Primary medulla oblongata teratomas

Report of 2 cases

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Medulla oblongata teratomas are rare. The authors report 2 new cases of teratomas that occurred exclusively in the medulla oblongata. The first case was in a 9-year-old boy who presented with a 6-month history of neck pain and repeated paroxysmal vomiting. Based on preoperative radiographic findings, the initial diagnosis was of an intraxial medulla oblongata hemangioblastoma. Intraoperatively, the cystic component of the tumor was gray, gelatinous, and soft in consistency. The solid component was light pink, rubbery, and nodular in appearance, with an identifiable boundary. The lesion was completely removed. Histopathological investigation revealed a mature teratoma. Postoperatively, the patient was supported with ventilator assistance and received a tracheotomy, but died of intracranial infection. The second case was in a 10-year-old boy with intermittent headache for 1 month. Radiographs revealed an exophytic cystic and solid lesion with dorsal involvement of the medulla oblongata. The lesion was predominantly solid, pinkish gray, tenacious, and moderately vascularized, with clearly delineated surgical dissection planes. The histopathological examination confirmed a diagnosis of immature teratoma. Total resection was achieved, followed by postoperative chemotherapy. He was alive without recurrence of the lesion or symptoms at 59 months after surgery.

Resection of medulla oblongata teratoma is challenging, with inherent surgical risks that are contingent on the tumor growth pattern. Teratomas should be considered in the differential diagnosis of brainstem lesions. Chemotherapy has been suggested for immature teratomas. Long-term follow-up and larger studies of teratomas in unusual locations are required to improve practitioners’ understanding of this disease’s treatment and outcomes.

KEY WORDS • brainstem • germ cell tumor • medulla oblongata • teratoma • oncology

Intracranial teratomas account for 2%–5% of all teratomas in infancy, and 0.3%–0.6% of all intracranial neoplasms.3 They are more commonly reported near the midline, in the pineal and suprasellar regions, and in the third ventricle. Teratoma is extremely rare in the brainstem and is seldom reported in children older than 2 years of age.3,7 We report 2 cases of teratomas located exclusively in the medulla oblongata. To our knowledge, the cases we present here are the first 2 pediatric brainstem teratomas to be reported in the literature.

Case Reports

Case 1

History and Examination. A 9-year-old boy presented with a 6-month history of neck pain and repeated paroxysmal vomiting. Results of the physical examination and neuroendocrine tests were within normal limits, and the medical history was not remarkable. A CT scan showed a hypodense lesion in the medulla oblongata. An MRI scan revealed an intramedullary cystic mass of homogeneous hypointensity, measuring 1.4 × 0.8 × 1.0 cm in maximal dimensions on T1-weighted images (Fig. 1A), with homogeneous hyperintensity on T2-weighted images (Fig. 1B) and nodular enhancement on T1-weighted images after administration of Gd (Fig. 1C and D), without surrounding edema or suspected infiltration. However, diffusion-weighted imaging was not performed. The lesion was interpreted as a cystic hemangioblastoma with a mural nodule.

Operation. The patient underwent a midline suboccipital craniotomy and gross-total removal of the lesion. Intraoperatively, the cystic component of the tumor (Fig. 2A) was gray, gelatinous, and soft in consistency. The

This article contains some figures that are displayed in color online but in black-and-white in the print edition.
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solid part of the tumor (Fig. 2B) was light pink, rubbery, and nodular in appearance, with an identifiable boundary. Histopathological examination revealed a mature teratoma of the medulla oblongata with components of squamous epithelium (positive for cytokeratin 5/6), glandular epithelium (positive for cytokeratin 8/18), brain parenchyma (positive for synaptophysin), and fatty tissue (Fig. 2C–G). The myoepithelial cells surrounding glandular epithelium and fat cells were positive for S100 (Fig. 2H).

Postoperative Course. Postoperatively, the patient suffered from motor weakness and dysphagia and was able to breathe with ventilator assistance; a tracheotomy was performed due to poor respiratory function and deficits of the lower cranial nerves. The child’s clinical course was complicated by severe intracranial infection. Examination of the CSF following lumbar puncture showed a positive Pandy test and significantly increased CSF cell count (the total cell count in CSF was 1425 cells/μl, and the white blood cell count in CSF was 1125 cells/μl). Hydrocephalus developed during the postoperative course, as demonstrated by a CT scan obtained 19 days after surgery, with subsequent ventricular puncture performed with continuous external drainage. Initially cefoperazone sodium and sulbactam sodium (500 mg/12 hrs) were administered intravenously for 15 days without any therapeutic effect. Culture of the CSF and a drug sensitivity test suggested methicillin-resistant Staphylococcus aureus (MRSA) infection with multidrug resistance. The antibiotics were replaced by norvancomycin (500 mg/12 hrs) and meropenem (500 mg/8 hrs); these were also delivered intravenously. Repeated analysis of CSF specimens from the lateral ventricle indicated ventriculitis. The intracranial infection progressed, with intracranial hypertension, and eventually the patient died of severe ventriculitis 22 days after operation.

