Primary Epidural Peripheral Primitive Neuroectodermal Tumor of the Thoracic Spine
—Case Report—

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Abstract

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A 25-year-old male patient presented with an extremely rare primary spinal peripheral primitive neuroectodermal tumor (pPNET) manifesting as acutely progressive paraparesis and back pain. Neuroimaging and intraoperative examination showed that the tumor was confined to the epidural space of the thoracic spine. The patient was treated successfully by gross total resection of the tumor followed by chemotherapy and local radiotherapy. The present case illustrates the unexpected occurrence and important differential diagnosis of primary epidural pPNET of the thoracic spine in young patients presenting with progressive paraparesis and back pain.

Key words: chemotherapy, epidural peripheral primitive neuroectodermal tumor, radiotherapy, spinal cord tumor

Introduction

The concept of primitive neuroectodermal tumors (PNETs) was first introduced by Hart and Earle in 1973 to describe predominantly undifferentiated tumors of the cerebrum,8) and later the central (cPNET) and peripheral types (pPNET) were proposed.3,5,17) cPNETs and pPNETs are distinct entities with different clinical, immunohistochemical, and genetic profiles.3,11,14,15,17) The dissimilarities between cPNETs and pPNETs are significant for clinicians, because the location of disease, tumor pathology, treatment strategy, and prognosis differ. cPNETs are a group of embryonal tumors of the central nervous system (CNS), and recently have been referred to as CNS PNETs to avoid confusion.17) pPNETs are a type of soft-tissue peripheral malignant round cell tumors, like rhabdomyosarcoma or Ewing’s sarcoma (EWS).2) pPNET and EWS share similar immunohistochemical, ultrastructural, and molecular biologic profiles.4,6,11,14) The expression of CD99 (MIC2) and the presence of EWS-FLI1 chimeric gene are highly specific for pPNETs and EWS. A new classification scheme was proposed for the differential diagnosis of pPNET and EWS based on conventional light microscopic and immunohistochemical findings. The presence of Homer-Wright rosettes and/or the expression of at least two neural markers indicate pPNET. The absence of Homer-Wright rosettes and no or only one neural marker indicate EWS.21) The literature regarding primary spinal pPNETs is somewhat confusing, as authors might not distinguish clearly between cPNET, pPNET, and EWS. However, cPNETs do not commonly result from chromosomal translocations. At present, cPNETs and pPNETs are considered both clinicopathologically and genetically distinct. Moreover, pPNETs rarely occur in the spine and CNS, and often in the chest wall, trunk, lower extremities, kidney, and orbit.

Here, we report an extremely rare case of primary spinal pPNET confined to the epidural space of the thoracic spine.

Case Report

A 25-year-old male presented to another hospital 18 days after acute onset of back pain and motor weakness of both legs. The patient’s symptoms progressed, with the development of decreased sensation in both legs, followed by severe motor weakness and inability to ambulate. He also experienced sphincter dysfunction with urinary retention. Magnetic resonance (MR) imaging demonstrated an isointense extradural mass compressing the spinal cord at T7 on T1- and T2-weighted images (Fig. 1A, B). The tumor was homogeneously enhanced after administration of contrast medium (Fig. 1C). Computed tomography showed osteosclerotic changes but no bone destruction of the T7 vertebra. The patient was referred to our institute one day after presentation. Physical examination found reduced motor strength of both legs to 2/5.

The patient was brought to the operating room as an emergency, and underwent T6-T8 osteoplastic laminotomy. The tumor was easily identified after
removal of the laminae. The tumor appeared to be elastic hard and had compressed the spinal dura mater. Careful dissection revealed the proximal and distal extent of the tumor. The tumor had not adhered to the underlying dura (Fig. 2). The origin of the tumor appeared to be in the proximity of the exit portion of the left T7 nerve root. Gross total resection of the tumor was accomplished without damaging the dura mater or sacrificing the nerve roots, but residual tumor possibly remained around the neural foramen of left T7 nerve root.

After surgery, the patient demonstrated satisfactory recovery of neurological function. He was able to ambulate independently with effort on postoperative day 7. Histological examination showed solid growth of small round cells with a high nucleus-cytoplasmic ratio. Immunostaining showed that the cells were positive for CD99 (MIC2), synaptophysin, and neuron-specific enolase, but negative for any lymphocyte markers (Fig. 3). The MIB-1 labeling index was more than 50%. The histological diagnosis was pPNET.

