NEUROLOGICAL PHYSICAL EXAMINATION FOR MIDLEVEL PROVIDERS

Presented by:
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Objectives:
1. Describe the steps of a neurological examination
2. Understand basic anatomy associated with a normal examination
3. Recognize abnormalities on examination and the anatomy associated
Components of a Neurological Examination:

- Cranial Nerves
- Motor
- Sensory
- Reflexes
- Coordination
- Gait/Balance
Cranial Nerves

- Optic II: Cerebral hemisphere
- Olfactory I: Cerebral hemisphere
- Oculomotor III: Midbrain
- Trochlear IV: Midbrain
- Trigeminal V: Midbrain
- Abducens VI: Pons
- Facial VII: Pons
- Acoustic VIII: Pons
- Glossopharyngeal IX: Pons
- Vagus X: Medulla
- Hypoglossal XII: Medulla
- Accessory XI: Medulla
### Special Sensory Cranial Nerves

<table>
<thead>
<tr>
<th>CN</th>
<th>Origin</th>
<th>Function</th>
<th>Exam</th>
<th>Abnormality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Olfactory (I)</td>
<td>Cerebral hemisphere</td>
<td>Sense of smell</td>
<td>Often deferred, one nostril at a time, test with common smells (Cinnamon, cloves, coffee, peppermint)</td>
<td>Anosmia</td>
</tr>
<tr>
<td>Optic (II)</td>
<td>Cerebral hemisphere</td>
<td>Visual acuity/fields, Light reflex</td>
<td>Snellen chart one eye at a time, confrontation test, opthalmoscopic exam</td>
<td>Blindness, visual field cuts, absence of light reflex</td>
</tr>
<tr>
<td>Acoustic/Vestibular (VIII)</td>
<td>Pons, medulla (lesser)</td>
<td>Hearing, balance</td>
<td>Rub fingers together one ear at a time, Weber test, Rinne’s test, Dix-Hallpike positional test</td>
<td>Hearing deficits, Vertigo, disequilibrium, nystagmus</td>
</tr>
</tbody>
</table>
Visual Field Defects

Blind Right Eye: lesion of the optic nerve of the eye itself.

Bitemporal Hemianopia: lesion at the optic chiasm, typically pituitary tumor.

Left homonymous Hemianopia: lesion of the right optic tract

Left Homonymous Superior Quadrantanopia: “Pie in the Sky” Lesion to Meyer’s loop on opposite side (temporal)

Left Homonymous Inferior Quadrantanopia: Lesion to Optic Radiation on opposite side (Parietal)
# Ocular Motor Cranial Nerves

<table>
<thead>
<tr>
<th>CN</th>
<th>Origin</th>
<th>Function</th>
<th>Exam</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oculomotor (III)</td>
<td>Midbrain</td>
<td>Elevation of eyelid, Pupillary constriction and accommodation</td>
<td>Eye and eyelid position, 6 cardinal directions, diplopia, light reflex</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Eye movement: In and medial Up and Out Down and Out Up and In</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Muscle: Medial rectus Superior rectus Inferior rectus Inferior oblique</td>
<td></td>
</tr>
<tr>
<td>Trochlear (IV)</td>
<td>Midbrain</td>
<td>Eye movement Dow and In</td>
<td>same</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Muscle: Superior oblique</td>
<td></td>
</tr>
<tr>
<td>Abducens (VI)</td>
<td>Pons</td>
<td>Eye movement Out and lateral</td>
<td>same</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Muscle: Lateral rectus</td>
<td></td>
</tr>
</tbody>
</table>
### Ocular Motor Cranial Nerves continued

<table>
<thead>
<tr>
<th>CN</th>
<th>Abnormality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oculomotor (III)</td>
<td>3\textsuperscript{rd} nerve palsy (down and out gaze, mydriasis, ptosis), diplopia</td>
</tr>
<tr>
<td>Trochlear (IV)</td>
<td>4\textsuperscript{th} nerve palsy (affected eye does not adduct), head tilt to unaffected side to prevent diplopia</td>
</tr>
<tr>
<td>Abducens (VI)</td>
<td>6\textsuperscript{th} nerve palsy (affected eye goes medial), diplopia</td>
</tr>
</tbody>
</table>

