

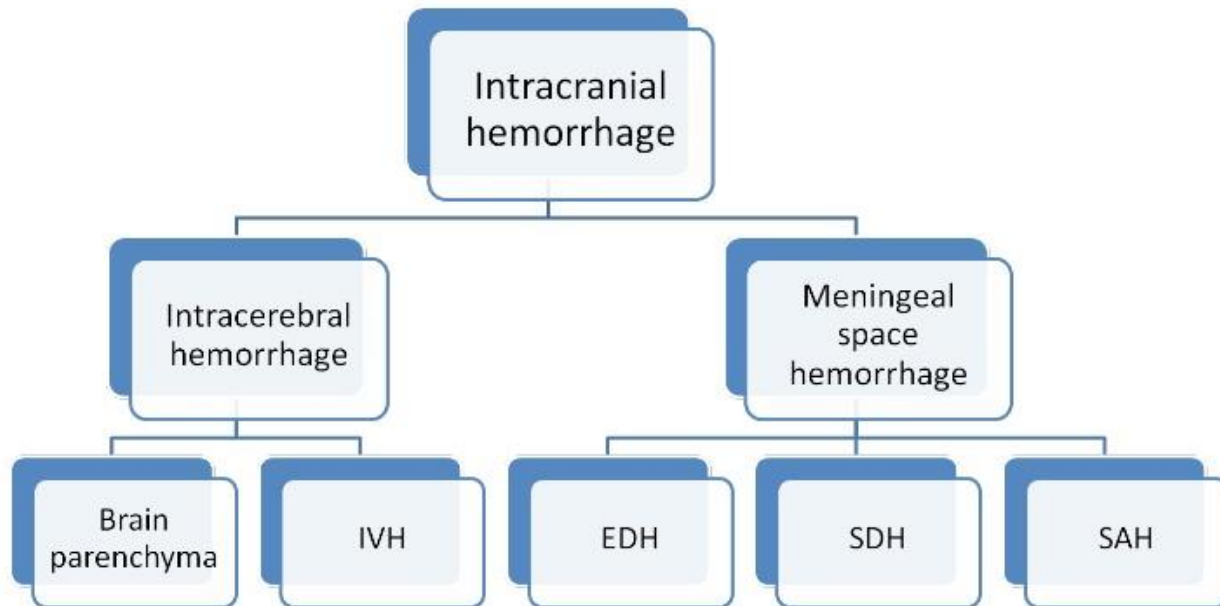
# Intracerebral Hemorrhage

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- Introduction
- Etiology
- Pathophysiology
- Clinical presentation
- Diagnosis and Imaging
- Treatment

# Introduction



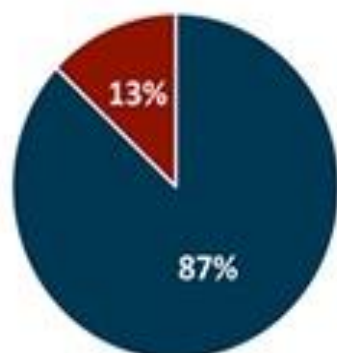
# Types of Stroke

## US Distribution

US total stroke annually 800,000

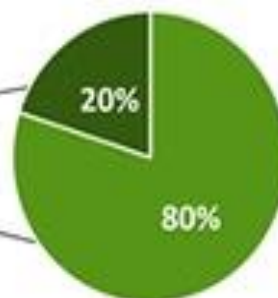
- US ischemic stroke approximately 87% of these are ischemic, 13% are hemorrhagic
  - Of those 87% that are ischemic, about 80% of those are non-cardioembolic

Total Annual Stroke



■ Ischemic ■ Hemorrhagic

Ischemic Stroke



■ Non-Cardioembolic ■ Cardioembolic

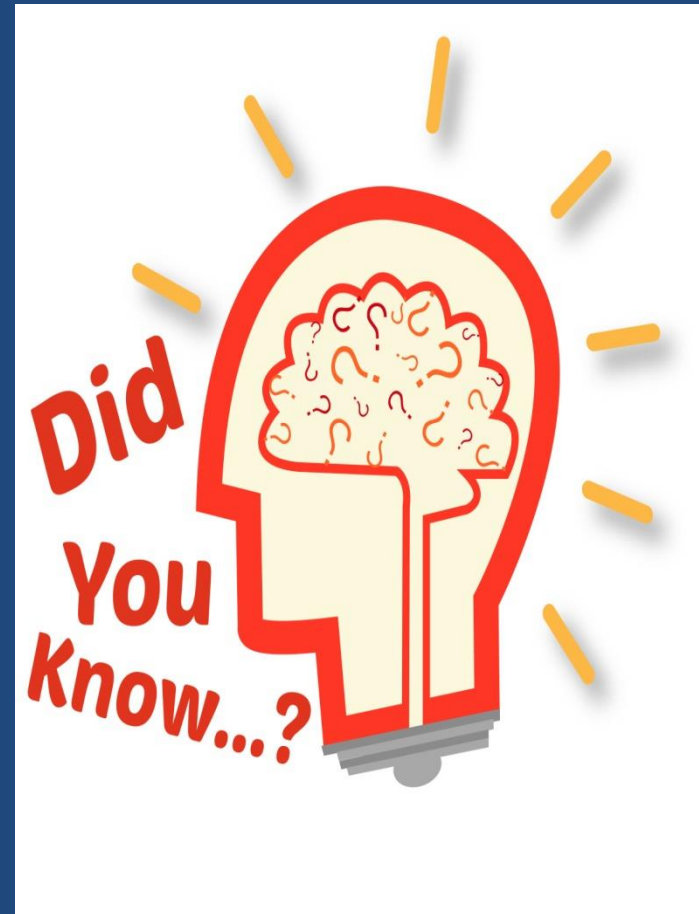
# Epidemiology

## Epidemiology

- Asian countries have a higher incidence of intracerebral hemorrhage than other regions of the world.
- A higher incidence of intracerebral hemorrhage has been noted in Chinese, Japanese, and other Asian populations, possibly due to environmental factors (eg, a diet rich in fish oils) and/or genetic factors.

# Mortality and Disability

- Overall, 40% mortality at 1 month and 54% at one year
- Only 12-40% are functionally independent long term
- 2010 – 62.8 million lost DALYs with ICH compared to 39.4 million in ischemic stroke



# Epidemiology

## Epidemiology

- Annually, more than 20,000 individuals in the United States die of intracerebral hemorrhage.
- Intracerebral hemorrhage has a 30-day mortality rate of 44%.
- Pontine or other brainstem intracerebral hemorrhage has a mortality rate of 75% at 24 hours.
- Incidence of intracerebral hemorrhage increases in individuals older than 55 years and doubles with each decade until age 80

# Risk Factors

- HTN
- Excessive ETOH use
- Smoking
- Age
- Ethnicity/Race
- Medications
- Sympathomimetics





# Etiology

## Etiology

- Hypertensive ICH
  - Essential
  - Eclampsia
- Non-hypertensive ICH
  - Vascular malformation: AVM, Aneurysm, Cavernous hemangioma
  - Bleeding disorders/anticoagulant
  - Amyloid angiopathy
  - Trauma
  - Tumor
  - Drug abuse: amphetamine, cocaine, PPA

# Pathophysiology

## Pathophysiology

- Primary immediate effect
  - Hemorrhage growth
  - Increase ICP
- Secondary effect
  - Downstream effect
  - Edema
  - Ischemia

# Hypertensive ICH

- basal ganglia (40-50%),
- lobar regions (20-50%),
- thalamus (10-15%),
- pons (5-12%),
- cerebellum (5-10%),
- other brainstem sites (1-5%).

