Metastatic Pineal Tumors Treated by Neuroendoscopic Surgery

—Two Case Reports—

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Abstract

Two patients presented with metastatic pineal tumors. A 69-year-old man had gait disturbance, dementia, and urinary incontinence but no history of previous malignancy. Magnetic resonance imaging of the brain revealed a 23-mm tumor in the pineal region and obstructive hydrocephalus. A 37-year-old man had been treated for thyroid cancer. He presented with vomiting and consciousness disturbance. Brain magnetic resonance imaging revealed a 28-mm pineal tumor associated with intratumoral hemorrhage and accompanying obstructive hydrocephalus. Both patients underwent neuroendoscopic biopsy and third ventriculostomy through the foramen of Monro, resulting in reliable histological diagnoses and subsidence of hydrocephalus.

Key words: metastatic brain tumor, pineal region, third ventriculostomy, endoscopy

Introduction

Neoplasms of the pineal region comprise about 3.5% of all intracranial tumors.⁵⁾ Metastasis of malignant neoplasms to the pineal gland is very rare, and accounts for only 3.8%¹⁰⁾ of all pineal region tumors and only 0.4%⁵⁾ to 3.8%¹⁴⁾ of all metastatic intracranial tumors. Most such metastases were diagnosed posthumously. We treated 2 patients with metastatic tumors of the pineal gland manifesting as acute-onset hydrocephalus.

Case Reports

Case 1: A 69-year-old man without a previous history of malignancy presented at a local neurosurgical clinic with gait disturbance, dementia, and urinary incontinence. Computed tomography (CT) of the brain showed a tumor in the pineal region accompanied by obstructive hydrocephalus and he was referred to our hospital. Magnetic resonance (MR) imaging of the head revealed hydrocephalus and a pineal tumor 23 mm in diameter compressing the tectum (Fig. 1). The tumor was heterogeneously enhanced after gadolinium administration. Positron emission tomography demonstrated a lesion with increased uptake in the hilum of the left lung in addition to the pineal gland hot spot. Chest CT revealed a 38-mm diameter tumor in the left hilum. His serum level of neuron-specific enolase was 106 ng/ml (normal range <10 ng/ml). During the preoperative investigations his level of con-

sciousness decreased and he fell into a stupor. He manifested hypoxia due to lung atelectases.

He underwent neuroendoscopic biopsy and third ventriculostomy under general anesthesia (Fig. 2). Histological findings were compatible with metastasis from small cell carcinoma of the lung (Fig. 3). Postoperatively, his hydrocephalus gradually improved and he was able to communicate and walk with assistance. He received whole brain irradiation with a total dose of 30 Gy. He was discharged home for recuperation and terminal care, and died of respiratory failure due to lung cancer progression 4 months after surgery.

Case 2: A 37-year-old man with treated thyroid papillary carcinoma and bone metastases underwent second thyroidectomy for recurrence at our hospital. Soon thereafter he manifested vomiting, headache, and consciousness disturbance. Brain CT revealed a pineal tumor and obstructive hydrocephalus. MR imaging disclosed a 28-mm diameter tumor and intratumoral bleeding (Fig. 4A, B).

Neuroendoscopic third ventriculostomy and tumor biopsy were performed through the foramen of Monro and his neurological condition improved dramatically. Histological findings were consistent with his earlier thyroid cancer (Fig. 5). MR imaging performed 2 weeks after the operation revealed another 4-mm diameter lesion in the left cerebellar hemisphere, which was suspected to be a metastatic lesion. Stereotactic radiation with a 30-Gy dose to the periphery and 30 Gy to the pineal and left cerebellum lesion resulted in marked decrease in the tumor size (Fig. 4C, D). He was discharged home without neuro-

Table 1 Summary of reported cases with metastatic pineal tumors diagnosed in life

