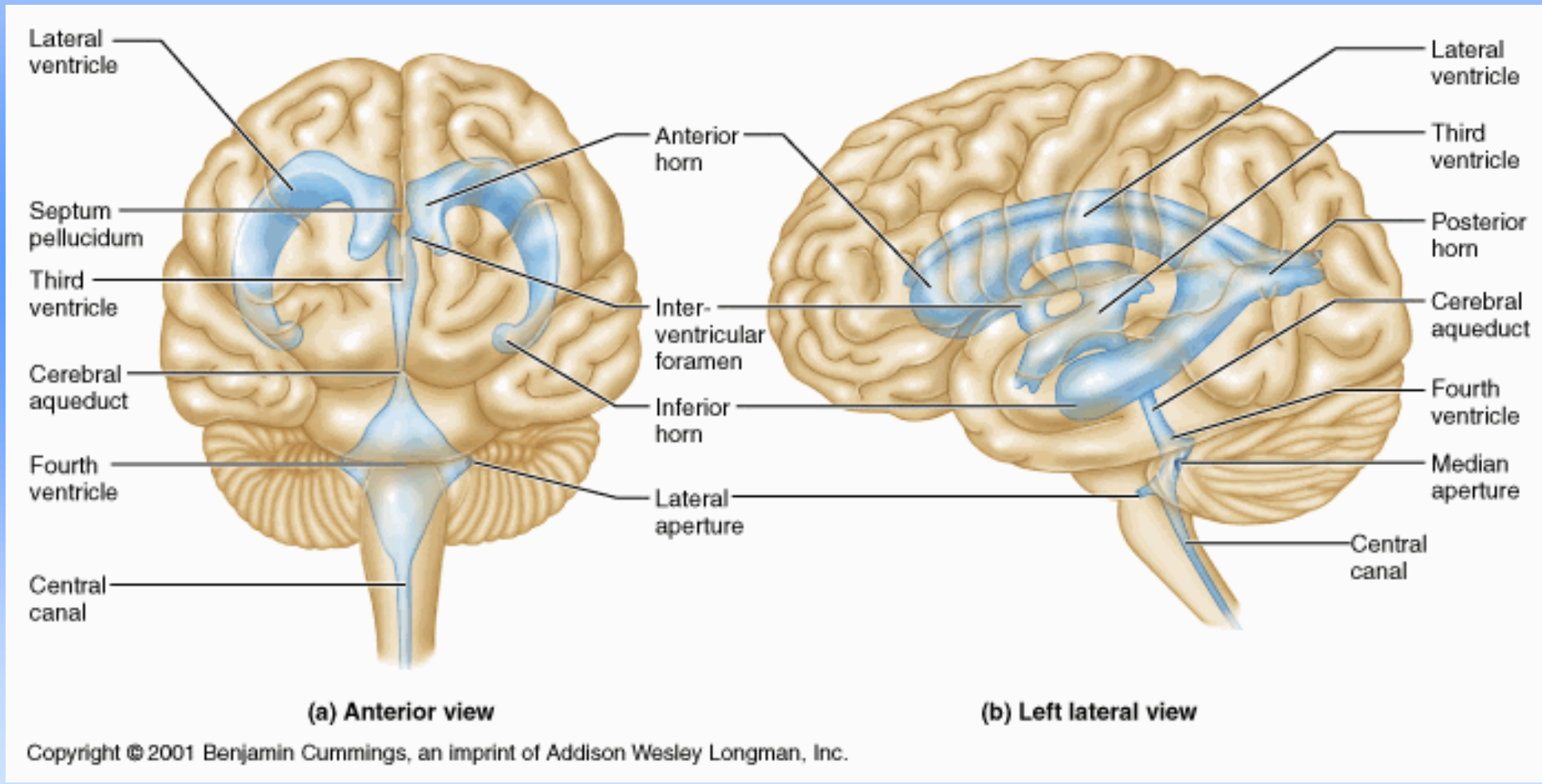
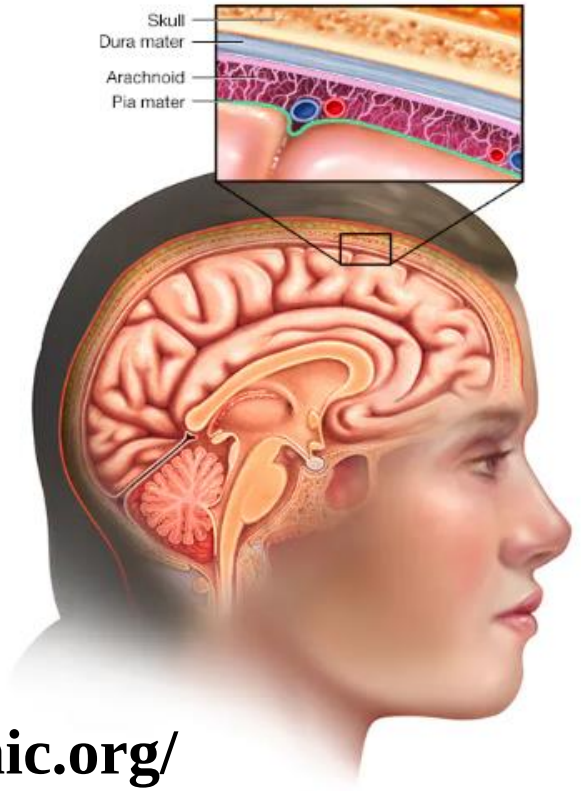
Professor Leila Rinatovna Akhmadeeva

Meninges and cerebrospinal fluid



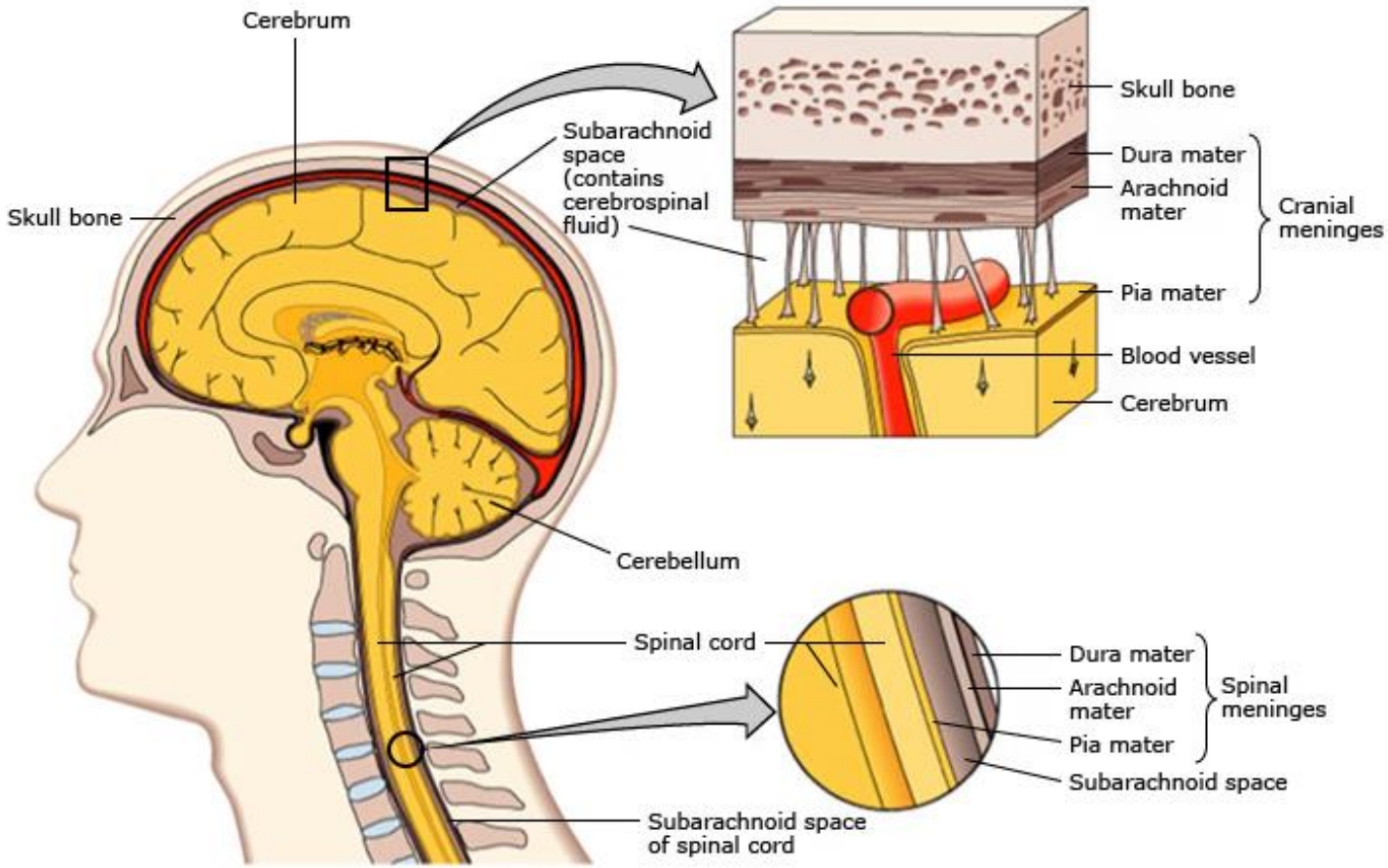
Meninges



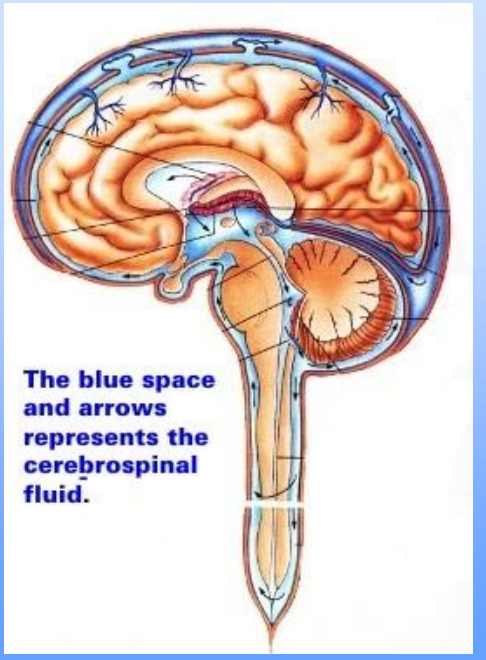
https://www.mayoclinic.org/

Three layers of membranes known as meninges protect the brain and spinal cord. The delicate inner layer is the pia mater. The middle layer is the arachnoid, a web-like structure filled with fluid that cushions the brain. The tough outer layer is called the dura mater.

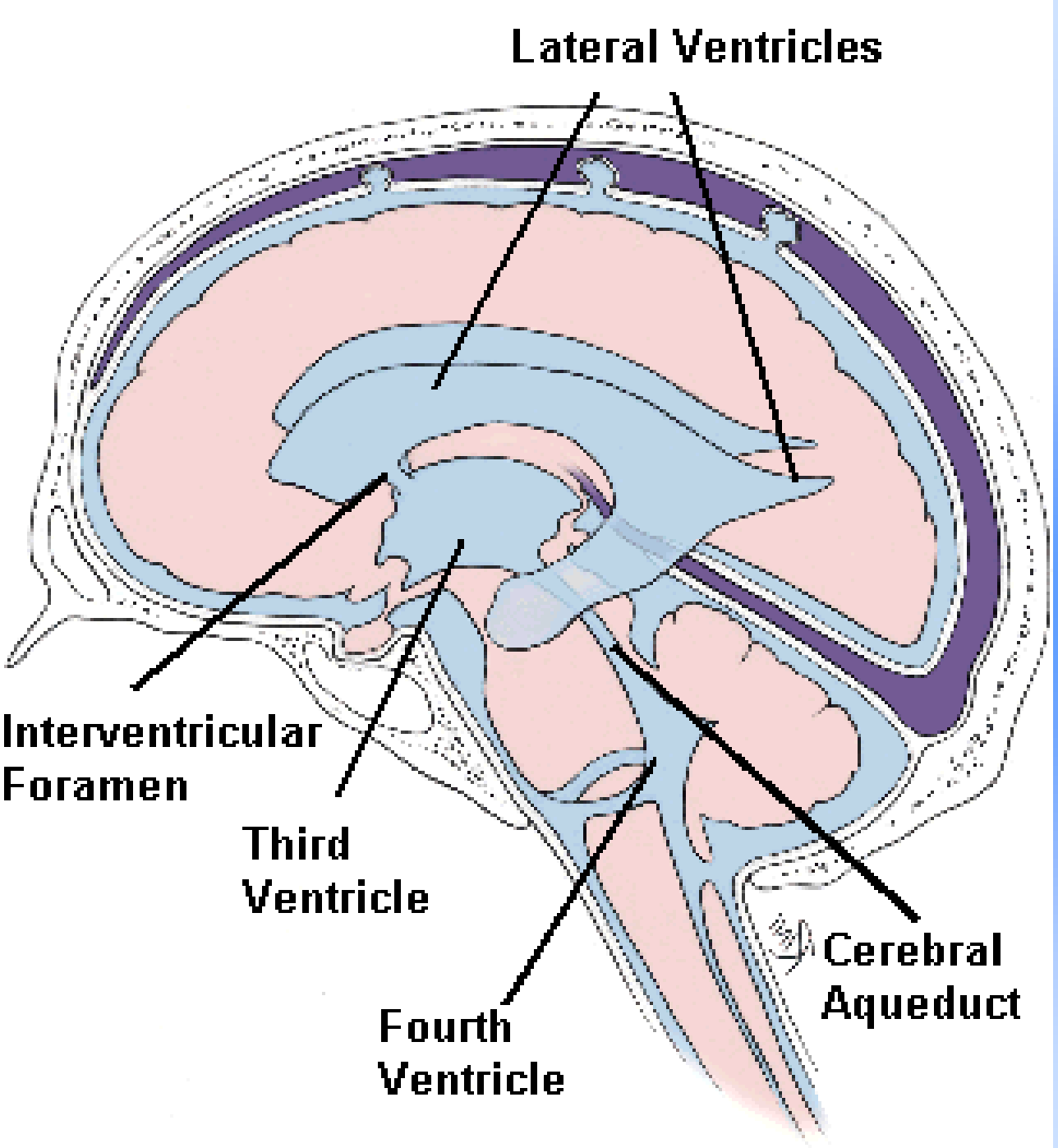
Meningeal layers of the brain and spinal cord

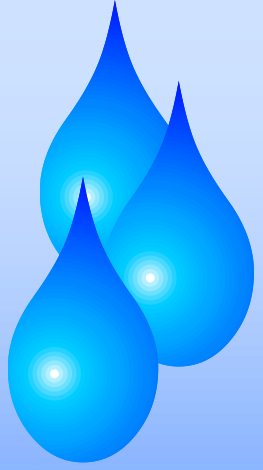


Reproduced with permission from: Microbial diseases of the nervous system. In: Microbiology: An Introduction, 8th ed, Tortora GJ, Funke BR, Case CL (Eds), Pearson Education, Inc., San Francisco 2004. p.617. Copyright © 2004 The Authors.



