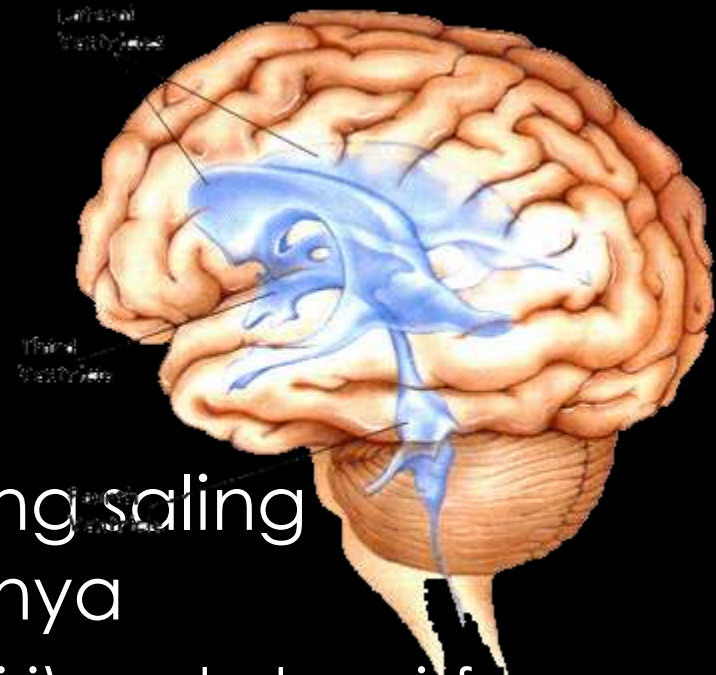


# Hydrocephalus

Dr. Ken Wirastuti, M Kes, Sp.S

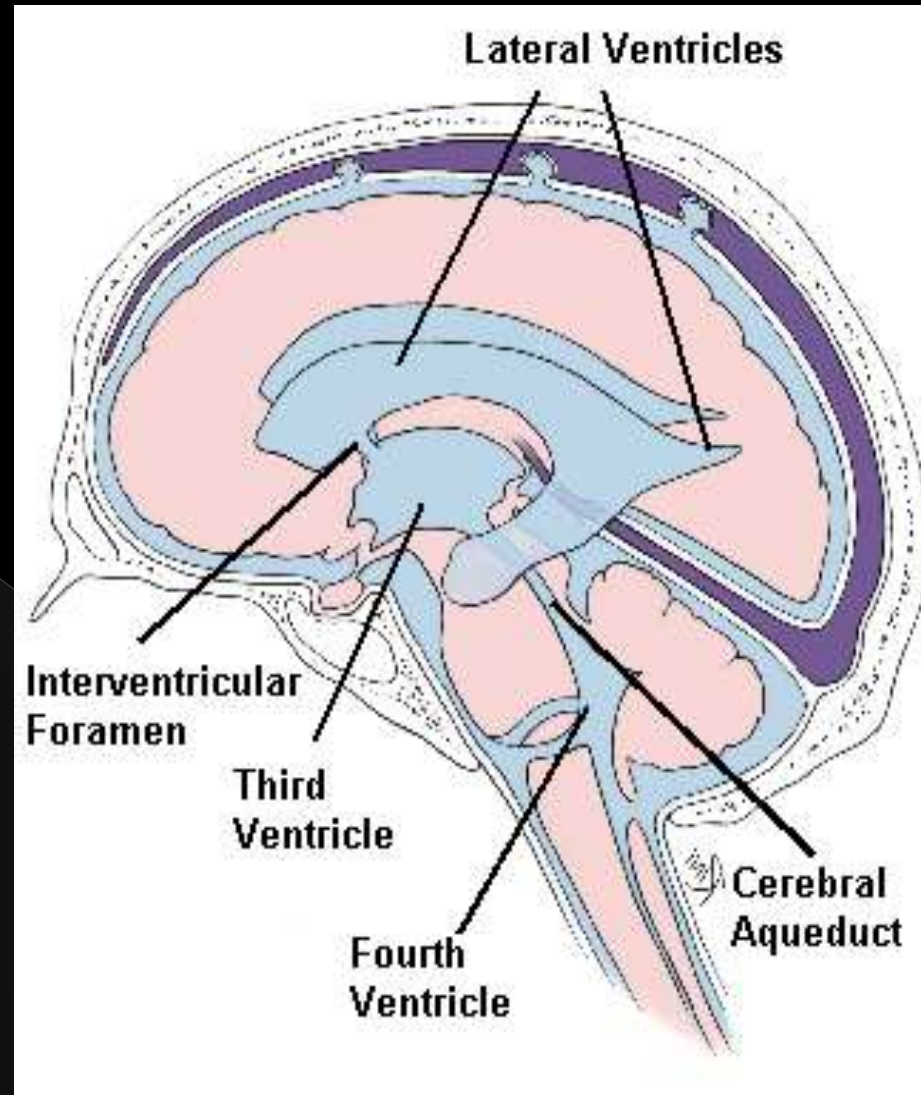
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UNISSULA/RSI.SULTAN AGUNG SEMARANG

# VENTRIKEL OTAK



- Terdapat 4 buah ventrikel yang saling berhubungan satu sama lainnya
  - > 2 ventrikel lateral (kanan dan kiri) pada hemisfer serebri
  - > Ventrikel III diensefalon
  - > Ventrikel IV pons dan medula oblongata
- Dindingnya dibatasi oleh sel epitel kuboid disebut sel ependim → tempat-tempat tertentu melebar disebut pleksus khoroideus yang berfungsi memproduksi LCS

- Masing-masing ventrikel lateral dihubungkan dengan ventrikel III melalui foramen interventrikulare (monro)
- Ventrikel III berhubungan dengan ventrikel IV aquaductus serebri (sylvius)
- Ventrikel IV berhubungan dengan rongga subarachnoid melalui foramen luscka (di sebelah lateral) dan foramen magendi (di sebelah medial)

