Gates Method for GFR Measurement

TO THE EDITOR: Recent correspondence by Ginjaume and associates (*1*) and by Gates (*2*) expressed some disagreement over the accuracy of the Gates method of glomerular filtration rate (GFR) measurement. Neither group cites our work (*3–5*) or that of Fawdry and associates (*6*).

Gates reported that the accuracy of his method was ±7 ml/min (residual standard deviation vs. creatinine clearance) (*7*). If that were true, it would rival the accuracy of methods based on a single blood sample—but without venipuncture or laboratory work. Unfortunately, other investigators have been unable to duplicate his results (*1,3,6*). Indeed, the accuracy he claims is even better than that of his reference method, creatinine clearance (*4,8,9*).

This does not imply that the Gates method is not clinically useful. The example of creatinine clearance demonstrates that even a crude estimate of GFR is clinically useful. Schuster and Seldin point out that the principal advantage of creatinine clearance is its convenience (*8*); the Gates method offers comparable accuracy with even greater convenience. However, for those nuclear medicine clinics that have laboratory facilities, more accurate methods for measuring GFR are available. Our own recommended routine method for quantitating renal function is an ERPF method based on a single 44-min plasma sample (*10*), though a GFR measurement based on a single 3-hr plasma sample is offered as an alternative (*11*). Counting plasma samples is not inconvenient for those who do it routinely. So far, we have performed over 12,000 such tests at the request of our clinical staff. Our own experience with various gamma-camera-based methods for GFR estimation has been presented elsewhere (*3,4*), with quantitative analysis of the components of error (*5*). While our numerical results are similar to those reported in Ginjaume's letter, we do not agree with Ginjaume that depth correction will solve the problem. Both we and Fawdry (*6*) found that depth correction did not make much difference. The effective attenuation coefficient is less than the theoretical, so that variations in depth have less effect than one might expect.

Rehling and associates (*12*) have obtained intriguing results, using a gamma camera alone (without blood samples) to estimate GFR. Their method is similar to one that we called the "corrected Assailly method" (*4*) but differs in the following respects.

1. They divided both sides of the integrated mass balance equation [our Eq. (22), their Eq. (6)] by cardiac activity before applying regression analysis. Since cardiac activity does not change much in the time interval used, one would not expect this algebraic rearrangement to have much effect on the results.

2. They smoothed the cardiac time-activity curve. Since high count rates were obtained over the heart (over 5,000 counts/20-sec frame); we did not smooth.

3. They avoided the necessity of a blood sample by assuming the blood volume in the cardiac region of interest (ROI) to be the same for every patient, whereas we estimated the blood volume in the cardiac ROI for each patient by means of a single calibration blood sample. We are surprised that they found their approximation to work as well as it did. Their accuracy with no blood sample was as good as ours with a single 20-min blood sample [though not as good as with a single 3-hr sample (*11*)]. This is clearly a promising method, if other groups also find they can draw the cardiac ROI in such manner as to include a reproducible blood volume.

The above remarks apply to typical adult patients. The available evidence suggests that the gamma camera methods are more accurate in children (*1,13–15*), small animals (*16*), and renal transplants (*17*) than in the typical adult. Single-sample plasma clearance methods are not yet available for pediatric GFR measurement, though a method has been reported for ERPF in older children (*18*). Therefore, the gamma camera methods may be preferred for GFR estimation in children.

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A Simple Disposal Method for Radioactive Xenon

TO THE EDITOR: Xenon is slightly soluble in water (*1*) (11.9% by volume at 25°C). A standard laboratory water vortex vacuum pump was used to incorporate xenon in the pump's water flow down a sink, as 10 mCi of carrier-free xenon-133 occupies only 9×10^{-3} μl at NTP (2.5×10^{14} atoms).

As a further trap to prevent outgassing back into the laboratory, and increase the mixing time for gas and water, the outlet of the pump was coupled to a 12-mm internal diameter polythene tube which was pushed down the plug hole through to the far side of the water seal.

In practice, the complete disposable xenon breathing system is simply coupled to the pump after use. In 5 min, all the patient's exhaled breath and xenon have been flushed down the sink and the whole apparatus returns virtually to background radioactivity.

Although xenon is easily detected as the water flows through the waste pipes, no activity returns to the laboratory or appears in the external ventilation pipe for this drainage system.

Dilution with the remainder of this institution's liquid wastes render the radioactive level orders of magnitude below the discharge limits allowed in guidelines issued by our National Health and Medical Research Council. Note that if it is intended to adopt this simple form of xenon gas disposal, local regulations must be considered, including the need to identify any inspection traps en route to a trunk sewer. Such traps should be labeled to require a radiation level check before being opened.

It would be simple to make a bedside apparatus for the imaging room that will aspirate xenon during the washout phase of the study. As long as the route of the sink waste is known not to pass near sensitive gamma detecting instruments or trap locally within a building, there should be no problem operating this form of dilution and dispersal safely.

We have disposed of 125 mCi ^{133}Xe within a week, including 25 mCi in 1.5 hr without any alteration of background levels in the laboratory or in the vicinity of the external ventilation sump.

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Left Ventricular Volume Measurements by Radionuclide Angiography

TO THE EDITOR: The recent report by Dr. Verani and co-workers (*1*) establishes yet another attenuation coefficient to be used in the calculation of absolute left ventricular volume from radionuclide angiocardiograms. Among the factors to account for the variation in reported values for attenuation coefficients they might include the use of water as an attenuating and scattering medium in in vitro experiments as a simplification of the chest wall and thoracic contents.

As a general statement, I do not agree that "it is unlikely that the radionuclide technique will have enough accuracy to detect small, physiological, or pathological changes of left ventricular volumes." The problems of reproducing left ventricular depth, background counts, and left ventricular edges manually have to a large extent been overcome by the method for left ventricular volume measurement we now employ routinely in our laboratory (*2*).

We reported that left ventricular count determination (edge detection and background subtraction) is more reproducible using a semi-automated second derivative edge detection algorithm than manual techniques (*3*). Using this method of left ventricular count determination to calculate stroke counts, and with simultaneous stroke volume measurements by thermodilution, we were able to derive a mean *apparent* tissue attenuation coefficient of 0.16 cm^{-1}.

The reproducibility of left ventricular "depth" measurement is, we think, enhanced by use of a computer program to find the center of left ventricular count density in the anterior projection. The center of the left ventricle is identified manually in the left anterior oblique projection, however.

This method of left ventricular count determination and this apparent tissue attenuation coefficient have been prospectively applied in volume determinations for comparison with contrast ventriculographic volume measurements (*2*). Although our radionuclide angiocardiograms and single-plane contrast ventriculograms were performed within 1 hr of each