CEREBROSPINAL FLUID (CSF)


Lateral Ventricles
Interventricular Foramen
Third Ventricle
Fourth Ventricle
Cerebral Aqueduct



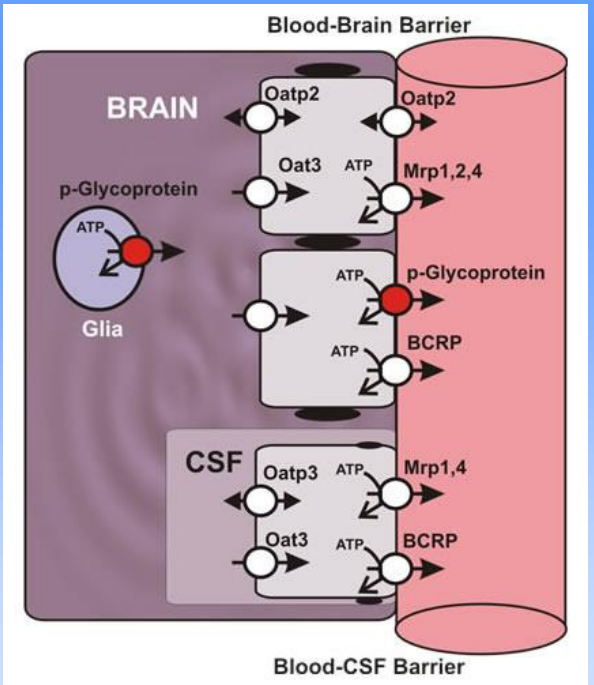
FUNCTIONS

1. Protection
2. Transport + metabolic

Production

Ultrafiltration from blood

Chorioid plexuses of lateral ventricles



Production

450 - 700 ml/day

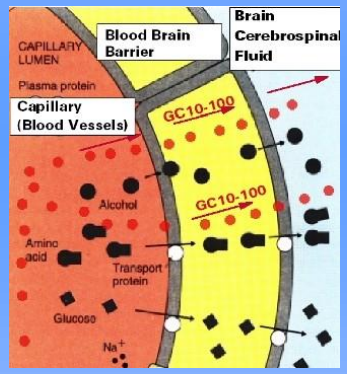
New – every 6-7 hours

At a time – 140 ml

In ventricles – 25 ml

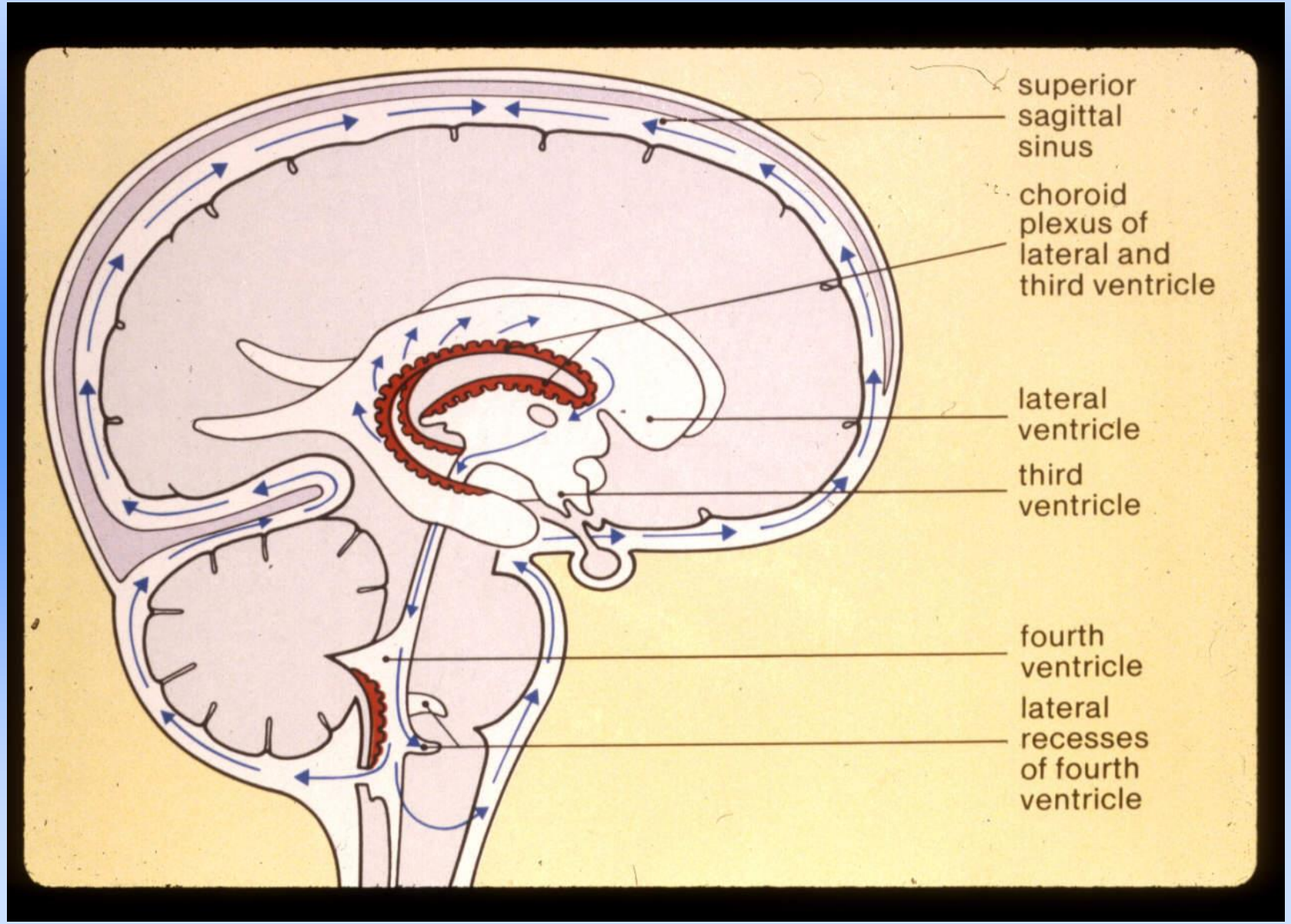
0.2-0.7 ml/min

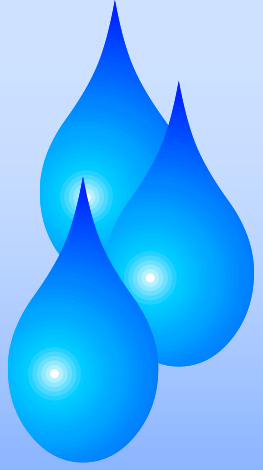
Blood-brain barrier



http://www.neuropathologyweb.org/chapter14/chapter14CSF.html

Circulation





Боковые желудочки

↓

Отверстие Монро (межжелудочковое)

↓

Третий желудочек

↓

Сильвиев водопровод → IV желудочек

↓

Отверстия Мажанди (мед. – 1) и Люшка (лат. – 2)

↓

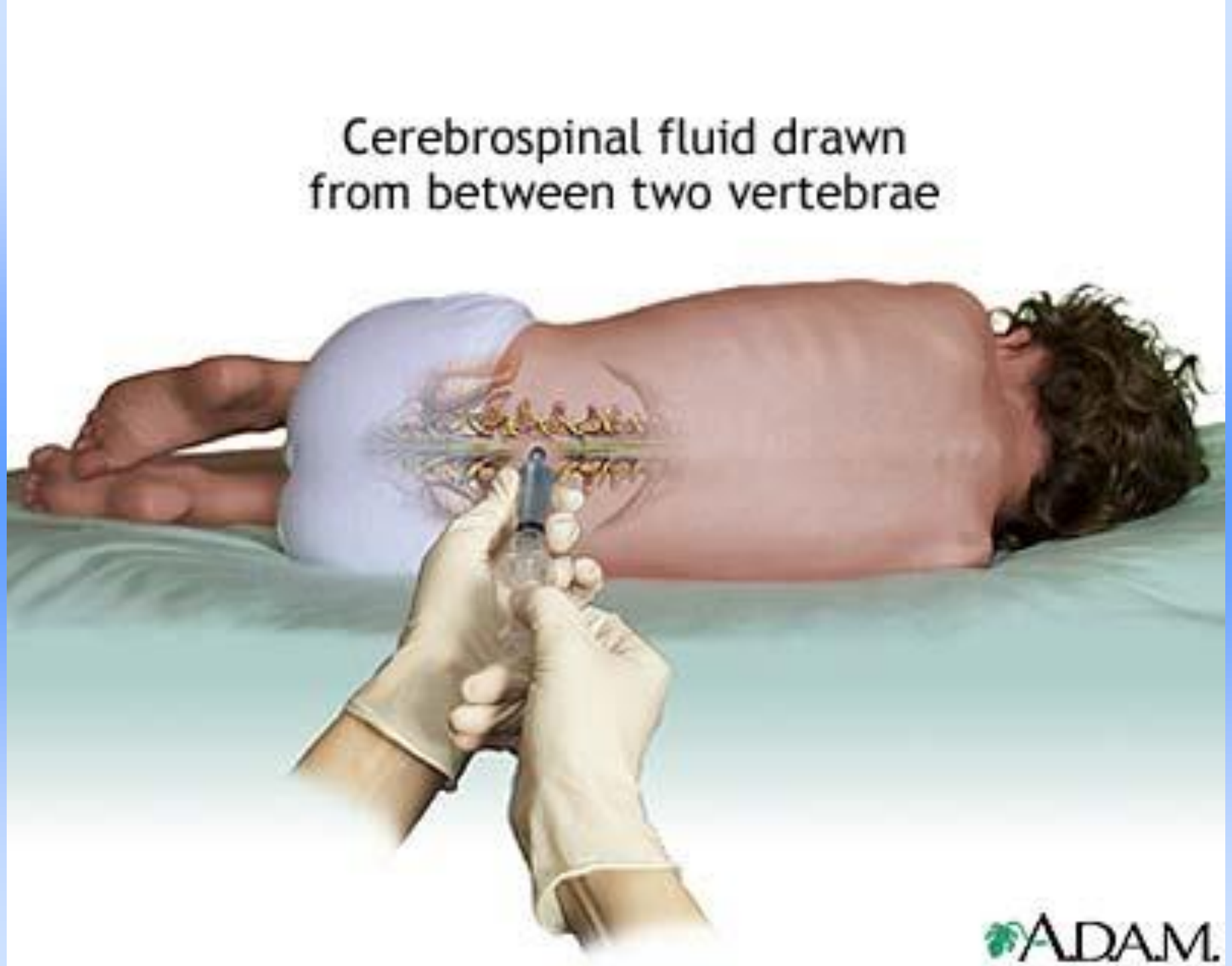
Субарахноидальные пространства вокруг головного и спинного мозга

