LETTERS TO THE EDITOR

Re: Preoperative Technetium-99m Imaging of a Substernal Parathyroid Adenoma

With regard to the article by Drs. Naunheim et al. (*1*), we have the following observation. Recently we encountered a patient with a parathyroid adenoma demonstrated by Tc-99m MDP bone scintigraphy. A 62-yr-old man, in a soporific state, presented with severe hypercalcemia that prompted the diagnosis of primary hyperparathyroidism or hypercalcemia due to a malignancy. Bone scintigraphy, performed to exclude skeletal metastases, revealed extensive soft tissue uptake of Tc-99m MDP in the lungs, myocardium, and an abdominal scar from a cholecystectomy. In addition, a dense area of increased uptake was found in the lower right part of the neck (Fig. 1).

In spite of calcitonin therapy the patient died, and at autopsy a parathyroid adenoma was found adjacent to the thyroid. The histologic study showed extensive microcalcifications in the adenoma and also in the lungs and heart. In view of the bizarre bone scan, the Tc-99m MDP preparation used was checked for the presence of free pertechnetate, but none was found. Since microcalcifications are often observed in parathyroid adenoma, the use of Tc-99m MDP should be considered for studies to determine if parathyroid adenoma is present.

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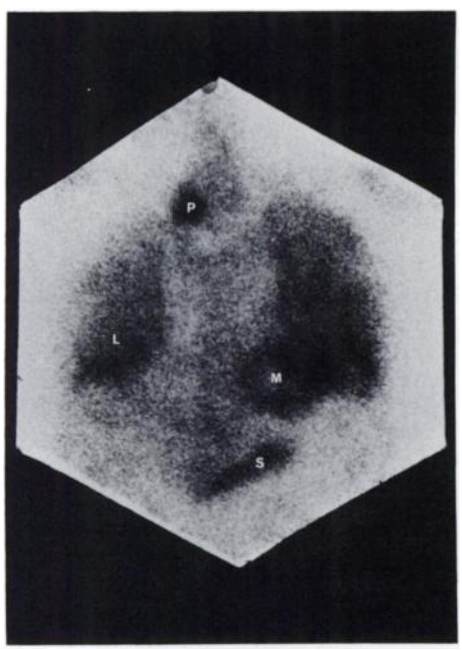

FIG. 1. Tc-99m MDP scintigraphy. Note marked accumulation of activity in lungs (L), myocardium (M), abdominal scar (S) and the parathyroid adenoma (P).

REFERENCE

1. NAUNHEIM KS, KAPLAN EL, KIRCHNER PT: Preoperative technetium-99m imaging of a substernal parathyroid adenoma. *J Nucl Med* 23:511-513, 1982

Re: Preoperative Technetium-99m Imaging of a Substernal Parathyroid Adenoma

Naunheim et al. (*1*) describe the accumulation of ^{99m}[Tc] pertechnetate in a parathyroid adenoma and suggest that the technique has been overlooked as a means of imaging parathyroid adenomas.

Over the last 12 mo we have scanned 20 patients who have subsequently been shown surgically and histologically to have solitary parathyroid adenomas. We used both pertechnetate and Tl-201 thallous chloride as described by Ferlin et al. (*2*). All the patients were scanned after 2 mCi (75 MBq) of Tc-99m pertechnetate, using a pinhole or converging collimator. We have reviewed these cases and identified those instances where the adenoma was not covered by thyroid tissue and where pertechnetate uptake could be evaluated separately (Fig. 1). In none of these 11 cases was there parathyroid uptake of pertechnetate above background levels.

Our experience suggests that pertechnetate imaging is not in itself useful for detecting parathyroid adenomas either in normal or ectopic locations. The combined technique described above, however, has proved very valuable; a full assessment of the technique will be published shortly.

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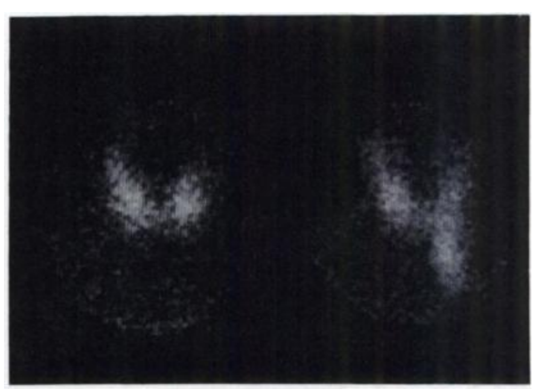

FIG. 1. Technetium image of thyroid (left) and thallium image of same patient (right) showing thyroid and parathyroid adenoma just inferior to left lobe of thyroid. No significant uptake of technetium is seen in region of adenoma.

REFERENCES

1. NAUNHEIM KS, KAPLAN EL, KIRCHNER PT: Preoperative technetium-99m imaging of a substernal parathyroid adenoma. *J Nucl Med* 23:511–513, 1982
2. FERLIN G, BORSATO N, PERELLI R, et al: Technetium-thallium subtraction scan; a new method in the preoperative localization of parathyroid enlargement. *Eur J Nucl Med* 6: A12, 54, 1981

Reply

We are pleased to hear that Drs. Gaunt, Young, Croft, Wells, Coakley, and Collins have amassed a series of cases illustrating the value of combined imaging with Tl-201 and [Tc-99m] pertechnetate in the detection and localization of parathyroid adenomas. Their work should provide valuable confirmation of the earlier report of Ferlin et al. on this subject.

