جامعة المستقبل
كلية التقنيات الصحية والطبية
قسم تقنيات الاشعة

# الفحوصات الشعاعية الخاصة
# المرحلة الثالثة

# Lecture 3 & 4

## C.T of the brain

اعداد

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# Brain CT Scan

- A Brain CT scan is a complex scan of internal structures that are located inside that head and produces multiple images that are used to diagnose a range of conditions.
- The cross-sectional images generated during a CT scan can he reformatted in multiple planes. They can even generate three- dimensional images. These images can be viewed on a computer monitor, printed on film or by a 3D printer, or transferred to a CD or DVD.
- Brain CT scans are ordered when there a patient suffered serious symptoms in the head area, like severe headaches or dizziness, as well as when a patient suffers an accident with head-related injuries. They are used to diagnose a range of conditions, including aneurysms, bleeding in the brain, strokes, and brain tumors.

# How do brain CT scans work?

Brain CT scans are the same as other types of CT (computed tomography) scans, except they are taken of the head region. They are a diagnostic medical image test that generates multiple images of the skull, brain and blood vessels.

During a brain CT, a **donut-shaped** device will circle the head and captures pictures of it from various angles. The images that the scan generates are cross-sectional images, which means the images produced are sliced through the middle of the structure.

# Indications for a Brain CT

- Brain tumours
- Brain aneurysms
- Bleeding of the brain
- Fluid build up in the skull (known as hydrocephalus)
- Brain atrophy
- Structural anomalies
- Brain infection
- Abnormal blood vessels of the brain (known as arteriovenous malformation)
- Other brain conditions

## CONTRAINDICATIONS

- Pregnancy
- Hypersensitivity to iodinated contrast media.
- Blood Urea and serum creatinine (Creatinine >1.5mg/dl)

# Benefits

- CT scanning is painless, noninvasive and accurate.
- A major advantage of CT is its ability to image bone, soft tissue and blood vessels all at the same time.
- Unlike conventional x-rays, CT scanning provides very detailed images of many types of tissue as well as the lungs, bones, and blood vessels.
- CT examinations are fast and simple; in emergency cases, they can reveal internal injuries and bleeding quickly enough.
- CT is less sensitive to patient movement than MRI.
- CT can be performed if you have an implanted medical device of any kind, unlike MRI.
- No radiation remains in a patient's body after a CT examination.

# RISKS

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

- CT scanning is, in general, not recommended for pregnant women unless medically necessary because of potential risk to the baby.

- IV contrast manufacturers indicate mothers should not breastfeed their babies for 24-48 hours after contrast material is given.

- The risk of serious allergic reaction to contrast materials that contain iodine .

# Contrast-enhanced CT (optional)

The purpose of contrast in the setting of head imaging is to evaluate the physiological and pathological processes that alter the permeability of the blood-brain barrier that causes abnormal contrast enhancement.

- **Therefore, contrast-enhanced CT allows the identification of abnormal contrast enhancement including :**
- brain metastases: variable enhancement of the lesion post-contrast
- meningioma: solid intense enhancement of the lesion post-contrast
- brain abscesses:
  - double rim sign: hypodense outer rim and a hyperdense inner rim
  - single rim of hyperdense or isodense
  - fluid/pus: hypoattenuating center
- necrotic neoplasm (e.g. glioblastoma) or abscess: outer enhancing ring surrounding a necrotic center
- meningitis and meningoencephalitis: Leptomeningeal enhancement
- multiple sclerosis: contrast enhancement of plaques
- lymphoma: enhancement of lesion post-contrast
- ependymitis and ventriculitis: thin linear enhancement of the margins of the ventricles

# How to prepare for your brain CT Scan

- You will be asked not to eat or (drink) anything for a few hours beforehand, if contrast material will be used in your exam. You should inform your physician of all medications you are taking and if you have any allergies.
- To prepare for your appointment you will need to remove all metal objects, like jewelry, piercings, a watch, hairpins and removable hearing aids.

# POSITION

- **Patient Position:** supine with their arms by their side
- with the head in the head holder. Center the table height such that external auditory meatus (EAM) is at center of the gantry. To decrease the ocular lens exposure, the scan angle should be parallel to a line created by the supraorbital ridge and the inner table of the posterior margin of the foramen magnum.
- **Topogram Direction:** Craniocaudal
- **Scan Type:** Axial
- **Position/Landmark:** 2-3cm (20-30mm) above the vertex.
- **Start Location:** Skull base.
- **End Location:** Skull vertex.
- **scan geometry**

