Therefore, the above-mentioned techniques are now applied in our laboratory to kidney dynamic studies, such as perfusion, secretion, excretion and also difference in dynamics upon the postual change etc. And also these fundamental image processings are very useful and necessary for dynamic data processings.

A High Resolution Gammacamera

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A new Gammacamera with high position resolution capability is developed. The gammacamera is based on the delay line position computing circuit, and its out view is the same as standard type gammacamera GCA-101. Using the delay line position computing circuit, the output signals from PMT's which are far from the scintillation event in the NaI (T*l*) crystal contribute very little to position signals and high position resolution capability can be obtainable. The intrinsic position resolution (FWHM) is 8.5 mm for ^{99m}Tc. Ordinal bar phantom studies for intrinsic resolution show this camera resolves 3/16 inch (4.7 mm) bars separated by a like distance.

The system resolution of a garmmacamera is determined by two factors, one is the intrinsic resolution of the detector and the other is resolution capability of collimator.

To improve the system resolution of the camera high resolution collimator for 140 KeV is developed. The optimum geometric structure is determined theoretically.

Applying new fabrication techniques, the collimator has the position resolution of 8 mm at 100 mm far from the collimator surface and exhibits the detecting sensitivity 1.25 times as great as ordinal 4000 hole collimator.

Combining the high resolution collimator to the new gammacamera system resolution of 11.5 mm is obtainable.

To clarify the performance of the camera and the collimator, scintigrams of IAEA Liver Slice phantom are taken.

Nonlinear Image Processing in Radioistope Scintigraphy

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The problem of increasing the resolution of a radioisotope scintigram can be formulated as the solution of a convolution type integral equation, but solving this integral equation is extremely difficult if noise is present in the data.

In order to overcome this difficulty, we previously investigated the "Least Squares Deconvolution Method" in which the expected squared difference between observed and processed image distribution was minimized.

In this report two practical nonlinear techniques are discussed. At first, by minimizing the weighted expected squared difference in which the weight function is chosen to be signal-to-noise ratio (square root of observed count number), nonlinear normal equation was obtained.

Unfortunately, the problem then becomes very much more difficult mathematically. However, the zeroth order approximate solution of this nonlinear normal equation which may be called nonlinear matched filtering was shown to be a practically useful method of smoothing and enhancement in clinical radioisotope scintigraphy. The other method of treating the noise of scintigram is the logarithmic preoperation method.

Some fluctuative effects in image construction may be realistically modeled as multiplicative processes rather than additive one.

Then, the distribution of statistical fluctuation can be approximated by lognormal law rather than by normal one. The approximate lognormal fluctuation law of count number from constant radionuclide was proved by plotting the data on normal probability sheet.

In such cases, logarithmic preprocessor separates the multiplicative noise from signal and allows conventional smoothing and deconvolution theory to be applied. We applied the averaging and differential operator method of approximate deconvolution after logarithmic operation to observed image matrix. Then the output was raised to an exponential power to restore the effect of the logarithmic operation.

Data Processing of Renogram Using Small Digital Computer

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A study of data processing of ^{131}I Hippuran renogram was performed by a small digital computer, in order to offer various parameters for computer to obtain a precise diagnosis of renal function.

During renography, pulses from the scintillation detectors were recorded on the magnetic tape as a media converter, and stored in the memory of computer. From this stored image, various parameters of renogram were calculated as described below, and the original and logarithmic curves were plotted by a digital plotter. A differential curve was calculated from the original renogram, then by this differential curve Segments A, B and C were decided, and the maximum CPM in the Seg. A and Seg. B and the time to each maximum CPM and the ratio of these maximum CPM were calculated. Each area of these segments and their percentages were calculated.

From the logarithmic curve of renogram, Seg. C was divided into two parts: the initial relatively steep slope (Curve 1) and the secondary gentle slope (Curve 2), and the time to an intersecting point of these two curves was estimated.

The differences of CPM between Curve 1 and Seg. B were considered to be the renal uptake of Hippuran, and this accumulation curve was obtained as an exponential function. These Curves 1, 2 and Accumulation Curve were expressed by the approximate exponential functions and the exponents of these functions were expressed also by the form of the half value time.

CPM due to ^{131}I Hippuran in the nonrenal tissues in the field of view of the detector, i.e. blood background formed a relatively large proportion of the standard renogram. It may be valuable, to remove the distortion of the standard renogram curve mixed by blood background.

The authors have developed a method of blood background subtraction including the use of two channels analogue subtraction unit