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BASIC INVESTIGATION OF QUANTIFIABLE POSITRON AUTORADIOGRAPHY.

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We have recently reported the basic principle, procedure and application of multiple labeled autoradiographic technique using positron emitting radionuclide tracer. However, there still remains some problems before establishing the quantitative procedure of the positron autoradiography. We made the experiment to solve the problems of standardization process of positron autoradiography.

Gelatin solution contained various dose of F-18 was frozen and cut 20 μ m thickness. Then the sections were exposed to the X-ray film for 6 hours followed by the exposure of commercially available C-14 autoradiographic standards for 7 days instead in the same experimental condition.

The linear relationship between the optical density and the radioactivity was observed both in F-18 sections and C-14 standards. The results obtained in this experiment suggest that the quantifiable positron autoradiography can be underwent by simply using the C-14 standards if the experiment was performed under the same scheduled condition. The standardization procedure of positron autoradiography which we have tried will surely be useful as a simple and reliable technique.

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THE QUANTITATIVE DOUBLE TRACER AUTORADIOGRAPHY WITH ^{14}C -DG ^{18}F -FDG FOR MEASUREMENT OF LCMRgl CHANGE.

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The tracers ^{14}C -2-deoxy-D-glucose (^{14}C -DG) and ^{18}F -2-deoxy-2-fluoro-D-glucose (^{18}F -FDG) are being used for measurement of local cerebral metabolic rate for glucose (LCMRgl) in animals and in men respectively. We designed the method for measuring the change of LCMRgl in the same animal by quantitative analysis of the double tracer autoradiograms with ^{14}C -DG and ^{18}F -FDG. First of all ^{14}C -DG was administered intravenously and arterial samples were obtained over a period of 45 minutes following the protocol, and then psychoanaleptics methyl phenidate was administered, 15 minutes later ^{18}F -FDG was administered and arterial samples were obtained as well. The rats were decapitated at the end of arterial sampling and autoradiograms were prepared as usual method. The first exposure of 15 hours is formed by ^{18}F and the second exposure of 7 days is formed by ^{14}C . The time interval between the two exposures were for 3 days. The ^{14}C and ^{18}F concentrations in brain tissue were determined and used to calculate LCMRgl using Sokoloff's model. The significant increment of LCMRgl was observed in gray matter by methyl phenidate, and we ensured the method was useful for the determination of LCMRgl change.

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EVALUATION OF [^{18}F]-4-FLUOROANTYPYRINE FOR CEREBRAL BLOOD FLOW TRACERS.

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The injectable flow tracer labelled with short-lived nuclide became to be valuable ^{18}F -4-fluoroantypyrine (FAP) has been reported to be useful for the measurement of cerebral blood flow, but its kinetics have not been clarified in rat. FAP was prepared by the method of Shiue et al. The partition ratio of FAP between organic solvent/water phase and whole blood/plasma was not affected by wide range of pH and in time course, respectively. These data were favorable characteristics for blood flow tracer. After intravenous administration of FAP, blood urine and bile were sampled and analyzed for the time courses of radioactive metabolite with a HPLC. The radioactive metabolite of FAP was detected in plasma at even one minute after the administration and excreted into urine and bile. After the incubation of FAP with whole blood in vitro condition FAP degradation occurred within one minute, but not changed in saline solution at room temperature for more than 20 hours. These data showed that FAP was not so stable in severer condition (in vivo), so it is necessary to correct the net amount of FAP that diffusable to brain in quantitative autoradiography.

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DETERMINATION OF LOCAL WATER CONTENT USING ACTIVATION AUTORADIOGRAPHY

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Endogenous oxygen-16 content in rat brain was determined as ^{18}F image by means of nuclear reaction and autoradiography, and was converted into local water content. (Materials and Methods)

The 20 μ m thickness rat brain frozen section, the section of desiccated ones, and 10 μ m polyester film were set to the aluminum target holder and connected to the beam course of cyclotron. They were cooled down to -190°C by liquid N_2 and irradiated by ^3He beam for 5min at 2 μA . Incident beam energy was adjusted to 7.6MeV to get the most effective ^{18}F radioactivity by $^{16}\text{O}(^3\text{He}, p)^{18}\text{F}$ reaction. Quantitative autoradiography of these samples were processed. The optical density of dried section was subtracted from that of frozen section and converted to the local water content, (Results)

The water contents obtained were as follows: sensory-motor cortex 79.3 \pm 0.8%, hippocampus 81.5 \pm 0.2%, thalamus 78.5 \pm 2.1%, and amygdala 83.0 \pm 0.2%.

In conclusion, this activation autoradiography is useful and applicable to the various brain studies.