Primary Extradural Peripheral Primitive Neuroectodermal Tumor (Extraskelatal Ewing’s Sarcoma) Arising from the Sacral Spinal Nerve Root: A Case Report and Review of the Literature

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Abstract
Primitive neuroectodermal tumors (PNET) are rare, and are even rarer when they arise from the spinal cord tissue. Therefore, we report a case of peripheral PNET that arose from the sacral spinal nerve root.

The patient was a 30-year-old woman who presented with left lower extremity pain, and MRI revealed a neoplastic lesion in the left S1 nerve root canal of the sacral region. Subsequent imaging and testing were not able to confirm a diagnosis, although we suspected a benign tumor as a candidate for the differential diagnosis. We performed surgery to remove the tumor, and confirmed total resection. Our subsequent pathological testing confirmed a diagnosis of peripheral PNET, and we elected to treat the patient using concurrent radiotherapy and the standard chemotherapy for Ewing’s sarcoma. The treatment was successful, and the patient was free from recurrence at the 27-month follow-up.

Although it may be impossible to achieve a preoperative imaging diagnosis in similar cases, we believe that imaging remains an important part of the differential diagnosis to facilitate successful treatment.

Keywords
Primary extradural peripheral primitive neuroectodermal tumor; Extraskelatal Ewing’s sarcoma; Sacral spinal nerve root

Introduction
Primitive neuroectodermal tumors (PNET) are rare malignancies that exhibit neural differentiation and consist of small round cells arising from the neuroectoderm. These tumors are classified as central PNET (cPNET; embryonal neoplasm and medulloblastoma arising in the cerebrum, brain stem, and spinal cord parenchyma) or peripheral PNET (pPNET; a type of Ewing family tumor arising from the soft tissues, excluding the central nervous system) [1]. Although Ewing’s sarcoma commonly occurs in children’s bones, it is rare that pPNET arises from the spinal cord tissue [1]. Therefore, we report an extremely rare case of a pPNET arising from the sacral spinal nerve root.

Case Report
A 30-year-old woman presented with left leg pain. She had no significant medical or family history, although she had felt the lower-extremity pain for several days after the spontaneous delivery of her second baby. After approximately 2 months, she consulted a primary care physician because of deterioration of the pain, and MRI revealed a neoplastic lesion in the left S1 nerve root canal of the sacral region. Thus, she was referred to our hospital.

At initial presentation, she reported experiencing strong pain extending from her left hip to the posterior femoral and crural regions, particularly at night along with insomnia. The pain persisted during rest, but was not exacerbated by walking or body motion. The visual analog scale score was 80–90 mm. An examination revealed that her patellar tendon reflex was normal in both legs, but the left Achilles tendon reflex was absent. Manual muscle testing revealed no lower-extremity weakness, and the straight leg raising test provided negative results for the right leg and a positive result at 60° for the left leg. We observed mild hypoesthesia in the lateral left foot. No bladder or rectal disturbances were observed. We began treatment using oral tramadol hydrochloride/acetaminophen (equivalent to 150 mg/day and 1,300 mg/day, respectively) and pregabalin (75 mg/day), although this treatment was unsuccessful. Thus, we doubled the analgesic doses and added a buprenorphine patch (5 mg/day) to achieve better pain control.

The laboratory data and plain radiography were normal, although CT revealed markedly enlargement of the left S1 nerve root canal. MRI failed to visualize the left S1 nerve root itself, although we observed a tumor extending along the nerve root from the nerve root canal to the anterior wall of sacrum. The tumor exhibited low intensity in the T1-weighted image, heterogeneous intensity in the T2-weighted image, and enhancement of the marginal region in the T1-weighted and gadolinium-enhanced image (Figure 1). We did not observe osteolytic findings or intravenous infiltration, and we considered a benign tumor (nerve sheath tumor or neurofibroma) with necrosis inside as a candidate for the differential diagnosis.

