Presentation and Management of Raised Intracranial Pressure

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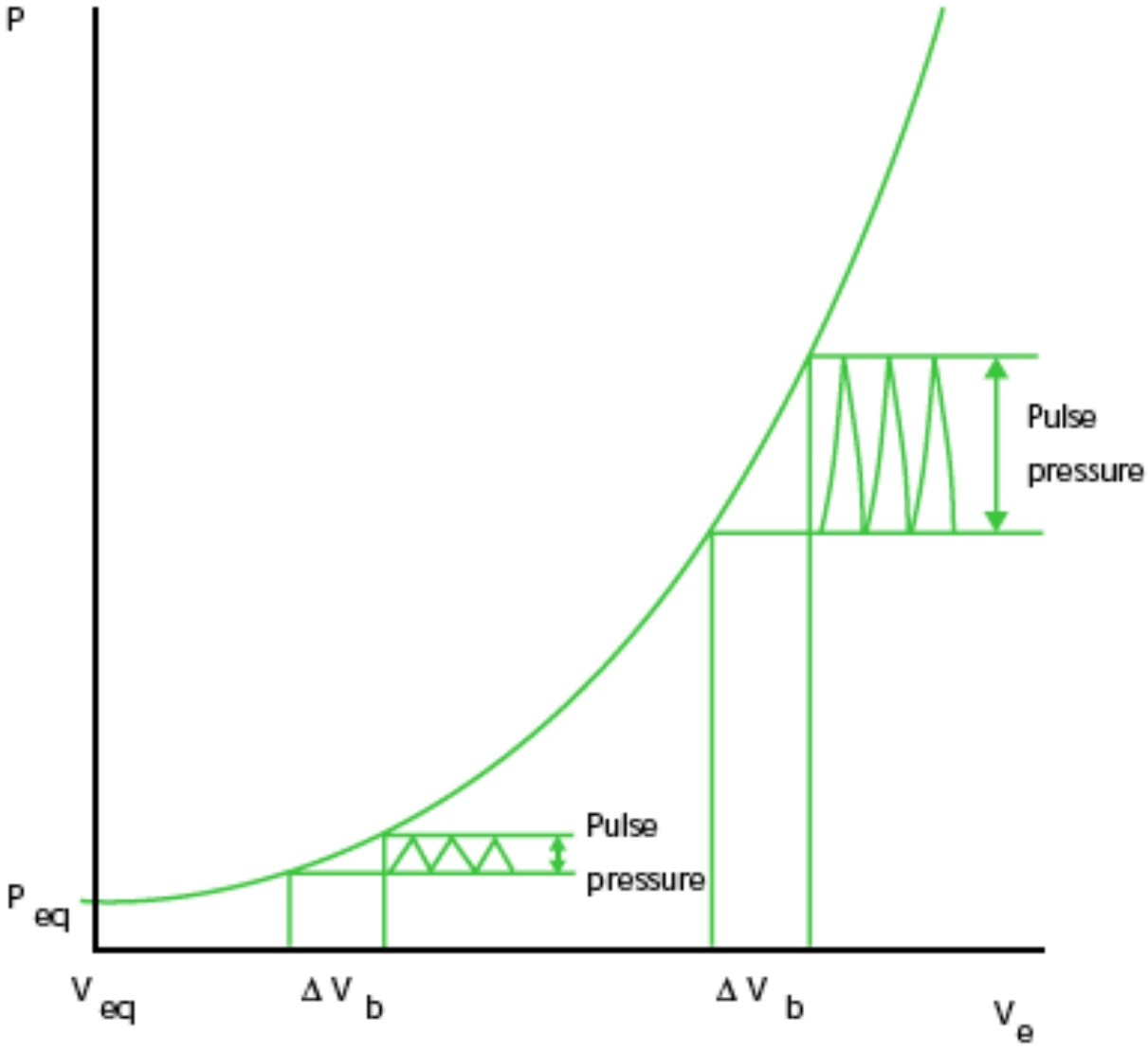
Neurosurgery

Basics

- Components of cranium
  - Brain 1400 ml
  - CSF 75-100 ml
  - Blood 75ml
- Monro-Kellie Doctrine
  - These contents are incompressible
  - Therefore, change in volume of the brain is associated with change in CSF or blood volume

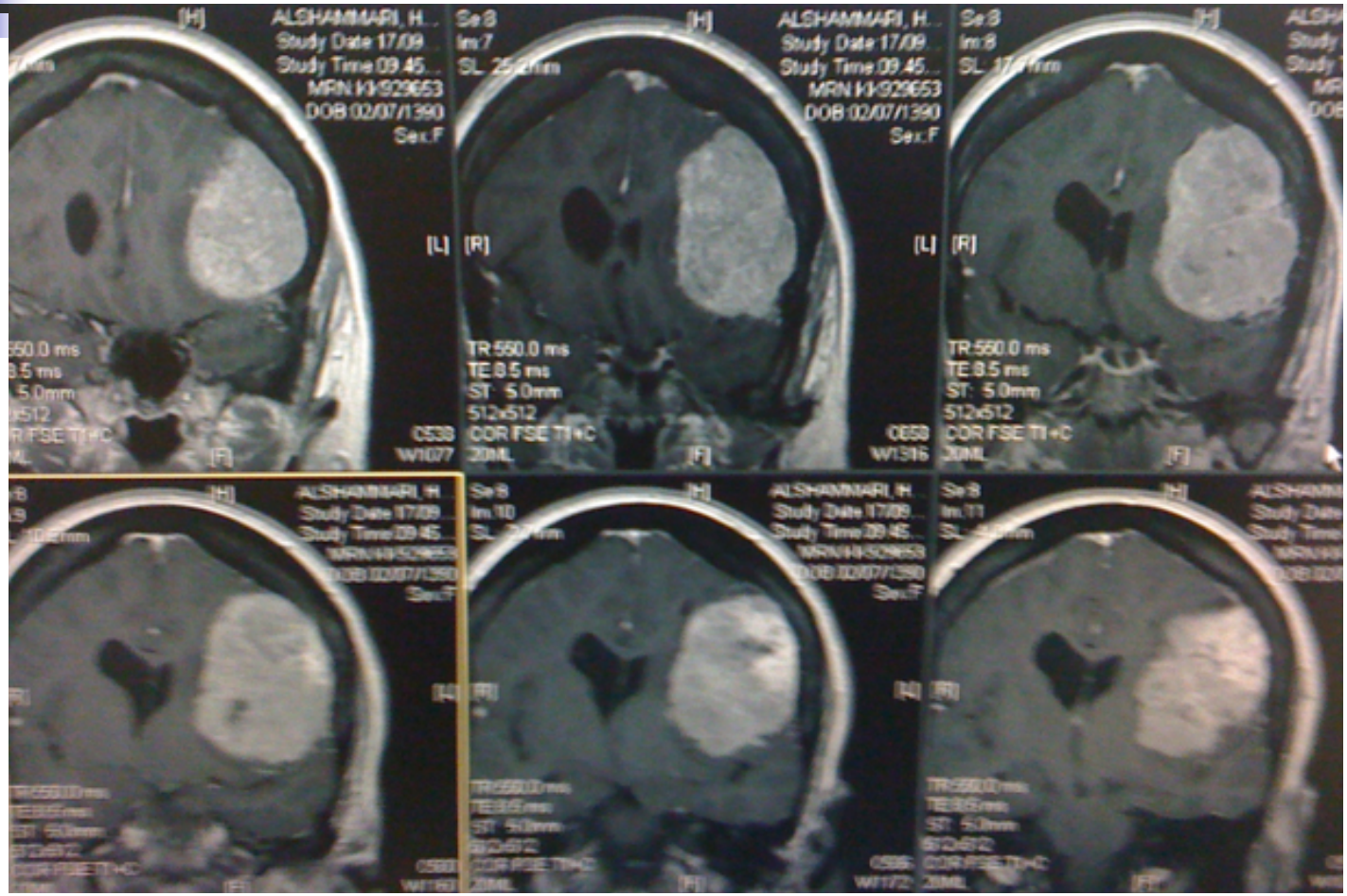
Pressure-Volume

- Increase in volume in one compartment leads to change in volume in the other ones.
  - E.g. brain tumor ---> CSF volume ↓then blood volume ↓
- For how long could this go on?