# Clinical Presentation

## Clinical presentation

- Alteration in level of consciousness (approximately 50%)
- Nausea and vomiting (approximately 40-50%)
- Headache (approximately 40%)
- Seizures<sup>[3]</sup> (approximately 6-7%)
- Focal neurological deficits

# Clinical Presentation

## Focal neurological deficits

- Putamen - Contralateral hemiparesis, contralateral sensory loss, contralateral conjugate gaze palsy, homonymous hemianopia, aphasia, neglect, or apraxia
- Thalamus - Contralateral sensory loss, contralateral hemiparesis, gaze palsy, homonymous hemianopia, miosis, aphasia, or confusion

# Clinical Presentation

## Focal neurological deficits

- Lobar - Contralateral hemiparesis or sensory loss, contralateral conjugate gaze paresis, homonymous hemianopia, abulia, aphasia, neglect, or apraxia
- Caudate nucleus - Contralateral hemiparesis, contralateral conjugate gaze paresis, or confusion

# Investigations

## Investigation

- Laboratory studies
  - CBC
  - Coagulogram
  - Electrolyte
  - others
- Imaging
  - CT brain w/o contrast

# Investigations

## CT-brain

- demonstrates acute hemorrhage as hyperdense signal intensity
- Multifocal hemorrhages at the frontal, temporal, or occipital poles suggest a traumatic etiology.
- Hematoma volume can be approximated by  $(A \times B \times C)/2$
- Iodinated contrast may be injected to increase screening yield for underlying tumor or vascular malformation.



# The Workup...

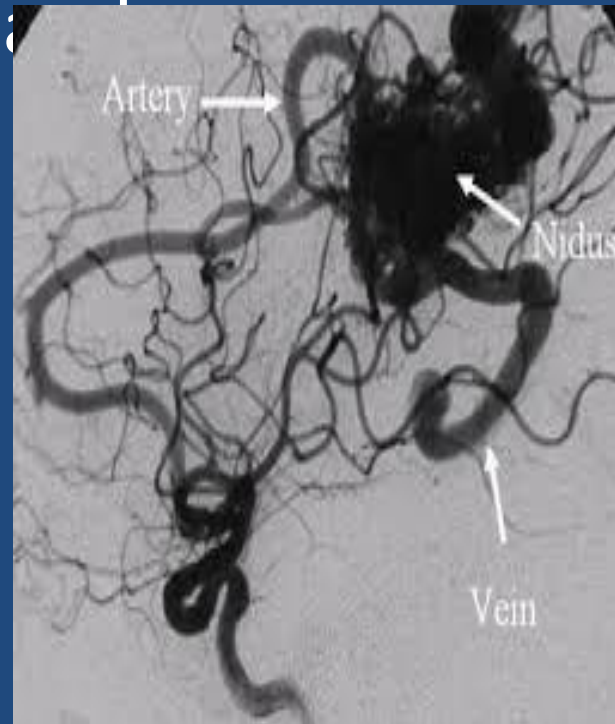


- CT head – no contrast
- CTA head/neck – suspect vascular etiology
  - Careful interpreting noncon CT head after CTA
- MRI brain – with gado if looking for neoplasm
- MRA/MRV - if allergic to CT dye or if looking at venous outflow
- Cerebral angiography



# Other Causes

- AVM, aneurysms, and other vascular malformations (venous and arterial angiomas)
- CVT
- Intracranial neoplasm
- Amyloid angiopathy
- Moya Moya



## Vessel imaging

- CT angiography permits screening of large and medium-sized vessels for AVMs, vasculitis, and other arteriopathies.

# The Workup...



- CT head – no contrast
- CTA head/neck – suspect vascular etiology
  - Careful interpreting noncon CT head after CTA
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**DO**  
**SOMETHING!**

What to do?????



- Control BP!!!!
  - Guidelines – reduction of SBP to 140
    - Anderson/Qureshi studies – Interact 2 and ATACH 2
      - Not clear if SBP > 220
    - Use labetalol and/or nicardipine drip to titrate blood pressure
- Between 15-23% of patients > hematoma expansion in first few hours
- A word about penumbra

# What do we do??

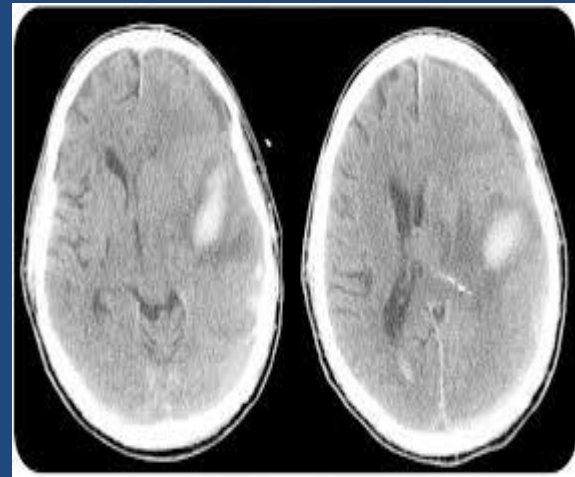
- EBP nursing care
  - Watch for neuro decline
  - Type and cross with your labs!
  - HOB > 30
  - Head midline
  - Prevent vagal maneuvers
  - Control SBP
  - Treat hyperglycemia
  - Treat hyperthermia
  - Seizure prophylaxis
  - DVT prophylaxis



- Typically, do not make patients DNR within the first 48 hours

# Cerebral Edema: Sodium and CO2

- Use the ventilator to manage CO2



- Get the sodium up

- Mannitol/3% or even 23.4% (requires central line) for herniation

# Surgery anyone????

- EVD

- CLEAR III trial – no outcome benefit with venous thrombolysis

tPA



- Craniotomy

- Depends on etiology

- \*\*Depends on AC/APT status

- Depends on timing

- Depends on location

- STICH II – no overall favorable outcome

- MISTIE II – MIS techniques

- MISTIE III – underway

- Cerebellar ICH





# Subarachnoid Hemorrhage



- Usually due to aneurysm rupture
- Can be perimesencephalic SAH
- Coil/Clip
- NIMOTOP/NIMODIPINE
- Strict BP control
- Hydrocephalus
- Vasospasm
- Sodium
- Urine output

