Metastatic Brainstem Tumor Manifesting as Hearing Disturbance
—Case Report—

Satoshi TSUTSUMI, Naoaki HORINAKA, Kentaro MORI, and Minoru MAEDA

Department of Neurosurgery, Juntendo University Izunagaoka Hospital, Shizuoka

Abstract
A 53-year-old male, who had undergone a left upper lung lobectomy for cancer 2 years previously, presented with metastatic brainstem tumor manifesting as hearing disturbance. At first an otorhinolaryngologist treated him for senile sensorineural hearing disturbance. However, he suffered gait ataxia and was referred to our department. On admission, neurological examination found mild cerebellar ataxia on the left and gait unsteadiness. Neurootological analysis revealed central-type sensorineural hearing disturbance on the left both in the pure tone audiogram and speech discrimination test. Neuroimaging studies revealed a ring-like enhanced mass centered in the ventral left middle cerebellar peduncle, partly extending to the inferior cerebellar peduncle. Peritumoral edema extending to the ipsilateral cochlear nucleus was recognized. He underwent surgery via a left lateral suboccipital transcondylar approach. The histological diagnosis was adenocarcinoma identical with the primary lung cancer. Intra-axial brainstem metastatic lesion can be a cause of hearing disturbance, so should be included in the differential diagnosis for a patient complaining of hearing disturbance, especially with a past history of cancer.

Key words: metastasis, cerebellar peduncle, hearing disturbance

Introduction
Metastatic tumor is a very unusual cause of hearing disturbance and consequently the underlying malignancy can easily be missed. We treated a patient presenting with hearing disturbance due to a single brain metastasis in the ventral middle cerebellar peduncle. The anatomical characteristics and safe operating window of the peri-middle cerebellar peduncle region are also discussed.

Case Report
A 53-year-old man noticed left-sided hearing disturbance of a few weeks' duration. He did not experience tinnitus. He had undergone left upper lobe resection for primary lung cancer 2 years before. The histological diagnosis was adenocarcinoma. Periodical follow-up imagings and laboratory tests showed no recurrence. At first he consulted an otorhinolaryngologist and was followed up under a diagnosis of senile sensorineural hearing disturbance. However, a few months after the onset of hearing disturbance, he began to be aware of gait unsteadiness inclining to the left side while walking, which was gradually exacerbated. He was referred to our department on April 12, 2000, with suspected intracranial lesion.

Neurological examination found dysmetria and decomposition in the left upper and lower extremities, clumsy fine movement in the left hand, negative Romberg's sign, ataxic gait with a tendency to incline to the left, and induced alternate gaze nystagmus of Bruns type. Ocular movement showed no restriction and both facial sensation and movement were intact. Lower cranial neuropathy was not found. Neither motor weakness nor sensory disturbances were noticed. Neurootological study revealed hearing disturbance on the left. The pure tone audiogram showed hearing disturbance in all frequency bands, and the speech discrimination test was 40% of the normal value on the left. Auditory brainstem response (ABR) showed only the first wave on the left, and the following waves were not clearly discriminated. ABR was intact on the right.
Fig. 1  T₁-weighted magnetic resonance images showing a ring-like enhanced mass, 12 × 13 × 15 mm in maximal dimensions, centered in the ventral left middle cerebellar peduncle, extending to the inferior cerebellar peduncle, and partly adjacent to the left lateral wall of the fourth ventricle. The fourth ventricle is patent. No other metastatic lesion is recognized intracranially.

Computed tomography (CT) revealed a ring-like enhanced mass beside the left lateral wall of the fourth ventricle. Hydrocephalus was not seen. Magnetic resonance (MR) imaging showed the mass was centered on the ventral aspect of the left middle cerebellar peduncle, 12 × 13 × 15 mm in greatest diameter, had partly extended to the inferior cerebellar peduncle, and was partly adjacent to the left lateral wall of the fourth ventricle. The mass appeared as low intensity on T₁-weighted imaging and high intensity on T₂-weighted imaging, with ring-like enhancement after gadolinium-diethylenetriaminepenta-acetic acid administration (Fig. 1). The effect of peritumoral edema extended to the cochlear nucleus and inferior cerebellar peduncle on the T₂-weighted image (Fig. 2). No other intracranial abnormalities were found. Chest CT showed no cancer recurrence. Systemic gallium-67 scintigraphy showed no abnormal uptake. Examined serum tumor markers were negative. Cerebral angiography showed no abnormality except for an incidental berry left vertebral artery (VA)-posterior inferior cerebellar artery (PICA) aneurysm, which was 3 × 3 mm in maximal diameter. The preoperative diagnosis was metastatic brain tumor in the left middle cerebellar peduncle.

