IMAGING OF A NON TRAUMATIC BRAIN EMERGENCY

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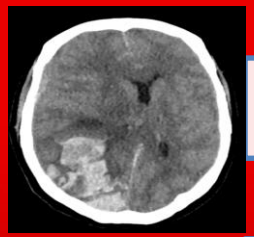
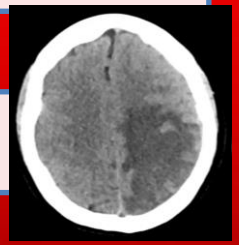
INTRODUCTION

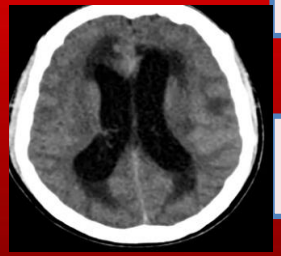
- "Brain Neuroemergency" is a non traumatic acute presentation of neurologic symptoms
- Neuroimaging is vital for the diagnosis and subsequent management
- Important considerations in developing an imaging protocol for these cases include time urgency, availability of expertise,
- Radiologists should be aware about the imaging features and possible differential diagnosis of various neuroemergencies

OVERVIEW



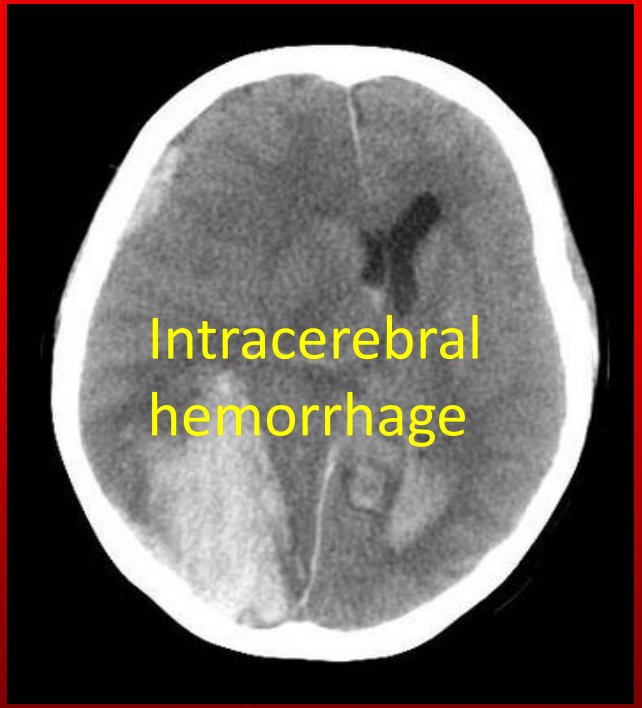
- Hemorrhage
- Edema

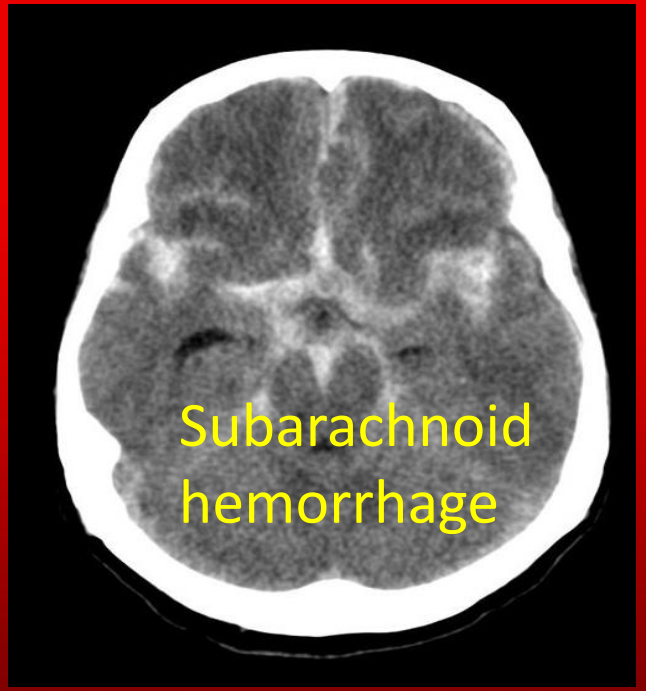




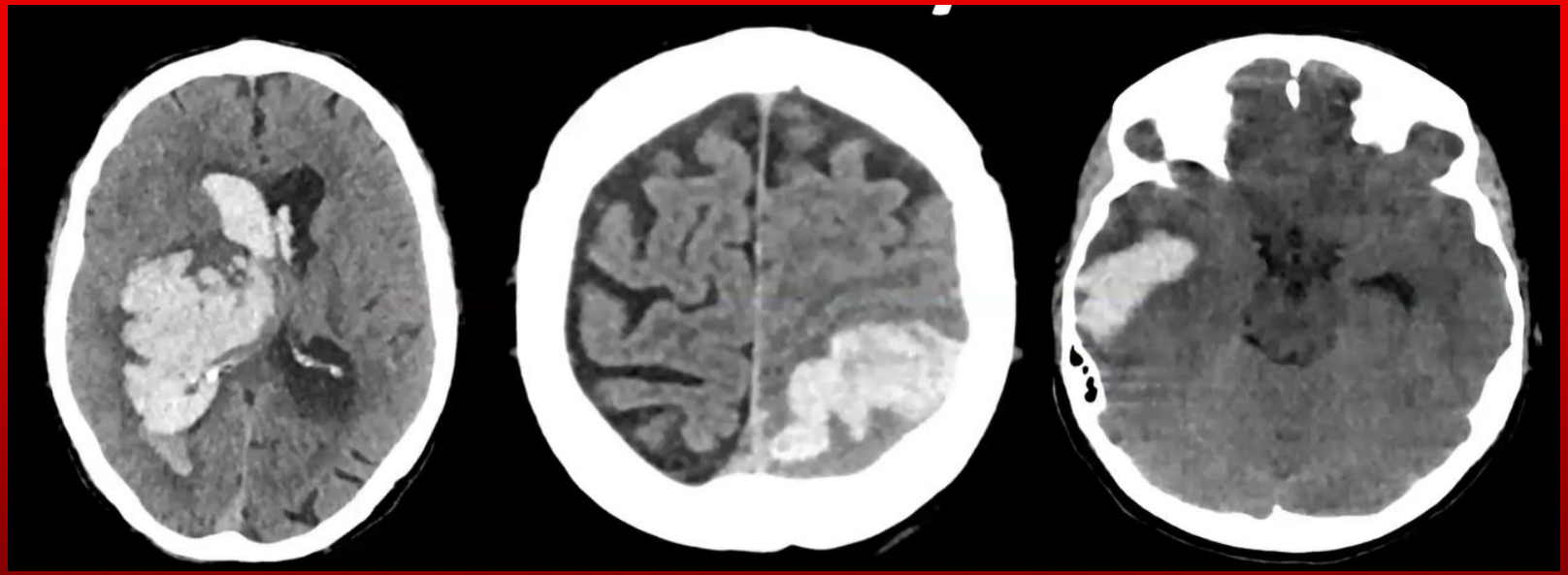
- Hydrocephalus
- Excluding : Acute Ischemic Stroke

CEREBRAL HEMORRHAGE





INTRACEREBRAL HEMORRHAGE



What is the cause ??

Eldery patients

Primary

- Hypertention
- Cerebral amyloid angiopathy

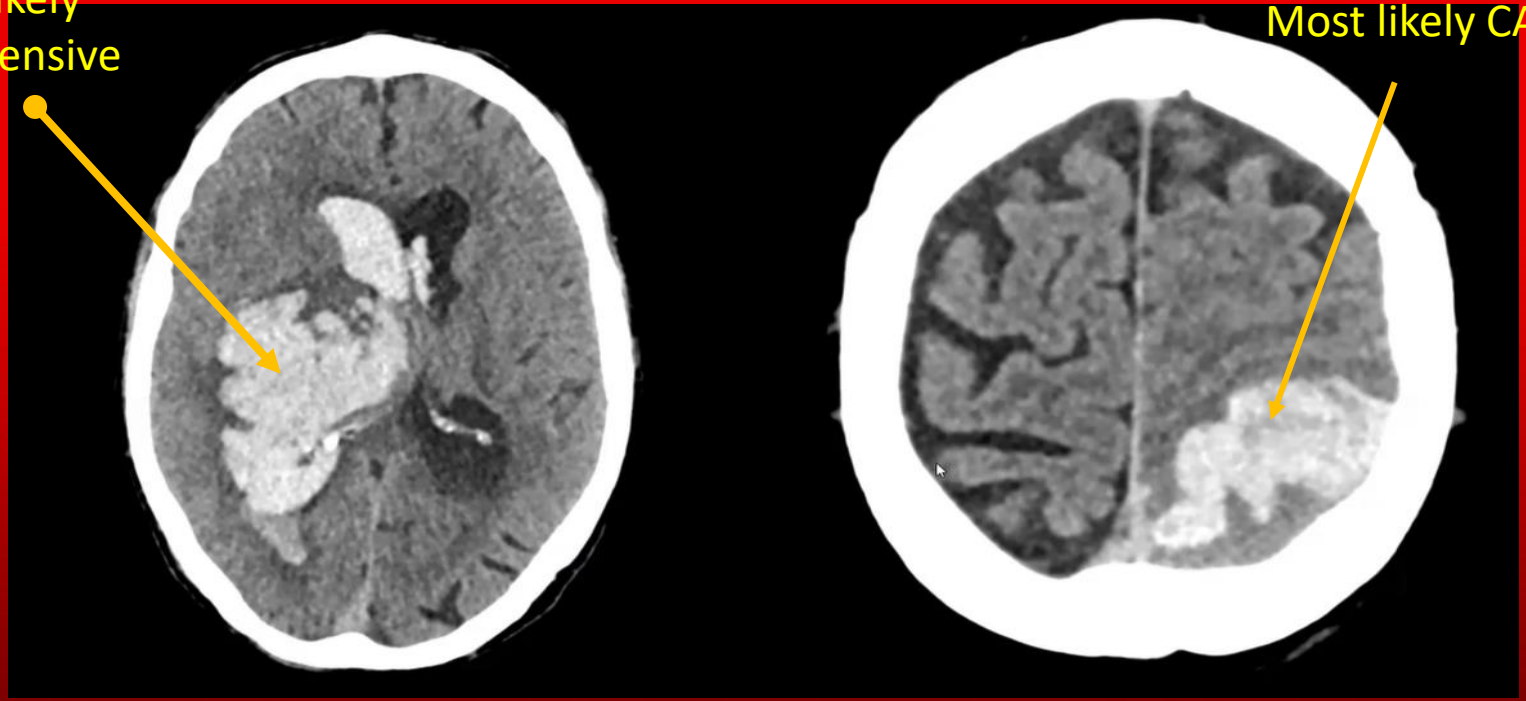
All ages

Secondary

- Tumors
- Cerebral venous thrombosis
- Vascular malformation
- Coagulation disorders

Most likely hypertensive

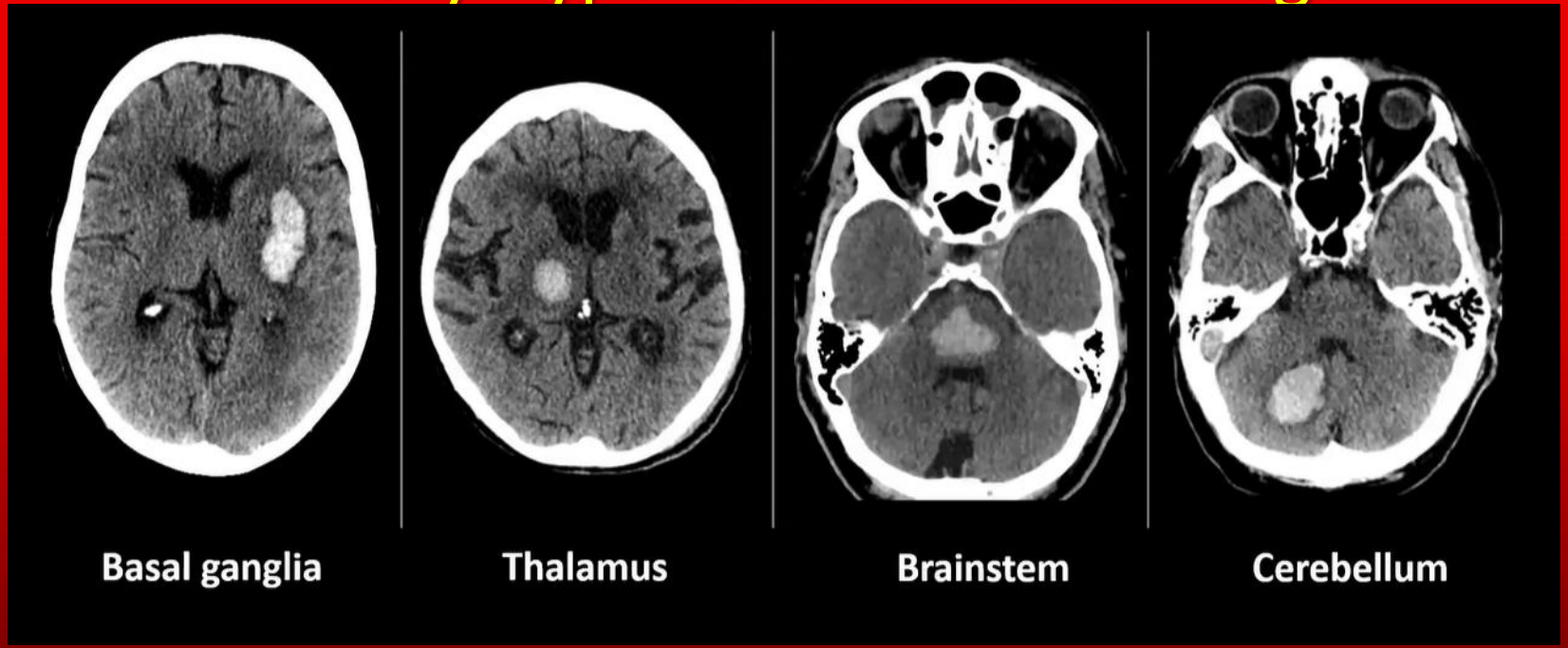
Most likely CAA



Deep ICH

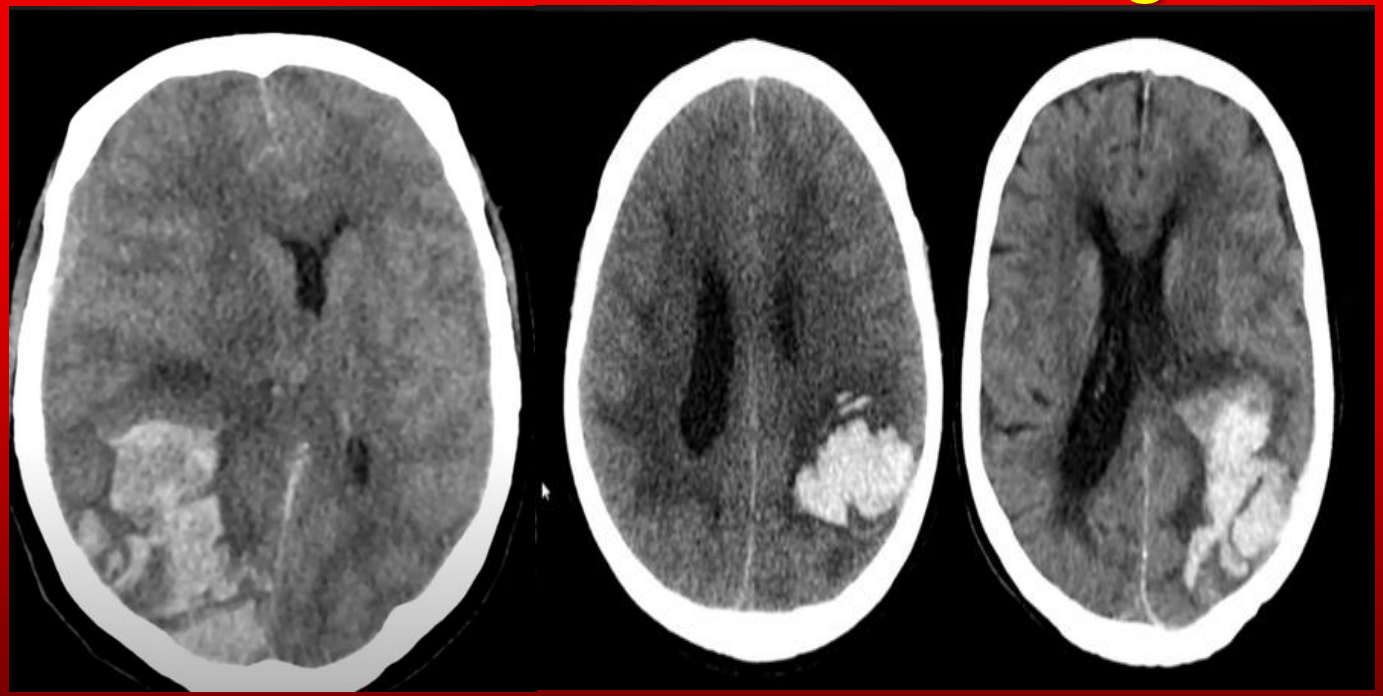
Lobar ICH

Primary Hypertensive hemorrhage

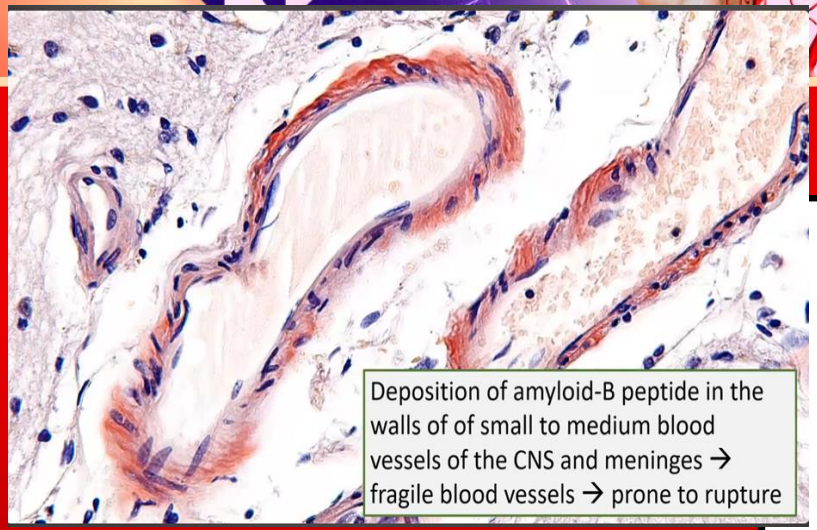


A deep ICH has a high likelihood of being a hypertensive homorrhage in older patient (>45 years) with long standing hypertension

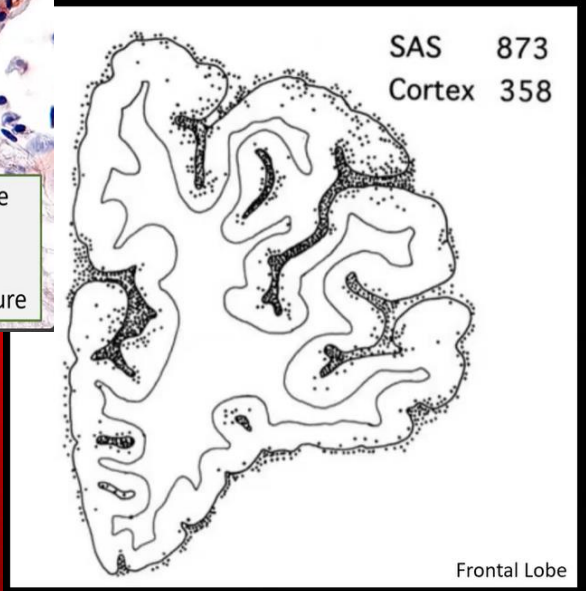
Lobar hemorrhages

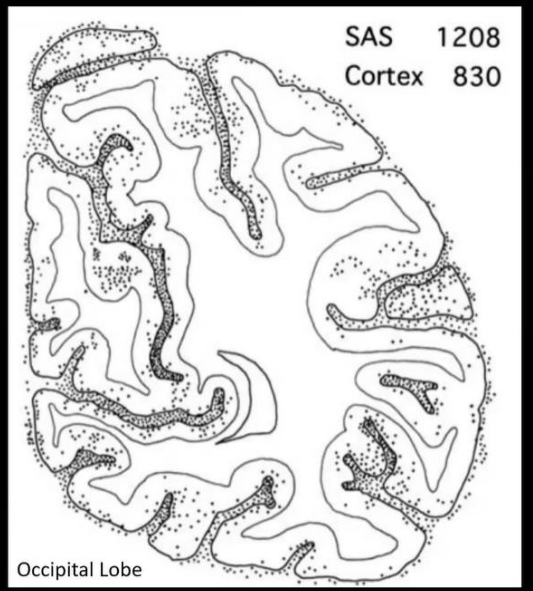


- Lobar ICH are located in the periphery of the cerebral lobes
- Most common cause of lobar hemorrhage in the eldey is cerebral amyloid angiopathy
- Perform MRI to confirm and rule out other diagnosis



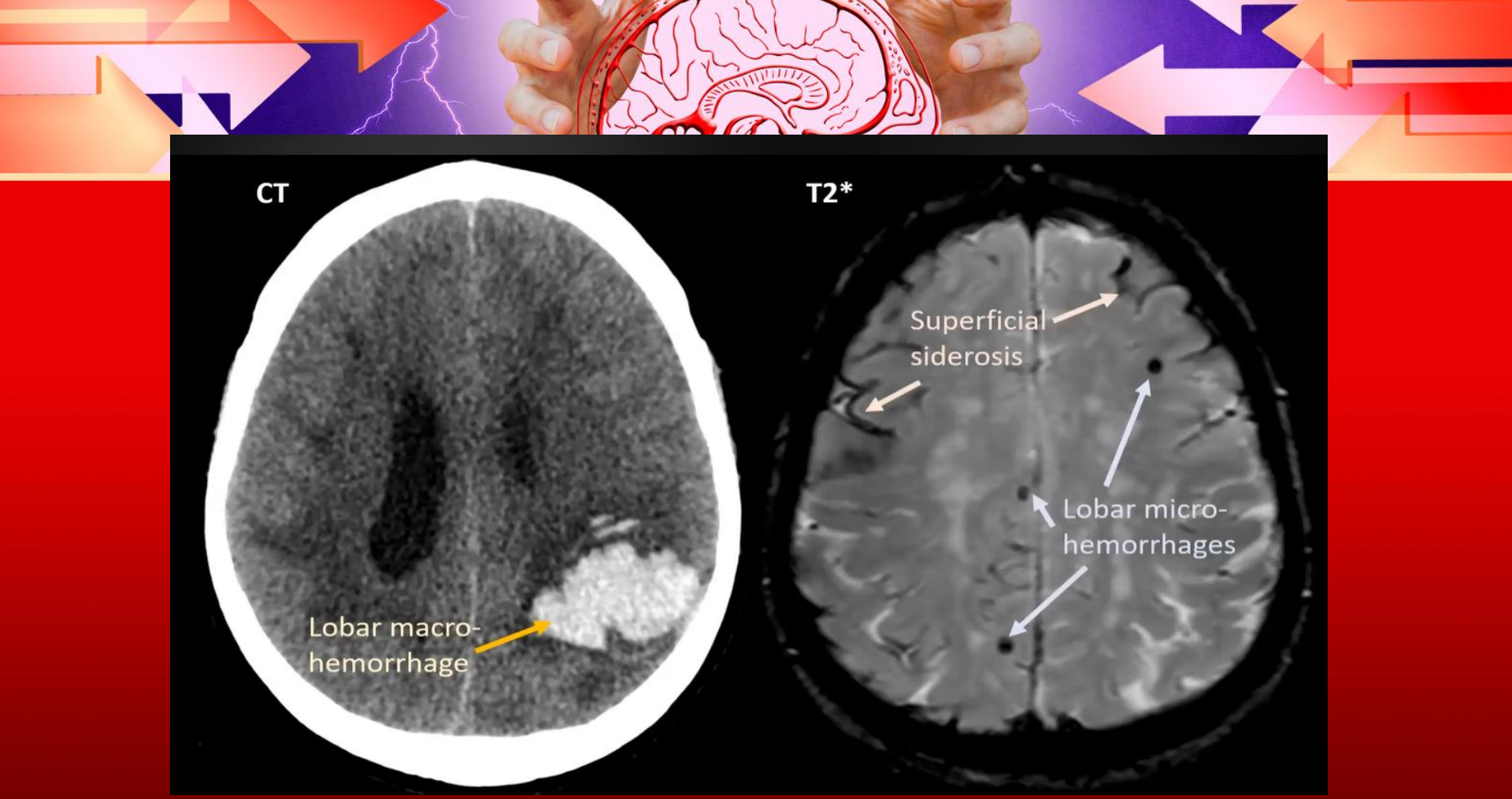
Deposition of amyloid-B peptide in the walls of of small to medium blood vessels of the CNS and meninges → fragile blood vessels → prone to rupture





Most amyloid depositions are found in small leptomeningeal or cortical arteries, never in deep perforating arteries.

