

Recurrent malignant glioma: detection with ^{131}I labeled monoclonal antibody G-22, positron emission tomography and magnetic resonance imaging

Motoo OSHIMA,* Jun YOSHIDA,** Toshihiko WAKABAYASHI,** Kengo ITO,**
Masanori TADOKORO,*** Takashi KATO*** and Sadayuki SAKUMA***

**Department of Radiology, Nagoya First Red Cross Hospital and **Departments of Neurosurgery,
and ***Radiology, Nagoya University School of Medicine*

A 45-year-old man with suspected recurrent malignant glioma was evaluated by magnetic resonance imaging (MRI), positron emission tomography (PET) and ^{131}I labeled monoclonal antibody G-22 (G-22) scan. Following Gadolinium-DTPA, a T₁-weighted spin echo image (TR 500 msec, TE 20 msec) demonstrated a large mass with an irregular margin in the left temporo-parietal area. An ^{18}F labeled fluorodeoxyglucose PET study demonstrated marked accumulations in the left temporo-parietal area. Serial ^{131}I -G-22 scintigraphy was obtained for a week after the injection. The uptake was most increased on the 2nd day after the injection. ^{131}I G-22 was specific for tumor-associated antigens.

Key words: glioblastoma, ^{131}I labeled monoclonal antibody, positron emission tomography

INTRODUCTION

CEREBRAL GLIOMAS are the most frequent tumors in all intracranial tumors.^{1,2} Patients with malignant glioma have a poor prognosis despite radiotherapy and surgical approaches.¹ Magnetic resonance imaging (MRI) and computed tomography (CT) are useful for detecting patients with primary brain tumors.^{3,4} Positron emission tomography (PET) provided metabolic information in the evaluation of patients with brain tumors.⁵ Clinically, the study of glucose metabolism with ^{18}F labeled fluorodeoxyglucose (FDG) has been utilized.^{6,7} In our laboratory, a variety of monoclonal antibodies (MoAbs) against glioma-associated antigens were produced. One of them is designated as G-22.^{8,9}

In the present study, we report an immunoscintigraphy with ^{131}I G-22 for the differentiation of recurrent tumor from necrosis in a patient who had

undergone intracranial surgery for glioblastoma. The results were compared with MRI and PET.

CASE REPORT

A 45-year-old man had undergone surgery in 1983 for the removal of a glioblastoma in the left parieto-occipital lobe. After the operation he also received radiation therapy and had a good clinical course without symptoms until in 1989, when he had a headache and a recurrence was suspected.

MRI was performed with a 1.5-T Signa unit (GE Medical Systems, Milwaukee). Following Gadolinium (Gd)-DTPA, T₁-weighted spin echo images (500/20[repetition time msec/echo time msec]) were obtained, with 5 mm section thickness, two excitations each, a 256×186 image matrix, and a 24 cm field of view. A large mass with an irregular margin in the left temporo-parietal area was demonstrated. However, dural enhancement was also noted in the brain (Fig. 1). PET study was performed with FDG, in a Headtome IV unit (Shimadzu, Kyoto, Japan).¹⁰ After the transmission scanning, 111 MBq of FDG was injected intravenously. A PET image was obtained 50 minutes after the injection. An FDG PET

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For reprints contact: Motoo Oshima, M.D., Department of Radiology, Teikyo University School of Medicine, 2-11-1, Kaga, Itabashi-ku, Tokyo 173, JAPAN.

study demonstrated marked accumulations in the left temporo-parietal area, and multiple small hot spots were also noted in the brain (Fig. 2).

The ^{131}I G-22 scintigraphy was obtained according to the following method. The F(ab')₂ fragment of G-22 was labeled with I by a modified chloramine T technique.⁸ The radiolabeled antibody (1.0 mg, 63 MBq) was dissolved in 200 ml/physiological saline and infused intravenously for 30 minutes. The present study was approved by the ethical and isotope committees at Nagoya University. Informed consent was given by each patient.

