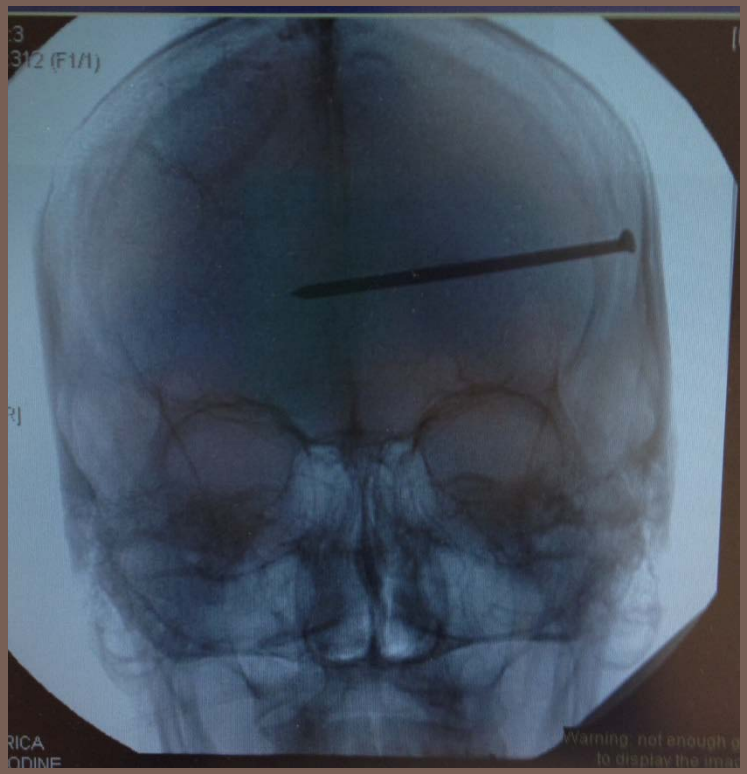


HEAD INJURY
AND OTHER BRAIN BLEEDS

Christine K. Compisi, PA-C
NorthShore University HealthSystem

Outline

- Brief head/brain A&P
- Exam of the head injury patient
- Imaging guidelines
- Scalp laceration
- Skull fracture
- Brain bleeds
  - Epidural hematoma
  - Subdural hematoma
  - Subarachnoid hemorrhage
  - Intraparenchymal hemorrhage
  - Intraventricular hemorrhage
- Concussion
- Diffuse axonal injury

Background

- Leading cause of traumatic death in pts <25
- 80% of head injuries are mild (GCS 14-15)
- 10% moderate
  (GCS 9-13)
- 10% severe (GCS <9)

A&P

- Fused sutures = rigid vault = constant intracranial volume
- Rigid vault contains: 1. brain. 2. blood. 3. CSF.
- Monro-Kellie hypothesis
- Normal ICP 5-15/20mmHg
- CPP = MAP – ICP
  - Increased ICP → ischemia

Brain Injury – Primary vs Secondary

- Primary brain injury
  - Occurs at impact
  - Mechanical, irreversible damage
- Secondary brain injury
  - Occurs from ongoing neuronal damage, hematoma, brain swelling, ischemia or infection, hypoxia, hypotension, intracranial hypertension

Brain Injury – Focal vs. Diffuse

- Focal Damage
  - Cortical contusions and lacerations
  - Subdural hemorrhage
  - Extradural hemorrhage
  - Herniation
  - Infection
- Diffuse damage
  - Diffuse axonal injury
  - Cerebral swelling
  - Cerebral ischemia

Head Injury - Approach

- History
- PE
- Finger stick blood sugar
- Warning signs for neuroimaging
  - worst HA of life, vomiting, worsening over days, aggravated by exertion or valsalva, fever, neck stiffness, altered mental status, abnormal neuro exam, peri- or retro- orbital pain, sudden onset

Head Injury - Exam

- Circulation
  - Pulse and blood pressure
  - IV fluids for hypotension
  - →CT abdomen?
- Airway
  - Obstruction? ETT? Anesthesia?
- Breathing
  - O2 if needed
  - Examine chest for possible flail segment or hemo/pneumothorax
  - →chest Xray?

