4A Neuro
Spinal conditions
Spontaneous Intracranial Hypotension

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Epidemiology

- Not rare, an important cause of new daily persistent headaches among young & middle age individuals
- Prevalence: ~1 per 50,000, probably underdiagnosed
- F:M ~ 2:1, onset in 4th or 5th decade
- Associated with connective tissue disorders (Marfan, Ehler Danlos)
Etiology & Pathogenesis

- Generally caused by spinal CSF leak
- Precise cause remains largely unknown, underlying structural weakness of spinal meninges is suspected
- Hx of trivial traumatic events elicited in 1/3
- Wide variety of dural defects; simple dural hole, fragile meningeal diverticula, absence of dura cover spinal nerve root, bone/disc pathology

JAMA 2006;295(19):2286-96
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Etiology & Pathogenesis

- Decreased CSF volume may be final common pathway in pathophysiology
- Altered distribution of craniospinal elasticity due to spinal CSF leak may be final common pathway
- So, “spontaneous spinal CSF leak” are preferred terms

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JAMA 2006.;295(19):2286-96
MR Signs of Intracranial Hypotension

- Diffuse pachymeningeal (dural) enhancement
- Bilateral subdural effusion/hematomas
- Downward displacement of brain
- Enlargement of pituitary gland
- Engorgement of dural venous sinuses
- Prominence of spinal epidural venous plexus
- Venous sinus thrombosis & isolated cortical vein thrombosis

UKRC 2015  AJNR 2008.; 29:1164-70
Monroe-Kellie Rule

- Sum of volumes of intracranial blood, CSF & cerebral tissue must remain constant in an intact cranium
- Loss of CSF can be compensated by increased vascular component or by increased intracranial CSF component
Monroe-Kellie Rule

- Accounting for pachymeningeal enhancement, engorged venous structures, pituitary hyperemia and subdural effusions
- Subdural hematoma may caused by tearing of bridging veins or rupture of thin wall vessels in subdural zone
- Sagging of brain is caused by loss of CSF buoyancy
Diffuse Pachymeningeal, (Dural) Enhancement

- Diffuse, uniform thickness
- Located at convexity, along falx cerebri, tentorium & posterior fossa dura
- Disappears after successful treatment

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Bilateral Subdural Effusion/Hematomas

- Incidence: 10-50%
- Tend to be thin (2-7 mm), typically occur over supratentorial convexity
- Have variable MR signal, depending on protein conc. & presence of blood
- Disappear after successful treatment

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Downward Displacement of The Brain

- Low lying cerebellar tonsils
- Effacement of prepontine cistern, flattening of pons against clivus
- Effacement of perichiasmatic cistern with bowing of optic chiasm over pituitary fossa
Engorgement of Dural Venous Sinuses

- On T1W the middle 1/3 of dominant transverse sinus, shows convex borders
- All venous sinuses become engorged
- The falx & tentorium show marked enhancement
Occasionally patients may even present with a compressive myelopathy due to a prominent venous epidural plexus.
Spinal Extradural Fluid Collections
Treatment

- Many cases resolved spontaneously
- There is no randomized control trial evaluation of the treatment option
- Conservative approach: bed rest, oral hydration, caffeine intake, use of abdominal binder
Treatment

- Mainstay of treatment is **epidural blood patch (EBP)** - epidural injection of autologous blood into epidural space
- Effective in relieving symptoms in ~1/3, presumably by dural tamponade and sealing the leak
- If unsuccessful, it can be repeated
Treatment

- If EBP fail, direct EBP or percutaneous placement of fibrin sealant is recommended
  - Requires knowledge of exact site of CSF leak
- Surgical Rx is reserved for Pt who failed nonsurgical Rx
- Often successful when focal CSF leak is identified
- Ligation or placement of muscle pledget

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Pre- post Tx appearance

Left: MRI shows ‘sagging’ brain & large pituitary gland. Right: after Tx & symptom resolution the brain & gland have a normal appearance.

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Pituitary gland changes in Intracranial Hypotension

Pre- & post treatment changes. The pituitary gland was initially enlarged & after Tx it becomes normal in size.

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**Table 1: Diagnostic criteria for spontaneous spinal CSF leak and intracranial hypotension**

<table>
<thead>
<tr>
<th>Criterion A</th>
<th>Demonstration of a spinal CSF leak (ie, presence of extrathecal CSF),</th>
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<tbody>
<tr>
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<td><strong>Criterion B</strong></td>
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Imaging Modalities for Detection of CSF leakage

- Radioisotope cisternography
- MR imaging
- CT myelography
- MR myelography
- Intrathecal Gd-enhanced MR
- Digital subtraction myelography

► Most common site of CSF leak reported as the cervicothoracic junction & thoracic area, could be single or multiple sites

