Experience in Use of Multi-Labeled Autoradiography by Means of 18F-Fluorodeoxyglucose and 14C-Iodoantipyrine

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III. 19 Experience in Use of Multi-labeled Autoradiography by Means of ^{18}F-Fluorodeoxyglucose and ^{14}C-Iodoantipyrine

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Purpose

The history of the autoradiography (ARG) using multi-labeled compounds is not long, and there have been only a few reports on the combination of ^{123}I or ^{131}I and ^{14}C.[2,3] We performed physiopathological and biochemical studies of ischemic acute vascular disorders using ARG in small animals as a prestage of the use of ECAT to establish the multi-labeled autoradiography as a procedure of ARG (table 1).

Methods

As shown in scheme 1 and 2, the ischemic region of ipsilateral cerebral hemisphere was induced in monogolian gerbil weighing 70 to 80g, anesthesized with intraperitoneal pentobarbital, under monitoring of EEG by clipping the right common carotid artery for 30 minutes. After 30 minutes, ^{18}F-fluorodeoxyglucose (^{18}F-FDG) was injected intravenously at 1 to 1.5 mCi/0.5 ml of saline in the animal with or without releasing the common carotid artery. After 29 minutes, ^{14}C-iodoantipyrine (^{14}C-IAP) was injected intravenously at 15 μCi over one minute just before sacrifice, and then the animal was sacrificed at the end of the infusion. The brain was removed and frozen in ground dry ice. After frozen homogenously, the brain was cut into slices of 20 μm of thickness using microtome, placed on the cover glass and dried on the electric heating plate at around 70°C. Using a cassette, the dried slice was placed tightly on the x-ray film. After 6 or 8 hours, the film was developed and examined for the local utilization of ^{18}F-FDG[4] in the brain, namely local glucose metabolism. After 3 days, the slice was placed tightly on a separate x-ray film and the film was developed after one or two weeks. Then, the distribution of ^{14}C-IAP[5] (i.e. local cerebral blood flow) was examined.

Results and Discussion

1. The local cerebral blood flow was not increased in the hippocampus of the lesion side and part of the thalamus and basal ganglia in the animals receiving ischemia for 30 minutes and then restarting of the blood supply, while glucose

metabolism was stimulated in the animals after the same treatment. As shown in fig. 2, columner pattern was observed in the site with high uptake, which was not observed in the control (fig. 1). This seems to be the seizure focus based on EEG pattern.

2. As shown in fig. 3, a clear depression of the circulation volume was observed in the lesion side of the animals receiving ishemia for 30 minutes without recerculation using ARG with ^{14}C-IAP. In the same site, a stimulation of glucose metabolism was noticed mainly in the hippocampus, basal ganglia and part of amygdaloid nucleus. This finding is of interest in relation of the Misery-perfusion syndrome as Baron et al. described.[1)]

3. A high-resolution imaging was obtained using ARG with ^{18}F-FDG as in cases with ^{14}C-IAP. ARG using ^{123}I or ^{131}I in addition to ^{18}F and ^{14}C seems promising in the future.

4. The present method provides a useful approach for the investigation of cerebral blood flow and metabolism under the same conditions in the same individual by further investigaion on the synthesis of labeled compounds and its selection.

5. The present results provide the useful information on the basic properties for brain imaging in human using positron emission tomography (PET).

