Lecture (No.8)

RADIOLOGY of SPINE DISEASES

Rawabi Alghamdi
Hanan Alsalman
Maha Alkubaidan
Reem Aljurayyad
Ayshah Almahboob

Ghadeer Alwuhayd
Hanan Alrabiah
Dalal Alqadi
Suliman Alshammari
Khawla Alothman

Resources:
- Lecture by dr. Sajjad Hussain
The Imaging Methods to Evaluate Spine are:

- Plain X-Ray Films
- Myelogram – injection of contrast medium in CSF followed by x-ray images. Rarely performed now-a-days
- Computed Tomography (CT Scan)
- Magnetic Resonance Imaging (MRI)
- Discogram – injection of contrast medium in the disc followed by x-ray images.
- Spinal angiography – to evaluate arteries and veins
- Ultrasound – more in children
- Radionuclide Bone Scan – intravenous injection of radioactive material bound to phosphonates which deposit in bones, followed by images by gamma camera.
- DEXA – radionuclide scan for bone density (osteoporosis)

1- X-RAYS (RADIOGRAPHS):

Often the first diagnostic imaging test, quick and cheap
Small dose of radiation to visualize the bony parts of the spine
Can detect :
  o Spinal alignment and curvature
  o Spinal instability – with flexion and extension views
  o Congenital (birth) defects of spinal column
  o Fractures caused by trauma
  o Moderate osteoporosis (loss of calcium from the bone)
  o Infections
  o Tumors

✓ May be taken in different positions (ie; bending forward and backward) to assess for instability

2- COMPUTERIZED TOMOGRAPHY (CT SCAN):

Uses radiation to obtain 2-D and 3-D images, Patients must lie still on a table that moves through a scanner, Cross-sectional images are obtained of the target areas. Much detailed information regarding bony and soft tissues.
Better in visualizing:
  o Degenerative or aging changes, Herniated discs.
  o Spinal alignment.
  o Fractures and fracture patterns.
  o Congenital / childhood anomalies.
  o Areas of narrowing in spinal canal through which spinal cord and spinal nerve roots pass.

✓ Entire spine can be imaged within a few minutes.
✓ A contrast material may be injected intravenously or intrathecally to make some areas clear.
✓ Poor in visualizing inner details of spinal cord.

3- MYELOGRAM:

A contrast material is injected into CSF (usually between L3 & L4) to better identify areas where spinal cord or spinal nerves may be compressed.

the procedure:
Under local anesthesia, a needle is placed into lower lumbar spinal canal, and then CSF flow is confirmed. Contrast medium is then injected which mixes with CSF around spinal cord, making it visible on x-ray images Often a CT scan is also performed after this
May be performed when MRI is contraindicated.
4- Magnetic Resonance Imaging (MRI):
The gold standard of imaging for spinal disorders. Does not use ionizing radiation. Can identify abnormalities of bone, discs, muscles, ligaments and spinal cord. Intravenous contrast is sometimes administered to better visualize certain structures or abnormalities, Patient lies still in a tunnel like structure for about 25 minutes. Claustrophobic (phobia from close spaces) patients may need sedation (also we can use MRI scanner the open type), and children often need general anesthesia. Contraindications include:
  o Implanted devices e.g. cardiac pacemakers and other electromagnetic devices.
  o Certain metal clips and stimulators.
  o Artificial joints and spinal hardware may still have MRI scans.
✓ MR images are multi-planar
✓ MR images are very high resolution

Entire spine imaged by MRI which is better than CT in detecting minor lesions and does not use ionizing radiation.
5- DISCOGRAM:
Discs are the cushions between the vertebral bodies while MRI and CT scans can provide structural information, **discogram** better identifies the relationship of disc to pain.

PROCEDURE:
A needle is placed into center of the disc under fluoroscopy (continuous x-ray imaging).
A contrast material (dye) is injected. Radiologist then observes if patient experiences pain that is similar to his/her usual pain, and is increased by injecting contrast. X-rays (+ CT scan) are then done to see if dye stays within the center of the disc or leaks to outer border of the disc indicating a tear in annulus fibrosus of disc which can be a source of pain.

### Congenital Anomalies

Usually the congenital anomalies of the **spinal cord coexists with the spinal** (the vertebral bodies, spinal process…etc) **anomalies**.

**MRI** is the best to assess the contents of the cavity, extent of abnormalities, and **spinal cord**.

**CT** shows bony structures the best and is often used **before surgery**.

Skin covered defects: Spina bifida occulta.
Open skin defects: Spina bifida aperta, Meningocele and Meningomyelocele.

