

**Case Report****Pilomyxoid Astrocytoma in Cerebellum**Peng-fei Ge<sup>1</sup>, Hai-feng Wang<sup>1</sup>, Li-mei Qu<sup>2</sup>, Bo Chen<sup>1</sup>, Shuanglin Fu, Yinan Luo<sup>1\*</sup><sup>1</sup>Department of Neurosurgery, <sup>2</sup>Department of Pathology, the First Affiliated Bethune Hospital, Jilin University, Changchun 130021, China

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**ABSTRACT**

Pilomyxoid astrocytoma is a new identified variant type of pilocytic astrocytoma, and typically locates in the hypothalamic and chiasmatic region. Herein, we reported a nine-year-old boy with pilomyxoid astrocytoma in the cerebellum. MRI scanning showed a tumor involved the cerebellar vermis, tonsil, the fourth ventricle and brainstem. It was homogeneous isointensity on T1WI, relative hyper-intensity on T2WI, hyper-intensity on fluid attenuated inversion recovery (FLAIR) images, and uniform enhancement on contrast T1WI. The tumor was sub-totally removed and was proved histologically to be pilomyxoid astrocytoma. Follow-up at the 5th month, MRI showed the residual tumor enlarged at the brainstem. The patient survived 10 months after the operation, and finally died of respiration failure resulting from brainstem dysfunction.

**Key words:** Pilomyxoid astrocytoma; Pilocytic astrocytoma; Cerebellum; Brainstem**INTRODUCTION**

Pilomyxoid astrocytoma (PmA) is a recently established type of glioma, which has been considered to be pilocytic astrocytoma (PA) until Tihan et al. firstly summarized its features from a series of pediatric cases<sup>[1]</sup>. It has some specifically clinical features, including malignant biologic behavior, early onset, higher rate of recurrence and cerebrospinal fluid (CSF) dissemination. To our best knowledge, only three cerebellar PmAs were mentioned previously without detailed description in English literature<sup>[2, 3]</sup>. Therefore, additional knowledge is needed to supplement our recognition to PmAs. Herein, we reported a nine-year-old boy with cerebellar PmA, and discussed its characteristics in combination with literature review.

**CASE REPORT**

A nine-year-old boy was admitted to our department for intermittent headache for one month, and morning nausea and vomiting for one week. He had no family history of neurofibromatosis. Neurological examination mainly revealed papilledema, nystagmus, increased muscular tension, and ataxia. MRI scanning showed a mass involving the cerebellar vermis, tonsil, the fourth ventricle and brainstem. The mass was homogeneously iso-intense on T1W sequences, relatively hyper-intense on T2W sequences, and hyper-intense on fluid attenuated inversion recovery (FLAIR) images (Figure 1). Perilesional edema was not found on MRI. It extended superiorly into the quadrigemina

cistern and inferiorly to the first cervical vertebra level, even invaded into the ventral space of the brainstem. The CSF circulating pathway was blocked so that the supratentorial ventricles enlarged obviously. When contrast medium gadolinium was injected, it enhanced homogeneously. At surgery, a temporary shunt was firstly placed into the right lateral ventricle via occipital horn to lower the intracranial pressure by draining CSF. Then, midline sub-occipital craniotomy and C1 laminectomy were performed. The dura mater did not show any abnormality, but the arachnoid on the cerebellum thickened apparently. The tumor was red, hard and vascularised. Despite the tumor had no capsule, it demarcated clearly with the normal tissues, so that it was not difficult to remove the tumor from the cerebellum. However, when we dissected the tumor from the medulla oblongata, the heartbeat slowed down significantly from 90 per min to 30 per min. Therefore, a thin layer of tumor tissue was not removed and remained on the medulla oblongata surface. Moreover, we could not reach the tumor in the ventral space of the medulla oblongata and it was not removed either. Histological examination of the removed tissues revealed that piloid cells converged on blood vessels in a monomorphous myxoid background (Figure 2). Immunohistological examination showed the staining index for Ki-67 (MIB-1) was 2%, and for O<sub>6</sub>-methylguanine-DNA methyltransferase (MGMT) 40%. Additionally, the glial fibrillary acidic protein (GFAP) staining was diffusely positive. Thus, it was diagnosed as PmA. The drainage shunt was withdrawn from the lateral ventricle on the 3rd day. The postoperative complications mainly included incomplete facial palsy and oculomotor paresis, but these symptoms gradually recovered in three months. Although we made adjuvant therapy plans for him, his family did not accept any one. At the 5th month after operation, he

