# Neurological Assessment
## Red Flags

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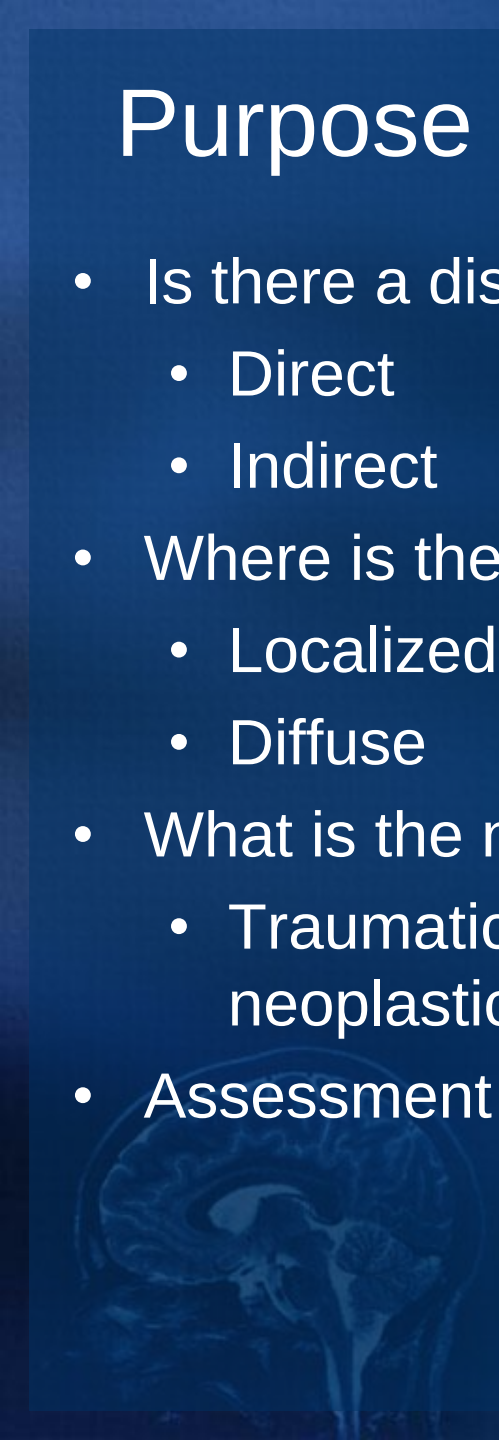
# Objectives

Upon completion of this presentation the participants will be able to:

- Outline a systematic approach to a neurological assessment.
- Apply a targeted exam for specific patient populations.
- Identify deficits and anticipate possible courses of action.

# Purpose of the Neurological Examination

- Is there a disease involving the nervous system?
  - Direct
  - Indirect
- Where is the disease?
  - Localized
  - Diffuse
- What is the nature of the disease process?
  - Traumatic, Toxic-metabolic, infectious, vascular, neoplastic, autoimmune, degenerative or hereditofamilial
- Assessment of brain function



# Systematic approach to a neurologic assessment

- Mental status
- Cranial nerves
- Motor function
- Reflexes
- Sensory function

# The Neurologic Exam

- Mental Status
  - Level of Consciousness
    - Alert- patient is awake and attentive to normal levels of stimulation
    - Lethargic-patient appears drowsy and may fall asleep if not stimulated
    - Obtunded- patient is difficult to arouse from a somnolent state and is frequently confused when awake
    - Stupor- patient responds only to strong, generally noxious stimuli and returns to the unconscious state when stimulation is stopped
    - Coma- patient cannot be aroused by any type of stimulus

# Mental Status

- Arousal- the physiological and psychological state of being awake
- Awareness/Attention- Cannot occur without arousal. The ability to focus and maintain one's consciousness on a particular stimulus or task without being distracted by other stimuli
  - Patients can be conscious but not attentive

# Mental Status

- Orientation
  - Person, place, time, situation
- Language function
  - Fluency, comprehension, repetition, naming and word finding, reading and writing
- Cortical and Cognitive functions
  - Fund of knowledge, calculation ability, proverb interpretation, gnosia and agnosia, praxia and apraxia

| Table | Glasgow coma scale. | |
|---|---|---|
| *Eye opening* | | |
| Spontaneous |  | 4 |
| To loud voice | | 3 |
| To pain | | 2 |
| None | | 1 |
| *Verbal response* | | |
| Oriented |  | 5 |
| Confused, disoriented | | 4 |
| Inappropriate word | | 3 |
| Incomprehensible sounds | | 2 |
| None | | 1 |
| *Best motor response* | | |
| Obeys |  | 6 |
| Localizes | | 5 |
| Withdraws (flexion) | | 4 |
| Abnormal flexion posturing | | 3 |
| Extension posturing | | 2 |
| None | | 1 |

# Cranial Nerves

- CN I- Olfactory
- CN II- Optic
  - Visual acuity, visual fields , funduscopic exam and afferent pupillary light reflex
- CN III- Oculomotor
  - Eye movements, eye lid elevation, accommodation and efferent pupillary light reflex
- CN IV- Trochlear
  - Eye movement (inward and down)

# Cranial Nerves

- CN V- Trigeminal
  - Facial sensation, muscles of mastication, and afferent corneal reflex
- CN VI- Abducens
  - Lateral eye movement
- CN VII- Facial
  - Facial movement, taste anterior tongue, and efferent corneal reflex
- CN VIII- Acoustic (Vestibulocochlear)
  - Hearing and balance

