Hydrocephalus

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Objectives

- Definition
- Epidemiology
- Physiology & Pathophysiology
- Classification
- Etiology
- Signs & Symptoms
- Imaging
- Differential Diagnosis
- Treatment options & Shunt malfunction or infection

Hydrocephalus
Definition

The term derived from the Greek words:

- “Hydro" meaning water
- “Cephalus" meaning head

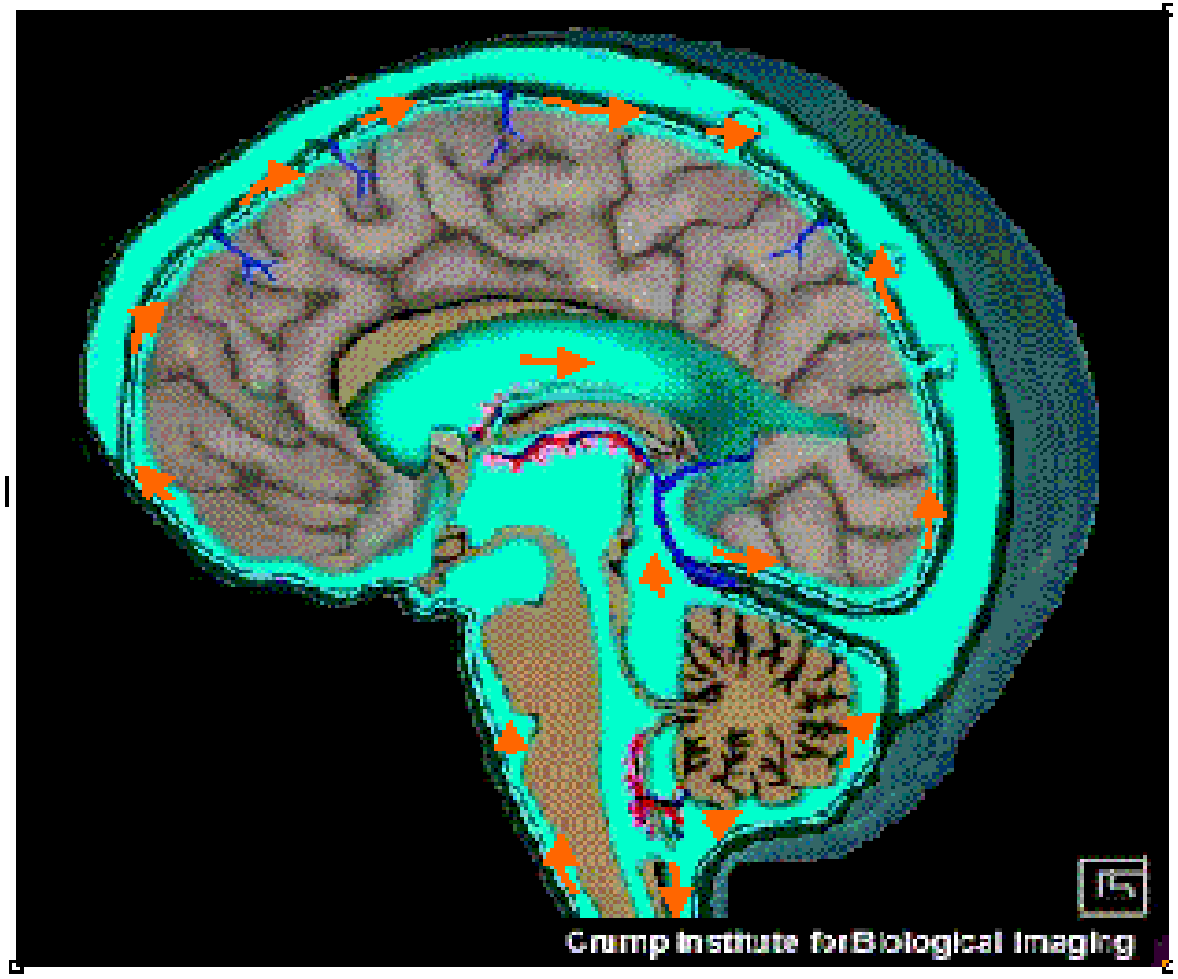
➢ Abnormal accumulation of cerebrospinal fluid (CSF) in the ventricles, or cavities, of the brain.