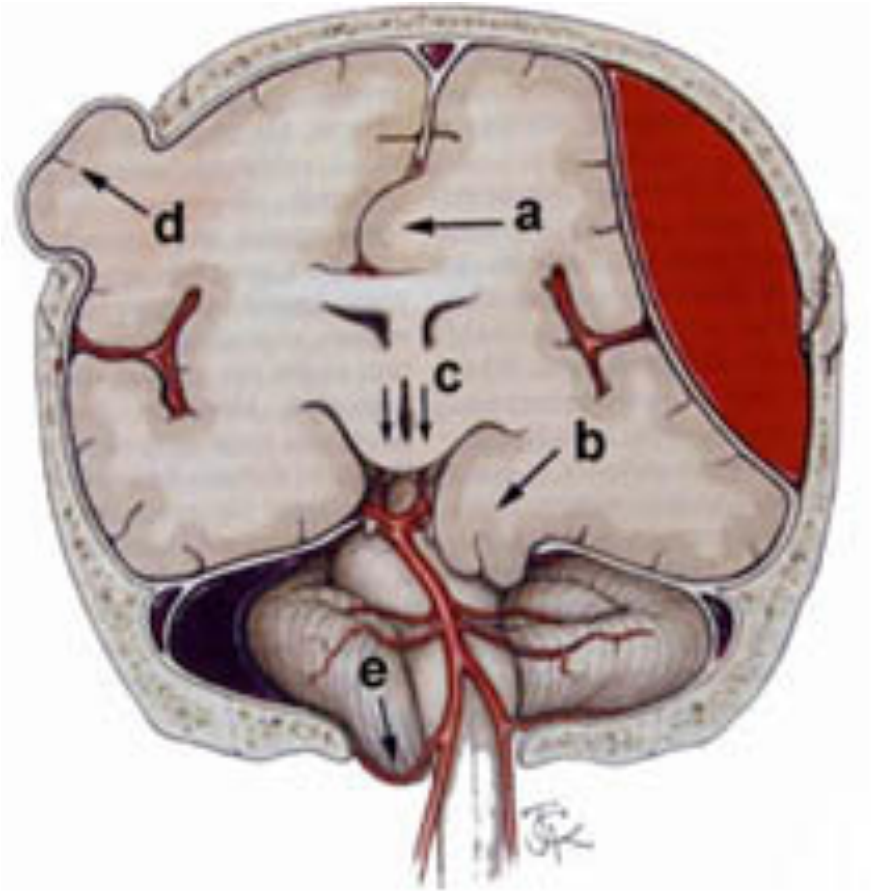


Raised ICP Laurence T Dunn, J neurol Neurosurg Psychiatry, 2002

Can somebody walk around with a raised ICP?

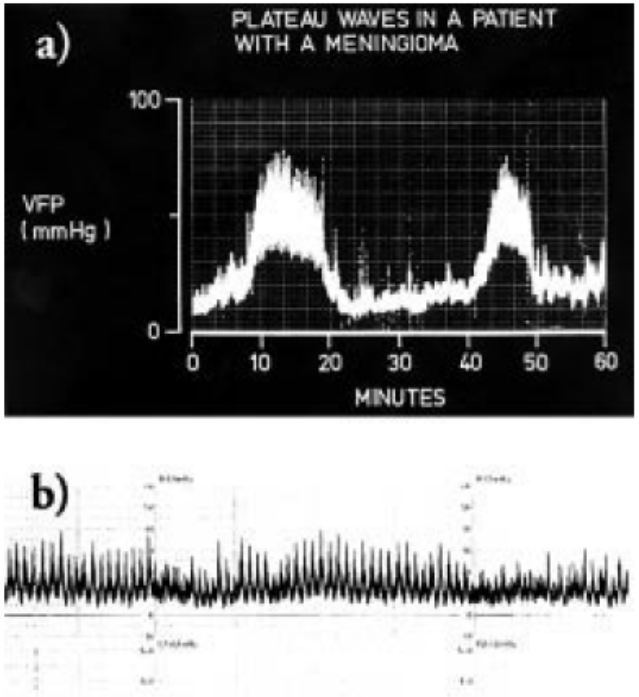


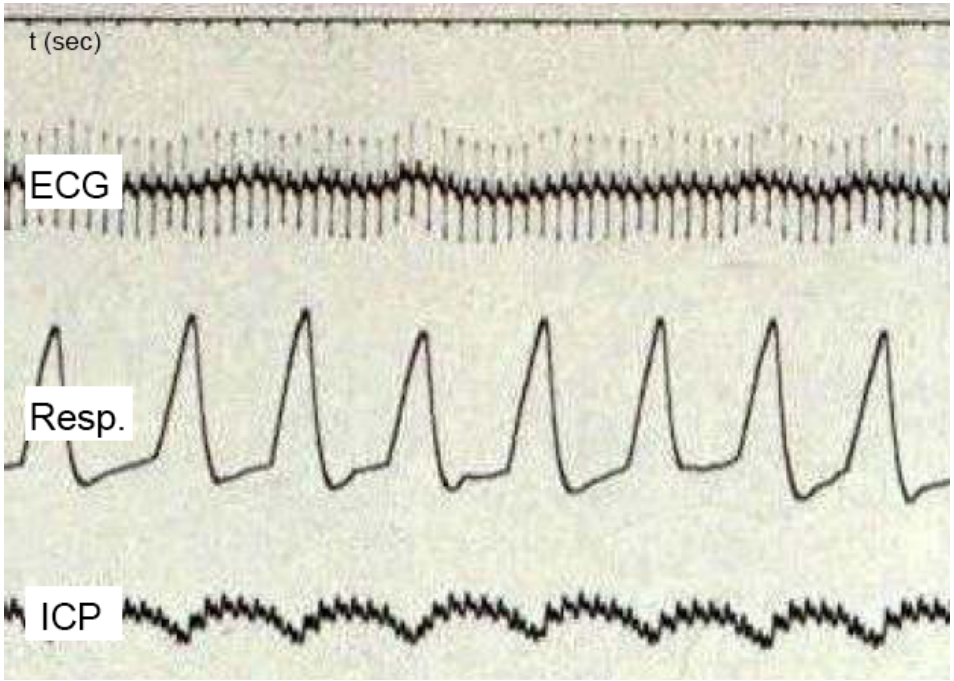
Raised ICP and brain shift



A. **Cingulate herniation**
B. **Uncal herniation**
C. **Central herniation**
D. **Outside herniation**
E. **Tonsillar herniation**

ICP waveform





Normal ICP

Table 1 Normal intracranial pressure values

Age group	Normal range (mm Hg)
Adults	<10–15
Children	3–7
Term infants	1.5–6

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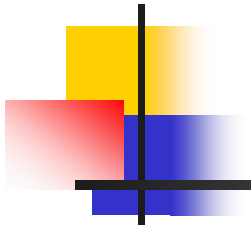
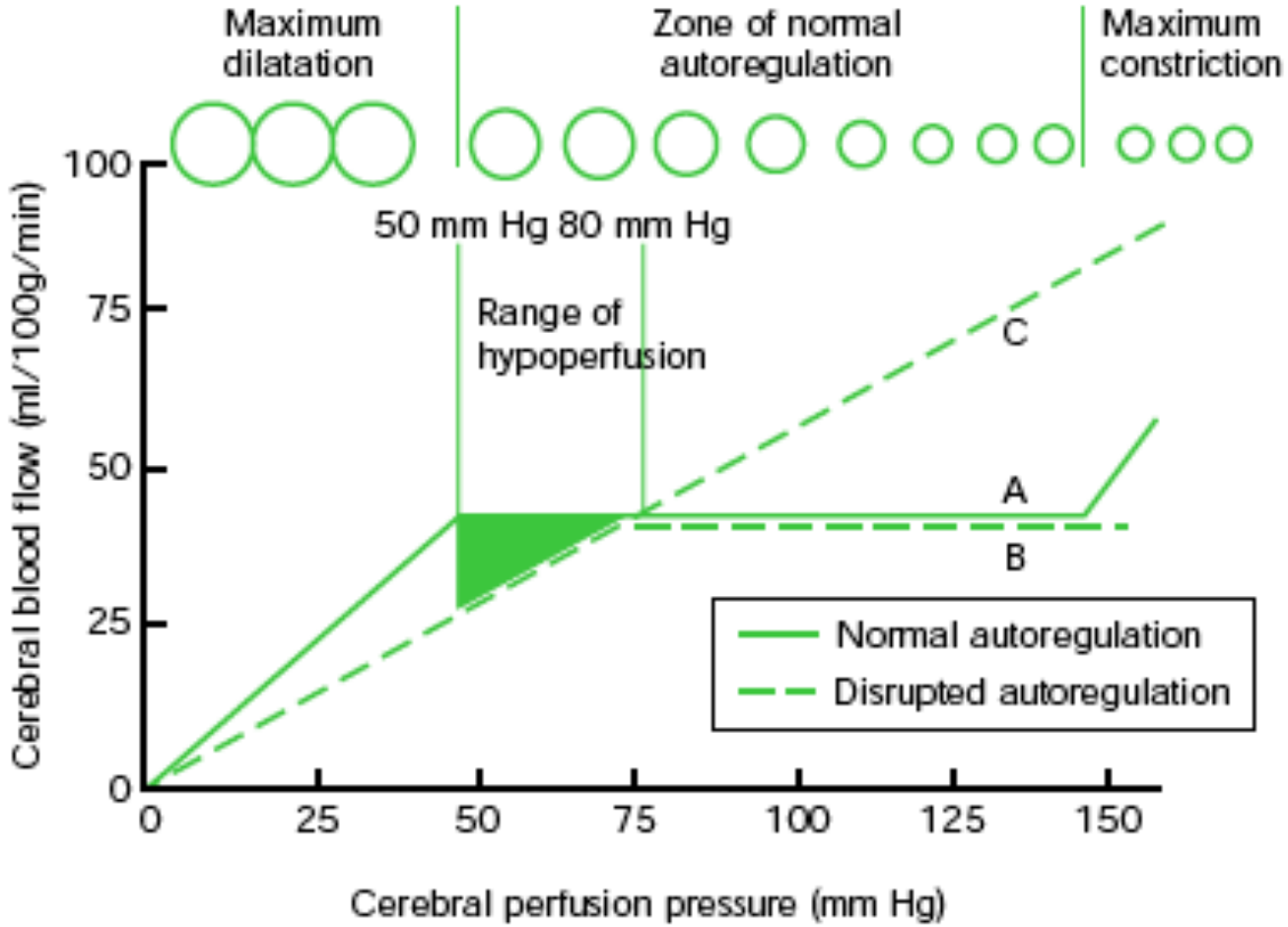