# Cranial Nerves

- CN IX- Glossopharyngeal
  - Taste  & sensation posterior tongue, sensation posterior oropharynx, and palate movement, afferent gag reflex
- CN X- Vagus
  - Uvula and soft palate movement, muscles of larynx and pharynx, cough reflex, efferent gag reflex
- CN XI- Spinal Accessory
  - Sternocleidomastoid and Trapezius muscles
- CN XII- Hypoglossal
  - Tongue movement

# Motor Exam

| Grade | Muscle strength |
|---|---|
| 0 | No palpable or visual evidence of muscle contraction |
| 1 | Palpable or visual evidence of trace contraction |
| 2 | Active movement with gravity eliminated |
| 3 | Active movement against gravity |
| 4 | Active movement against gravity and resistance |
| 5 | Full strength |

# Motor Exam

- In lethargic patients always start with central stimuli followed by peripheral stimuli
- Coordination
  - Finger to nose test, rapidly alternating movements, rapidly tap the tip of the thumb with the tip of the index finger, and heel to shin movements

# Sensation

- Superficial sensation
  - Light touch, pain and temperature
- Deep sensation
  - Joint perception, vibratory sense and pain from deep-lying structures

# Two things you MUST know!!!

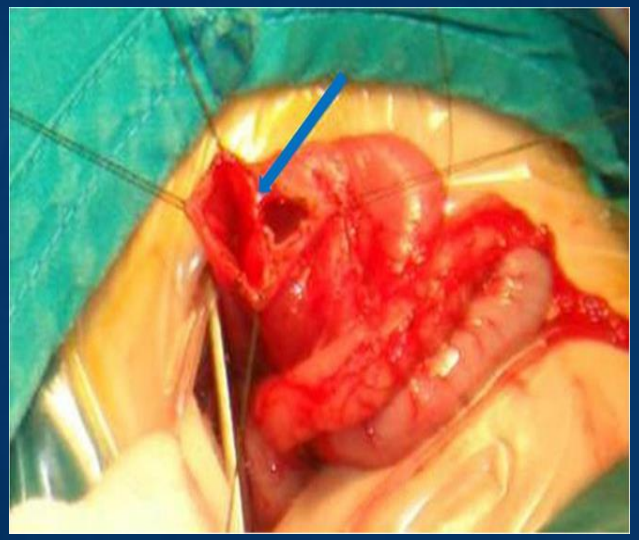
- Timing!
- Baseline exam!

# Patient Cases

- Identify the deficits associated with each patient case
- Attempt to localize the lesion associated with each patient case
- Anticipate diagnostic labs and test that will be ordered
- Anticipate potential treatments based on the findings of the diagnostic labs/test

# Case 1

- 44 year-old female who presented to the ED after a MVC. In the ED she was awake, alert and oriented x 3. She had a CT of the head, chest, abdomen and pelvis that revealed bilateral pulmonary contusions, a grade 2 liver laceration, and pneumoperitoneum. She was taken to the OR for an Ex-lap with washout and small bowel resection. Her small bowel was left in discontinuity so her abdomen was left open. She remained intubated and was placed on Fentanyl and Propofol infusions with a plan to take her back to the OR in 24 to 48 hours.



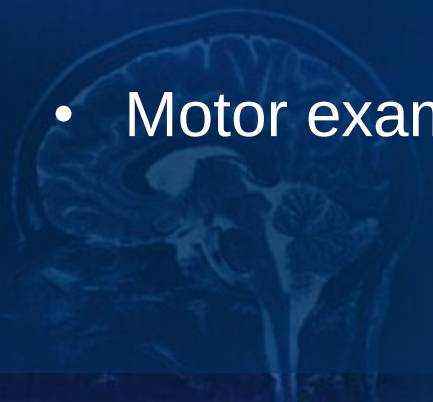
# Case 1

- POD #1 during a physical assessment she was noted to have a right gaze deviation and a fixed, dilated right pupil.

- What else would you like to know?

# Case 1

| Neuro Exam | Findings |
| --- | --- |
| • Mental status | • Sedated exam, does not open eyes to painful stimuli |
| • Cranial nerves | • Rt gaze deviation, dilated unreactive Rt pupil. Positive corneal reflexes bilaterally. Positive cough and gag. Face taped. |
| • Motor exam | • Localizes to central stimuli with RUE, withdrawals RLE. Flaccid LUE/LLE |