Planar images of the brain were obtained sequentially for a week (144 hrs) with a digital gamma camera (GCA-70AS, Toshiba, Tokyo) with a high energy, parallel-hole collimator dedicated to a mini-computer. The energy discriminator was set at 364 KeV with a 25% window. Marked uptake was seen in the left temporo-parietal area (Fig. 3). After intracranial surgery, recurrent glioblastoma was revealed by histological examination. The highest radioactivity reached the tumor on the 2nd day after the injection.

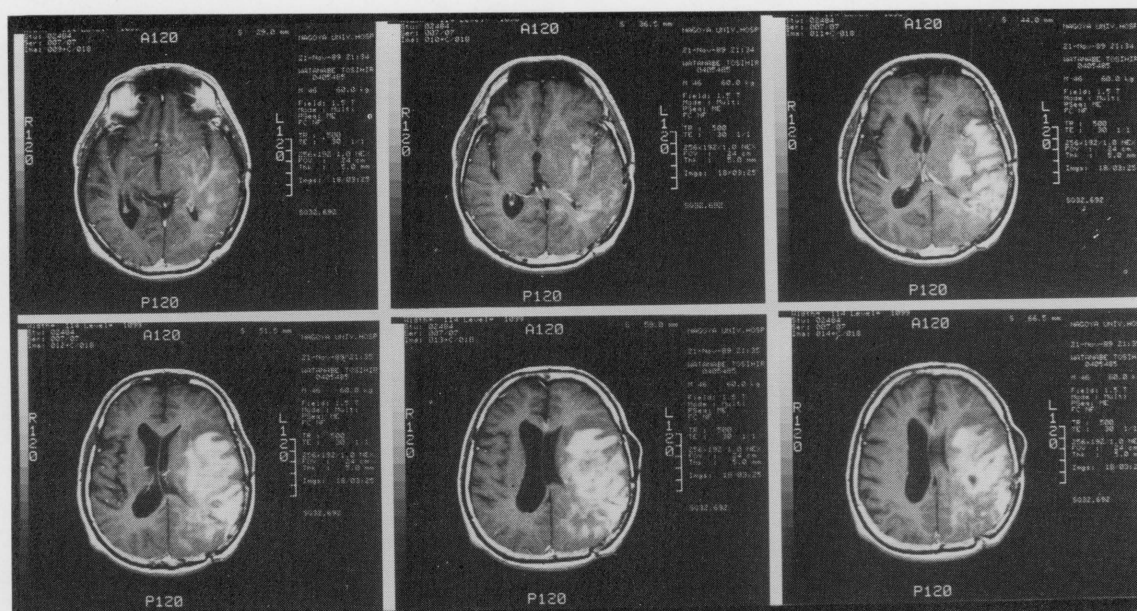


Fig. 1 Following Gd-DTPA, T1-weighted MR images (TR 500 msec, TE 30 msec) demonstrated a large mass with an irregular margin in the left temporo-parietal area. However, dural enhancement was also noted in the brain.