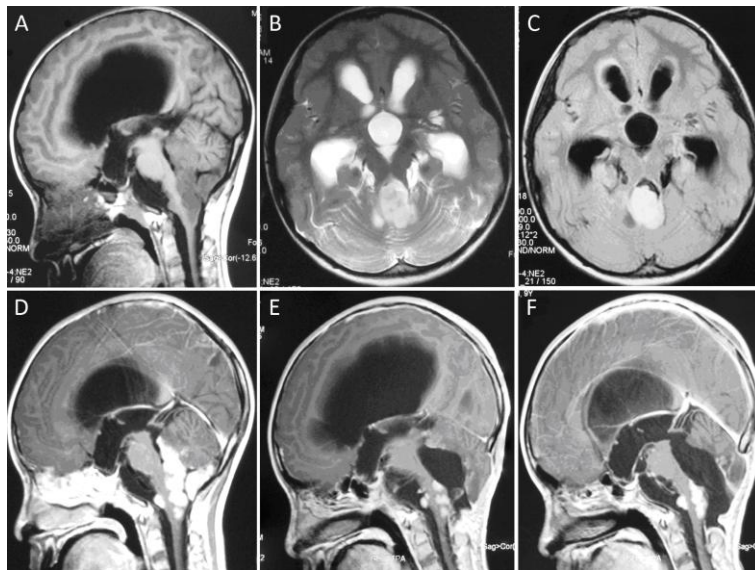
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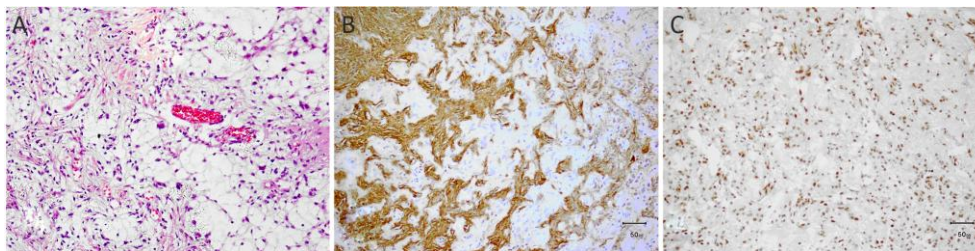
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presented headache, nausea and vomiting again, and the contrast MRI showed the volume of the residual tumor on the brainstem became larger than that at the 2nd month

(Figure 1). The patient survived 10 months after the first operation, and finally died of respiration failure resulting from brainstem dysfunction.



**Figure 1.** MRI images of pilomyxoid astrocytoma involving cerebellum and brainstem. The pilomyxoid astrocytoma showed homogeneous isointensity on sagittal and coronal T1W sequences (A), and hyperintensity on T2W sequences (B) and FLAIR images (C). It enhanced homogeneously (D), indicating it was solid. Contrast MRI at the 2nd month after operation showed residual tumor at brainstem (E). Contrast MRI at the 5th month showed the residual tumor at brainstem became larger (F).



**Figure 2.** Histological images of PmA. Piloid cells arranged angiocentrically in a monomorphous myxoid background, without PA features such as Rosenthal fibres or eosinophilic granular bodies (A, HE staining, x20). Immunohistochemical staining for GFAP were diffusely positive (B, ABC staining, x20). Immunohistochemical staining index for MGMT was 40% (C, ABC staining, x20).

## DISCUSSION

Since the pathological characteristics of PmA were described in 1999, PmA has aroused great interests of neuropathologists and neurosurgeons. Some authors even re-examined the cases that were previously diagnosed as PA and found some of them should be PmA. By now, almost 100 cases of PmA have been reported in the English literature and the overwhelming majority of the patients were children aged from 2 months to 4 years<sup>[4]</sup>. PmAs were typically in the chiasmatic-hypothalamic region, but they were also found in other locations, including the spinal cord, the temple lobe and the occipital lobe<sup>[3, 5, 6]</sup>. However, until now, only three PmA cases have been mentioned to be located in the cerebellum without detailed description<sup>[2, 3]</sup>. In our case, the tumor was not only located in the midline region of the cerebellum, but also extended outside and filled in the fourth ventricle, so that the circulating pathway of cerebral spinal fluid was blocked and the initial symptoms were induced by increased intracranial pressure.

