Multiple Primary Brain Tumors of Different Histological Types

—Report of Two Cases—

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Abstract

Simultaneous development of histologically different primary brain tumors aside from phacomatoses or previous irradiation is rare, and its preoperative diagnosis is still difficult. We report two such cases, a 49-year-old male with an acoustic neurinoma and a cerebellar hemangioblastoma and a 69-year-old female with a parietal convexity meningioma and an ipsilateral frontal lobe astrocytoma. The tumors in the first case developed closely, so some local stimulation probably acted as a developmental factor. However, the tumors in the second case developed in distant areas and were considered coincidental.

Key words: multiple brain tumors, hemangioblastoma, neurinoma, meningioma

Introduction

The simultaneous development of histologically different brain tumors generally occurs in patients with phacomatoses or radiation therapy for brain tumors, and rarely occurs spontaneously. We encountered two cases of multiple primary brain tumors with different histological types, who demonstrated important implications for preoperative neuroimaging diagnosis. The characteristic features and possible developmental mechanisms of multiple primary brain tumors are discussed.

Case Reports

Case 1: A 49-year-old male developed fever, cough, and expectoration at the beginning of January, 1988. A chest x-ray taken at a local hospital revealed an abnormality in the right hilus. He was then transferred to the surgical department of our hospital. Lung cancer was diagnosed, and a right middle and lower lobectomy was performed on March 9, 1988. The histological diagnosis was well-differentiated, squamous cell carcinoma. The postoperative course was uneventful, but he was admitted to our department

on April 7, 1988, because a computed tomographic (CT) scan showed a neoplastic lesion in the posterior fossa.

On admission, he had a gaze nystagmus towards the right and decreased right auditory acuity in the range of 2000–4000 Hz. There was no abnormality in the ocular fundi. A precontrast CT scan revealed an irregular, nodular high-density area in the right cerebellopontine (CP) angle (Fig. 1 *left*). Postcontrast, the mass was homogeneously enhanced and appeared larger (Fig. 1 *right*). A T₁-weighted axial magnetic resonance (MR) image showed flow-void signs at the medial part of the mass near the lateral recess of the fourth ventricle (Fig. 2A). Gadolinium-diethylenetriaminepenta-acetic acid (Gd-DTPA) contrast showed an irregularly enhanced medial mass and a round, homogeneously enhanced lesion in the CP angle (Fig. 2B). A T₂-weighted MR image showed a well-demarcated, high-intensity area with small low-intensity spots (Fig. 2C). A bone-window CT scan showed a trumpet-shaped enlargement of the right internal auditory meatus (Fig. 2D). Right vertebral angiograms revealed a marked tumor stain fed by the branches of the anterior inferior and posterior inferior cerebellar arteries (Fig. 3). A collision tumor of acoustic neurinoma and cerebellar hemangioblastoma was diagnosed. He refused opera-

Fig. 1 Case 1. *left*: Precontrast CT scan, showing a nearly round, high-density area in the right CP angle. *right*: Postcontrast CT scan, demonstrating two different components with good enhancement.

tion and was discharged on April 20, 1988.

He was readmitted 7 months later with headache, nausea, and dizziness. On the second admission, he had ataxic gait, gaze nystagmus towards the right, and decreased right auditory acuity. The hearing disturbance and size of the posterior fossa mass le-

Fig. 3 Case 1. Right vertebral angiograms, anteroposterior (*left*) and lateral (*right*) views, demonstrating a tumor shadow fed by the anterior inferior and posterior inferior cerebellar arteries.

sion had not aggravated compared with the previous study.

A right suboccipital craniectomy was performed on November 16, 1988. The tumor feeders were all coagulated and excised. The vascular tumor located

Fig. 2 Case 1. A: T_1 -weighted axial MR image [spin echo (SE), 400/35 msec], showing two low-intensity areas in the right CP angle. B: After administration of Gd-DTPA, the focus in the CP angle is homogeneously enhanced, but the lesion on the right of the fourth ventricle is irregularly enhanced. C: T_2 -weighted axial MR image (SE, 2000/90 msec), showing a demarcated high-intensity area with round low-intensity spots. D: Bone-window CT scan, showing a trumpet-shaped enlargement at the entrance of the right internal auditory canal.

Fig. 4 Case 1. *left*: Photomicrograph of the CP angle tumor, showing a typical Antoni A-type neurinoma with compact bundles of elongated, fibrillated cells. HE stain, $\times 100$. *right*: Photomicrograph of the cerebellar tumor, showing a hemangioblastoma with many stromal cells. HE stain, $\times 100$.

at the lateral recess of the fourth ventricle was removed. The laterally located CP angle tumor was then removed to preserve the facial nerve.

Histological examination showed the laterally located CP angle tumor to be a typical schwannoma with fascicular arrangement (Fig. 4 *left*). The medial tumor at the lateral recess of the fourth ventricle had abundant small blood vessels interposed with foamy cells characteristic of hemangioblastoma (Fig. 4 *right*).

The postoperative course was uneventful, and he was discharged with residual ataxic gait and decreased auditory acuity.

