# Cerebral Circulation and Metabolism of Malignant Brain Tumor - Clinical Investigation by Positron Emission Computed Tomography -

# IV. 11 Cerebral Circulation and Metabolism of Malignant Brain Tumor - Clinical Investigation by Positron Emission Computed Tomography -

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Positron emission computed tomography (PECT) has made it possible to demonstrate various in vivo physiological informations quantitatively with the aid of the positron-emitting radiopharmaceuticals, which can not be obtained by the current diagnostic tools. In this paper, our preliminary experiecens in PECT study of malignant brain tumor are presented.

## Method and Cases

Regional cerebral blood flow (CBF), regional cerebral metabolic rate of oxygen ($CMRO_2$), oxygen extraction fraction (OEF) and cerebral metabolic rate of glucose (CMRGlc) were measured by ECAT II using the $^{15}O$ continuous inhalation method[1,2] and the $^{18}F$-fluorodeoxyglucose method.[3]

Four patients with malignant brain tumor were studied. The diagnosis were three gliomas (case 1,3,4) and one metastasis from lung cancer (case 2), based on the clinical findings, angiography and X-ray CT.

## Results

Results were summarized in Table 1.

CBF value of the brain tumor varied; some are high and other are low including case 2 which showed only 1 ml/100g/min due to cyst formation. On the other hand, CEF and $CMRO_2$ were low in all 3 cases except case 2 compared with the value of contralateral cortex (Fig. 1). CMRGlc study was performed in only 1 case (case 4) and it showed remarkably high glucose metabolism.

After the radioimmunochemotherapy (RAFP therapy) these physiological parameters changed; intratumoral CBF decreased and OEF increased in case 3(Fig. 2), and CMRGlu decreased in case 4 (Fig. 3), while in both cases clinical symptoms were improved with the treatment.

## Discussion

Our clinical experiences in PECT succeeded in demonstrating the several characteristic features of malignant brain tumors, although the cases were a few in number. Low OEF in the tumor was recognized except for one case with cyst formation, regardless of the CBF value. This results support the data

previously reported by Ito et al.[4]. Consequently, this low OEF value resulted in low $CMRO_2$ in the tumor, however, intratumoral CMRGlc was remarkably high in case 4. The dissociation between high CMRGlc and low $CMRO_2$ clearly indicates anaerobic metabolism occuring in the malignant brain tumor, while the normal cerebral metabolism usually shows the coupling between CMRGlc and $CMRO_2$.

It is of great interest that the physiological parameters of the brain tumors changed following the treatment. Low OEF and high CBF became close to the normal value in case 3 and high CMRGlc decreased dramatically. These results may open a new field of PECT not only to evaluate the effect of treatment but also to reveal the recurrence of brain tumor in its very early stage from the aspects of circulation and metabolism.

It is noteworthy that CBF, $CMRO_2$, OEF and CMRGlc decreased even in the contralateral cortex after the treatment. The treatment consisted of radiation (local brain 3000rad, whole brain 3000rad), ACNU, FT-207 and PSK. Among these, radiation therapy seems to be responsible to these change. Delayed radiation necrosis has been pointed out one of the most series side effects of radiation therapy[5], however, this unfavarable changes should be emphasized and careful follow-up study is strongly needed.

Our experiences in PECT study showed us relavent findings of malignant brain tumors which will surely be useful for management of this disease.

Acknowledgement

Collaborations of all the members of Cyclotron Radioisotope Center, Tohoku University were greatly appreciated. Especially we thank to Mr. S. Watanuki for his skilled ECAT operation.

Reference

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Table 1. CBF, $CMRO_2$, OEF and CMRGlc of the tumor and contralateral cortex.

| Pre-treatment | | CBF (ml/100g/min) | $CMRO_2$ (mg/100g/min) | OEF | CMRGlc (mg/100g/min) |
|---|---|---|---|---|---|
| Case 1 | Tumor | 50 | 2.2 | 0.32 | |
| | C/L cortex | 40 | 2.5 | 0.40 | |
| Case 2 | Tumor | 1 | 0.1 | 0.5 | |
| | C/L cortex | 25 | 2.0 | 0.5 | |
| Case 3 | Tumor | 100 | 3.5 | 0.25 | |
| | C/L cortex | 55 | 5.5 | 0.40 | |
| Case 4 | Tumor | 30 | 2.0 | 0.40 | 11.0 |
| | C/L cortex | 40 | 2.5 | 0.45 | 5.0 |
| Post-treatment | | | | | |
| Case 3 | Tumor | 40 | 2.0 | 0.30 | |
| | C/L Cortex | 40 | 2.0 | 0.30 | |
| Case 4 | Tumor | | | | 2.5 |
| | C/L cortex | | | | 4.5 |

