Neurosurgery Student Syllabus

(Put together by Edward Flotte, MD
Assistant Professor, Department of Neurosurgery
University of Mississippi Medical Center)

I. *Neuroanatomy*

- It is recommended that you review basic neuroanatomy before your rotation

II. ***Neurologic Exam****: the most important thing to learn on this rotation*

- 3 main types: Awake patients, Comatose patients, and Pediatric patients

Awake Patients:

- 5 main components. Performed and documented in this order:

1. Level and content of consciousness (i.e. Alert & Oriented x3); **and Speech**

Level of consciousness (LOC):

A. Glasgow Coma Scale (GCS): 3 to 15. Sum of: Eye Opening (1-4), Speech (1-5), and Motor (1-6).
Know how to use (do not memorize specifics). Purpose:
1. Prognostic in head injury
2. Descriptive: for MDs to quickly communicate LOC in any neurologic disease to communicate how "sick" a patient is.

B. Adjectives (Alert → Somnolent → Lethargic → Stuporous/Obtunded → Comatose) are nonspecific, avoid them whenever possible. Outside ER docs will often tell us a patient is "comatose" (and we are preparing to operate), and the patient will arrive mildly somnolent. **Please do not use the term "unresponsive",** it means nothing. A patient may arrive comatose and if the outside MDs neurologic exam is "Neuro: unresponsive" we don't know if the patient deteriorated en route, or if they have been comatose for several hours. **The GCS is most accurate; use it when LOC is important (acute injuries) and give subscores (ie GCS 9: E2S4M3).** Use common sense: if it is an MVC or stroke, the GCS is appropriate; if the patient is in for an elective back operation or gallstones, gout, etc. you can say "A (alert) & Ox3".

Content of Consciousness: "higher cognitive processes": thought, judgment, memory, spatial ability, etc.
Only useful if patient is alert and able to communicate.
Can be altered in psychiatric disease, neurologic disease (dementia), or structural disease (frontal lobe tumor)
Described in various ways:
1. Orientation (ex. O x 3 – oriented to time, place, person)
2. Mini Mental Status Exam: More specific; can pick up subtle changes in dementia, tumors, etc. In depth testing can be done by neuropsychologists

Speech: test for fluency, appropriateness/comprehension, and repetition (impaired in Broca's, Wernicke's, and conduction aphasias respectively)

Any of the above can be altered in "Altered Mental Status" - avoid this diagnosis

2. Cranial nerves

CN I. Olfaction: not tested unless there is a suspected deficit

CN II.

A. Visual Acuity: Each eye separately. Proceed to next step if unable to perform:
1. Reading text (if equivocal can use Rosenbaum pocket screener)
2. Finger perception (how many fingers am I holding up?)
3. Light perception

B. Visual Fields: Test each eye separately. Use confrontation: stand directly opposite the patient and move an object into the field of view and ask patient when they see it

C. Fundoscopic: Mainly Papilledema. Check any time a patient comes in with a head injury or increased ICP - this may be your only chance to see it.

CN III, IV, VI

A. Extraocular Movements (EOM) (and nystagmus)

B. Pupillary Reflex: most significant cause of unilateral dilation ("blown pupil") is uncal herniation (see below)
Remember do not give mydriatics to trauma patients - you need to be able to check their pupils

CN V: Trigeminal:

A. Touch both sides of the face simultaneously in all 3 division and ask if it feels the same in each
B. If questionable: masseter and temporal muscles (clench jaw) or corneal reflex (make sure there are no contact lenses in the eyes)

CN VII: Facial: Close eyes and smile. Remember UMN affects lower face only; LMN affects upper & lower
CN VIII: Acoustic: Rub fingers or whisper in each ear
CN IX/X: Hoarseness? Dysphagia? Palatal rise. Gag reflex.
CN XI: Accessory: Shoulder Shrug
CN XII: Hypoglossal: Stick tongue out (deviates to weak side)

3. Motor

A. Strength: Use standard 0-5/5 scale.
Arms: Delts, Bi, Tri, Wrist Extensors (WE), Oppenens pollicis (OP), Hand intrinsics (HI)
If normal: To test for subtle weakness test pronator drift or hold arms above head
Legs: Iliopsoas (IP), Hams, Quads, Anterior Tibialis (AT), Gastroc, EHL
If suspicious: Heel walk tests gastroc, toe walk tests AT
For subtle proximal weakness: shallow-knee bend, rise from chair, step on stool