3\textsuperscript{rd} nerve palsy

6\textsuperscript{th} nerve palsy
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<tbody>
<tr>
<td>Trigeminal (V)</td>
<td>Pons, lesser in midbrain and medulla</td>
<td>Mastication, sensation (V1) ophthalmic, (V2) maxillary, (V3) mandibular</td>
<td>Test sensation of each vector, strength of masseter and temporal muscles</td>
<td>Motor: Weakness of Jaw, ipsilateral deviation of opened jaw&lt;br&gt; Sensory: sudden sharp pains due to triggers, hemianesthesia</td>
</tr>
<tr>
<td>Facial (VII)</td>
<td>Pons, lesser in medulla</td>
<td>Facial movement, taste anterior 2/3 of tongue (sweet/salty)</td>
<td>Smile, show teeth, pursed lips, wrinkle nose/forehead, raise eyebrows, close eyes tightly. Taste typically deferred</td>
<td>Facial paralysis, loss of corneal reflex, of lacrimation, dry mouth, Loss of taste ipsilateral anterior tongue</td>
</tr>
<tr>
<td>Glosso-pharyngeal (IX)</td>
<td>Medulla</td>
<td>Elevation of pharynx, taste posterior 1/3 of tongue (bitter/sour)</td>
<td>Location of uvula when pt says “Ah”, gag reflex, voice quality, speech</td>
<td>Dysphagia, loss of taste in posterior tongue, loss of gag reflex</td>
</tr>
<tr>
<td>Vagus (X)</td>
<td>Medulla</td>
<td>Swallowing, vocalization, sensation of epiglottis, pharynx, larynx</td>
<td>Same as above</td>
<td>Dysphagia, hoarseness, contralateral deviation of uvula, loss of cough reflex</td>
</tr>
</tbody>
</table>
**Trigeminal Neuralgia:** Sensory disorder characterized by sharp sudden stabbing/burning pains to unilateral side of face, caused by triggers such as brushing teeth, wind/cold, eating/drinking, shaving.

**Atypical facial pain:** similar to TN, but is more constant and persistent, not triggered, described as sharp, dull, crushing, aching, burning, pulling, squeezing. Can affect scalp and neck.

**Bell’s Palsy:** Paralysis of facial muscles on affected side.
### Other Motor Cranial Nerves

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<thead>
<tr>
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<th>Abnormality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accessory (XI)</td>
<td>Medulla</td>
<td>Trapezius and sternocleidomastoid movement</td>
<td>Shrug shoulders, turn head</td>
<td>Weakness in turning head toward opposite side and shrugging shoulders</td>
</tr>
<tr>
<td>Hypoglossal (XII)</td>
<td>Medulla</td>
<td>Tongue movement</td>
<td>Open mouth, protrude tongue, move tongue side to side</td>
<td>Unilateral atrophy of tongue, ipsilateral deviation on protrusion</td>
</tr>
</tbody>
</table>
Physical Examination

- Motor
- Sensory
- Reflexes

"The results of your physical exam are fine, except for your reflexes: They're more 'dog-like' than 'cat-like'."
## Motor Strength Grading Scale

<table>
<thead>
<tr>
<th>GRADE</th>
<th>STRENGTH</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>Active movement against gravity and full resistance; normal muscle strength</td>
</tr>
<tr>
<td>4</td>
<td>Active movement against gravity and some resistance; the examiner can overcome the muscle resistance</td>
</tr>
<tr>
<td>3</td>
<td>Active movement against gravity. (Patient is able to raise or lift the extremity up)</td>
</tr>
<tr>
<td>2</td>
<td>Active movement of the body part when gravity is eliminated. (Patient is able to move the extremity in bed such as moving it side to side, and wiggling the toes or fingers; but cannot raise or lift the extremity up off the bed)</td>
</tr>
<tr>
<td>1</td>
<td>A very weak muscle contraction is palpated; only a trace of a contraction is evident, but no active movement of the body part is noted</td>
</tr>
<tr>
<td>0</td>
<td>No muscle contraction is detectable</td>
</tr>
</tbody>
</table>
Motor Exam: Strength

- Upper Extremities:
  A. Shoulder movement (Serratus anterior)
  B. Abduction of shoulder (Deltoid) - C5
  C. Elbow Flexion (Bicep) - C5
  D. Elbow Flexion (Brachioradialis) - C6
  E. Elbow extension (Tricep) - C7
Motor Exam: Strength

- Upper Extremities continued
  
  F. Pronator Drift
  G. Wrist Extension - C6
  H. Wrist Flexion - C7
  I. Finger Extension - C7
  J. Finger Flexion (Grip) - C8
  K. Finger Abduction - T1
  L. Finger Adduction - T1
  M. Thumb opposition - T1
Motor Exam: Strength

- Lower Extremities
  A. Hip flexion (Iliopsoas) – L1, L2
  B. Hip adduction – L2, L3, L4
  C. Hip abduction (Gluteus Medius) – L5
  D. Hip extension (Gluteus Maximus) – L5, S1
  E. Knee extension (Quadriceps) – L2, L3
  F. Knee flexion (Hamstring) – S1
Motor Exam: Strength

