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True Measurement of the Angle in a Slant Hole Collimator

TO THE EDITOR: I read with interest the article by Kaplan et al. (*1*) on the three-dimensional localization of internal mammary lymph nodes by radionuclide scintigraphy in which the depth of the lymph nodes was calculated from a reference point using a slant hole collimator technique described by Siddon et al. (*2*). However, the authors did not mention if they verified the angle of their slant hole collimator. When we set up a similar protocol at our institution, we found that the angle of our "30°" slant hole collimator was in fact 26.4°. This was found fairly easily by fixing two point sources at a known depth "A" from each other and then taking two images with the slant hole collimator rotated 180° between images. These images are acquired on computer and then added together. The distance between the two images of each source are measured on computer and translated to true distances using a known conversion factor of mm/pixel. These values are given as D2 and D1 for the two point sources. Tan θ can then be calculated from the formula:

$$\text{Tan } \theta = \frac{\text{D2—D1}}{\text{A} \times 2}.$$

Tan θ can be verified by making similar measurements at varying heights of the collimator above the point sources. In our case, if we had not made this correction, a 14% error would have resulted. Translating this into distances, a calculated depth of 3 cm from the reference point based on the erroneous use of 30° is in fact 3.49 cm—almost a half-cm error.

A second question, concerns the number of nodes visualized using the slant hole collimator technique versus the anterior image. Rose et al. (*3*) found an average of eight lymph nodes per patient visualized on the anterior projection versus an average of 4.3 lymph nodes per patient visualized on both the anterior and lateral projections thus making it impossible to calculate the depth for all lymph nodes using orthogonal projections. In our limited experience, we found a similar problem with the slant hole collimator. The authors did not comment on this in their article although the data appears to be available.

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REPLY: Dr. Fawcett has drawn attention to one potential source of error in the determination of lymph node location when using slant hole collimators (*1*). In fact, there are several sources of error which could effect the final determination. These include errors from the collimator, gamma camera position gains, display system gains, and the digitizing tablet when using Poloroid film as input for data points.

In our 1982 paper (*2*), we evaluated the errors in the total determination process and found that we could localize a node utilizing this lymphoscintigraphic technique to within 3 mm, disregarding the effect of patient motion. At the time, this degree of precision and accuracy was sufficient for clinical use and we felt that knowing the exact error due solely to the collimator was not necessary; we were interested in the overall performance of the process.

Prompted by Dr. Fawcett's letter, we repeated our previous localization experiments and found that the error in depth measurement was again 1.2 ± 1.8 mm. Determination of the collimator angle using an analysis similar to that proposed by Dr. Fawcett yielded 29° ± 1°. As demonstrated in our 1982 paper (*2*), the error in the collimator angle is less than the error introduced by other uncertainties in the analysis.

With respect to the question of nodal visualization using slant hole vs. parallel hole collimation, in the paper by Rose et al. (*3*) we used a parallel hole collimator. Indeed, the increased collimator-to-target distance and the soft-tissue attenuation encountered on the lateral view, resulted in suboptimal visualization of the subxyphoid and supraclavicular nodes. This is not the case with the slant hole collimator however.

The mean of 4.6 nodes per patient included for analysis in our current study (*1*) was based upon prospectively localizing only those nodes which were to be included in the opposing tangential radiation beams. Nodes above and below these levels were routinely visualized (on occasion requiring two additional views) but were intentionally excluded from three-dimensional analysis.

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Imaging with Pentavalent [^{99m}Tc]DMSA in Patients with Medullary Cancer of the Thyroid

TO THE EDITOR: In response to the comments of Clarke et al. (*1*) in their publication on imaging techniques in patients with medullary cancer of the thyroid (MCT), we are still having limited success with pentavalent techetium-99m (^{99m}Tc) DMSA, preparing the material as they have described. It is still our opinion that the outcome of imaging is dependent on the stage of the disease, the likelihood of a positive result being low in the early stages of the diseases (*2*).