  slice thickness: <5 mm

  slice increment: 0.5 mm

**contrast injection protocol**

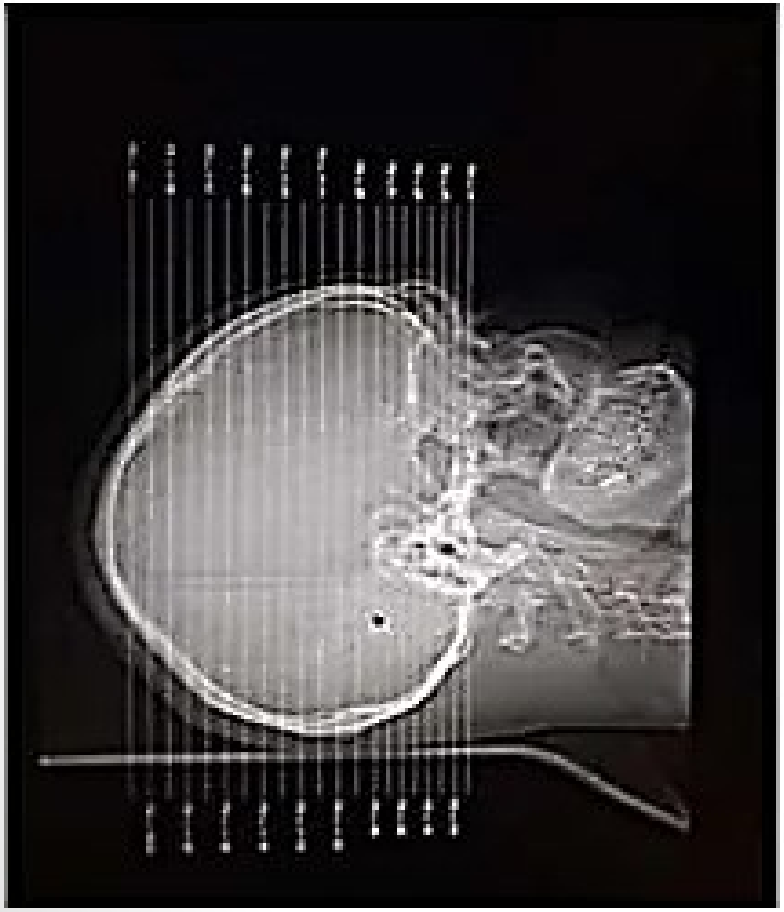
non-contrast performed first

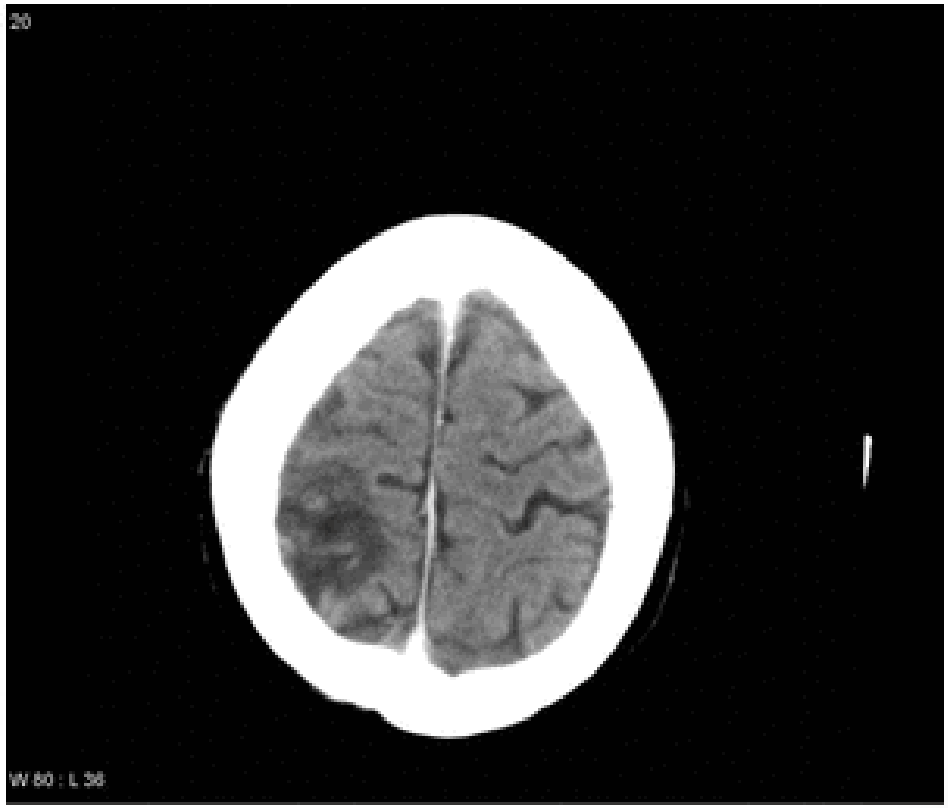
delayed phase post-contrast acquisition

- 50 cc hand injection or 1 cc/s pressure injection ± saline chaser
- delayed acquisition: >5 minutes post-contrast injection

# Topogram of head with scan lines showing the plane and scan range

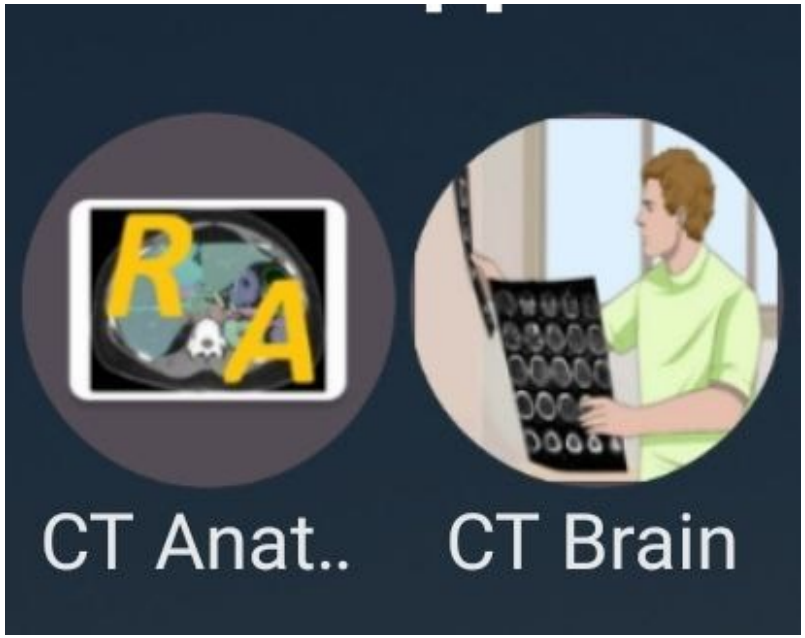
**Native Axial CT scan**





# LET'S VIEW app : Brain anatomy & Termonology

**Please download CT anatomy and CT brain for Android mobile phones**



# Terminologies

Hypo dense (Right parietal infarction)

Hypodense lesion

# Termomologies


Hyper dense (Right temporal hemorrhage)

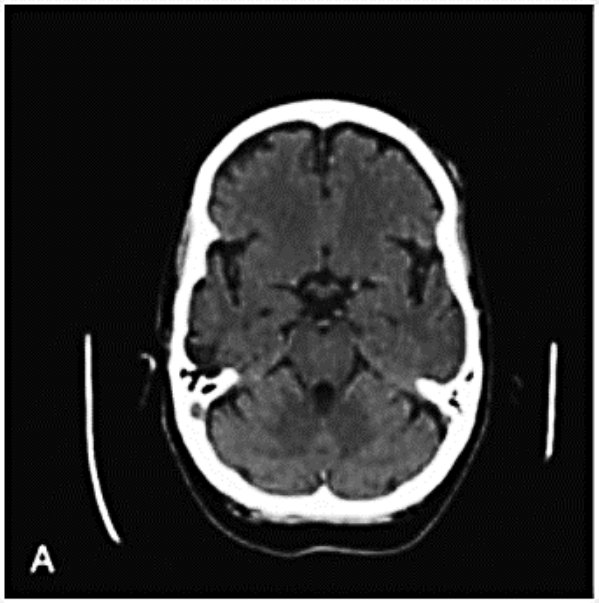
Hyperdense lesion

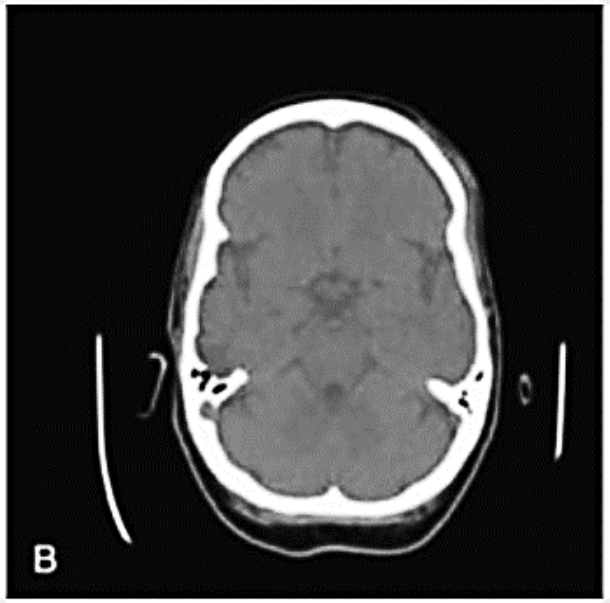
# Termomologies

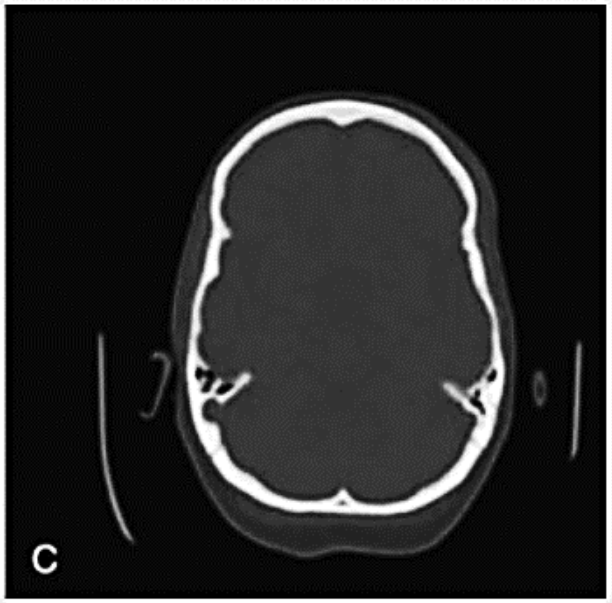
Iso dense (Right subacute subdural hematoma)