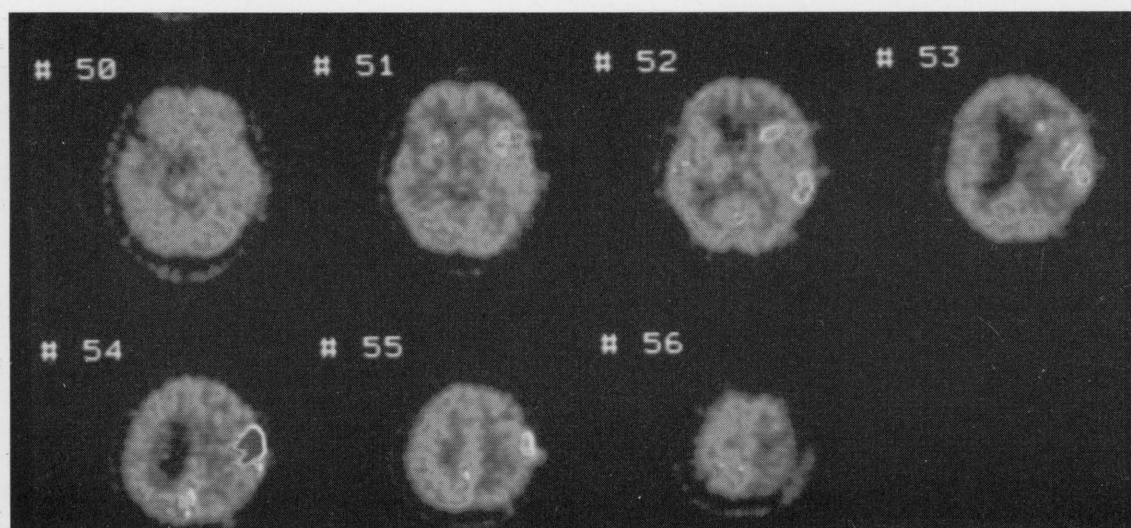
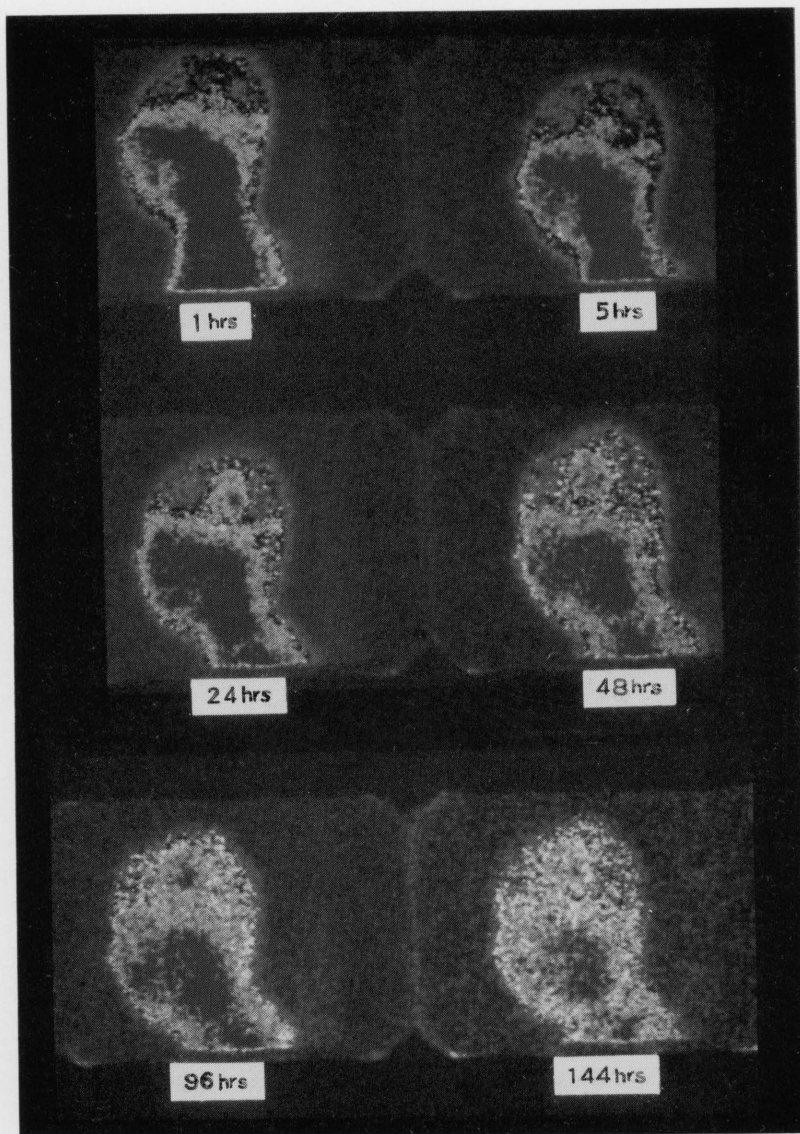
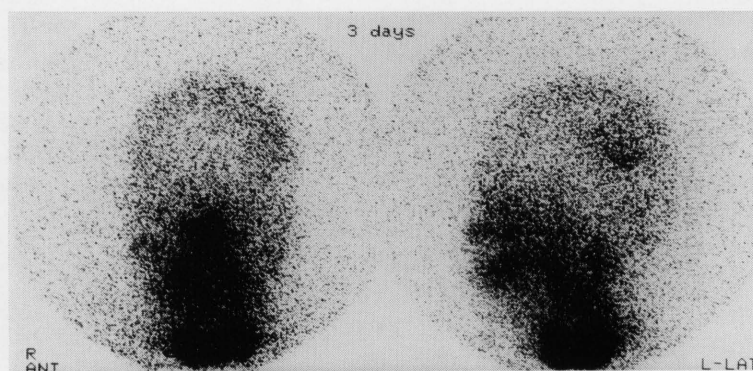


