Malignant Transformation of a Neurenteric Cyst in the Posterior Fossa Presenting with Intracranial Metastasis: A Case Report and Literature Review

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Introduction

A neurenteric cyst, also known as enterogenous cyst, endodermal cyst, respiratory cyst, and bronchogenic cyst, is a rare benign cystic lesion, generally arising in the intradural extramedullary space in the lower cervical and upper thoracic spine. While the incidence of spinal neurenteric cysts has been reported to be 0.3%–0.5% of all spinal tumors, neurenteric cysts in the posterior fossa are relatively rare. Because one-third of patients treated by subtotal or partial resection experience symptomatic recurrence, total resection is considered to result in favorable outcomes based on the benign nature of these cysts. The malignant transformation of benign neurenteric cysts is extremely rare. In this report, we describe a case of a neurenteric cyst in the posterior fossa that eventually showed malignant transformation and intracranial metastasis and review of the relevant literature.

Case Report

A 47-year-old woman with no past medical history presented with a headache, which had gradually worsened over the past 1 year. Her neurological examination revealed no deficit on the initial visit. Magnetic resonance (MR) images revealed diffuse growth and intracranial metastasis with significant mass effect on the left cerebellar hemisphere (Fig. 1A). To relieve her headache and confirm the pathology, she was treated via left suboccipital approach for subtotal resection, which left a small membranous residual lesion strongly adhered to the brainstem. The residual portion was not significantly visible on the postoperative MR images, and the mass effect was completely resolved (Fig. 1B). Histopathological examination revealed that the cyst wall was composed of a single-layered columnar epithelium similar to the respiratory and intestinal tract (Fig. 1C). Immunohistochemistry for glial fibrillary acidic protein (GFAP; clone 6F2, DAKO, Carpinteria, California, USA), vimentin (clone V9, DAKO, Carpinteria, California, USA), neuron specific enolase (clone BBS/NC/VI-H14, DAKO, Carpinteria, California, USA), and S-100 was negative. The epithelium showed weak staining for carcinoembryonic antigen (clone A0115, DAKO, Carpinteria, California, USA, Fig. 1F) and diffuse staining for epithelium membrane antigen (EMA; clone E29, DAKO, Carpinteria, California, USA, Fig. 1I). The patient developed postoperative pharyngeal and vocal cord paralysis on the left side. After over 1 month, when she showed a considerable recovery from these deficits, the patient had been treated with subtotal resection leaving a small mass strongly adhered to the brainstem was achieved. Histopathological diagnosis was neurenteric cyst with no malignant features. This lesion recurred 4 years after the first surgery in the form of a cystic mass adjacent to the brainstem. In addition, histopathological examination of a specimen from the second surgery revealed malignant transformation. The patient declined to undergo radiation therapy and was conservatively managed. Three years after the second surgery, MR imaging showed recurrence of the solid mass. Although the patient had been treated with subtotal resection and radiation therapy, she died with metastatic masses and significant mass effect. Three years after the second surgery, MR imaging showed recurrence of the solid mass. Although the patient had been treated with subtotal resection and radiation therapy, she died with metastatic masses and significant mass effect. Three years after the second surgery, MR imaging showed recurrence of the solid mass.

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symptoms, she was discharged with a plan for follow-up.

However, the patient abandoned follow-up visits at 6 months after surgery because she believed that her condition was stable. Four years after her final follow-up visit, she returned to our department complaining of headache, taste disorder, and gait disturbance. MR images demonstrated recurrence of a cystic mass with a small and slightly enhanced solid portion adjacent to the brainstem that was considered to be a regrowth from the residual lesion of the initial resection (Fig. 2A). She underwent subtotal resection and placement of a cyst-cisternal shunt. We again had to leave a small solid portion of the tumor because of the severe adhesion to the brainstem. Histopathological examination of the specimen obtained during the second resection revealed that the basic structures had not changed, but some atypical nuclei and loss of cell polarity were evident (Fig. 2B). Results
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of immunohistochemistry for EMA, carcinoembryonic antigen, GFAP, vimentin, neuron specific enolase, S-100, and AE1/AE3 were the same as those of the specimen obtained from the first surgery. No p53 mutation was detected (Fig. 2C). The MIB-1 labeling index was 3% (Fig. 2D), suggesting an increased proliferative potential as well. One month after surgery, she was discharged with good relief from symptoms. After a thorough discussion regarding the treatment options including radiation therapy, she declined treatment with radiation and was followed up in our outpatient clinic every 3 months with regular imaging every 6 months.

