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PERFOMANCE OF WHOLE-BODY 7 SLICE POSITRON COMPUTED TOMOGRAPHY.

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A 4-detector ring 7-slice whole body positron CT (PCT) has been developed and its performance was evaluated. This PCT has 768 BGO detectors (192 per ring) and employs a continuous rotation scan (0.5 rps). Ring diameter was 82 cm and the total axial slice length was 12.0 cm. Sensitivity including scatter for 20 cm ø cylinder phantom was 34.2 and 52.2 kcps/µm/ml (in-plane and cross-plane, respectively). Spatial resolution for reconstructed image was 7.6 mm FWHM at the center of field of view. The PCT resolved 3.0 mm ø hot spots clearly in Derenzo phantom study. Tranmission and emission images of thoracic phantom containing the "heart" filled with Ga-68, the "lung" and the "spine". The heart image showed homogenous isotope distribution with standard deviation less than 6% after attenuation correction.

We conclude that this whole-body PCT multi-slice PCT provides high sensitivity and spatial resolution. Further basic study should be necessary for quantitative analysis.

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VALIDATION AND LIMITATION OF PHYSIOLOGICAL MEASUREMENT BY POSITRON COMPUTED TOMOGRAPHY.

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To validate the physiological measurement by positron computed tomography (PCT), the limit of accuracy in measurement of regional myocardial blood flow (RMBF) was assessed with left atrial injection of Ga-68 microspheres and arterial sampling technique in eight open chest dogs with or without coronary ligation. PCT myocardial activity was determined in 8.4 x 8.4 mm regions of interest and RMBF was calculated using arterial reference blood counts. A cylindrical uniform phantom containing Ga-68 was used to obtain a calibration factor for conversion of PCT measurements to sample counting values.

Average RMBF in the eight dogs was 70 ml/min/100g by tissue counting and 63 ml/min/100g by PCT, with an average absolute error of 14%. The correlation of RMBF by tissue counting and PCT in 16 radial segments around a transverse ring of left ventricular myocardium yielded r=0.88, RMBF(PCT) = 0.81 x RMBF(counting) + 5.18. The results demonstrate that using appropriate tracer and a scanner with sufficiently high resolution, RMBF can be accurately measured by PCT.

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EFFECT OF POSITRON RANGE ON SPATIAL RESOLUTION IN POSITRON EMISSION COMPUTED TOMOGRAPHY.

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High spatial resolution of positron emission computed tomography is important for quantitative measurements. Positron range limits the spatial resolution of positron computed tomography systems. To evaluate effect of the positron range on the spatial resolution, projection of positron range distribution for a line source placed perpendicularly to the tomogaphic plane is assumed to be a cusp-shaped function and response function of coincident detector pairs by Gaussian function. The response function of the coincident detector pair is convolved with the projection of the positron range distribution and reconstructed by using Shepp-Logan filter. Increase in width of line spread function due to the positron range was evaluated for systems with detector pair resolutions from 1 to 15 mm full-width half-maximum (FWHM). For instance, for a system with 3 mm FWHM detector pair resolution, positron ranges of ^{11}C, ^{68}Ga and ^{82}Rb result in projections of 2.7, 18.0 and 23.9% increase in FWHM, respectively, and line spread functions of 2.24, 12.5 and 12.8% increase in FWHM, respectively.

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STUDY OF THE FACTORS EFFECTING ATTENUATION CORRECTION MEASUREMENT IN POSITRON EMISSION COMPUTED TOMOGRAPHY.

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Quantitation in positron emission computed tomographic images can be achieved by attenuation correction of annihilation γ rays. Attenuation is measured directly with external positron sources. Attenuation correaction factors (ACFs) measured have statistical errors which are inversely proportional to the square root of the total counts for the measurement. The noise in emission image increases by these errors.

Therefore effects of the errors on ACFs of emission images were investigated by simulation studies. The phantom diameter is 20cm. It was found that noise levels in emission images obtained with less than a million counts were $\geq$9.4%, if ACFs were noise-free. When these images were corrected using noisy ACFs obtained with $\geq$4 million effective counts, %SD of noise levels were increased but less than 3 %. It was also found that applying smoothing on ACFs may be useful to reduce the noise levels in emission images.