Fig. 2 FDG PET study demonstrated marked accumulations in the left temporo-parietal area. However, multiple hot spots were also noted in the brain.



A



B

Fig. 3 ^{131}I G-22 scintigraphy started at 1 hr and continued until 144 hrs (6 days) after the injection. A. Left lateral images (1 hr, 5 hrs, 24 hrs, 48 hrs, 96 hrs, and 144 hrs). B. Anterior and left lateral images (3 days). The marked uptake was seen in the left temporo-parietal area. Histological examination revealed recurrent glioblastoma after surgery. The tumor to normal brain ratio was highest on the 2nd day.

DISCUSSION

Dean, et al.¹¹ reported that there were significant difference between low-grade astrocytoma, anaplastic astrocytoma, and glioblastoma groups in MRI scores. However, MRI may not be accurate in differentiating among tumor recurrence, tumor remnant, and the brain injury due to the therapy.⁶ Elster, et al.¹² reported that abnormal dural enhancement may persist for decades in MRI study with Gd-DTPA in patients who had undergone intracranial surgery. Dural enhancement was also noted in our study (Fig. 1). FDG PET is able to assess the degree of malignancy at the time of diagnosis since low-grade tumors are less metabolic than high-grade tumors.¹³ The ability to determine the degree of malignancy has important therapeutic implications. PET scanning is more accurate than CT or MRI in detecting persistent tumor in the postoperative period and in differentiating recurrent tumor from necrosis after therapy.^{10,14} However, FDG PET does not accumulate specifically in glioblastoma. For instance, FDG PET can also be used to evaluate patients with meningiomas.⁷ The effects of edema and therapy on the metabolism of the normal brain must also be considered.⁶ In addition, seizure foci result in areas of hypermetabolism.⁶ In our case, multiple small spots in the brain were difficult to interpret (Fig. 2).

It is expected that a useful biochemical technique will be established as a diagnostic adjunct to neuro-radiological imaging. Previously we reported MoAb against glioma-associated antigens in cerebrospinal fluid, designated as G-22.⁸ The uptake of high-grade glioma was high, but that of low-grade gliomas was low.⁸ In the experimental study, a clear image of a human glioma subcutaneous tumor was obtained with a ¹²³I labeled G-22 F(ab')₂ fragment.⁹

In this study, the radioimaging of ¹³¹I G-22 showed a marked uptake in the left temporo-parietal area. Histological examination after intracranial surgery revealed recurrent glioblastoma (Fig. 3). The optimal imaging time was the 2nd day after the injection.

¹³¹I G-22 scan might be useful for the differentiation of recurrent tumor from necrosis in a patient who had undergone intracranial surgery for glioblastoma. The abnormal uptake of G-22 tends to suggest that this class of MoAb might have the potential for tumor immunotherapy by injecting systemically or intrathecally, or perhaps by using other isotopes with more effective therapeutic characteristics.

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