18F-FDG Accumulation in Experimental Abscess

III. 5. ^{18}F-FDG Accumulation in Experimental Abscess

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Introduction

[^{18}F] 2-Fluoro-2-deoxy-D-glucose (^{18}F-FDG) as a parameter of glucose metabolism[1] has been widely used for diagnosis of various diseases and treatment evaluation in positron emission tomography (PET) [2-5], but has been believed to be inadequate to detect inflammatory lesion[6]. Lately, clinical cases of high accumulation of ^{18}F-FDG in abscess have been reported[7-8], but the distribution of ^{18}F-FDG in abscess was not sufficiently investigated. In this study, we have evaluated the accumulation and distribution of ^{18}F-FDG in experimental abscess by tissue distribution study and macro-autoradiography (macro-ARG).

Materials and Methods

ANIMALS

Male C57BL/6 mice weighing from 25 to 30 g were used. To produce abscess, the mice in 5 groups, each containing 5 mice, were subcutaneously inoculated with 0.2 ml of E. coli suspension containing about 2×10^8 cells in their left groin. They had free acces to food and water, and were used on Day 3, 7, 10, 14 and 21 after the inoculation for ^{18}F-FDG tissue distribution study. Other 5 mice without inoculation were used for control. A mouse on Day 7 after the inoculation was used for macro-ARG.

^{18}F-FDG TISSUE DISTRIBUTION STUDY

The mice were injected with 1.85 MBq of ^{18}F-FDG through the tail vein and were killed 1 hr later. Organ and tissue samples were excised, blotted to remove adhering blood, and weighed. The radioactivities of the samples were counted with a well-type NaI (Tl) autogamma counter and corrected for decay. The ^{18}F-FDG uptake in the sample was expressed as differential uptake ratio (DUR).

MACRO-ARG

The mouse on Day 7 after the inoculation was injected with 37 MBq of ^{18}F-FDG and killed 1 hr later. The abscess tissue was quickly dissected, embedded in O.C.T. compound (Miles Inc. U.S.A.) and frozen with dry-ice. The frozen sample block was sectioned in a cryostat at -20 °C. The 10 μm-thick section was mounted on a clean glass slide, air-dried and directly contacted with ARG film (MARG ^{3}H-type, Konica, Japan). After 2 hr exposure, the film was photographically processed. The section on the slide was stained with hematoxylin and eosin, and examined under light microscope.

Results and Discussion

Figure 1 shows the ^{18}F-FDG uptakes in the abscess, muscle of the back, skin tissue of the right groin, liver and blood sequentially after the inoculation of E. coli. The uptake in the abscess rapidly increased until Day 7, then gradually decreased and became constant at Day 14 and 21. The uptakes in the muscle, skin, liver and blood were almost constant sequentially after the inoculation and were lower than those in the abscess.

Figure 2 shows ^{18}F-FDG macro-autoradiogram and illustration of the abscess section. On the autoradiogram, the high density of silver grain was observed in the abscess rim and surrounding tissue, but the scare density in the abscess center. The high density area on autoradiogram corresponds microscopically to the layers of phagocytes such as macrophages and neutrophils, and the granulation tissue of fibroblast surrounding the abscess. The central grain-free area corresponds to the purulent matter in the abscess center.

Our study showed that ^{18}F-FDG apparently accumulated in the experimental abscess produced by E. coli, and microscopically distributed in the abscess rim and surrounding tissue consisting of phagocytes and fibroblasts. These indicate that the glucose metabolism in the abscess is more active at chronic phase of inflammation characterized by monocyte infiltration and proliferation of fibroblast than acute phase characterized by exudative reaction of increased vascular permeability and neutrophil infiltration. It is concluded that ^{18}F-FDG PET is clinically useful to detect the abscess and evaluate the treatment.

Reference

1) Sokoloff L. et al., J. Neurochem. **28** (1977) 897.
2) Larson S.M. et al., J. Nucl. Med. **22** (1981) 875.
3) Di Chiro G. et al., Neurology **32** (1982) 1323.
4) Yonekura Y. et al., J. Nucl. Med. **23** (1982) 1133.
5) Kubota K. et al., Clin. Nucl. Med. **17** (1992) 361.
6) Som P. et al., J. Nucl. Med. **24** (1983) 288.
7) Tahara T. et al., J. Comput. Assist. Tomogr. **13** (1989) 829.
8) Sasaki M. et al., J. Comput. Assist. Tomogr. **14** (1990) 486.