- Cerebral autoregulation
  - Ability of cerebral vessels to maintain cerebral perfusion within strictly determined limits
    - Rise in SBP ----> Constriction of cerebral arteries
    - Low SBP ----> cerebral vessels dilate to accommodate
  - Loss of autoreglation: Change in cerebral blood flow with the change in BP

Cerebral Autoregulation



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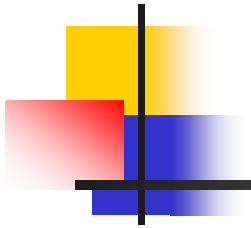
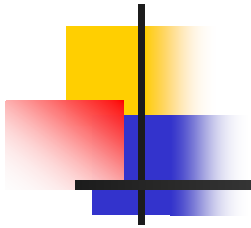
BP and CBF

- If ICP goes up, how does the brain get perfusion?
  - Process of autoregulation
  - CPP = MAP - ICP
  - If:
    - MAP=85 mmHg
    - ICP=15 mmHg
    - CPP ?



- CPP 50-140 mmHg



- 20 year old man. Had car accident (MVC) as unrestrained driver.

  He presented with BP 75/30, HR 125 bpm. Unconscious, with right hemiplegia.

What is going on?

Possible Causes

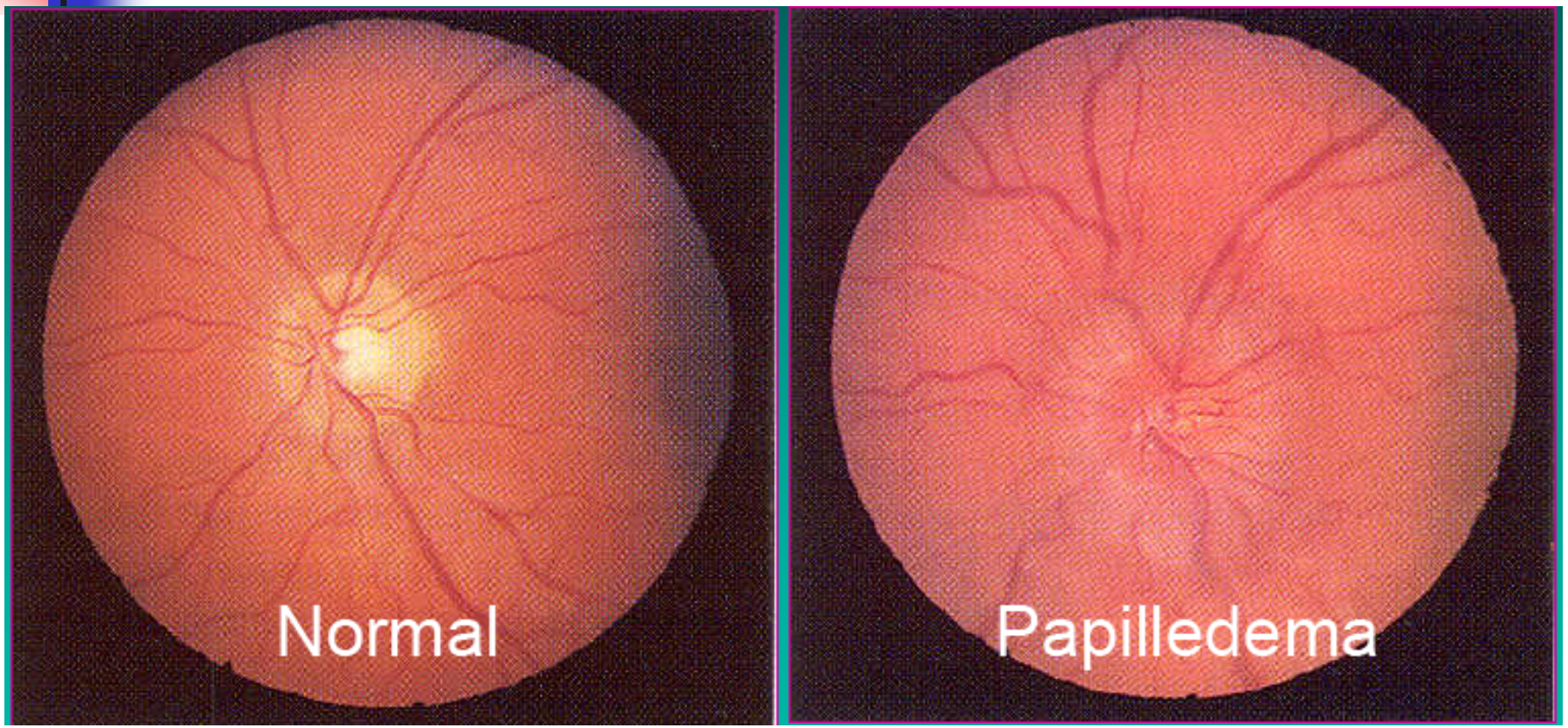
- VITAMEN D
- Other:

Table 2 Examples of causes of raised intracranial pressure

Pathological process	Examples
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

Clinical Presentation of raised ICP

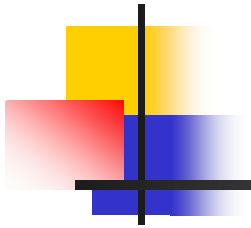
- Headache, vomiting, papilloedema
  - Headache
    - Early morning
    - Throbbing / Bursting
    - ↑ sneezing, coughing
  - Papilleodema
    - Reliable but may take several days
    - Associated fundal hge indicates acute and severe rise in ICP