# Hemorrhagic Transformation

## HI 1/2 – PH 1/2

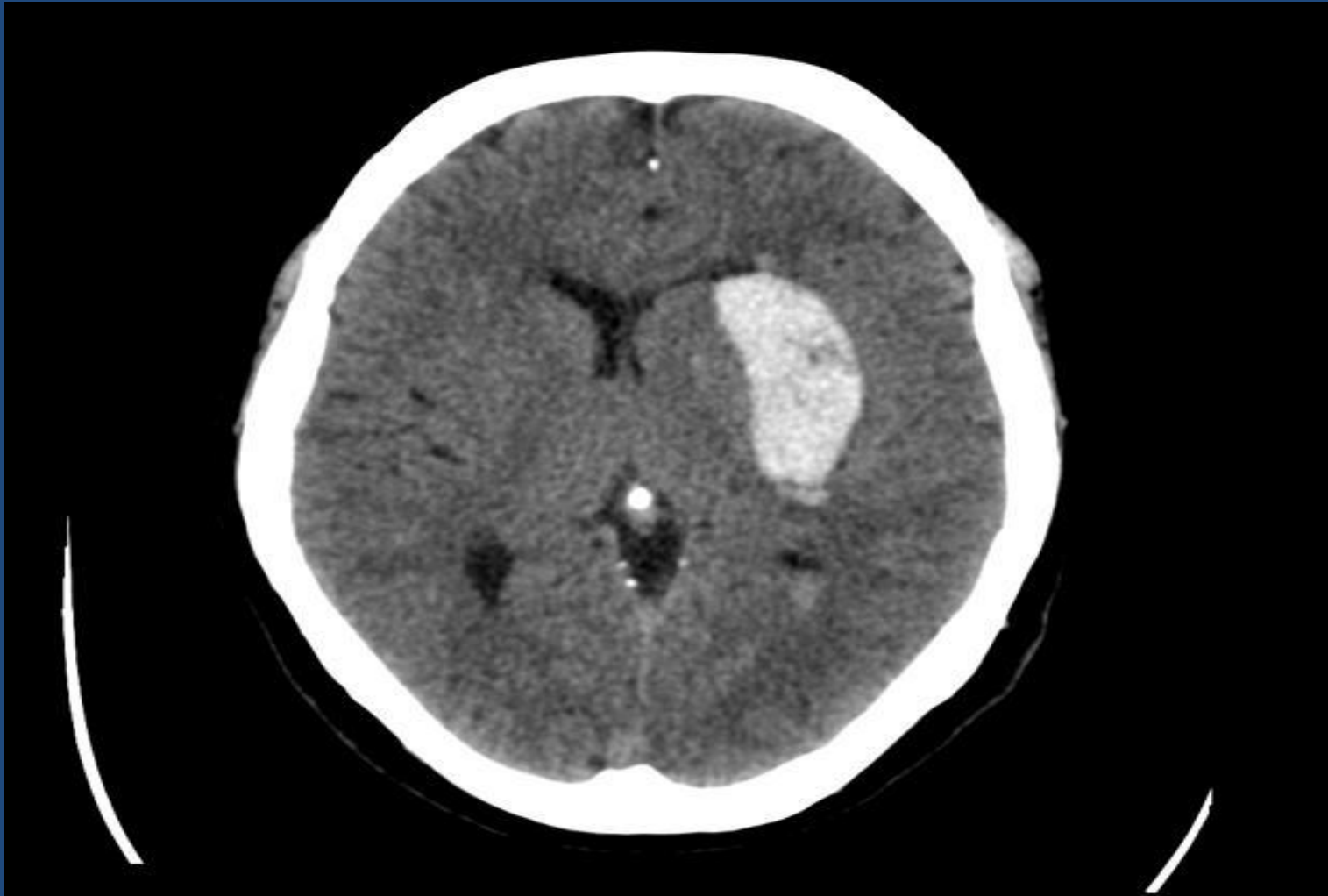
- > 50% have some hemorrhage
  - 0.6%-3% >> untreated patients
  - 6% in treated patients
- Risk Factors
  - Older age
  - larger stroke size
  - cardioembolic stroke etiology<sup>1</sup>
  - anticoagulant use
  - fever
  - hyperglycemia
  - low serum cholesterol
  - Acutely elevated systolic blood pressure
  - thrombolytic therapy/recanalization
- Treatment



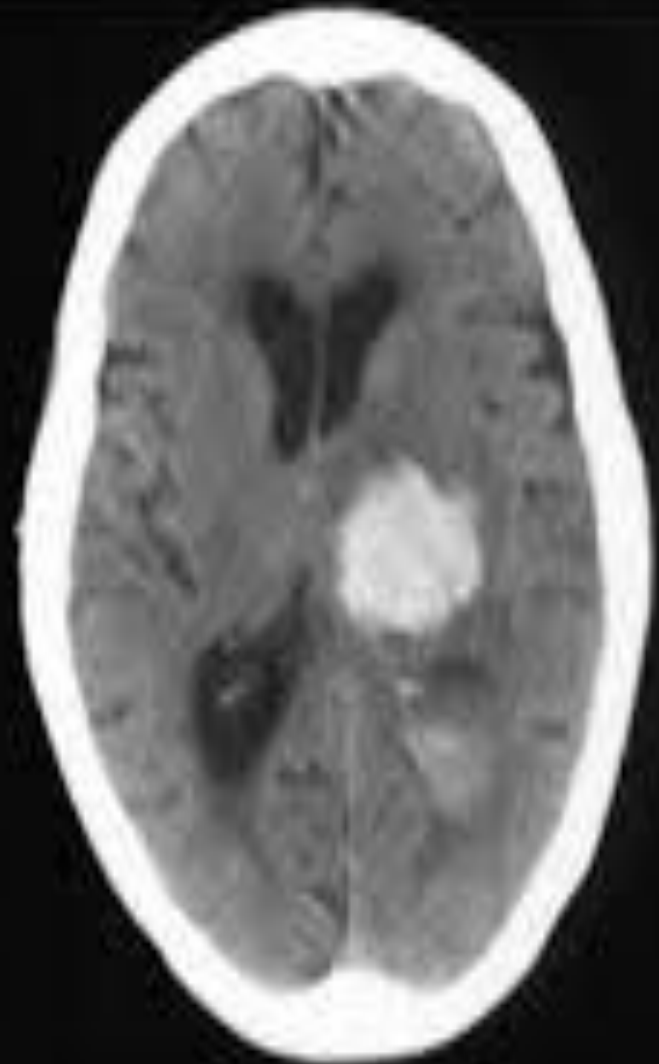
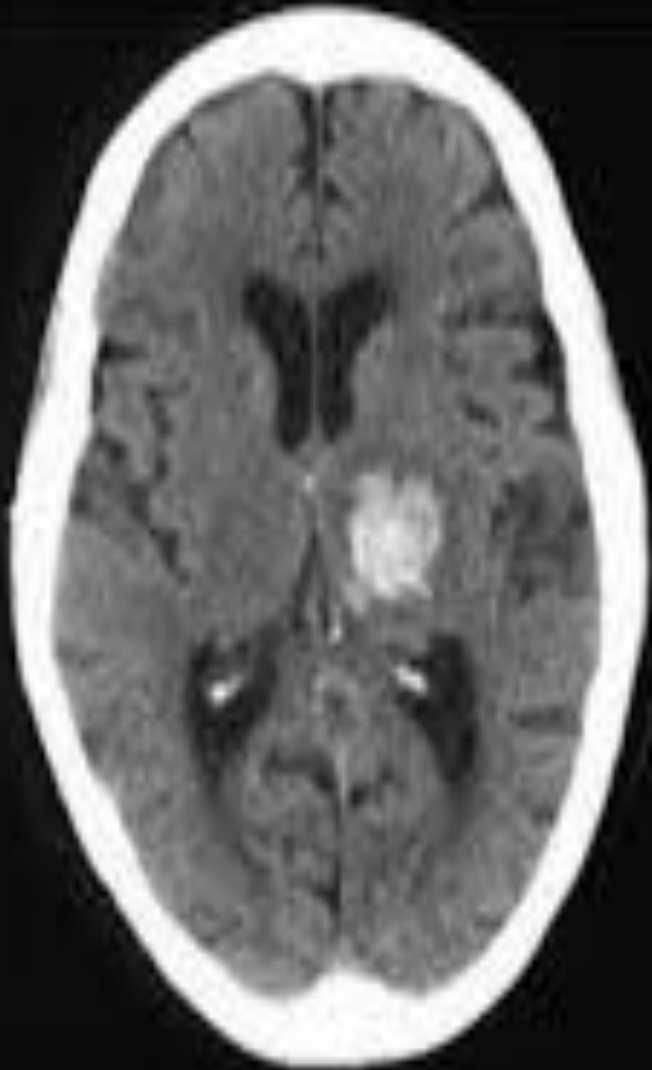
# Hypertensive hemorrhage

