Disorders of the Spine & Peripheral Nerves

An Introduction

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Spine Disorders & Neurosurgery

• Neurosurgery for spine disorders comprises approximately 70% of the entire practice for most centers.

• You or someone you know are far more likely to encounter spine problems than any other neurosurgical disorder.

• Knowing the key components to examine, and recognizing emergent vs. urgent vs. elective cases is critical.
The Basic Spine Exam: MOTOR

- Use one nerve root for every muscle
  - C5 Deltoid (shoulder abduction)
  - C6 Biceps (arm flexion)
  - C7 Extensor carpi (wrist extension)
  - C8 Finger flexors (grip)
  - T1 Finger intrinsics (finger abduction)
  - L2 Iliopsoas (hip flexion)
  - L3 Quadriceps (knee extension)
  - L4 Tibialis anterior (ankle dorsiflexion)
  - L5 Extensor hallucis longus (1st toe flexion)
  - S1 Gastrocnemius (ankle plantar flexion)
The Basic Spine Exam: SENSORY

- Use these key landmarks

  - C6  1\textsuperscript{st} & 2\textsuperscript{nd} fingers
  - C7  Middle finger
  - C8  4\textsuperscript{th} & 5\textsuperscript{th} fingers
  - T4  Nipples
  - T10 Umbilicus
  - L3  Knee
  - L4  Lateral dorsal portion of foot
  - L5  Medial dorsal portion of foot
  - S1  Plantar portion of foot
The Basic Spine Exam: OTHER

- Straight leg raise sign
  - Indicates a lower lumbar HNP with nerve root compression (radiculopathy)

- Range of motion for assessment of instability (neck/back)

- Hyperreflexia signs
  - Hoffman’s sign
  - Babinski sign

- Bowel/Bladder dysfunction

- The #1 pathophysiology underlying “Low back pain” is DEPRESSION, not a neurosurgical problem - so many patients don’t need an operation just because they’re in clinic with only back pain.
Frequent Spine Problems

• Cervical herniated nucleus pulposus
• Cervical stenosis
• Lumbar HNP *
• Lumbar stenosis

• *** Remember: HNP, a.k.a. hemiated disk or slipped disk or ruptured disk – all mean essentially the same thing to us when described in lay language
Cervical HNP

• History
  – Pain in neck and arm (travels along nerve root, thus “radiculopathy”) may or may not be related to trauma or action, worsened with position sometimes

• Exam
  – Use the motor and sensory exams (mentioned) to determine nerve root affected. A disc is between 2 levels, and will affect the LOWER nerve root – e.g. C5-6 HNP causes C6 radiculopathy, which may reveal biceps weakness and decreased sensation at the thumb & index finger

• Treatment
  – Conservative treatment: NSAIDS → Steroids → Traction → Anterior Cervical Discectomy & Fusion if no improvement

• Prognosis
  – More than 70-80% have significant relief of pain and some resolution of other symptoms

MRI: T2 (best sequence) shows a disc herniation which narrows the spinal canal and nerve root foramen (as seen by arrow).

http://www.josephmaroon.com/mded2.htm
Lumbar HNP

- **History**
  - Pain in low back and leg (travels along nerve root, thus “radiculopathy”) – may or may not be related to trauma or action, worsened with sitting down (usually in younger people)

- **Exam**
  - Use the motor and sensory exams (mentioned) to determine nerve root affected. A disc is between 2 levels, and will affect the LOWER nerve root – e.g. L5-S1 HNP causes S1 radiculopathy, which may reveal ankle plantar flexion weakness and decreased sensation at the bottom of the foot; also + straight leg raise

- **Treatment**
  - Conservative treatment: NSAIDS \(\rightarrow\) Steroids \(\rightarrow\) Traction \(\rightarrow\) Lumbar microdiscectomy if no improvement

- **Prognosis**
  - More than 70-80% have significant relief of pain and some resolution of other symptoms

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MRI: T2 (best sequence) shows a disc herniation which narrows the spinal canal and nerve root foramen (as seen)

Cervical Stenosis

- **History**
  - Neck pain and progressive difficulty in fine motor movement and walking (due to posterior column dysfunction resulting from myelopathy)

- **Exam**
  - Marked upper motor neuron findings c/w upper cervical myelopathy – hyperreflexia, Hoffman’s sign, Babinski sign

- **Treatment**
  - Conservative treatment: NSAID; however, this will not help the narrowing → need cervical decompression (usually dorsal laminectomy)

- **Prognosis**
  - Pain may improve, but the goal of this operation is to prevent worsening of myelopathy which may or may not improve vs. baseline.