Hydrocephalus
Epidemiology

- Prevalence ≈ 1-1.5%
- Incidence ≈ 1-2/1000 births

Hydrocephalus

Physiology: CSF Circulation



Hydrocephalus
Pathophysiology

Hydrocephalus usually develops as a result of either:

- Conditions causing decreased CSF absorption (Most common)

- Conditions causing CSF overproduction (choroid plexus papilloma, choroid plexus carcinoma). Rare

Hydrocephalus
Functional Classifications

- Non-communicating: (Obstruction proximal to Arachnoid granulations, within the ventricles)

- Communicating: (Obstruction at Arachnoid granulations)

Note: Previously the terms obstructive & nonobstructive were used

Hydrocephalus
Etiology

Congenital ≈ 70%

- Chiari malformation
- Aqueductal stenosis
- Dandy Walker Syndrome

Acquired

- Infection
- Hemorrhage
- Masses
- Post-op
- Post-traumatic

Hydrocephalus

Signs & Symptoms (Young children)

- Cranium enlarges > face (HC > 1.25cm/week)
- Irritability, N/V
- Fontanel full, bulging
- Scalp veins enlargement
- 6th nerve palsy
- Sun sitting sign (part of Parinaud's syndrome)
- Hyperactive reflexes
- Apneic spells
- Splaying of cranial sutures

Hydrocephalus

Signs & Symptoms (Older children & Adults)

Those of increased ICP:

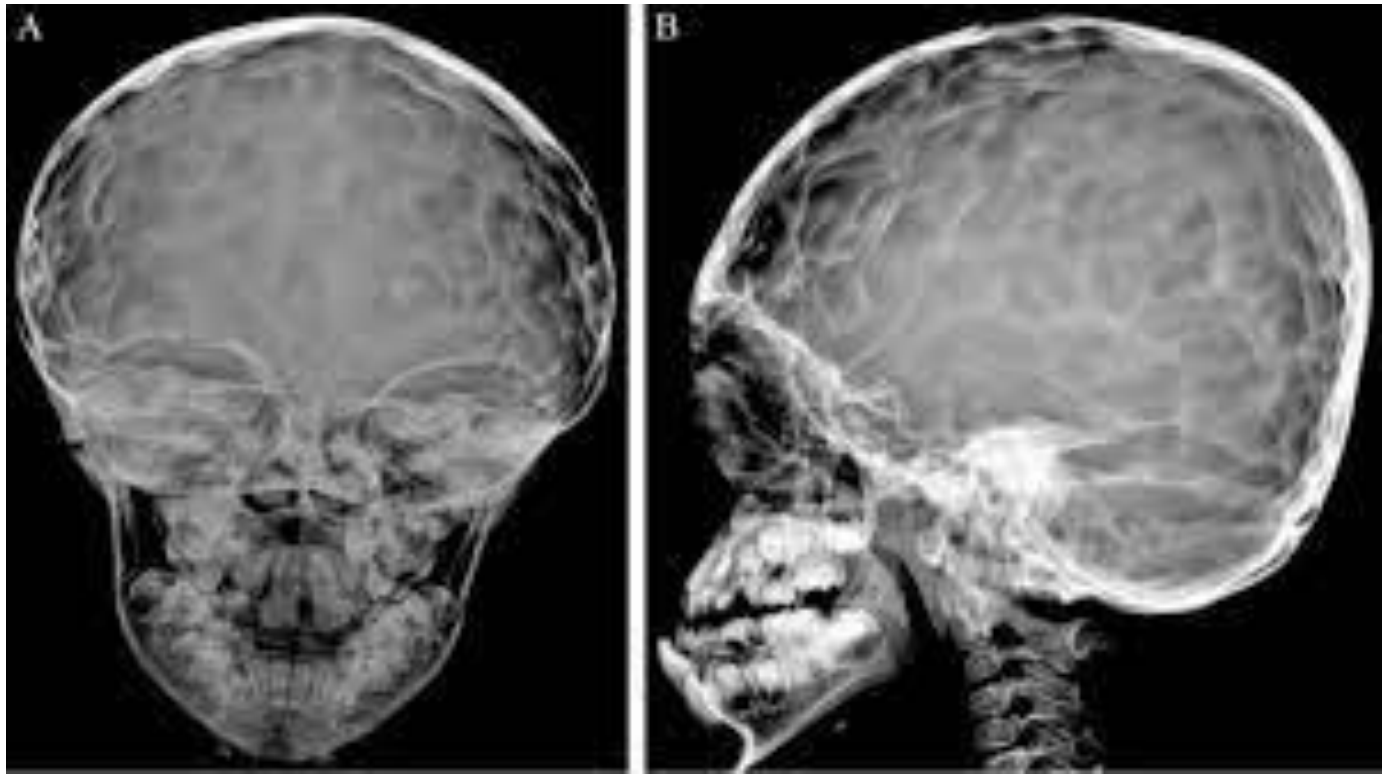
- Headache
- Drowsiness
- Nausea/ Vomiting
- Gait changes
- Up-gaze palsy
- 6th nerve palsy
- Papilledema