- Putamen
- Thalami
- Pontine
- Cerebellum
- Lobar

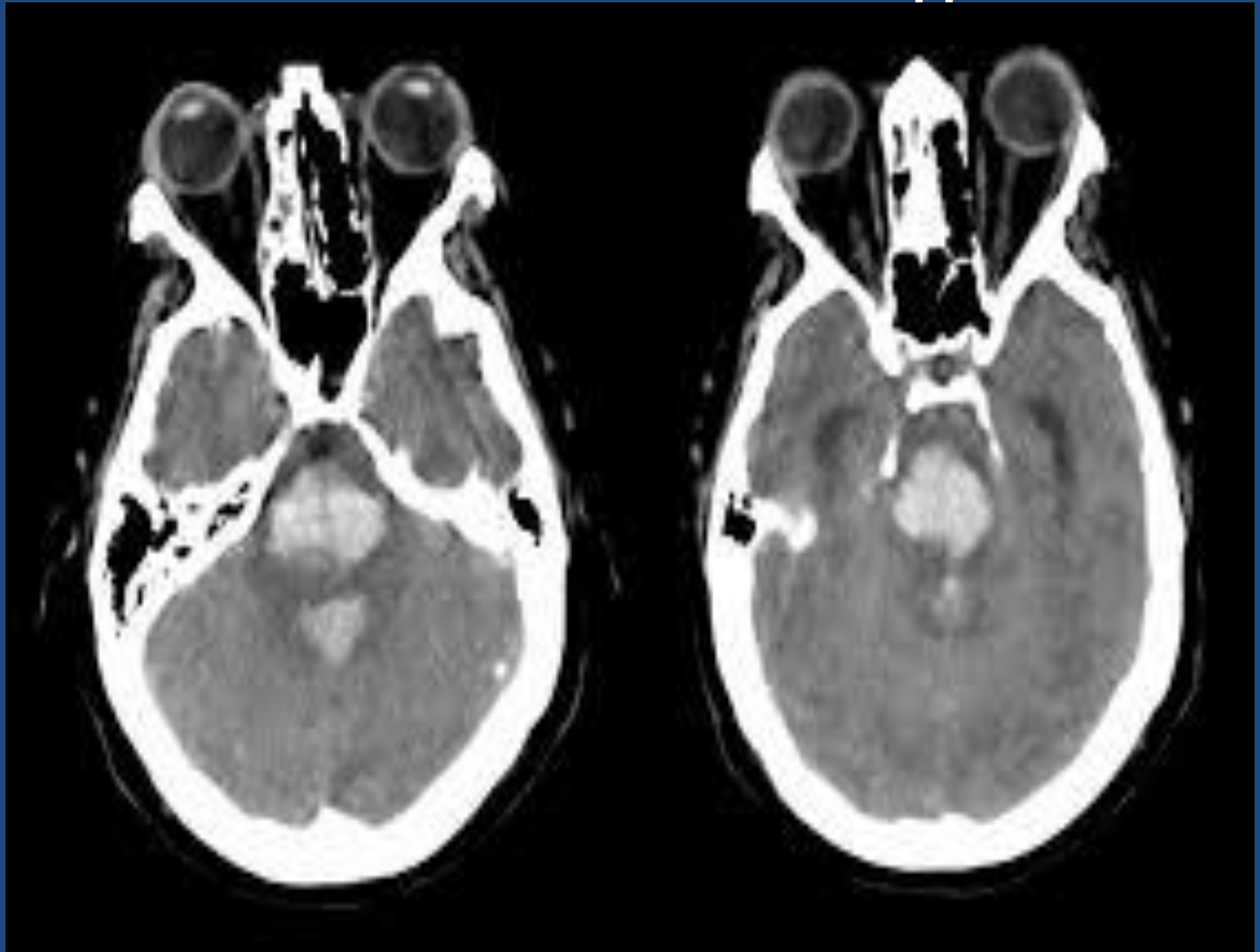
# Putamen Hemorrhage