MRI: T2 (best sequence) shows marked cervical stenosis which narrows the spinal canal (loss of CSF signal, as seen) – compare top left vs. right (stenosis vs. normal)

http://mripractice.tripod.com/mrpractice/id11.html
Lumbar Stenosis

- **History**
  - Back pain and “NEUROGENIC CLAUDICATION” which means inability to walk more than a few yards without legs “giving way”; SITTING makes the symptoms BETTER – these are the older people hunched over a grocery cart in the supermarket, because leaning forward helps their symptoms

- **Exam**
  - Usually normal sensory/motor exam; leaning forward helps their pain

- **Treatment**
  - Conservative treatment: NSAID; however, this will not help the narrowing → need lumbar decompression (usually dorsal laminectomy)

- **Prognosis**
  - Pain and ability to resist fatigue may improve, and the patient may walk much more than before without tiring; also prevents further damage.

MRI: T2 (best sequence) shows marked lumbar stenosis which narrows the spinal canal (loss of CSF signal, as seen)

http://w3.uokhs.edu/neurosurgery/public/lumbarstenosis.html
Spine-related emergencies

- Spinal epidural abscess
- Spinal epidural hematoma
- Cauda equina syndrome
- Any disorder (HNP or stenosis) with rapidly deteriorating neurological function
Spinal Epidural Abscess

- Epidural abscess
  - Sx: Back pain, fever, spine tenderness
  - Risk Factors: Diabetes, IVDA
  - Presentation: dependent upon region → may result in neurological decline
  - Treatment: MUST take for surgical evacuation if patient has worsening neurological function; RARELY can observe small epidural abscess, if no neurological decline. Need Abx.
  - If associated with osteomyelitis → may need surgical stabilization procedure also
  - Usually due to hematogenous spread (S. aureus) → can biopsy (CT-guided) for ID

http://www.aafp.org/afp/20020401/1341.html
Spinal Epidural Hematoma

- **Presentation**
  - Usually related to anticoagulation, rarely from spontaneous source (e.g. spinal AVM); associated with severe pain
- **Exam**
  - Depends upon location of bleed / extent of bleed
- **Radiographs**
  - MRI or Myelogram – mass effect, and shows filling defect on myelogram
- **Treatment**
  - Surgical evacuation if neurological deficit
- **Prognosis**
  - Depends upon extent of injury & reversibility

73 y.o. F on anticoagulation developed a spontaneous epidural bleed (arrows)

Cauda Equina Syndrome

- **History**
  - Similar as for HNP, but associated with bladder (>bowel) incontinence

- **Exam**
  - Similar as with radiculopathy, but need to check post-void residual (HIGH, as normal is less than 100cc) and rectal exam (decreased tone)

- **Radiographs**
  - Significant compression of cauda equina

- **Treatment**
  - Surgical decompression

- **Prognosis**
  - Depends upon quickness of decompression and reversibility of sx

http://www.ams.ac.ir/AIM/0362/0362146.htm
Spine Trauma

- Covered under the Neuroradiology & Neurotrauma presentations given by us
Spine surgery: What are our goals?

1. Alleviate pain by decompression of nerve roots.
2. Ensure stability so that the bony infrastructure housing the spinal cord and nerve roots does not “slip” and damage important nervous system structures.
3. Allow a “scaffolding” with hardware (plates, screws, rods, etc.) until solid bone forms.
4. Restore function, or arrest worsening, of nervous system function (e.g. by removal of spine tumors).
Examples of 5 common operations

• Cervical spine:
  – Anterior cervical discectomy & fusion (ACDF)
  – Dorsal cervical Laminectomy

• Lumbar spine:
  – Dorsal lumbar laminectomy
  – Lumbar microdiscectomy
  – Dorsal pedicle screw fusion
ACDF
Anterior Cervical Discectomy & Fusion (with Plate)

• Pre-operative diagnosis
  - Cervical HNP → radiculopathy

• Steps of procedure
  1. Patient is in supine position, with incision usually to just right of midline at the anterior neck
  2. Perform discectomy
  3. Replace disk with bone graft (we use cadaveric allograft)
  4. Fix construct with plate across vertebral bodies
  5. Patient does NOT need to wear C-collar due to the plate fixation

• Post-operative evaluation/management
  - Post-operative X-rays
  - No major restrictions other than no heavy lifting

Post-ACDF films show plate, with disc spaces containing bone for fusion

http://www.josephmaroon.com/mded2.htm
Dorsal Cervical Laminectomy

- **Pre-operative diagnosis**
  - Cervical Stenosis → Myelopathy

- **Steps of procedure**
  1. Patient is in prone position, with incision in midline at the posterior neck.
  2. Dissect muscles off lamina
  3. Remove lamina midline, and medial aspects of facets, so underlying dura/spinal cord are decompressed