Reasons for MRSA infection might be as follows: the pediatric patient undergoing both craniotomy and tracheostomy suffered from blood loss, respiratory dysfunction, inadequate nutritional intake, and impaired neutrophil function that increased the risk of developing infection.

Fig. 1. Case 1. Preoperative MRI studies. Axial T1- (A) and T2-weighted (B) MRI studies showing homogeneous hypointensity and hyperintensity, respectively, with a questionable tubercle of isointensity at the ventral part of the cystic wall. Axial (C) and sagittal (D) T1-weighted images after contrast administration showing detection of a nodular hyperintense focus without cystic wall contrast enhancement.

Fig. 2. Case 1. Intraoperative photographs and histopathological sections. The cystic component of the tumor (white arrow) was gray, gelatinous, and soft in consistency. The black arrow indicates the stria medullaris (A). The solid part of the tumor (white asterisk) was light pink, rubbery, and nodular in appearance, with an identifiable boundary (B). Postoperative histopathological examination showed stratified epithelium, glandular tissue, and adipose tissue (C and D). Immunohistochemical stains showed that squamous epithelium was positive for cytokeratin 5/6 (E), glandular epithelium was positive for cytokeratin 8/18 (F), brain tissue was positive for synaptophysin (G), and both myoepithelial cells surrounding glandular epithelium and fat cells were positive for S100 (H). H & E (C and D) and immunohistochemical (E–H) stains. Original magnification ×200 (C and D) and ×100 (E–H).
Additionally, invasive manipulation of ventriculocentesis might render the patient more susceptible to MRSA. Perioperative care, monitoring of CSF cell count, and early treatment of infection might be important to prevent such fatal ventriculitis.

Case 2

**History and Examination.** A 10-year-old boy presented with intermittent headache and vertigo for 1 month without vomiting, nausea, or sensorimotor deficit. The physical examination revealed a positive Romberg sign; other neurological functions were within normal limits. The family history and medical history were unremarkable. The patient did not undergo preoperative brain CT scans. The MRI scans (Fig. 3A–D) showed an exophytic cystic and solid lesion that dorsally involved the medulla oblongata without a distinguishable tumor boundary and that was 3.4 × 3.6 × 3.2 cm in size. The lesion had heterogeneous intensity (hypo- to hyperintensity) on both T1- and T2-weighted images, with multiple fluid-fluid levels, and it appeared to show heterogeneous enhancement in the solid component. A hyperintense signal on T1-weighted images indicated hemorrhage. The lesion was preoperatively diagnosed as a medulla oblongata glioma.

**Operation.** A midline suboccipital craniotomy with electrophysiological monitoring was performed. Intraoperatively, the lesion was found to originate from the medulla oblongata, extending from the striae medullares rostrally to the spinal cord at C-1 caudally, and containing intrallesional hemorrhages of various stages with hemosiderin staining. The lesion was predominantly solid, pinkish gray, tenacious, and moderately vascularized, with clear surgical planes. The medulla oblongata was dissected along the posterior median sulcus, and the lesion was completely removed by en bloc resection (Fig. 3).

**Postoperative Course.** Postoperatively, the patient suffered from deficits of the lower cranial nerves and underwent tracheotomy and nasogastric feedings that were closed and discontinued, respectively, 2 months after surgery. The histopathological examination revealed a diagnosis of immature teratoma (Fig. 4). The patient achieved a complete recovery at 4 months postoperatively and received 4 cycles of chemotherapy (3 days per course at 2-month intervals: etoposide 100 mg/day; ifosfamide 2500 mg/day; cis-diaminedichloroplatinum 50 mg/day). Radiotherapy was not administered. After a follow-up of 59 months he was free of tumor recurrence, symptoms, and dissemination of the lesion.