Normal
Papilledema

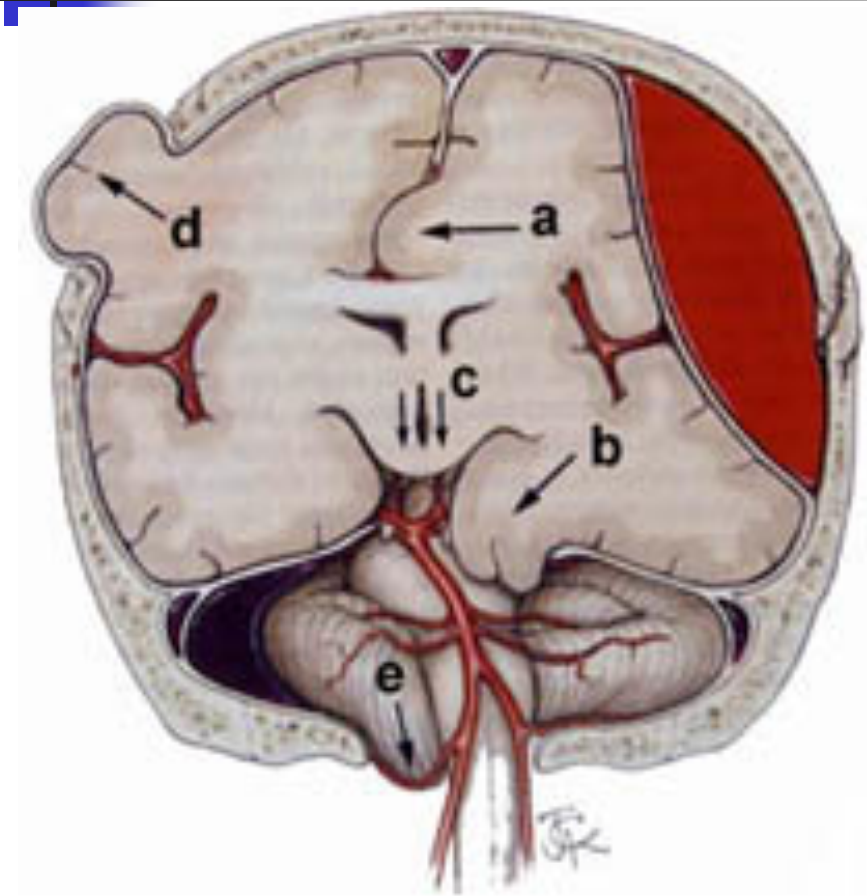
GCS

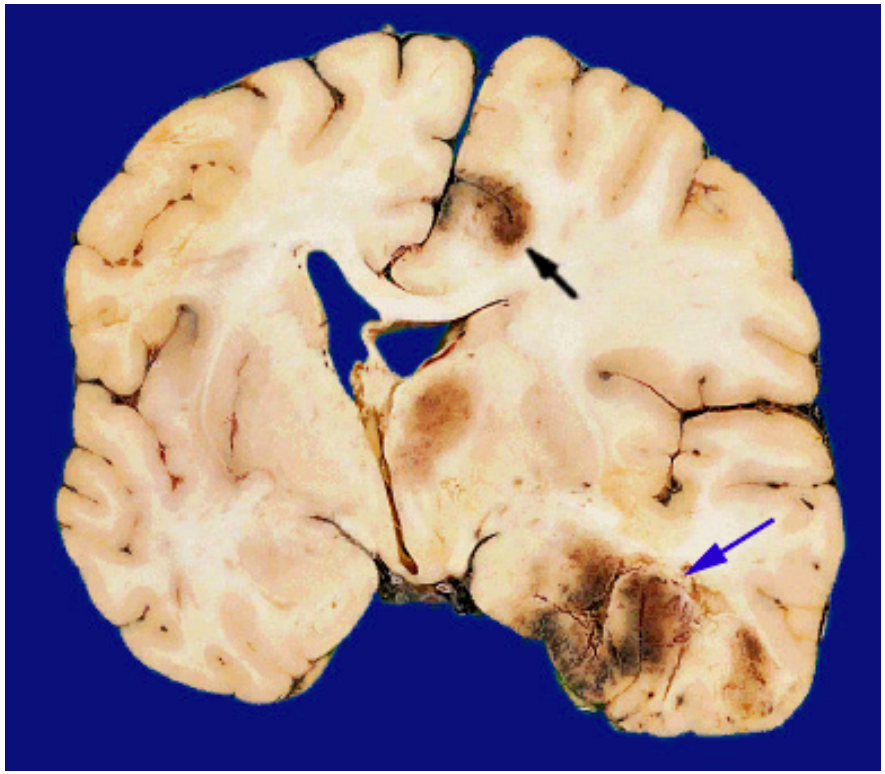
Glasgow Coma Score		
Eye Opening (E)	**Verbal Response (V)**	**Motor Response (M)**
4=Spontaneous 3=To voice 2=To pain 1=None	5=Normal conversation 4=Disoriented conversation 3=Words, but not coherent 2=No words.....only sounds 1=None	6=Normal 5=Localizes to pain 4=Withdraws to pain 3=Decorticate posture 2=Decerebrate 1=None
		Total = E+V+M

Decreased Level of Consciousness



- Neurological:
  - Pupillary dilation
  - Hemiplegia
  - Cranial nerve deficit





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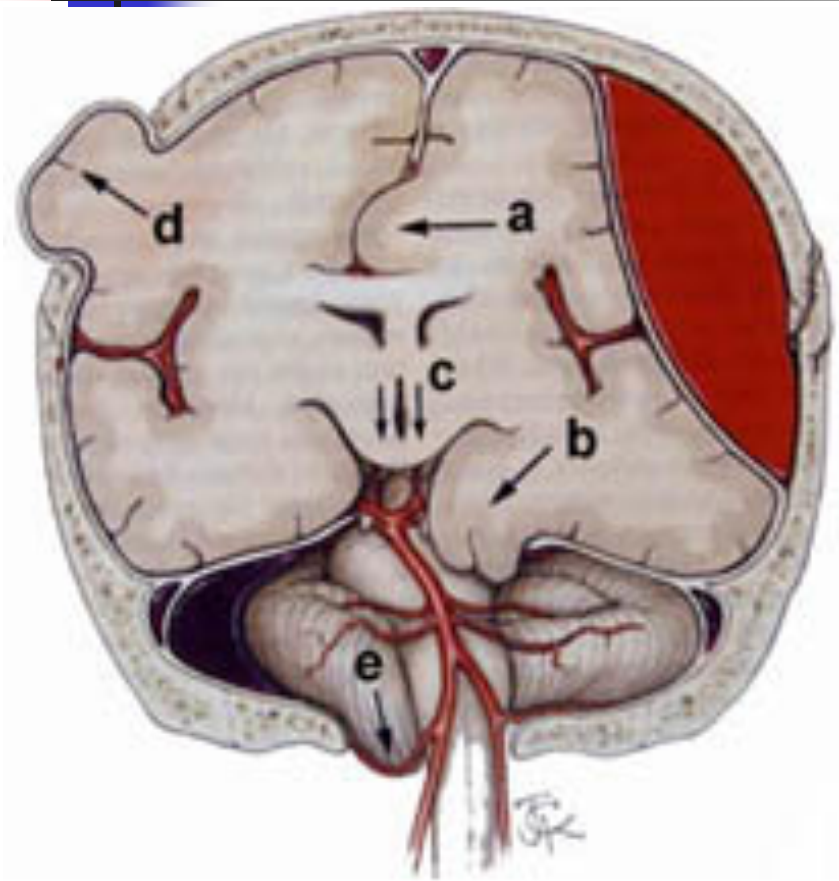
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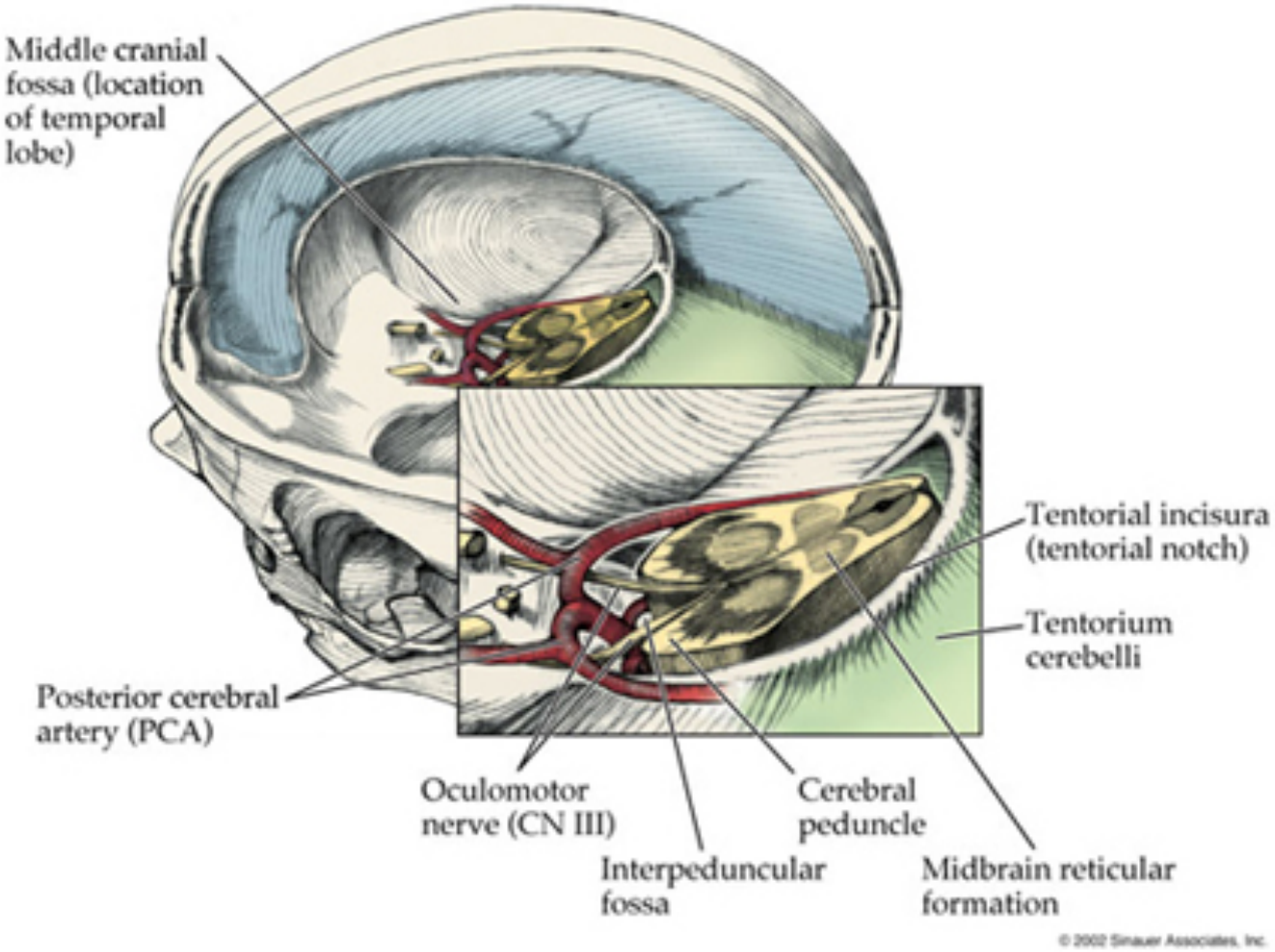