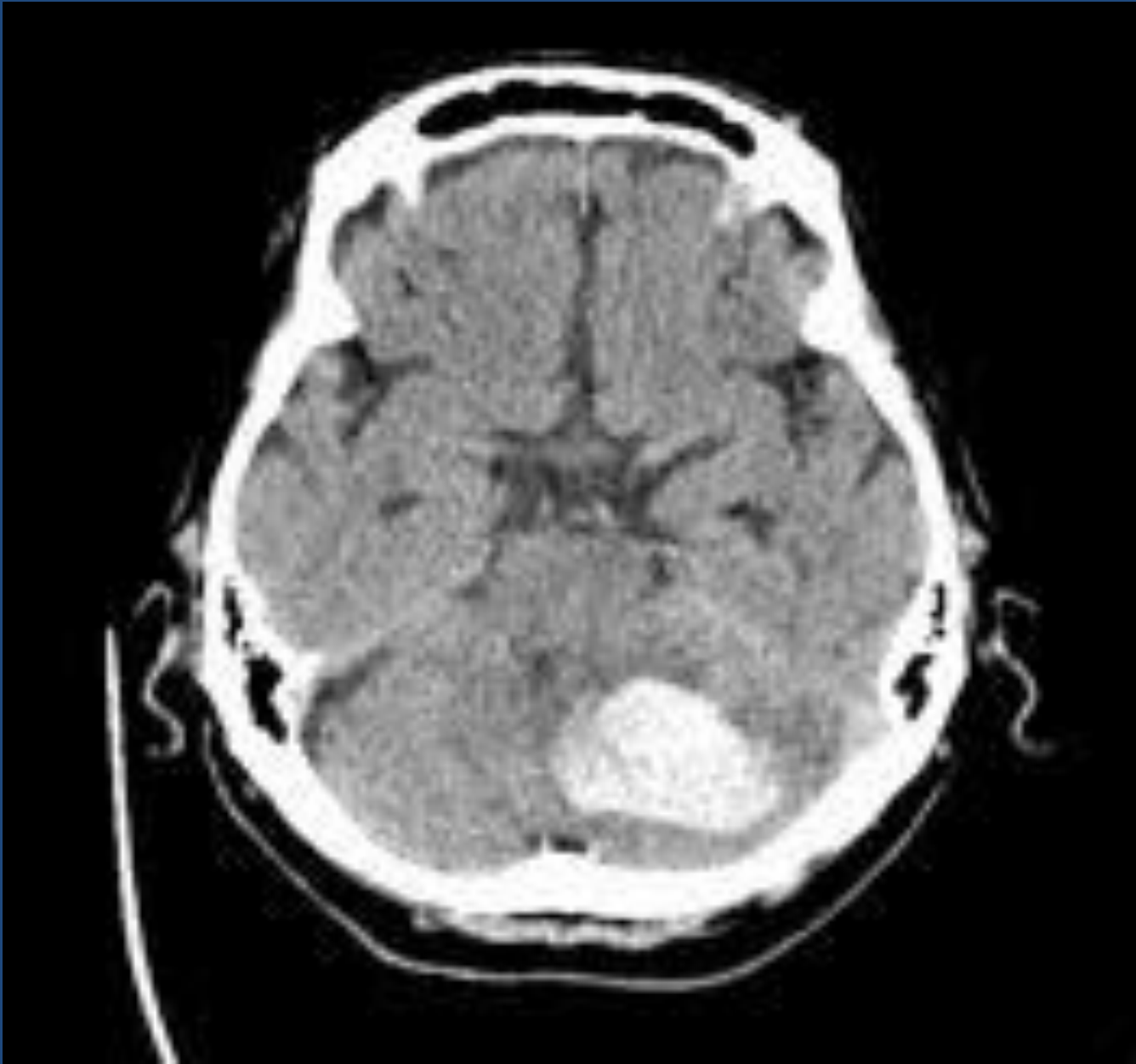
# Thalamic hemorrhage



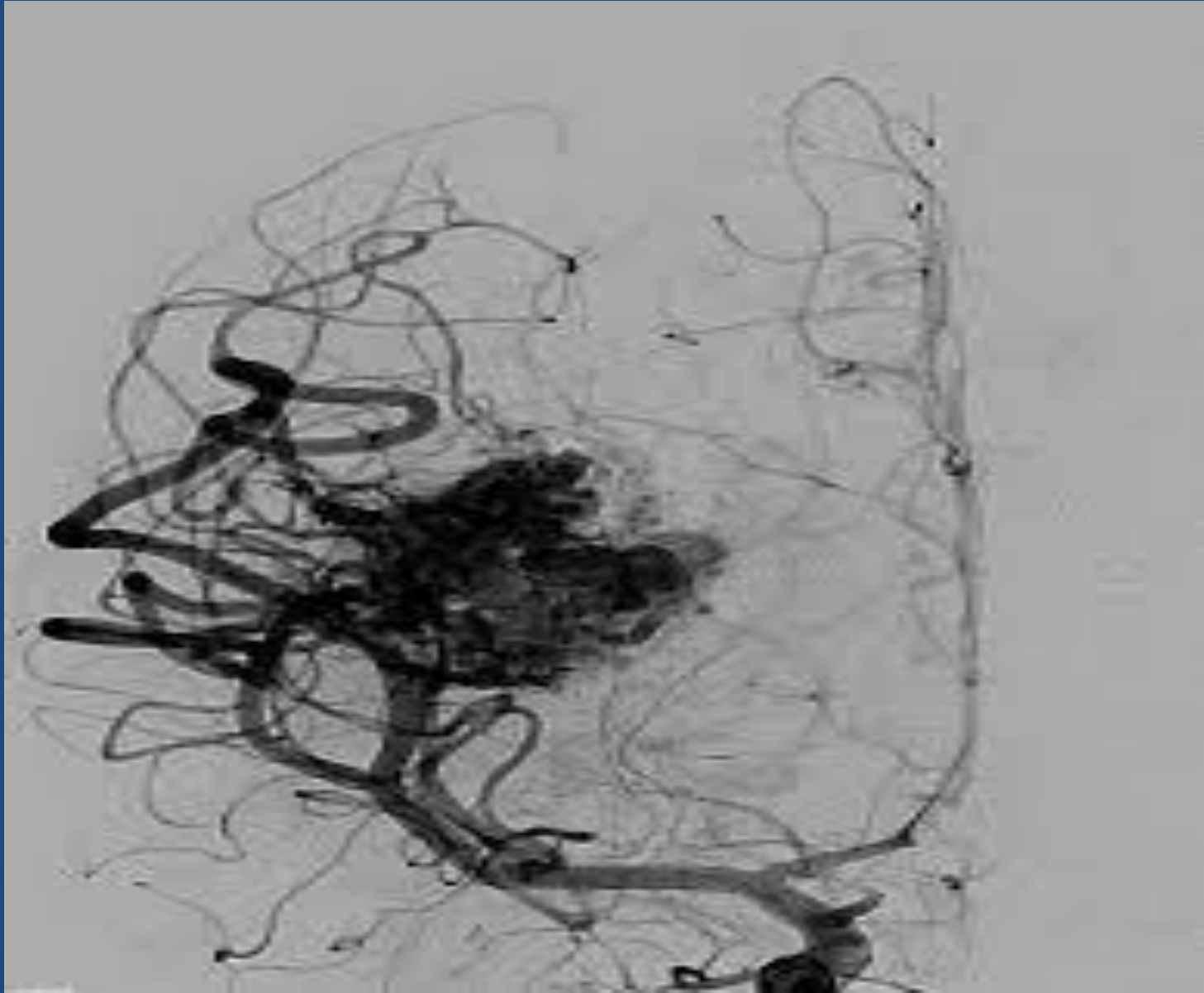