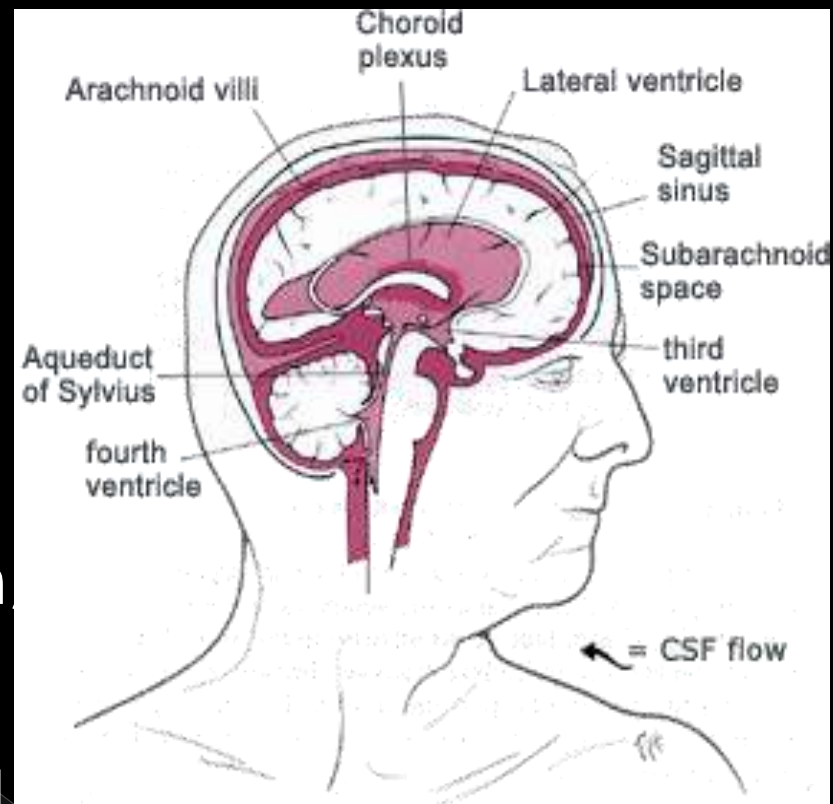


# LIQUOR CEREBRO SPINAL

- ⦿ Merupakan cairan yang jernih, tidak berwarna.
- ⦿ Berada dalam ruang subarachnoid
- ⦿ Volume:  $\pm$  120 - 150 cc
- ⦿ Kecepatan produksi 3cc/menit
- ⦿ Fungsi:
  - > Merupakan bantalan bagi otak yang melindunginya dari pukulan atau goncangan
  - > Merupakan media untuk pembuangan komponen2 yang berlebihan atau bahan2 sisa dari cairan ekstraseluler ke dalam sistem sirkulasi darah.

# LCS

- Tekanan normal LCS pada posisi berbaring berkisar  $\pm 50 - 180 \text{ mm H}_2\text{O}$ , yang dapat dipengaruhi oleh tekanan vena, obat-obatan dan lesi massa desak ruang (SOL)
- Diresorbsi oleh vili arachnoid yang terletak di bagian atas otak (dalam sinus sagitalis)
- Mengandung beberapa komponen:
  - > Protein : 15 – 45 mg%
  - > Glukosa: 45 – 80 mg%
  - > Sel : sel mononukleus/wbc 1 – 5 /mm<sup>3</sup>



# Hidrocefalus

- Adalah volume LCS yang berlebihan di dalam ventrikel.
- Terjadi akibat ketidakseimbangan antara sekresi dan absorpsi (menyebabkan peningkatan tekanan intraventrikel) melalui 3 mekanisme:
  1. Produksi likuor yang berlebihan
  2. Peningkatan resistensi aliran likuor
  3. Peningkatan tekanan sinus venosa
- Penyebabnya:
  - > Kelainan bawaan/congenital
  - > Didapat : infeksi otak, tumor otak, perdarahan otak, cedera kepala

# Klasifikasi Hydrocephalus

1. **Non-communicating**: obstruction of the csf outflow within the ventricles such as congenital malformation, neoplasm, or hematoma; → blockage of CSF flow within the ventricular system, with dilatation proximal to the obstruction
2. **Communicating hydrocephalus (non-obstructive)**: results from faulty absorption or inadequate absorption of cerebrospinal fluid (CSF) resulting from infection, trauma, or obstruction by thick arachnoid membrane or meninges; → blockage of CSF flow beyond the outlet of the 4<sup>th</sup> ventricle

