

Head Trauma

- The goal of treatment is to prevent secondary brain injury
- You accomplish this by
 - Ensuring adequate oxygenation
 - Maintaining a blood pressure high enough to perfuse the brain
- Do not delay transfer by waiting for a CT head

NORMAL ICP: 10mmHg

Anything over 20mmHg is associated with a poor outcome

MONRO-KELLIE DOCTRINE

- the head is a rigid vessel
- thus, the total volume of fluid must remain the same
- as a mass grows, it displaces venous blood and CSF first, and so there is some compensation for its volume
- when you run out of CSF and venous blood, the ICP rises sharply
- herniation occurs around 60-70 mmHg

CEREBRAL BLOOD FLOW

- normal is 50-55ml of blood per every 100g of brain tissue, per minute
- much higher in children: approaches 90ml between 1 year and puberty
- cerebral perfusion pressure needs to be above 60mmHg
- thus, you need a MAP of around 70-80
- you also need to maintain normal PaCO₂ and PaO₂

CLASSIFICATION OF HEAD INJURY

- **MECHANISM:**
 - Blunt vs penetrating
- **SEVERITY:**
 - GCS 14 and above: mild
 - GCS 9 to 13: moderate
 - GCS under 8: severe
- **MORPHOLOGY:**
 - Skull fractures
 - Linear or stellate; open or closed
 - Base of skull fracture has a whole range of recognisable signs, such as Battles sign, periorbital hematoma, CSF rhinorrhoea, CSF otorrhoea.
 - **Hearing loss and facial paralysis may also occur; immediately (severed nerve) or with a delay of several days (better prognosis)**
 - Diffuse brain injuries
 - **CONCUSSIONS = NORMAL CT**
Concussion is a head injury with transient loss of consciousness without focal signs
 - **DIFFUSE BRAIN INJURY WITH HYPOXIA = swollen brain, loss of gray-white differentiation**

- **DIFFUSE AXONAL INJURY**
 - Shearing injury in a high velocity deceleration or impact, produces multiple small punctuate hemorrhages
 - Outcome is uniformly poor
- **Extradural hematomas**
 - Less common –9% of comatose patients, 0.5% of awake ones
 - Lenticular or biconvex hematomas on CT
 - Usually from the middle meningeal
- **Subdural hematomas**
 - More common- 30%
 - The underlying injuries are more severe
- **Contusions and intracerebral hematomas**
 - Common – 20-30%
 - 20% of them will cause enough of a mass effect to require decompression
 - take a while to mature; require repeat CT in 24 hrs

MANAGEMENT OF MINOR BRAIN INJURY

... about 3% of these have sudden unexpected deteriorations

- **WHO GETS A HEAD CT?**
 - Failure to return to GCS of 15 within 2 hours
 - Clinical suspicion of a skull fracture
 - More than two episodes of vomiting
 - Loss of consciousness for longer than 5 minutes
 - Retrograde amnesia for longer than 30 minutes
 - Dangerous mechanism of injury
 - Intoxication
 - Severe headaches
 - Anticoagulated patient
 - Focal deficit
 - Anyone older than 65 yrs
- **Of all people who satisfy these criteria,**
 - If the GCS is 13, - 25% will have CT findings and 1.3% will need neurosurgery
 - If the GCS is 15, - 10% will have CT findings and 0.5% will need neurosurgery
- **If they don't satisfy the above criteria, and if there are no CT changes, and the patient is asymptomatic, you can observe them for several hours and then discharge them**

MANAGEMENT OF MODERATE BRAIN INJURY

... about 10-20% of these have sudden unexpected deteriorations

- WHO GETS A HEAD CT?
 - everybody
- Admit them all
- Everyone will need serial neuro obs for 24 hrs
- Anyone with CT abnormalities will need another CT after 24 hrs

MANAGEMENT OF SEVERE BRAIN INJURY

- GET A HEAD CT unless it delays transfer

AIRWAY, BREATHING:

- mortality is doubled if they are hypoxic
- if the GCS is 8, you need to intubate them

CIRCULATION:

- mortality is doubled if they are hypotensive
- maintain a MAP of over 70

NEUROLOGICAL EXAMINATION:

- GCS score
- Pupil responses
- Use the BEST motor response – it's a better prognostic indicator

SECONDARY SURVEY:

- lateralizing signs: which limb withdraws, which flexes?

ADDRESS HYPOTENSION FIRST! Neurosurgical evaluation is a second priority

CT Head:

- midline shift of over 5mm = neurosurgical intervention

MEDICAL MANAGEMENT

- the goal is to prevent secondary injury
 - Intravenous fluids to establish normovolemia
 - Ventilate but don't let the PaCO₂ fall below 30
 - Only hyperventilate in case of acute neurological deterioration
 - Nobody really uses mannitol any more; however, if you HAVE to,
 - 20% solution; 1g/kg administered as a bolus
 - May be useful if they are herniating
 - Post-traumatic epilepsy happens in 5% of patients with closed head injuries and in 15% with severe head injuries:
 - Give a loading dose of 1g phenytoin

SURGICAL MANAGEMENT

- Clean the scalp wound and close it
- A depressed skull fracture needs an operation if it is depressed by more than its own thickness, and if its open and contaminated
- Drilling the head in ED rarely evacuates enough of the hematoma to make a difference

MANAGEMENT OF PENETRATING BRAIN INJURY

- A CT head, duh.
- Broad spectrum antibiotics
- Phenytoin loading – 1g as infusion
- Early ICP monitoring

BRAIN DEATH

- GCS of 3
- Non-reactive pupils
- Absent brainstem reflexes
- No spontaneous ventilatory effort

ANCILLARY STUDIES:

- EEG
- Absent cerebral blood flow
- ICP exceeds MAP for 1 hour or longer

All of this must be in absence of sedating medications

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