# Pontine hemorrhage



# Cerebellar hemorrhage

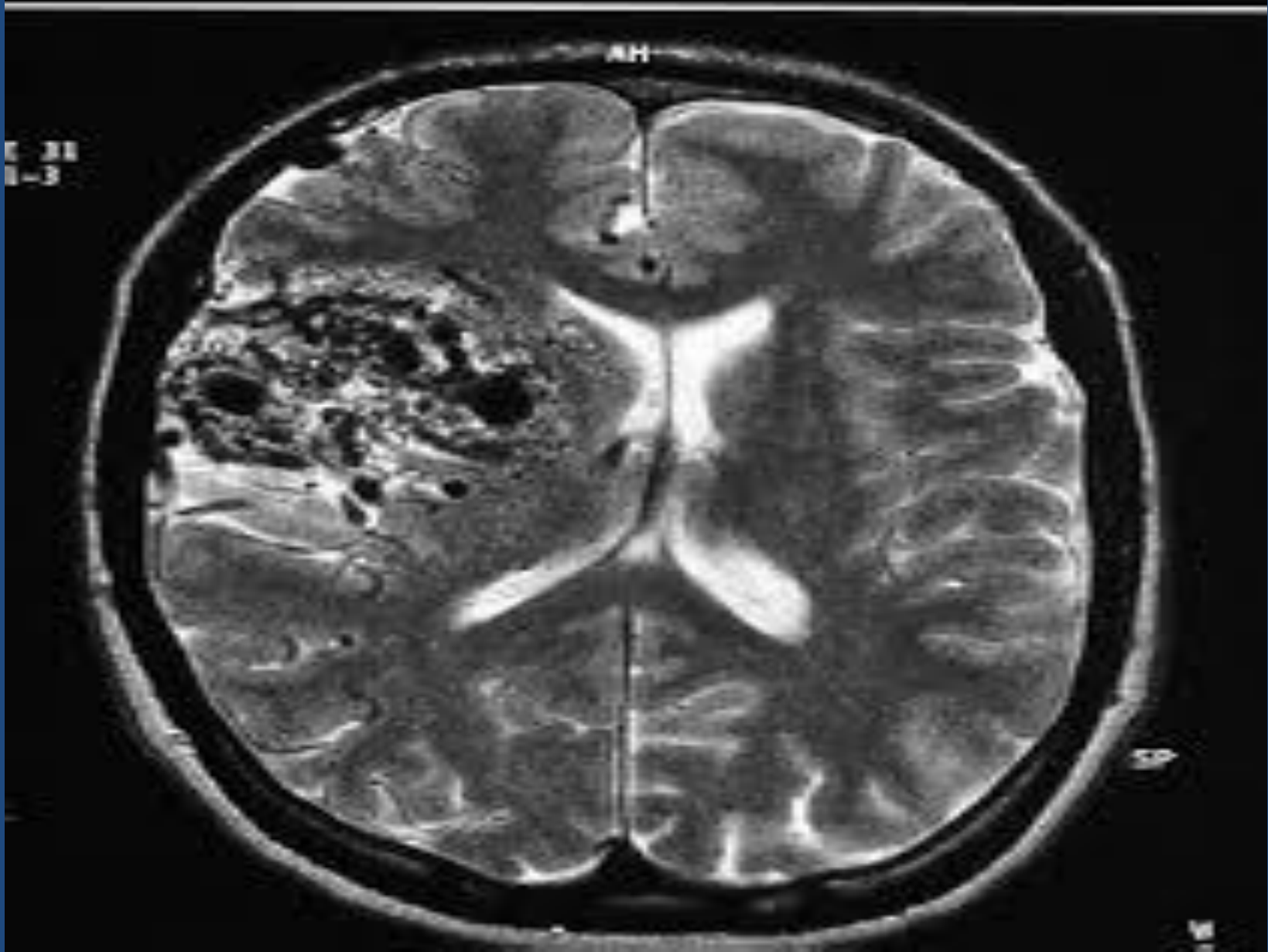


# AVM

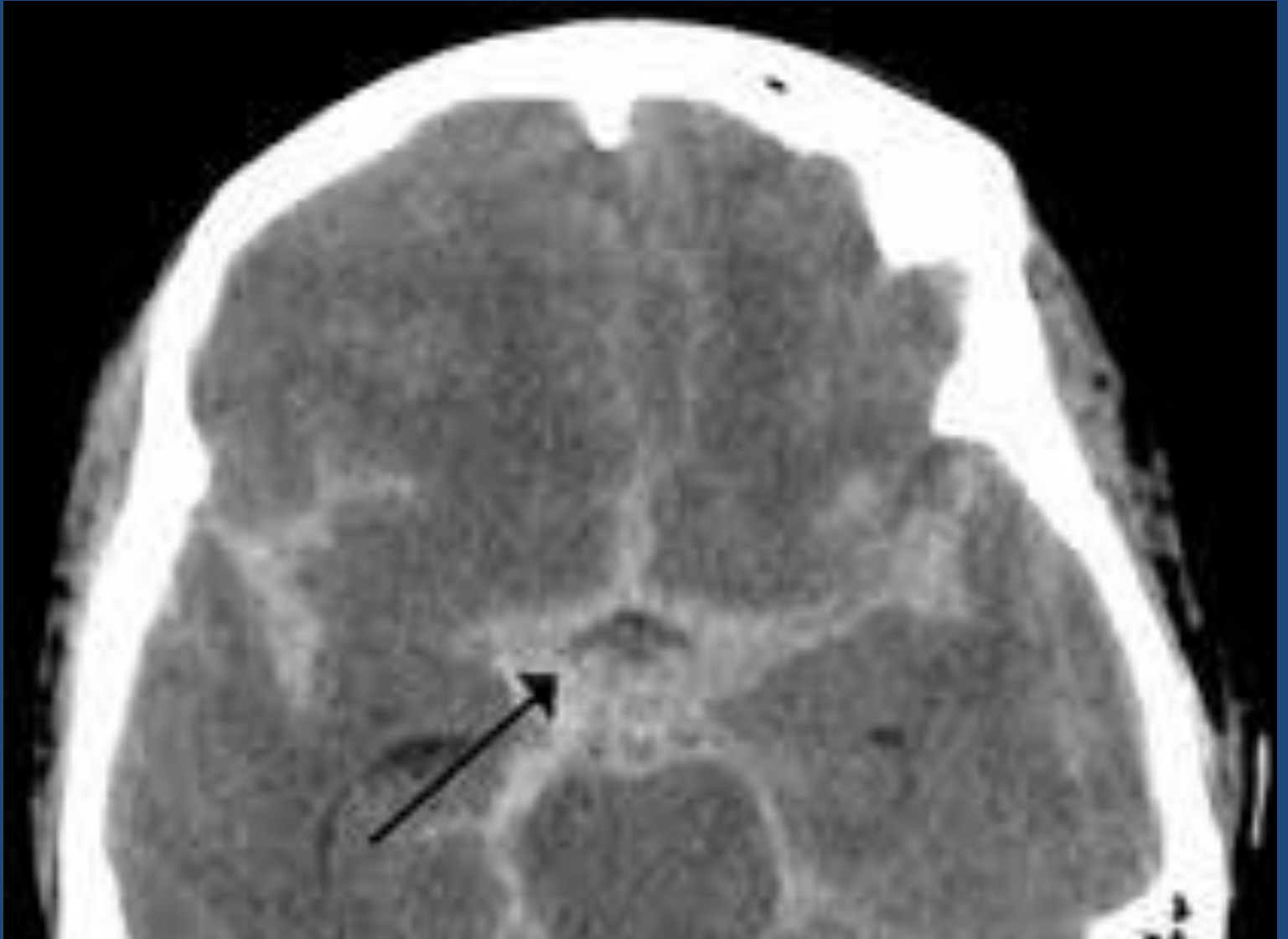




