Neurological Assessment: More than GCS

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Components of the Neurological Examination

- Level of Consciousness
- Motor Function
- Cranial Nerves
- Vital Signs
LOC Assessment

- Most sensitive indicator of change in patient
- Orientation to person, place, time, and situation
- Two components of LOC
  - Orientation
  - Arousal
Motor Function

- Follow commands – assess strength for equality bilateral
- Drift test
- Painful stimuli
- Motor responses
- Posturing
Assessment of Drift

Posturing

Decorticate or Decerabrate?
Assessing Comatose Patient

- Eyelid tone
  - tested by raising eye lids and noting rate and completeness of closure
  - deep coma - slower and more incomplete closure

- Roving eye
  - spontaneous, slow and random horizontal eye deviation found in an unconscious patient with an intact brainstem
Assessing Comatose Patient

- **Ocular bobbing**
  - fast downward and slow upward eye movement
  - indicates pons damage

- **Ocular dipping**
  - slow downward and fast return
  - indicates diffuse anoxic insults
Cranial Nerves (CN)

- I Olfactory
- II Optic
- III Oculomotor
- IV Trochlear
- V Trigeminal
- VI Abducens
- VII Facial
- VIII Vestibulocochlear
- IX Glossopharyngeal
- X Vagus
- XI Accessory
- XII Hypoglossal
3 Groups of 4 CN

- Group 1
  - CN I, II (originate cerebral cortex)
  - CN III, IV (originate midbrain)

- Group 2
  - CN V, VI, VII, VIII (originate pons)

- Group 3
  - CN IX, X, XI, XII (originate medulla)
Ipsilateral except CN IV (contralateral)
Cranial Nerve Assessment

- Cranial Nerve I Olfactory
  - Olfactory (sensory)
  - Smell
  - Usually not tested
  - May be tested in patients after head injury or pituitary surgery
  - Use coffee for testing
  - Loss of taste
Sniff Test
Testing
Results

- Perceiving an odor indicates intact olfactory pathway
- while identifying the **actual odor** indicates cortical functioning
Abnormality

- Amnnesia
- Inability to perceive or recognize not only smells but also taste
- May complain of a loss of taste
- Some with a loss of taste will enjoy spicy foods (stimulation trigeminal nerve)
Causes

• Brain injury with frontal lobe involvement
  • loss of smell (5% to 20% TBI) and as high as 80% with presence of CSF rhinorrhea

• Olfactory groove meningioma

• Skull base tumors (spenoidal ridges)

• Frontal lobe gliomas
Olfactory Groove Meningioma
Cranial Nerve II (Optic)

- Function
  - Visual acuity
  - Visual fields
  - Pupil reaction (receives light impulse – afferent)
  - Color vision and day/night vision
Testing

- Read name pin, cards, or count fingers
  - Cover one eye
  - Wear corrective eyewear
- Use a snellen chart
  - Pocket chart 6 ft
- Ask about blurred vision
  - Acuity is best tested if patient awake and alert
    - Blink due to threat may be used
    - Wandering of the eye impairs evaluation
Testing

- Use color plates to assess color vision
  - Loss of red perception is usually the first lost in neurological disorders
  - Graying or desaturation of the red
Testing

- Assess visual field cuts
- Remember: the optic tract splits into superior and inferior tracts as well as medial and lateral visual fields
Hemianopsia

- Hemianopsia – impaired vision in half the visual field of each eye
- Do not cross the vertical field of vision
Homonymous

- Right homonymous is a defect in the right half of each eye
  - Caused by lesions distal to optic chiasm
- Vision is lost in ipsilateral nasal field and the contralateral temporal field
- Does not affect acuity but may only read half of the line on the acuity chart
Heteronymous

- Impaired vision in opposite halves of the eyes
  - right half of one eye and left half of the other
- Bitemporal hemianopsia is usually due to injury at the optic chiasm
  - Pituitary adenoma
Other Terms

- Congruous – field defects both eyes match exactly
- Incongruous – field defects do not match
- Scotoma – an area of impaired vision in the field with normal surrounding vision
Visual Field Losses

- Quadrantopsia – loss quarter section of field vision
  - Superior quadrantopsia
    - “pie in sky”
    - Caused by a lesion in temporal lobe affecting Meyer’s loop
  - Inferior quadrantopsia
    - Implies a parietal lobe lesion
Visual Extinction

- Most characteristic of lesions in nondominant hemisphere
  - When bilateral visual stimulus is delivered
Localization

- Before optic chiasm
  - monocular vision
  - impaired color perception
  - afferent pupillary defect
Localization

