In The Name of GOD

Reading the Brain CT

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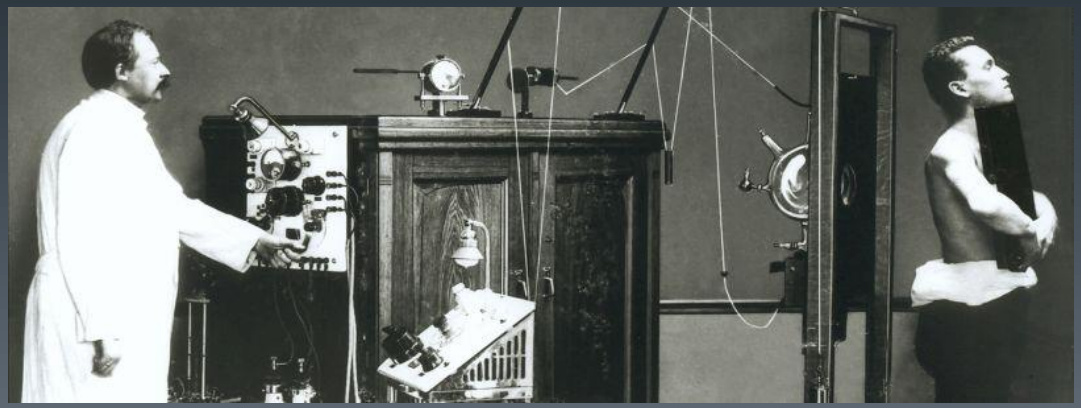
Intruduction

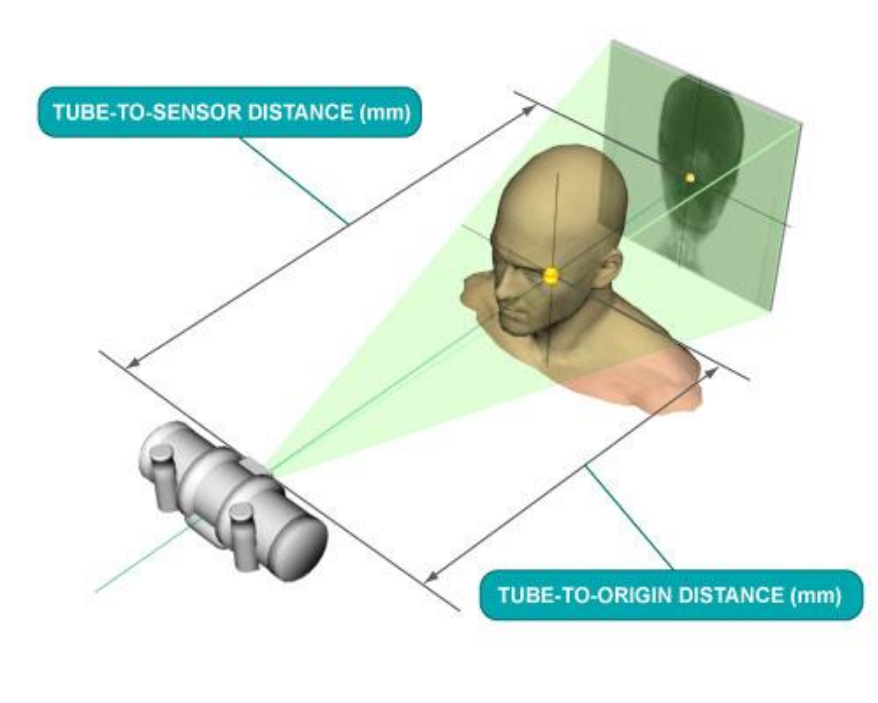
Inside of the body

Intruduction

- X_Ray And Radiograhy



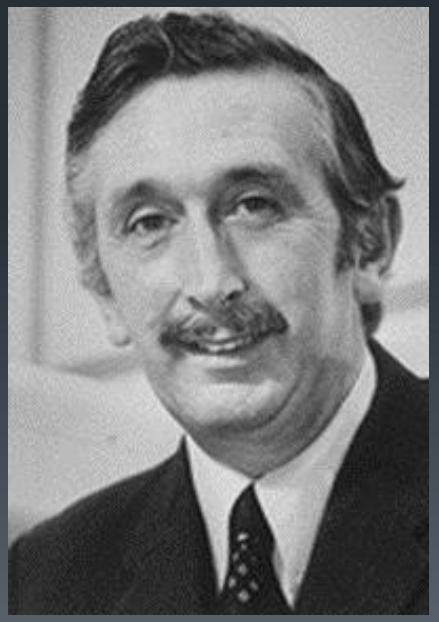
Radiograhy



Intruduction
CT Scan, History

1972, Sir Geoffrey Hounsfield and Coworkers

Gradually Advancements in Availability, Speed, Physiologic Assesments, Reconstruction, Safety



Intruduction
CT Scan in neurologic Field

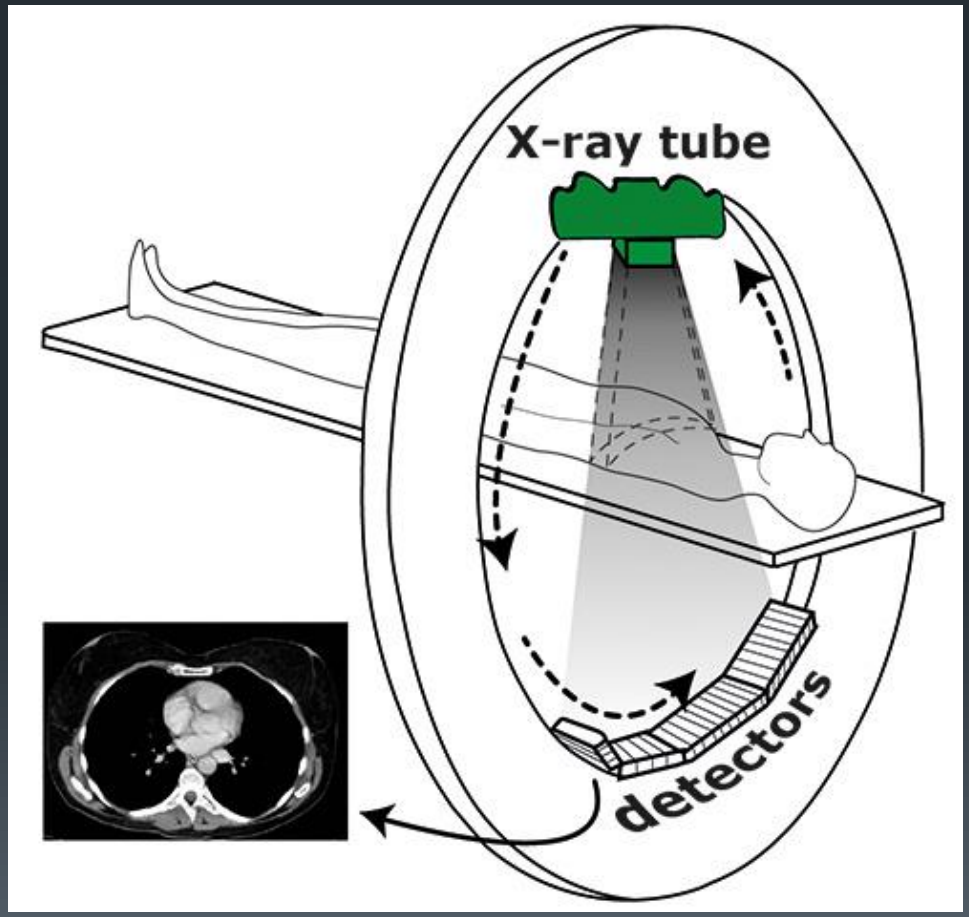
First Screening tool for Diagnosis of Intracranial pathologies After :

- Acute loss of consiuosness (seizure **,...)**
- any acute neurologic deficite Specially in emergency **situations(weakness, ...)**
- Severe and new onset headach
- Craniofacial Trauma
- Follow up Assesments
- Post operation Assesments
- Contraindacation of MRI

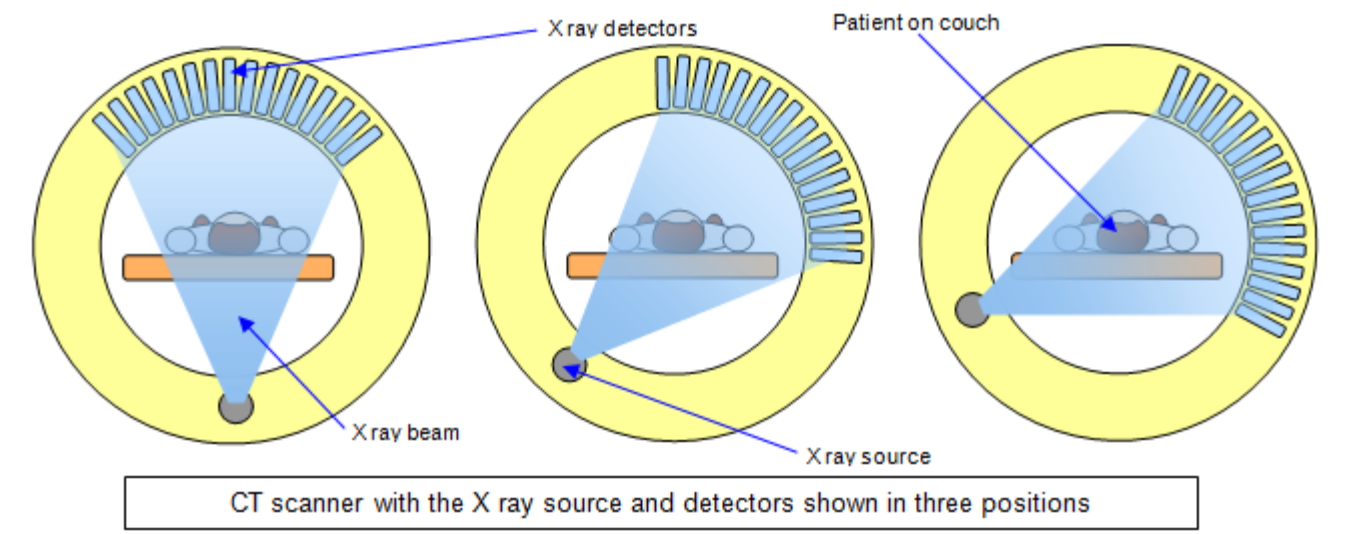
Intruduction
Technique

- Source
- Detector
- Computer(to voxel)

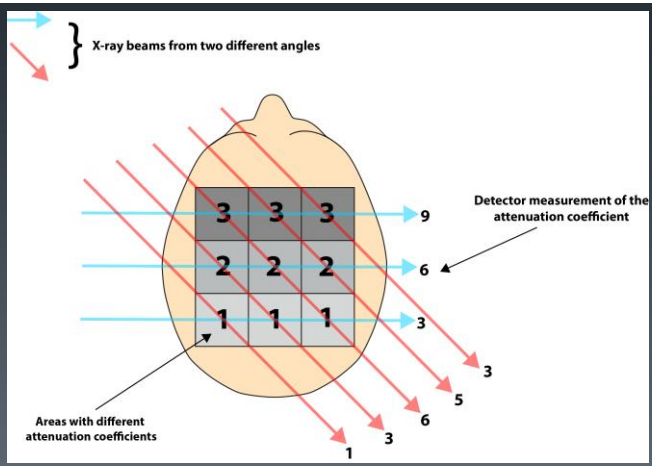
- Tomography



Intruduction Technique



CT scanner with the X ray source and detectors shown in three positions



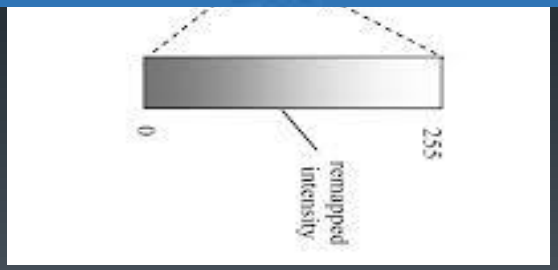
Intruduction
Technique, Hounsfield Unit

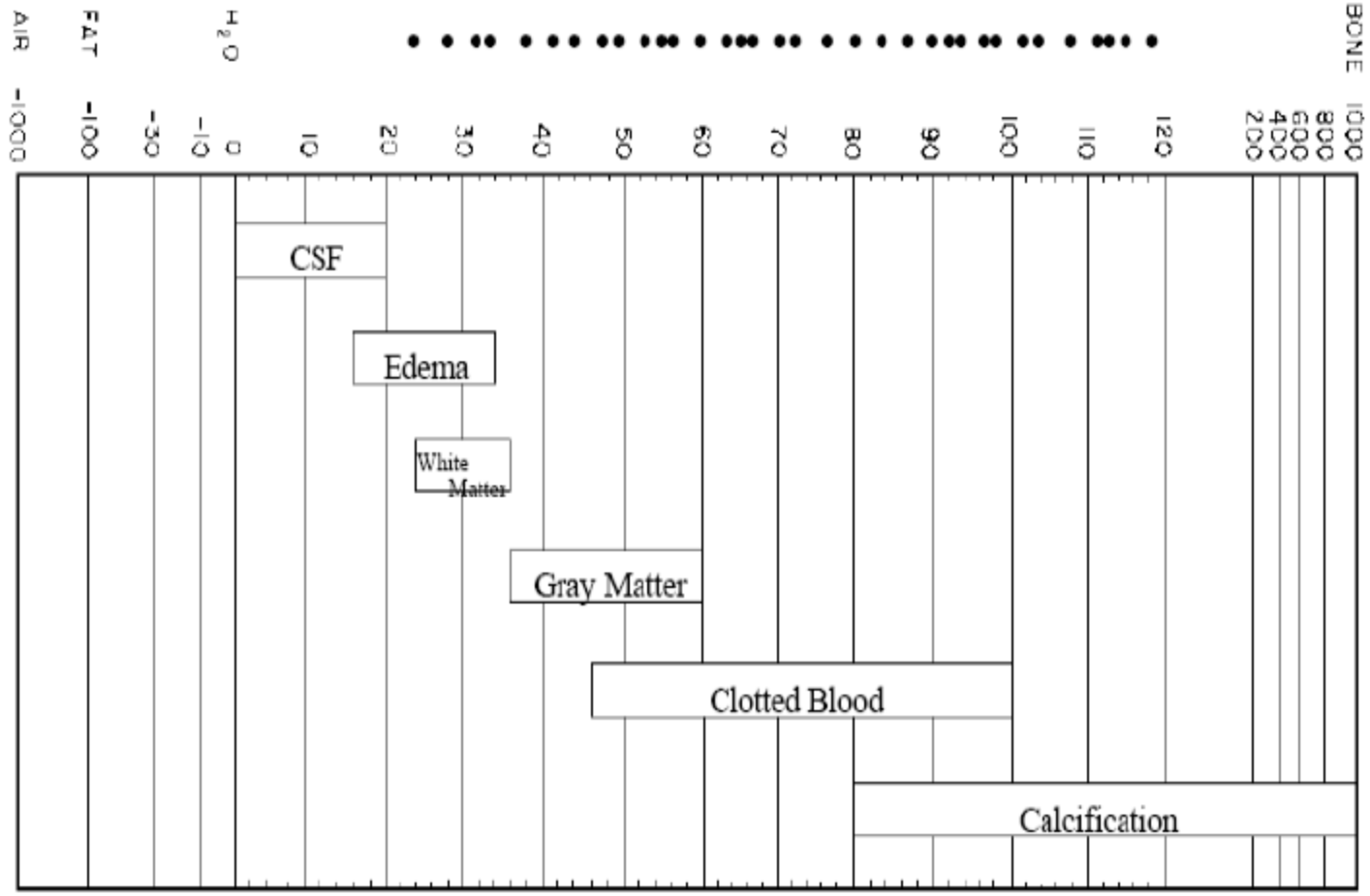
Attenuation coefficiant

air	--- 1000
fat	---70
Pure water	**0**
Csf	+8
White matter	+30
Gray matter	+45
blood	+70
Bone/calcification	+1000

Intruduction
Technique, Hounsfield

CT Windowing

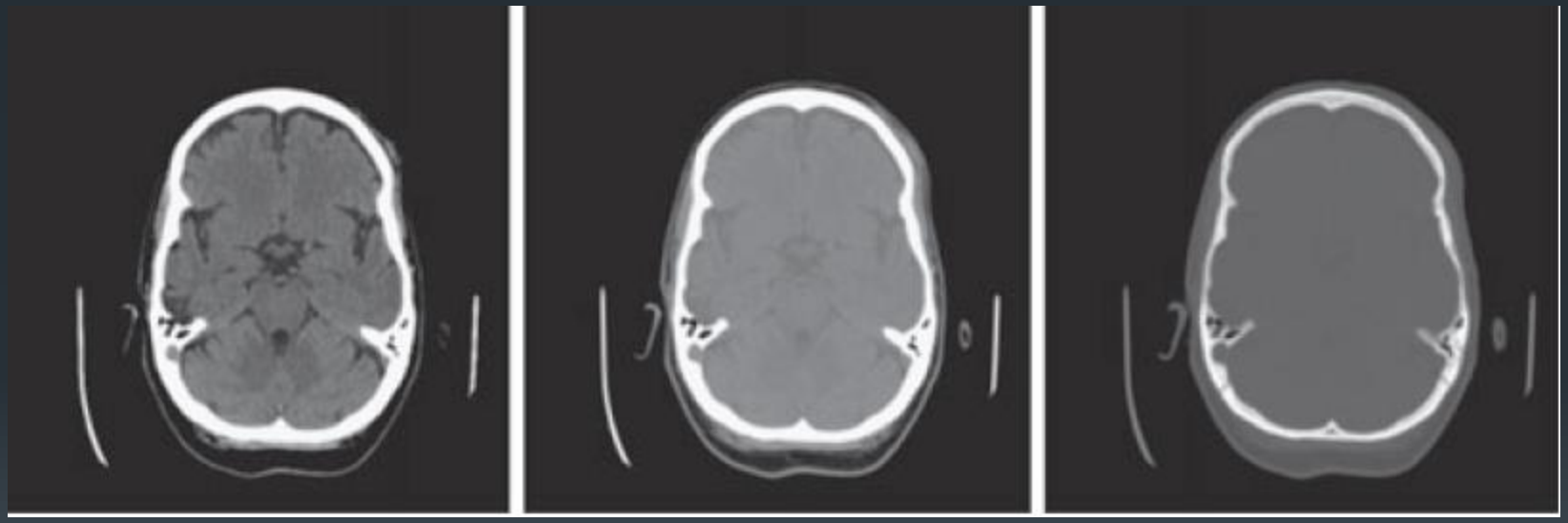




← Brain Window - level 35, width 70

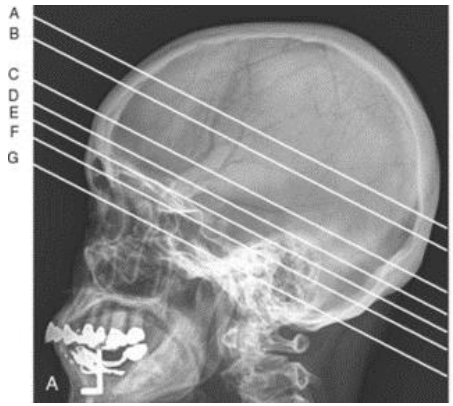
← Subdural Window - level 35, width 200

Bone Window - level 1000, width 1000 →



Intruduction
Technique

- Patient Position
- Head position
- Interval
- Slice Thickness
- Orbitomeatal



Intruduction
CT Scan , Advantages

1.CT scanning is painless, noninvasive and accurate.

2.Unlike conventional x-rays, CT scanning provides very detailed images of many types of tissue as well as the lungs, bones, and blood vessels at the same time.

3.CT examinations are fast and simple; in emergency cases, they can reveal internal injuries and bleeding quickly enough to help save lives. unlike MRI. useful for children and the elderly

4.CT has been shown to be a cost-effective imaging tool for a wide range of clinical problems.

Intruduction
CT Scan , Advantages

5.CT may be less expensive than MRI. In addition, it is less sensitive to patient movement.

6. CT can be performed if you have an implanted medical device of any kind, unlike MRI.

7-CT imaging provides real-time imaging.

8-Neuronavigation

9-Ct Guided Biopsy

Intruduction
CT Scan , Disadvantages

1.There is always a slight chance of cancer from radiation. However, the benefit of an accurate diagnosis far outweighs the risk.

2.The effective radiation dose from this procedure is about 0.6-10 mSv, which is about the same as the average person receives from background radiation in eight months until 3 years.

3.Women should always inform their physician or x-ray technologist if there is any possibility that they are pregnant.

4.CT scanning is, in general, not recommended for pregnant women because of potential risk to the baby.

Intruduction
CT Scan , Disadvantages

5.Nursing mothers should wait for 24 hours after contrast material injection before resuming breast-feeding.

6.The risk of serious allergic reaction to contrast materials that contain iodine is rare, and radiology departments are well-equipped to deal with them.

7.Children should have a CT study only if it is essential for making a diagnosis and should not have repeated CT studies unless absolutely necessary.

8.Weakly Identify Posterior fossa pathologies

Intruduction
CT Scan Types

- Axial Brain CT Scan Without Contrast

Intruduction
CT Scan Types

- **Axial Brain CT Scan With Contrast**

- 100 cc-200 cc iodinated Contrast material
- Catheter 18-20 G
- Iv contrast is given to better evaluate:

  Vascular structures

  Tumors

  Sites of infection

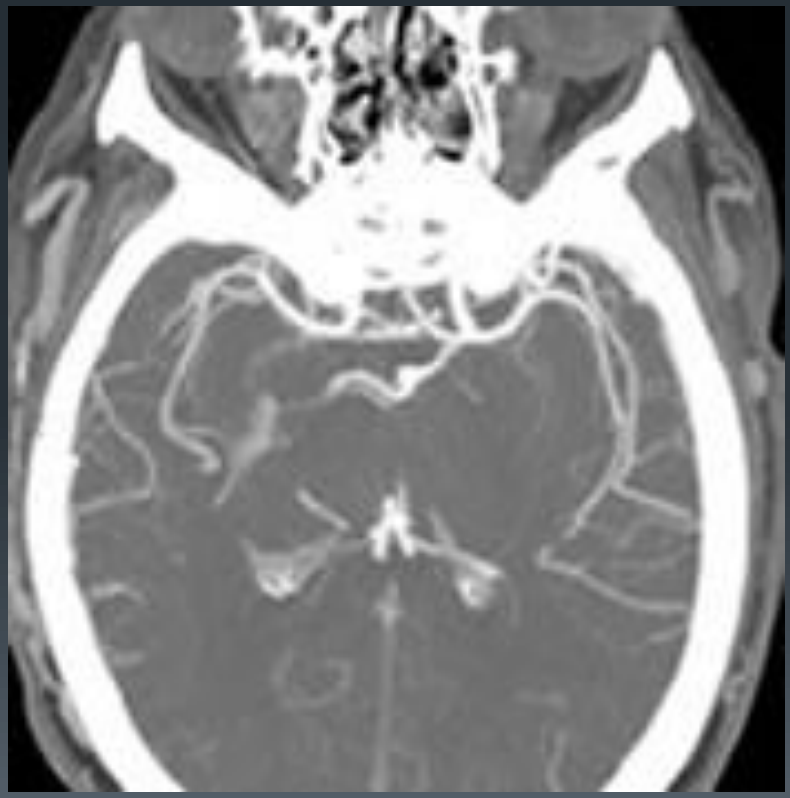
- Relative contraindications:

  Allergy, renal failure

Intruduction
CT Scan Types

- Brain CT Angiography

- Submilimeter slice,reconstructionable
- Relatively noninvasive Imaging of Great Head and Neck vasculature
- Intravenous inj.
- Alternative for Conventional Angiography (complication)
- Diagnose of vascular malformation
- Preoperation Planing(Hypervascular tumor or vascular encasement)



Reconstruction

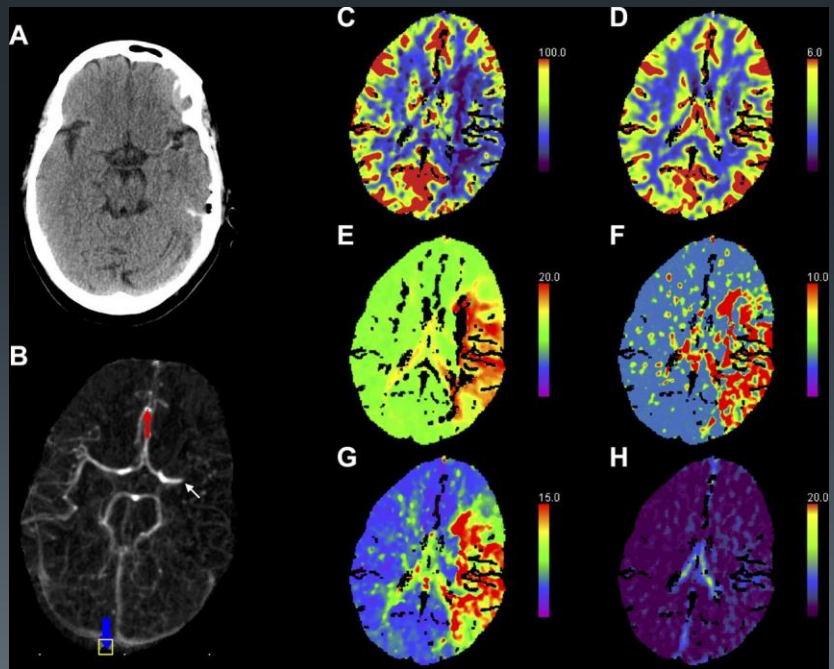
Contrast

- Specification,

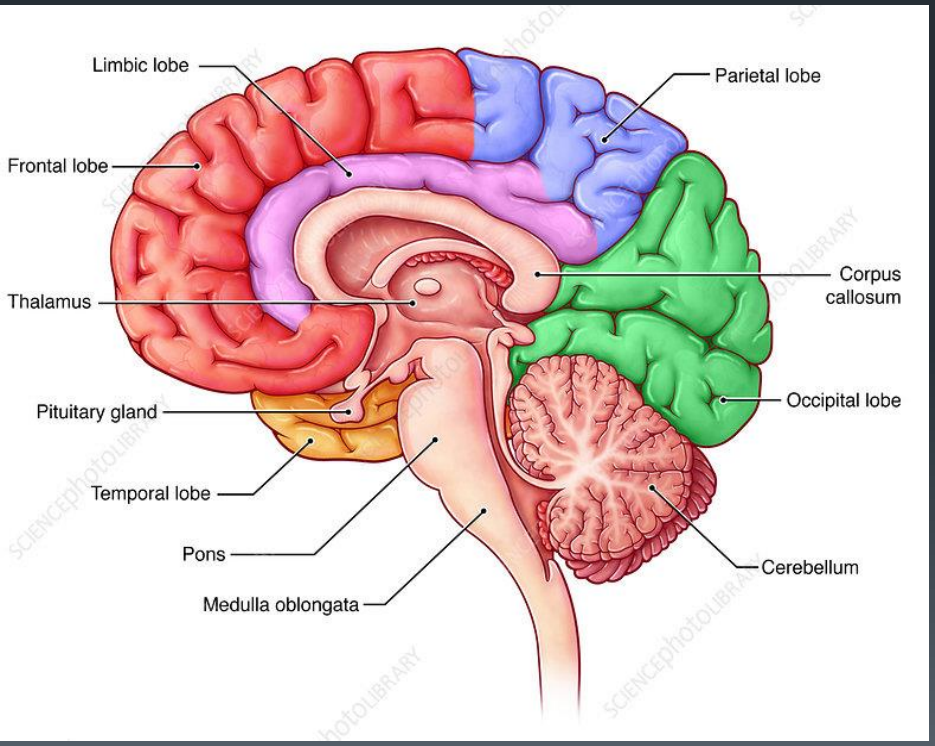
- Metrizamide
- Iohexal(ominipaque)
- Iodixanol(visipaque)
- Iopromide(Ultravist)

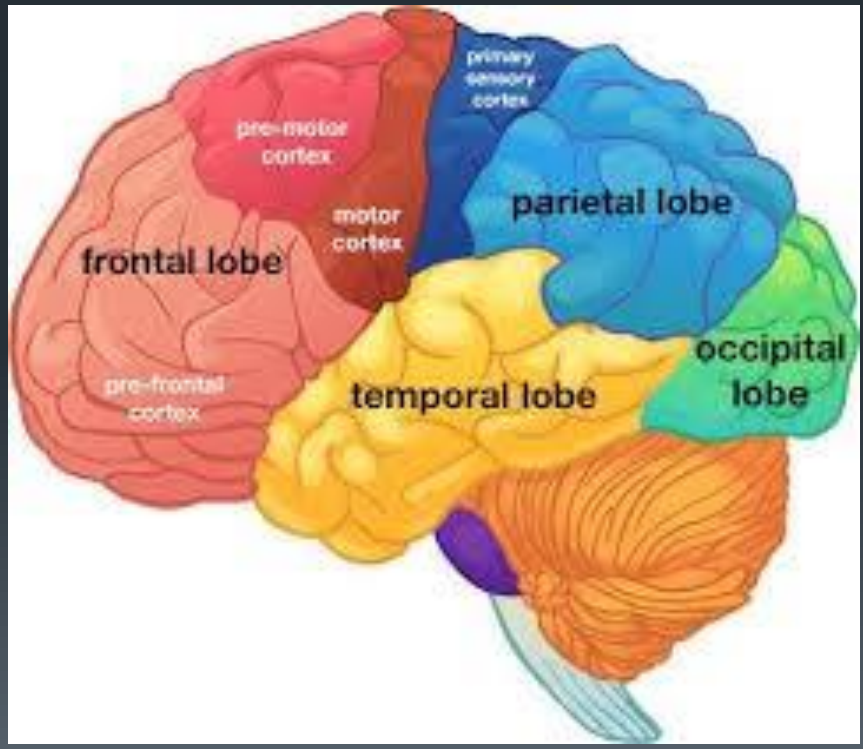
Brain Perfusion CT Scan

- Physiologic Data
- Contrast inj
- Imaging during a minute
- **“Time- Density” Curve for each Voxel**
- CBF(ml/min/100gr)
- MTT(min)
- CBV(cc/100gr)
- Use in Acute Cerebral Stroke

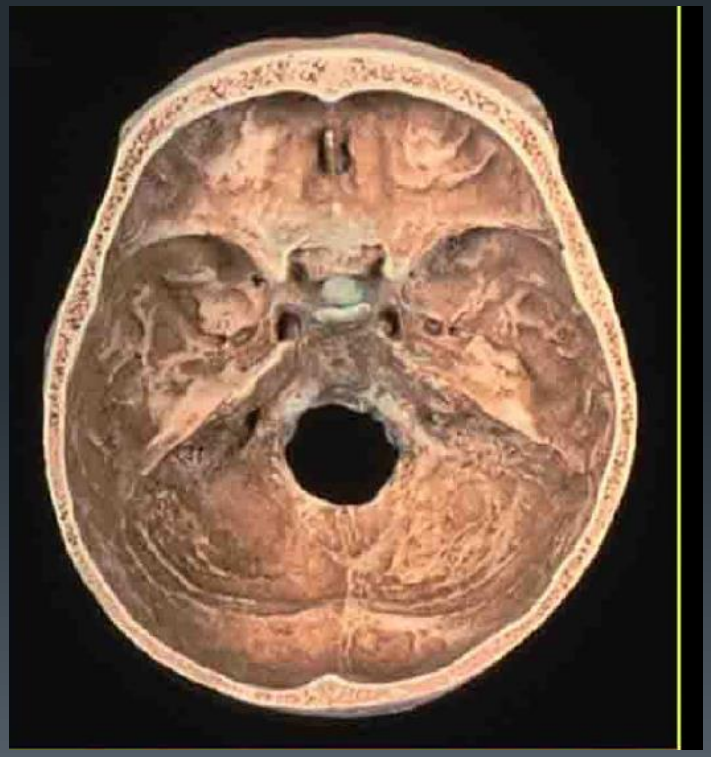


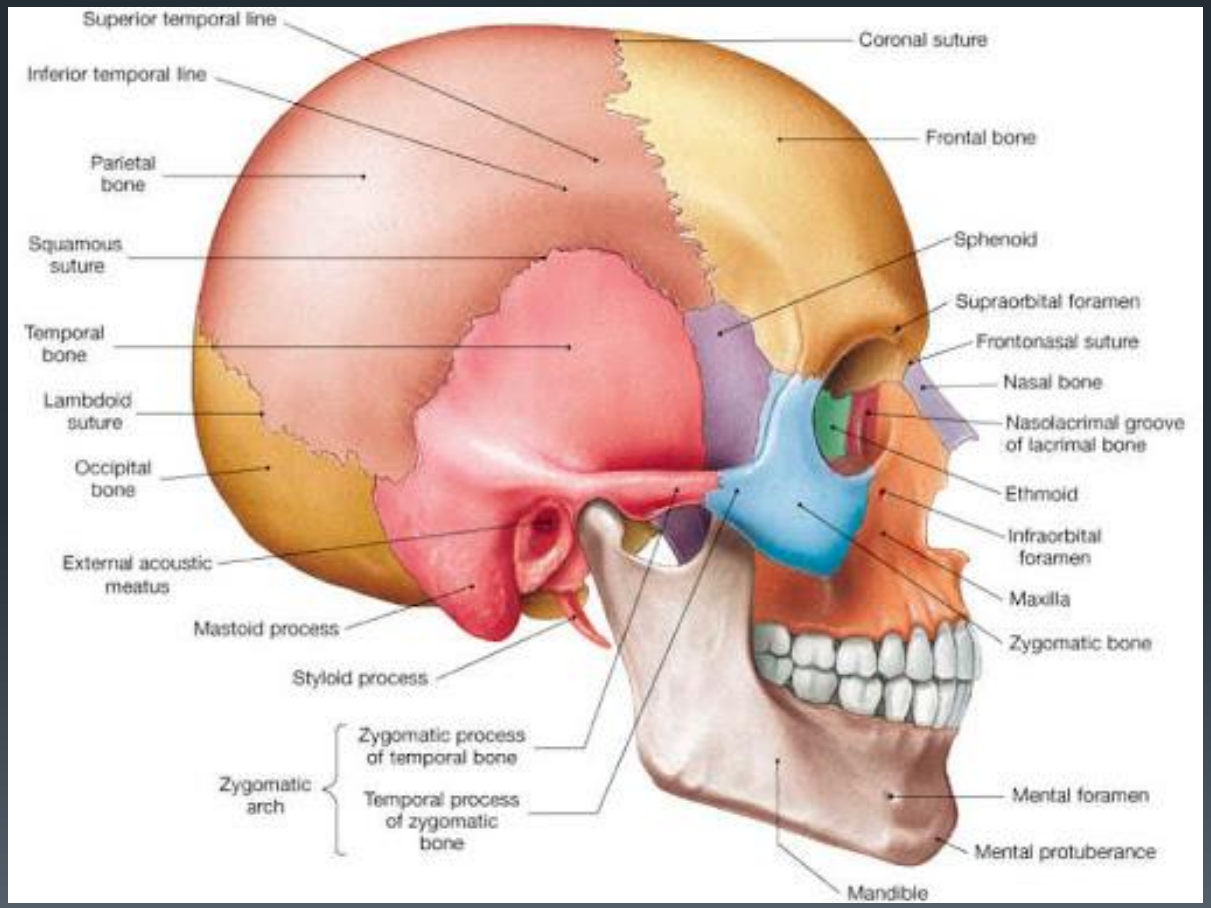
Anatomy
Brain Lobes



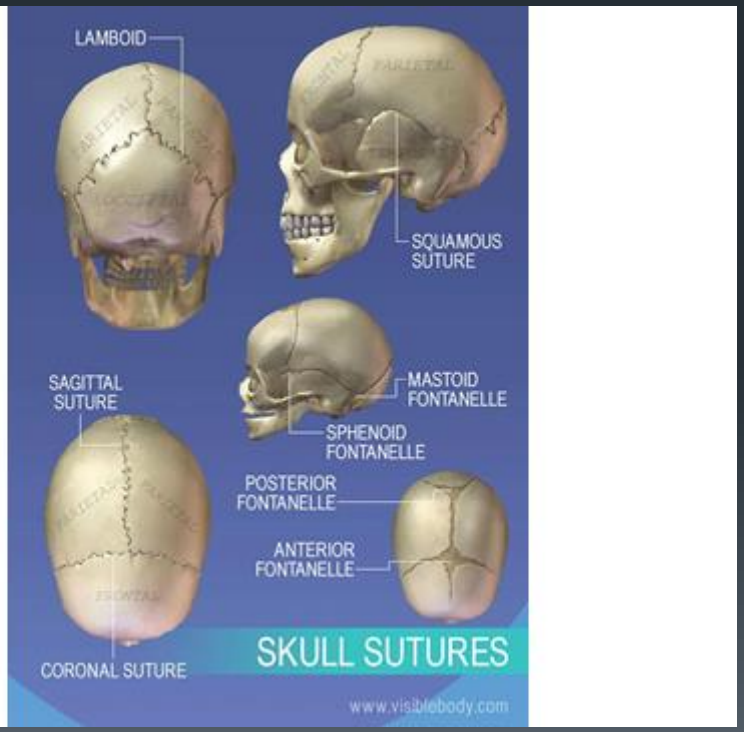


Anatomy
Skull Base , Cranial Fossa

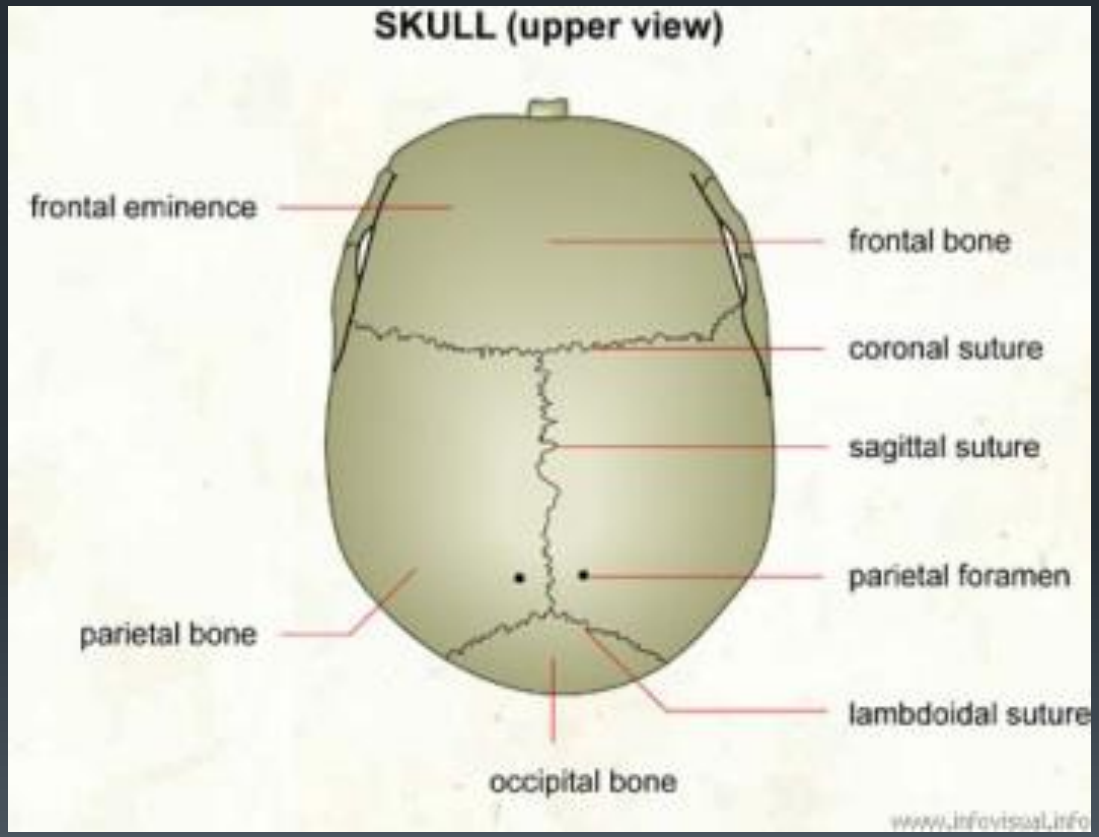



Superior temporal line
Inferior temporal line
Parietal bone
Squamous suture
Temporal bone
Lambdoid suture
Occipital bone
External acoustic meatus
Mastoid process
Styloid process
Zygomatic arch
Zygomatic process of temporal bone
Temporal process of zygomatic bone
Coronal suture
Frontal bone
Sphenoid
Supraorbital foramen
Frontonasal suture
Nasal bone
Nasolacrimal groove of lacrimal bone
Ethmoid
Infraorbital foramen
Maxilla
Zygomatic bone
Mental foramen
Mental protuberance
Mandible