References

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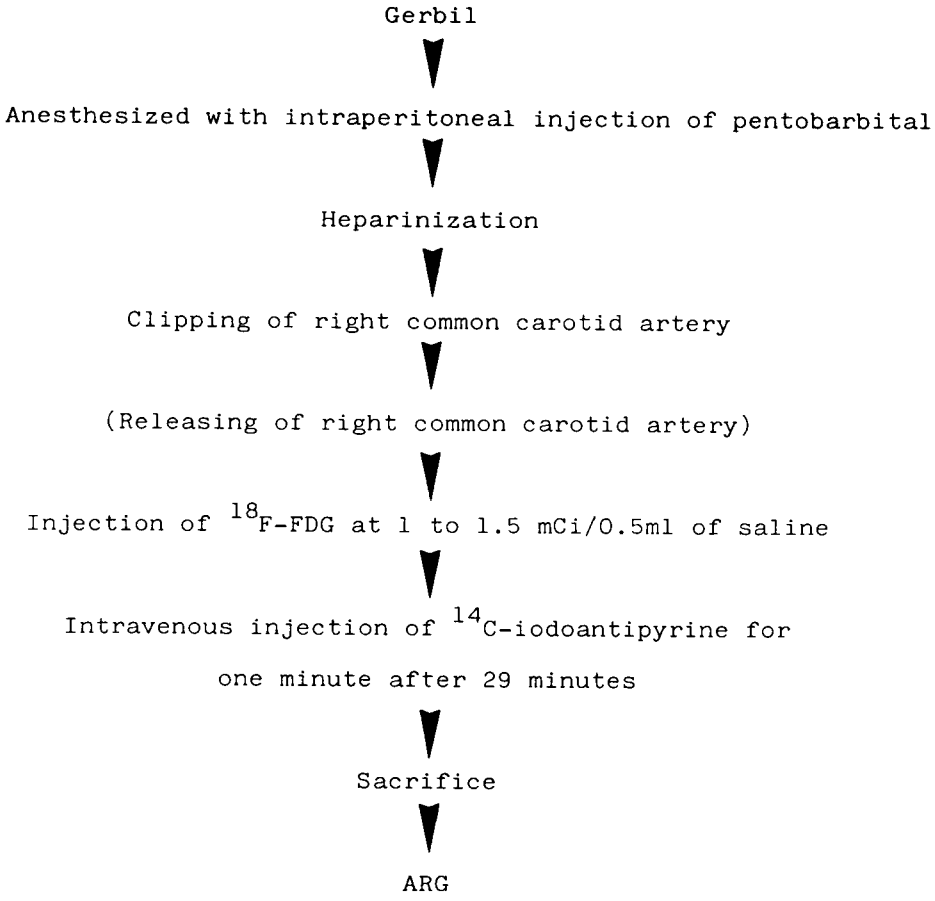
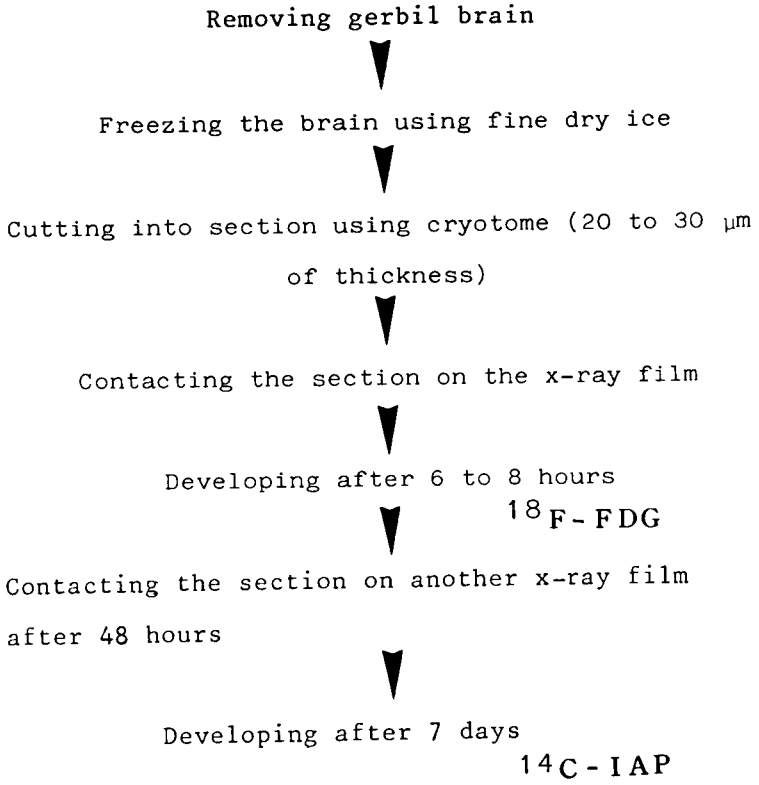
Table 1. Merits of ARG

1.	Permanent recording
2.	High sensitivity of detection
3.	Clear distribution of the radioactive compound
4.	High accuracy of the location
5.	Easy and simple procedure
6.	Alternative procedure for ECAT imaging in small animals



Scheme 1. Experimental process 1.
Preparation of experimental model.



