Closed Head Injury: Headache to Herniation

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EMS TECHNOLOGY PROGRAM

Objectives

- Describe the pathological process of a closed head injury and increased intracranial pressure.
- Recognize the signs and symptoms of a closed head injury patient who is decompensating (herniating).
- Field treatment of a closed head injury patient.

Normal Anatomy

Skull

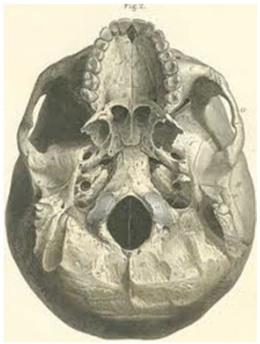
Brain

Meninges

Dura Mater

Arachnoid

Pia Mater



Normal Anatomy

- Skull
- Brain
- Meninges
- Dura Mater
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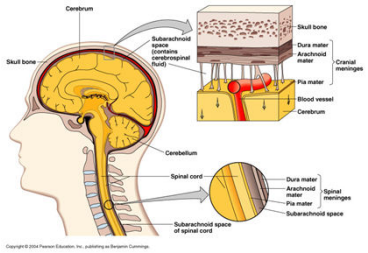
- Pia Mater



Closed Head Injury (2014)

A Little Physiology (Very Little)

My Brain Needs	To Get O_2 and Glucose
• Oxygen • Glucose	• I need perfusion • I need Cerebral Perfusion Pressure (CPP) How do I get it?

Closed Head Injury (2014)

Cerebral Perfusion Pressure

- I need blood flow with decent pressure
  - Blood Pressure
  - Mean Arterial Pressure (**MAP**)
  - MAP = $\frac{\text{Diastolic} + \text{Diastolic} + \text{Systolic}}{3}$
  - 70mmHg – 120mmHg is normal perfusion pressure for organs
- I have a consistent yet low Intracranial Pressure (ICP)
  - Approximately 10mmHg

Closed Head Injury (2014)

Cerebral Perfusion Pressure

CPP = MAP – ICP (minimum CPP of 60 – 70mmHg)

- If I keep a decent Blood Pressure my CPP is good.
- If I keep my ICP low my CPP is good.
- Mess with either of these and my brain suffers. ☹

For example:

- Drop my MAP below 60 – 70mmHg.
- Increase my ICP to greater than 20mmHg.

Closed Head Injury (2014)

I've Got Gas

Oxygen (PaO_2)	Carbon Dioxide (CO_2)
• Normal: 80–100mmHg • Get your PaO_2 > 100mmHg and the blood vessels constrict • Drop your PaO_2 and your blood vessels dilate	• Normal 35-45mmHg • Drop your CO_2 and blood vessels vasoconstrict. • Increase your CO_2 and vasodilate.

Closed Head Injury (2014)

CPP Normal Compensation

Slight Rise in ICP	Gas
• Jump the B/P up slightly • Maybe vasodilate some. Our body will do anything to keep the brain comfortable!	• Hyperventilate to get rid of carbon dioxide and vasoconstrict.

Closed Head Injury (2014)

- Important Stuff
- Concussion
- Coup-Contracoup
- Intracerebral hemorrhage
- Epidural hematoma
- Subdural Hematoma
- Increased ICP
- What to do in the field.

Tony; "You only have 25 minutes to discuss the Important Stuff!"

Closed Head Injury (2014)

Concussion

- Somatic: Loss of or change in consciousness.
- Cognitive: Felling in a fog
- Emotional: Changeability
- Behavioral: Irritability
- Cognitive Impairment: Slowed reaction times and/or sleep disturbances.
- Ataxia, Headache,
- Negative Progression Process: Lots of little's add up to major signs and symptoms.
  - NFL

Closed Head Injury (2014)

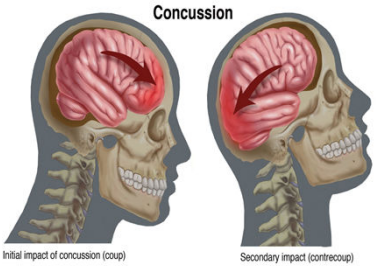
Coup - Contra coup

Primary blunt trauma.

Does not describe the severity of injury, just the mechanism of cerebral impact.

Coup: Initial impact

Contra coup: recoil impact. Can be as severe as the coup.