B. Note Bulk, Tone, Fasiculations, Tremor, etc.
Spasticity and rigidity are both types of increased muscle tone. What's the difference?
Tremor: intention = cerebellar; resting = Parkinson's

C. Reflexes: Ankle (clonus?), Knee, Biceps, Triceps, Babinski
Reinforce by having patient clench their teeth or hands

4. Sensation - test briefly in all 4 extremities

A. Pinprick
B. Light touch and/or temperature
If the patient is difficult to examine, it may be easier for them to say if a reflex hammer is cold or not (you can cool it off under a sink)
C. If suspicious: proprioception, vibration
D. If suspicious for cortical lesion and position and touch are intact: stereognosis, graphesthesia, 2-point localization, extinction (see above)

5. Coordination and Gait: tests cerebellar function, proprioception, and strength

A. Coordination: Finger-to-Nose, Romberg, dysdiadokinesia
Romberg: sways with eyes open or close = cerebellar deficit; sways with eyes closed only = proprioceptive deficit
Dysdiadokinesia: difficulty tapping fingers or flipping hand. Cerebellar defect
B. Gait: normal and heel-to-toe

Miscellaneous:

1. Meningeal signs: think meningitis OR subarachnoid hemorrhage
Kernig (flex hip then extend knee), Brudzinski (patient flexes hips when neck is flexed)
2. Carotid Bruit: carotid stenosis

Comatose (Unconscious) Patients:

1. GCS: eye opening, verbalization, motor response
Painful stimuli: press on nailbed with pen; squeeze tissue near axilla
Decorticate posturing: flexes elbows, extends legs
Decerebrate posturing: extends elbows and legs
Nonspecific, but decerebrate generally worse (think: losing entire brain (cerebrum) worse than losing just cortex)

2. Cranial Nerve and brainstem reflexes

a. Pupillary (II -> III): "blown pupil" (see uncal herniation below)
b. Corneal (V -> VII): tests pons
c. Gag (IX -> X): tests medulla
d. Doll's eyes: Move patient's head side to side. Brainstem intact: eyes stay fixed. Brainstem injury: eyes move w/ head
e. Cold Water Calorics: inject cold water (100cc) into ear. Make sure tympanic membrane is intact
Brainstem intact: eyes move to side of water; Brainstem injured: eyes don't move (forget that COWS thing)

In head trauma check for signs of basilar skull fracture: Battle's & Raccoon's signs, otorrhea, hemotympanum, rhinorrhea
In spinal cord injury check anal tone and sensation

Pediatric Patients:

1. Measure Head circumference
2. Feel fontanels and head shape (transillumination if suspicious): anterior closes at 2 years; posterior at 2 months; bulging fontanels due to increased ICP, usually due to hydrocephalus

3. Check vision and eye movement with penlight. Test blink reflex (to bright light) in newborns
   if suspicious for abuse check fundus for retinal hemorrhages
4. Can check CN XII by pinching nostrils (causes tongue to protrude)
5. Muscle tone (hold infant up & look for scissor legs)
6. Reflexes: check adult reflexes (ankle, knee, etc) AND infantile: Babinski (to 6 mos), Grasp (4 mos), step (variable)
   Moro (6 mos), etc; check for absence, asymmetry, or persistence of reflexes
5. Check sensation by withdrawal to pinprick
6. Developmental: walking, talking, etc

Examples:

1. Awake (normal) Patient:

Neuro: A&Ox3. Speech fluent & appropriate.
CN: PERRL 3mm. VFF (visual fields full). VA (visual acuity) WNL.
EOMI. Face symmetric, sensation normal. Hearing WNL.
Tongue & palate ML (midline).

Motor:	delt	bi	tri	WE	HI	OP/	IP	Quad	Ham	Gast	AT	EHL
R	5	5	5	5	5	5	5	5	5	5	5	5
L	5	5	5	5	5	5	5	5	5	5	5	5

reflexes/Babinski: (draw stick figure)
Sensation: intact to fine touch/pinprick throughout (if there is a deficit draw a picture)
Coordination: FTN normal. (-) Romberg. Gait normal. HTT (heel-to-toe) WNL

2. Comatose Patient:

Neuro: GCS 6 (E1V2M3) No eye opening. No commands.
Decorticates (B), symmetric.
Pupils: (R) 2mm reactive, (L) 6mm NR
(+) corneal, (+)gag, normal doll's
TM intact, no Battles, raccoons. R parietal 6 cm lac.

