- 500ml/day CSF made to replenish volume of 150ml.
- ICP = MAP-CPP. Normal ~10mmHg. Raised = >20mmHg sustained for >15min.
- ICP monitoring if severe HI & coma, intracerebral haemorrhage, Reye's, hydrocephalus
    - Variety of devices, most commonly a ventricular device, also subdural & extradural

Causes of raised intracranial pressure

- Localised mass lesions: traumatic haematomas (extradural, subdural, intracerebral)
- Neoplasms: glioma, meningioma, metastasis
- Abscess
- Focal oedema secondary to trauma, infarction, tumour
- Disturbance of CSF circulation: obstructive hydrocephalus, communicating hydrocephalus
- Obstruction to major venous sinuses: depressed fractures overlying major venous sinuses, cerebral venous thrombosis
- Diffuse brain oedema or swelling: encephalitis, meningitis, diffuse head injury, subarachnoid haemorrhage, Reye's syndrome, lead encephalopathy, water intoxication, near drowning
- Idiopathic: benign intracranial hypertension

Presentation

- *Headache:* more worrying if nocturnal, on waking, worse on coughing or moving head and associated with altered mental state.
- *↓LOC:* lethargy, irritability, slow decision making and abnormal social behaviour. Untreated, can deteriorate to stupor, coma and death.
- *Vomiting:* (in early stages without nausea)
- *Eye changes:* including irregularity or dilatation in one eye. Unilateral ptosis or III and VI nerve palsies. In later stages, ophthalmoplegia and loss of vestibulo-ocular reflexes.
- *Papilloedema:* blurring of the disc margins, loss of venous pulsations, disc hyperaemia and flame-shaped haemorrhages. Later, obscured disc margins and retinal haemorrhages.
- *Cushing reflex:* (↑BP, widened pulse pressure and ↓HR).
- *Other:* Late hemiparesis

Investigations

- CT/MRI to determine underlying lesion.
- Check and monitor ABG, blood glucose, renal function, electrolytes and osmolality.

Management

Aim to prevent 2° brain injury. Be aware that actions that lower the MAP will also lower CPP.
Full monitoring T, BP, heart monitor, RR, SaO_2, $ETCO_2$, art BP, CVP
Supportive:

- *Oxygenation:* keep pO2>60mmHg, ideally~100mmHg,
- *Fluids:* normal vascular volume & osmolarity
- *BP:* aim for MAP 80mmHg
- *BSL:* maintain normoglycaemia
- *Na^+:* maintain at 140-145mmol/L, higher if ?impending herniation
- *Temperature:* avoid pyrexia & shivering as will ↑ICP & ↑pCO_2
- *Seizures:* treat aggressively or prophylactically with phenytoin loading (controversial)

Specific:

- *Posture:* elevate head of bed 30°
- *Intubate:*
  - Allows better control of pO2, pCO2
  - Consider premed of **fentanyl** 2mcg/kg (no evidence for **lignocaine** or NMBA) to blunt sympathetic & ICP rises
  - Generally can use **ketamine** 1-2mg/kg (may sl ↑ICP but improves CPP) or (**midazolam** 0.1-0.3mg/kg + **fentanyl** 1-2mcg/kg), plus **suxamethonium** 1.5mg/kg
  - Alternatives are **thiopentone** 3-5mg/kg or **propofol** 0.5-1.5mg/kg (beware ↓BP), and **rocuronium** 1mg/kg
- *Analgesia and sedation:* **propofol** or **morphine**/**midazolam** to prevent gagging on ETT.
- *Neuromuscular blockade:* – avoid if possible - reduces rises in ICP from muscle activity
- *Hyperventilation:* lowers ICP by inducing hypocapnoeic vasoconstriction but may ↓cerebral perfusion. Aim for low normal pCO_2 35-40mmHg or 30-35mmHg if ?herniating
- *Barbiturate coma:* can ↓ICP, also reduces cerebral metabolic rate.
- *Osmotic reduction if acute deterioration/herniating:*
  - **Mannitol 20%** 0.5-1g/kg over 15min **SE:** Hypovolaemia.
  - **3% saline** 5ml/kg over 15min **SE:** Hyperosmotic/hypernatraemic state.
- *Hypothermia:* Controversial as not of proven benefit. Cooling to 32-33°C may be effective in lowering refractory intracranial hypertension but is associated with a relatively high rate of Cx including pulmonary, infectious, coagulation, and electrolyte problems, rebound ↑ICP.

Surgery:

- *CSF drainage*
- *Decompressive craniectomy*
- *Clot evacuation*
- *Specific lesion removal*