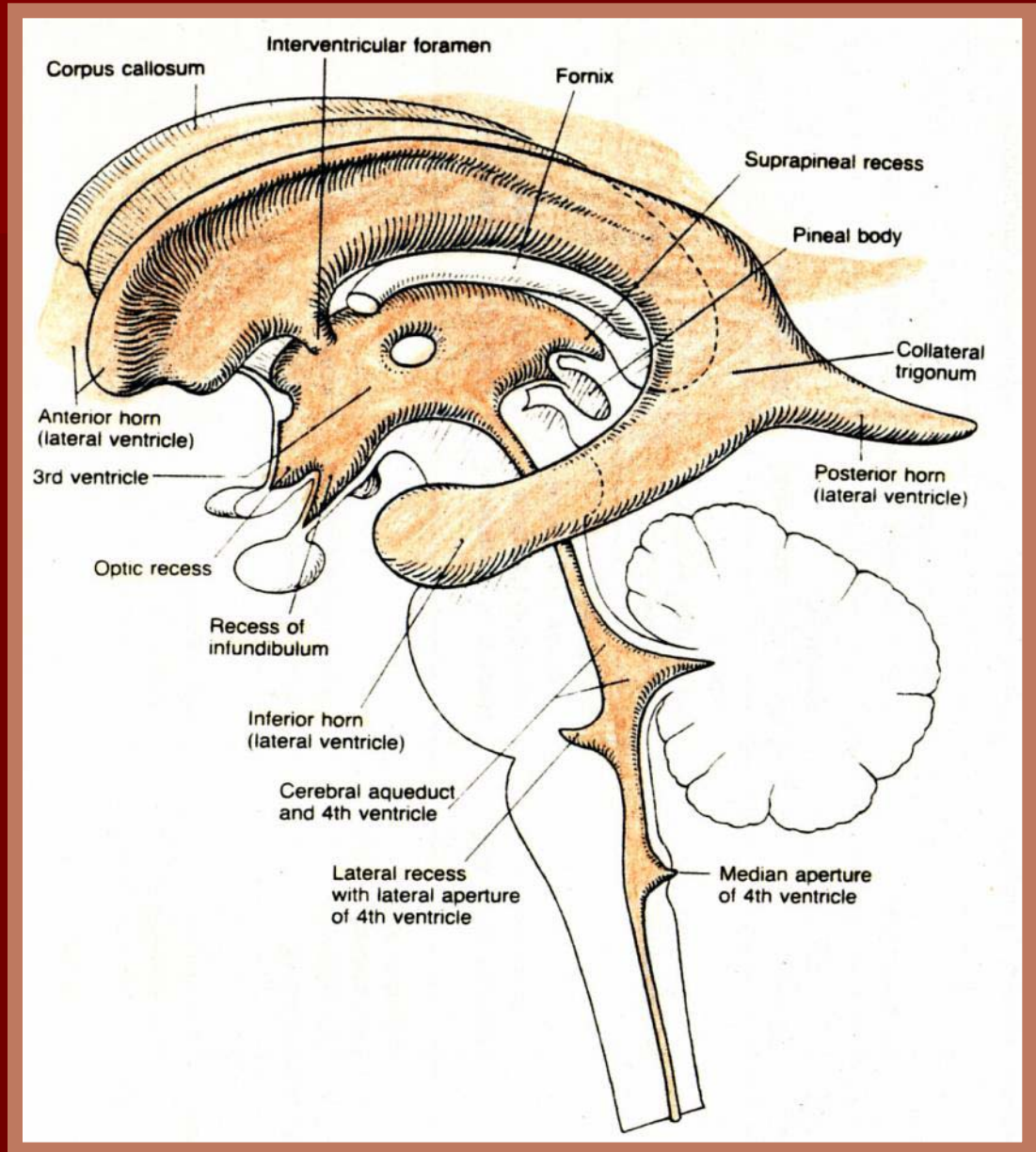


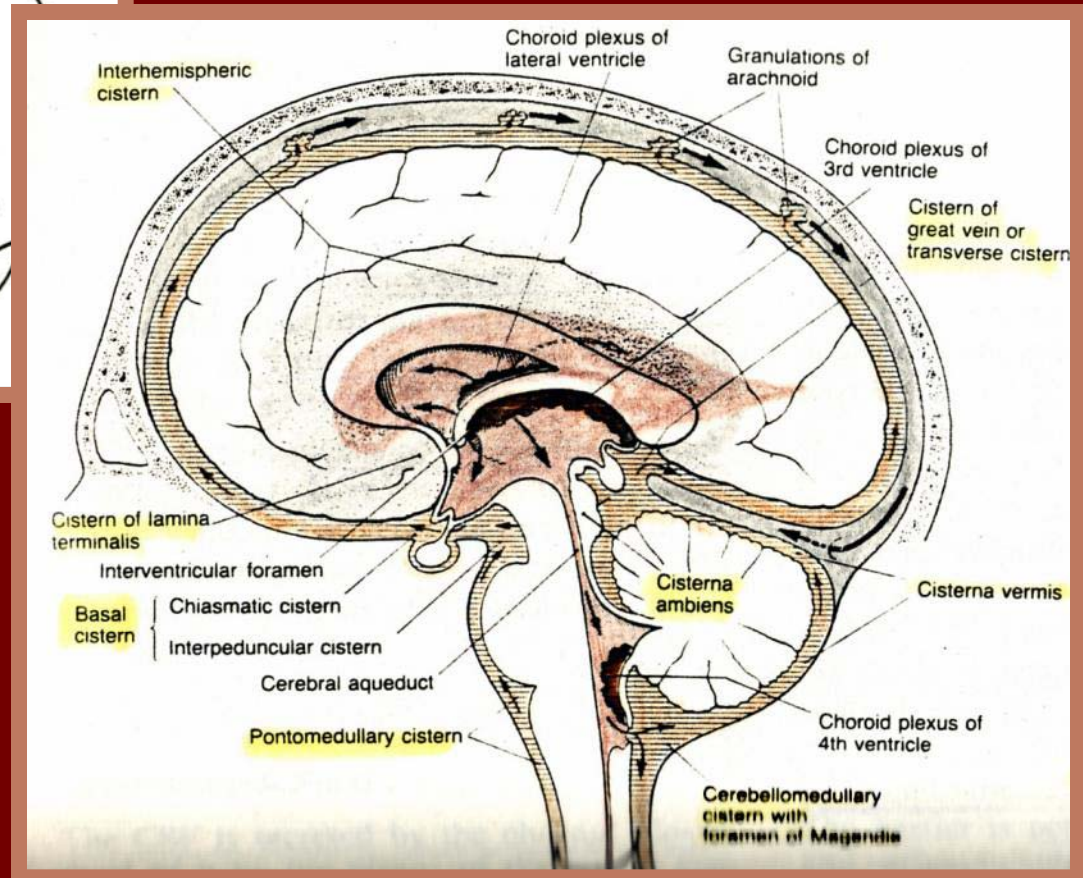
Hydrocephalus in children

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University Hospital Brno

Ventricle system



Ventricle system, cerebral cisterns



Hydrocephalus taxonomy

- hypersecretion
- hyporesorption
- obstructive (non-communicating)
- communicating (non-obstructive)
- congenital
- acquired
 - posthaemorrhagic
 - postinfectious
 - posttraumatic
- internal
- external
- active
- arrested

Signs and symptoms

- Makrocephaly, fontanelle bulging, „setting sun sign“, Parinaud sy
- **Intracranial hypertension**
 - cephalgia - diffuse, worse headache, reverse Tinnel´s sign
 - vomitus - explosive, no nausea
 - vertigo
 - seizures
 - unconsciousness
 - respiratory and cardiac arrhythmia

Hydrocephalus



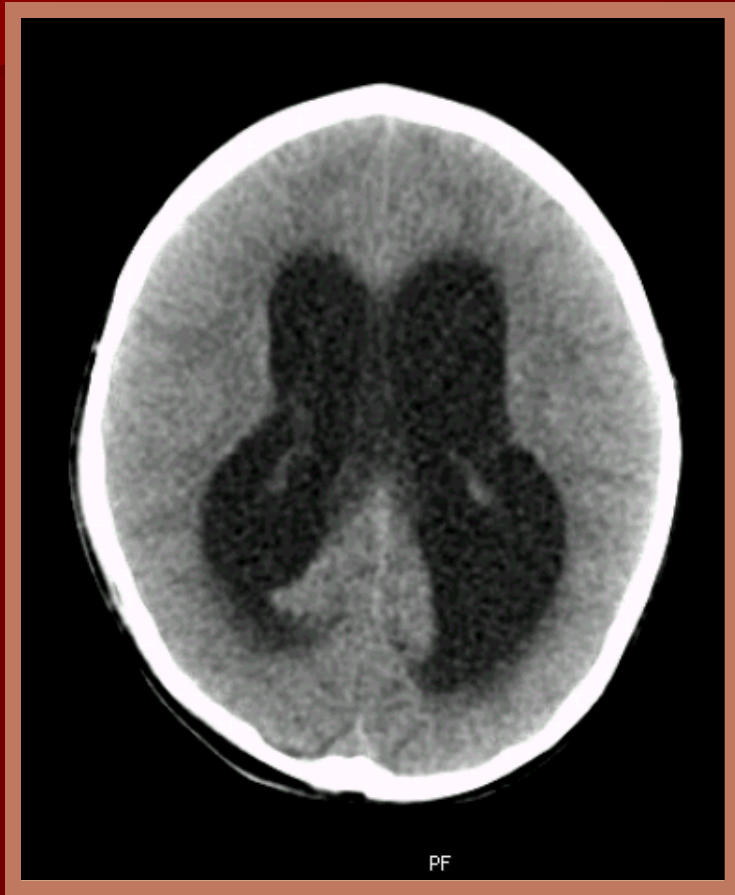
Diagnosis of hydrocephalus

- Neurology examination
- Neuroimaging modalities
 - ultrasound
 - CT
 - MRI
- Ocular fundus

