## BMIPP in Hypertrophic Cardiomyopathy

**TO THE EDITOR:** We read with interest the paper by Kurata et al. on myocardial SPECT with $^{123}$I-beta-methyl-branched fatty acid in hypertrophic cardiomyopathy (*1*). In light of the poor spatial resolution of the imaging system they used, we are, however, concerned by their contention of finding a larger apparent left ventricular size with $^{123}$I-BMIPP than with $^{201}$Tl.

Indeed, the ratio of the apparent left ventricular size in the early $^{123}$I-BMIPP study to that in the $^{201}$Tl study was $1.20 \pm 0.03$. Assuming a circular shape of the left ventricle, the surface area would be given by $\pi(d/2)^2$, d being the inner diameter of the cavity. Therefore, the ratio of the left ventricular diameter in the $^{123}$I-BMIPP study to that in the $^{201}$Tl study would be $(1.20)^{1/2}$, or 1.095. Taking 55 mm as a normal left ventricular diameter (which, being the normal end-diastolic dimension, is an overestimation in normal hearts, and even more so in cases of hypertrophic cardiomyopathy), the absolute difference between the diameter in the $^{123}$I-BMIPP and $^{201}$Tl studies would be $0.095 \times$ 55 mm, or 5.23 mm at most. This, however, is far beyond the spatial resolution of an imaging system with a FWHM of 21 mm. In other words, the increase of the left ventricular surface area of 20%, as measured by the authors, would go undetected.

The theory of error propagation predicts the relative error on the ratio of the surface areas to be four times the relative error on the diameter. Taking $0.5 \times$ FWHM, or 10.5 mm, as the error (which is an underestimation), and 55 mm as the diameter (which is an overestimation), the relative error on the diameter is at least 19%, leading to an error on the ratio of no less than 76%. Therefore, the mean value that was determined experimentally to be 1.20 might vary between 0.29 and 2.11.

One might argue that this is not in keeping with the reportedly low standard errors. The method of generating the left ventricular outline, however, tends to maximize the surface area, because it is based on a search for maximal activity on radii. Together with the coarse spatial resolution, this could enhance the reproducibility of the measurements, thus explaining the low standard errors obtained with the phantom. Reproducibility, however, is distinct from precision.

One might also criticize our reasoning by saying that our way of calculating the errors is not relevant, because in reality the surface area was not calculated, but measured directly. In fact, the way of measuring the surface area—counting the number of pixels on a line per line, or column per column, basis and then adding these numbers—is correctly modeled by the calculation we use; the only assumption we make is that the left ventricular outline is a circle.

At last, the significant difference found between the ratio in a heart phantom and that in the patient's hearts is open to criticism, because it is unfair to compare the measurements in the patients (each performed once) with the repetitively determined value in the phantom, and secondly because the size of the phantom is not mentioned.

In conclusion, the data presented do not support the conclusion that in hypertrophic cardiomyopathy, the apparent left ventricular size measured with $^{123}$I-BMIPP exceeds that with $^{201}$Tl. No matter how sophisticated the methodology used, spatial resolution that is not in the images from the very beginning cannot be recovered.

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## Application of a Continuous Ventricular Function Monitor with Miniature Cadmium Telluride Detector to Patients with Coronary Artery Bypass Grafting

**TO THE EDITOR:** We read with great interest the fine editorial presented by Dr. Lahiri and the preceding work of Dr. Taki in the March 1992 issue of the *Journal* (pages 448–449 and 441–447, respectively). Capintec has been involved in the technique Dr. Lahiri describes as the ambulatory VEST for several years. The appropriate name of the system referenced is the CAPINTEC-VEST or C-VEST; both are registered trade names of our company. I am sure that the omission of our name was unintentional.

Publications correlating this technique with established methodologies (*1*) and during balloon angioplasty (*2*) and upright bicycle exercise (*3*) have shown close correlation with the gamma camera. Further investigations, including response to snow shoveling (*4*), mental stresses (*5,6*) and post-surgery (*7*), have correlated well with gated blood-pool studies.

The techniques described by Drs. Taki and Lahiri help expand the boundaries of nuclear medicine, a vision shared by science and industry.

