# Evaluation of the Radiation Effect on the Uptake of (F-18)-2-Fluoro-2-Deoxy-D-Glucose in Experimental Tumor

# IV. 8 Evaluation of the Radiation Effect on the Uptake of (F-18)-2-Fluoro-2-Deoxy-D-Glucose in Experimental Tumor

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The purpose of the cancer therapy is the eradication of the cancer cells. We need not only more effective therapeutics but more proper diagnosis concerning about the effectiveness of the cancer therapy.

(F-18)-2-fluoro-2-deoxy-D-glucose ((F-18)-FDG) was found to be an excellent tumor diagnostic agent, experimentally[1,2] and clinically.[3] (F-18)-FDG uptake in tumors relates to the vivid glucose metabolism of the tumor cells (i.e. viable tumor cells). So, it may be expected that the reduction of the viable tumor cells after any therapy results in the reduction of (F-18)-FDG uptake in tumors. In this paper we analysed the radiation effects on the uptake of (F-18)-FDG in experimental tumors.

## Materials and Methods

Male Donryu rats weighing between 120 and 150 gram were used. Transplantable ascitic hepatoma AH109A cells were innoculated to the animals subcutaneously. When the tumor size reached between 10 and 15 mm in diameter, the experiments were performed. The animals were anesthetized with sodium pentobarbital intraperitoneally. The tumors of the anesthetized animals were exposed to 0, 10, 10 and 40 Gy with single fractions of X-rays (250 kV, 20 mA, HVL 0.5 mmCu + 1 mmAl).

Tumor volumes were assessed by measuring the three mutually perpendicular diameter every day. (Fig. 1a)

The animals were administered (F-18)-FDG at 2, 24, 72 and 168 hours after 10 Gy, at 168 hours after 20 Gy and at 24, 48 and 168 hours after 40 Gy irradiation. Fifty minutes after the intravenous administration of (F-18)-FDG, the animals were killed by cervical dislocation. Then the tumors were excised, counted and weighed. The uptake of (F-18)-FDG in tumors were expressed as % dose/g. The ratios of (F-18)-FDG in irradiated tumors to unirradiated tumors were obtained with % dose/g basis.

## Results

Fig. 1b shows the change of (F-18)-FDG uptake ratio of the irradiated tumors. (F-18)-FDG uptake ratios irradiated with three different doses were decreased with the same rate until third day after irradiation. (F-18)-FDG uptake ratios were decreased to 0.37 and 0.29 at seventh day after 20 and 40 Gy irradiation respectively and was increased to 0.90 at seventh day after 10 Gy irradiation.

## Discussion

The reduction of (F-18)-FDG uptake in irradiated tumors are related to the reduction of the irradiated tumor volume. But our results showed that the decrease of (F-18)-FDG uptake are not only due to the decrease of the tumor volume. Because of (F-18)-FDG uptake ratio were obtained with % dose/g basis, the decrease of the total tumor uptake of (F-18)-FDG was more than that of the tumor volume. (F-18)-FDG uptake ratio at seventh day after 40 Gy irradiation was 0.29 and relative tumor volume at seventh day was 0.43. Total decrease of (F-18)-FDG uptake in tumor was: $0.29 \times 0.43 = 0.12$. So, we concluded that the decrease of (F-18)-FDG may be due to the decrease of the viable tumor cells in the tumor tissue after irradiation and not necessarily due to the volume reduction of its tissue.

(F-18)-FDG uptake ratio was increased to 0.90 at seventh day after 10 Gy irradiation. This may be directly related to the regrowth of the tumor which is the results of the increased number of the viable tumor cells.

Whitfield et al. reported that the glucose metabolism was not inhibited in vitro by 10 Gy irradiation in radioresistant L-strain cells. On the contrary, the glucose metabolism of the radiosensitive thymic cells was easily destroyed by 10 Gy irradiation. Thus the effect of the irradiation to the glucose metabolism is secondary to the radiation damage.

As for clinical application we consider that therapeutic response of cancer may be possible by assessment of different uptake of (F-18)-FDG before and after therapy.

## References


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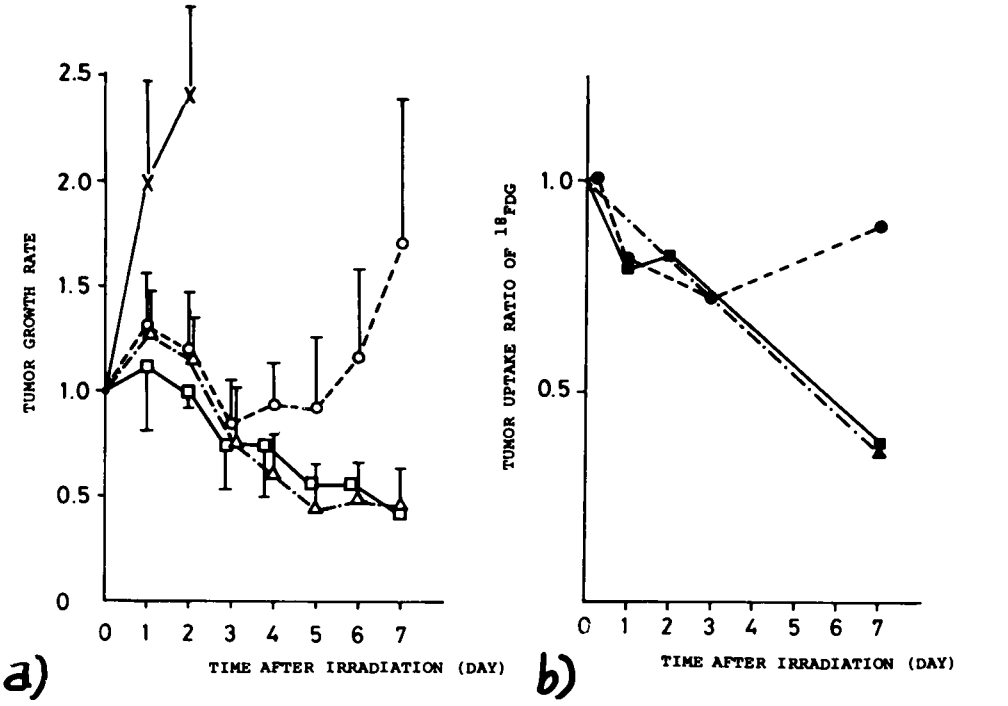


Fig. 1.

TUMOR GROWTH RATE AFTER IRRADIATION

TUMOR UPTAKE RATIO OF $^{18}$FDG AFTER IRRADIATION

X——X , o---o, △···△, □—□, represent the tumor qrowth rate irradiated with 0Gy, 10Gy, 20Gy and 40Gy, respectively.

●---●, ▲···▲, ■—■, represent the tumor uptake ratio of $^{18}$FDG irradiated with 10Gy, 20Gy and 40Gy, respectively.