Takeda et al. Neuropathol 2003;23,254-261.


CT
T2*
Lobar macro-
hemorrhage
Superficial
siderosis
Lobar micro-
hemorrhages

Eldery patients

Primary

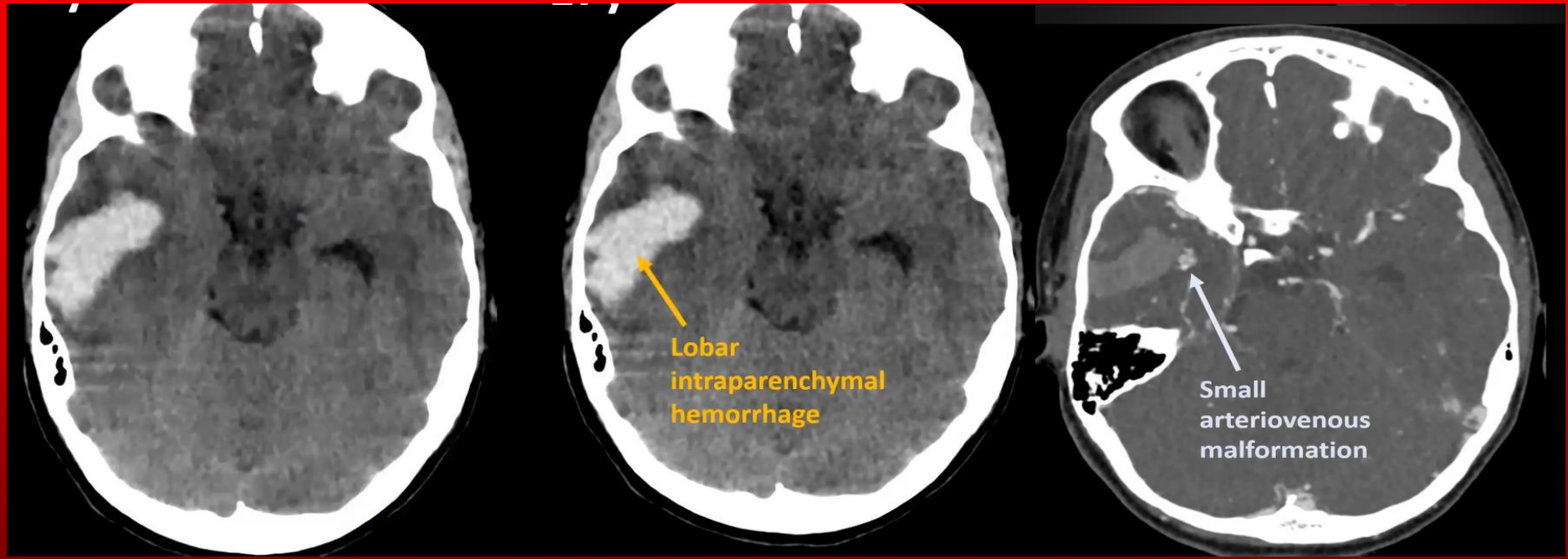
- Hypertention
- Cerebral amyloid angiopathy (CAA)

All ages

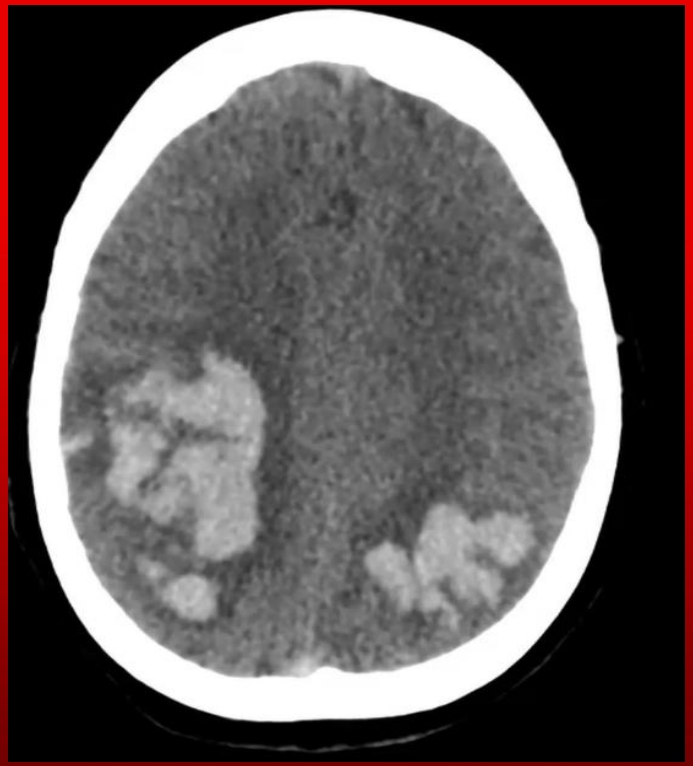
Secondary

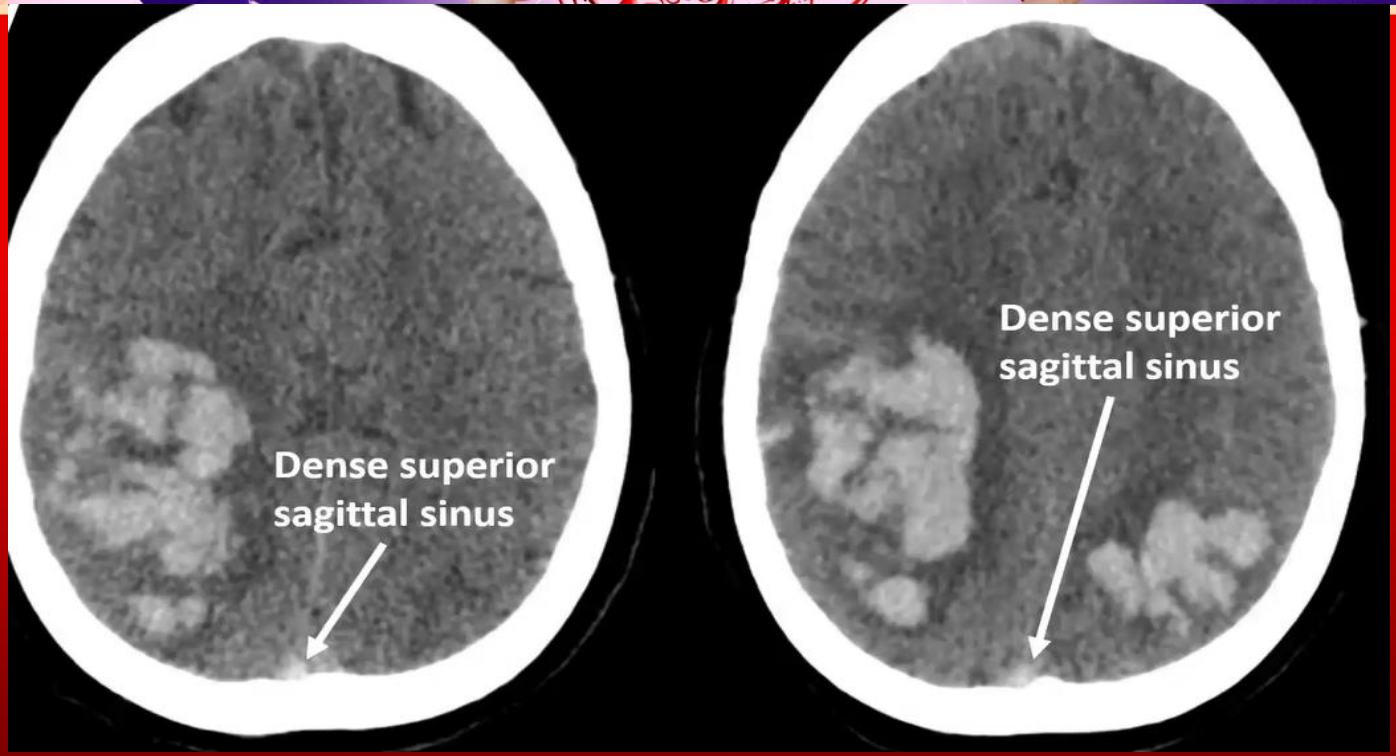
- Tumors
- Cerebral venous thrombosis
- Vascular malformation
- Coagulation disorders

Female 17 years with headache



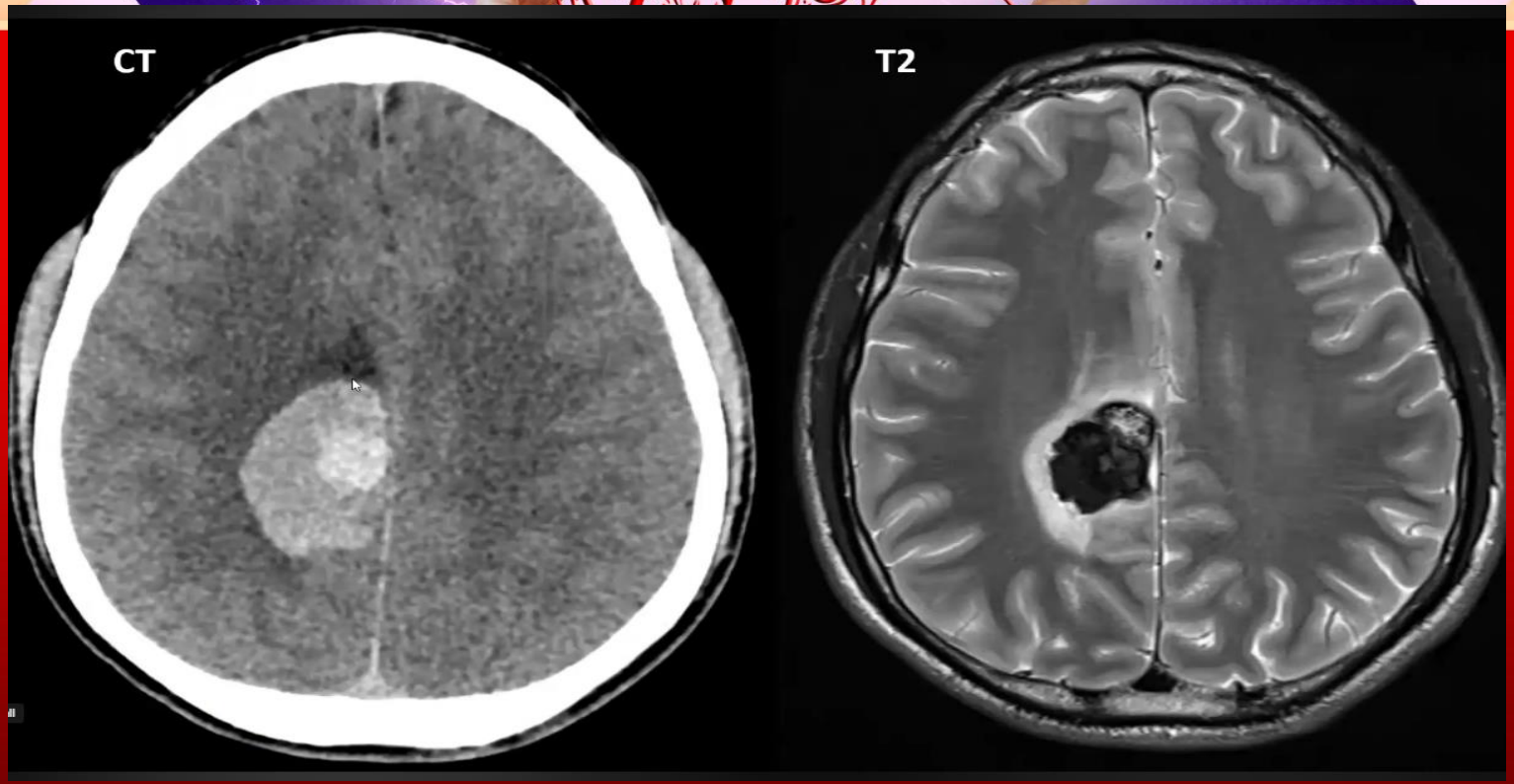
Female 35 years

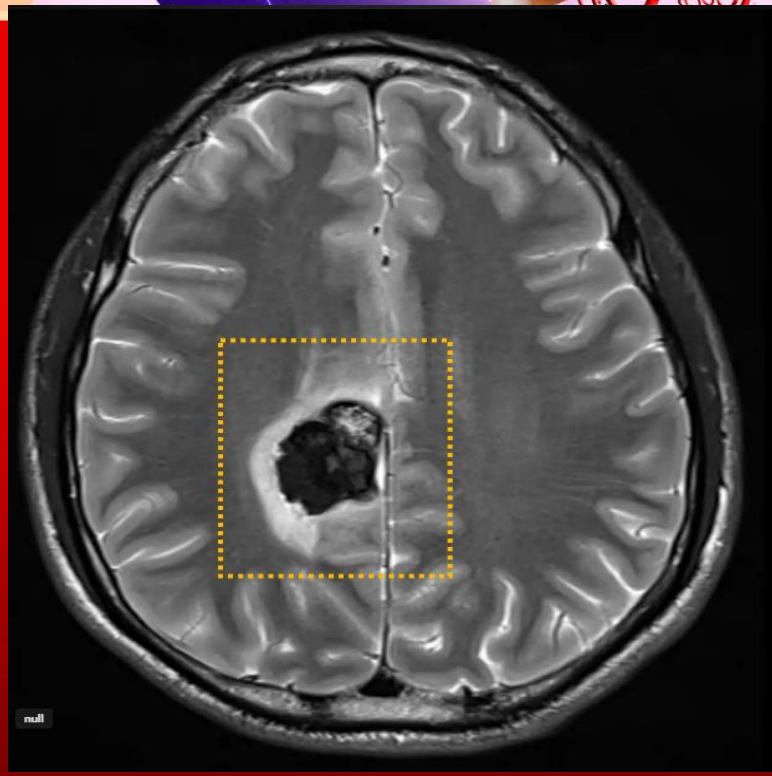


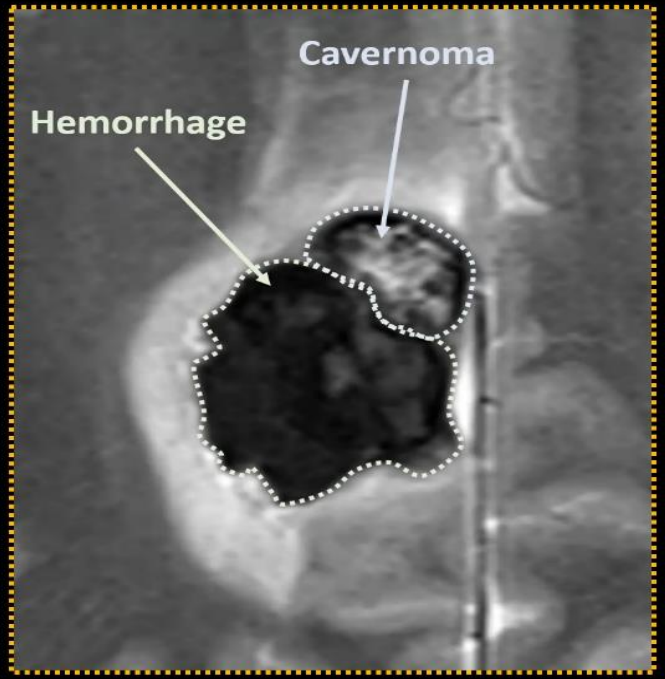

Dense superior
sagittal sinus
Dense superior
sagittal sinus

Cerebral Venous Thrombosis

Thrombosis of the superior sagital sinus with secondary venous congestive hemorrhages in both parietal lobes

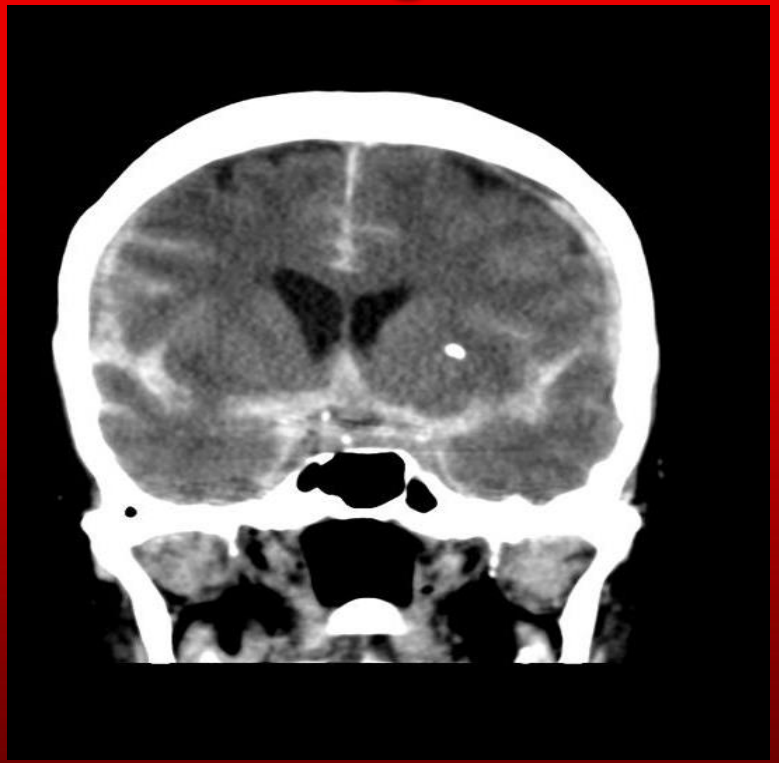

CT
T2

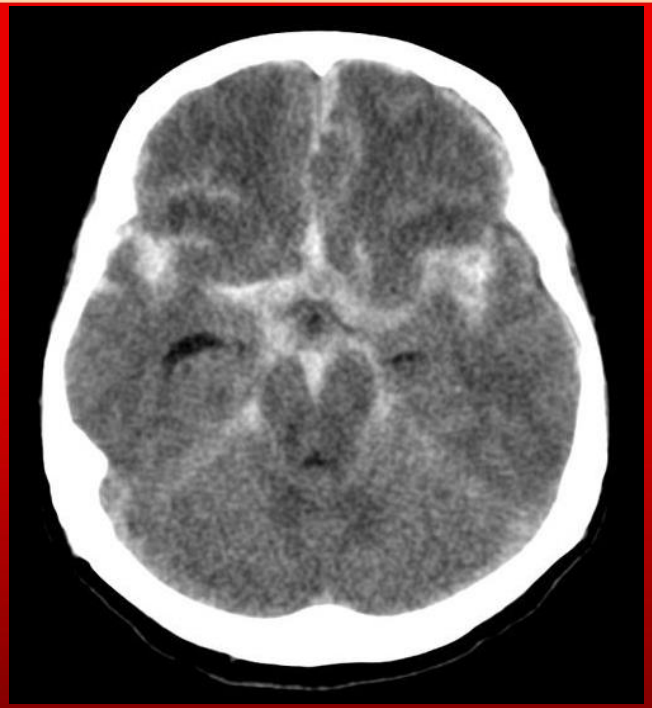



Cavernoma
Hemorrhage

In younger patients always to find the cause of superficial ICH by performing CTA, CTV and / or MRI

