Tumor and tumor mimics in pediatric spine

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Learning objectives

We will review the different prevalence of pediatric spinal masses.

We will show MR imaging features of pediatric spinal masses including tumor and tumor mimics.

Background

Imaging findings and the differential diagnosis of tumors of the spine are well-known through textbook and several review articles. Tumors of the spine can be classified according to their pathologic origin or their location.

In pediatric age group, tumors of the spine are uncommon and frequent tumors are different from that of adults.

Also, there are nonmalignant or nonneoplastic masses in the pediatric spine, which may be mistaken by the radiologist for a malignant tumor.

Imaging findings OR Procedure details

A. Tumors in pediatric spine

1. Extradural
(1) Leukemia

In contrast to adult leukemia, most patients with spinal epidural leukemic involvement in pediatric group are symptomatic. Patients with spinal epidural leukemia present with signs of meningeal irritation. Occasionally, the leukemic masses grow up to sufficient size to compress nerve roots or spinal cord (Fig.1). On MRI, epidural mass is isointense to neural tissue with homogenous enhancement. Differential diagnoses are extraosseous Ewing’s sarcoma and lymphoma.

(2) Lymphoma

Patients with lymphoma present in older children with large soft tissue mass. Predeliction sites are paraspinal and epidural spaces (Fig.2).

(3) Metastasis

Neuroblastoma is the fourth most common tumors in children. It most often originate in the adrenal gland. Spinal metastasis from neuroblastoma show multifocal bone marrow signal change similar to other metastasis, leukemia, and lymphoma (Fig.3).

2. Intradural

(1) Astrocytoma

The most common spinal cord tumor in children is astrocytoma (60%), followed by ependymoma (30%). In adults, more than 50% of spinal cord tumors are ependymomas.

Astrocytomases are located more eccentrically in the spinal cord, enhance less intensely, and the enhancement is less sharply demarcated than in ependymomas. In clinical practice, it is more important to identify the level of the solid portion of the tumor than to differentiate these two tumors (Fig.4).

(2) Ependymoma

Myxopapillary ependymoma is rare (10%) in children (Fig.5), which comprise 50% in adults. Also 50% of pediatric spinal cord tumors are located in cervical or cervicothoracic spine, as compared with 28% in adult.

(3) Paraganglioma

Paragangioma and myxopapillary ependymoma can have very similar gross and microscopic appearances and are the main differential diagnoses for cauda equina spinal tumors (Fig.6).

(4) Metastasis from intracranial tumor
Dssemination from intracranial tumor through the CSF more frequently seen in children than in adults. This manner of tumor spread is commonly observed in medulloblastoma, ependymoma, germinoma, pineal gland tumor. These drop metastases to cauda equina are seen in 40% of patients with medulloblastoma. Rarely, intramedullary metastasis via central canal of spinal cord have been reported (Fig.7).

**B. Tumor mimics in pediatric spine**

1. **Cyst**

   (1) Meningeal cyst

   Extradural meningeal cyst may occur in children and causing spinal cord compression. It may be congenital (true arachnoid cyst) or acquired (arachnoid loculation). It is usually located dorsal to the thoracic spinal cord (Fig.8).

   (2) Syringohydromyelia

   Tumor-associated syringomyelia from congenital or post-traumatic syringomyelia is difficult. If an area of contrast enhancement is present within or adjacent to the syringomyelia, the diagnosis of tumor-related cyst should be considered. Chiari I malformation alters CSF dynamics at foramen magnum, thus results in development of syrinx (Fig.9).

2. **Nonneoplastic mass**

   (1) Epidural lipomatosis

   Abundant epidural fat in midthoracic and distal lumbar spinal canal cause compression of thecal sac (Fig.10). It is uncommon in children.

   (2) Langerhans cell histiocytosis (LCH, Histiocytosis X)

   Vertebral collapse (vertebral plana) or a lytic lesion are shown at presentation (Fig.11).