3. Pediatric Patient:

4mo HC 42cm normocephalic; fontanel flat & soft
+ blink; follows light, EOM appear intact
MAEW (moves all extremities well)
Normal tone all 4 ext
MAE to pinprick
Reflexes: (draw stick-figure or) + Babinski, Moro, grasp
Develop: rolls over, coos, regards faces

Glasgow Coma Scale (Adult)

EYE OPENING		
Spontaneous	Eyes open when you go to bedside	4
To voice	Eyes open to command	3
To pain	Eyes open to suctioning, venipuncture, nailbed pressure, etc.	2
None	Eyes do not open	1
BEST VERBAL RESPONSE		
Oriented	Can state name, location, day of week	5
Confused	Not likely to know day of week, address, etc. May be able to name US president. Names seem to be retained better than numbers	4
Inappropriate words	Inconsistent answers, may give name occasionally, may repeat same word over & over	3
Incomprehensible sounds	Mumbling & inarticulate sounds with no apparent meaning	2
None	No verbal response	1
BEST MOTOR RESPONSE		
Obeys commands	Commands can be complex	6
Localizes pain	Grabs at offender or purposeful withdrawal	5
Withdraws (pain)	Knows there is pain but cannot localize it. Entire body withdraws	4
Flexion (pain)	Decortication; flexes arms on chest, extends legs	3
Extension (pain)	Decerebration; arms extend & internally rotate, legs extend with stimulation or spontaneously	2
None	No response, flaccid	1

III. NEUROSURGICAL DISEASE

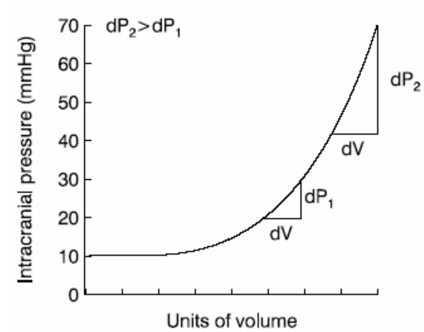
I. General concepts

A. Intracranial Pressure (ICP): VERY IMPORTANT CONCEPT

Increased ICP is the result of many different disease processes – traumas, tumors, bleeds, etc.
Normal ICP: 8-12 mmHg (same units as BP); Dangerous ICP >20
The skull is a closed box containing brain, blood, and CSF. If the volume of any one of these is increased (or a mass is added) the pressure in the head increases (this is known as the Monro-Kellie Hypothesis – see graph)
Things that can be added to increase ICP (Causes):

1. Blood: EDH, SDH, SAH, ICH (spontaneous or traumatic)
2. CSF: Hydrocephalus, Idiopathic Intracranial Hypertension
3. Brain/Mass: Tumor, Trauma (cerebral contusions)
4. Edema: Infarct, trauma (diffuse edema or contusions), tumors

As you can see, trauma is the most common cause, but it can occur with many diseases



Effects/Signs of increased ICP (in approximate order of appearance):

1. Nausea/Vomiting, Headache
2. Altered mental status (global cerebral dysfunction)

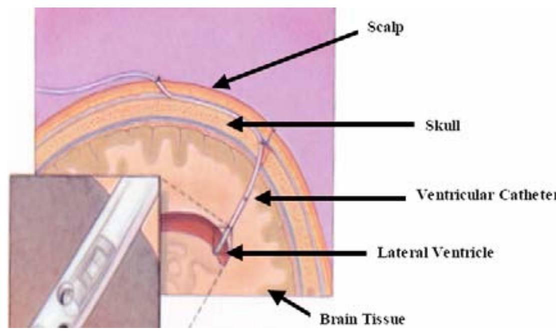
3. In kids: Bulging fontanels
4. Papilledema
5. Cranial nerve palsies (especially CN VI) as they are pressed on
6. Cushing's triad: hypertension, bradycardia, & respiratory irregularity
7. Endstage: Blown Pupil, etc. (see cerebral herniation below)

So if you see these signs and suspect increased ICP, how do you measure it?
With a ventriculostomy: see below. It is the only way to really measure ICP.