# Communicating Hydrocephalus

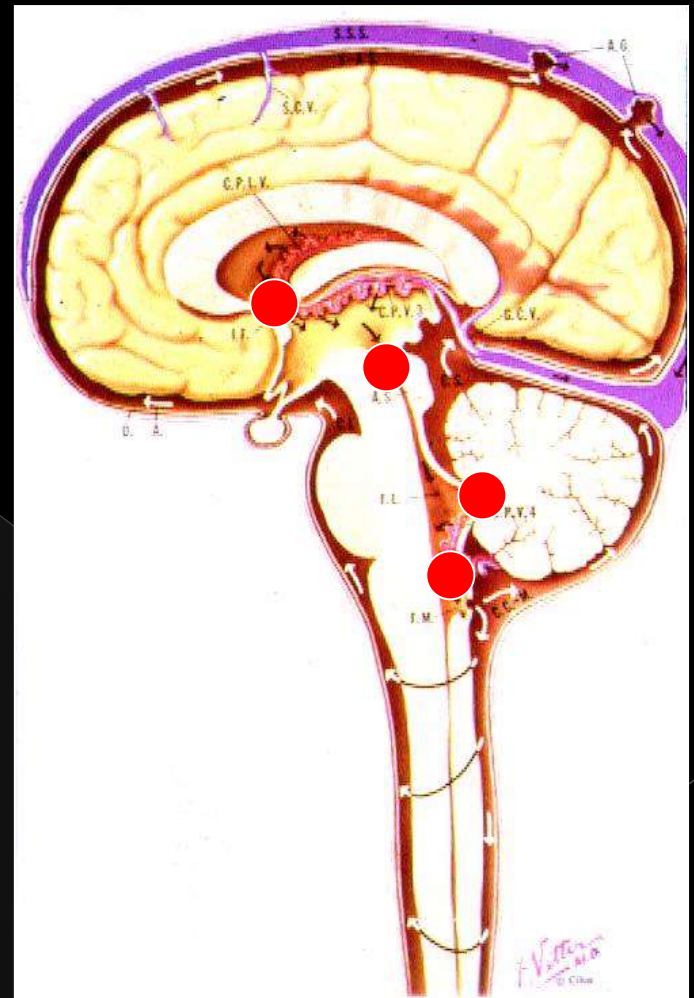
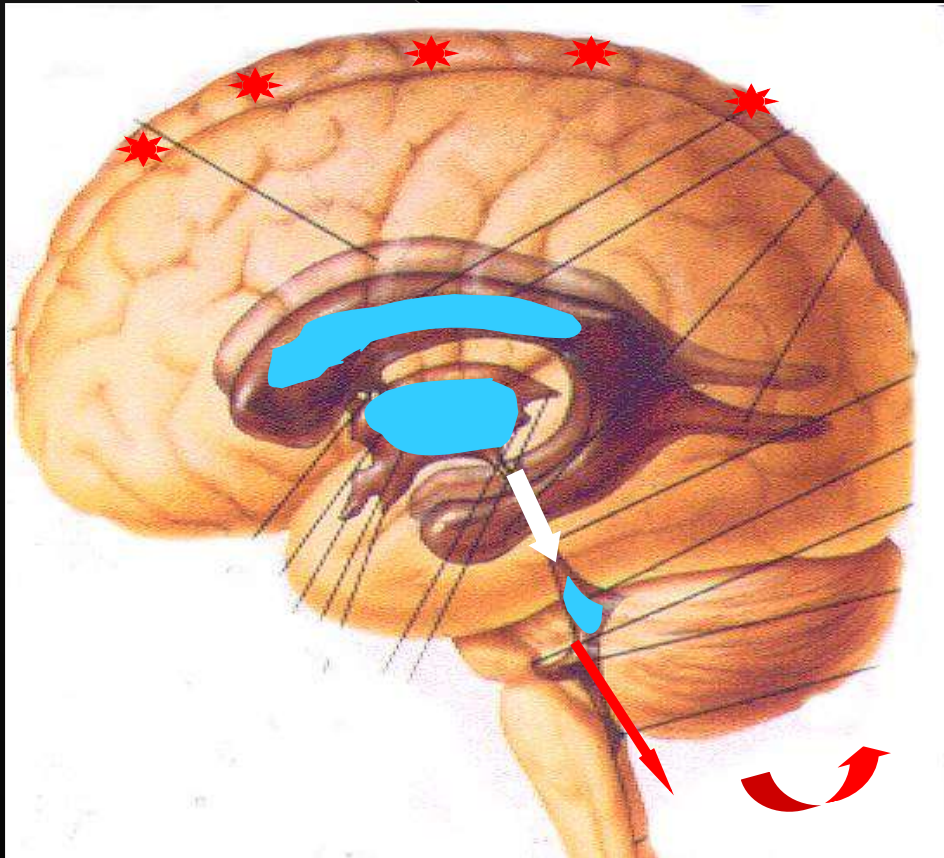
- is the situation where there is communication between the ventricular system and the subarachnoid space
- Blockage of CSF flow over the cerebral convexities/absorption at the arachnoid granulations secondary to:
  - SAH, meningeal metastasis, granulomatous meningitis
- Rapid CSF production
  - eg. choroid plexus papilloma



