LETTERS TO THE EDITOR

Regional Ventilatory Clearance by Xenon Scintigraphy: A Critical Evaluation of Two Estimation Procedures

Bunow et al. (*1*) have recently compared two estimation procedures for the analysis of regional ventilatory clearance using xenon scintigraphy. One of these procedures involves a least squares fit whereas the other utilizes the Stewart-Hamilton equation, which provides a measure of the clearance time-constant by dividing the area under the curve by its initial height (A/H technique). Their conclusions were that the two procedures have comparable reliability but that the A/H technique is preferred for clinical use because of its simplicity and speed.

It is rather unfortunate that they did not include the ratio of moments technique described by Nosil et al. (*2*), who showed errors in transit time about half those obtained by the area-over-height technique.

The A/H technique utilizes the Stewart-Hamilton equation: τ(transit time) = $\int C(t)dt/C_0$, where C(t) represents the counts at any time t during the washout phase and C_0 the counts at its onset.

The ratio of moments can be expressed by: τ(transit time) = $\int C(t)tdt/\int C(t)dt$.

The numerator in this expression is clearly prone to less statistical error than the denominator in the Stewart-Hamilton equation, and the ratio of moments is as simple and almost as rapid to calculate as the area-over-height value.

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REFERENCES

1. BUNOW B, LINE BR, HORTON MR, et al: Regional ventilatory clearance by xenon scintigraphy: A critical evaluation of two estimation procedures. *J Nucl Med* 20:703-710, 1979

2. NOSIL J, HUGHES JMB, HUDSON FR, et al: Functional imaging of lung ventilation using the concept of mean transit time. *Phys Med Biol* 21:251-262, 1976

Reply

We thank Dr. Goddard for his interest and comments on our work, and we regret omitting the ratio of moments method from our comparison of techniques. This omission is unfortunate, since Nosil et al. (*1*) have suggested that it may be more accurate than the Stewart-Hamilton equation (A/H). It should be noted, however, that we studied an important modification of the A/H method, one that minimizes its sensitivity to statistical error in C_0. This modification generates approximately equal numbers of counts in the numerator and denominator of the A/H formula by integrating counts during the equilibrium period. For washin-washout periods that are at least threefold the clearance time, our simulations show that equilibrium averaging substantially reduces the variation in clearance time estimates without introducing significant bias.

Dr. Goddard suggests that the ratio of moments formula may produce smaller statistical errors than the modified A/H method. We found, however, that the modified A/H estimates were as accurate as those produced by the method of least squares. This suggests to us that the method is nearly optimum for single-pixel data. The ratio of moments technique may be as good, but it is unlikely to be better. On the other hand, we have reservations about the clinical use of the ratio of moments technique where finite washout periods and background activity must be considered. The ratio of moments formula for truncated clinical studies is nonlinear, implicit, and computationally less efficient than that for the untruncated case. Moreover, although Nosil et al. (*1*) did not analyze the effect of background on the accuracy of the ratio of moments formula, it should be extensive, because background activity at the end of the washout period (large t) contributes significant error to the numerator of the moments ratio.

These considerations dampen our enthusiasm about the ratio of moments technique. There seems little to suggest that it would be preferable to the methods we have studied.

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REFERENCE

1. NOSIL J, HUGHES JMB, HUDSON FR, et al: Functional imaging of lung ventilation using the concept of mean transit time. *Phys Med Biol* 21:251-262, 1979

Premature Evaluation of a Ge-68→Ga-68 Distillation Generator

In their first article on ionic Ga-68 generators (*1*), Neirinckx and Davis assert some premature conclusions about a research project of ours that is still in progress. We have been studying a Ge-68→Ga-68 generator based on the distillation of carrier-free Ge-68 from a HCl medium (probably as predominantly H_2GeCl_6 rather than $GeCl_4$ (*2*)), and our initial findings have been presented in a preliminary fashion (*3*). While it is true that these data were obtained with apparatus and technique firmly embedded in the mainstream of basic research, we also recognize the desirability and necessity of adapting this potential generator to a practical or clinical environment. For the past year we have been developing and experimenting with a prototype distillation system that is cyclic, simple, and potentially adaptable to automation. Our aim is to devise a generator that is as uncomplicated as other more typical separation procedures and that provides a good separation factor for ionic Ga-68 over the useful lifetime of the generator.

Recent results at 1-100-μCi activity levels have been encouraging and lead us to believe that the above goals are obtainable. Experiments with 1-5 mCi of Ge-68 are currently in progress, and we will be able to draw more firm conclusions from these runs when