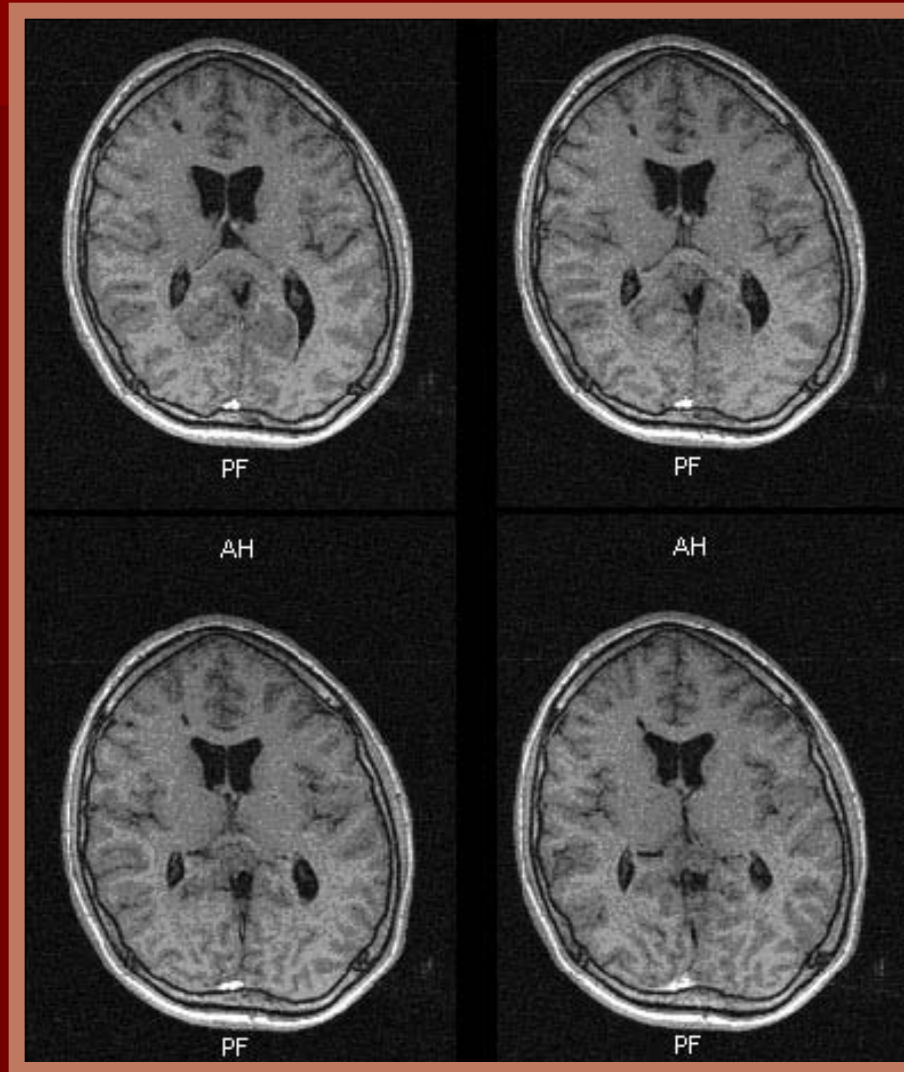
Cerebral ultrasound examination



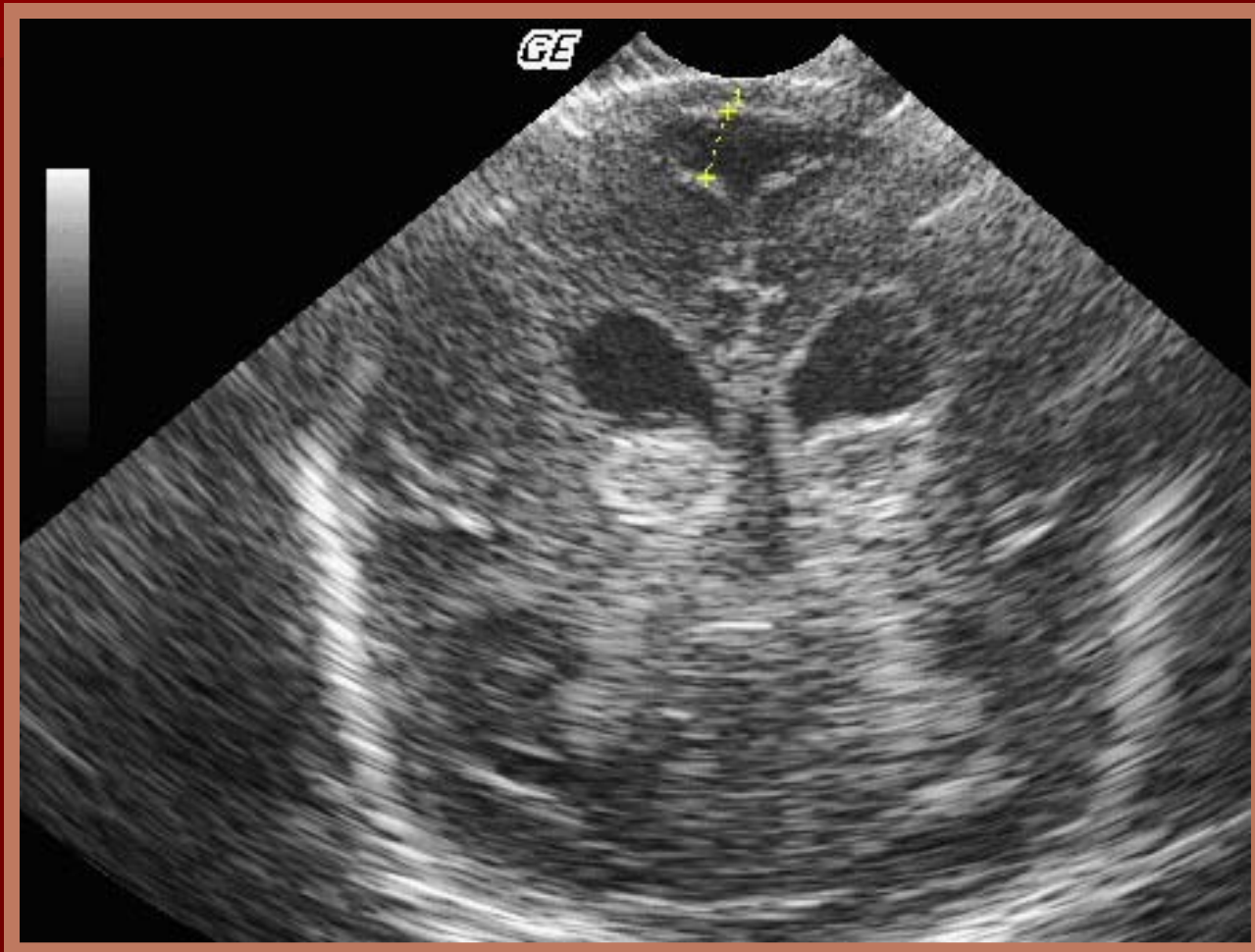
Cerebral CT



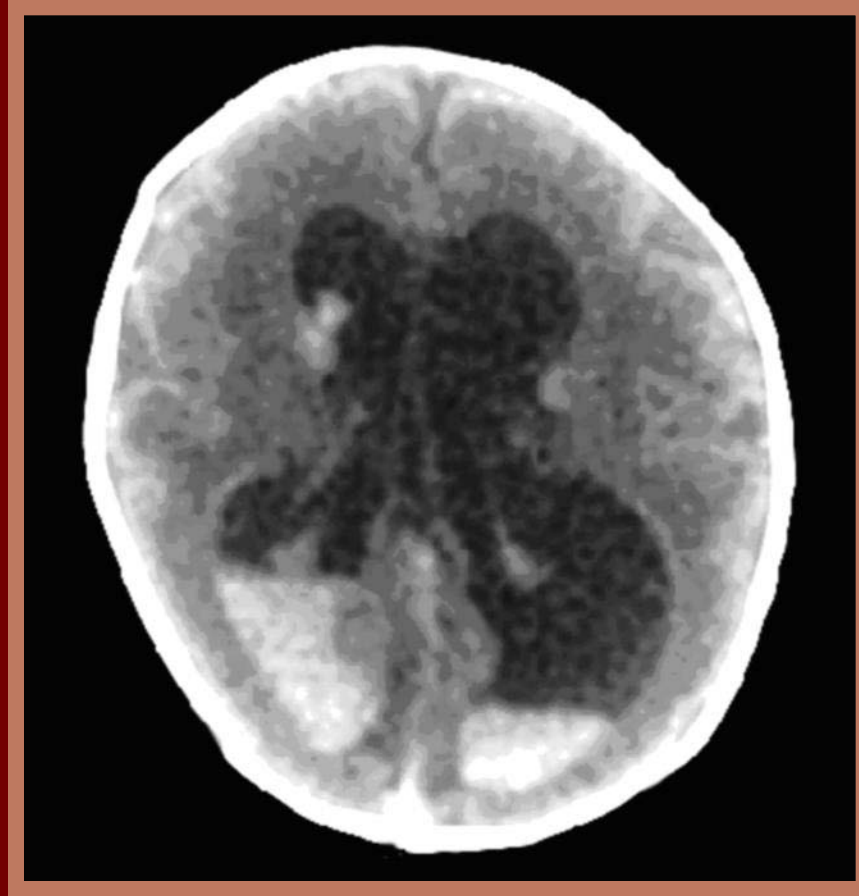
Cerebral MRI



Posthaemorrhagic hydrocephalus ultrasound imaging



Posthaemorrhagic hydrocephalus CT imaging



Hydrocephalus treatment

- Medical
- Surgery

Hydrocephalus treatment temporary

- Medicamentose (diuretics)
- Spinal tap
- Ventricular puncture
- Ventricular drainage
- Lumbar drainage

Posthaemorrhagic hydrocephalus temporary treatment



Surgical treatment of hydrocephalus

- Drainage - shunting - VA, VP, (Nulsen, Spitz, Holter, Pudenz)
- Neuroendoskopy techniques