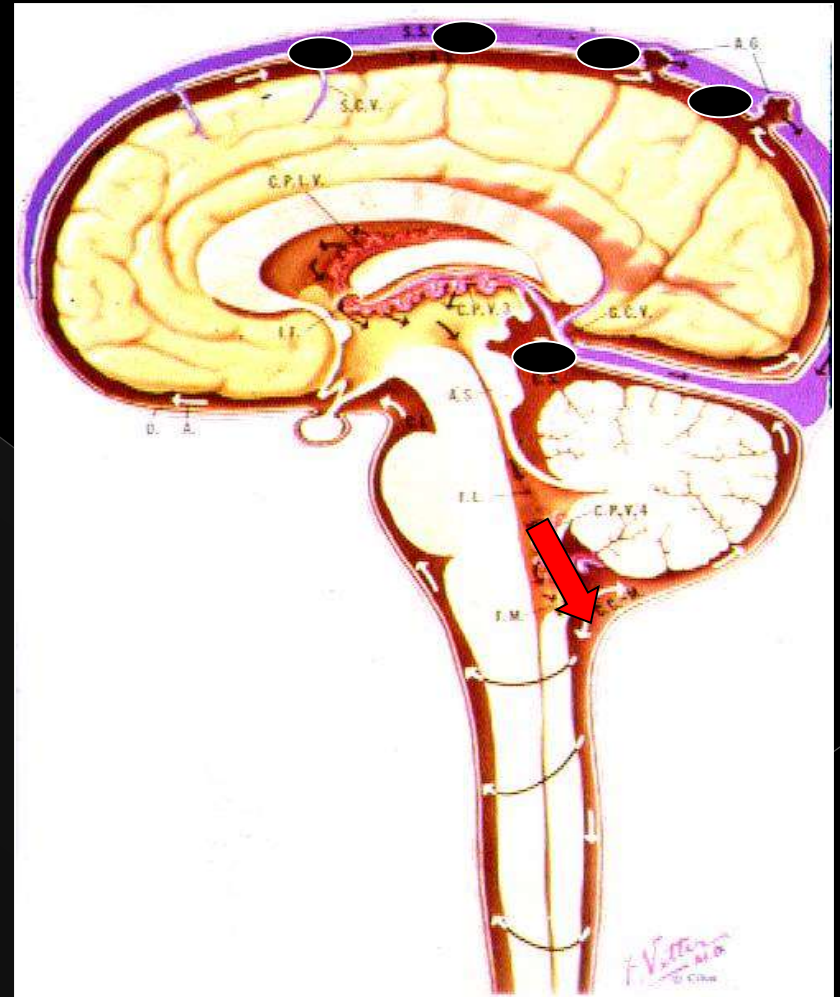
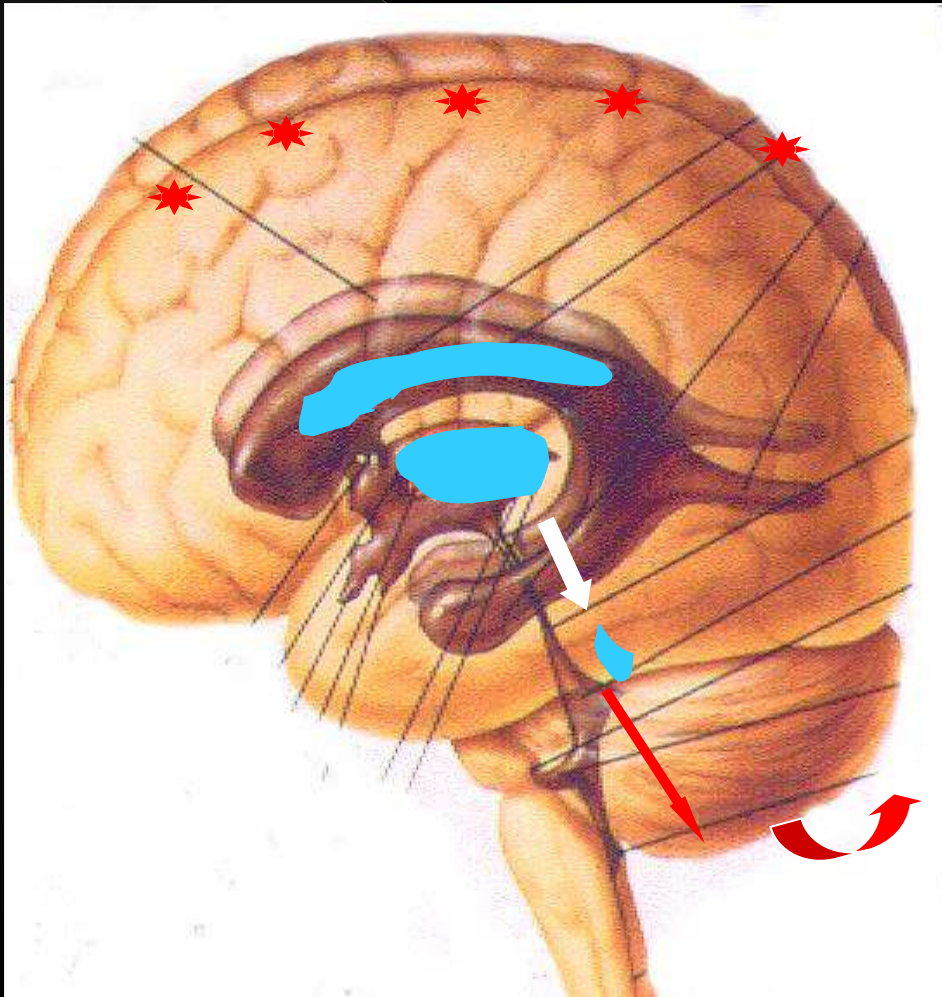
# Non-communicating Hydrocephalus

- is no communication between the ventricular system and the subarachnoid space
- Location of obstruction/causes:
  - > Lateral ventricles → ependymoma, meningioma
  - > Foramen of Monro → third ventricular colloid cyst
  - > Aqueduct of Sylvius → congenital aqueductal stenosis, IVH
  - > Fourth ventricle/foramen of Luschka and Magendie → congenital, tumour, extrinsic compression

# KLASIFIKASI HYDROCEPHALUS COMMUNICATING v NONCOMMUNICATING



# HYDROCEPHALUS COMMUNICATING v NONCOMMUNICATING

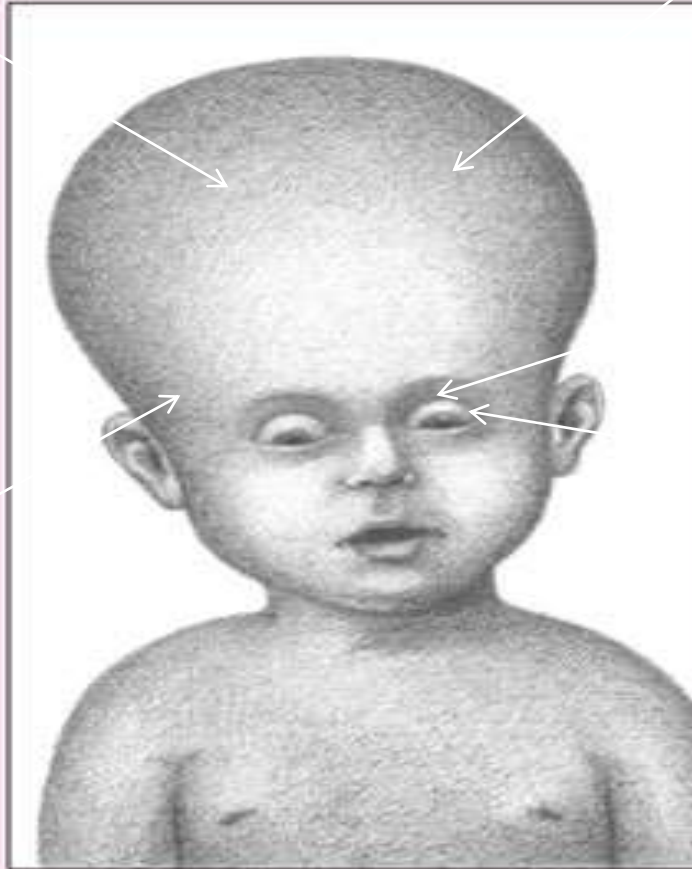


# Symptoms and signs

1. Increasing head size in the infant because of open sutures and bulging fontanel
2. Prominent scalp veins and taut, shiny skin
3. "Sunset" eyes
4. Increased intracranial pressure: projectile vomiting not associated with feeding, irritability, anorexia, high shrill cry, seizures, cracked pot sign, consciousness
5. Damage to the brain because increased pressure decreases blood flow to the cells, causing necrosis

## Identifying setting-sun sign

With this late sign of increased intracranial pressure in an infant or a young child, pressure on cranial nerves III, IV, and VI forces the eyes downward, revealing a rim of sclera above the irises.



