New method to calculate rate constants of kinetics of [F-18]2-fluoro-2-deoxy-D-glucose (FDG) in the brain pixel by pixel was developed. The method uses tomographic images for 40 minutes after FDG injection and sequential plasma FDG radioactivity concentrations. Based on the three compartment model by Sokoloff, a time sequence of single pixel of the serial tomograms was represented by the following equation.

\[ C(t) = A f(t) + B g(C, t) \]

Three unknowns, A, B and C, each of which was a function of \( k^* \), was determined pixel by pixel employing the least-square method. Each rate constant and cerebral metabolic rate of glucose were mapped pixel by pixel. It took about twenty minutes to calculate rate constants of five slices of 128x128 image by VAXll/750.

In a normal man, CMRglc calculated by the present method was not different from that by the method using fixed \( k^* \). But in some patients with brain tumor, rate constants were significantly larger than normal values. Thus, in such a case, pixel \( k^* \) values should be calculated and hence CMRglc should be calculated using these rather than fixed \( k^* \) value.

The procedure of dynamic \(^{11}\text{C}O_2\) positron emission tomography (PET) was established and applied to the several diseases. Tomographic scan started soon after inhalation of \(^{11}\text{C}O_2\) and were obtained using Head-Tome III (Shima-zu). Data sampling time was one second and one image took about 20 seconds. Usually 16 images were obtained. The accuracy of data sampling time was examined using air phantom. The blood clearance of \(^{11}\text{C}\)-activity in the artery was obtained.

There were 3 different patterns of dynamic images depending on the central pathogenesis. Leuko syndrome revealed the first image like \(^{15}\text{O}\) image. But low RI uptake area in the 1st image showed the increment of RI uptake with time. The lesion of cerebral malignant lymphoma showed rather lower RI uptake in the first image which entirely different from \(^{15}\text{O}\) image. But this region increased RI uptake in the next few images which look like \(^{11}\text{C}O_2\) image. The region of glioma showed the high blood volume by \(^{11}\text{C}O\) and high RI uptake like \(^{15}\text{O}\) image which did not change with time.

The discrepancy of dynamic images may result from the different pathogenesis of central nervous system involvement.