Basics of CT-HEAD

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1. Previously known as CAT (Computed Axial Tomographic) scan.

2. The word tomography derived from Greek word Tomos means slice or section and grapho means to write or describe

3.Tomography is an imaging by sectioning that uses any kind of penetrating wave

FEW WORDS BEHIND THE CT SCANINNG

1. The development of this non-invasive technique in the 1970s revolutionized the investigative approach to intracranial pathology & it is now used routinely.

2. In our country it was first established in 1989 in BIRDEM & Dhaka CMH

3. A pencil beam of X-ray traverses the patient's head and a diametrically opposed detector measures the extent of its absorption.

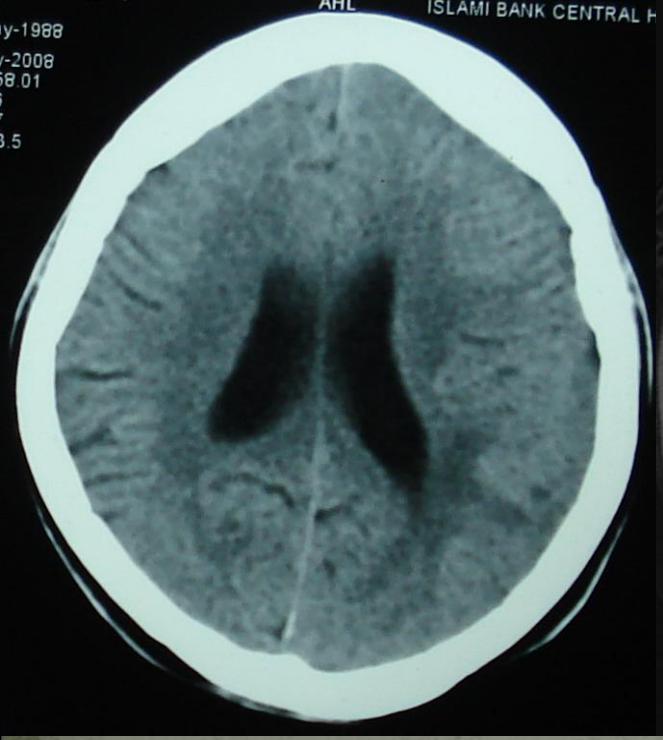
4. It differs from conventional radiography in that a more sensitive X-ray detection system is used and the data is manipulated by a computer.

5. The operator selects the level and thickness to be imaged: usually between 1.0-10mm. Thinner section provide more accurate information.

Types of CT-head view

Usually CT head is the following types:

1. **Tissue window: Here soft tissue is highlighted**
2. **Bony window: Here bone and calcifications are highlighted**
3. **CT head with contrast: Blood vessels and highly vascularized tissue are visible**
4. **Special CT scan of head:**
   - **3D reconstructed CT scan of head**
   - **Plain/Reconstructed CT angiogram of head**



Soft tissue window/plain CT

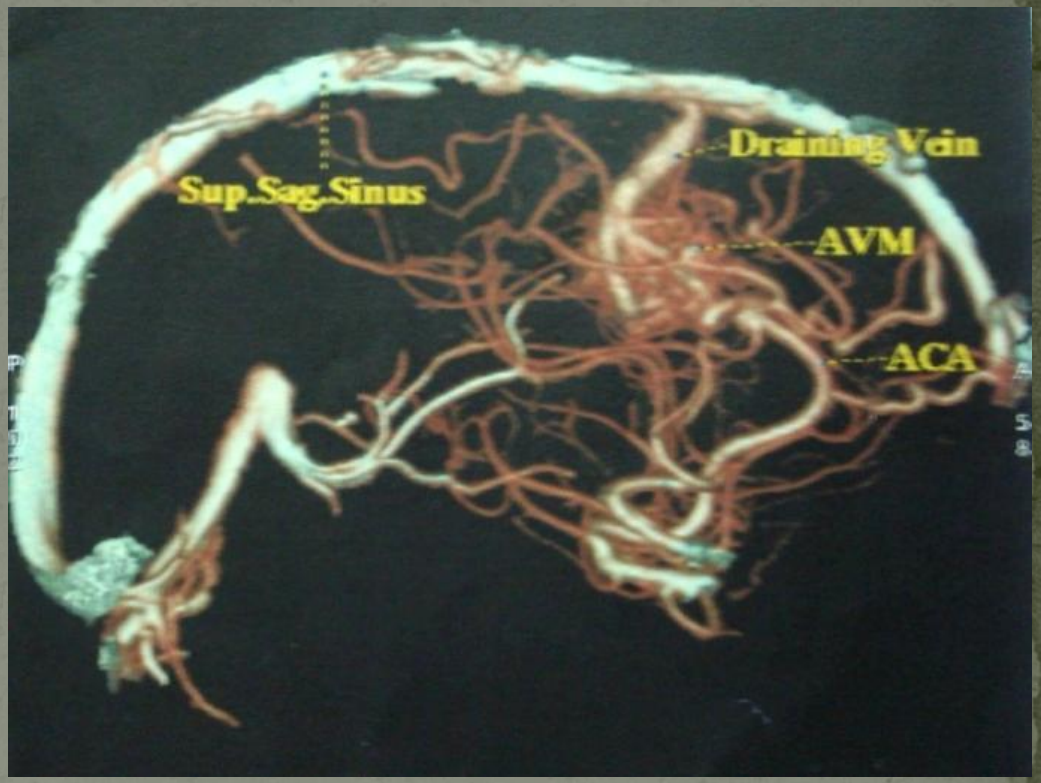
Bony window

IV Contrast CT

3D Reconstructed CT scan of head

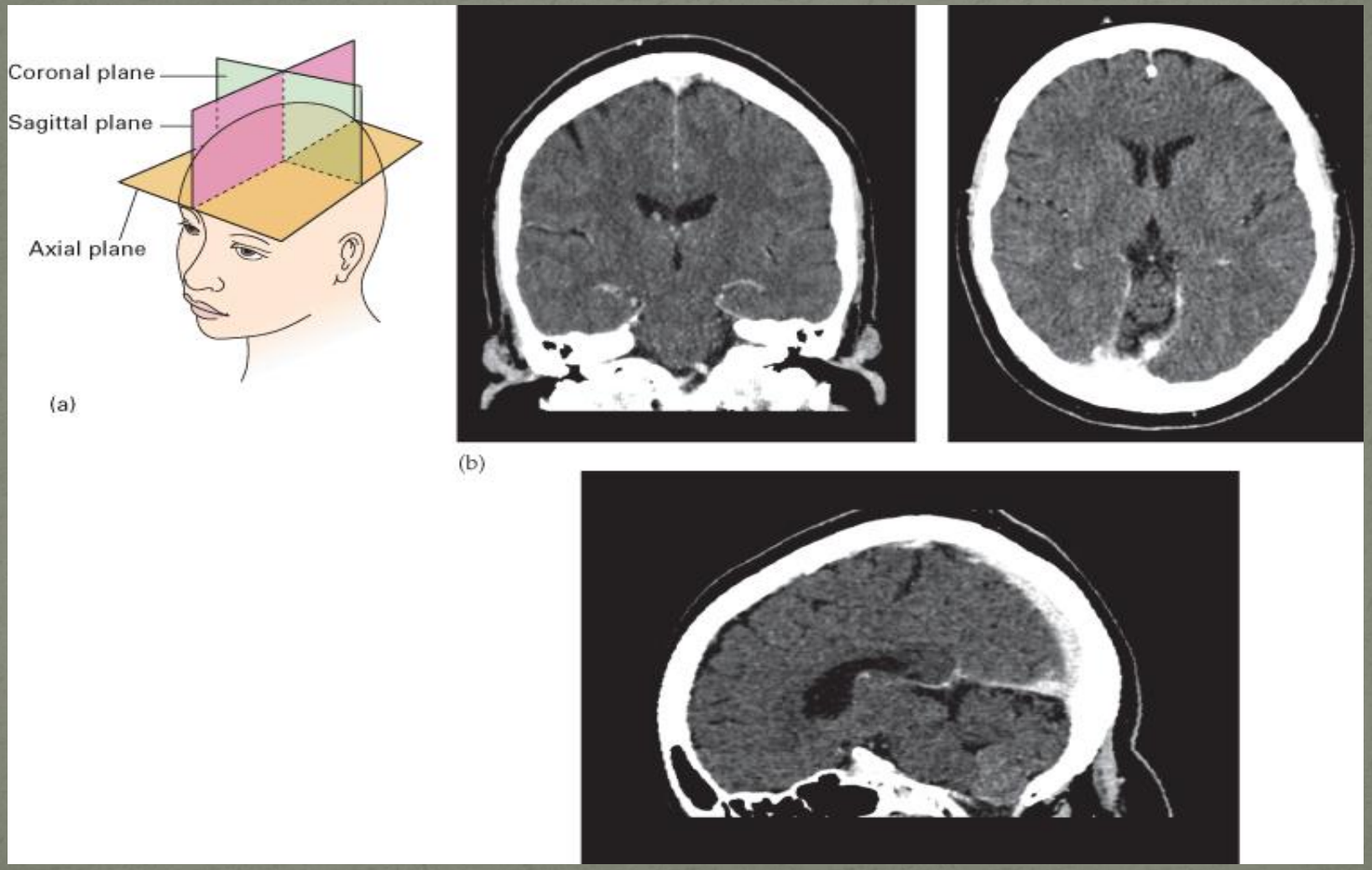
CT angiogram of head

Plain CT angiogram of brain



Reconstructed CT angiogram of brain

Planes of CT head



Axial section

a. Most popular section

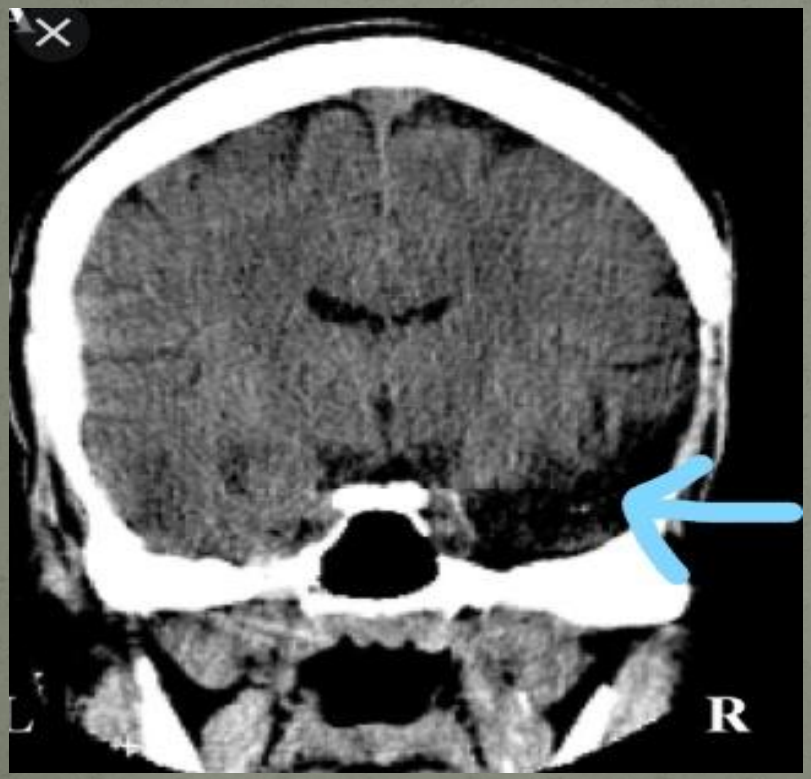
b. Most of the structures are seen here

c. Problem –

- Posterior cranial fossa can not be clearly seen
- Sella and Supra sellar space are not clearly seen
- Demarcation of Cerebellum and Occipital lobe
- Demarcation of Parietal and temporal lobe
- Demarcation of mid brain, pons and medulla.

Coronal section

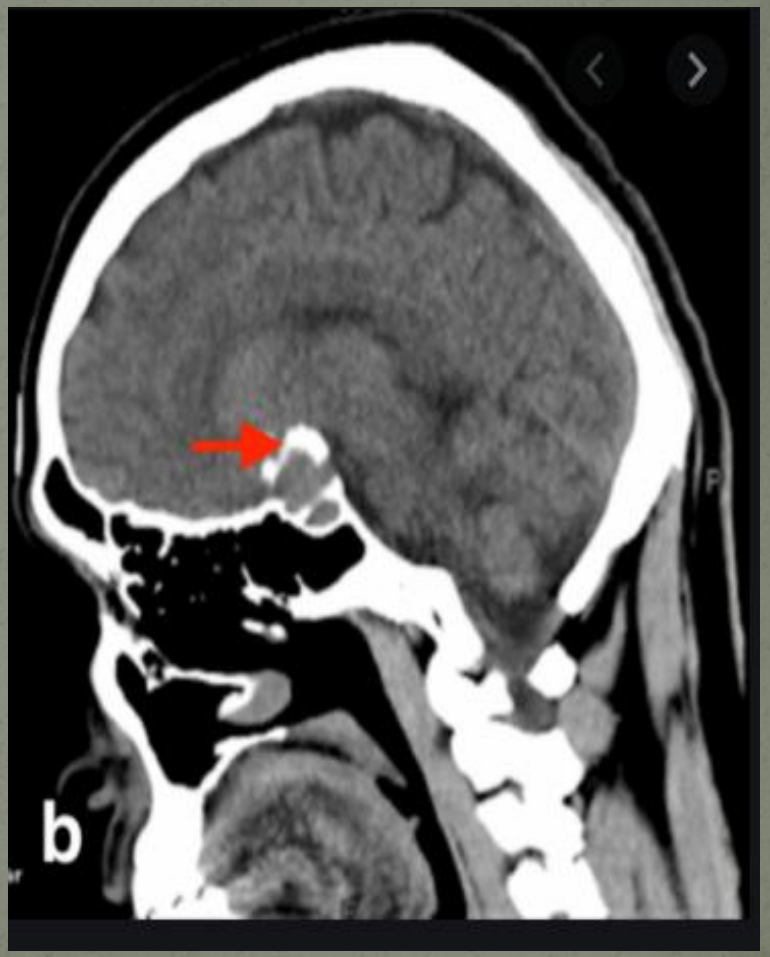
Temporal lobe abnormality



C-P angle tumor

Sagittal section

Sella and supra sellar space. (Pituitary & hypothalamic lesion)



Advantages of CT scan (over MRI)

1. Cheaper
2. More available
3. Quick, it takes about few minutes. So it is the method of choice for restless or critical patients and for babies
4. Bony abnormalities and calcifications can be visualized
5. It can detect acute (< 2 weeks) hemorrhage

Disadvantages of CT scan (over MRI)

1. Radiation hazard, so contraindicated in pregnancy
2. Good resolution cannot be achieved in all planes. In fact, only axial planes have good resolution
3. Posterior fossa of head and spinal canal, nerve root lesion, white matter lesion are not well visualized because X-ray cannot penetrate bone

Contd..

4. Poorer resolution. CT cannot detect lesions< 5 mm, whereas MRI can detect up to 1 mm. But now a days 64 slice CT scan can take 1 mm section
5. CT cannot detect inflammatory/ demyelinating lesions
6. In acute Infarct CT may be negative for first 6-12 hrs.

Indications of CT- Head

1. Vascular lesion (Stroke)
2. Head injury
3. ICSOL(tumor, cyst, metastasis)
4. Infective(tuberculoma, brain abscess, hydatid cyst, toxoplasmosis, cysticercosis, HIV)
5. Cerebral edema
6. Hydrocephalus
7. Secondary causes of Headache and seizure

CT scan of head is expressed in terms of density

Isodense: Normal parenchyma is isodense

Hyperdense: Whiter than normal parenchyma

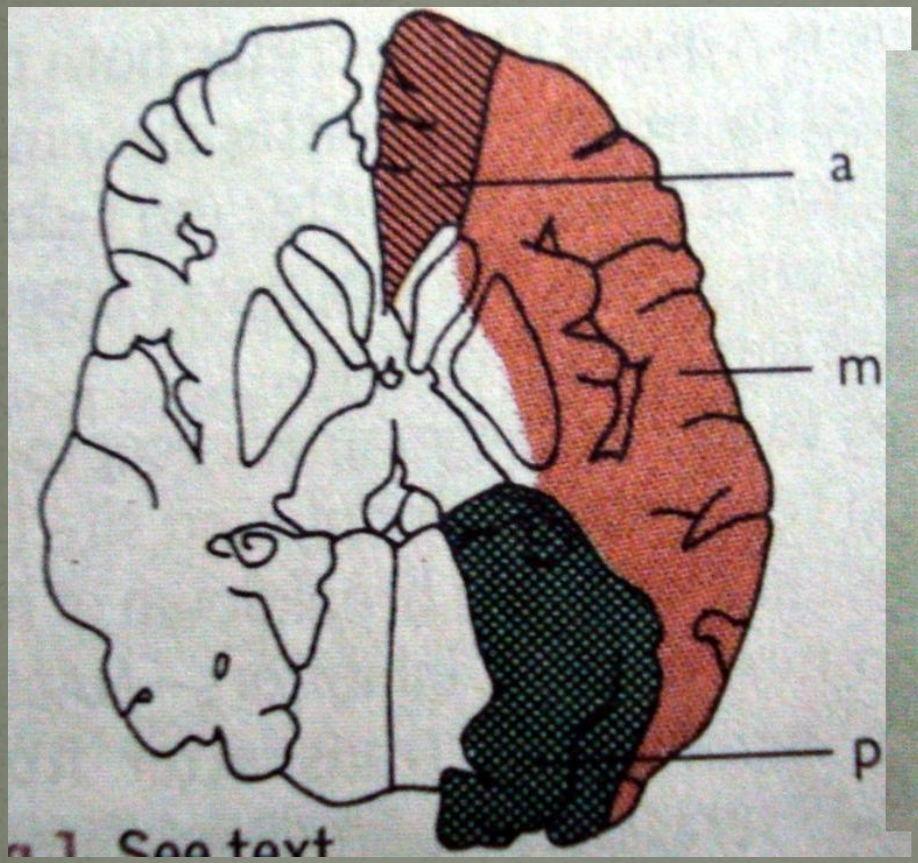
Hypodense: Darker than normal parenchyma

