Extrahepatic Uptake of Technetium-99m-Phytate

TO THE EDITOR: The April 1990 issue of *The Journal of Nuclear Medicine* contains a report by Picard et al. (*1*) on the phenomenon of extrahepatic uptake of technetium-99m-phytate (^{99m}Tc-phytate). They state that "the advantage of ^{99m}Tc-phytate over ^{99m}Tc-sulfur colloid is its gradual redistribution from liver to spleen and bone marrow in the presence of increasing impairment of liver function." The truth is that all colloids used in scintigraphy of the reticuloendothelial system (RES) will show redistribution when the RES cells in the liver have a decreased capacity to handle colloids (*2*). Another fact is that patients with advanced cirrhosis have a decrease in the total phagocytic and metabolic functions of the RES (*3*).

In order to get exact information regarding uptake in the bone marrow, the best way is to record the uptake in the pelvic region during a constant time and with the same administered activity (*4*). To get objective information regarding the uptake in the spleen and the liver, it is best to record spleen/liver (S/L) ratios on computerized images. Another important factor is that the colloid is constant from batch to batch; albures is such a colloid. It is a human serum albumin colloid that is metabolized in the RES cells and has a narrow particle size distribution. The uptake of albures is rather similar to sulphur colloid but the uptake in the spleen is somewhat lower (*4*). We have made a similar study of the uptake of ^{99m}Tc-albures (*5*). Although the distributions of albures and phytate are different, our results should be of interest. Gamma camera planar studies and emission computed tomography (ECT) were performed on selected patients.

The S/L ratio was measured from computerized planar pictures over two central parts of maximal uptake over the liver and the spleen. The thickness of the liver and the spleen were measured from ECT for the two regions. Regarding the observed ratios of the planar pictures, the thickness of the liver seemed to be of minor importance. However, the ratios were strongly correlated to the thickness of the spleen.

A formula was derived, which calculated the volume of and the spleen and corrected for increasing attenuation with distance in the body. Most observations from the patient measurements appeared along the graph of the calculated formula. In cases with splenomegaly, the S/L ratio derived from the posterior registration was about the same as from ECT. In cases without splenomegaly, the S/L ratios found by ECT were significantly higher and more correct than the values recorded from posterior registration.

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Influence of Region of Interest Selection on the Scatter Multiplier Required for Quantification in Dual-Window Compton Correction

TO THE EDITOR: During discussion after the presentation "Dual-Window Compton-Scatter Correction in Phantoms: Errors and Multiplier Dependence on Energy" (*1*) at the 1990 Society of Nuclear Medicine Annual Meeting, the question arose as to why our scatter multiplier, k, is so large compared to that of others. In published work on the matter (*2*), we list a k value of 1.30 in the subtracted-image mode with maximum likelihood (ML) reconstruction. On the other hand, with similar windows, Jaszczak et al. (*3*) found a k value of 0.5. Now, one usually thinks of k as the ratio of the scattered counts within the photopeak window over the scattered counts within the scatter window for a given pixel. Thus, it could be defined to be spatially variant. In practice, however, it is usually defined to be a single weighting factor in the subtraction part of a complex procedure designed to produce a desired end. In our case, the desired end is quantification of a spatially-restricted hot object in a series of tomograms relative to a known-activity version of the same. We then write a proportionality:

$$\frac{A_U}{A_R} = \frac{C_U}{C_R}, \tag{1}$$

where A_U is the activity for the unknown object, A_R is that for the reference object, C_U is the tomogram strength for the unknown, and C_R that for the reference. Moreover,

$$C_U = C_P - k \cdot C_S, \tag{2}$$

where C_P is the total strength within given regions of interest (ROIs) for the tomograms reconstructed from the photopeak-window data and C_S is the same from the scatter-window data. Since we choose k in a calibration so that the calculated A_U agrees with the true value, k cannot have a prior definition and, in fact, its value obviously depends on the ROIs involved in the quantification procedure.

Recognizing that the Compton-scatter image has poorer resolution than the photopeak image because second-order

TABLE 1
The k Value Versus Sphere Location, Cylinder Size, and Background Activity for ML Algorithm in Subtracted-Image Mode for Two Different Size ROIs for the Reference Source

				k	
	Cylinder diameter	Sphere location	Specific activity ratio	Tight ROI for ref. source	Big ROI for ref. source
1	Large	Off-axis	0.00	0.73	0.41
2	Large	Off-axis	0.04	0.67	0.43
3	Large	Off-axis	0.09	0.53	0.36
4	Large	Off-axis	0.15	0.44	0.32
5	Large	Off-axis	0.20	0.48	0.37
6	Large	Off-axis	1.00	0.31	0.28
7	Large	On-axis	0.00	0.75	0.43
8	Small	Off-axis	0.00	0.78	0.48
9	Small	On-axis	0.00	0.73	0.43
		Average value		0.60	0.39

scatters are accepted by the lower-energy window, Jaszczak et al. went all the way to the edges of the SPECT image of a line source they were quantifying (thus using total counts). To be consistent, they also went to the edge of the planar image for their reference line source acquired in air. This procedure is perfectly reasonable for an isolated object. Looking ahead to the possibility that there might be a nearby hot object in our volume of interest, we defined a tight ROI for our spheres of unknown activity. For a line source in a cylindrical phantom, Monte Carlo simulations (where the true answer is known) show (*4*) that use of k = 0.5 leads to undercorrection of scattering in the projection at the source, but overcorrection in the wings. This implies that larger k values are needed to produce correct activities within a limited ROI in a reconstructed image, as we found.

One might consider increasing the value determined for C_S so that the single k value, which produces accurate quantification, would be smaller and, therefore, more like that for the pixel opposite the wings for a hot object. To do it, one could use two different size ROIs to evaluate the unknown objects—the one for C_P being tight as before, but the one for CS is larger (thus, accounting for picking up counts due to the poorer resolution in the scatter image). We have reevaluated our data following this procedure and obtained the results shown in Table 1. The required k value now averages 0.60 when a tight ROI is employed for the reference source. This value is only 20% greater than the Jaszczak et al. value of 0.5. With a 4x larger ROI for the reference source, the average drops to 0.39, 22% less than 0.5.

With the new procedure of using a larger ROI for the scatter image plus a larger ROI for the reference source, the k value is fairly constant with increasing background (see second column under k value in Table 1) as with the tight ROI selections previously recommended (*2*). Thus, a lower but constant k value is possible. However, when the object to be quantified is near another hot object, a large ROI in the scatter image may be heavily distorted by the activity of the nearby object. So, the technique of a tight ROI with a large k value (*2*) may still be the best practical approach.

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