Surgical treatment of hydrocephalus

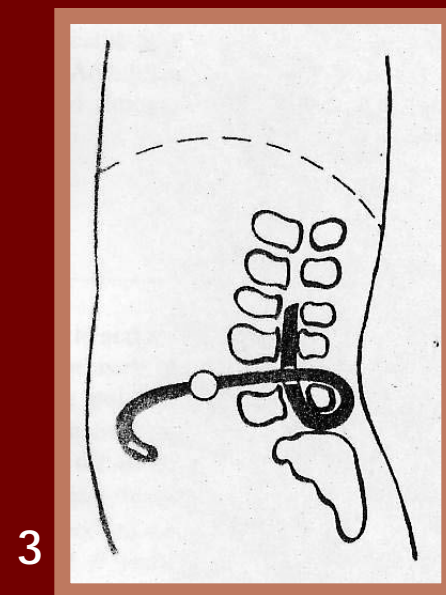
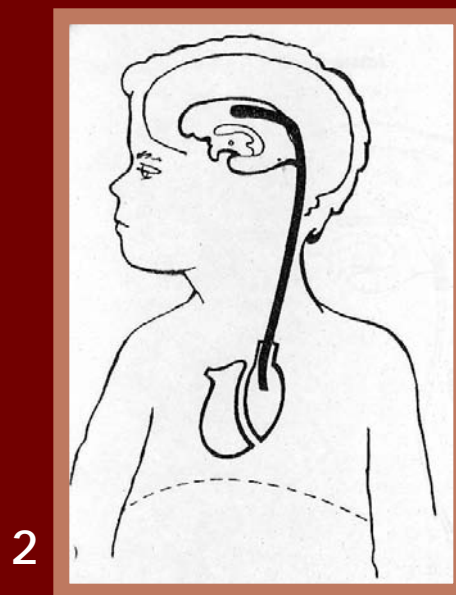
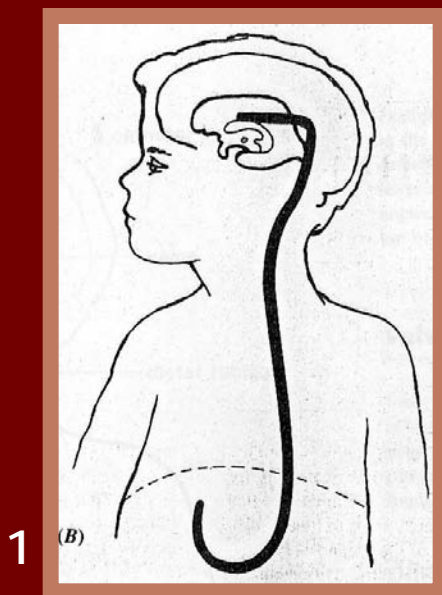
- A. Eliminating of obstruction cause (e.g. tumor extirpation)
- B. Arteficial CSF communication (neuroendoskopy, Stookey - Scarff)
- c. CSF drainage

Drainage

- Most common surgery performed
- Communication between the ventricles and CSF resorption space

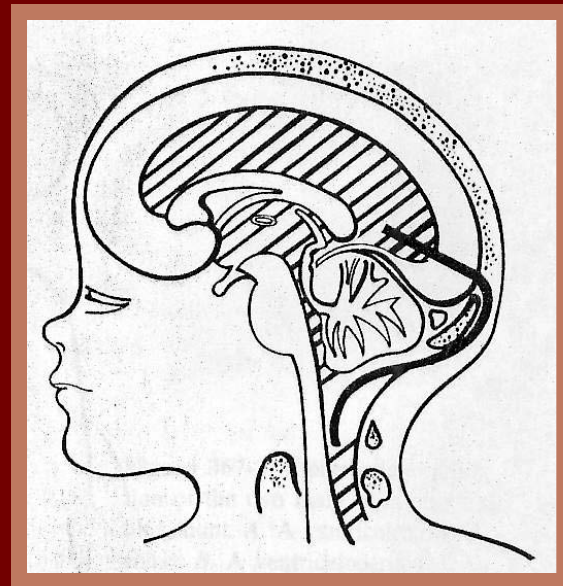
Drainage modifications

- Ventriculo - peritoneal VP (pic. 1)
- Ventriculo - atrial VA (pic. 2)
- Lumbo - peritoneal (pic. 3)



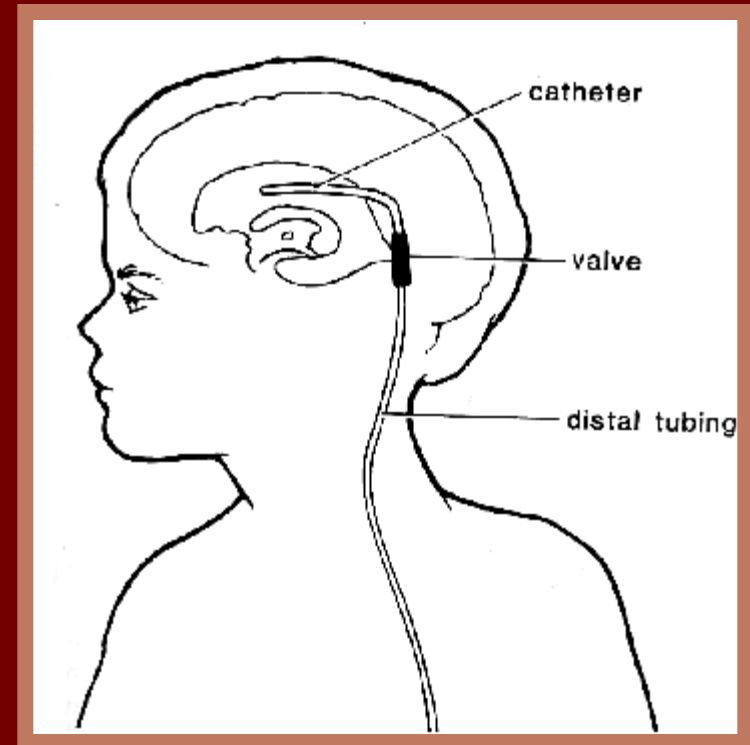
Drainage modifications

- Ventriculo - subgaleal
- Ventriculo - pleural
- Torkildsen



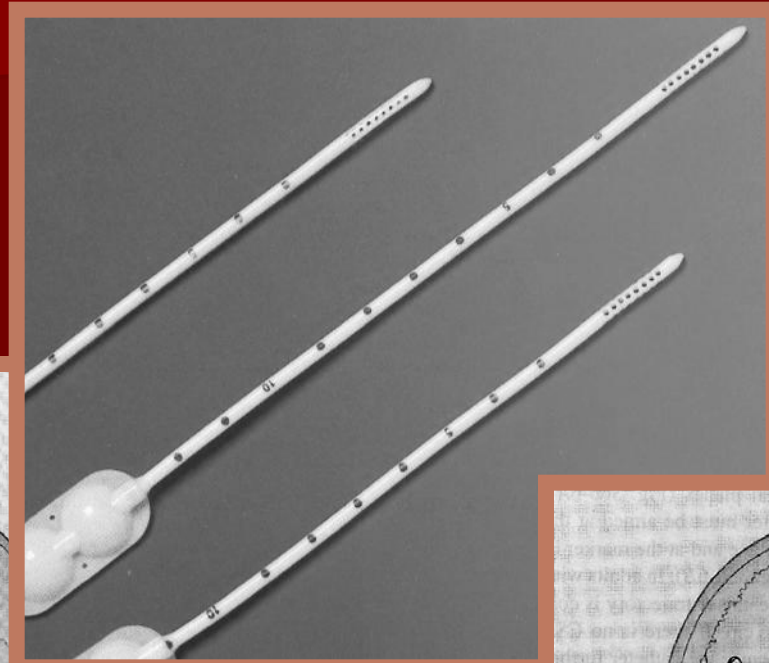
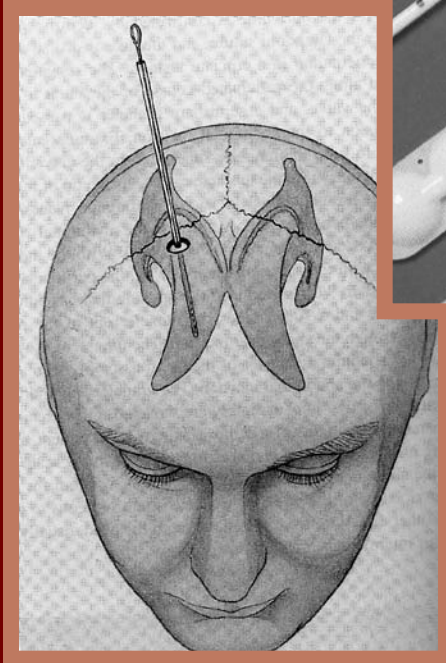
V-P drainage

- Ventricular catheter
- Valve
- Peritoneal catheter

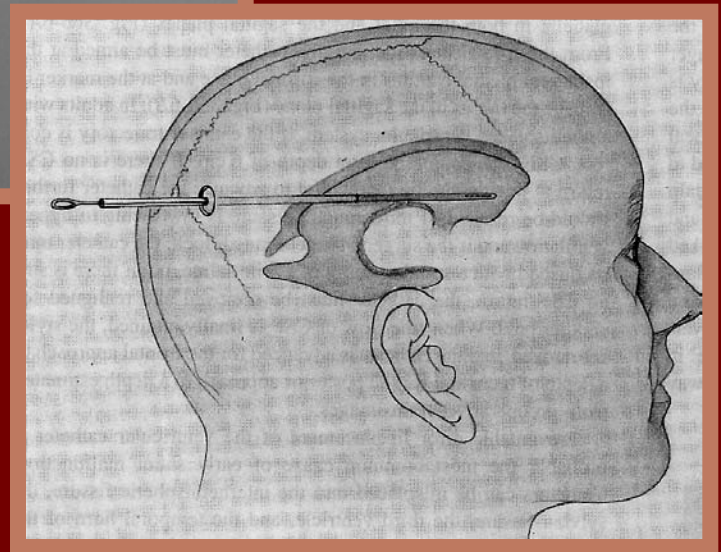


Insertion of ventricular catheter

Dorso-frontal



Parieto-occipital



Valves - non programmable

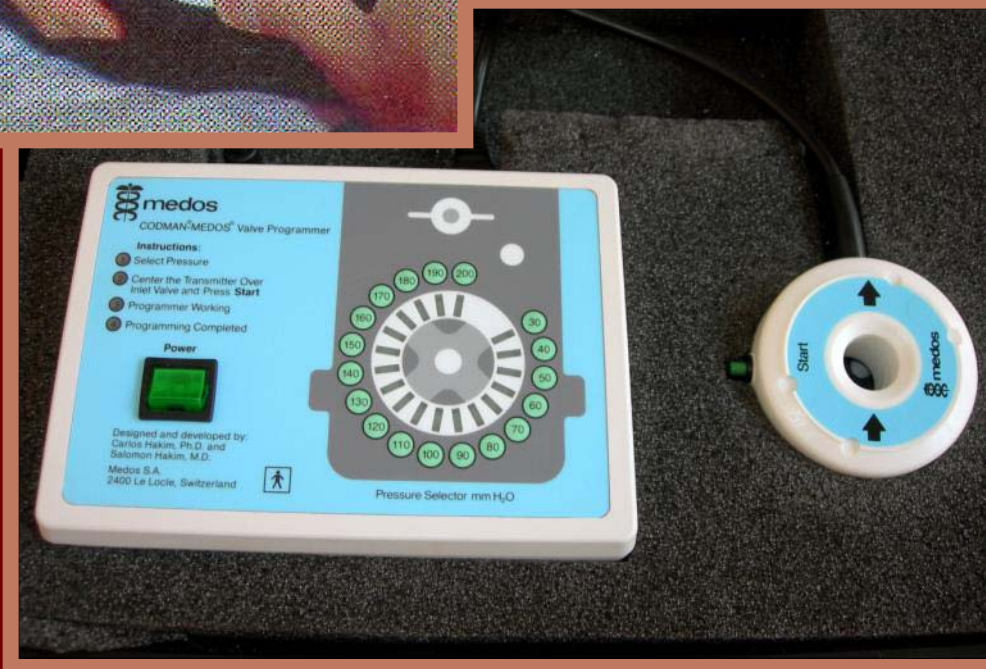
- Valve opening pressure:
 - low pressure 50 mm H₂O
 - middle pressure 100 mm H₂O
 - high pressure 150 mm H₂O