Our own case report was offered with the hope of rekindling interest in the development of a noninvasive imaging procedure for the successful localization of a tumor which till now has been refractory to our best and newest imaging techniques. We did not intend to suggest that pertechnetate imaging was likely to prove the best approach for the future; it merely deserved further investigation. Judging by the reports of Gaunt et al. and Ferlin et al., this has been done, and much-needed help in this area is on its way.

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Re: Thyroid Uptake Measurements with I-123: Problems and Pitfalls: Concise Communication

In their recent communication, Chervu et al. (*1*) have analyzed some of the problems and uncertainties attending the conventional measurement of thyroid uptake with I-131, and have concluded that these are aggravated by the use of I-123. As a result, and probably in view of the widespread clinical use of I-123, they have suggested a lengthy and somewhat tedious protocol for the I-123 measurement. Unfortunately, there are many more problems with this sort of measurement than those discussed by these authors, but there are also more powerful approaches for resolving the large majority of them. We have particularly in mind the method of coincidence counting using I-123 that we have pioneered and developed at our institution over the past decade. As a consequence, we feel that it may be rather sterile to perpetuate the proverbial conflict between the classicists and the modernists. We suggest that it will be more fruitful to come to final terms with an antiquated and grossly inaccurate technique, and to redirect our efforts and energies at promoting the wider use of the better method. Our purpose here is to consider the overall set of problems and to indicate how the method of coincidence counting handles them.

1. Smaller patient dose. It has long been known that I-131 causes a higher radiation dose to the patient than I-123, and cannot, for example, be used in children (*2–4*) for whom, at least in certain cases, it might approximate potentially carcinogenic levels (*5*). By contrast, this dose can be considerably reduced with I-123 by virtue of its shorter half-life, weaker gamma energy, and lack of beta emission. The corresponding reduction can reach up to two orders of magnitude depending on the patient's uptake level. While this factor alone should make I-123 the nuclide of choice, the corresponding advantage must unfortunately be offset by new difficulties, as discussed by Herman et al. (*6*) and Chervu et al. (*1*): enhanced tissue attenuation, and greater proximity of the Compton scatter to the 159-keV total-absorption peak, rendering uncertain the spectral definition of the latter. This is no major tragedy, however, because satisfactory solutions to these and other problems can be obtained by the method of coincidence counting.

2. No phantom required. The problems associated with differences between characteristics of the variety of neck phantoms used in different institutions, as well as between patients' necks and phantoms, have been extensively discussed in the literature (e.g., *1,6,7*). Additionally, the use of different phantoms hinders both standardization of the measurements and inter-institutional comparisons. By contrast, coincidence counting obviates completely the need for a phantom since it provides the absolute thyroidal activity without reference to a neck phantom. As early as 1940, Dunworth (*8*) showed that, if as a result of a single decay, a radionuclide emits nearly simultaneously two or more particles or rays, then the absolute activity of the emitter could be determined by coincidence counting without the use of a reference standard. This idea has been applied by several authors to thyroid measurements with I-125 (*9–12*). We have further developed and amplified the technique in the case of I-123 particularly, and have applied it extensively both in the laboratory and with patients (*13–17*).

3. Simultaneous determination of extrathyroidal neck activity. In thyroid uptakes, the assumption of uniform labeling of the body iodine pool entails that a neck detector will see not only the thyroid but also the plasma, red blood cells, saliva, gastric juices, etc. Part of this extrathyroidal activity could be eliminated by collimating the detector and shielding the photomultiplier. A number of ad hoc procedures have been used for estimating the remaining activity: use of a section of the thigh with approximately the same size and shape as the neck (*18*), subtraction of the room background (*19*), use of thyroid-eclipsing shields—so-called B-filters (*20*), use of a combination of shielded and unshielded neck and thigh counts (*21*), subtraction of measurements before and after the i.v. injection of radioiodine (*22*), etc. By contrast, our technique (*17*) provides the extrathyroidal neck activity simultaneously with the thyroid activity. It also provides, perhaps for the first time, an index for gauging the neck vascularity. Thus, an individual patient correction could be performed every time uptakes are taken.

4. No correction required for thyroid gland depth. To account for the variation in depth of the thyroid, several procedures have again been devised using: the differential absorption between two widely separated photon energies, e.g., the 364-keV gammas from I-131 and the 28-keV x-rays from the Te-123 daughter of I-123 (*22*), or the differential absorption of single-energy photons at two distances from the neck (*23*), or the properties of the photopeak-to-Compton scatter ratio (*24*). On the other hand, we have shown (*25*) that by the proper positioning of the probes in a coincidence count arrangement, the uptake can be determined independent of the gland depth.

In summary, while I-123 may have exacerbated certain problems of thyroid uptake measurement with I-131 (greater tissue attenuation due to the lower electron-capture photon energies, and proximity of the Compton and photopeaks), its combined use with coincidence counting presents several important advantages: lower patient dose, no required phantom or other reference standard, extrathyroidal neck activity determined separately and individually for each patient, and independence of gland depth in the neck. The method has also recently been extended to larger-sized sources (Unpublished data, AL Fymat, MA Greenfield, WNP Lee). Applications of the method in other clinical investigations are also worthy of mention: vitamin B-12 absorption, retention and accessibility in the body or in selected organs such as the liver