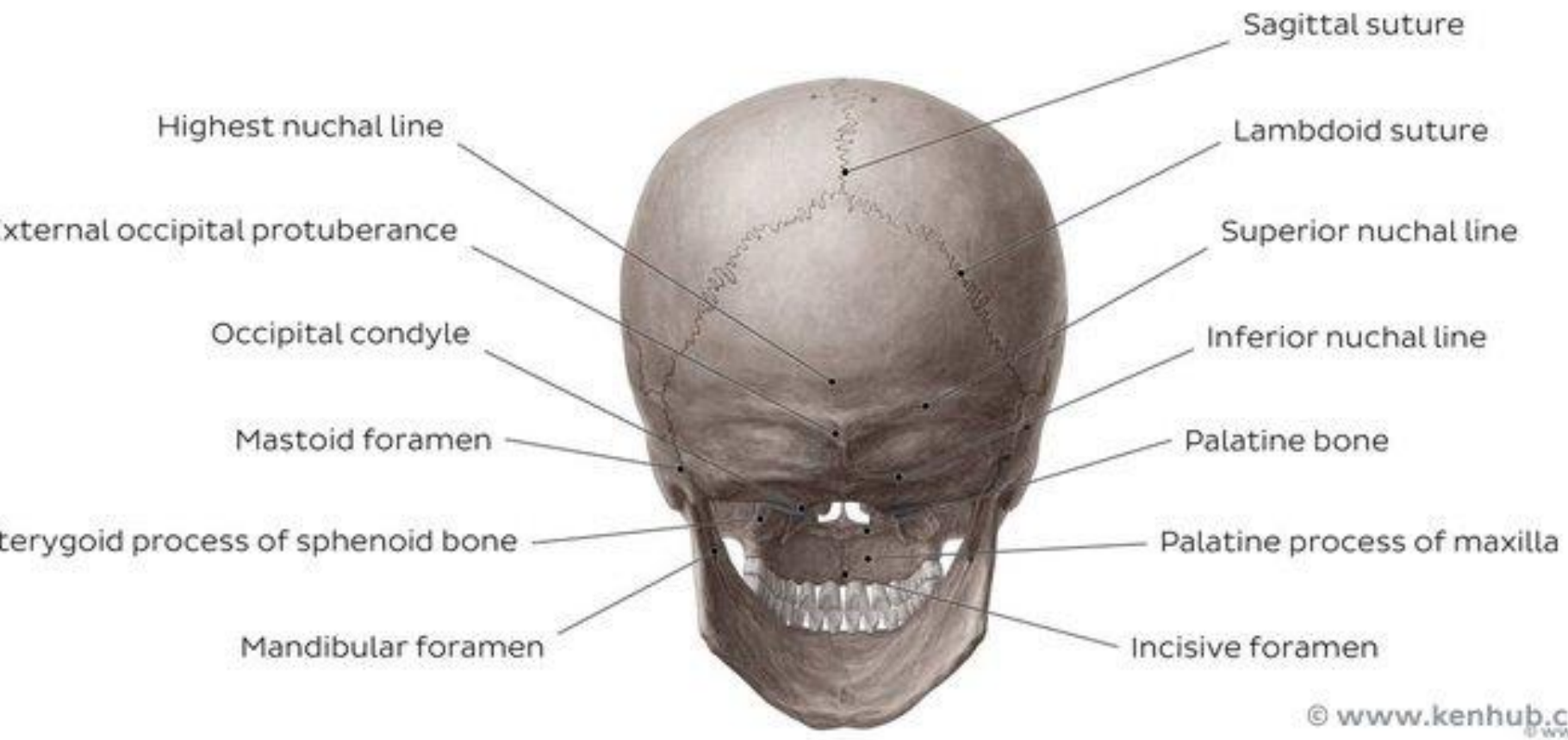
Anatomy
Skull , Sutures



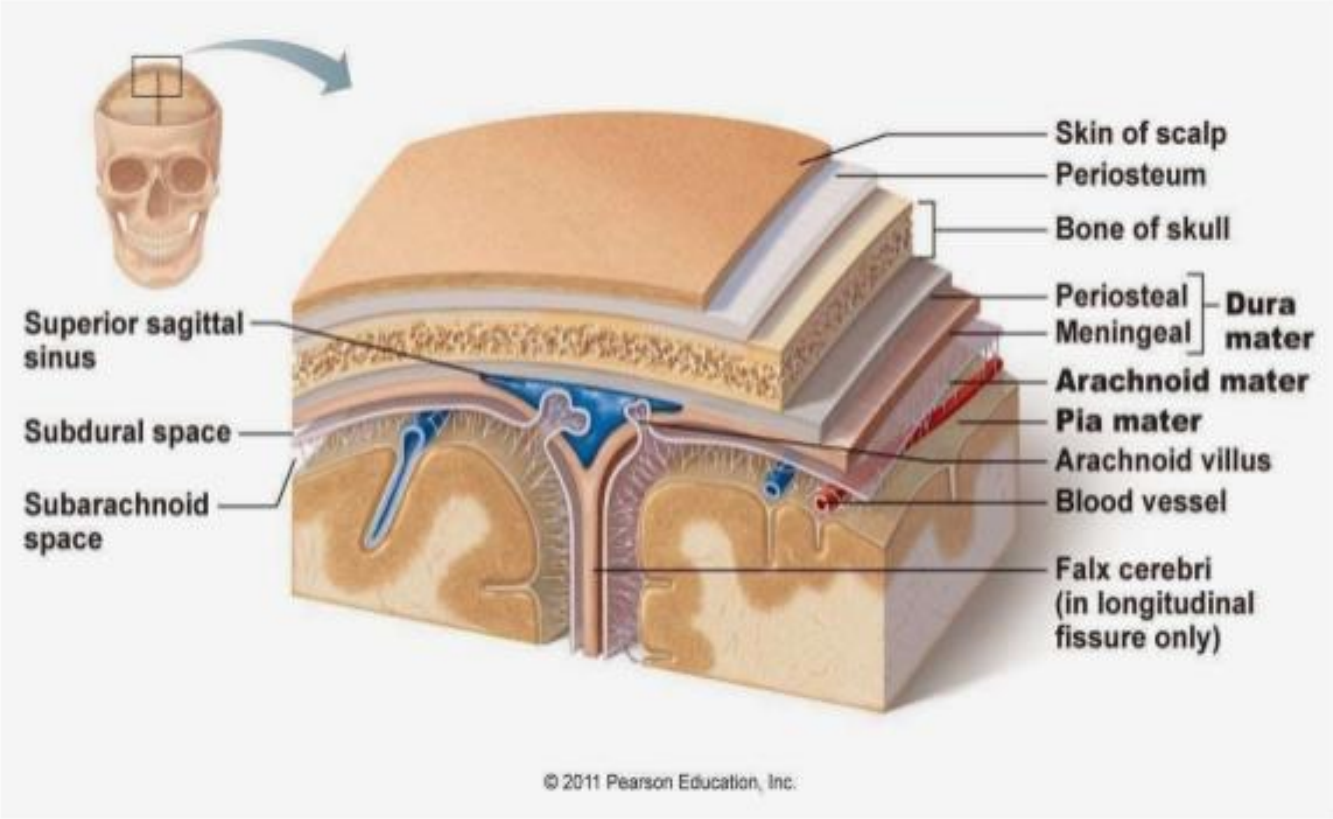
Anatomy
Skull , Sutures



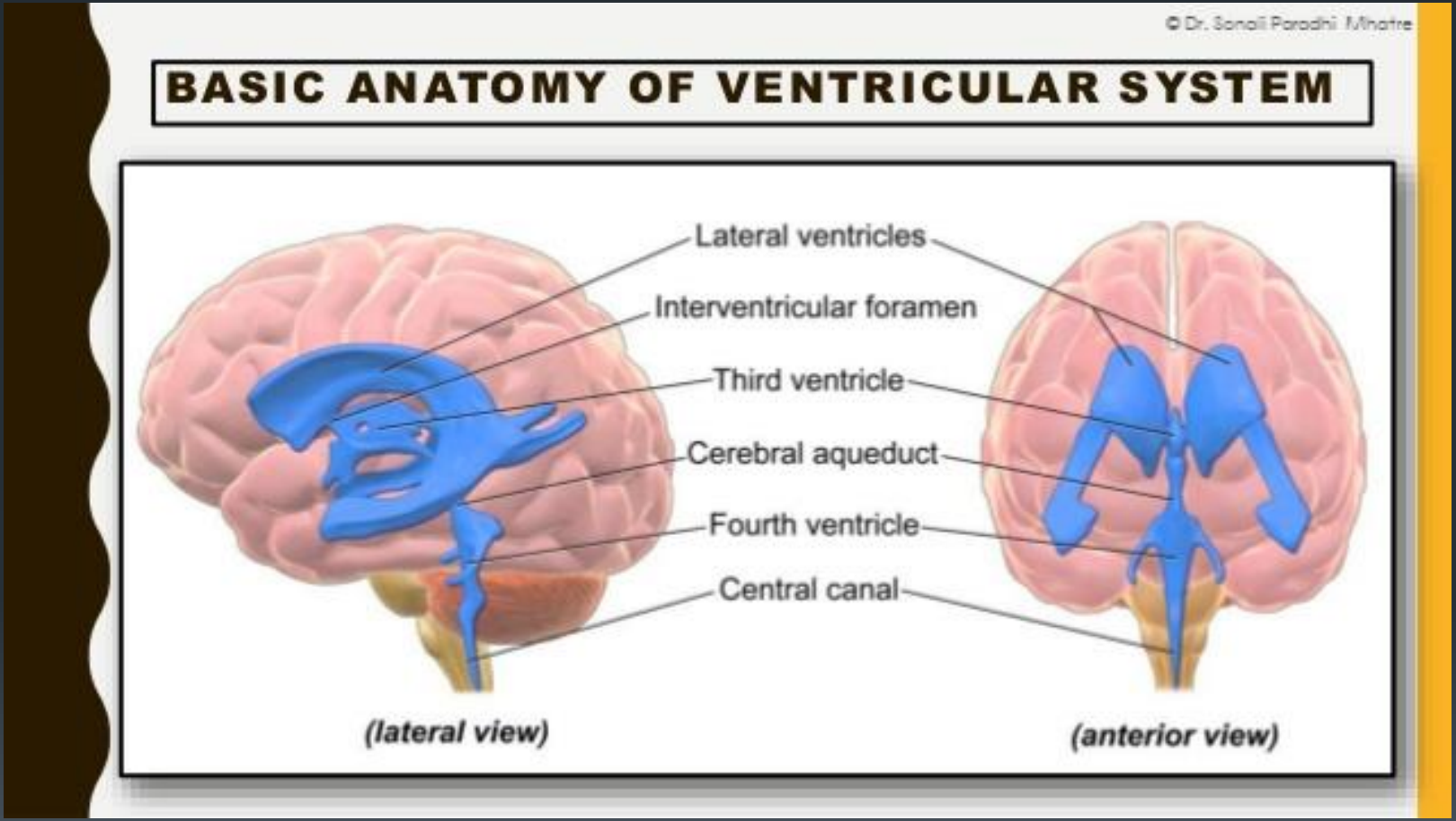
Anatomy
Skull , Sutures



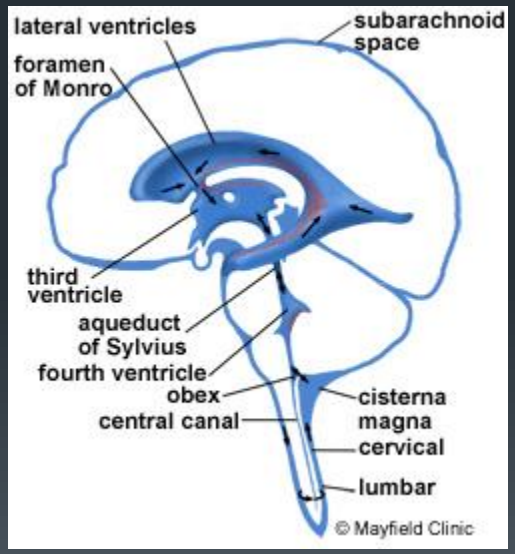
Anatomy
Cranium Coronal Section



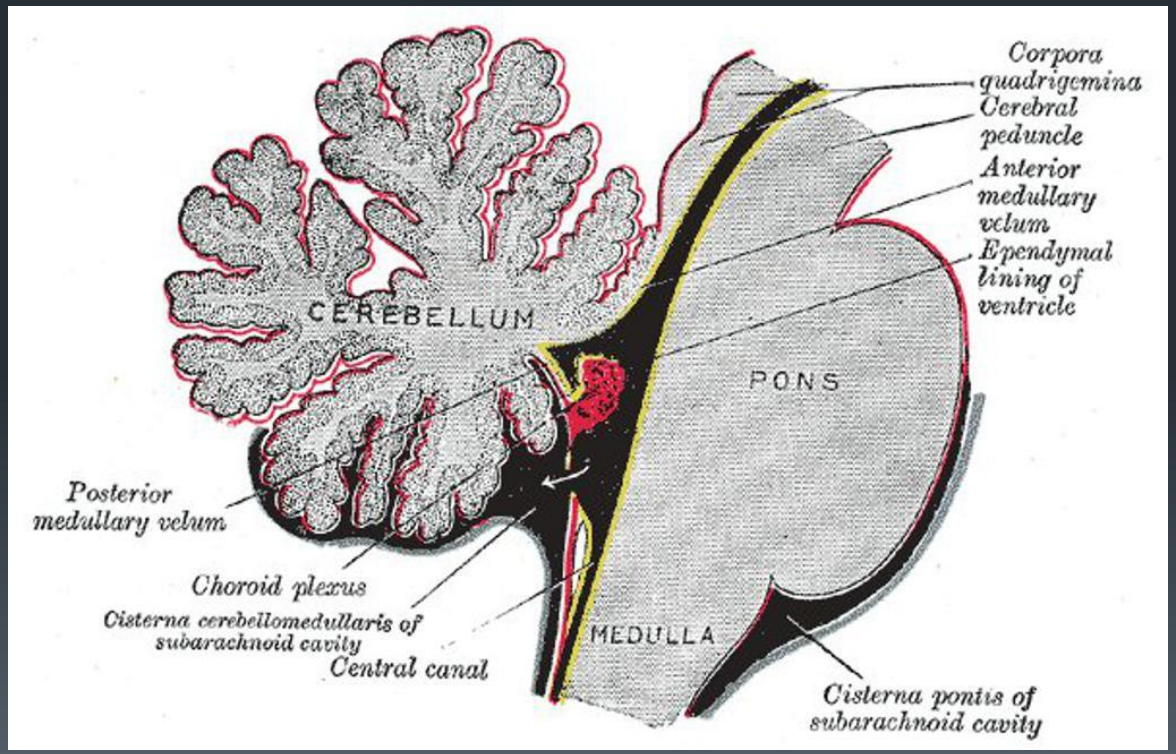
Anatomy
Ventricles



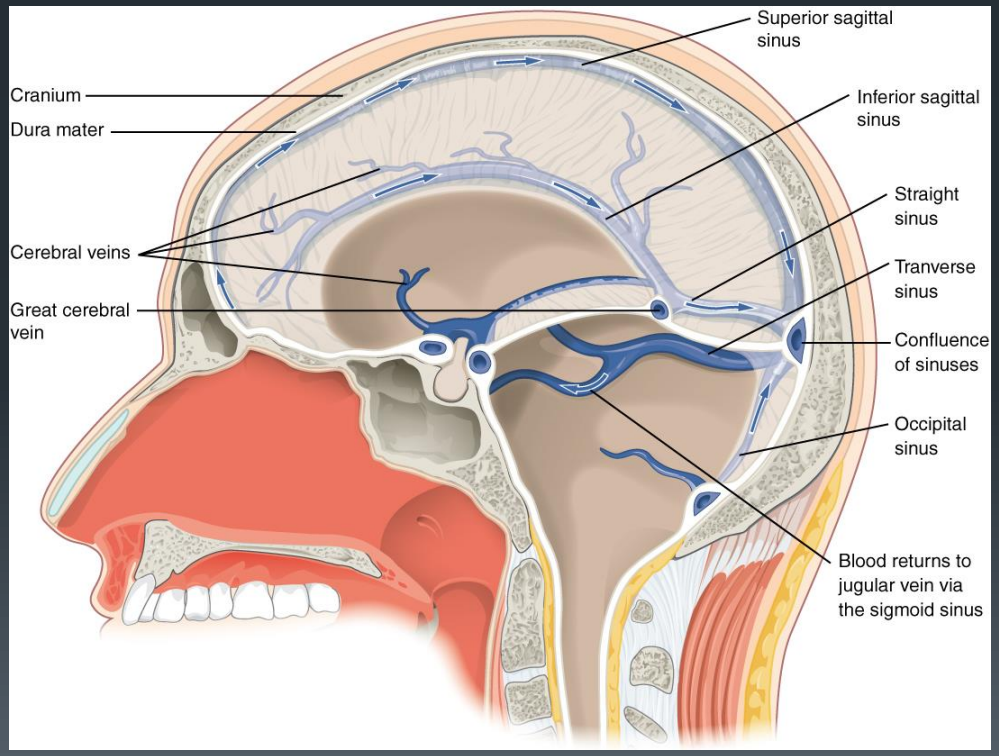
Anatomy
Ventricles



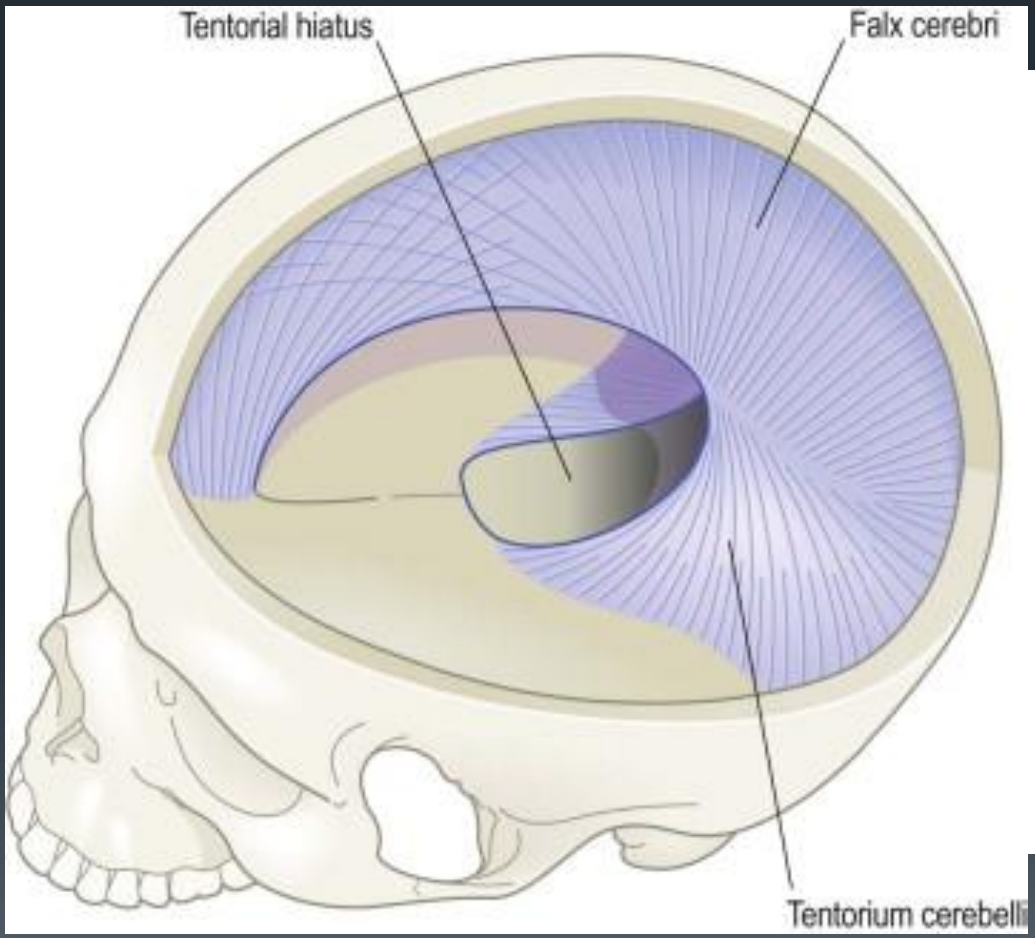
Anatomy
Ventricles

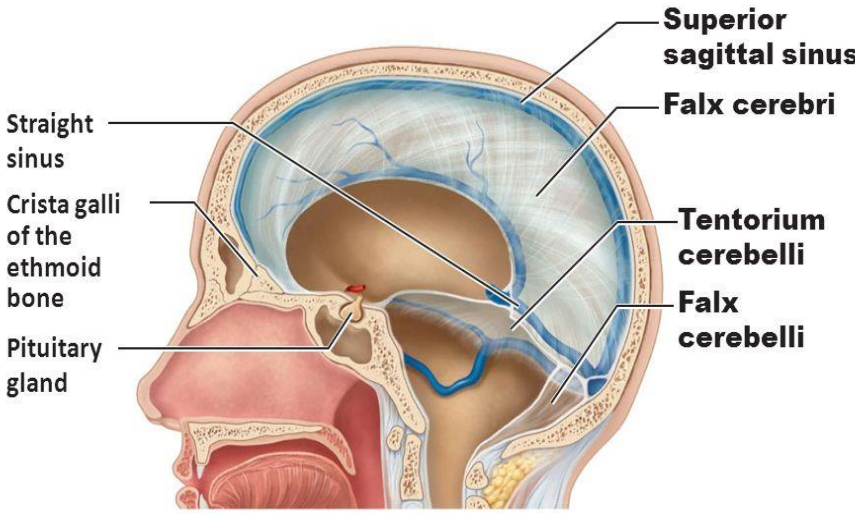


Anatomy
Veins And Venous Sinuses



Anatomy
Falx and Tentorium





Anatomy
Cisterns

- CircumMesencephalic Cistern

  around midbrain, effaced first with ICP raising and herniation Syndromes

- Suprasellar Cistern

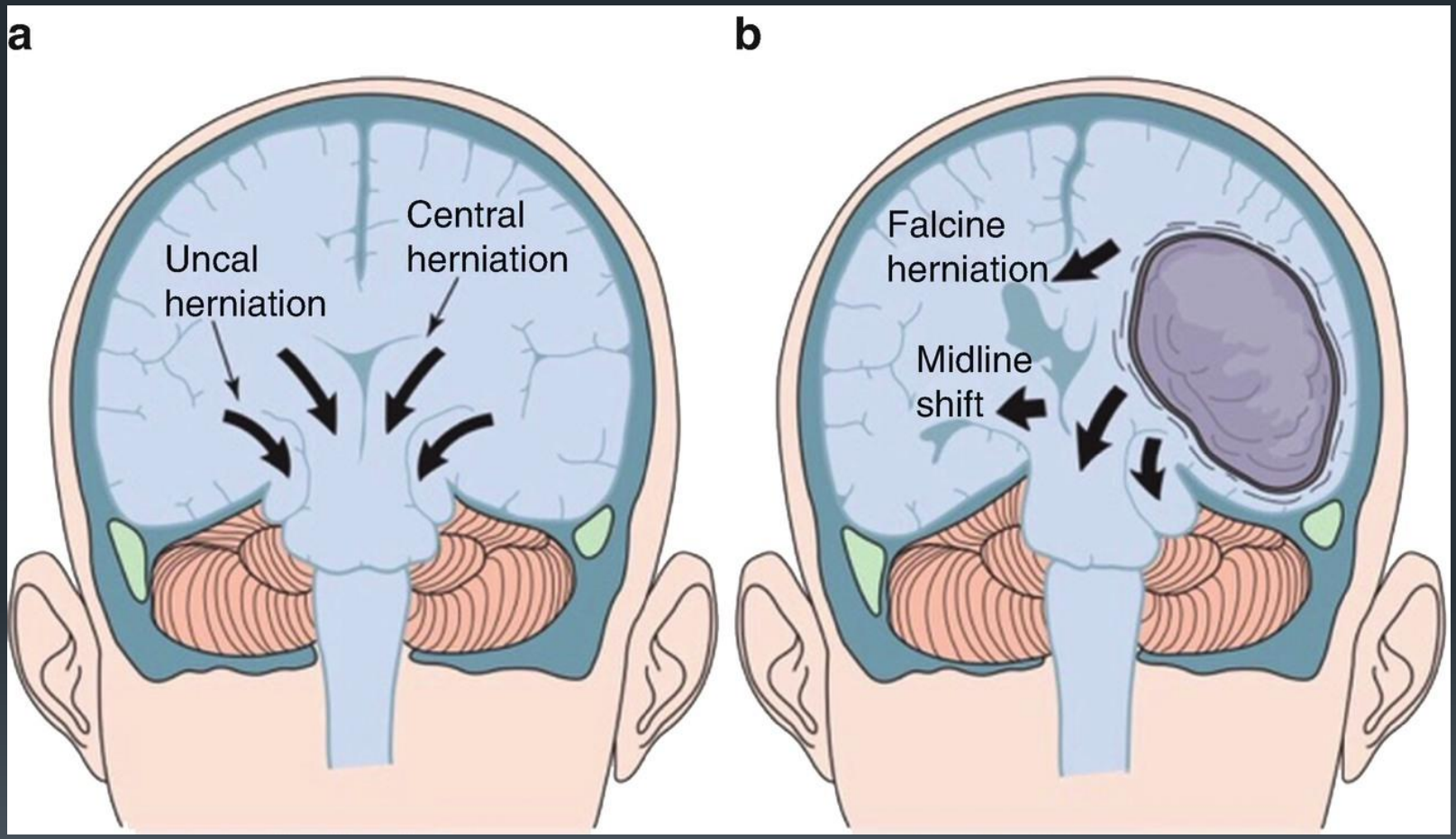
  Star-shape above sella, contains circle of willis

- Quadrigeminal Cistern

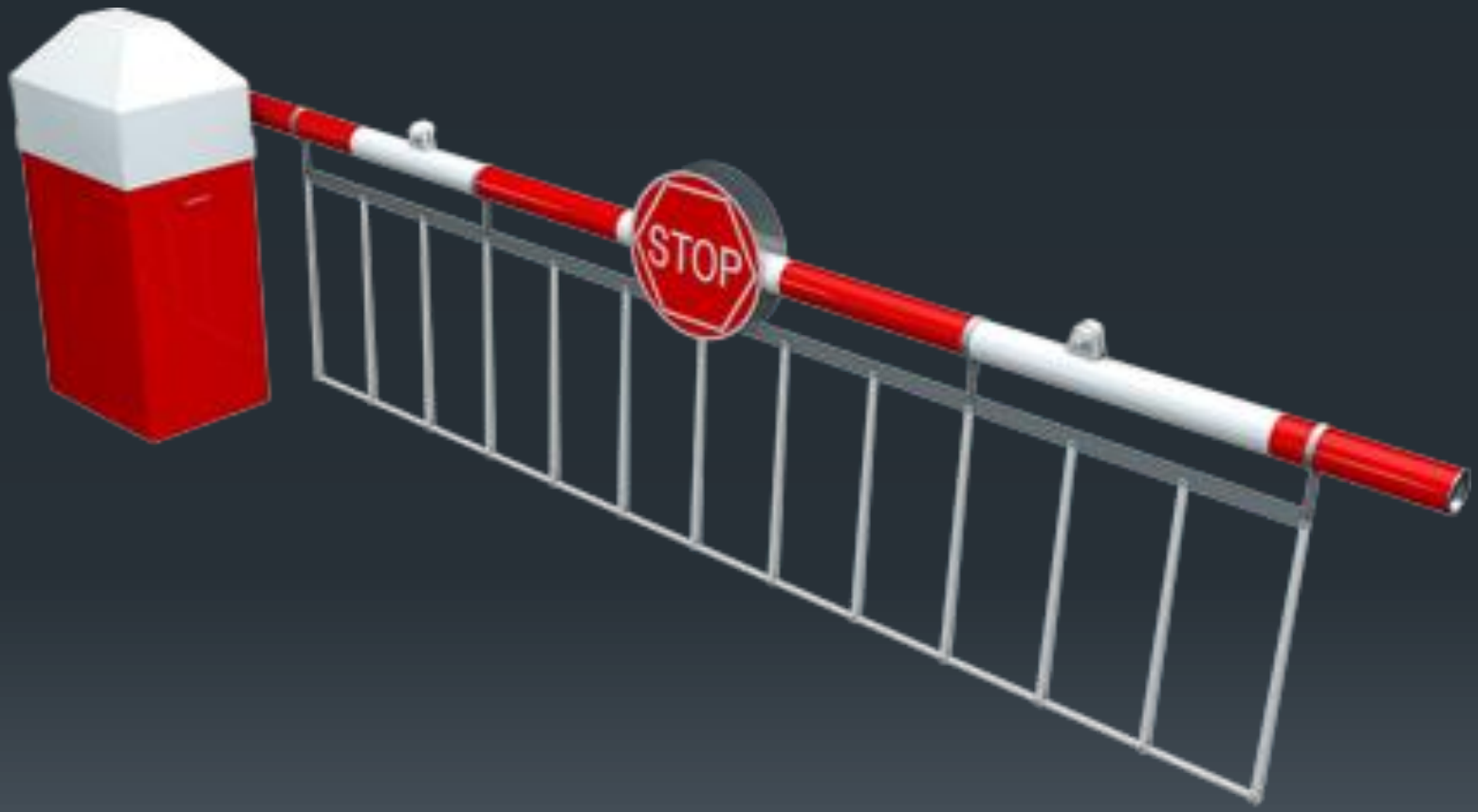
  W- shape at top of midbrain, effaced with Central herniation