Head Injury - Exam

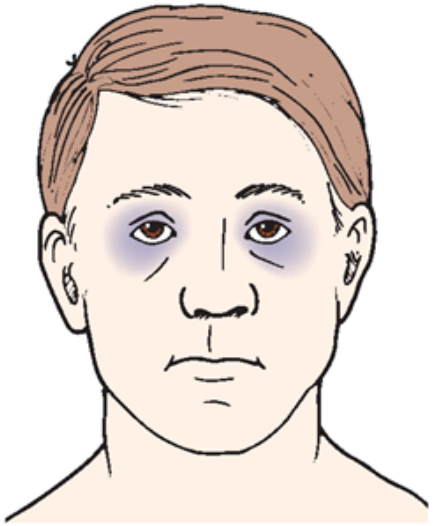
- Head/spinal injury
  - LOC & focal signs
  - →CT head
  - Consider possibility of spinal injury
  - →CT/Xray spine
- Limb injuries
  - Examine limbs for lacerations and fractures
  - →Xrays

Head Injury – Focused PE

- Lacerations
  - explore deep lacs with a gloved finger for evidence of a depressed fracture
- Grazing/bruising
  - if frontal lac or bruising, consider cervical spine injury

Head Injury – Focused PE

- Fractures signs = potential route of infection/meningitis
  - CSF rhinorrhea
  - Raccoon's eyes
  - Subconjunctival hemorrhage



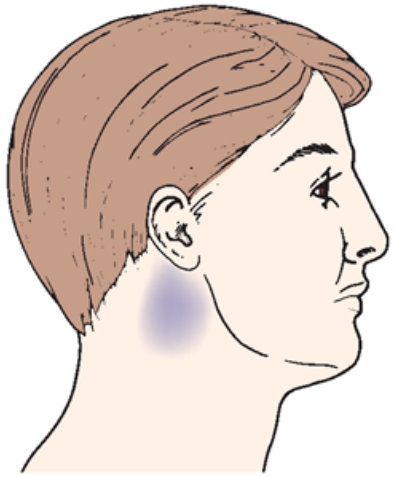
B Raccoon's eyes

Head Injury – Focused PE

- More fracture signs
  - Hemotympanum
    - Bleeding from the EAM

  - Battle's sign
    - Bruising over the mastoid

      May take 24-48 hours to develop



C Battle's sign

Head Injury – Focused PE

- Level of Consciousness
- Pupil Response
  - Ipsilateral dilation initially
- Eye Movements
- Limb weakness
  - Contralateral
- Vital signs
- Cranial nerves

HCT Criteria

- Immediate CT scan if:
  - GCS <13 on initial assessment
  - GCS <15 2hrs from injury
  - Suspected open or depressed skull fx
  - Sign of basal skull fx
  - Post traumatic seizure
  - Focal neurologic deficit
  - >1 episode of vomiting
  - If amnesia or LOC with bleeding disorder/anticoagulants
- Scan within 8 hrs of injury if:
  - Amnesia or LOC with age >65 or dangerous MOI
- In children
  - Lower threshold
  - Any of the above or impairment of level of consciousness in <1yr – presence of bruise, swelling or laceration

Cervical Imaging Criteria

- AP, lateral and odontoid xrays if:
  - Impaired neck rotation to right or left
  - No indication for CT scanning
  - Not safe to assess clinically
  - Neck pain/midline tenderness in a 65+ y/o or dangerous mechanism of injury
  - To exclude injury urgently (i.e. prior to surgery)
- CT cervical spine if:
  - Intubated
  - Continued suspicion despite xrays
  - Inadequate xrays
  - Undergoing CT scanning for another reason (i.e. GCS <13 or multi-region trauma)
- Children <10y/o
  - AP and lateral views only (no odontoid)
  - Use CT to clarify abnormalities or uncertainty