Isodense lesion

# CT Windowing

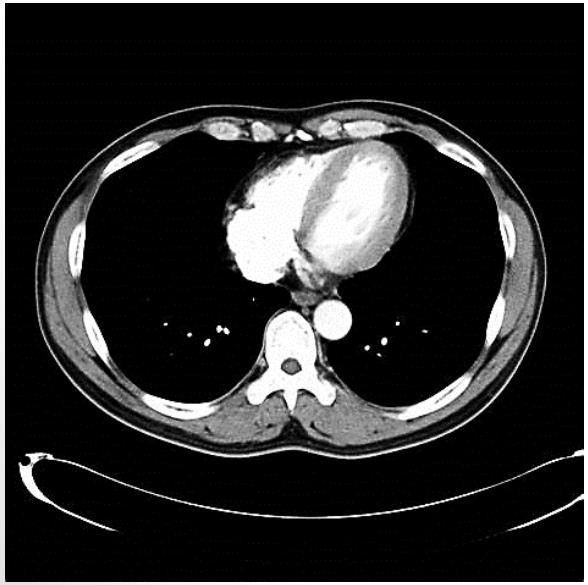


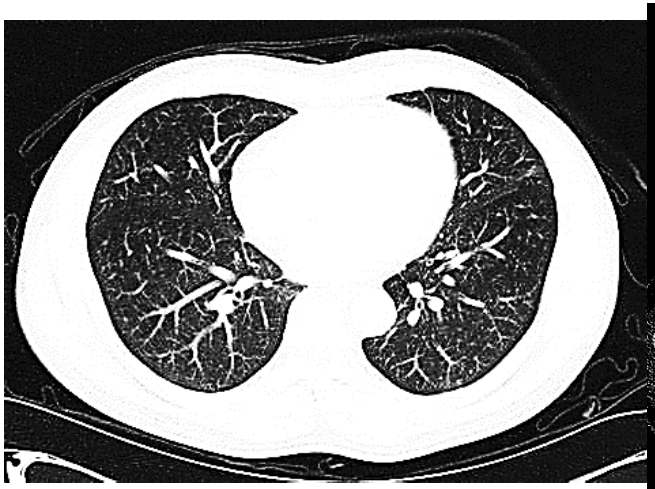



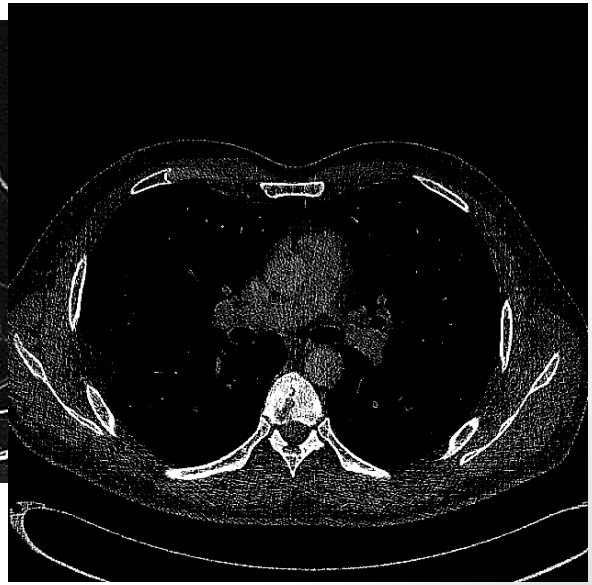




**Brain window**
**(soft tissue window)**

**Bone window**
**(To evaluate fractures )**







**Lung window**

# Common CT attenuation values

| Structure | Attenuation value in HU |
|---|---|
| Air | From -500 To -1000 HU |
| Fat | From -10 To - 200 HU |
| Water | From 0 To 15 HU |
| Brain tissue | From 30 To 40 HU |
| Recent hematoma | From 60 To 90 HU |
| Calcifications | More than 100 HU |
| Bone | From 200 HU and above |
| Brain edema and infarction | around 20 HU |
| Normal liver parenchyma | around 60 HU |

| DESCRIPTION | Approx. HU | DENSITY |
|---|---|---|
| Calcium | > 1000 | Hyperdense |
| Acute blood | 60-80 | Hyperdense |
| Grey matter | 38 (32-42) | Hyperdense |
| White matter | 30 (22-32) | Isodense |
| CSF | 0-10 | HYPODENSE |
| Fat | -30 to - 100 | Hypodense |
| Air | - 1000 | Hypodense |

