Letter to the Editor

A Noisy Photomultiplier Tube: Its Unusual Effect on Gamma Camera Image Uniformity

Nonuniformities in an Anger camera response to a flood field of radiation is normally associated with malfunction of one or more photomultiplier (PM) tubes or their associated electronic circuitry. Location of the defective components can normally be deduced from the pattern of the nonuniformity of a flood image. We recently observed a nonuniformity in a flood image on a jumbo field-of-view gamma camera that provided a totally misleading indication of the camera fault.

Figure 1A shows an image of an intrinsic flood obtained with a ^{99m}Tc point source. There is a large band of nonuniformity on the right side of the image. An image of a BRH phantom showed a similar nonuniformity with some loss in image resolution (Fig. 1B). The cause of this nonuniformity was initially suspected to be a defective cathode ray tube in the analog image formatter as the degree of nonuniformity varied with repeated flood images. However, a concurrent calibration of the formatter with point sources of ^{57}Co placed on the camera collimator showed a tail on some of the sources. Placement of further sources on the camera yielded the image seen in figure 1C. Examination of the camera head by the service engineer showed a noisy PM tube. The location of this tube was diametrically opposite the nonuniform area and coincided with the intersection of lines drawn through the tails of the point source images. The reason for the tails on these images was contamination of the pulse arithmetic calculation of gamma ray location. On a random basis, noise from the PM tube was added to the pulse arithmetic signals causing a shift in the positioning of some events toward the noisy PM tube. The errors in pulse positioning increased with distance from the noisy PM tube causing the nonuniformities in the flood image to appear diametrically opposite it.

The noisy PM tube was replaced and image uniformity and resolution returned to normal. In our experience this is an uncommon cause of image nonuniformity, but one that can be easily identified by examining images of point sources placed on the gamma camera collimator.

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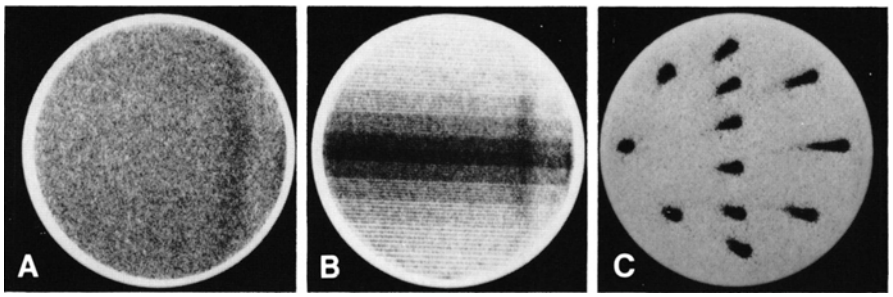

FIG. 1. (A) Intrinsic flood field image (2 million counts) obtained with a point source of ^{99m}Tc. A dark nonuniform band is present on the right side of the image. (B) Intrinsic image of a BRH phantom obtained with ^{99m}Tc. There is slight loss of resolution on the right side of the image. (C) Extrinsic image obtained using point sources of ^{57}Co placed on the collimator face. Note the presence of tails on the point source images, increasing in length from left to right across the image.