- Sylvian Cistern

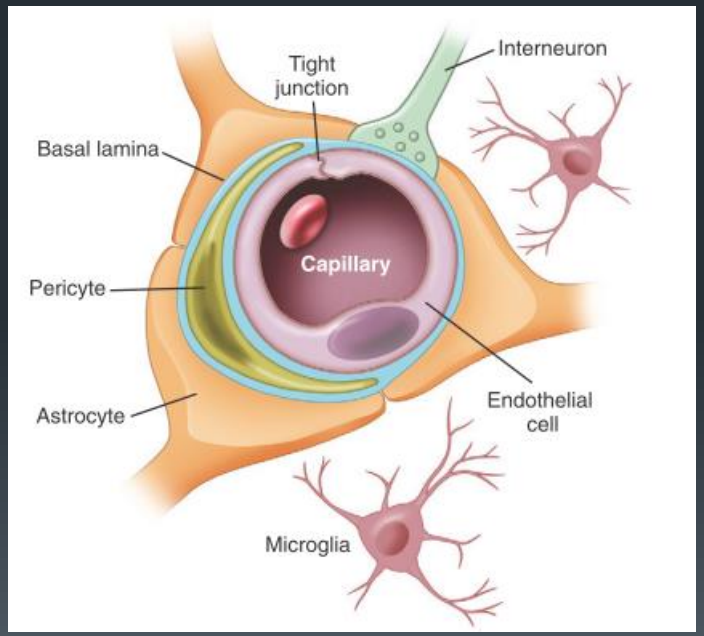
  Between Frontal and Temporal Lobes


a
Uncal herniation
Central herniation
b
Falcine herniation
Midline shift

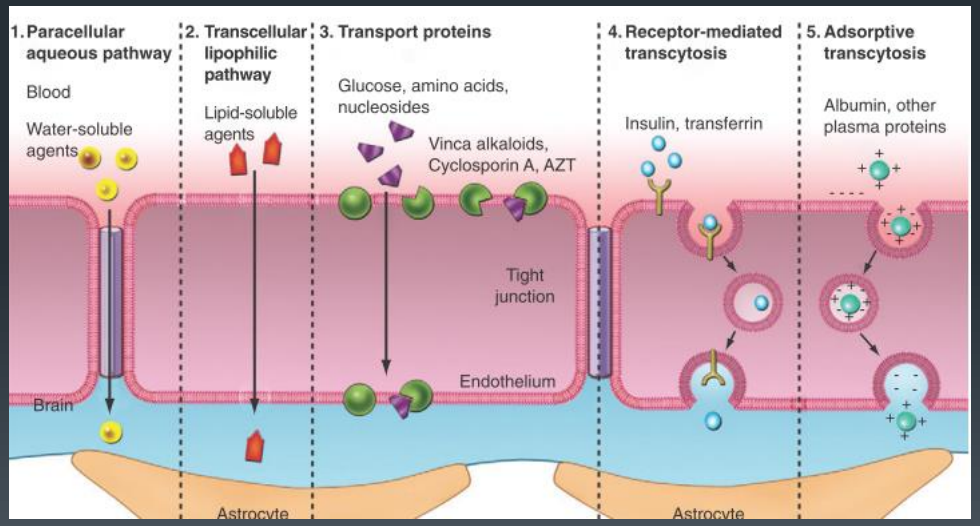
Anatomy
Blood Brain Barrier



Anatomy
Blood Brain Barrier



Anatomy
Blood Brain Barrier



Anatomy
Blood Brain Barrier

Anatomy
Blood Brain Barrier

- Types Of Edema

- Vasogenic
- Cytotoxic

- **Now……**

Brain CT Scan Reading

Brain CT Scan Reading

- Normal CT

- Center to Out
- Problem Oriented

- **Pneumonic "Blood Can Be Very Bad"**

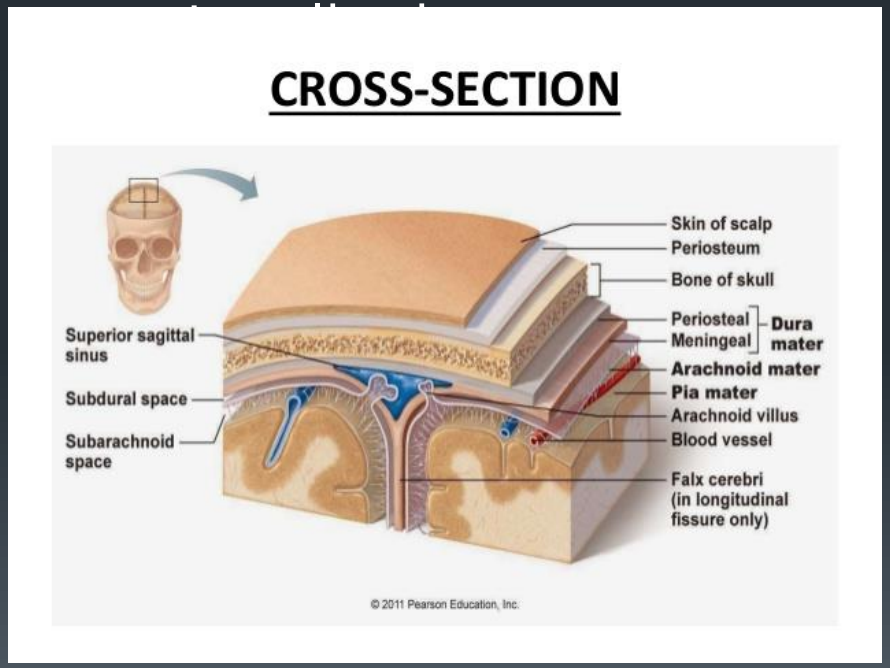
"Blood, Cistern , Brain , Ventricle , Bone"

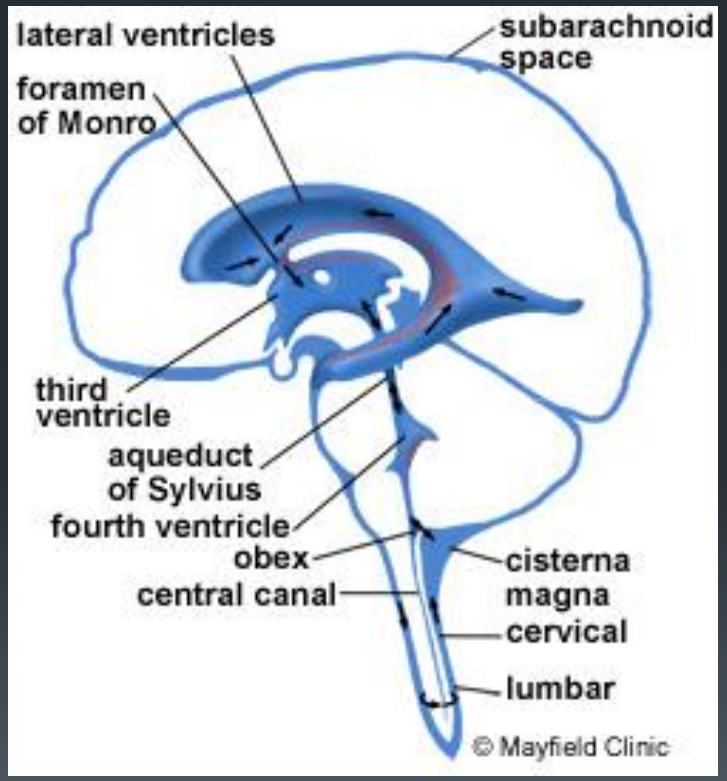
(.....)

- 25cc
- 5mm MLS
- Cushing triad
- Head elevation

Blood

Brain CT Scan Reading Blood

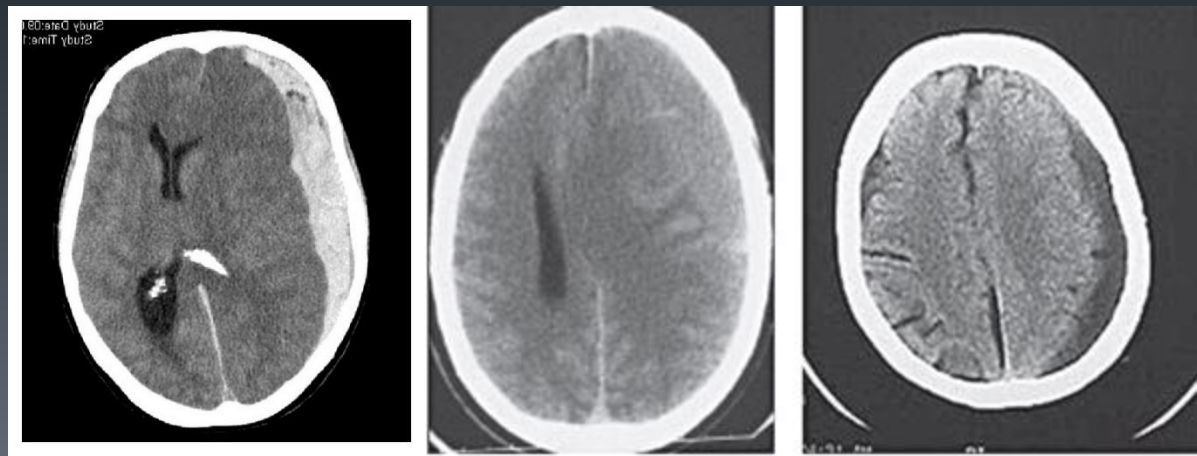




Brain CT Scan Reading Blood

- Attenuation Coefficient

- Acute : 70 **HU (Globin and Hem)**……..1w
- Sub Acute : 30-45 **HU** ……..1-2 wk
- Chronic : <30 **HU**……..2-3 wk

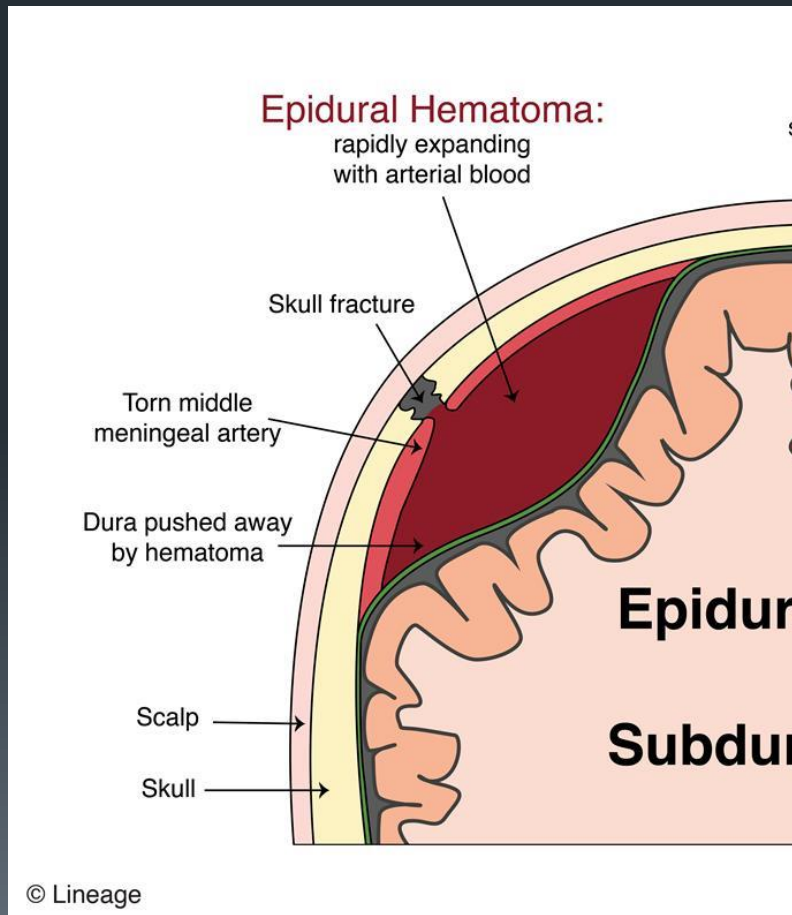


Brain CT Scan Reading Blood

- Epidural Hematoma
- 15mm,30cc

Brain CT Scan Reading Blood

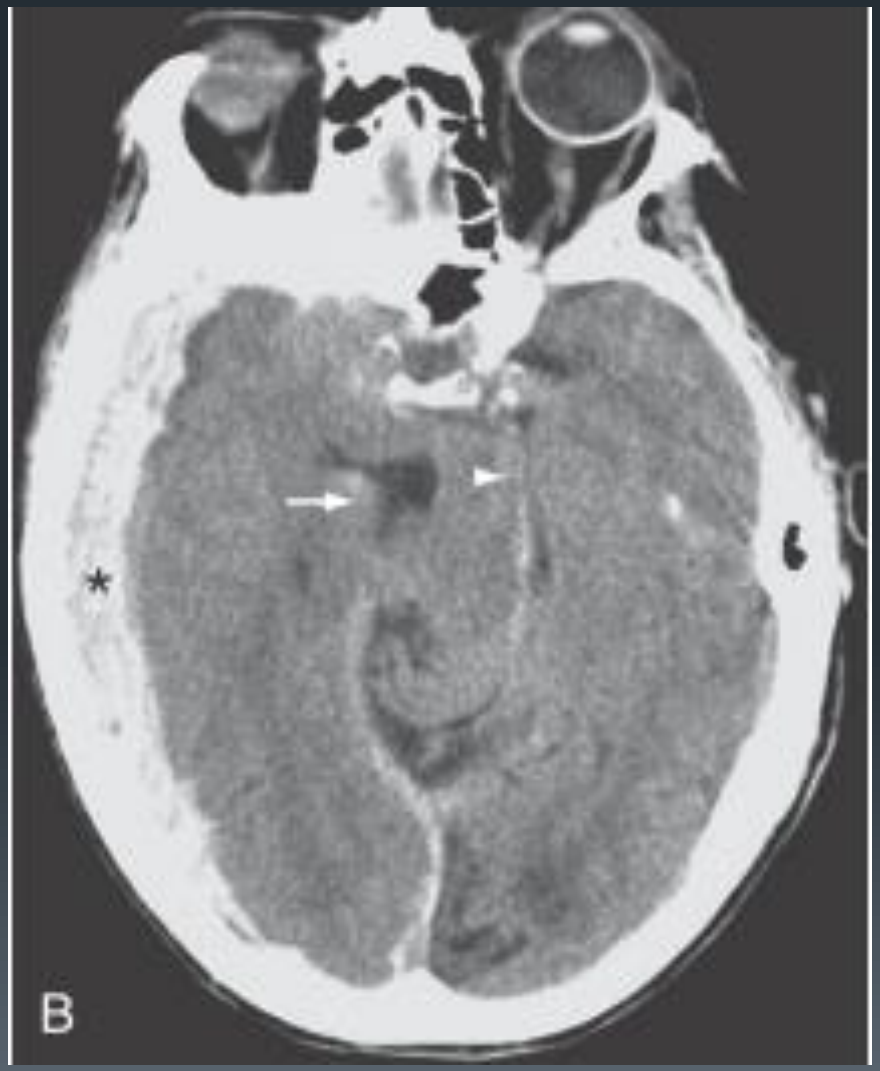
- Epidural Hematoma

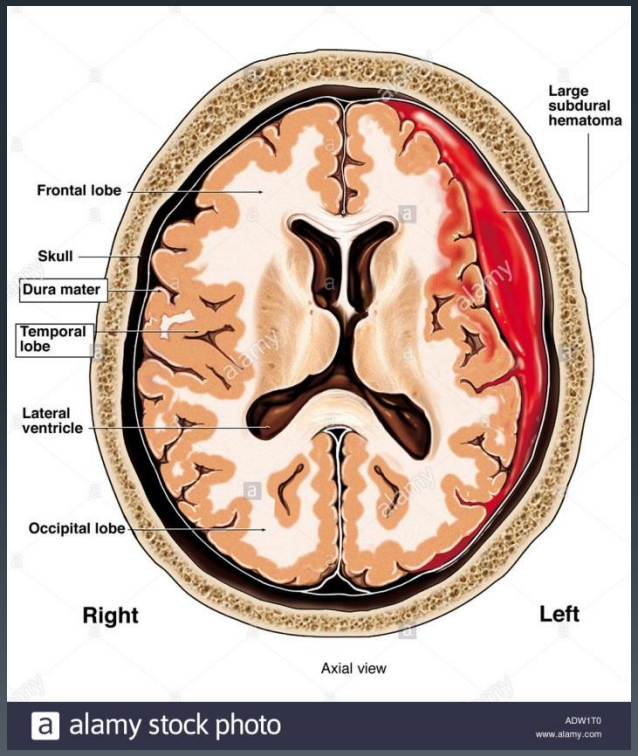


Brain CT Scan **Reading…** Blood

- Subdural Hematoma

- 10mm,5mm MLS



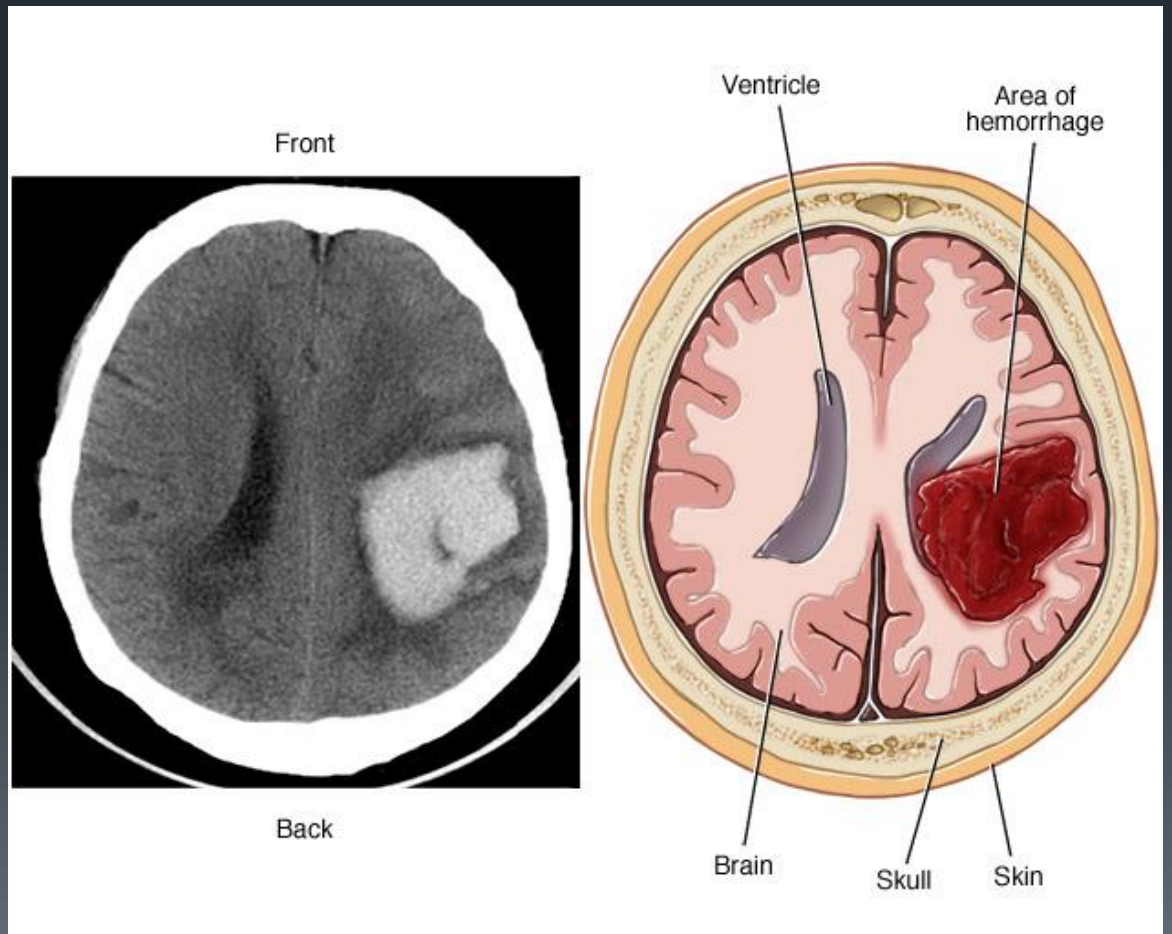

Large subdural hematoma
Frontal lobe
Skull
Dura mater
Temporal lobe
Lateral ventricle
Occipital lobe
Right
Left
Axial view
alamy stock photo
ADW1T0
www.alamy.com

Brain CT Scan **Reading…** Blood

- Intracerebral hematoma(or Intraparenchimal hematoma)

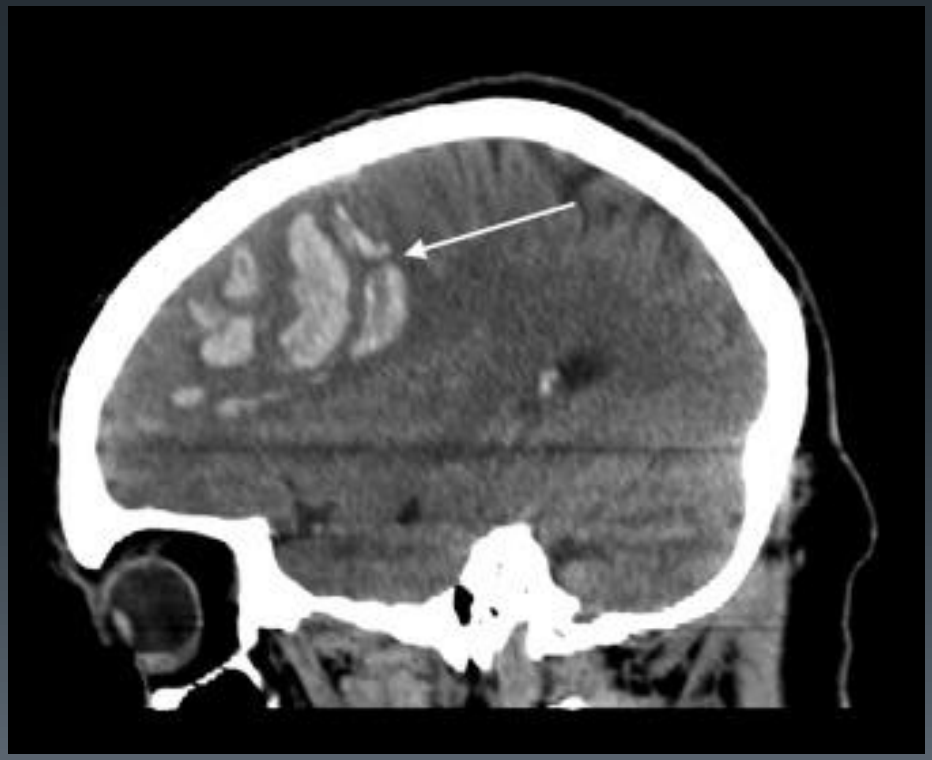
- Trauma
- Amyloid Angiopathy
- Avm
- Aneurysm
- Tumor

- 25cc-50cc



Brain CT Scan **Reading…** Blood

- Intracerebral hematoma(or Intraparenchimal hematoma), Due to Cerebral Venous Thrombosis



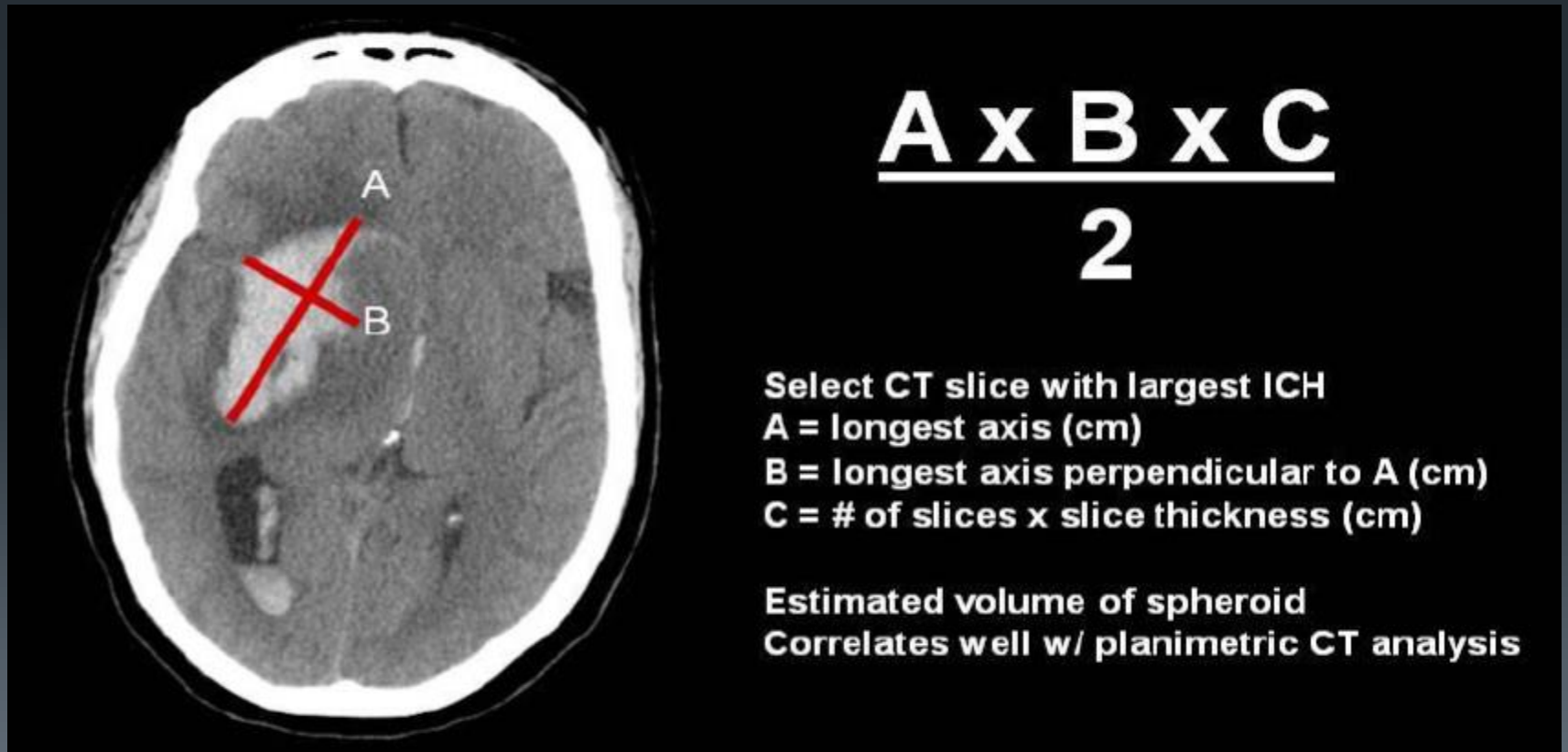
Brain CT Scan **Reading…** Blood

Intracerebral hematoma(or Intraparenchimal hematoma) Due to Hypertention

- Basal ganglion
- thalamus
- Cerebellum
- Brain stem

Brain CT Scan **Reading…** Blood

- Intracerebral hematoma(or Intraparenchimal hematoma),(globe~25mm)

