Letters to the Editor

Repeatability of Estimates of Left-Ventricular Volume from Blood-Pool Counts: Concise Communication

We read with interest the paper “Repeatability of…” by Burns et al. (1), and agree that the proposed semiautomatic method for determination of left-ventricular (LV) blood-pool count determinations is one of the best reproducible techniques available today. However, the applied technique, proposing an in vivo labeling method and correction for the patient’s particular half-time for blood-pool activity by drawing venous blood samples during the intervention, makes this method very cumbersome in clinical practice. In contrast to the determination of absolute volumes, we favor serial estimations of relative LV volume changes on the basis of background-corrected end-diastolic and end-systolic counts. To decrease the variability of the patients’ decline in blood-pool activity, we use an in vivo/in vitro labeling method (2) that allows control of labeling efficiency before injection of activity. By injection of only high-quality labeled red cells (efficiency > 90%) the stability of blood-pool labeling remained within a range of 5% through 6 hr after injection—even during peak exercise and postexercise studies. Only about 5% of the injected activity of 20–25 mCi Tc-99m was found in the urine up to 6 hr. In healthy controls, supine stress radionuclide ventriculography showed a decrease of LV end-diastolic counts by 20% at peak exercise, and of end-systolic counts by 40%. In patients with coronary artery disease (documented myocardial infarction or angiographically proven CAD), LV counts during exercise showed either decrease, no change, or an increase, providing information besides the EF for the clinical assessment of these patients. This correlates with data of Freemas (3) using a similar method of volume calculation. In summary, in spite of the systematic underestimation of volumes by techniques without attenuation correction (4), we consider these methods to be of great practical clinical value for the estimation of relative LV volume changes. Use of the more sophisticated labeling technique mentioned above eliminates blood sampling during acquisition and maintains clinically valuable data. This makes the method more attractive for routine clinical use.

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References


Reply

We are grateful for the comments of Drs. Fridrich, Pichler, and Gassner regarding our paper “Repeatability of estimates of left-ventricular volume from blood-pool counts” (1). The in vivo/in vitro labeling of red blood cells with Tc-99m might well afford improved stability of the label, but “more sophisticated labeling” does not, in our view, preclude the necessity for blood sampling during acquisition, particularly during and after exercise. Konstam et al. (2) have shown that there are changes in circulating blood-pool activity with exercise and propose mechanisms that might apply to other interventions. In order to measure or estimate changes in left-ventricular volume using radionuclide ventriculography, we feel that blood sampling during acquisition is necessary irrespective of the method of RBC labeling used.

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References


Re: Preparation of Sterile Xenon-133 In Saline for Tissue Perfusion Studies

DiPiazza and Harbert (1) have described a simple, expedient, and inexpensive method for producing xenon in cold saline for almost all nuclear medicine laboratories. They recognize the desirability of cost containment following the advent of Diagnostic Related Group (DRG) regulations. As the authors know, however, the trade-off in lower cost has its “price” in terms of radiation safety and technical considerations. Our early (2) and recent experience has convinced us that working with radioxenon is not for the novice. We call attention to the following:

1. Commercial Xe-133 vials are packaged both under negative and ambient pressure. An attempt to completely fill a vial, packaged under ambient pressure, with a saline Xe-133 solution will
result in a significant release of radioxenon, necessitating the use of an exhaust hood (which should be used in any event) for this purpose. Completely filling the vial with saline solution is an absolute requirement of this procedure to minimize loss of xenon to the air, and it is best accomplished in the negative-pressure vial.

2. Because the noble gas, radioxenon, rises in an aqueous medium, the vial must be held upside down in a lead shield while the saline is being added to dissolve the xenon, and also during equilibration in the refrigerator.

3. The vial should also be upside down during withdrawal of the xenon solution to avoid leakage across the needle, which should be of 25 gauge or smaller bore. A second prepared saline syringe placed into the inverted vial aids in adding solution to the partial vacuum created on withdrawal of the xenon-in-saline dose.