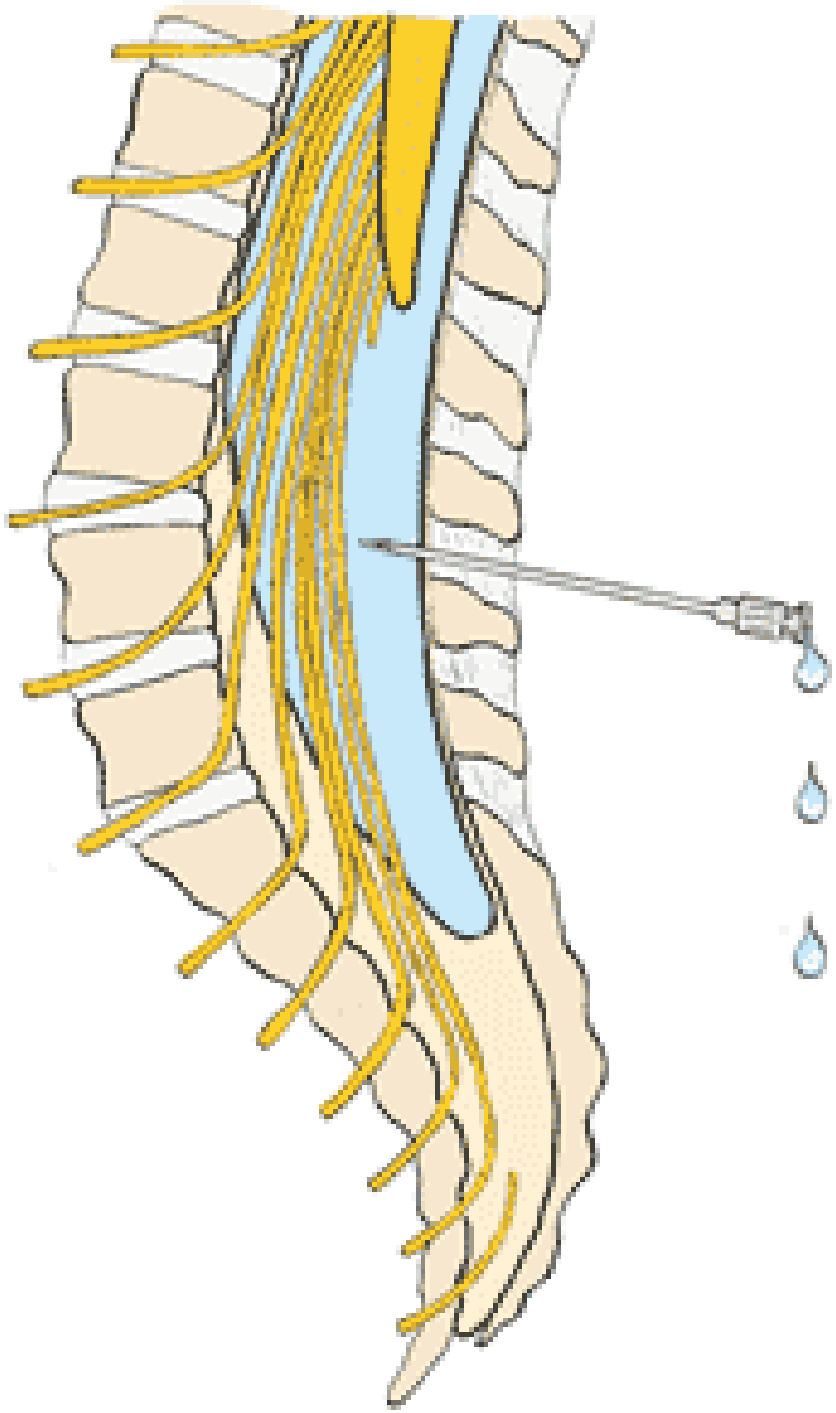
↓

Реабсорбция в кровь в венозные синусы через арахноидальные грануляции


AGERE
AC
BENE
LÆTARI
R. White Sculp.
FRANCISCUS DELEBOE SYLVIUS. Medicinæ
Practicæ in Academia Lugduno-Batava Professor.


Mr. le Docteur MAGENDIE.


Cerebrospinal fluid drawn
from between two vertebrae
A.D.A.M.



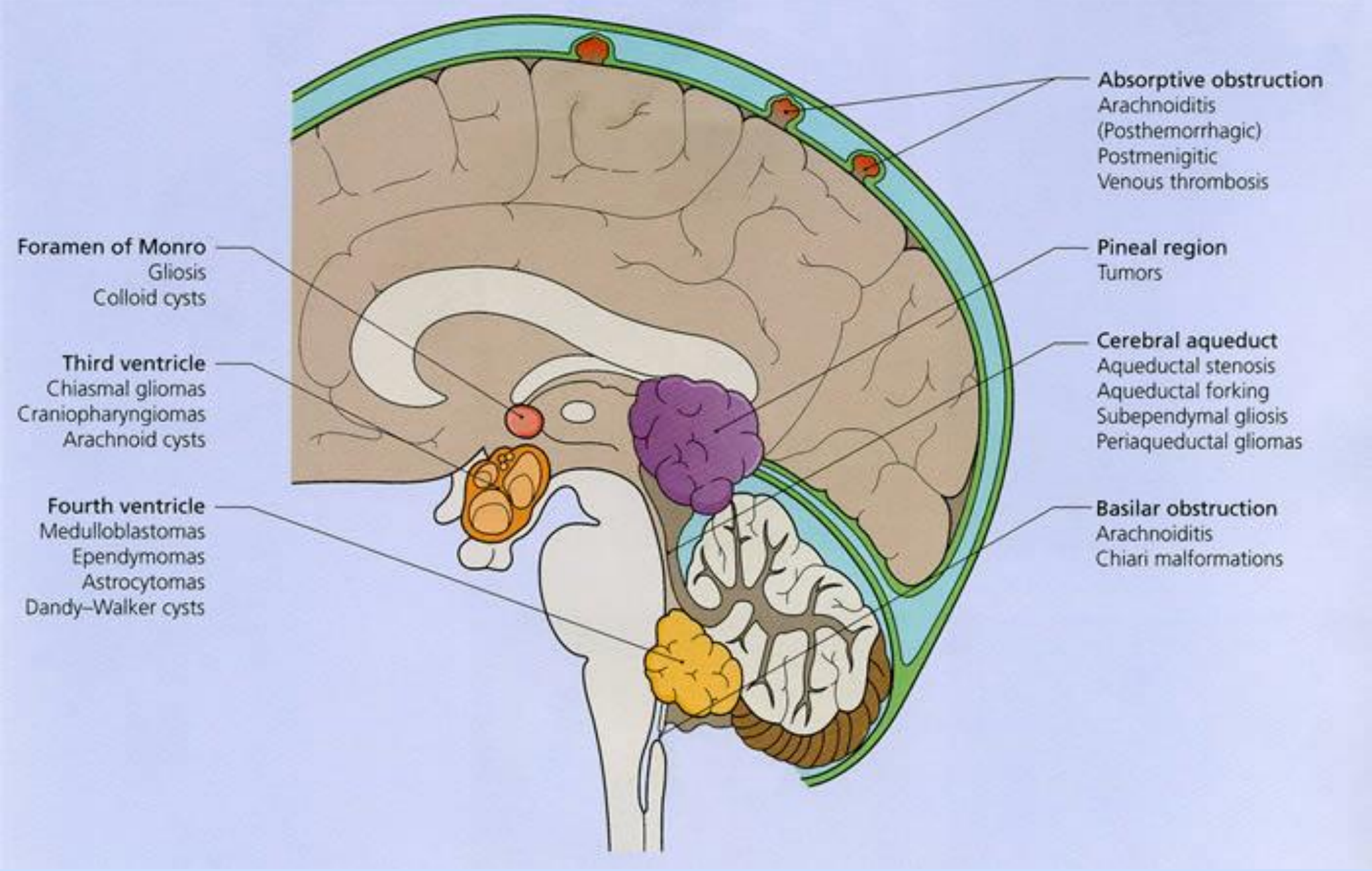
CSF: normal values and changes in patients

Table 1 Typical constellation of CSF parameters in some neurological diseases

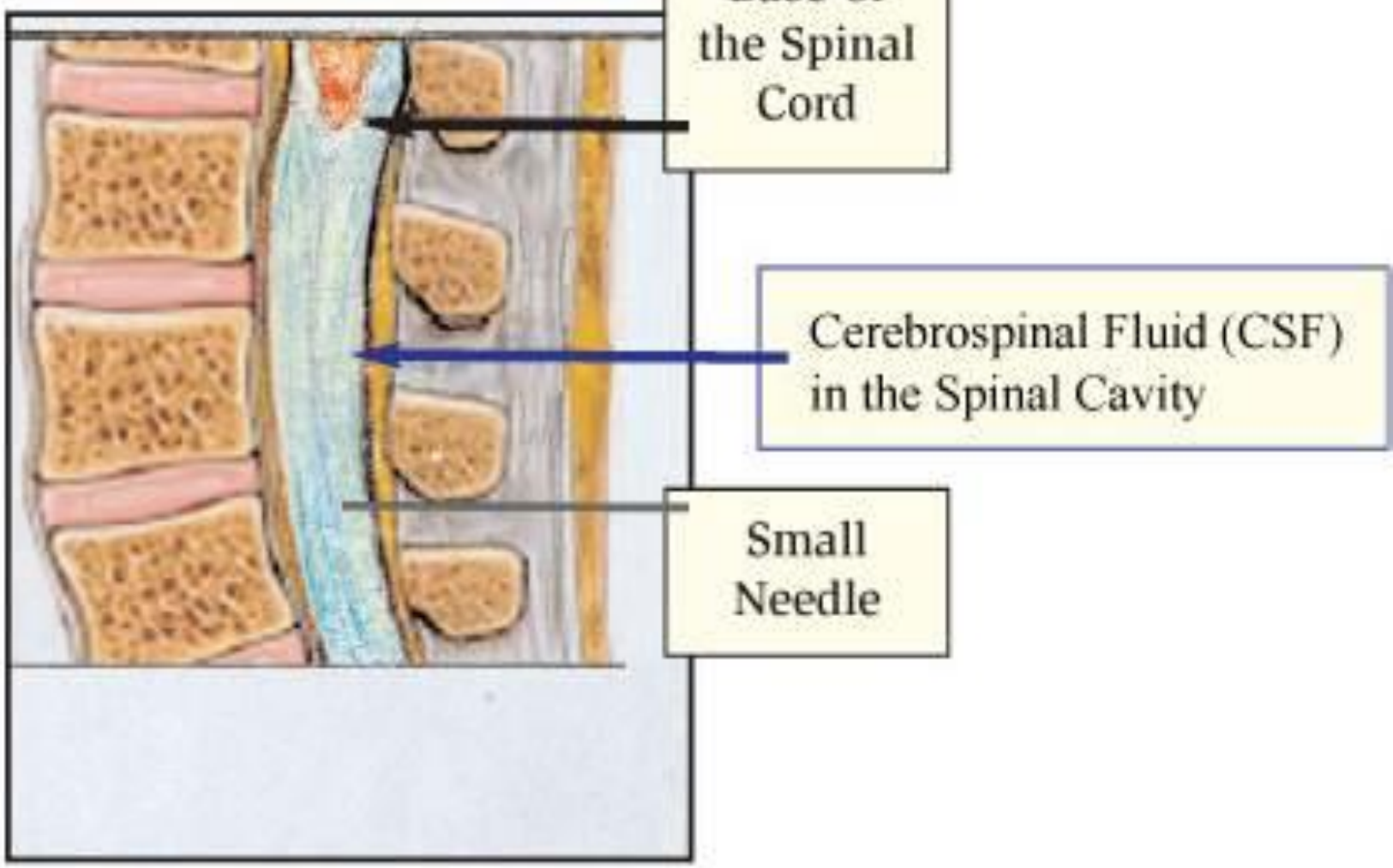
	Total protein (g/l)	Glucose ratio (mmol/l)	Lactate	Cell count	Typical cytology (per 3.2 μl)
Normal values[a]	< 0.45	> 0.4–0.5	< 1.0–2.9	< 15	MNC
Disease					
Acute bacterial meningitis	↑	↓	↑	> 1000	PNC
Viral neuro-infections (meningo/encephalitis)	=/↑	=/↓	=	10–1000	PNC/MNC
Autoimmune polyneuropathy	↑	=	=	=	
Infectious polyneuropathy	↑	=	=	↑	MNC
Subarachnoidal haemorrhage	↑	=	=	↑	Erythrocytes, macrophages, siderophages, MNC
Multiple sclerosis	=	=	=	=/↑	MNC
Leptomeningeal metastases	↑	=/↓	Na	=/↑	Malignant cells, mononuclears

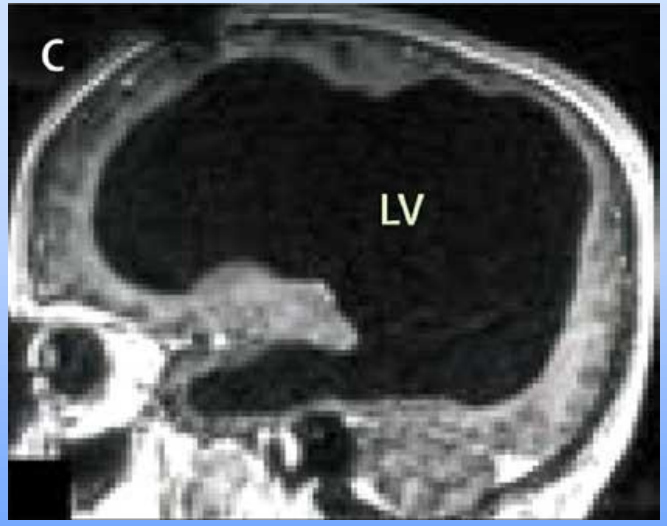
CSF, cerebrospinal fluid; MNC, mononuclear cells; PNC, polymorphonuclear cells. ↑/↓, increased/decreased; =, within normal limits; na, evidence not available. [a]Normal values are given for lumbar CSF in adults.

