A Neurological change
Is it PNS or CNS???

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Localization of Neurological S/S

- Objectives
- Distinguish peripheral from central neurological complaints
- Review some of the differential for peripheral neuromuscular complaints
- Discuss a few etiologies for peripheral neuromuscular complaints and their management
Central Nervous System

- Brain and Spinal Cord

(b) Left side of brain

Danial Cummings
Principles: The length principle, Symmetry rule
The Spinal Tracts

Ascending tracts
- Fasciculus gracilis
- Fasciculus cuneatus
- Posterior spinocerebellar tract
- Anterior spinocerebellar tract
- Lateral spinothalamic tract
- Anterior spinothalamic tract

Often called the posterior white columns. Carry discriminative touch and conscious proprioception.

Motor tracts
- Descending tracts
  - Lateral corticospinal tract
  - Rubrospinal tract
  - Anterior reticulospinal tract
  - Lateral reticulospinal tract
  - Olivospinal tract
  - Anterior corticospinal tract
  - Vestibulospinal tract
  - Tectospinal tract

These tracts come from a variety of locations in the brain, as a group are termed the "extra-pyramidal tracts", and are generally associated with balance and muscle tone.

From the spinal cord to the cerebellum. Carry subconscious proprioceptive stimuli. Proprioception is "body sense" and "muscle sense", the perception of body position and muscle position necessary for coordinating movements.

The corticospinal tracts carry voluntary motor stimuli from the cerebral cortex to motor neurons in the spinal cord. They are also called the "pyramidal tracts" because some of them cross in the pyramids of the medulla.
Neurological Assessment

- Is it CNS or PNS?
- If PNS – is muscle or nerve?
- If CNS – lesion above or below the foramen magnum?
- If above foramen magnum – is it above tentorium cerebelli or below?
- If above tentorium – R or L hemisphere – gray matter or white matter?
- Are multiple systems involved?
Localization of Signs/symptoms

- Nerve root
  - Radiating pain corresponding to a nerve root distribution
  - Numbness or weakness in a nerve root
  - Diminished reflexes (LMN signs) in territory of nerve root

- Peripheral nerve
  - Distal paresthesias, sensory loss, or weakness
  - Diminished distal reflexes

- Neuromuscular junction
  - Waxing & waning weakness
  - dysarthria, dysphagia, ptosis, diplopia

- Muscle
  - Weakness (usually proximal)
Motor signs & Symptoms

- **Central**
  - Weakness or paralysis from the site of the lesion distally
  - Unilateral or bilateral
  - Upper motor neuron signs are seen distally to the lesion
    - Spasticity
    - Positive Babinski
    - Brisk reflexes
    - B & B involvement

- **Peripheral**
  - Paresis or paralysis of a muscle or muscle group which they innervate
  - Peripheral lesions may be unilateral and limited in the degree of limb involvement or bilateral depending on the etiology (GBS)
Sensory Involvement

- **Central**
  - Spinal lesions are more commonly bilateral, involve multiple dermatomes and have a sensory level that is easily defined.
  - Ensure that you examine the dermatomes on the trunk as you may miss a sensory level.

- **Peripheral**
  - Generally restricted, expressed in a dermatomal distribution.
  - Usually have a sharp demarcation whereas central lesions are more vague in their demarcation.
  - Stocking-glove distribution is generally a peripheral neuropathy.
Bilateral Symptoms

- These may be peripheral or central (spinal cord)
- A definite sensory level means it is central
- Motor loss R/T PNS disease tends to affect the distal muscles of the legs more than the proximal ones except for certain varieties of GBS & diabetic neuropathy
- Associated autonomic dysfunction (incontinence) means central involvement
- Associated UMN signs means central
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  1st & 2nd fingers
  - C7  Middle finger
  - C8  4th & 5th fingers
  - T4  Nipples
  - T10 Umbilicus
  - L3  Knee
  - L4  lateral dorsal portion of foot
  - L5  Medial dorsal portion of foot
  - S1  Plantar portion of foot
Deep Tendon Reflexes