   (3) Neurofibromatosis type 1 (NF 1)

   Neurofibromatosis is autosomal dominant neurocutaneous disorder. If patient has multiple localized neurofibromas or plexiform neurofibroma, diagnosis of NF 1 should be considered. MRI show heterogeneously enhancing lobulated mass along the course of peripheral nerve. NFs are also involve spinal canal, neural foramen with associated scoliosis and widening of spinal canal (Fig.12).
Fig. 1: A 2-year-old girl with ALL (early B cell type) and resultant spinal cord infarction, epidural and subdural hematoma. After induction chemotherapy, she subsequently developed bilateral lower extremity pain, then complete numbness of the lower extremities. Spine MRI demonstrated spinal cord infarction from T9 level downwards associated with an epidural and subdural hematoma. There is complex heterogeneous T1 bright and dark and T2 bright and dark signal abnormality from the spinal canal throughout the lumbosacral region, consistent with hemosiderin and mixed extra-axial blood and clot within the anterior epidural and subdural spaces.
Fig. 2: A 11-year-old boy with lymphoma in posterior epidural space of T spine. There is a large posterior thoracic epidural mass spanning the region from the bottom of the T7 vertebral body to the T9-T10 disc space. The mass demonstrates mostly intermediate signal intensity on the T1 and T2WI with a small focus of increased signal intensity which may represent hemorrhage. The mass demonstrates diffuse homogenous post-contrast enhancement. This mass results in severe canal stenosis and cord compression.
Fig. 3: A 4-year-old boy with bone metastasis from adrenal neuroblastoma. There are variable sized ill-defined signal changes in bodies of thoracolumbar spine.
**Fig. 4:** Cervical spinal cord astrocytoma. Sagittal images show expansion of spinal cord from the foramen magnum to T8 level. Both cystic and solid components of the mass are seen.
Fig. 5: A 17-year-old man with myxopapillary ependymoma. There is enhancement of a mass occupying the spinal canal in the lumbar spine extending from L1 superiorly to the termination of the thecal sac in the sacrum. Nerve roots are within the mass and compressed along the posterior lateral thecal sac bilaterally. The enhanced sagittal images reveal nodular contiguous enhancement along the surface of the distal thoracic spinal cord and conus medullaris, which may represent both metastases and physiologic enhancement of vessels. Two oval lesions along the dorsal surface of the conus medullaris may represent lipomas or focal hemorrhage.
Fig. 6: A 8-year-old boy with infiltrating paraganglioma. There is a rim-enhancing CSF intensity collection or nodule in the thecal sac dorsal to S1 and S2, displacing cauda equina dorsally and laterally. There is also extensive enhancement of the roots of the cauda equina as well as enhancement along the surface of the conus. Differential diagnosis may include intradural abscess, myxopapillary ependymoma.
Fig. 7: A 9-year-old boy with medulloblastoma of the cerebellum and intraspinal and leptomeningeal dissemination. On contrast-enhanced MRI, multiple enhancing intradural nodules are seen along the entire spinal cord.
Fig. 8: A 3-year-old-girl with extradural meningeal cyst. There is a cyst in the dorsal aspect of the canal from T12 to L3-4, resulting in displacement and mild deformity of the conus as well as crowding of the proximal cauda equina nerve roots.
**Fig. 9:** Syringohydromyelia with associated Chiari I malformation. Central canal of spinal cord is dilated from C4 to T9, suggesting syringohydromyelia. Cerebellar tonsil is enlarged and extend below the foramen magnum.
**Fig. 10:** Epidural lipomatosis. Abundant epidural fat in thoracic spinal canal is noted on T1WI.
Fig. 11: Langerhans cell histiocytosis (LCH) of lumbar spines in 7-year-old (A) and 15-month-old (B) boy. Focal destructive lesion of L1 (A) and vertebral plana of L3 (B) are two different patterns of LCH.
Fig. 12: Plexiform neurofibromatosis type I with large epidural mass and spinal cord compression. It involves cervical nerve, brachial plexus, and sacral plexus. Kyphoscoliosis, dural ectasia are also seen.
Conclusion

The spinal tumors in children are rare. The ratio of brain to spinal tumors in children is 20:1 as compared to 5:1 in adults. Although imaging features of spinal tumors in pediatrics are similar to those affecting adults, the incidence and the presentation are quite different.

This exhibit shows MR imaging features of some pediatric spinal tumors and tumor mimics in spinal canal and neural foramen.

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