How do you treat it? First make sure blood pressure and respiratory parameters are good, then proceed in this order until the ICP is controlled:

1. Sedation: agitation can increase ICP
2. Elevate the head of the bed: increases venous return
3. Mannitol: osmotic effect decreases cerebral edema
4. Hyperventilation: to CO_2 30-35, no lower (check ABGs)
   CO_2 is a cerebral vasodilator, therefore lower the CO_2 to get vasoconstriction and decrease the amount of blood in the brain.
6. Ventriculostomy to drain CSF (see below)
7. Surgery:
   A. Removal of hematoma (EDH, SDH, contusion)
   B. Decompressive craniectomy: if no mass (diffuse edema) then surgeon removes part of the skull for “more room”

In general: at the first sign of increased ICP call a neurosurgeon



Ventriculostomy:
The surgeon drills a hole in the skull and passes a catheter (which can measure pressure) into the lateral ventricle
Both diagnostic (measures ICP) and therapeutic (drains CSF - lowers ICP)
Indications:
1. Severe traumatic brain injury (GCS <8)
2. Acute hydrocephalus (due to a tumor, bleed, etc. blocking CSF drainage suddenly)
   Shunts function as permanent ventriculostomies to drain CSF

Cerebral Herniation

Endpoint of untreated masses or increased ICP.
Uncal herniation: Uncus (medial temporal lobe) is forced below the tentorium into posterior fossa, usually due to ipsilateral mass, squeezing the brainstem (#2 in figure). Signs:
2. CN III compression: dilated pupil (usually ipsilateral)
2. Midbrain compression: ipsilateral hemiplegia (contralateral pyramid compressed)

Herniation may also be falcine (#1), tonsillar (#4), or transcranial through a fracture (#4)

Cerebral Herniation

B. Radiology
1. Be able to tell if a film is a CT or MRI
2. Know the difference between T1 and T2 weighted MRI: CSF if dark on T1 and white on T2
3. Know how to locate major anatomical structures
4. Know the appearances of the 4 types of intracranial hemorrhage on CT (see below)
5. On CT: Acute blood is bright, subacute blood is isointense, and chronic blood is dark; An infarct is dark.
6. Cerebral angiogram: catheter inserted into femoral artery & advanced into carotid and vertebral arteries, dye is injected, and X rays taken in quick succession. Used to look for aneurysms and AVMs
7. See Cervical Spine X-rays in trauma below

There are neuroradiology books in our neurosurgery library should you want to look at one (ask a resident).

II. Trauma

A. Head Injury

Major risk is increased ICP from blood or edema. See treatment above under ICP.
Remember ABCs: Airway, Breathing, CAT scan.

Skull fractures:
Depressed skull fracture: elevate if severe (> 1cm) or open. Other skull fractures are watched.
What is the significance of Basilar Skull Fracture signs (Battles, Raccoons, etc)? The fractures are not surgically treated. However, they have a high incidence of CSF leaks that are a risk for meningitis and the patient must be watched
CSF leaks are treated conservatively with head of bed elevation If it hasn't stopped by 2 weeks, close surgically.

B. Spine and Spinal Cord Injury

1. **Spinal Cord Injury (SCI)**

   Careful motor, sensory, and reflex exam to establish spinal "level". Check anal tone/voluntary contraction and anal sensation

   Obtain Spine X-rays and CT scan to look for the causative fracture.

   Treatment: Steroids (solumedrol). Start within 8 hours (in the ER).

   If any function is preserved below the level of injury then the SCI is "incomplete".

   If the SCI is complete after 24 hrs, recovery is 0%

2. **Spine (vertebral) injury**

   A. Cervical

   Neck pain or tenderness should make you very suspicious for a fracture. If there is no neck pain then a fracture is very unlikely. However is present neck pain might just be from muscle strain, not necessarily a fracture

   If patient has no deficits, the danger is an occult fracture/instability that can cause delayed cord damage

   Point of workup below is to rule out fractures and ligamentous instability

   Keep C-collar ("Philly" (Philadelphia) collar) on until:

   1. C-spine x-rays read as normal (see below)
   2. Patient is alert and not intoxicated, and the neck is nontender on exam

   Cervical-spine X-rays: all trauma/MVC patients should have:

   1. Lateral C-spine
      A. To be adequate you must be able to see the top of T1
      B. Prevertebral soft tissue: if increased may indicate swelling due to fracture
   2. "AP" (anterior-posterior)
   3. Odontoid view

   If the initial films are normal but the patient is complaining of pain, then obtain flexion/extension xrays and/or a CT