Postoperative MR imaging revealed gross total resection of the tumor. Positron emission tomography and brain MR imaging, obtained after surgery, revealed no other tumor in the whole body or brain. Following the surgery, the patient received three courses of chemotherapy with ifosfamide, cisplatin, and etoposide (ICE). After chemotherapy, the patient was given radiotherapy of 45 Gy/25 fractions to the local spine. MR imaging revealed complete remission of the tumor at 6 months after surgery (Fig. 4). The patient’s condition was stable without symptoms or compromise at the latest follow-up examination.

**Discussion**

Only 13 cases of the primary pPNETs have been reported in the spine, including our present case (Table 1). Non-primary pPNETs in the spine, cPNETs, EWS, or pathologically undetermined pPNETs were excluded. The patients were aged from 8 to 52 years (mean 24 years). The symptoms often showed progressive compromise, within about 2 weeks to 8 months. The tumors arose in every level of the spine, in the intramedullary, intradural extramedullary, or extradural spaces. About half of all cases were located extradurally. All patients underwent surgery with gross total resection in 9 cases and biopsy in 2 cases. Eleven patients received both chemotherapy and radiotherapy after definitive diagnosis. One patient received only radiotherapy. One patient did not receive any chemotherapy or radiotherapy, but the fol-

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**Fig. 1** Sagittal T1 (A, C) and T2-weighted (B) magnetic resonance images of the thoracic spine obtained before surgery showing an isointense tumor compressing the spinal cord, with homogeneous enhancement with contrast medium (C).

**Fig. 2** Intraoperative photograph showing that the tumor (**) had not adhered to the underlying dura (*).

**Fig. 3** Photomicrographs showing that the tumor consisted of a monotonous population of small round cells with a high nucleus-cytoplasmic ratio and positive for CD99. A: hematoxylin and eosin stain, B: CD99 immunostain, original magnification ×400.

**Fig. 4** Sagittal T2-weighted magnetic resonance image of the thoracic spine obtained 6 months after surgery showing no evidence of tumor recurrence.
### Table 1 Reported cases of histologically confirmed peripheral primitive neuroectodermal tumors of spinal origin

<table>
<thead>
<tr>
<th>Case No.</th>
<th>Age (yrs)</th>
<th>Sex</th>
<th>Duration of illness (mos)</th>
<th>Spinal level</th>
<th>Location</th>
<th>Treatment</th>
<th>Chemotherapy</th>
<th>Radiation</th>
<th>Follow up (mos)</th>
<th>Recurrence or metastasis</th>
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<td>10</td>
<td>M</td>
<td>3</td>
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<td>resection</td>
<td>+</td>
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<td>20</td>
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<td>M</td>
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<tr>
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<td>M</td>
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<td>biopsy</td>
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<td>F</td>
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<tr>
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<td>L4–S1</td>
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</table>

**Cases**: 16

**Description**: The table lists reported cases of histologically confirmed peripheral primitive neuroectodermal tumors of spinal origin, including the case number, age, sex, duration of illness, spinal level, location, treatment, chemotherapy, radiation, follow-up duration, and recurrence or metastasis. The table highlights the variability in treatment modalities and follow-up times, with some cases showing local control and other cases requiring craniospinal axis radiation.

### Discussion

Low-up duration after surgery was the shortest period of 3 months. Multiple adjuvant or neoadjuvant chemotherapeutic agents were used for systemic chemotherapy, including multiagent therapy with the use of alkaloid (vincristine), deoxyribonucleic acid synthesis inhibitor (cisplatin), and alkylating agents (cyclophosphamide).

In the present case, we decided to introduce 3 courses of ICE chemotherapy early after surgery based on the therapeutic effects of ICE for recurrent or refractory tumors in the EWS family.7 The standard chemotherapy regimen for primary pPNETs in the spine has not been established, but cisplatin-based combination chemotherapy may be the first-line treatment in recurrent or refractory EWS tumors.7 Seven of the 12 previous patients received local adjuvant radiotherapy, and 4 patients received craniospinal axis radiation. No experience has confirmed whether craniospinal axis radiation is more effective than local radiation. In the present case, we decided to give local control irradiation, as the tumor was confined to the extradural space with no evidence of craniospinal spreading. The present case definitely needs careful follow up, because the long-term overall outcome of primary spinal pPNET is still unclear and does not appear to be optimistic.

The present extremely rare case of primary epidural pPNET of the thoracic spine illustrates the unexpected occurrence and important differential diagnosis in young patients presenting with progressive paraparesis and back pain. Multidisciplinary treatment should be standard, but further clinical investigation is required.

### References


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