Subarachnoid hemorrhage

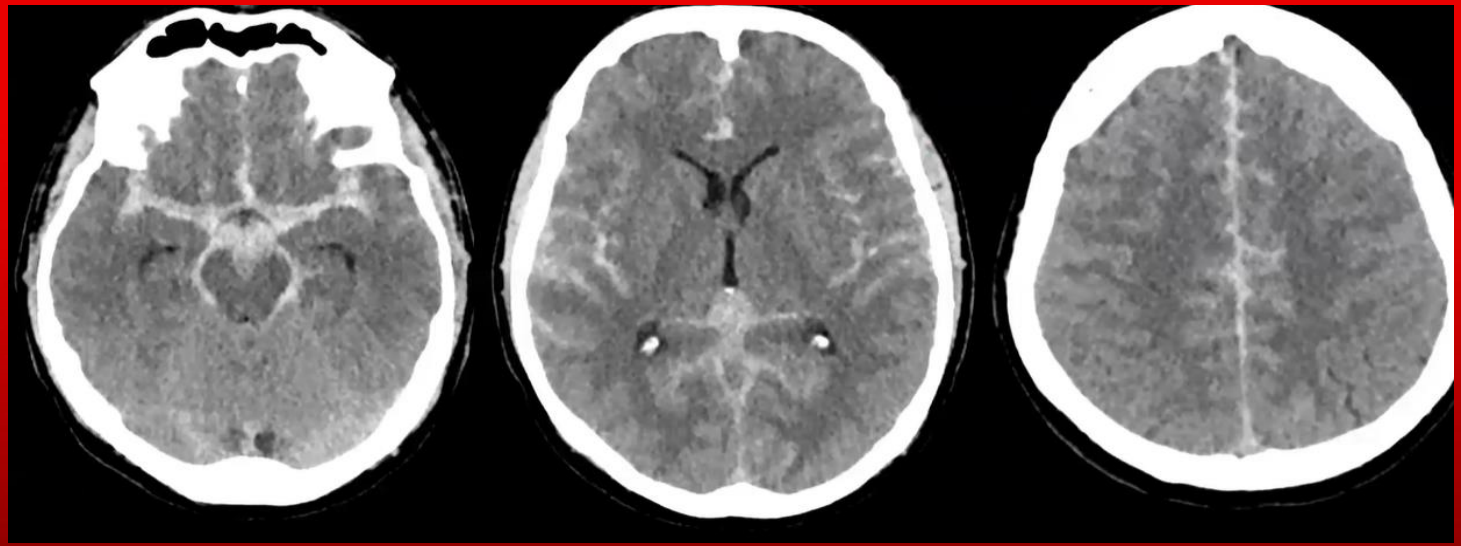




Spontaneous SAH

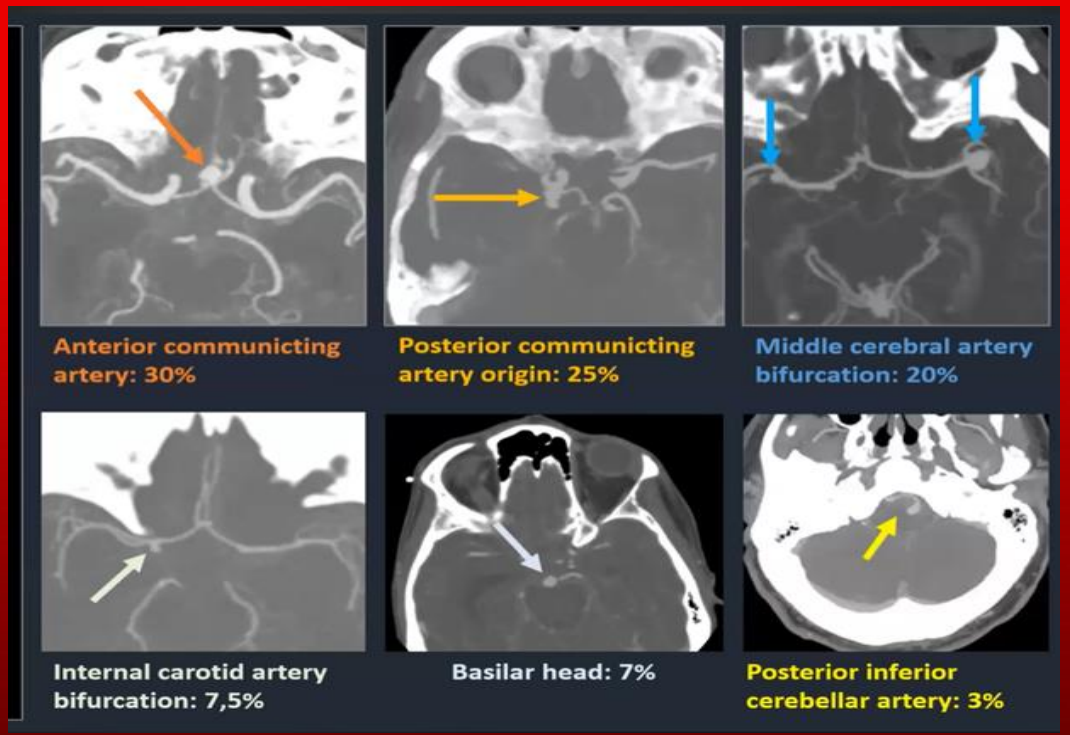
1. Ruptured berry / sacular aneurysm : 85%
2. Perimesencephalic SAH : 10%
   - AVM
   - Dural AVF
   - Cerebral amyloid angiopathy
   - Reversible cerebral vasoconstriction
   - CSVT
   - Cerebral vasculitis

Suprasellar cysterns with diffuse peripheral extention



Aneurysmal SAH

Next step CT Angiography

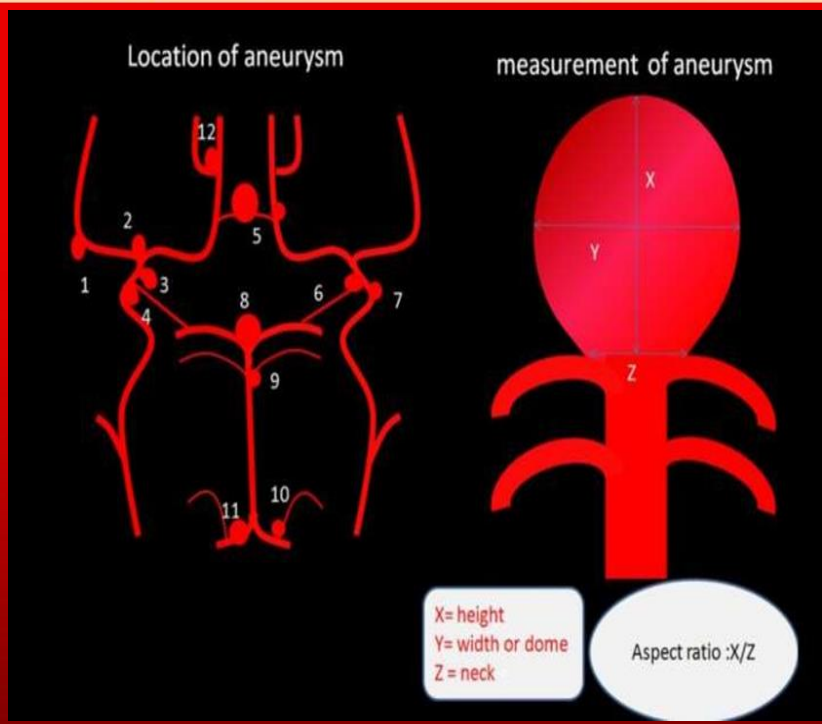


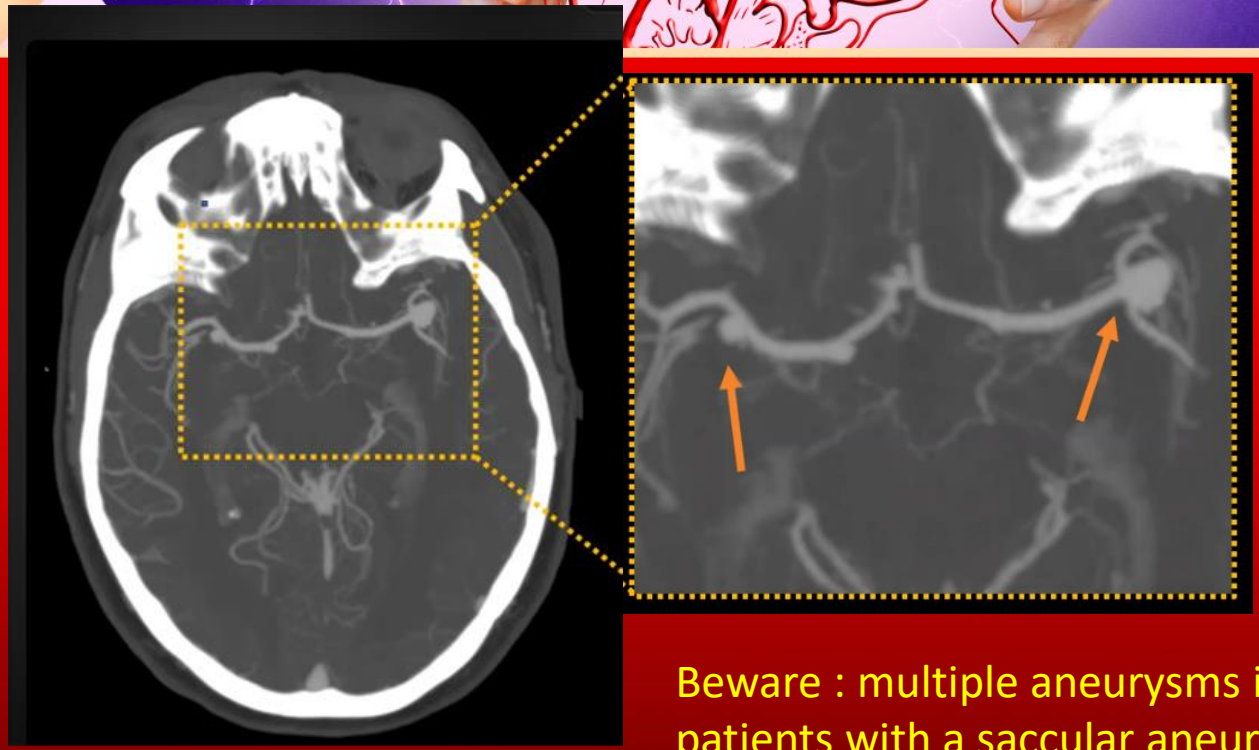
Aneursym Classification

1. According to the size of the aneurysm:
   - Small ≤ 5 mm
   - medium 5 to < 15 mm
   - large 15 to < 25 mm
   - giant ≥ 25 mm
2. According to the size of the neck of aneurysm:
   - Small neck aneurysms : neck size < 4 mm
   - large neck aneurysms : neck size > 4 mm.
3. Morphologically :
   - Saccular (berry aneurysm) → is the most common form
   - Fusiform

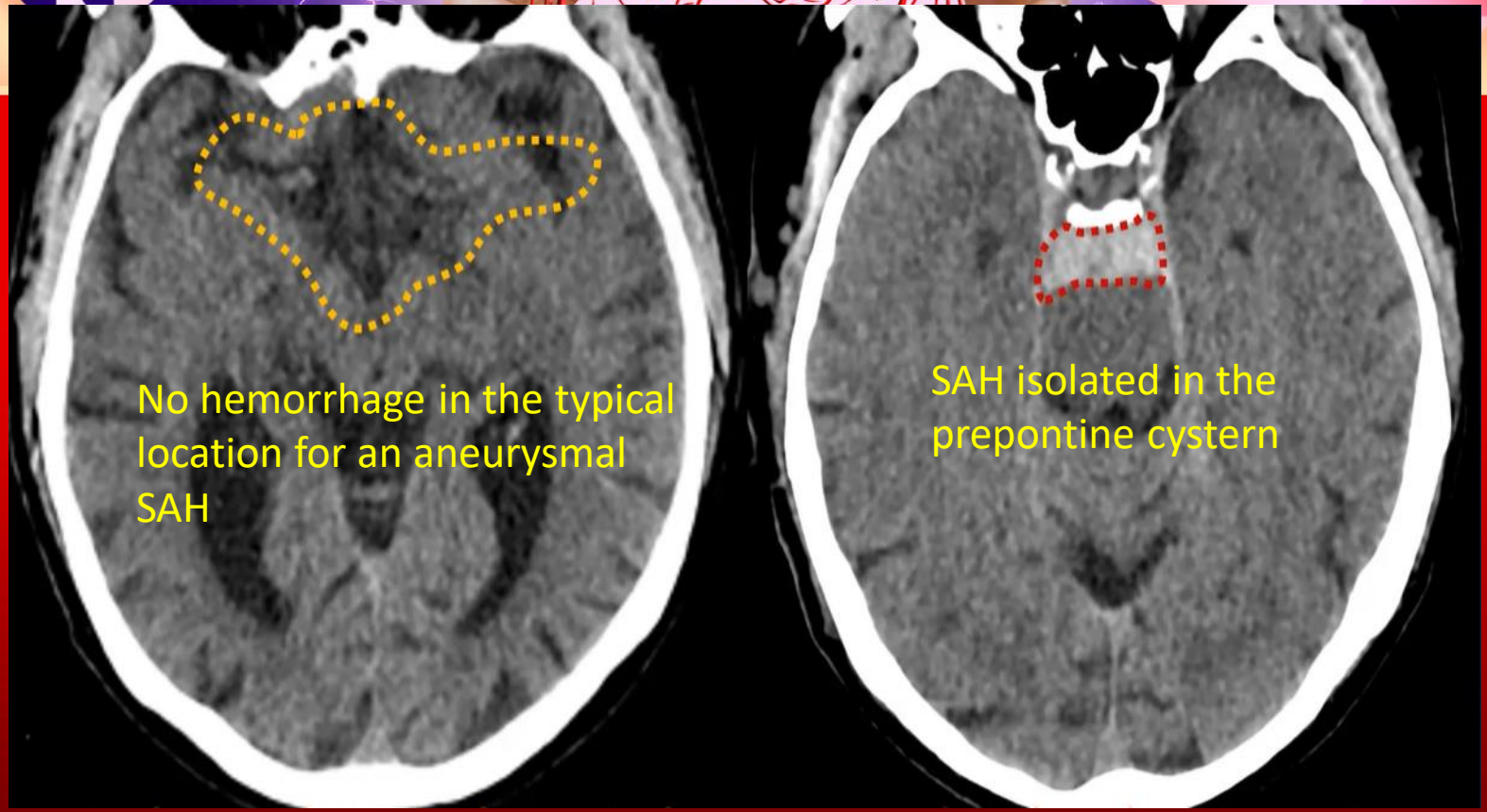
CT Angiography:

- It is the best method for identification of aneurysm
- The following are to be reported in an Angiography reports :
  1. Site of aneurysm
  2. Size of the aneurysm → described in three dimensions (length , width/domeand height)
  3. Size of the neck of aneurysm
  4. Aspect ratio (ratio of height to neck)
  5. Dome to neck ratio
  6. Direction of the aneurysm
  7. Arteries adjacent to or arising from the aneurysm
  8. Presence of vasospasm, if any
  9. Presence of other aneurysm (usually seen in 15 %).

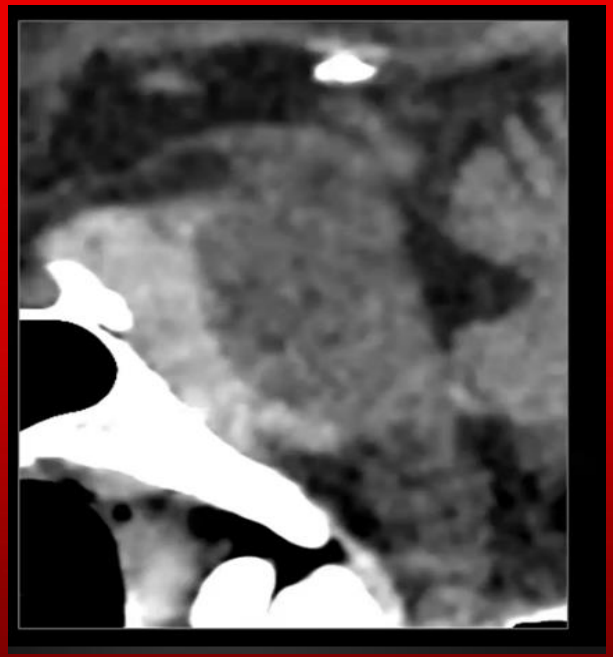




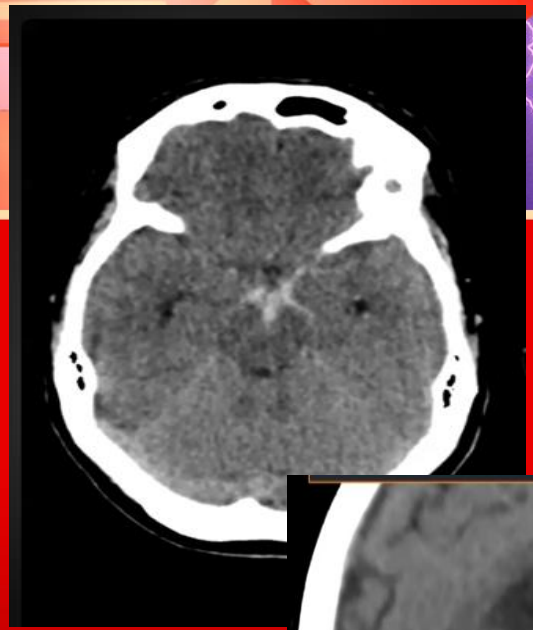
Beware : multiple aneurysms in 15-30% of patients with a saccular aneuryms

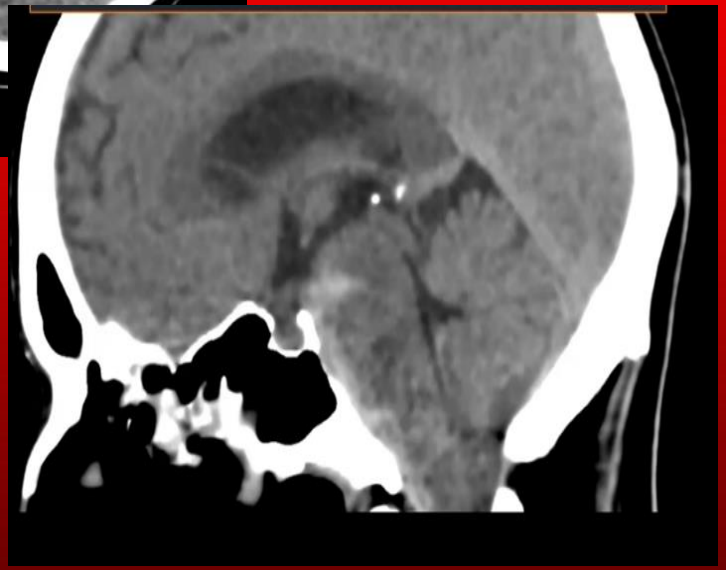

No hemorrhage in the typical location for an aneurysmal SAH
SAH isolated in the prepontine cystern

Perimesencephalic SAH



- Distinct pattern of SAH in the basal cysterns anteriorly of midbrain and pons
- Represents 5-10% of SAHs
- 95% → negative angiography, no aneurysm or other cause found
- Presumed venous origin
- Excellent prognosis



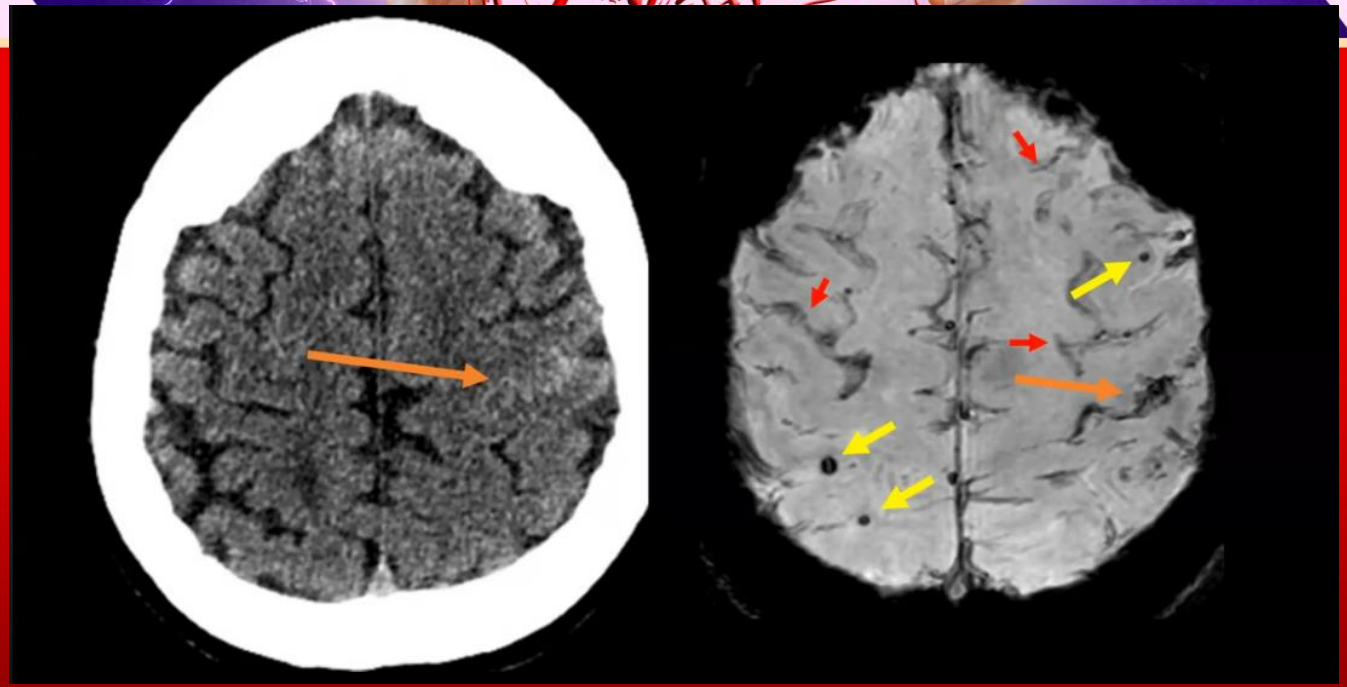


Limited SAH extention is only allowed :

- Anteriorly in the interhemispheric fissure
- Medially in the sylvian cysterns
- Sediment levels in the occipital horns of the lateral ventricles

Convexity SAH

- Accounts for 6% of spontaneous SAH cases
- Very heterogenous etiology
- Elderly pateinets → CAA (cerebral amyloid angiopathy) most frequent
- Young patients → RCVS (Reversible cerebral vasoconstriction syndrome) most frequent (thunderclaps)