F. Deisenhammer et al. *European Journal of Neurology* 2006, 13: 913–922

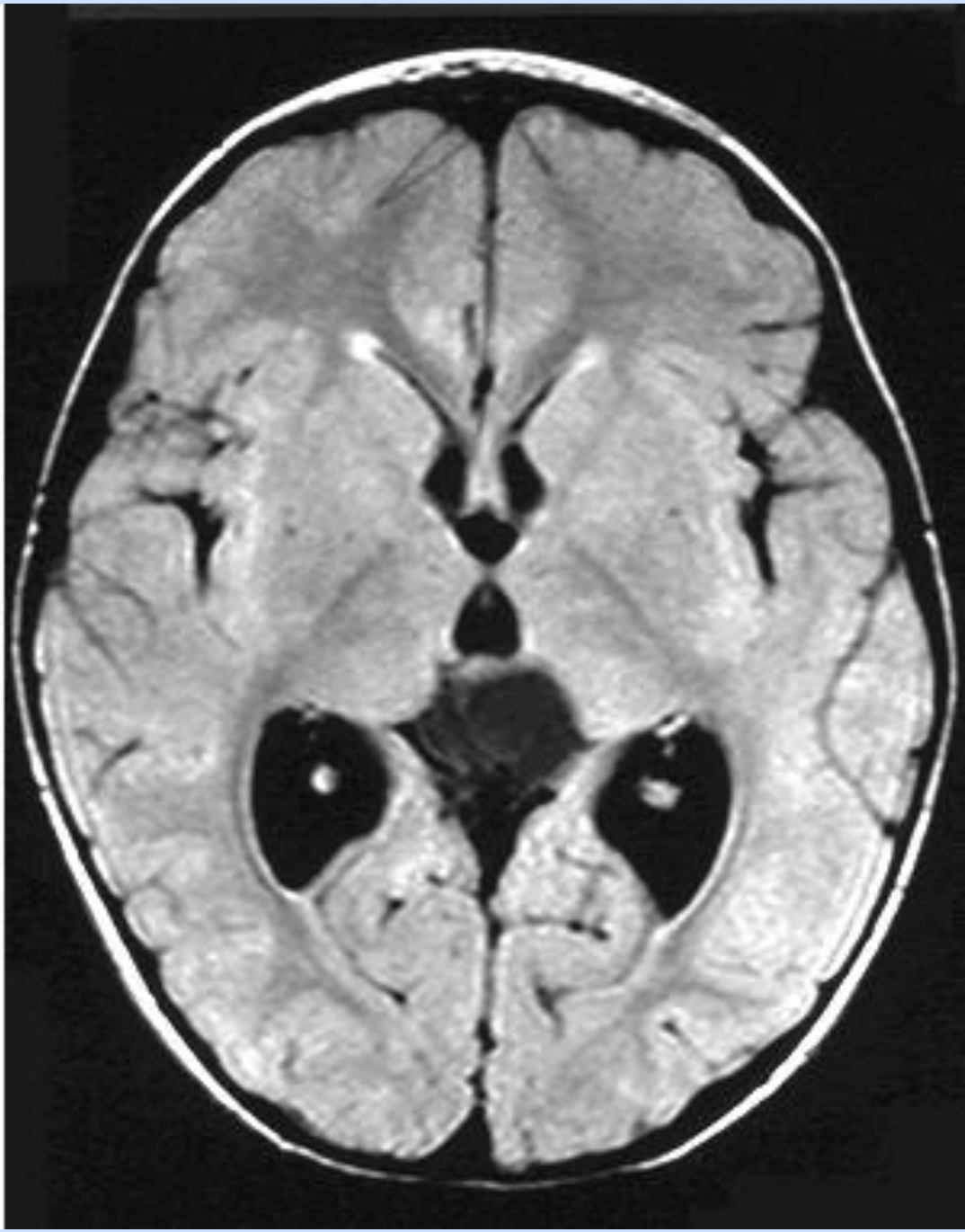

Absorptive obstruction
Arachnoiditis
(Posthemorrhagic)
Postmenigitic
Venous thrombosis
Foramen of Monro
Gliosis
Colloid cysts
Pineal region
Tumors
Third ventricle
Chiasmal gliomas
Craniopharyngiomas
Arachnoid cysts
Cerebral aqueduct
Aqueductal stenosis
Aqueductal forking
Subependymal gliosis
Periaqueductal gliomas
Fourth ventricle
Medulloblastomas
Ependymomas
Astrocytomas
Dandy–Walker cysts
Basilar obstruction
Arachnoiditis
Chiari malformations

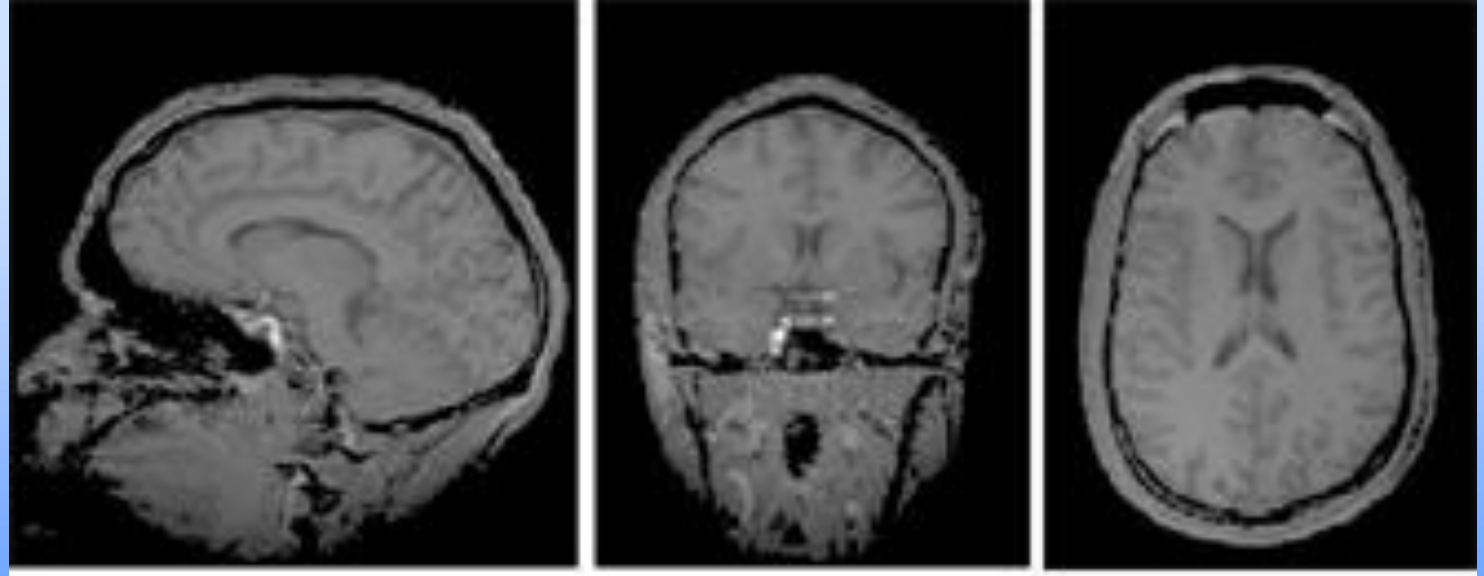
Assessment of CSF flow





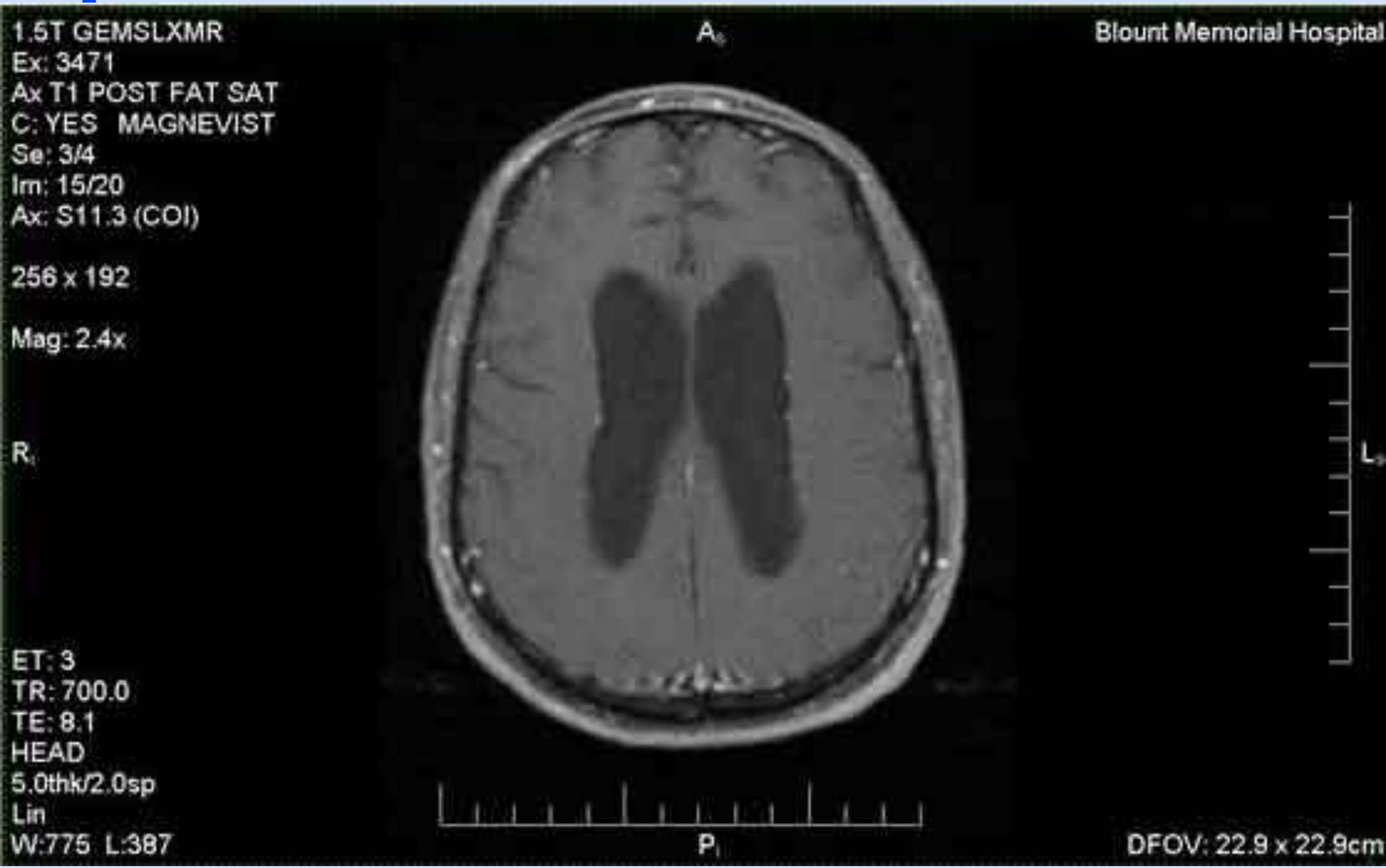
HYDROCEPHALUS



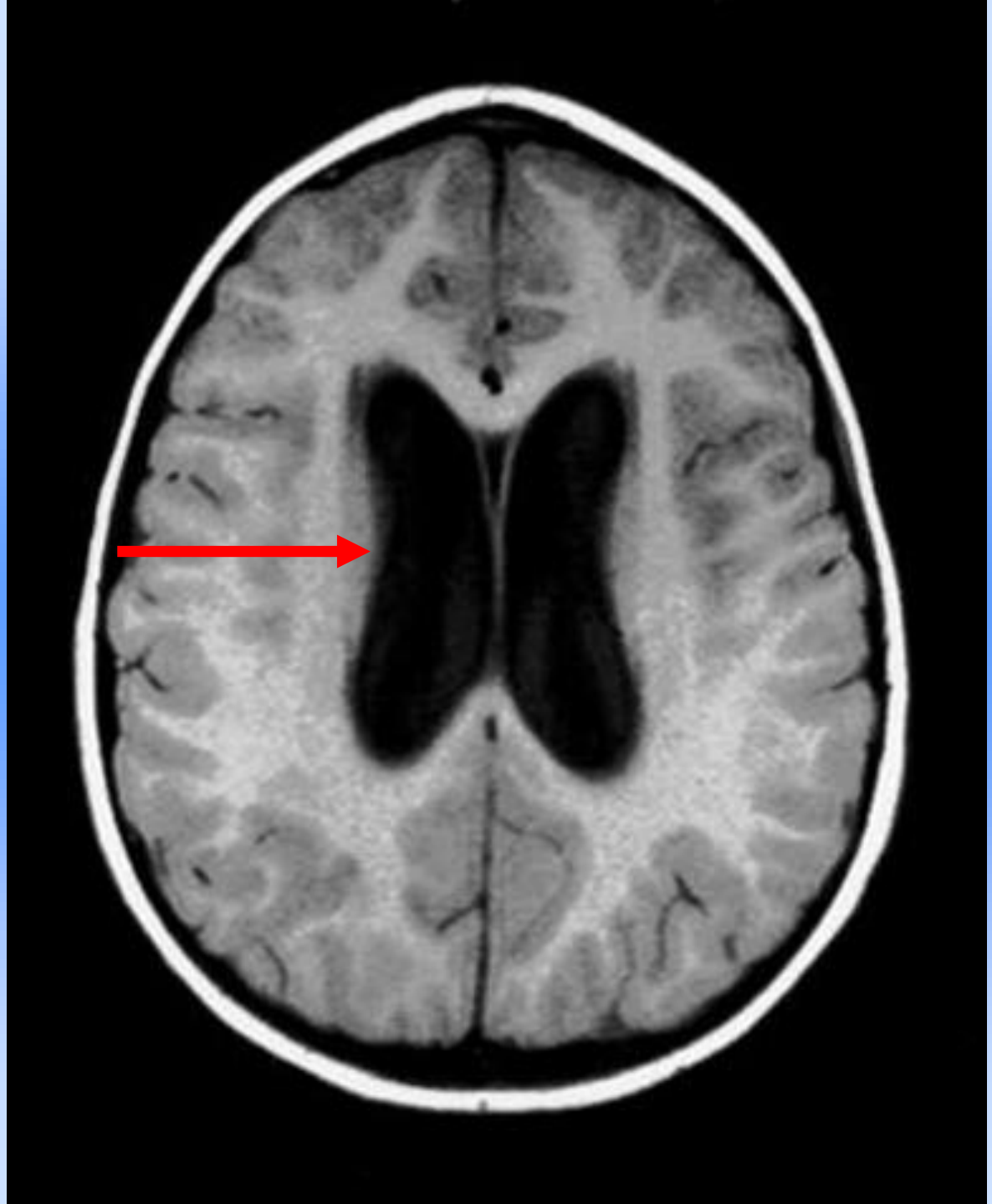

sagittal
coronal
axial (horizontal)


