activity and on the organ in a human-sized manikin. This study suggests that by using radioisotope scanners, it is possible to quantitate the activity of organs, in addition to a thyroid gland, when the scan counts are summed and averaged over a selected area, and corrections are applied for nearby activity.

Differential Radioisotope Image

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The radioisotope image (area image) obtained with various imaging devices consists of an array of counting-rates in elemental areas over the entire image-plane. The counting-rate is an integral count during the unit time interval. So, the usual radioisotope image can be called as "integral image."

Here we present a new method of image visualization, "differential imaging," in which the rate of change in counting-rates in elemental areas is calculated from the "integral image" and plotted as a function of positions.

As an "integral image," the digital image obtained from a thyroid phantom using a rectilinear scanner was employed,(1) and differential calculation was carried out using a digital computer, Burroughs 5500.

The resulting digital "differential image" was smoothed by averaging the values in 9 neighboring areas, and then plotted as a function of positions using symbols of different densities.

The "differential image" thus plotted were compared with the "integral image," and the contour of the phantom was more clearly demonstrated.

Although there are several problems left to be solved, we think the "differential image" could be used together with conventional "ingral image" in actual clinical practice.

(1) T. Nagai, T. A. Iinuma, and S. Kida: J. Nucl Med. to be published.

The Differentiated Radioisotope Image

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The radioisotope scintigrams are constituted of basic points with variable amplitude in static scanning or variable density distribution in movable scanning, and have one to one correspondence to the radioisotope intensity distribution. Their image quality is basically worse than x-ray image qualtiy. Therefore, the former requires many displaying systems of radioisotope scintigrams; multi-scanning, re-scanning, photoscanning color-scanning and television-retrieving, etc. Now, I propose the differentiated radioisotope image as a method of reconstruction of radioisotope image.

The increasement ΔI of radioisotope in the range of $\Delta \times$ is proportional to the gradient of radioisotope intensity distribution:

However strong radioisotope intensity distribution may be, its gradient is zero if it is definite.

In order to take the differentiated radioisotope image, the out-put of radioisotope scanning systems may be only differentiated difference of counting may be recorded in every minute moving distance. But optical differentiation is simple and convienent. I was developed negative and positive image, superimposing one another in some deviation. If we can take the basic points of radioisotope scintigrams as noises, the noise spectra can be smoothed out by defocusing or so, because its spectra are high, but the object has the low Fourier spectra. Thus, differentiation and smoothing were carried out without computor-rtrieving. Thy give the more observable radioisotope image and the more accurate defect size, negative or positive.

Modulation Transfer Function of Radioisotope Scanning System (2)—Some considerations on the methodological problems in measuring of the MTF—

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In a previous paper, it was reported that using the radioisotope paper Siemens star and liquid Siemens star, the Modulation Transfer Function (MTF) was measured and confirmed the justification of theoretical calculation, that is, the MTF of radiisotope scanning systems is identified with the Fourier transformation of the directional function of the collimator. Recently, Fourier analysis is about to be prevalent in radioisotope scanning field. This paper reported some considerations on the methodological problems in measuring of the MTF of radioisotope scanning systems.

1) About the chart for the MTF of radioisotope scanning systems. The Siemens star has some excellent advantages and using it is simple and convienent for the measurement of the MTF. The MTF, when the point source or line source response is Fourier-transformed, has higher frequency than the MTF, when the Siemens star is used. It is because the results of the former are not calculated in taking account of area or linear efficiency of the collimator. Using the obtained effective length and directional function of the collimator, the response curve of the collimator when the area source or the paper Siemens star is used, is about 1.5-2.5 times wider in half peak width than the response curve of teh point source.

2) About the recorder. The MTF of radioisotope scanning systems should be measured in taking account of its frequency response and amplitude response; ours is not accurately responsed to higher frequency range than 0.5 cycle per second and to the input of more than 0.5 V in 0.2-0.3 cycle per second.

3) Quantum noise and signal-to-noise ratios. The radioisotope samples with average counting 36, 54, 83, 137, 227, 450, and 860 have standard deviation of 5.6, 7.9, 11.3, 15.6, 25.5, 35, that is, in other word, they have the signal-to-noise ratios of 8.0, 8.4, 9.5, 10.8, 11.6, 12.5, 13.8, dB in conventional scanning conditions using a single hole collimator. When radioisotope counting is recorded as in measuring MTF, of which values quantum fluctuations influence in reading, their fluctuations around the average counting level have the standard deviation, or in other word their signal-to-noise ratios of 5.5, 5.6, 5.6, 7.0, 7.9 8.8, 10.2 dB. Their signal-to-noise ratio's fluctuation has similar order in comparison with the 80%observable signal-to-noise ratios of the radiographic images of the bone and lung arteries in our noise masking experiment.