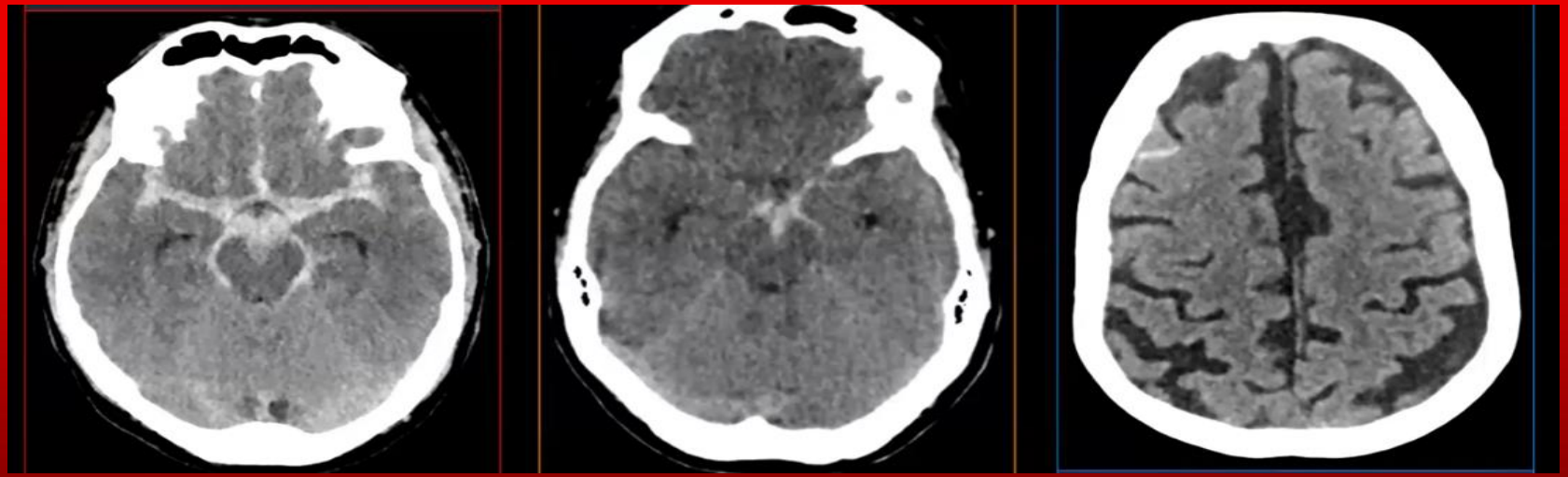
Convexity SAH in elderly patients → CAA

Convexity SAH in younger patients → RCVS

Suprasellar cysterns with diffuse peripheral extension

Perimesencephalic and basal cysterns (only)

Convexity SAH

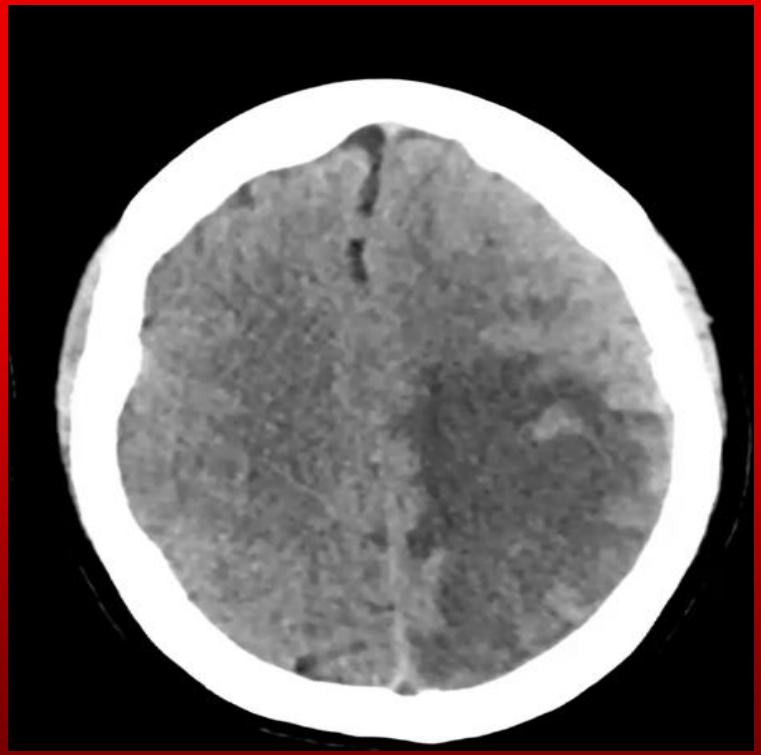


Characteristic of ruptured berry aneurysm

95% : negative angiography
5% : aneurysm, AVM, AVF

Infrequent, diverse & heterogenous etiology (CAA, RCVS, CSVT, vasculitis

Cerebral edema

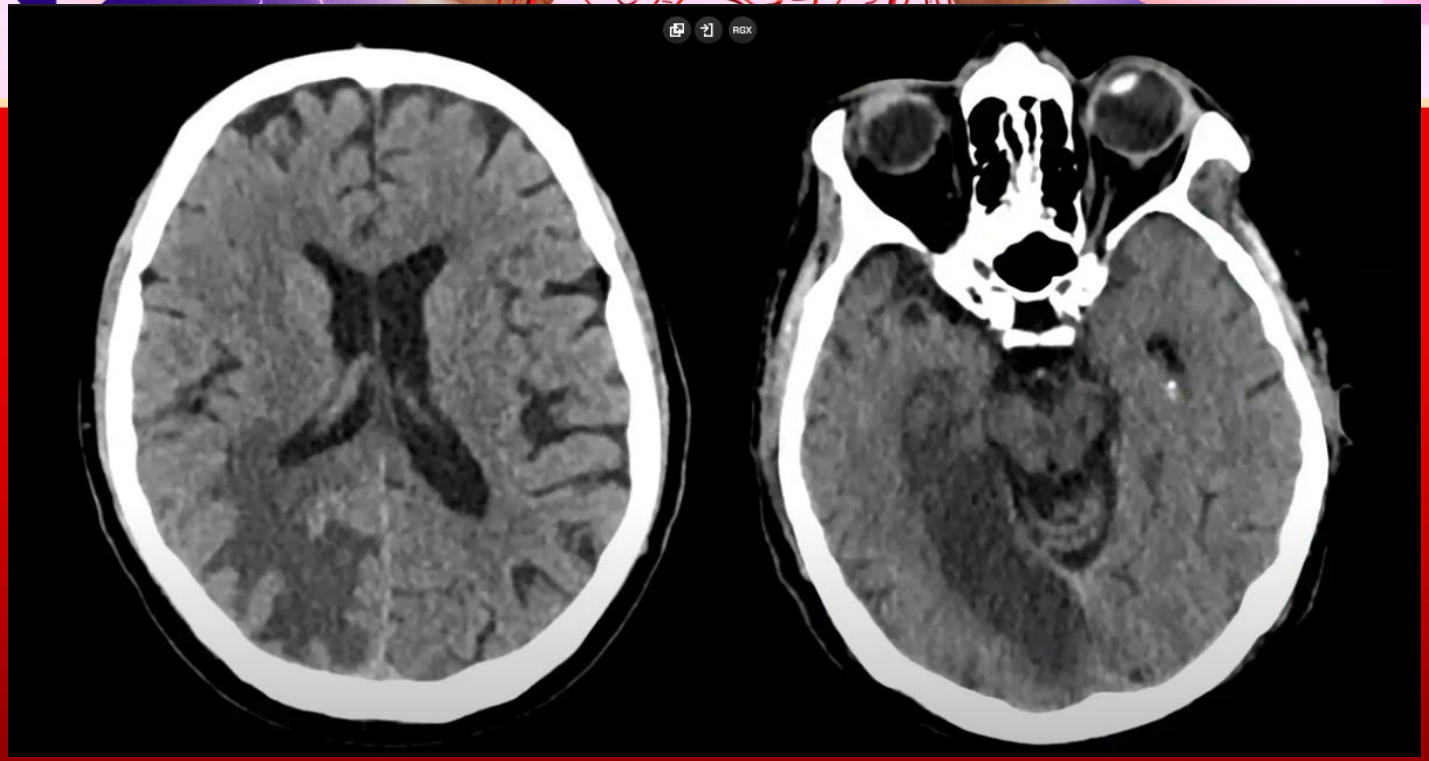


With an underlying lesion

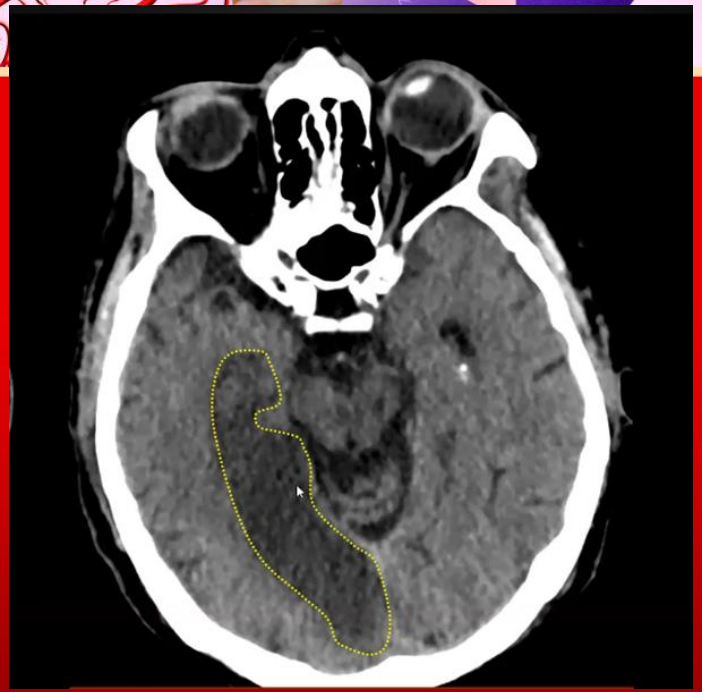
- Tumor
- Infection

Without an underlying lesion

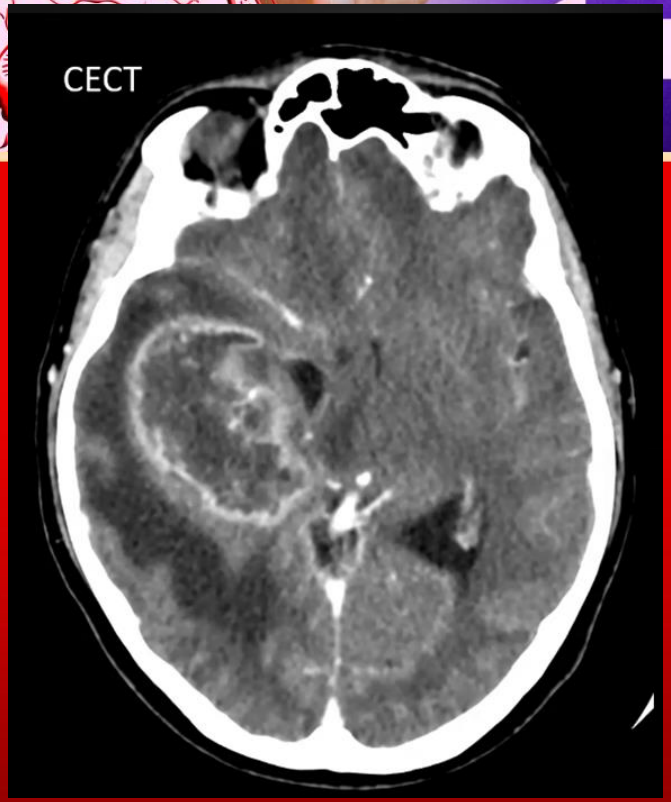
- PRESS
- Herpes
- Venous thrombosis


RGX

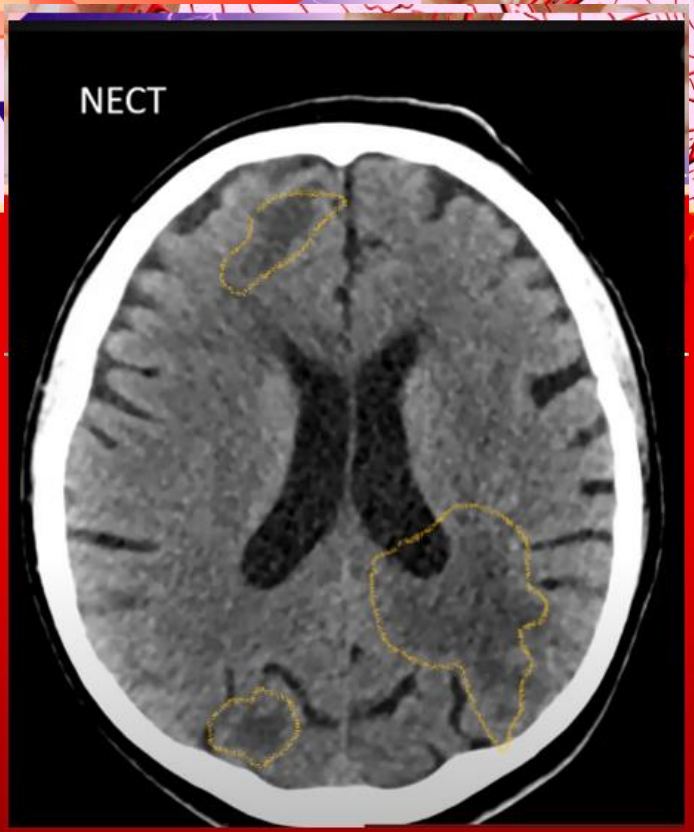
Edema with sparing of the cortex = vasogenic edema → tumor, infection

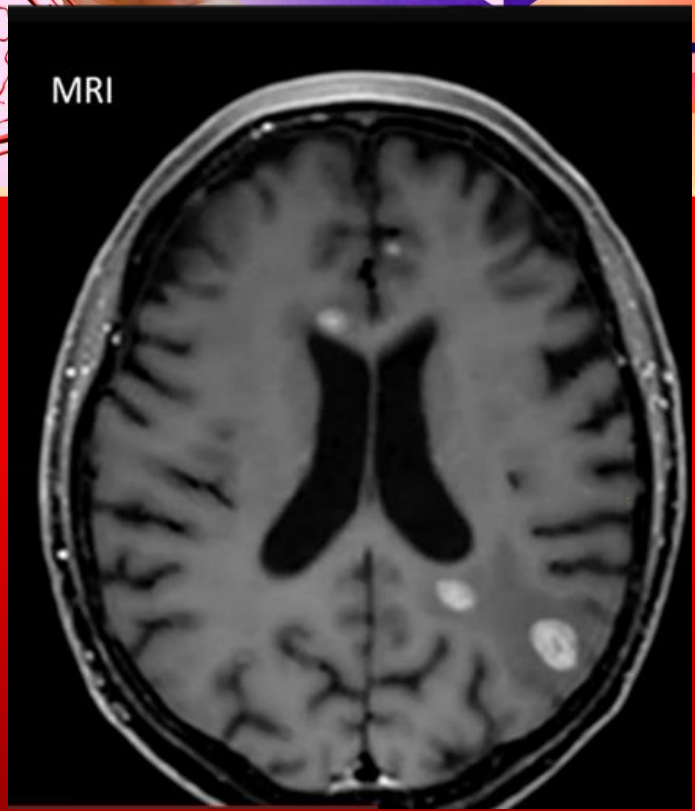


Edema with involvement of the cortex = cytotoxic edema = ischemic infarction



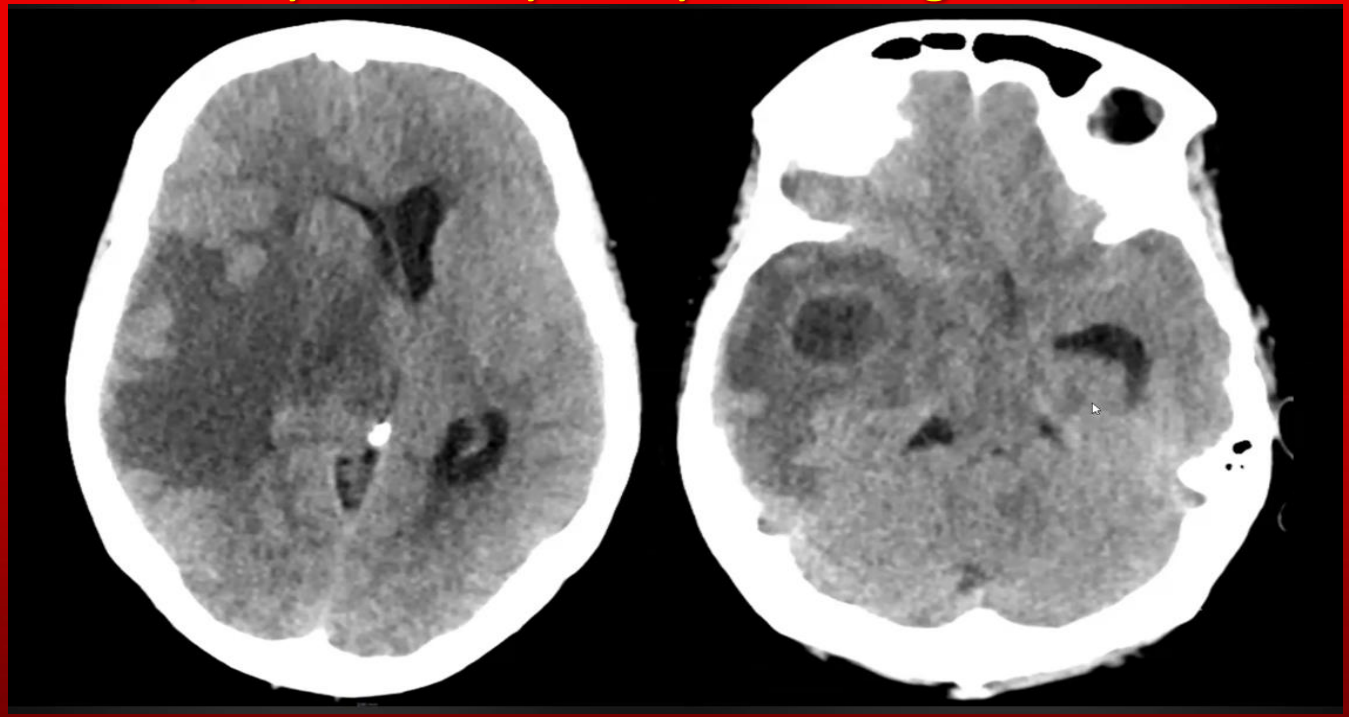
Solitary central necrotic mass in an adult : GBM or metasttasis

