Studies on the Digital Computer Processing of the Radioisotope Image through the Scinticamera

K. Torizuka, K. Hamamoto and T. Mukai

Central Clinical Radioisotope Division, Kyoto University, School of Medicine, Kyoto

Application to the static studies

The radioisotope distribution in the entire organ after the administration of radioisotope to the patient was memorized into 40×40 matrices in the 1600 channel analyzer through the scinticamera (Pho/Gamma III, Nuclear Chicago), and tansferred into the magnetic tape, and then fed into the FACOM 230-60 digital computer of Kyoto University Data Processing Center. In processing the digital data, each element of the 40 by 40 matrices was initally subjected to a nine element smoothing involving bounding and averaging of the original counts in the matirix elements, and the iterative approximation was performed by the resolving power array of a collimator with $7 \times 7 = 49$ elements obtained from the lines or point spread function, according to Iinuma and Nagai's method (J. Nucl. Med., 9: 507, 1968). Then, the highest counting area was determined in the matrix, and was divided into 20 levels, each of which was destined to be given a typed symbol to be printed in the matrix.

Computer scintigrams of thyroid gland with ^{131}I or $^{99m}TcO_4$, lung with ^{131}I-MAA and liver with ^{198}Au-colloid were made. And also, liver scintiphotography with ^{67}Ga citrate was performed on 20 patients with liver tumor. The positive scintiphotograms were obrained in 10 cases. In the same position after the ^{67}Ga scintiphotography ^{198}Au-colloid was injected. The subtraction scintigram was obtained by subtracting ^{198}Au-colloid activity from ^{67}Ga activity in each matrix which was fed into the magnetic tape. In 4 out of 5 cases with negative ^{67}Ga scintiphotography, the foci were revealed on the subtraction scintigram distinctly.

Application to the dynamic studies

The functional imaging of the liver with the scinticamera was performed after the intravenous administration of 150 μCi of ^{131}I-BSP. Exposures were made at three-minute intervals for a period of one and a half hours, and the distribution of radioactivity in the liver was accumulated by the 1600 channel analyzer, and was transferred to the magnetic tape successively. Each element was initially subjected to a nine-element smoothing, and was stored into the core in the computer successively. After the determination of the liver field, the logarithm of the chronological counts collected at each matrix on each frame was fitted into two exponential functions, such as, accumulation phase, $Ae^{-\lambda_1 t}$ and excretion phase, $Ae^{-\lambda_2 t}$ by the least square method. Then, the values of A, λ_1 and λ_2 were divided into 10 levels, and were printed out by the different symbols. Each of A, λ_1 and λ_2 distributions in the entire liver was displayed as one representation, and this was very useful to obtain the regional function.

The volume of each chamber in the heart was determined from the RI dilution curve in each chamber after the intravenous administration of $^{99m}TcO_4$ solution as a bolus. In the phantom experiment, the volume determined by the analog simulation of the $^{99m}TcO_4$ dilution curve in each chamber coincided with the actual volume. Clinical studies were investigated by the same procedure after the intravenous administration of ^{131}I-RISA and $^{99m}TcO_4$ solution.

Summary

It can be considered that the digital computer processing provides the significant improvements in the details of scan display, and the combined use of scinticamera, 1600 channel analyzer and magnetic tape system is a very useful tool for the quantitative dynamic study.