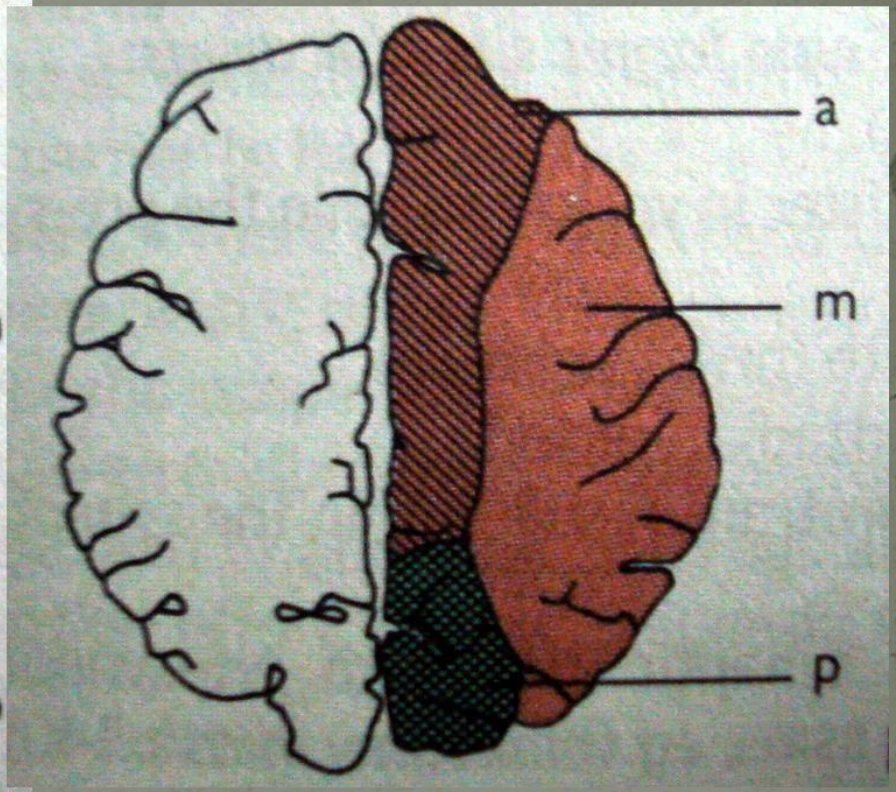
Hypodense (black) lesions

1. Air e.g. In nasal cavity, paranasal sinuses
2. Fluid except blood, e.g. CSF, water(edema)
3. Infarct
4. Space occupying lesions (SOL) especially cystic lesion
5. Old hemorrhage (>2-3 weeks)

Infarct	SOL
1. Maintain vascular territory	1. Not maintained
2. Not well circumscribed	2. Well circumscribe margin
3. Edema – small / not disproportionate	3. Edema – disproportionate/ large
4. No / minimal pressure effect	4. Pressure effect (sulcal & ventricular effacement, midline shifting)
5. Not take contrast at margin (enhancement)	5. Contrast enhancement (at margin / tissue)

Vascular territory





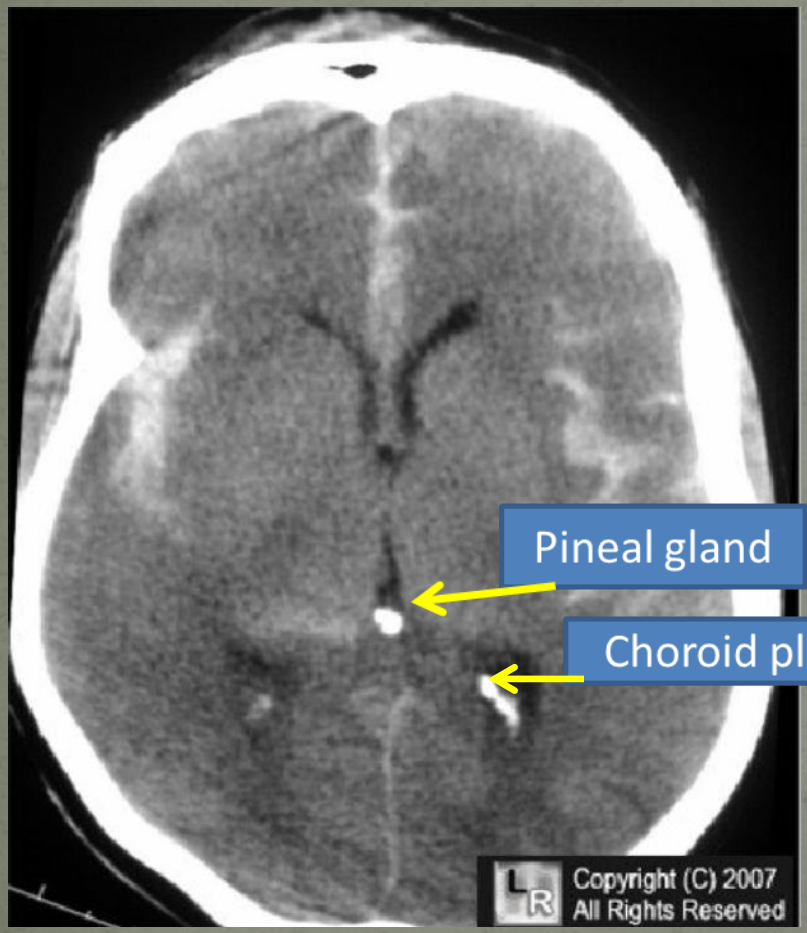
Hyperdense (white) lesions

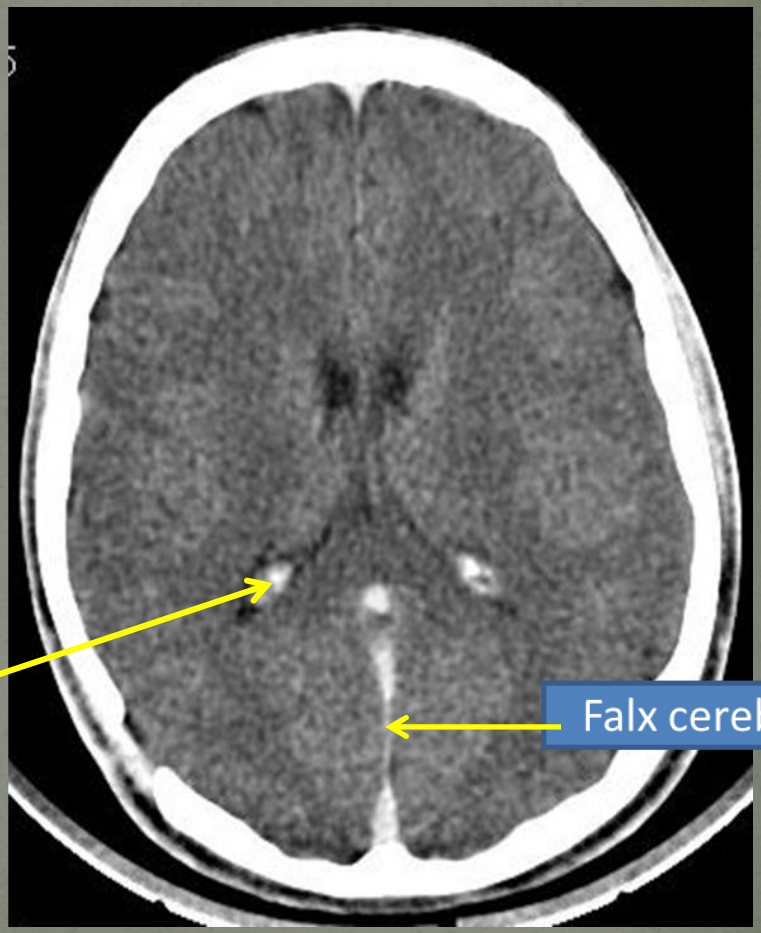
1. Bones
2. Calcifications
3. Acute Haemorrhage(Blood pigments- bilirubin and biliverdin are radio opaque)
4. Contrast material

Physiological calcifications

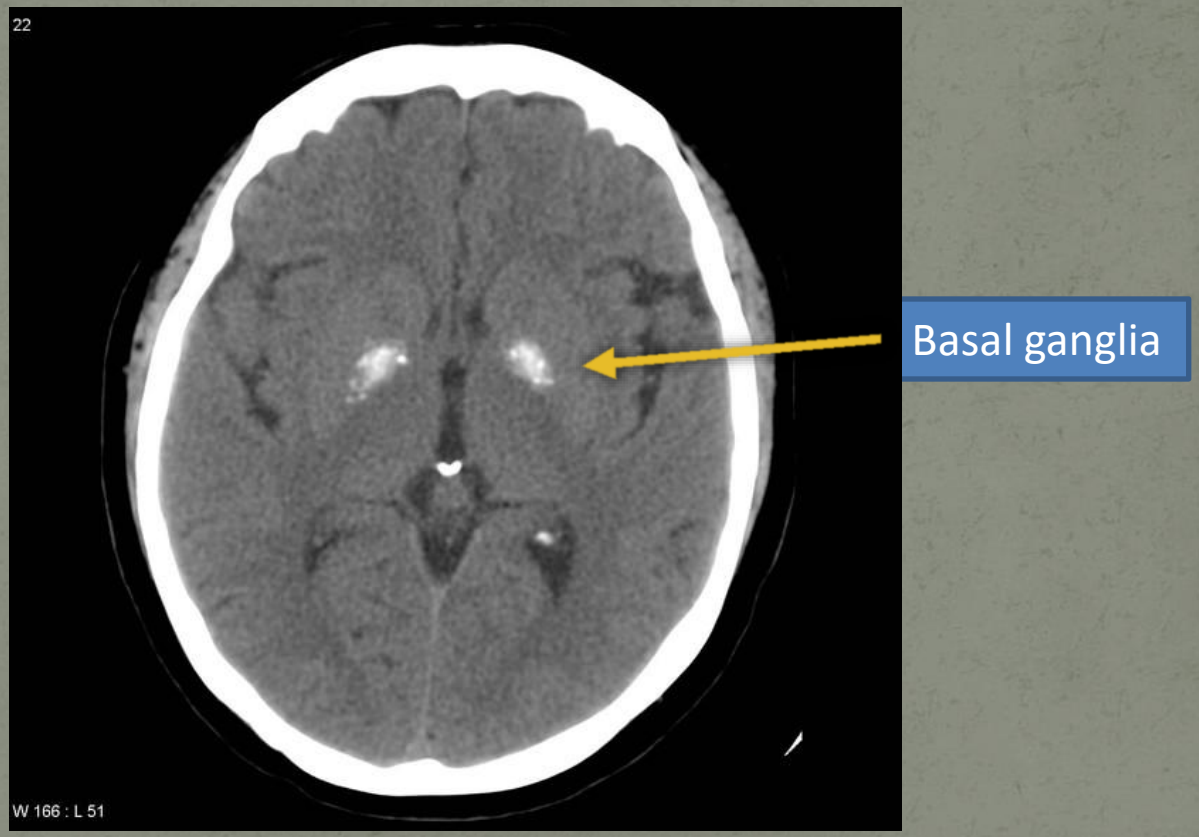
1. Falx cerebri
2. Choroid plexus(suspended in the posterior horn of lateral ventricle)
3. Pineal gland(in third ventricle)
4. Basal ganglia(Speckled calcifications)
5. Tentorium cerebelli

Physiological calcifications





Physiological calcifications



Mixed density lesion

ICSOL(mostly benign tumor)

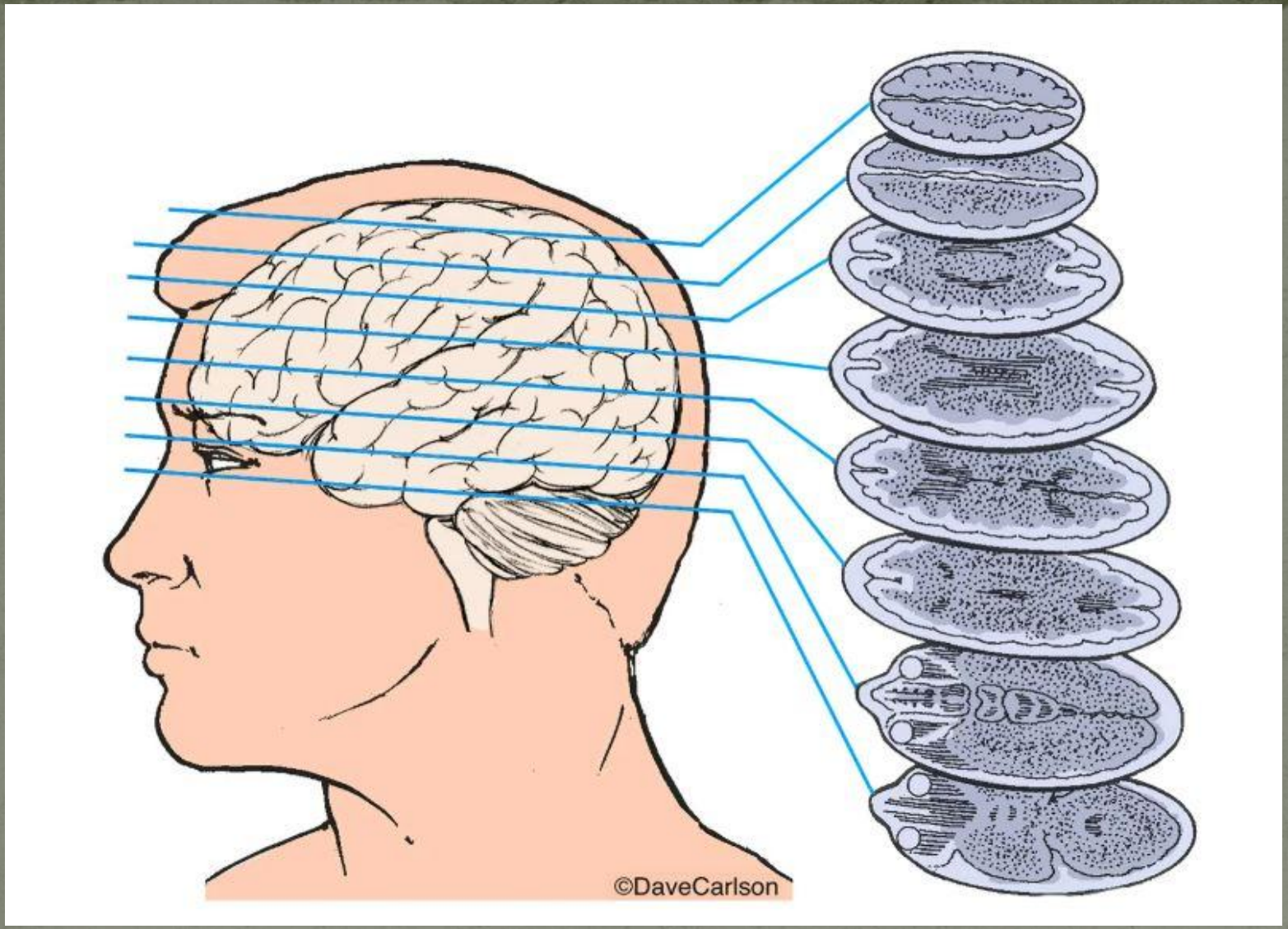
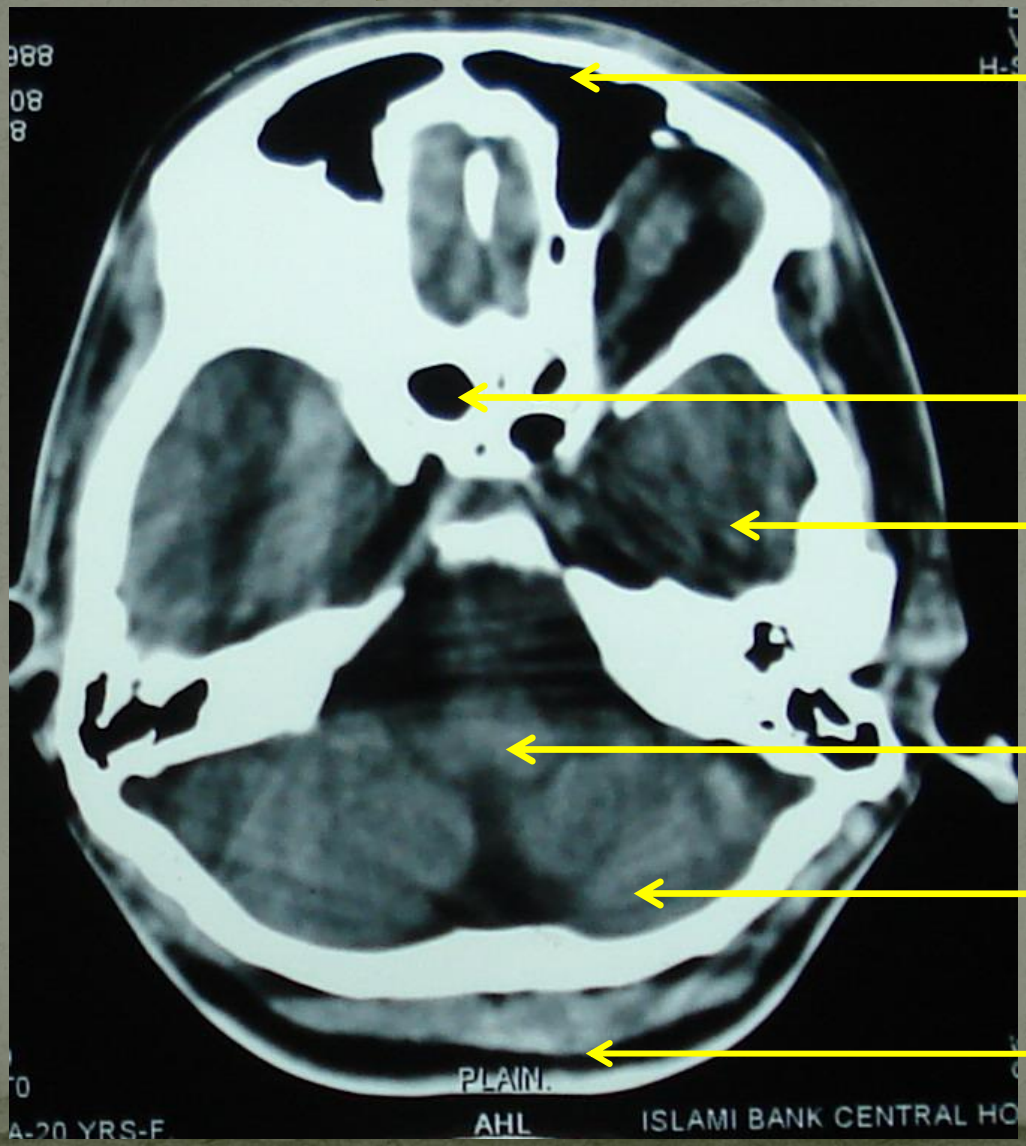


Illustration showing how CT scan takes 'slice' images at successive levels.