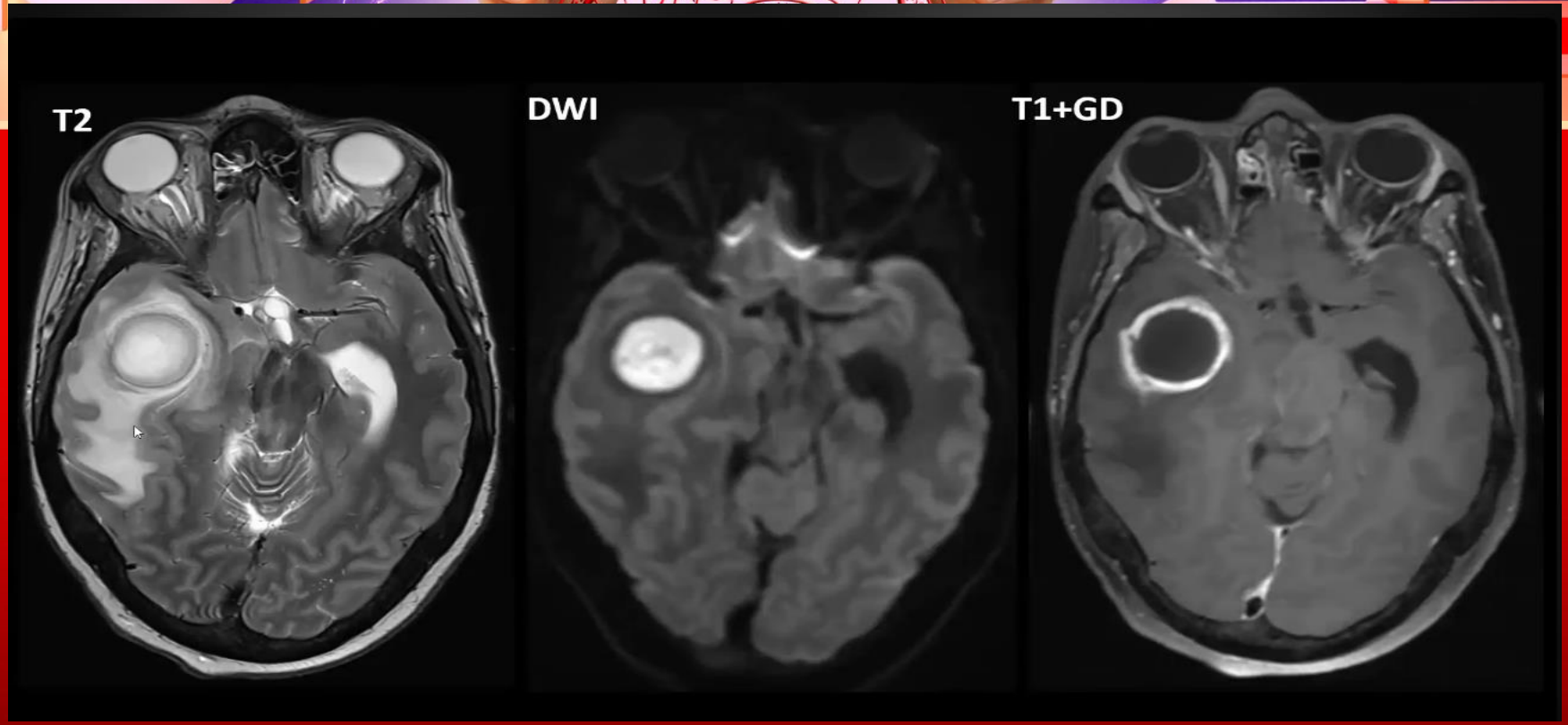




Multifocality →cerebral metastasis

Male,37 yo with hystorty of the right otitis media





Brain abscess

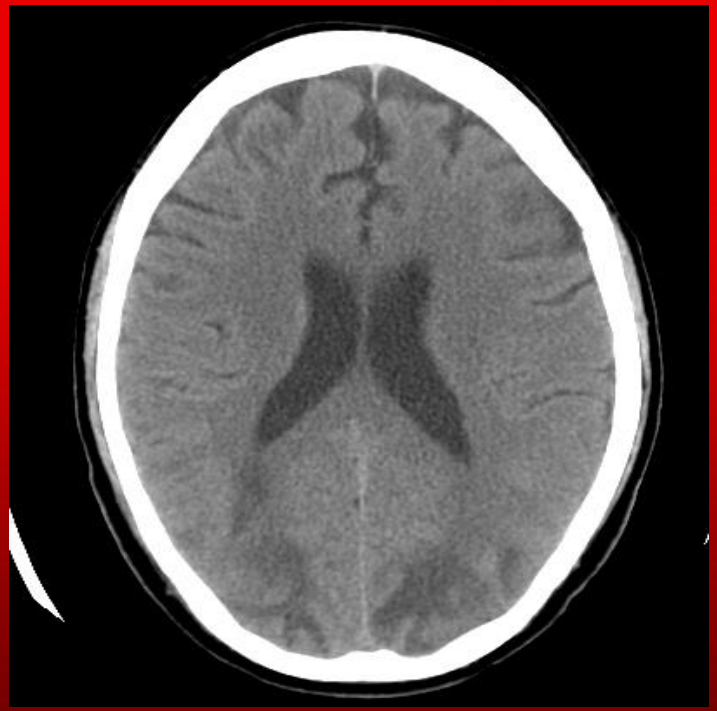
With an underlying mass lesion

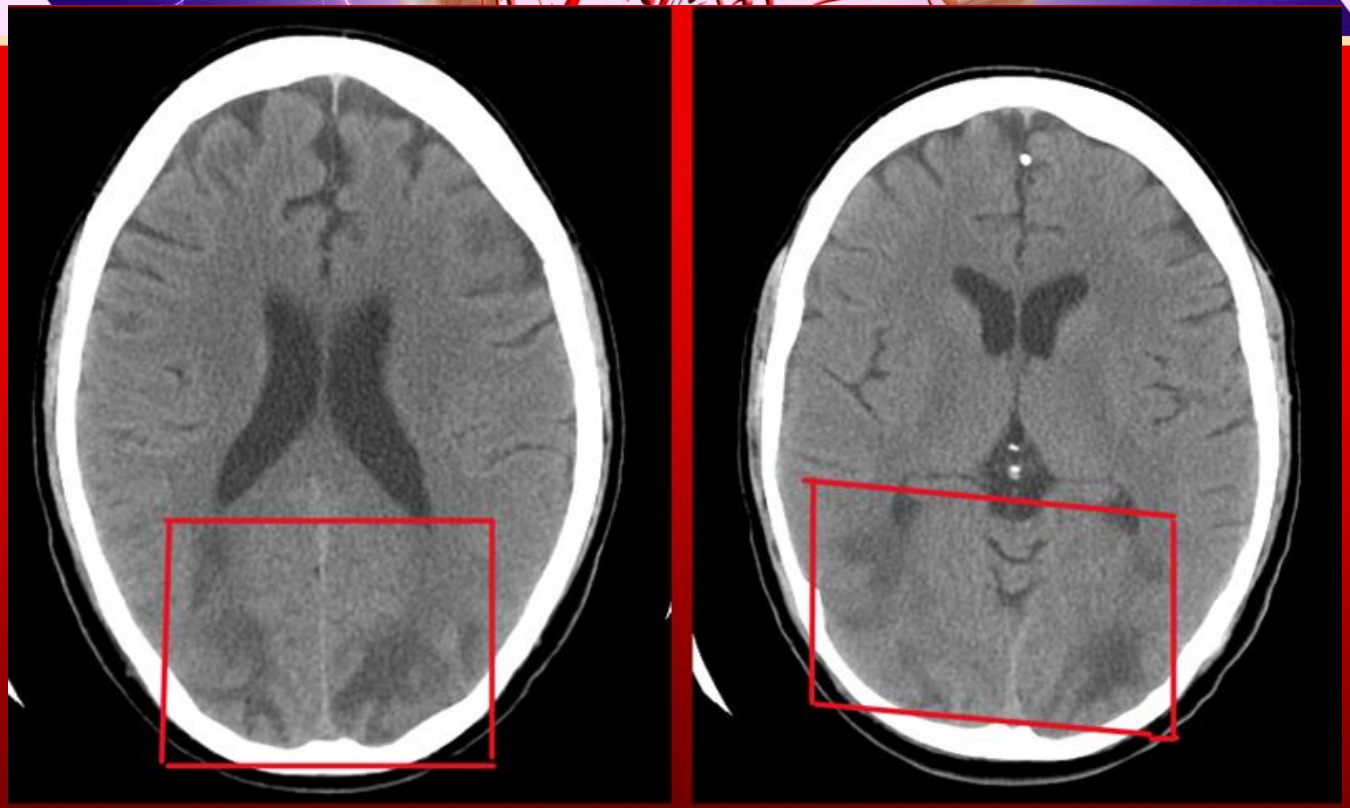
- Tumor
- Infection

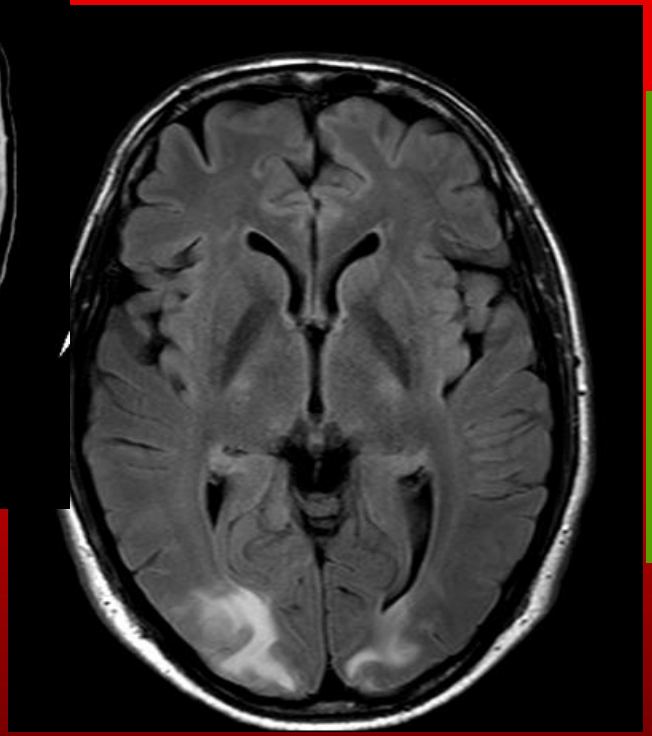
Without an underlying mass lesion

- PRESS
- Herpes
- Venous thrombosis

Female 57 years, with acute bilateral blindness







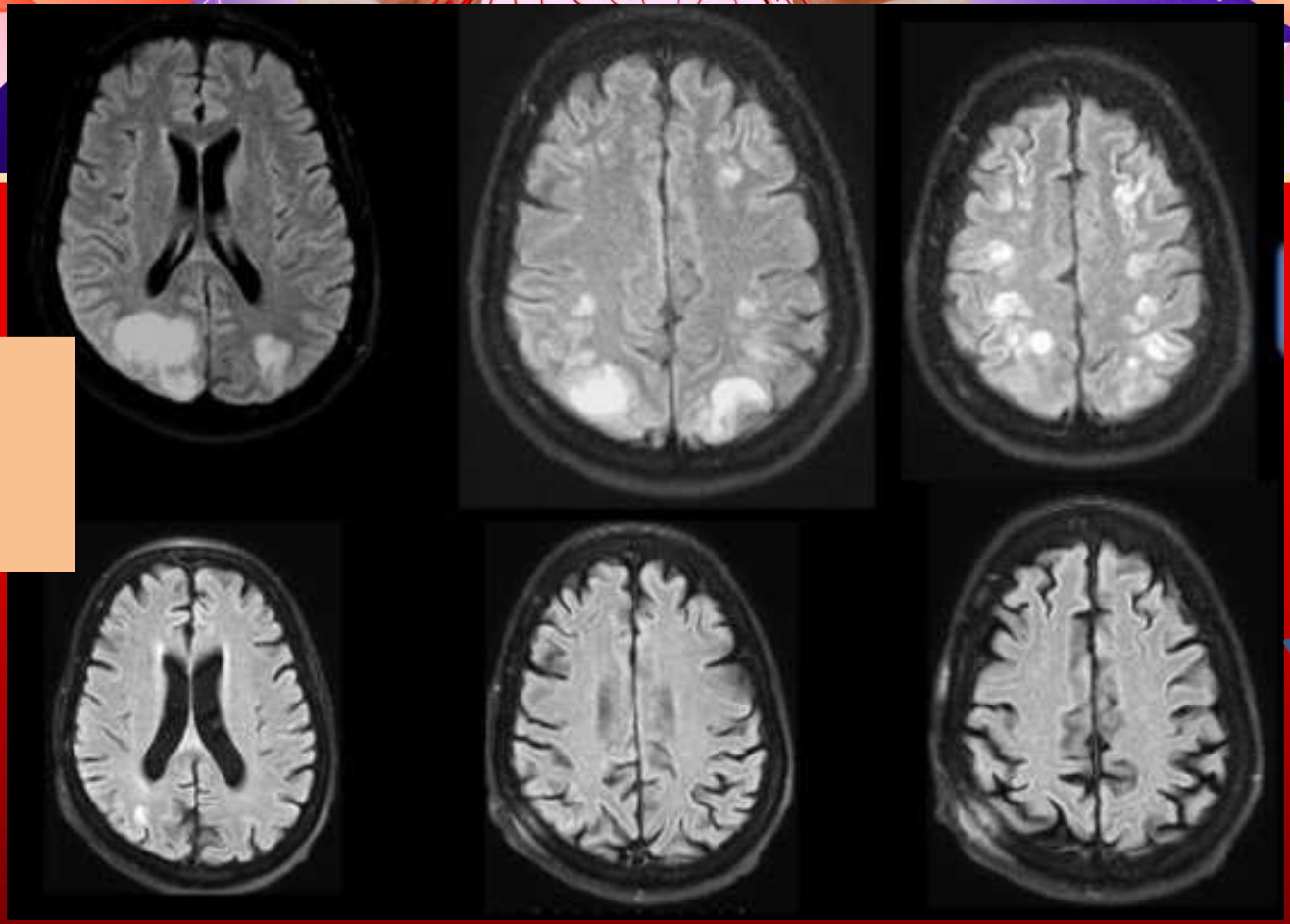
PRES

- Posterior
- Reversible
- Encephalopathy
- Syndrome

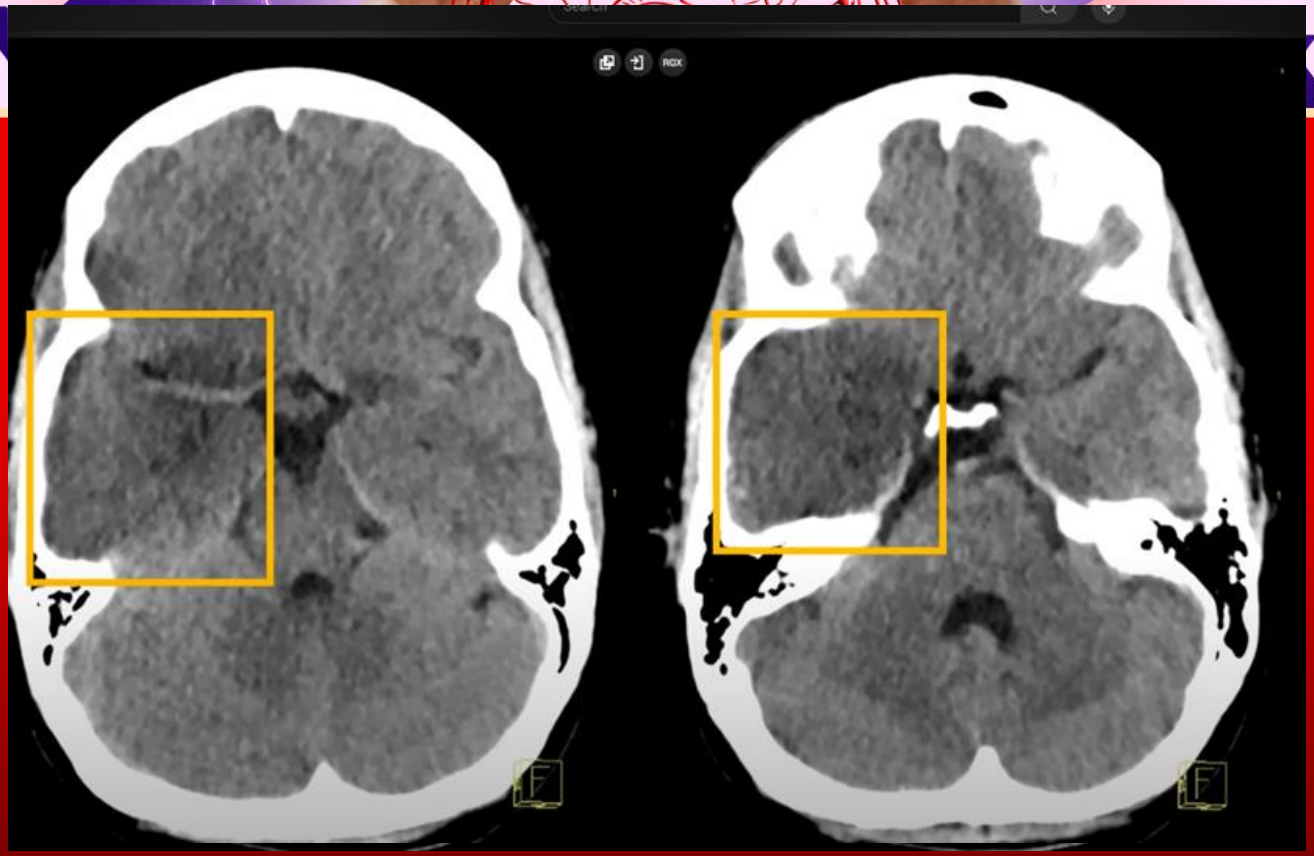
POSTERIOR REVERSIBLE ENCEPHALOPATHY SYNDROME (PRES)

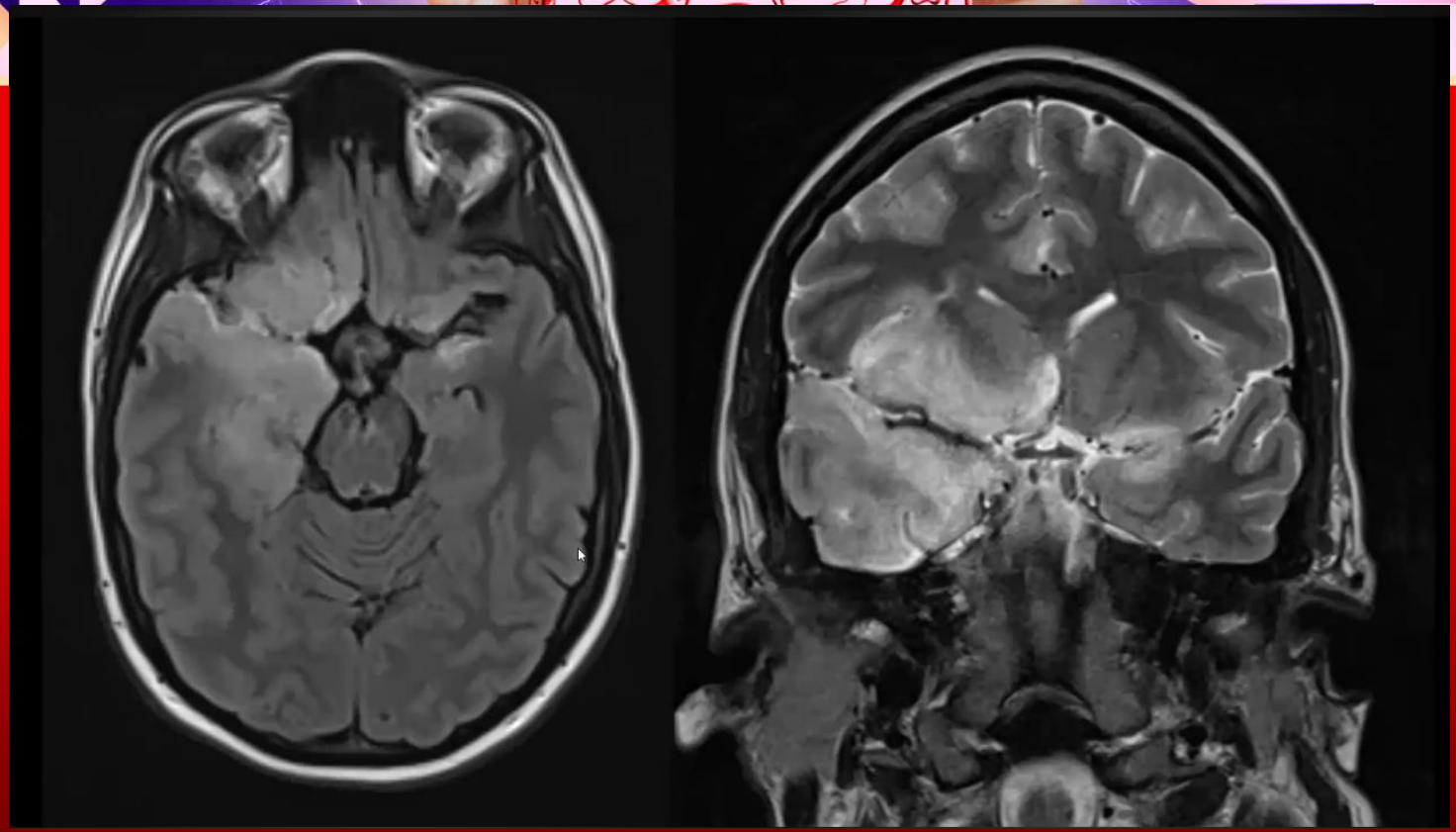
- PRES is a neurotoxic state with unique pattern on imaging and is associated with number of complex clinical conditions
- Initially, described for involvement of the posterior cerebral lobes, hence coined as PRES, however other regions of the brain are also involved.
- Etiology- two theories are described
  1. Failure in auto-regulatory mechanism secondary to severe hypertension leads to hyperperfusion and endothelial damage and subsequent vasogenic edema.
  2. Vasoconstriction and hypo perfusion leads to brain ischemia and subsequent vasogenic edema.