- Lower Extremities continued

G. Ankle Dorsiflexion (Tibialis Anterior) – L5
H. Ankle Plantarflexion (Gastrocnemius) – S1
I. Foot Inversion – L4, L5
J. Foot Eversion – S1
K. Extensor Halucis Longus (EHL) - L5

*not shown*
Sensory

- Pain and light touch
- Position Sense - a variety of muscular senses by which the position or attitude of the body or its parts is perceived.
- Stereognosia - the mental perception of depth or three-dimensionality by the senses, usually in reference to the ability to perceive the form of solid objects by touch.
- Graphesthesia - Tactual ability to recognize writing on the skin.
- Extinction - Neurological disorder characterized by inability to recognize two simultaneous stimuli on opposite sides of the body, or proximally and distally, though either one can be sensed alone.
Spinal Nerve Roots in Relation to Vertebrae
Reflexes

- Biceps - C5
- Triceps - C7
- Brachioradialis - C6
- Patellar - L4
- Achilles - S1
Hyperreflexia: overactivity of physiological reflexes

- The condition is most commonly seen in people with spinal cord injuries above the sixth thoracic vertebra (T6). It may also affect people with multiple sclerosis, Guillain-Barré syndrome, and some head or brain injuries. Sometimes the condition is a side effect of medication or illegal drugs such as cocaine and amphetamines.

https://www.youtube.com/watch?v=PPPgTq3L6k4
Hyporeflexia: underactivity of bodily reflexes

- primarily due to the damage in the nerves that pass through the spinal cord and diverges to the extremities. The damage in the nerve causes the dysfunction of the nerve and such damage is particularly true in pinched nerves brought by several matters that can press the nerve and prevent it from functioning properly.
Pathologic Reflexes

**Hoffman reflex:** involuntary thumb interphalangeal joint flexion after palmar to dorsal flicking maneuver applied to middle finger distal phalanx

**Babinski reflex:** involuntary dorsiflexion of the hallux and spreading of the lesser toes in response to forceful scratching of plantar/lateral aspect of foot

**Ankle clonus:** involuntary repetitive dorsiflexion of ankle in response to one-time forceful dorsiflexion of ankle by examiner
Physical Examination

- Coordination
- Gait/Balance
- Other examination techniques

*This isn't part of the exam anymore: I do it to sharpen my hand/eye coordination.*
Coordination

- Requires that four areas of the nervous system function in an integrated way:
  1. The motor system, for strength
  2. The cerebellar system, for rhythmic movement and steady posture
  3. The vestibular system, for balance and coordinating eye, head, and body movements
  4. The sensory system, for position sense

- Abnormalities are usually associated with cerebellar disease, upper motor neuron weakness, loss of position sense (neuropathy), or extrapyramidal disease.
To Assess Coordination:

1. **Rapid alternating movements:**
   - Strike one hand on the thigh, raise the hand, turn it over, and strike the back of the hand down on the same place.
   - Tap the distal joint of the thumb with the tip of the index finger.
   - Tap your hand with patient’s ball of foot.

✓ Observe speed, rhythm, and smoothness of movements.
✓ Look for slow, irregular, and clumsy movements.
To Assess Coordination:

2. **Point-to-point movements:**
   - Have patient touch your index finger and then their nose alternately several times, then move finger.
   - Heel to shin
   - Abnormal if movements are clumsy, unsteady, and vary in speed, force and direction. Finger may overshoot its mark- called dysmetria.
To Assess Coordination:

3. **Standing in specific ways:**
   - **Romberg Test:** Stand with feet together and eyes open and then close both eyes for 20 to 30 seconds.
   - Loose balance with eyes closed—loss of position sense.
   - Loose balance with eyes opened or closed—cerebellar ataxia.

   - **Pronator Drift:** Stand for 20 to 30 seconds with arms straight forward, palms up, eyes closed. Push arms downward.
   - Pronation of one forearm suggests a contralateral corticospinal tract lesion.
   - Cerebellar incoordination causes arms to bounce and overshoot each other.
To Assess Coordination:

4. **Gait and other related body movements:**
   - Walk heel-to-toe in a straight line, called tandem walking.
   - A gait that lacks coordination with instability is called ataxic.
   - Walk on the toes, then on the heels
   - Respectively tests for plantar flexion and dorsiflexion of the ankles, indicating distal muscle weakness in the legs.
   - Inability to heel-walk is sensitive for upper motor neuron weakness.
Gait Abnormalities

A. Spastic hemiparesis: unilateral upper motor neuron disease (stroke, MS, cerebral palsy, TBI)
B. Scissors gait: bilateral spastic paresis of legs
C. Steppage gait: lower motor neuron disease, foot drop (MS, polio, disc hemiation, Guillain-Barre)
D. Sensory ataxia: loss of position sense of leg, unsteady wide based gait, especially eyes closed (peripheral neuropathy)
E. Cerebellar ataxia: staggering, unsteady, wide based with eyes open or closed (cerebellar lesions)
F. Parkinsonian gait: stooped posture, hips/knees flexed, short/shuffling steps (Parkinson’s)
Landmarks of the Spine

- C7
- T1
- T7
- T8
- L1
- T12
- L4
- Iliac crest
- Posterior superior iliac spine
- S2
- Coccyx
Testing for Sciatic Tension

Straight Leg Raising - Lying

1. Ask the patient to lie as straight as possible on a table in the supine position.

2. With one hand placed above the knee of the leg being examined, exert enough firm pressure to keep the knee fully extended. Ask the patient to relax.

