A Hybrid Image Processor for Nuclear Medicine

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A hybrid-type nuclear-medicine image information processing system has been developed, which is capable of collecting overall a variety or RI images and analyzing them. It consists of two sections; one is for filing on-line or off-line the information of scintiscanner or scinticamera, and the other is digital processing based on a small computer. "Organic" processing of the nuclear medicine information is thus possible by utilizing characteristic features of the respective sections.

In the analog filing section, which collects the RI images overall, a change-over in the multichannel input can be done either manually or on-line. Images are filed in the random-access type VTR through an analog buffer memory. The mode of image collection is continuous, intermittent, or stationary; the display is also in either of these three. Images are input into the computer when required. And hard copies of the image in display can be produced in 25 sec. The cpu, which controls on-line the analog section and acquires dynamic images at high speed, has the performance of 16KW and access time 660 nsec; and the real time processing is possible by means of channel and index register. Both the analog (TV) and the digital sections are with a display device, being optionally used dependent on the purpose. In this way, the function of man-machine communication is enhanced. As seen, information of not only the nuclear medicine but also X-ray images can be filed in the system. Compared with the conventional processing of only localized information, the system should thus contribute to overall image-information collection and its processing in a hospital.

Relationship between Count Density and Detectability of Lesions

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Image quality of a scintigram depends on count density—counts per cm^2 which contributed for producing that scintigram. In order to determine suitable count density, we examined relationship between count density and detectability of negative and positive lesions.

Lesions were made of various sized aclylite cylinders and various height of $Na^{131}I$ tubes randomly placed in $Na^{131}I$ solution, which give 25, 50 and 75% depth and height of changes in count density respectively. Count density tested were from 50 through 1600 counts/cm^2. Three

scintigrams in each count density render 18 scintigrams in all. These scintigrams were viewed by 8 physicians of nuclear medicine, four with naked eye and four with a reducing glass. Two confidence levels—probable lesion and suspected lesion'were assigned.

Number of detected lesions as well as confidence level varied among observers. Detectability of each lesion in each count density were obtained from mean number of lesions detected correctly by four observers. Detectability of probable lesions with a reducing glass were nearly identical to the sum of probable and suspected lesions with naked eye. While suspected lesions with naked eye contained almost no false positive, with a reducing glass they contained considerable amount of false positives. In this experiment, detectability of probable lesions with a reducing glass, we concluded, gave the relashonship between count density and lesion detection.

Result: On detecting negative lesions, it needs relatively high count density. A lesion which gives about 50% depth change of counting rate needs at least 200 counts/cm^2, and to detect a lesion of lower counting rate change—25% depth—it needs more than 1600 counts/cm^2. As for positive lesions, it seems rather easy to detect with relatively low count density. Lesions of 50% height counting rate change can be detected in a scintigram of 50 counts/cm^2.

RI Data Processing System for Nuclear Medicine (Report 9)

Fourier transform compartmental analysis in RI tracer kinetics

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Compartmental analysis has been in wide practical use for tracer kinetic studies using RI in biological system, because the data of radioactive decay process may be frequently represented by a linear combination of negative exponentials of the form:

$$f(t)=\sum_{i=1}^{n} Ai\exp(-\lambda i\cdot t)$$

Here, n,Ai and λi represent a number of compartments, the initial size and decay constant of compartment i respectively.

In this analysis these parameters, n, Ai and λi have biological or physical significance. To estimate them, peeling method has been widely used among several methods owing to simplicity of the procedure. For automatic analysis by computer, however, it has difficult problems to estimate an accurate straight line on a semi-logarithmic plot due to large statistical errors in the tail of a decay curve.