- Symetric, bilateral
- No diffusion restricted
- Reversible



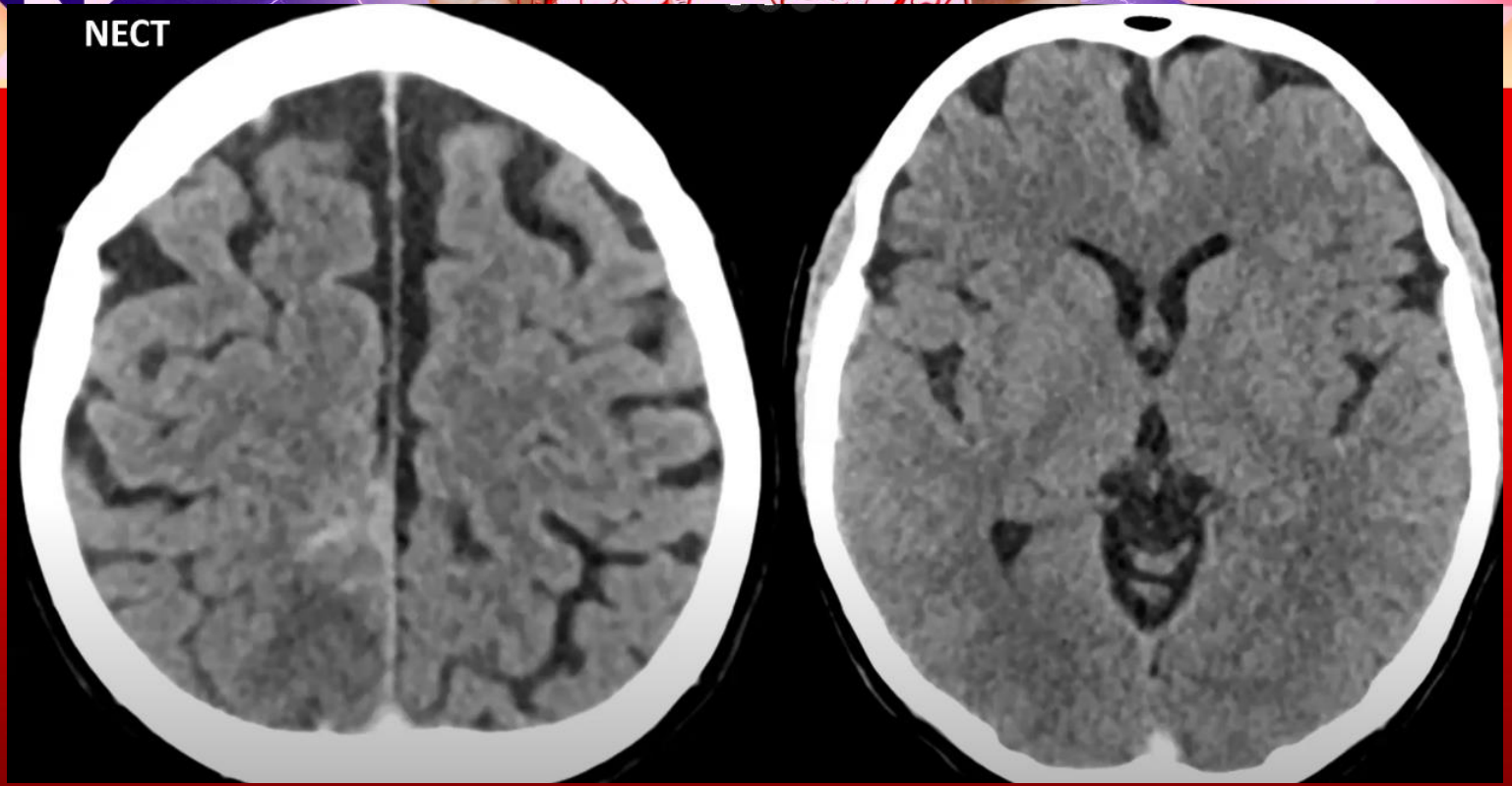
1 month

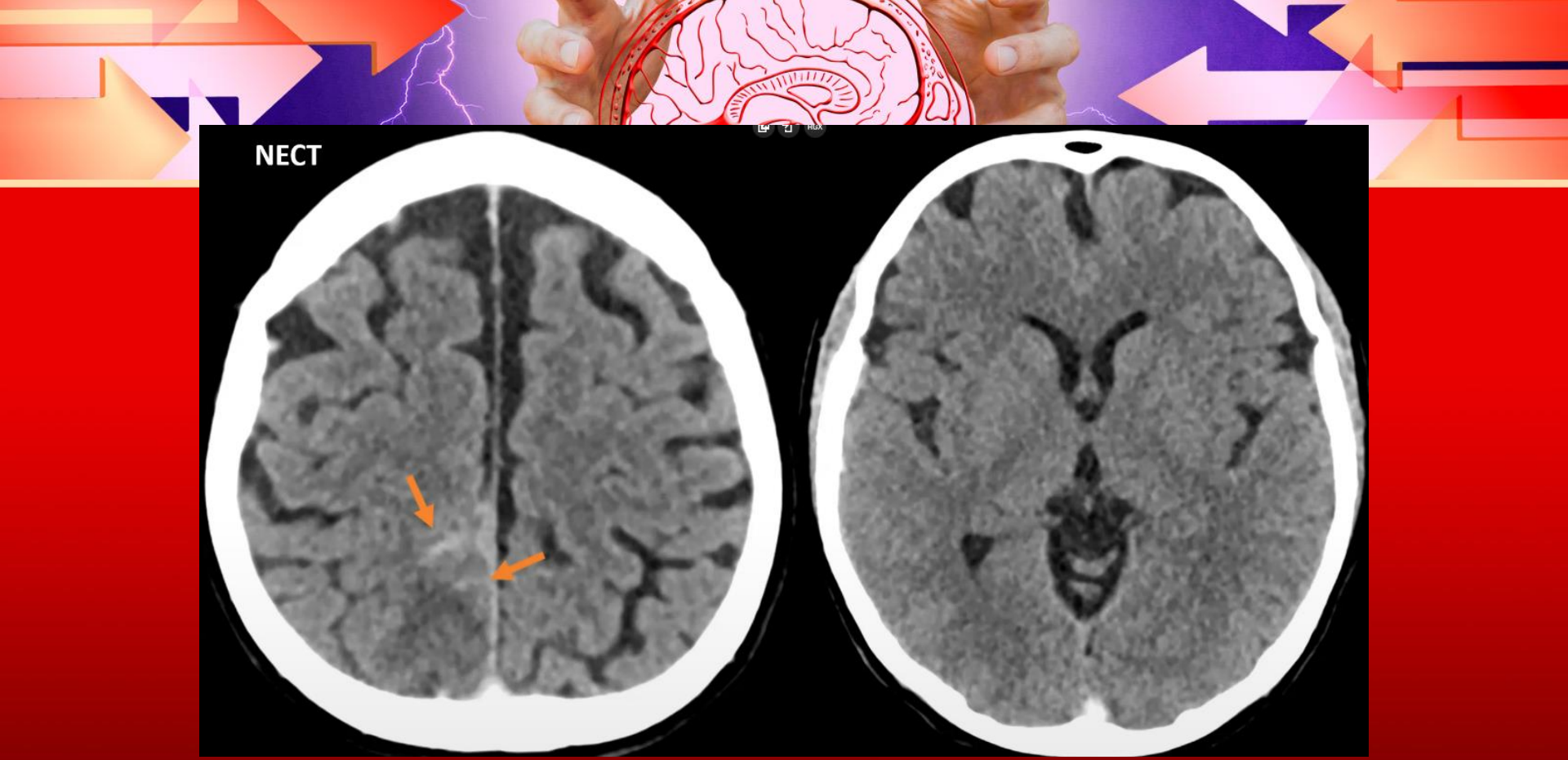


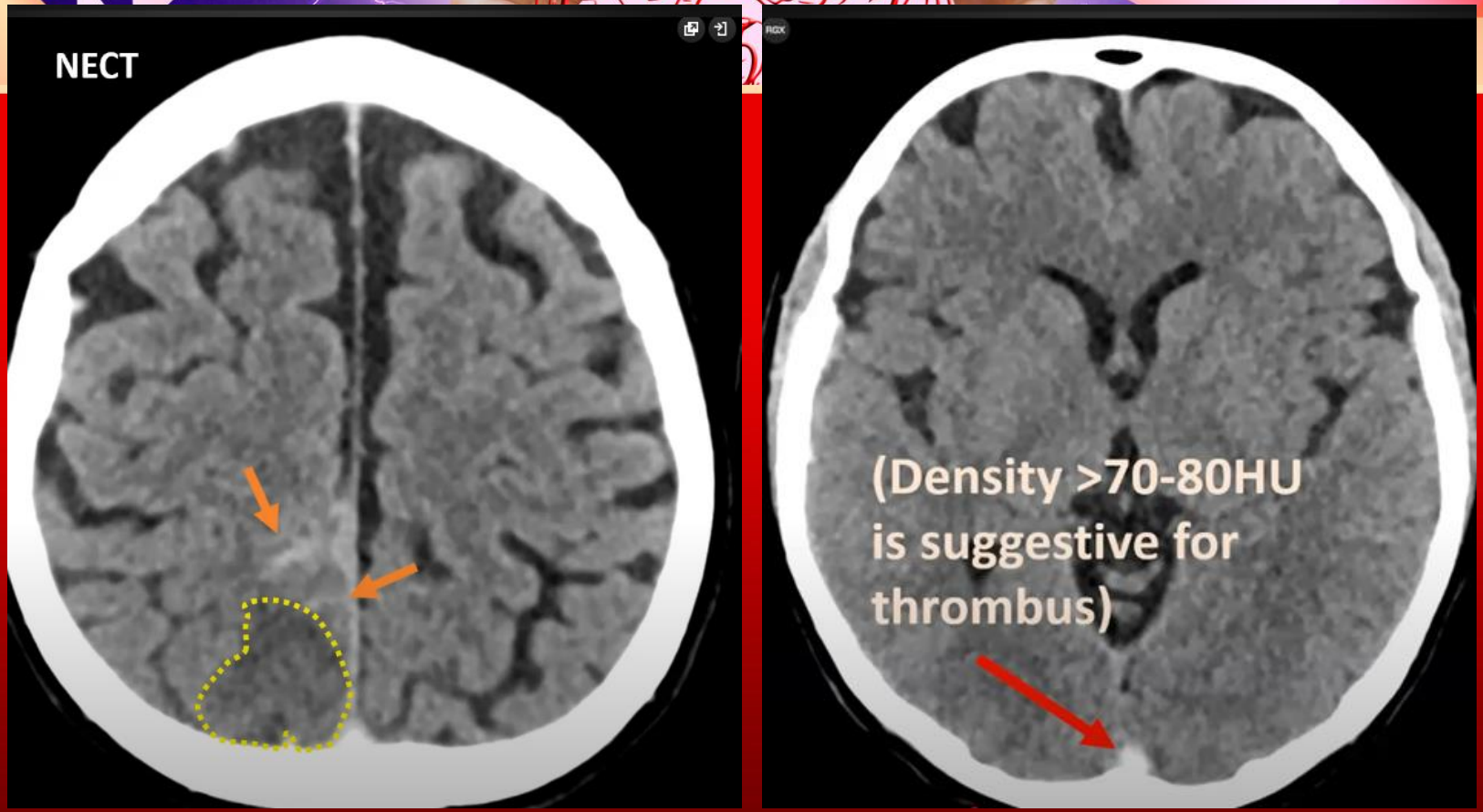


Herpes Simplex Encephalitis

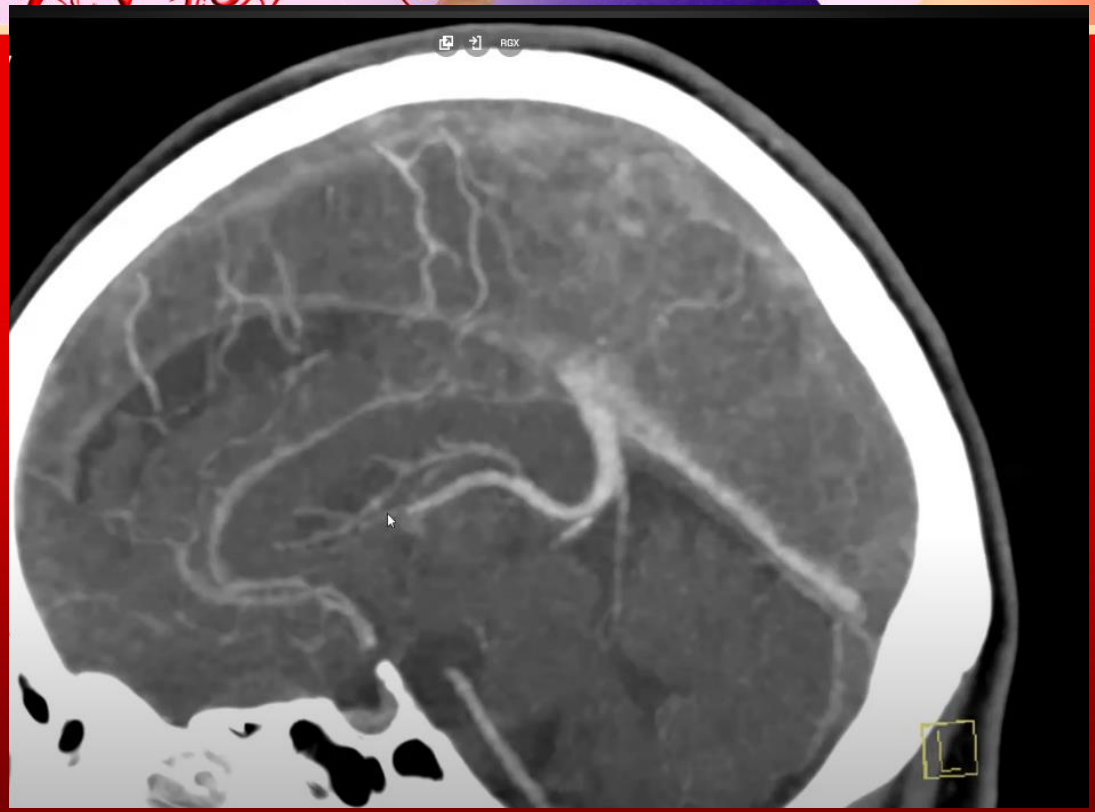
- Most common fatal sporadic fulminant viral encephalitis
- Unspesific symptoms : fever, headache, focal meurological, deficitis, seizures, encephalopathy
- Typical radiological pattern :
- Bilateral asymmetrical involvement limbic system, insula, inferior frontal cortex ; starts temporal

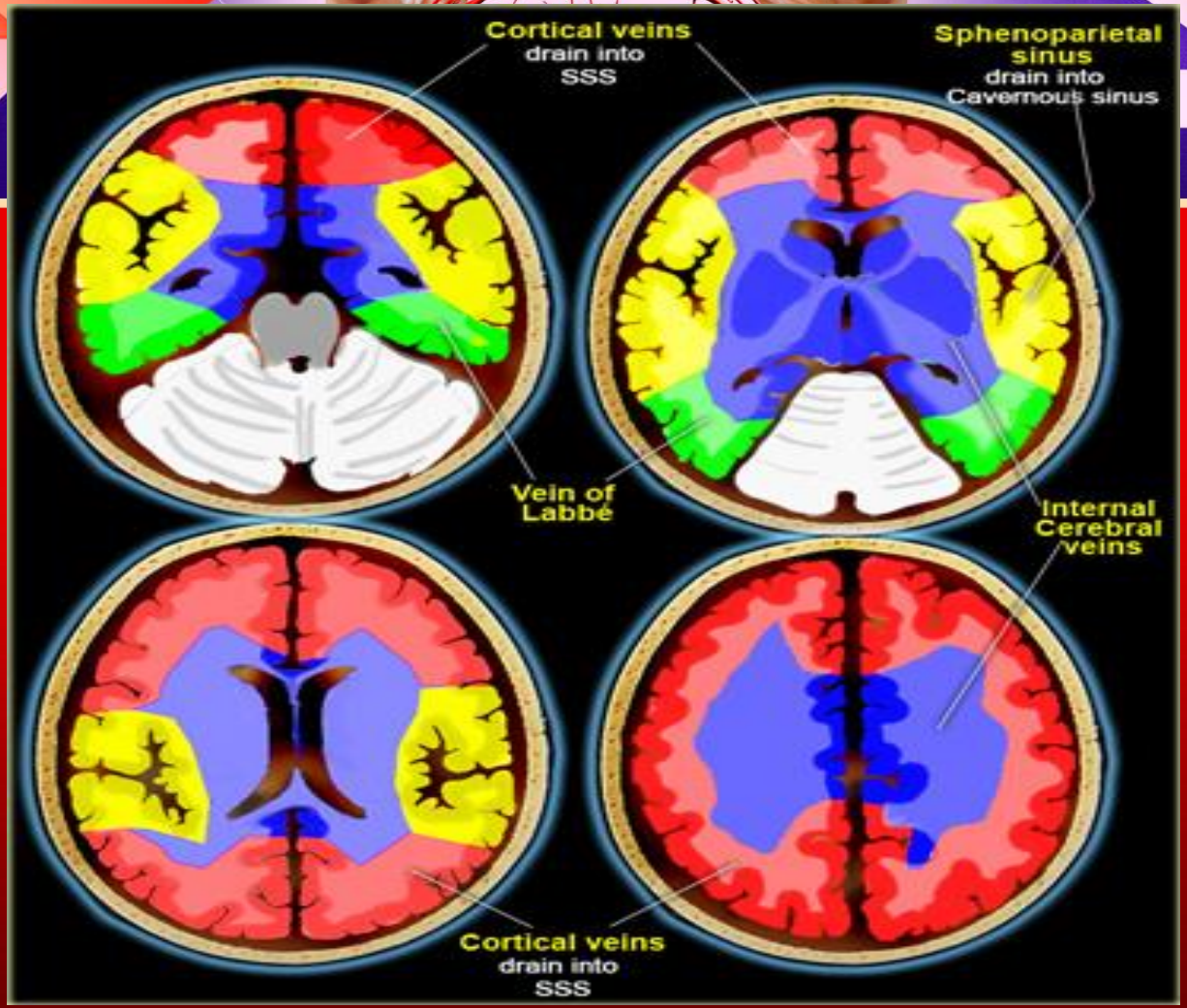

NECT

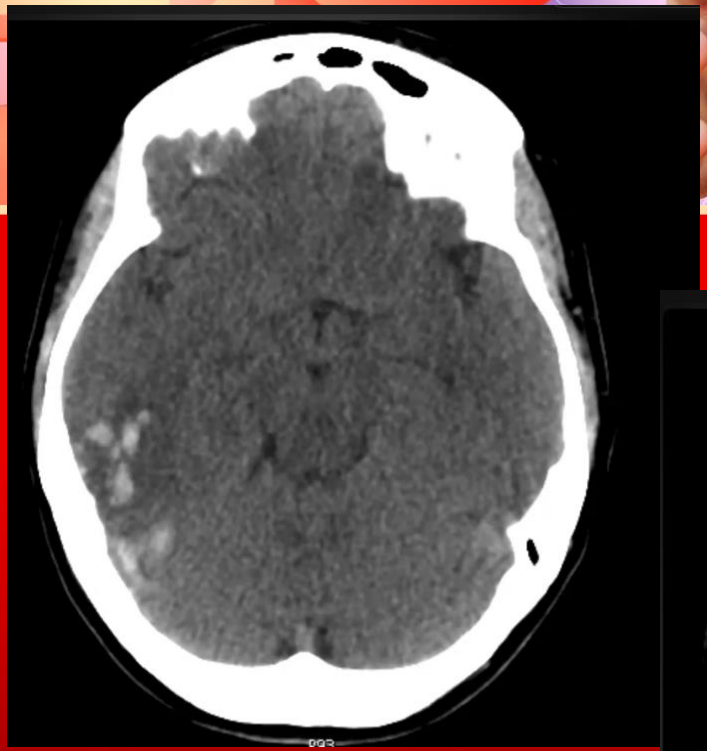

NECT

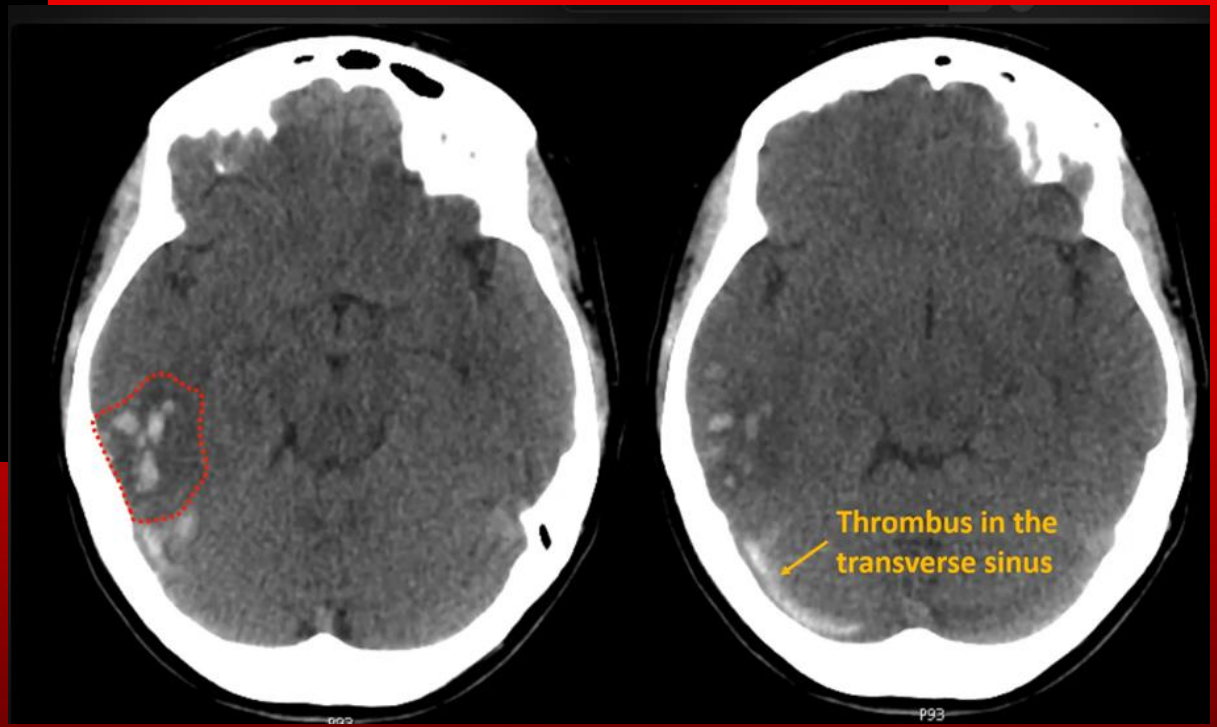

NECT
(Density >70-80HU
is suggestive for
thrombus)

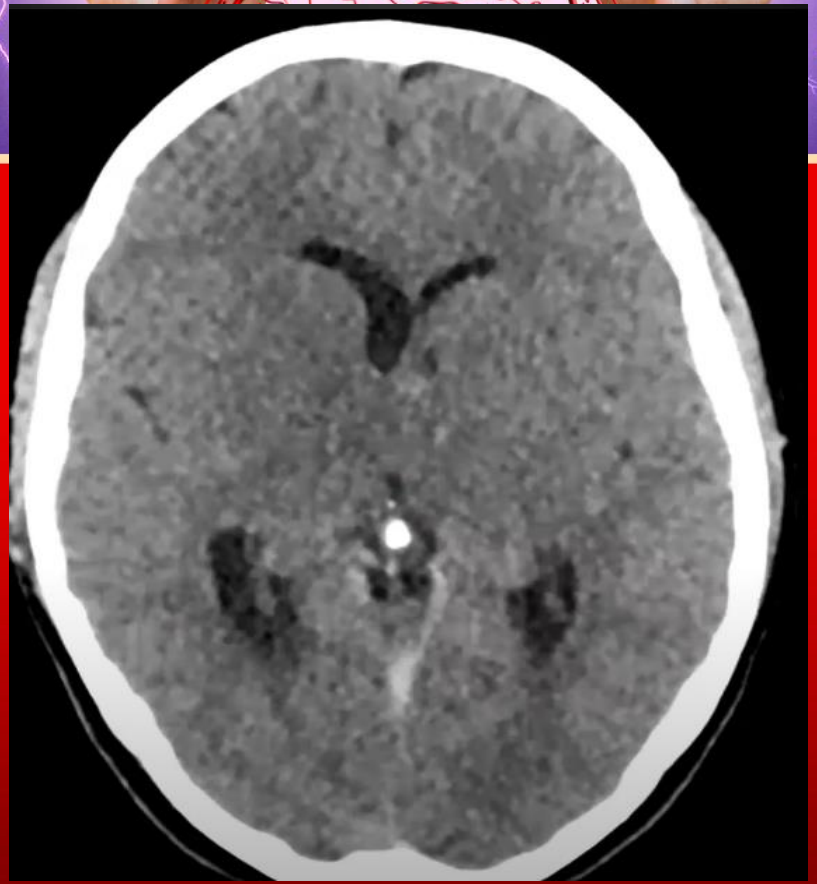
CT Angiografi

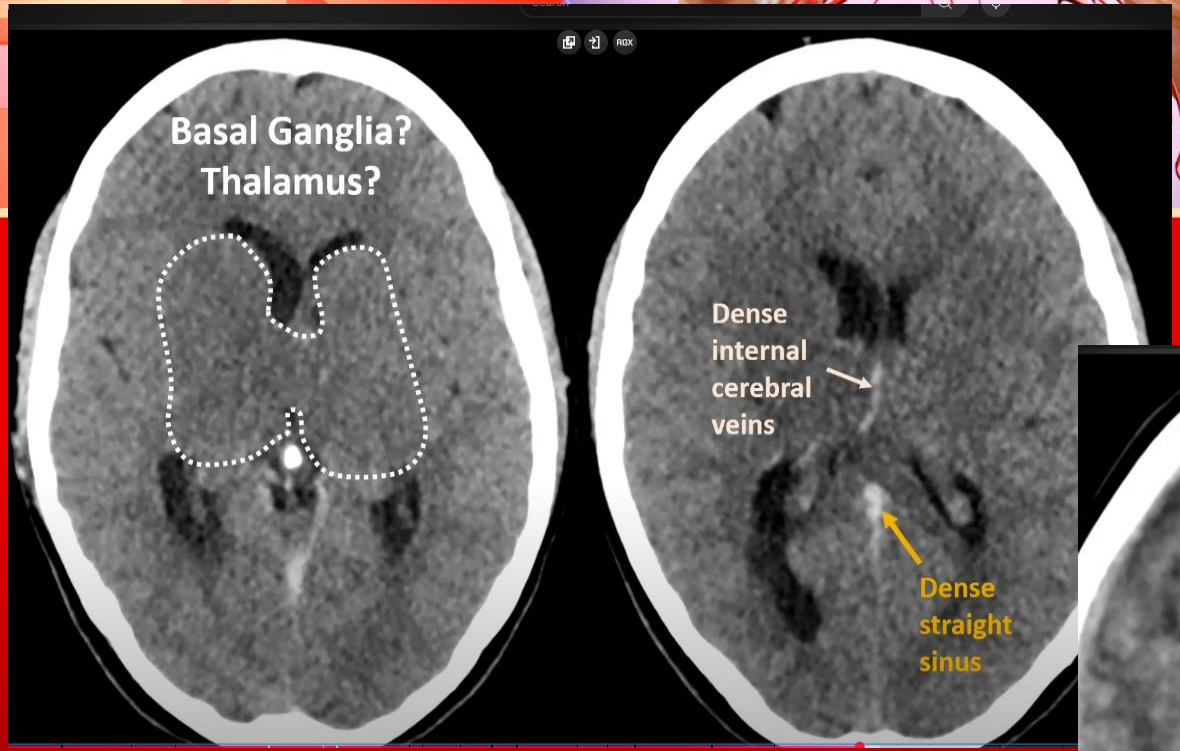



Cortical veins
drain into
SSS
Sphenoparietal
sinus
drain into
Cavernous sinus
Vein of
Labbé
Internal
Cerebral
veins
Cortical veins
drain into
SSS