- Optic chiasm injury
  - Heteronymous visual defect
    - Bitemporal hemianopsia
  - Preservation of visual acuity and color perception
  - Normal optic disc
Localization

- After the optic chiasm
  - contralateral homonymous hemianopsia
  - normal visual acuity
  - usually no affect on color vision
Bilateral Occipital Injury

- Bilateral homonymous hemianopsia with extreme defects in cortical function results in visual loss
  - **Cortical blindness**
- Patient is usually unaware and denies the existence of the deficit
Papilledema
CN III (Oculomotor)

- **Function:**
  - Elevation eyelid
  - Efferent arc of pupillary reaction
  - Extraocular eye movement
Testing

- Testing:
  - Observe eyelid symmetry & opening
  - Assess pupil size & reaction
  - CN III palsy (ptosis, dilated nonreactive pupil, down & out position)
Nobody loves you when you're down and out.

Right eye: Downward and outward gaze, dilated pupil, eyelid manually elevated due to ptosis

Left: Normal
Testing

- Observe for eye lid symmetry and opening
- Drooping of eyelid is called ptosis
  - Horner’s syndrome
    - usually partial
  - 3rd nerve palsy
    - often complete unless partial 3rd nerve palsy
  - Mild to moderate bilateral ptosis occurs with musculoskeletal disorders
    - Myasthenia gravis
Pupil Assessment

- Pupil size normal 2-6 mm
  - size is not reliable with bare eye
- Size depends upon balance between sympathetic and parasympathetic innervation
- Observe size and symmetry prior to shining light in eyes in a moderately lit room
- Normal pupil shape is round
Different Pupil Appearances

Round

Keyhole

Ovoid

Irregular

Pupil Assessment

- Direct reaction
  - Test each eye separately for reaction

- Consensual reaction
  - Shine light in one eye and observe opposite eye for reaction

- Check for accommodation
  - Have the patient follow finger as comes towards the nose, the pupils should constrict as finger comes closer
CN III

- Mydriasis – blown pupil
- Bilateral mydriasis – bilateral blown pupil
- “Hipus” reaction
- Miotic – pinpoint & nonreactive
- Anisocoria - unequal pupil size
  - 10-17% of population
Extraocular Muscles (EOM) Assessment

CN III, IV, VI

Muscles of the Eyes and Associated Cranial Nerves

Testing EOM

- Six fields of vision
- Movement should be smooth and conjugate throughout not a series of saccades
- Assess if pupil go all the way out to the corners of the orbit
  - Assess for no white closest to where the finger is
Testing EOM

- If patient does not follow commands, watch their eyes when tracking movement in the room

- Test alignment of the pupils by shining penlight midline on the pupil
  - Look at the reflection from the pupils to determine if they are midline

- While checking extraocular eye movement, ask the patient if they see double at any time during the examination
TESTING EOM

- Watch for nystagmus during the examination (right or left)
  - The direction is determined by quick component

- Note any eyelid lag

- Check for optic convergence – hold a finger midline and move towards nose and watch for eyes to converge

- Test overcome with Doll’s eyes maneuver
EOM Abnormalities

- CN III
  - Down & out position
- CN IV
  - Upward position
- CN VI
  - Inward position
Fatiguuable Ptosis: MG
Cranial Nerve Assessment

- Cranial Nerves **III** Oculomotor, **IV** Trochlear and **VI** Abducens
  - Oculomotor, trochlear, abducens
  - Motor nerves that are tested together
  - Eye movement
Diplopia

- Diplopia is worse with gaze in the direction of the involved muscle
- Usually tilt head in an unusual position to minimize diplopia
Diplopia

Single Vision

Diplopia Worse
Exopthalmos

- Protrusion of orbit
- Subtle proptosis can be better appreciated by looking down at both eyes from above the head
- Causes include:
  - orbital mass lesions
  - carotid cavernous fistula
  - cavernous sinus thrombosis
  - meningioma
Trigeminal CN V

- Sensory (3 levels) - there are three distinct divisions of the nerve branches
  - sensory of the forehead and cornea (ophthalmic)
  - sensory of cheek and upper mouth (maxillary)
  - sensory of jaw, lower teeth, and oral mucosa (mandibular)

- Test sensory
  - have the patient close their eyes and identify the location and type of sensation.
  - use a cotton swab for dull and pin for sharp in all three divisions
Distribution of the Sensory Components of Cranial Nerve V

Trigeminal CN V

- Corneal reflex
  - Direct and consensual eye blink
  - Cranial nerve VII (facial) is the motor component of the reflex arc
- Bell’s phenomenon
  - the eyes deviate upward when testing the corneal
  - intact midbrain and upper pons
CN V Motor