Programmable valves



system Codman



Programmable valves

system Strata Medtronic



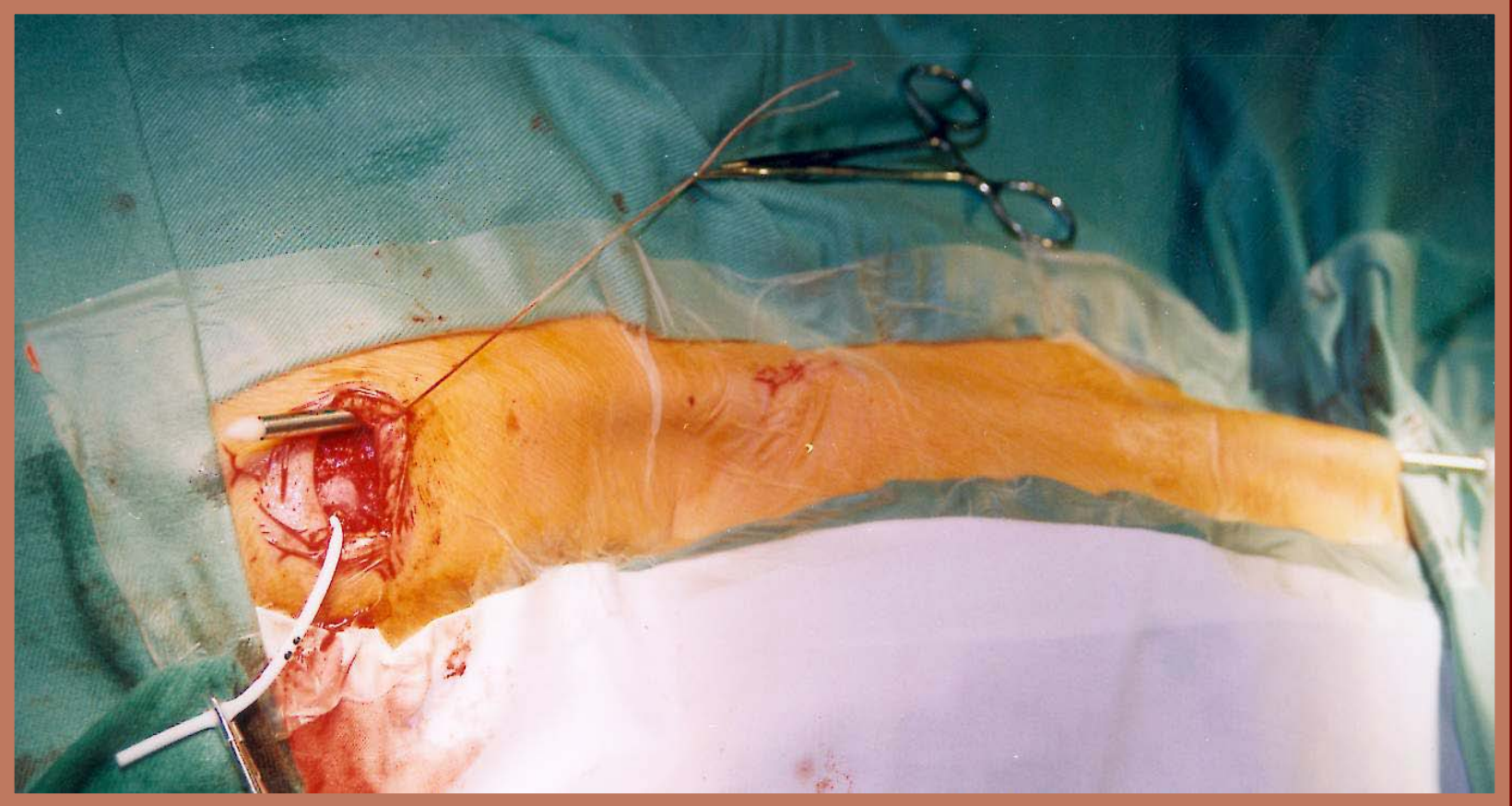
Surgery - drainage - VP shunt patient positioning



Surgery - drainage - VP shunt



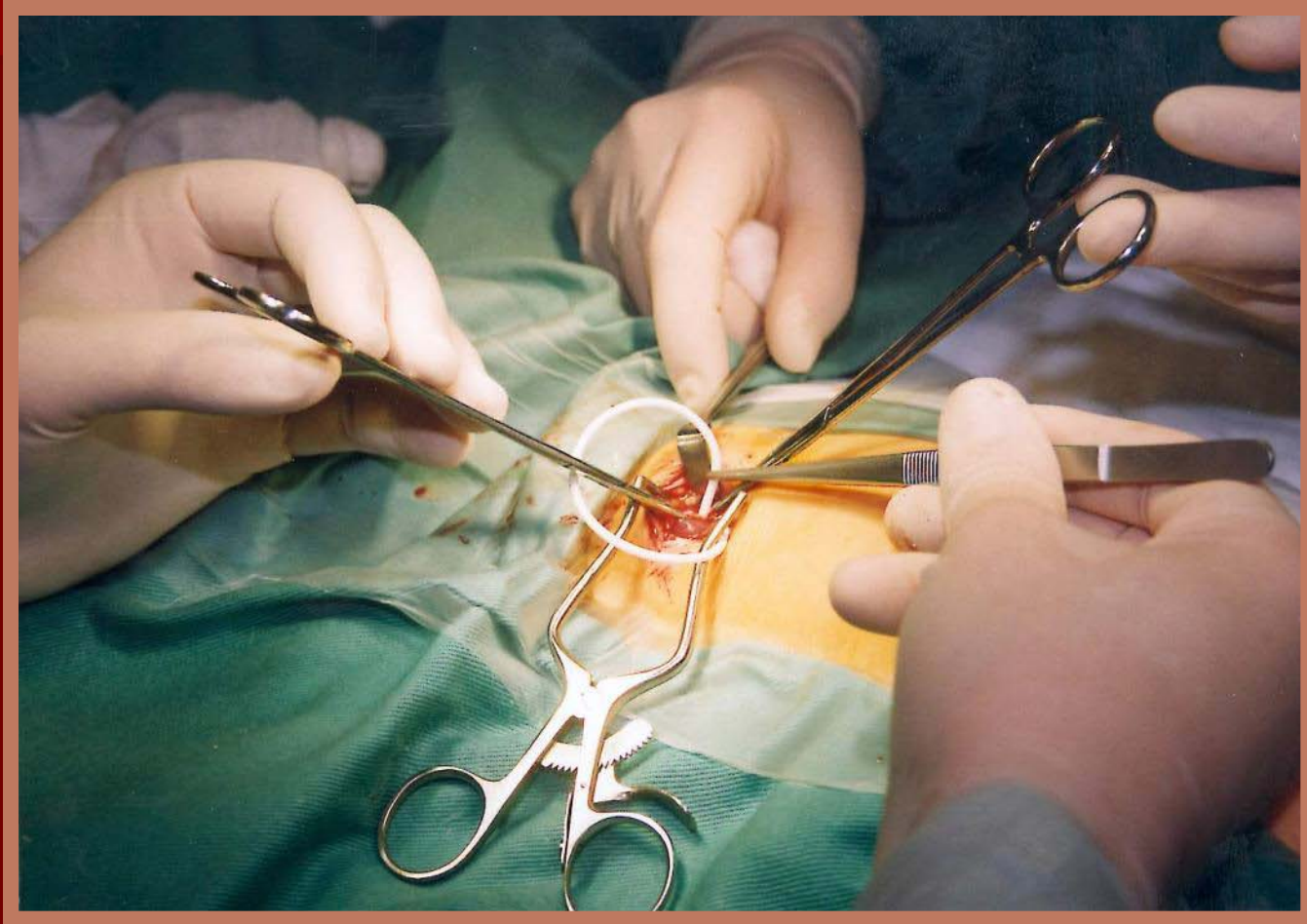
Surgery - drainage - VP shunt



Surgery - drainage - VP shunt



Surgery - drainage - VP shunt



Surgery - drainage - VP shunt



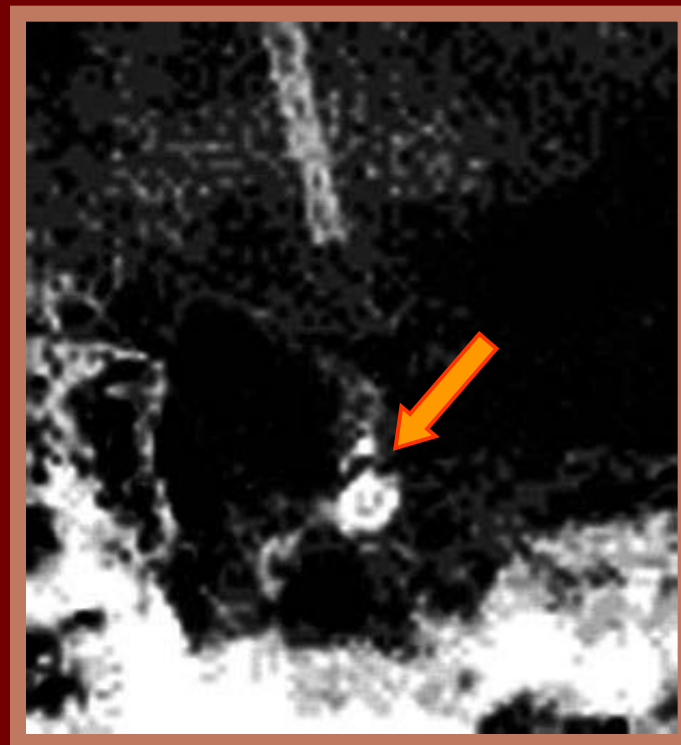
Shunt malfunction

- Neurological examination
- Fundus oculi
- Percutaneous valve test
- Valve pressure resetting
(programmable valves only)