As an independent type of glioma, PmA has some

specific features in histology, which include monomorphous growth of piloid cells with an angiocentric pattern, being rich in myxoid background, and lacking of Rosenthal fibers or eosinophilic granular bodies<sup>[7]</sup>. Similarly, PAs also consist of piloid cells, but these cells grow in a biphasic pattern, mixed with Rosenthal fibers and eosinophilic granular bodies<sup>[7]</sup>. According to the above-mentioned PmA features in histology, our case was diagnosed as cerebellar PmA. Compared with PA that had been considered to arise from astrocytes, the cell origin of PmA is still unclear<sup>[8]</sup>. Parsa et al. pointed that pilocytic astrocytomas did not undergo spontaneous malignant transformation<sup>[9]</sup>. However, recent reports described PmA could spontaneously regress to PA in several years, indicating that these two types of tumors were associated genetically<sup>[10, 11]</sup>.

On MRI, PmA also has similar signal patterns to PA, and they both show isointensity on T1W sequences, hyperintensity on T2W sequences and on FLAIR images. However, some features could be used to distinguish PmA from PA on MRI. PAs are usually cystic with solid mural nodules and are surrounded by edema. When contrast

medium was administered, PA often showed intense enhancement in the nodule or the cyst wall. On the contrary, PmAs are often solid, rarely with peripheral edema. In PmAs, 40% cases showed homogenous enhancement and 30%-60% cases displayed heterogeneous enhancement<sup>[12,13]</sup>. In our case, the tumor showed the above mentioned typical MRI features. Moreover, it was located in the midline cerebellar vermis and tonsil, significantly different from the cerebellar hemisphere which is the common location of cerebellar PAs<sup>[14]</sup>. Therefore, in the cerebellum, tumor's location and MRI signal pattern might be helpful to differentiate PmAs from PAs.

For the patients with PmA, regardless of total or partial resection, a majority of the postoperative recurrences took place within one year and the local recurrence rate was 76%<sup>[15]</sup>. The average survival time was 6 months when a recurrent tumor was demonstrated by MRI<sup>[1,12]</sup>. Nevertheless, Fernandez et al. mentioned a case of cerebellar PmA in his paper, which recurred 8 years after the initial operation and the patient was free of tumor for almost fifteen years after the second resection<sup>[2]</sup>, indicating that radical resection of cerebellar PmA would lead to a good prognosis. By contrast, in our case, at the 5th month of follow-up, MRI demonstrated re-growth of the residual tumor at the brainstem, despite no significant tumor recurrence was found in the cerebellum. Moreover, immunohistological examination showed the staining index for Ki-67 was 2%, indicating that it grew fast. We thought two factors affecting tumor recurrence in this case. Firstly, tumor invasion into the medulla oblongata made radical removal impossible, because the remarkable heartbeat slowdown forced us to give up dissecting it from the medulla oblongata. Secondly, more importantly, it was very difficult to reach the tumor which was located within the ventral space of the brainstem via occipital craniotomy. Therefore, involvement of the brainstem, especially the medulla oblongata, is an important factor influencing the prognosis of the patients with cerebellar PmA. However, recent reports showed that postoperative chemotherapy could elongate PmA patient's survival to 6 years without tumor recurrence<sup>[12]</sup>, and chemotherapy could make PmA regress remarkably<sup>[15]</sup>. Thus, for the PmAs which can not be removed totally, chemotherapy seems to be a choice of treatment. However, in this case, the immunohistological staining index for MGMT was 40%, indicating that temozolomide would not be effective for this patient. Moreover, the boy's family refused other chemotherapy. Thereby, we did not get clinical materials to evaluate the effects of chemotherapy on brainstem PmA.

In summary, we reported in details a rare cerebellar PmA with brainstem involvement. On MRI, this case indicates the imaging features of cerebellar PmA include solid mass, homogeneous enhancement, and no peripheral edema, and locate in the middle regions of the cerebellum. Our case also shows involvement of medulla oblongata would predict earlier recurrence and worse prognosis.

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