We created a 7-cm paramedian skin incision to expose the left laminae (L5–S2). After laminectomy of the caudal part of L5 and rostral part of S1 lamina along the course of the left S1 nerve root, we observed the swollen and congested left S1 nerve root. The tumor was identified on the ventral side of the dorsal root ganglion after caudal laminectomy of the S1 lamina along the S1 nerve root. The tumor’s surface was dark red and relatively hemorrhagic (Figure 2E), while the core was mainly filled with soft white necrotic tissue. A small tumor specimen was removed for pathological diagnosis, and the remaining tumor was removed using an ultrasonic aspirator (SONOPET UST–2001, Stryker Corporation, Kalamazoo, MI, USA). We confirmed total resection of the tumor up to the anterior wall of sacrum, although the nerve root was left intact because we only observed mild adhesion of the tumor tissue to the left S1 nerve root.
Hematoxylin-eosin staining revealed densely packed small round cells with intensely stained nuclei (small round cell tumor) and incomplete rosettes dispersed over the microscopic field (Figure 2F). Immunohistochemical staining revealed positivity for MIC 2 (CD99) and negativity for chromogranin A and S100. According to these findings, the tumor was pathologically diagnosed as a pPNET. Normal findings were observed after cerebrospinal fluid testing and head-and-cervicothoracic MRI. Furthermore, whole-
body FDG-PET imaging detected no abnormal findings, except near the left S1 nerve root. Based on these findings, we confirmed a diagnosis of primary pPNET arising from the left S1 nerve root in the sacral region.

The patient’s leg pain markedly improved immediately after surgery, and we reduced the tramadol hydrochloride/acetaminophen dose to one-half of the pre-operative dose. At 5 weeks after surgery, we initiated the standard chemotherapy for Ewing’s sarcoma (alternating vincristine/doxorubicin/cyclophosphamide [VDC] and ifosfamide/etoposide [IE]), and the patient completed 9 courses of VDC therapy and 8 courses of IE therapy with concomitant radiotherapy (total radiation of 50.4 Gy). The patient was free from recurrence at the 27-month follow-up.

Discussion

Approximately 130 cases of pPNET arising from spinal cord tissue have been reported [1,2], and these tumors account for only 0.4% of all primary spinal tumors [1]. The tumor is typically located in the cervical or thoracic spine [2], and pPNETs arising from the nerve root in the sacral region (as in the present case) are extremely rare, only 5 cases are reported in the English literature [1-5]. The mean age at onset was 23.6 years (range: 7-44 years).

Interestingly, pPNETs exhibit non-specific MRI findings, and a preoperative differential diagnosis is very difficult, despite the fact that imaging may reveal the possibility of a nerve sheath tumor. In the present case, the tumor was located in the sacral nerve root canal and exhibited low intensity in the T1-weighted image, heterogeneous intensity in the T2-weighted image, and marginal enhancement in the T1-weighted and gadolinium-enhanced image. These findings were insufficient to establish a preoperative diagnosis.

As there is no established treatment for primary spinal pPNET, multimodal therapy according to the treatment for Ewing’s sarcoma is recommended [1,2]. The surgery involves total or subtotal resection and VDC/IE is used as adjuvant chemotherapy, which is believed to improve the 1-year and 2-year survival rates [2]. Although radiotherapy is performed in many cases, there is no consensus regarding the exposure dose (usually 30-50 Gy). However, despite the use of multimodal therapy, the reported 1-year and 2-year survival rates are 80.6% and 51.9%, respectively, and approximately 50% of patients die within two years because of local relapse or intradural dissemination [2]. The good outcome in the present case may be related to the fact that the pPNET arose from the sacral nerve root, and was completely extradural and totally resectable, with minimal risk of intradural dissemination. Nevertheless, the survival rate is very low after 5 years [2], and careful follow-up of our patient will be needed to achieve an early and accurate diagnosis of any subsequent recurrence.

Conclusion

We experienced an extremely rare case of pPNET arising from the nerve root in the sacral region. The patient was treated using multimodal therapy and was free from relapse at approximately 30 months after the diagnosis. Although it was impossible to achieve a preoperative imaging diagnosis in this case, imaging remains an important part of the differential diagnosis to facilitate successful treatment.

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References