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Use of a compact pixellated gamma camera for small animal pinhole SPECT imaging

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Objectives: Pinhole SPECT which permits *in vivo* high resolution 3D imaging of physiological functions in small animals facilitates objective assessment of pharmaceutical development and regenerative therapy in pre-clinical trials. For handiness and mobility, the miniature size of the SPECT system is useful. We developed a small animal SPECT system based on a compact high-resolution gamma camera fitted to a pinhole collimator and an object-rotating unit. This study was aimed at evaluating the basic performance of the detection system and the feasibility of small animal SPECT imaging. ***Methods:*** The gamma camera consists of a 22 × 22 pixellated scintillator array of 1.8 mm × 1.8 mm × 5 mm NaI(Tl) crystals with 0.2-mm gap between the crystals coupled to a 2″ flat panel position-sensitive photomultiplier tube (Hamamatsu H8500) with 64 channels. The active imaging region of the camera was 43.8 mm × 43.8 mm. Data acquisition is controlled by a personal computer (Microsoft Windows) through the camera controller. Projection data over 360° for SPECT images are obtained by synchronizing with the rotating unit. The knife-edge pinhole collimators made of tungsten are attached on the camera and have 0.5-mm and 1.0-mm apertures. The basic performance of the detection system was evaluated with ^{99m}Tc and ^{201}Tl solutions. Energy resolution, system spatial resolution and linearity of count rate were measured. Rat myocardial perfusion SPECT scans were sequentially performed following intravenous injection of ^{201}TlCl. Projection data were reconstructed using a previously validated pinhole 3D-OSEM method. ***Results:*** The energy resolution at 140 keV was 14.8% using a point source. The system spatial resolutions were 2.8-mm FWHM and 2.5-mm FWHM for ^{99m}Tc and ^{201}Tl line sources, respectively, at 30-mm source distance (magnification factor of 1.3) using a 1.0-mm pinhole. The linearity between the activity and count rate was good up to 10 kcps. In a rat study, the left ventricular walls were clearly visible in all scans. ***Conclusions:*** We developed a compact SPECT system using compact gamma camera for small animals and evaluated basic physical performances. The present system may be of use for quantitation of biological functions such as myocardial blood flow in small animals.

Key words: SPECT, pinhole collimator, compact pixellated gamma camera, small animal