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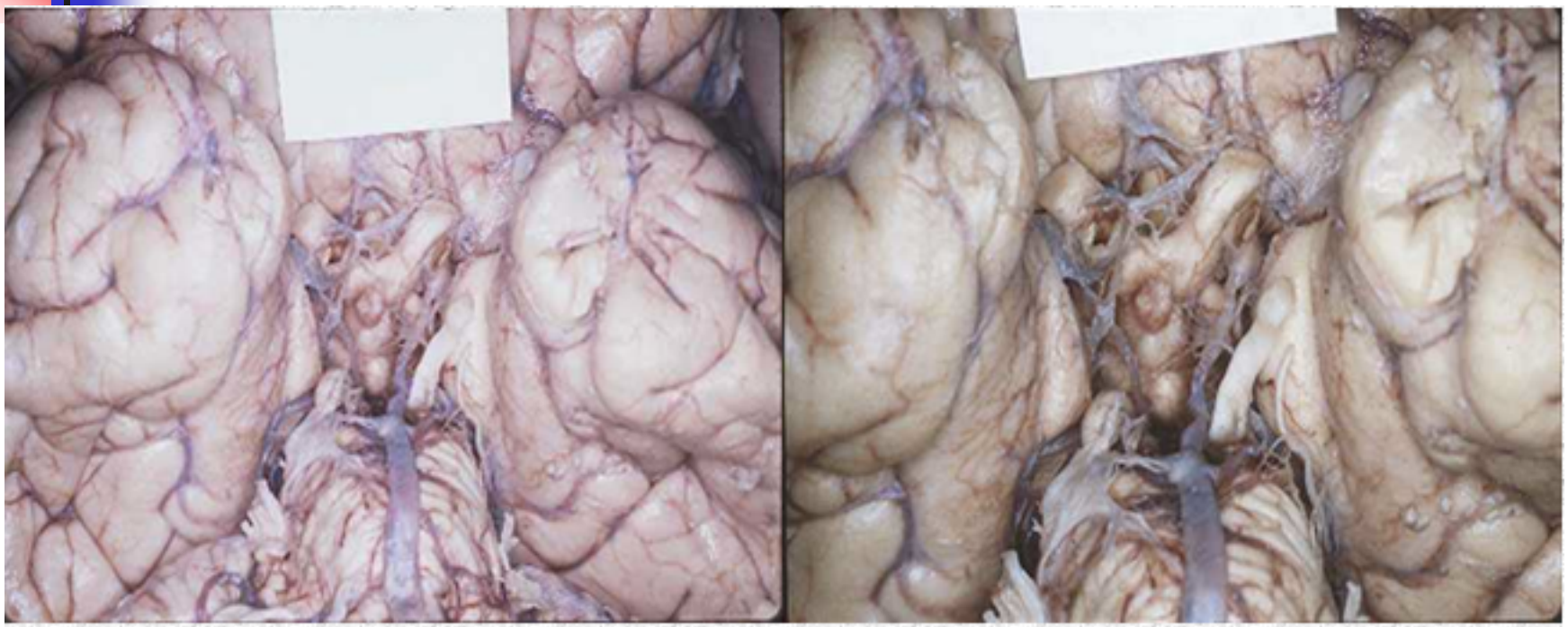
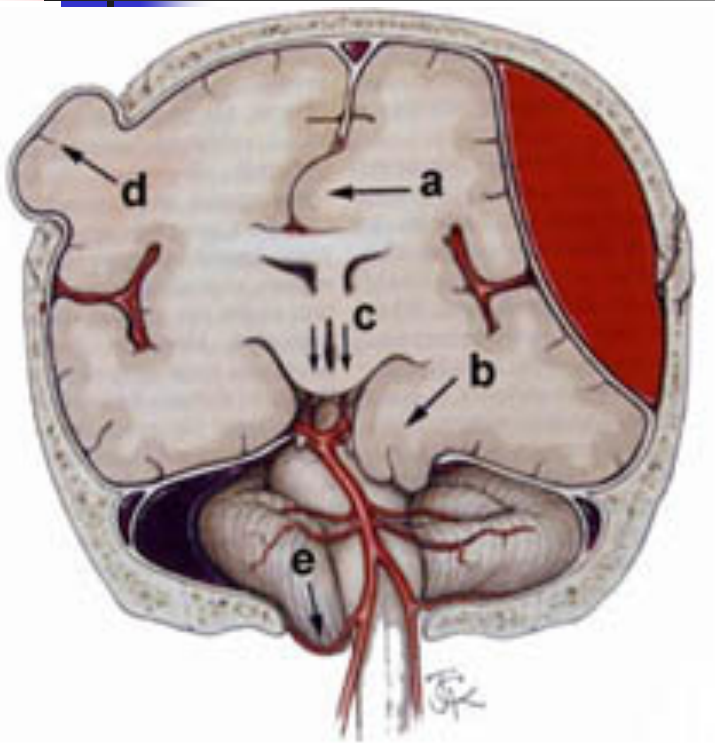
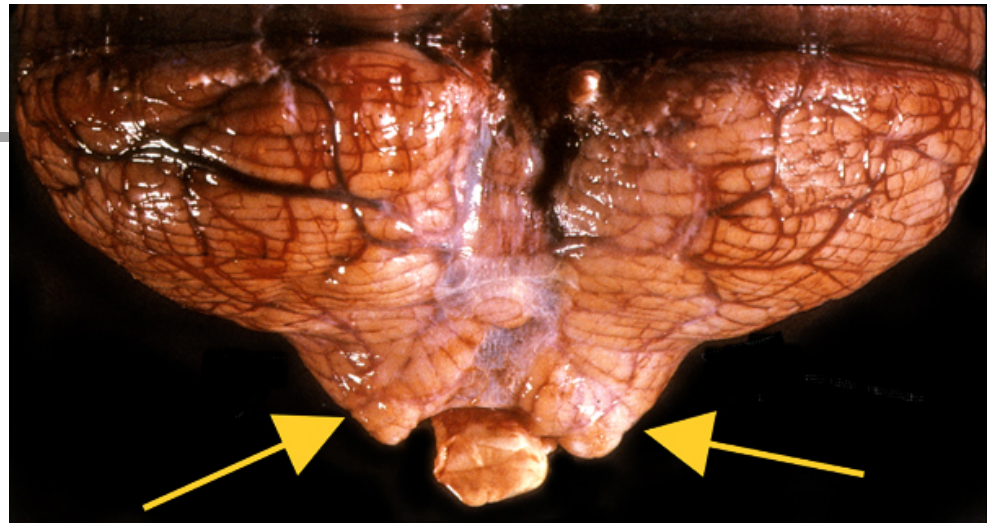
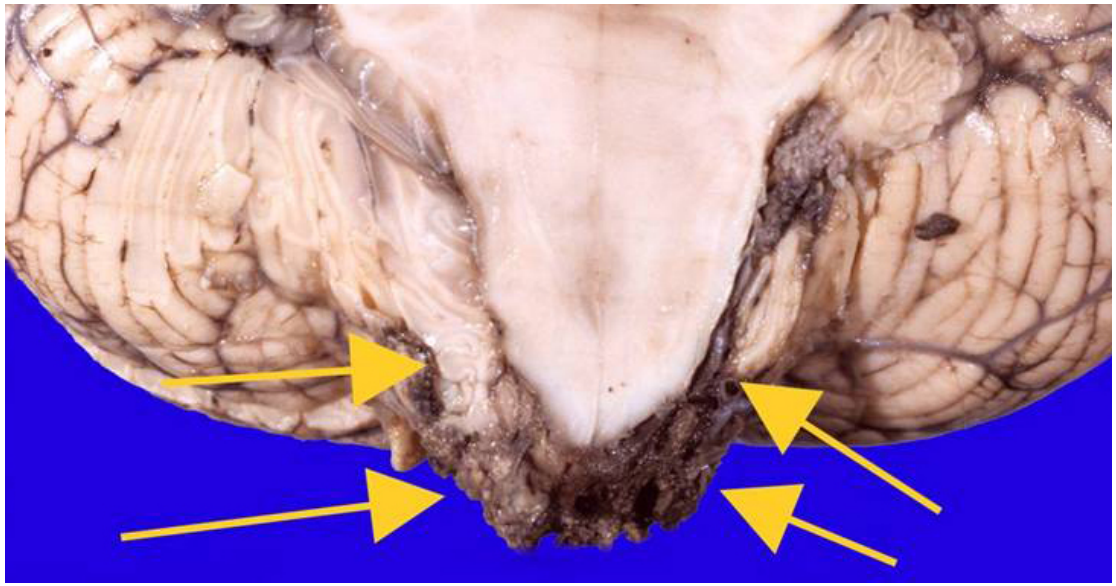