# Case 1

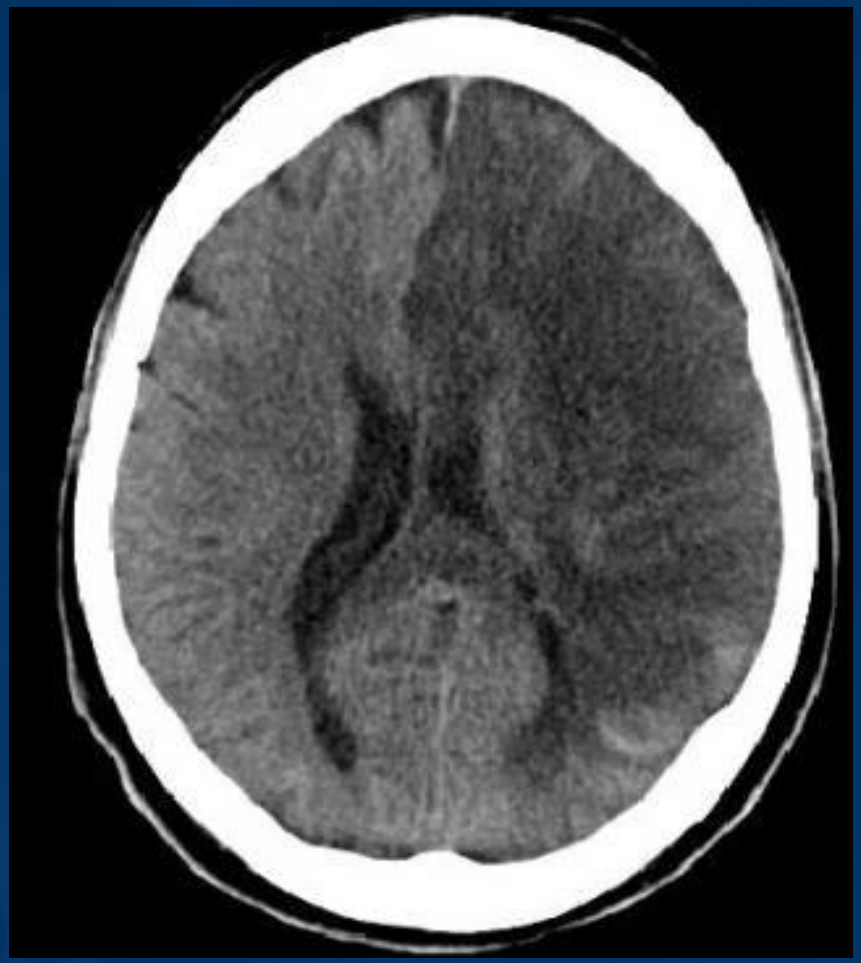
- Labs
  - Blood glucose, BMP, PT/PTT, INR, CBC, T&S, Trop, toxicology screen, ETOH level, ESR or thrombin time
- Diagnostic tests
  - Non-contrast Head CT, ECG, MRI, EEG

# Differential diagnosis

- Ischemic stroke
- Hemorrhagic stroke
- SDH
- Seizure
- Mass lesion

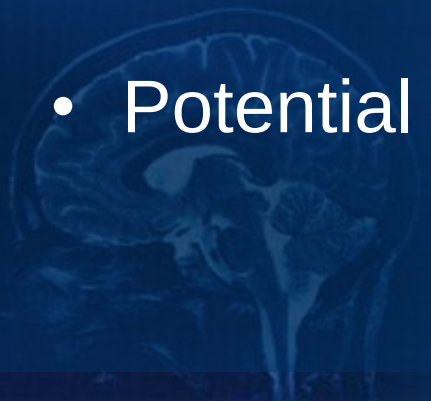
# Case 1

- Head CT reveals a right ACA/MCA ischemic stroke with mass effect on the lateral ventricle and early uncal herniation



# Case 1

- Potential treatments
  - Osmotic therapy (Mannitol or hypertonic saline), Neurosurgery consult for possible decompressive hemicraniectomy
- Potential causes
  - Carotid dissection, cardioembolic



# Clinical Manifestations

**MCA Stroke**

- Hemiparesis
- Hemiplegia
- Hemianesthesia
- Hemianopia
- Aphasia
- Neglect
- Gaze deviation