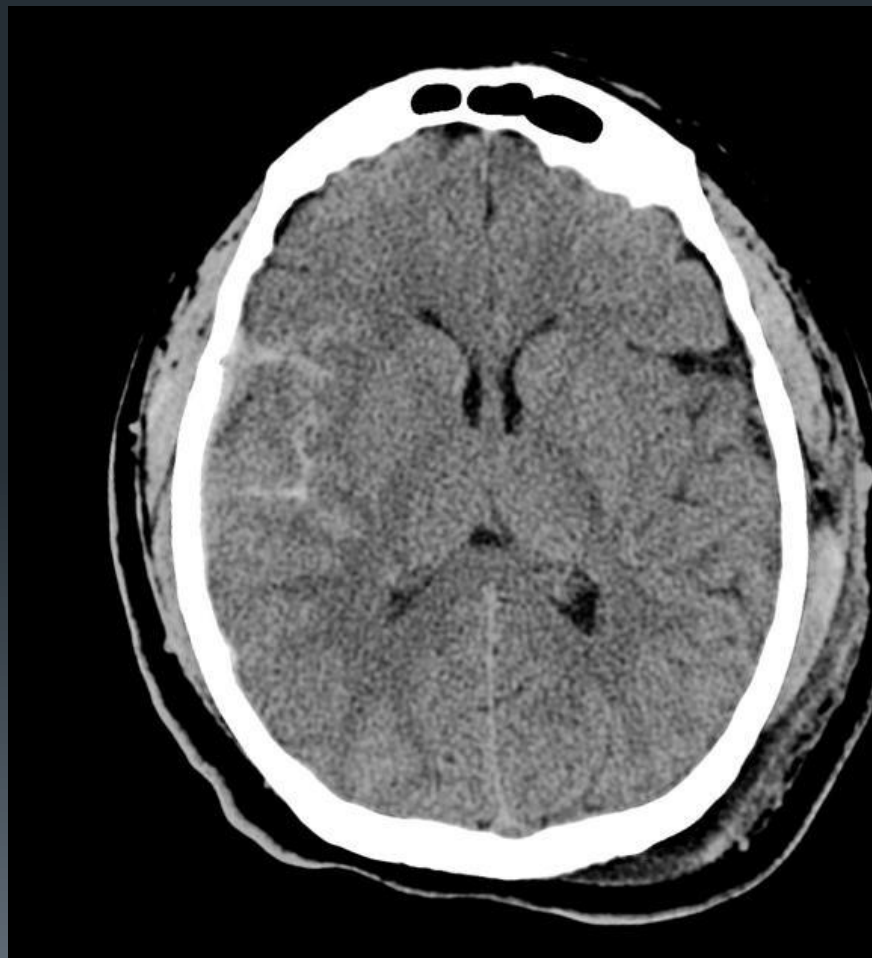


Brain CT Scan Reading…
Blood

- Contusion

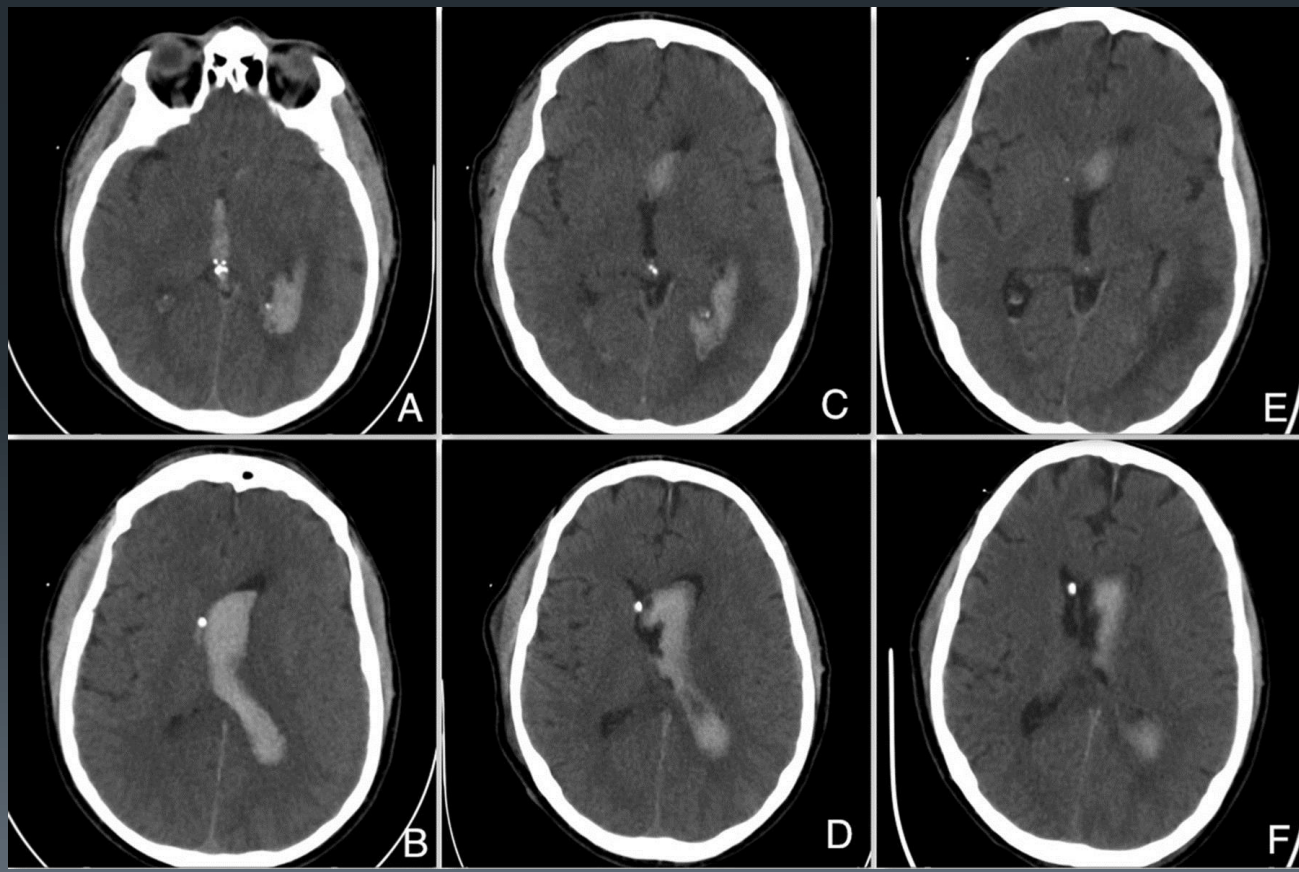
Brain CT Scan **Reading…** Blood

- Sab Arachnoid Hematoma



Brain CT Scan **Reading…** Blood

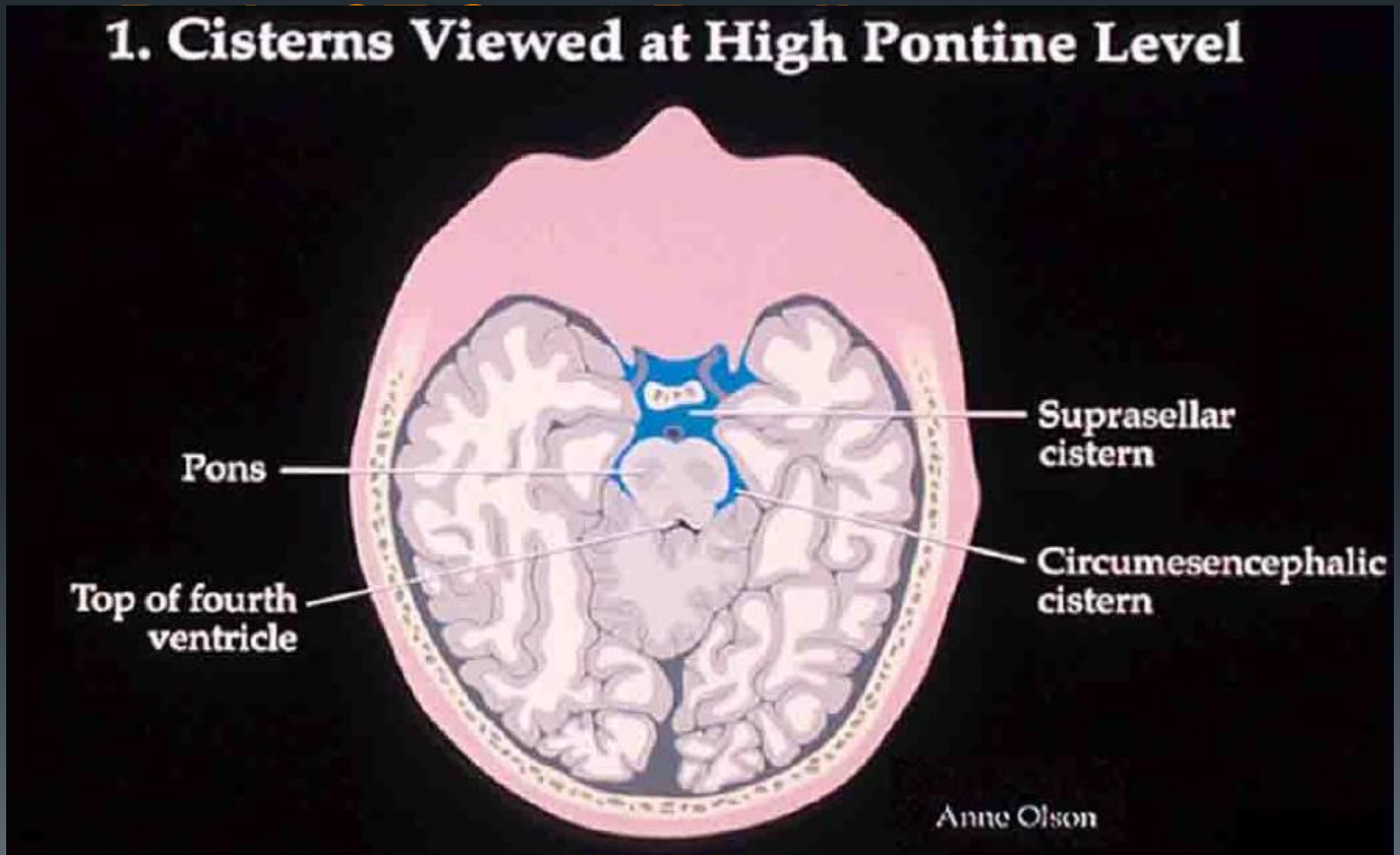
- Intraventricular Hematoma

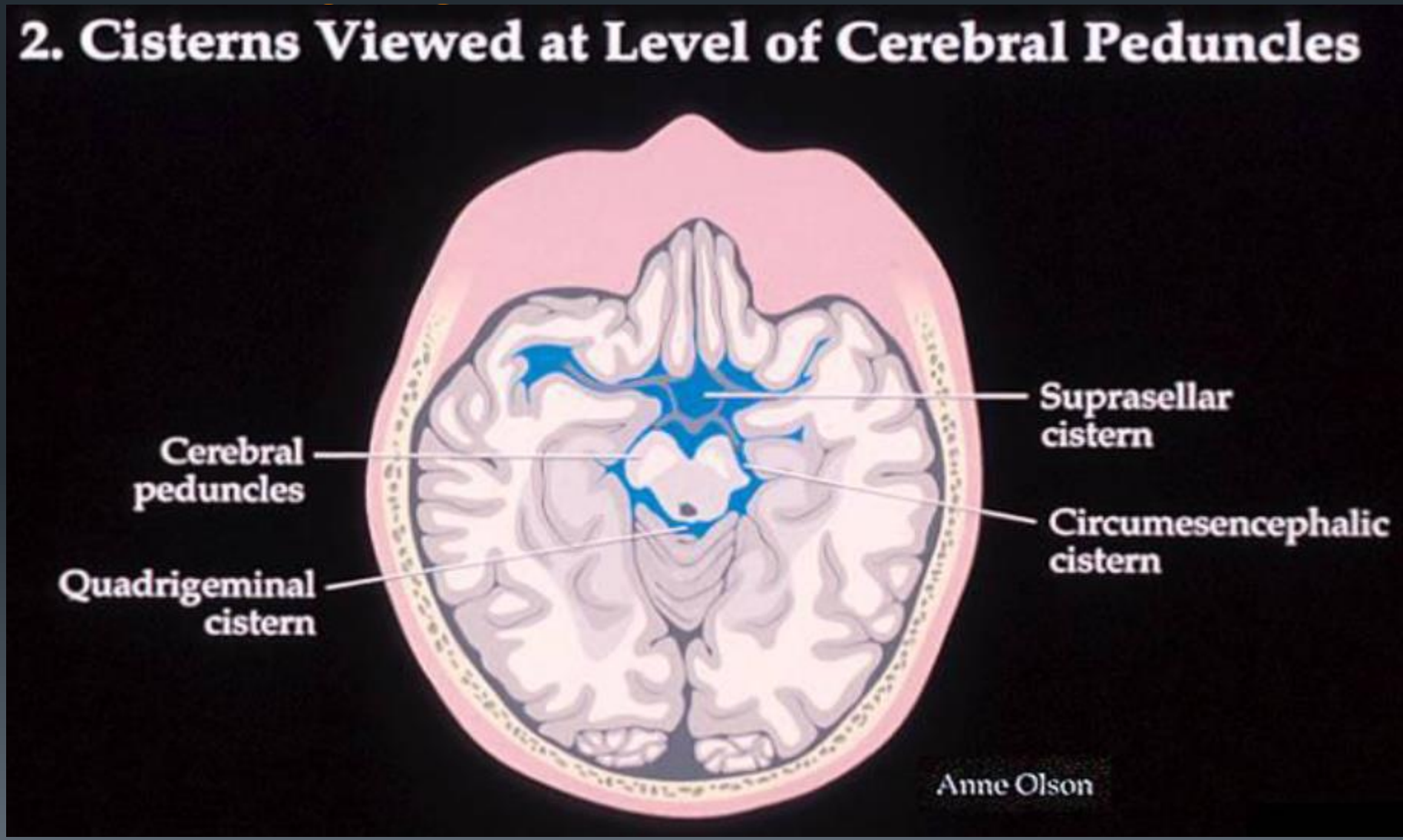


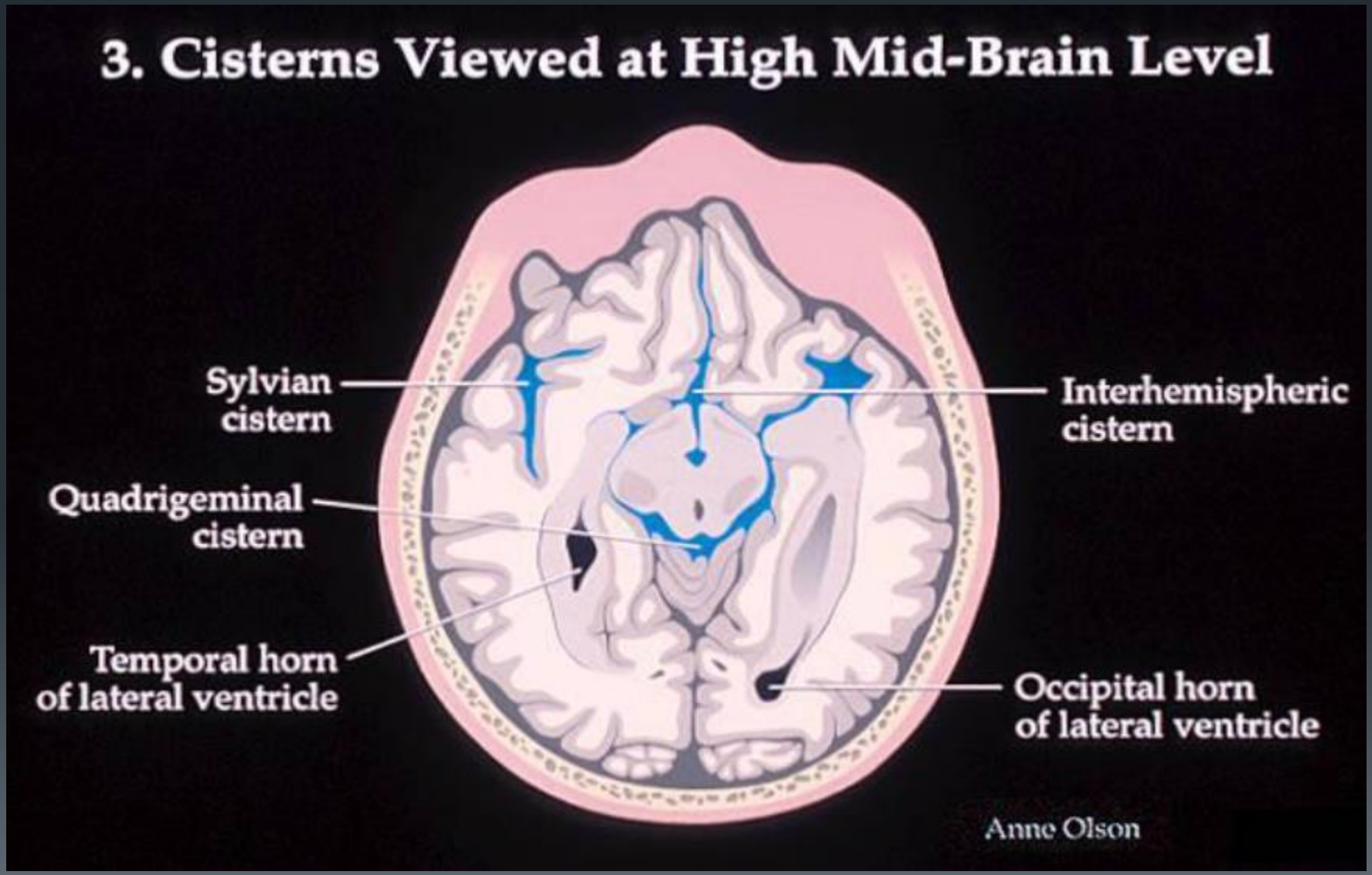
Cistern

Brain CT Scan Reading…
Cistern

- Importance(Effacement, Hematoma)


1. Cisterns Viewed at High Pontine Level
Pons
Top of fourth ventricle
Suprasellar cistern
Circumesencephalic cistern
Anne Olson


2. Cisterns Viewed at Level of Cerebral Peduncles
Cerebral peduncles
Quadrigeminal cistern
Suprasellar cistern
Circumesencephalic cistern
Anne Olson

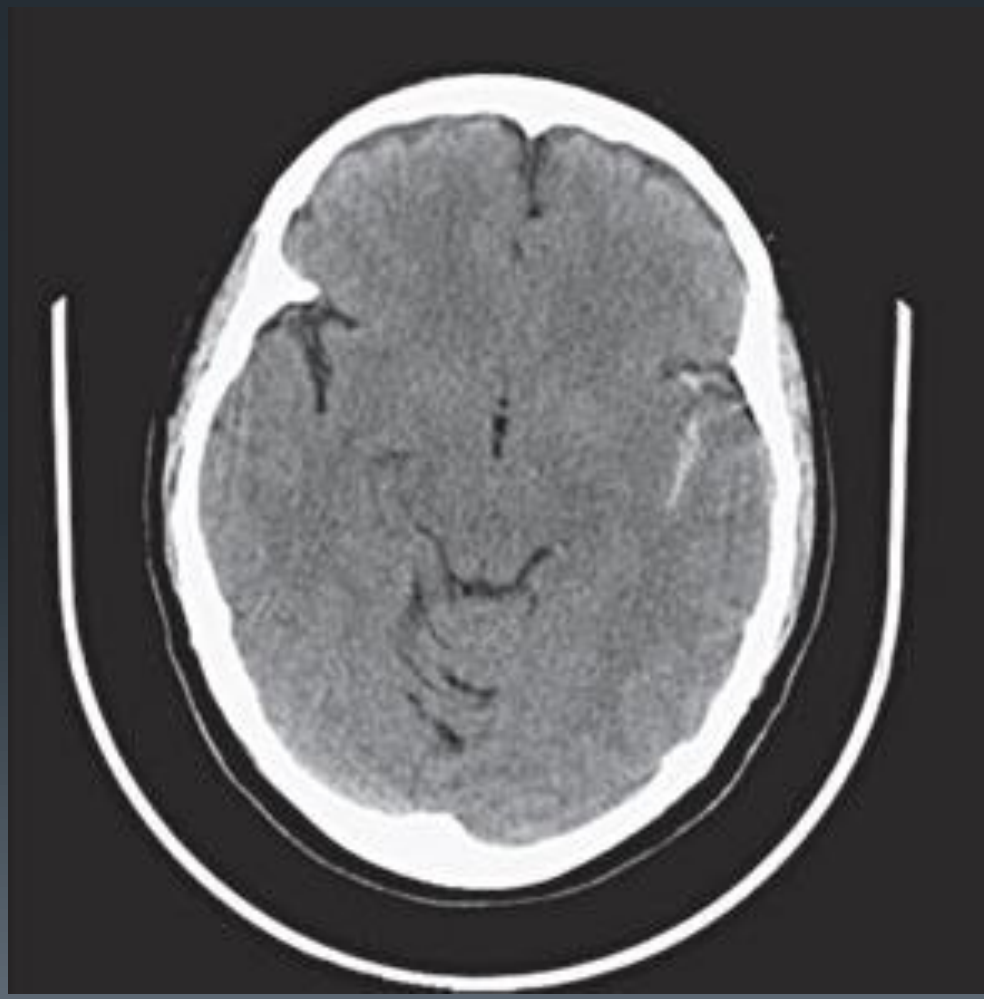

3. Cisterns Viewed at High Mid-Brain Level
Sylvian cistern
Interhemispheric cistern
Quadrigeminal cistern
Temporal horn of lateral ventricle
Occipital horn of lateral ventricle
Anne Olson

Brain CT Scan **Reading…** Cistern

SAH

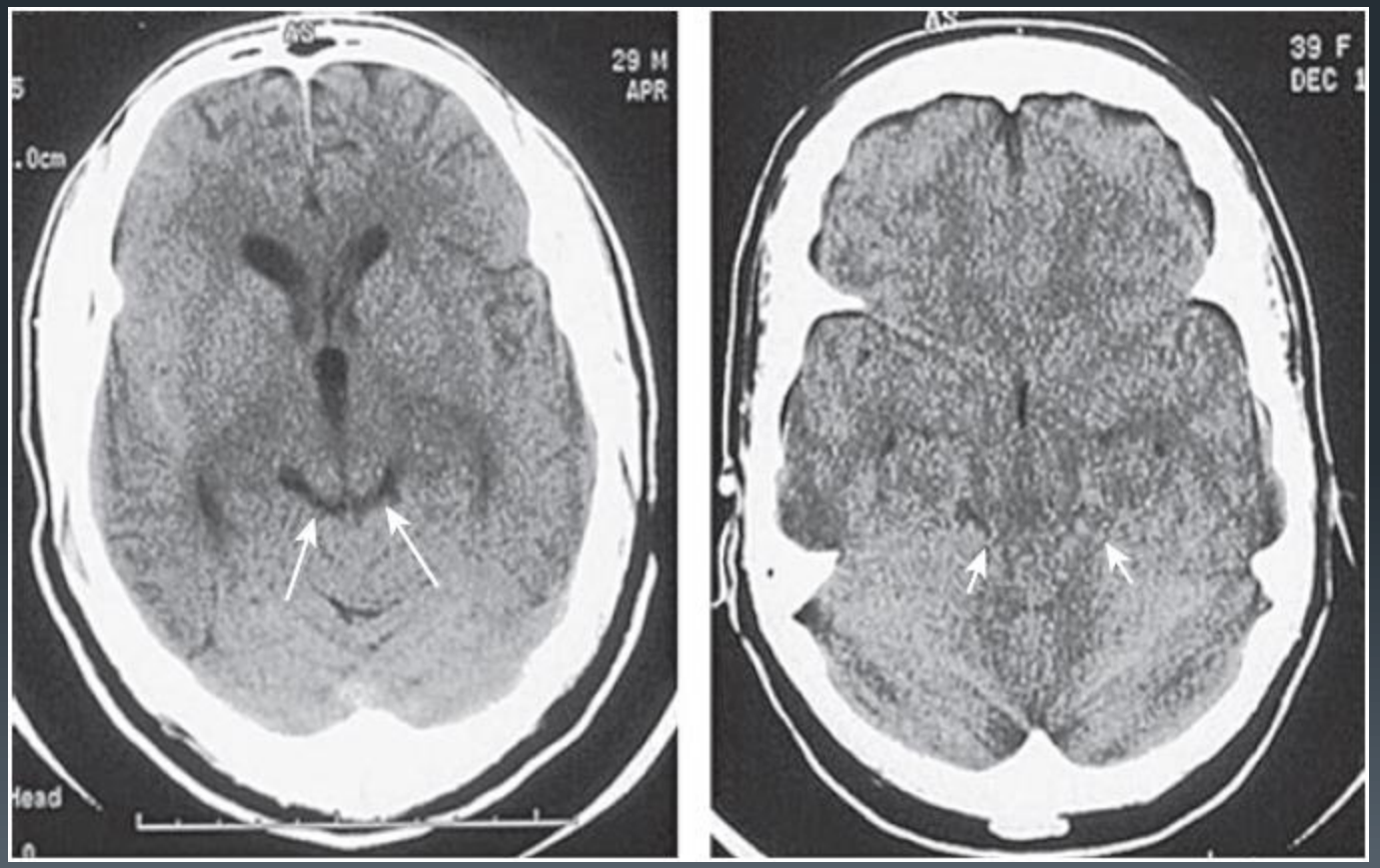
GCS

SAH



Brain CT Scan Reading…
Cistern

- Normal ~ Elevated Intracranial Pressure



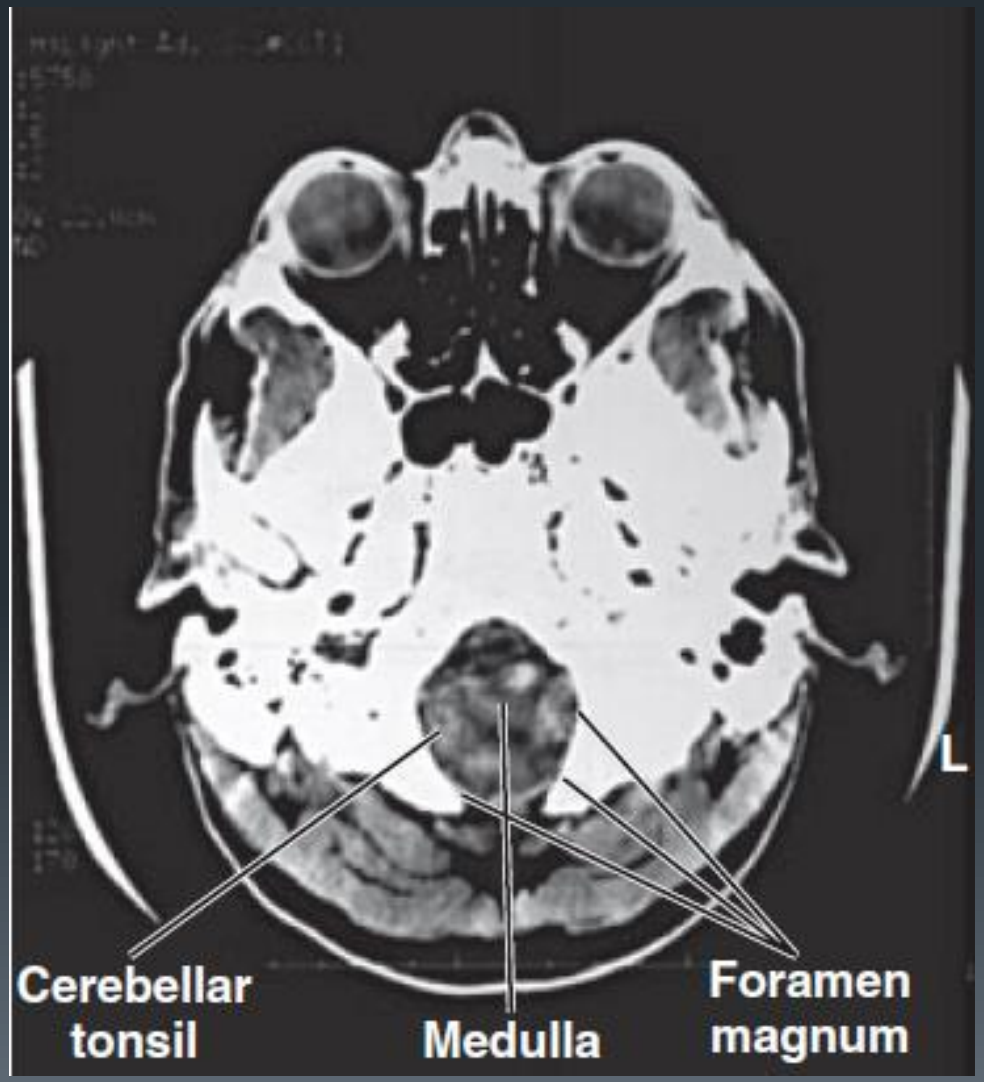
BRAIN

Brain CT Scan Reading…
Brain (Normal)

Gray matter_white matter Differentiation
Symmetry
Sulcuses
Midline Shifting(5mm)

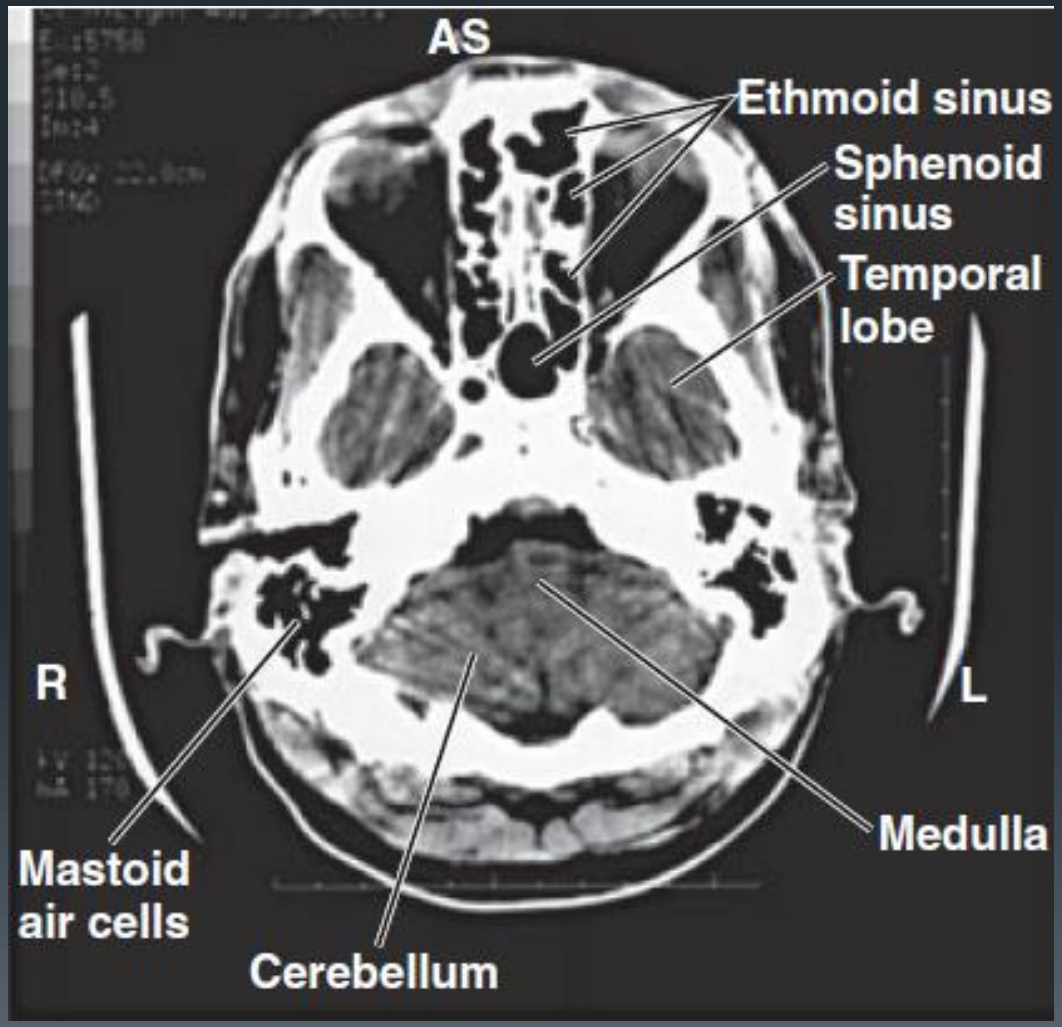
Brain CT Scan Reading…

Brain (Normal)



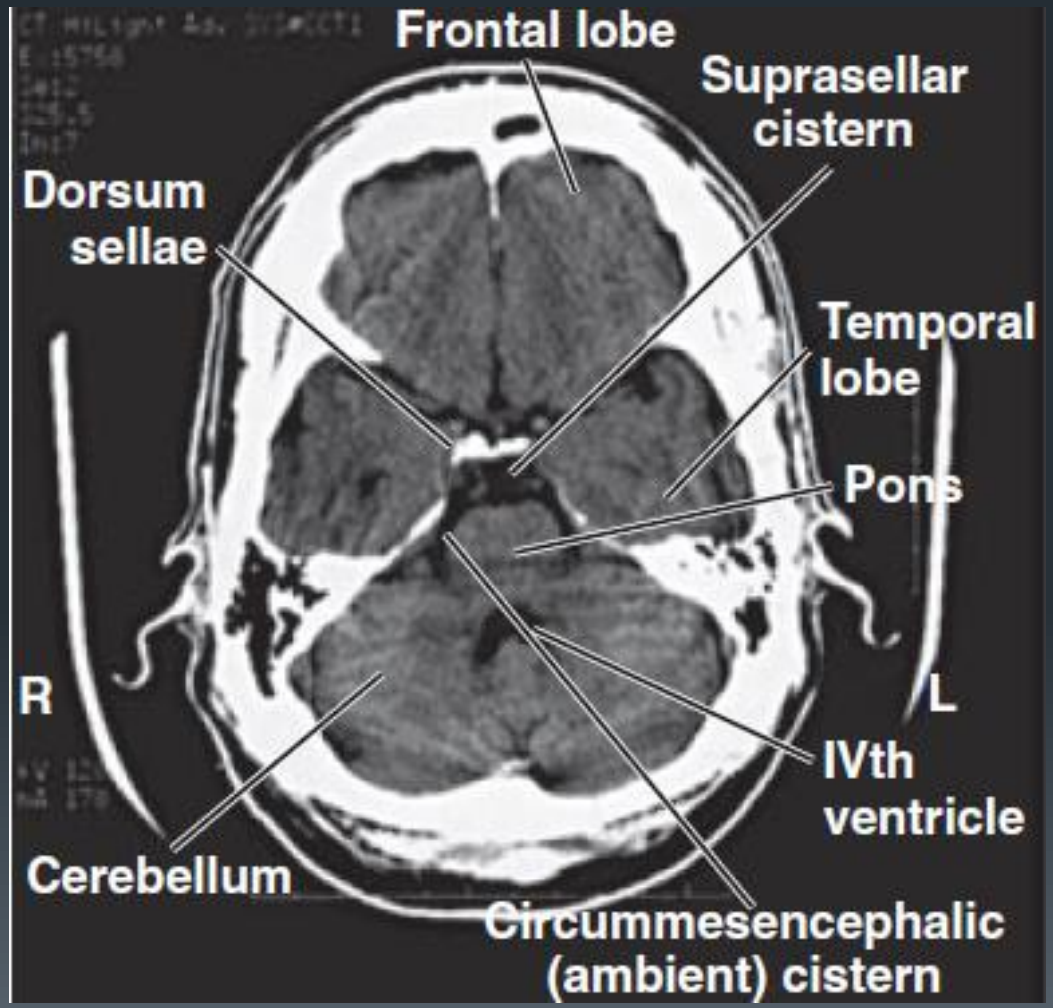
Brain CT Scan Reading…

Brain (Normal)



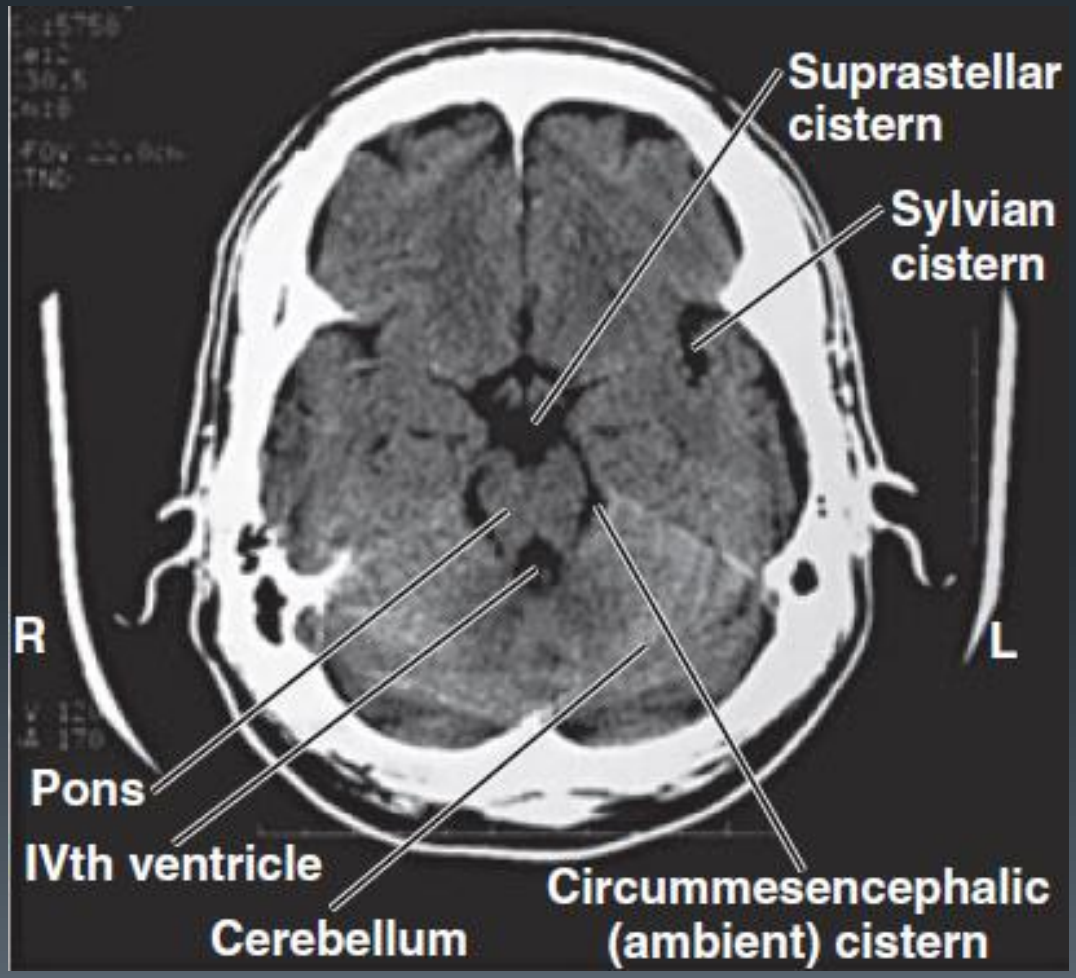
Brain CT Scan Reading…

Brain (Normal)



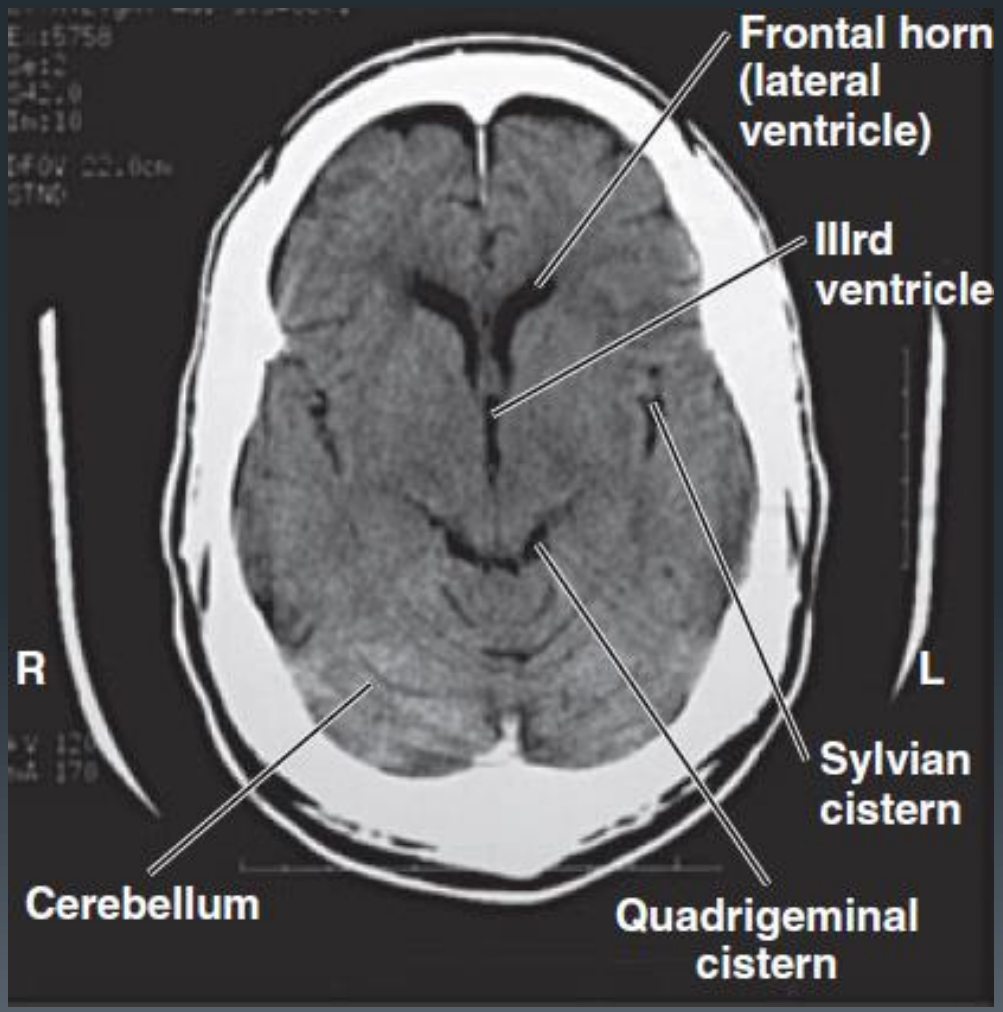
Brain CT Scan Reading…

Brain (Normal)



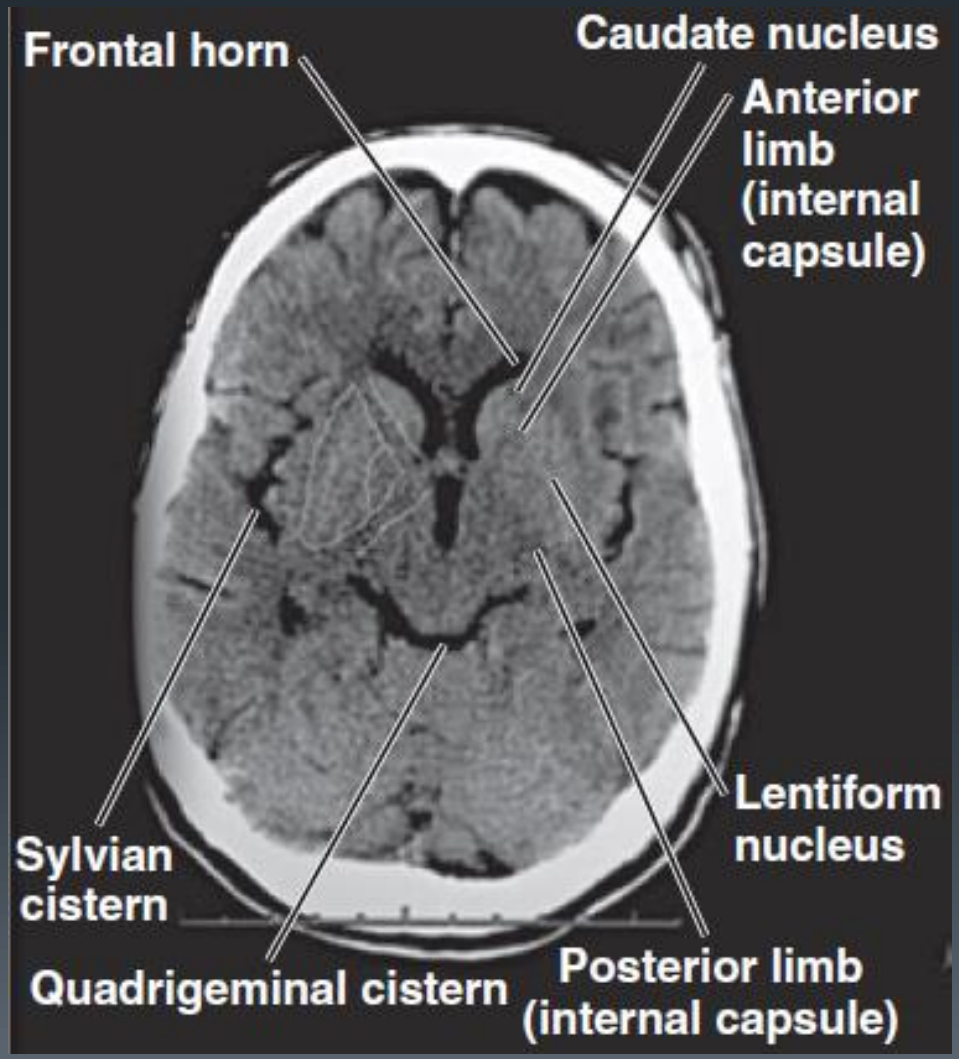
Brain CT Scan Reading…

Brain (Normal)