<table>
<thead>
<tr>
<th>Occulta= means hidden</th>
</tr>
</thead>
<tbody>
<tr>
<td>You do not see the anomaly by your eyes</td>
</tr>
<tr>
<td>But you can feel the missing spinal process</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Aperta=</th>
</tr>
</thead>
<tbody>
<tr>
<td>you can see the anomaly through an open skin</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Meningocele:</th>
</tr>
</thead>
<tbody>
<tr>
<td>The meninge are herniated but no spinal cord bulging</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Meningomyelocele:</th>
</tr>
</thead>
<tbody>
<tr>
<td>The meninge herniated with spinal cord bulging</td>
</tr>
</tbody>
</table>

Multiple fusion abnormalities of vertebrae on plain film
To assess the trauma we do an X-ray without moving the traumatic patient. We look to 2 important things.

1. **Alignment** – by drawing lines different lines on the image.
2. *Prevertbral soft tissue.*

If both are normal, that means usually there is no significant injury.

**Plain film assessment of trauma**  
– the first imaging method–

**Alignment should be normal – check by drawing lines**

**Memorize those normal images:**
Abnormal (trauma) example:
1- Alignment – normal.
2- soft tissue- abnormal
   patient get trauma on x-ray we found abnormal soft tissue may be due to hemorrhage, this is fracture suspicious case we have to send the patient to CT scan (IMP).

Jefferson Fracture:
Fracture on both anterior and posterior C1.
  ✓ Lateral displacement of C1
  ✓ Coronal reconstruction from a CT confirms the findings from the odontoid view
  ✓ Axial CT clearly shows the location of the fractures of C1
Hangman’s Fracture (C2 Fracture):

Fractures through the pars interarticulare of C2 (the fracture between and the spines process) resulting from hyperextension and distraction. Hyperextension (e.g. hanging, chin hits dashboard in road accident)

Radiographic features: (best seen on lateral view)
1. Prevertebral soft tissue swelling
3. Anterior dislocation of C2 vertebral body

Bilateral Facet Dislocation

Complete anterior dislocation of vertebral body resulting from extreme hyperflexion injury. Associated with a very high risk of cord damage.

(vertebral body compress an another vertebral body)
Unilateral Facet Dislocation

Facet joint dislocation and rupture of the apophyseal joint ligaments resulting from rotatory injury
Mechanism: simultaneous flexion and rotation such in boxing.

Note: 1 facet injury, patient could be stable. But if 2 facet or 1 facet and 1 vertebral body injured patient will be unstable.

Burst Fracture:

Results from axial compression
Injury to spinal cord is common due to displacement of posterior fragments
CT is required for all patient to evaluate extent of injury

INFECTIONS

Discitis and Osteomyelitis:

Usually the result of blood–borne agents
Especially from lung and urinary tract. Most common pathogen is staphylococcus, Streptococcus less common. Gram-negative rods in IV drug abusers or immunocompromised patients E. Coli, Proteus, Non-pyogenic, Tuberculosis and Coccidioidomycosis. May occur after invasive procedure like Surgery, Discography, Myelography. In children, infection begins in vascularized disc. In adults, in anterior inferior corner of vertebral body with spread across disk to adjacent vertebral endplate
Site of involvement
L3/4
L4/5
Unusual above T9
Usually involvement of one disk space (occasionally 2)
**IMAGING FINDINGS**

**PLAIN FILMS**
Narrowing and destruction of an intervertebral disk
Earliest plain film sign
Indistinct adjacent endplates with destruction
Often associated with bony sclerosis of the two contiguous vertebral bodies
Paravertebral soft tissue mass
Endplate sclerosis (during healing phase beginning anywhere from 8 weeks to 8 months after onset)
Bone fusion after 6 months to 2 years

**MRI**
Bone marrow edema in infected vertebrae, discs and paraspinal soft tissues
Dark on T1 and bright on T2 images
Enhancement of inflammed tissues after contrast
Fluid collections (abscesses) are common

A. Sagittal T1 MRI shows decreased signal of vertebral bodies and disc with end plate destruction
B. Sagittal T2 MRI shows increased signal in corresponding areas with anterior subligamentous abscess, epidural involvement and extension of inflammation in T6 with preserved endplate
C. Axial contrast-enhanced T1 MRI shows peripheral enhancement of paravertebral abscess and marked enhancement of epidural tissues causing displacement of spinal cord
D. CT shows lytic lesion in vertebral body and paravertebral abscess with calcifications

Note:: things that doctor mentioned in infections are:
Osteomyelitis >> vertebral bone
Discitis >> the disc
Both usually combined
The cuse, bloodborn, post surgery, lumbarpuncture and …graphy
MCQ ::
tumor inside the cord >> the cord will be big and expanded.
Tumor outside the cord >> the cord will be displaced and thin.

Inside the cord, but the cord not changed, so it is not tumor.