Case No.	Author (Year)	Primary tumor	Primary diagnosis preceded	Manifestation	Chemotherapy	Radiosurgery	CSF diversion	Survival period (mos)
1	Yamamoto et al. (1987) ²¹⁾	gastric ca.	yes	hydro.	no	yes	VPS	3
2	Kashiwagi et al. (1989) ⁶⁾	lung ca.	no	hydro.	yes	yes	VPS	4
3	Keyaki et al. (1989) ⁹⁾	lung ca.	no	hydro.	yes	yes (60 Gy)	VPS	9
4	Weber et al. (1989) ²⁰⁾	lung ca.	yes	hydro.	no	yes (31 Gy)	not performed	2
5	Vaquero et al. (1991) ¹⁹⁾	lung ca.	no	hydro.	no	no	VPS	1
6		melanoma	no	hydro., diplopia	no	no	VPS	2
7		ca. (ND)	no	headache	no	yes (60 Gy)	ND	2
8	Suganuma et al. (1994) ¹⁸⁾	lung ca.	yes	fatigue, loss of weight	yes	yes	ND	10
9	Borqui et al. (1996) ³⁾	lung ca.	no	seizure, hydro.	no	no	yes, no detail	2
10	Schuster et al. (1998) ¹⁷⁾	esophageal ca.	yes	hydro.	no	yes	VPS	ND
11		esophageal ca.	yes	dizziness, Parinaud's syndrome	no	yes	ND	ND
12	Murata et al. (1999) ¹²⁾	renal cell ca.	no	hydro.	yes	no	VPS	15 (alive)
13	Ramina et al. (1999) ¹⁶⁾	colorectal ca.	no	Parinaud's syndrome	yes	no	ND	3
14	Kanai et al. (2000) ⁷⁾	gastric ca.	yes	headache, hydro.	no	yes (60 Gy)	not performed	6
15	Pople et al. (2001) ¹⁵⁾	ca. (ND)	ND	ND	no	yes	ND	6
16		ca. (ND)	ND	ND	no	yes	VPS	36 (alive)
17		ca. (ND)	ND	ND	yes	no	ND	ND
18		ca. (ND)	ND	ND	no	no	ND	3
19	Kakita et al. (2003) ⁶⁾	lung ca.	yes	hydro.	no	no	VPS	0
20	Ahn et al. (2005) ¹⁾	lung ca.	no	hydro.	yes	yes (36 Gy)	not performed	5
21	Boscherini et al. (2006) ⁴⁾	gastric ca.	no	hydro.	yes	yes	3V	ND
22	Lassman et al. (2006) ¹¹⁾	esophageal ca.	yes	hydro.	ND	no	VPS	1
23		renal cell ca.	yes	hydro.	ND	yes	VPS	2
24		lung ca.	no	hydro.	ND	no	VPS	2
25		cervical ca.	yes	hydro.	ND	yes	not performed	5
26		lung ca.	no	hydro.	ND	yes	VPS	124
27		breast ca.	yes	hydro.	ND	no	not performed	7
28		lung ca.	no	hydro.	ND	yes	3V	21
29		gastric ca.	yes	hydro.	ND	yes	3V	7
30		colon ca.	yes	hydro.	ND	yes	3V	5
31		ND	no	hydro.	ND	yes	VPS	4
32	Present Case 1	lung ca.	no	hydro.	no	yes (30 Gy)	3V	4
33	Present Case 2	thyroid ca.	yes	hydro.	no	yes (30 Gy)	3V	8

ca.: carcinoma, CSF: cerebrospinal fluid, hydro.: hydrocephalus, ND: not described, 3V: third ventriculostomy, VPS: ventriculoperitoneal shunt.

logical symptoms and he died 8 months later of unknown direct causes. During this 8-month period he did not report to our clinic with recurrent symptoms of hydrocephalus.

Discussion

We treated two patients with metastatic tumors of the pineal gland. The metastasis derived from lung carcinoma and the symptoms attributable to the pineal lesion preceded the diagnosis of the primary lesion in our Case 1. The metastatic tumor was found during treatment for recur-

Fig. 1 Case 1. Preoperative axial T₂-weighted (A), axial T₁-weighted (B), axial T₁-weighted with gadolinium (C), and sagittal T₁-weighted with gadolinium (D) magnetic resonance images showing a 23-mm pineal tumor as almost isointense to the cerebrum and enhanced heterogeneously, with accompanying hydrocephalus.

Fig. 2 Case 1. Endoscopic images showing the thin floor of the third ventricle before penetration (A), and the pineal region tumor biopsied without major bleeding (B).

rent thyroid cancer in our Case 2.