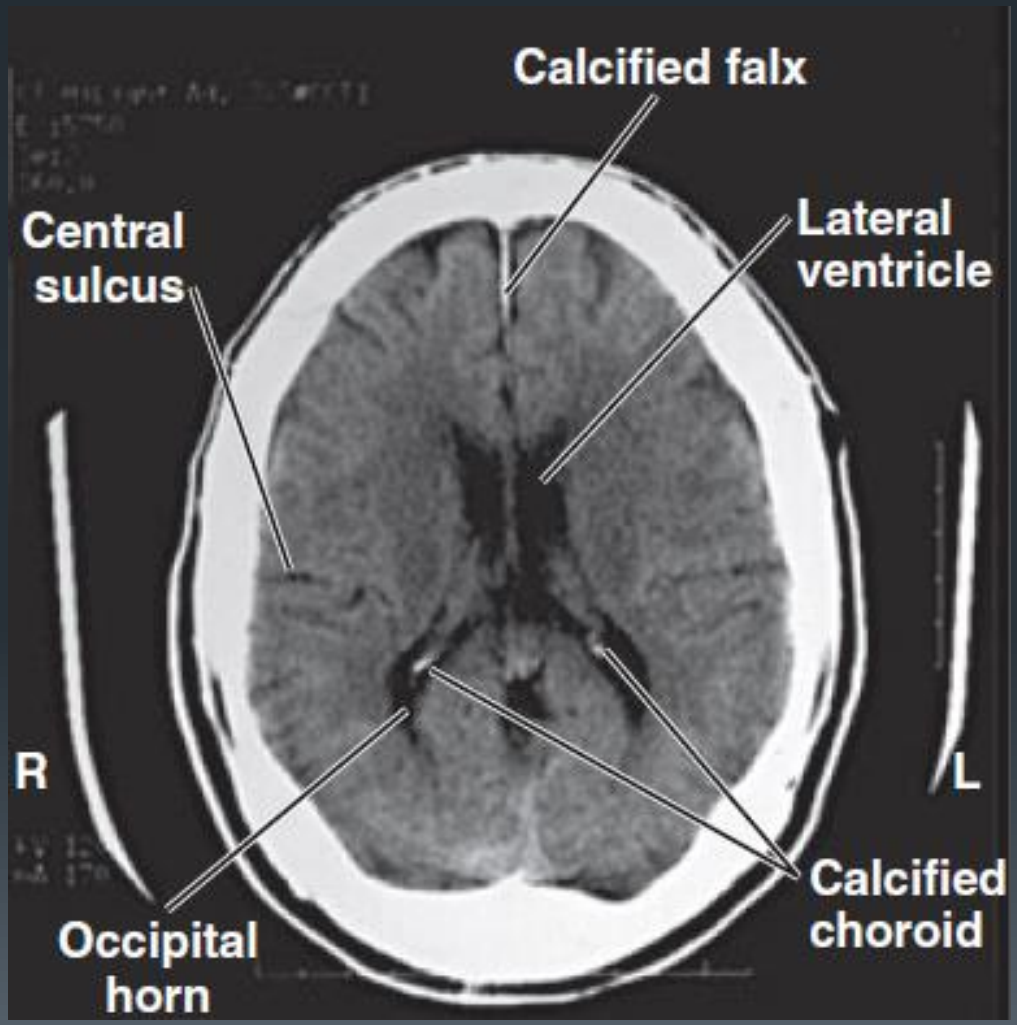
Brain CT Scan Reading…

Brain (Normal)



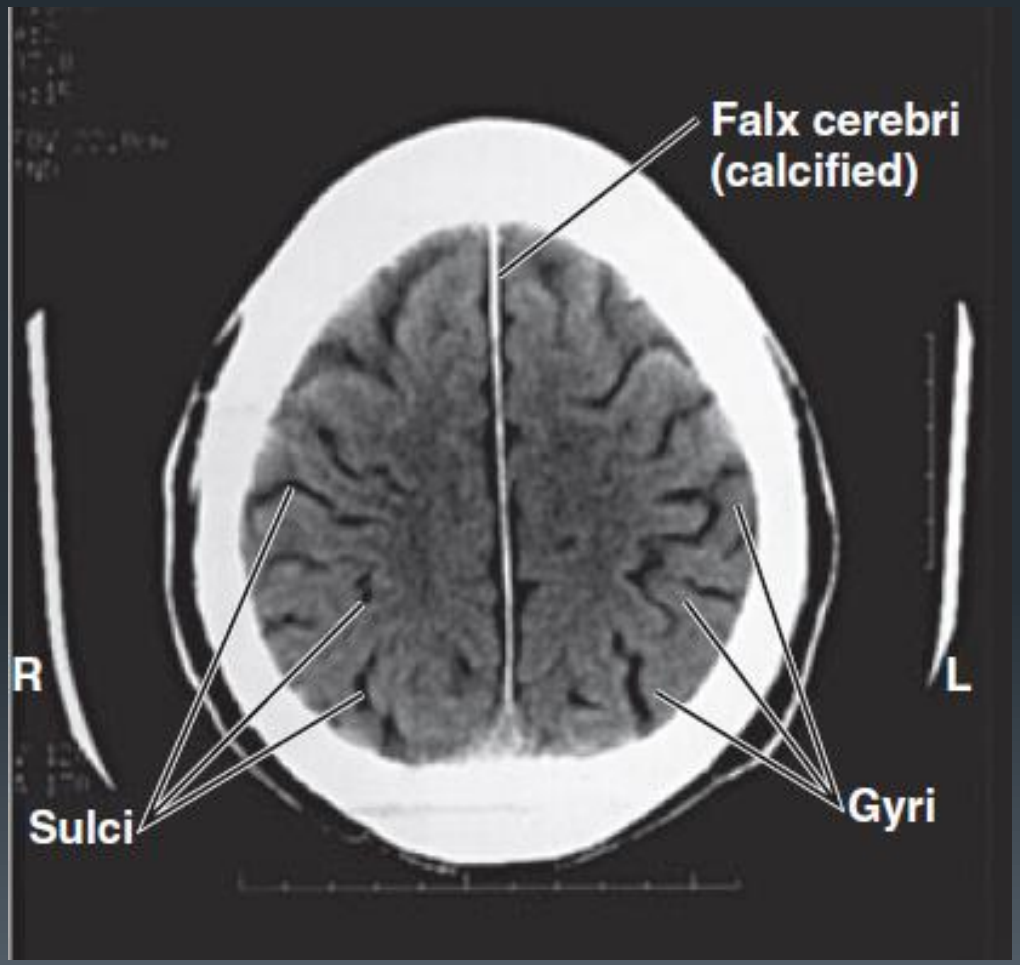
Brain CT Scan Reading…

Brain (Normal)



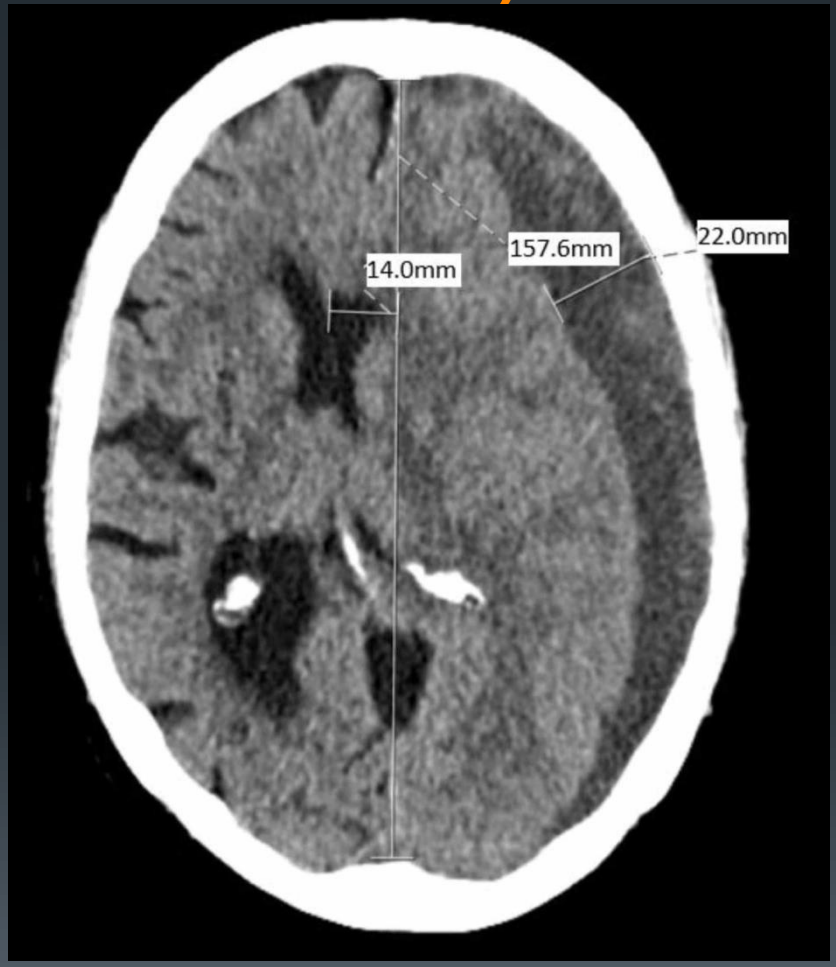
Brain CT Scan Reading…

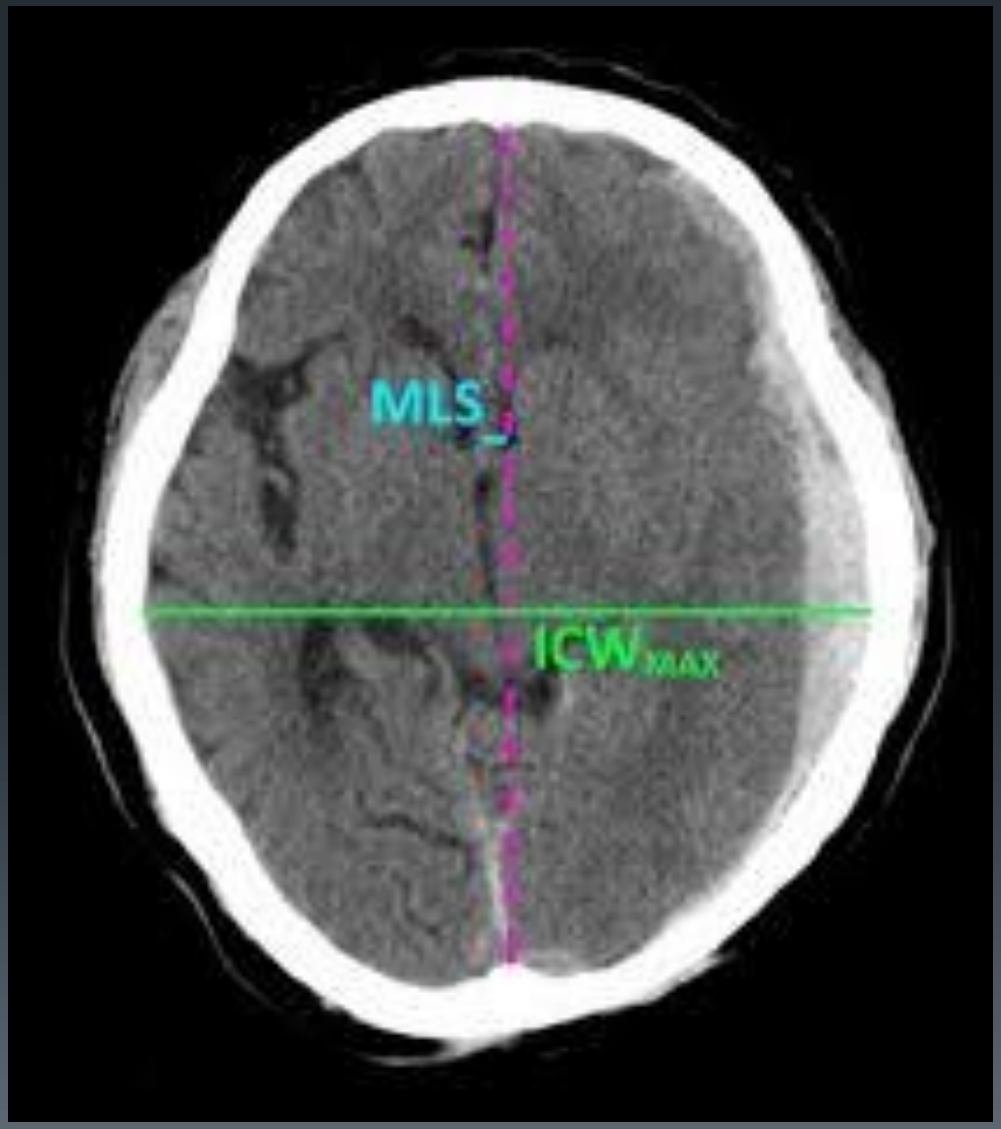
Brain (Normal)



Brain CT Scan Reading…

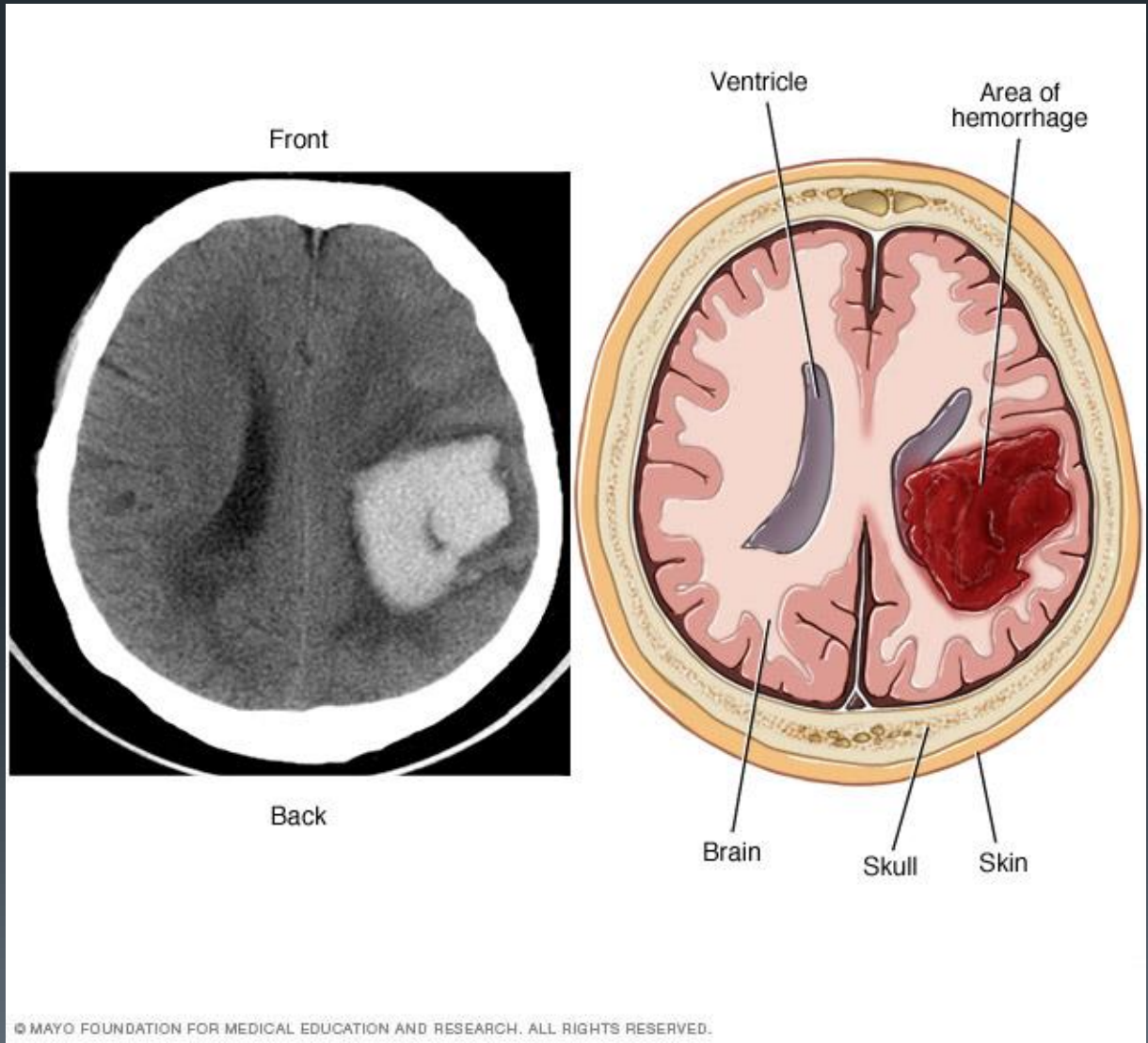
Brain (Midline Shift)




MLS
ICW MAX

Brain CT Scan **Reading…** Brain

- ICH



Brain CT Scan **Reading…** Brain

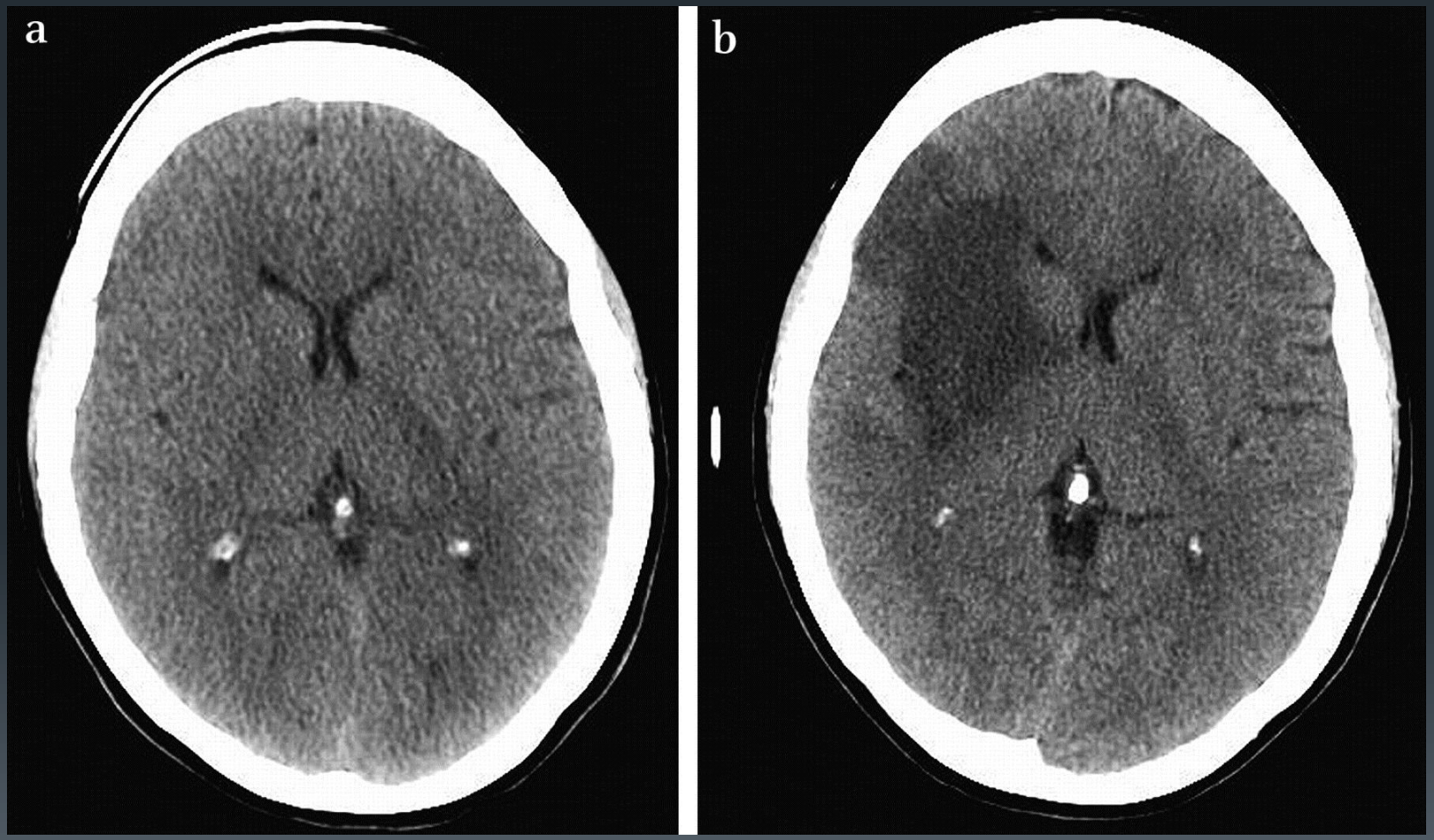
- Vasogenic Edema

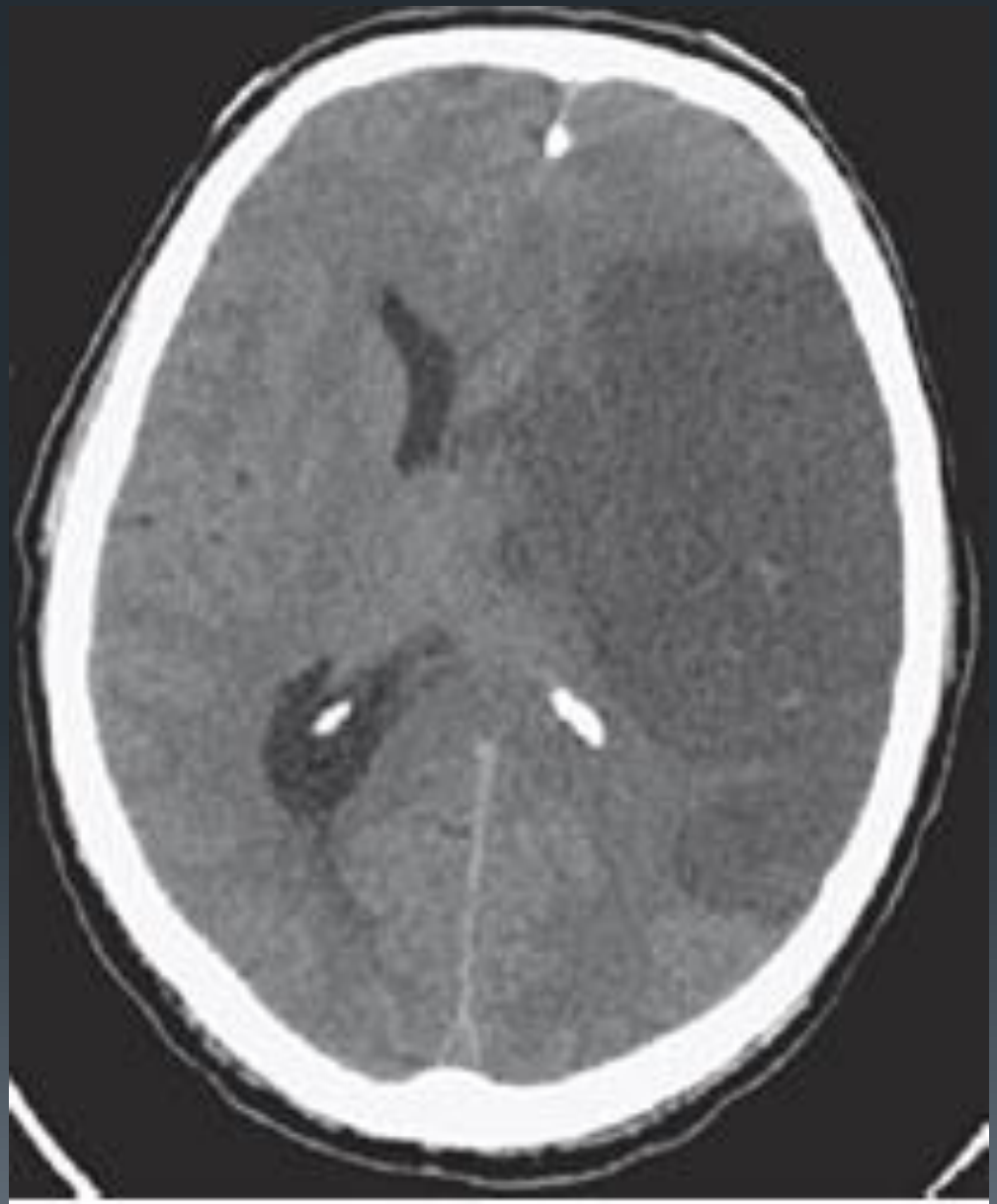
- Vasogenic Edema

Brain CT Scan **Reading…** Brain

- Ischemic Stroke

(with ischemic edema)