**Discussion**

Teratomas generally occur in supratentorial sites, and those located supratentorially far outnumber those

![Fig. 3. Case 2. Preoperative and postoperative MRI studies. Preoperative T1- (A) and T2-weighted (B) axial images showed an exophytic solid and cystic lesion dorsally involving the medulla oblongata with heterogeneous intensity (hypo- to hyperintensity), an unclear tumor boundary, hemorrhage, and multiple fluid-fluid levels. The lesion appeared to demonstrate heterogeneous enhancement in preoperative T1-weighted axial (C) and sagittal (D) images after administration of Gd. T1-weighted axial (E) and sagittal (F) images with administration of Gd obtained 72 hours after surgery showed complete resection of the lesion. Postoperative T1-weighted axial (G) and sagittal (H) images with administration of Gd at the most recent evaluation showed complete removal of the lesion without recurrence.](image-url)
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Fig. 4. Case 2. Histopathological examination revealed immature cartilage (left) and epithelial tissue (right). High-density chondrocytes with moderate nuclear atypia, karyomegaly, and hyperchromatism in a few chondrocytes, as well as binuclear chondrocytes, were noted in the immature cartilage tissue (left). Variably sized monolayered or multilayered arrangements of epithelial cells appeared as tubular glands (right). Disintegrated glands, necrosis, significant epithelial atypia, mitoses, and prominent nucleoli were also observed. H & E, original magnification ×200.

that occur in infratentorial sites. Despite a male predominance, however, neonatal teratomas are more frequently diagnosed in females.1,7 Teratomas of the brainstem are extremely rare. In the current series, we present 2 new cases of medulla oblongata teratomas that are exophytic and intraaxial, respectively, with significantly different outcomes. Thus far, only 17 cases of primary brainstem germ cell tumor (GCT) have been reported (15 germinomas,7 1 mixed GCT,7 and 1 teratoma9), with distinct characteristics in terms of age (mean age 24.2 years, range 12–40 years), ethnic group (all Asians), and histological subtypes (predominantly germinomas),2,8 yet without consistent neuroradiological features.

To our knowledge, only 1 case of teratoma in the medulla oblongata and only 1 case of midbrain mixed GCT have been previously described (Table 1).7,9 The first case, reported by Tsuzuki et al.,9 was a 39-year-old male patient with a malignant teratoma of the medulla oblongata who underwent partial resection and chemoradiotherapy (the specific chemoradiotherapy regimen was not reported). However, the residual tumor regrew, and he died 3 months after surgery. The other case, presented by Koh et al.,7 was a 14-year-old boy who harbored a midbrain mixed GCT composed of mature teratoma (95%) and germinoma (5%) cells. The patient underwent subtotal resection and received combination chemotherapy followed by radiotherapy and was alive 1 year after surgery.

Many brainstem lesions can be diagnosed accurately based on the neurological examination and neuroradiography results; however, a significant number of brainstem lesions (approximately 10%–20%) are misdiagnosed preoperatively, and biopsy or surgery is reserved for lesions with diagnostic uncertainty.2,8 Hemangioblastoma, which was considered in the differential diagnosis of Case 1, might help to differentiate the cystic component, which manifests as hypointensity in cystic hemangioblastoma and, in contrast, hyperintensity in teratoma with a gelatinous matrix, although this radiographic sequence was not used in Case 1. In malignant teratomas, alpha-fetoprotein and human chorionic gonadotropin levels are useful for monitoring the tumor activity, as previously emphasized by Koh et al.7 but were not obtained in our 2 cases.

Chemotherapy with platinum agents has been recognized as effective for intracranial immature teratomas in older children.2,6 The case with an unspecified chemotherapy regimen reported by Tsuzuki et al.9 the single case from our series, and the literature review2,7,9 do not present sufficiently robust data to establish the preferred postoperative adjuvant treatment, although chemotherapy is recommended for immature or malignant teratoma.4 Given the paucity of data regarding teratoma in the medulla oblongata, our experience suggests that the inherent surgical risk depends on the tumor growth pattern and that, despite the unusual location, a favorable outcome may result from resection and chemotherapy in cases of immature teratoma.

Conclusions

Medulla oblongata teratomas are extremely rare. Surgery is both essential and challenging. Teratomas should be considered in the differential diagnosis of lesions that occur in the brainstem. Chemotherapy is suggested in cases of immature teratoma. This course of treatment requires additional investigation with long-term follow-up and studies with larger sample sizes of tumors in this unusual location.

Disclosure

The authors report no conflict of interest concerning the materials or methods used in this study or the findings specified in this paper.

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