Trans-tentorial herniation: - Ipsilateral dilated pupil
- Contra-lateral weakness







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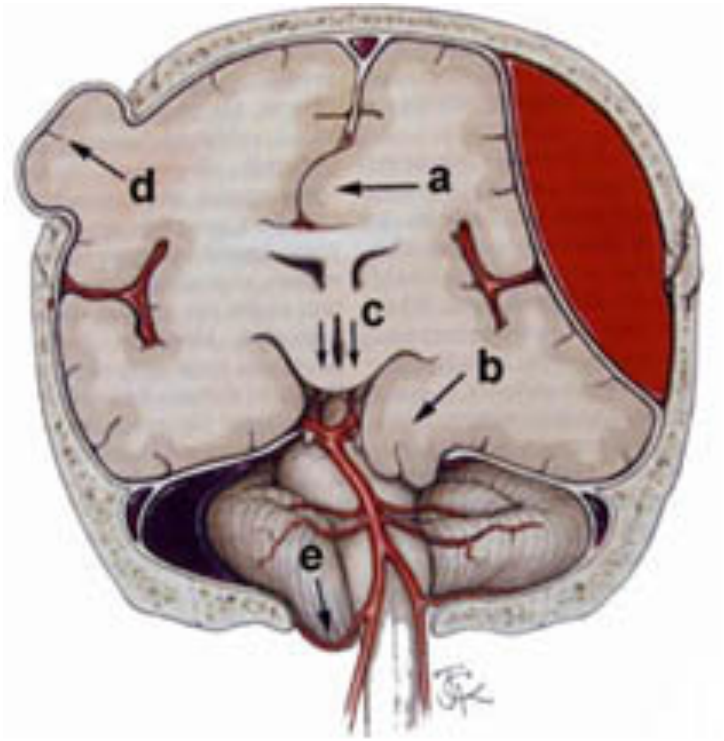
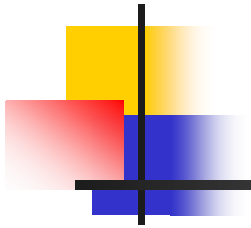
False localization

- Kernohan's notch



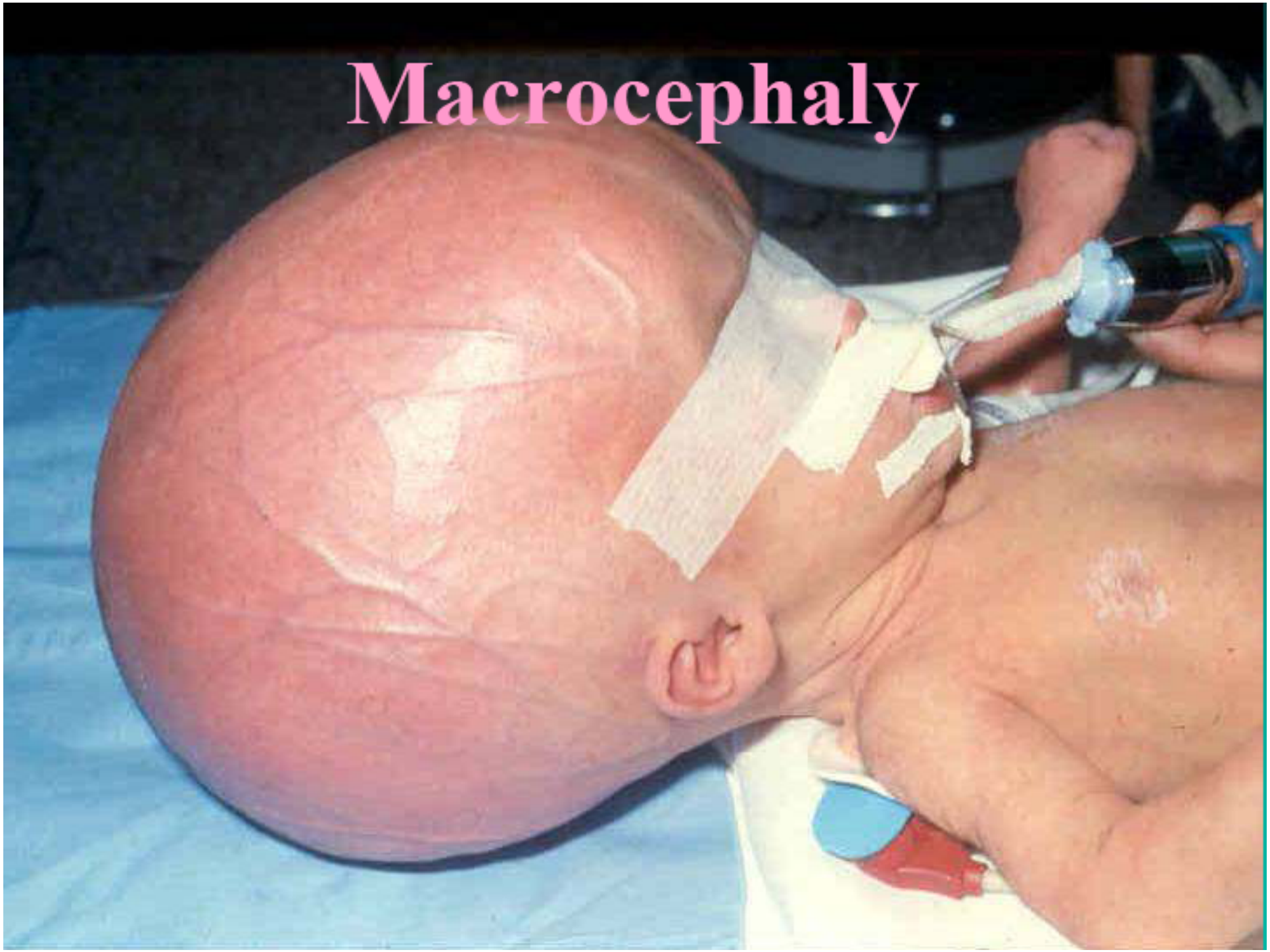


- Systemic:
  - Raised BP (recall: CPP=MAP-ICP)
  - Respiratory change:
    - Cheyne-Stokes breathing:
      - Oscillating periods of apnea-tachypnea
      - Respiratory centers compromise

Raised ICP in infants

- Widened sutures
- Increased Head circumference
- Dilated head veins
- “Sun set” eyes

Macrocephaly



Investigations

- URGENT CT head
- NO Lumbar Puncture

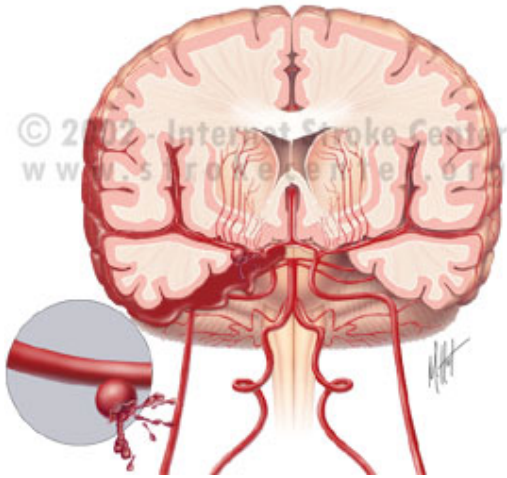
What is the treatment of high ICP?

