**Definition**

- **Epidemiology**
  Accounts for approximately 46% of cervical spine injuries.

- **Etiology, pathophysiology, pathogenesis**
  Results from maximum flexion of the cervical spine.
  - Maximum extension of posterior vertebral elements and compression of anterior elements.
  - Often associated with anterior disk herniation.

  The most important types of flexion fracture are:
  - **Anterior wedge fracture**: Least severe form of flexion injury.
    - Avulsion of a fragment from the anterior margin of the superior endplate with an intact posterior margin.
    - Higher energy trauma will produce a wedge vertebra and may involve the posterior margin.
  - **Teardrop fracture**: A triangular fragment resembling a teardrop is avulsed from the anteroinferior aspect of the vertebral body in flexion.
    - This is usually combined with a tear in the posterior longitudinal ligament.
    - Although the posterior margin is not affected, the injury is unstable.
    - Often a cause of paraplegia.
    - Occurs in the lower cervical spine (C5) in 70% of cases.
  - **Anterior subluxation or dislocation**: Tearing of the posterior ligament complex or avulsion of the ligament from the vertebral body causes one vertebra within a segment to tilt anteriorly relative to the adjacent caudal vertebra.
    - Stability depends on the severity of the angulation and translation.

**Imaging Signs**

- **Modality of choice**
  Multislice CT
  - Slice thickness in the cervical spine 1 mm to maximum 3 mm with sagittal reconstructions.
  - Where spinal cord injuries or injuries to the ligament complex are suspected.
  - MRI.

- **Radiographic findings**
  Compression of the vertebral body.
  - Disrupted alignment.
  - Prevertebral soft tissue swelling (normal appearance of soft tissue does not exclude a fracture).
  - Avulsion of the anterior margin of the superior endplate in an anterior wedge fracture.
  - Avulsion of the anterior margin of the inferior endplate in a teardrop fracture.
  - In anterior subluxation or dislocation, one vertebral body is tilted anteriorly, opening a gap between the spinous processes and causing incomplete articulation of the facet joints. The subluxed vertebra may be displaced anteriorly.

- **CT findings**
  The signs seen on conventional radiographs are also visualized on CT, although with far greater sensitivity.
  - Sagittal reformations are helpful.

- **MRI findings**
  T1-weighted, T2-weighted STIR: The fracture and degree of displacement are visualized.
  - Integrity of the ligament complex can be evaluated.
  - Spinal cord edema and/or bleeding are visualized.
Definition

- **Epidemiology**
  Rare highly malignant tumor (round-cell sarcoma) occurring in childhood and adolescence • Age 5–20 years.

- **Etiology, pathophysiology, pathogenesis**
  Closely related to PNET • Permeative osteolytic tumor arising from the medulla, usually with a large soft tissue component • The intervertebral disk is spared • Arises from the vertebral body (occasionally from two) • Only 5% of lesions are sclerotic • Extraosseous soft tissue component in over 50% of cases • Metastases (lung, bone, lymph nodes) arise in over 20% of cases.

Imaging Signs

- **Modality of choice**
  Conventional radiographs, CT (diagnosis) • MRI (extent of tumor).

- **General**
  Aggressive permeative (moth-eaten) osteolysis • Periosteal reaction • Soft tissue component (50% of lesions).

- **Radiographic findings**
  Permeative bony destruction with a broad transitional zone • Periosteal reaction (“onion peel” appearance, “hair on end,” Codman triangle) on the vertebral bodies is often not distinct • Compression fracture.

- **CT findings**
  Bony destruction • Infiltration of paravertebral structures • Soft tissue component.

- **MRI findings**
  T1 hypointensity, significant enhancement after contrast administration • T2 and STIR hyperintensity • Evaluation of soft tissue component • Infiltration of paravertebral and intraspinal structures • Caution: Hemorrhage and necrosis can alter the appearance of the lesion.

- **Nuclear medicine**
  Pronounced radionuclide uptake (searching for metastases).

Clinical Aspects

- **Typical presentation**
  Pain • Fever and leukocytosis (mimics osteomyelitis) • Swelling • Developmental anomaly • Pathologic fractures present in over 10% of cases.

- **Therapeutic options**
  Preoperative chemotherapy (goal: 90% reduction in tumor size); combination modality therapy • Resection followed by chemotherapy.

- **Course and prognosis**
  In 50% of cases with localized disease, survival is good • Rate of tumor recurrence is over 15%.
**Fig. 5.41** Fatigue, slightly elevated temperature, leukocytosis. Conventional lateral radiograph of the thoracic spine (detail). Moderately sclerotic anteriorly compressed vertebral body. Tumor has penetrated the posterior cortex. The matrix is highly inhomogeneous, a sign of osteoblastic and osteolytic posterior bone remodeling.

**Fig. 5.42** CT of the thoracic spine (axial). Large right anterolateral soft tissue tumor with impression of the trachea. Lesion extends to the aortic arch.
Differential Diagnosis

**Neuroblastoma**
- PNET can only be distinguished by histologic examination

**Langerhans cell histiocytosis**
- More geographic lesions

**Osteosarcoma**
- 80% involve matrix calcification

**Eosinophilic granuloma**
- Histiocytosis X

**Osteomyelitis**
- Fever, leukocytosis, elevated erythrocyte sedimentation rate
- Intervertebral disk also affected

Selected References


Greenspan A, Remagen W. Differential Diagnosis of Tumors and Tumor-like Lesions of Bones and Joints. Lippincott-Raven 1998


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**Fig. 5.43** CT of vertebra T8 (axial, bone window). Extensive osteolysis of the vertebral body with paravertebral tumor masses isodense to soft tissue.
**Definition**

Intramedullary accumulation of cerebrospinal fluid resulting from dilation of the central canal (hydromyelia) or paracentral cavitation (syringomyelia); these conditions are often simultaneously present and indistinguishable. 

