

Computerized tomography (CT scan)

Introduction

Tomography is one of the imaging investigation, it present from 1960.

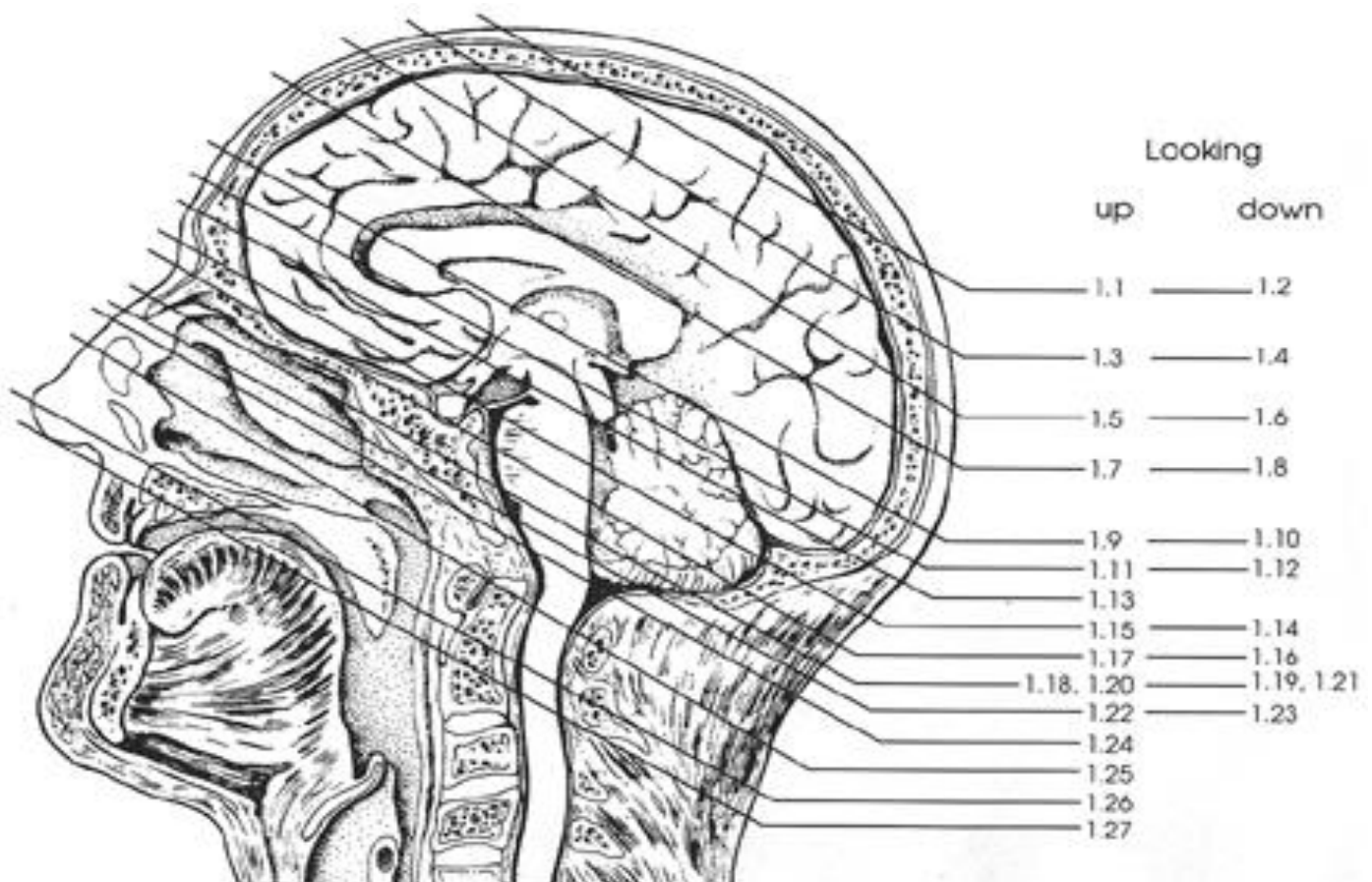
Mechanism of Action:

Tomography is the technique of rotating a radiation detector around the patient so that the image obtained gives additional three- dimensional information.

In plain film tomography the source of XR ray & the photographic film move around the patient to produce an image of the structures at a particular depth within the body, bringing them into sharp focus, while deliberately blurring (unclear) structures above & below them.

In computerized tomography, the same technique of usual tomography, but instead of film, there is detectors which attach to computer, this detector will catch the signal & convert it into pulse, then to computer as image of different section.

So CT scan is a form of XR examination , in which the source & detector (CT scanner) & the information obtained can be used to produce cross sectional image (i.e. CT scan can produce an image of slice through the body at a particular level)



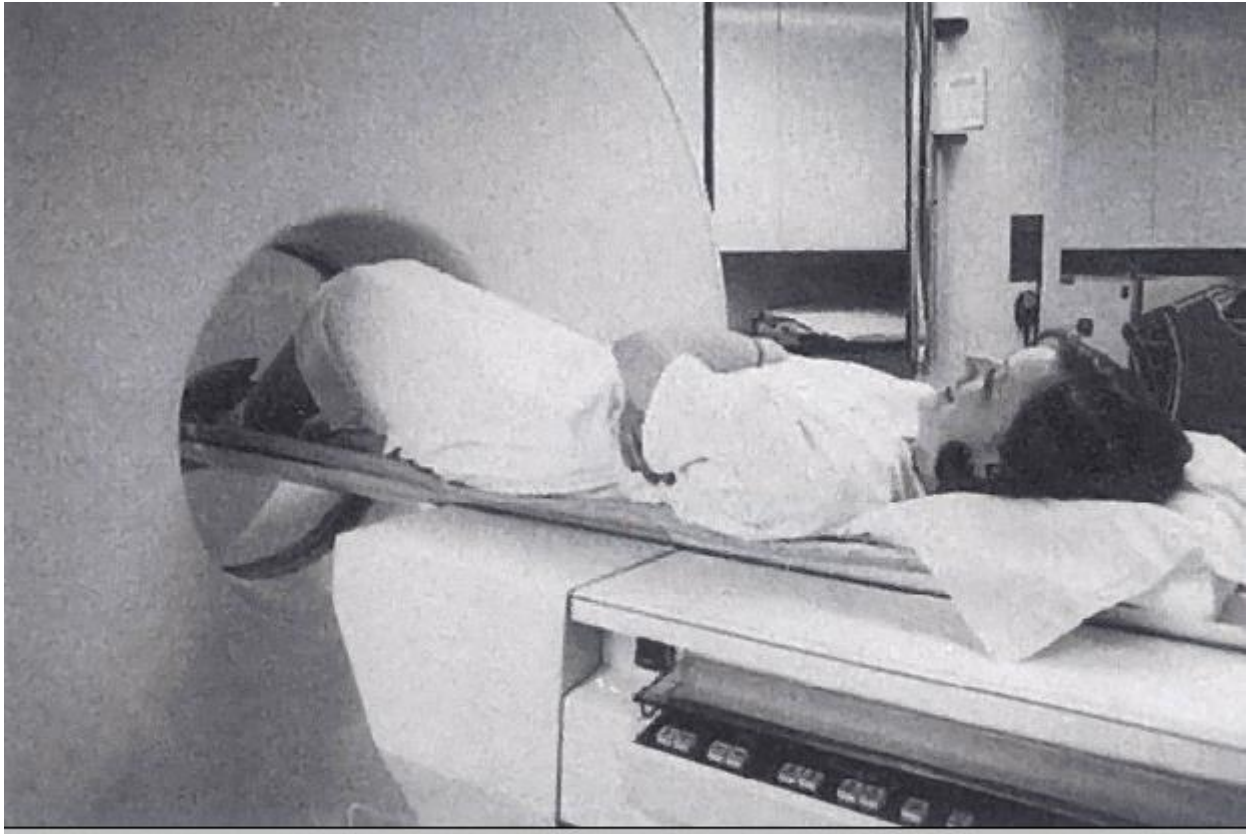


Fig. 2 The usual examination position for patients undergoing CT. Greater comfort is provided by using the support behind the knees.

N.B. when the no. of the detector increase, the clearance of the image is increase, the usual no. of detectors is used now about 400.

What is the principle of CT scan?

The principle of CT scan is XR penetration & XR attenuation.

The XR can penetrate any organ & when penetrate it, it will face many different density tissues like bone, muscle, fat, fluid or CSF.