- General measures:
  - Head elevation (30 degrees)
  - No neck compression
  - Mannitol for patients who have decreased LOC (or Furosemide)
  - Steroids (Dexamethazone) for tumors
  - Hyperventilation: controlled to PCO2 35-40 mmHg
  - Sedation, muscle relaxants
  - Hypothermia
  - Barbiturates: terminal option

What is the treatment of high ICP?

- Specific treatment:
  - Depends on the cause
    - VITAMEN D

Vascular - SAH / ICH



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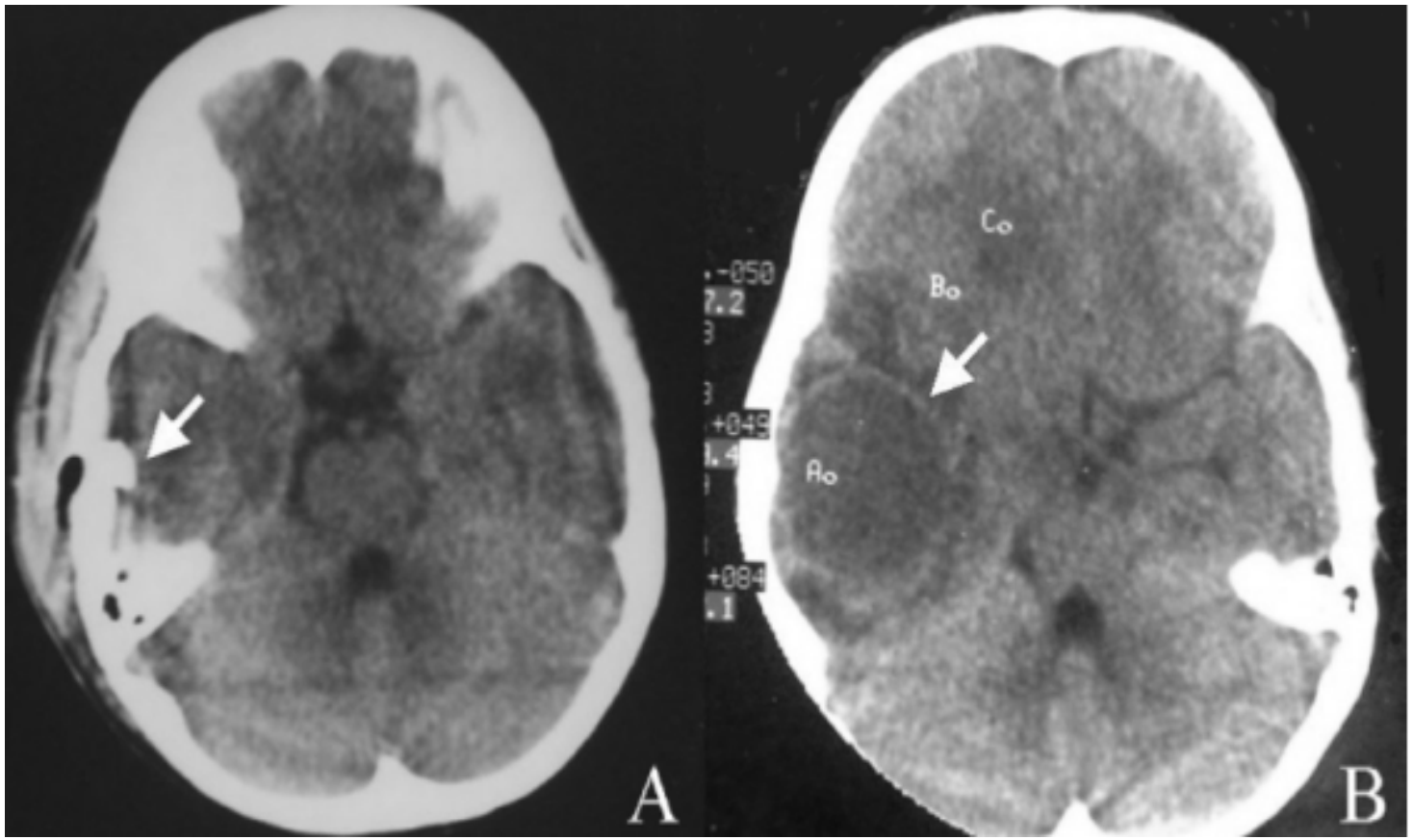
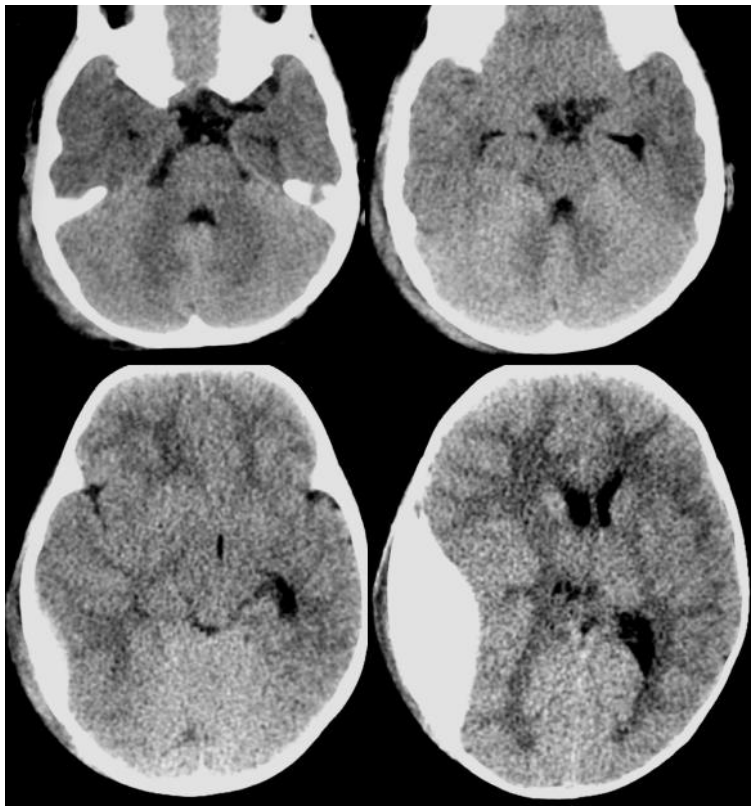
Infection - Abscess