Closed Head Injury (2014)

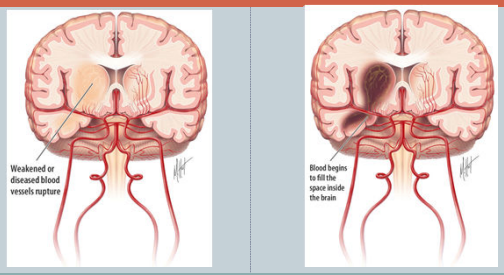
Intracerebral Hemorrhage

- Mostly frontal and temporal lobes
- Subarachnoid / aneurysm
- Usually a medical incident but can be trauma

Closed Head Injury (2014)

Intracerebral Hemorrhage

Normal Anatomy **Bleed**



Closed Head Injury (2014)

Signs/Symptoms

Hypertension

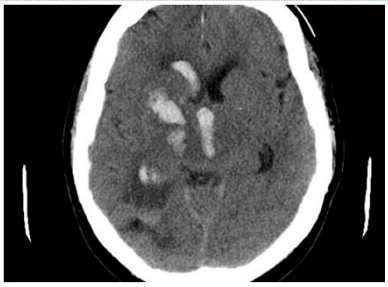
Headache (worst of my life).

Progressive and rapid loss of consciousness.

High ICP

Hemiplegia

Pupil abnormalities



Intracerebral Hemorrhage

Closed Head Injury (2014)

Between skull and dura mater.

Associated with fracture of temporal or parietal skull.

Lacerates middle meningeal artery.

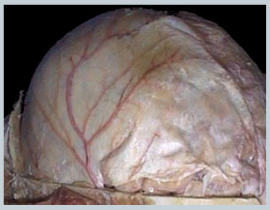
Rapid, Rapid, Rapid

Epidural Hematoma

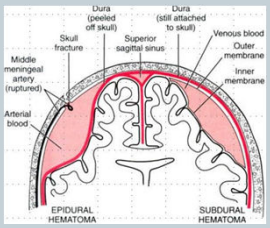
Closed Head Injury (2014)

Middle Meningeal Artery
(Supplies Skull and Dura Mater)

On the Surface



Lacerated



Closed Head Injury (2014)

Epidural Signs and Symptoms

- Loss of Consciousness
- Lucid Period
- Maybe headache C/O
- Maybe nausea/vomicking
- Crash
- Rapid rise in ICP
  - We will get to this!
- Seizure
- Posturing
  - Decorticate (Flexion)
  - Decerebrate (Extension)
- Need to relieve pressure!

Closed Head Injury (2014)

Beneath the Dura mater.

Venous bleed

Bridging veins

Acceleration/Deceleration

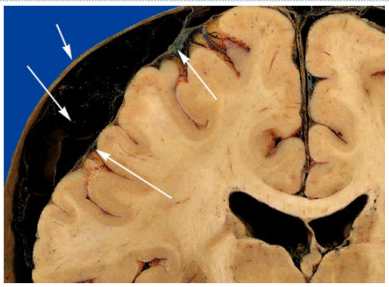
Jarring injury

More injury to brain tissue

Acute or Chronic

Acute (within 48 hours)

Chronic (>48 hours, days, weeks, month)



Subdural Hematoma

Closed Head Injury (2014)

Signs and Symptoms

Acute

Altered LOC

Steady decline

Increased ICP

Hemiparesis/Hemiplegia

Fixed pupils

Chronic

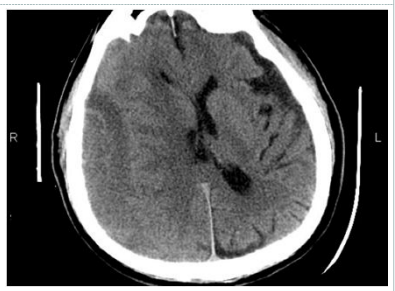
Headache

Progressive decreased LOC

Ataxia

Incontinence / Seizure

Axonal / Focal Brain Injury



Subdural Hematoma

Closed Head Injury (2014)

Closed Head Injury

Frontal

Frontal

Closed Head Injury (2014)

Closed Head Injury

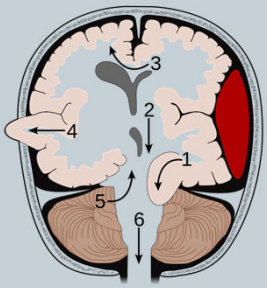
Frontal **Temporal**

Intracranial Pressure

- CPP = MAP – ICP
- The ICP elevates either slowly (subdural) or rapidly (epidural) or somewhere in between.
- Why they are sick doesn't matter to us!

