LETTERS TO THE EDITOR

Re: Performance of the Rotating Slant-Hole Collimator for the Detection of Myocardial Perfusion Abnormalities

We enjoyed reading the paper by Ratib et al. (*1*) on the performance of a rotating slant-hole (RSH) collimator in myocardial tomography. In general, this paper reconfirmed our previous work with the quadrant slant-hole (QSH) collimator (*2,3*). In addition, the paper (*1*) offers an explanation—partial-volume effect—of the cold artifact created by oblique slicing of the myocardial phantom. However, we would like to bring to the authors' attention that, after we reported this artifactual phenomenon in 7-pinhole tomography (*4*), we also reported and published a similar observation on slant-hole tomography last year (*5,6*).

The conclusion reached by the authors' studies from phantom is that, except for one problem, RSH tomography is superior to planar imaging for myocardial tomography. The problem is that there is no way to eliminate the artifact caused by oblique slicing. In other words, before image acquisition there is no way to align properly the collimator and camera with the long axis of the left ventricle (LV) so that oblique slicing will not occur in the first place.

Seven-pinhole tomography has a positioning guideline intended to achieve this alignment. Under ideal alignment, the center view of the myocardium should be as round as possible. Furthermore, the six peripheral views of the myocardium should be elongated symmetrically with respect to the center. These guidelines are difficult to follow because of the distortion (magnification changes and loss of sensitivity with depth) introduced by the pinhole itself. It is therefore logical that a hybrid system between the 7PH and RSH collimators could have the advantage of both techniques. Such a hybrid system is a multiple-view slant-hole collimator.

The quadrant slant-hole (QSH) collimator system we have been working on is more than simply an assembly of four pieces of the slant-hole collimator core to gain sensitivity. As it turns out, it also solves the problem of proper alignment. This is the direct result of four simultaneous and symmetrical views that can be identified with the orthogonal x and y axes of the field. Because of the large slant-hole angle (40°), each myocardial image is elongated enough to be elliptical in shape, with no distortion. The projections of the LV long axis, straight lines that bisect each ellipse, can then be pretty well visualized on the CR persistence scope or computer screen during positioning. With the two pairs of opposing long axes visually identified and compared with the x and y axes for alignment, a misalignment of 15–20° between the axes of the collimator and LV can readily be appreciated and corrected before acquisition takes place. Alignment in the long axis of the LV can be achieved to be within ± 10° with the QSH collimator. If an appreciable misalignment is detected, a 10-deg step adjustment of the camera's orientation in the direction indicated is warranted until an acceptable alignment is reached. Fortunately, not too many patients need adjustment if the starting orientation of the camera is properly chosen. From our experience with 300 patients, the starting angle lies in the range of 30–35° LAO and 15–20° cephalad.

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Re: Studies of the In Vivo Uptake of Ga-67 by an Experimental Abscess: Concise Communication

I would like to comment on a recent Concise Communication in *The Journal of Nuclear Medicine* by Hayes et al. (*1*). In this paper the authors postulate two pathways to explain the difference in Ga-67 kinetics between soft-tissue tumors and normal and inflammatory tissue. They suggest that Ga-67 uptake by tumor tissue occurs by passive diffusion of uncharged $Ga(OH)_3$ across plasma and lysosomal membranes, followed by irreversible binding of the Ga-67 to lysosomal proteins. They consider the binding process in tumors to be due to the low intralysosomal pH with production of $Ga(OH)^{2+}$ and $Ga(OH)_2^{+}$ ions. This would make the gallium act like a permeant weak-base lysosomotrophic agent in tumor tissue.

In contrast, the authors postulate that accumulation in normal and inflammatory tissue takes place by endocytosis, followed by binding (mechanism unspecified) to lysosomal proteins. They apparently came to this conclusion because they could not alter the kinetics of Ga-67 in malignant tissue using a false-carrier load (scandium, iron citrate, or colloidal iron), but could induce changes in normal and inflammatory tissue by this method.

Data from our laboratory indicate that while this explanation might be persuasive if one considered only data obtained with false carriers, it loses credibility when one considers the results with true carrier. Stable Ga, if administered 2 hr after the injection of carrier-free Ga-67, will markedly reduce uptake of the tracer in both tumor and normal tissue (*2*). Furthermore, the rate of Ga-67 egress is much faster from nonmalignant than from malignant tissues, with very little of the Ga-67 eliminated from the tumor one-half hour after the carrier load. Extensive egress takes place from normal tissue during this same interval (*3*).