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Spinal MR Imaging

- Search for the point of CSF leak is difficult and often unsuccessful
- Usually reveals extradural fluid collection, spinal meningeal enhancement, and dilatation of epidural venous plexus
- Location of extraarachnoid or extradural fluid collection rarely reflect leakage site
- May help Dx in Pt with normal cranial MRI
CT Myelography

- Considered most reliable imaging technique
- Need thin slice section
- Screening of the whole spine may cause large amount of radiation exposure (>10mSv)
- Additional scan is frequently required in slow flow fistula
CT Myelography

- On-table for fast leaks - uttana shishosana (extended puppy pose)
- Delayed for slow leaks
MR Myelography

- Not invasive, no radiation exposure
- A study of Yoo et al performed in 15 Pts with SIH, detectable in 12-13 cases
- Use 2D or 3D FSE heavily T2W
- All Pt improved after conservative treatment (2) or EBP (13)
Gd MR Myelography

- Unlicensed use of gadolinium
- No ionising radiation
- Slow technique, not for fast leaks
- Fat sat T1w sequences
- Prone to artefacts (failure of fat sat, flow signal)
Digital Subtraction Myelography

- For fast leaks
- Usually done under GA for breath arrest

JM Hoxworth et al ‘localization of a rapid CSF leak with digital subtraction myelography AJNR 2009 30
• 16G Touhy needle
• Midline approach
• Patient prone, decubitus or seated
• As much autologous blood as possible (40mls+)

• Back pain
• Change in headache
• No complications to date
**Tisseel Fibrin Glue**

- 2ml
- 4ml
- 10ml
- CT Guidance
- Transforaminal approach
- 22G spinal needle
- 4mls *Tisseel* fibrin glue
- Local and radicular pain
- Change in headache
- No complications to date
Case 1

- 77 yo lady
- Headache, mild confusion following fall
- Outside imaging: bilateral CSDH
- Transferred to neurosciences centre
- Bilateral burr hole drainage
- Comatose
- Repeat drainage
- Comatose
- 30mls autologous blood epidural patch at C1/2
- Full neurological recovery
Case 2

- 23 yo F
- Short Hx sudden onset severe headache
- Bedbound
- Cranial imaging supportive of SICH
- Transient responses to lumbar EPB
• CT myelogram identified single thoracic leak site
• Treated with 4mls Tisseel fibrin glue via tranforaminal injection under CT guidance
- Rapid change in headache
- 5/7 non-postural High pressure headache
- Full recovery
References

2. Diffuse pachymeningeal hyperintensity and subdural effusion/hematoma by FLAIR MRI in patients with spontaneous intracranial hypotension. AJNR 2008; 29:1164-70
4. Intradural spinal vein enlargement in intracranial hypotension. AJNR 2005; 26:34-38

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Non Degenerative Spinal Conditions

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Introduction

The vast majority of spinal imaging is performed for back pain or other symptomatology attributable to varying degrees of spinal degeneration.

It is so common that it is very easy for a radiologist to see an abnormality in the spine and attribute it to degenerative changes.

In most cases they would be right. However !! It is not the only process that leads to spinal disease.
Aims

- To help differentiate other disease processes from degenerative changes.

Conditions included

- Non degenerative spondyloarthropathies
- DISH and other ossifying disorders
- Infection
- Others
Osteoarthritis in the spine

- Primary OA, usually occurs in the elderly
- Secondary OA in the younger age group
- Clinical Features
  - Pain
  - Stiffness
  - Reduced mobility
- Acute exacerbations can mimic inflammatory arthritides and other conditions can mimic OA on imaging.
Pathophysiology of Spinal OA

- Aging- the nucleus of the disc is poorly vascularised and with age ‘drys out’.

- This leads to great mechanical stress on the disc and endplates. Of course the more load the spine, the quicker the degeneration.

- The disc degeneration leads to hypermobility of the vertebrae and in turn osteophytic spurs and then osteophytes develop, in order to stabilise the adjacent vertebrae.

- In addition the ligamentum flavum may stiffen and buckle into the spinal canal dorsally.
Radiological Findings in OA of the Spine

- Disc degeneration
  - Disc space height loss
  - Signal change on MRI
  - Disc herniation - Canal/ lateral recess/ foraminal stenosis
- Endplate Changes
  - Modic changes
- Osteophyte formation
Disc Degeneration
Endplate Changes

- Modic Endplate Changes - Type I
Endplate Changes

- Type II
Endplate changes

- Type III
Degenerative endplate mimics
Degenerative endplate mimics

Andersson Lesion
Endplate mimics
Endplate mimics

Infection- spondylodiscitis
Disc/Endplate Mimics

Scheuermann's Disease
Scheuermann’s Disease

- Osteochondrosis of the secondary ossification centres.
- Affects the lower dorsal and upper lumbar spine predominately, but whole spine can be involved.
- Results in kyphosis and vertebral endplate irregularity.
- Pain is not a predominant feature (20%), most present with kyphosis or imaging findings picked up incidentally.
- Unclear pathophysiology but normally 1\textsuperscript{st} presents at 13-16 years old, but vertebral changes persist into older age. Also slight predominance in taller individuals.
Osteophytosis
Degenerative osteophyte
Syndesmophyte Vs Osteophyte
**DISH**