Scalp Laceration

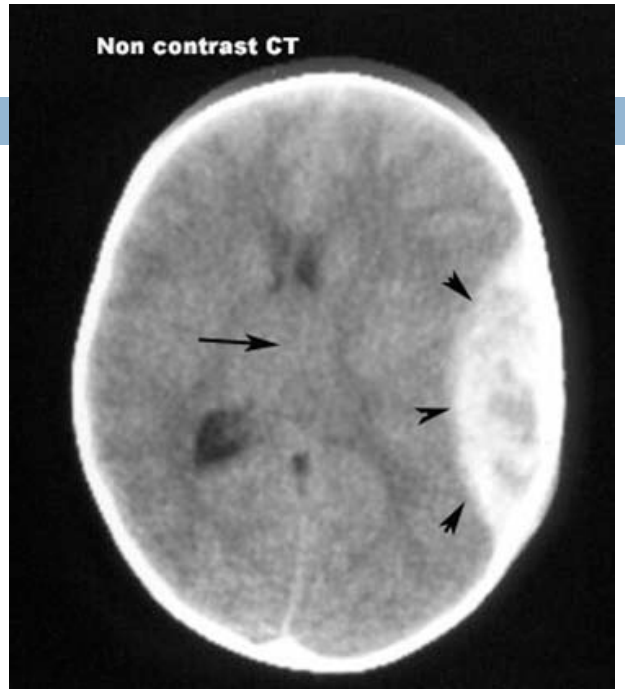
- Direct blow to the head
- Scalp will bleed
- Explore skull for depressions and scalp for other lacerations
- Noncontrast HCT if indicated
- CBC, chem, coags, T&S, tox screen if sig blood loss
- Hemostasis, irrigation, closure
  - If galea not involved → staples
  - If galea involved → repair galea with absorbable sutures, skin with interrupted or vertical mattress sutures (3-0 nylon or Prolene)
- If no other injuries, can d/c. Otherwise admission and observation

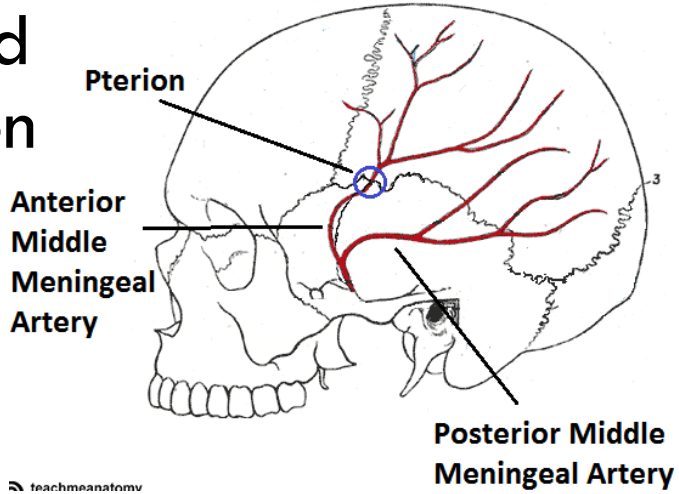
Skull Fracture

- Direct blow to the head, pt c/o pain
- Findings
  - Skull depression
  - raccoon eyes, Battle sign, otorrhea and rhinorrea, 7th nerve palsy, hemotympanum
- Imaging:
  - Skull xray
  - noncontrast HCT
- Management:
  - Guided by injury
- Obs 23hr admission minimum
- Indication for surgical intervention:
  - depressed greater than thickness of the skull
  - open fracture
  - dural lac
- Complications:
  - Infection
  - Epilepsy
- GCS more indicative of underlying brain injury or hemorrhage

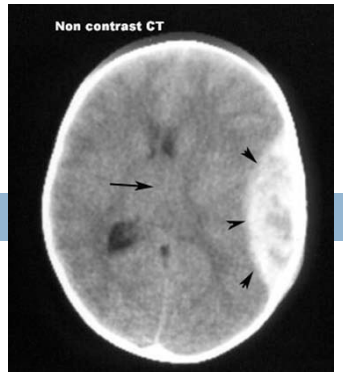
Epidural Hematoma

- Tearing of the middle meningeal artery
- Blood accumulates between the skull and dura
- Cause: head injury
- Initially lucid, followed by rapid deterioration