a
b



Brain CT Scan **Reading…** Brain

- Tumors

Brain CT Scan **Reading…** Brain

- Tumors

Brain CT Scan **Reading…** Brain

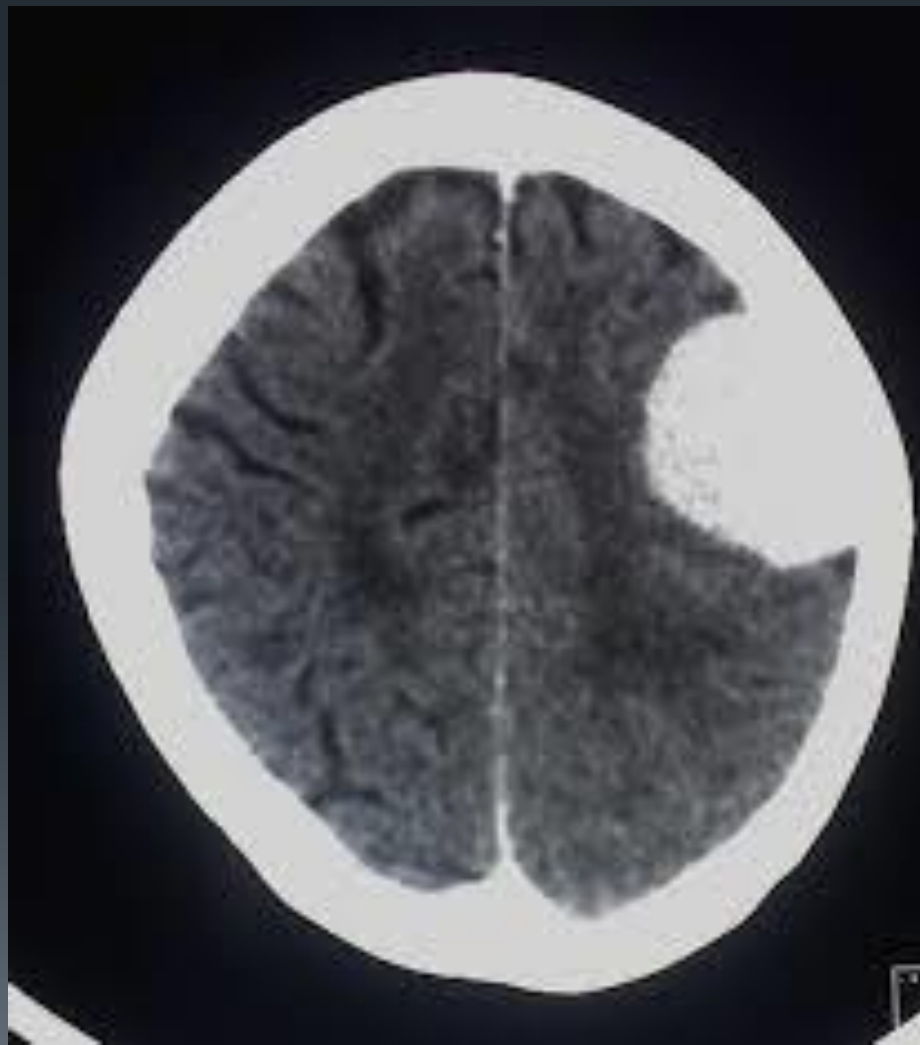
- Tumors

Brain CT Scan **Reading…** Brain

- Tumors

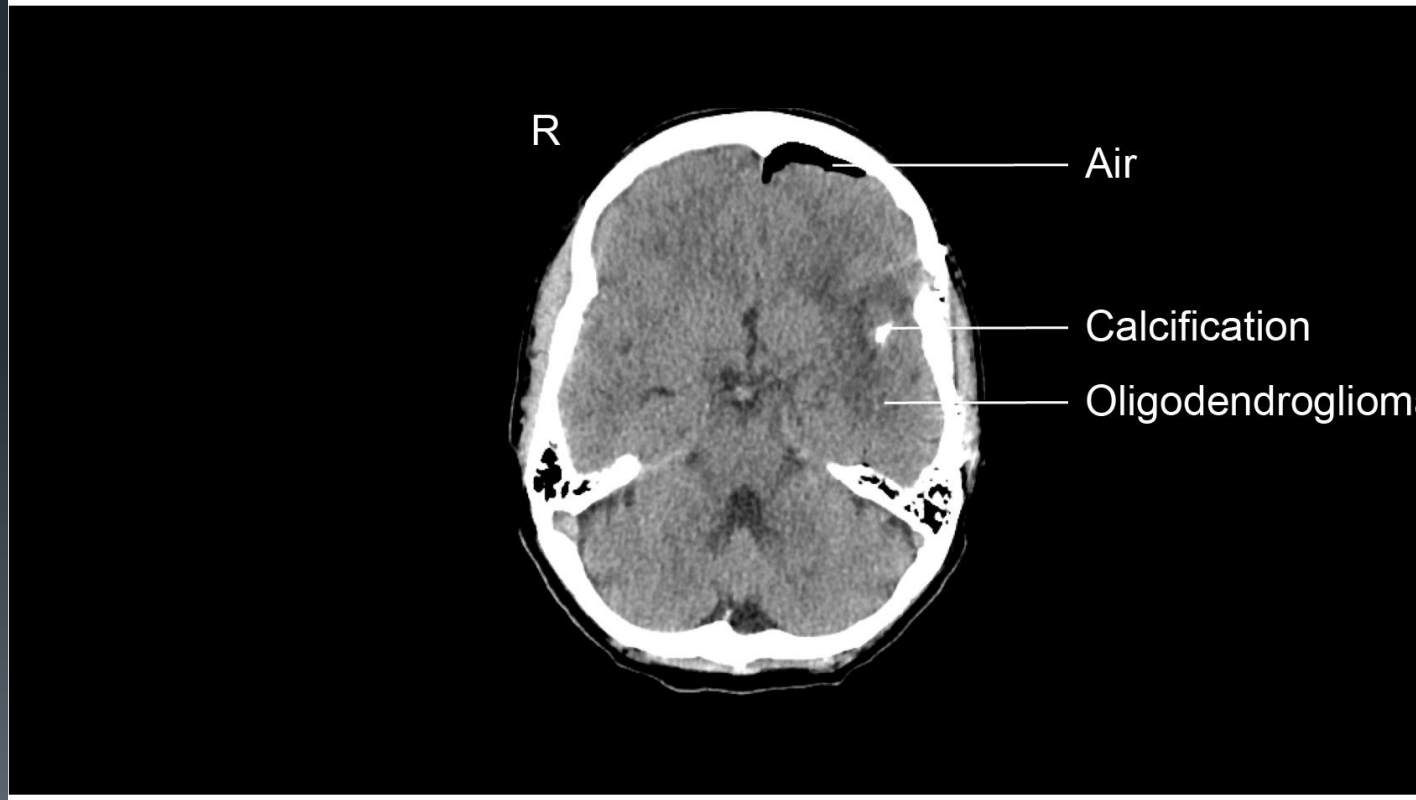
Brain CT Scan **Reading…** Brain

- Tumors



Brain CT Scan **Reading…** Brain

- Tumor

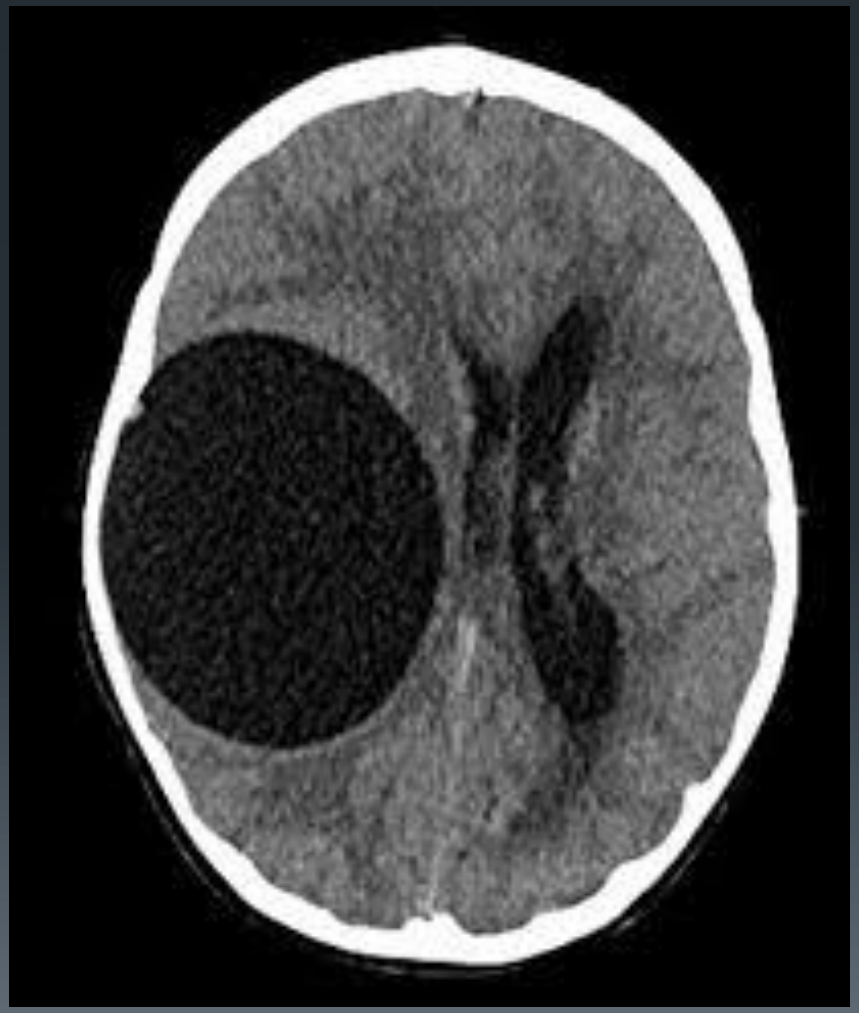


Brain CT Scan **Reading…**

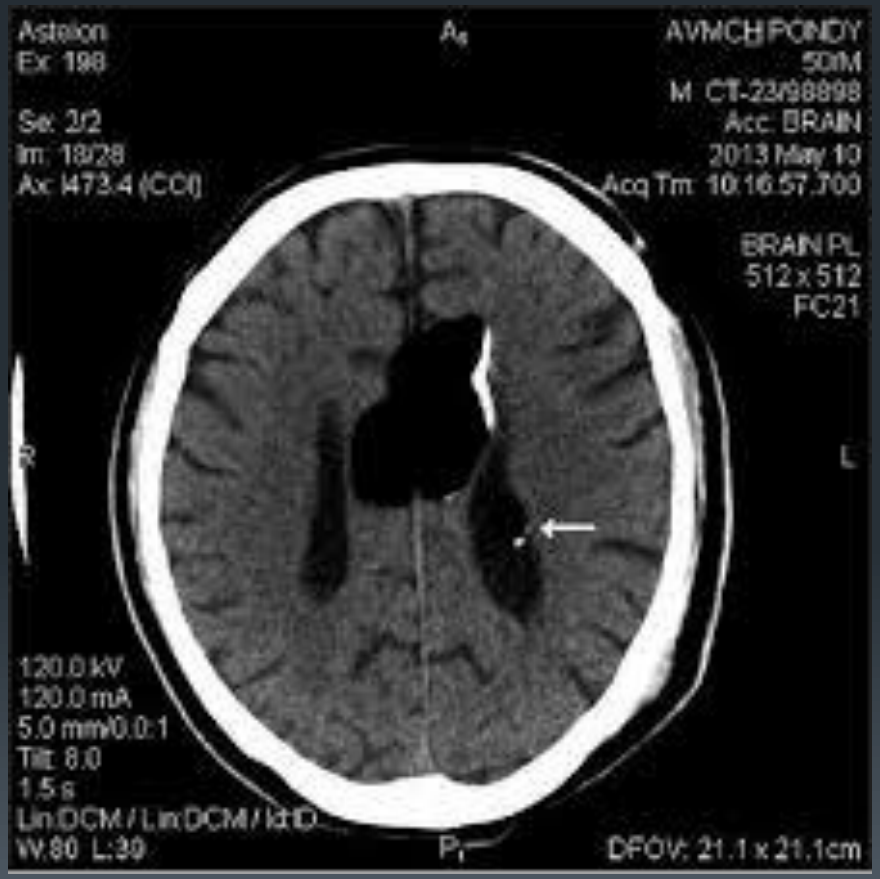
- Abscess

Brain CT Scan **Reading…** Brain

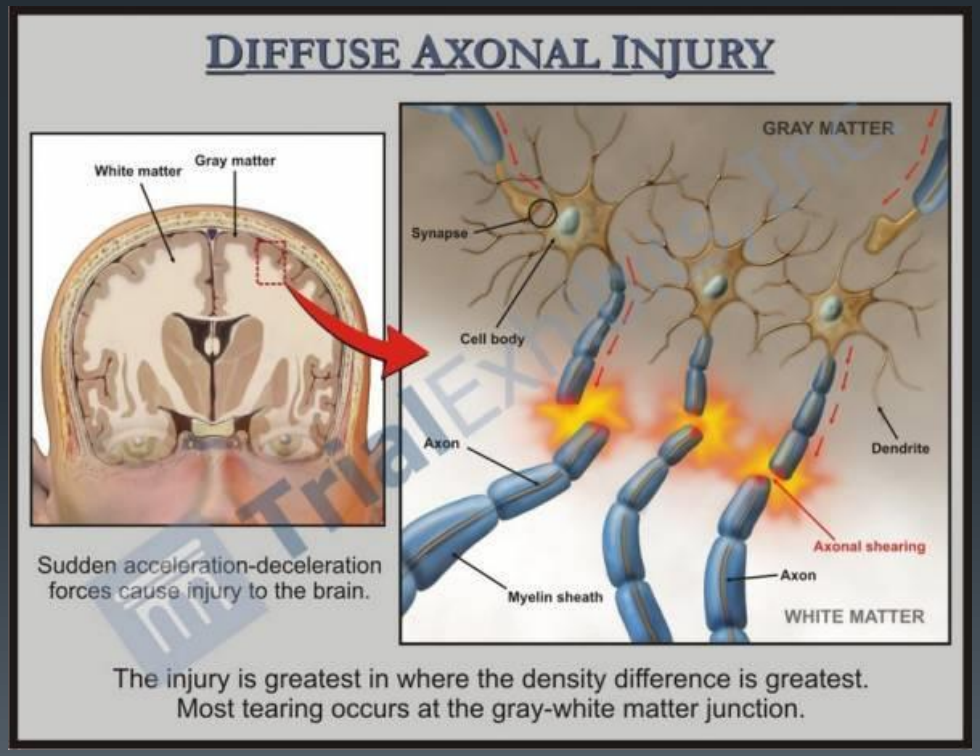
- Cyst



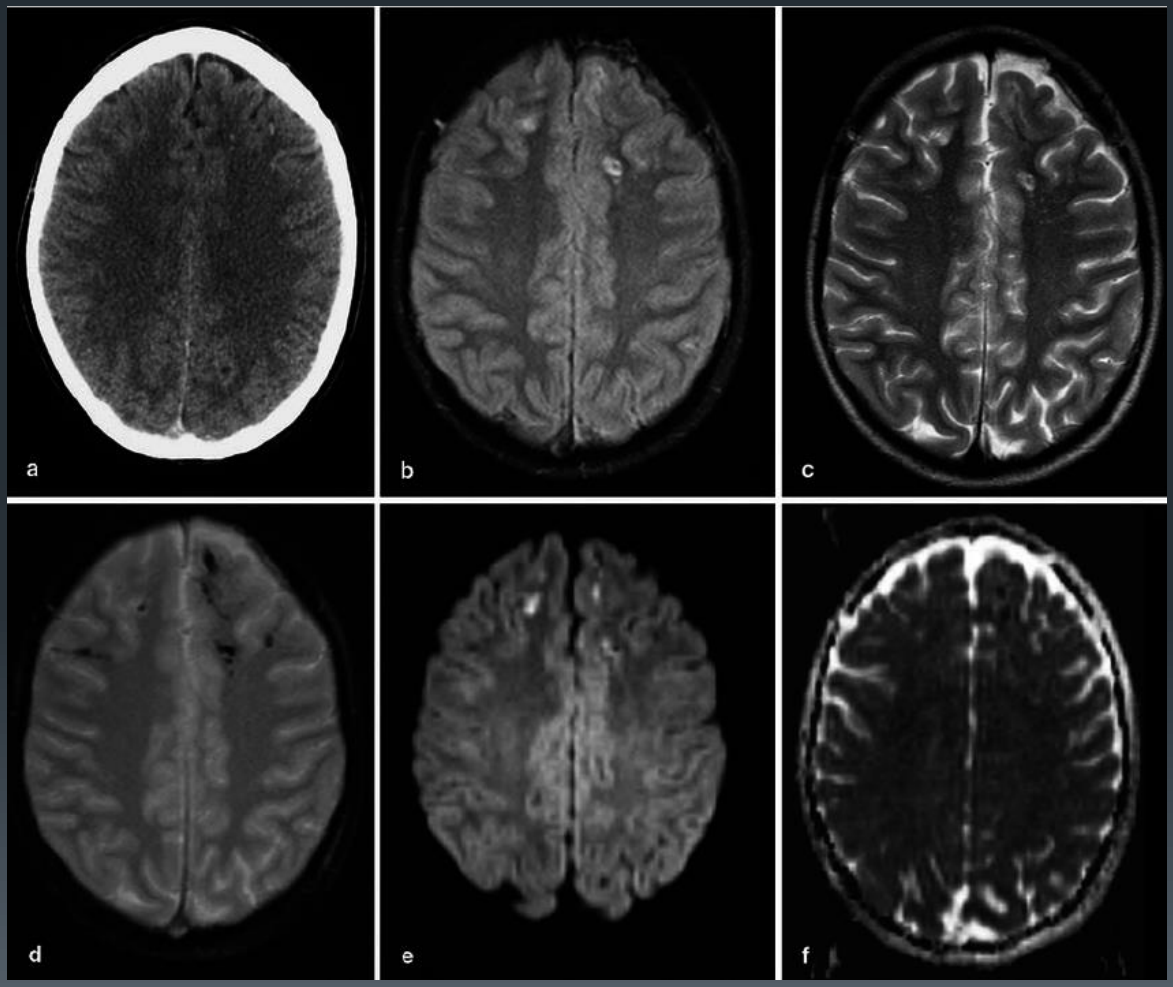
lipoma


Asteion
Ex: 198
Se: 2/2
Im: 18/28
Ax: 473.4 (CCI)
AVMCH PONDY
50M
M CT-23/98898
Acc: BRAIN
2013 May 10
Acq Tm: 10:16:57.700
BRAIN PL
512 x 512
FC21
R
L
120.0 kV
120.0 mA
5.0 mm/0.0:1
Tilt: 0.0
1.5 s
Lin:DCM / Lin:DCM / Id:D
WW:80 L:39
DFOV: 21.1 x 21.1cm

Brain CT Scan Reading…
Brain




Diffuse axonal injury


a
b
c
d
e
f

Brain CT Scan Reading…

Brain

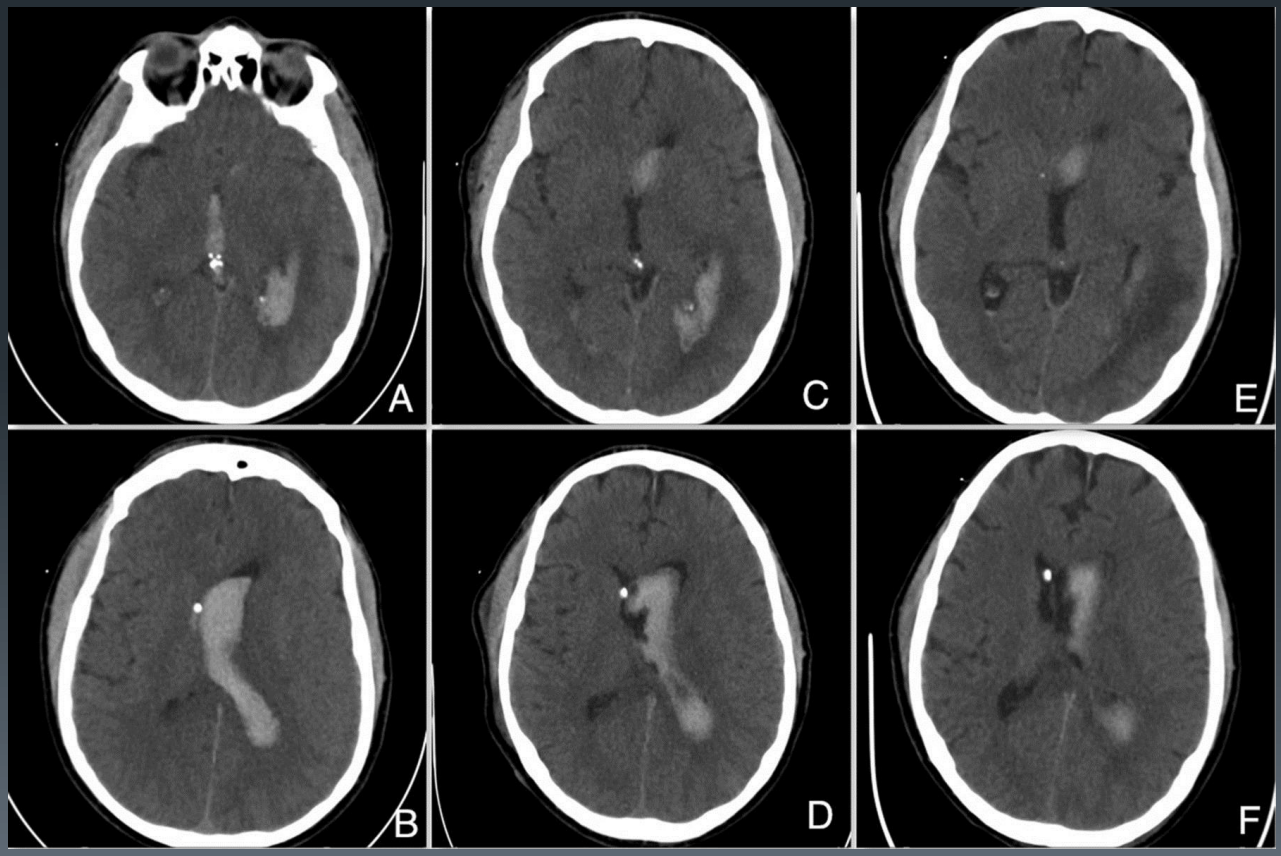
Normal CT

Diffuse Injury

Ventricle

Brain CT Scan **Reading…** Ventricles

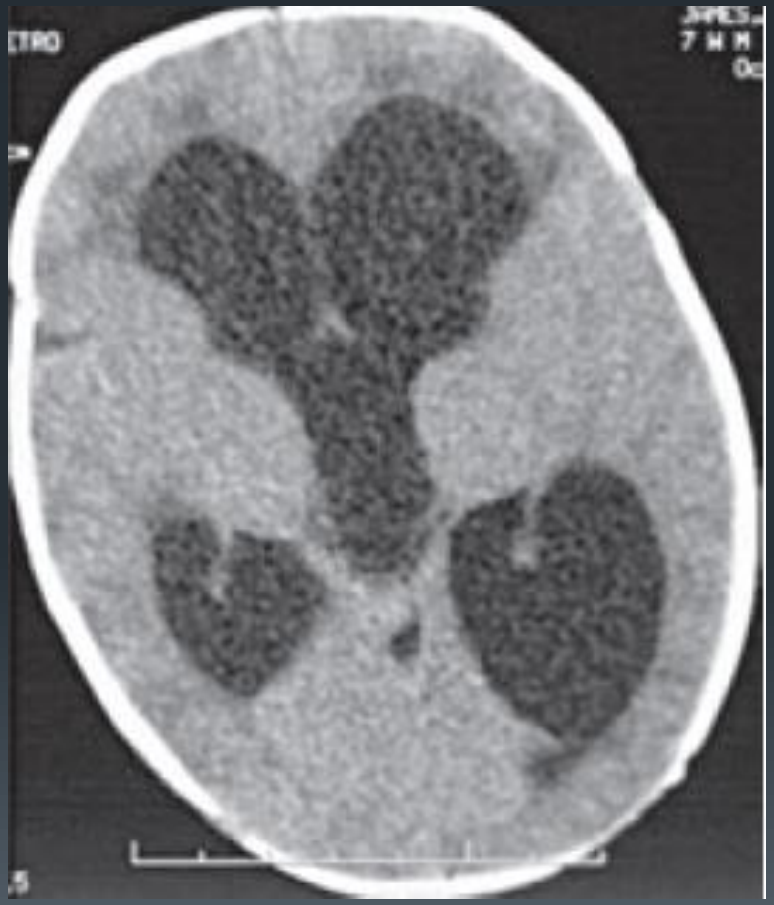
- IVH



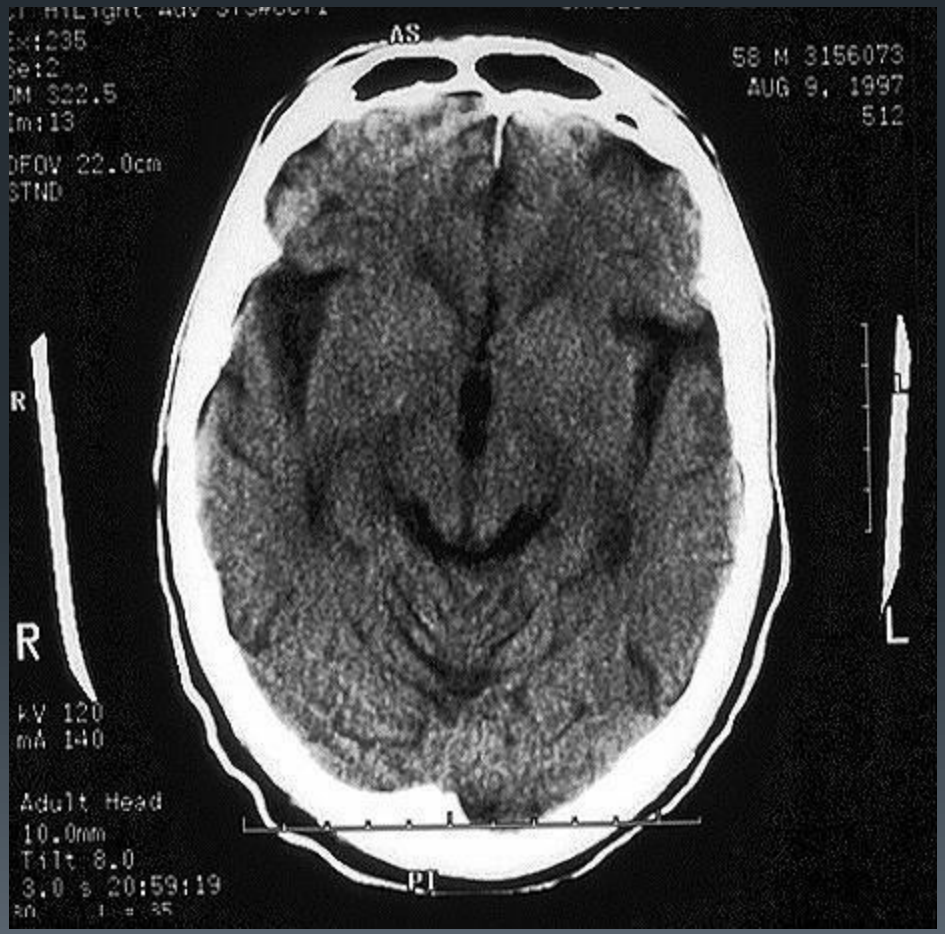
ICH & IVH

Brain CT Scan **Reading…** Ventricles

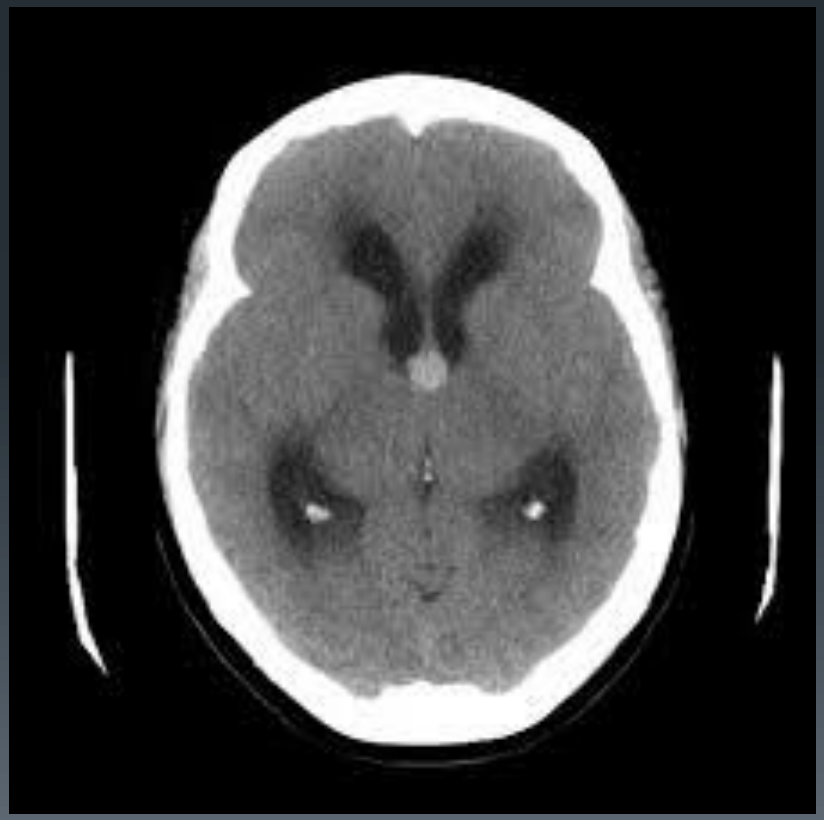
- Hydrocephalus

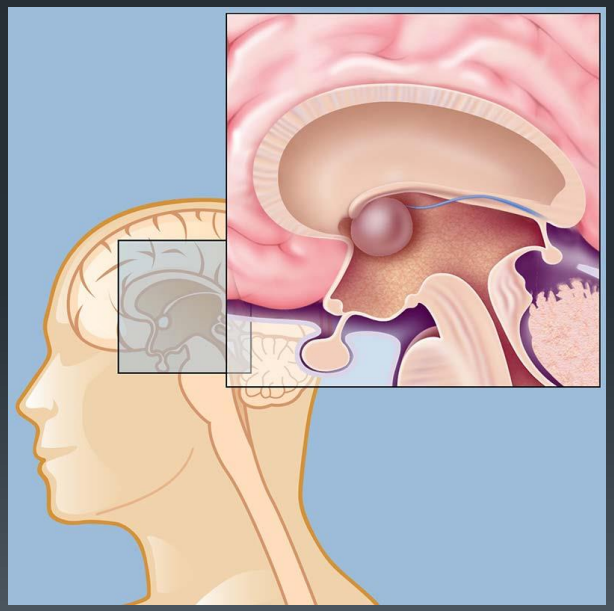


- Brain Atrophy



Colloid Cyst



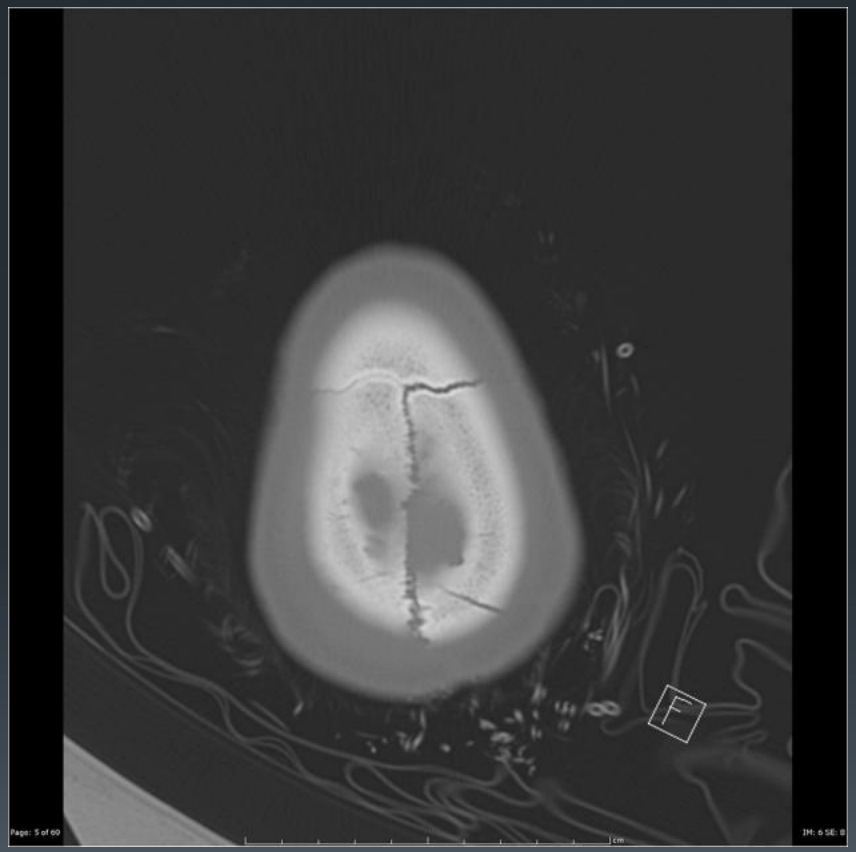


Brain CT Scan **Reading…** Ventricles

- Compression and Shifting

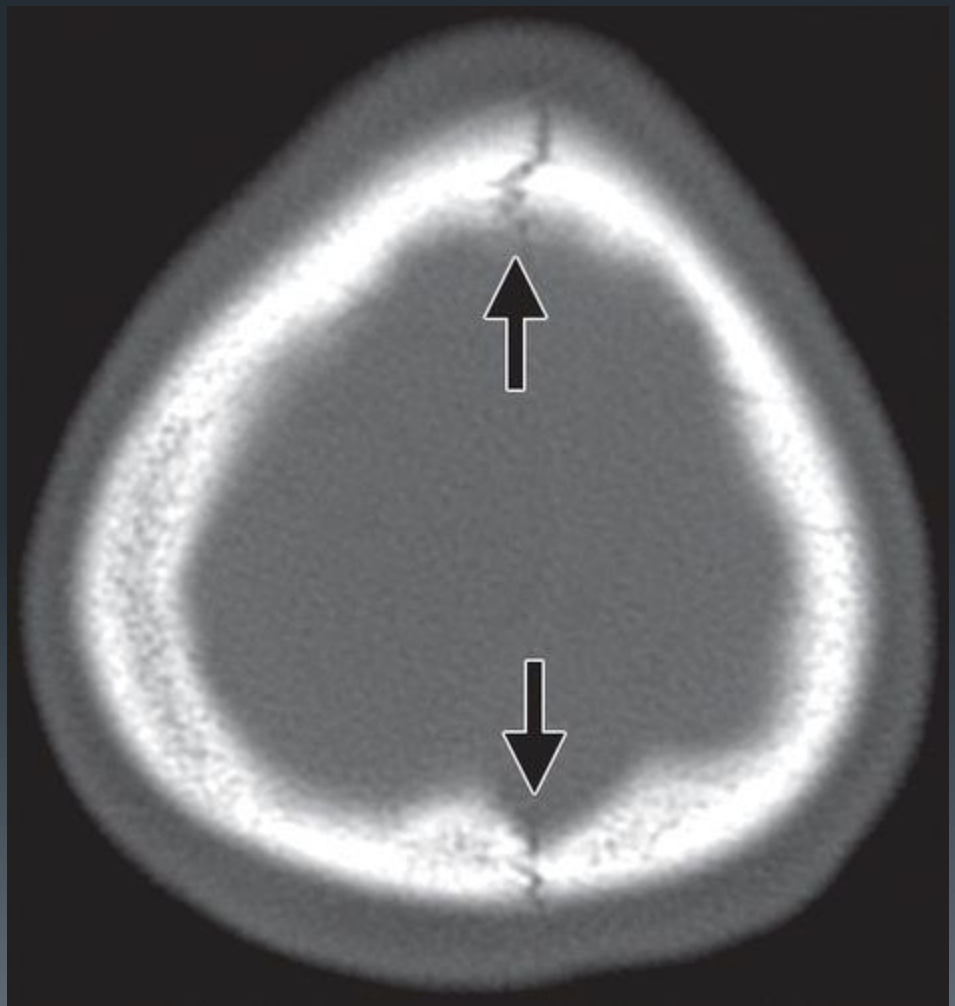
Brain CT Scan **Reading…** Bone , Skull Sutures

- Coronal S.



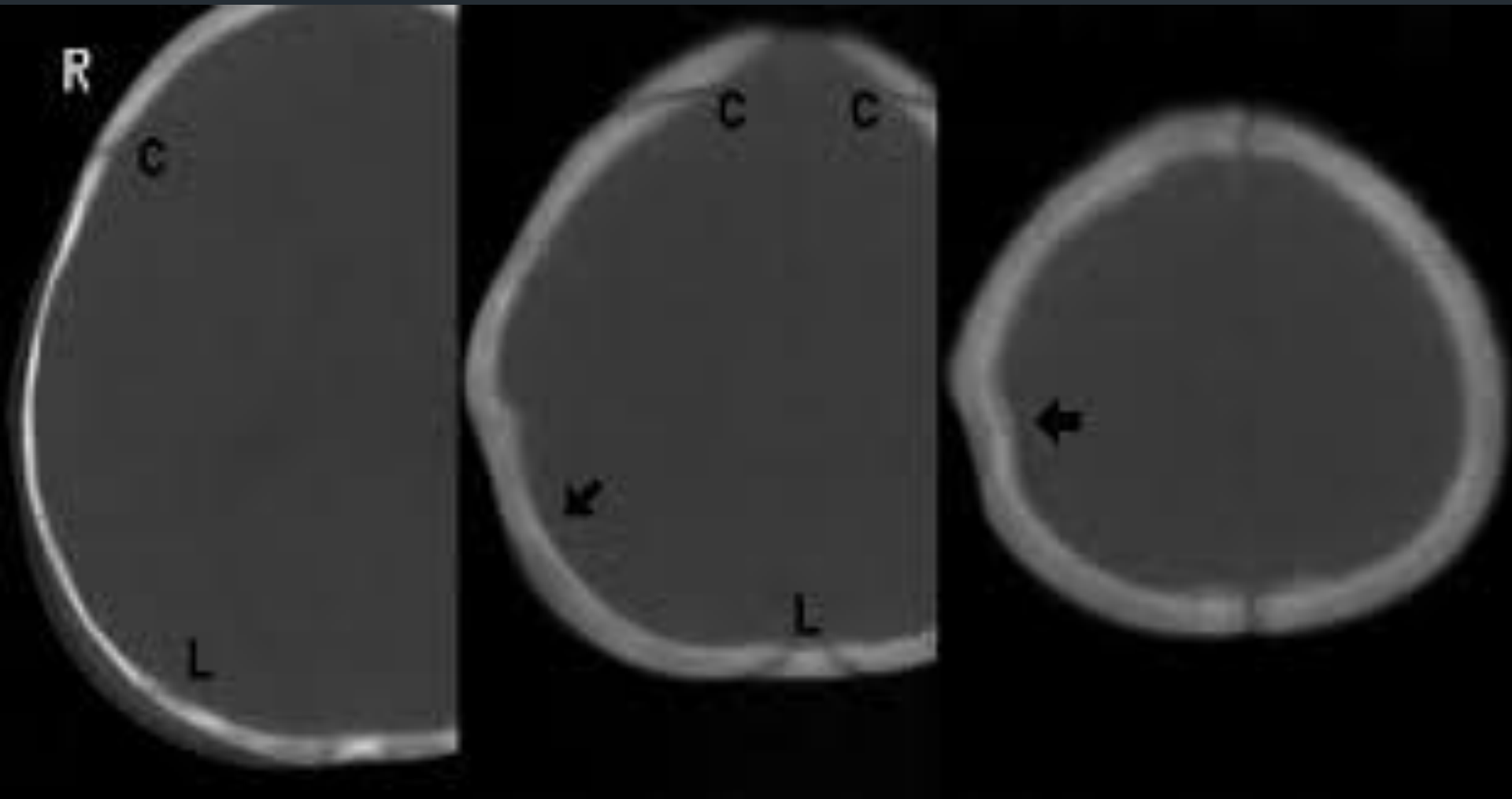
Brain CT Scan **Reading…** Bone Skull Sutures

- Sagittal S.



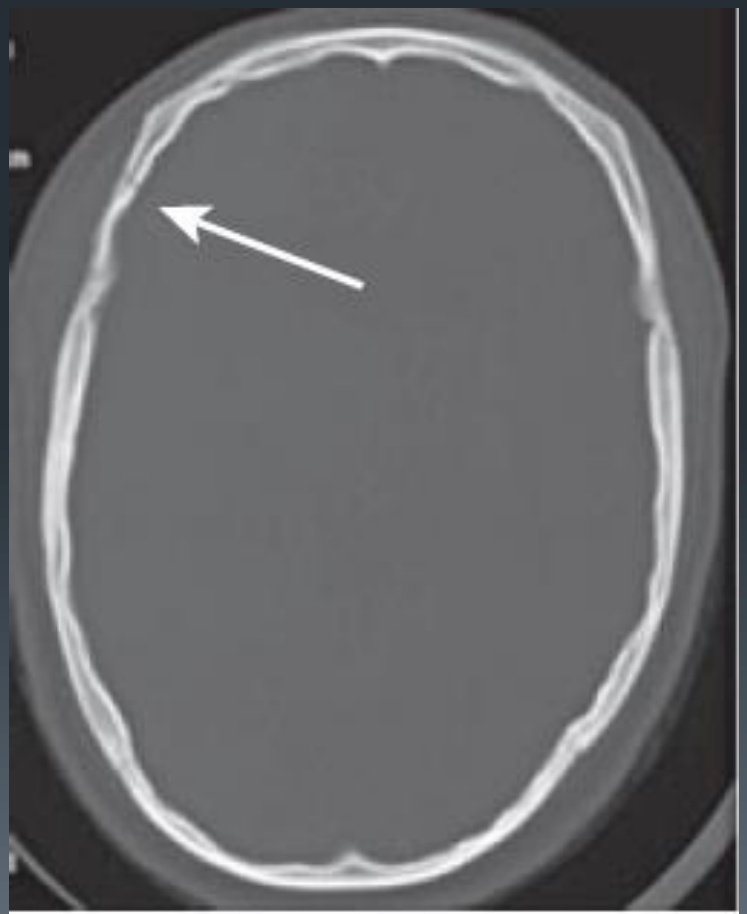
Brain CT Scan **Reading…** Bone Skull Sutures

- Lambdoid S.