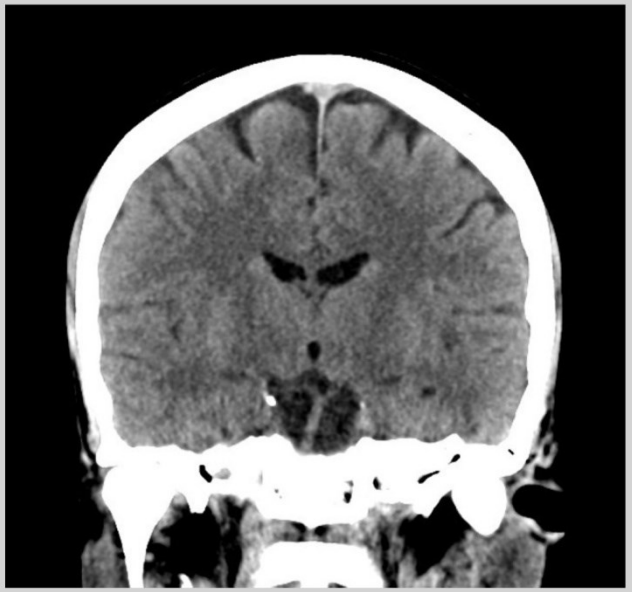
## Axial

Non-contrast axial CT

## Sagittal

Non-contrast sagittal CT

## Coronal

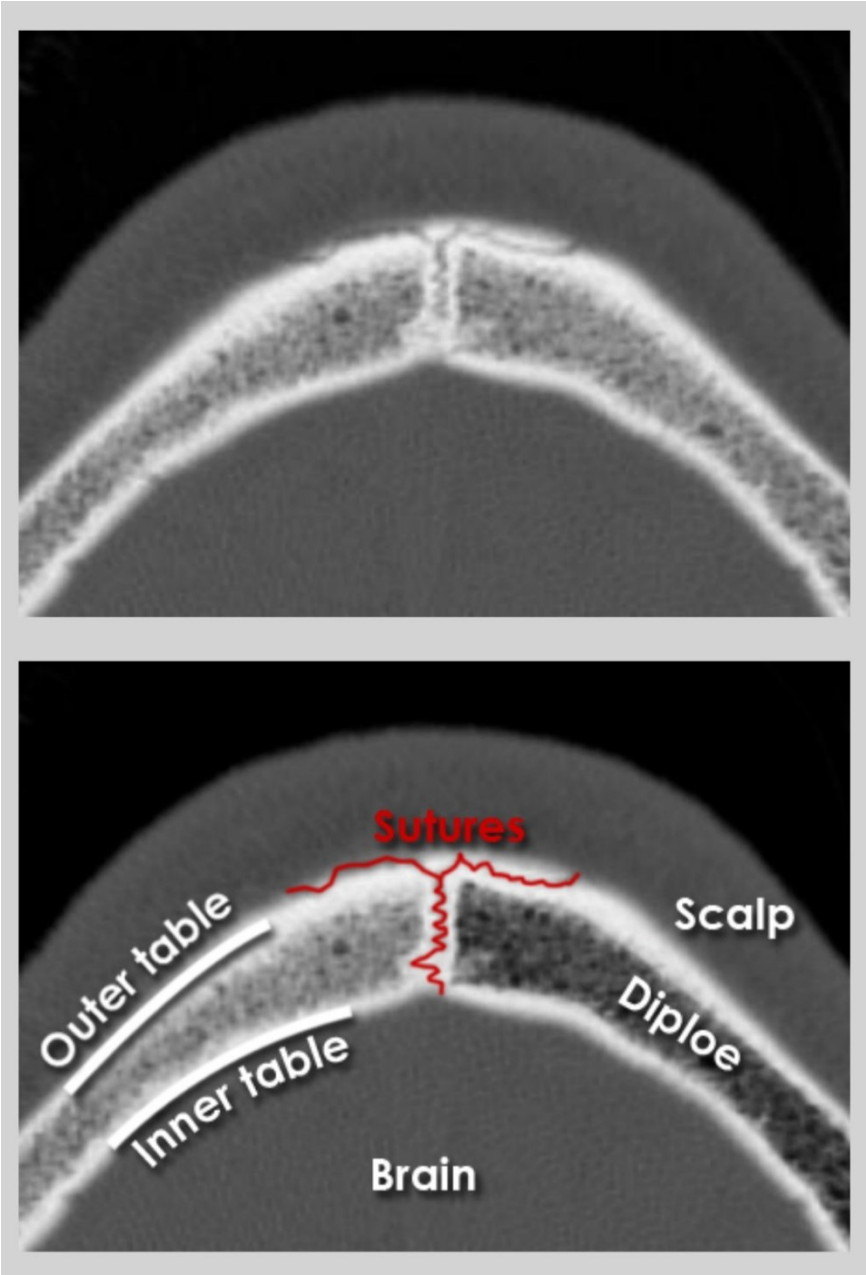


Non-contrast coronal CT

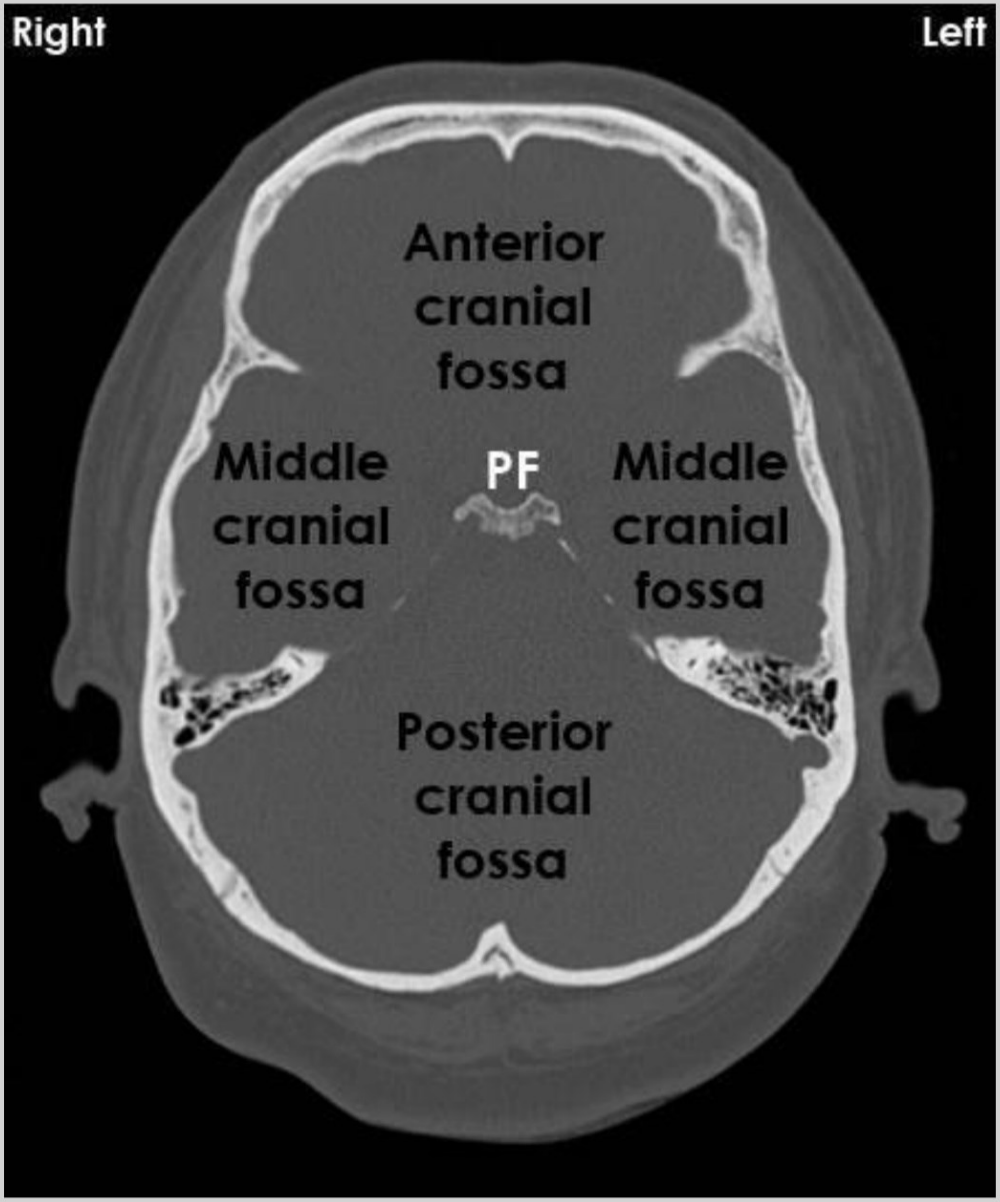
Non-contrast axial CT

Post-contrast Axial CT

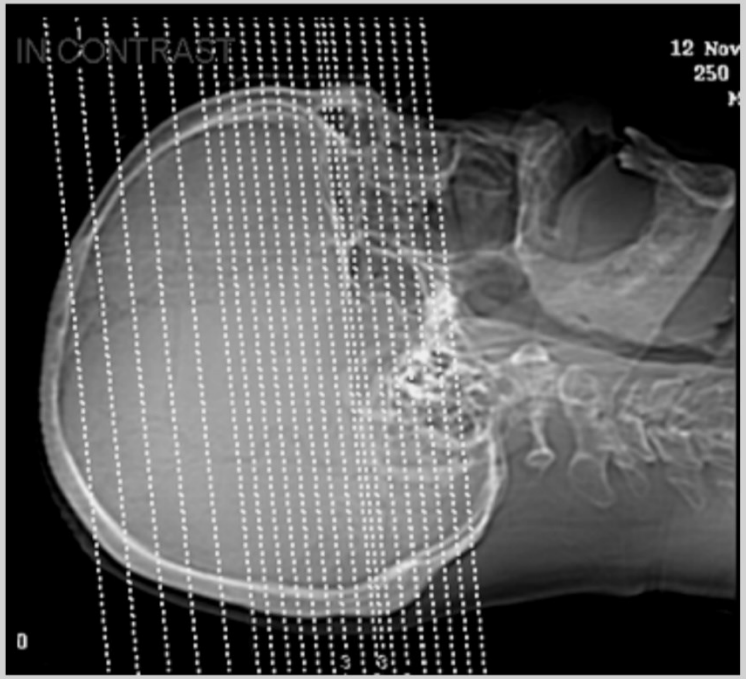
# Simple cranial bone anatomy

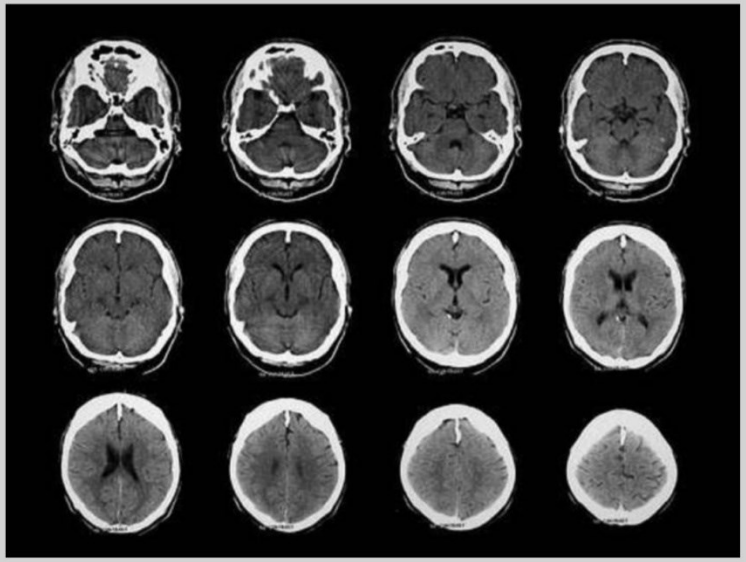


# Simple anatomy



## Series of CT Brain Slice Sections



# Division of Brain Lobes

- **F= F**rontal lobes
- **P= P**arietal lobes
- **T= T**emporal lobes
- **O= O**ccipital lobes

# Brain stroke in CT scan

# STROKE

Sudden onset focal deficit
In vascular area

1. Ischemic strokes (80%)

- Hypertension
- Vascular malformation
- Tumors
- Seizures

2. Hemorrhagic strokes (15%)

- Sudden cessation of adequate mount of blood reaching part of brain
- atherosclerosis , age , family history , smoking ,diabetes mellitus
- The result of No blood , No o2+glucose = irreversible cell death

# STROKE

1. Early hyper acute : 0 – 6 hours
2. Late hyper acute 0 - 24 hours
3. Acute : 24 hours to week
4. Sub acute : 1 – 3 weeks
5. Chronic :  more 3 weeks