Hydrocephalus
Features of Chronic HCP

- Beaten Copper (Silver) cranium
- 3rd ventricle herniating into sella
- Erosion of sella
- Temporal horns less prominent than in acute
- Macrocrania
- Atrophy of corpus callosum
- Delayed closure of fontanels
- Developmental delay

Hydrocephalus

Features of Chronic HCP. Beaten copper cranium

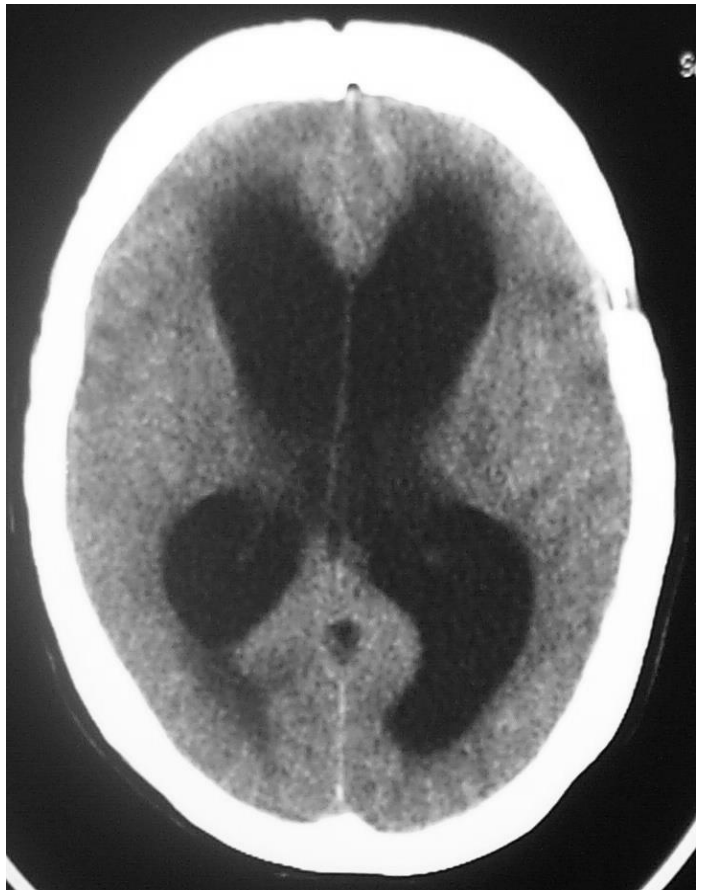


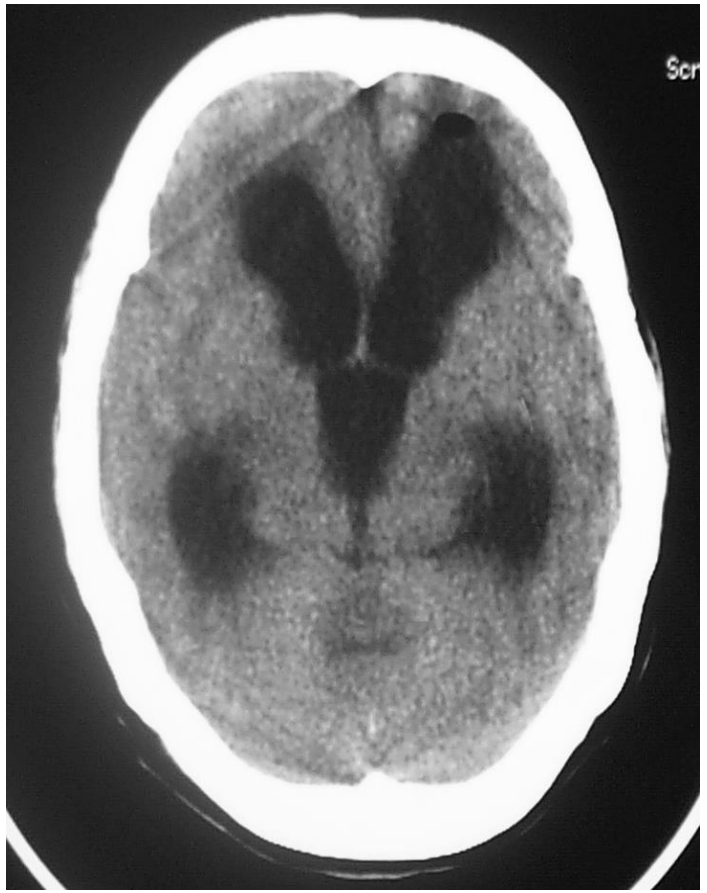
Hydrocephalus
Imaging

CT/MRI criteria of HCP

- Temporal horns ≥ 2mm