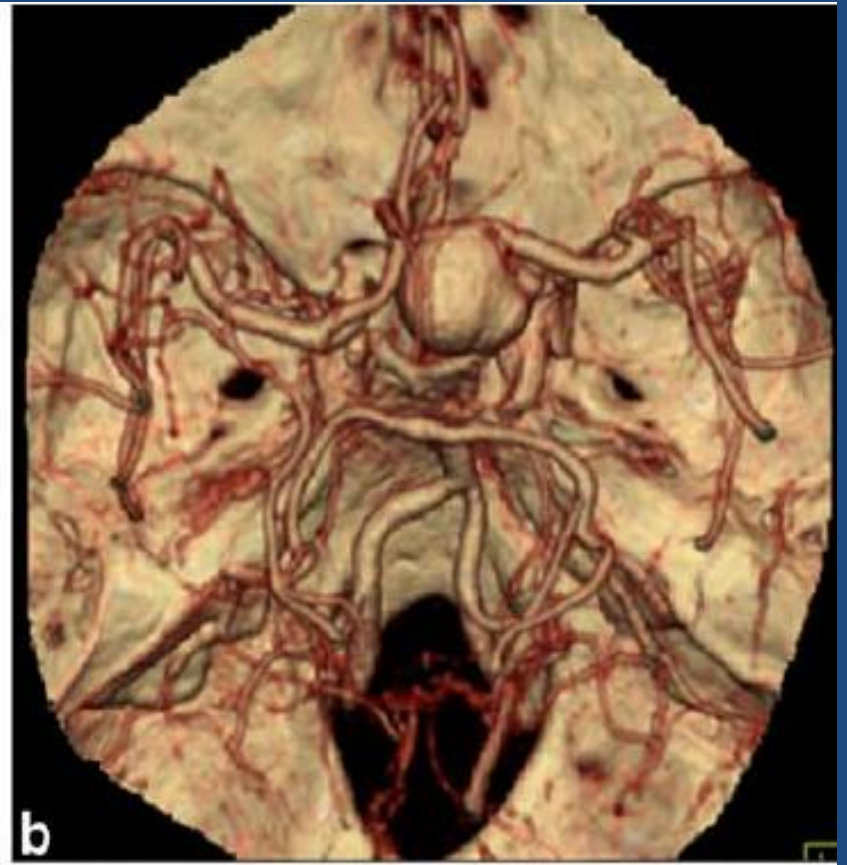
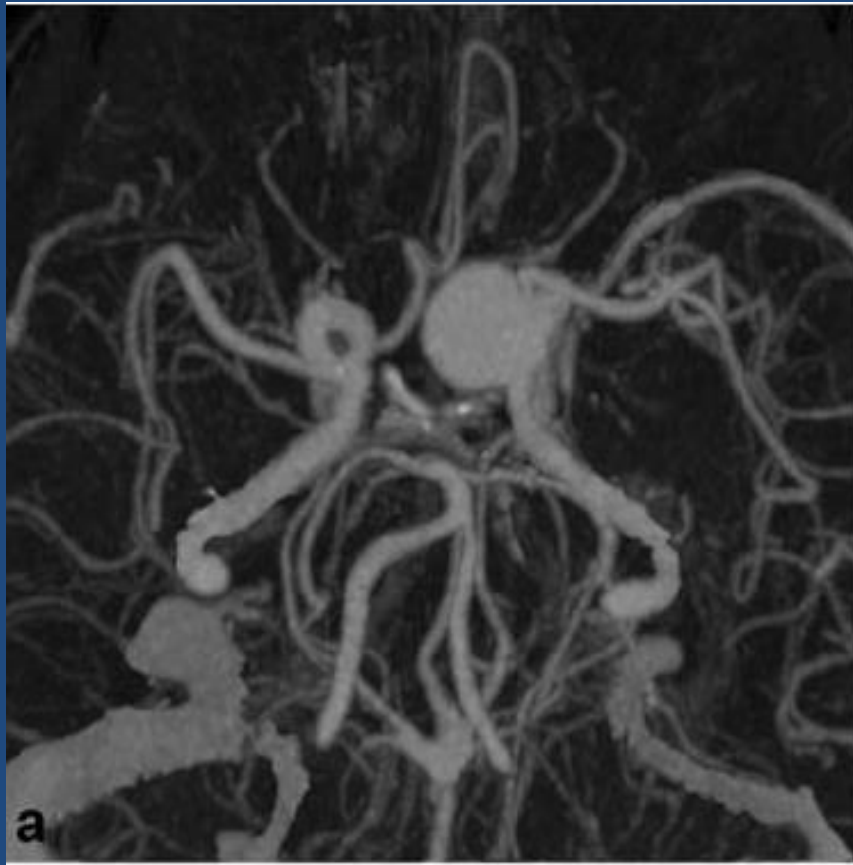
# AVM



