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EXPERIMENTAL ANALYSIS OF ERRORS AND ITS CORRECTION OF POSITRON STUDY OF HEADTOME.

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Accidental coincidence measured by Tc-99m was double of theoretical coincidence, $2\tau C_1 C_2$, where 2τ is coincidence time window and C_1 and C_2 single count rates of individual detectors. Scattered coincidence for 20 cm of Ga-68 with various slice thickness was evaluated as 0.013 x (slice thickness) x true coincidence). These two factors were corrected by subtracting mean value of events in off-area of projections. Attenuation coefficient measured by comparing projections of blank scan and transmission scan of 20 cm water pool was 0.016 cm^{-1}. Mismathed shape for attenuation correction induced serious image distortion not only of reconstructed values but also of contour, therefore, accurate delineation detection of object or transmission correction using ring source is indispensable. Efficiency of each coincidence pair can be calibrated by employing ring source or disk source. Ring source calibration had advantage to simultaneously correct attenuation correction, but with increasing statistical error. Disk source calibration was convenient for routine studies with small increase of statistical noise. These correction techniques gave high quantitativity of relation of pixel values and emitter distribution of object.

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PERFORMANCES OF NaI DETECTOR OF "HEADTOME" FOR POSITRON ANNHILATION RAY.

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In Positron Emission Computed Tomography, the performance of the imaging device has been specified primarily by the characteristics of the detector. We studied the response of NaI detector when detecting positron annihilation ray (511 KeV). The study was made mainly by using the NaI detector used in the Hybrid Emission CT "HEADTOME" we had developed. A series of measurements were carried out positioning two detectors with 40 cm distance and scanning Na-22 point source in water between the detectors perpendicular to the detector axis. Both detectors were inclined from 0° through 30° to change incident angle of positron annihilation toward crystal face. Energy window was set from 100 to 700 KeV. We presented the results as follows; 1) When scanning the point source at various distance from the center of two detectors spatial resolution changed about 10 % but sensitivity did negligible. 2) Beam mask which was made of lead in order to improve spatial resolution and placed on crystal face, degraded uniformity of spatial resolution. 3) Shortening the crystal length from 7 to 5 cm made sensitivity decrease 10 % and resolution deteriorate 0.8 mm FWHM. 4) As the results of varying the width of the crystal, it seemed that 20 mm width was optimal at any incident angle.

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THE ANALYSIS OF OPTIMUM WOBBLE PARAMETER OF HEADTOME.

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The positron measurement with Ga-68 has already started using the hybrid emission CT HEADTOME. HEADTOME provides two mechanical functions for sampling raysums in positron measurement, the ring rotating and the ring wobbling. The half-detector rotation improves the ray sampling by a factor of two, but the other rotational increments do not increase the ray sampling per view. Thus, the detector array is moved in a small circular motion which called the "wobble" to improve the ray sampling. We investigated the optimal diameter of wobble and number of wobble points with employing the computer simulation. The studies resulted that the choice of wobble diameter of (3/4) x (D/2) (D: detector width = 20.6 mm) produced the uniform sampling and 9, or possibly 7, wobble points combined with a half-detector rotation were sufficient to meet the sampling requirement. These results were reflected in our HEADTOME II under developed. On the present system the wobble diameter was $(1/\sqrt{2})$ x (D/2). The spatial resolution of reconstructed images with 5 wobble points was 11 mm and 13 mm FWHM at 2 cm and 10 cm radius respectively. The spatial resolution was not improved with the other increasing wobble points at 64 x 64 matrix (pixel size 3.7 mm x 3.7 mm).

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HEADTOME II :MULTISLICE HYBRID EMISSION TOMOGRAPH.

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Design of multislice hybrid emission tomograph HEADTOME II was reported. Basically HEADTOME II is an upgraded machine of present HEADTOME to achieve multislice scanning to view whole brain at once, and to improve performance in dynamic study. The detector consists of three rings of circular array of 64 NaI crystals. NaI measures 16 x 28 x 50 mm. Between NaI crystals 2 mm lead septa are used. Ring diameter is 420 mm and planer field of view is 210 mm. Center to center distance between rings is 35 mm and axial field of view is 100 mm. Lead ring of 5 mm are interlaid between NaI rings. Four collimators are exchangeable from backward of gantry. Single photon collimator is rotating drum on which many tungsten septa are planted with progressively increasing angle against the center of field of view. By rotating this drum collimator focus point of each detector move whole field of view. High resolution collimator will provide 6 mm FWHM and high sensitivity collimator 80 kcps/(μCi /ml) for Tc-99m study. Positron collimators consist of conventional lead doughnuts. High resolution collimator has 20 mm slice gap and high sensitivity 28 mm slice gap. Only high sensitivity collimator will enable cross slice.