Although her condition remained stable since the second surgery, she presented with hyperacusis 3 years later. MR imaging showed a rapid recurrence of the solid mass with significant compression of the brainstem (Fig. 3A). Although she underwent partial resection of the tumor followed by fractioned stereotactic radiation therapy (isocenter dose total 50 Gy/25fr), local tumor control failed. A metastatic lesion was noted in the right frontal lobe on MR images (Fig. 3B). Metastasis also occurred in the cervical cord. Histopathological examination of the specimen from the third surgery revealed cells with mitotic nuclei and more prominent cellular atypia (Fig. 3C). Pseudostratified nuclei and loss of cell polarity were widely observed. PAS staining confirmed an enhanced mucin production (Fig. 3D). These findings were similar to a mucinous adenocarcinoma. Immunohistochemistry for the p53 mutation was this time strongly positive (Fig. 3E). The MIB-1 labeling index was 9% (Fig. 3F). She did not respond to the radiation therapy and died of aspiration pneumonia followed by aggressive deterioration of systemic conditions.

Discussion

Neurenteric cysts represent a rare pathological condition and account for approximately 0.01% of all central nervous system tumors and 0.3%–0.5% of spinal tumors. Although the most common location of neurenteric cysts is ventral to the lower cervical and upper thoracic spine, they can also arise in the intracranial regions. Bejjani et al. reported that 90% of intracranial neurenteric cysts were located in the posterior fossa. Neurenteric cysts originate from imperfect separation of neuro-ectodermal elements and endodermal elements during the third week of gestation. The cyst wall
consists of a single layer cuboidal or columnar epithelium similar to gastrointestinal or respiratory epithelium.\textsuperscript{1,17)} Therefore, their epithelium is positive for cytokeratin, carcinoembryonic antigen, and EMA, but negative for GFAP and S-100 protein on immunohistochemical analysis.\textsuperscript{1,18)} Although most neurenteric cysts are histologically benign,\textsuperscript{1,18,19)} Perrini et al. reported that one-third of cases of neurenteric cysts that underwent malignant transformation were treated by partial or subtotal resection later experience symptomatic recurrence.\textsuperscript{6) On the other hand, pathological proof of malignant transformation in the surgical specimen is extremely rare. Our literature search identified three cases of neurenteric cysts that underwent malignant transformation.\textsuperscript{12–14)} Combined with cases of intracranial neurenteric cysts with malignant features, eight cases of malignant neurenteric cysts have been reported in the literature (Table 1). Notably, all of these eight cases were observed in intracranial neurenteric cysts, and malignant transformation of a spinal neurenteric cyst has never been reported, although they occur much more frequently in the spinal cord. The reason for this discrepancy is not clear, but approximately 50% of neurenteric cysts in the spine and the cervicomedullary junction occur with other bony anomalies such as scoliosis, spina bifida, and Klippel-Feil syndrome,\textsuperscript{20)} whereas intracranial neurenteric cysts are very rarely associated with bony changes.\textsuperscript{21)} This might suggest that some genetic or embryological backgrounds differ from intracranial lesions to spinal ones. Staining for the p53 mutation was negative in the specimen obtained from the first and second surgeries, but was strongly positive on the third specimen. Along with the similar case report,\textsuperscript{13)} p53 mutation might be indicative of malignant transformation of neurenteric cysts. Although we had left only a small membranous tumor tissue on the brainstem in the first surgery, the patient experienced devastating recurrence and metastasis. The cyst-cisternal shunt placed on the second surgery might have induced the intracranial metastasis, but it might have eventually happened irrespective of the shunt considering the highly malignant features of the third specimen. Based on our case and previous reports of malignant transformation after gross total resection, recurrence with malignant transformation of a histologically benign neurenteric cyst can occur several years after the initial treatment, indicating the importance of long-term follow-up even when surgeons believe that gross total resection has been achieved.