Epidural Hematoma



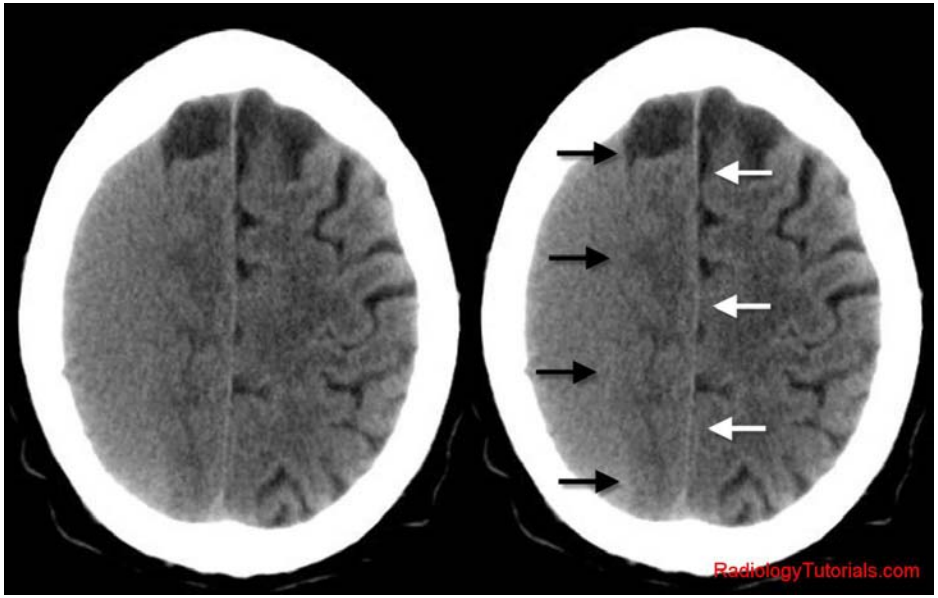
- Exam:
  - Ipsilateral pupil deviation
  - +/- contralateral hemiparesis
  - N/V, +/- seizures
  - Hyperreflexia
  - + babinski
  - 90% assoc. with a linear skull fracture
- Imaging:
  - Noncontrast HCT
- Management
  - Airway
  - Neurosurg consult
  - CBC, chem, coags, T&S, +/- PFA
  - Reverse coagulopathy: Vit K, FFP, Novo7, Kcentra
  - Admit
  - Surgery if symptomatic

Subdural Hematoma

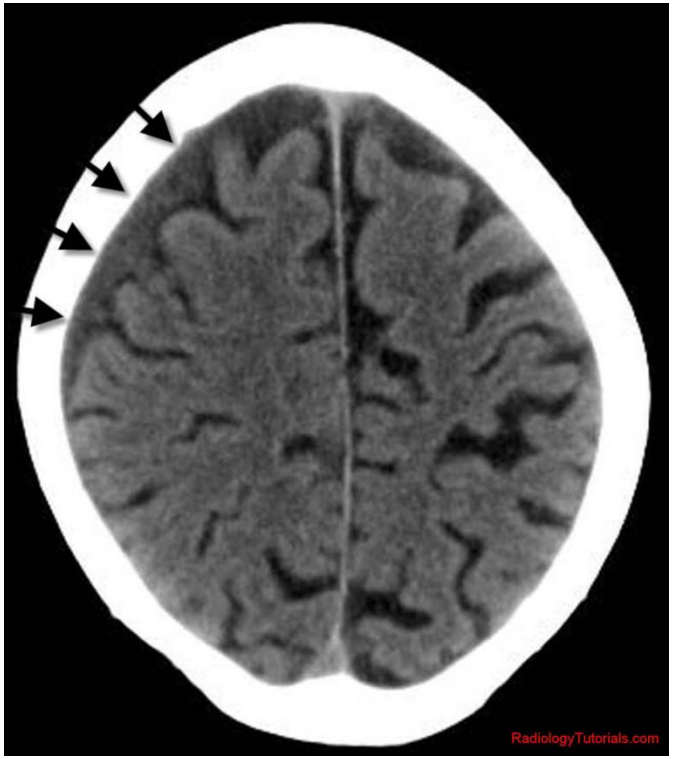
- Blood in subdural space (between dura & arachnoid)
- Acceleration/deceleration injury
- Can be acute (<48h), subacute (2d – 3wk) or chronic (>3wk)
- Range from HA with nausea to comatose and flaccid
- Noncontrast head CT → crescent shaped mass.
  - Hyperdense (BRIGHT) if acute
  - isodense (SAME) if subacute
  - Hypodense (DARK) if chronic
- Labs: CBC, chem, coags, T&S, +/- PFA

