Neurological exam made easy!

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Objectives

- Quick review of the neurological exam
  - Anatomy and physiology
  - Neurological exam of the comatose patient
    - GCS
    - Pupils
    - Brainstem reflexes
  - Neurological exam with spinal cord injury
    - Myelopathy / radiculopathy
    - ASIA
    - Spinal cord syndromes

Important concept

1. You only find what you are searching for...
2. Any change in the level of consciousness
3. Any change from the baseline neuro (motor++)

Neuroanatomy review

The neuro exam is like describing somebody...

Brain + cerebellum
Brainstem
Cranial nerves
Spinal cord
Peripheral nerves
Muscles
Nervous system

Central
- Brain
- Cerebellum
- Brainstem
- Spinal cord

Peripheral
- Cranial nerves
- Peripheral nerves
- Neuromuscular junction
- Muscles

Brain
- Frontal lobe
- Parietal lobe
- Temporal lobe
- Occipital lobe

Cerebellum
- Connected to brain + spinal cord + cerebellum
- Small!!!
- Contains:
  - Nuclei for cranial nerves
  - Control of vital signs
  - Consciousness
  - Motor/sensory pathways

Cranial nerves
- I: Olfactory nerve
- II: Optic nerve
- III: Oculomotor nerve
- IV: Trochlear nerve
- V: Trigeminal nerve
- VI: Abducens nerve
- VII: Facial nerve
- VIII: Auditory nerve
- IX: Glossopharyngeal nerve
- X: Vagus nerve
- XI: Accessory nerve
- XII: Hypoglossal nerve

EOM: CN III, IV, VI
Facial movement: CN VII
Facial sensation: CN V
Swallowing: CN IX, X
Complete neuro exam

- Consciousness
- Higher cognitive functions
- Cranial nerves
- Motor / sensory
- Cerebellar function
- Reflexes
- And much more...

Complete neuro exam

- Takes time!!!!!!
- Not possible to do with every patient
  - Need cooperative patient
    - Sensory exam
    - Cerebellar exam
    - Visual...

Neuro exam

Awake + cooperative

Complete neuro exam

Comatose

Limited neuro exam
- GCS
- Pupillary
- Brainstem
- Reflexes

Comatose patient
Causes of coma

Metabolic vs structural

Structural
- Bihemispheric problem
- Diencephalic
- Brainstem lesion

Metabolic
- Drug/alcohol
- Encephalopathy (E+, BUN...)
- Seizure

Glasgow coma scale (GCS)

- Trauma
- Quick, reproducible, well known
- Scoring from 3 to 15
- Eye opening / verbal / motor response
- The best score for each response
- Confounding factors
  - T: Intubated, S: sedation, P: paralysis
- GCS 15: e4v5m6

GCS

<table>
<thead>
<tr>
<th>Eye opening</th>
<th>Verbal</th>
<th>Motor</th>
</tr>
</thead>
<tbody>
<tr>
<td>4: Spontaneous</td>
<td>5: Oriented</td>
<td>6: Follow command</td>
</tr>
<tr>
<td>3: To voice</td>
<td>4: Confuse</td>
<td>5: Localizing</td>
</tr>
<tr>
<td>2: To pain</td>
<td>3: Inappropriate</td>
<td>4: Withdraw</td>
</tr>
<tr>
<td>1: None</td>
<td>2: Sounds</td>
<td>3: Flexion</td>
</tr>
<tr>
<td></td>
<td>1: None</td>
<td>2: Extension</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1: None</td>
</tr>
</tbody>
</table>

Motor testing

- Response to painful stimulus
  - Supraorbital pain
  - Central pain (sternal, retromandibular)
- Localization
  - Crossing the midline
  - Will try to reach the stimulus
  - Not a stereotypical response
- **Strongest predictor of outcome**

Localization

- Decortication (flexion)
- Decerebration (extension)
Disadvantages

- Loss of information with summation
- No pupillary response or lateralization
- +/- reliability with sedation / analgesia

Example

- 65 possibilities for a moderate TBI
  – GCS 9-12...

Pupillary response

- Information about the brainstem
- Size, reactivity, symmetry
- CN II and III
- Sympathetic and parasympathetic influx
- Anisocoria = difference of 1 mm

Facts to know...

- **Sympathetic influx** = Mydriasis (BIG)
  – Hypothalamus, brainstem, superior cervical ganglia, ICA, reach the pupil
- **Parasympathetic influx** = Miosis (SMALL)
  – Midbrain, CN III
- The balance between sympathetic and parasympathetic determines the size of the pupils

Why a big pupil with herniation?

- CN III is compressed by the herniating brain
- No more parasympathetic (miosis) influx to the eye
- The sympathetic influx still working
Horner syndrome
- ptosis
- miosis
- anhydrosis

CN III palsy
- ptosis
- mydriasis
- down and out deviation

Brainstem reflexes

- Pupillary response
  - Midbrain, CN II, CN III
- Corneal reflex
  - CN V – VII, pons
- Oculocephalic (doll’s eye)
  - CN VIII, pons
- Occulovestibular (caloric)
  - CN VIII, pons
- Gag and cough reflex
  - CN X, CN IX, medulla
- Respiration (apnea test)
  - Medulla

Spinal cord injury
Spinal cord

Goal of physical exam
- Myelopathy (spinal cord)
- Radiculopathy (nerve root – peripheral nerve)
- Other

Neurophysiology review

Myelopathy vs radiculopathy

- **Upper motor neuron signs**
  - Spasticity
  - Hyperreflexia
  - Clonus
  - Hoffman / Babinski sign
  - Weakness

- **Lower motor neuron signs**
  - Weakness
  - Atrophy, fasciculation
  - Areflexia
  - Sensory / motor deficit in a dermatoma/myotoma
Sensory exam

• Pain + temperature
  – Spinothalamic tract (anterior portion of cord)
• Vibration + proprioception + light touch
  – Posterior column (posterior portion of cord)

Motor exam

• LMN sign: anterior horn
• UMN sign: corticospinal tract

Sphincters

• Anal tonus
• Bulbocavernous reflex
  – Lowest segmental reflex that disappears during spinal shock (but is the first to come back)
Nothing! Sensory only Motor < 3 Motor > 3 Normal

ASIA IMPAIRMENT SCALE

- A = Complete: No motor or sensory function is preserved in the sacral segments S4-S5.
- B = Incomplete: Sensory but not motor function is preserved below the neurological level and includes the sacral segments S4-S5.
- C = Incomplete: Motor function is preserved below the neurological level, and more than half of key muscles below the neurological level have a muscle grade less than 3.
- D = Incomplete: Motor function is preserved below the neurological level, and at least half of key muscles below the neurological level have a muscle grade of 3 or more.
- E = Normal: motor and sensory function are normal

Spinal cord syndromes

Summary

- TBI
  - GCS
  - Pupillary
  - Brainstem
- Spine
  - Myelopathy vs radiculopathy
  - ASIA when SCI

Summary

- We only find things that we are searching for!
- Need good basal neuro exam for comparison
- Urgent:
  - Any change in the level of consciousness
  - Any change in the GCS motor score

References

- Plum and Posner’s diagnosis of stupor and coma, 2007
- Atlas of human anatomy, Netter
- Neuroanatomy: Text and atlas, 2003
- Head and neuroanatomy, 2007