Diffuse Idiopathic Skeletal Hyperostosis (Forestier disease)

- Bony proliferation at the sites of tendinous and ligamentous insertion.
- No clear pathophysiology, but usually affects the elderly.
- If seen in a young patient think of differential diagnosis including juvenile rheumatoid arthritis or ankylosing spondylitis.
- Most common in the thoracic spine but can occur anywhere. Usually flowing osteophytes over 4 or more segments on the side opposite the aorta.
- Enthesiopathy can also be seen
DISH
DISH- Mimic

Courtesy of Dr. J Harris
Inflammatory Spondyloarthropathies

- Spondyloarthropathies are inflammatory joint diseases of the vertebral column associated with the MHC class I molecule HLA-B27.
- The term “seronegative spondylarthropathy” is used because the conditions may mimic rheumatoid diseases such as rheumatoid arthritis, but serological (blood) tests are typically negative for rheumatoid factor (RhF).
Inflammatory Spondyloarthropathies

Subgroups (with increased HLA-B27 frequency) are:

- Ankylosing Spondylitis
- Reactive arthritis (Reiter's syndrome)
- Enteropathic arthritis associated with inflammatory bowel disease
- Psoriatic arthritis
- Undifferentiated SpA
- Whipple disease and Behçet disease may also be linked to HLA-B27, as may undifferentiated spondyloarthropathy
Ankylosing Spondylitis

- Ankylosing is a chronic, inflammatory arthritis and autoimmune disease.

- It mainly affects joints in the spine and the sacroiliac joint in the pelvis. Eventually can cause fusion.

- Strong genetic predisposition.

- About 90% of the patients express the HLA-B27 genotype.

- Males Females 9:1
Ankylosing Spondylitis

- Synovial Joints - Facet and costotransverse joint arthropathy
- Enthesiopathy
- Sacroilitis
Enthesitis - Romanus Lesion
Enthesitis
Bamboo Spine
Andersson Lesion
Sacro-ilitis

- Early involvement
- Bilateral
- Symmetric
- MR superior than plain films
Complications of AS
Psoriatic arthropathy
Psoriatic arthropathy

- Spondylo-arthritis (30-35% of cases)
- Can be different in character from ankylosing spondylitis.
- It may present as sacro-iliitis, which may be asymmetrical and asymptomatic, or spondylitis, which may occur without sacro-iliitis and may affect any level of the spine in "skip" fashion.
- In more longstanding disease asymmetric paravertebral ossifications develop.
Psoriatic Arthritis
Rheumatoid Arthritis

- Rheumatoid arthritis (RA) is a chronic, systemic inflammatory disorder that may affect many tissues and organs, but principally attacks the joints.
- Onset is generally in adulthood, peaking in the 4th and 5th decades.
- Produces an inflammatory synovitis that often progresses to destruction of the articular cartilage and ankylosis of the joints.
RA of the Spine

- Mainly the cervical Spine is affected
- Erosion of the dens
- Atlantoaxial subluxation and Segmental Subluxation
- Ankylosis and Erosion of the facet Joints
- Disc destruction
- Osteoporosis and Insufficiency Fractures
RA of the Spine

Courtesy of Dr J Harris
RA of the Spine
Baarstrup’s Disease

- Degenerative condition.
- Occurs when there is contact and rubbing of the spinous processes, leading to intra-spinous bursitis and degenerative changes in the spinous processes.
- Can be a cause of localised back pain, relieved by flexion and worse on extension.
- Can lead to other complications, such as thickening of the ligamentum flavum and epidural cysts.
Baarstrup’s Disease
Baarstrup’s Disease
Ossification of the Posterior longitudinal Ligament

- Important Cause of Myelopathy
- More common in patients of Asian Descent
- Mainly affects elderly Males
- 75% of the time the Cervical Spine is affected
- Associated with DISH, AS and other spondyloarthropathies
- Exact pathogenesis is uncertain
Ossification of the Posterior longitudinal Ligament
Calcification of the Ligamentum Flavum

- Unknown Aetiology
- Can be an important Cause of Thoracic Myelopathy
- Most commonly occurs in the Thoracic Spine
- Associated with Metabolic conditions such as x-linked hypophosphatemic rickets and CPPD
Calcification of the Ligamentum Flavum
Infection

- Mimicking erosive arthritis
Conclusion

- Although less common, non degenerative disease can affect the spine and should always be considered when reporting on spinal radiological studies.

- A multi-modality approach to imaging and a considered clinical approach can help narrow the differential for spinal disease.

- Be wary of mimics of degenerative changes.

- Know your diseases and look for disease complications.
Acknowledgements

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Articles for reference