3. With the other hand cupped under the heel, slowly raise the straight limb. Tell the patient, "If this bothers you, let me know, and I will stop."

4. Monitor for any movement of the pelvis before complaints are elicited. True sciatic tension should elicit complaints before the hamstrings are stretched enough to move the pelvis.

5. Estimate the degree of leg elevation that elicits complaint from the patient. Then determine the most distal area of discomfort: back, hip, thigh, knee, or below the knee.

6. While holding the leg at the limit of straight leg raising, dorsiflex the ankle. Note whether this aggravates the pain. Internal rotation of the limb can also increase the tension on the sciatic nerve roots.

Straight Leg Raising - Sitting
Testing for Carpal Tunnel Syndrome

Cutaneous innervation of the hand
- Radial: clear section
- Median: stippled section
- Ulnar: diagonal lines

A. Tinel's sign: positive if pain and tingling elicited by tapping over the median nerve on affected side

B. Phalen's sign: positive if tingling and pain occur in the wrists when they are flexed at right angles for at least 1 minute
<table>
<thead>
<tr>
<th>Lobe</th>
<th>Major Functions</th>
<th>Major Structures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frontal</td>
<td>Cognitive Functions (Reasoning, abstraction, concentration, executive control)</td>
<td>Motor Cortex: Precentral gyrus</td>
</tr>
<tr>
<td></td>
<td>Memory, voluntary eye movement, motor control of speech (dominant),</td>
<td>Premotor Cortex</td>
</tr>
<tr>
<td></td>
<td>somatic motor control (respiratory, GI, blood pressure)</td>
<td>Broca’s area: inferior frontal gyrus</td>
</tr>
<tr>
<td>Parietal</td>
<td>Gross sensation, characteristics of sensation, awareness of body</td>
<td>Primary Sensory Cortex: Postcentral gyrus</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sensory Association Area</td>
</tr>
<tr>
<td>Temporal</td>
<td>Hearing, language understanding and formation</td>
<td>Primary Auditory Receptive area: just inferior to</td>
</tr>
<tr>
<td></td>
<td></td>
<td>lateral sulcus</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Wernicke’s Area: inferior to above</td>
</tr>
<tr>
<td>Occipital</td>
<td>Vision, visual association</td>
<td>Primary Visual Cortex</td>
</tr>
<tr>
<td>Cerebellum</td>
<td>Coordination of movements, equilibrium</td>
<td>Posterior Fossa below transverse fissure</td>
</tr>
</tbody>
</table>
Cerebral Vascular Distributions
**Posterior cerebral artery**

Symptoms include:
- Visual problems
- Prosopagnosia (can’t recognize faces)
- Alexia (inability to read)
- Aphasai (can’t comprehend spoken words)

**Middle cerebral artery**

Symptoms include:
- Contralateral face and arm weakness and sensory loss
- Mild or no leg weakness
- Head and eyes deviated toward side of stroke
- If left-sided, may produce aphasia (trouble speaking)
- If right-sided, may cause deficits of spatial perception, hemineglect, and apraxia (trouble completing movements)

**Anterior cerebral artery**

Symptoms include:
- Contralateral leg weakness and sensory loss
- Mild or no upper extremity involvement
- Balance problems
- May produce aphasia (trouble speaking) if left-sided

**Verteobasilar system**

Symptoms include:
- Vertigo (dizziness)
- Nystagmus
- Vision problems
- Facial weakness
- Dysphagia (trouble swallowing)
- Dysarthria (trouble speaking)
- Loss of pain and temperature sensation
- Ipsilateral Horner's syndrome:
  - ptosis (eyebrow drop)
  - miosis (pupil constriction)
  - anhidrosis (loss of sweating)

**Lacunar infarct**

Symptoms include:
- Weakness of the arm, leg, or face that is not accompanied by sensory loss (pure motor stroke)
- Ataxia (coordination problems) and leg weakness
- Clumsy hand syndrome
- Sensory loss not accompanied by weakness (pure sensory stroke)
- Absence of higher cortical symptoms (language, vision, facial recognition, etc.)
References


