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TOMOGRAPHIC MAPPING OF RATE CONSTANTS OF [F-18]FDG MODEL AND ITS PHYSIOLOGICAL MEANINGS.

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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.

$$Ci(t) = A\ f(t) + B\ g(C, t)$$

Three unknowns, A,B and C, each of which was a function of k*s, 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 VAX11/750.

In a normal man, CMRGlc calculated by the present method was not different from that by the method using fixed k*s. 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.

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O-15 CO2 SINGLE BREATH INHALATION METHOD FOR CEREBRAL BLOOD FLOW MEASUREMENT.ITS REPRODUCIBILITY AND APPLICATION FOR MEASUREMENT OF CO2 RESPONSE.

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A method for cerebral blood flow (CBF) measurement using an O-15 CO2 single breath inhalation and a positron emission tomography was developed as a clinical tool. After the single breath inhalation of 30-50 mCi O-15 CO2, PET scan by HEADTOME III for 40 sec and continuous monitor of arterial activity for 3 min were performed. The arterial activity curve was scaled using a single sample after the end of the continuous monitor. CBF was obtained based on a particle fraction principle. Calculation was carried out by the early picture method by Kanno & Lassen. In order to induce the hypercapnia condition, 100 % CO2 gas was poured into a face mask at rate of 500 ml/min. Reproducibility of the method was measured with two normal volunteers and revealed less than 15 % difference with the whole brain mean CBF. CO2 response of CBF was measured with two volunteers and a patient with cerebral infarction. With hypercapnia CBF changed 7 % per mmHg PaCO2 with a whole brain, but regionally it was found that CO2 response was lower with the white matter (4 %) than the gray matter (9 %).

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$^{11}CO_2$ DYNAMIC POSITRON EMISSION TOMOGRAPHY: PROCEDURE AND POSSIBLE APPLICATION TO MEASUREMENT OF REGIONAL CEREBRAL BLOOD FLOW.

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The procedure of dynamic $^{11}CO_2$ positron emission tomography(PET) was established and applied to the several diseases. Tomographic scan started soon after inhalation of $^{11}CO_2$ and were obtained using Head-Tome III(Shimazu). 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}C-activity in the artery was obtained.

There were 3 different patterns of dynamic images depending on the central pathogenesis. Leigh syndrome revealed the first image like $C^{15}O_2$ 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 $C^{15}O_2$ image. But this region increased RI uptake in the next few images which look like $^{11}CO_2$ image. The region of glioma showed the high blood volume by ^{11}CO image and high RI uptake like $C^{15}O_2$ image which did not change with time.

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

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VISUALIZATION OF BRAIN FUNCTION USING A POSITRON TOMOGRAPHY.

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PET studies of brain function map are already reported but not free from technical problems like that subjects studies become very nervous in PET room and not suitable for sensitive test. F-18-DG has long half life and it is difficult to get both of pre and post stimuli data in the same day. The former problem is solved if the subjects are injected isotope in comfortable room and get stimuli before scans but this leads another problem of gamma-ray attenuation correction. So we analyzed error factors in various attenuation correction method. And to solve the relatively long half life of FDG we applied O-15 flow method. Some interesting results in normal volunteers or diseased subjects will be shown.