**Right MCA stroke**

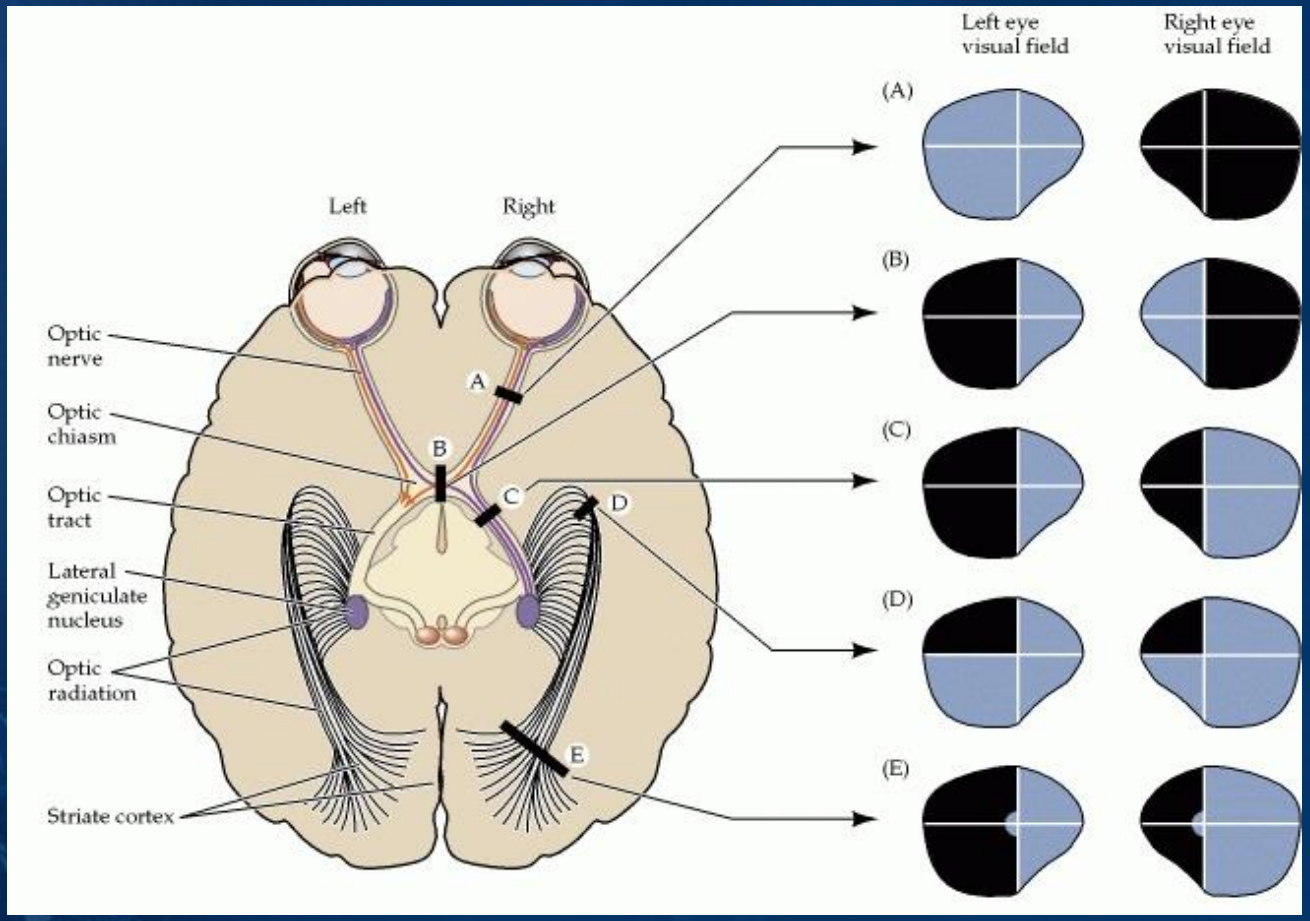
# Clinical Manifestations

**Anterior cerebral artery stroke**

- Lower extremity hemiplegia
- Primitive reflexes
- Confusion
- Abulia
- Behavioral changes
- Disturbance in memory

**Anterior cerebral artery stroke**

# Localizing visual field defects



# Case 2

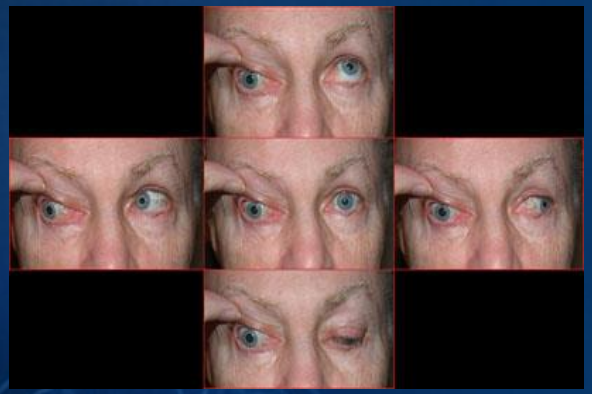
- 68 year-old female with a PMH of HTN, HL, DM, and tobacco use who presented to the ED with a complaint of the worse headache of her life. She reports that the headache started while she was running on her treadmill. She describes it as sharp, holocephalic in nature, and rates it a 10 out of 10. The pain has no alleviating factors and is exacerbated by movement and light. She also reports 2 episodes of vomiting since the onset of her headache.

    - What else would you like to know?

# Case 2

## Neuro Exam

- Mental status
- Cranial nerves



- Motor exam

## Findings

- Awake, alert and oriented x 3
- Left pupil 5mm nonreactive, right pupil 3mm briskly reactive. 3rd cranial nerve palsy on left. Face symmetric, tongue midline, uvula midline.
- Moves all extremities well, motor strength 5/5 throughout

# Case 2

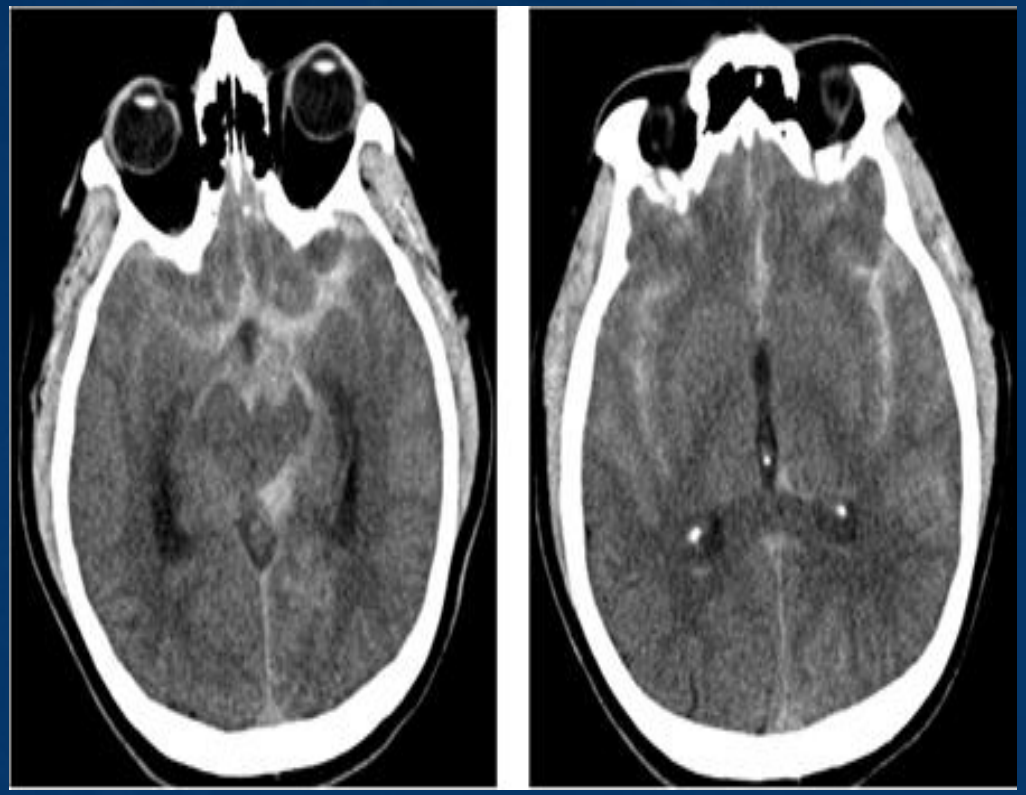
- Labs
  - BMP, PT/PTT, INR, CBC, T&S, Trop, pregnancy test, toxicology screen, ETOH level
- Diagnostic tests
  - Non-contrast Head CT or Head CT angio, Lumbar puncture, Cerebral angiography, CXR