Case 2: A 69-year-old female noted a partial seizure of the left arm for several minutes on October 15, 1988. Because convulsive seizures became frequent and weakness of the left arm developed, she was hospitalized in our department on December 5, 1988. She had no history of malignant tumor.

On admission, her consciousness was clear and a monoplegia of the left arm was noted. The cortical sulci in the right parietal lobe were unclear on precontrast CT scans (Fig. 5 *upper*). Postcontrast CT scans revealed two solitary round masses in the right frontal lobe and parietal convexity (Fig. 5 *lower*). Right carotid angiograms showed a tumor shadow in the parietal region, fed by the parietal branch of the middle meningeal artery. All tumor markers were negative. Possible metastatic brain tumor was diagnosed.

A right frontotemporoparietal craniotomy was performed on January 13, 1989. The parietal tumor attached to the dura mater was elastic hard and grayish white, and could be excised easily. The frontal lobe tumor invading into the cerebral white matter was

Fig. 5 Case 2. *upper*: Precontrast CT scans, showing a slightly high-density area in the right parietal lobe. *lower*: Postcontrast CT scans, demonstrating a nearly circular lesion in the right parietal lobe as well as a round lesion in the ipsilateral frontal lobe.

soft and grayish yellow, and was subtotally excised.

Histological examination showed the right parietal tumor to be a typical meningotheliomatous menin-

Fig. 6 Case 2. *left*: Photomicrograph of the right parietal tumor, showing a typical meningotheliomatous meningioma. HE stain, $\times 200$. *right*: Photomicrograph of the frontal tumor, showing a moderately differentiated astrocytoma. HE stain, $\times 200$.

gioma (Fig. 6 *left*). The frontal lobe tumor had a medium cell density with moderately vascular proliferation. There was no cellular atypism or focal necrosis. The diagnosis was moderately differentiated astrocytoma (Fig. 6 *right*).

The postoperative course was uneventful, and she received 5000-rad radiation therapy.

Discussion

Primary brain tumors with different histological types rarely develop spontaneously together; the incidence is only 0.3% of all brain tumors.⁴⁾ The most frequent reported combination of histologically different brain tumors is meningioma and glioma^{1,6,8,10,11,15)} followed by meningioma and neurinoma^{1,9,14)} and by meningioma and pituitary adenoma.^{3,7,9,12)} The recent advance in neuroimaging for the diagnosis of brain tumor has resulted in more reports of multiple primary brain tumors. However, the correct preoperative diagnosis of such tumors is still difficult. Table 1 summarizes clinical cases with multiple brain tumors of different types confirmed preoperatively. Multiple brain tumors developing simultaneously in almost the same region occurred in only three cases.

In our Case 1, MR imaging provided useful information to identify the location and nature of the tumors, which had both developed adjacently in the posterior fossa. In Case 2, however, the tumors were located in the ipsilateral frontal and parietal lobes, and an incorrect preoperative diagnosis of metastatic brain tumor was made.

Possible mechanisms for the development of multiple brain tumors with different histological types, aside from phacomatoses or previous irradiation,

Table 1 Summary of 10 cases of histologically different brain tumors, which were preoperatively diagnosed

Case No.	Author (Year)	Age/Sex	Location and histology of tumors
1*	Nagashima <i>et al.</i> (1963) ¹¹⁾	42/M	lt frontal astrocytoma, lt sphenoidal ridge meningioma
2	Kitamura <i>et al.</i> (1965) ⁹⁾	24/F	lt acoustic neurinoma, lt frontal meningioma
3	Akagi <i>et al.</i> (1973) ¹⁾	23/F	lateral ventricle meningioma, lt acoustic neurinoma
4	Brennan <i>et al.</i> (1977) ³⁾	36/M	lt sphenoidal ridge meningioma, pituitary adenoma
5*	Deen and Laws (1981) ²⁾	65/M	intracellular meningioma, craniopharyngioma
6	Hyodo <i>et al.</i> (1982) ¹⁾	52/F	lt parietal meningioma, pituitary adenoma
7	Schnegg and Tribolet (1984) ¹⁴⁾	39/M	lt facial nerve neurinoma, lt parietal meningioma
8	Ohata (1985) ¹²⁾	50/F	pituitary adenoma, falcatentorial meningioma
9	Kawaguchi <i>et al.</i> (1986) ⁸⁾	55/M	rt parietal meningioma, lt parietal glioblastoma
10*	Suzuki <i>et al.</i> (1987) ¹⁵⁾	75/F	lt frontal astrocytoma, lt frontal meningioma

*Two different tumors adjacent in the brain.

are: 1) entirely coincidental development of the tumors,⁹⁾ 2) the initial tumor acts as a stimulus on the surrounding cerebral parenchyma or meningeal tissue to induce a new tumor in a different tissue,¹³⁾ 3) a carcinogenic stimulus develops tumors in different tissues simultaneously,¹⁰⁾ 4) a residual embryonic structure becomes the basis for subsequent multiple brain tumor development,²⁾ *etc.* The tumors developed close together in Case 1, so some local stimulation probably acted as a factor in the development of the other tumor. In Case 2, however, the tumors developed in distant areas. Therefore, the

development was probably coincidental.

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