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COUNT RATE CHARACTERISTICS AND A METHOD OF DEADTIME CORRECTION IN POSITOLOGICA III.
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We have studied the relationships of the source activity and the count rate of Positologica III, a whole-body multislice PET scanner, using several kinds of phantoms containing C-11 solution. In 20cm diameter cylindrical phantom, as much as 12% count loss occurred at the count rate of 10kcps per slice, suggesting the necessity of deadtime correction in quantitative PET studies. However a wide variation existed in the relationships of count loss and true coincidence count rate depending on the source distribution, and the deadtime correction using the count rate itself was unsuccessful. Most count losses occur at the address encoders of the electronics circuitry, and our result indicated that the rate of the count loss was determined mainly by the single rate regardless of source distribution. Therefore we measured the single rate to correct for the count loss employing the saturable process model. This method enabled deadtime correction independent of the distribution of source and attenuation material. On the other hand, deadtime correction using the random coincidence rate was sensitive to the statistical errors when the count rate was low.

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A STATISTICAL STUDY ON THE VARIATION OF CROSS-CALIBRATION FACTORS BETWEEN PET AND WELL COUNTER.
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The cross-calibration factor (CF) between the regional count obtained by PET and activity concentration measured by well counter, which is used to count the arterial blood activity, has a paramount importance for the quantitative capability of the PET studies. When the sensitivity of the detectors are normalized by the blank scan, CF should be constant as long as the same external source is used. We measured CF every week (totally 18 times) using the same external source and a 20cm diameter cylindrical phantom containing Ga-68 solution and evaluated its variation and reliability. The standard deviation of CF ranged from 0.7 to 0.9% of the mean, depending on the slice. We employed variance analysis technique to separate the variation into the between-experiment component and the residual component. The standard deviation of each component was 0.63% and 0.55% of the mean, respectively. The former was attributed to the sensitivity variation of the well counter and the experimental errors in counting technique. The sensitivity fluctuation of PET detectors was considered responsible for the latter. This analysis helped us investigate the source of CF variation and minimize it.

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DAILY AND WEEKLY FLUCTUATION OF SENSITIVITY IN CLINICAL PET SYSTEM.
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Daily and weekly fluctuations of sensitivity of HEADTOME III were evaluated as a routine clinical tool for quantitative study using a positron emission tomograph (PET). The sensitivity of the PET was measured using a plane source filled with Ge-68 three times a day for the week long after the maintenance of detector gain and timing adjustment was done, and the other week immediately after the maintenance was done. In the first week the fluctuation resulted in more than 1 % at maximum within a day, and 0.5 % as average in the week. However, in the second week after the maintenance, it was reduced to 0.6 % at maximum in a day and 0.2 % as average. In order to evaluate the relationship between these fluctuation and circumstance of PET and well detector, correlations of sensitivities with a room temperature or humidity were examined. But any significant correlation was not found. Thus, it is inevitable to calibrate the sensitivity more frequently than once a day. The simple correction method was proposed using sensitivity for the ring source filled with Ge-68 which takes only 5 min.

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A SIMULATION STUDY OF A METHOD TO REDUCE POSITRON ANNIHILATION SPEED DISTRIBUTIONS USING A STRONG MAGNETIC FIELD IN PET.
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The positron range in tissue will be one of the fundamental limits to the spatial resolution in a future positron emission tomograph giving sub-milli-meter resolution. It is one solution for this limitation to apply a magnetic field to reduce the positron range. In this study, a three dimensional Monte-Carlo simulation code has been developed in order to evaluate how strong magnetic field confines the positrons effectively. The spread has been calculated by simulating the positron trajectories under various strength of the external magnetic field and for various positron maximum energies.

The results are shown in figures.