- The major deep tendon reflexes
- Biceps – C5-6
- Triceps – C7-8
- Patellar – L3-4
- Achilles – S1-2
- Planter reflex (babinski) – UMN process - dorsiflexion of the big toe with fanning out of the smaller toes

- Symmetric hyporeflexia – nonpathologic or metabolic or peripheral neuropathy
- Symmetric Hyperreflexia – systemic – hypocalcemia or hyperthyroidism
- Unilateral hyperreflexia – UMN process
- Unilateral hyporeflexia - LMN
- Asymmetric reflexes - pathologic
## UMN vs. LMN

<table>
<thead>
<tr>
<th>Finding</th>
<th>UMN lesion</th>
<th>LMN lesion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Muscle bulk</td>
<td>Preserved</td>
<td>Atrophy</td>
</tr>
<tr>
<td>Muscle tone</td>
<td>Spastic</td>
<td>Flaccid</td>
</tr>
<tr>
<td>Spontaneous</td>
<td>None</td>
<td>Fasciculations</td>
</tr>
<tr>
<td>Movements</td>
<td>None</td>
<td>Fasciculations</td>
</tr>
<tr>
<td>Reflexes</td>
<td>Increased</td>
<td>Decreased</td>
</tr>
<tr>
<td>Babinski’s reflex</td>
<td>Present</td>
<td>Absent</td>
</tr>
<tr>
<td>Examples</td>
<td>Stroke, MS</td>
<td>Neuropathy</td>
</tr>
</tbody>
</table>
Key Components

- Onset & time course of the symptoms
- Symmetry of symptoms
- Is the deficit motor, sensory or both (sensorimotor)?
- Are the sensorimotor signs & symptoms proximal, distal or both?
- Do the symptoms fluctuate, if so is it associated with activity?
- Are there symptoms that suggest CN involvement such as, diplopia, dysarthria, or ptosis?
Case Study

- A 41 yr old male presents with left neck pain and left arm weakness over the past 6 weeks
- Pain radiates down the radial aspect of his left forearm (lateral outside of arm)
- The neck pain is aggravated when he sneezes
- Paresthesias of the left thumb and index finger
- Gait is slightly unsteady
- Urinary urgency for one week
Neurological exam

- He is in mild discomfort with VSS
- Mental status & CN are normal
- Spasticity in both LES with clonus in the ankles
- Strength: deltoids 5/5, biceps 4+/5, triceps 5/5, wrist extensors 5/5, LEs strength normal
- Sensory: decreased pinprick over lateral aspect of left arm, left thumb & 2\textsuperscript{nd} digit
- Reflexes: triceps 3/4, biceps 0/4, brachioradialis 0/4, knees 3+/4, ankles 4/4, Plantar responses are extensors bilaterally
- Gait: normal, tandem with mild difficulty
Localization & Explanations

- The sensory loss seen – lateral aspect of the left arm extending to left thumb & 2nd digit – The sensory distribution of left C6 nerve root (left C6 dermatome) – lesion in the nerve root
- A dermatome is a strip of skin supplied by an individual spinal nerve root
- A spinal cord lesion produces a sensory level
- A lesion in the brainstem produces a sensory loss only on one side of the body (hemisensory loss)
Localization & explanation

- The left arm weakness is due to LMN lesion or UMN lesion?
- The left arm weakness is due to LMN dysfunction
  - The left biceps weakness is associated with absent left biceps & brachioradialis reflexes
  - Cervical nerve root lesion (radiculopathy)
- An UMN lesion would produce hyperactive upper extremity stretch reflexes
Gait dysfunction

- Gait dysfunction due to UMN lesion
- The knee & ankle are hyperreflexic
- Both plantar reflexes are upgoing
- Lesion in the corticospinal tracts
- You can have a lesion in the tracts extending to a nerve root
- A combined UMN lesion (Myelopathy) & LMN lesion (Radiculopathy)
Henry! Stop that awful chirping this minute!