   Flexion/Extension xrays: Patient must be alert and cooperative. Have the patient flex and extend their neck as far as they comfortably can. The physician does not move the patient's neck. If vertebrae slip on each other (subluxation) >4mm, it is unstable

   Treatment: 2 goals

   1) Reduction: getting bones to line up so they heal properly. May be done open (surgical) or closed.
      Closed reduction done with cervical traction: tongs screwed into patients skull and attached to a weight to pull vertebrae back into alignment
   2) Stabilization: Immobilizing the fracture site once its reduced so that the bone or bone graft has a chance to heal.
      May be external or internal (surgical):
      External: cervical collars or halo vests. Prevent (hopefully) the patient from moving their neck
      Internal: Surgery. Instrumentation (rods, plates) and fusion (bone graft).
      The purpose of instrumentation (rods, plates, etc) is to stabilize the fracture until it heals or the bone graft becomes solid

   Some fracture types (examples): Jefferson's: ring of C1. Hangman's: bilateral C2.

   B. Thoracic/Lumbar

   Get T/L spine films (AP & lateral) on patients with back pain or significant forceful mechanism: MVC, fall > 6ft, unknown

   General principles are similar to cervical fracture

III. Vascular

A. Intracranial Hemorrhage: blood within the skull.

4 main types. Know the CT appearance of each.

The first two (EDH and SDH) are usually traumatic, The second two (ICH and SAH) can be spontaneous or traumatic

EDH, SDH, and ICH present as an expanding mass producing symptoms depending upon where they are located (eg hemiparesis), then symptoms of increased ICP and eventually herniation

1. **Epidural (EDH)**: Due to a torn artery in the epidural space (usually the middle meningeal, torn by a skull fracture)

   Usually acute - arterial, therefore develops quickly

   Diagnosis: CT. Convex (Semi-circle) blood near skull

   Treatment: If large requires evacuation

2. **Subdural (SDH)**: usually due to a torn "bridging vein" between the brain and the skull.

   May be acute or chronic.

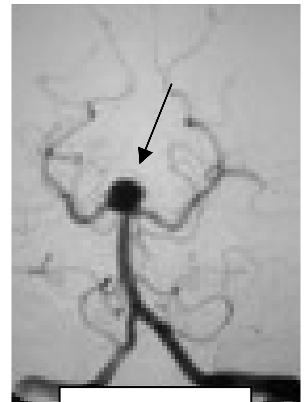
   Acute: due to major trauma

   Chronic: usually due to minor trauma (falling) or spontaneously in elderly or alcoholics (brain atrophy stretches the veins). Often causes a gradual deterioration of mental status in the elderly

   Diagnosis: CT. Concave (moon-shaped) blood near skull

Treatment: Usually requires evacuation (unless small and patient is awake)

3. **Intracerebral (ICH):** in the brain substance
   - May rupture into ventricle (Intraventricular Hemorrhage)
   - May be spontaneous or traumatic (traumatic ICH is called a contusion)
   - Spontaneous ICH: usually due to hypertension, occasionally due to tumors, AVMs, or other things (see below)
     - Hypertensive ICH: occurs in basal ganglia, thalamus, cerebellum and pons (dangerous areas) due to small aneurysms (Charcot-Bouchard) that form on small arteries in these areas.
   - Treatment: surgical evacuation if the clot is large and the patient is deteriorating
4. **Subarachnoid (SAH)**
   - Overall trauma is the most common cause of SAH (due to tearing of small cortical surface blood vessels), but this SAH is not clinically significant.
   - The most common clinically significant cause of SAH are ruptured cerebral aneurysms (bleeding into the CSF)
     - These are "berry" aneurysms located on the Circle of Willis
   - Symptoms: sudden onset of the worst headache of their life, meningismus (blood irritates meninges), photophobia
   - Diagnosis: Head CT scan shows diffuse blood in CSF spaces (around the brain)
     - If CT is non-diagnostic but clinical suspicion is high perform a lumbar puncture (LP) to look for RBCs in the CSF
     - If either of above is positive then obtain a cerebral angiogram to look for an aneurysm
   - Treatment: prevent the aneurysm from bleeding again (re-rupture)
     - Surgery: "Clipping": metal clip placed across aneurysm neck, or
     - "Coiling": metal coils placed in aneurysm endovascularly by a radiologist
   - SAH may cause hydrocephalus (blood clogs up CSF drainage)



Arteriogram showing aneurysm

SDH

EDH

ICH

SAH

B. Carotid stenosis

- Atherosclerotic plaque forms at the bifurcation of the carotid; Can cause stroke by either emboli or decreased flow
- "Symptomatic" if causing ipsilateral TIAs or strokes (e.g. transient hemiparesis, aphasia)
  - Amarosis fugax: "shade coming down" over one eye; due to emboli to retinal arteries.
- Signs: Carotid bruit
- Diagnosis: Carotid ultrasound (or arteriogram)
- Treatment: Carotid endarterectomy: carotid clamped off, opened up, and plaque scraped out. Usually done if the carotid is stenosed >60% of its diameter.