1st section from Base of the Skull

2nd section from Base of the Skull

3rd section



Frontal air sinus

Sphenoidal air sinus

Temporal lobe

Medulla oblongata

Cerebellum

Scalp

4th section

At the level of lower pons

Orbital cavity

Sphenoidal air sinus

Ant. clinoid

Temporal lobe

Dor. sela

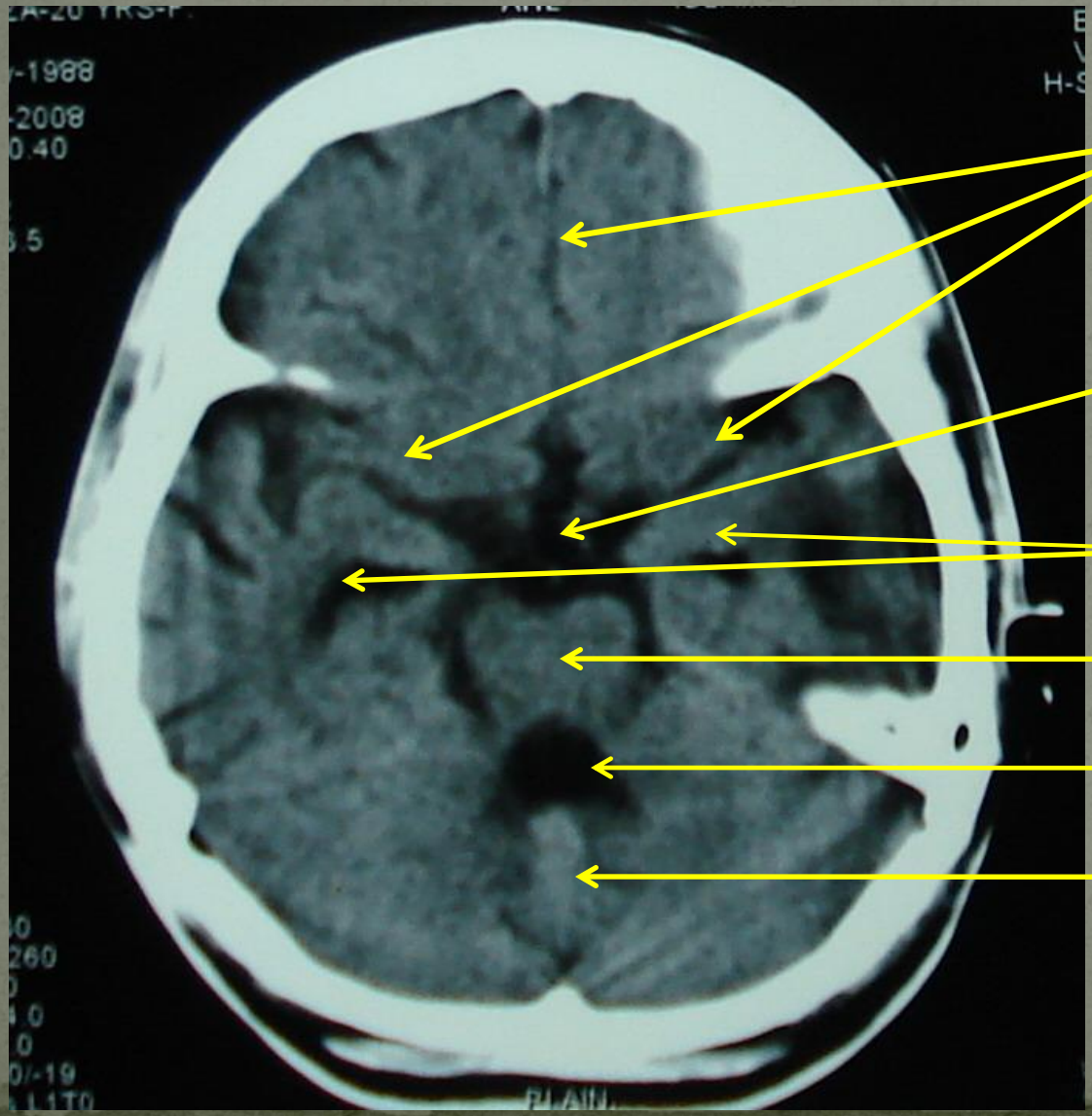
Lower Pons

4th ventricle

Cerebellum

5th section

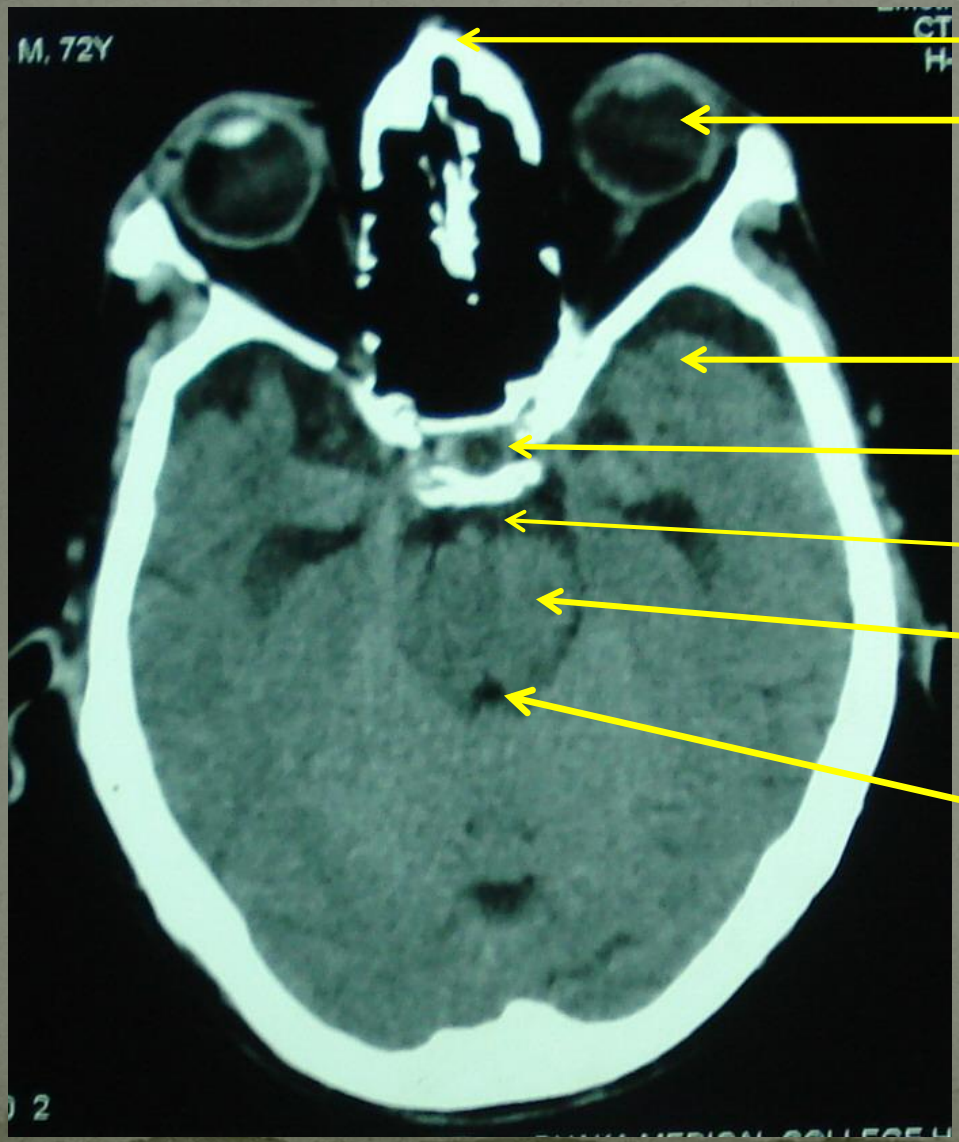
At the level of mid Pons



- Inter hemispheric fissures
- Chiasmatic / basal cistern
- Temporal horn of lat. ventricle
- Mid Pons
- 4th ventricle
- Vermis of cerebellum

6th section

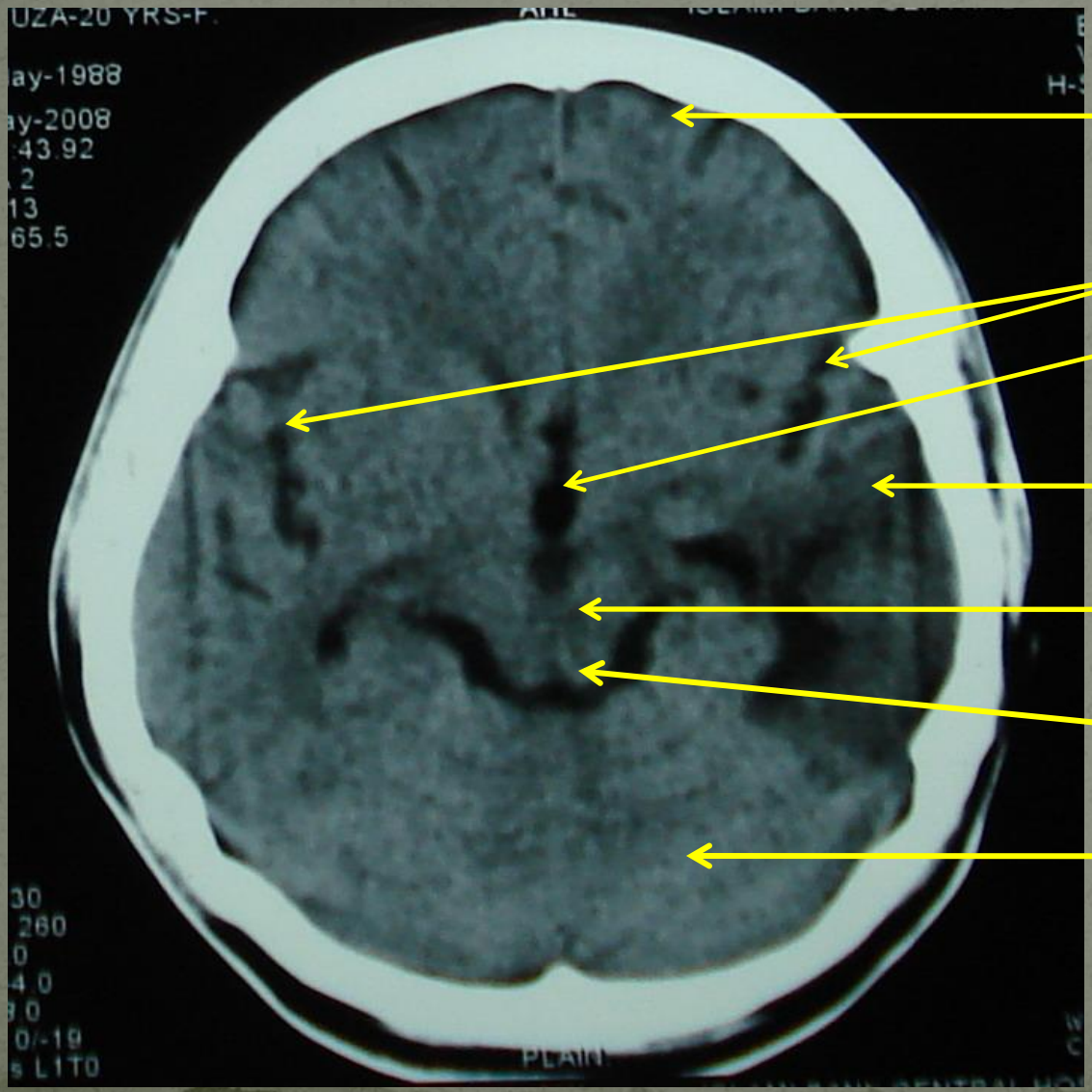
At the level of superior pons



- Nose
- Eye ball
- Temporal lobe
- Pituitary fossa
- Basilar artery
- Superior Pons
- 4th ventricle

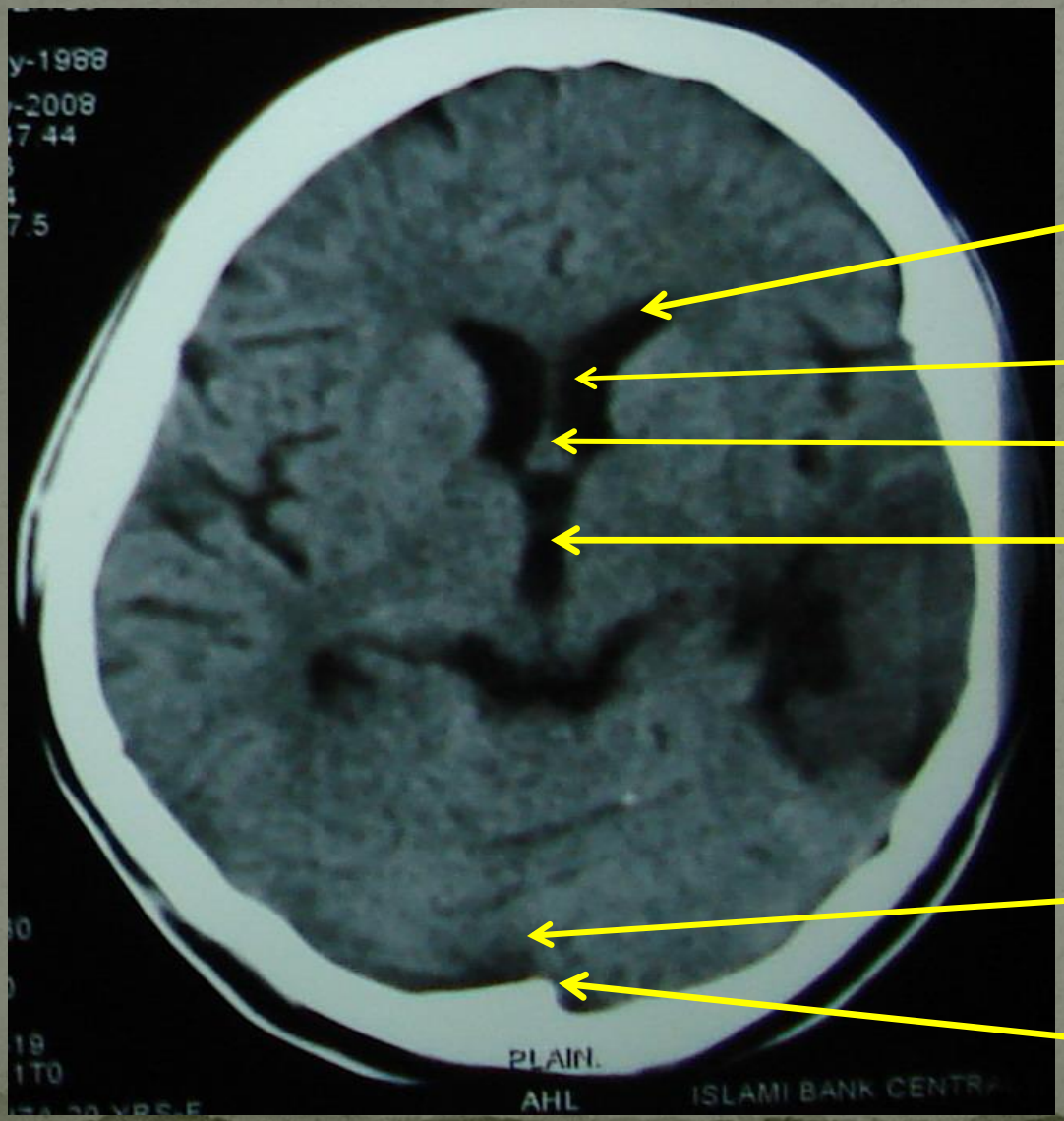
7th section

At the level of Midbrain



- Frontal lobe
- Sylvian fissure
- 3rd ventricle
- Temporo-parietal lobe
- Midbrain
- Quadrigeminal cistern
- Part of cerebellum & occipital lobe