# Differential diagnosis

- SAH
- Migraine headache
- AVM
- Intracranial arterial dissection
- Cocaine and amphetamine use
- Mycotic aneurysm
- Pituitary apoplexy
- Moyamoya disease

# Case 2

- Head CT reveals that she has diffuse subarachnoid hemorrhage



# Case 2

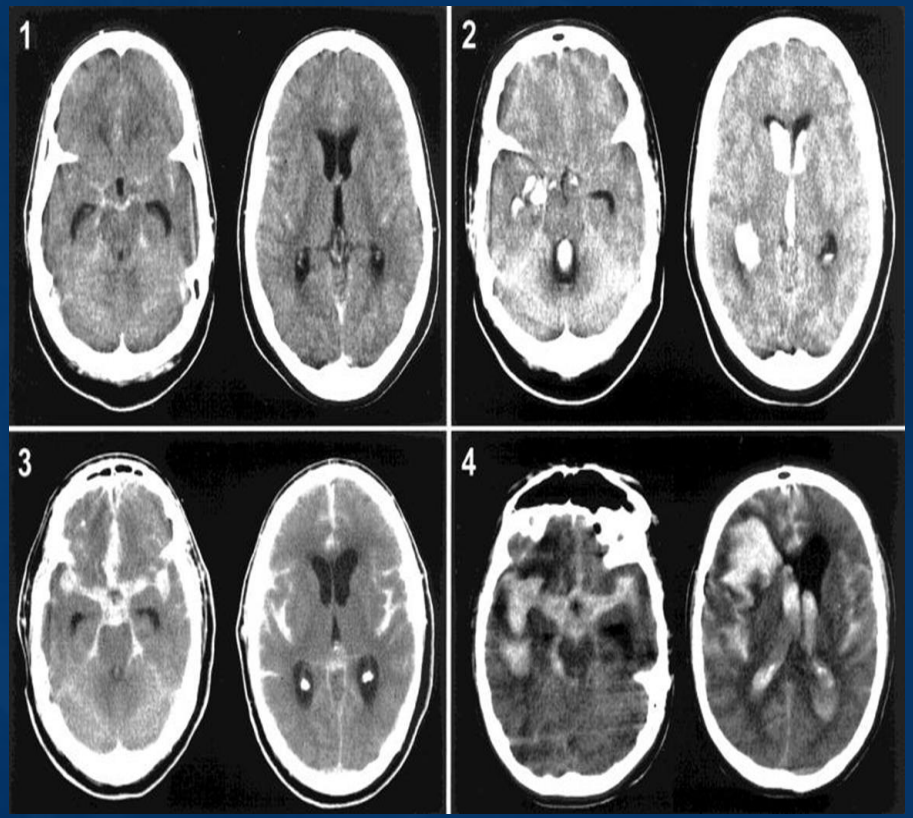
## Hunt and Hess Scale

Table 3. Hunt And Hess Classification Of Subarachnoid Hemorrhage.

- **Grade 1:** Asymptomatic, or minimal headache; slight nuchal rigidity.
- **Grade 2:** Moderate to severe headache, nuchal rigidity; no neurological deficit (apart from cranial nerve palsy).
- **Grade 3:** Drowsiness, confusion, or mild focal deficit.
- **Grade 4:** Stupor, moderate to severe hemiparesis; possible early decerebrate posturing.
- **Grade 5:** Deep coma, decerebrate posturing, moribund.

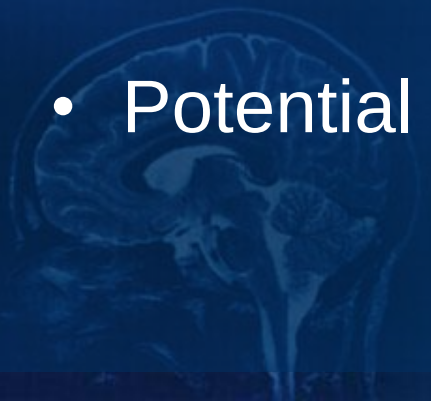
Adapted from: Hunt WE, Hess RM. Surgical risk as related to time of intervention in the repair of intracranial aneurysms. *J Neurosurg* 1968;28:14-20.