X-rays



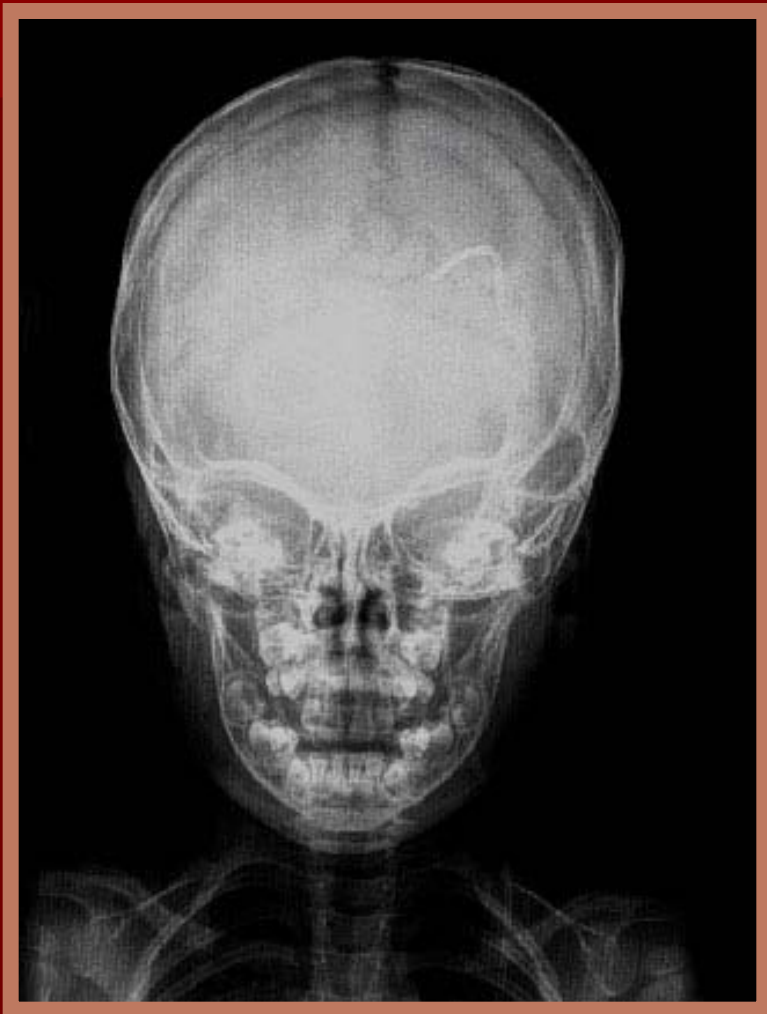
system Codman
valve markers



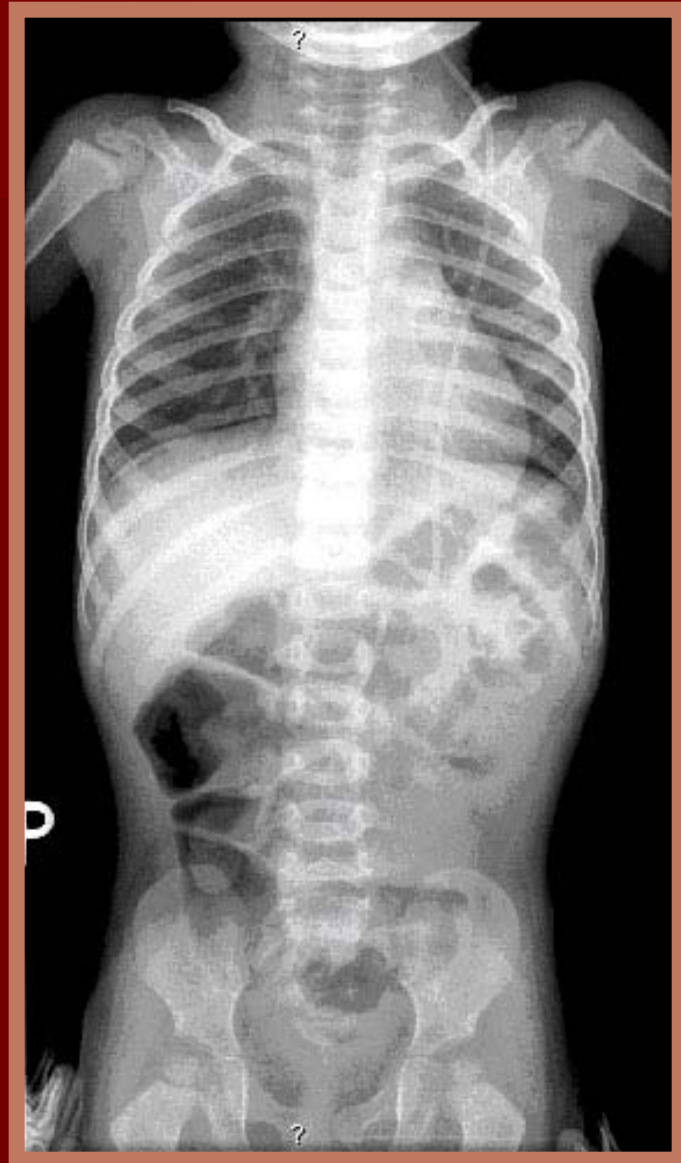
Laboratory examinations

- FW, blood count, inflammation markers, serum osmolarity
- CSF examination - valve puncture (bacteriology, biochemistry, cytology)

