG. 2. Posterior projection scintiphotos of patient with right upper and left lower zone pulmonary emboli. Perfusion study on left (^{99m}Tc-MAFH) and inhalation study on right (^{113m}In-$InCl_3$) were obtained at the same sitting. Scintiphoto on right was taken during inhalation of radionuclide. "Hot" area between apices of lungs represents activity in breathing valve and tubing.

the simple, small Bird(R) nebulizer instead of an ultrasonic model enables much smaller volumes of radiopharmaceutical to be nebulized. This permits more rapid accumulation of activity in the lungs and thereby reduces the time required for inhalation.

This system may be used in combination with pulmonary perfusion studies employing technetium-labeled compounds. Both radionuclides have a monoenergetic gamma emission (^{113m}In, 392 keV; ^{99m}Tc, 140 keV) and can thus be readily separated by pulse-height analysis. This property allows both perfusion and inhalation studies to be performed virtually simultaneously in any position without movement of the patient. Accurate assessment of ventilation/perfusion relationships throughout both lung fields is thus possible (Fig. 2).

Important advantages are that both radionuclides persist in the lungs for sufficient time to allow either scintiphotographic or conventional rectilinear scanning techniques to be performed; and both have sufficiently short half-lives to allow repetition of the studies at frequent intervals if desired with the minimum of discomfort and hazard to the patient.

ACKNOWLEDGMENTS

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