Absorption of X-ray by these different tissues depend on:

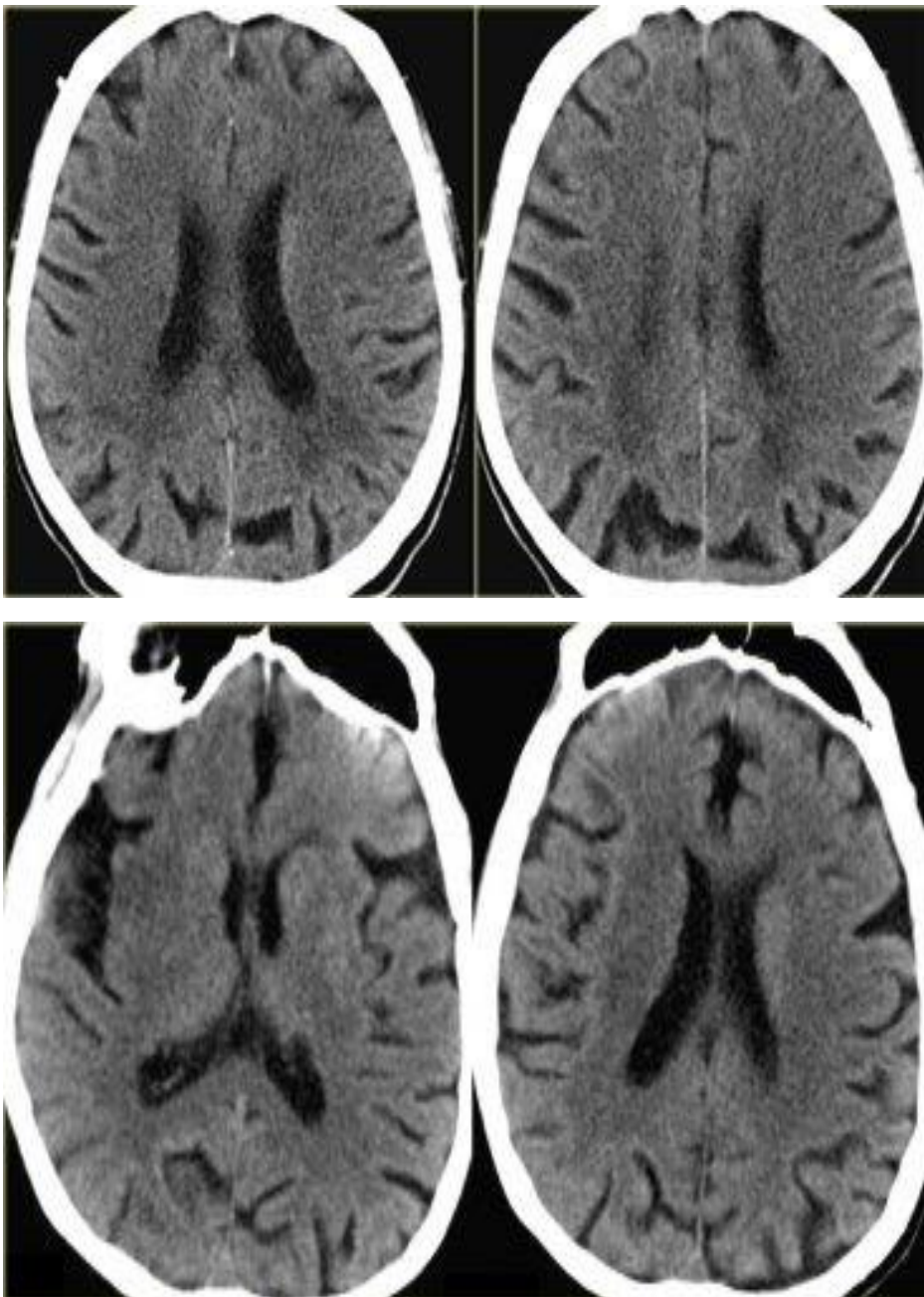
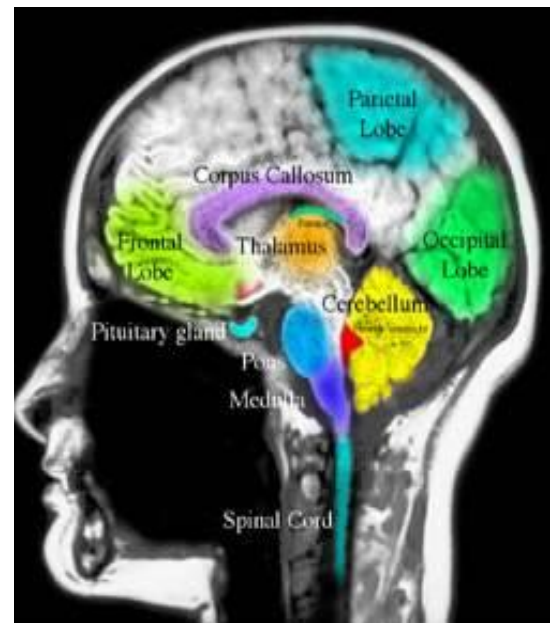
- Thickness
- Conc. Of material
- Molecular weight of the substance

The higher the thickness, the higher the Molecular weight, the more the absorption of the XR & more attenuation examples:

- Bone: is highly attenuated material, because it absorbed much XR so it appear white in color.
- Soft tissues have less attenuation, so appear gray in color.
- Air has low absorption & low attenuation so it appear black in color.

Normal brain (anatomy)

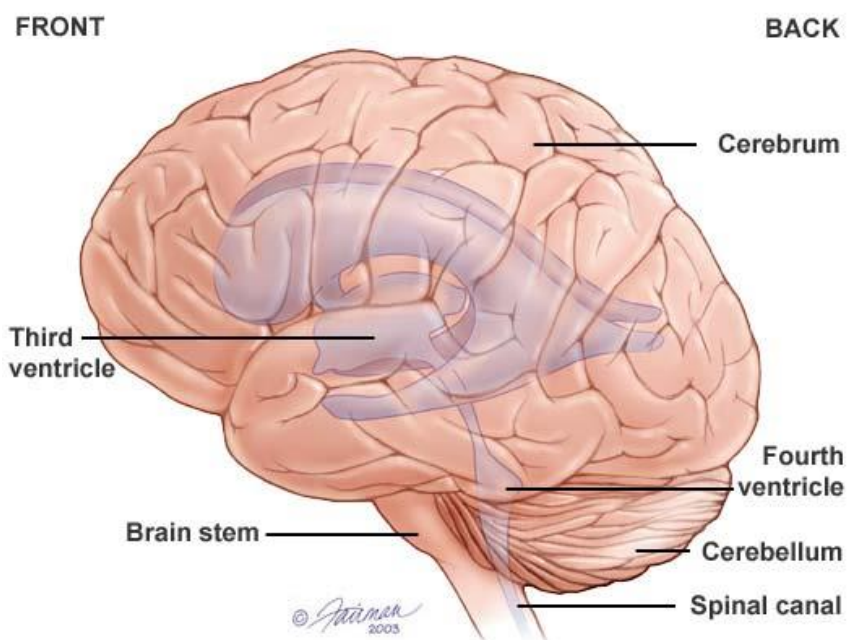
- Cerebral hemisphere
- Frontal lobe
- Parietal lobe
- Temporal lobe
- Occipital lobe
- Posterior fossa
- Cerebellum & brain stem





