concentration Tc-99m (say 150 mCi/3 cc), then a newborn dose of 0.5 mCi would contain 17,000 particles. However, preparations containing less than 50 mCi would deliver more than 50,000 particles.

The importance of using a high concentration of Tc-99m is obvious, but should be emphasized. Alternatively, if lower Tc activities are considered in order to avoid waste, a single kit can be split to provide several doses, each delivering a smaller number of particles.

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FOOTNOTE

* Pulmolite, New England Nuclear Corp., Boston MA.

REFERENCES

1. ALLEN DR, FERENS JM, CHENEY FW, et al: Critical evaluation of acute cardiopulmonary toxicity of microspheres. *J Nucl Med* 19: 1204-1208, 1978
2. DAVIS MA, TAUBE RA: Pulmonary perfusion imaging: Acute toxicity and safety factor as a function of particle size. *J Nucl Med* 19: 1209-1213, 1978
3. THURLBECK WM: Postnatal growth and development of the lung. In *Lung Disease—State of the Art (1974-1975)*, Murray JF, ed. New York, NY, American Lung Association, 1976, pp 33-74
4. DAVIES G, REID L: Growth of the alveoli and pulmonary arteries in childhood. *Thorax* 25: 669-681, 1970
5. EMERY JL, MITHAL A: The number of alveoli in the terminal respiratory unit of man during late intrauterine life and childhood. *Arch Dis Child* 35: 544-547, 1960

Reply

We appreciate the interest in our work expressed by Dr. Heyman and fully concur with his concern for safety in pediatric pulmonary perfusion scintigraphy. Although this particular aspect of safety was beyond the scope of our investigation, we welcome the opportunity to comment here.

It is our belief that all adult lung scanning with commercially available MAA kits (particle size 10-60 μm) should be performed with no fewer than 10^5 and no more than 10^6 particles. In our clinics we formerly added 60 mCi of $^{99m}TcO_4^-$ to the MAA vial. This gave 250,000 MAA particles per 3-mCi dose immediately after preparation (8:00 am) and approximately 750,000 particles at the end of the day (5:00 pm). In the event of an emergency lung scan after 5:00 pm, a new vial of MAA was prepared. Under these circumstances, a pediatric dose of 0.5 mCi involved 42,000 aggregates at 8:00 am and 125,000 at 5:00 pm. With the recent widespread use of the fission ^{99}Mo-^{99m}Tc generator, which yields higher concentrations of pertechnetate, and the increased use of pediatric pulmonary perfusion scintigraphy, we have made it mandatory to add at least 120 mCi of pertechnetate to our MAA vial, giving an equivalent pediatric dose of 21,000 particles at 8:00 am and 63,000 at 5:00 pm.

Since we are a central radiopharmacy serving seven Harvard-affiliated hospitals, we use 120 to 150 mCi of Tc-99m-MAA daily. Therefore, we are able to achieve safety and economy simultaneously. For smaller institutions, which cannot afford to reconstitute their MAA kits with 120 mCi of pertechnetate, may we suggest either using unit dose kits containing 10^6 or fewer particles, or splitting the kit by reconstitution with 2 ml of generator eluent (saline), then removing and discarding an appropriate amount (say 1.5 ml containing 3,750,000 particles), and adding 30 mCi to the remaining 1,250,000 MAA particles.

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Scanning Dose and the Detection of Thyroid Metastases

Němec and coworkers (*1*) have again demonstrated that the quantity of I-131 administered to a patient before scanning for thyroid metastases alters the number of lesions detected by the technique (*2*). They conclude that machine setting, absolute quantity of I-131 concentrated by the lesion, and the background are important in this phenomenon. That these factors affect the detection of thyroid metastases by radionuclide imaging is undoubtably true, but the problem is more complex than the authors imply.

To begin with, the types of thyroid cancer that concentrate I-131 are rarely "pure" even when they appear so by light microscopy (*3*); neither are they a homogeneous group regarding differentiation (*4*). Furthermore, what the microscope reveals as a state of differentiation may not be reflected in the malignant tissues' ability to carry out enzymatic processes necessary for trapping and organification (*5*). It would not be unusual, therefore, if the acquisition of the radiopharmaceutical proceeded at different rates from site to site. The end result of this would be varying concentrations of I-131 (on a per-gram basis) in the metastatic deposits.

Secondly, it cannot be assumed that the blood flow per gram of tissue is the same to all metastatic areas. Certainly it is not the same to all parts of a primary tumor (*6*). If all other parameters remained constant, blood flow alone would be an important reason for the detection of one lesion in preference to another.

The size of a metastasis would be yet another variable, since the detector would be more likely to "see" a 10-g lesion that concentrated very little I-131 than a 1/2-g tumor that concentrated twice that amount per gram.

Differing rates of egress of radiopharmaceutical from the viable tumor (*7*) could also play a part in detectability. Stanbury and Brownell have shown (*8*) that the half-times for release of tracer in patients administered diagnostic and therapeutic quantities of I-131 for metastatic thyroid cancer are the same, ranging from 3 to 12 days. This is much faster than the total-body half-times for I-131 in normal patients following the same procedures. Thus, the rapid rate of egress of I-131 from a thyroid metastasis following a diagnostic (low) dose could shift a lesion from the detectable to the nondetectable level. This same rate of egress following a therapeutic dose would be less critical in detection, however, because of the large amount of I-131 initially in the lesion.

The one common denominator that could affect all of these variables is the plasma level of the radiopharmaceutical. In general, the higher the plasma level of tracer at time zero, the higher will be the plasma level at some distant time. A large dose of I-131 might produce plasma levels such that those tumor cells slow in acquiring I-131 could sufficiently concentrate the tumor to be detectable by our techniques; "low dose" on the other hand might not. Indeed, it is partly the plasma levels of I-131 that determine our ability to detect thyroid metastases that are not obvious before removal of a normal thyroid. The normal thyroid acts as a sump and, along with renal excretion, drops the plasma level of radioiodine at a very rapid rate. Remove the thyroid and the plasma iodine levels fall more slowly. It should not be surprising, therefore, to find the same phenomenon at work when the plasma levels are kept high by the administration of large quantities of radiopharmaceutical.