Four patients with elevated calcitonin levels and MCT diagnosed histologically were studied recently with pentavalent [^{99m}Tc] dimercaptosuccinic acid DMSA. The results of the imaging are shown in Figure 1. Patient 1 (female, age 58 yr) had a calcitonin level of 109,000 ng/1 (normal range < 45 ng/1) at the time of radionuclide imaging. Biopsy had already confirmed the presence of MCT in the liver and ultrasound had revealed nodules in both lobes of the thyroid. As can be seen from Figure 1, there was uptake of ^{99m}Tc in both lobes of the thyroid, with that in the right lobe being much more pronounced. (There was also increased uptake of radionuclide in the liver). Patient 2 (female, age 55 yr) with a family history of multiple endocrine neoplasia, type 2a, had a calcitonin level of 3,450 ng/1 at the time of imaging. There was uptake of radionuclide in both lobes of the thyroid (Fig. 1) much more so, however, in the left lobe. No other areas of increased uptake were noted. Total thyroidectomy was later undertaken and multiple medullary carcinomas in both lobes of the thyroid were found at pathology. Patients 3 (female, age 50 yr) and 4 (female, age 25 yr) were from the same family, with a history of multiple endocrine neoplasia, type 2a. Their calcitonin levels were 494 and 2,000 ng/1, respectively, at the time of imaging. As can be seen from Figure 1, there was minimal uptake in the right lobe of the thyroid in Patient 3 but no thyroidal uptake of radionuclide in Patient 4. The distribution of radionuclide elsewhere had normal appearances. Ultrasound examination revealed thyroid nodules in both patients. Subsequent total thyroidectomy revealed MCT in the right lobe of Patient 3 and in both thyroid lobes of Patient 4.

Clarke et al. (*1*) visualized pentavalent [^{99m}Tc]DMSA uptake in all patients with proven metastatic MCT. The time from diagnosis of the disease to radionuclide imaging ranged from 2–18 yr. In our four patients with proven MCT, imaging was carried out within 2 yr of initial presentation and in only one case (Patient 1) was there proven metastatic spread of the disease. Convincing tumor uptake was observed in only two of our patients.

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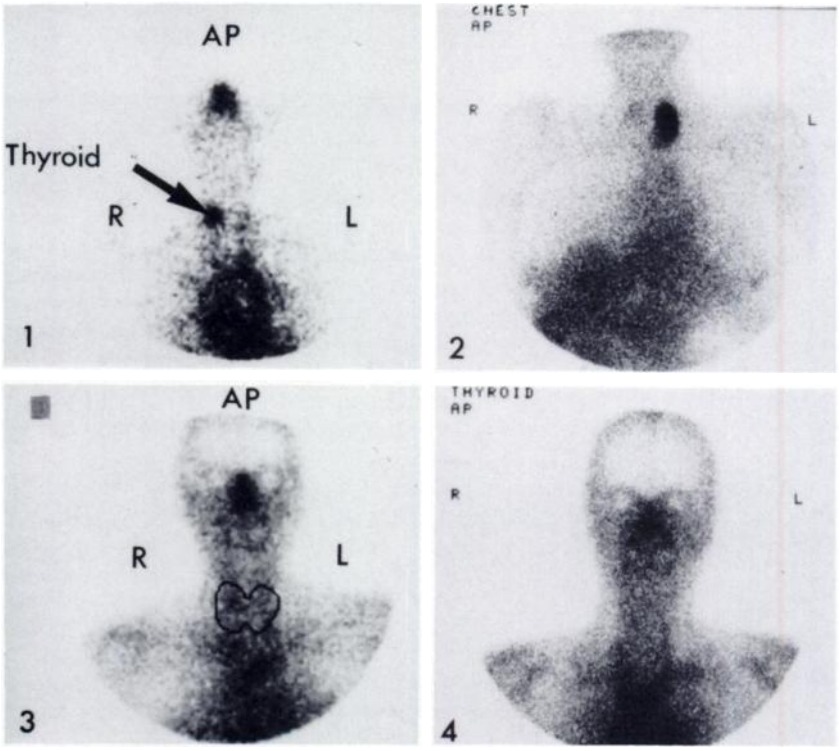

FIGURE 1
Radionuclide images in four patients with proven MCT, taken 2 hr after the administration of 200 MBq pentavalent [^{99m}Tc]DMSA. In these cases where thyroidal uptake was observed, 300 mg sodium perchlorate were given intravenously at the end of the study to check that uptake of the radionuclide was not due to the presence of free pertechnetate.