LETTERS TO THE EDITOR

Re: Determination of Organ Volume by Single Photon Emission Tomography

A recent paper in your journal described a method: "Determination of Organ Volume by Single-Photon Emission Tomography" (*1*). According to the authors the threshold values 45 or 46% should be chosen to get the proper outline of an organ. However, our group has found that the problem is more complicated.

It is fundamental that the numerical value registered for a voxel in a tomographic slice is determined by the radionuclide content in a much larger volume of the object. Assuming that proper attenuation correction is performed (which is seldom the case) the numerical value of the voxel may be considered as a weighted mean value for the content of a sphere with a radius of about 50 mm. The size and the weighting factors of this sphere are determined by the characteristics of the gamma camera, the settings of the pulse-height analyzer and the software program.

If a sufficiently large area of a plane surface is measured, it is presumed that the proper threshold value to outline the plane should be 50%, but if the object's size corresponds to one voxel, it is evident that the threshold value must be close to 100%. In the case of spheres we have found that the proper threshold setting ranges between 40 and 100% (*2*).

The sphere of sensitivity of the tomographic system, which is equivalent to the set of weighted factors mentioned, can be described by the formula:

$$F(x,y,z) = e^{-k_1(x^2 + y^2) - k_2 z^2},$$

where k is determined by the characteristics of the gamma camera and pulse-height analyzer, and $k_1 = k_2$ if the resolution is the same along all axes. The distance from the central voxel is

$$\sqrt{x^2 + y^2 + z^2}.$$

Using this formula the proper threshold settings for spheres of different sizes can be calculated and the results can be compared with phantom measurements. In the calculations it must be recognized that the maximum value in the central voxel depends on the size of the sphere. Thus the relation between the proper threshold setting and the size of an object is rather complicated and should be considered in the calculations. We have found it more convenient to have a fixed threshold value of 45% and to make corrections (*3*).

This procedure to calculate organ volume from transverse ECT reconstructions is used in clinical routines at our hospital. Measurements from the oblique reconstructions are unadvisable (*2*). We perform measurements of liver volume before and after surgical treatment, of liver and spleen volume in malignancy, and of kidney volume in children with reflux.

A much more complicated task is to measure tracer concentrations in different organs, since the attenuation correction used with a standard system is incorrect (*2,3*). We intend to analyze these problems in the future.

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3. SÖDERBORG B, DAHLBORN M, KARLBERG N, VIRGIN J: Numerical Analysis of ECT. In *Nuclear Medicine and Biology—Proceedings of the Third World Congress of Nuclear Medicine and Biology I.* Raynaud, C, ed. Paris, Pergamon Press, 1982, pp 514-517

Reply

Since the publication of this paper we have continued to work on the problem of phantoms for livers and kidneys in man. The original work was carried out in Orsay, France, using a General Electric 400 T camera interfaced to an Informatek SIMIS IV

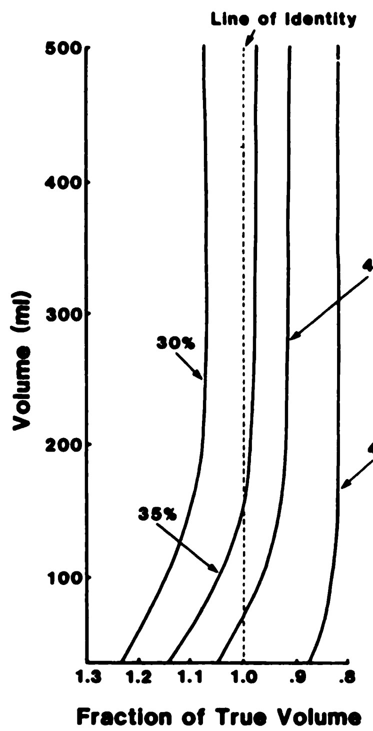

FIG. 1. Theoretical volumes of phantoms calculated with various thresholds, plotted against actual volume (dotted line). At volumes greater than ~170 ml, true volume is best predicted using 35% maximum concentration. These data were collected at UCH (London).