C
LV


C
56

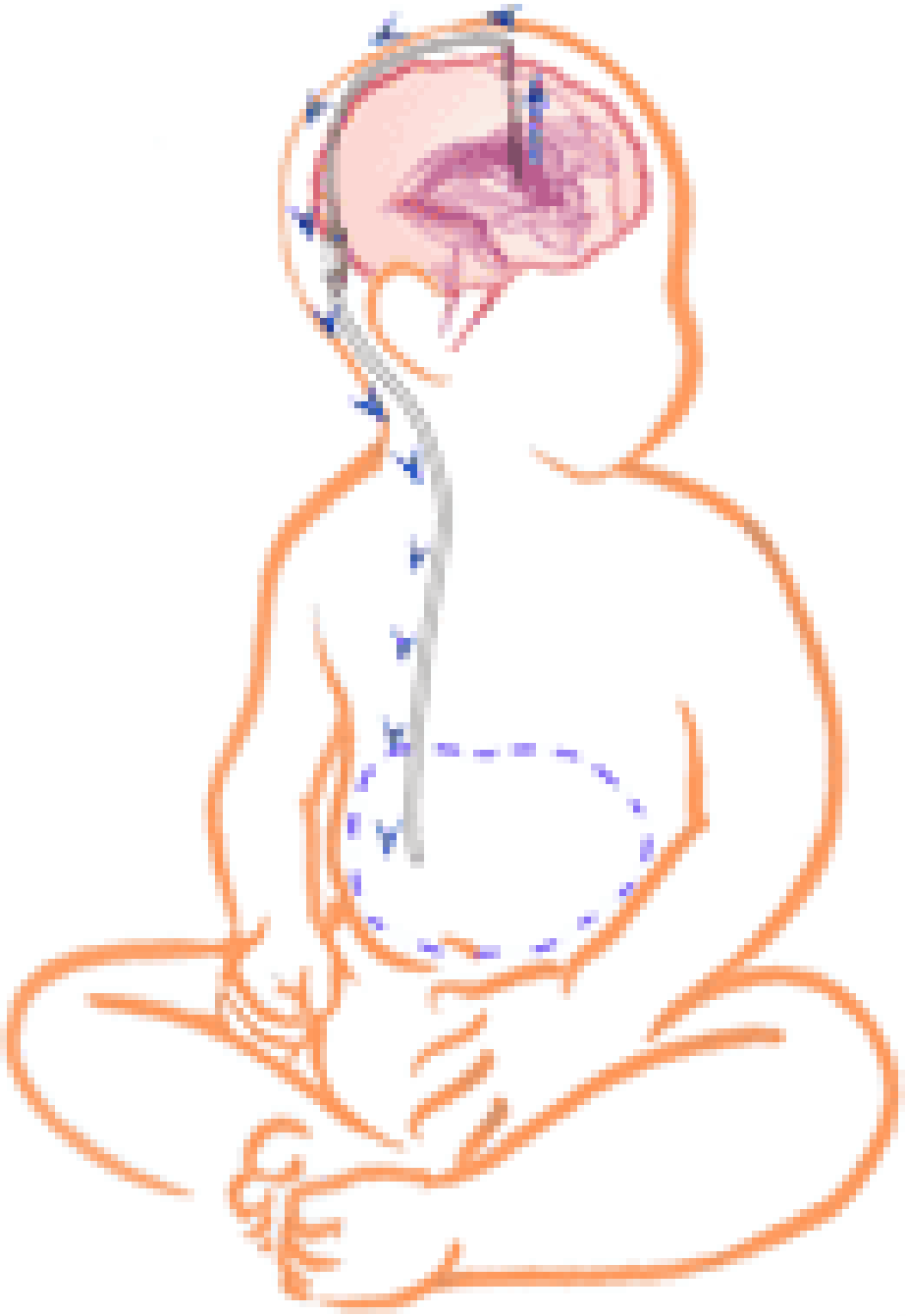

1.5T GEMSLXMR
Ex: 3471
Ax T1 POST FAT SAT
C: YES MAGNEVIST
Se: 3/4
Im: 15/20
Ax: S11.3 (COI)
256 x 192
Mag: 2.4x
R
ET: 3
TR: 700.0
TE: 8.1
HEAD
5.0thk/2.0sp
Lin
W:775 L:387
A
P
L
Blount Memorial Hospital
DFOV: 22.9 x 22.9cm

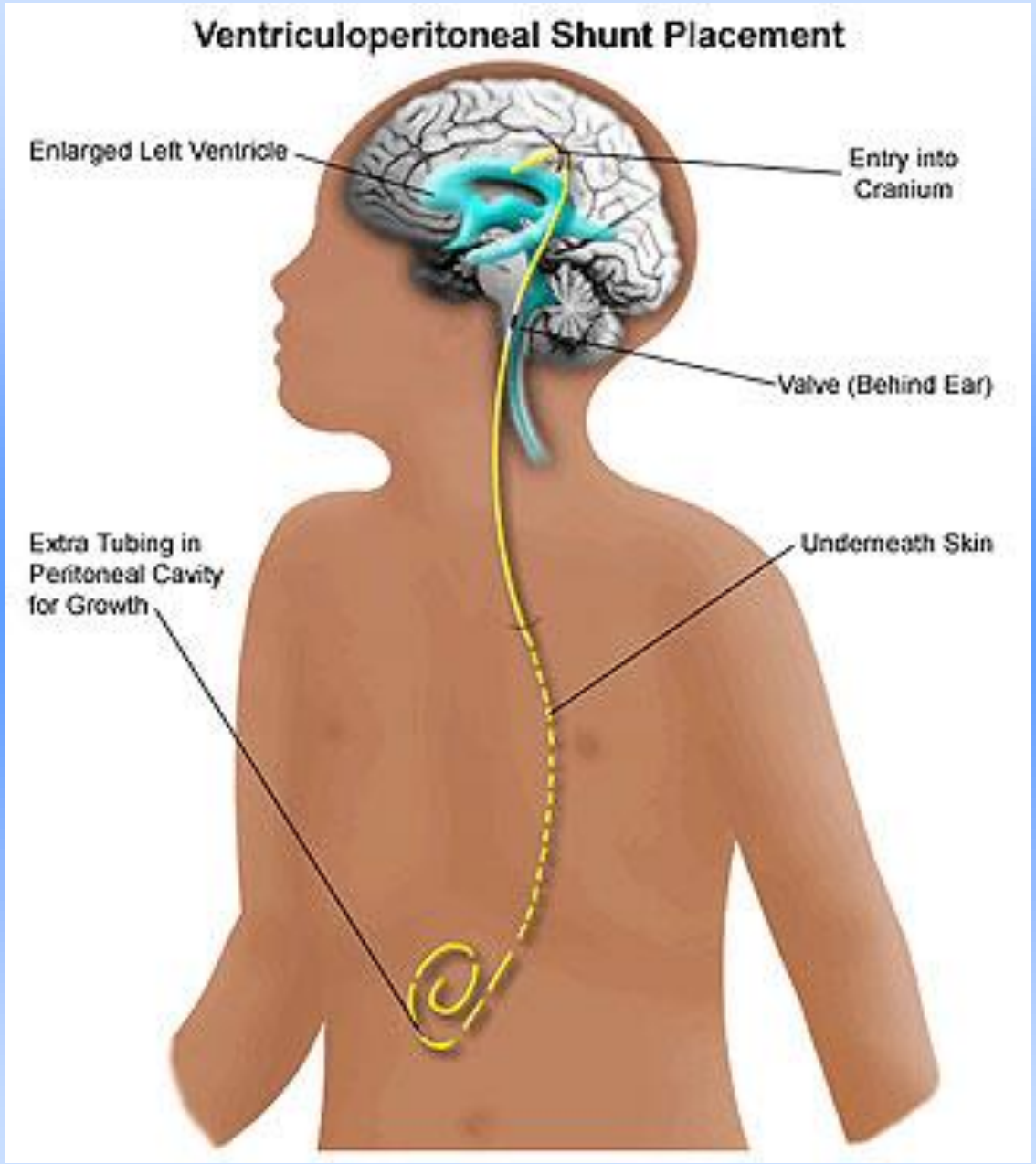

1003502
M 7Y
08:44
20-MAY-1998
IMAGE 37
STUDY 5
H
MAGNETOM VISION
H-SP VB31B
+ : F A L
A
sel 70
*R
TR 540.0
TE 14.0/1
TA 02:21
AC 1
BRAIN
SP -2.6
SL 5.0
FoV 240*240
256 *512o
Sag
W 1060
C 532



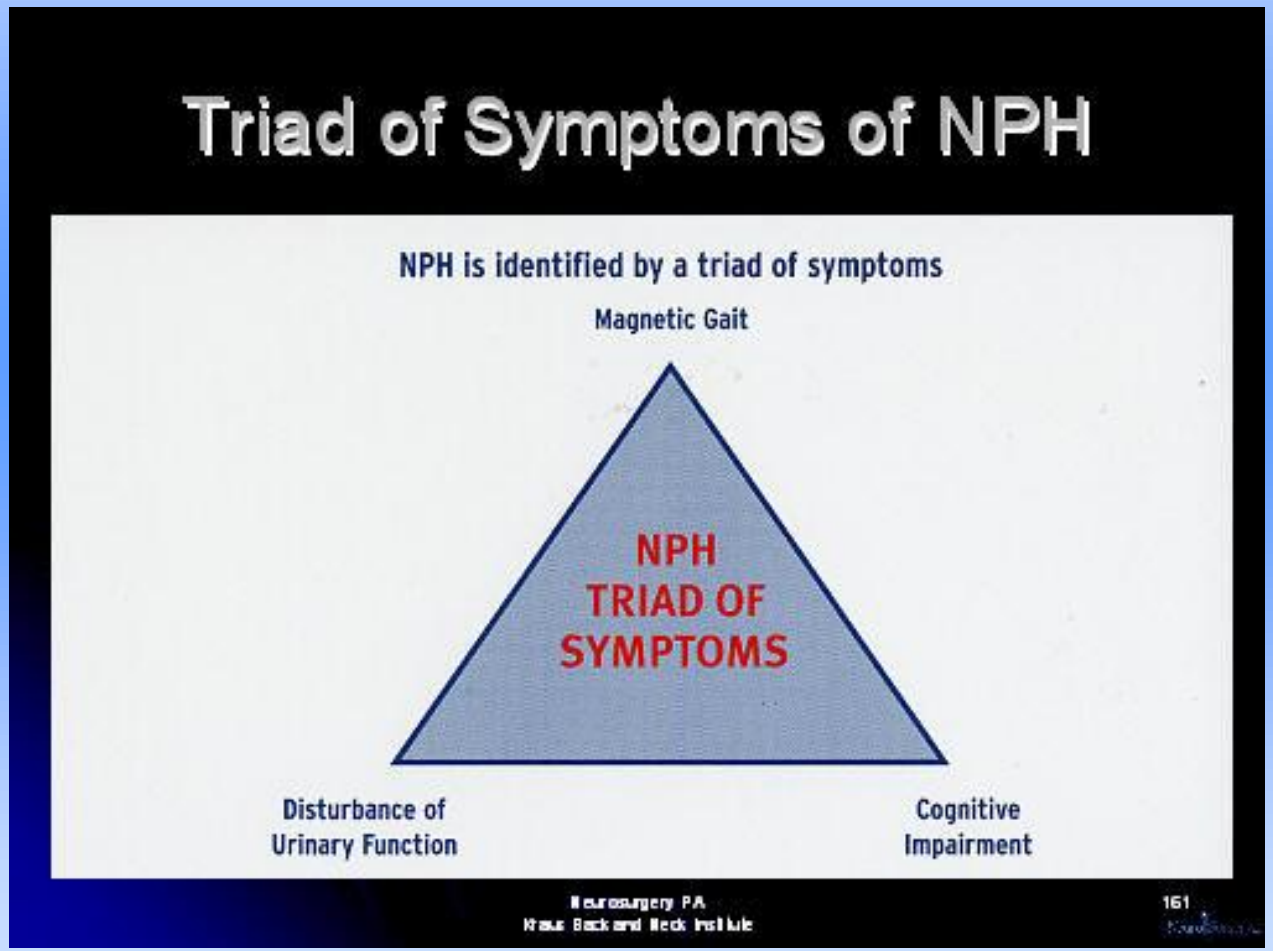
What is it?