Tense anterior fontanelle

Cracked pot sounds on skull percussion

Lid retraction

Impaired upward gaze

Thin scalp with dilated viens

# Normal Pressure Hydrocephalus

a condition that rarely occurs in patients younger than 60 years

Etiologi:

- 50% cases NPH secondary to other illnesses
  - Subarachnoid hemorrhage
  - Meningitis
  - Cranial trauma
- 50% cases idiopathic

Diagnostic Triad:

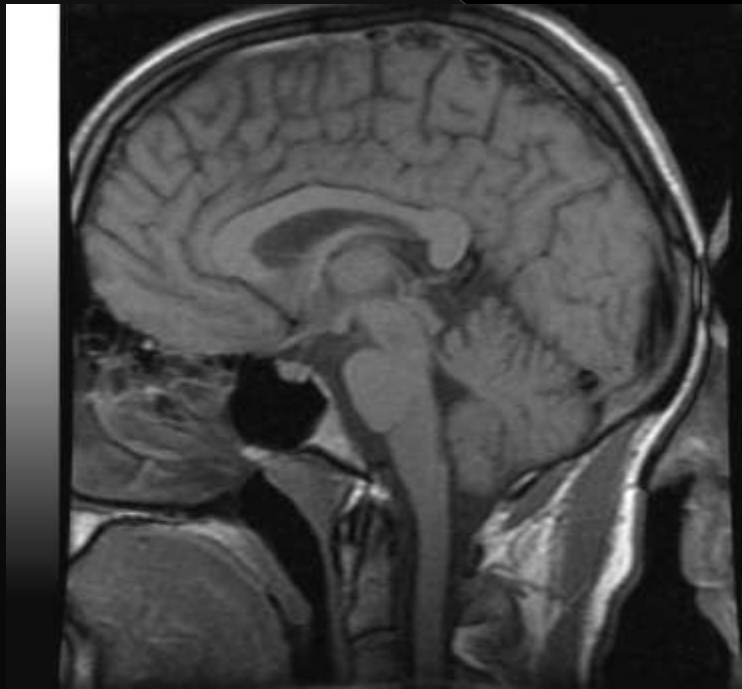
- Gait Disturbance
- Urinary Incontinence
- Dementia

# Diagnosis test

- ◉ Skull x-ray
- ◉ Ventriculography
- ◉ MRI
- ◉ C T scan



# Normal Ventricles





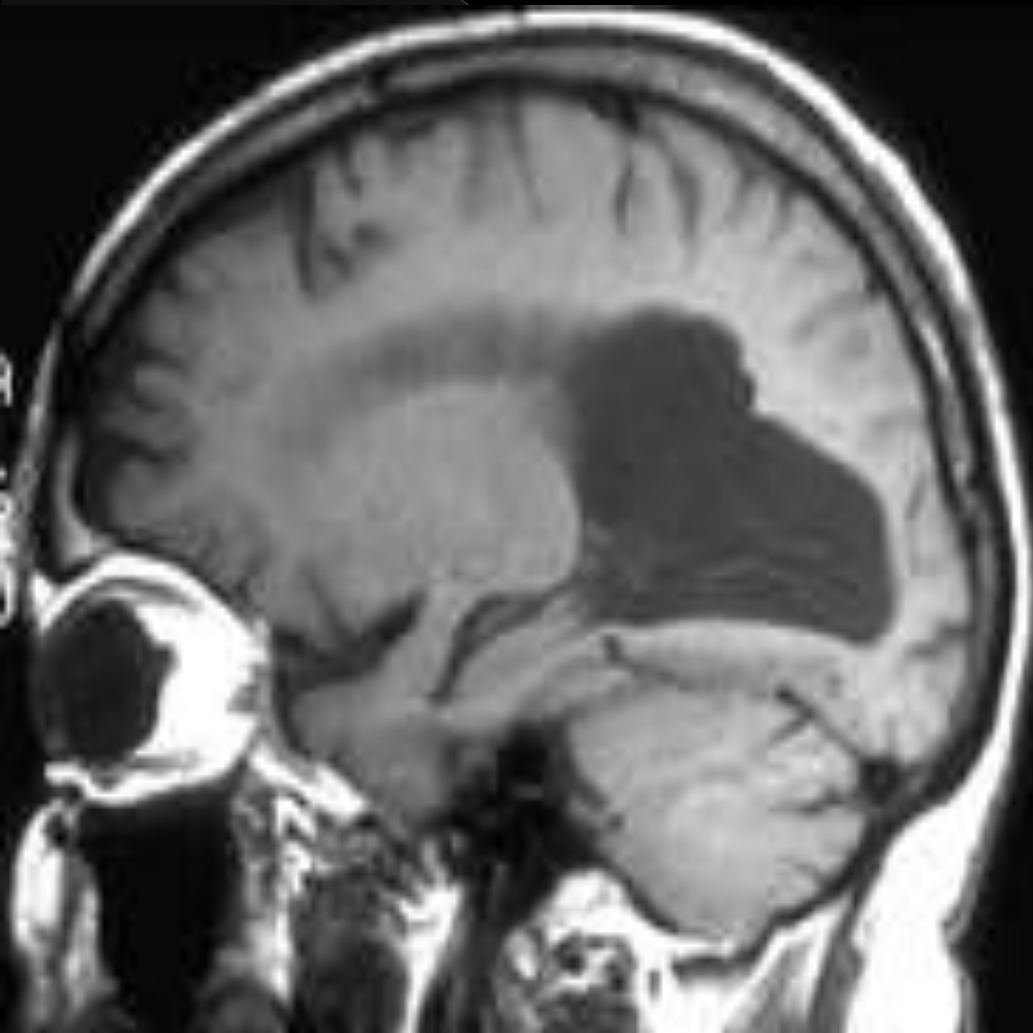
# Enlarged Ventricles



Enlarged  
Ventricles



# Enlarged Ventricles



# HYDROCEPHALUS

## TREATMENT ALTERNATIVES

### 1. Shunting

- Immediate effect
- ~ 100% reliability (although 50% of current shunts are replaced within 5 years)
- ~75% of patients are treated by this methodology