http://www.UnlikelyStories.com  (c) 2000 Michael P. Stype
Woman with chronic pain

- A 38 year old secretary
  - Right wrist pain – worst at night
  - Weakness when grasping things
  - Periodic tingling and numbness in her right thumb & index finger
The median n. - spinal roots
**C6, C7, C8, T1**

The radial n. - spinal roots
**C5, C6, C7, C8, T1**

The ulnar n. - spinal roots
**C8 and T1**
Nerves of the Hand

Median

Ulnar

Radial
CTS Diagnosis

- Tinel's sign
- Phalen's sign
- Check for atrophy in the affected hand
- EMG
- Symptoms
  - Pain which is aggravated by wrist flexion & extension and may radiate to elbow
- Waking with pain at night due to flexion during sleep
- Burning, numbness or tingling in the fingers and hand, sometimes extending to the elbow
- Grasping objects may be difficult
Frequent Spine Problems

- Cervical herniated nucleus pulposus (=HNP)
- Cervical stenosis
- Lumbar HNP
- Lumbar stenosis
- *** Remember: HNP, a.k.a. herniated disk or slipped disk or ruptured disk – all mean essentially the same
Cervical HNP

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

- **Neurological Exam**
  - Use the motor and sensory exams 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
Lumbar HNP

- **History**
  - Pain in low back & 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)

- **Neurological Exam**
  - Use the motor and sensory exams 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
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

http://www.ams.ac.ir/AIM/0362/0362146.htm
PNS VS CNS

- **Subjective**
  - CO difficulty moving one side of the face
  - Specific questions; Neuro exam

- **Objective**
  - Facial paralysis including the forehead

- **Assessment**
  - Peripheral or central cause
Focal Neuropathies-Bell’s Palsy

- Most common cause of acute facial paralysis
- Sudden facial weakness, difficulty with articulation, problems keeping an eye closed, or inability to keep food in the mouth one side.
- One sided weakness of the face involving the forehead
  - Treatment
    - acyclovir
    - Steroid controversial
    - Eye care to avoid corneal abrasions
    - lacrilube and patching
The upper part of the facial nucleus receives UMN fibers from both cortices. However, the lower part has from only the opposite cortex.
In upper motor neuron facial palsy, the lower part of the face on the opposite side of the lesion is paralyzed (quarter of the face).

Upper part of nucleus has UMN supply from BOTH cortices and hence spared.
In lower motor neuron facial palsy, the entire one side (half) of the face on the side of lesion is paralyzed.

Facial nerve is the final neural pathway.
PNS VS CNS

- Subjective
  - Vertigo
- Objective
- Assessment
- Plan
Tinnitus

- Peripheral vertigo – Vertigo due to disturbances in the vestibular apparatus of the inner ear
- Central vertigo – Vertigo caused by disease of the CNS
- Conductive hearing loss – Hearing loss resulting from lesion to structures in the outer or middle ear that converts air conduction into bone conduction
- Sensorineural hearing loss – Hearing loss from a lesion in the inner ear or 8th CN
- Electronystagmogram (ENG) – A record of nystagmus activity measured by detecting the electrical activity of the extraocular muscles
Case Study