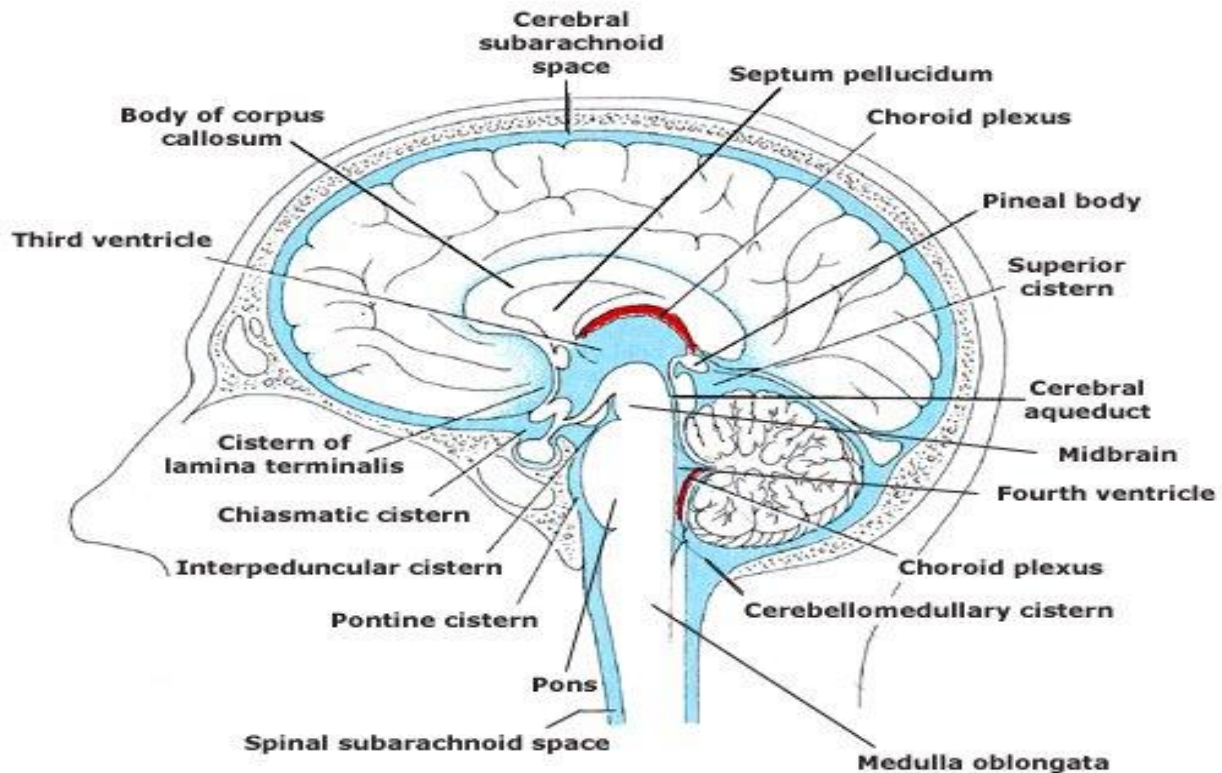
Ventricular system

1. Lateral ventricle (frontal horn , body ,temporal horn ,& occipital horn) .
2. Third ventricle .
3. Fourth ventricle .



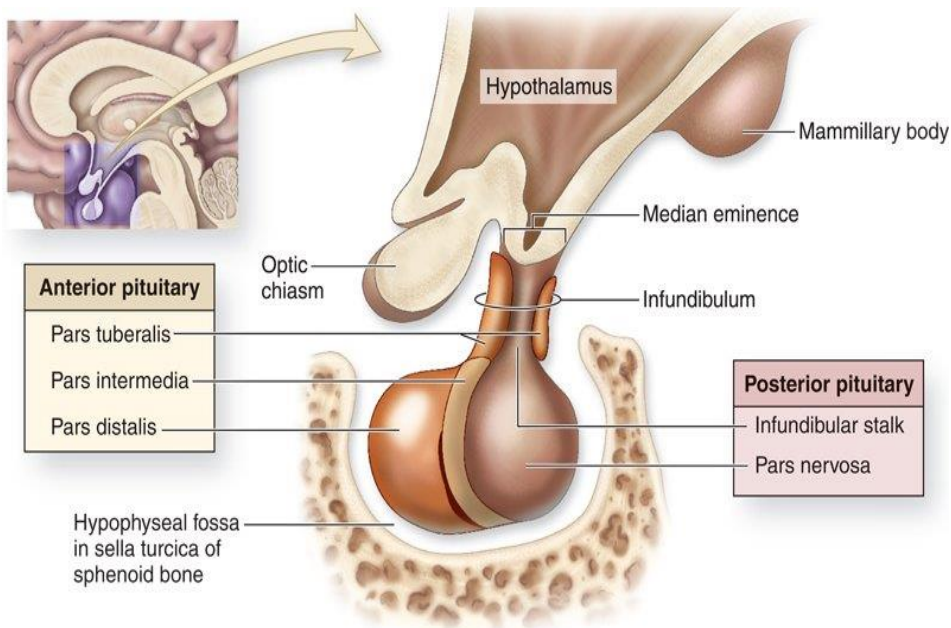
Subarachnoid space diagram

Diagram of the subarachnoid spaces and cisterns (blue) as seen in a median section of the brain



Pituitary fosse

- Anterior clinoid process
- The region of the sella tursica
- Posterior clinoid process
- Channel like area black in color (cerebello pontine angle)
- Lesser wing of the sphenoid bone & below it immediately the greater wing of sphenoid.



CT terms

- Iso dense, same density to organ examine
- Hyper dense higher than the organ examined
- Hypo dense lower than the organ examined

Density levels of different types of tissues

Density levels of almost all soft tissue organs lie within a range 10-90 HU, Water density 0 HU, fluid 10-15 HU depending on their density , air -1000 HU, fat -100 - -50 HU , bone & calcification 100 & above HU , ossification 1000 & even more HU depending on the density

Encephalitis

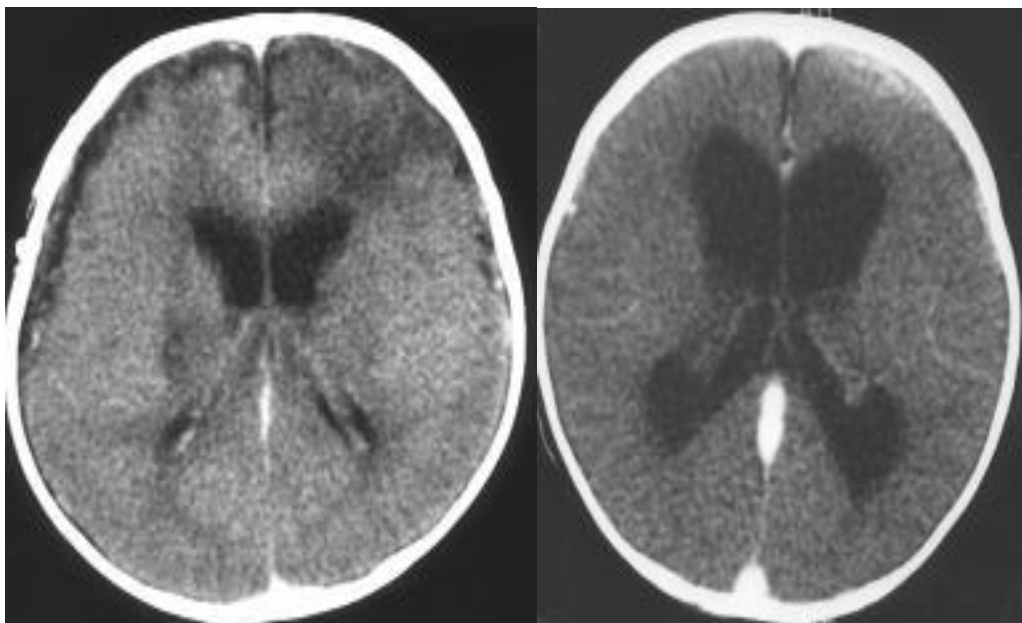
- Age : young & adolescence mostly .
- Clinical picture : patient come with headache , vomiting , blurring of vision .
- Usually the disease preceded by flue or vaccination , HS virus can also cause encephalitis .

CT finding

- Low attenuation of white matter (due to the edema)
- Compressing the ventricular system (also due to edema) specially the frontal & the body of the lateral ventricle become slit like .

Complication

- Brain destruction (because the disease cause brain necrosis) .
- Atrophy of the brain tissues with subsequent loss of volume & dilatation of the ventricular system .
- Hydrocephalous .



Herpes encephalitis

same as usual encephalitis but there will be low attenuation or hypo density area in the tempo frontal or tempo priato frontal with evidence of patchy whitish area due to the clotted blood (hemorrhage) .