- **Post-operative evaluation/management**
  - Discharge after 1-2 days
  - Does not need to wear C-collar
  - No major restrictions (other than no heavy lifting)

http://www.cerebral-palsy.net/stenosis/claminectomy.html
Dorsal lumbar laminectomy

- **Pre-operative diagnosis**
  - Lumbar stenosis → radiculopathy

- **Steps of procedure**
  1. Patient is in prone position, with incision at midline
  2. Muscles are stripped off the laminae
  3. Lamina is removed, with medial facetectomy, to decompress the underlying dural nerve root sheath

- **Post-operative evaluation/management**
  - Discharge after 2-3 days
  - No major restrictions, other than no heavy lifting
Lumbar microdiscectomy

• Pre-operative diagnosis
  – Lumbar HNP \(\rightarrow\) Radiculopathy

• Steps of procedure
  1. Patient is in prone position, with incision at midline between the two levels
  2. Muscle is stripped off laminae, and a partial laminectomy is done to expose the underlying dura
  3. The dural is gently pulled to one side, and the disk below is removed

• Post-operative evaluation/management
  – Patients are generally discharged at one day post-op, with no major restrictions other than no heavy lifting

Following the hemi-laminectomy (shown at left), the nerve root is gently retracted, and the disk fragment underlying it is removed.

http://www.spineuniverse.com/
Dorsal pedicle screw fusion

• Pre-operative diagnosis
  – Lumbar instability → mechanical back pain (pain with movement)

• Steps of procedure
  1. Patient in prone position, with incision midline over areas to fuse
  2. Muscle is stripped off the laminae, facets, and out to transverse processes
  3. Pedicles are palpated, and screws are inserted, connected by rods to fixate those vertebra to remove “instability”

• Post-operative evaluation/management
  – Patients wear a brace for several weeks, and post-operative X-rays reveal extent of fusion
  – No major restrictions other than lifting, bending, lifting, bending
Spine tumors

- Classified by space they occupy:
  - Extradural
    - Metastatic tumors most common – usually breast, prostate, renal cell
  - Intradural extramedullary
    - Meningioma, Schwannoma
  - Intramedullary
    - Astrocytoma, Ependymoma, Hemangioblastoma

- The most common type of spine tumor is METASTATIC
Spine Tumors: Examples

Case 1: Schwannoma

Case 2: Meningioma

Case 3: Lymphoma

http://www.burtonreport.com/InfSpine/AnatTumors.htm
Differential diagnosis

- Spinal cord pathology can be due to many not-so-obvious problems, which are not neurosurgical. A few of them include:
  - Multiple sclerosis – can be variable, depending upon which fiber tracts are affected by the demyelinating process
  - Amyotrophic lateral sclerosis (Lou Gehrig's disease) – Both upper and lower motor corticospinal neurons sx. → tongue fasciculations + lower extremity hyperreflexia
  - Acute inflammatory polyradiculopathy (Guillan-Barre Syndrome) – Acute loss of lower motor neuron function, diagnosed by albuminocytologic dissociation (more albumin, less cells)
  - Poliomyelitis: Anterior horn cell (lower motor neuron sx)
  - Toxins: Various peripheral neuropathy/spinal cord pathology scenario
  - Vitamin deficiency: e.g. Vitamin B-12 deficiency causing dorsal column dysfunction (same as tertiary syphilis)
Inflammatory Spinal Cord Lesion: Multiple Sclerosis

http://medlib.med.utah.edu/kw/ms/mml/ms_cspine02.html
Peripheral Neuropathy:

Carpal Tunnel Syndrome

• Carpal tunnel syndrome
  • Due to compression at the flexor retinaculum, with resulting median nerve compression → results in weakness of supplied muscles DISTAL to this (e.g. index finger-thumb apposition task) and thenar muscle atrophy, and numbness along lateral portion of hand
  • Can be confirmed using EMG/NCV testing (electromyography/nerve conduction velocity)
  • Treatment is conservative (brace) first → surgical decompression if no better

http://www.aboutcts.com/carpal_tunnel.html
Peripheral neuropathy: Ulnar neuropathy

- **Ulnar neuropathy**
  - Due to compression (usually) at the elbow, with resulting weakness in hand intrinsics & hypothenar muscle atrophy; also associated with numbness @ medial aspect of hand
  - Can be confirmed using EMG/NCV testing
  - Treatment is conservative (brace) first → surgical decompression if no better

Anatomical dissection of ulnar nerve: Arrow indicates transposition, which is performed in some cases to avoid recurrence

http://www.hku.hk/ortho/ortho/newsletter/newsletter03/1.html
References

• http://www.emedx.com/emedx/diagnosis_information/back-neck_disorders/low_back_slipped_disk_mri-2.htm
The End