(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.

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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 the day at different times can be done readily. We do not agree that the coincidence counting method will cure all of the problems of thyroid uptake measurements.

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Re: Attenuation Compensation in Single-Photon Emission Tomography: A Comparative Evaluation

I wish to offer two criticisms of the recent article by Lewis et al. (*1*) in which the following methods of attenuation compensation were compared: (a) filtered back-projection; (b) exponential ray-sum combining method; (c) geometric-mean corrector; and (d) iterative least-squares steepest-descent method. The authors concluded that "the additional expense of the iterative method is not justified under the conditions of this study." I suggest that this conclusion was reached primarily because their choice of an iterative procedure was inadequate.

First, the χ^2 function minimized by their iterative method did not contain any weighting factor for the random error of each projection-ray measurement. This might well explain the worse sum-of-squares error (SSE) that resulted from their iterative reconstructions of the low-count simulated data presented in Table 1. It may also affect the accuracy of lesion size determinations.

Second, χ^2 minimization using the steepest-descent method is significantly slower than the method of conjugate gradients, which converges in about ten iterations (*2*). Another iterative technique (*3*), based on the method of Chang (*4*), has been shown to be capable of providing absolute activity measurements in only three iterations by repeatedly applying a first-order correction during the analytic reconstruction of each iteration's error projections. If an array processor were available, the reconstruction time for this type of iterative procedure could be comparable to that of the noniterative reconstruction methods.

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Re: Attenuation Compensation in Single-Photon Emission Tomography: A Comparative Evaluation

There exists a tendency among nuclear medicine users of digital image processing to do lengthy computer work without paying due attention to the theory behind the image processing.

The paper referred to (*1*) is a typical example in which the authors confuse two very different problems in this field: image enhancement and restoration, and image analysis. Filtering in the reconstruction of images (paragraph B in the paper) belong to the first type of problem. Establishing relationships between an image and a template ("reference image") is a problem in image analysis to obtain a description of its properties. When the description refers to specific parts (regions or objects) in the picture, the technical literature speaks of "segmentation operations" (thresholding, edge detection, matching, and tracking). When these properties do not depend on the number of counts at each pixel but only on the relative positions of the points, we are talking of "geometrical operations," and when we are involved with properties of parts of the image and its relationships, "description operations" are required.

By calculating the SSE index for different images (obtained by the authors using different activity ratios and restoration methods), we are measuring a specific picture characteristic (perhaps texture). When using the Lesion Size index we are measuring a different property and, a priori, there should be no correlation between them.

Finally, the specialized literature (*2,3*) provides specific techniques to optimize restoration algorithms based on a-priori knowledge of the degradation function, the noise, constraints on the solution of the restoration algorithms (least-squares Winer filtering, residual statistical or average properties, etc.), or particular combinations (as in proposals A, B, C and D of this paper), in which a priori knowledge of the attenuation coefficient is considered. In this kind of discussion (Ref. 4 is a good example) phantom images are used for performance tests of the mathematical solution, but they are not used to extract information from the reconstructed image.

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Reply

The purpose of our work was highly focused in its scope, namely, to investigate a specific property of some selected reconstruction