Brain abscess

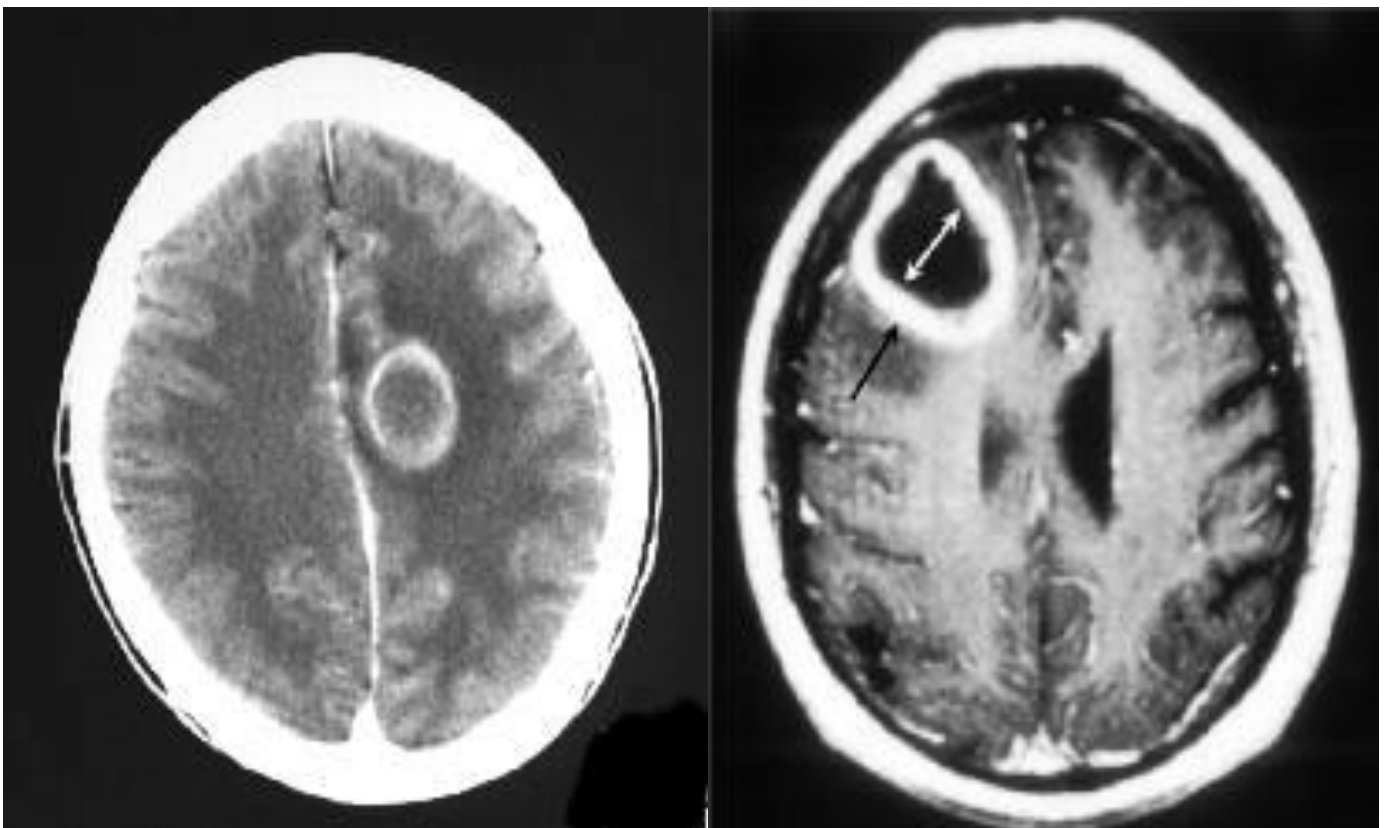
CP: high fever for long duration with focus of infection, patient may be toxic, or present with epilepsy (focal)

CT finding

- Hypo dense area surrounded by large area of peri focal edema, which may cause shifting of the midline).
- After injection the lesion show ring pattern of enhancement so the peripheral aspect of the lesion become clearer.

DDx

- Secondary metastasis, patient have history of primary malignancy, beside absence of the fever.
- Primary necrotic tumor, neither Hx of primary, nor fever are present.



Infarction

- Acute
- Chronic

Acute infarction

History: sudden onset of hemiplegia , with slurred speech .

CT features:

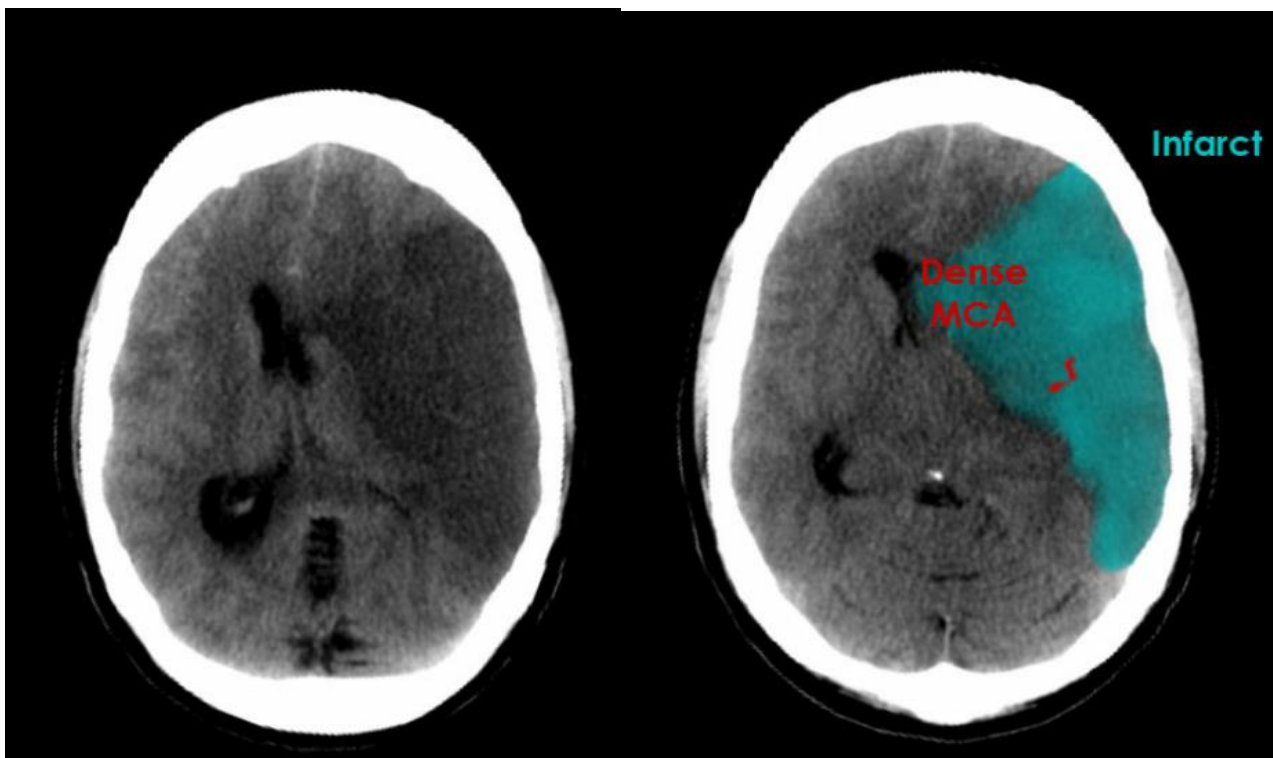
- Wedge shape area of hypo density involve the tributaries of anterior , middle or posterior cerebral arteries , (i.e. parieto frontal & parieto occipital area)
- Shift of the midline to the other side .
- Compression of the ipsi lateral aspect of the regional ventricle by the edema
- Dense middle artery sign

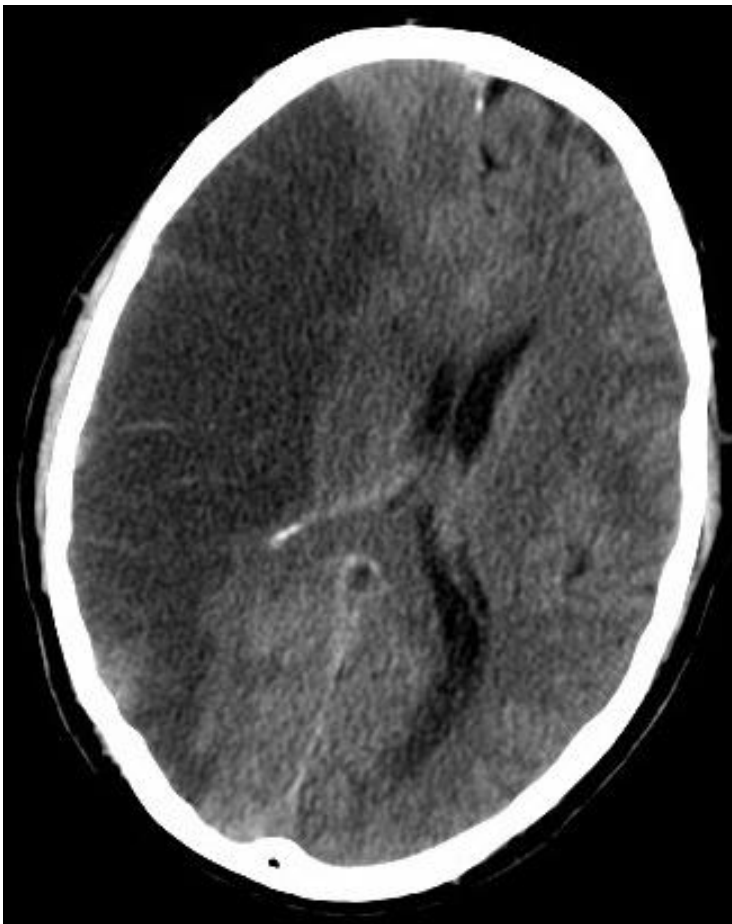
Chronic infarction

- The necrotic area will be liquefy & change to the source of fluid (porencephalon) .

