ANALYSIS AND CORRECTION OF SPATIAL DISTORTIONS PRODUCED BY THE GAMMA CAMERA

Spatial distortions produced by the optical and electronic systems of the gamma camera will produce an apparent nonuniform sensitivity response of the crystal as outlined recently in the Journal (1). If corrections for these distortions are obtained independently as detailed in the paper, then the correction for the spatial distortion should be made to an image before the correction for the sensitivity distortion since the spatial distortions as indicated in this paper may cause a larger error in the sensitivity distortion than a sensitivity distortion will cause in a spatial distortion. A better approach would be to perform an iterative procedure to obtain the spatial and sensitivity correction factors such that they are commutative.

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REFERENCE


AUTHOR’S REPLY

Dr. Perry raises two interesting and important points: first, to what extent spatial distortions in gamma camera images contribute to observed nonuniform sensitivity response (and vice versa), and second, whether spatial or sensitivity corrections should be first applied to a gamma camera image. The purpose of our paper was to describe and illustrate the use of a computerized technique for the analysis and correction of spatial distortions in gamma camera images, without regard at that time to those points raised by Dr. Perry, which, however, we have subsequently been investigating.

Regarding the first point, we collected ⁹⁹mTc sheet and grid source images, each of 3 million total counts, using the 4,000-hole technetium collimator and Pho/Gamma HP camera/PDP-8/I imaging system, and generated sensitivity and spatial correction factors for the entire 50 × 50 data matrix. The camera was well-tuned, the count variation across the flood image having a standard deviation of 8% of the mean count. Application of spatial correction factors to this flood image insignificantly reduced the sensitivity uniformity to a standard deviation of 7% of the mean count value. Conversely, application of sensitivity corrections to the grid source image reduced the mean spatial error by 17% from 1.86 to 1.55 mm. These results confirm those of a previous study (1) in which the ranges and means of x and y spatial errors were reduced by up to 36% on application of sensitivity correction factors. Thus the sensitivity nonuniformity caused a larger distortion in the grid image than the spatial errors produced in the flood image, contrary to Dr. Perry’s suggestions.

These data suggest that at that level of sensitivity uniformity (s.d. = 8%) spatial error correction does not significantly improve sensitivity uniformity of an image and that application of spatial correction factors is not worthwhile. However, nonuniform sensitivity contributes significantly to spatial distortions, and application of sensitivity correction factors does improve image linearity. We are currently investigating the effect of spatially correcting flood images recorded with an increasingly detuned camera, with increasing count variation across the crystal face, to determine if the sensitivity variations are significantly reduced.

Regarding the second point, it is thus not yet known which route of image correction should be followed for maximum fidelity of object reproduction—spatial before sensitivity, sensitivity before spatial, or an iterative procedure, as suggested by Dr. Perry. In any case, the flood or grid source image, from which sensitivity or spatial correction factors are generated for the second correction, must first have been corrected for spatial or sensitivity distortions, respectively. We are currently investigating the first two routes of gamma camera image correction to determine their relative efficacy for image correction. At present it appears that sensitivity distortions contribute more to overall image distortion than spatial errors, and it is more important for laboratories with limited computer facilities to correct for nonuniform sensitivity response than for