X-rays



X-rays



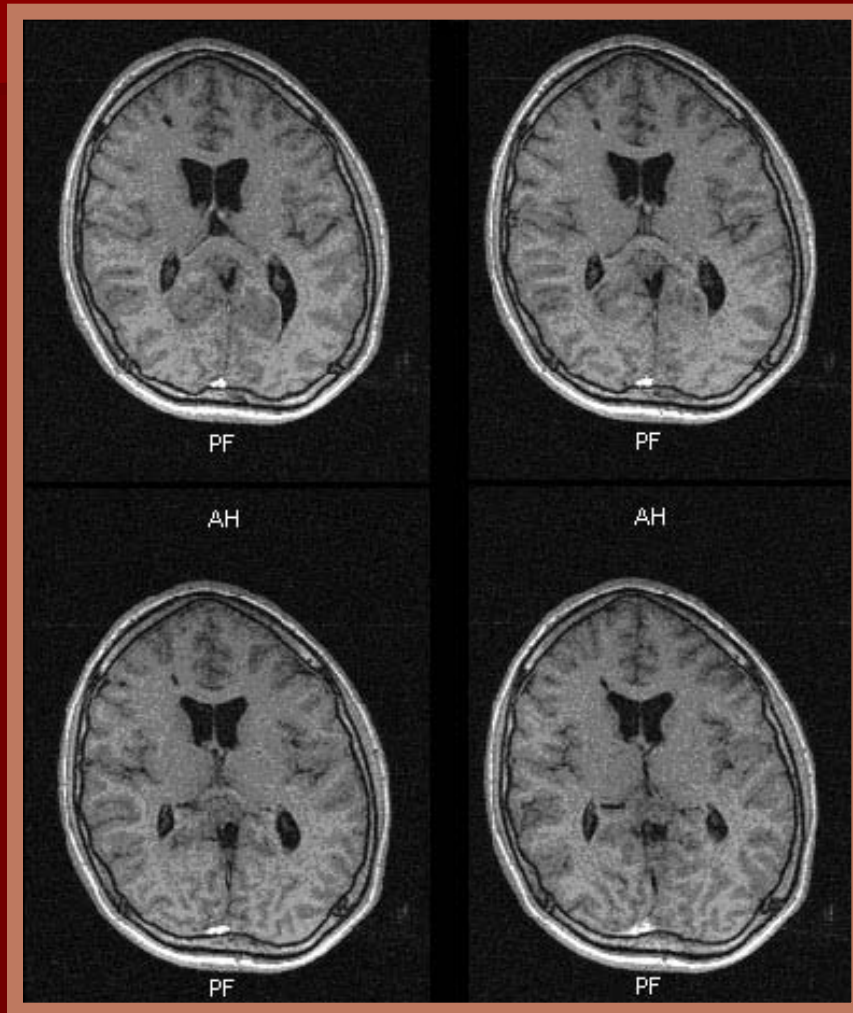
Ultrasound



CT

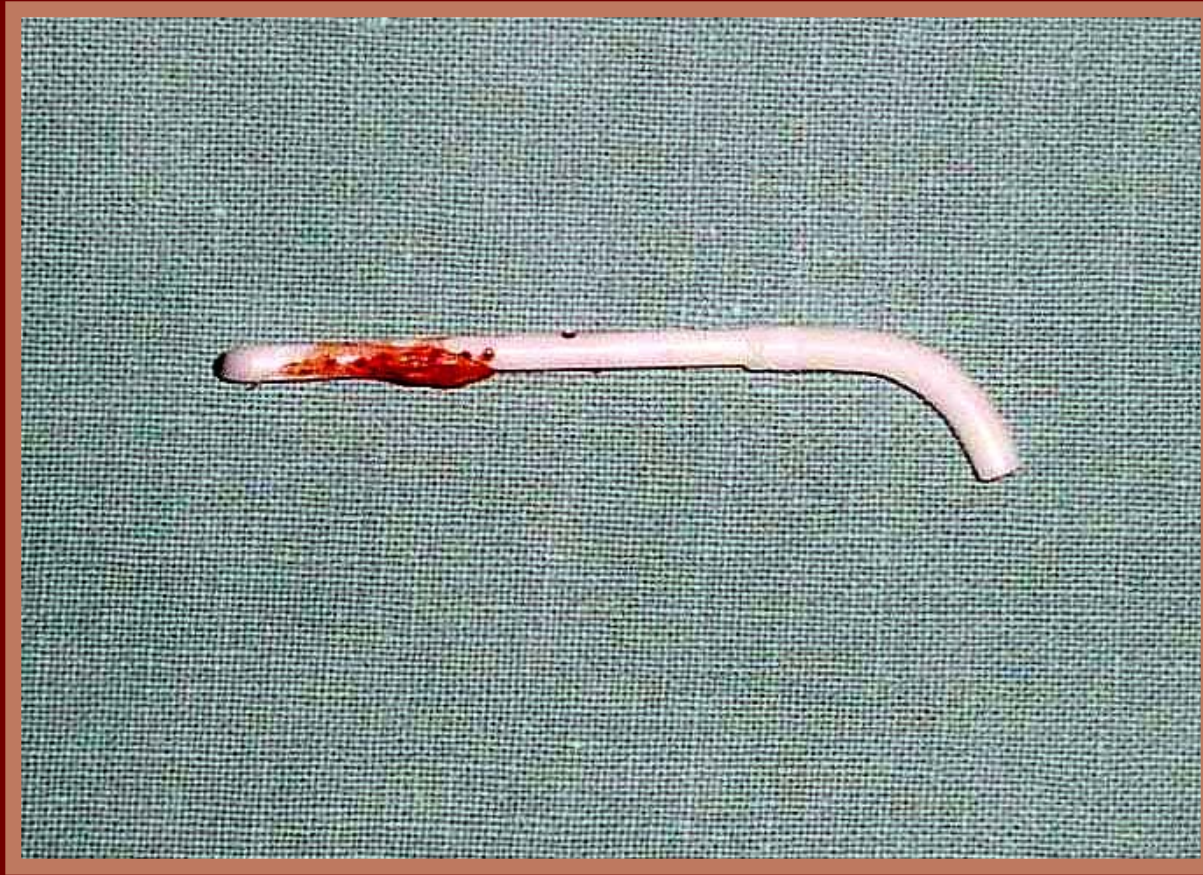


MRI

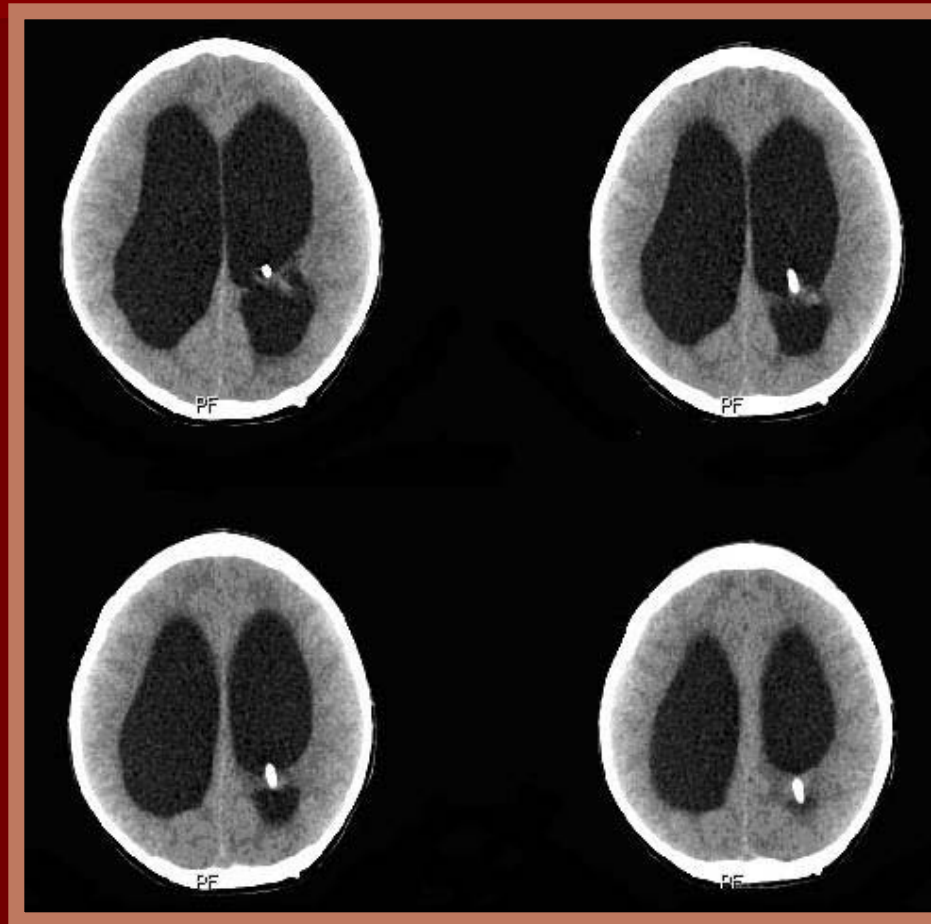


Cave programmable valves

Central (ventricular) catheter malfunction - blood clot obturation



Central (ventricular) catheter malfunction - chorioideal plexus adhesions



Central (ventricular) catheter malfunction - malposition



Central (ventricular) catheter malfunction

Surgical treatment - catheter repositioning or replacement



Valve malfunction

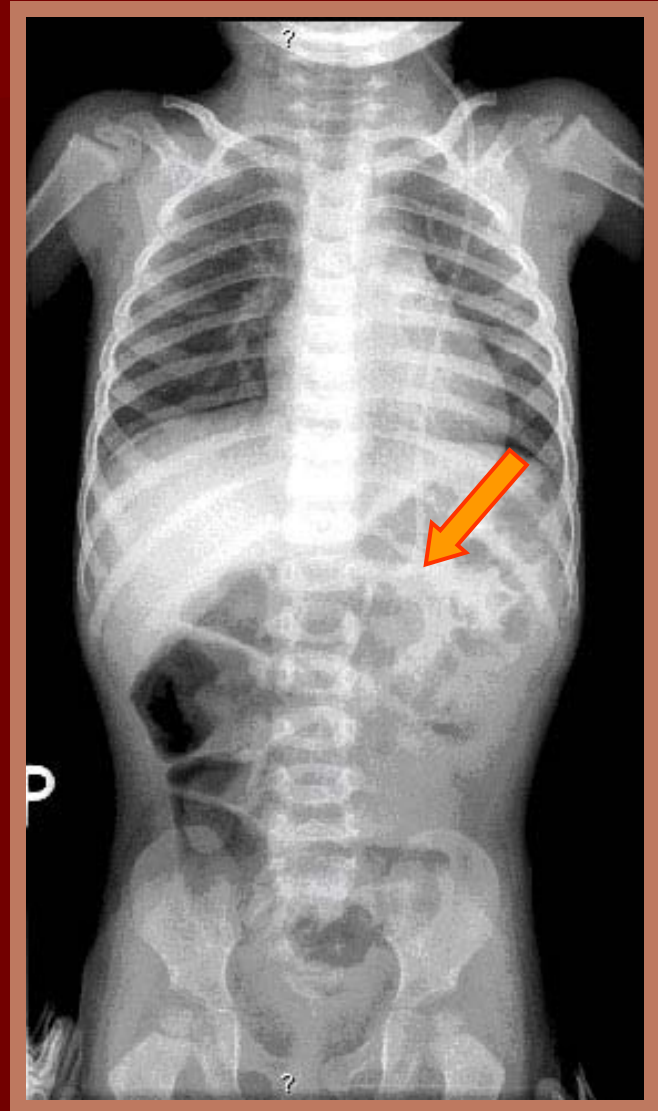
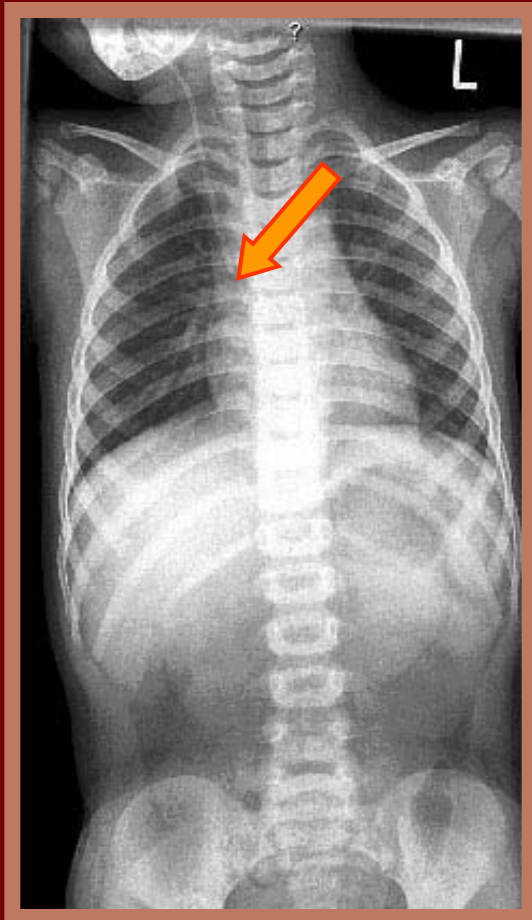
- Blood clot obturation
- Elevated CSF viscosity (inflammatory process)
- Slit ventricle syndrom