8th section



Ant. / Frontal horn of lateral ventricle

Septum pellucidum

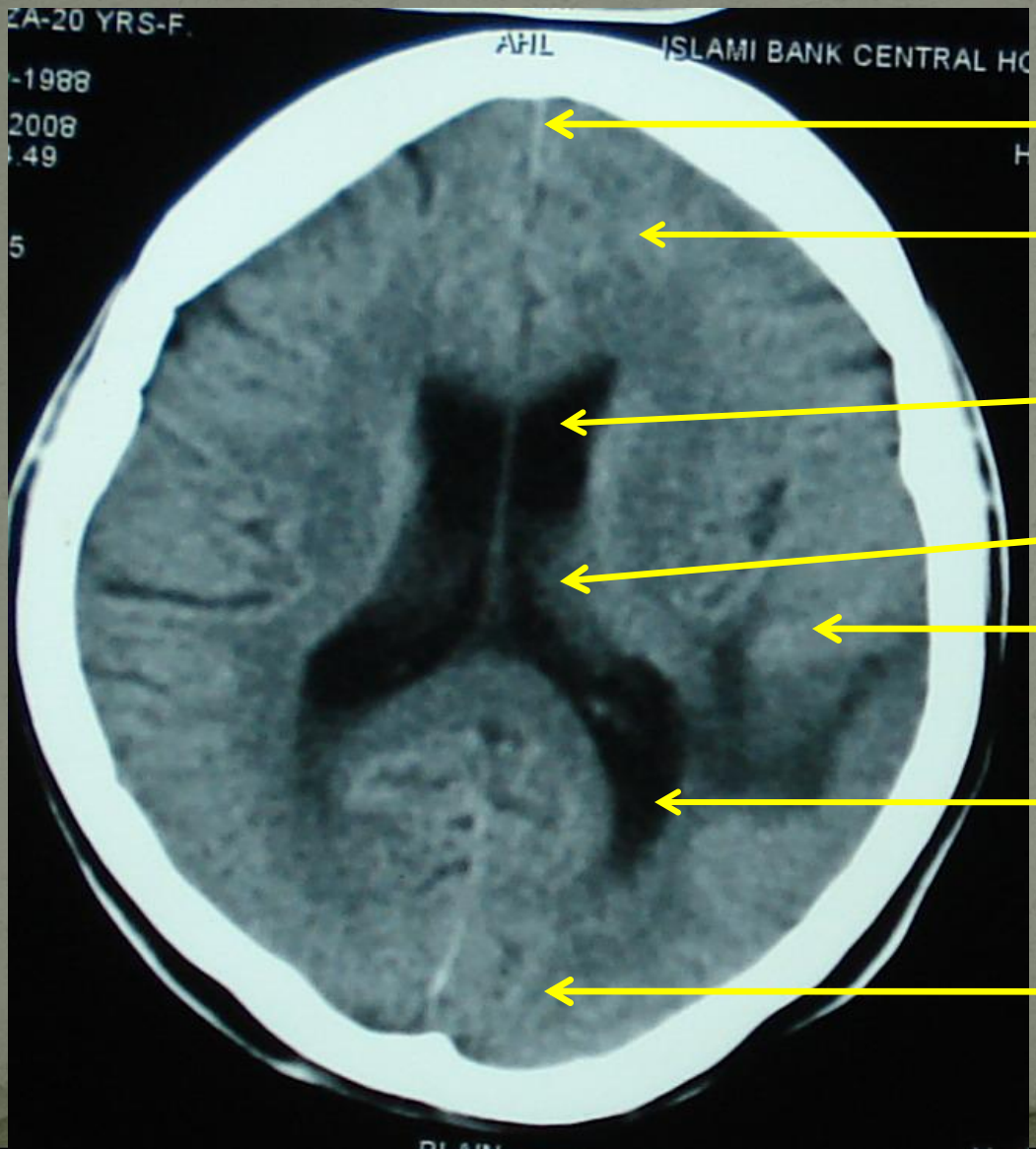
Fornix

3rd ventricle

Occipital sinus in falx cerebelli

Internal occipital protuberance

9th section



Falx cerebri

Frontal lobe

Lateral ventricle

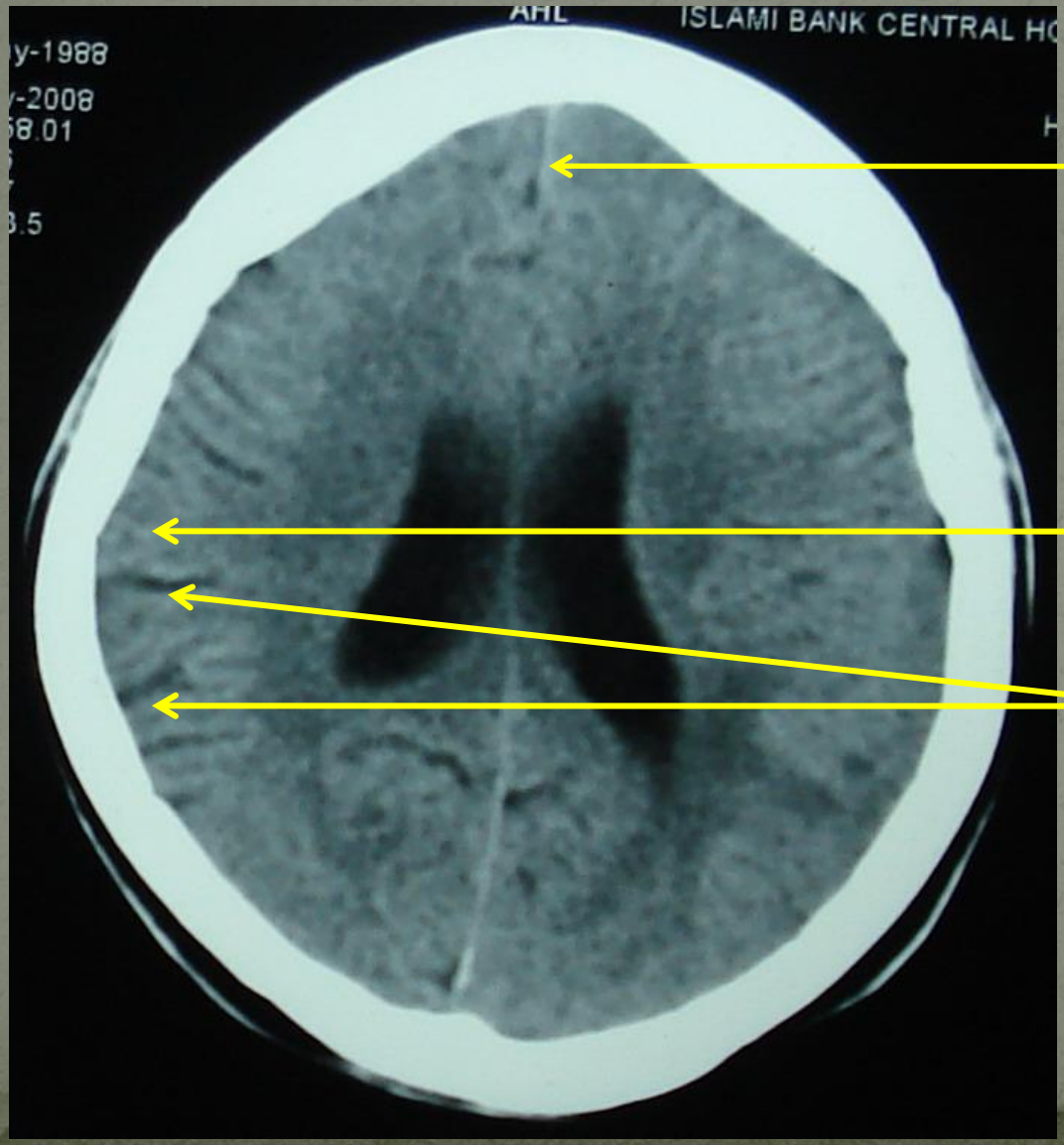
Body of lateral ventricle with choroid plexus

Parietal lobe

Post/Occipital horn of lateral ventricle

Occipital lobe

10th section

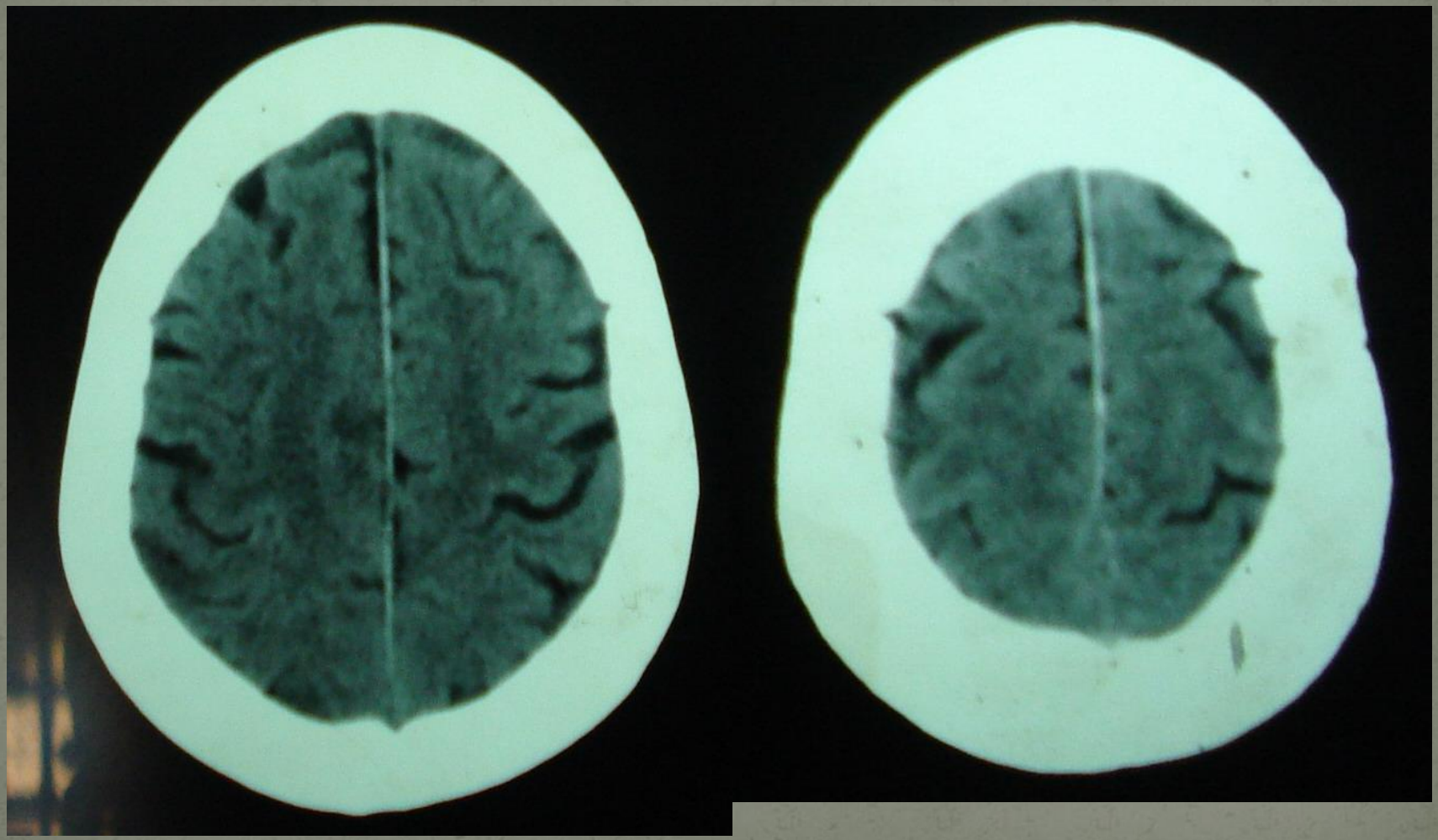


Falx cerebri

Gyrus

Sulcus

11th, 12th section



Common abnormalities (95%)

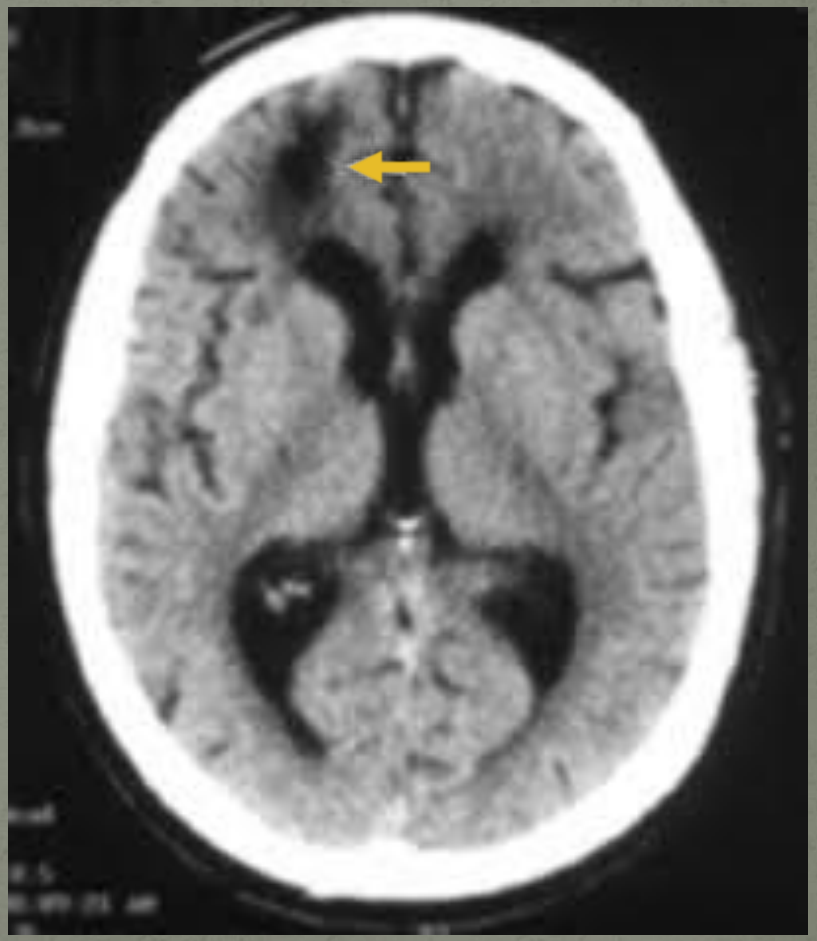
- Infarct :
  - *a. Cortical*
  - *b. Sub-cortical*
  - *c. Cerebellar*
  - *d. Brainstem*
- Hemorrhage
  - *a. ICH*
  - *b. SDH*
  - *c. EDH*
  - *d. SAH*
- Space occupying lesion (SOL)

Uncommon abnormalities (5%)

- Hydrocephalus:
  - *a. Obstructive.*
  - *b. Non obstructive.*
- Diffuse brain edema
- Abnormal calcification

This is a non contrast axial plan CT scan of head showing a hypo dense shadow in right frontal lobe.

So, my radiological diagnosis is infarct in right anterior cerebral artery territory

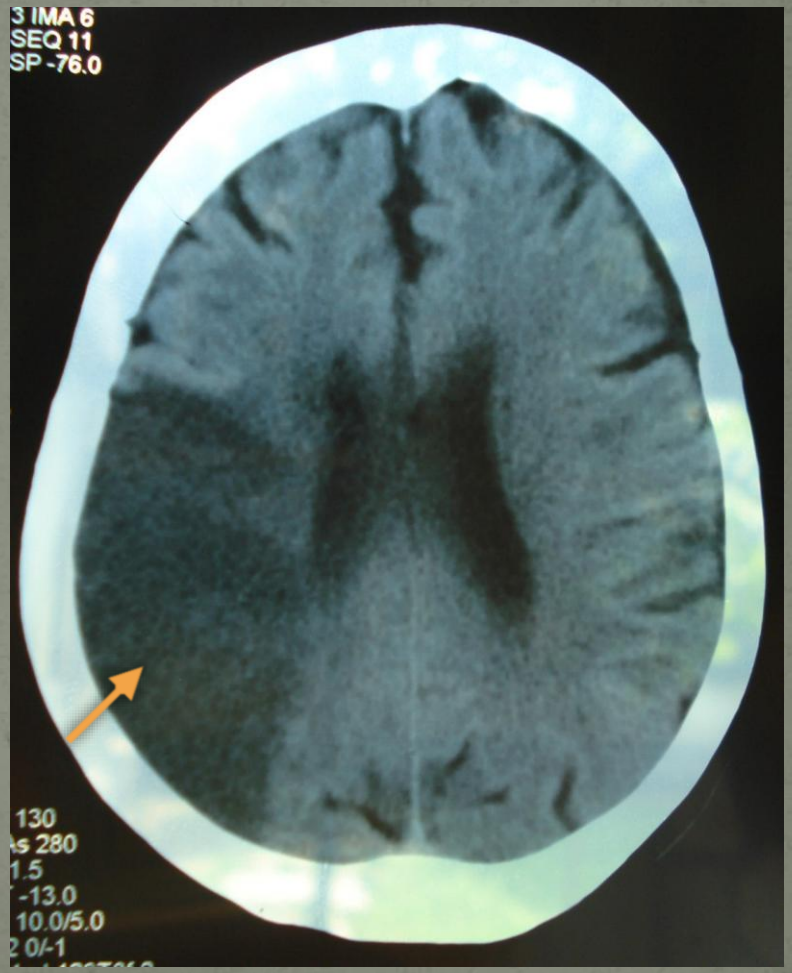


This is a non contrast axial plan CT scan of head showing a hypo dense shadow in right occipital lobe.

So, my radiological diagnosis is infarct in right posterior cerebral artery territory

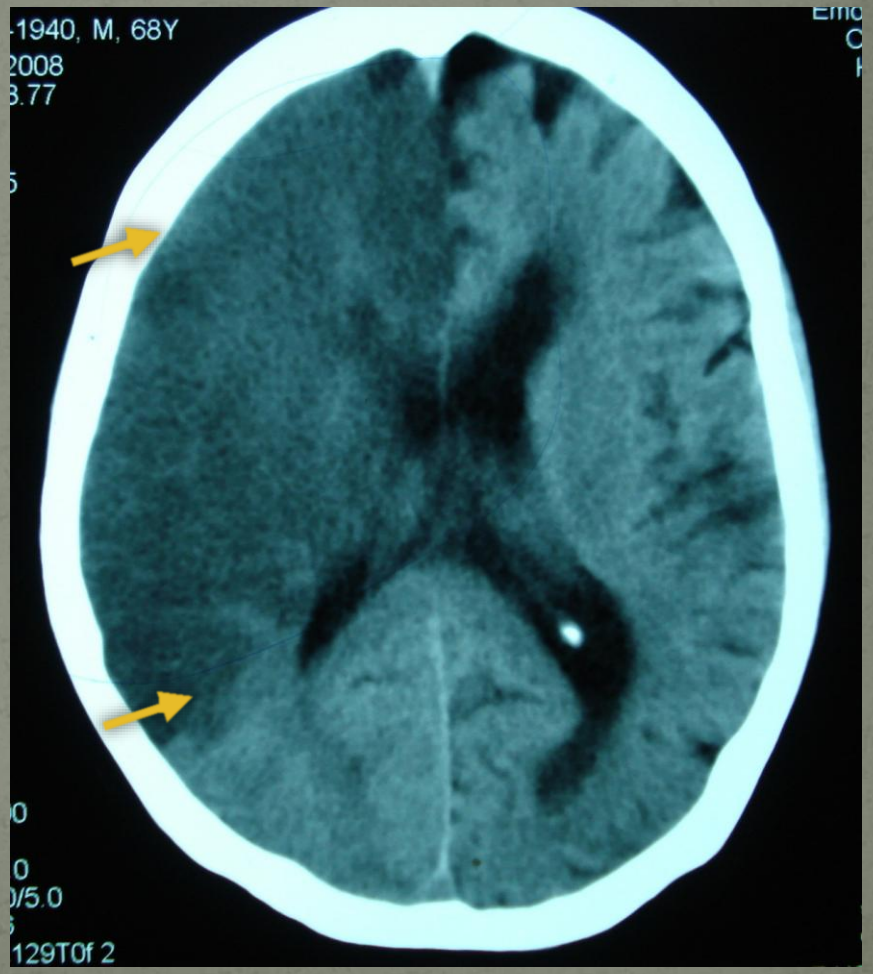
This is a non contrast axial plan CT scan of head showing a hypo dense shadow in right parietal lobe.

So, my radiological diagnosis is infarct in right middle cerebral artery territory



This is a non contrast axial plan CT scan of head showing a hypo dense shadow in right fronto-parietal lobe.

So, my radiological diagnosis is infarct in right anterior & middle cerebral artery territory



Venous Infarct

When to suspect:

a. Para-sagittal/bi thalamic

b. Temporal lobe infarction

c. Cortical edema or hemorrhage

d. Peripheral lobar hemorrhage

e. Arterial territory not maintained

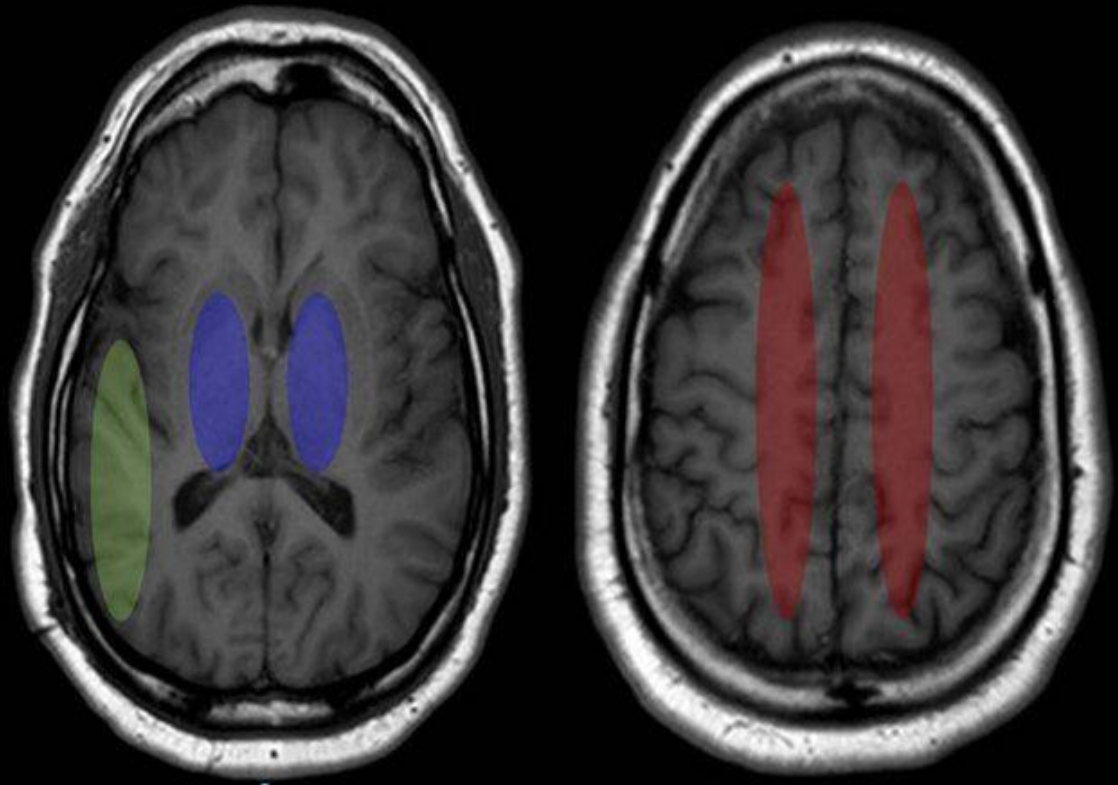
Clinically:

a. Seizure

b. Headache

c. Loss of consciousness

Venous infarction territories



Infarction occurs in a non-arterial location, especially when bilateral or hemorrhagic. Typical locations may be seen as shown on the left:

- Vein of Labbé territory
- Internal cerebral vein territory
- Superior sagittal vein territory

This is a non-contrast axial plan CT scan of head showing a small hypodense area in the left parietal lobe involving the cortex only.