On the other hand, false carriers (Fe, Sc) will not displace Ga-67 from tumor tissue to any extent at early times. Indeed, we have demonstrated enhancement of Ga-67 concentration by viable tumor when the Fe^{3+} is appropriately administered (*4–6*). The effect of Fe^{3+} on Ga-67 kinetics in healthy tissue, in contrast, is similar to that of carrier Ga.

These findings, indicating the difference in effect between true

and false carriers on normal and malignant tissue, are not compatible with the passive mechanism of Ga-67 uptake by tumor tissue proposed by the authors. The data imply a far more dynamic process.

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Reply

It is our contention that Ga-67 probably enters malignant and normal soft tissues by two entirely different routes. We proposed this in a previous publication, together with an overall scheme for the general biodistribution of Ga-67 (*1*), to which we refer the reader. Our recent paper, we feel, provides evidence that the basic route of entry for Ga-67 into inflammatory tissue may be similar to that involved with normal soft tissue. The discussion in this paper contains our speculations as to the actual processes that might be involved in the uptake of Ga-67 by malignant tissues, normal soft tissues, and inflammatory lesions.

When mg/kg quantities of stable gallium are administered along with Ga-67, the binding sites for gallium on plasma proteins (principally transferrin) are saturated and the gallium present in the plasma exists mainly in an unbound state. This in turn leads to an elevated excretion of gallium and to an increase in the deposition of Ga-67 in bone. At the same time, tumor and soft-tissue uptakes are decreased to roughly the same extent. The fact that administration of stable gallium after Ga-67 produces less egress of Ga-67 from tumor tissue than it does from normal tissue is an interesting observation, but it is not necessarily inconsistent with our proposed pathways for Ga-67 uptakes in tumor and normal tissue. We had previously found that the Ga-67 present in extracts of tumor tissue is associated to a large extent with a 45,000-dalton glycoprotein (*2,3*). Such is not the case with extracts of normal soft tissues. It is possible that the Ga-67 that has already entered tumor cells and is bound by this protein may be less susceptible to exchange with stable gallium than that taken up by normal soft tissue. Furthermore, the passive diffusion process, which we suggest is mainly involved in the uptake of Ga-67 by tumor tissue, would be more rapid than an endocytotic process (*4*).

Iron and scandium, rather than being "false carriers," are better identified as agents that block the binding of Ga-67 to plasma transferrin. Neither iron (III) nor scandium (III), however, concentrates appreciably in malignant tissue, even when given in minute amounts. On the other hand, these two substances, like stable gallium, force the Ga-67 that is present in plasma into an unbound state. This results (as with stable gallium administration) in increases in both the excretion and bone deposition of Ga-67 and in decreases in its uptake in normal soft tissues, but the concentration of Ga-67 in tumor tissue is not significantly changed (*1,5*). Thus tumor tissue is able to compete effectively for nontransferrin-bound Ga-67 even in the presence of an increased excretion and bone uptake of Ga-67, whereas normal soft tissues are not. Furthermore, when we enhanced the binding of Ga-67 to plasma transferrin by both exogenous and endogenous means, the changes observed with iron and scandium administration were completely reversed (*1*). These observations, together with our findings with abscess-bearing animals, prompted us to propose the schema for the uptake of Ga-67 in soft-tissue tumors, normal soft tissues, and inflammatory processes that appears in the paper in question.

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Is the Radiochemical Purity of Tc-99m Radiopharmaceuticals Decreasing?

Data presented at the National Symposium Workshop on Quality Assurance in Nuclear Medicine (*1*) revealed that the radiochemical purity of Tc-DTPA was lower in 1981 than in 1980. To test this hypothesis of decreasing radiochemical purity further, a second study was undertaken using radiopharmaceutical quality-control measurements routinely recorded at the University of New Mexico Radiopharmacy.

The method used to measure radiochemical purity is thin-layer chromatography, using acetone to separate free pertechnetate, and saline to separate reduced hydrolyzed technetium. For soluble products, both measurements are made and subtracted from 100% to give the percentage purity. For insoluble products, only free pertechnetate is measured and subtracted to give the reported purity data.

In this study, the results of the seven most-used Tc-99m radiopharmaceuticals were retrieved from the records of October 1980 and October 1981. The manufacture of the reagent kits did not change during this period. Means and standard deviations for radiochemical purity were calculated. The significance of the