Distal catheter malfunction

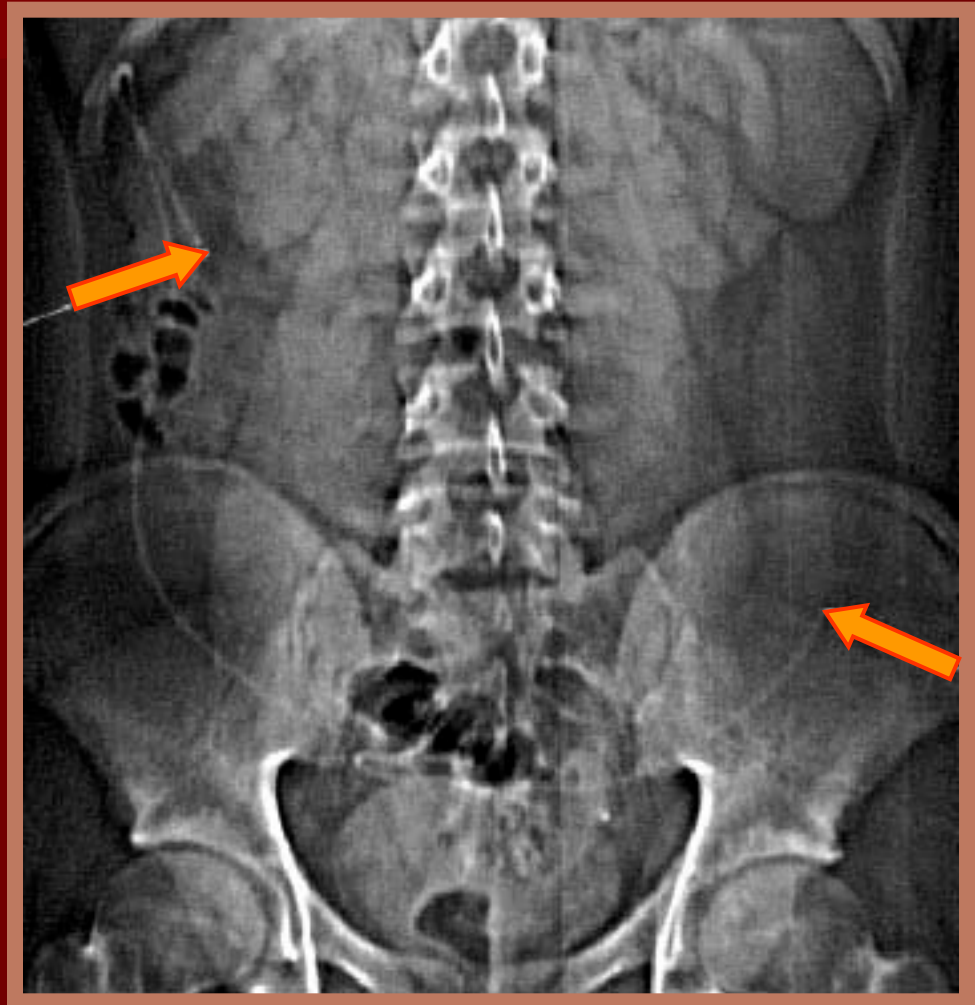
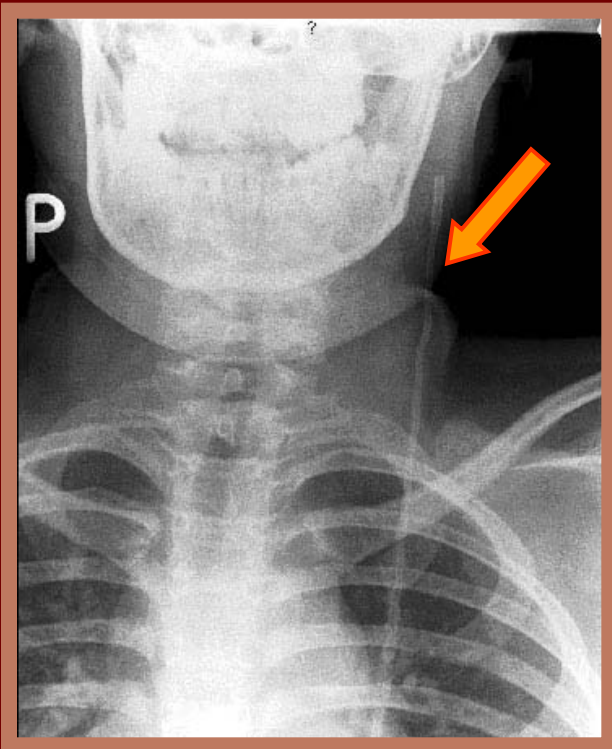
- **Unsufficient catheter lenght due to pts growth (X - rays)**
- **Distal catheter malfunction causes:**
 - Continuity cut-off
 - Peritoneal adhesion
 - **Peritoneal pseudocyst**
 - septic
 - aseptic
 - Peritonitis due APE
 - Hyporesorbtion - ascites
 - Catheter intolerance, catheter expulsion
 - Displacement to subcutaneous tissue
 - Intestine perforation
 - Hernia inguinalis, umbilicalis
- **Atrial catheter malfunction causes**
 - Catheter thrombus (heart ultrasound)

Unsufficient catheter lenght due to pts growth



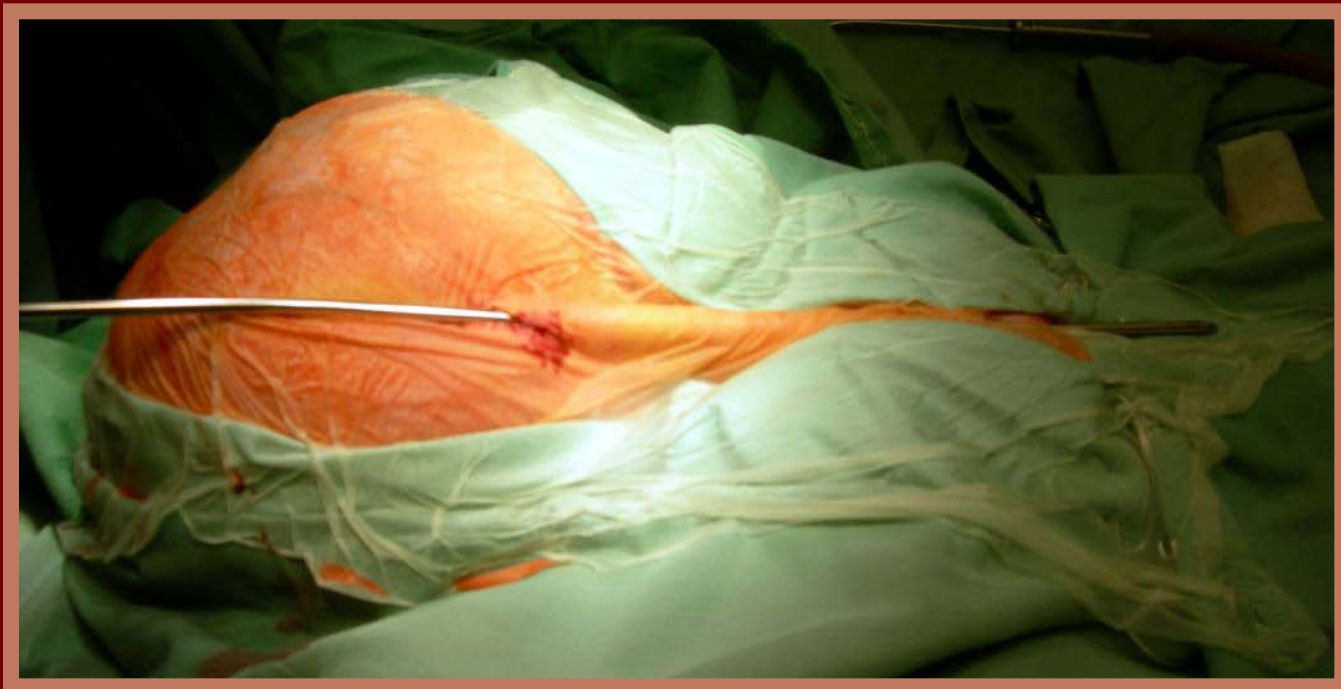
Continuity cut-off

- Diconnection
- Disruption



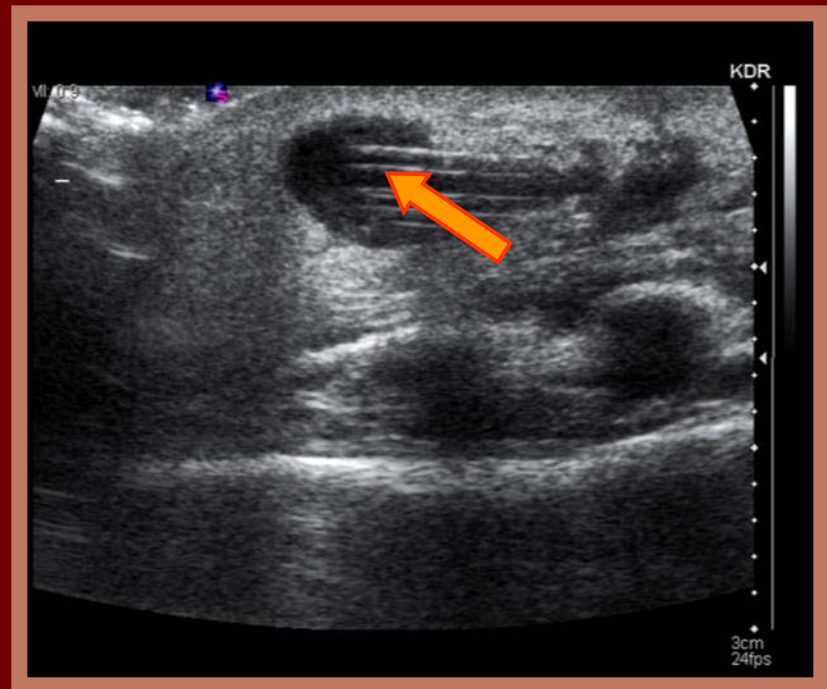
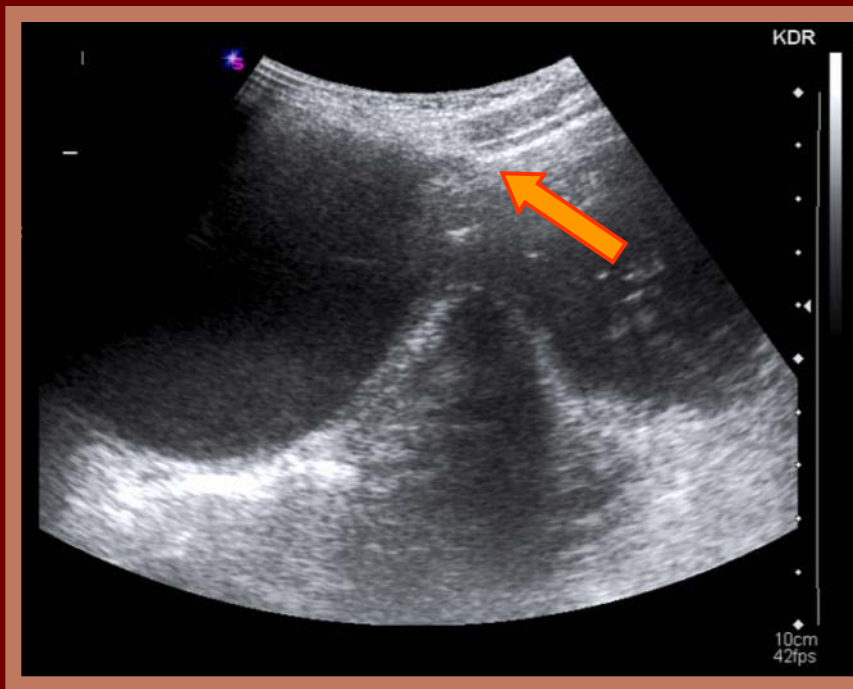
Treatment - immediate surgery