## Modified Fisher Score



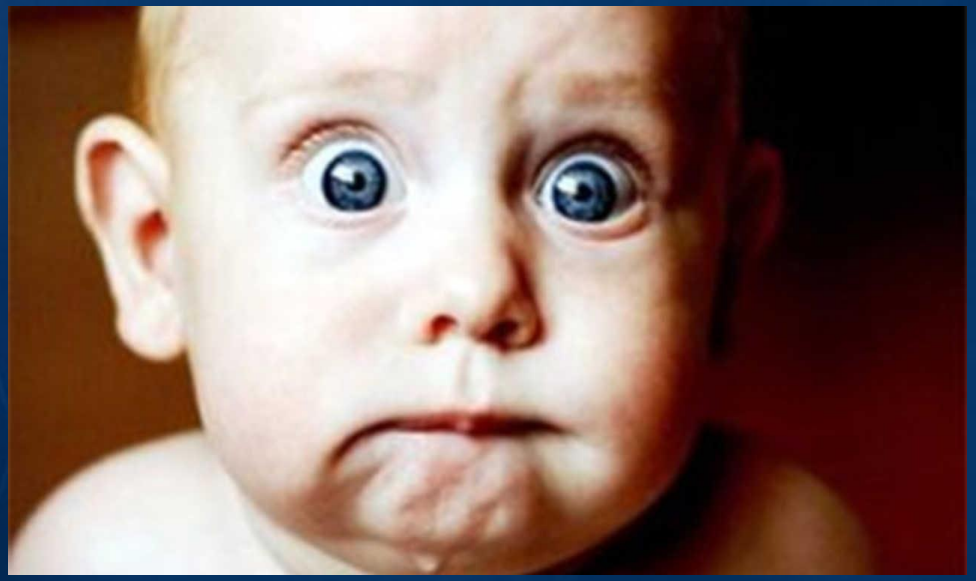
# Case 2

- Potential treatments
  - Neurosurgery consult for coiling versus clipping of aneurysm
  - B/P control
  - Nimodipine
  - Seizure prophylaxis
- Potential causes
  - Right posterior communication artery aneurysm



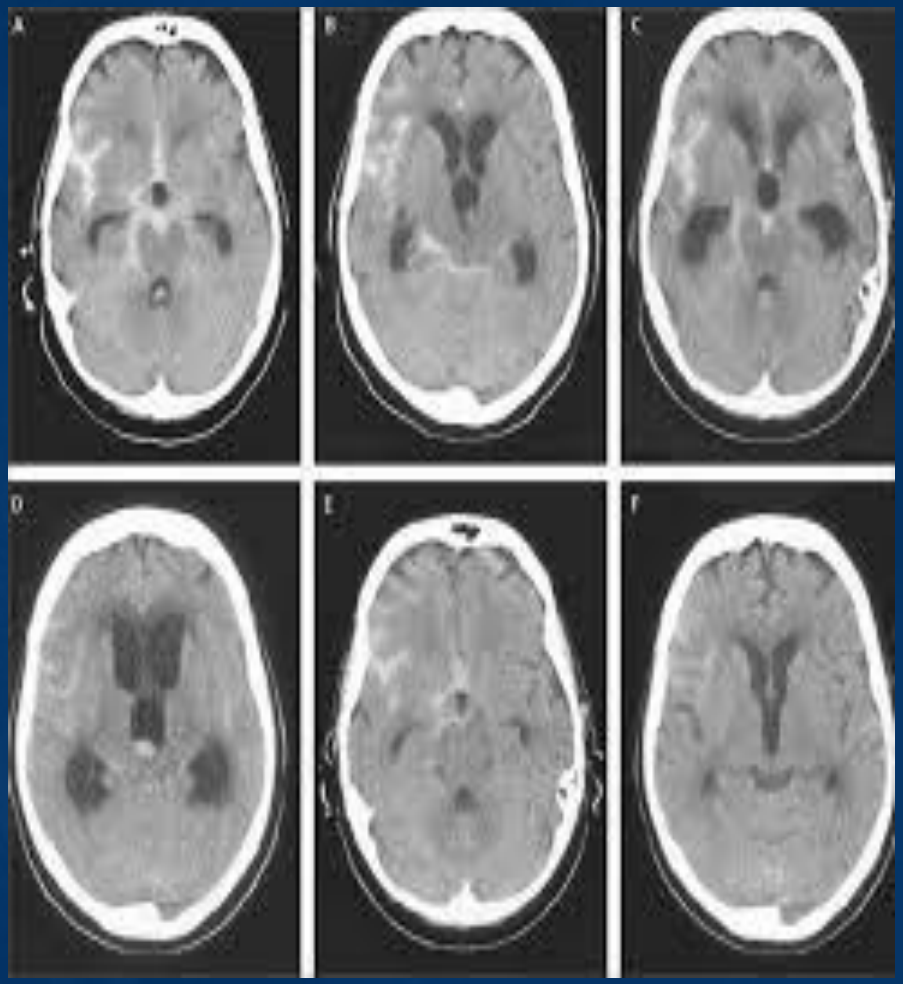
# Case 2 continued

- While awaiting neurosurgical consultation you notice that your patient has become increasingly somnolent. It now requires constant noxious stimuli to get your patient to open her eyes. Where the heck is neurosurgery and what the heck are you going to do now?!?!



# Case 2

- Complete a neurologic assessment
- Repeat Head CT
  - Rebleeding?
  - Hydrocephalus?
  - Vasospasm?
  - Seizure?
  - Cerebral edema?



# Case 2

- Hydrocephalus
- Neurosurgery to the rescue! An external ventricular drain is inserted with an opening pressure of 34!