- A 45 yr old female who noted recent hearing loss – progressively worse in months
- One day she started hearing better louder but felt the room spinning + n/v
- Lying down in bed with her eyes open made it better
- A few episodes of hearing loud noise + vertigo
- Neuro exam – nystagmus fast beating to the right
<table>
<thead>
<tr>
<th>Central Vertigo</th>
<th>Peripheral Vertigo</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vertigo is mild</td>
<td>Vertigo is severe</td>
</tr>
<tr>
<td>Brain stem signs are present</td>
<td>No brain stem signs</td>
</tr>
<tr>
<td>Hearing loss is rare</td>
<td>Hearing loss is common</td>
</tr>
<tr>
<td>Nystagmus is:</td>
<td>Nystagmus is:</td>
</tr>
<tr>
<td>Multidirectional</td>
<td>Unidirectional</td>
</tr>
<tr>
<td>Nonfatigable</td>
<td>Fatigable</td>
</tr>
<tr>
<td>Abrupt in onset</td>
<td>Of long latency of onset</td>
</tr>
<tr>
<td>Of long duration</td>
<td>Of short duration</td>
</tr>
<tr>
<td>Findings/Studies</td>
<td>Sensorineural Hearing Loss</td>
</tr>
<tr>
<td>------------------</td>
<td>---------------------------</td>
</tr>
<tr>
<td>Type of loss</td>
<td>High frequency</td>
</tr>
<tr>
<td>Weber test</td>
<td>Lateralized to unaffected ear</td>
</tr>
<tr>
<td>Rinne test</td>
<td>Air conduction&gt; Bone conduction</td>
</tr>
<tr>
<td>Audiogram</td>
<td>Reduced bone conduction Reduced air conduction</td>
</tr>
</tbody>
</table>
Localization & Explanation
Meniere’s disease

- Patients with vestibular disorders causing peripheral vertigo prefer to lie on the unaffected ear because this allows them to look toward the affected side decreasing the nystagmus.

- Nystagmus with fast beating component to the right suggests dysfunction of vestibular apparatus on the left side.

- The fast nystagmus beats away from the affected ear and the slow beats toward the affected ear because lesions in the vestibular apparatus decrease the rate of firing of the semicircular canals on the side of the lesion affecting the input of signal into the brain stem oculomotor system.

- The eyes tend to drift toward the affected ear (slow component of nystagmus).

- The cerebral cortex provides a corrective saccade to the opposite direction (the fast component of nystagmus).
Disorder of the PNS: Myasthenia Gravis

- Myasthenia gravis
  - Progressive weakening of the skeletal muscles
  - Fasiculations & muscle atrophy (ALS)
  - Intermittent ptosis
  - An autoimmune disorder
  - Antibodies destroy acetylcholine receptors

Ptosis due to weakness of eyelid muscles
THE NERVE! TELLING ME MY EYELIDS ARE GETTING HEAVY...
Differential diagnosis

Mnemonic DANG THERAPIST

- **D** = Diabetes
- **A** = Alcohol
- **N** = Nutritional deficiency (vitamin B12)
- **G** = Guillain Barre S.
- **T** = Toxic (heavy metals) or metabolic (thyroid)
- **H** = Hereditary (hereditary motor sensory neuropathy)
- **E** = Environmental
- **R** = Recurrent (CIDP)
- **A** = Amyloid
- **P** = Porphyria
- **I** = Inflammatory (GBS, HIV, Vasculitis)
- **S** = Systemic diseases
- **T** = Tumor (Paraneoplastic neuropathy)
Peripheral Nervous System

- When the sensory component is involved, test for proprioception, vibratory sensation, and pain and temperature sensibility.
- When the motor system is involved there is wasting, fasciculations, & weakness.
- In peripheral nerve process there is reduction or absence of reflexes.
- Autonomic dysfunctions may cause pupillary dysfunction, orthostatic hypotension, and tachy- and bradyarrhythmias.
Clinical Highlights

- Testing motor function – asymmetric strength deficits
- No need to evaluate every muscle group
- Central (UMN) lesion result in Hyperreflexia & increased muscle tone but not atrophy or fasciculations
- Peripheral lesions result in hyporeflexia, decreased muscle tone, atrophy, & fasciculations
- Babinski reflex is a useful indicator of UMN disease
- Combination of UMN & LMN
- Balance/coordination requires the integration of cerebellar, visual, vestibular, & proprioceptive function
- Consider each aspect individually in evaluating a balance or coordination problem
What do you think can change neurons and their connections?

- Accidents
- Drugs
- Alcohol
- Disease
When I Woke Up This Morning
I Had One Nerve Left.
And Damned If You Didn't Get On It!

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