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DEVELOPMENT OF HIGH SENSITIVITY SLANT HOLE GAMMA CAMERA COLLIMATOR FOR MEASUREMENT OF rCBF BY INTRAVENOUS Xe-133 INJECTION.

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We developed a new high sensitivity collimator for the non-invasive measurment of rCBF with a gamma camera system. The collimator was designed as a slant hole type, which permitted closer approah to the patient's head. It has 1200 holes of 7.6 mm in diameter, 20 mm length,15 mm septal thickness and 30 degree of the slant angle. The count rate with the collimator was 9700 cps for 100 μCi of Xe-133, which was 17 times higher than that with the ordinary high sensitivity low energy collimator supplied by the manufacturer. The values of FWHM for the collimator were 20 mm at collimator surface, and 35 mm at 50 mm distance from the surface in air. In 15 cases with intravenous slow injection of 10 mCi of Xe-133, peak counts ranged 128353±3496 counts/5sec [mean±SD] in the hemisphere, and 1046±292 to 1745±546 counts/5sec[mean±SD] in the 20×20 mm regional ROIs, respectively. These results suggested that the newly developed collimator has sufficient sensitivity and resolution for the non-invasive rCBF measurement with a gamma camera system.

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FACTORS AFFECTING ACCURACIES OF TOMOGRAPHIC MEASUREMENT OF rCBF BY HEADTOME.

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Factors affecting accuracies of tomographic regional cerebral blood flow (rCBF) were investigated using a Xe-133 inhalation method and a dynamic single photon tomograph, HEADTOME. Several improvement and device were attempted based on the investigation.

To minimize statistical error and loss of xenon gas, suitable volume of inhalation bag and breath-synchronized control of gas inhalation system were required. To avoid time mismatching between the tomographic head data and the endtidal air curve, the interval of these data acquisition timing was standardized. Mouth piece was superior to a face mask for the inhalation to diminish the effect of scattered radiation from the nasal cavity. Setting of window lower level on discriminator was one of the most important factor to avoid a scattered radiation especially in case of Xe-133. Other sources of possible errors were evaluated and improvements against the sources were also attempted.

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AN ATTEMPT TO ASSESS AND CORRECT THE INFLUENCE OF SCATTERED RADIATION ON CBF STUDIES.

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In rCBF studies with Xe-133 i.v. injection method, measurements over frontal and temporal regions will unavoidably be contaminated by scattered radiation from airways. To diminish the problem of the airway artifact, we tried the new computer algorithm for estimation and correction of the airway contamination of the head clearance curves. After the starting i.v. injection of Xe-133, the radioactivities are recorded in the head and airway regions for 11 min with 1 sec sampling intervals. The increased radioactivities were shown in the head regions due to variations in the isotope concentration in the airways accompanying the respiratory cycles. These count rates in the head and airway regions were integrated and the integrated values were described as ΔH and ΔA. The weight of the artifact was calculated from the ratio ΔH/ΔA. The corrected curve (Cc) was then calculated according the formula: $Cc(t)=C(t)-\Delta H/\Delta A \cdot C(t)$; C(t);head curve, Ca(t);end-tidal air curve. The presence of Xe-133 in the airways produced extracranial count rates that equaled 1.3% to 6.4% of those normally recorded at the end of a one-minute i.v. injection. The airway artifacts were suggested to increase the calculated CBF values (F1) by 1.8% to 2.2% of the true values.

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A STUDY FOR QUALITATIVE IMPROVEMENT OF IMP SINGLE PHOTON ECT IMAGE.

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N-isopropyl-I-iodoamphetamine(IMP) can be used to evaluate regional cerebral perfusion in humans. However,high guality image of IMP using single photon ECT(SPECT) is not necessarily obtained because gamma camera rotating SPECT has larger head-to-detector distance and can not detect sometimes enough radioactivity for high quality image. Furthermore, brain uptake of IMP is less than 8% of injected dose.

One of the method to obtain high quality image of IMP using gamma camera rotating SPECT is expected to performe SPECT at as smaller head-to-detector distance as possible. In the present study a slant hole collimator and 400AC/T camera with a parallel hole collimator were adopted as the methods to achieve shorter head-detector distance. The phantom study and clinical study in the present investigation revealed that SPECT data acquired at shorter distance had better resolution and higher quality image. The method adopted in the present study was considered to be useful for qualitative improvement of IMP image using SPECT.