4. While the syringe containing xenon in saline is being carried, the needle cap should be tightly closed and pointed downward. This will help to minimize the loss of xenon to air, since xenon has a tendency to equilibrate more with air than with saline due to a very high partition coefficient of 0.9.

5. If glass syringes (matched barrel and plunger) are used, the plunger and barrel should be wetted with saline to minimize leakage. With disposable syringes the xenon will be absorbed into the petroleum- or rubber-based gasket upon sitting (2). Thus, one cannot realistically consider the prepackaging of unit doses in syringes for more than a few hours at best, and expect to deliver the anticipated activity.

6. Additionally, potentiometer settings on the dose calibrator must be viewed in light of the final unit dosage container (glass or plastic syringe). Because of the potential for leakage on transfer, it is not sufficient merely to assay the xenon vial before and after withdrawal (3).

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REFERENCES


Reply

We welcome the comments of Drs. Levine and Malhi. Since Mallinckrodt, Inc., the sole U.S. supplier of xenon-in-saline, has recently abandoned production, alternative methods of production became especially important. We have the following observations:

1. We used the 2-ml xenon vials from Medi-Physics. These are supplied under ambient or near-ambient pressure, with air as the diluent; thus most of the vial’s content is air. While completely filling the vial with saline certainly yields higher specific activity of the xenon-in-saline, we do not see how this can be done without withdrawing most of the air and, therefore, most of the xenon. All published methods of producing xenon-in-saline that we know have used xenon supplied in evacuated containers (1–6). Most of the methods lie beyond the capability or patience of most clinical laboratories. Nevertheless, with vials containing 20 mCi of Xe-133 in air, the injection of 1 ml of cold saline into the vial, then refrigerating, will by our method yield a specific activity of at least 2 mCi/ml. This concentration is sufficient for most tissue-perfusion studies in which intradermal or intramuscular injections are made. The injection of 1 ml of saline into the 2-ml xenon vials presents little or no problem of xenon escape during filling or extracting the saline.

Inversion of the vial during saline injection and extraction, as recommended by Drs. Levine and Malhi, is of course essential, as is the use of a fume hood. We “wet” our syringe with the xenon-in-saline mixture, rather than just saline so as to decrease the diluting effect when small volumes are injected.

Truly, the method of preparation described by Carroll et al. (1) is “not for the novice.” Its inherent difficulties, expense, and radiation-safety problems prompted us to develop a procedure that can be performed by any well-trained technologist. The cost of demonstrating our method’s efficacy is merely a syringe and a vial of xenon.

2. Recent calls to several manufacturers revealed that all manufacturers dilute xenon-133 with gas upon filling unit dose vials intended for lung ventilation studies. New England Nuclear Corporation dilutes their Xe-133 with 95% CO2. The vial when shipped is under “slight” negative pressure. We have no experience with this product, but it may achieve somewhat higher xenon-in-saline concentrations.

3. Other correspondents have questioned the sterility of the vial contents. The USP (Vol. XX, p. 1038) requires 2.5 mrad as acceptable exposure for sterilizing medical products. The assumptions of Goddard and Ackery (7) and calculations of the radiation dose absorbed by the tracheal mucosa during Xe-133 ventilation studies provide a useful model for this problem. They assumed a cylindrical airway of 1.5 cm radius and 10 cm long, lined with mucus 50 μm thick. Assuming a concentration of 1 μCi/ml and the integrated exposure to equal 1.22 min in the single breath study, they calculated an exposure of 0.16 rad to the mucosa or 0.95 rad/min per μCi/ml. This model assumed no backscatter. Using the same geometric assumptions, organisms attached to the walls of a xenon vial containing 15,000 μCi/ml would receive an initial exposure of at least 8.55 × 10^6 rad/hr. The recommended exposure of 2.5 × 10^6 rad would thus be achieved in less than 3 hr. These estimates are conservative because backscatter is probably negligible.

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REFERENCES