SDH: Imaging

Subacute (isodense)



Chronic (hypodense)



SDH: Treatment

Treatment:

- Airway management, emergent neurosurgical evaluation
- If increased ICP or midline shift → mannitol & phenytoin (per neurosurgery)
- Reverse coagulopathy (Vit K, FFP, Novo7, Kcentra)
- Nonoperative
  - Admission. Repeat CT scans at 6hrs and 24hrs after initial scan
- Operative
  - Symptomatic, >1cm with mass effect
- More common than epidural hematoma
- Comatose and flaccid patients with SDH have an extremely poor prognosis, should discuss with family

Subarachnoid Hemorrhage

- CC: “worst HA of my life”, acute, onset known
- Cause: trauma or spontaneous
- Sx: HA, N/V, seizures, syncope, AMS
- Imaging: noncontrast HCT
  - 95% sensitive for acute SAH within 6-24hrs
  - If negative and high suspicion → LP
  - If concern for a ruptured cerebral aneurysm, obtain CT angiogram (CTA head)

Subarachnoid Hemorrhage

- Treatment
  - Airway
  - Elevate HOB to 30 degrees
  - SBP 90-140, HR 50-90
  - Reverse coagulopathy
  - Neurosurgery
    - Nimodipine – decreases vasospasm
    - Keppra – seizure proph
    - Admit. +/- angiogram.

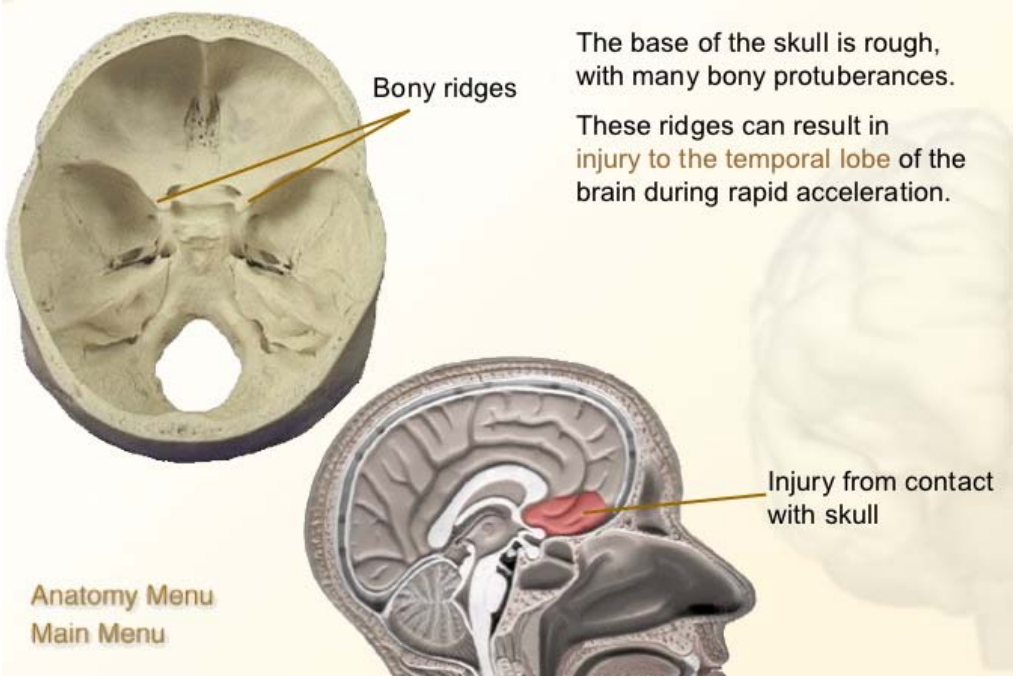
Subarachnoid Hemorrhage

- Outcome

Hunt-Hess Scale for SAH	
Grade	Percent Survival
1. Asymptomatic or mild HA	70%
2. Moderate to severe HA, nuchal rigidity, no neuro deficits or other CN palsy	60%
3. Confusion, drowsiness, mild focal signs	50%
4. Stupor or hemiparesis	40%
5. Coma, moribund appearance, posturing	10%