- FH/ID > 50%
- Evan's ratio (FH/max. biparietal D.) > 30%
- Ballooning of frontal horns & 3rd ventricle
- Transepndymal absorption
- Bowing of Corpus Callosum on Sagittal MRI

Hydrocephalus
CT



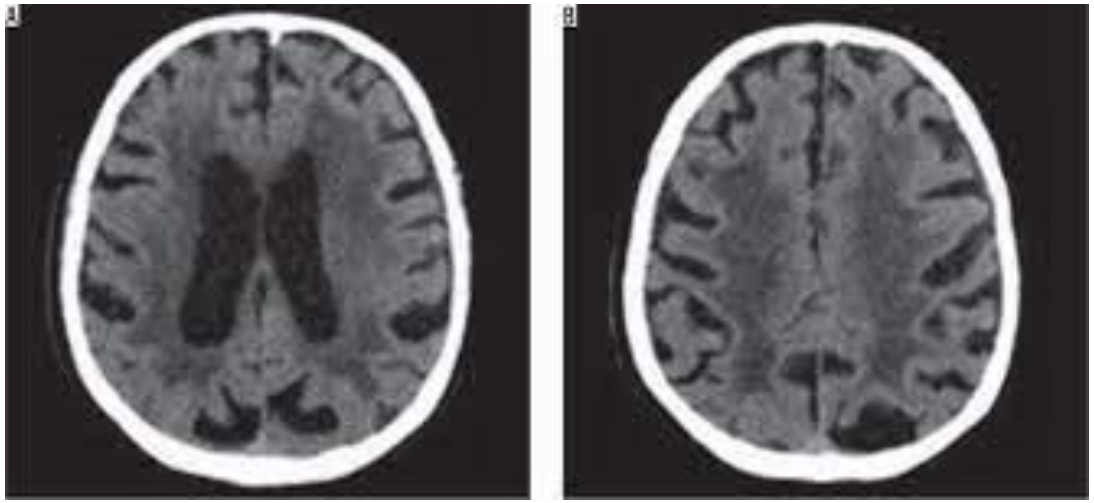


Hydrocephalus
Differential Diagnosis

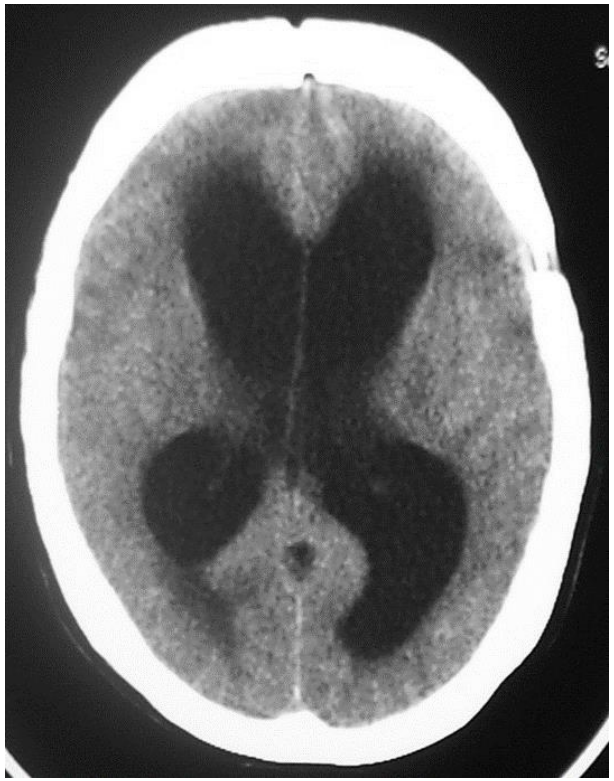
- Brain atrophy (HCP ex vacuo)
- Hydranencephaly (EEG, Angio)
- Developmental anomalies (CC agenesis)

Hydrocephalus
Differential Diagnosis

Brain atrophy (HCP ex vacuo)