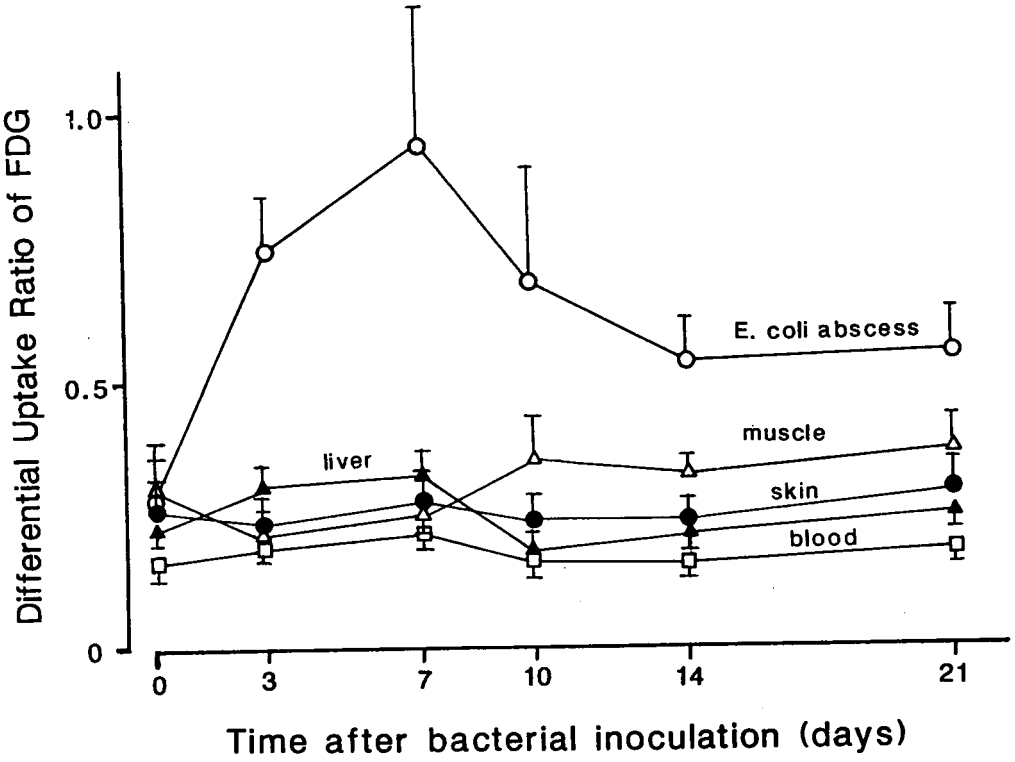

Fig. 1. ^{18}F-FDG uptakes in mice sequentially after inoculation of E.coli.

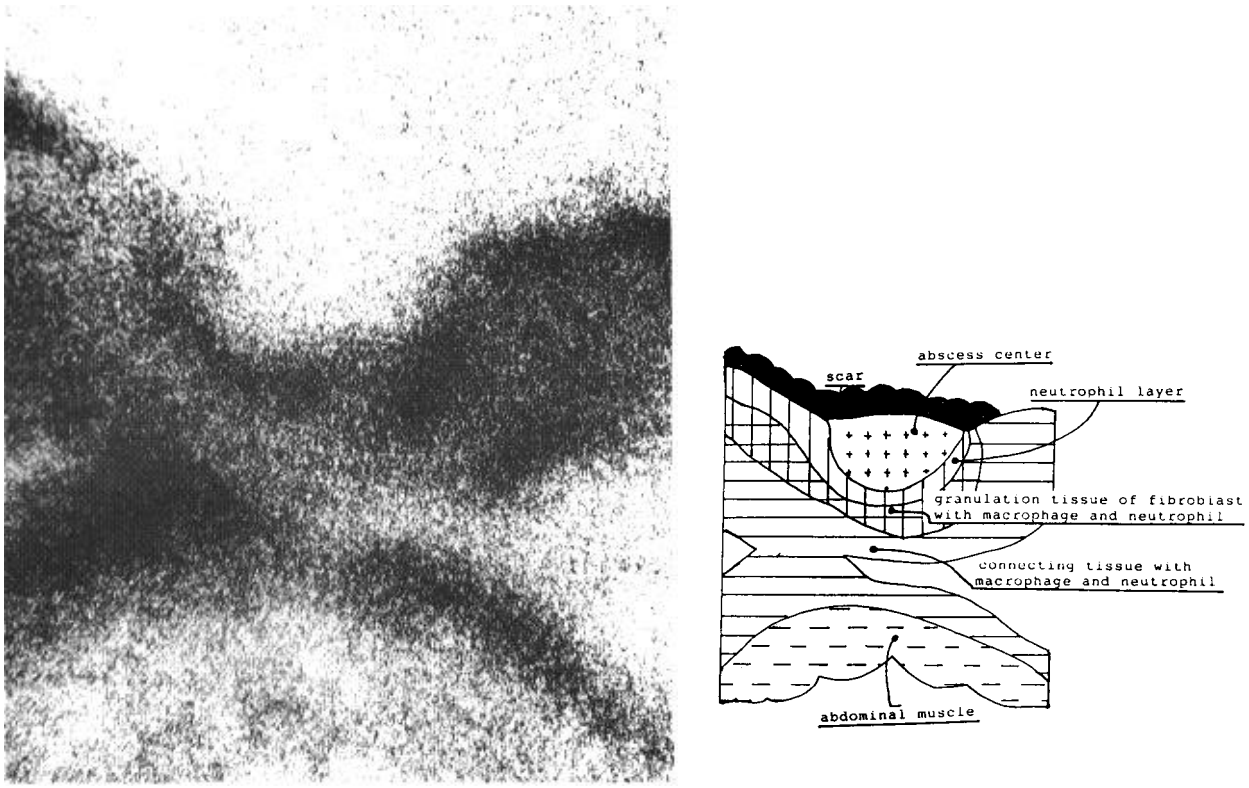

Fig. 2. A). ^{18}F-FDG macro-autoradiogram of E. coli abscess section in mouse. B). Illustration of the same section stained by H. E.