**SAVED BY THE SCAN**

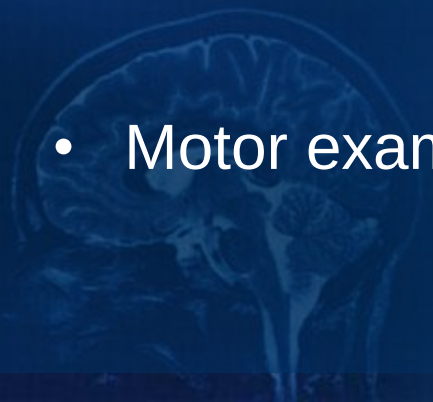
# Case 3

- 24 year-old male with unknown PMH is admitted to the MICU with sepsis 2/2 intravenous drug use. He was initially hemodynamically unstable so he was intubated in the ED, sedated, and placed on pressors. He is now hospital day #3 and with broad spectrum antibiotics his hemodynamics are improved so he was weaned off pressors. The decision was made to discontinue his sedation and extubate him. After several hours of no sedation he appears comatose. A neuro assessment is completed and he is found to have a left gaze deviation.

What else would you like to know?

# Case 3

| Neuro Exam | Findings |
| --- | --- |
| • Mental Status | • Comatose |
| • Cranial nerves | • Left forced gaze deviation, pupils 4mm bilaterally (trace reactive), corneal reflexes bilaterally, does not doll, face taped, trace cough with stimulation, trace gag with stimulation |
| • Motor exam | • Flaccid, no movement to central or peripheral stimuli |



# Case 3

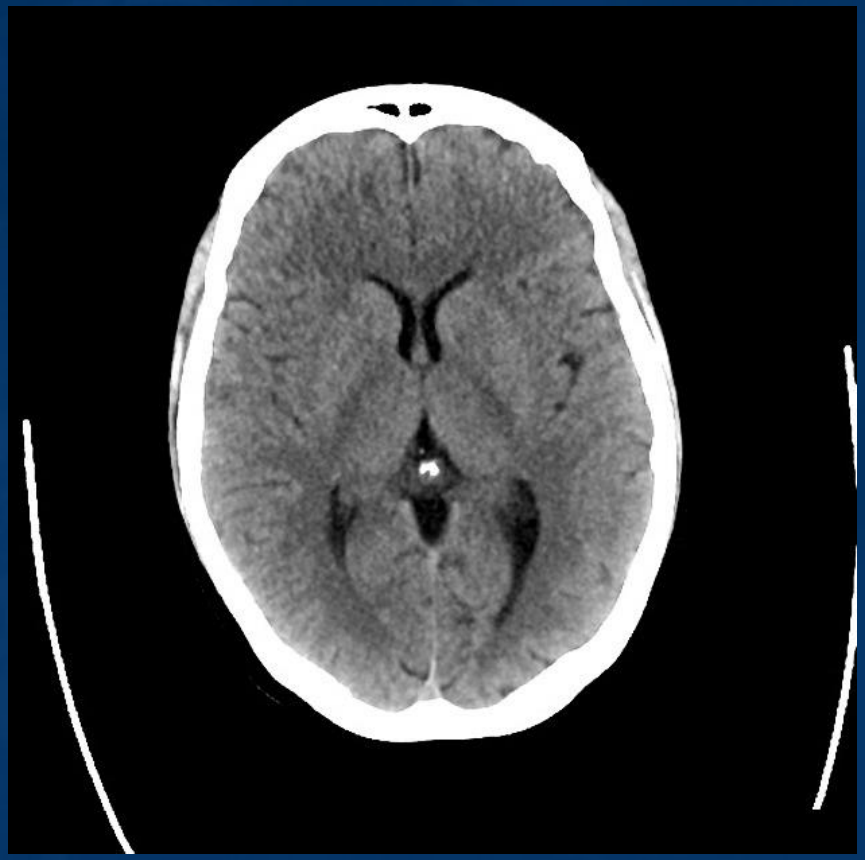
- Labs
  - BMP, PT/PTT, INR, CBC, toxicology screen, ETOH level, BG, HIV, ammonia
- Diagnostic tests
  - Non-contrast Head CT or Head CT angio, Lumbar puncture, EEG, MRI of brain with and without contrast, ECHO

# Differential diagnosis

- Ischemic stroke
- Hemorrhagic stroke
- Seizure
- Mass lesion
- Meningitis
- Still sedated

# Case 3

- Head CT- normal
- Labs- unremarkable, however upon chart review you see that his UDS was positive for Benzodiazepines in the ED in addition to an elevated blood ETOH level
- EEG- status epilepticus!!!



# Case 3

- Potential treatments
  - Emergent and urgent medication for seizure control STAT! Continuous EEG, Neurology consult
- Potential causes
  - Benzo withdrawal, ETOH withdrawal, meningitis, encephalitis, history of epilepsy and noncompliance with meds

# Case 4

- 72 year-old male with no significant PMH (because he does not go to the doctor) presents to the ED after a fall. According to the patient's wife he was walking into the kitchen to make breakfast when she heard him fall. She found him on the floor covered in blood so she called EMS. Upon arrival EMS noted that he had a head laceration, left sided weakness, and dysarthria. His blood pressure was 246/122 so he was given Hydralazine 10mg and transported to the ED. He remains hypertensive with his most recent B/P 228/114.

What else would you like to know?