Scheme 2. Experimental process 2. Preparation of ARG.

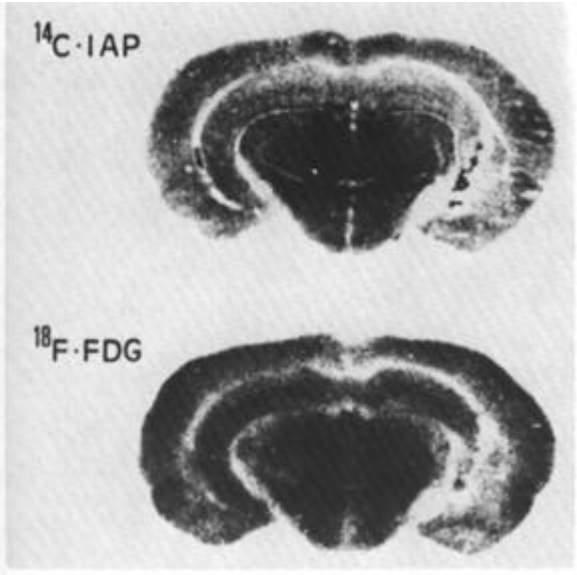


Fig. 1. ARG in a normal gerbil
Upper figure: ^{14}C-IAP,
Lower figure: ^{18}F-FDG

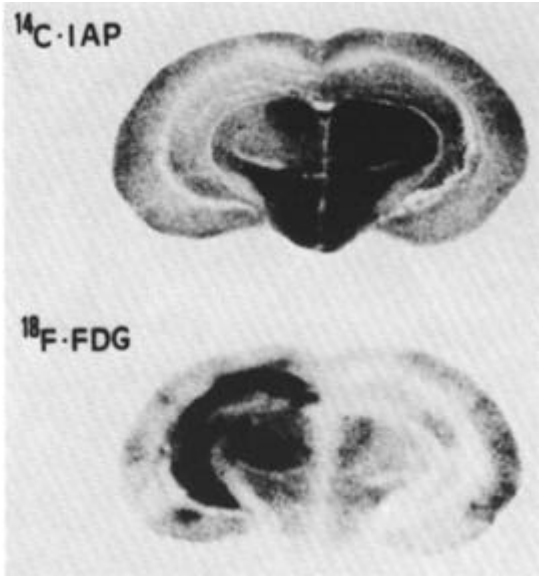


Fig. 2. ARG in a gerbil receiving ischemia for 30 minutes and recirculation 30 minutes later.
Upper figure: ^{14}C-IAP,
Lower figure: ^{18}F-FDG

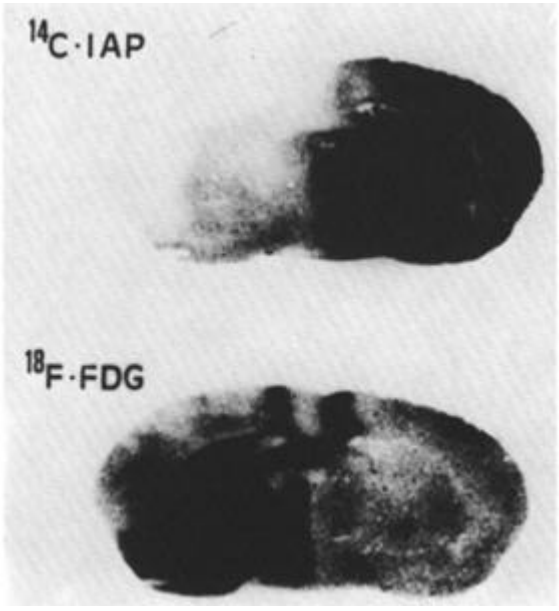


Fig. 3. ARG in a gerbil receiving ischemia for 30 minutes without recirculation.
Upper figure : ^{14}C-IAP, Lower figure : ^{18}F-FDG