LightSpeed Ultra
Ex: 4781
BRAIN
Se: 2/3
Im: 10/28
Ax: S28.2 (COI)
512 x 512
STANDARD
Mag: 1.2x
R
140.0 kV
180.0 mA
5.0 mm
Tilt: 10.0
ET: 4.0 s
GP: 2.0 s
TS: 0.00 mm/s
SPR:
Lin
W:80 L:40
A
P
St Marys Health System
L
DFOV: 25.0 x 25.0cm



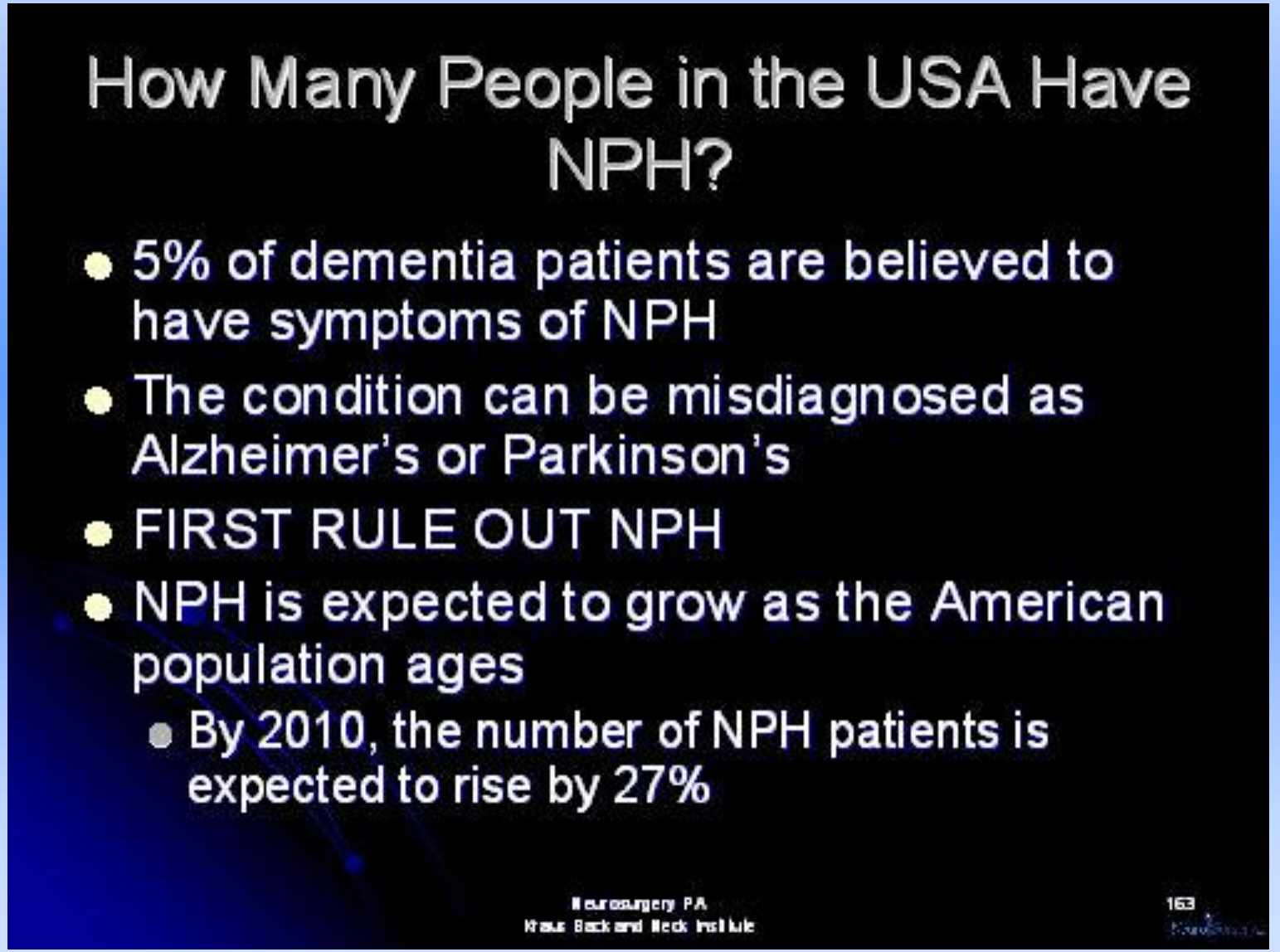

Ventriculoperitoneal Shunt Placement
Enlarged Left Ventricle
Entry into Cranium
Valve (Behind Ear)
Extra Tubing in Peritoneal Cavity for Growth
Underneath Skin