So, my radiological diagnosis is Cortical infarct in left MCA territory.

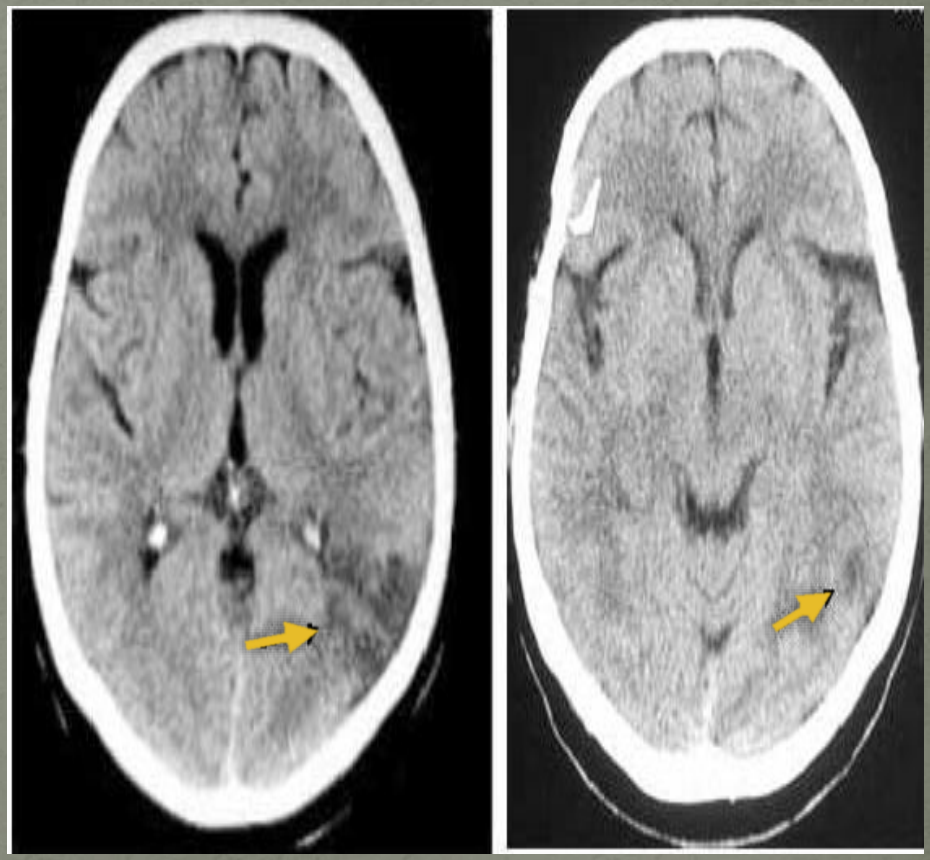
Causes:

a. Cardio embolic

b. Atheroembolic

c. Venous

d. Metastatic

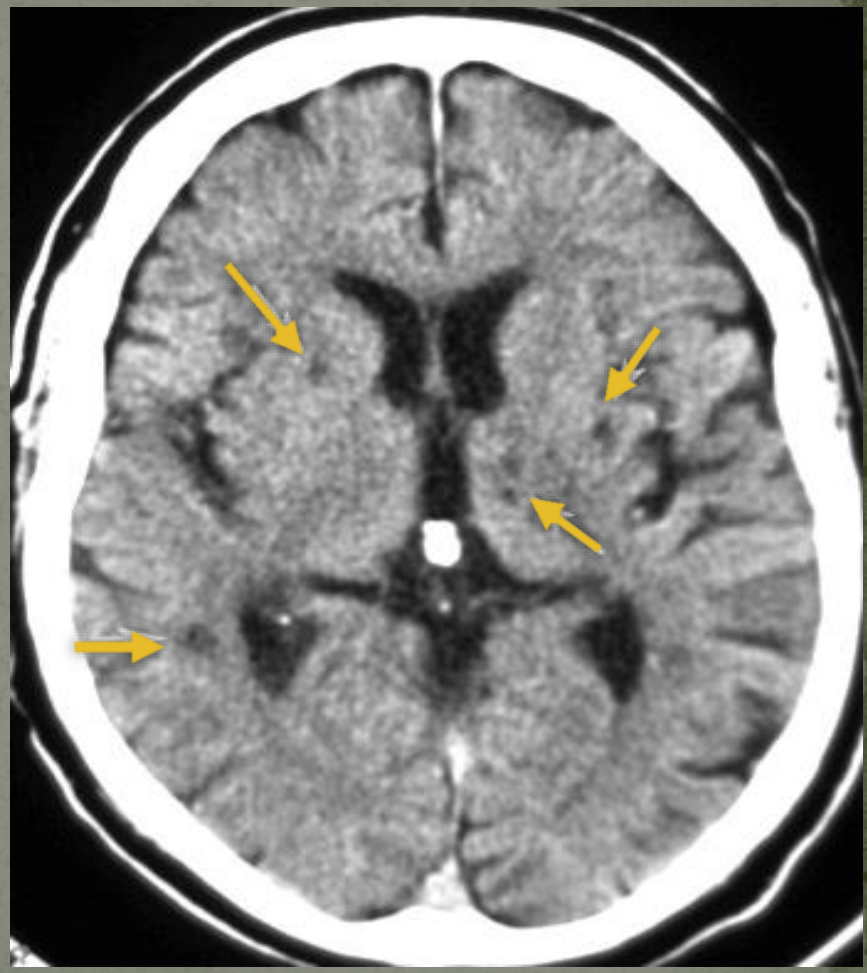


This is a non-contrast CT scan of head showing multiple small hypodense shadows in bilateral thalamo-ganglionic regions.

So, my radiological diagnosis is bilateral lacunar infarcts.

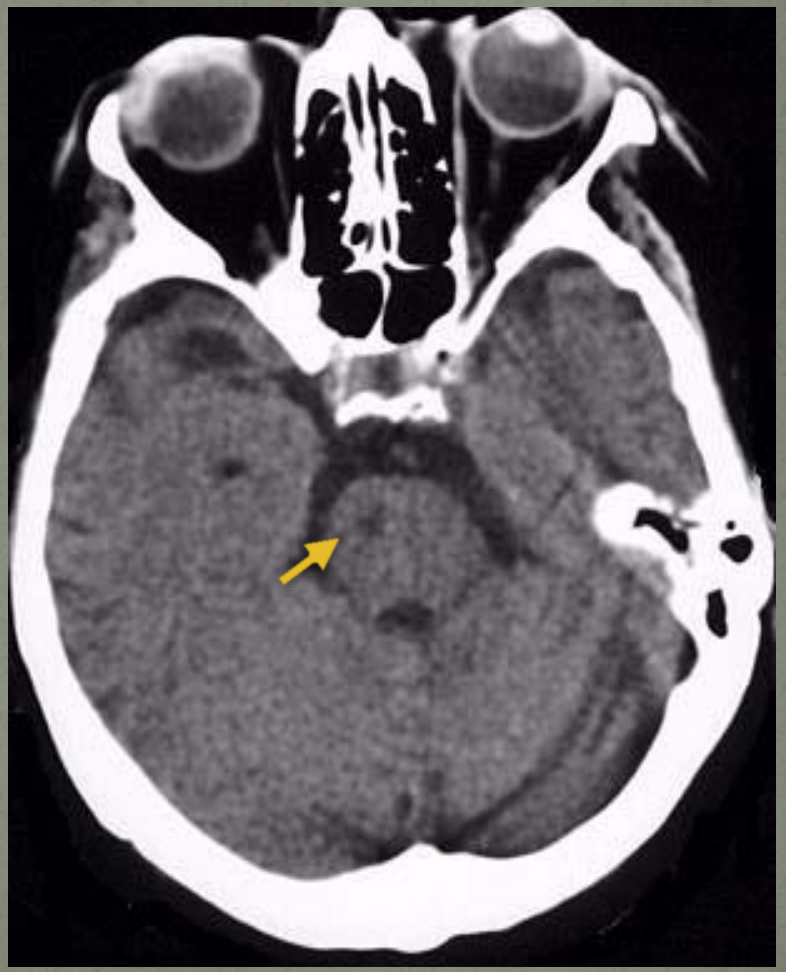
Q: What will be the possible cause.

Ans: Athero-embolism causing blockage of lenticulo-striate (end artery) branch of cerebral arteries.

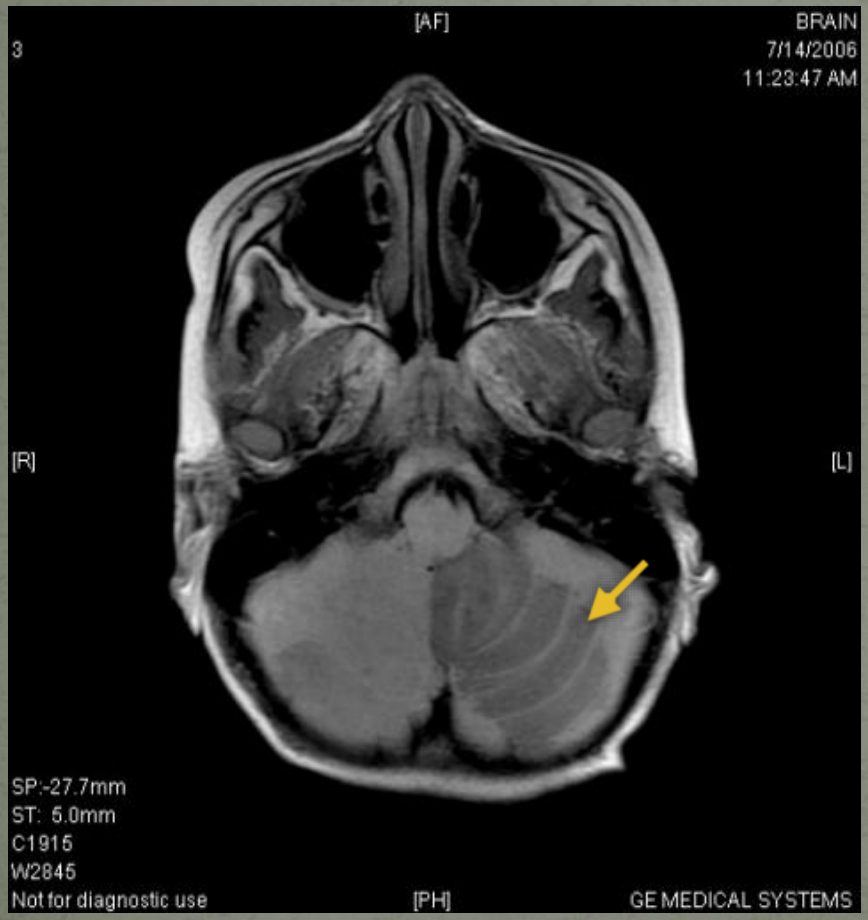


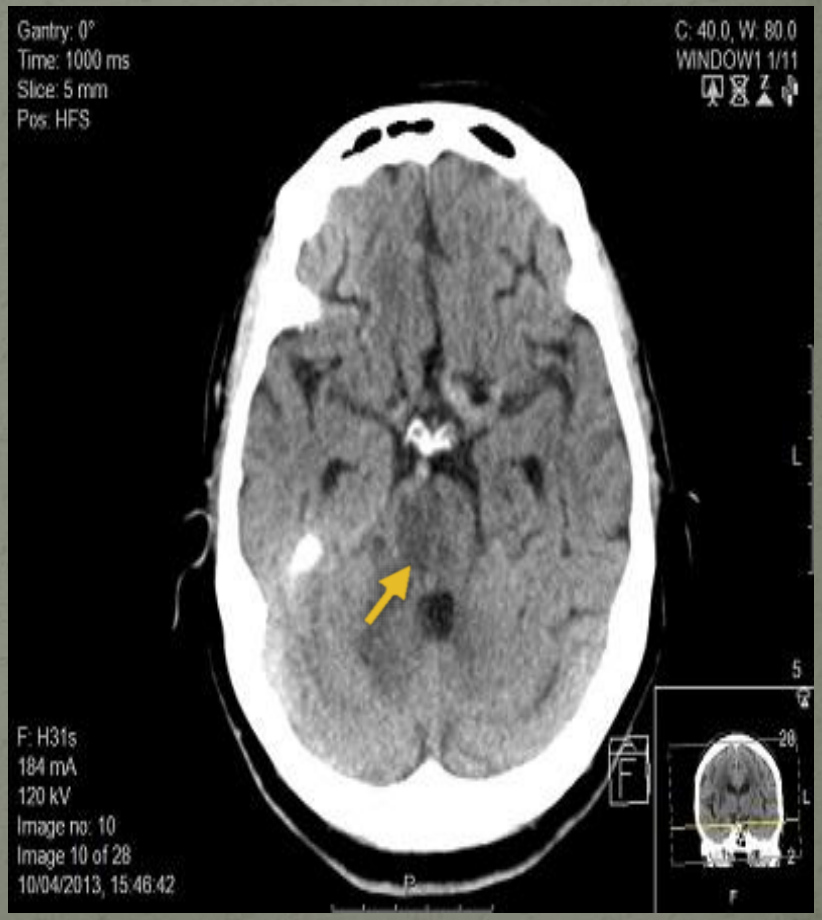
This is a non contrast axial plan CT scan of head showing a hypo dense shadow in right side of the pons.

So, my radiological diagnosis is infarct in the pons

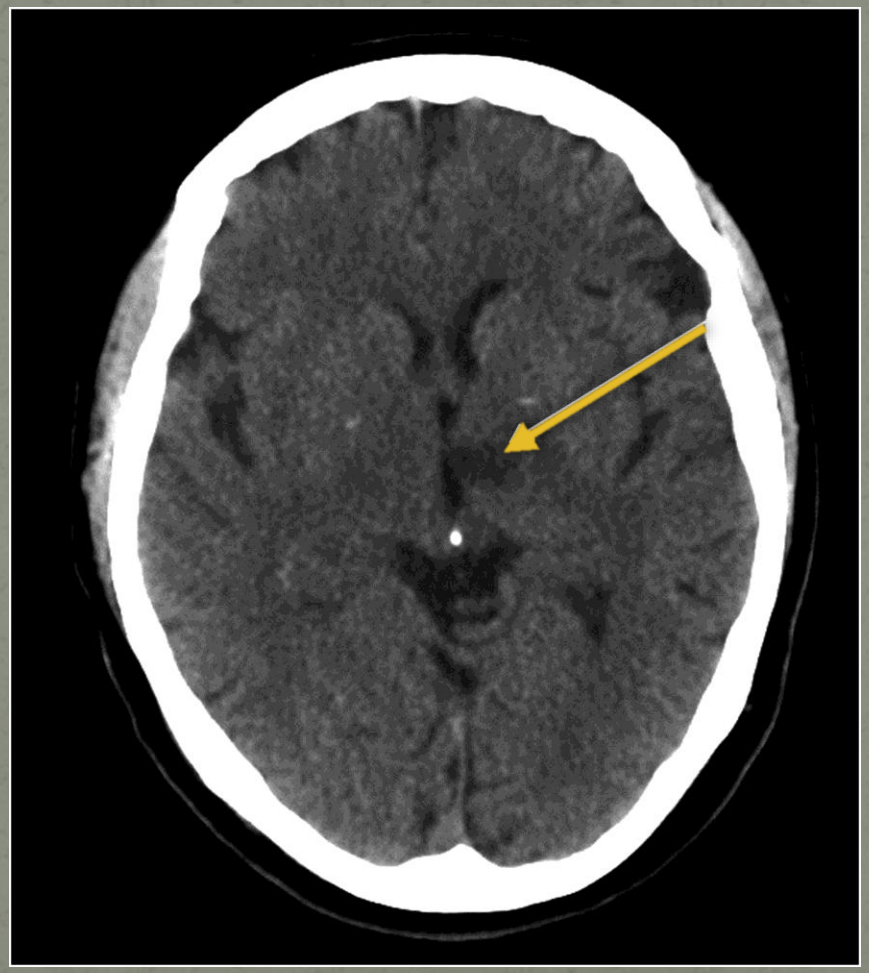


Lt. Cerebellar & brain stem infarct





Left Thalamic Infarct

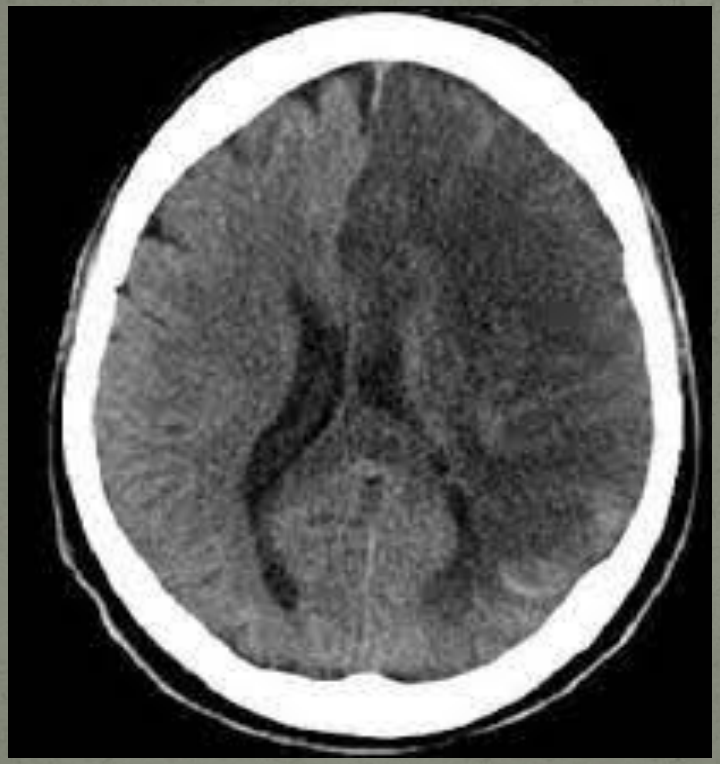


Old vs New Infarct

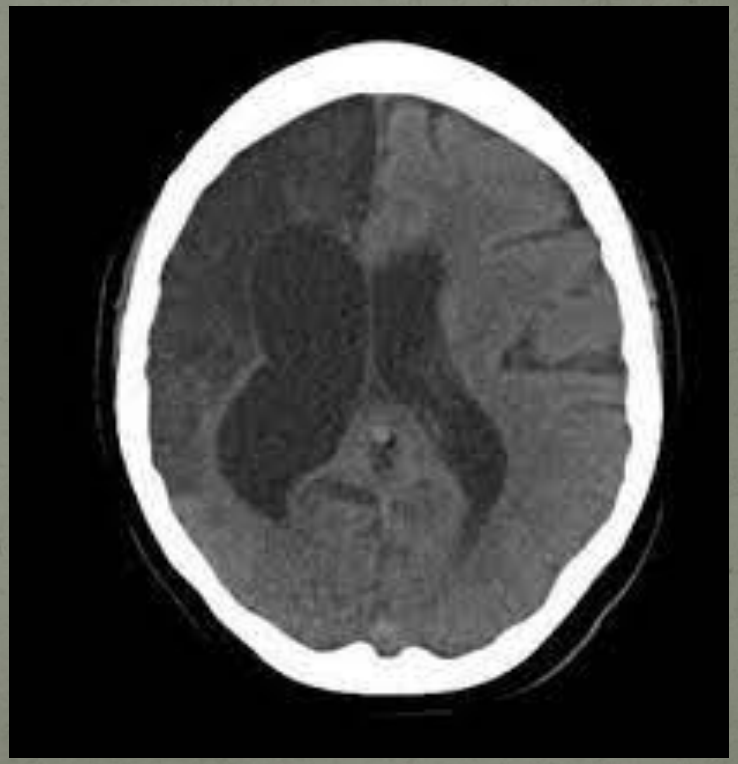
New Infarct	Old Infarct
a. Less hypodense	a. More hypodense
b. Larger	b. Smaller due to gliosis
c. Ventricle- normal	c. Ventricles- larger
d. Sulcus obliterated	d. Sulcus prominent