Increased ICP

- Increased pressure due to an expanding hematoma in the brain (any growing mass).
- Brain begins to herniate
- Shift away from injury
- Follows path(s) of least resistance.
- Where it goes gives you the signs and symptoms



Increased ICP
Signs and Symptoms

- Altered level of Consciousness
  - Arouses to pain
  - Look at Glasgow Coma Scale (especially motor)
  - Posturing
    - Decorticate
    - Decerebrate
  - Frank Coma

These event may be rapid or slow!

- Airway
  - Patent
  - Needs adjunct
  - Prepare to tube
  - Maintaining the airway is imperative for any chance of survival.
    - Main indication for RSI in the field.

Glasgow Coma Scale

Glasgow coma scale

		Score
Eye opening	spontaneously	4
	to speech	3
	to pain	2
	none	1
Verbal response	orientated	5
	confused	4
	inappropriate	3
	incomprehensible	2
	none	1
Motor response	obeys commands	6
	localises to pain	5
	withdraws from pain	4
	flexion to pain	3
	extension to pain	2
	none	1
Maximum score		15

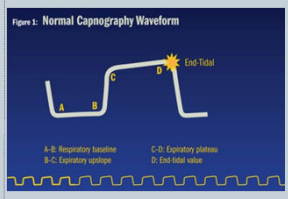
Increased ICP
Signs and Symptoms

- Breathing
  - Normal with slight elevated rate.
  - As they digress
    - Central Neurogenic Hyperventilation
      - Fast and Deep
    - Cheyne Stokes
    - Biots
    - Hypoventilation

- Infringement on Medulla
- Method to compensate
- Hyperventilates to decrease PCO_2 (vasoconstrict)

Increased ICP
Signs and Symptoms

- Breathing Continued
- Measure the End Tidal CO_2.
  - Waveform capnography
  - Ventilate them to keep End Tidal CO_2 at **30mmHg**
  - **Never below 30mmHg**
- **Below 30mmHg could cause cerebral vasoconstriction and ischemia**



Closed Head Injury (2014)

Increased ICP
Signs and Symptoms

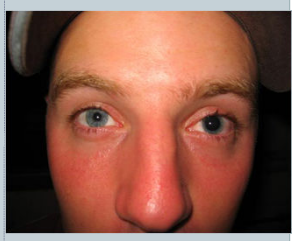
- Circulation
  - Pulse will be slow (slowing down) 30 – 50 / minute
  - Bounding
  - Blood Pressure will be elevated (i.e. 200/110)
- Do not speed the pulse up or lower the B/P

- Due to the herniation, pressure is exerted on the medulla.
- Brain sends out signals to increase B/P because it is dying (sympathetic NS)
- Stimulation of Baroreceptors located in carotid arteries and aortic arch cause a parasympathetic response and slow pulse.
- Also pressure on medulla can slow pulse.

Closed Head Injury (2014)

Increased ICP
Signs and Symptoms

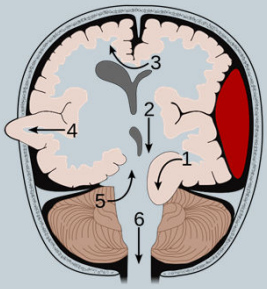
- Pupils
  - Sluggish
  - Blown Pupil
    - Not Aniscoria (awake)
    - They are unconscious
  - Pressure on 3rd Cranial Nerve.



Closed Head Injury (2014)

Increased ICP
What's Happening

- Increased pressure in skull from expanding hematoma.
- Pushing brain our foramen magnum.
- Pushing brain up and over.
- Patient dies.



Closed Head Injury (2014)

Treatment of Increased ICP

- Need to stop hemorrhage!
- So we blow off CO_2 to vasoconstrict.
  - BUT, when I do this I run the risk of cutting off blood flow to an already injured brain.
- Intubate, ventilate, capnography!
- Sux if you must!
- Keep at 30mmHg!

Closed Head Injury (2014)

Treatment of Increased ICP

- Pulse is Slow so leave it go!
- B/P is high, still alive!
- B/P low – no, no, no!
- Keep head of bed elevated 20 – 30 degrees if possible!
- Protect C-Spine!
- If B/P pressure is low (<100 systolic) you need to give fluids.
- No permission for permissive hypotension.

Closed Head Injury (2014)

Treatment of Increased ICP

- Get them to the right place ASAP.
- Minimal scene time for airway only!

Have a Great Day!