Arteriogram showing carotid stenosis

IV. Tumors

Symptoms: focal deficits, headache, seizures

Adults: Types of primary tumors in order of incidence (note that metastases are most common of all)

- Astrocytomas: Originates from astrocytes. May be low-grade or malignant. Most common type of primary brain tumor.
  - Glioblastoma Multiforme (GBM): very malignant astrocytoma. Incurable.
- Meningioma: Benign tumor on outside of the brain (meninges). 2nd most common.
- Acoustic Neuroma: Tumor on cranial nerve VIII. Causes tinnitus, deafness.
- Pituitary adenomas: Present with:
  - 1) Mass effect: bitemporal hemianopsia due to compression of the optic chiasm

2) <u>Endocrinopathy</u>: Cushings (ACTH), Acromegaly (GH)

Most require surgery (usually transsphenoidal – through the nose).

Prolactinomas may be treated with dopamine agonists like bromocriptine (why?)

Children: posterior fossa tumors most common (medulloblastoma, ependymoma)

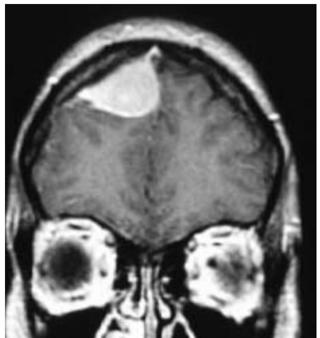
Reasons to operate on malignant tumors:

1) Get tissue for pathologic diagnosis – see what it is

2) Decompression: Relieve ICP and mass effect to improve symptoms (i.e. headaches, paresis)

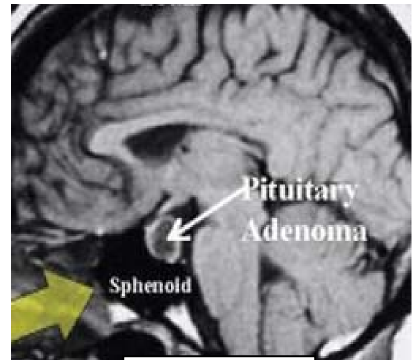
Dexamethasone (Decadron) – steroids - used to decrease edema, improve symptoms

Astrocytoma (GBM)



Meningioma

Acoustic Neuroma



Pituitary Adenoma

V. Spine

MRI: Herniated Lumbar Disc

A. Low back pain: in 85% of patients no diagnosis can be made

No diagnostic tests are needed unless:

Neurologic deficits are present

"Red flags" (cancer, fever, weight loss, IV drug use) are present

It persists > 4 weeks

Treat with NSAIDs, light exercise

B. Herniated Disc: intervertebral disc compresses nerve roots or spinal cord

1. Lumbar Discs: most commonly L4/5 and L5/S1

Produce radicular <u>leg</u> pain (not just back pain)

<u>Radiculopathy</u>:

4 components: radiating pain, weakness, numbness, diminished reflexes

Pain exacerbated by Valsalva, coughing, prolonged sitting

L45: weak EHL & AT, numb dorsal foot

L5S1: decreased ankle reflex, weak gastrocnemius, numb lateral foot

On exam: positive <u>Straight Leg Raise</u> (with patient supine, raise their leg; positive only if radicular leg pain is elicited – not back pain)

Treatment: Surgery for:

1) Pain for > 4 weeks (85% improve spontaneously in 4 weeks) or severe disabling pain

2) Progressive motor deficit

3) <u>Cauda equina syndrome</u>: compression of cauda equina by disc causes bladder and bowel incontince which may be permanent unless <u>emergent</u> surgery is performed

Generally treated with <u>"microdisectomy"</u>: disc removed with help of operating microscope

2. Cervical Discs:

Can compress nerve root (radiculopathy) or spinal cord (myelopathy)

<u>Radiculopathy</u>: radiating pain, weakness, numbness, decreased reflexes in the affected arm

<u>Myelopathy</u>: Weakness, increased reflexes, spasticity in the legs and arms below the disc.