### 2. Drug treatment

- Initially, it was shown that Acetazolamide reduced CSF production by the choroid plexus
- In a series of Hydrocephalus in immature infants the drug was used and success was claimed as shunts was avoided in 50% of the cases
- 0% of patients are treated by this methodology

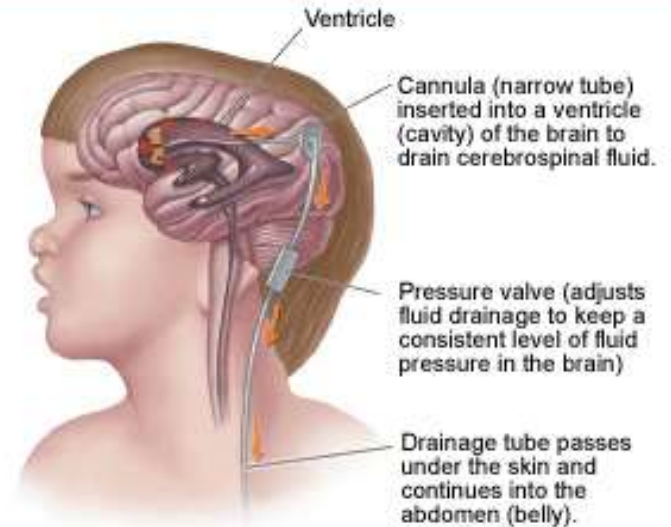
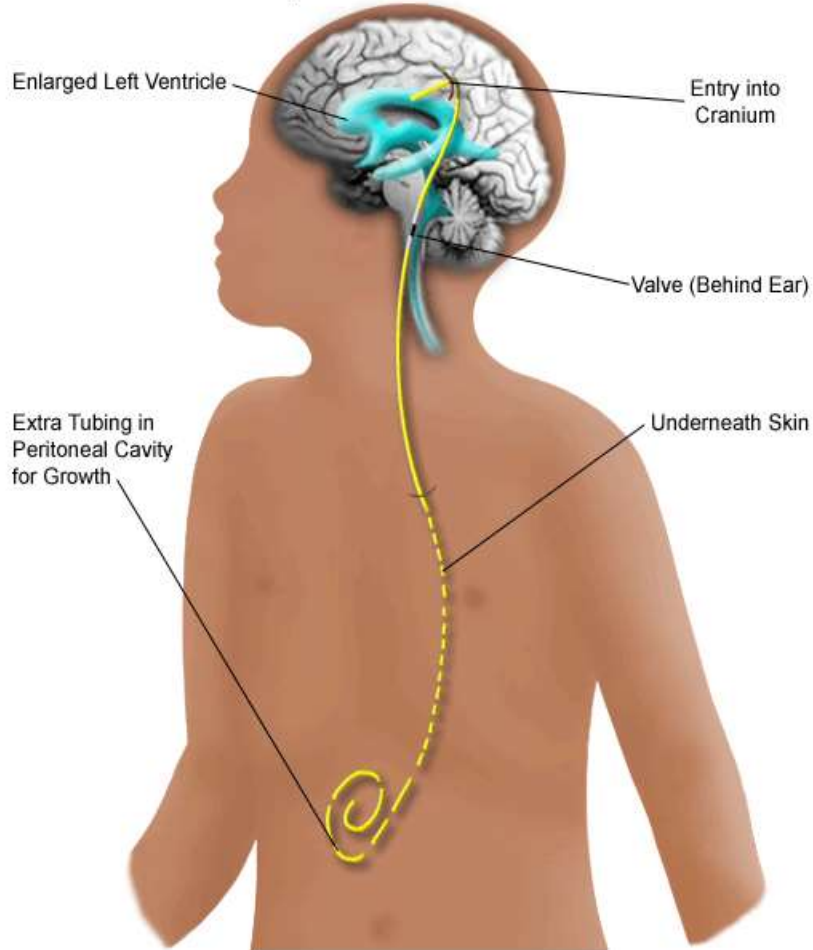
### 3. Ventriculostomy (intracranial procedure)

- Immediate effect
- When first developed the procedure had high mortality and morbidity rates. Today it is a very safe procedure
- ~25% of patients are treated by this methodology

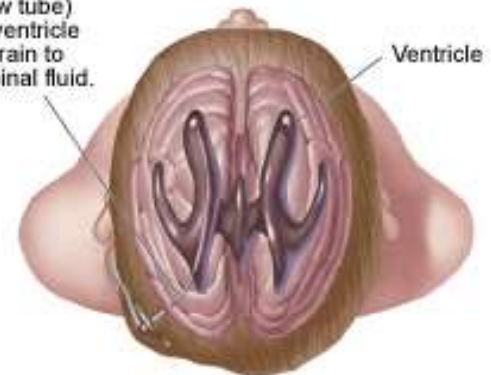


# Therapy

## Ventriculoperitoneal Shunt Placement



Cannula (narrow tube) inserted into a ventricle (cavity) of the brain to drain cerebrospinal fluid.