*Syringobulbia*: Spread into the medulla oblongata.

*Communicating syringomyelia*: Occurs in 14% of cases. Involvement of the fourth ventricle, associated with hydrocephalus.

- Congenital malformations: Chiari I malformation, encephalocele, Dandy-Walker syndrome, cysts.
- Meningitis.
- Intraspinal hemorrhage.

*Noncommunicating syringomyelia*: 65% of cases. No communication with the fourth ventricle.

- Chiari I malformation.
- Spinal arachnoiditis.
- Tethered cord.
- Cystic degenerative tumors (ependymomas, astrocytomas).
- Atrophic syringomyelia (ex vacuo syringomyelia).
- Loss of parenchyma from spinal trauma or infarction.
- Equally common in both sexes. Peak age: 20–40 years.

**Imaging Signs**

- **Modality of choice**
  
  MRI.

- **Radiographic findings**

  *Associated bony malformations of the spine*: Atlantooccipital fusion, spina bifida, Klippel-Feil deformity.

  *Secondary bony changes*: Scoliosis, dilation of the spinal canal, degeneration, and/or destruction of the facet joints.

- **CT findings**

  Detailed visualization of bony changes. 

  *CT myelography*: Where MRI is contraindicated.

- **MRI findings**

  General:

  - Sagittal and axial T1- and T2-weighted images.
  - CSF flow study (at the respective level or in the other CSF spaces).
  - Contrast studies are indicated in uncertain cases to exclude tumor.
  - *Complete spinal cord examination*: From the cervical spine including the foramen magnum (to exclude a Chiari malformation) to the lumbar spine.
  - Supplementary cerebral MRI to exclude a cerebral malformation.
T1:
Tubular to lobulated focal signal alteration in spinal cord, usually isointense to CSF, possibly partially septate.
  - Signal is occasionally hyperintense to CSF due to increased protein content
    - Spinal cord may be distended.
T2:
  - Focal signal alteration in the spinal cord, usually isointense to CSF.
  - The pulsatile motion of the syrinx fluid produces flow voids, a finding of prognostic importance as these lesions usually respond well to creation of a shunt.

**Clinical Aspects**

- **Typical presentation**
  Dissociated sensory deficits (often loss of sensitivity to pain and temperature)  
  Radicular pain  
  Weakness in the extremities, sensation of stiffness in the legs  
  Muscle atrophy in the upper extremities  
  Neurogenic arthropathy, progressive scoliosis  
  Brainstem symptoms where the lesion extends into the hindbrain.
Fig. 2.22  MR image of T5 (axial, T2). Eccentric cavitation on the left side at the level of T5. A fine linear structure extends from the spinal cord to the dura: post-traumatic tethering.

Fig. 2.23  MR image of the cervical spine (sagittal, T1) in an asymptomatic 27-year-old man. Hypointense longitudinal defect at C7.

Fig. 2.24  Same patient as in Fig. 2.23 (sagittal, T2). Hyperintense signal alteration.

Fig. 2.25  Same patient as in Fig. 2.23 (sagittal, T1 with contrast). No abnormal enhancement. No Chiari I malformation. Final diagnosis: typical syrinx.
Therapeutic options

Treatment is indicated only for symptomatic syrinx • Decompressive laminectomy and syringotomy (posterolateral myelotomy to drain the syrinx into the subarachnoid space) • Syrinx shunting • Percutaneous needle aspiration (Caution: Syrinx may refill) • Terminal ventriculostomy: With a lumbar syrinx, the filum terminale is opened to create communication between the terminal ventricle and subarachnoid space • Patients with posttraumatic syrinx respond especially well to surgical treatment.

Prognosis

This depends on the underlying cause and the severity of the neurologic deficit.

Differential Diagnosis

Cystic tumor or tumor component

Selected References

Fig. 2.8 a, b  Schematic diagram (a). Anterior wedge fracture with rupture of the posterior longitudinal ligament, spinal canal stenosis, and spinal cord compression. Conventional lateral radiograph of the cervical spine (b). Teardrop fracture with widening of the facet joint space.

Fig. 2.9 a, b  CT of the cervical spine (a coronal and b sagittal, volume-rendered). Teardrop fracture of C6 with posterior displacement of the vertebral body. To better visualize the injury, the respective slices anterior to the imaging plane have been cut away.
Clinical Aspects

- **Typical presentation**
  Trauma consistent with imaging findings • Severe neck pain • Neurologic symptoms may or may not be present.

- **Complications**
  Spinal cord injuries with distal neurologic symptoms.

- **Therapeutic options**
  Depends on the neurologic symptoms and degree of injury • Halo fixator is indicated in the absence of neurologic symptoms • Immediate decompression is indicated where neurologic symptoms and spinal cord compression are present.

Selected References

Burke JT, Harris JH. Acute injuries of the axis vertebra. Skel Radiol 1989; 18: 335–446