# STROKE

## Early

1. Hyper dense segment of vessel
2. Loss of grey-white differentiation

Hyperdense MCA sign

# STROKE

## Early

1. Hyper dense segment of vessel
2. Loss of grey-white differentiation

# STROKE

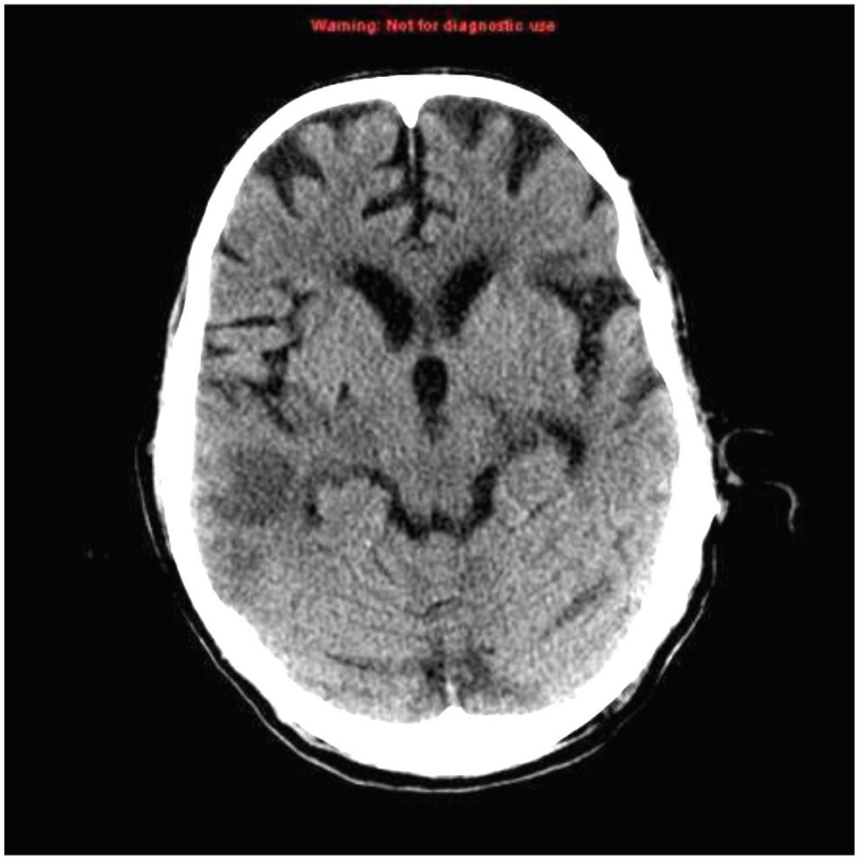
## Early

1. Hyper dense segment of vessel
2. Loss of grey-white differentiation

# STROKE

## Acute

- Hypo attenuation
- Swelling
- Mass effect

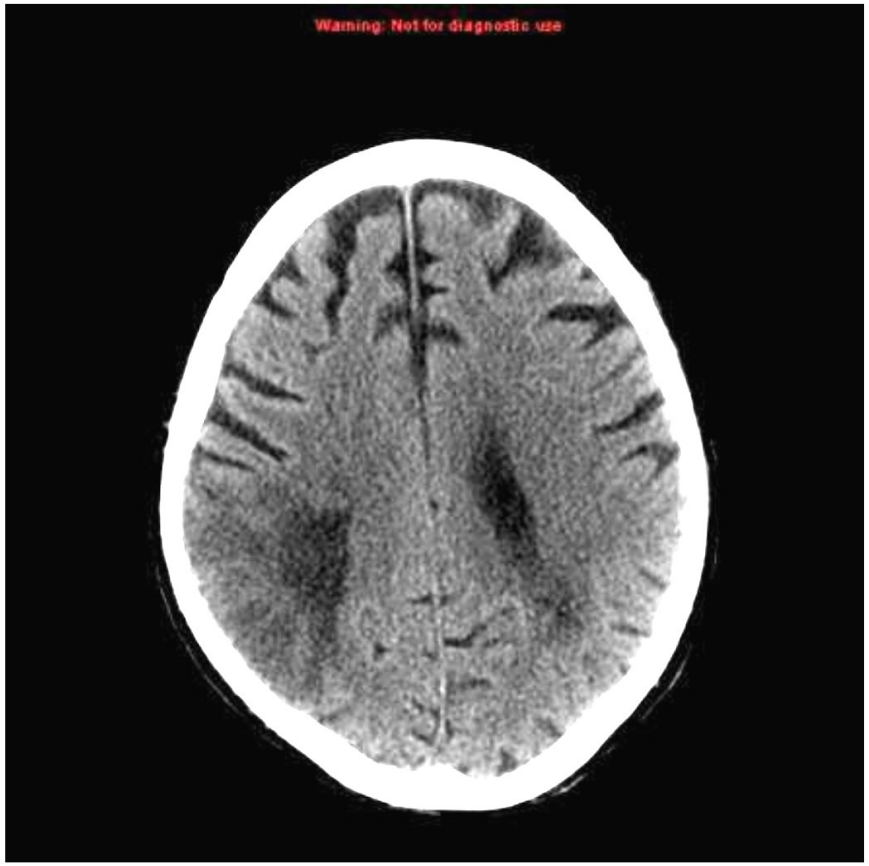



Acute infarction

# STROKE

## Acute

- Hypo attenuation
- Swelling
- Mass effect




Acute infarction

# STROKE

## Chronic

1. No swelling
2. Low density
3. Negative mass effect

Chronic Right MCA demonstrating encephalomalacia (CSF filling the 'dead'

# STROKE

## Chronic

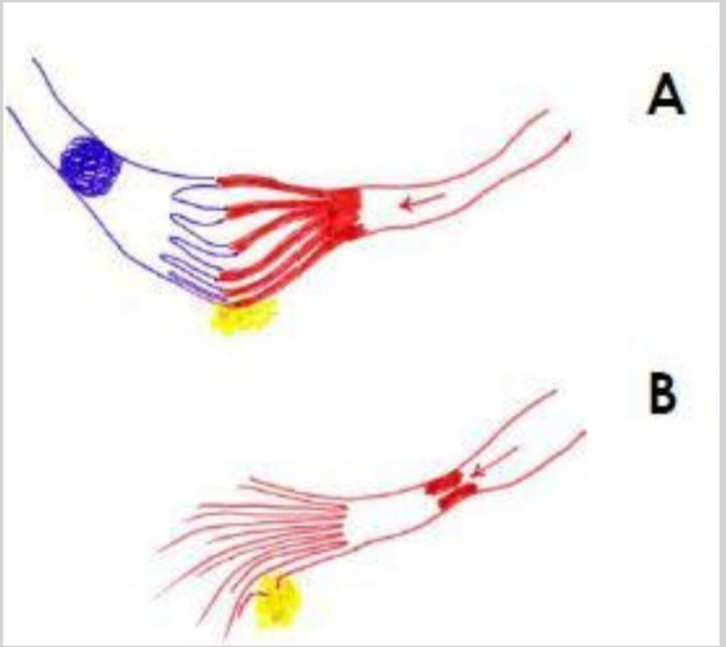
1. No swelling
2. Low density
3. Negative mass effect
   (Loss volume )

Chronic left PCA territory infarcts, demonstrating encephalomalacia (CSF

# STROKE

## Hemorrhagic infarction

- Venous thrombosis
- Arterial embolism




■ Venous occlusion → increase intracaillary pressure → rupture of some capillaries → hemorrhagic foci (A)

■ Sudden occlusion of the artery by an embolus → acute infarction. Recanalization of the embolus → gush of blood through the narrow canalized lumen → injury of some capillaries → hemorrhagic foci (B)

