Rapid Regrowth of Intracranial Clear Cell Meningioma After Craniotomy and Gamma Knife Radiosurgery

—Case Report—

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Abstract

A 24-year-old woman underwent craniotomy for falx meningioma (5 cm in diameter) on October 24, 1995. The deepest part of the tumor was located in the anterior horn of the lateral ventricle, which was not resected. The histology was clear cell meningioma (CCM), aggressive in nature. The MIB-1 labeling index was high (11%). She underwent gamma knife (GK) radiosurgery for the residual tumor with an irradiation dose of 16 Gy at the tumor periphery on May 24, 1996. The postradiosurgical course was uneventful. The residual intraventricular tumor gradually decreased in size, but the peripheral portion gradually grew into the diencephalic region. The patient remained in good condition for 5 years until September 2001, when she exhibited memory disturbance and lethargy. Magnetic resonance imaging demonstrated a large tumor (4.5 cm in diameter) in the diencephalon, compressing the optic nerves and fornix. The calculated tumor doubling time was 120 days. A second craniotomy was performed on October 9, 2001. The tumor was totally resected through the anterior transcallosal approach. The histology and the MIB-1 labeling index of the tissue from the second operation did not differ markedly from those of the first operation. Neither tumor recurrence nor metastasis has been observed to date. GK radiosurgery contributed to control of the residual intraventricular tumor, but the peripheral portion of the tumor, which received a relatively low radiation dose (16 Gy), grew rapidly. This suggests that a marginal dose of 16 Gy may not be sufficient for control of CCM.

Key words: clear cell meningioma, gamma knife radiosurgery, growth rate, MIB-1, radiation dose

Introduction

Clear cell meningiomas (CCMs) predominantly occur in the posterior fossa and the spinal canal. Supratentorial lesions are rare. The patient age range is broad but skewed toward the young with no sex predilection. CCMs are classified as grade 2 in the current World Health Organization (WHO) system. Intracranial CCMs have a more aggressive nature despite their benign appearance and often require multiple reoperations or radiation therapy. The optimal treatment of an intracranial meningioma is complete resection of the tumor, but cannot always be achieved due to various difficulties. We treated a patient with a supratentorial CCM by craniotomy followed by gamma knife (GK) radiosurgery which achieved transient control of the residual tumor, but the peripheral portion grew rapidly into the diencephalic region and required a second craniotomy to relieve the patient’s symptoms.

Case Report

A 24-year-old woman was admitted to our facility with complaints of headache and vomiting on August 2, 1995. She had a one-year history of headache. On admission, she exhibited bilateral papilledema. Magnetic resonance (MR) imaging demonstrated a large tumor in the anterior interhemispheric region (Fig. 1). The preoperative diagnosis was falx meningioma. She underwent craniotomy on October 24, 1995. The tumor was resected through the anterior interhemispheric approach. The deepest part of the tumor was located...
in the anterior horn of the lateral ventricle, which was not resected (Fig. 2). Unexpected sacrifice of the A3 segment of the right anterior cerebral artery, incorporated within the tumor, discouraged the surgeon from further resection of the intraventricular tumor. Although the patient exhibited no postoperative neurological deficits, MR imaging demonstrated an ischemic lesion in the distribution of the right anterior internal frontal artery.

Histological examination of the surgical specimen showed sheets and lobules of oval or polygonal cells with a clear cytoplasm (Fig. 3). Psammoma bodies were absent. Cytoplasmic glycogen content was demonstrated by periodic acid-Schiff staining. Immunohistochemistry showed positive reactivity for vimentin and epithelial membrane antigen, similar to other meningioma subtypes. We conducted the MIB-1 immunostaining and calculated the MIB-1 labeling index by a method reported elsewhere. The MIB-1 labeling index was 11%. The diagnosis was CCM. The postoperative course was uneventful and the patient was discharged one month later.

The patient underwent GK radiosurgery for the residual tumor on May 24, 1996. The tumor was covered with the 40% isodose volume administered at 10 target points using one 8-mm, six 14-mm, and three 18-mm collimators. A central dose of 40 Gy was used to obtain a marginal dose of 16 Gy (Fig. 4). The postradiosurgical course was uneventful. Periodical MR imaging observed gradual reduction.
The patient remained in good condition until September 2001, when she exhibited memory disturbance and lethargy. MR imaging demonstrated rapid growth of the tumor to 4.5 cm in diameter, extending into the left diencephalic parenchyma (Fig. 6). The tumor doubling time was 120 days, calculated as $T \times \log 2/\left(\log V_2 - \log V_1\right)$, where $V_1$ is the volume on June 9, 2000, $V_2$ is that on October 3, 2001, and $T$ is the MR imaging interval. A second craniotomy was performed on October 9, 2001. The tumor was totally resected through the anterior transcallosal approach. The histology and the MIB-1 labeling index of the tissue from the second operation did not differ markedly from those of the first. Postoperatively, the patient’s recovery was uneventful. She was discharged one month later and her memory disturbance has since gradually improved. Neither tumor recurrence nor metastasis has been detected since (Fig. 7).

**Discussion**

CCMs were classified as grade 1 tumors in the WHO classification of tumor of the central nervous system in 1993. However, recent studies have revealed...
frequent recurrence, regrowth, or metastasis of CCMs, requiring multiple reoperations or radiation therapy. The current WHO system classifies CCMs as grade 2. The MIB-1 labeling index of recurrent CCM can be as high as 13%, reflecting the tumor aggressiveness. In our case, the MIB-1 labeling index was 11%, which was compatible with the short tumor doubling time.

The long-term results of GK radiosurgery show effective control of residual benign meningiomas after open surgery. A marginal dose of 12 Gy or more achieves excellent local control of benign meningiomas, although relatively short follow-up periods limit the usefulness of the majority of available data. Other series reported that GK radiosurgery with a marginal dose of 10 Gy or less failed within one year in 30% of cases. On the other hand, the histological subtypes were not determined in the meningiomas treated by GK radiosurgery without craniotomy, which also hampers the accurate evaluation of the efficacy of GK radiosurgery. Aggressive meningiomas, even hemangiopericytomas, might be erroneously included in the analysis of GK therapy for benign meningiomas, because these tumors often cannot be discriminated on neuroimaging.

The efficacy of GK radiosurgery for CCMs is unclear, and the optimal radiation dose for CCMs has not yet been determined from two reports of GK radiosurgery for CCM. In one case, a tentorial CCM was subtotally resected and the residual tumor was treated by GK. In the other case, a recurrent CCM was treated by GK after gross total removal of a foramen magnum tumor. The efficacy of the GK radiosurgery was not discussed in detail. In our patient, GK radiosurgery contributed to control of the residual intraventricular tumor, but the peripheral portion of the tumor, which received a relatively low radiation dose (16 Gy), grew rapidly in the diencephalic region. This suggests that a marginal dose of 16 Gy may not be sufficient for control of CCM. In the present patient, the recurrent tumor was large enough to compress critical structures including the fornix, optic nerves, and hypothalamus at the tumor periphery. The marginal dose was limited by the presence of these adjacent critical structures, which are vulnerable to radiation injury. The tolerable dose to the optic nerves is considered to be approximately 8 to 10 Gy. Considering these constraints, repeated GK radiosurgery was inappropriate and a second craniotomy was performed.

References


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