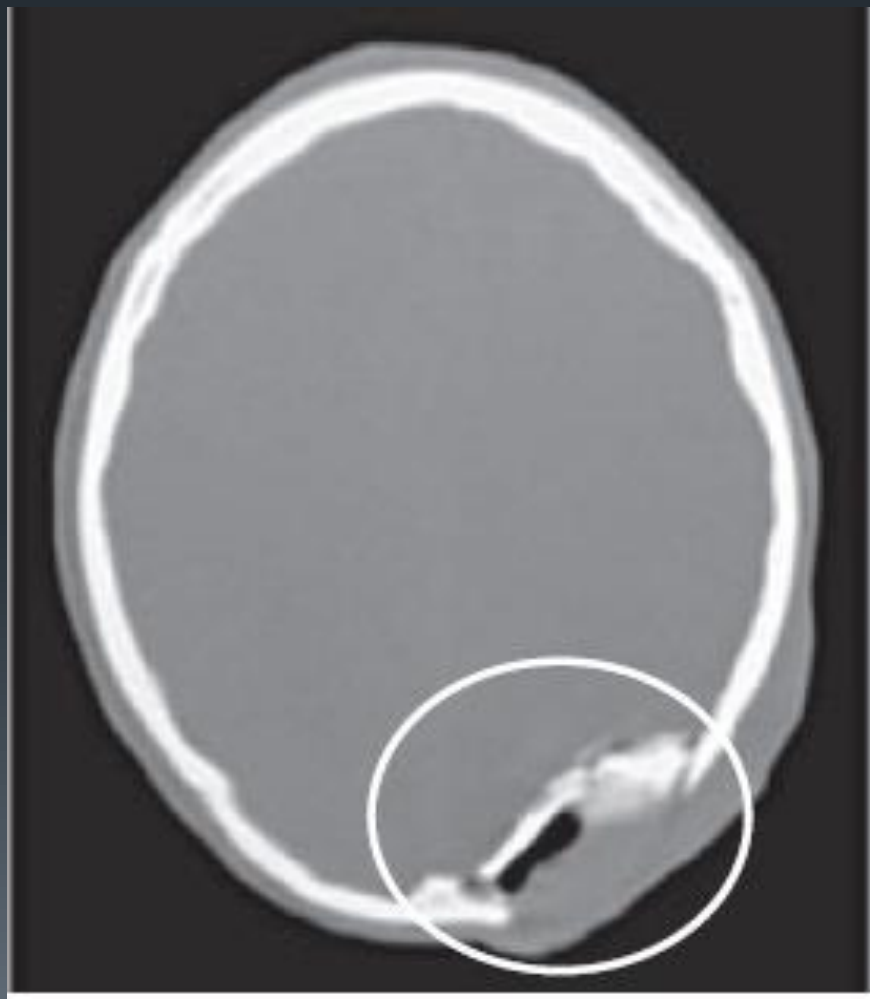

R
C
L
C
C
L

Brain CT Scan **Reading…** Bone

- Linear skull Fractures

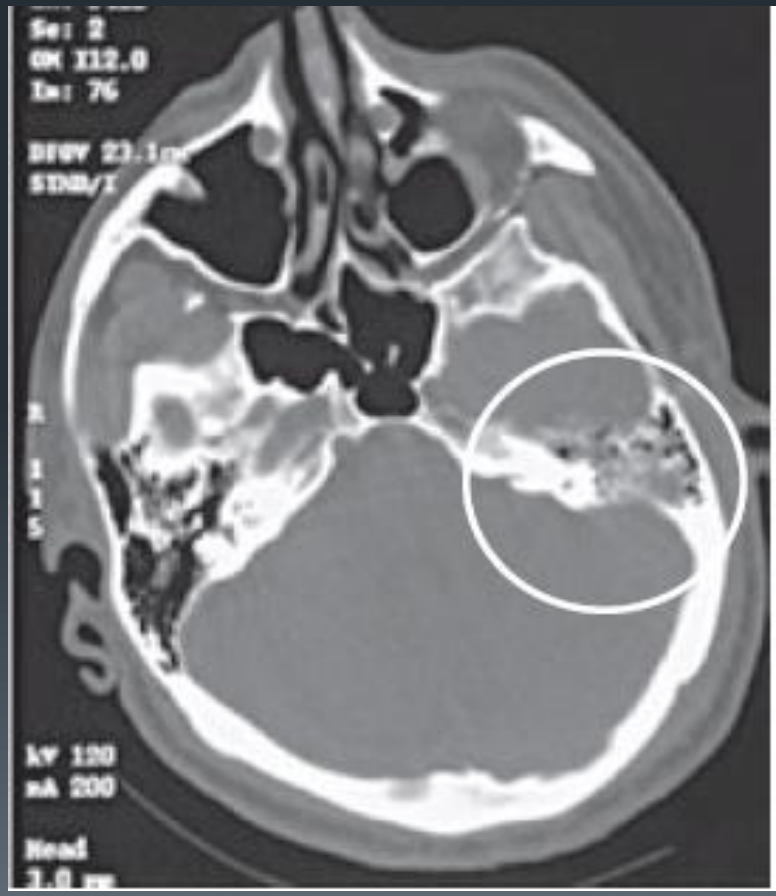


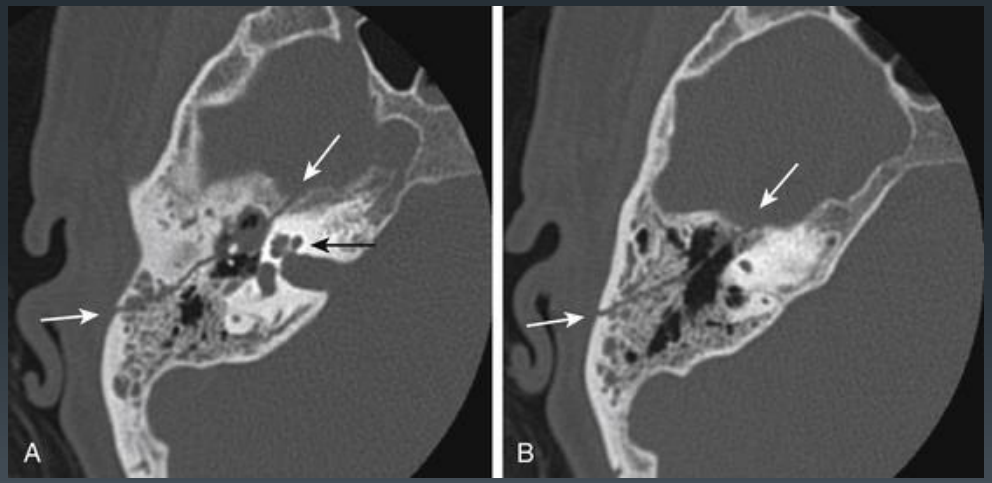
- Deppressed Skull Fracture

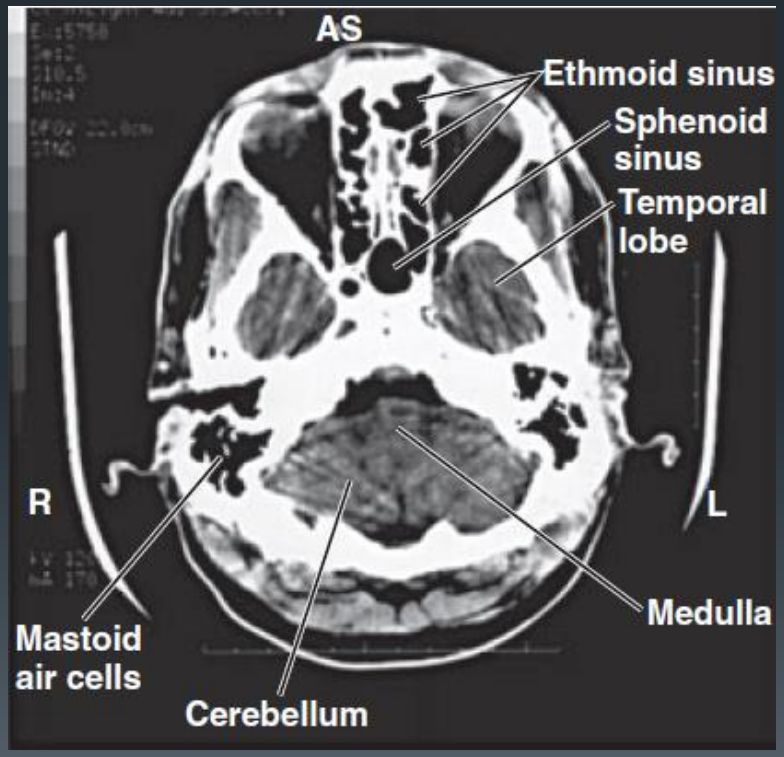


Brain CT Scan **Reading…** Bone

- Fractures of Skull base



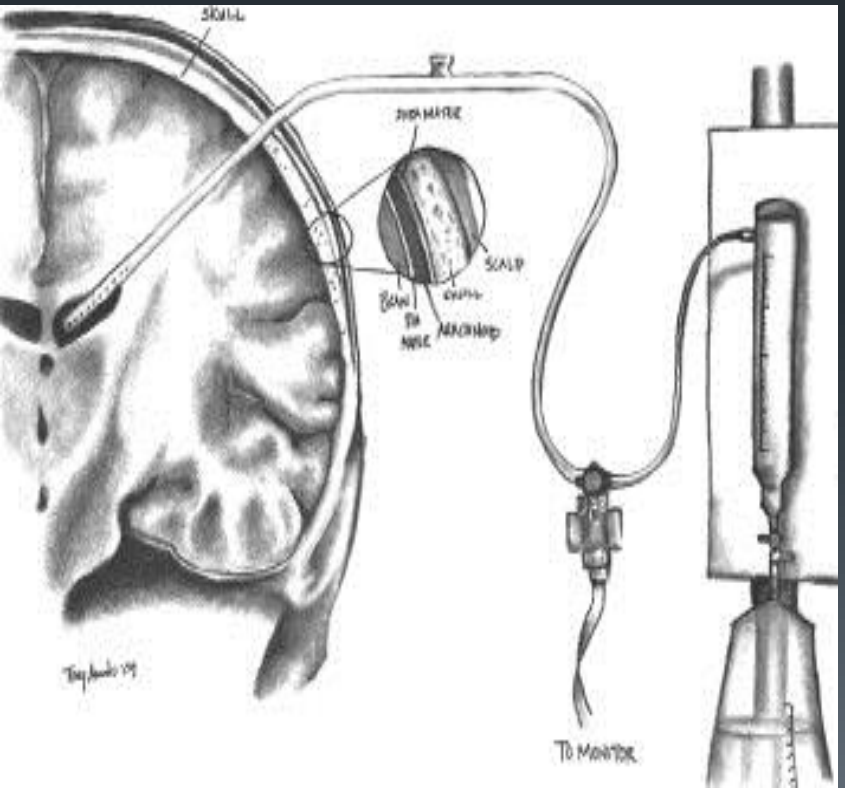

A
B

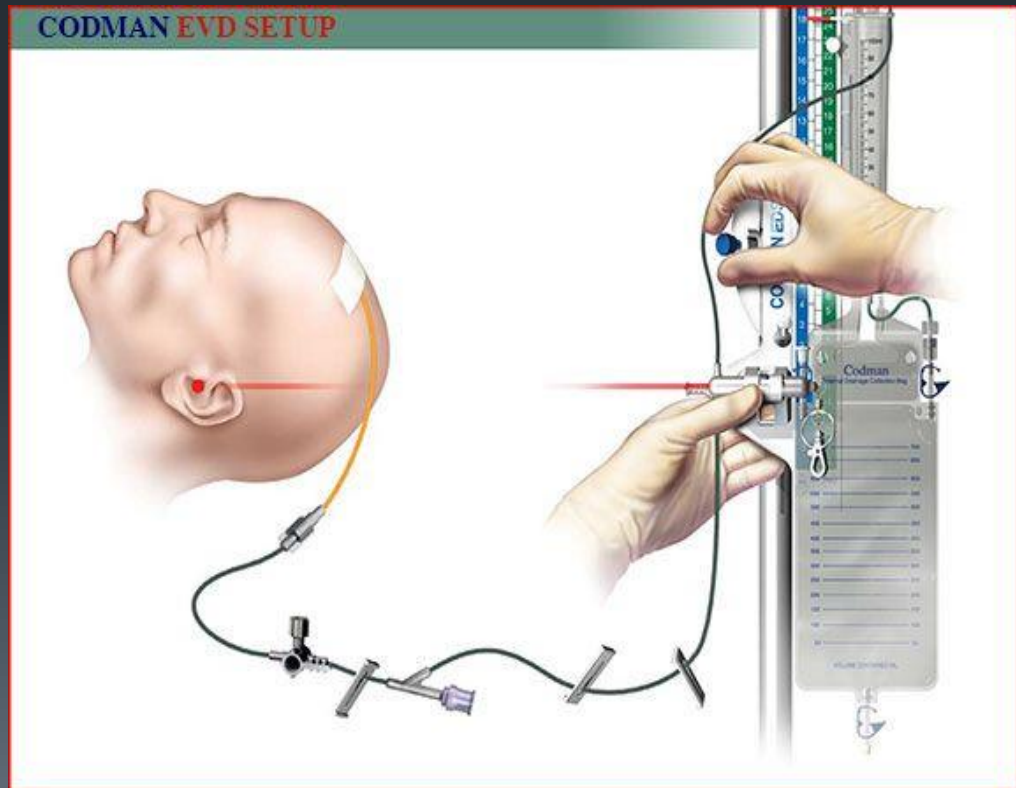

AS
Ethmoid sinus
Sphenoid sinus
Temporal lobe
R
L
Medulla
Mastoid air cells
Cerebellum

- Pneumocephaly

Post Operation Changes in Cranial Ct Scan

- External Ventricular Drainage



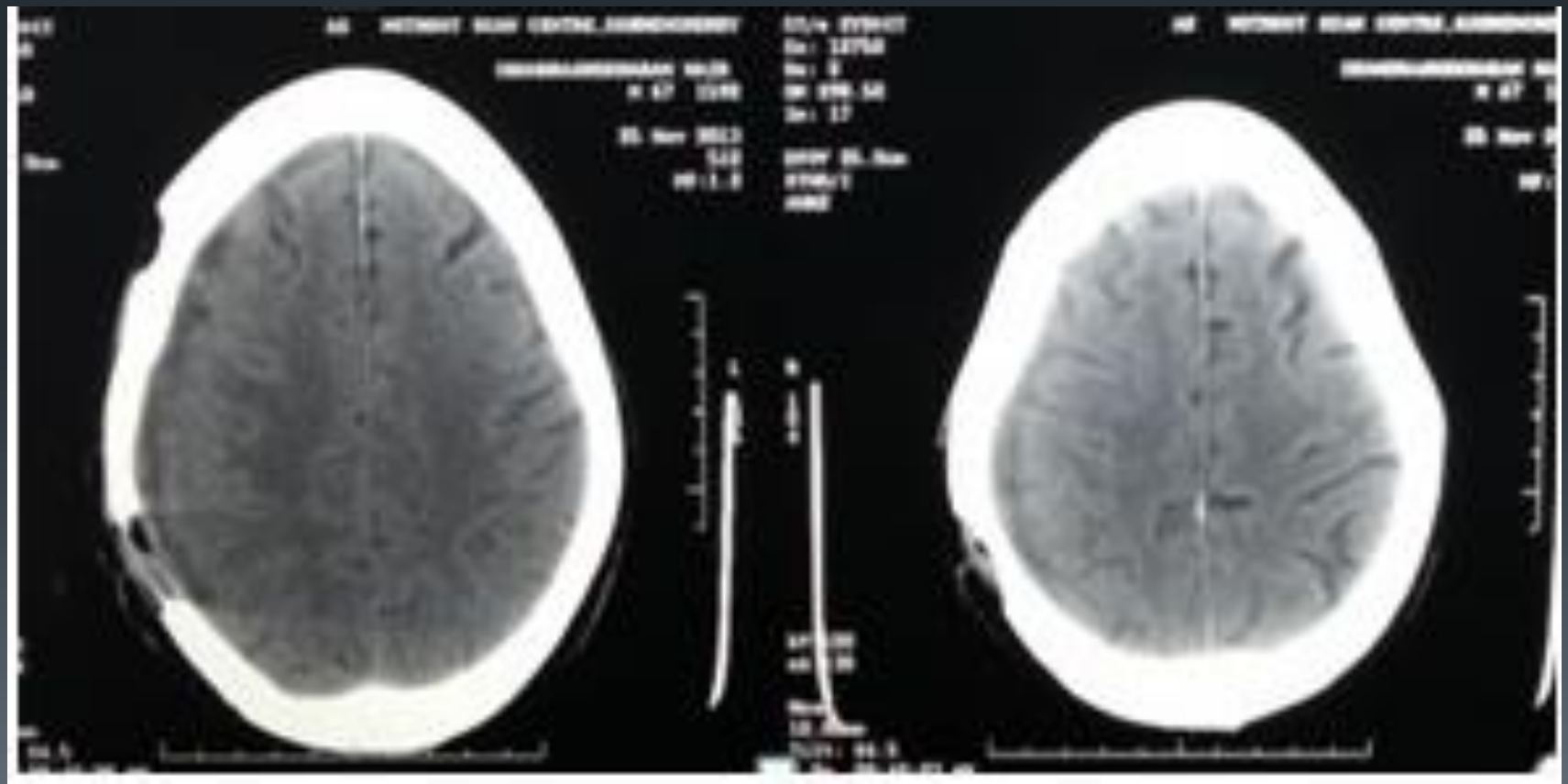


Post Operation Changes in Cranial Ct Scan

- External Ventricular Drainage

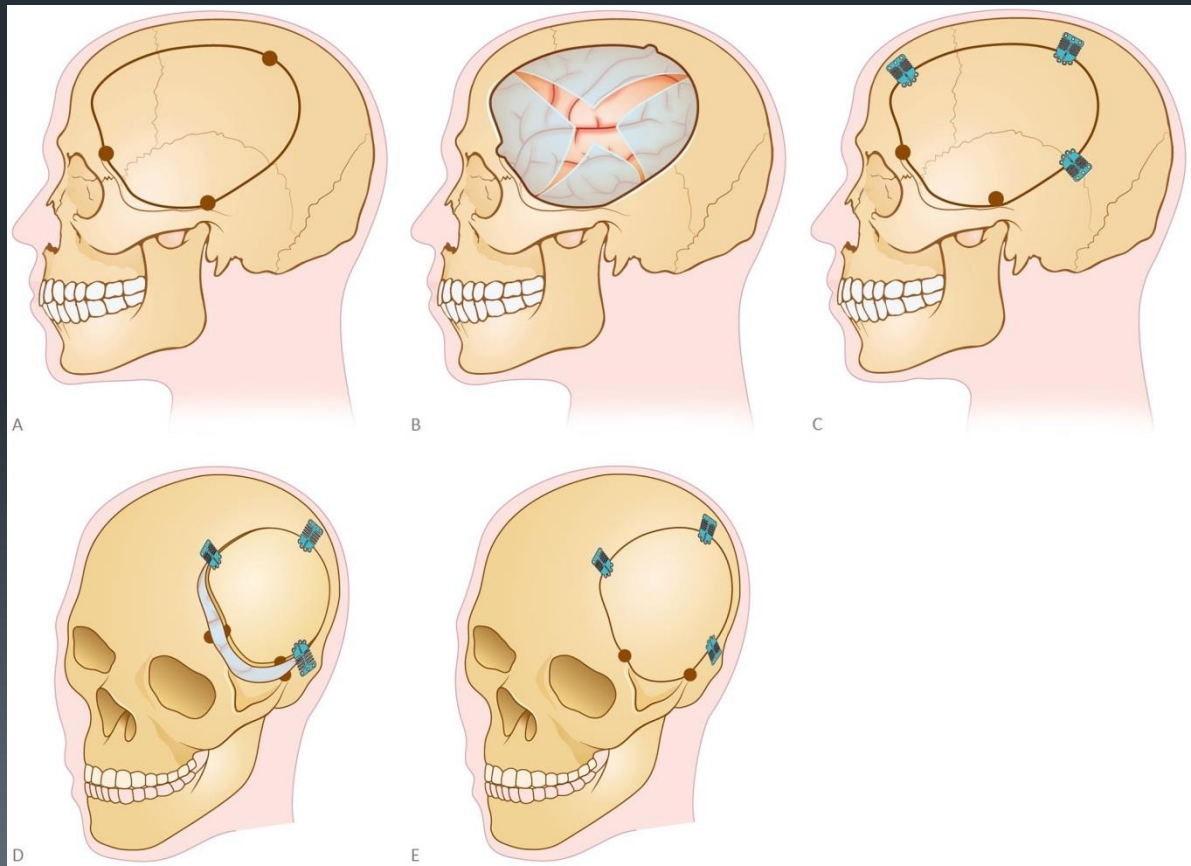
Post Operation Changes in Cranial Ct Scan

- Burr Hole Craniostomy

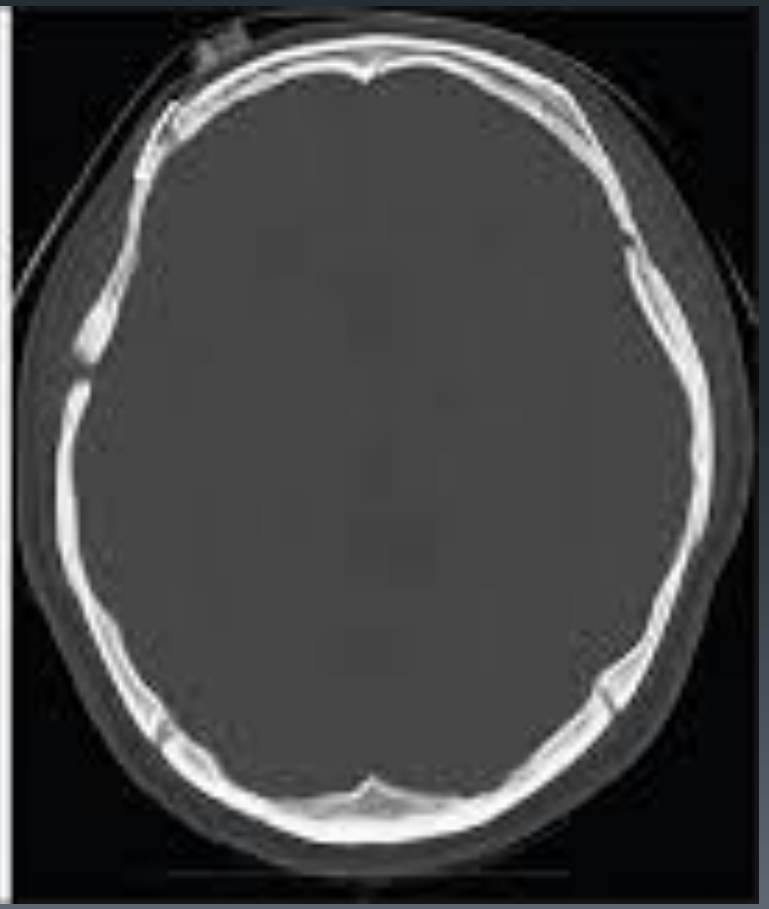


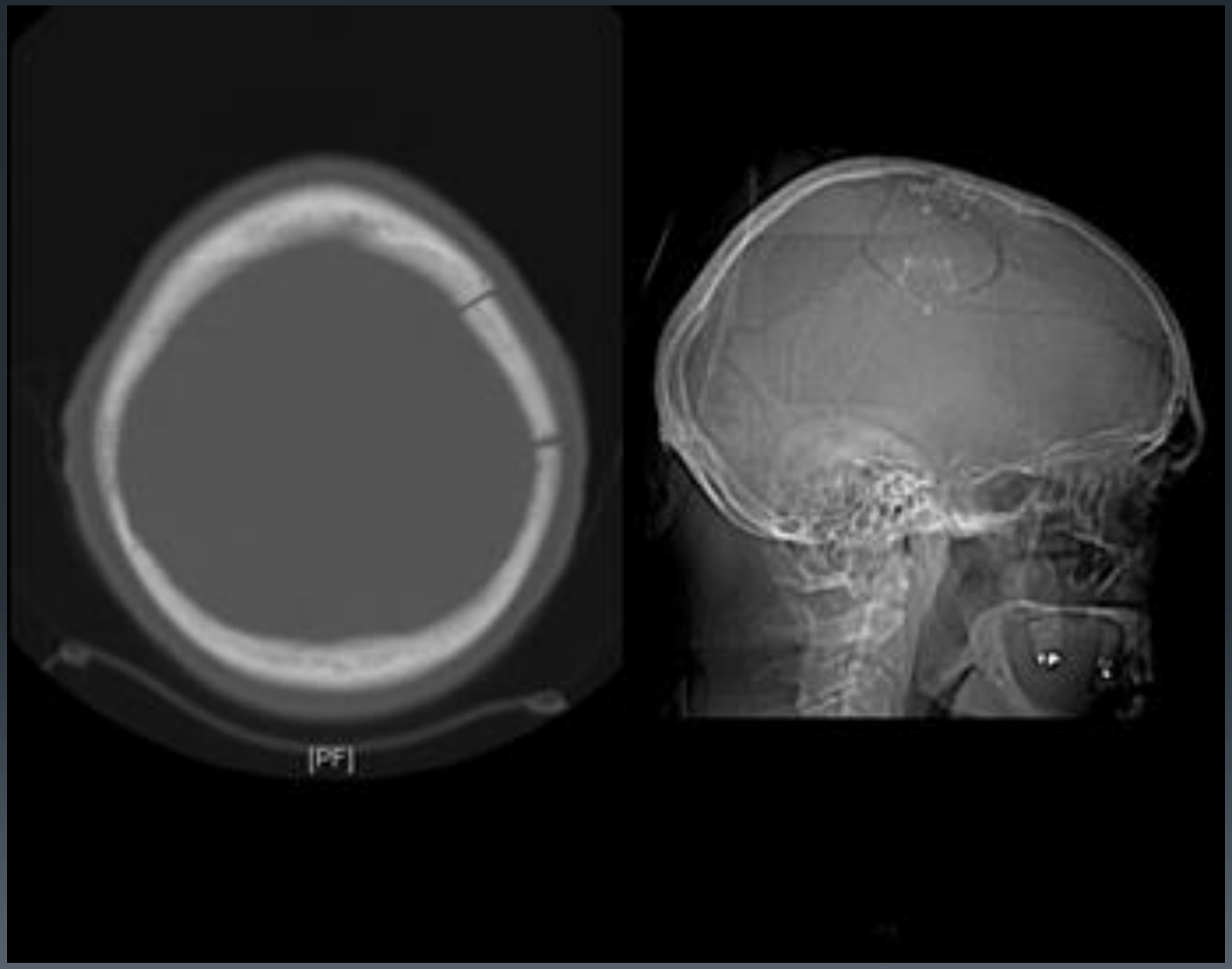
Post Operation Changes in Cranial Ct Scan

- Craniotomy & Cranioplasty



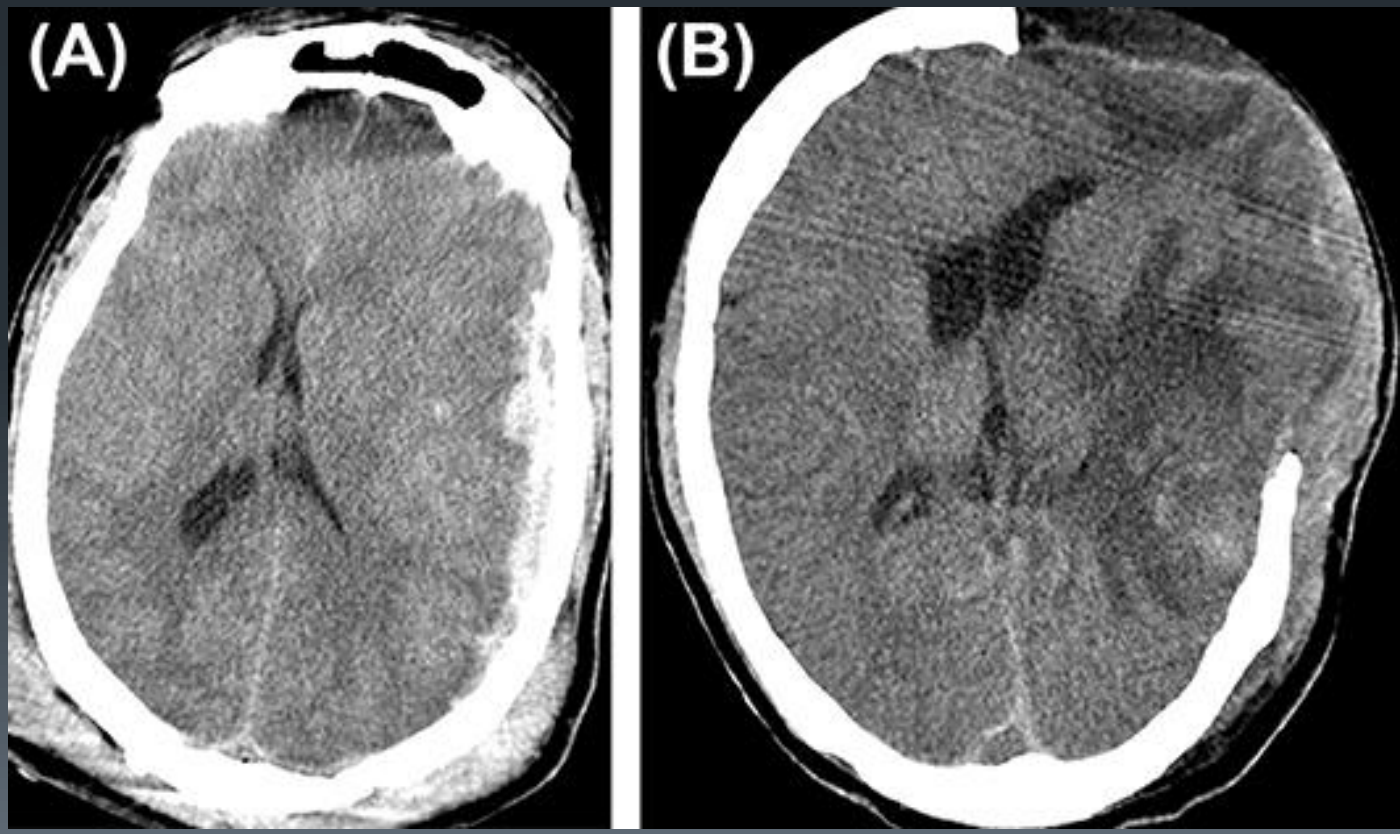
Post Operation Changes in Cranial Ct Scan

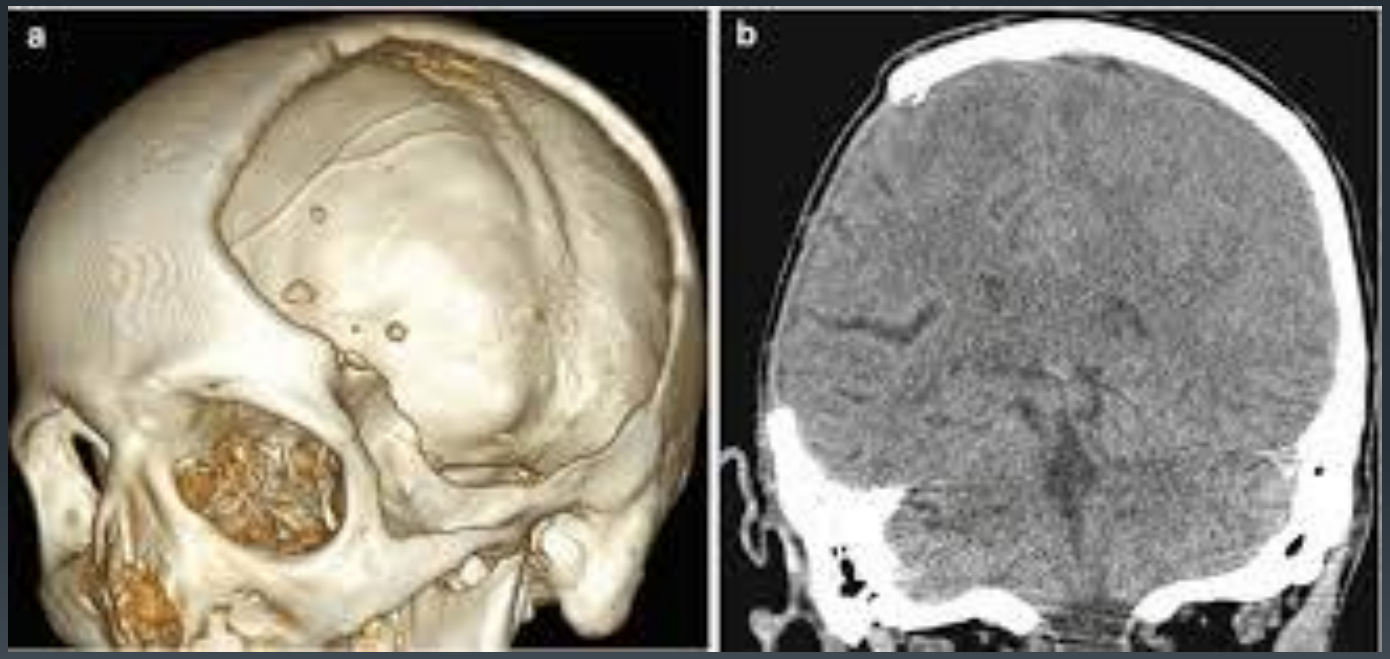



[PF]

Post Operation Changes in Cranial Ct Scan

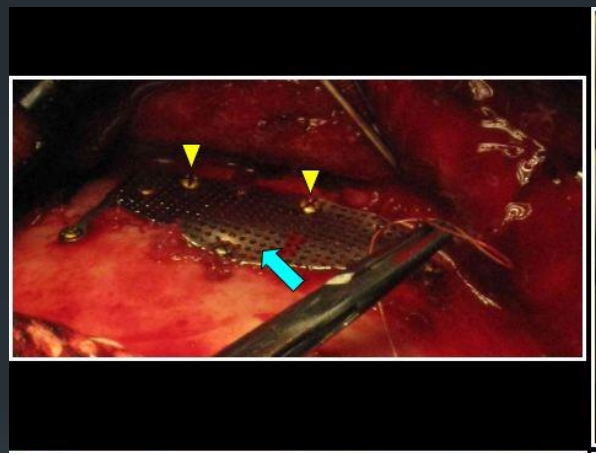
- Craniectomy

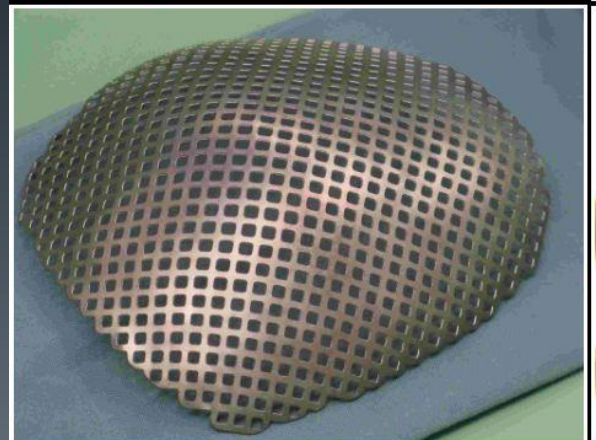



a
b

Post Operation Changes in Cranial Ct Scan

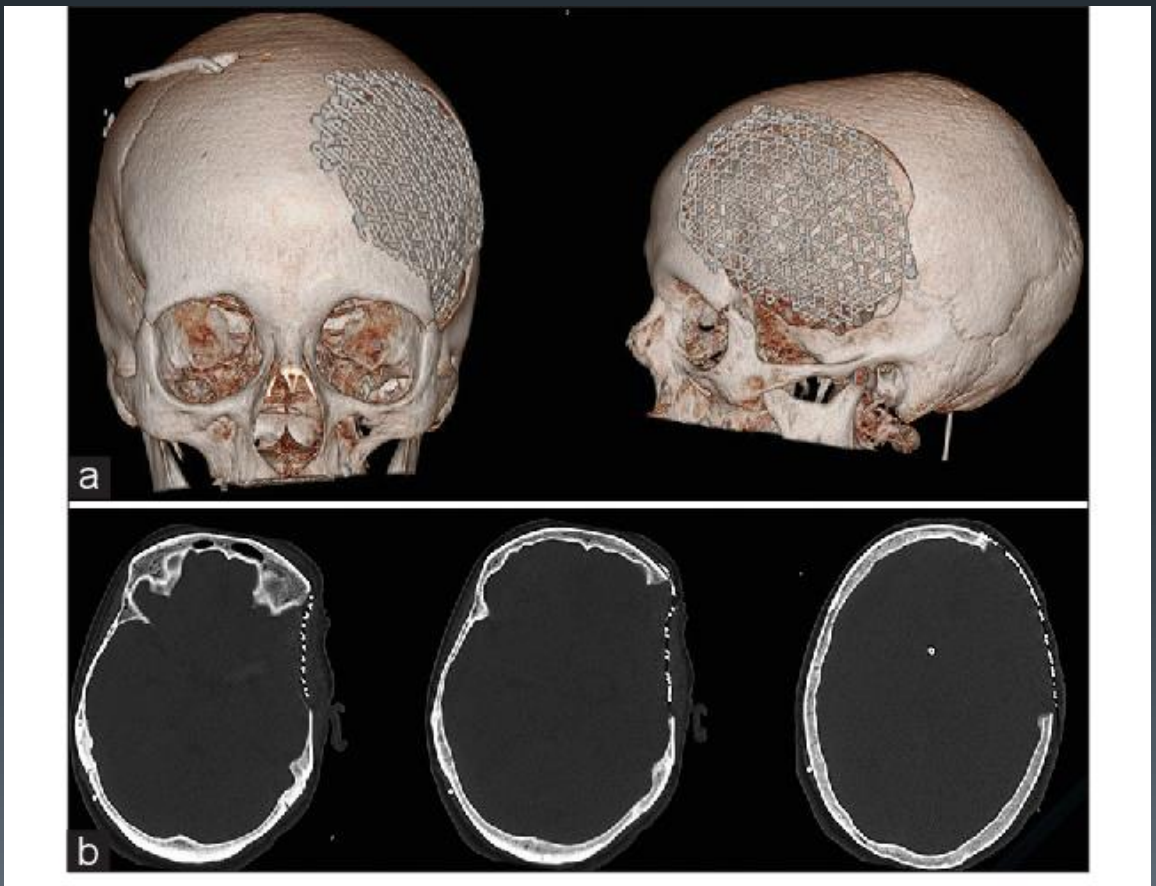
- Cranioplasty

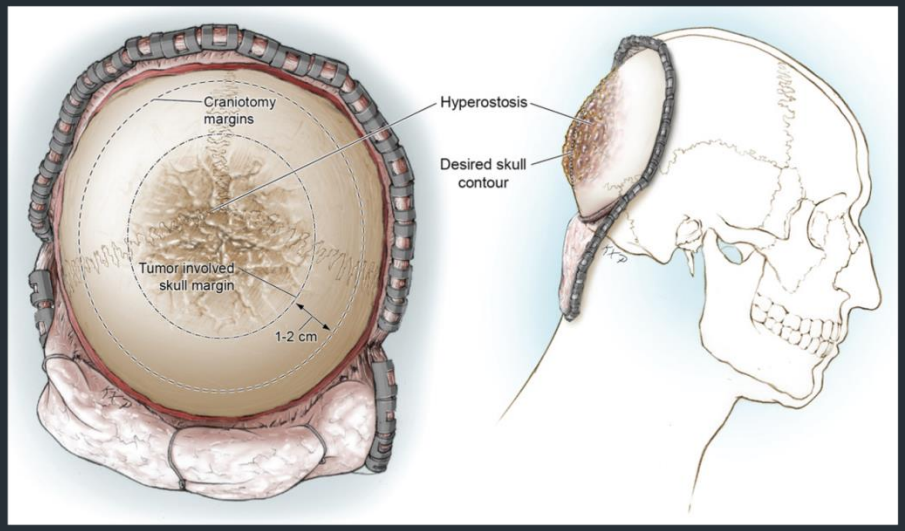


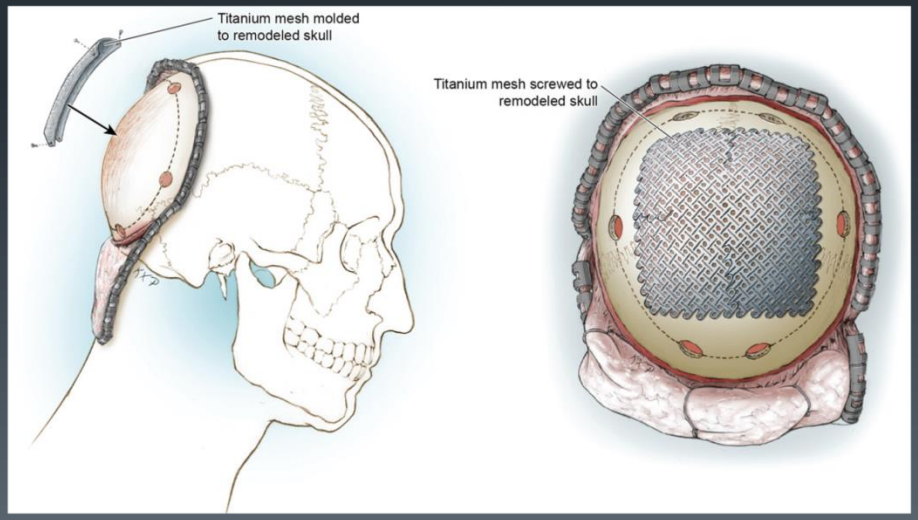


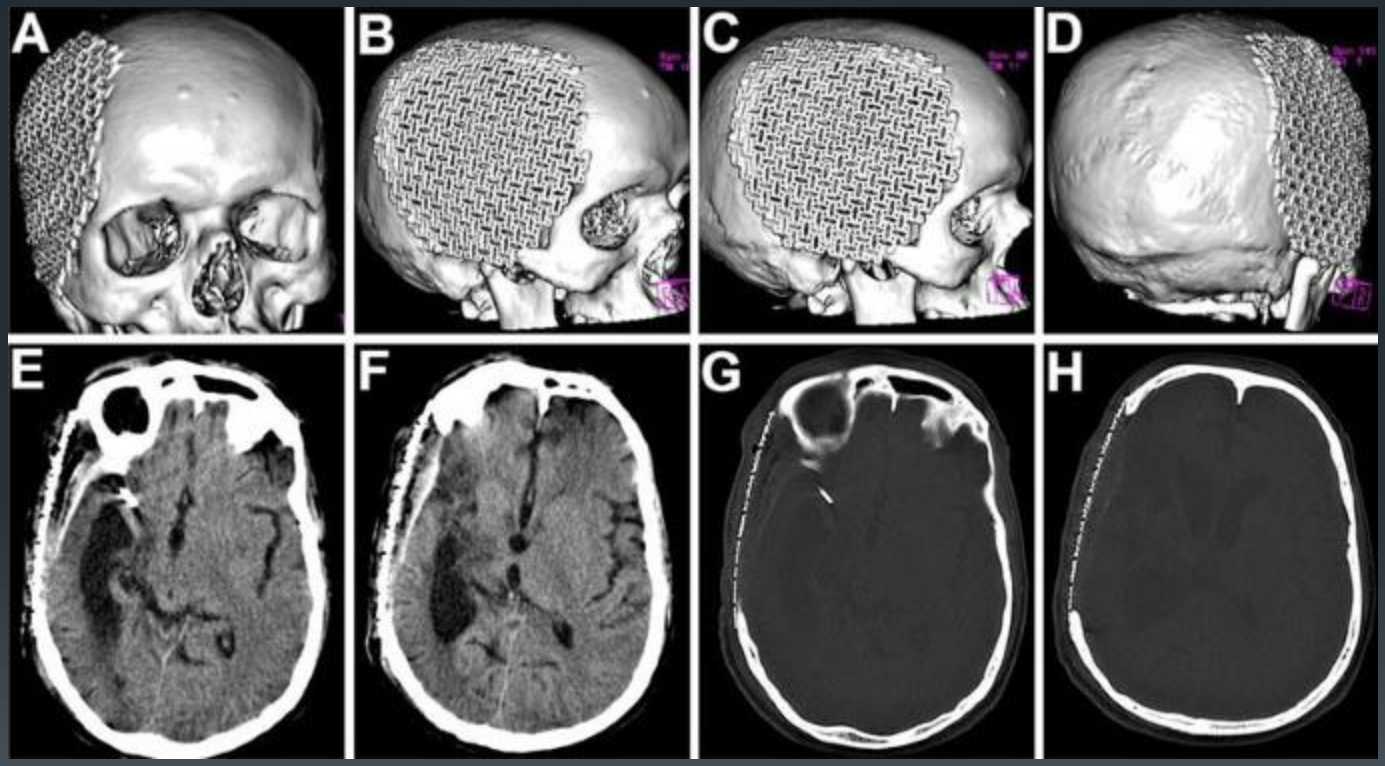
Post Operation Changes in Cranial Ct Scan