# STROKE

## Hemorrhagic infarction

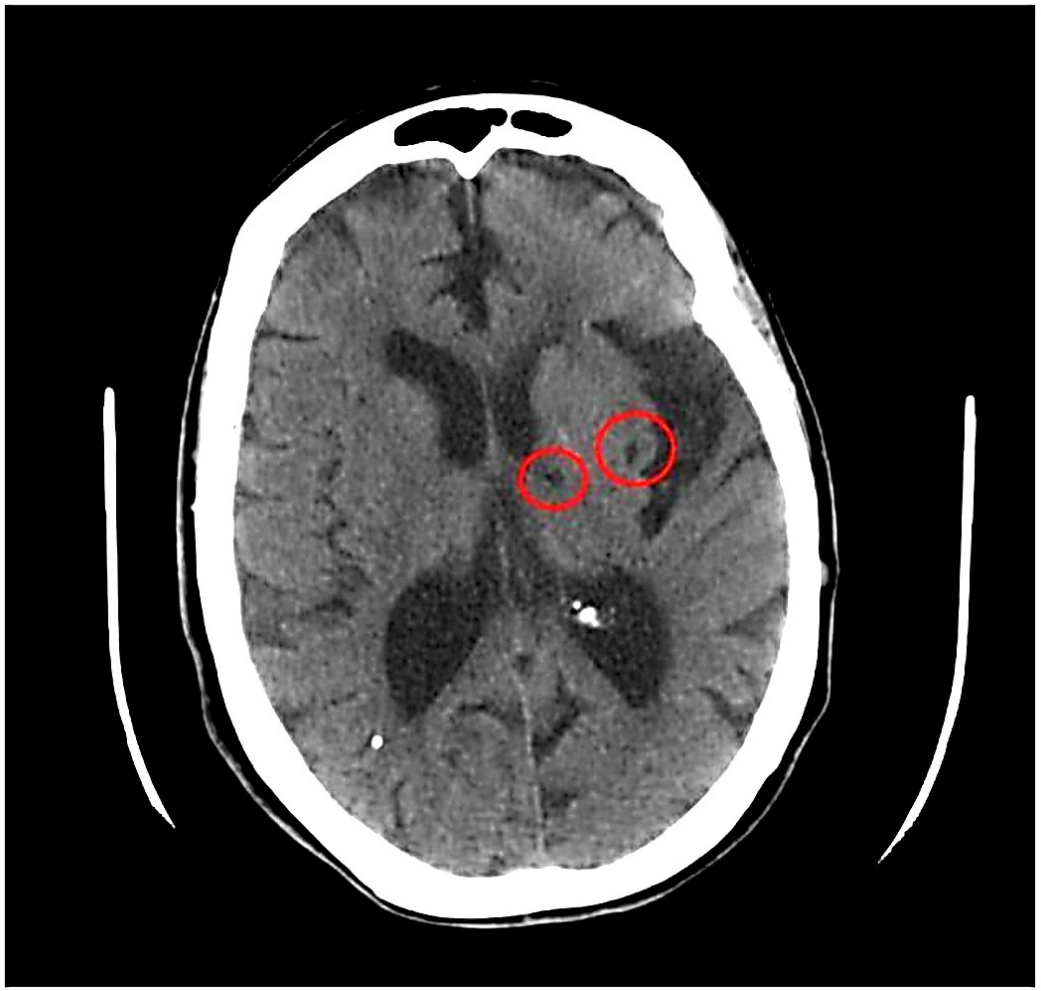
- Venous thrombosis
- Arterial embolism

Non contrast CT of right frontotemporal hemorrhagic infarction showing a large

# STROKE

## Lacunar infarction

- <15 mm in size
- Clinically silent
- Base of the brain



lacunar infarction

# STROKE

## Lacunar infarction

- <15 mm in size
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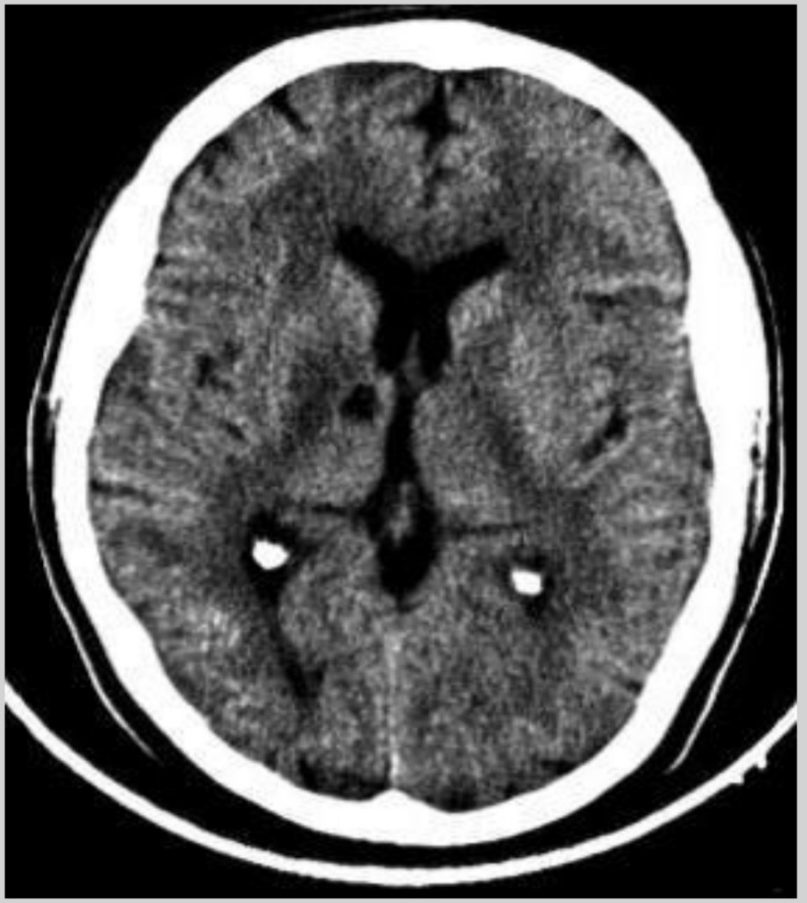
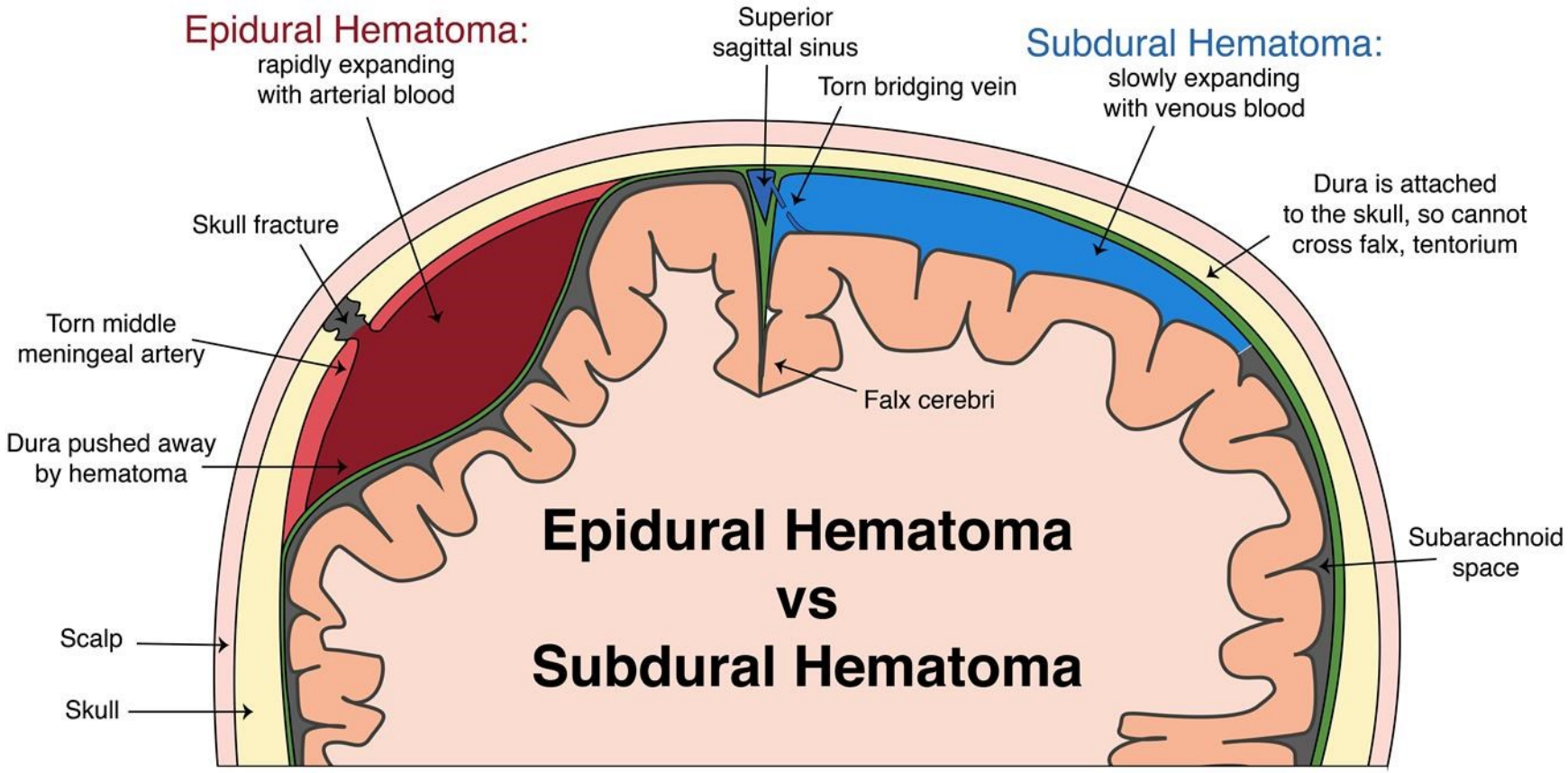
- Base of the brain