Manifests early as <u>gait difficulty</u> (falling), difficulty with fine movements in the hands (doing buttons)

Surgery for persistent arm pain, progressive weakness (arms or legs)

Usually anterior cervical discectomy and fusion (“ACDF”) performed: disc removed anteriorly

3. Spinal Stenosis: narrowing of the spinal canal congenitally and/or by osteophytes. Can occur in cervical or lumbar spine.

Cervical stenosis: Produces myelopathy.

Lumbar stenosis: Symptoms: "<u>Neurogenic Claudication</u>". Mimics vascular claudication. Pain in legs occurs with <u>walking.</u>

Often have stooped posture (in elderly)

Treatment for both: surgical removal of the nerve/spinal cord compression

VI. Infection

1. **Cerebral Abscess:** May be hematogenous (endocarditis) or direct spread (sinusitus, otitis). Treated with antibiotics ± surgery
2. Differential diagnosis of AIDS patient with brain mass: Toxoplasmosis, Lymphoma, PML

VII. Pediatrics

A. Hydrocephalus (HCP): excessive CSF

1. Non-communicating: obstruction of CSF flow in the ventricle causes ventricles to enlarge. May be congenital or due to masses (tumors, ICH) blocking flow
2. Communicating: arachnoid granulations clogged, don't reabsorb CSF. Causes: meningitis, SAH

Symptoms are those of increased ICP: headache, nausea, altered mental status
In children: increasing head circumference, bulging fontanels, anorexia
Diagnosis: CT scan - enlarged ventricles
Treatment: In conditions that might improve, you can use a ventriculostomy (or repeated LPs in communicating HCP) to draw off CSF temporarily. All other cases: Shunt. Ventriculoperitonal (VP shunt) most common: catheter from lateral ventricle to abdomen where CSF is reabsorbed


Myelomeningocoele

B. Developmental anomalies

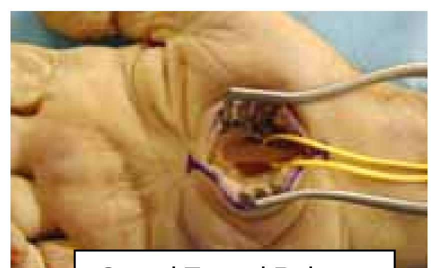
1. **Craniosynostosis**: premature fusion of sutures, causes funny-shaped head.
   Funny-shaped heads in babies are more often flattening caused by laying baby's head on same side all the time
2. **Chiari Malformation:** Cerebellar tonsils protrude through foramen magnum into the cervical spine
   Type I: Presents in adults as neck pain, headache, myelopathy. If severe treatment is surgery.
   Type II: Severe herniation of the tonsils. Presents in infancy (apnea, poor feeding). Only seen in babies with myelomeningocoeles
3. **Myelomeningocoele**: Spinal cord protrudes through skin. Requires immediate surgical closure in the neonate.

VIII. Movement disorders and pain

A. Parkinson's disease and tremor: deep brain stimulators placed in the subthalamic nucleus, globus pallidus, or thalamus
B. Pain

1. **Trigeminal Neuralgia**: paroxysmal pain, lasting seconds, triggered by sensory stimuli, unilateral, usually V2 or V3, no neurologic deficits.
   Treated by medicine (Tegretol) or surgery.
2. Chronic Pain of any type: Many neurosurgical procedures (including dorsal column and deep brain stimulation) used

IX. Peripheral Nerve


Carpal Tunnel Release

A. Nerve Injuries

Emergent repair: Clean cuts, progressive worsening (hematoma)
Others (traction injuries, GSW): wait 3 months to asses spontaneous improvement

B. Carpal tunnel syndrome: Median nerve compressed in carpal tunnel

Occurs in middle-aged patients who have repetitive movement of their hand at work (secretary, carpenter, etc)
Symptoms: pain/numbness in hand (brought on by activity, awakens patient at night), grip weakness
Signs: Phalen's test (flex wrists), Tinel's sign (tap on carpal tunnel) reproduce the pain.
NCV & EMG may help diagnosis
Treatment: NSAIDS, splint, steroid injections initially.
Surgery (carpal tunnel release) for refractory cases, severe motor/sensory loss