

First demonstration of portable Compton camera to visualize ^{223}Ra concentration for radionuclide therapy

Radionuclide therapy (RNT) is an internal radiation therapy that can selectively damage cancer cells. Recently, the use of alpha-emitting radionuclides was initiated in RNT owing to its dose concentration and short range. In particular, ^{223}Ra is widely used for bone metastasis cancer. Despite its potential for clinical applications, it is difficult to know whether the drug has been properly delivered to the target lesion. As such, we propose a new method of monitoring nuclear gamma rays promptly/simultaneously emitted from ^{223}Ra in alpha-decay by using a high-sensitivity Compton camera. We first observed a small bottle of ^{223}Ra solution that had a total radio-activity of 0.56 MBq. The reconstructed image converged at the correct position with a position resolution of ~ 20 mm at a plane 10 cm ahead of the camera. Next, we observed a phantom consisting of three spheres, with diameters ranging from 13 to 37 mm, filled with ^{223}Ra solution (9 kBq/ml) and then surrounded by a ~ 20 -cm layer of water. A 3D image was constructed by rotating the Compton camera around the phantom. Then, images were taken from eight directions at 30-min intervals, respectively. Although the image resolution remains limited at 351 keV, three spheres were resolved at the correct position in the 3D image with their relative intensities. Finally, we discuss current problems and plans for improving the sensitivity and angular resolution for future clinical applications.

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