Letters to the Editor

Direct Determination of the Attenuation Coefficient for Radionuclide Volume Measurements

TO THE EDITOR: We have read with interest the recent article by Keller et al. (*1*). This is one of the many studies which has attempted to calculate a better μ for use in attenuation correction of count-based left ventricular volume measurements. The authors have directly measured the attenuation from the right and left cardiac chambers. Unlike others who have failed to correct for scatter which is inherent with the broad beam nature of clinical nuclear medicine (*2–6*), these authors have included a scatter correction but, unfortunately, their approach demonstrates again what we believe to be a lack of appreciation for the fundamental problem of attenuation as it pertains to absolute ventricular volume measurements.

Based on the publication of their approach, we believe it is time to again re-emphasize, emphatically, that a universal attenuation coefficient, μ, should not be used for left ventricular volume measurements. We have directly measured left ventricular attenuation in over 40 patients and obtained a μ with a range of 0.087–0.132 cm^{-1} with a mean of 0.113 cm^{-1} using our buildup factor approach (*2*). The extreme variability in this number is substantiated by the authors' work. The data given in Figure 2 makes a prima facia case against the use of a single value for μ. Indeed, if the authors would have reported the mean $\pm$ 2 s.d. for μ, we believe that they would have reached the same conclusion. Since μ is a function of multiple parameters (*2*) it must be directly measured on an individual basis. It is not sufficient to determine a "better μ" which is obtained from lumped data using another regression equation relationship.

We believe the authors' results help to substantiate the validity of our proposed use of another method such as the buildup factor (*2–4*). We have argued that the conventional attenuation equation $A = A_0e^{-\mu d}$ (which is the authors' Eq. 1) is inadequate and should be modified to $A = B(\infty)\ A_0e^{-\mu d}$. $B(\infty)$, the buildup factor or scatter correction, is relatively constant for various source volumes simulating LV dimensions, ranging in value from 1.21–1.27 with a mean of 1.23 (*2*). In this recent study the authors have corrected for scatter by multiplying the attenuated activity A by 0.81 leading to a final equation $0.81\ A = A_0e^{-\mu d}$ or $A = (1/0.81)A_0e^{-\mu d}$. This is equivalent to $A = 1.23\ A_0e^{-\mu d}$, where 1.23 is equivalent to our calculated buildup factor. Incidentally, we have also reported that the attenuation equation for LV volumes using whole-frame counts should be $A = 1.15\ A_0e^{-0.12d}$ which is the same results that these authors have reported (*2*).

In summary, while the search for a "better μ" appears to continue, we hope that this letter again calls to attention the importance of using a direct measure of attenuation for each individual rather than using any single lumped value for μ.

References

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Jeffry A. Siegel
Alan H. Maurer
Temple University Hospital
Philadelphia, Pennsylvania

REPLY: We appreciate Dr. Seigel's and Dr. Maurer's interest in our paper "Direct Determination of the Attenuation Coefficient for Radionuclide Volume Measurements" (*1*). Drs. Siegel and Maurer have previously stated that they believe that the controversy over the proper choice of a universal attenuation coefficient, μ, in the calculation a transmission factor (TF) with $TF = e^{-\mu d}$ is superfluous (*2*). We are not yet persuaded, however, that such is the case. We acknowledge the considerable contributions of Drs. Siegel and Maurer and their associates for their work with ventricular volume determinations using values for μ, individually determined with an esophageal source (*3*), and in development of their buildup factor method (*2,4–5*). We suspect, however, that the vast majority of left ventricular volume determinations are now performed with a single left anterior oblique (LAO) view with correction for absorption with a regression equation or with application of a universal attenuation coefficient and measurement of depth of the ventricle in the thorax. Therefore, we believe that our main point, directed to those who correct with $TF = e^{-\mu d}$, is correct and still stands; namely, 0.12/cm is a more accurate universal μ than 0.15/cm. We acknowledge that our average value of 0.12/cm is just that, an average, and furthermore that the use of $\mu = 0.12$/cm in calculating left ventricular volumes is not a panacea. The depth of the ventricle in the thorax, the shape of the ventricle, the size of the region of interest, and amount of background activity relative to ventricular activity have been identified recently as potential sources of error in studies with phantoms (*6*). New ways to compensate for these errors in each individual case deserve investigation in human subjects. It is our belief that a search for better left ventricular volume determinations from a single, LAO view will continue because of the overall quality of the image in this view and its ease of application. Individual calculation of μ with an esophageal source (*3*) is likely to be superior to use of a universal value for μ, but is not, in our view, a practical technique for routine clinical studies. Fur-