Trauma

- Localized



Epidural Hematoma

Subdural Hematoma

Trauma

- Diffuse

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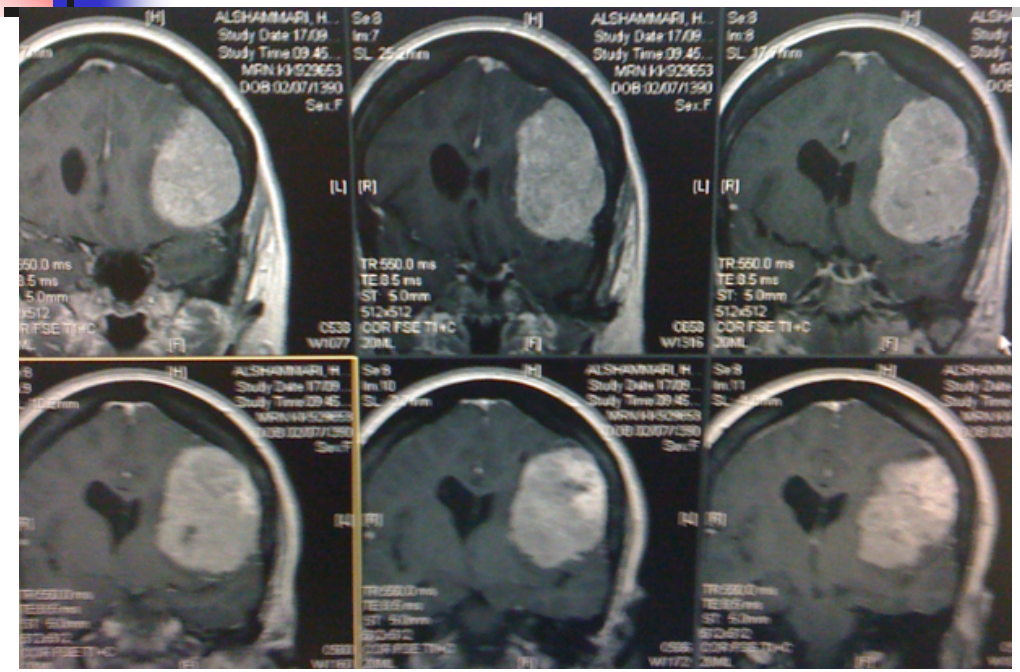
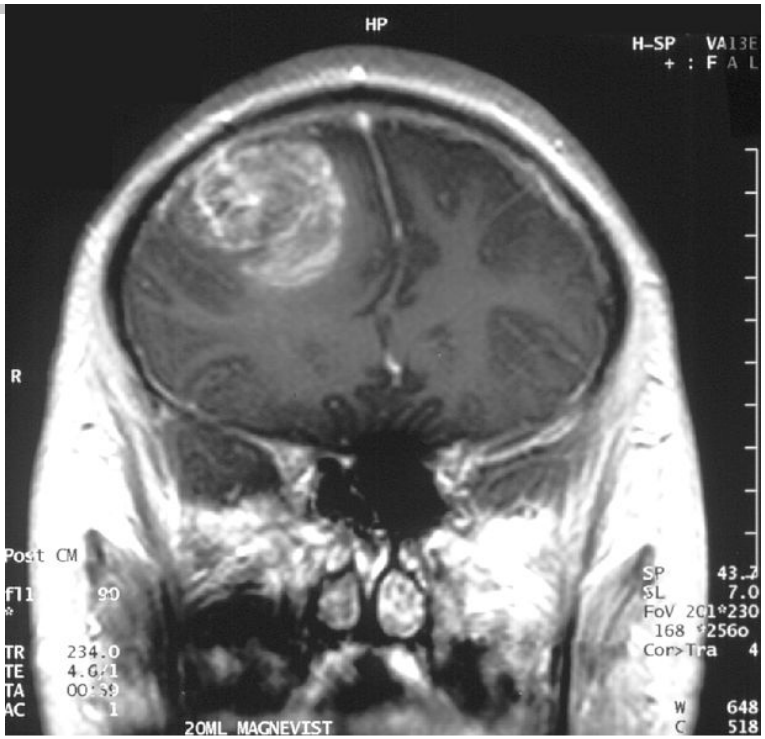
Tumor

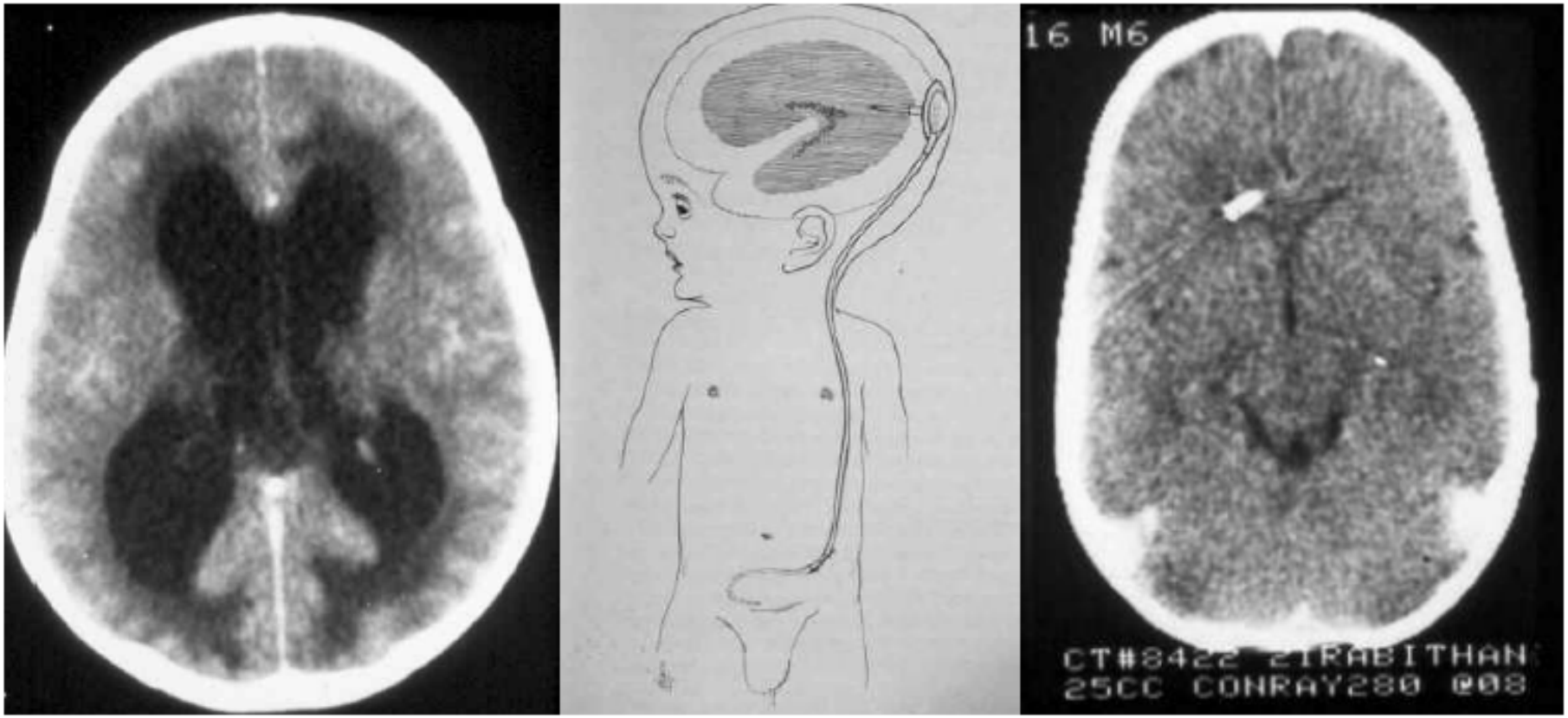




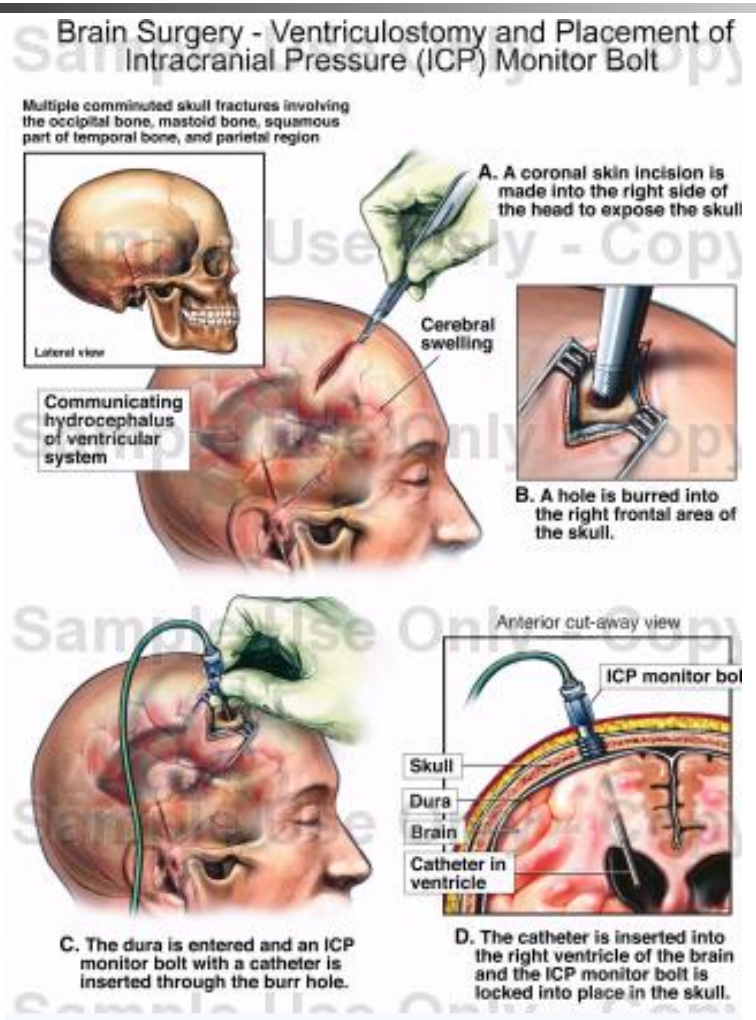
Meningioma

Glioblastoma Multiformi

Hydrocephalus



Can we monitor ICP?



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