Malignant neurenteric cysts are difficult to treat. Because of the paucity of cases in the literature, information regarding the prognosis and optimal treatment for malignant neurenteric cysts is lacking. Conventional radiotherapy and chemotherapy have shown little effect on histologically benign neurenteric cysts.\textsuperscript{1,18)} As shown in Table 1, among previously reported cases, two patients underwent radiation therapy and one died 1 year later and the other was not followed-up over the long term.\textsuperscript{13,14)} Sahara et al. reported a case of a neurenteric cyst in the foramen magnum with malignant transformation.\textsuperscript{15)} They administered chemotherapy (carboplatin and etoposide) in conjunction with radiation therapy after the

| Authors, year | Age, sex | Symptoms | Location | Initial resection | Initial pathology | Postoperative adjuvant therapy | Recurrence, follow-up period |
|---------------|----------|----------|----------|------------------|------------------|-----------------------------|----------------------------|
| Sahara et al. (2001)\textsuperscript{11)} | 54, M | neck pain | lt. anterior cervico-medullary junction (extra-axial) | GTR | NC | radiation chemotherapy | yes, 3.5 years |
| Surash et al. (2009)\textsuperscript{10)} | 46, M | headache and dizziness | rt. CP angle, (extra-axial) | GTR | NC | radiation | yes, 14 years |
| Okabe et al. (2014)\textsuperscript{12)} | 50, F | headache | rt. periventricular (intra-axial) | PR and Biopsy | NC | no | yes, 2 years |
| Present case | 38, F | headache | lt. CP angle | GTR | NC | radiation | yes, 8 years |
| Ho et al. (1998)\textsuperscript{9)} | 45, F | seizures and abnormal sensation | rt. parietal lobe (extra-axial) | GTR | NC with a well differentiated papillary neoplasm | no | no, 15 months |
| Monaco et al. (2003)\textsuperscript{20)} | 36, M | headache, vomiting, drowsiness | cisterna magna | GTR | NC with focal malignant features | no | no, 2 years |
| Gessi et al. (2008)\textsuperscript{10)} | 25, M | hypoaacusia, facial hemiparesis, visual disturbances, gait instability | rt. CP angle | GTR | NC with focal malignant features | no | yes, 5 months |
| Wang et al. (2009)\textsuperscript{11)} | 26, F | pain at the left occipital region | lt. CP angle, (extra-axial) | GTR | NC with focal malignant features | no | yes, 6 months (dissemination) |
| Dunham et al. (2009)\textsuperscript{12)} | 58, F | headache | rt. parietal lobe, (intra-axial) | GTR | NC with focal malignant features | no | no, 3 years |

GTR: gross total resection, NC: neurenteric cyst, PR: partial resection.
second resection, and the patient achieved stable disease for 6 months. Although we did not treat our patient with chemotherapy, the effect of radiation appears to have been limited in our case.

In conclusion, malignant transformation of a histologically benign neuroneurctic cyst can occur although its incidence remains unknown. Our literature search revealed that malignant transformation of benign neuroneurctic cysts occurs almost exclusively in intracranial cases. This appears to indicate the importance of long-term follow-up for subtotaly or partially resected neuroneurctic cysts, particularly for intracranial cysts.

Conflicts of Interest Disclosure
None of authors have any disclosure to report.

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