- Re-connection if possible
- Catheter replacement (removing the displaced one)



Peritoneal catheter - distal end - pseudocyst

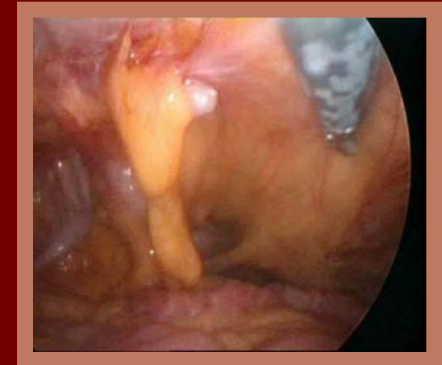
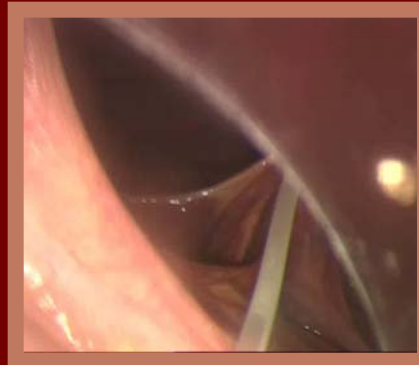
Ultrasound



Septic: elevated CRP, FW, leukocytosis

Peritoneal adhesions

- Localized - laparoscopy, catheter deliberation, replacement
- Diffuse - temporary external drainage
- Intraluminal - catheter replacement

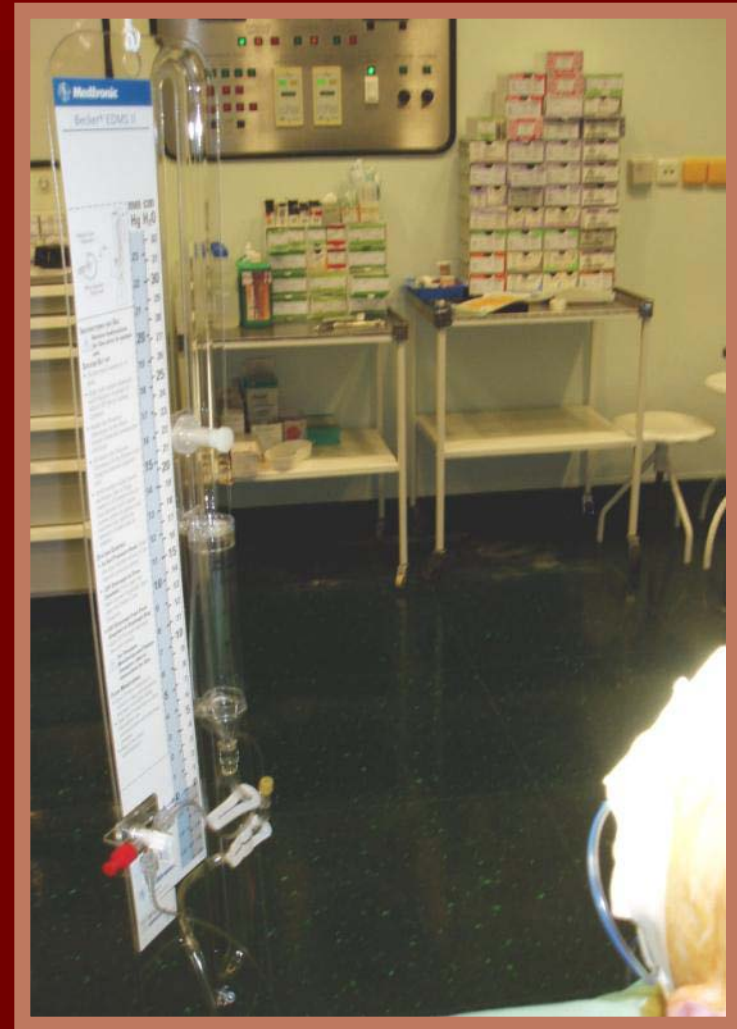


Laparoskopy 3D, system Viking



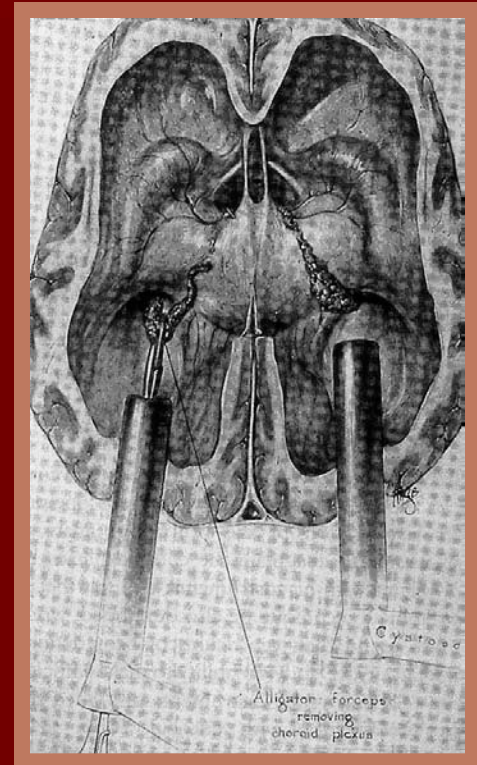
Infectious complication

- Drainage extraction
- Temporary external drainage
- Antibiotics

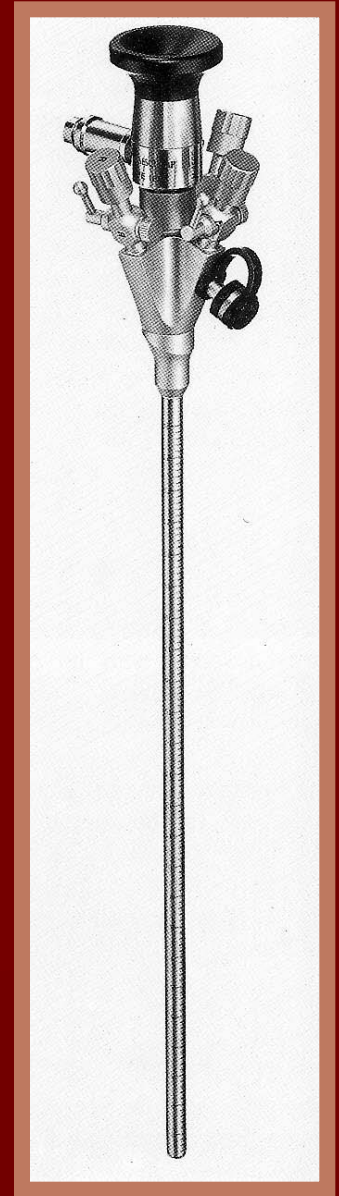
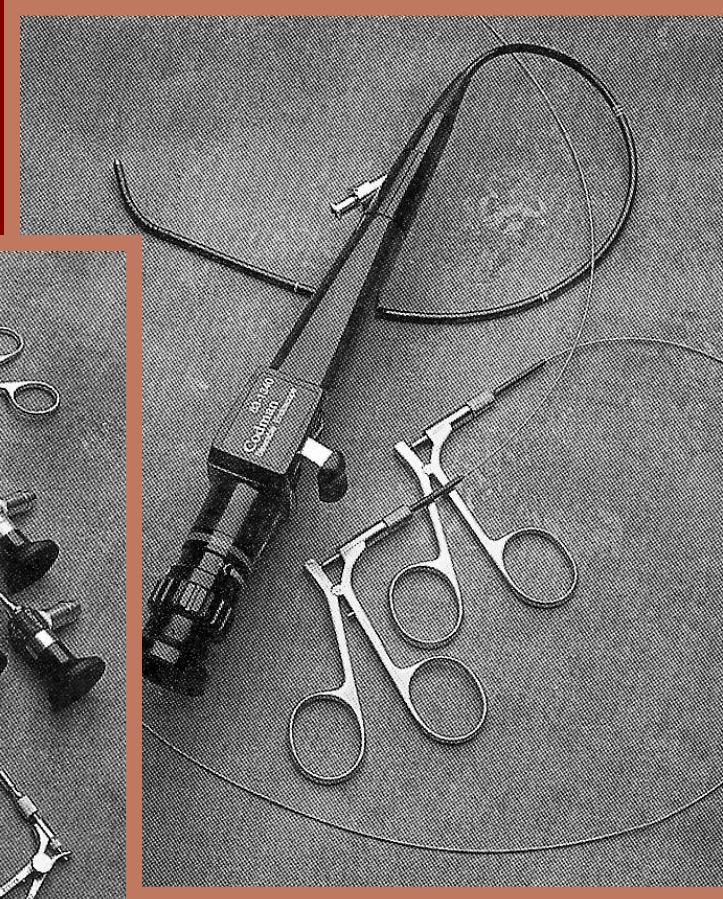


Neuroendoscopy

- 1923 - Mixer
 - first 3rd ventriculostomy
- '80.
 - neuroendoscopy techniques (flexible endoscopy, assisted endoscopy)



Neuroendoskopy



Neuroendoskopy

- Exstirpatio and biopsy of intra or periventricular expansions
- Cyst marsurpialisation
- Aqueductoplasty
- Third ventriculostomy

Indications for Neuroendoskopy

- Obstructive hydrocephalus
- Ventricular catheter implantation or replacement
- Ventricular (paraventricular) tumors
- Arachnoideal cyst
- Subdural space revision

Neuroendoskopy - complications

- Haemorrhagy
- Hyperthermia (aseptic)
- Pneumocephalus
- Periventricular tissue damage
- CSF fistula
- Infection
- SD haematoma