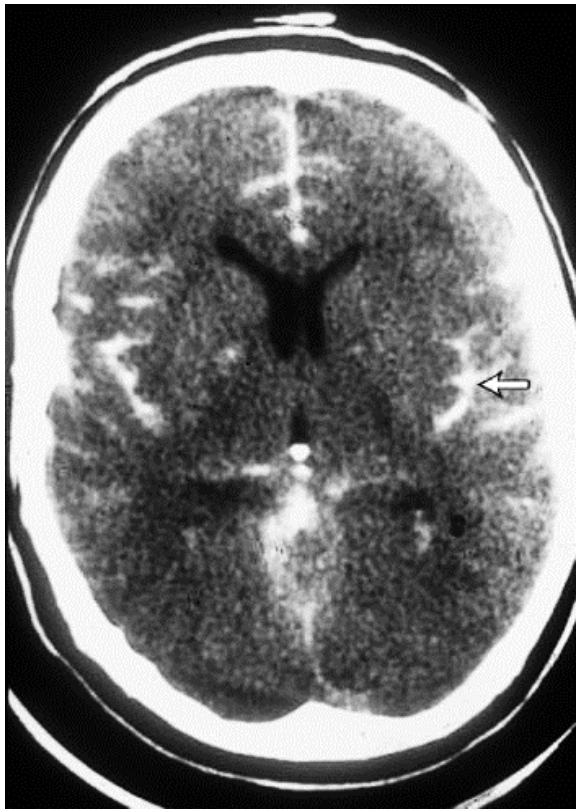


Right thalamic lacunar infarction showing a small hypodense focus in the anterior part of the thalamus with no mass effect

# Extra axial hemorrhage



Epidural hemorrhage



Subarachnoid hemorrhage

Subdural hemorrhage

# Hemorrhagic stroke

# &

# Intracranial hemorrhage

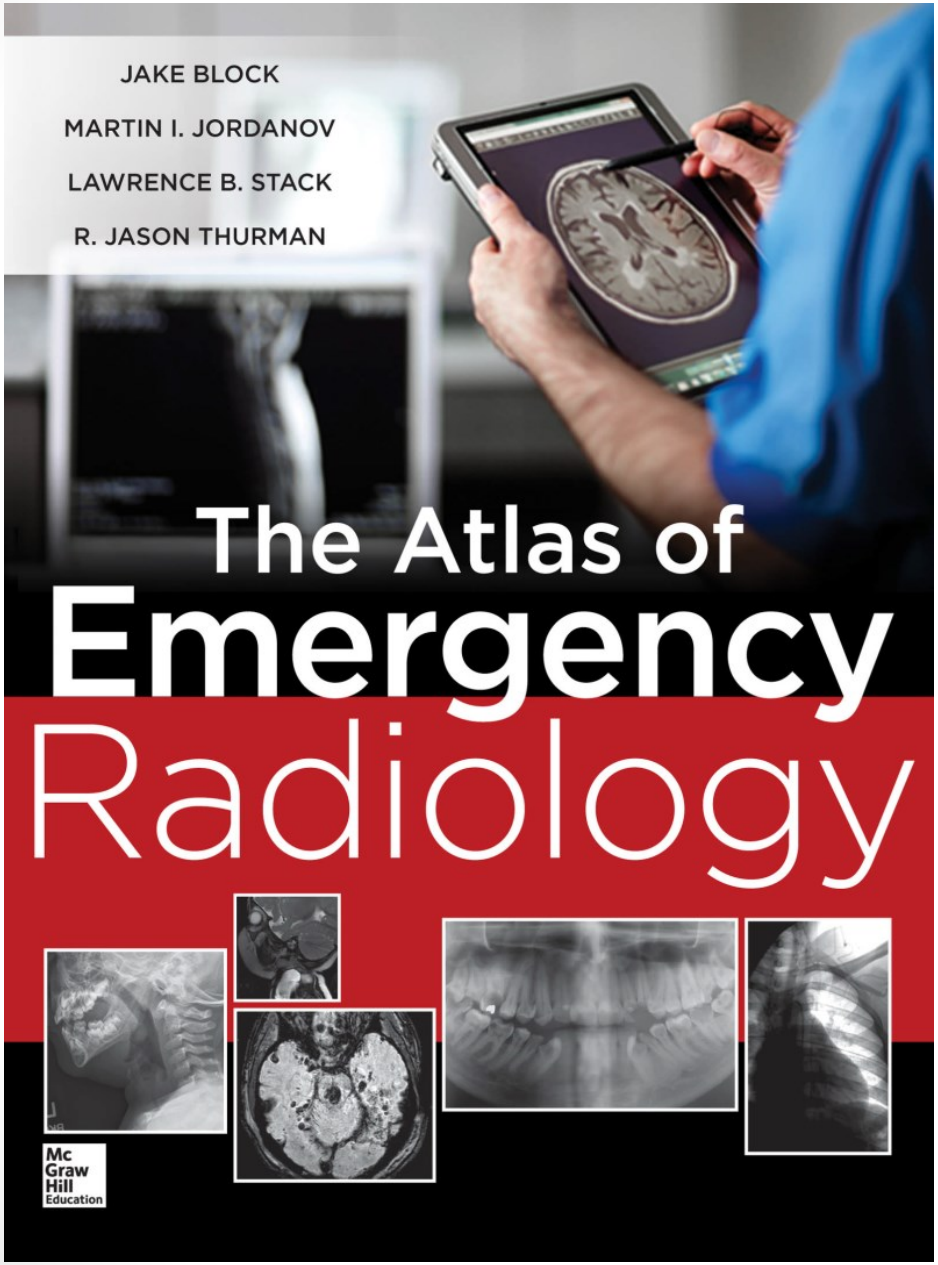
## Intracranial hemorrhage

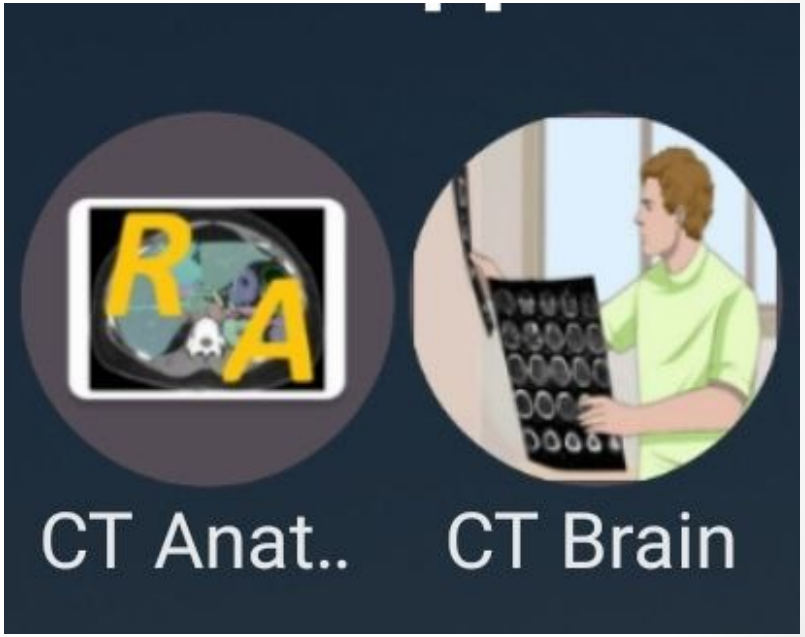
- Basal ganglia
- Lobar
- Thalamic
- Cerebellar

## Extra – axial hemorrhage

- Epidural (EDH)
- Subdural (SDH)
- Subarachnoid (SAH)
- Intraventricular (IVH)

# REFRANCES


JAKE BLOCK
MARTIN I. JORDANOV
LAWRENCE B. STACK
R. JASON THURMAN
The Atlas of
Emergency
Radiology
Mc Graw Hill Education


CT Anat..
CT Brain