# Case 4

| Neuro Exam | Findings |
| --- | --- |
| • Mental status | • Lethargic |
| • Cranial nerves | • Pupils are bilaterally 3mm and reactive. Nystagmus with vertical gaze and bilateral VI nerve palsy's. Weak gag and significant dysarthria. |
| • Motor exam | • Withdrawals left side to painful stimuli and localizes briskly with the right side. |

# Case 4

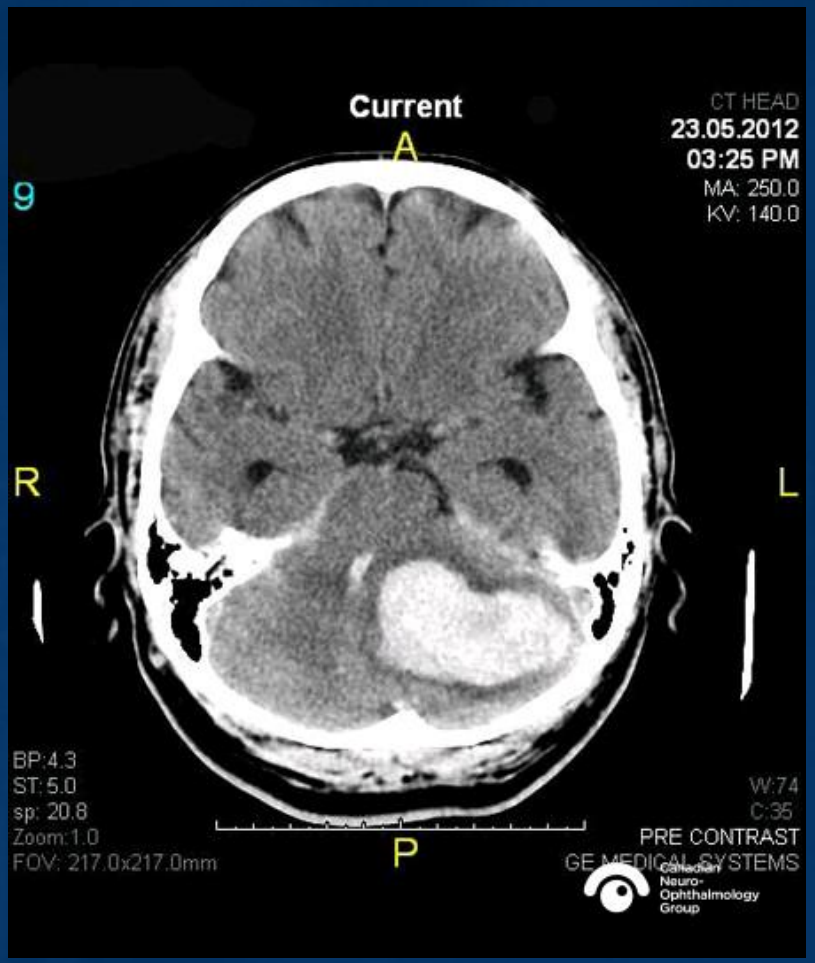
- Labs
  - BMP, PT/PTT, INR, CBC, toxicology screen, ETOH level, BG, troponin
- Diagnostic tests
  - Non-contrast Head CT or Head CT angio, ECG

# Differential Diagnosis

- Ischemic stroke
- Hemorrhagic stroke
- Subarachnoid hemorrhage
- Subdural hematoma
- Epidural hematoma
- Traumatic brain injury
- Tumor

# Case 4

- Labs- unremarkable
- Head CT angio- Left cerebellar hemorrhage



# Case 4

- Potential treatments
  - Blood pressure control, emergent neurosurgical consultation, possible External Ventricular Drain (EVD) insertion, possible OR for posterior fossa decompression and hematoma evacuation, Osmotic therapy
- Potential causes
  - Uncontrolled HTN, arterial venous malformation (AVM)

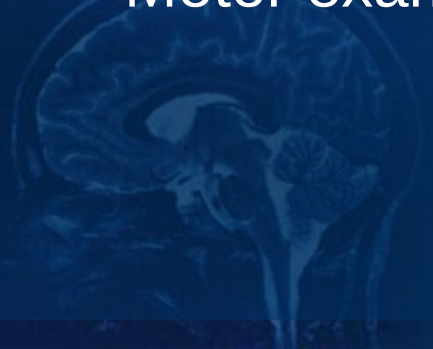
# Case 5

- 76 year-old female with a past medical history of HTN, HLD, DM, breast Ca who is POD #5 from an ORIF of her right femur. Unfortunately her hospital course has been complicated by DVTs and a PE for which she required a Heparin infusion. Upon physical exam this morning she was found to be less responsive.

What else would you like to know?

# Case 5

| Neuro Exam | Findings |
| --- | --- |
| • Mental status | • Obtunded |
| • Cranial nerves | • Pupils are bilaterally 4mm and reactive. Positive corneal reflexes. Positive dolls reflexes. Positive cough and gag. |
| • Motor exam | • Localizes briskly with RUE and RLE. Withdrawals LUE and LLE to painful stimuli. |



# Case 5

- Labs
  - Blood glucose, BMP, PT/PTT, INR, CBC, T&S
- Diagnostic tests
  - Non-contrast Head CT, +/-MRI, EEG

# Differential diagnosis

- Hemorrhagic stroke
- Subdural hematoma
- Seizure
- Mass lesion
- Recent pain medication
- Subdural or epidural empyema
- Meningitis

# Case 5

- Labs- unremarkable. PTT 74
- Non-contrast HCT shows acute right sided subdural hematoma with subfalcine herniation

# Case 5

- Potential treatments
  - Hold Heparin infusion, reverse the Heparin, likely intubation for airway protection, emergent neurosurgical consultation, HOB elevated, osmotic therapy
- Potential causes
  - Heparin infusion, may have had a SDH that was not seen on a previous HCT, new head trauma

# References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Thank You!