Intraparenchymal Hemorrhage

- Mass lesion, within the brain parenchyma, hyperdense on CT scan
- Commonly frontal/temporal lobes if traumatic cause
  - Close proximity to bony ridges
- Risk factors:
  - HTN
  - Age
  - h/o stroke
  - anticoagulant use
  - vascular malformation



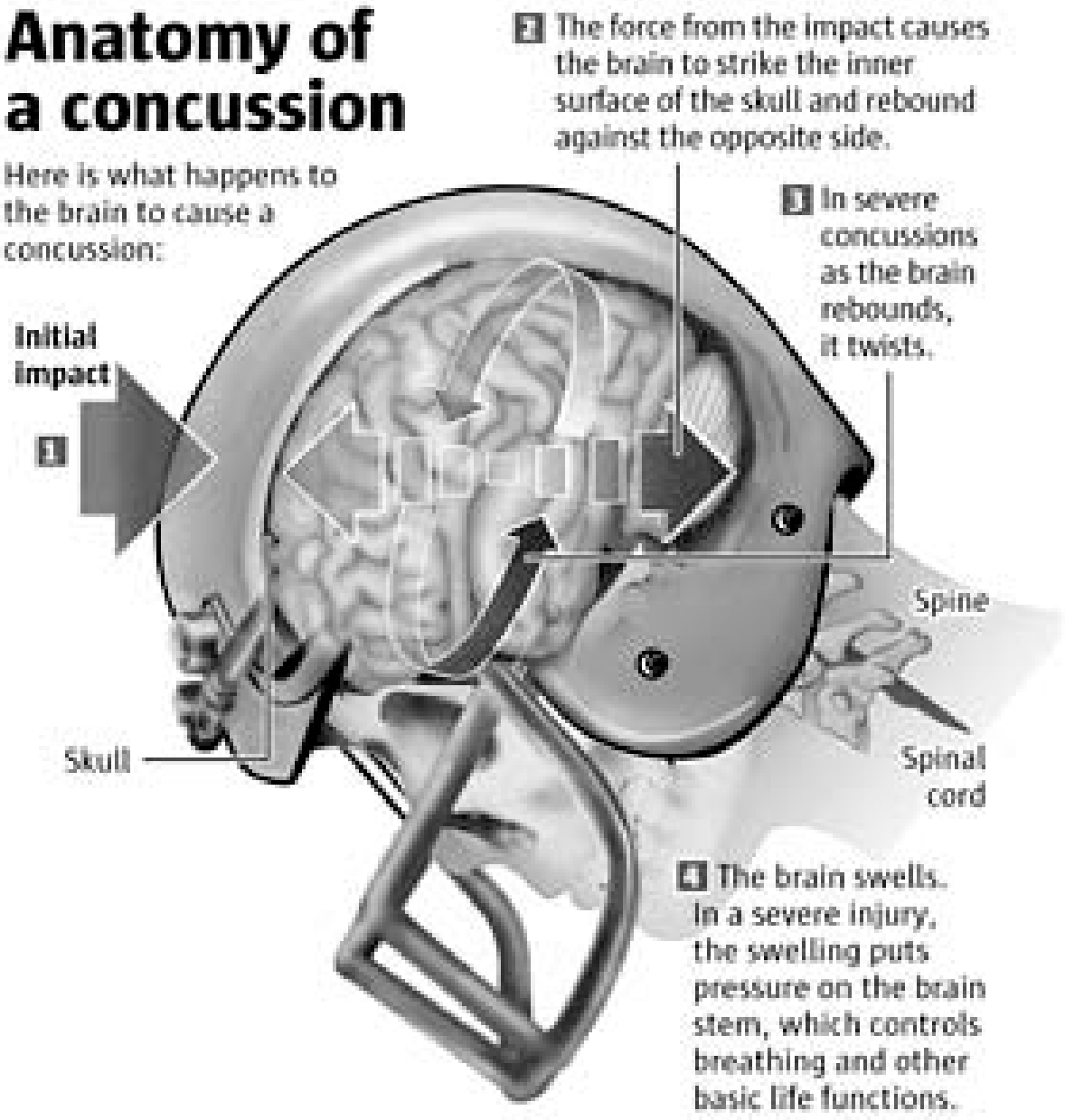
Intraparenchymal Hemorrhage

- Sx: HA, N/V
- Imaging
  - Noncontrast HCT → irregular hyperdensity surrounded by hypodensity (edemetous brain)
- Labs: CBC, chem, coags, T&S, +/- PFA
- Tx:
  - Airway
  - Reverse coagulopathy
  - Neurosurgery