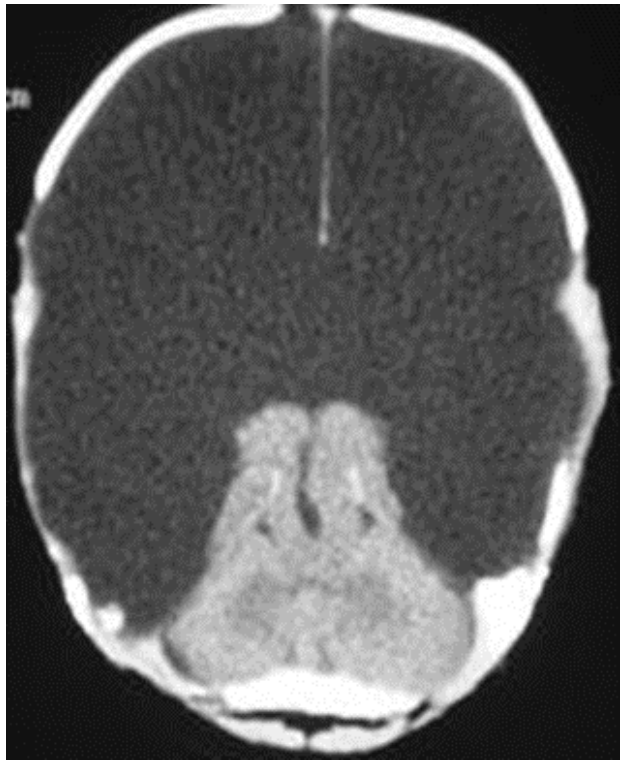


Hydrocephalus

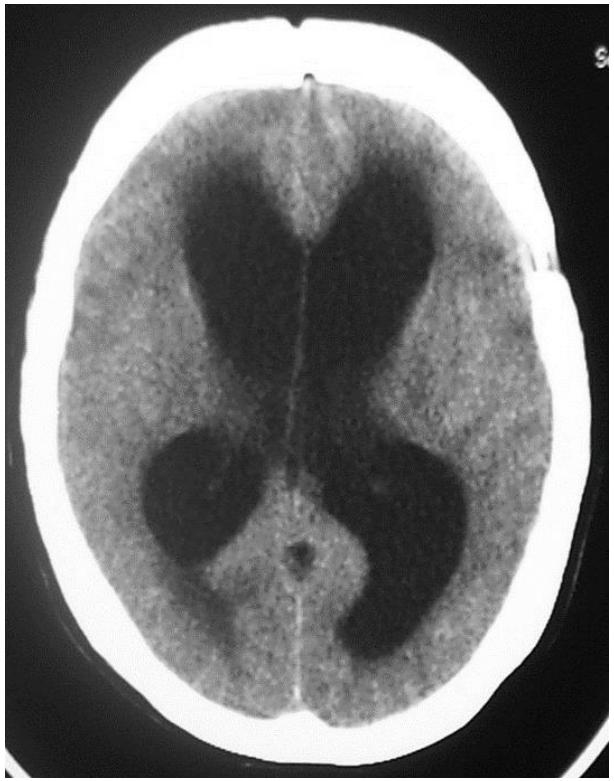


Hydrocephalus
Differential Diagnosis

Hydranencephaly



Hydrocephalus

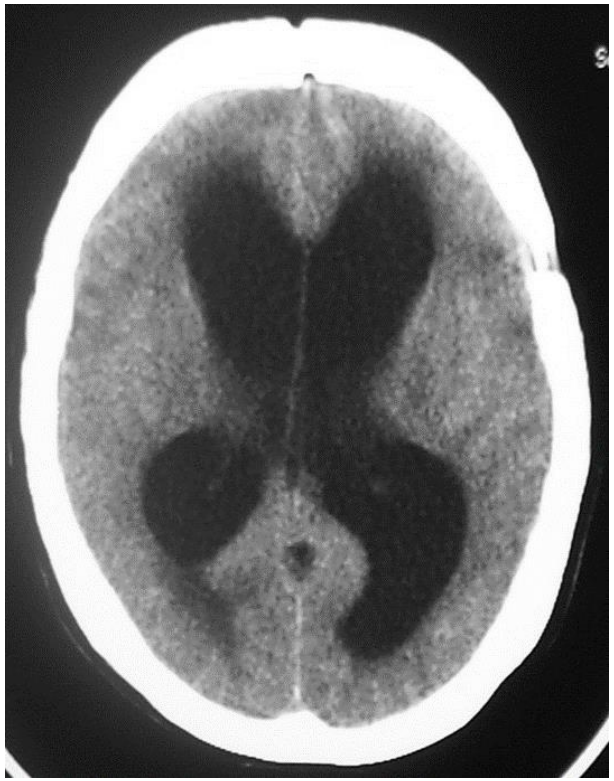


Hydrocephalus
Differential Diagnosis

Corpus Callosum agenesis



Hydrocephalus



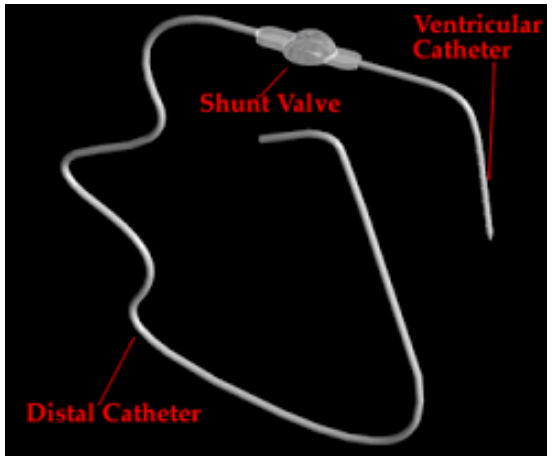
Hydrocephalus
Treatment

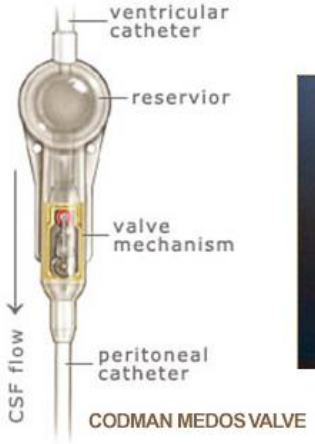
Surgical (no effective medical treatment)

- Ventriculoperitoneal (VP) Shunt (most common)
- Eliminating obstruction (like resection of 4th ventricle tumor)
- Endoscopic 3d ventriculostomy (ETV) in noncommunicating HCP

Hydrocephalus

Treatment. VP shunt (several companies)





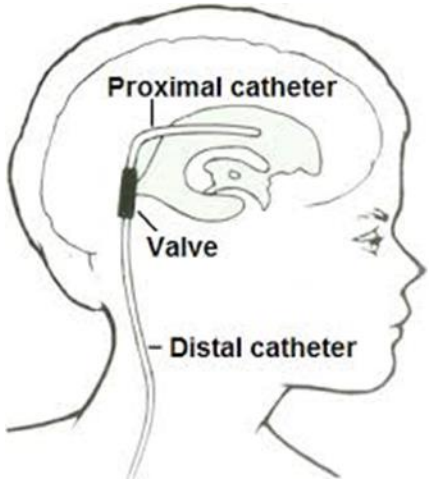
CODMAN MEDOS VALVE



MEDTRONIC STRATA VALVE

Hydrocephalus
Treatment. VP shunt

Diagram



Xray (Shunt series)



Hydrocephalus

Treatment. VP shunt. When to insert?

- If there are clinical & radiological signs of hydrocephalus

- In difficult to judge cases:

  - Admit & closely observe. A progressive change over time (ventricle size, head size, neurologic function) will guide

  - ICP monitor might be used also in these cases

Hydrocephalus
Normal ICP by age

Age	ICP range (mmHg)
Neonate	< 2
Infant	1.5 – 6
Young child	3 – 7
Adolescent (> 15 years)	< 15
Adult	< 15

Hydrocephalus

VP shunt malfunction. When to revise?

- The rate of shunt malfunction is 17% in the first year
- The clue to diagnose is the same: clinical & radiological deterioration!
- Drowsiness is the best clinical predictor of shunt malfunction
- There might be swelling around shunt tubing
- Respect parents opinion
- Do Shunt series (X-rays)
- Compare CT with the previous CT done when the shunt was working
- Any doubt, Revise the shunt!

Hydrocephalus
VP shunt infection

- A serious cause of morbidity & prolonged hospital stay in pediatric patients.
- The risk is 7.4 – 8.4% over one year F/U.
- 92% were diagnosed by 3 months.
- Sequelae:
  - ↓ intellectual performance
  - Psychomotor retardation
  - ↑ risk of seizures.