In the same side

New Infarct



Old Infarct(Gliosis-Encephalomalacia)



Hemorrhagic transformation of Infarct

Risk factors:

a. Large stroke

b. Increase age

c. Uncontrolled blood pressure.

d. Hyperglycemia

e. Bleeding and clotting disorder

f. Drugs: anticoagulants and thrombolytics

Cerebral Edema

a. Density similar as infarct

b. Do not maintain vascular territory.

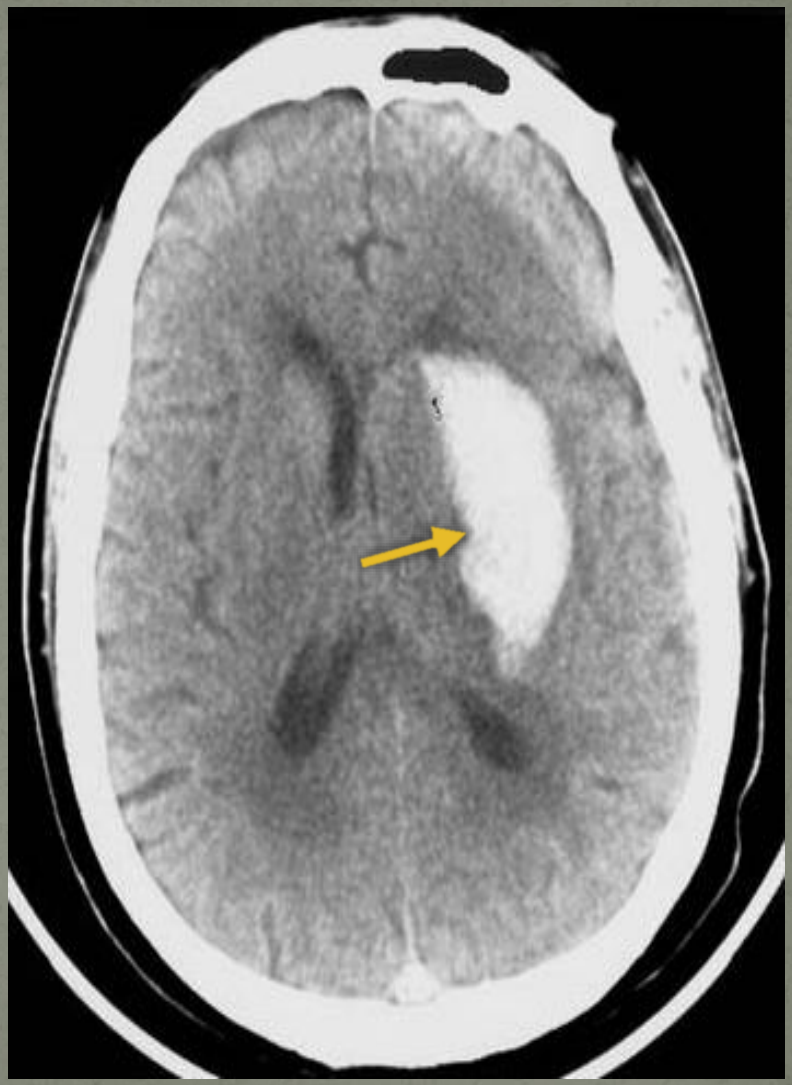
Intracranial Hemorrhage

4 types:

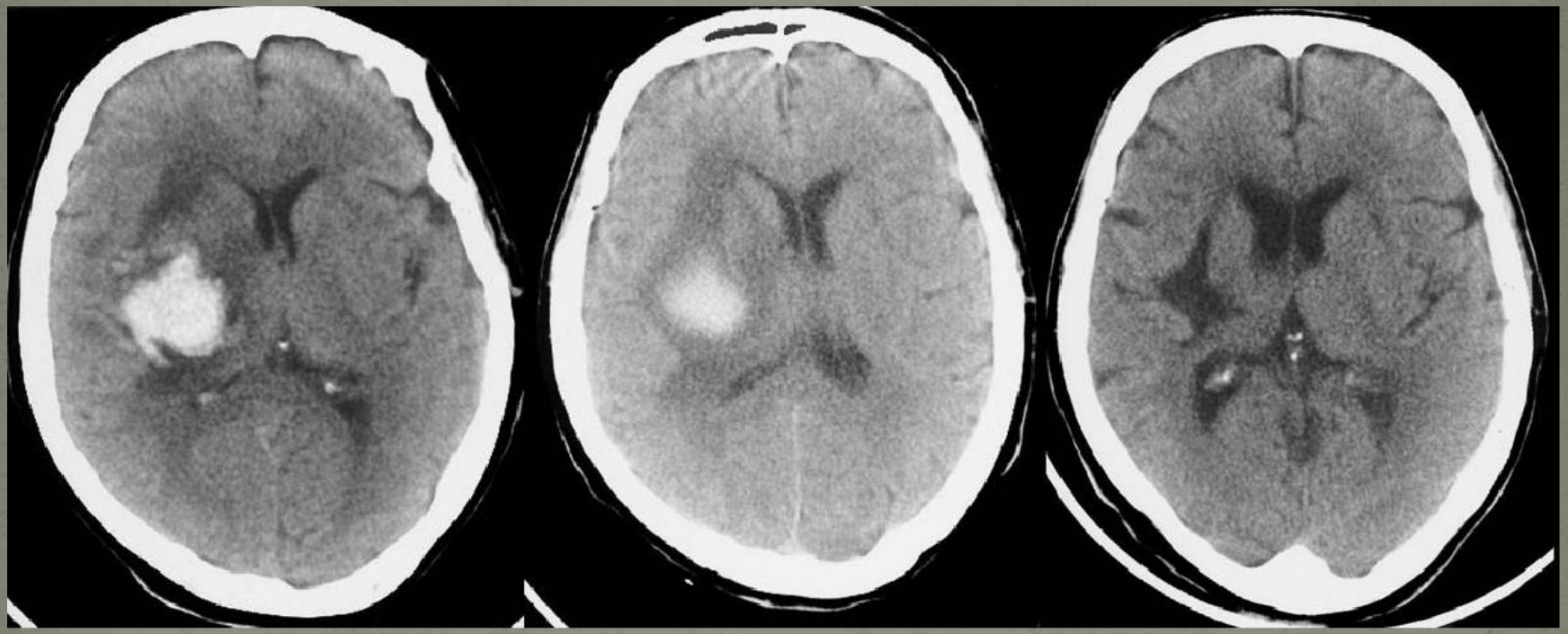
a. Intracerebral hemorrhage(ICH)
b. Subarachnoid hemorrhage(SAH)
c. Epi/extradural hemorrhage
d. Subdural hemorrhage

This is a non contrast multi-slice axial plane CT scan of head showing an ovoid shape well circumscribed, subcortical, hyperdense shadow on the left parieto-temporal region. There is compression of left lateral ventricle with minimal midline shifting.

So, my radiological diagnosis is left sided ICH

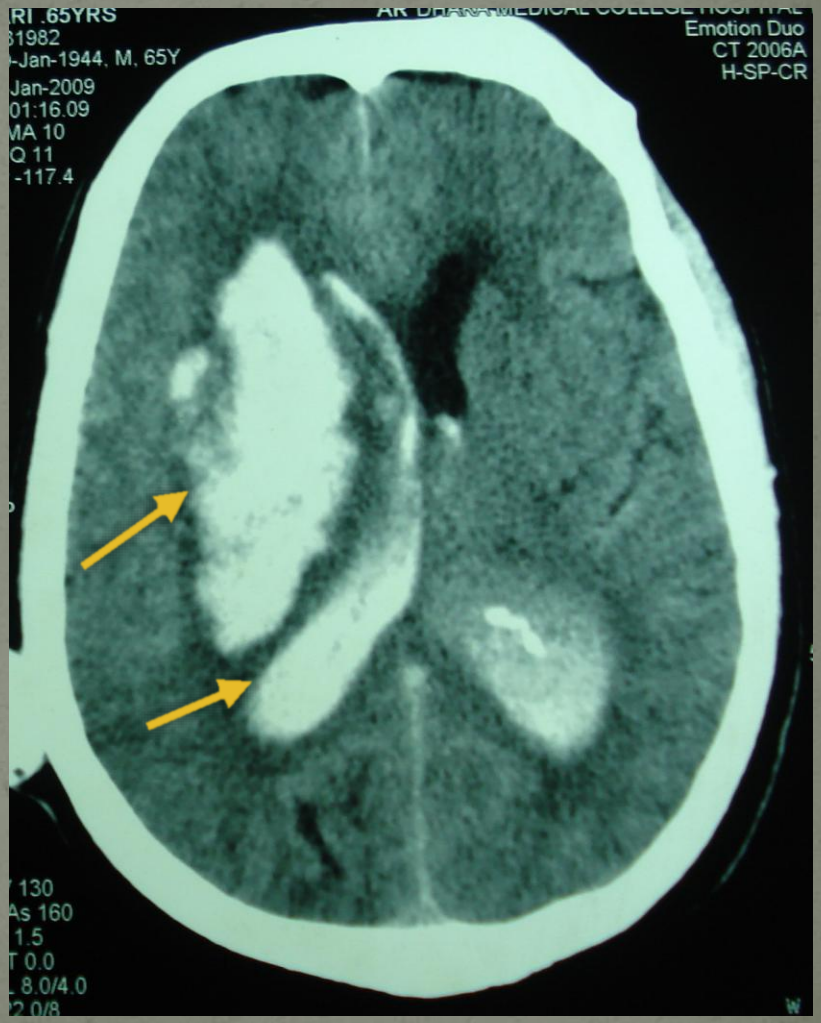


Resolving hematoma

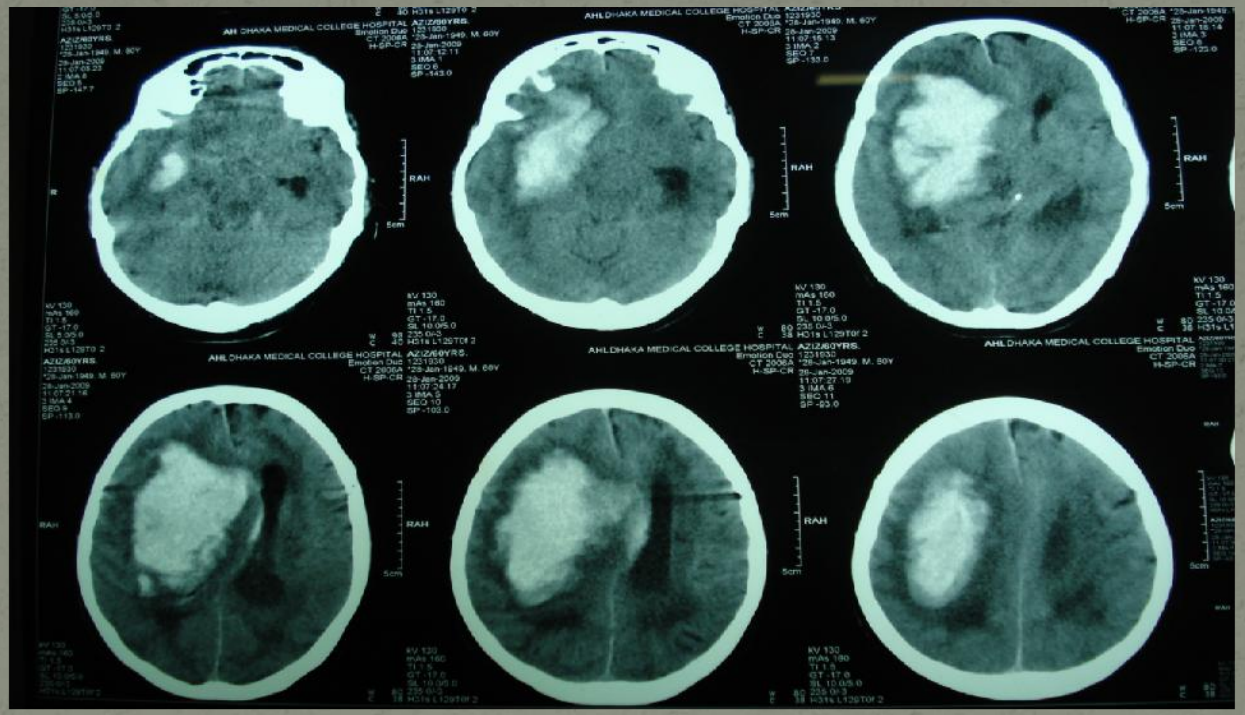


2 days | 2 weeks | 2 months

Right sided ICH with ventricular extension



How to measure the amount of hemorrhage in CT scan



(total number of Hemorrhagic slide – 1) X (Height X breath in cm of largest haemorrhage) = amount of blood in ml

Sub arachnoid Hemorrhage

ACOM aneurysm rupture

PCOM aneurysm rupture

Primary Intraventricular hemorrhage

Always consider:

