Effect of Radiation Therapy Against Intracranial Hemangiopericytoma

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Abstract

Seven cases of intracranial hemangiopericytoma were studied retrospectively to investigate the efficacy of radiation therapy. Tumor response evaluated by computed tomography and magnetic resonance imaging was obvious after 20–30 Gy irradiation. The total reduction rate was 80–90% and continued as long as 5–7 months after treatment. In five patients receiving radiation therapy before radical removal, the tumors were easily removed without massive hemorrhage. Histological inspection of specimens after irradiation showed a significant disappearance of tumor cells. Pyknosis frequently occurred in endothelial cells, and proliferating vessels with hyalinoid degeneration were also seen. Reticulin fibers between tumor cells were fewer, split, or absent. Preoperative radiation therapy is useful in the treatment of hemangiopericytoma involving considerable surgical risk. Postoperative radiation therapy should be given even if removal is complete.

Key words: meningioma, hemangiopericytoma, radiation therapy, neuroradiology

Introduction

Intracranial hemangiopericytoma is a vascular tumor characterized by Zimmerman's pericytes. These tumors may be angioblastic variants of meningiomas, or a separate biological and histological entity. Histochemical and electron microscopic studies suggest the latter to be correct. The high rate of metastatic recurrence also contrasts with meningiomas. Intracranial hemangiopericytomas have the same features as hemangiopericytomas elsewhere in the body.

Intracranial hemangiopericytomas frequently bleed profusely at operation because their blood supply derives from external and internal carotid arteries. Radiation therapy is frequently used because of the marked vascularity, but remains controversial. Here, we review our experience with radiation therapy in seven patients with intracranial hemangiopericytoma and discuss the radiosensitivity of the tumor.

Materials and Methods

This study included seven patients receiving surgery and pre- or postoperative radiation therapy for intracranial hemangiopericytoma between 1981 and 1989. There were six males and one female ranging in age from 16 to 71 years (average, 37.4 yrs). Table 1 summarizes their case histories and outcomes.

Hemangiopericytoma was diagnosed histologically using the following criteria: the tumors were located along the dural surface; microscopically, there were many capillary blood vessels; the tumor cells had nuclei with prominent chromatin; organized patterns such as whorls were absent; the tumor cells were surrounded by pericytes; the vascular pattern was "staghorn-like"; and Gitter staining revealed a fine network of silver stained fibers interlaced with the tumor cells. Four tumors extended to nearby petrous bone, the cerebellar tentorium, or the optic chiasm, and three in the falx and convexity.

Five patients receiving preoperative irradiation were followed by computed tomography (CT) and magnetic resonance (MR) imaging, and the tumor reduction rates estimated from the images.
Histological examination of biopsy specimens obtained before and after radiation therapy in three cases was used to evaluate the effect of radiation therapy.

### Results

Cases 1–4 received radical removal without radiation therapy for the initial tumor. All demonstrated tumor recurrence at a mean 4 years later. Cases 5 and 6 underwent biopsy because of massive intraoperative bleeding, followed by radiation therapy. Follow-up CT scans demonstrated a reduction in tumor size, and residual tumors were removed without massive bleeding. However, Case 6 showed tumor recurrence 5 years later. Case 7 received radiation therapy after radical removal.

Of the five patients with tumor recurrence, Cases 2–4 received radiation therapy before the second radical removal. CT scans showed a significant reduction in tumor size in Cases 3 and 4, and the tumors were easily removed totally. CT scans of Case 2 showed no significant reduction in tumor size, but the intraoperative hemorrhage was less than expected. Case 1 received radiation therapy after the second radical removal. Case 6 received radiation therapy alone, and 2 years later eventually died from whole body metastasis to bone outside the radiation area.

CT scans or MR images demonstrated significant reductions in tumor size after 20–30 Gy (Fig. 1). The total reduction was 80–90% (Figs. 2 and 3). Even 5–7 months after treatment, the tumor size remained reduced.

Histological examination of specimens after radiation therapy (Cases 3–5) showed a significant reduction in tumor size.
decrease in tumor cells. Pyknosis was frequently seen in endothelial cells, and proliferating vessels with hyalinoid degeneration also occurred. Fewer reticulin fibers were present between tumor cells and the fibers had a split appearance (Fig. 4).

Discussion

Radiation therapy can achieve temporary regression of hemangiopericytoma outside the brain in patients inoperable because of metastases. Both local radiation therapy (70–90 Gy) and chemotherapy can achieve palliation in some cases, but no remission was obtained.

Kruse reported that radiation therapy was of value in eight patients with intracranial hemangiopericytoma originating from the meninges. Fukui et al. found that preoperative radiation therapy caused a marked reduction in tumor size and vascularity based on angiography, and the tumors were removed more easily and safely. Goellner et al. found that 17 of 26 hemangiopericytomas recurred within 5 years of the first operation and whole body metastasis occurred in 23% within 8.6 years. They concluded surgery is of limited curative value and suggested that subtotal removal be followed by 50–60 Gy radiation therapy. Tumor recurrence should be treated with surgery and/or further radiation therapy. Jaaskelainen et al. reported that only one of three intracranial hemangiopericytomas irradiated upon recurrence was radioresistant. Guthrie et al. reported clinical data for a series of 44 meningeal hemangiopericytomas. Radiation therapy administered after the first operation extended the period before recurrence from 34 to 75 months, and extended survival from 62 to 92 months. They concluded that radiation therapy is advisable for meningeal hemangiopericytoma.

In our series, four initial tumors not irradiated after the operation recurred at a mean 4 years later. The other patients receiving radiation therapy were shown to demonstrate no recurrence for 4–5 years. However, one patient who received radiation therapy (Case 6) developed a recurrence and multiple metastases to the whole body.

Radiation therapy before radical removal, including recurrent tumors, achieved reduced tumor size and allowed easy removal without severe bleeding. Tumors responded to irradiation after 20–30 Gy, and one tumor continued to regress 7 months later. Takase and Watanabe reported a recurrent hemangiopericytoma which shrank after 60 Gy irradiation; follow-up CT showed marked regression.
of the tumor 1 year later. Some of our cases may achieve further tumor shrinkage over a longer period.

Histological study of meningioma biopsy samples before and after radiation therapy showed characteristic changes including fibrous and hyalinoid degeneration, old hemorrhage, and necrotic changes. Our study also found degeneration and disintegration of the tumor cell nuclei, and splitting of reticulin fibers. The effect of radiation therapy is therefore confirmed histologically.

Preoperative diagnosis of hemangiopericytoma is difficult. In our patients, diagnosis was based on operative findings. Radiation therapy was then preferred for recurrent or residual tumors. Angiography of intracranial hemangiopericytomas shows that the dural arteries are supplied from both meningeal and cortical vessels, and a network of small corkscrew-like vessels is present in the tumor. In most of our patients, the tumor consisted of cystic components. We suggest that radiation therapy should be the initial treatment for skull base hemangiopericytoma where there is a risk of permanent neurological damage. Postoperative radiation therapy should be given even if removal is believed to be complete or massive hemorrhage occurred at the initial operation. A radiation dosage in excess of 50 Gy is recommended to the primary tumor (or operative bed) plus a minimum margin of 2 cm. However, in our series intracranial recurrence occurred remote from the primary irradiated field, so we recommend whole head radiation therapy.

References


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