DESIGN AND PRERIMINARY EXPERIMENT OF A NEW COLLIMATOR FOR COMPTON SCATTER TOMOGRAPHY (CST)

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In the previous report we showed some physical characteristics of CST by the phantom experiments. We pointed out a low efficiency of CST for the exposure dose. A much poorer image is obtained by this method for the same exposure dose than images obtained by the conventional methods as the X-ray computed tomography (XCT). For example it needs the exposure dose of about one rad to collect 10000 count from a volume element of 5mm x 5mm x 10mm in our experimental condition. 10000 count per pixel corresponds to the statistical accuracy of 1.0 percent. In the XCT with the same exposure dose we can achieve the statistical accuracy of 0.4 percent to the volume element of 1.5mm x 1.5mm x 13mm. Such facts mean that CST is about 1/100 time as effective as XCT as to the exposure dose.

A new collimator is designed to overcome the weak point of CST mentioned above. This collimator consists of many parallel planes perpendicular to the scintillator surface. Pencil-shaped beam of gammaray is irradiated to the object from the direction perpendicular to the parallel planes. The coordinate in the object is determined both by the position of gamma-ray and by the collimator. The geometric resolution of this collimator for the gamma-ray direction is given by

$$Rg = \frac{a+b+c}{a} d$$

(a : collimator thickness, b : distance between collimator and cross section, c : distance between collimator and scintillator surface, d : interval of parallel planes) The geometric efficiency of this collimator is given by

$$g = \frac{1}{2\pi} \frac{d^2}{a(d+t)} \arctan \frac{l}{2(a+b+c)}$$

(l : collimator length, t: thickness of parallel plane) These ewuation shows that such a collimator is about 30-50 times as effective as a conventional one. In the preliminary experiment we have confirmed the relations mentioned above.

EVALUATION OF ^{99m}Tc PHARMACEUTICAL IMAGE IN MICE BY THE IMPROVED HUMAN SCANNER

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^{99m}Tc images of good quality in mice were obteined by improved human scanner with exclusive collimator.

The scanner was JSS-133U(ALOKA CO. Ltd.,). The improvement of scanner was only scanning speed down 25cm/min. to 10.8cm/min.. The three exclusive collimators were model CCI-52L2V(253 holes),model CCI-52L2W(517 holes)and CCI-52L2X(931 holes). About each collimator's FWHM,253 holes=5mm,517 holes =4mm or less,931 holes=3mm or less,and about relative sensitivity to the collimator for human (model CCI-525U-37 holes), 253 holes=36%, 517 holes=13% and 931 holes=2.3%.
It was conclued ,this scanner and collimators were very usefull for fundamental evaluation of ^{99m}Tc pharmaceuticals metabolism in small animals,model CCI-52L2W(517 holes) collimator was specially usable for scanning.