CT finding

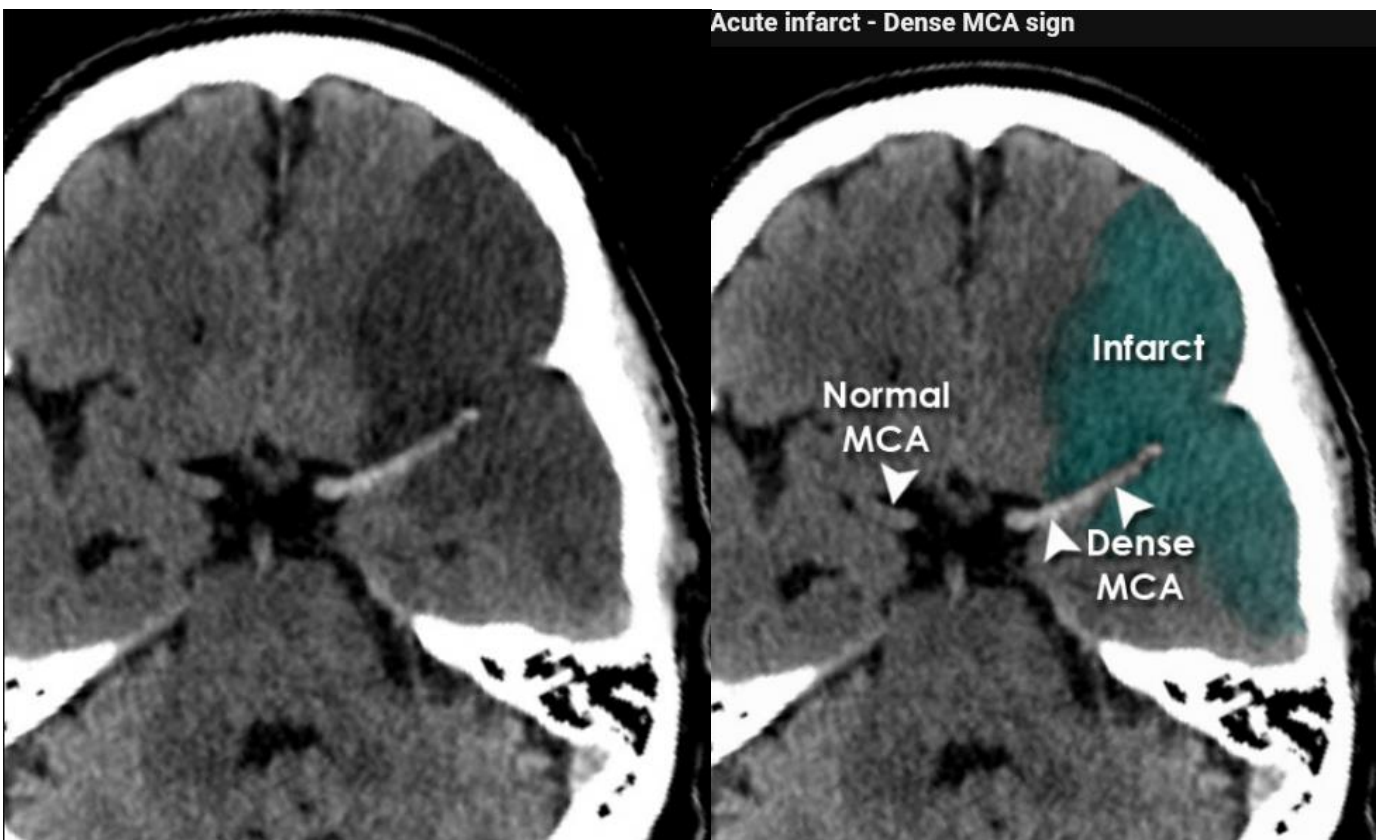
- Hypo density area as a result of blockage of AC , MC , & PC arteries .
- The ventricle will be dilated to compensate for the loosed brain tissue .





ACUTE INFARCTION

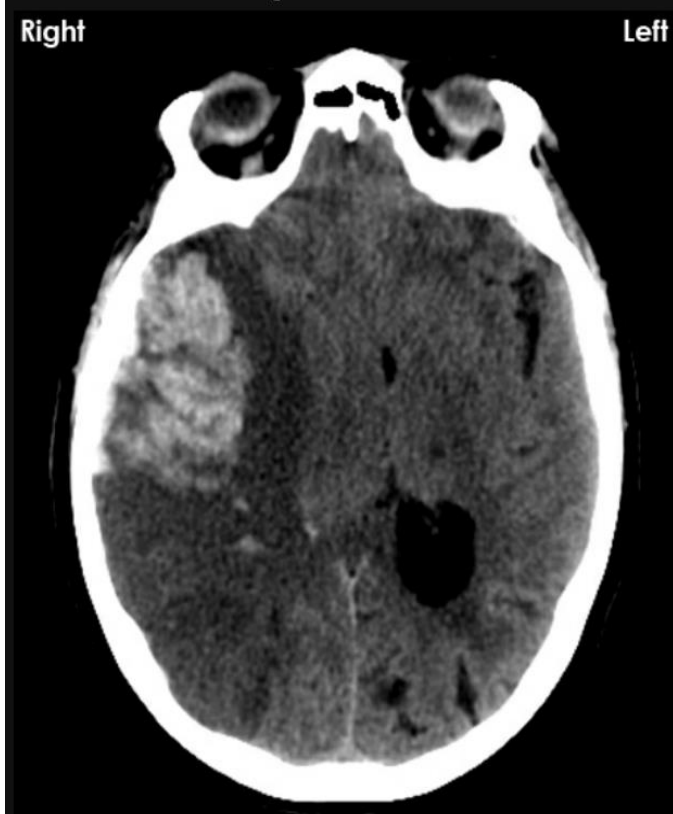
- * wedge shape hypo density area.
- * Shifting of the midline & frontal horn



Infarct with haemorrhagic transformation

Right

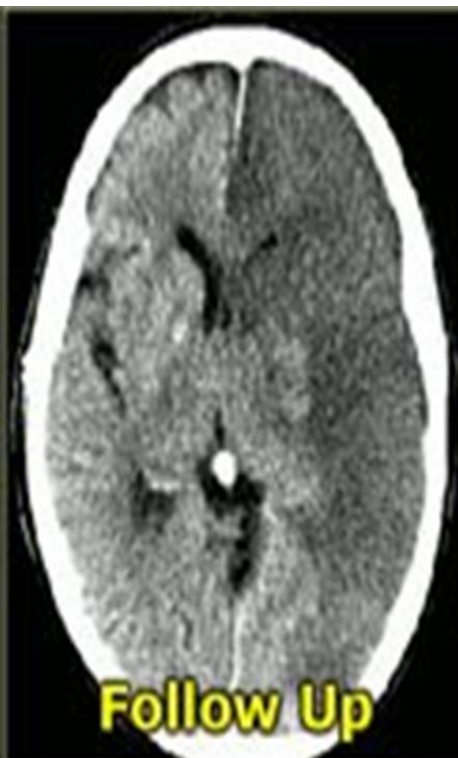
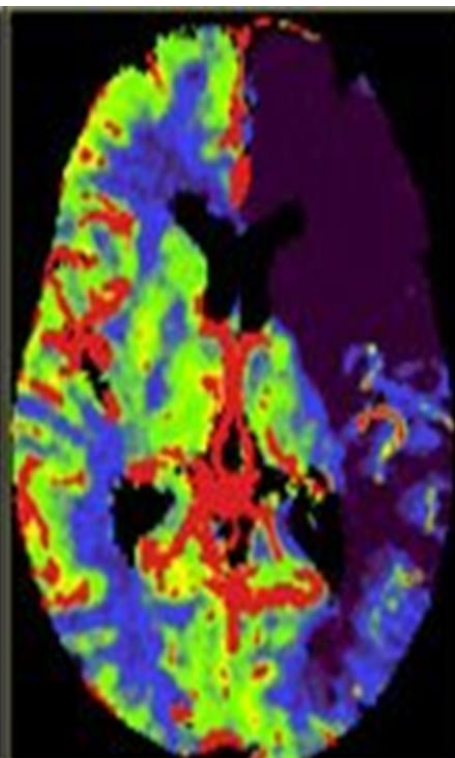
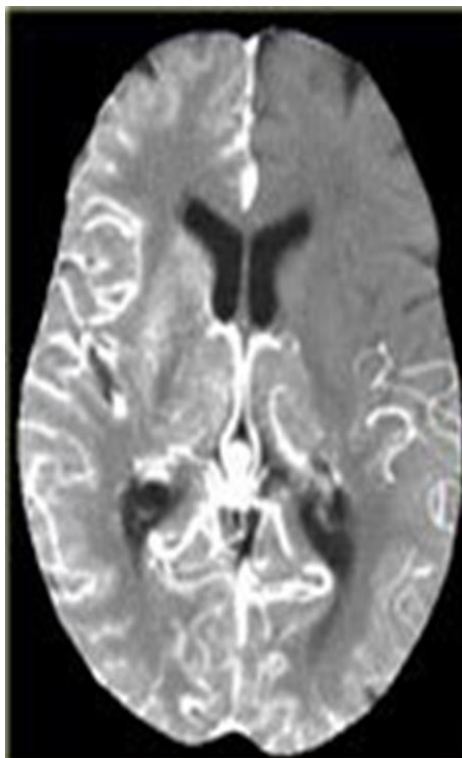
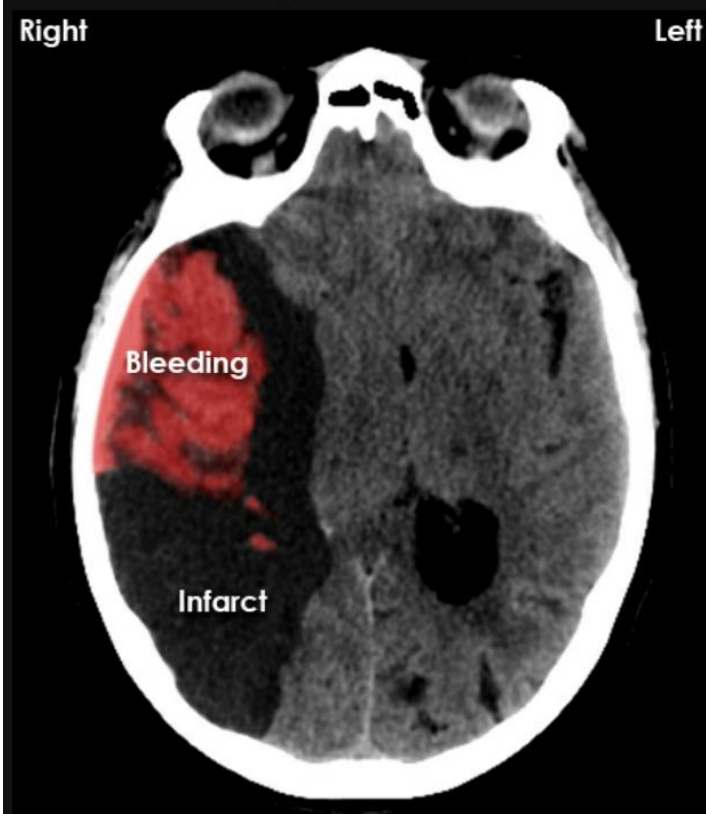
Left