Hydrocephalus

VP shunt infection. Common organisms

- Staph. Epidermidis 60%
- Staph. Aureus 18%
- Anaerobic 10%
- Other Gram (+) cocci 6%
- Gram (-) rods 6%

Hydrocephalus

VP shunt infection. Risk factors

- Younger age (esp. < 6 months)
- Prematurity (< 40 weeks at surgery) → ×5 Relative Risk
- CSF leak postoperatively
- Breached surgical gloves
- Use of neuroendoscope
- Previous infection
- Spinal dysraphism
- Operative time
- Number of persons in OR

Hydrocephalus

VP shunt infection. Antibiotic prophylaxis

- 1st gen. cephalosporin (Cephazolin)
- Dose 30mg/kg in pediatrics (2g in adults)
- Given on calling the patient to OR (60 min prior to skin incision)
- Repeated Q 6 hours & continued for 24 hours

Controversial:

- Intraventricular Antibiotics
- AB-impregnated catheters

Hydrocephalus
VP shunt infection. Presentation

- Fever (most common)
- Headache, vomiting, meningismus
- Irritability, seizures
- Local signs (redness, swelling over the shunt tract)
- Abdominal pseudocyst/ peritonitis

- Subacute bacterial endocarditis, Shunt nephritis (in VA shunts)

Hydrocephalus

VP shunt infection. Diagnostic tests

- Shunt tap: (No LP)
  - CSF C&S is the definitive method
  - CSF: ↓ glucose, ↑ protein, pleocytosis
  - CSF: eosinophilia >5%, neutrophilia >10%
- CRP > 7 mg/L
- Abdominal US or CT