Metastatic brain tumors of the pineal gland are rare. In a large survey of 10,489 intracranial metastatic tumors in Japan, only 37 (0.4%) were metastatic pineal gland tumors.⁵⁾ To date, approximately 180 metastatic tumors of the pineal region have been reported but discovery was posthumous in most cases.^{1,3-12,14-21)} Table 1 summarizes the clinical features of 33 reported cases with metastases in the pineal gland that were symptomatic and diagnosed in life. The mean age of the patients was 58.3 ± 12.5 years.

Fig. 3 Case 1. Photomicrographs of the biopsied specimen showing tumor cells with strong atypia and hyperchromatic nuclei proliferating in sheet-like formations (A: hematoxylin and eosin stain, $\times 200$), and tumor cells positive for neuron-specific enolase staining (B: $\times 200$).

Fig. 4 Case 2. A, B: Preoperative axial (A) and sagittal (B) T₁-weighted magnetic resonance images with gadolinium showing a 28-mm pineal tumor with heterogeneous enhancement associated with hydrocephalus, and hematoma in the anterior part of the tumor (arrows). C, D: Postoperative axial (C) and sagittal (D) T₁-weighted magnetic resonance images with gadolinium obtained 7 weeks after surgery and 4 weeks after gamma knife treatment showing subsidence of hydrocephalus, complete absorption of the hematoma, and shrinkage of the solid part of the tumor.

Lung carcinoma was the most common primary lesion, followed by esophageal, gastric, and colon cancer. The symptoms caused by the pineal lesions preceded the diagnosis of the primary lesion in 15 of the 33 patients.

Fig. 5 Case 2. Photomicrograph of the biopsied specimen showing tumor tissues intermingled with clots, and neoplastic cells exhibiting atypia and hyperchromatic nuclei proliferating in a papillary or honeycomb pattern compatible with thyroid papillary carcinoma. Hematoxylin and eosin stain, $\times 200$.

Twenty-five patients manifested symptomatic hydrocephalus with headache, nausea, gait disturbance, and dementia.

External cerebrospinal fluid diversion procedures, including ventricular drainage and ventriculoperitoneal shunting, inherently pose risks for infection and peritoneal neoplastic dissemination, but are used to address hydrocephalus. Neuroendoscopic third ventriculostomy has been introduced for obstructive hydrocephalus due to pineal region tumor. Six of the 33 patients including our 2 patients underwent neuroendoscopic third ventriculostomy for hydrocephalus, which was well controlled in all 6 cases. Histological specimens were obtained in 3 patients via the neuroendoscopic procedure.

To treat the metastatic lesions, 22 patients underwent radiation therapy which produced some reduction in tumor size in 11 patients. A good response was obtained in 1 of 8 patients who underwent chemotherapy, but average survival was 10 months and median survival was 4 months. Patients with pineal lesions recognized before the extracranial neoplasm tended to live longer than patients with extracranial neoplasm diagnosed before the pineal lesion. The direct cause of death tended to be systemic disease progression rather than the intracranial metastasis.

The preoperative diagnosis of metastatic pineal tumors based on CT and/or MR imaging studies is often difficult. In aged patients, the differential diagnosis of well-enhanced tumors should include pineal parenchymal tumors (pineoblastoma, pineocytoma), glioma, meningioma, and pineal papillary tumor. Whole-body imaging and tumor marker assay may yield clues leading to the correct preoperative diagnosis, thereby helping to avoid useless attempts at total resection of the pineal lesion. On the other hand, difficulty in control of bleeding was reported during neuroendoscopic biopsy of the pineal tumor.^{2,13)} Electric hemocoagulation systems such as PAL-1™ (Japan MDM, Inc., Tokyo) should be available during this procedure. Endoscopic transventricular biopsy should be considered if the results are indicative of pineal metastasis. Only endoscopic third ventriculostomy, followed by pineal radiation, may be a treatment option if there is a

high possibility of pineal metastasis.

The pineal gland is an uncommon intracranial site for the metastasis of extracranial tumors. Metastatic pineal gland tumors usually manifest as obstructive hydrocephalus and although patient survival is usually compromised, endoscopic trans-third ventricular surgery gives immediate relief from hydrocephalus and facilitates the definite histological diagnosis. The amelioration of neurological symptoms, transient stabilization of the general condition, and the correct selection of the treatment and/or the care of the systemic disease are made possible by this surgical modality.

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