He underwent surgery on May 8, 2000 via a left lateral suboccipital transcondylar craniotomy with neuronavigation system guidance (Stealth Station; Kobayashi Sofamor Danek Coop., Osaka). A dark red-colored mass partially protruding from the lateral recess with choroid plexus was recognized. The tumor could be aspirated and radically removed without excessive retraction of the contiguous neural structures. The histological diagnosis was moderately differentiated adenocarcinoma that was identical with the primary lung cancer. The incidental VA-PICA aneurysm was clipped.

His postoperative course was uneventful except for transient cerebrospinal fluid rhinorrhea that necessitated lumbar spinal drainage. MR imaging showed radical removal of the tumor (Fig. 3). His hearing disturbance did not show any improvement but cerebellar ataxia and nystagmus improved postoperatively. He was transferred to another institute for gamma knife radiosurgery for the tumor cavity.

Fig. 2  T₂-weighted magnetic resonance images showing the effect of peritumoral edema extending to the cochlear nucleus and inferior cerebellar peduncle (arrowhead).
Discussion

Pontine hematoma, medulloblastoma, cerebellar low-grade glioma, cerebellar hemangioblastoma, and multiple sclerosis are all reported etiologies of unilateral central-type hearing disturbance.\(^5\text{,}\!^6\text{,}\!^9\) Intracranial metastasis is a very unusual cause of such hearing disturbance with few reports of metastasis to the central auditory neural pathway and the adjacent middle cerebellar peduncle.\(^3\)

Anatomically, the middle cerebellar peduncle is composed mostly of the afferent fibers from the ventral pontine nuclei. The ventral part of the peduncle is situated in the pons adjacent to the inferior cerebellar peduncle and the central neural pathways of the vestibulocochlear system which is bilaterally innervated. The fibers of the trigeminal nerve intercross the most ventral aspect.

Dorsolaterally, the peduncle is covered by the quadrangular lobule of the cerebellum and the rostromedial part is continuous with the superior cerebellar peduncle.\(^3\text{,}\!^7\) These densely arranged critical neural structures result in wide ranges of neurological deficits and also preclude surgical intervention. Three patients with hemorrhages in the medioventral cerebellar peduncle presented with a characteristic syndrome which included ipsilateral cerebellar ataxia, peripheral-type facial nerve paresis, and ipsilateral gaze paresis.\(^10\) These findings were thought to be due to the compression of the facial colliculi, with involvement of the sixth cranial nerve nucleus and the middle cerebellar peduncle. Many types of neurological deficits have been associated with metastasis around the cerebellar peduncle.\(^1\text{–}\!^3\text{,}\!^7\text{,}\!^8\text{,}\!^10\) In our case, neither trigeminal, abducens, nor facial nerve neuropathy was seen, as the presenting symptoms were ipsilateral sensorineural hearing disturbance and cerebellar ataxia. Presumably, the hearing disturbance resulted from the impairment of the ipsilateral cochlear nucleus and the inferior cerebellar peduncle. Interestingly, the patient did not experience tinnitus, although two of three previous patients with intra-axial primary tumor causing central-type hearing disturbance complained of high-pitched tinnitus. These differences in symptoms must derive from the precise anatomical structures affected and the size of the causative lesion. Considering the bilateral innervation of the central auditory neural pathway, unilateral disturbance as a presenting symptom would undoubtedly be very rare.

Lesions deep in the cerebellar peduncle sometimes cannot be identified from the surface. A longitudinal incision should be made to the dorsal middle cerebellar peduncle just caudal to the hemispheric branches of superior cerebellar artery.\(^7\) The dissecting plane provided by this procedure is almost parallel to the fibers in the peduncle. Despite the dissection of the middle cerebellar peduncle, no deterioration of cerebellar ataxia was observed or only transiently emerged in four patients postoperatively. Dissection of the middle cerebellar peduncle along its fibers is beneficial for minimizing damage to the peduncle. In our case, the lesion was extra-axially exposed, so both the intra- and extra-axial components of the tumor could be removed via a lateral suboccipital transcondylar approach without entering the cerebellar peduncle.\(^4\) Unilateral hearing disturbance may be caused by a single metastasis, so we should consider this as part of the differential diagnosis in a patient complaining of hearing disturbance, especially with a history of cancer. The
neuronavigation system now allows accurate and confident intervention into some critical areas of the brain which were previously considered no-man’s lands. Considering the usual poor prognosis of a metastatic brain tumor, early intervention is essential for useful life.

References


Address reprint requests to: K. Mori, M.D., Department of Neurosurgery, Juntendo University Izunagaoka Hospital, 1129 Nagaoka, Izunagaoka-cho, Tagata-gun, Shizuoka 410–2295, Japan.