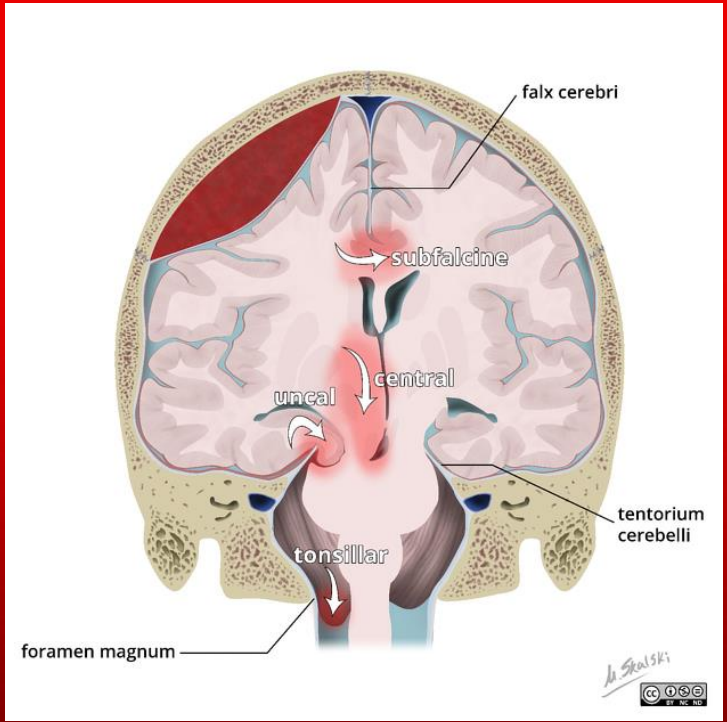


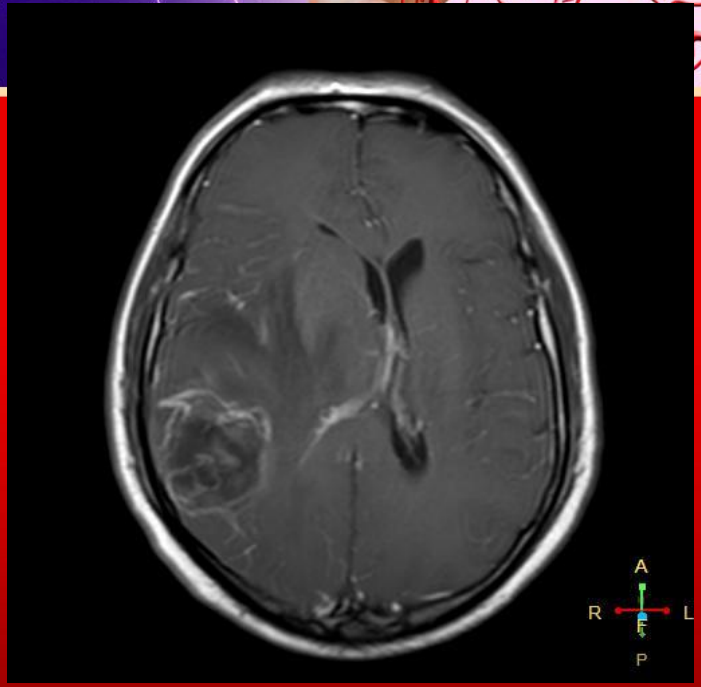

Thrombus in the
transverse sinus



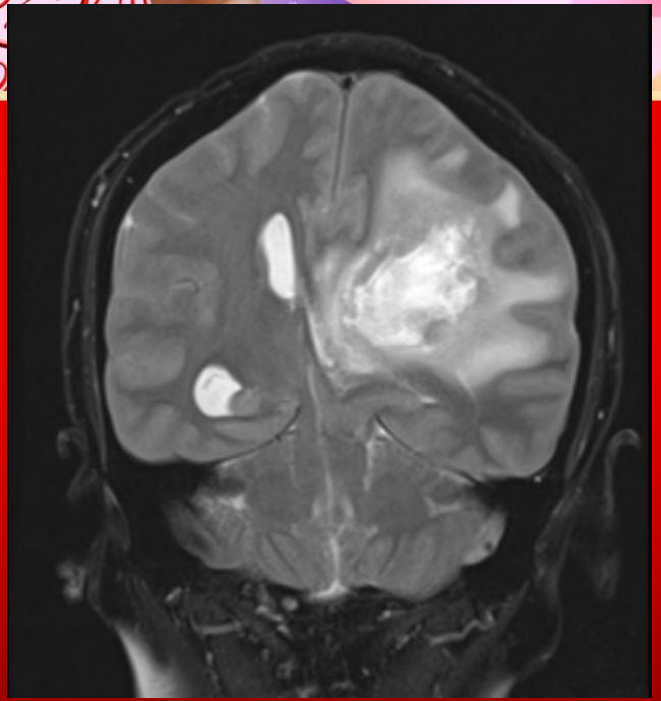

Basal Ganglia?
Thalamus?
Dense
internal
cerebral
veins
Dense
straight
sinus

Cerebral Herniation

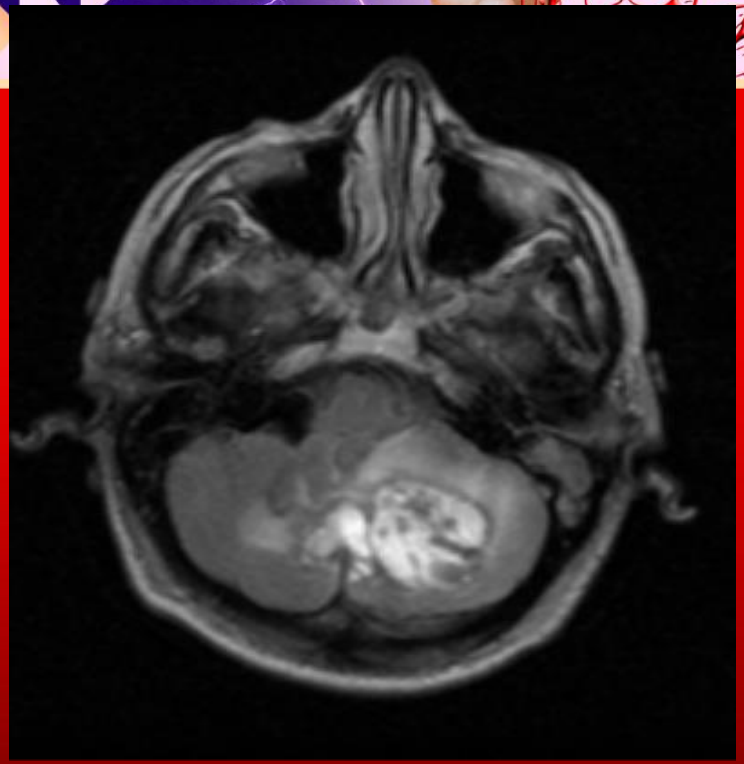


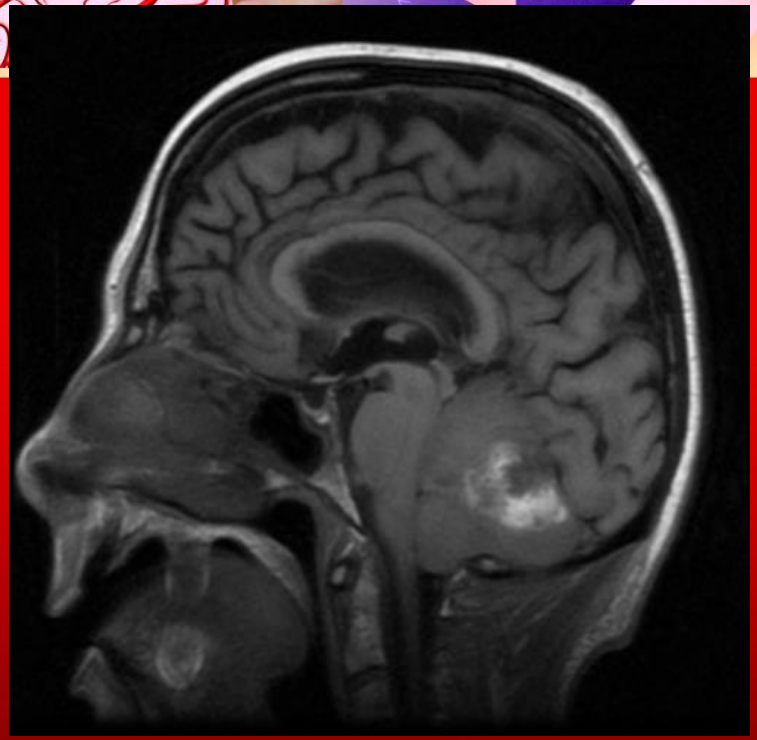


Subfalcine herniation



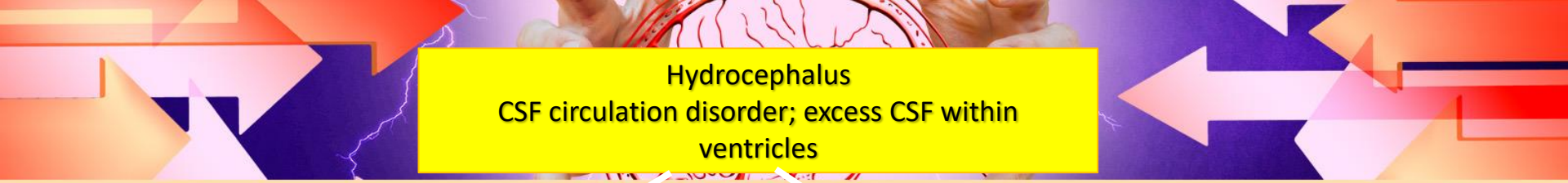
Uncal herniation





Ascending transtentorial herniation

HYDROCEPHALUS



Hydrocephalus

CSF circulation disorder; excess CSF within ventricles

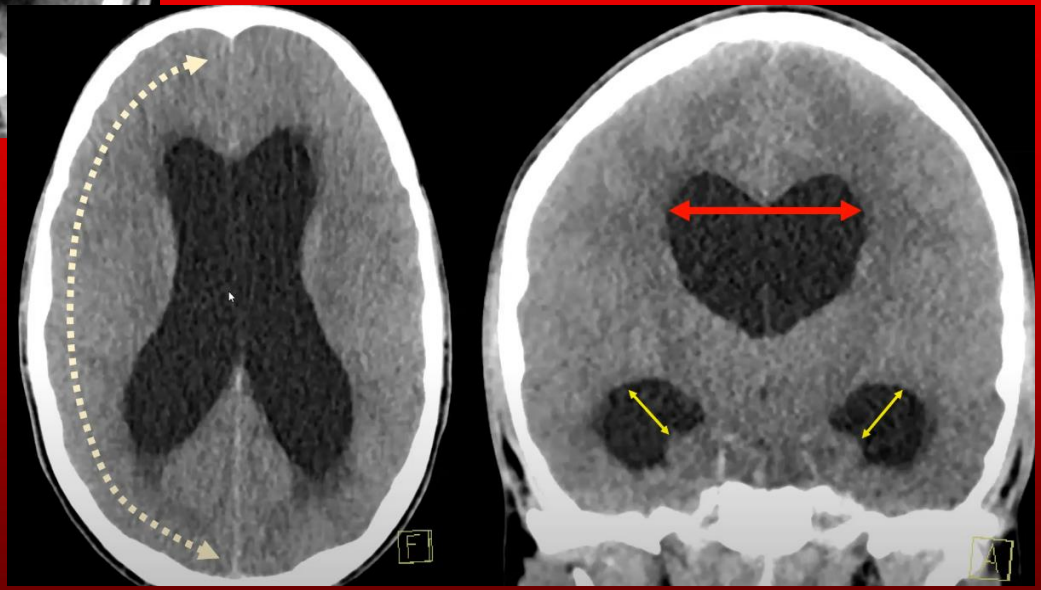
Non Communicating

- Obstructive (intraventricular obstruction)
  - Monro Foramen
    Sylvian aqueduct
    Fourth ventricle

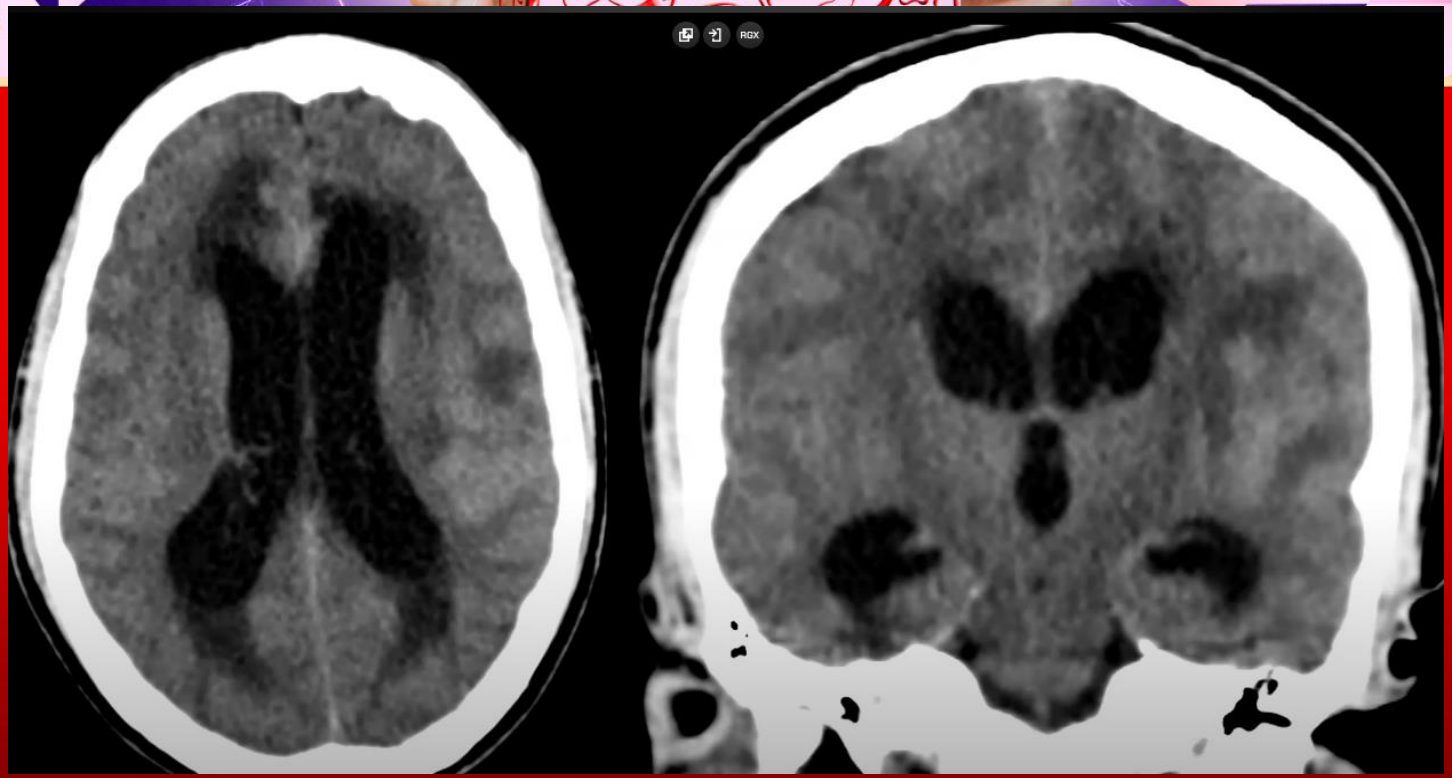
communicating

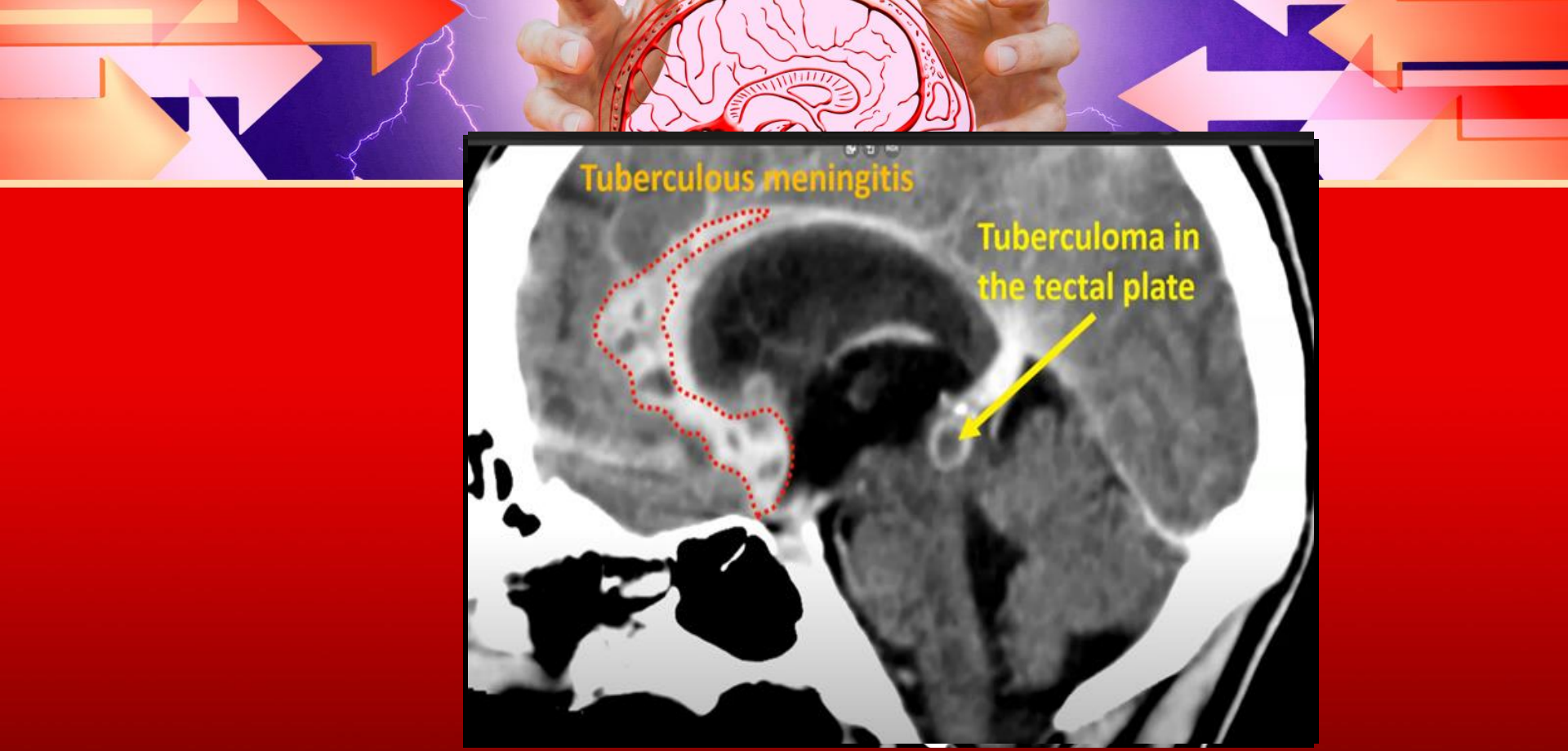
- Obstructive (extraventricular obstruction)
  - SAH
    Meningitis
- Non-obstructive
  - Plexus papilloma
    NPH