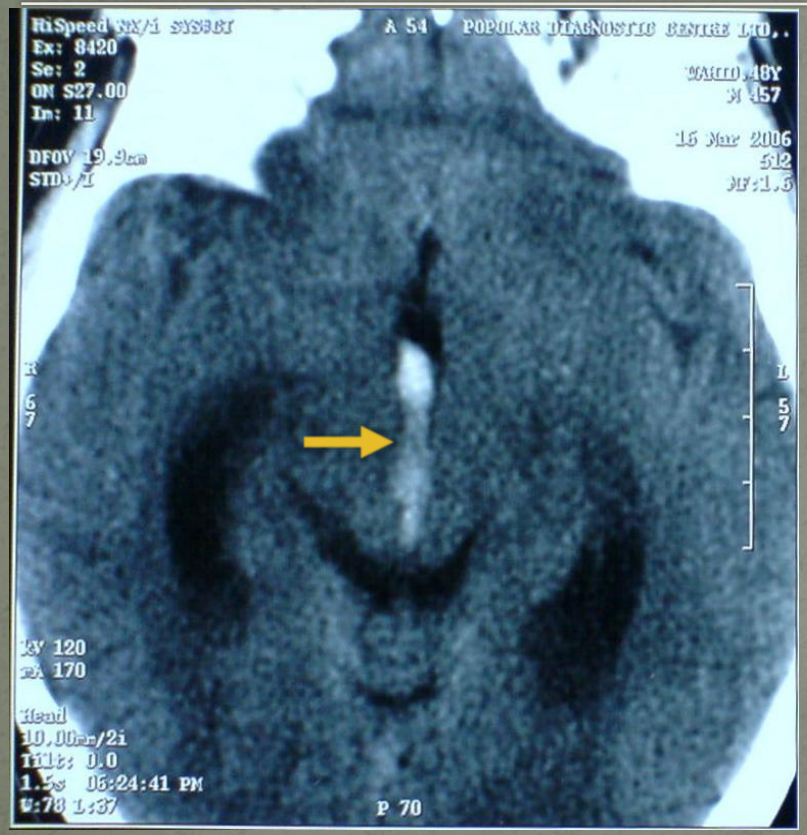
a. Hypertension

b. Vascular anomaly

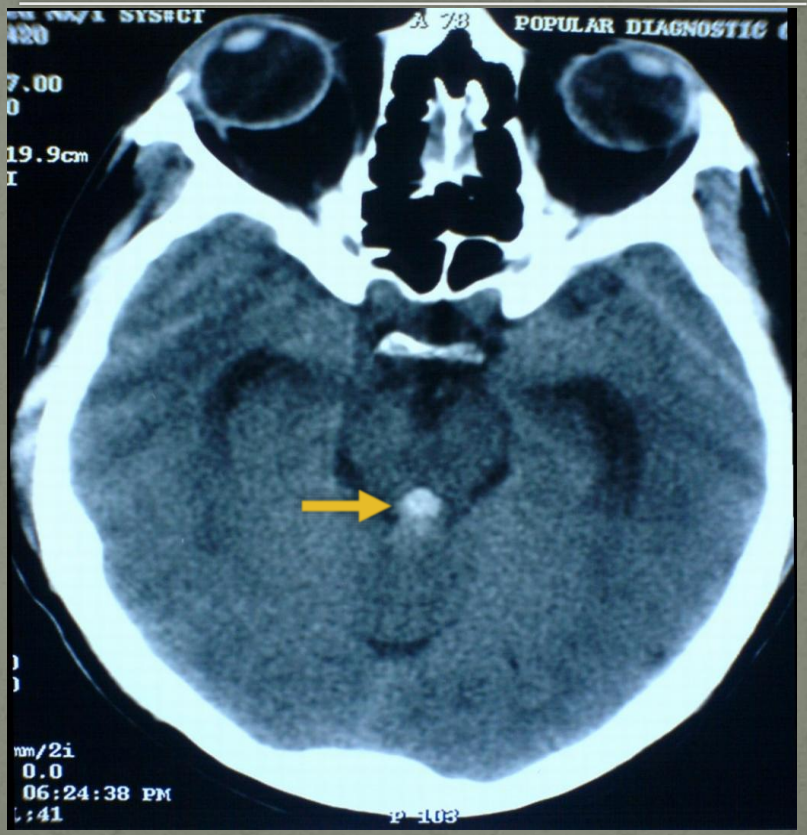
c. Anticoagulation

d. Bleeding and clotting disorder

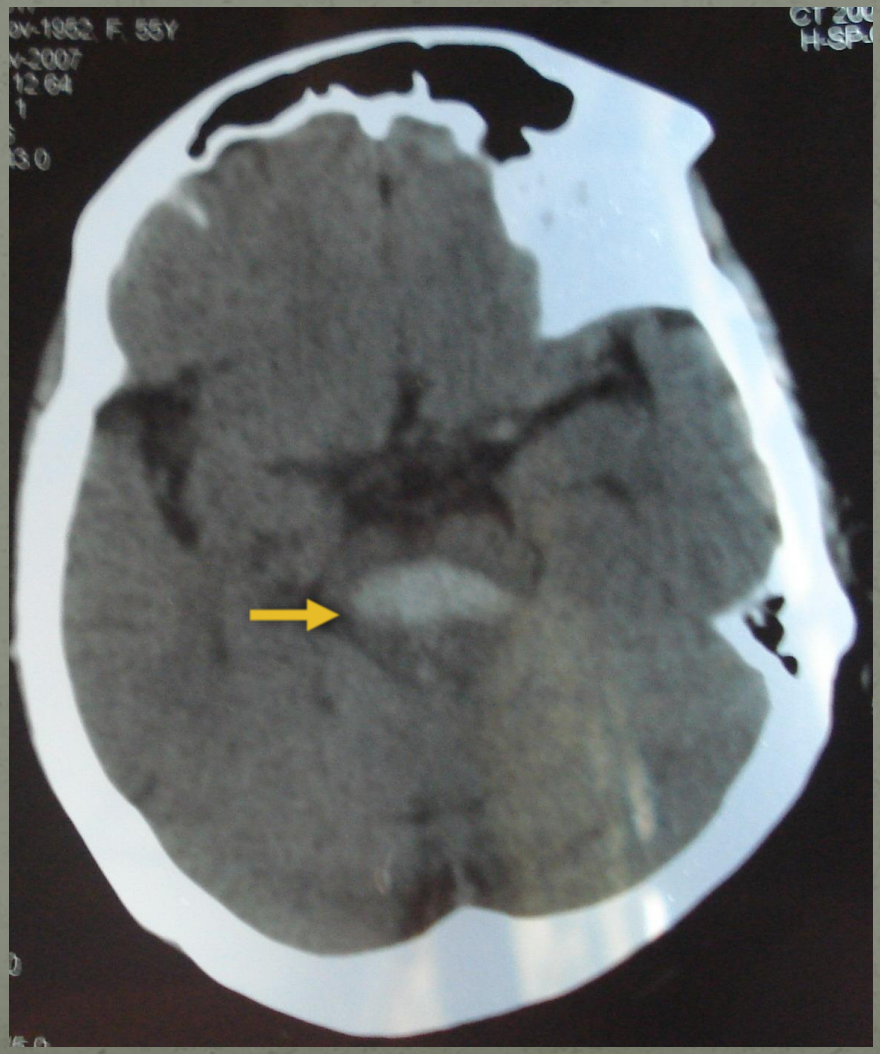
3rd Ventricular hemorrhage



4th Ventricular hemorrhage



Brain-stem hemorrhage

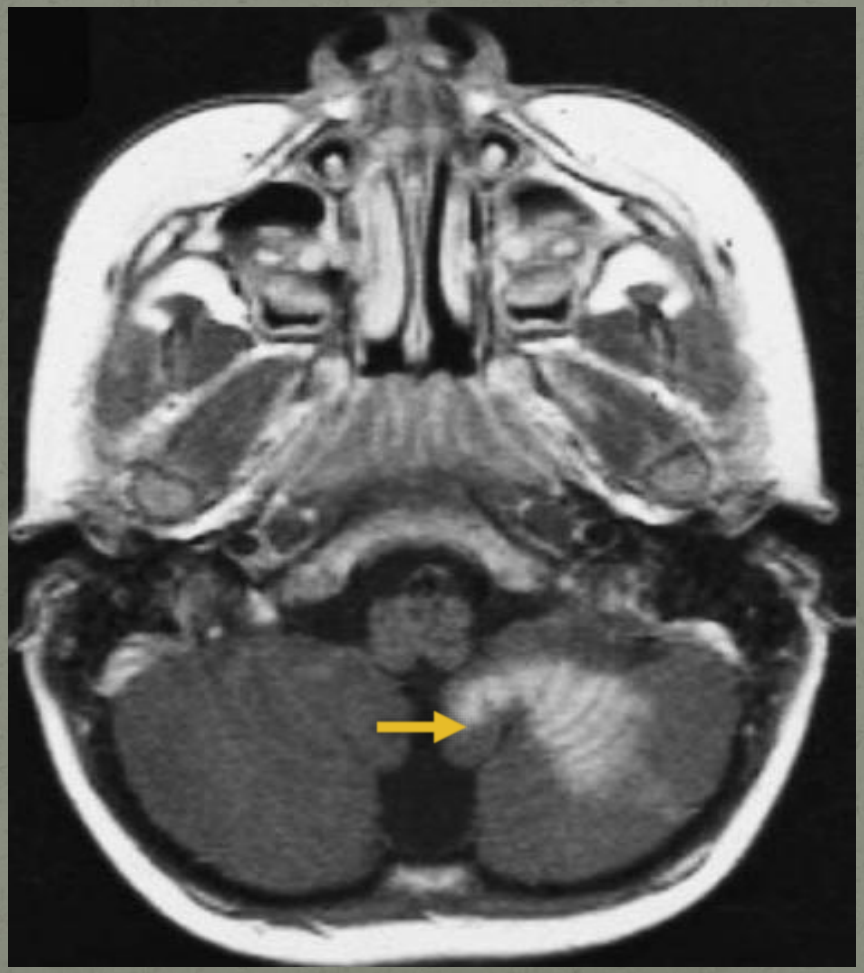


Cortical ICH in left parietal lobe due to

A. AVM, resembling bag of worms

B. Venous infarct

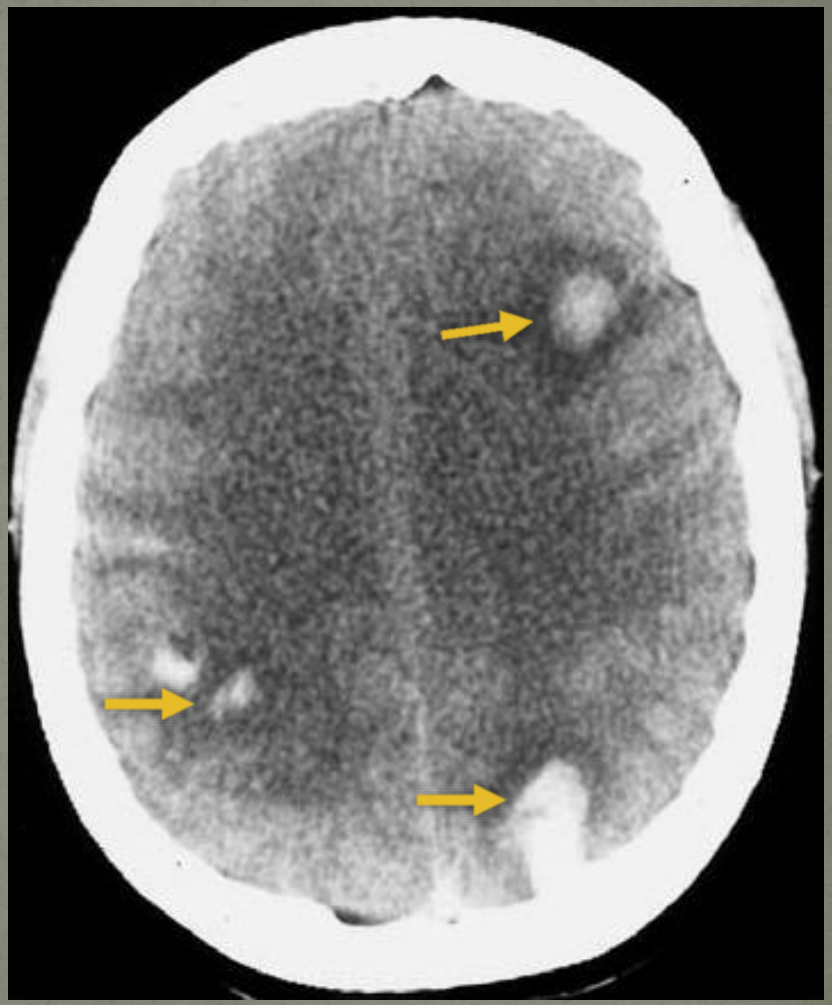
Left Cerebellar Hemorrhage



This is a non-contrast, axial CT scan of head showing multiple bilateral hyperdense shadows associated with thin rim of peri-lesional hypodense shadow.

So, my radiological diagnosis is multiple intra-cerebral hemorrhage

Most likely due to brain metastasis or anti-coagulant drugs



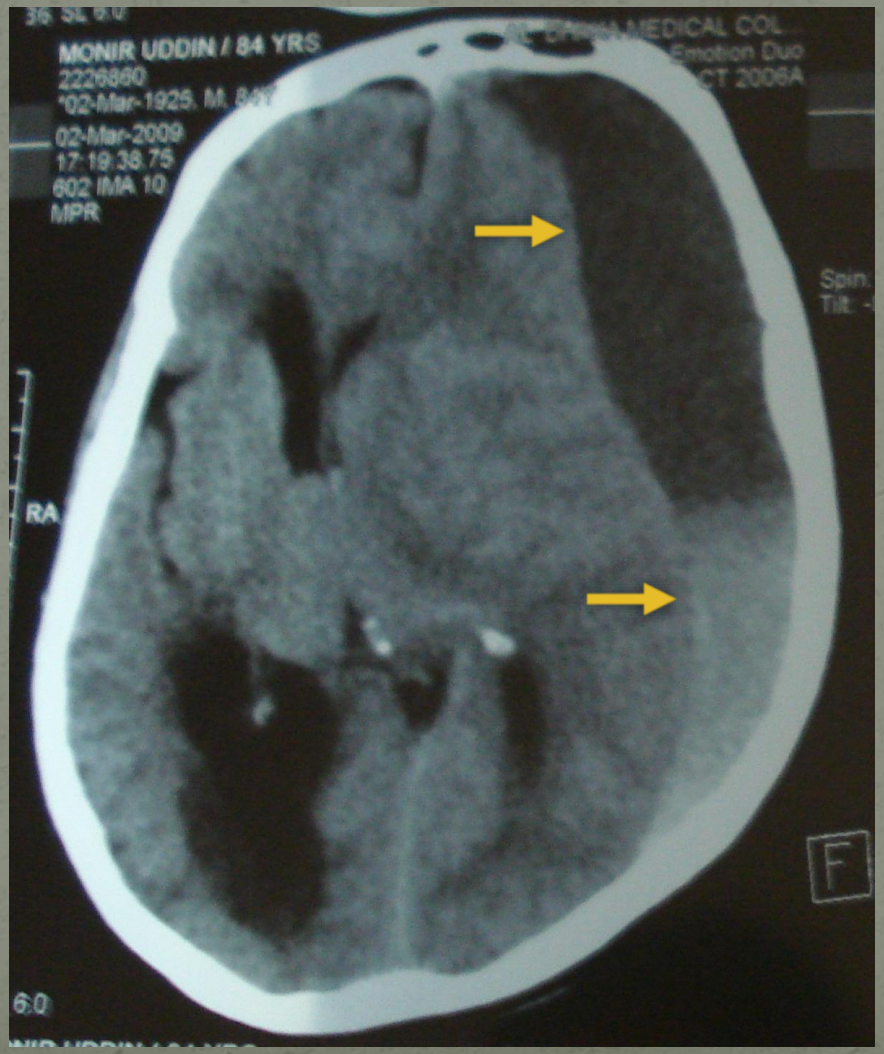
Acute Subdural Hemorrhage(Lt)

This is a non-contrast axial CT scan of head showing a high-density area paralleling the surface of the brain (Lt.). There are also compression of the Lt. lateral ventricle and shifting of the mid line.

Sub-acute SDH (>2 weeks)

Chronic SDH (>4 weeks)

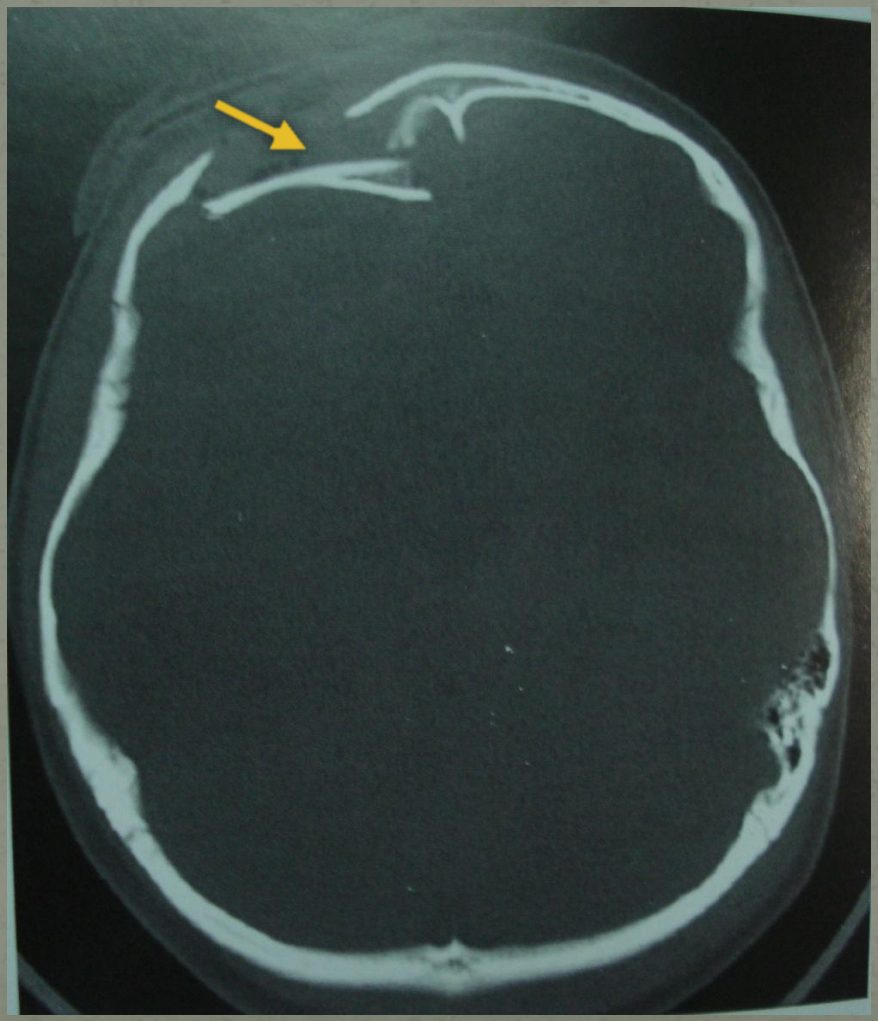
Acute on Chronic Subdural Hemorrhage



Epi/extra-dural Hemorrhage

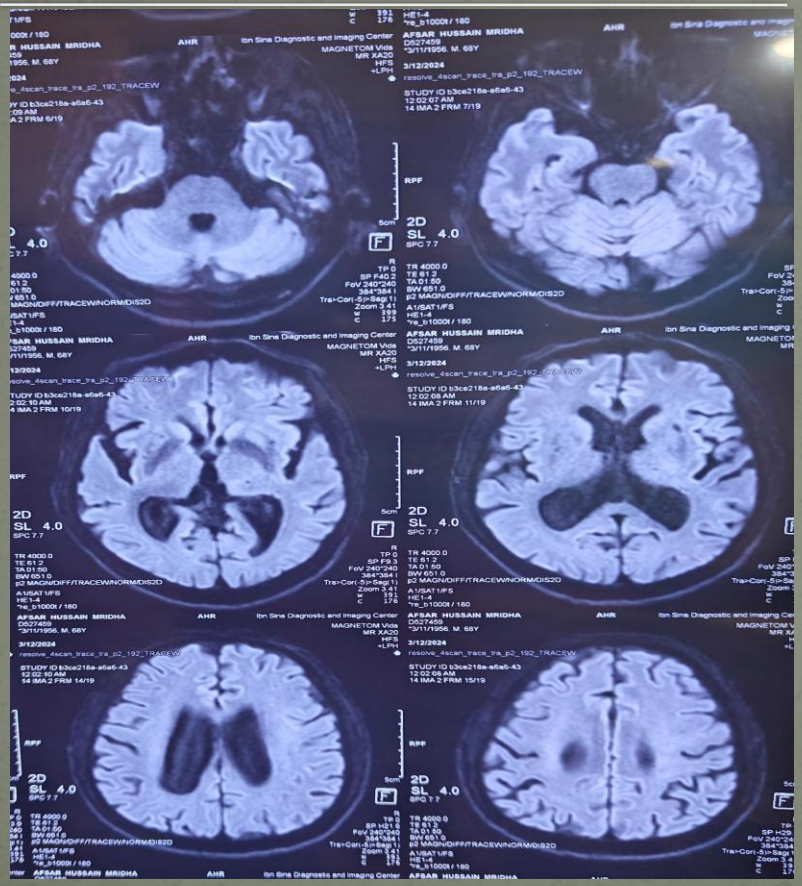
This is a non contrast axial CT scan of the head showing a hyper dense lentiform shadow in Rt. Parietotemporal region. There are also mid line shifting and prominence of left temporal horn of lateral ventricle.