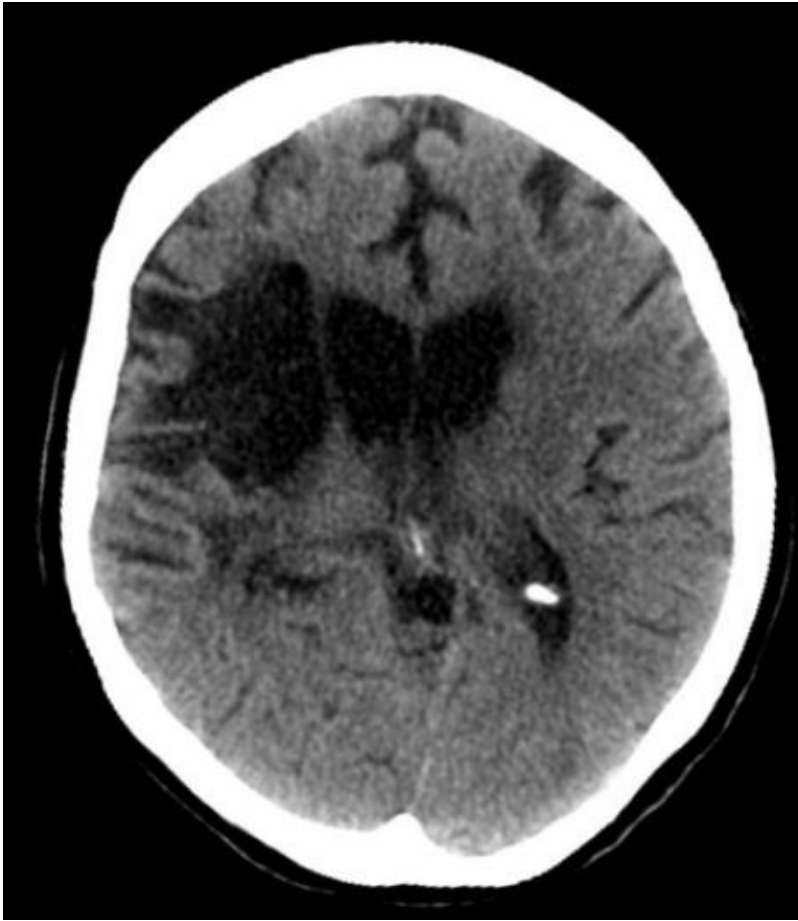


Infarct with haemorrhagic transformation

Right

Left





Chronic infarction

Hypo density area (pore encephalic cyst)

Dilated ventricle

Hemorrhage

Classify the brain hemorrhage according to the site:

- Epidural EDH
- Subdural SDH
- Sub arachnoids SAH
- Intra cerebral ICH
- Intra ventricular IVH

Other classification according to the onset of bleeding:

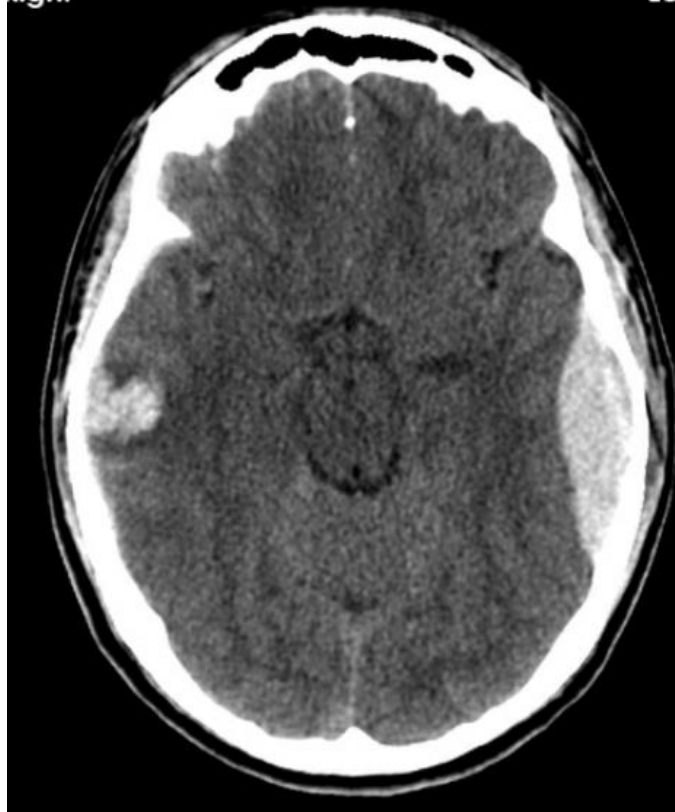
- Acute
- Chronic

Acute EDH

CT finding

- Hyper density area, 50-70 HU, due to the clotted blood, elliptical in shape, no edema around the lesion, but may cause shifting of the midline, or compression of the ipsi lateral ventricle if it is large enough.
- The source of bleeding of the haematome is injured middle meningeal artery so the lesion > 90 % associated with skull # at the site of the previous mentioned artery.

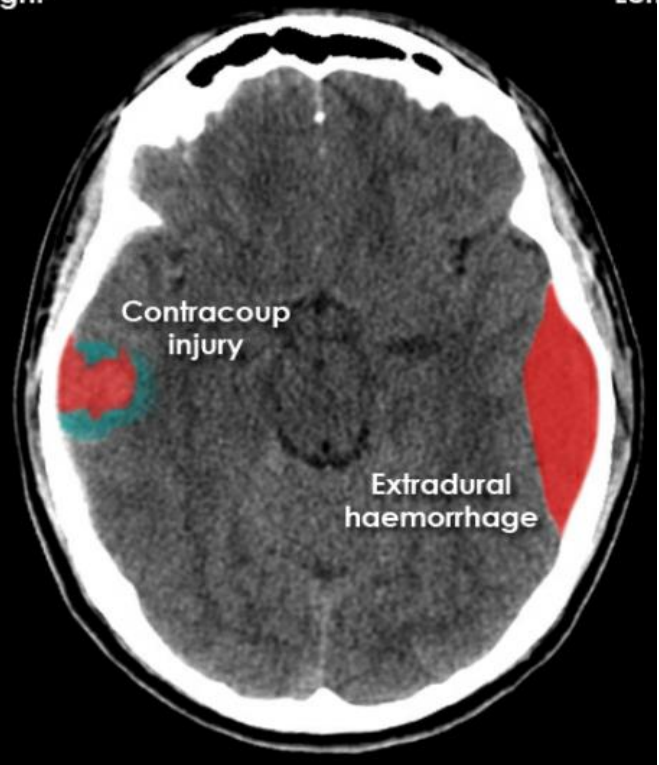
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Left Extradural haematoma (EDH) with contracoup injury