- Muscles of mastication
  - Temporalsis
  - Masseter

- Tested by:
  - Clench teeth
  - Move jaw laterally
  - Observe for deviation
  - Jaw moves away from weak side
  - Hallowed check
CN VII (Facial)

- “Face, ear, taste, tear”

Function
- Controls muscles for facial expressions
- Controls eyelid closure
- Taste sensation 2/3 tongue

Autonomic control of lacrimal, salivary, submandibular, and sublingual glands
- called “wet CN”
Cranial Nerves 7 and 3

CN 7
A hook; closes eyes

CN Ⅲ
3 pillars; opens eyes
Testing

- Testing:
  - Observe symmetry face
  - Ask patient perform facial expression
  - Nasolabial folds
  - Attempt to close eyelids against resistance
  - Taste
  - Ability to tear or produce saliva
Facial Droop
Facial Droop
UMN vs. LMN

- Cranial Nerve VII Facial
  - Upper motor neuron (cortical weakness)
  - Spares forehead
  - Lower motor neuron (Bell’s palsy)
  - Ipsilateral to lesion
  - Involves all facial muscles
Bell's Palsy compared to CVA

A. Facial nerve lesion (Bell's palsy)
- Nucleus of facial nerve (cranial nerve VII)
- Lesion in facial nerve

B. Supranuclear lesion
- Supranuclear lesion

Facial nerve

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CN VIII (Acoustic)

- Cranial Nerve **VIII** Vestibulocochlear
  - Acoustic (sensory)
    - Cochlear component (hearing)
    - Vestibular component (balance)
  - Nystagmus and vertigo
  - Cold caloric testing (coma vs. awake)
CN VIII (Acoustic) cont.

- Testing

- Hearing and Sound Conduction
  - Rubbing fingers or whisper into ear
  - Rumple paper, or watch ticking by the ear
  - Rinne's test or
  - Weber's test

- Vestibular
  - Balance
  - Romberg’s test
CN VIII (Acoustic) cont.

Acoustic neuroma on vestibulocochlear nerve puts pressure on facial nerve.
COWS

Cold caloric response

0°C

A normal tonic response

0°C

An asymmetrical response

0°C

A negative response
CN IX (Glossopharyngeal) & CN X (Vagus)

- CN IX Glossopharyngeal and CN X Vagus
- Initiation of swallowing and gag reflex
- Innervates the parotid gland for salivation
- Taste posterior 1/3 tongue
- Contains autonomic components
  - BP and CO2/O2 changes
CN IX, X

- Tested together due to overlap in function
  - Sensory
    - Posterior pharynx and larynx
  - Motor
    - Soft palate, pharyngeal muscles, vocal cords
    - Have patient say “AH” and assess soft palate and uvula
    - Palpate swallow reflex
    - Swallow evaluation
  - Phonation, swallow and gag reflex
    - Note quality of speech and presence dry mouth
      - Hoarseness of speech
Palate and Pharynx

Figure 1. Surface anatomy of the mouth
Palate and Pharynx

CN XI (Spinal Accessory)

- Cranial Nerve XI Accessory
- Intracranial portion joins CN X
- Assess extracranial portion
  - Spinal accessory (motor of spinal component)
    - Sternocleidomastoid and trapezius muscles
  - Shoulder shrug
  - Rotate head against resistance
CN XII (Hypoglossal)

- Cranial Nerve XII Hypoglossal
  - Observe tongue at rest
  - Tongue protrusion
  - Lateral pressure to each cheek
  - Observe for muscle atrophy
  - Say “round the ragged rock the rabbit ran”
Vital Sign Changes

- Changes in vital signs related to IICP are a late sign and indicate impending herniation.
- Respiratory pattern changes may be the earliest vital sign change of neurological deterioration.
Cheyne–Stokes Respirations

Central Neurogenic Hyperventilation

Apneustic Breathing

Cluster Breathing
Ataxic Breathing
Cushing’s Triad

- Bradycardia
- Elevation systolic pressure
- Widened pulse pressure
Special Testing

- To test coordination for cerebellar injuries;
  - have the patient run heel down the shin bilateral
  - rapid finger to nose coordination
  - rapidly touch fingers to thumb
  - pat leg with hand, alternating palm with back of hand
Oculovestibular Reflex

Oculocephalic Reflex

Doll’s Eyes

Babinski Reflex

Review Questions

1. What part of the assessment provides the most sensitive information regarding the patient’s neurological status?
   a. level of consciousness
   b. orientation questions
   c. pupillary response
2. What is the result when a patient has an injury to cranial nerve III?
   a. Dilation of the pupil
   b. Ptosis of the eyelid
   c. Difficulty in moving the eyes from side to side
   d. All of the above
Review Questions