- Blood C&S, Echocardiography
- Urine analysis

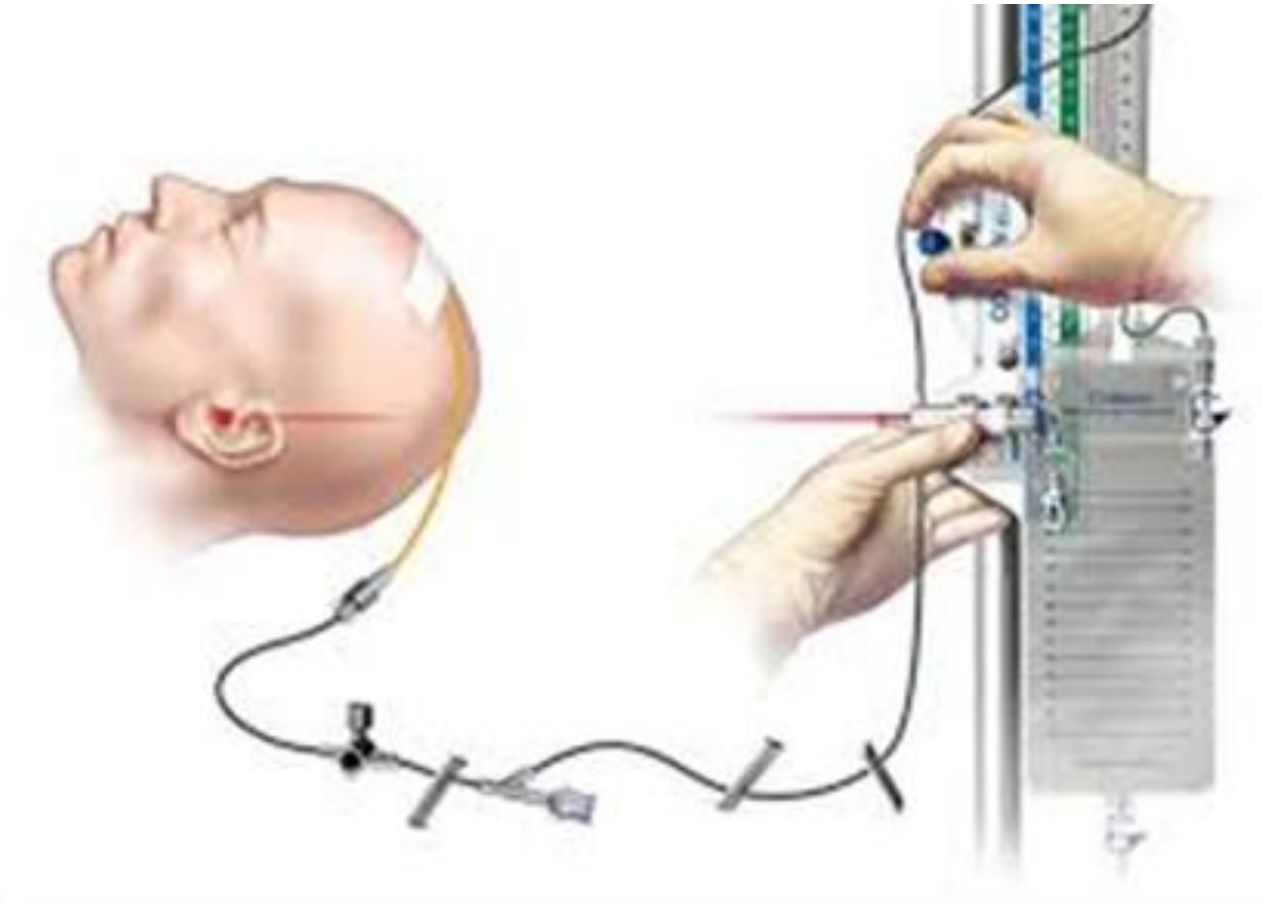
→ in VA shunts mostly

Hydrocephalus
VP shunt infection. Treatment

- Shunt removal & insertion of external ventricular drain (EVD)
- Broad spectrum antibiotics:
  - Vancomycin for Gram +
  - Rocephin for Gram -
- Adjust antibiotics according to C&S (culture & sensitivity)
- Reinsert shunt after 3 negative cultures (taken each other day)
- Continue antibiotics till 48 hours after reinsertion

- Sometimes: intraventricular + systemic AB

Hydrocephalus
External ventricular drain (EVD)



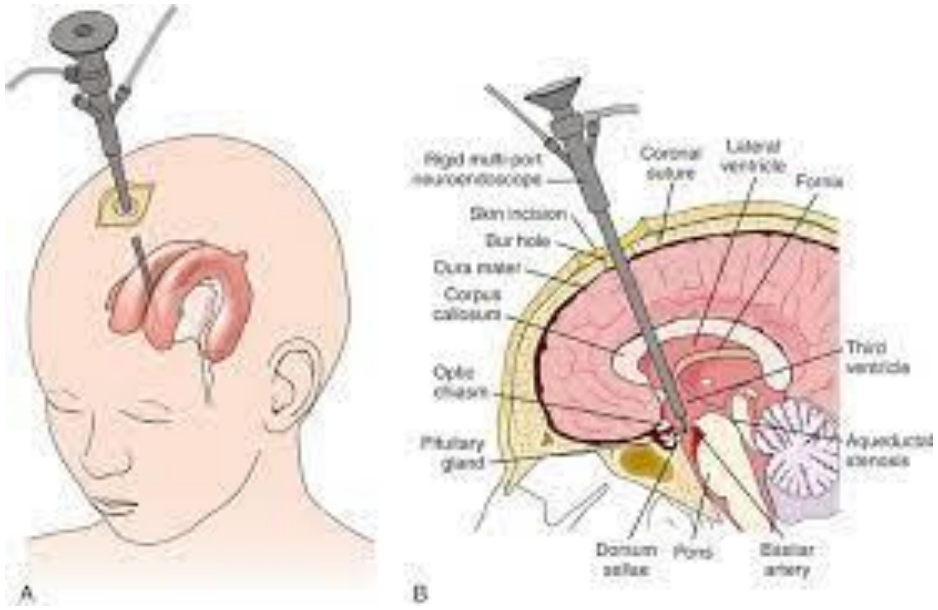
Hydrocephalus
Preventing VP shunt failures (malfunction/ infection)

- In children, the shunt failure rate was:
  - 31.3% for the 1st year
  - 4.5% per year thereafter

- Progress in preventing shunt failures has not been made over the last several decades.

Hydrocephalus

Treatment. Endoscopic Third Ventriculostomy (ETV)





Hydrocephalus

Treatment. ETV success score

Table 25.1 ETV Success Score

Category	Description	Value	Score
Age	<1 month	0%	___%
	1 to<6 months	10%	
	6 months to<1 year	30%	
	1 to>10 years	40%	
	≥10 years	50%	
Etiology	• post-infectious	0%	___%
	• myelomeningocele • post IVH • non-tectal brain tumor	20%	
	• aqueductal stenosis • tectal tumor • other	30%	
Shunt history	• previous shunt	0%	___%
	• no previous shunt	10%	
		Total (range 0–90%)	___%

Hydrocephalus

Treatment. ETV success score

- It is the approximate chance of an ETV lasting 6 months without failure.
- Scores < 40% correlated with a very low chance of success.
- Scores > 80% correlated with a better chance of success compared to shunting from the outset.

- Intermediate scores (50–70%): ETV had a higher initial failure rate compared to shunting, but after 3–6 months the balance shifted in favor of ETV

Thanks



Any Questions?