Right

Left



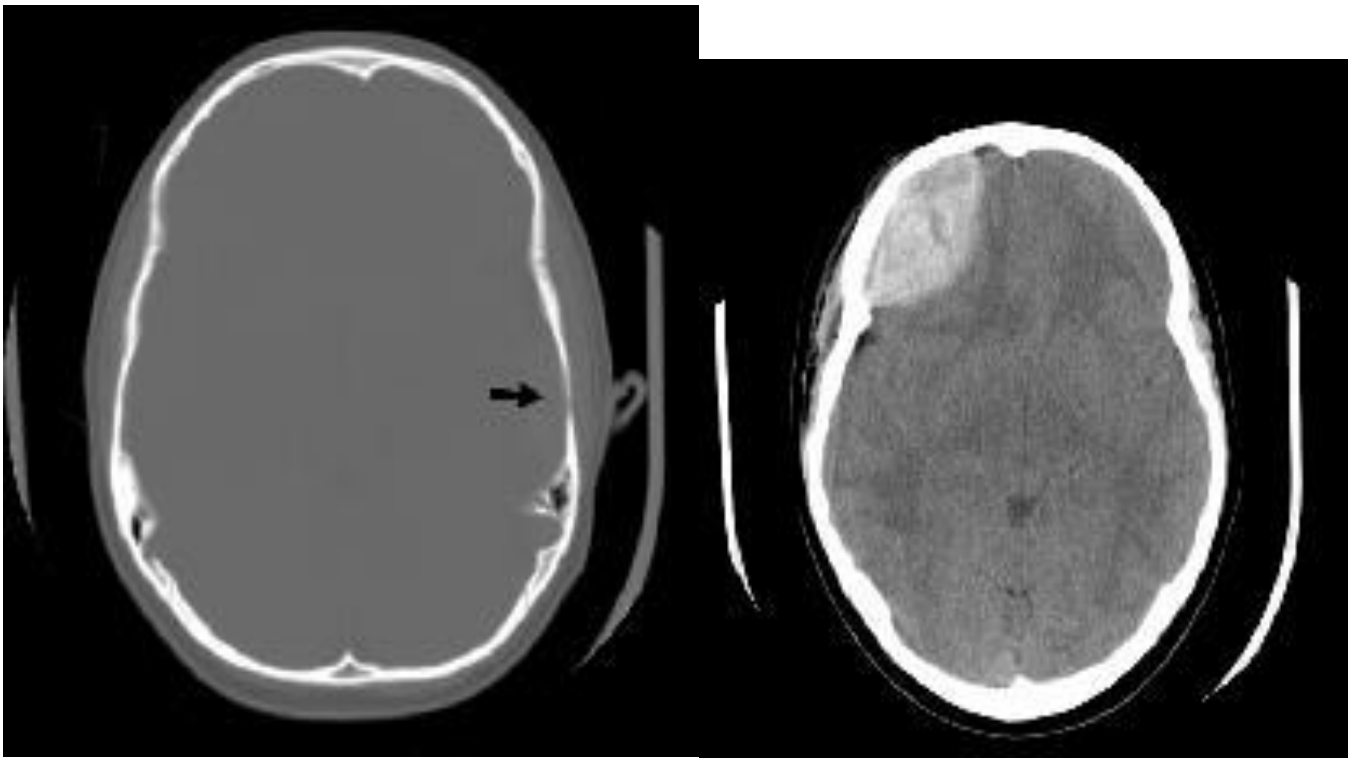
EDH

Biconvex hyper density area

Shifting of the midline

Compression of the ventricles





Acute SDH

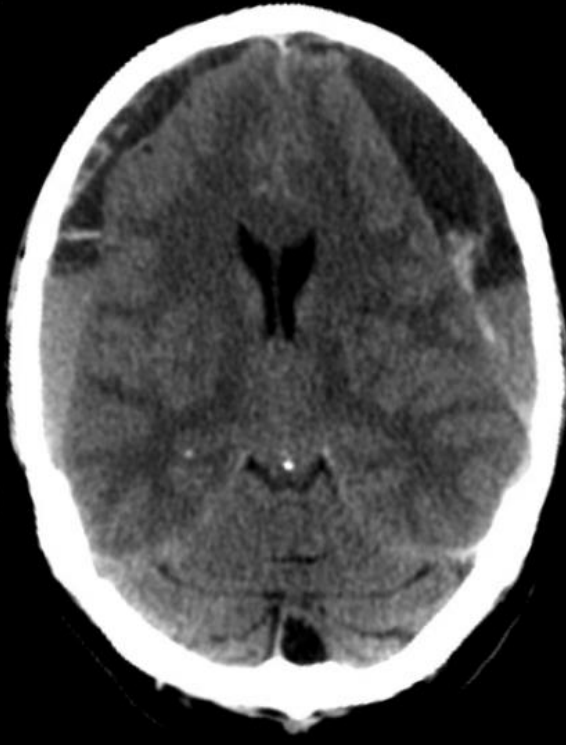
CT finding

- Crescent shape or oval shape of hyper density area their inner medial margin is irregular shaggy
- Associated with edema which cause shifting of the midline .
- The source of bleeding hematoma is venous , not associated with # , but occur as a result of disruption of subdural vein , more commonly to occur in the old age group , due to brain concussion , (brain atrophied wide SAS) & in the pediatric age group the SAS & cistern are wide also .



Chronic SDH with rebleeding

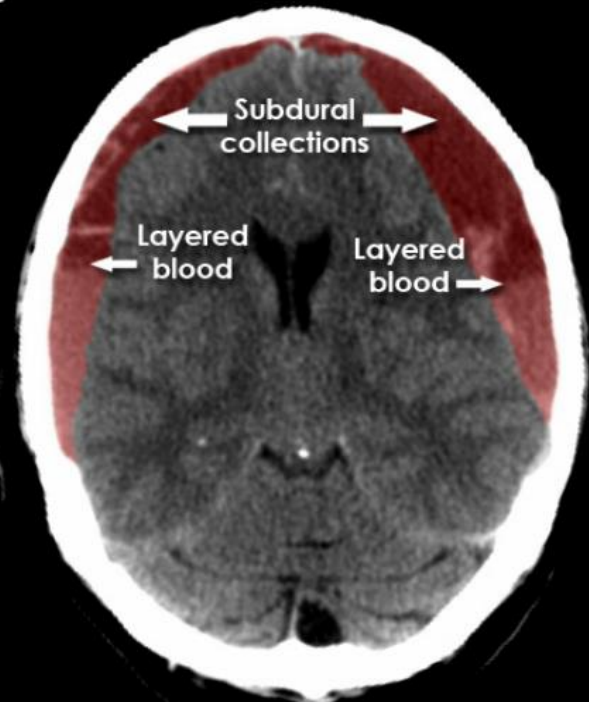
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Left Chronic SDH with rebleeding

Right

Left



Acute Intra cerebral hematoma

CT finding :

- Hyper dense area , surrounded by edema , any where within the brain parenchyma.
- Shifting of the midline
- Compression of the ipsi lateral ventricle .
- Associated with infarction , # , trauma concussion , tumor

Hypertensive Hemorrhage

Large intracerebral haemorrhage (ICH)