3. Where is the injury if a patient has dysphagia?
   a. Cranial nerve IX and X
   b. Cranial nerve II and III
   c. Cranial nerve IV and V
Review Questions

4. What would you expect to see in a patient with a T4 spinal cord injury?
   a. Lack of sensation and motor below the nipple line
   b. Ability to use upper extremities
   c. Potential for difficulty with respirations initially
   d. All of the above
Dermatomes

Assessment of the Patient After Spinal Cord Injury

- Determine level of injury: Sensory and motor.
- Identify complete or incomplete injury.
- Evaluate deterioration of the patient.
Intracranial Pressure

- The skull’s intracranial content volume is approximately 1,700 ml and includes:
  - brain
  - blood
  - CSF

- The fully developed skull is a rigid container that limits volume:
  - there is no room for expansion
CBF Regulation

• Autoregulation
  • Ability of an organ to maintain a constant blood flow
  • Major homeostatic and protective mechanism that occurs in the arterioles
  • Provides a constant CBF by adjusting the diameter of blood vessels
Cerebral Perfusion Pressure (CPP)

- CPP is the blood pressure gradient across the brain.
- Normal range is 60–100 mm Hg.
- Lower limits of CPP < 60 mm Hg lead to ischemia.
- Inadequate CPP leads to ischemia, which can lead to infarction < 40 mm Hg.
- CPP too high may cause hyperemia & increased ICP.
- CPP = MAP – ICP
Purpose of Monitoring

- Diagnose increased ICP
- Monitor treatment of increased ICP
- Treat increased ICP by venting CSF
- Monitor effects of nursing interventions
Indications ICP monitoring

- GCS < 8
- TBI
- Cerebral edema
- Deterioration neurological status
- Extensive surgical manipulation
- Poor grade SAH
- Meningitis
- Stroke
- hydrocephalus
ICP Issues

- Supratentorial measurements do not reflect infratentorial pressures
- Bilateral ICP monitoring shown large ICP differences if expanding mass unilateral
- Pressure reflected in fluid filled ventricles
Epidural Catheter

• Burr hole w/ catheter placed epidural space

• Advantages:
  • Easy & safe insert
  • Low risk infection, dura not penetrated
  • Less risk brain damage

• Disadvantages:
  • Not as accurate, indirect measurement
  • May produce “wedged” effect
  • Can not obtain CSF for Dx or Tx
Subarachnoid Monitor
Subarachnoid Monitor

- Placed in SA space

- Advantages:
  - Easy to insert
  - No disruption brain parenchyma
  - May be used pt w/ collapsed ventricles

- Disadvantages:
  - May have CSF leak
  - Risk of infection
  - Not as reliable, may underestimate actual ICP
  - Can not obtain CSF for Dx or Tx
  - Risk hemorrhage or hematoma formation
Intraventricular Monitor
PLACEMENT OF RIGHT FRONTAL VENTRICULOLOSTOMY CATHETER

LATERAL VIEW
Intraventricular Monitor

- Placed in the lateral ventricle nondominant hemisphere

- Advantages:
  - Most accurate
  - Access to drain & sample CSF

- Disadvantages:
  - Increase risk infection
  - CSF leak
  - Insertion difficult
  - May be unable locate ventricles
  - May occlude catheter w/ brain tissue
ICP Monitor

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Fiberoptic Catheter
Strain Gauge Catheter Tip
Fiberoptics

- Transducer tip catheter
  - May be placed SA space, parenchyma, intraventricular

- Advantages:
  - Eliminates fluid filled systems
  - Decreases risk infection
  - Does not require releveling or recalibrating

- Disadvantages:
  - Fiberoptics easily broken
  - May drift & only zeroed once prior to insertion
    - Codman’s Microsensor report daily drift -0.13 to +0.11
Management of Ventriculostomy

- Venting CSF
  - Intermittent
  - Continuous
- Dressing change
- Irrigation/ Flushing system
- Obtaining CSF samples
- Administration intrathecal medications
- Transporting patient
Management

- Obtaining readings
  - Drain/measure same time?
- Collection CSF sample
- Routine sampling of CSF for ventriculitis?
Intraventricular Monitor
Leveling
Drainage System
Overview of Codman Drainage System
Assessing Compliance: Using the ICP Waveform

- ICP waveform has three peaks:
  - P1—the percussion wave (arterial)
  - P2—the tidal wave (rebound)
  - P3—the dicrotic wave (venous)
Abnormal ICP wave form
(ICP = 18 mm Hg)