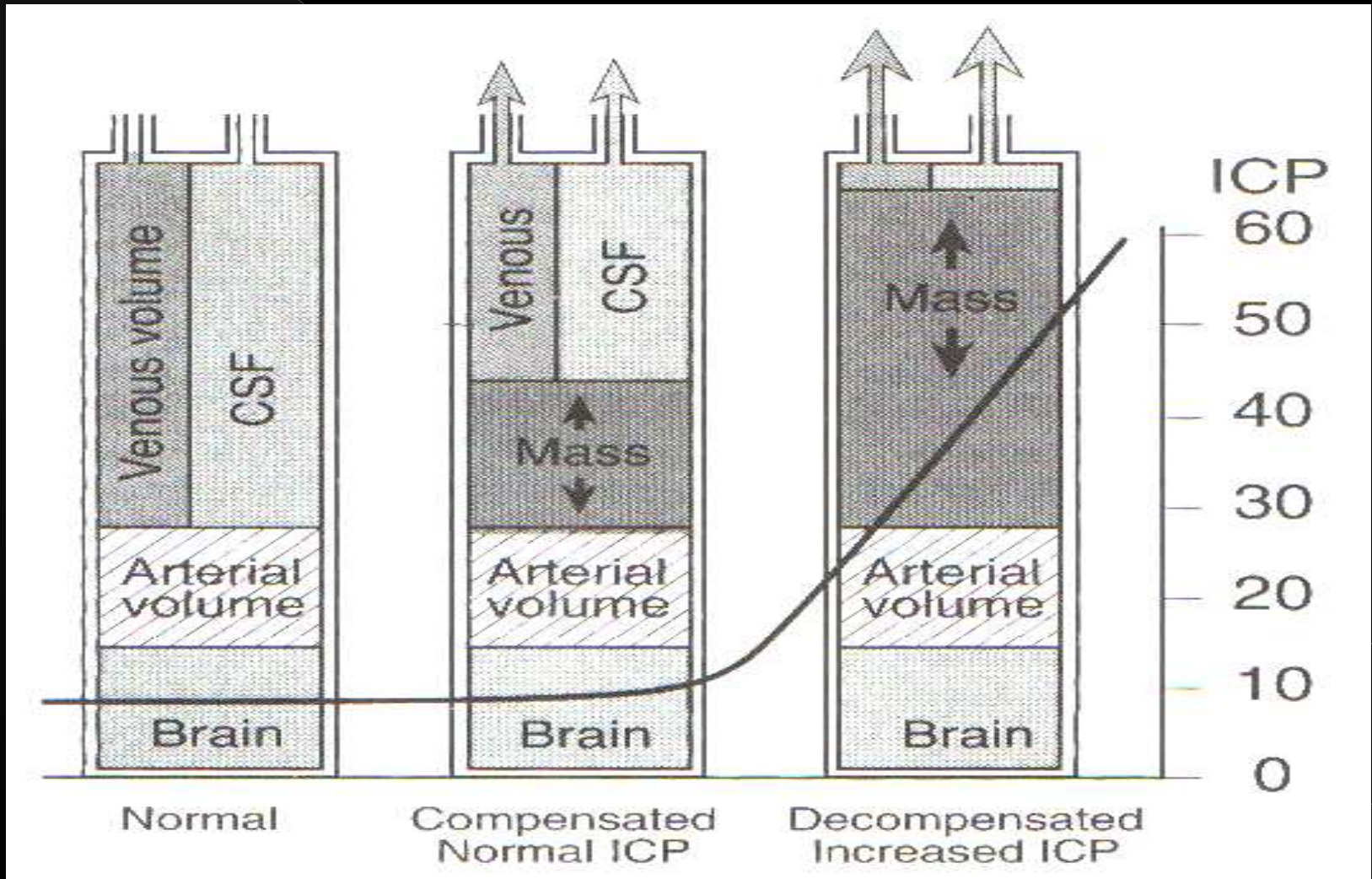


# **PATHOPHYSIOLOGI OF INTRACRANIAL PRESSURE**

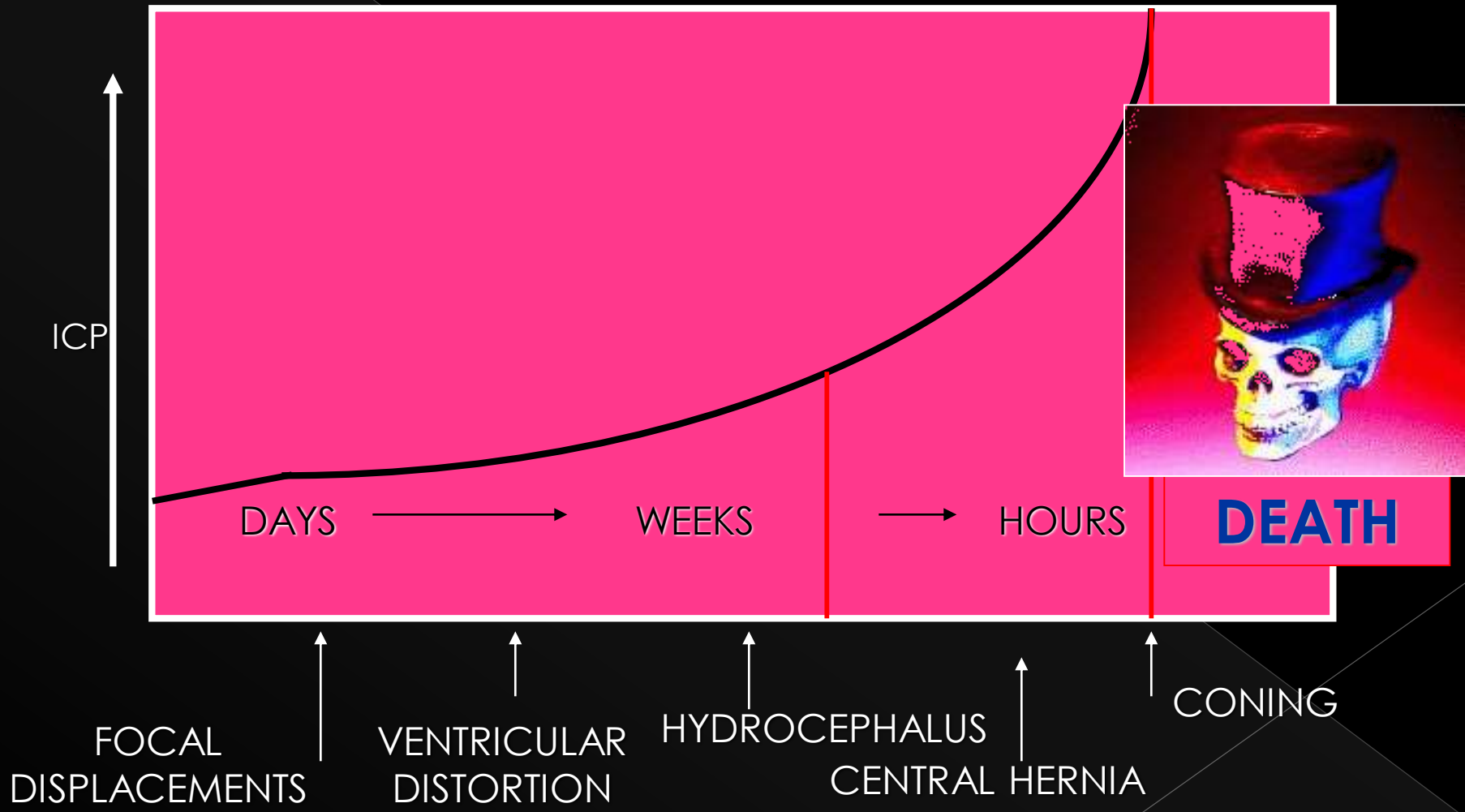
# Monroe-Kellie Principle

$$V \text{ darah (150)} + V \text{ LCS (150)} + V \text{ otak (1200)}$$

Brain	Blood
CSF	Mas
Bone	

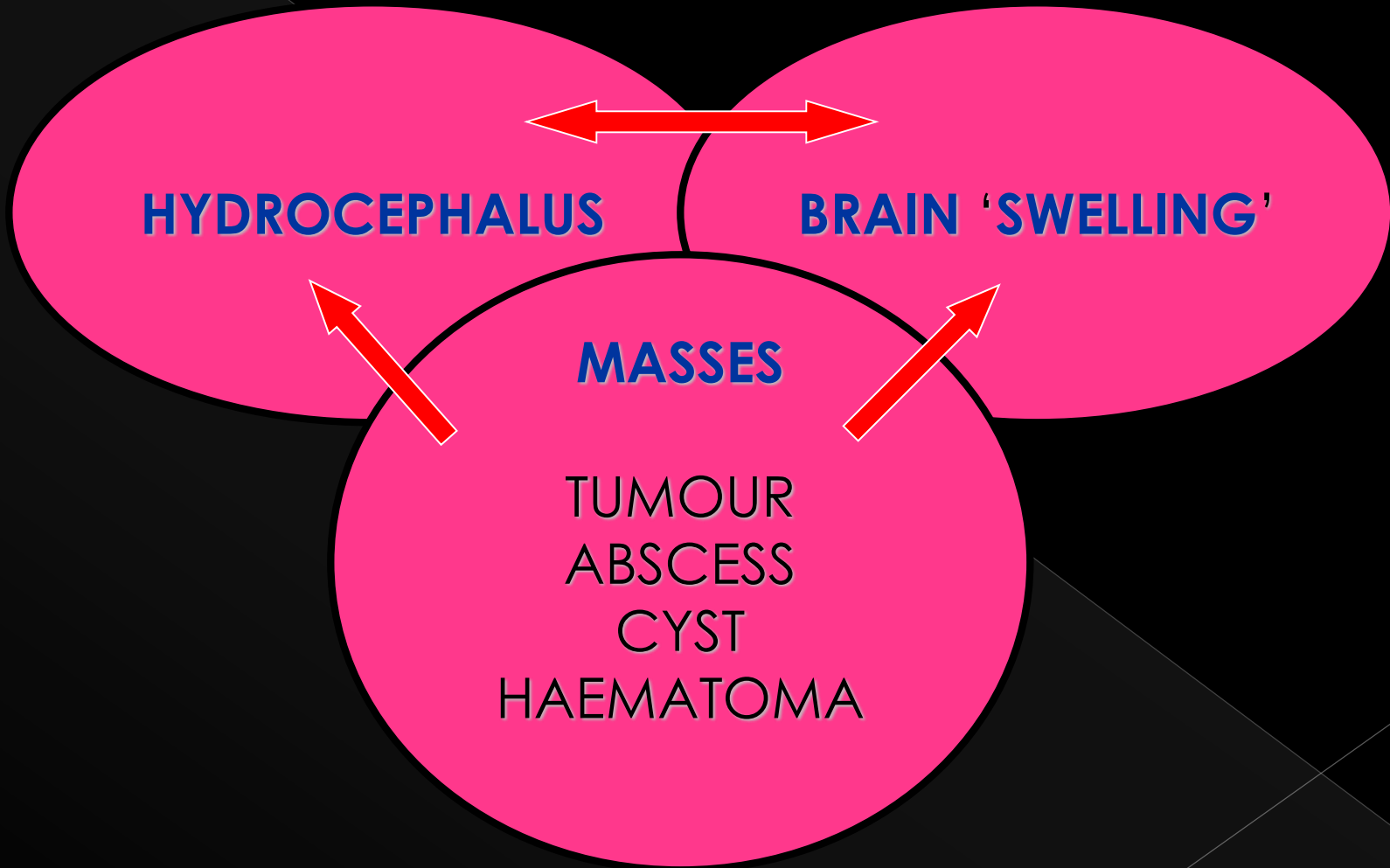


# RAISED INTRACRANIAL PRESSURE





# CAUSES of RAISED INTRACRANIAL PRESSURE



# Increased Intracranial Pressure Trias:

- Cephalgia
- Projectile nausea
- Papil oedema

# Edema Serebri

- ◉ **Vasogenic :**

- > kerusakan vaskuler endotel kapiler, gangguan tight junction, permeabilitas meningkat

- ◉ **Cytotoxic :**

- > gangguan pompa Na, K, ATP ase, Na intrasel meningkat

- ◉ **Interstisial :**

- > Transudasi

# *Terima Kasih*