Right

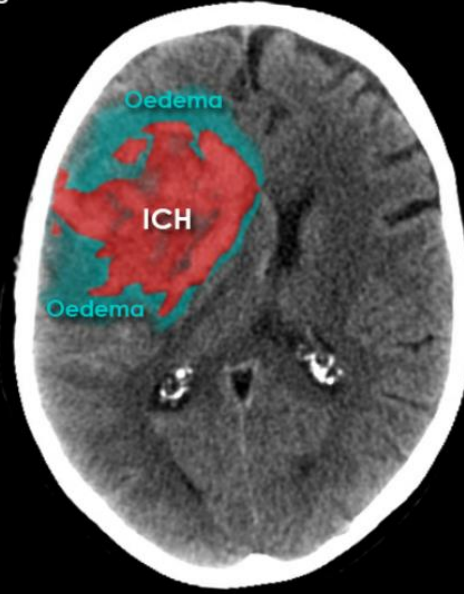


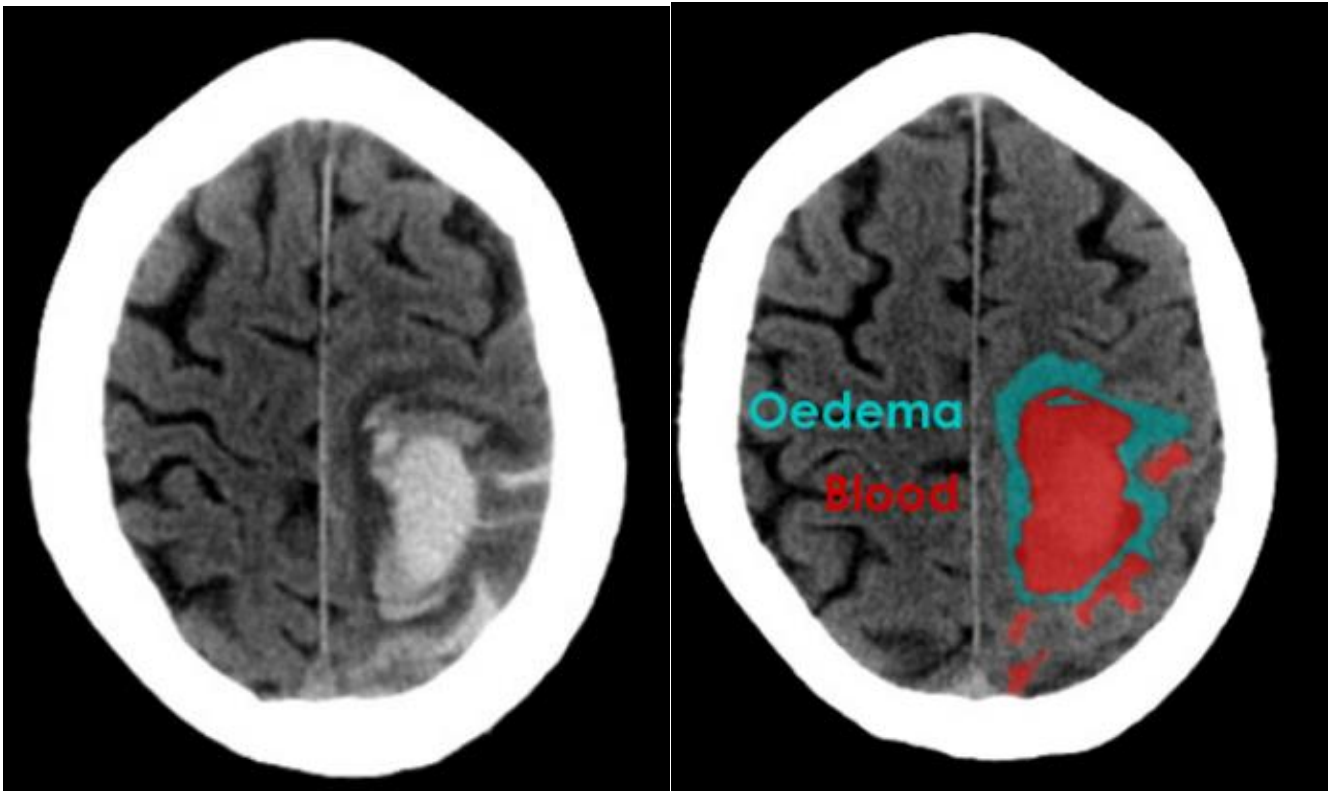
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Large intracerebral haemorrhage (ICH)

Right

Left





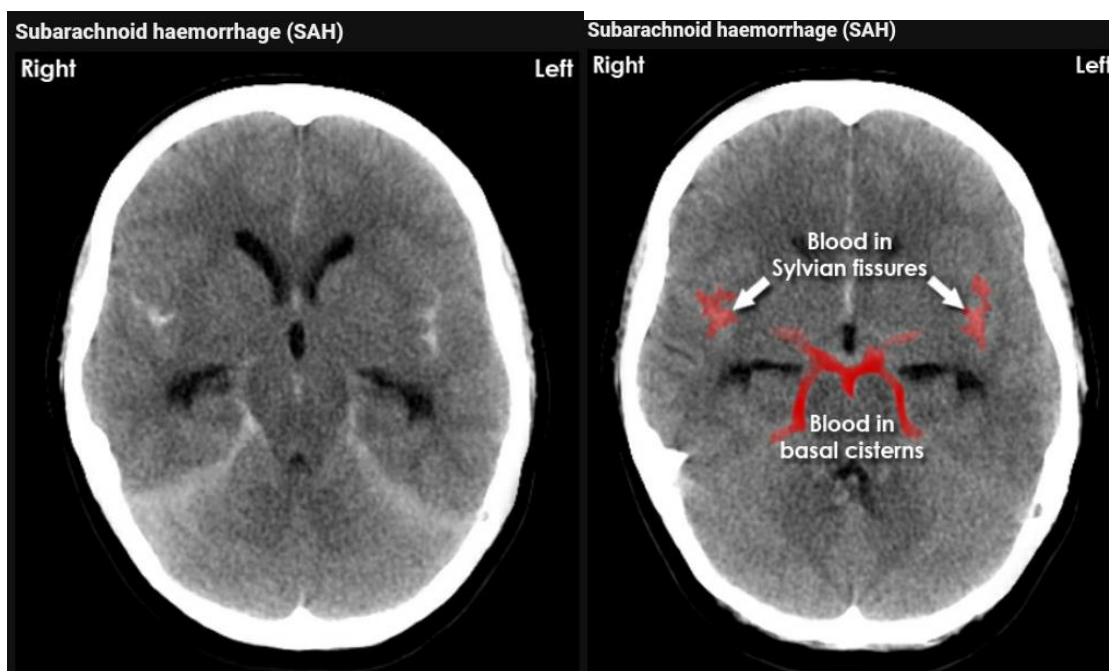
Subarachnoid hemorrhage

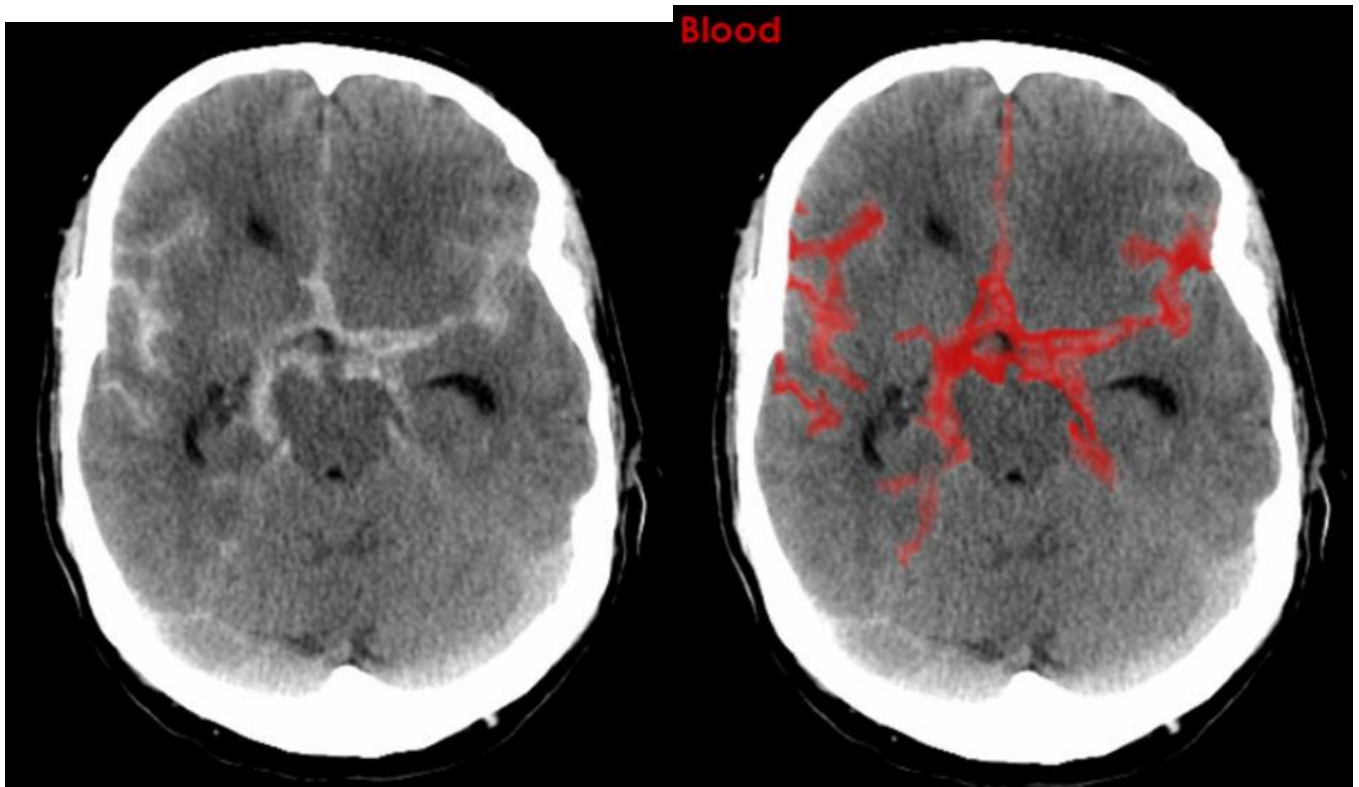
causes

- due to ruptured aneurysm over 90 % of cases specially at the circle of Willis .
- ruptured AV malformation .
- trauma .

CT finding

- hyper density is seen within the SAS (hyperdense sulci , being filled with clotted blood)
- opacified inter hemispheric fissure (become white & more dense)
- opacification of the falx cerebri .





SAH

White sulci

Opacified IHF