Normal pressure hydrocephalus

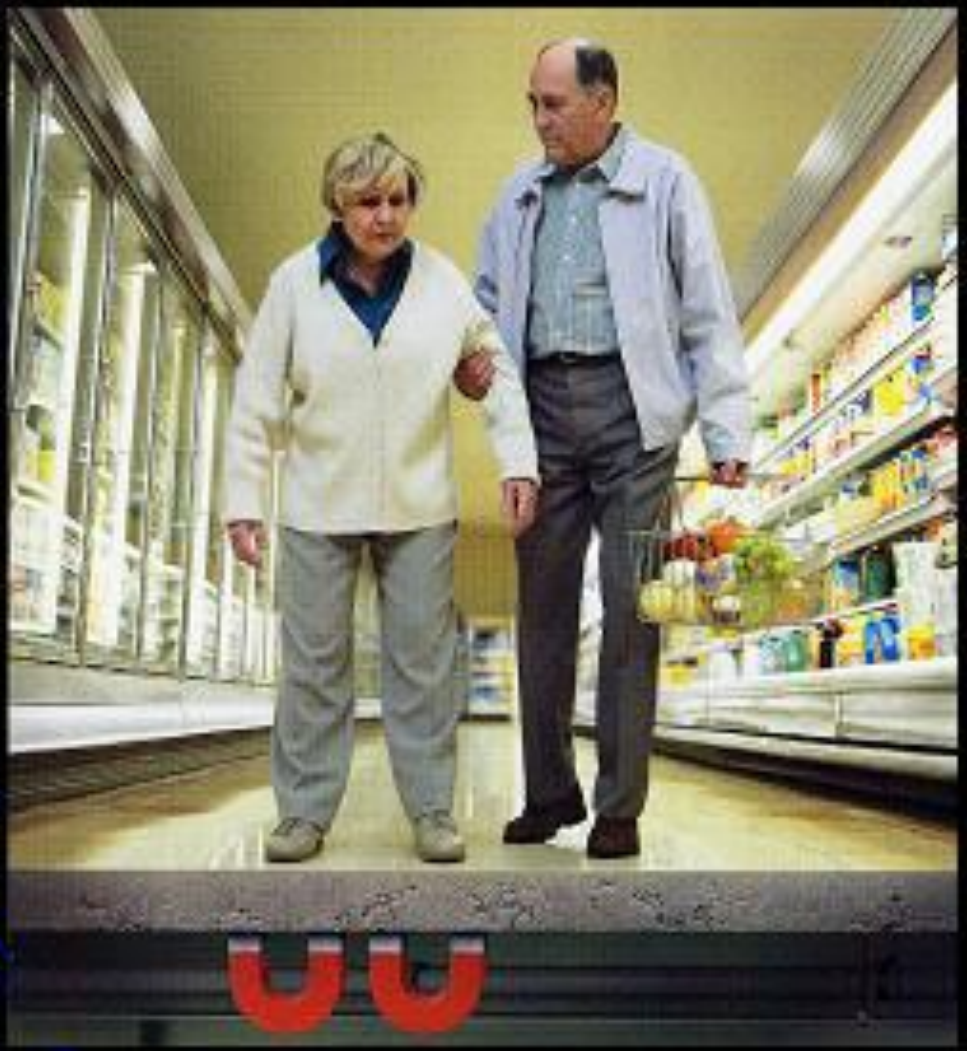


http://www.lowback-pain.com/nphnormalpressurehydrocephalus.htm

375 000 patients in the US

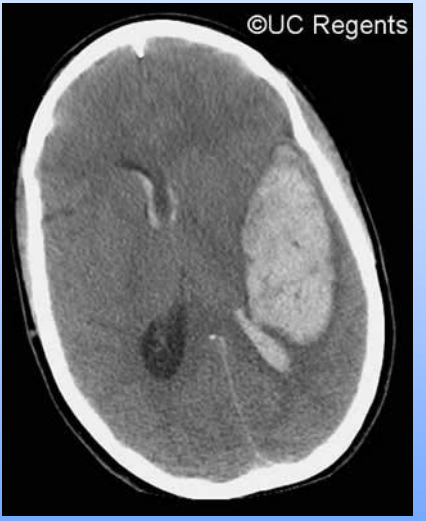


NPH

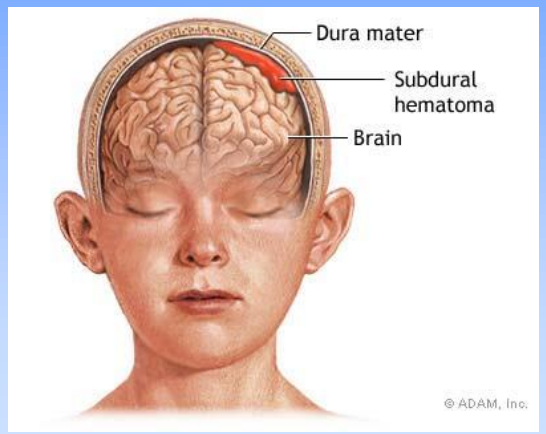


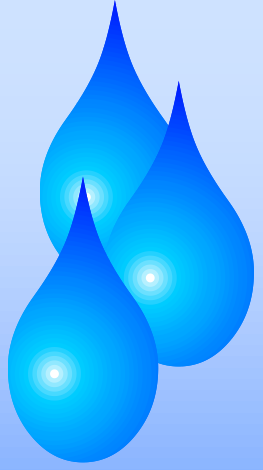
NPH, Treated

Programmable Valves



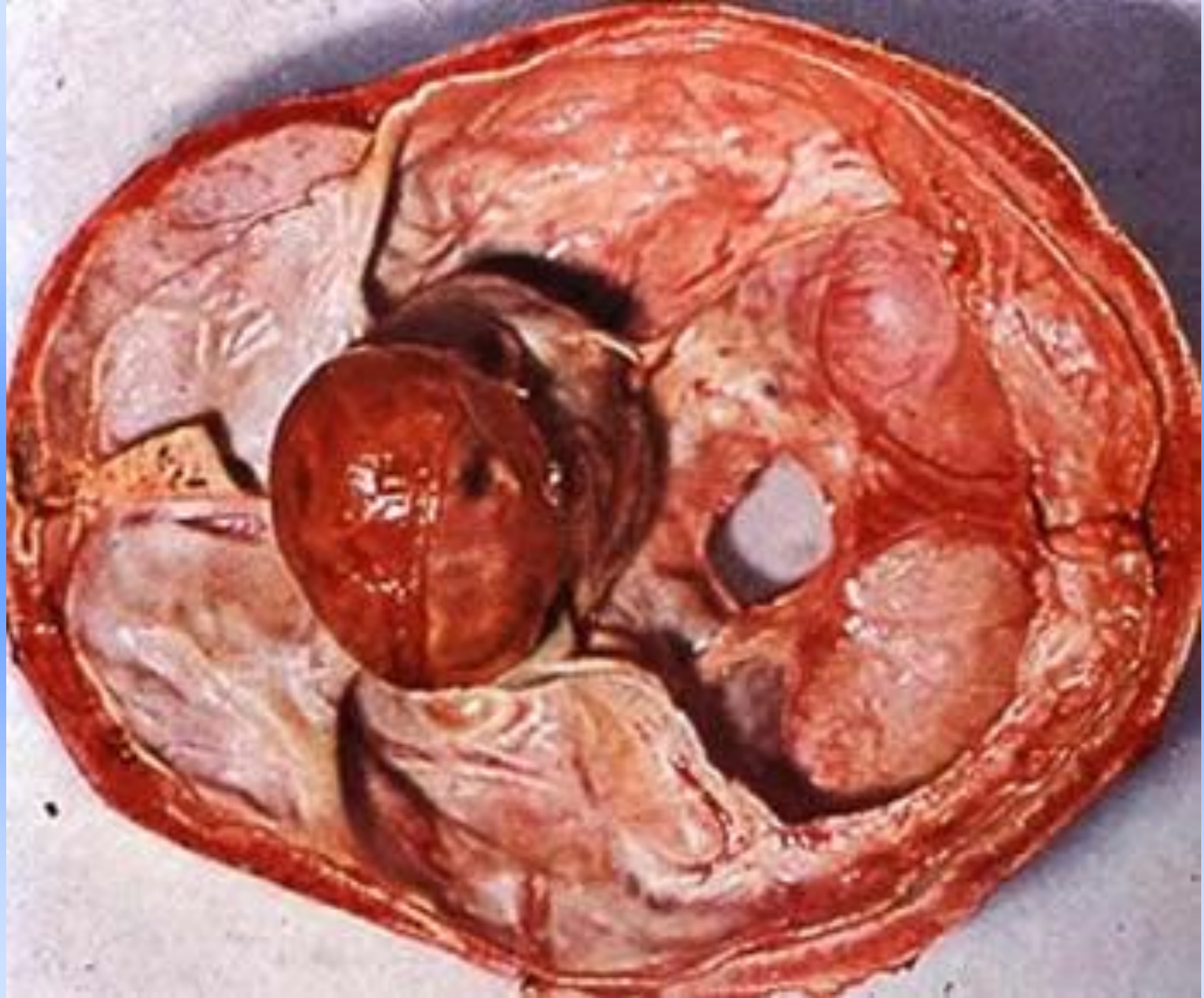
UNTRACRANIAL HYPERTENSION

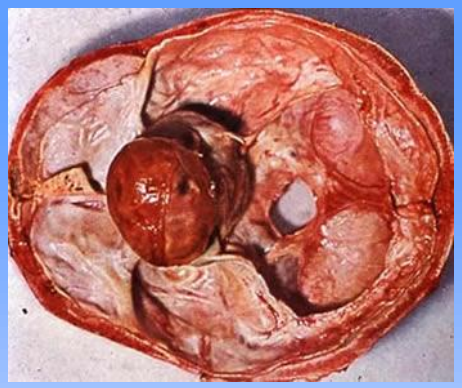


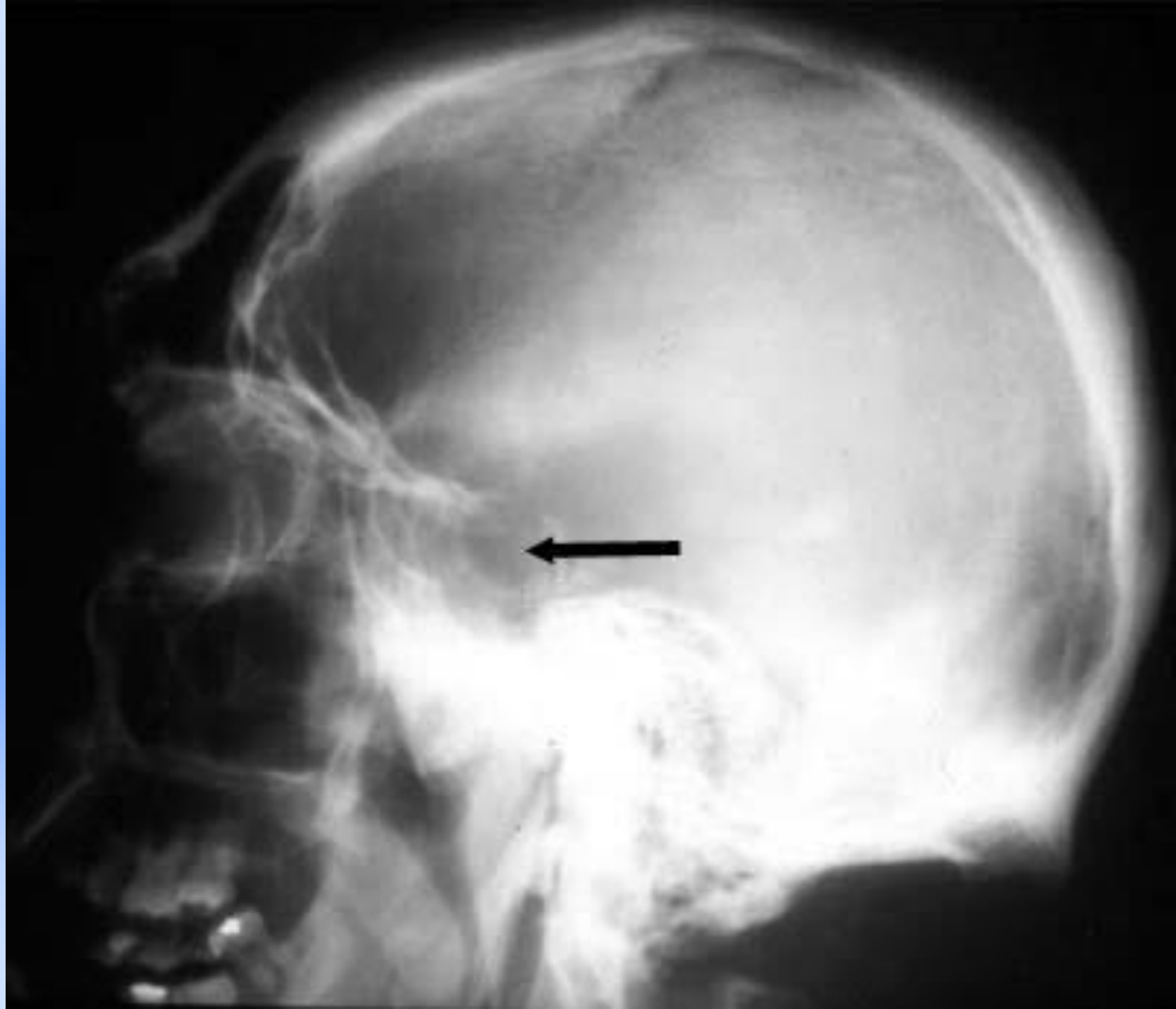


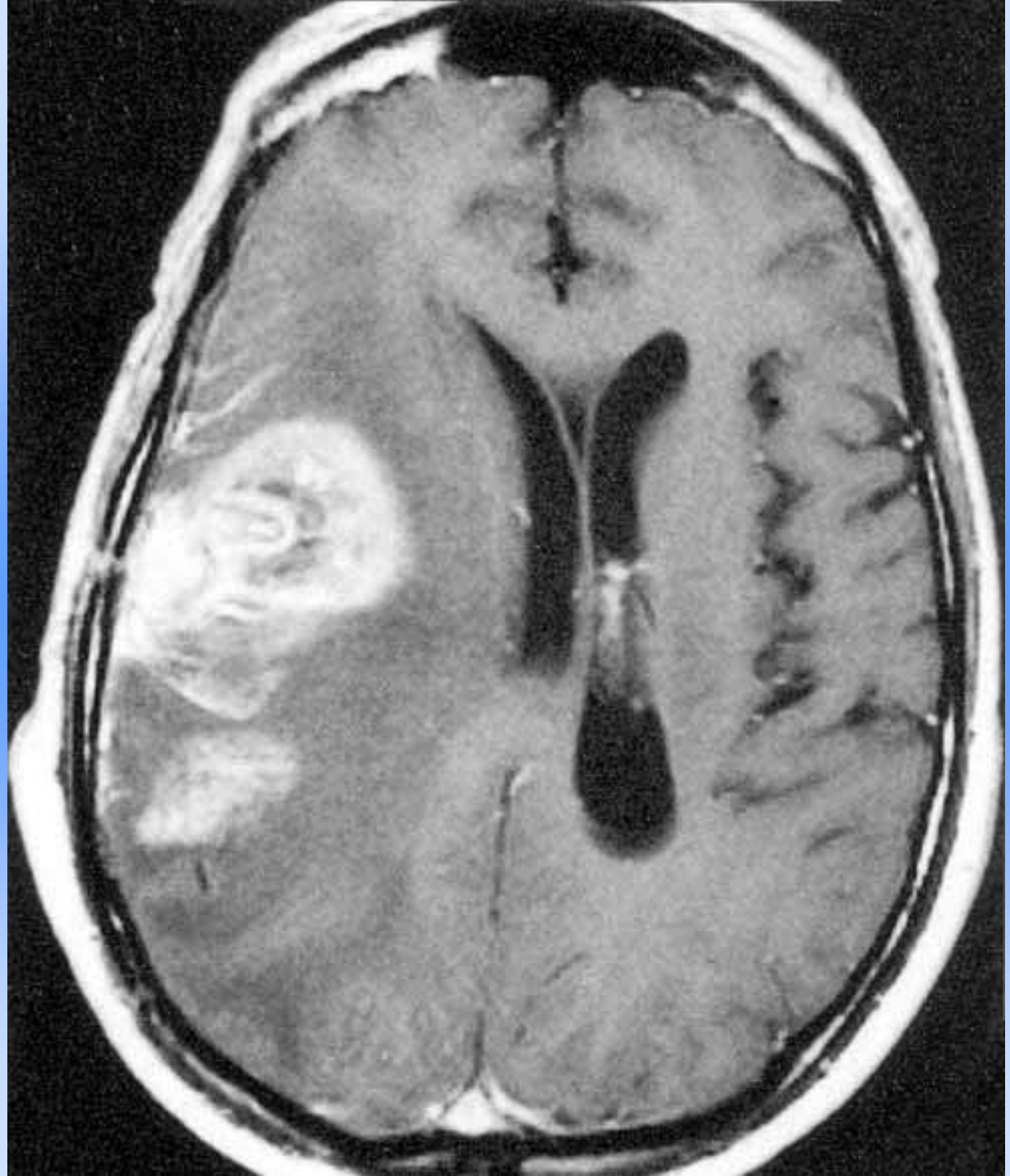
Intracranial hypertension is a spectrum of neurological disorders where cerebrospinal fluid (CSF) pressure within the skull is elevated. Normal CSF pressure varies by age. In general, CSF pressure above 250 mm H20 in adults and above 200 mm H2O in children signifies increased intracranial pressure (ICP).

Urgent!