Intraventricular Hemorrhage

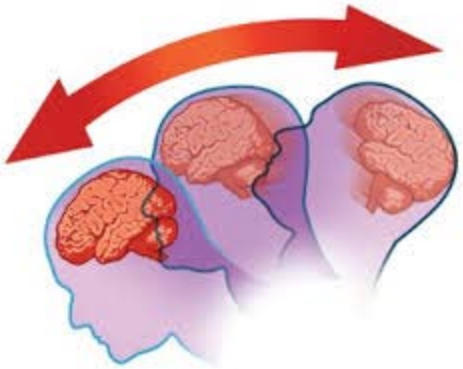
- Cause: typically secondary to intraparenchymal or SAH
- Sx: similar
- Tx: EVD

Concussion


Anatomy of a concussion
Here is what happens to the brain to cause a concussion:
1 Initial impact
2 The force from the impact causes the brain to strike the inner surface of the skull and rebound against the opposite side.
3 In severe concussions as the brain rebounds, it twists.
Skull
Spine
Spinal cord
4 The brain swells. In a severe injury, the swelling puts pressure on the brain stem, which controls breathing and other basic life functions.
Sources: Dr. Joy Rosenberg of Kaiser Permanente Medical Care Neurology; American Academy of Neurology; The Human Body
MARK NOWLIN / THE SEATTLE TIMES

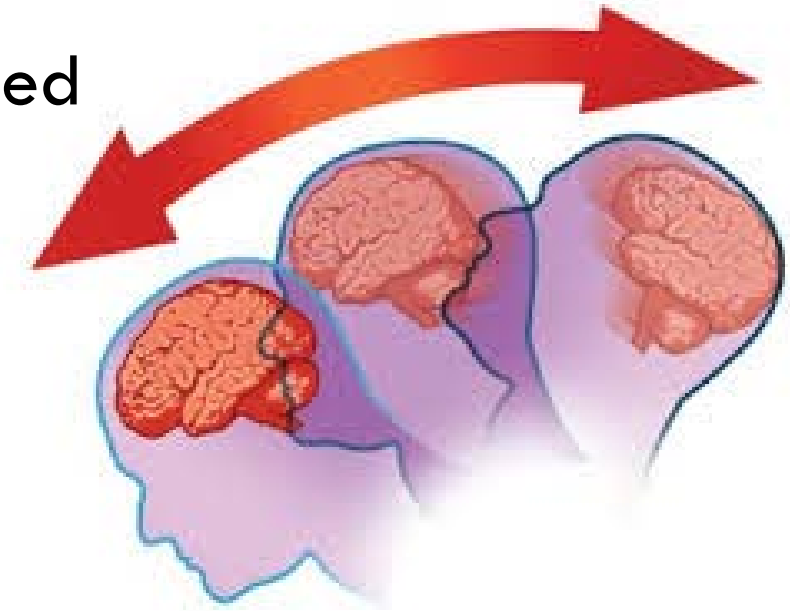
Post-concussive Syndrome

- Closed head injury +/- LOC.
- Spectrum of neuro complaints
- HA may last weeks to months
- Exam often normal
- Noncontrast HCT r/o bleed but otherwise of little yield
- Treat the symptoms
- Return to play after 2wks symptom free



Diffuse Axonal Injury

- Diffuse, devastating brain injury
- Cause: shearing forces disrupting nerve endings → brain cells die → swelling
- Patient presents in a coma
- Document neuro exam
- Noncontrast CT to r/o bleed
- MRI to guide prognosis
- Manage airway
- Neurosurgery



References

- Lindsay, K., Bone, I., & Fuller, G. (2010). *Neurology and Neurosurgery Illustrated*. UK: Elsevier Health Sciences.
- Jandial, R. (2004). *Neurosurgical Essentials*. St. Louis, Missouri: Quality Medical Publishing, Inc.
- Zane, R. D. (2010). *Pocket Emergency Medicine*. LWW.