- Cranioplasty



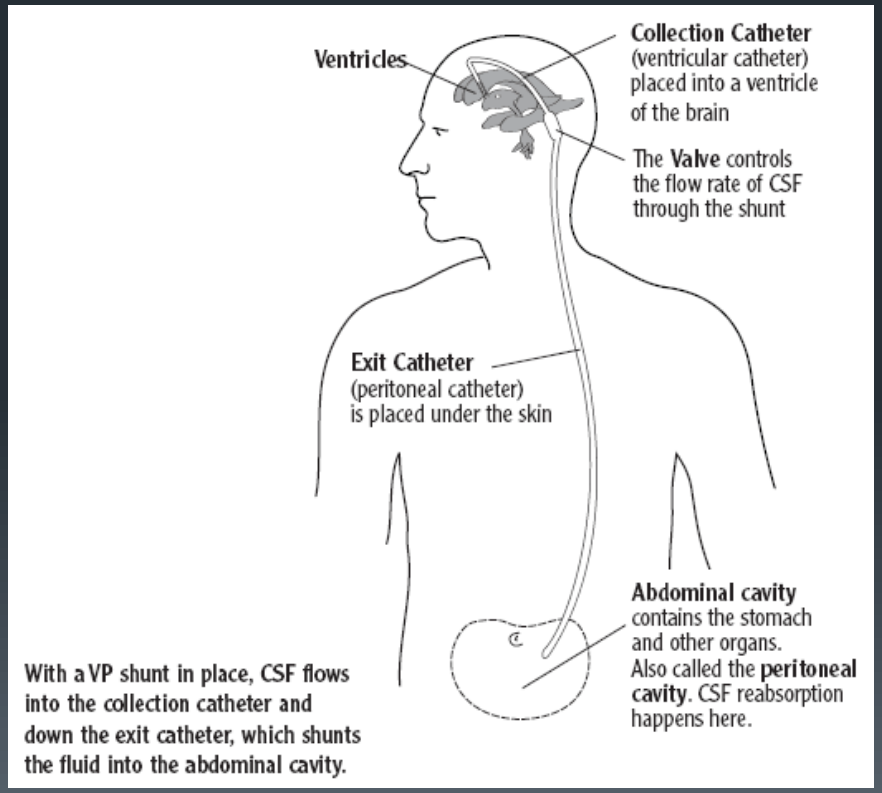

Craniotomy margins
Hyperostosis
Desired skull contour
Tumor involved skull margin
1-2 cm

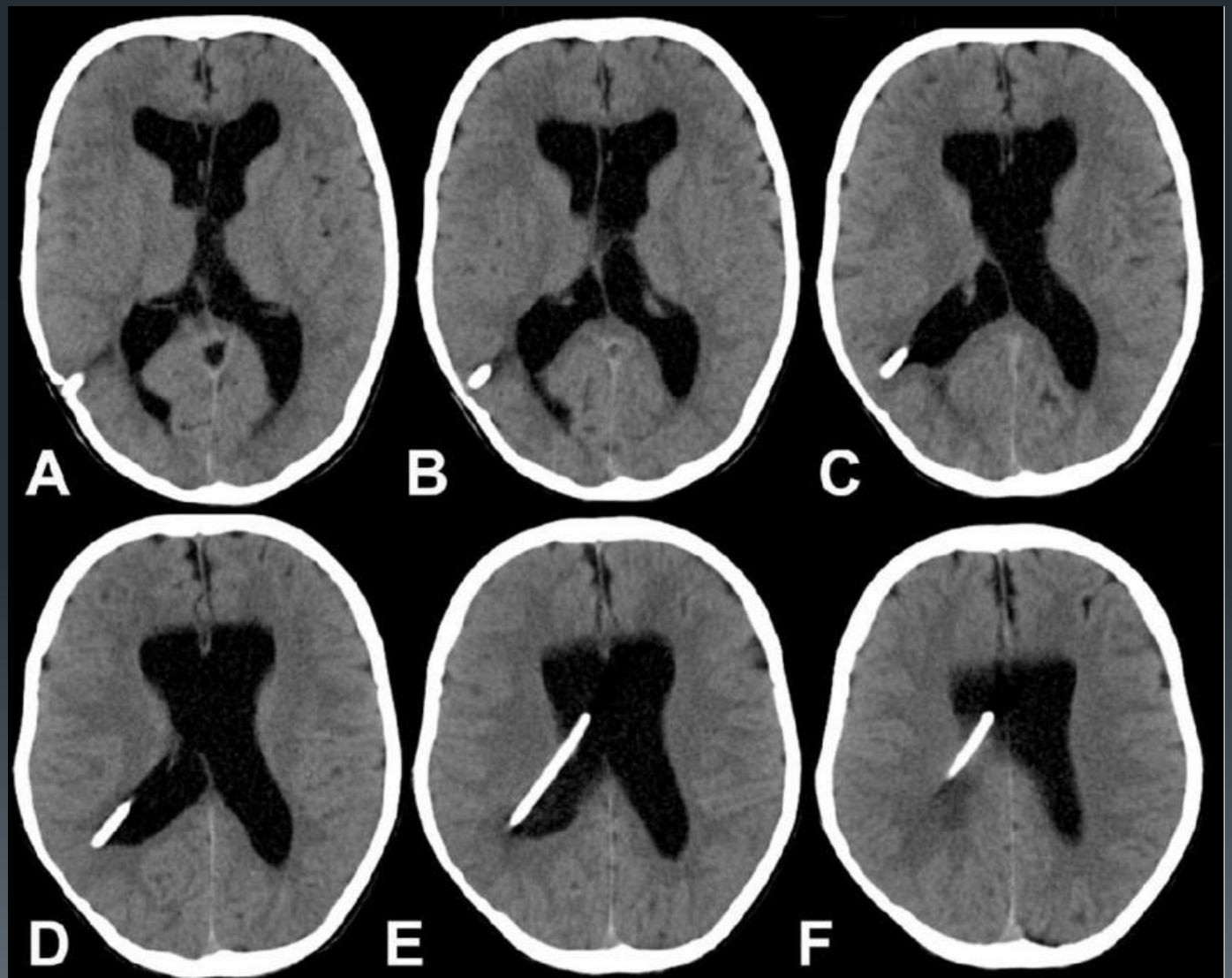

Titanium mesh molded to remodeled skull
Titanium mesh screwed to remodeled skull


A
B
C
D
E
F
G
H

Post Operation Changes in Cranial Ct Scan

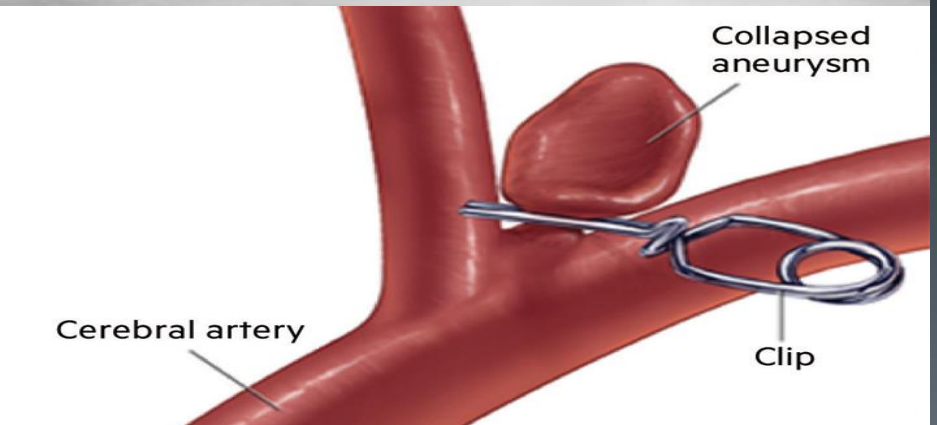
- Ventriculoperitoneal Shunting




A
B
C
D
E
F

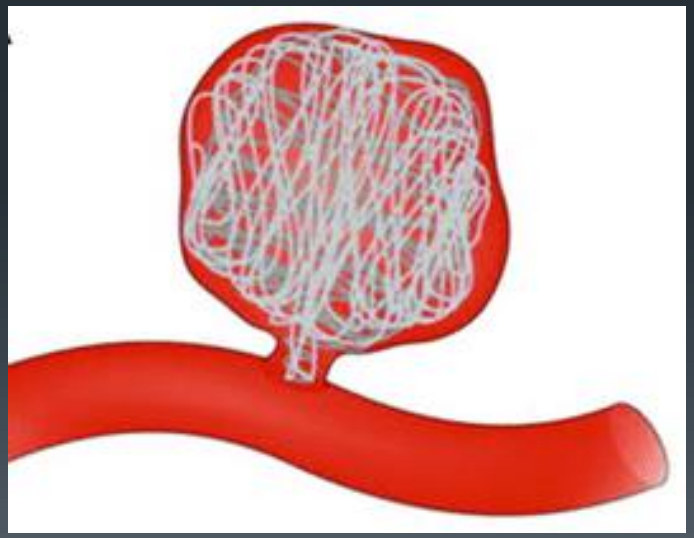
Post Operation Changes in Cranial Ct Scan

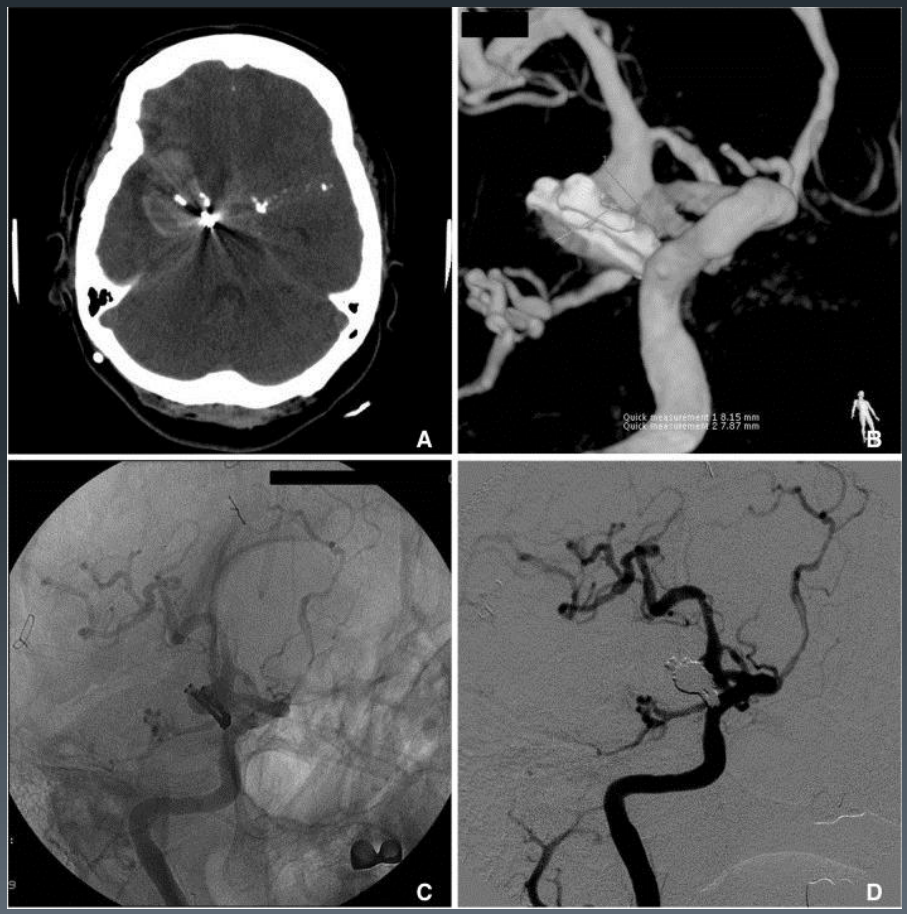
- Anurysm Clipping

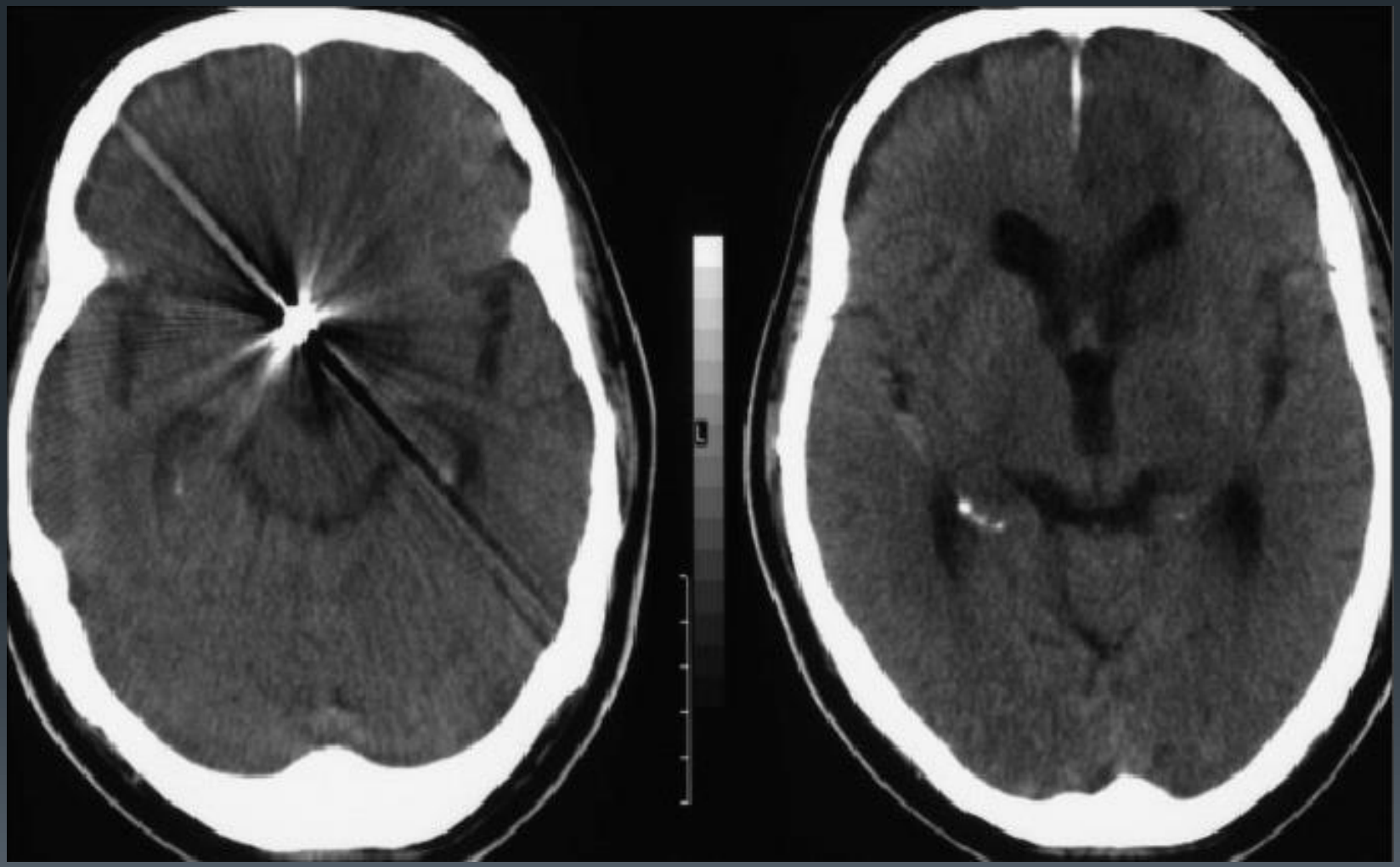


Post Operation Changes in Cranial Ct Scan

Endovascular Interventions





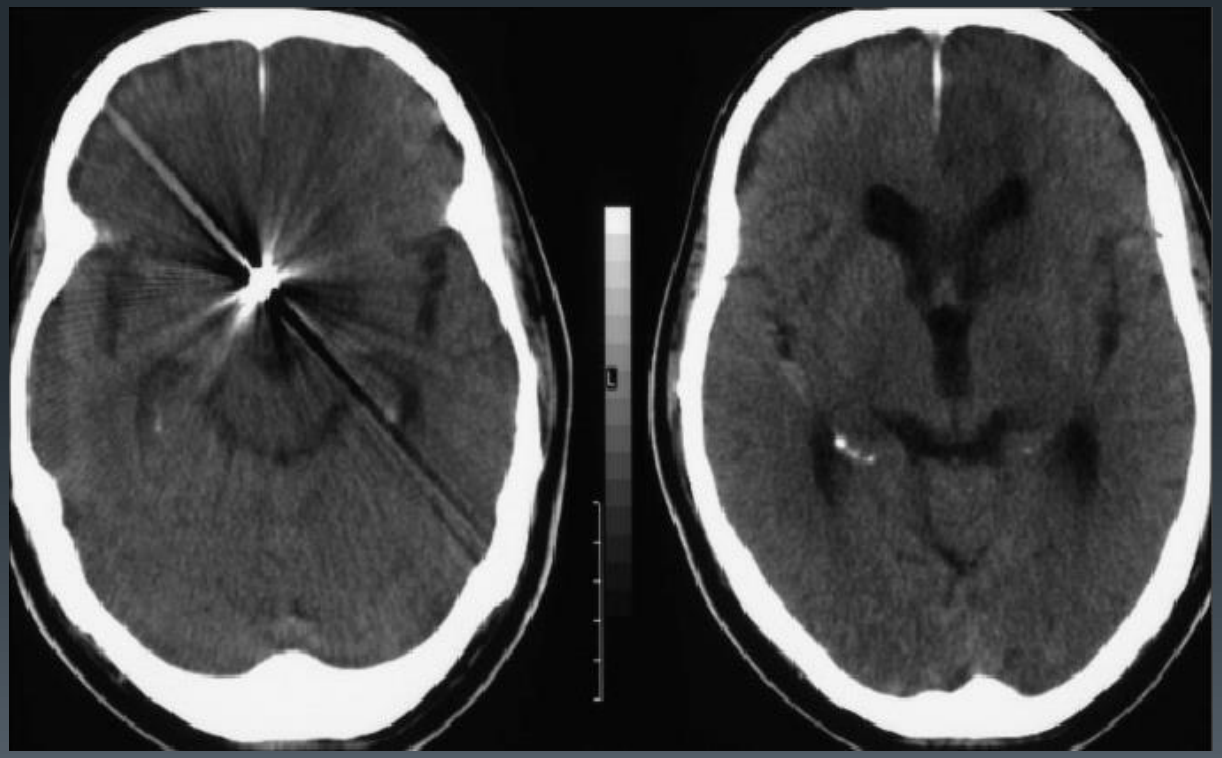


Artifacts

Motion Artifacts

Beam Hardening Artifacts

Metal Artifacts

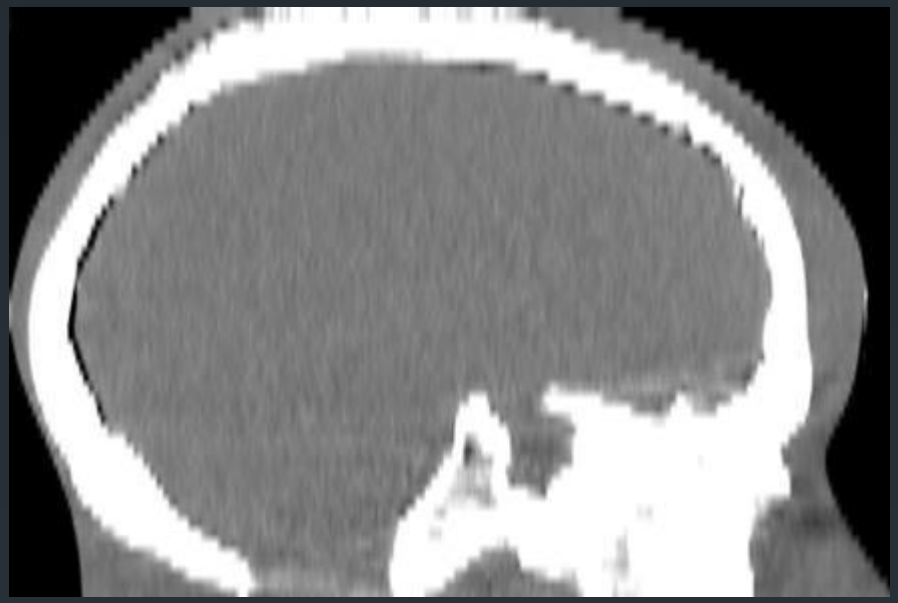


Partial Volume Effect (volume Averaging) Artifacts

Ring Artifacts

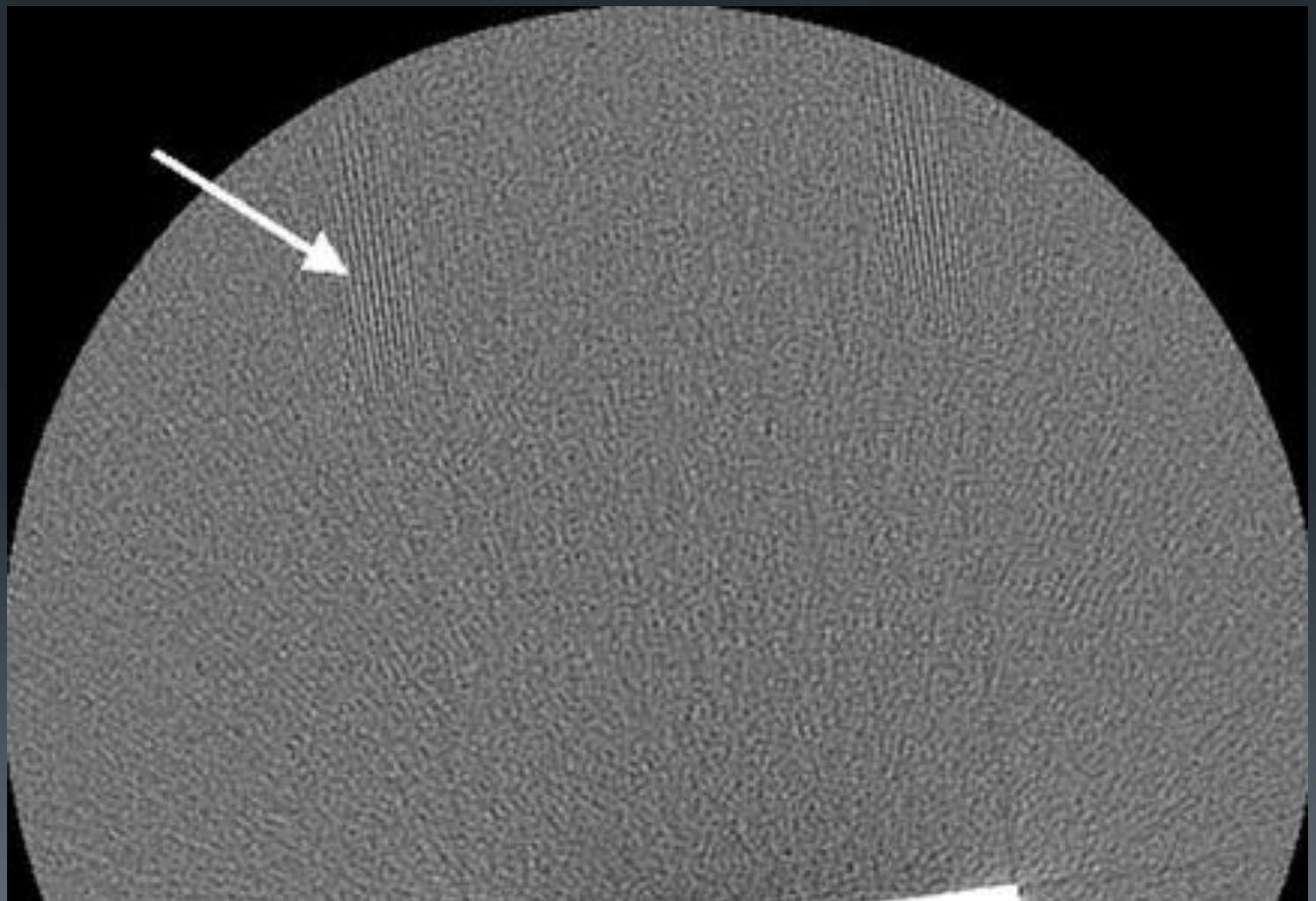
Out of Field Artifacts

Staircase Artifacts

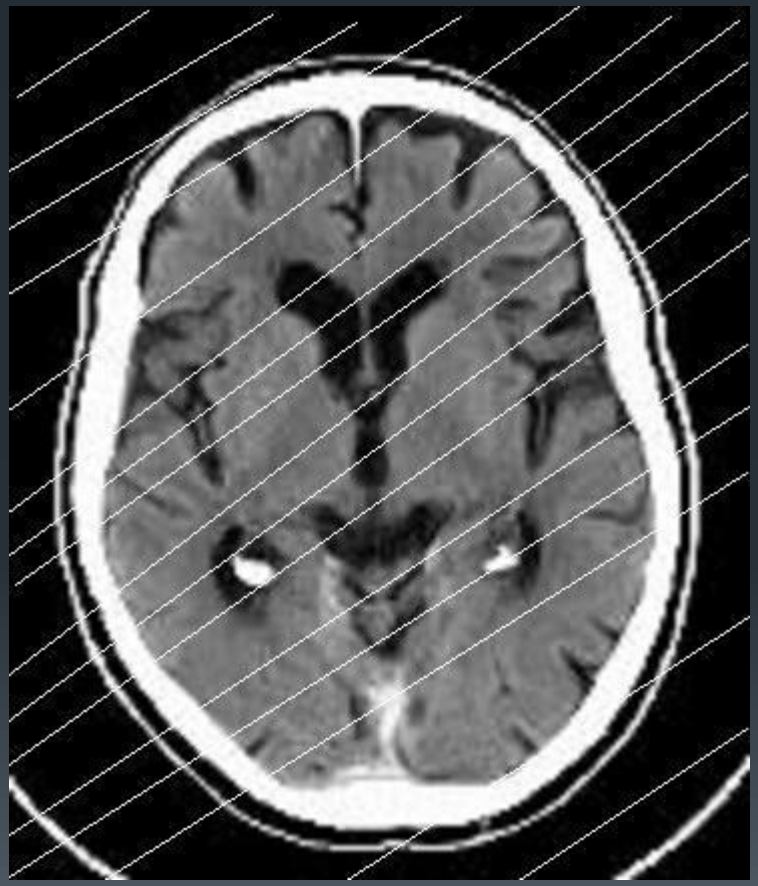


Line Artifacts

Alliasing Artifacts



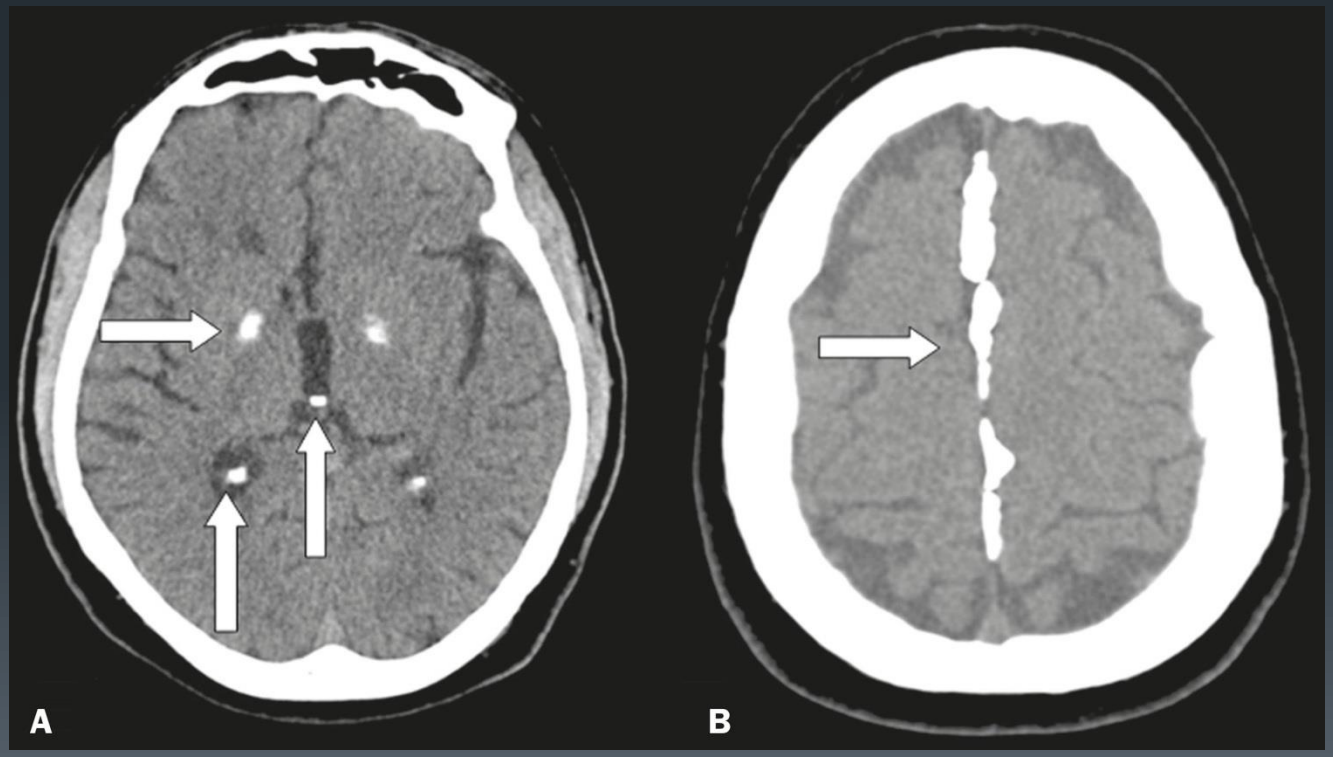
Tube Arcing Artifacts



Normal Calcification

Normal Calcification

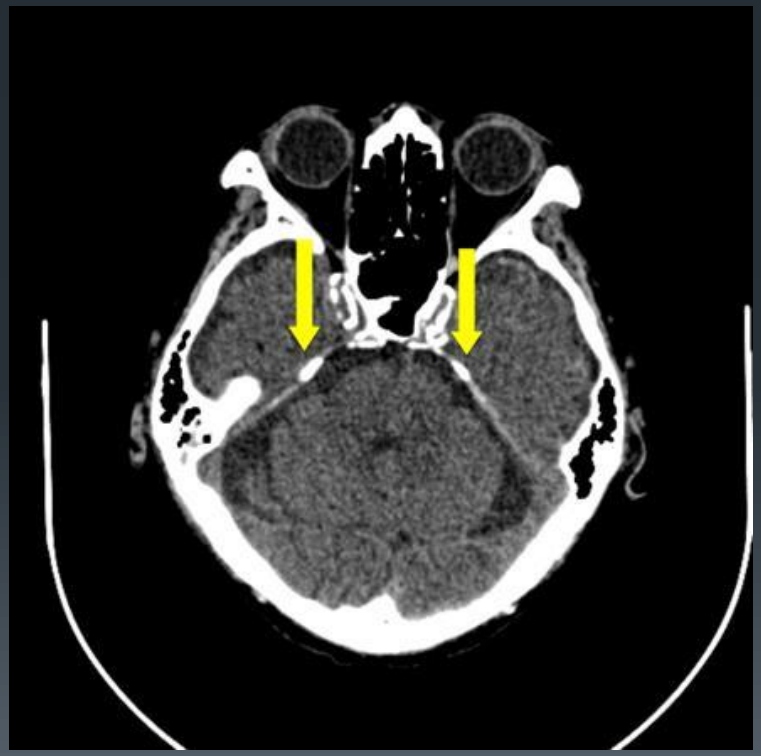
Normal Calcification



Normal Calcification

- Habenular Commissure
- Pineal Gland

Normal Calcification




Thanks for your attention