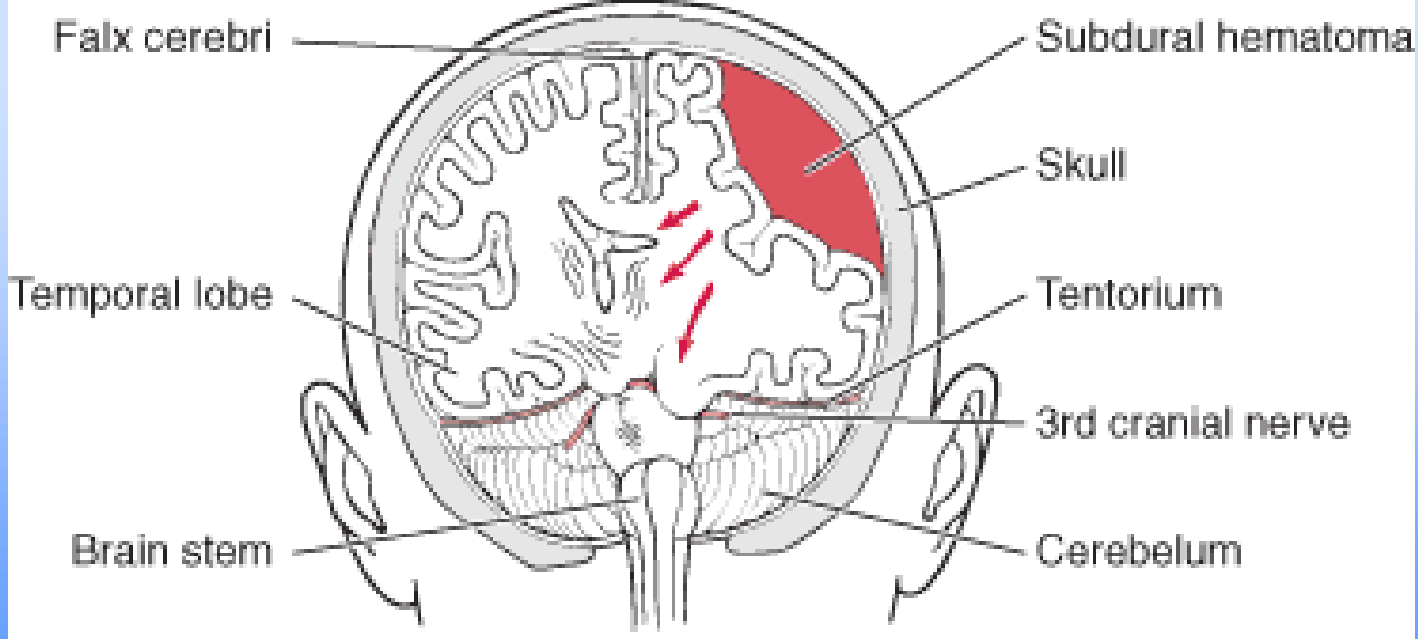




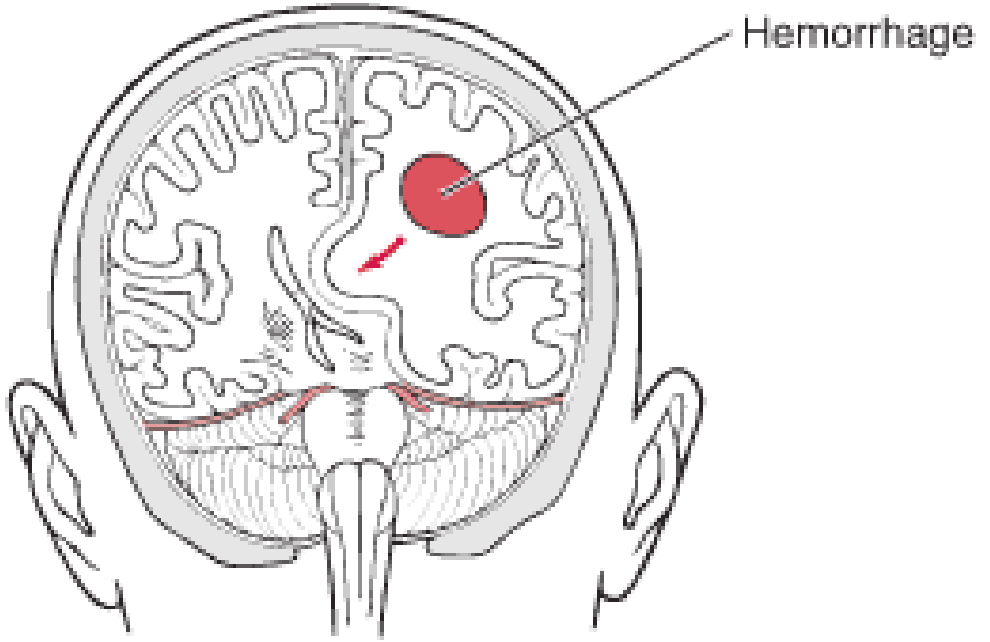




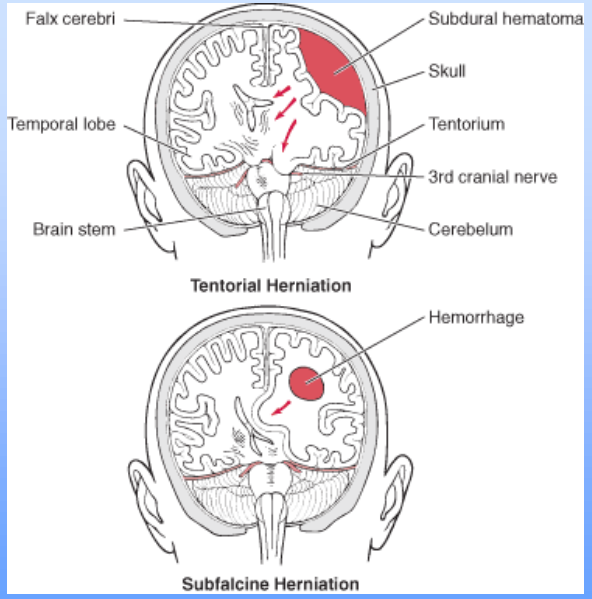

A

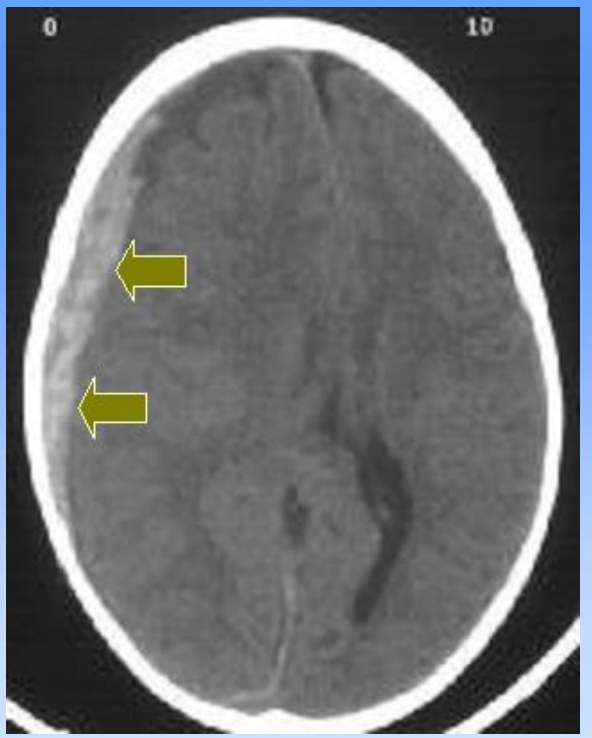


Tentorial Herniation



Subfalcine Herniation


Falx cerebri
Subdural hematoma
Skull
Temporal lobe
Tentorium
3rd cranial nerve
Brain stem
Cerebelum
Tentorial Herniation
Hemorrhage
Subfalcine Herniation

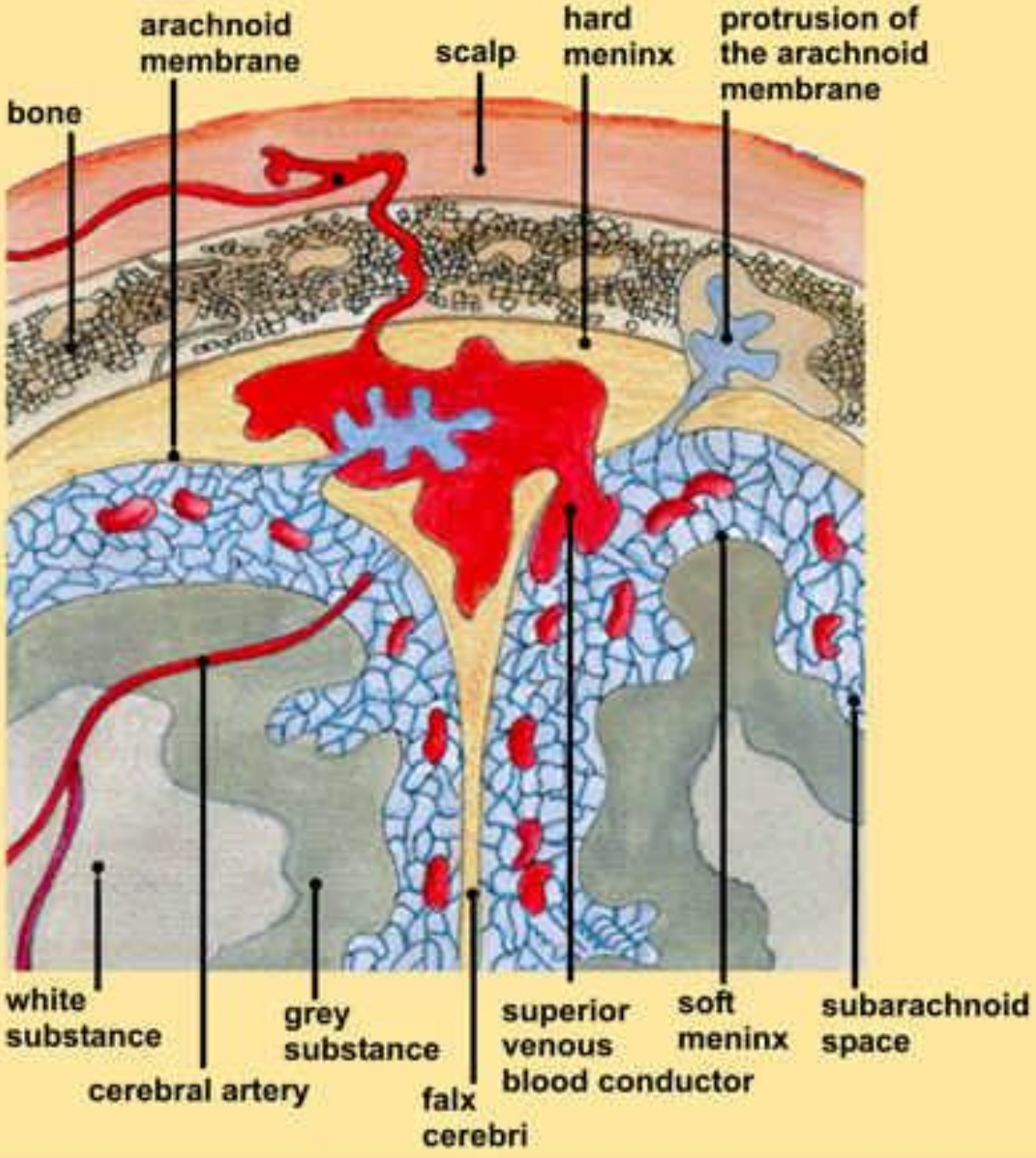

0
10

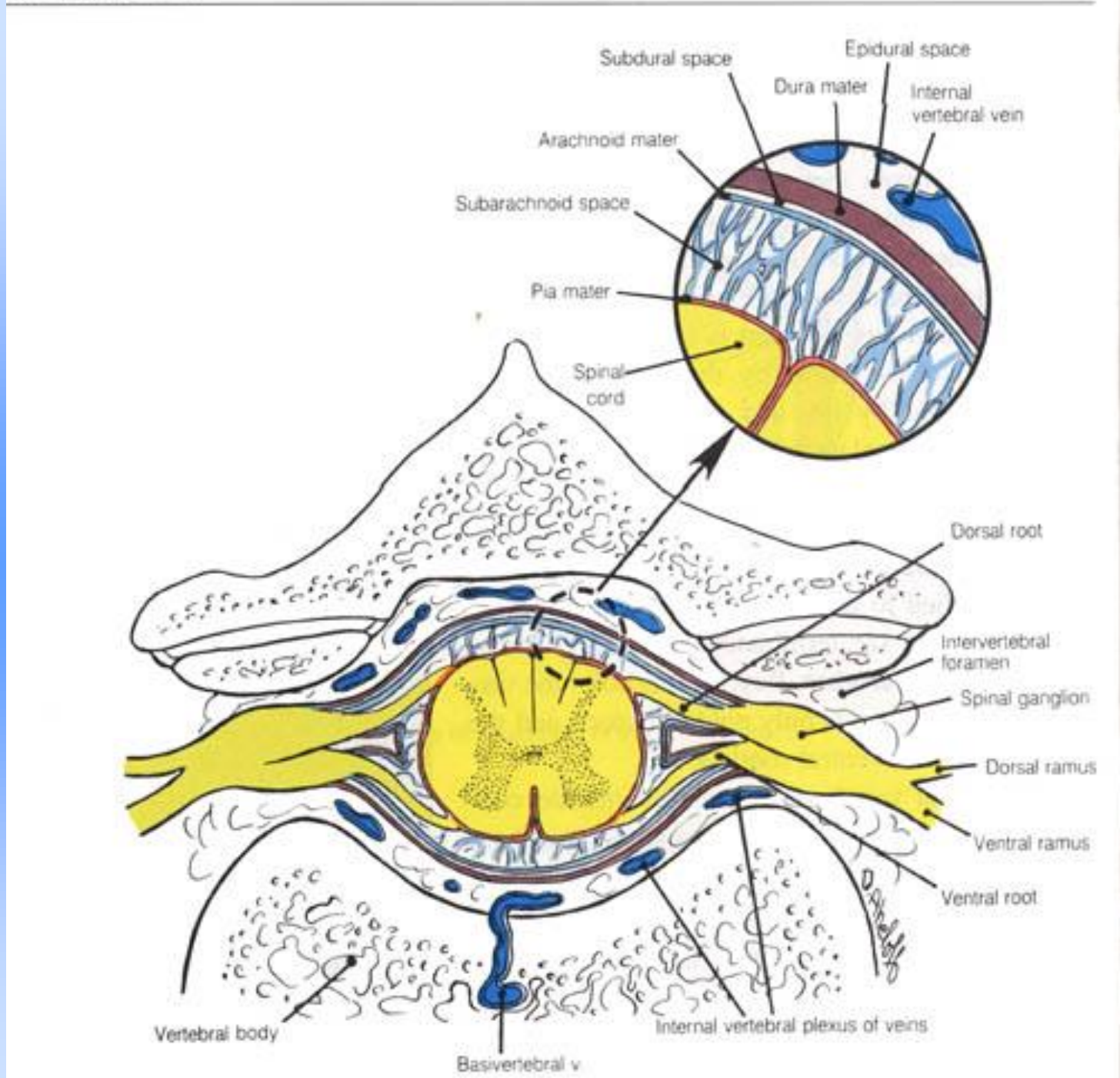
To learn at home:

Idiopathic intracranial hypertension (pseudotumor cerebri)

Meningeal signs

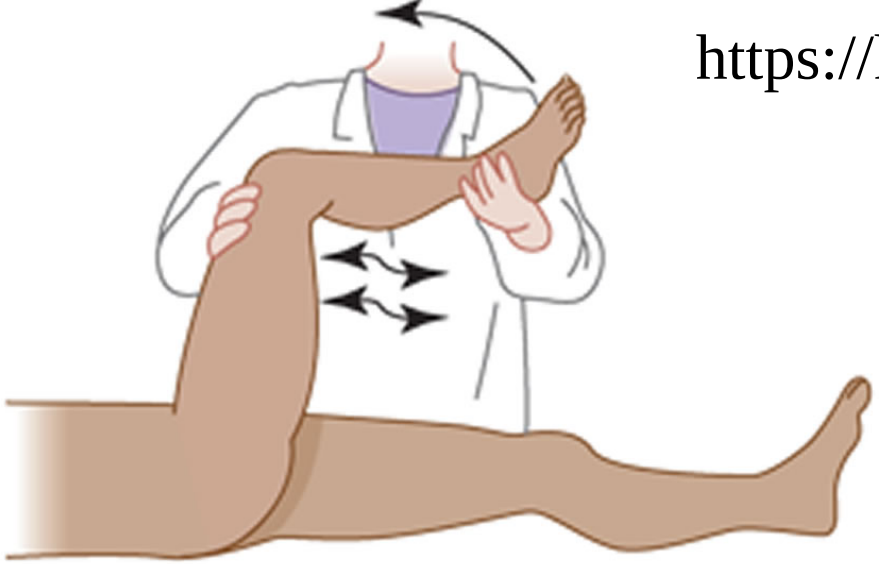
The Meninges




Subdural space
Epidural space
Dura mater
Internal vertebral vein
Arachnoid mater
Subarachnoid space
Pia mater
Spinal cord
Dorsal root
Intervertebral foramen
Spinal ganglion
Dorsal ramus
Ventral ramus
Ventral root
Vertebral body
Internal vertebral plexus of veins
Basivertebral v

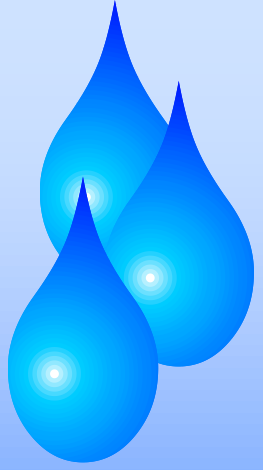
https://www.researchgate.net/figure/Male-child-presented-by-fever-severe-headache-nuchal-rigidity-and-change-in-mental_fig1_288834127

https://healthjade.net/kernig-sign/



A Kernig sign

B Brudzinski sign



Video Patient