Fracture of frontal Bone

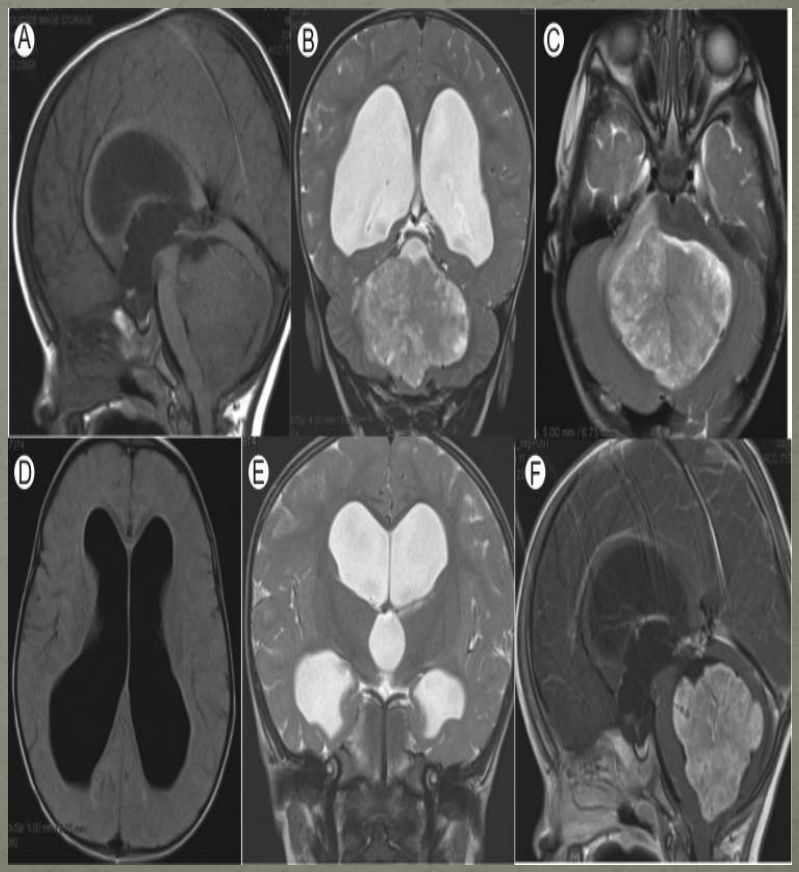


Hydrocephalus

Communicating/ non-obstructive

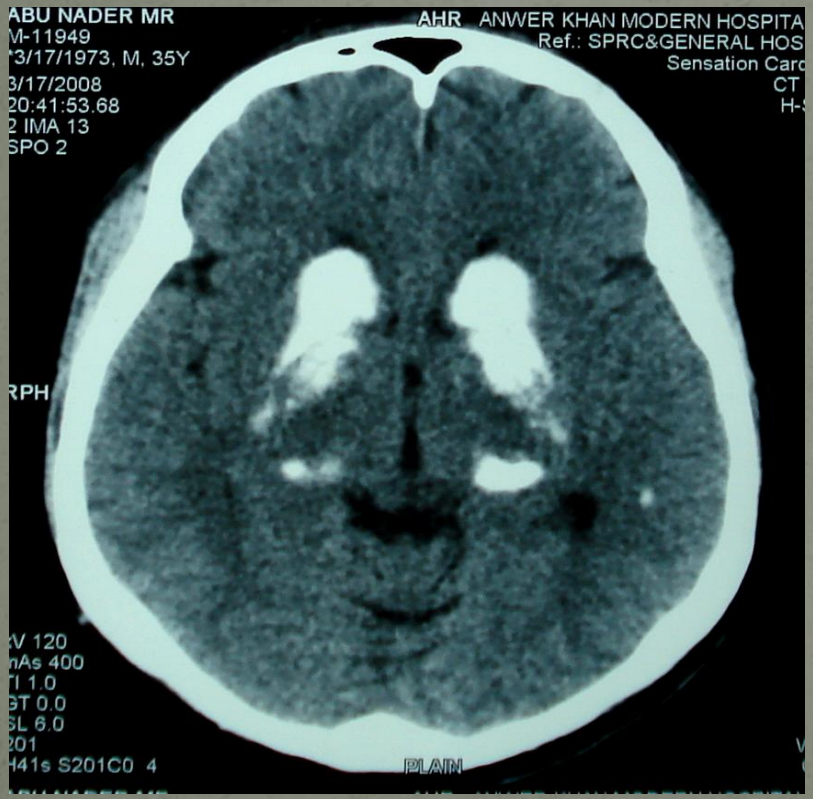


Communicating/ obstructive

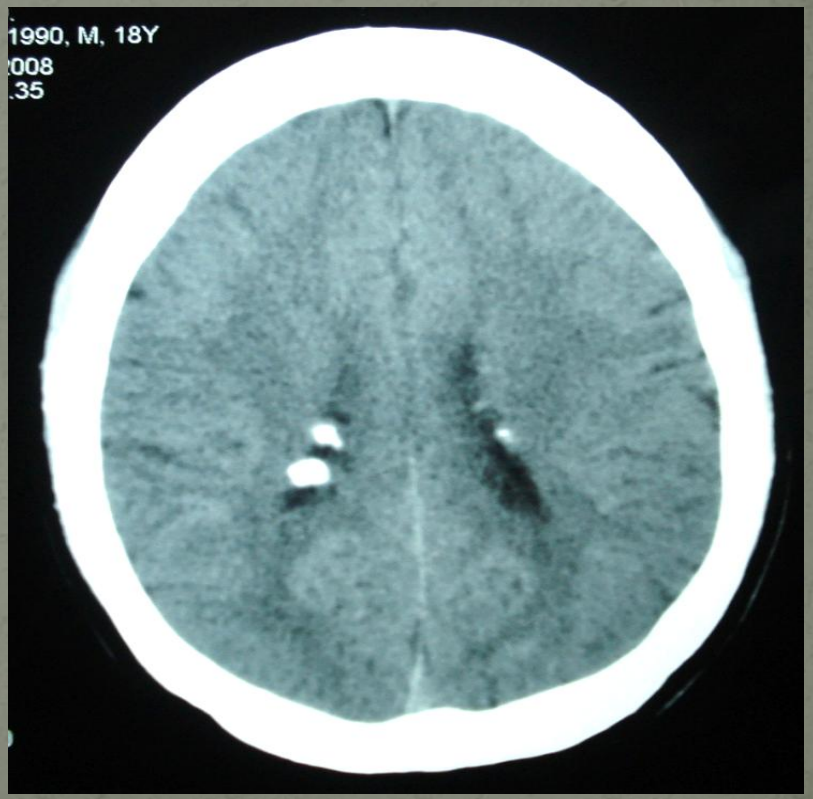


Pathological Calcification

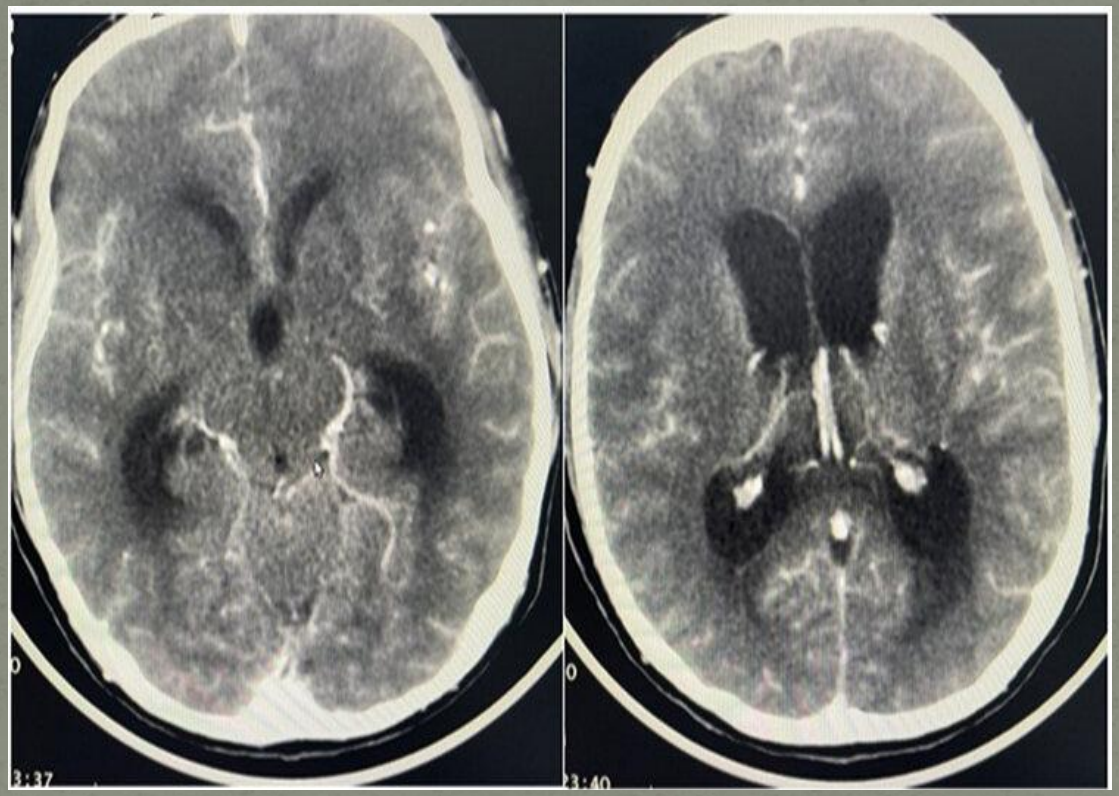
B/L basal ganglia calc in Fahr's Disease



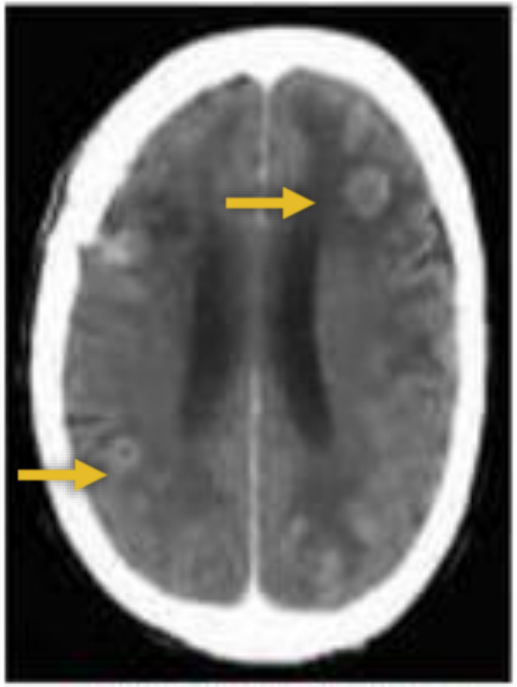
Sub-ependymal calc in Tuberous Sclerosis



Post contrast meningeal enhancement in TB-Meningitis



Tuberculoma

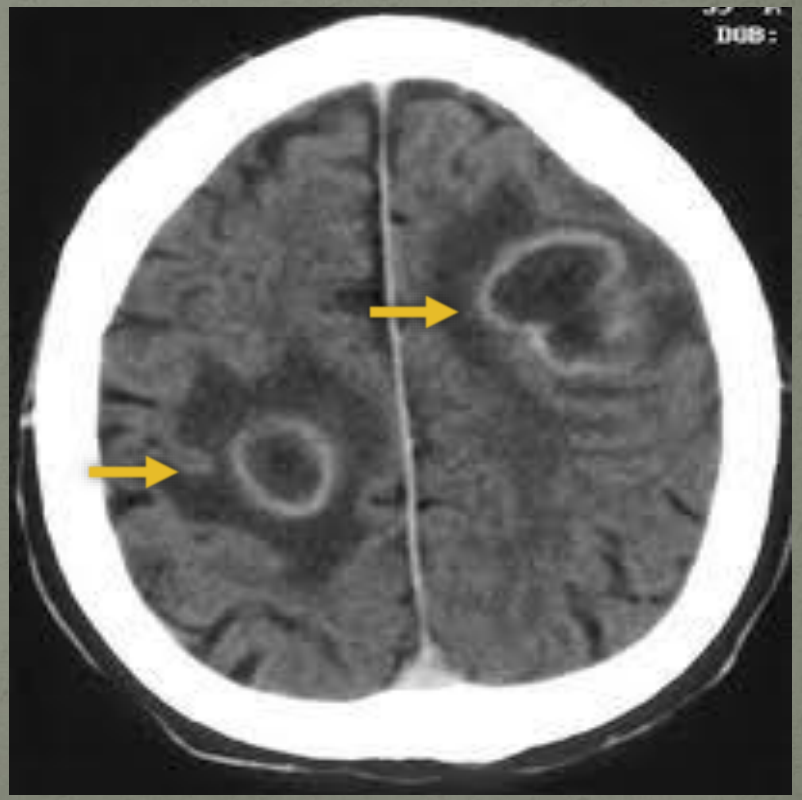


Parenchymal tuberculosis

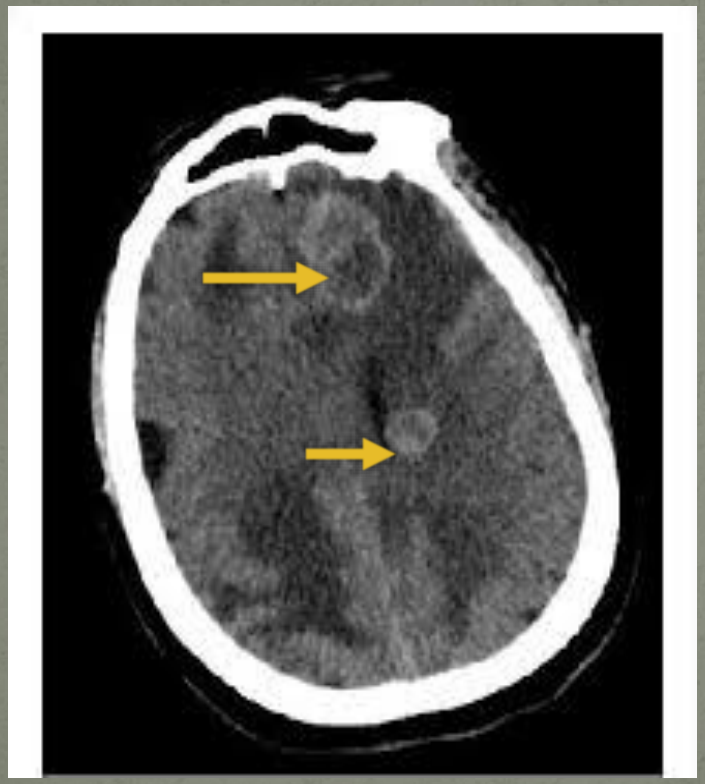
Contrast-enhanced CT scan shows multiple bilateral ring-enhancing lesions (Tuberculomas) in the frontal and parietal lobes

Hydatid Cyst

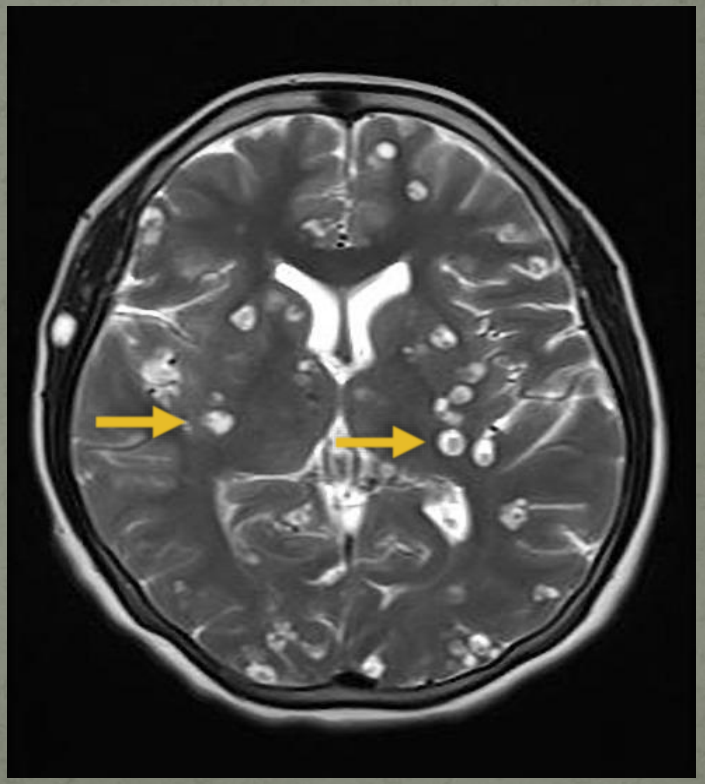
Brain Abscess



Multiple Metastasis

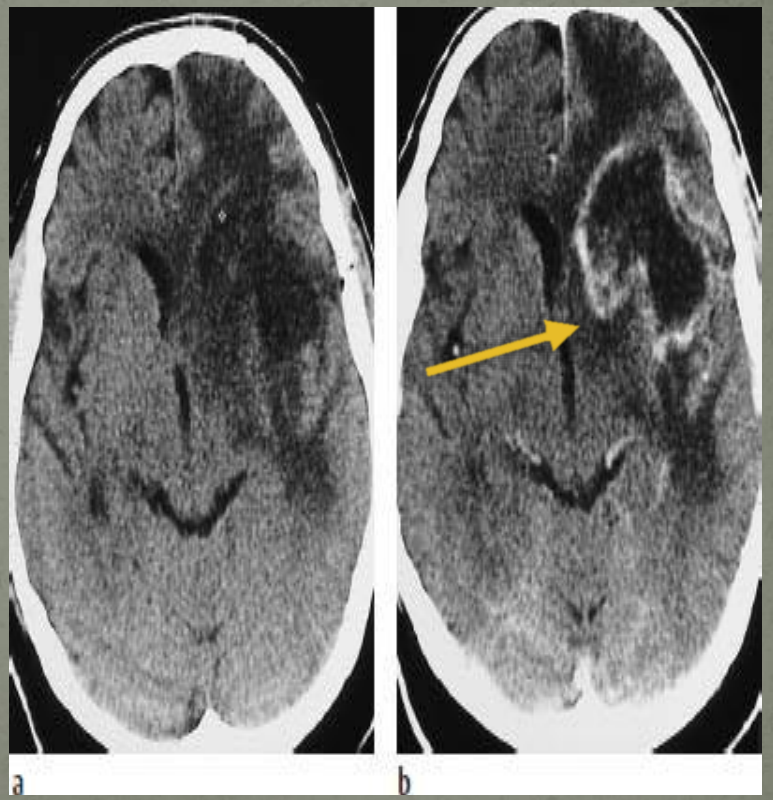


Neurocysticercosis



Meningioma

Glioma



A 30 year old married, obese female presented with episodic headache with blurring of vision for the last 5 years. She has been treated with various medications for migraine without improvement. She also underwent numerous CT brain, MRI brain and MRV brain which according to her all were normal. Here is the last CT brain. Interpret the CT scan

Medicine is learned by bedside and not in the classroom

Sir William Osler (1849-1919)

The value of experience is not seeing more but seeing wisely

Thank you All