Analysis of Radionuclide Computed Tomography for Dynamic Study. Preliminary System Using Multicrystal Gamma Camera

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Radionuclide computed tomography (RCT) system for brain imaging has been constructed using a conventional multicrystal gamma camera. The detector consists of a 14 × 21 mosaic NaI crystal separating 11 mm from each other and a 10 cm long tapered hole collimator with 0.5 mm thick septum. A patient on a revolving chair was rotated three times in front of the detector. Rotation was discontinuous with 9° step. At every rotation the revoluting axis was displaced by a third of crystal separating distance. Total scan required 10 min. After editting into 40 views radionuclide distribution was reconstructed using additive iterative method with attenuation correction. Reconstructed image was displayed on CRT in a 64 × 64 matrix of 3.67 mm pixel size. System performance was examined using ^{99m}Tc in various phantoms in 15 cm ϕ plastic cylinder. Spatial resolution across to section plane was 10 mm at the peripheral and 12 mm at the center. Accuracy and linearity of RCT number to activity were examined using phantoms filled with various concentration of ^{99m}Tc solution. RCT number plotted corresponding to activity was revealed correlation coefficient of 0.988. Relationship of RCT number to activity was, RCT number $=1.30 \times (\mu\text{Ci/m}l) + 1.53$. The second term of constant was scattered radiation where activity is zero. Clinical studies on patients with and without intracranial lesion using ^{99m}Tc-labeled pharmaceuticals were discussed.

Radionuclide Computed Tomography by Gammacamera (3)

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An attempt to reconstruct RI-emission CT was made by means of computer simulation, phantom and patient studies using gammacamera.

The section images were reconstructed by Fourier transform and convolution method with attenuation correction. The simulation were performed on the assumption that the cold/hot and disk phantom consisting of source with ^{99m}-Tc in water was measured by gammacamera. The projection data were obtained by taking account of the attenuation coefficients and line spread function of detector system to value of each pixel, and were given Poisson random nosie.

An approximate attenuation correction was done using either Sorenson's method or Kuhl's. The correction assumes the sclise field is circle with constant attenuation coefficient ($\mu=0.15\ \text{cm}^{-1}$). Reconstructed section images were comapred on concerning kind of correction function (filter), number of projection required, count level of data and effects of attenuation compensation. Discrepancy between true and reconstruction image were evaluated by cross correlation coefficients.

In the clinical studies, a patient was set on a lotating chair in front of the gammacamera, and the data from patient's head with ^{99m}-Tc was collected into magnetic disk memory for 30 sec at each of 36 views. The projection data were represented by sum of three rows of 64 × 64 data from each of the 36 frames.

These data were made about 20 slices in one case. The section images were successfully obtained by convolution method using high-cut filter, such as Chesler's, and projection data seemd to require at least 5 × 10^4 counts at 30 views.