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## Reconstitution and Fractionation of Radiopharmaceutical Kits

**TO THE EDITOR:** Several reports have appeared in the literature describing cost-saving measures by which radiopharmaceutical kits are reconstituted with saline, divided into portions in separate vials and refrigerated or frozen. These vials are thawed at a later time (hours to days) after which [$^{99m}$Tc]-pertechnetate is added. Piera et al. (*1*) and Ballinger (*2*) were able to demonstrate sustained stability of $^{99m}$Tc-HMPAO kits prepared from divided, reconstituted fractions, particularly if the kits were reconstituted with nitrogen-purged saline and subsequently frozen at −10°C. We have extended this approach to two of the newer radiopharmaceutical kits $^{99m}$Tc-sestamibi (DuPont/Merck, Billerica, MA) and $^{99m}$Tc-mertiatide (Mallinckrodt, St. Louis, MO).

The kits were initially reconstituted with 2 ml of low-dissolved-oxygen (LDO) saline and divided into four aliquots of 0.5 ml and placed in sterile vials. Three of the vials were frozen, while 20 mCi of $^{99m}$Tc-pertechnetate (obtained 1 hr after elution of a generator) was added to the other vial using the procedure recommended by the manufacturer. The radiochemical purity of the kits was also determined according to the manufacturer's instructions (ITLC for the sestamibi kit; a Sep-Pak cartridge for the mertiatide kit). The frozen kits were thawed 1–5 days after the initial reconstitution, and [$^{99m}$Tc]pertechnetate was added as described above. This procedure was repeated several times for each kit.

The $^{99m}$Tc-sestamibi kits exhibited excellent stability, even for the reconstituted aliquots that had been frozen for five days. A 90%–96% radiochemical purity was observed for all samples tested. However, the radiochemical purity of the mertiatide kits was unacceptably low for frozen aliquots stored for longer than one day.

The mertiatide kit is supplied as a lyophilized powder stored under argon gas. The instructions for the preparation of this kit call for the removal of this argon layer and replacing it with air in the vial. When the vials were reconstituted with LDO saline, the stored, frozen vials no longer had this argon layer. Thus, the low radiochemical purity observed for the frozen, reconstituted aliquots may have been due to the oxidation of the stannous chloride in the kit. This is apparently the same phenomenon observed by Ballinger during the preparation of reconstituted $^{99m}$Tc-HMPAO kits (*2*). Therefore, an adjustment was made in which the reconstituted aliquots were added to sterile vials that were purged with argon gas. The argon was added using a pressurized tank and an in-line 0.22 micron filter. These vials were then treated similarly to the other $^{99m}$Tc-mertiatide preparations and subjected to the same quality control procedures. A radiochemical purity of greater than 97% was observed for all aliquots, including one that had been frozen for 21 days.

These procedures are easily performed in a nuclear medicine department and can lead to substantial savings. By using the appropriate reconstitution procedures, the stability of the kits can be maintained for a time to sufficiently maximize the utility of the kit. While we have not evaluated the effect of the reconstitution, freezing and thawing of the kits on the quality of the scan, we assume that as long as the number of doses extracted from one kit does not exceed the manufacturer's recommendations, this should not be a problem.

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## Calculation of the Radiation Dose at a Bone-to-Marrow Interface

**TO THE EDITOR:** With great interest, we read the article by Johnson et al. (*1*). This article proposes a simple anatomical model and uses straightforward calculations to improve understanding of the absorbed dose distribution in bone marrow. The presentation of the results as a dose profile may enhance our understanding of the myelotoxicity of high activity doses of radionuclides. However, we would like the authors' comment on the following items:

1. Is the proposed anatomical model applicable to humans, in whom the marrow is always embedded in trabecles, even in the mid-femur (*2*)?
2. Do the authors expect a homogeneous absorbed dose in marrow cavities in humans, where the trabecle distances [± 1000 μm (*3,4*)] are comparable to the percentile distances $X_{90}$ [1000 μm for $^{153}$Sm and 1800 μm for $^{186}$Re (*5*)]?
3. Do the authors expect the results to change significantly because of possible deviations from the planar source approximation? Why is application of the lateral correction algorithm (LCA) not required?
4. With the EGS4 code, electrons less than 10 keV are neglected. However, these electrons do occur in the decay spectrum (*1,6,7*) of $^{153}$Sm and $^{186}$Re (Table 1) and may be

**TABLE 1**

| | β constant (g-cGy/μCi-hr) | | Electron constant (g-cGy/μCi-hr) | |
|---|---|---|---|---|
| Isotope | Johnson | MIRD | All E | E < 10 keV |
| $^{153}$Sm | 0.48 | 0.48 | 0.089 | 0.0083 |
| $^{186}$Re | 0.69 | 0.70 | 0.031 | 0.0022 |