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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.

PETER T. KIRCHNER
*EDWIN KAPLAN
KEITH NAUNHEIM
University of Iowa
Iowa City, Iowa
*University of Chicago
Chicago, Illinois

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

(*26–28*), and in health physics (*29*). We recommend therefore that coincidence counting with I-123 become the method of choice for thyroidal uptake and other physiological studies.

ALAIN L. FYMAT
MOSES A. GREENFIELD
W. N. PAUL LEE
University of California
Los Angeles, California

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Reply

The comments by Fymat et al. on thyroid uptake measurements with I-123 (*1*) highlight some significant problems. We do not believe that the protocol suggested in our report is lengthy or tedious, as they suggest. The proper use of stabilized instrumentation with proper gain settings may be overlooked in routine clinical measurements, and we emphasize the importance of this quality control. Even with the greatest care there is still an uncertainty in thyroid uptake measurements of about 5%.

Coincidence counting in the measurement of I-123 thyroid uptake, we believe, requires even greater quality control and expertise than is usual in the performance of the study. Whiting et al. (*2*) discuss the problems of coincidence counting of distributed sources (thyroid is an example). They note that the counting results are dependent on source size and probe placement. While significant accuracy may be achievable by optimization of probe position, additional work on more realistic thyroid phantoms and asymmetrical shapes appears needed. These limitations are further exacerbated in adults owing to variations of gland depth and size. These limitations are not mentioned by Fymat et al. in their assertion that coincidence counting is the method of choice for I-123 uptake measurements.

Measurement protocols should be suited to a routine clinical setting in which uptake measurements on several patients during