C/L: contralateral

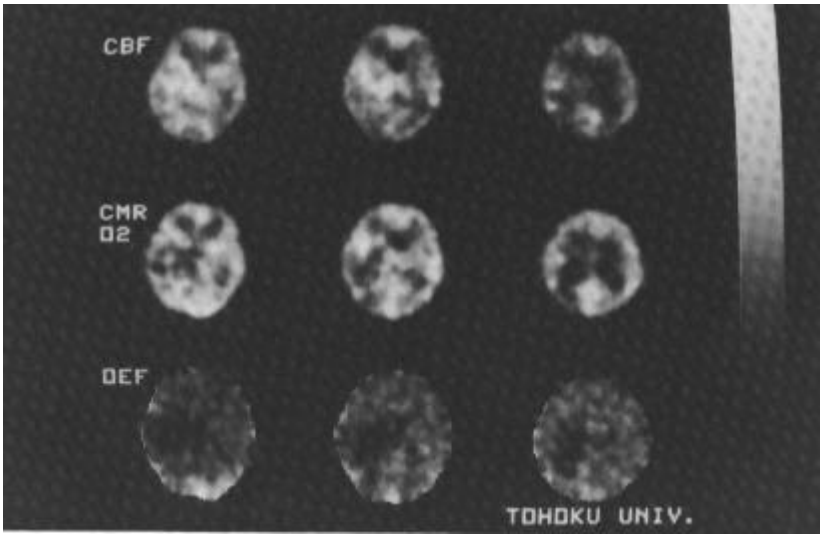


Fig. 1. case 3
A malignant brain tumor was in the left thalamus. PECT study was performed before the treatment. (The highest value in each parameters were adjusted to the top of the scale.)

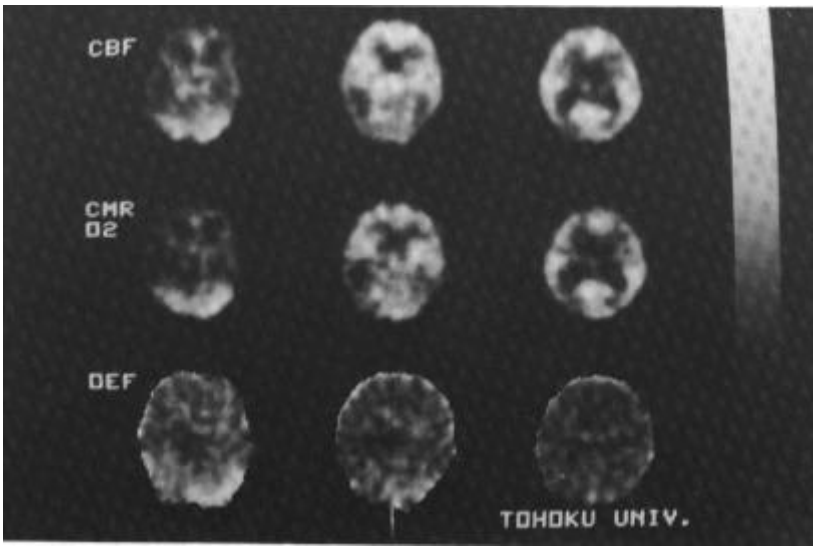


Fig. 2. case 3
After the treatment.

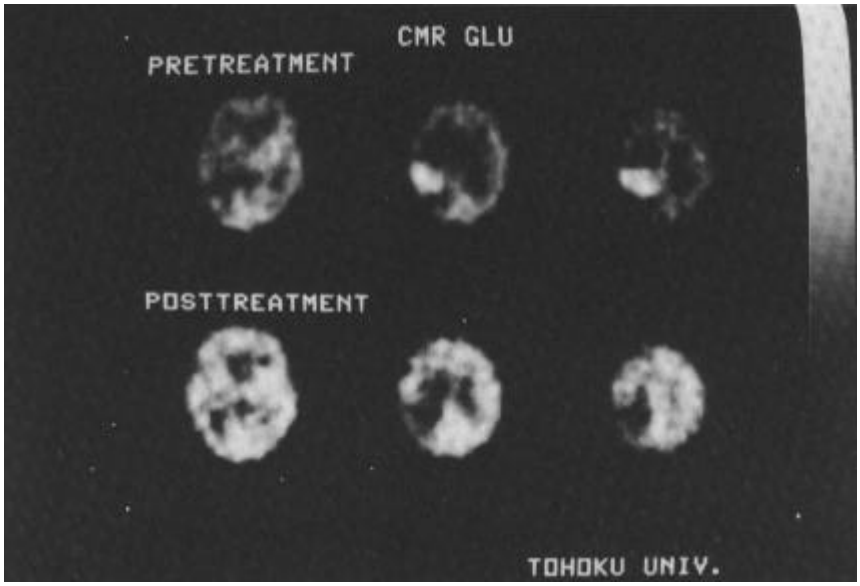


Fig. 3. case 4
A malignant brain tumor was in the left parietal region. This examination was done before and after the treatment.