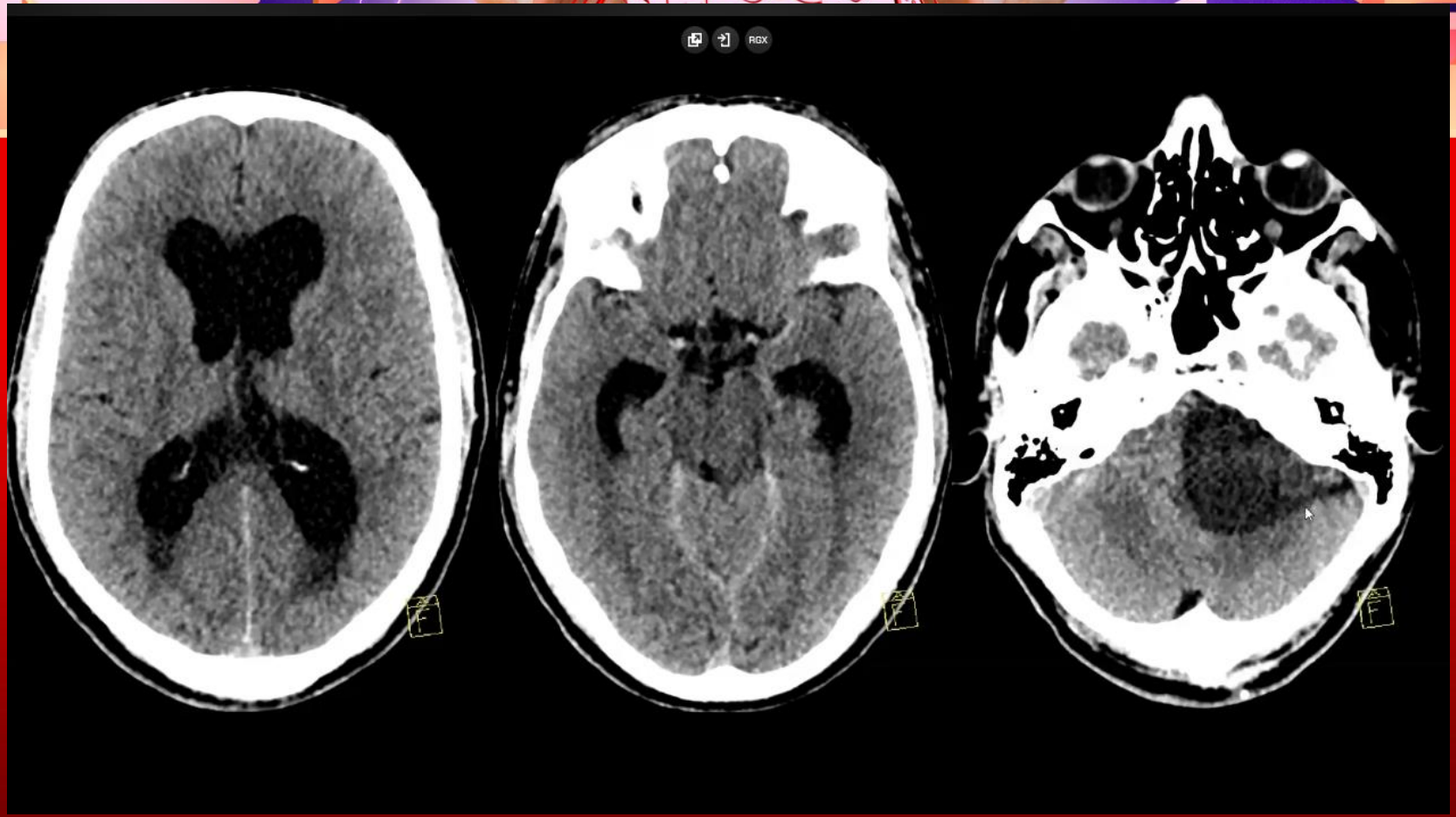

F


F
A

Colloid cyst


RGX


Tuberculous meningitis
Tuberculoma in
the tectal plate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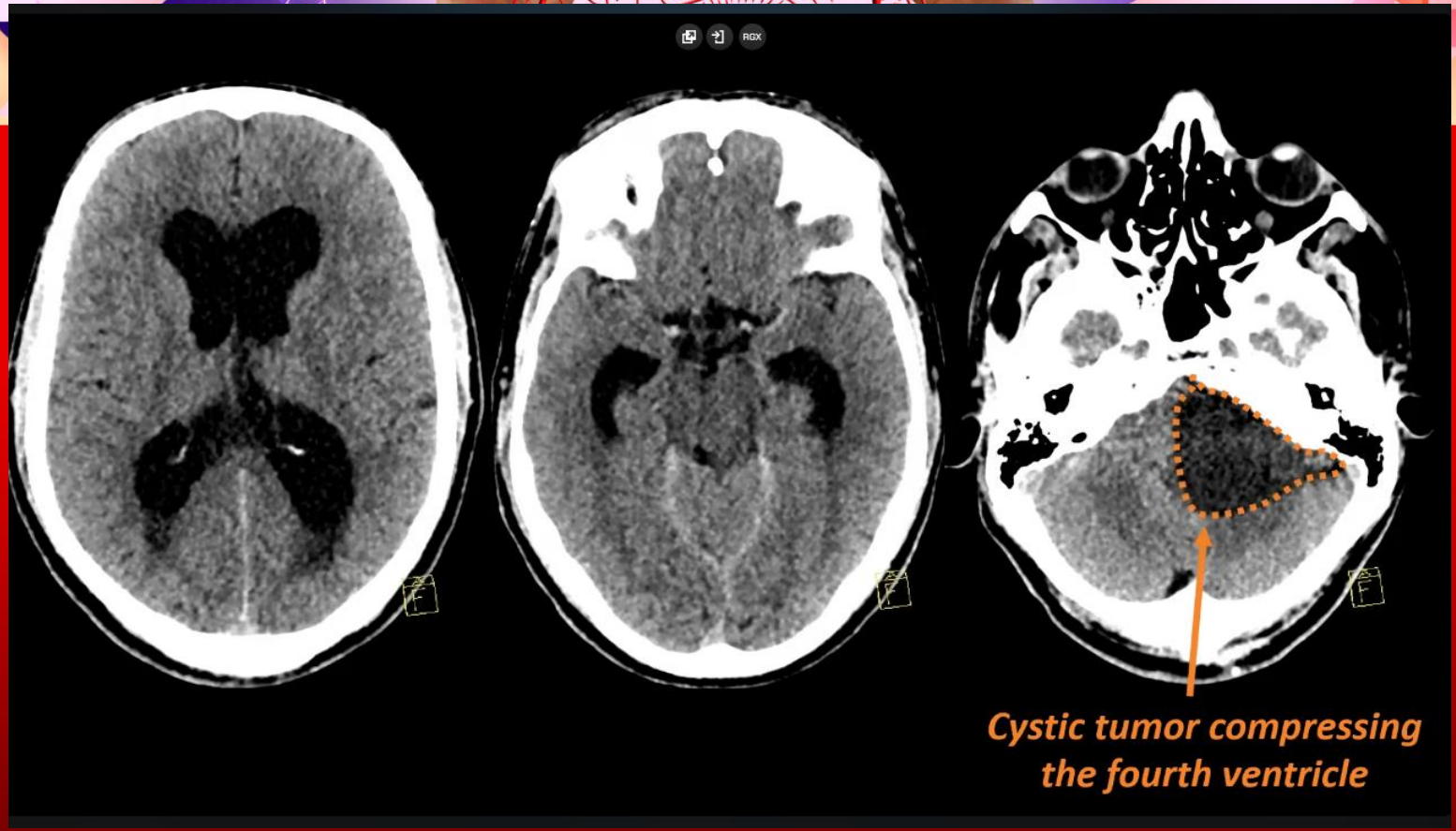
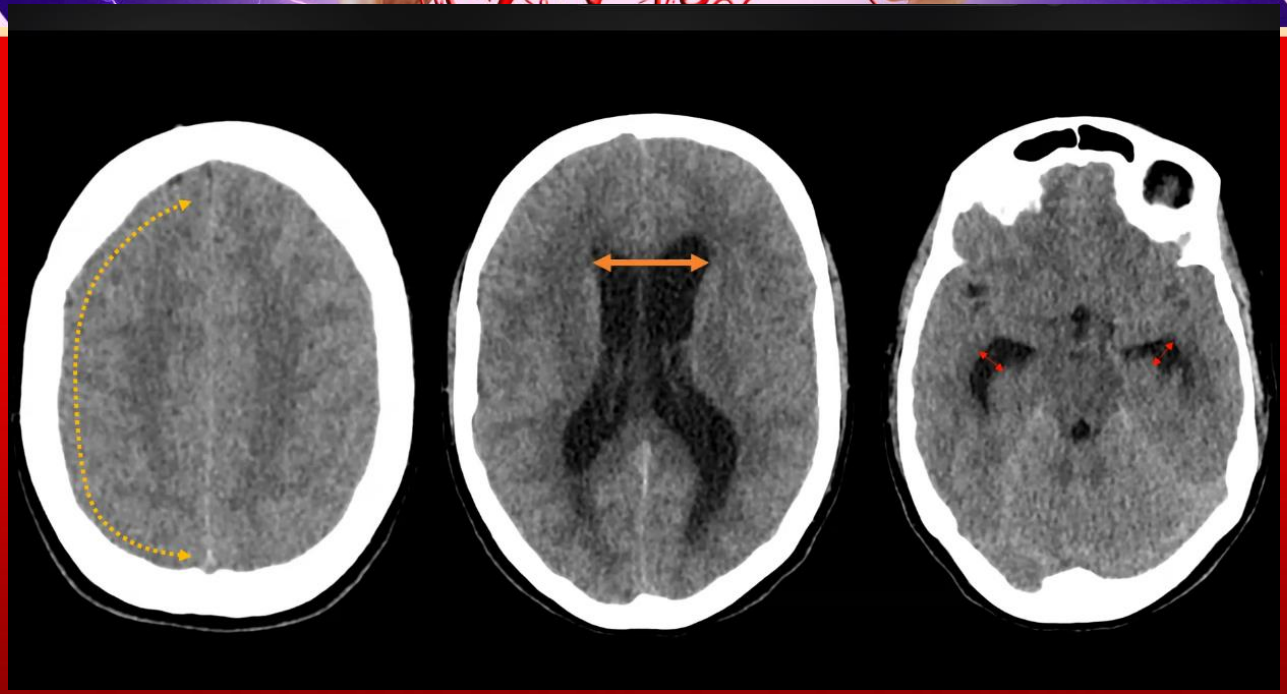
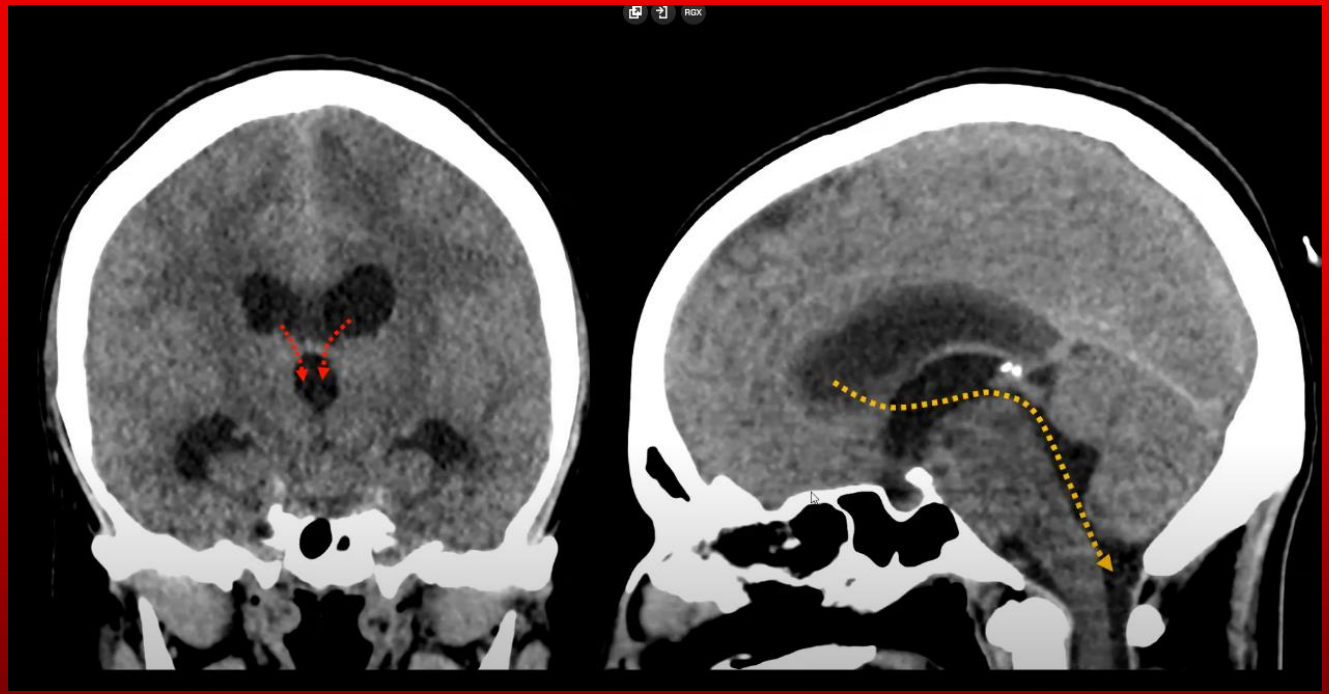

RGX
Cystic tumor compressing
the fourth ventricle

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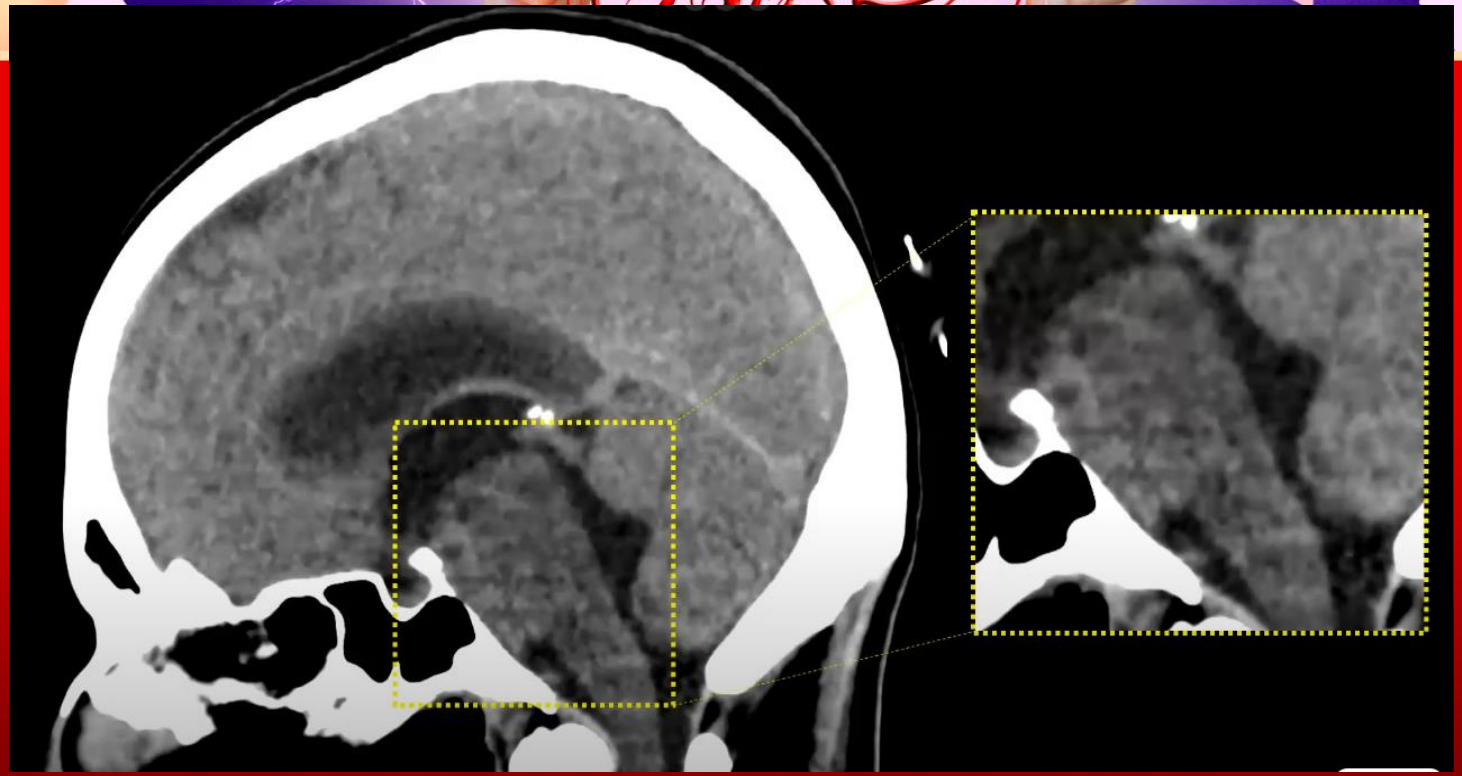
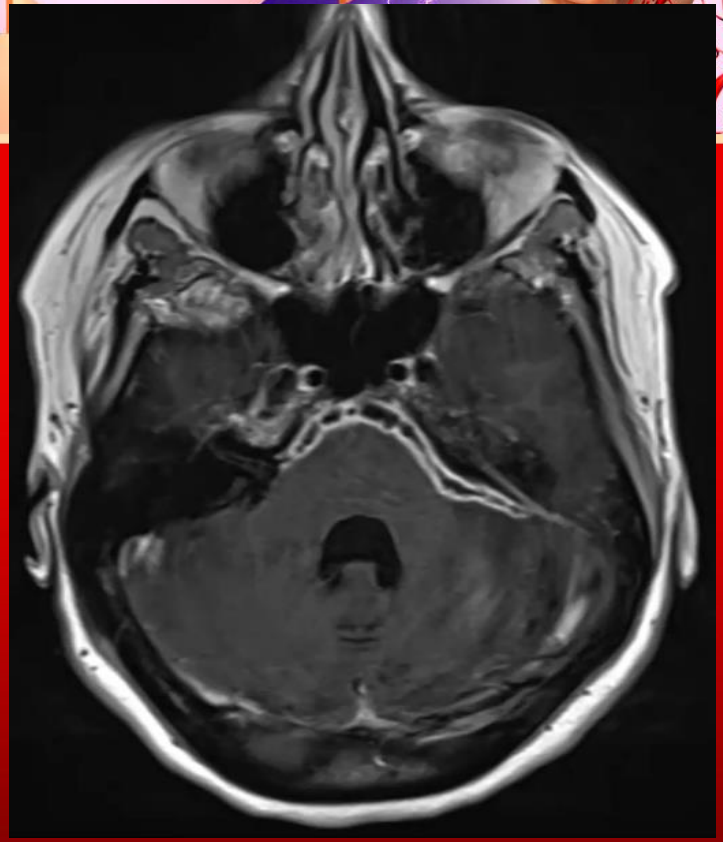
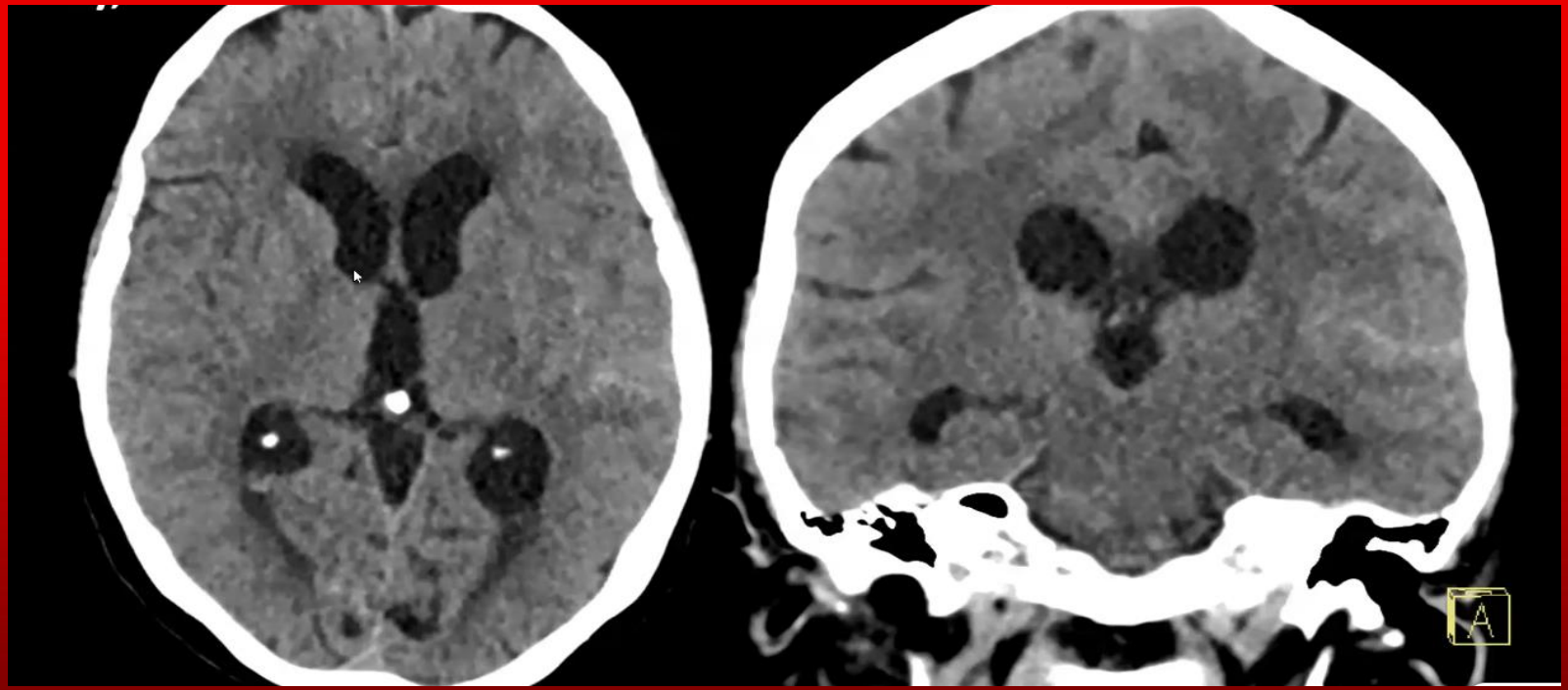




CNS tuberculosis meningitis


A

Take Home Messages

- Several clinical conditions like infection, vascular lesion, or tumors can cause a non traumatic brain emergency
- Conventional as well as advanced neuro imaging plays a vital role in timely diagnosis of the disease and subsequent management.
- CT is an accurate tool for diagnosis of most of the nontraumatic brain emergencies and their complications, but MRI provides higher accuracy in diagnosis of abnormalities
- Familiarity with the anatomic landmarks and the imaging appearance of brain diseases and their complications is mandatory subject for radiologists.

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