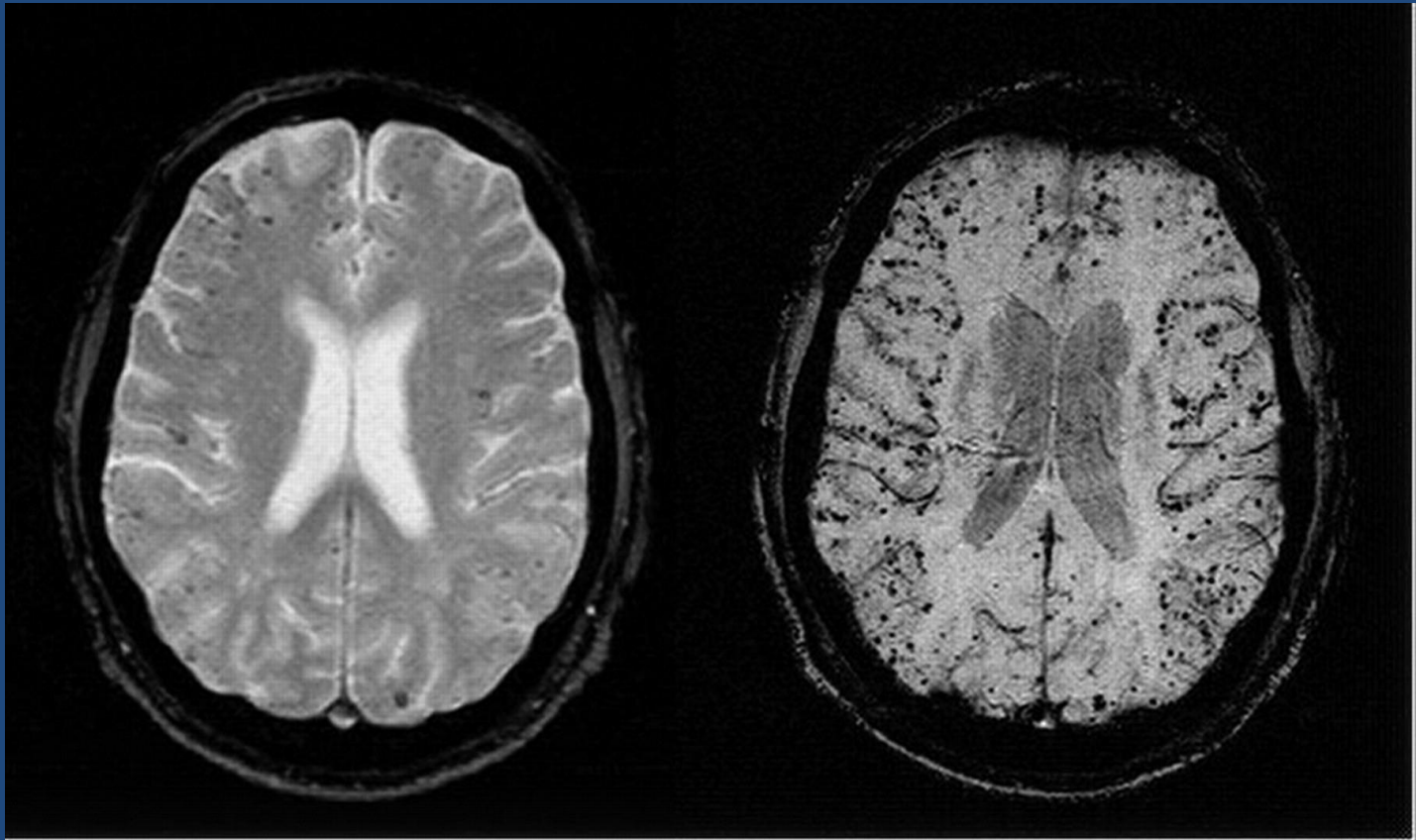
SAH



# Aneurysm

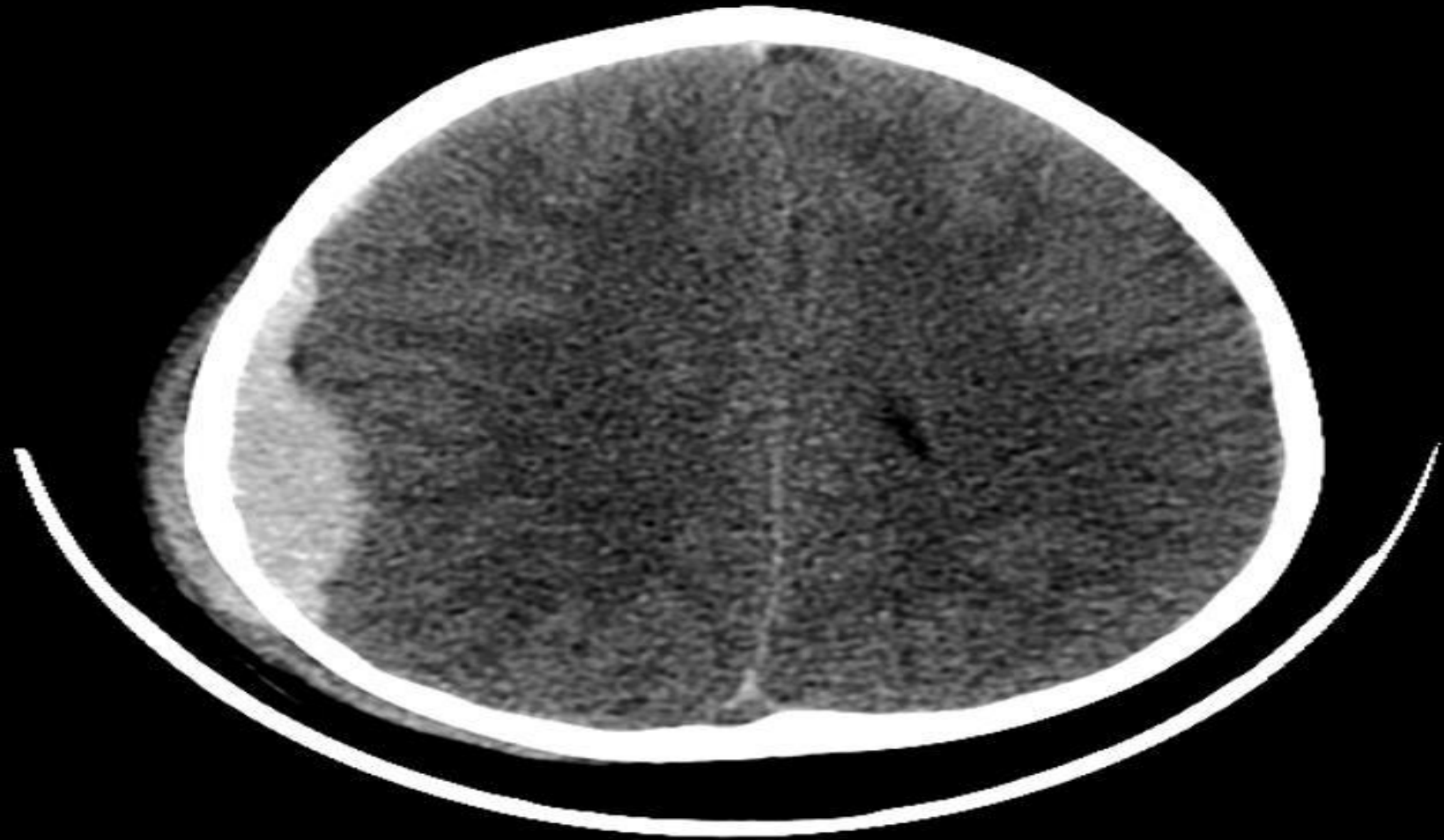


# Amyloid Angiopathy

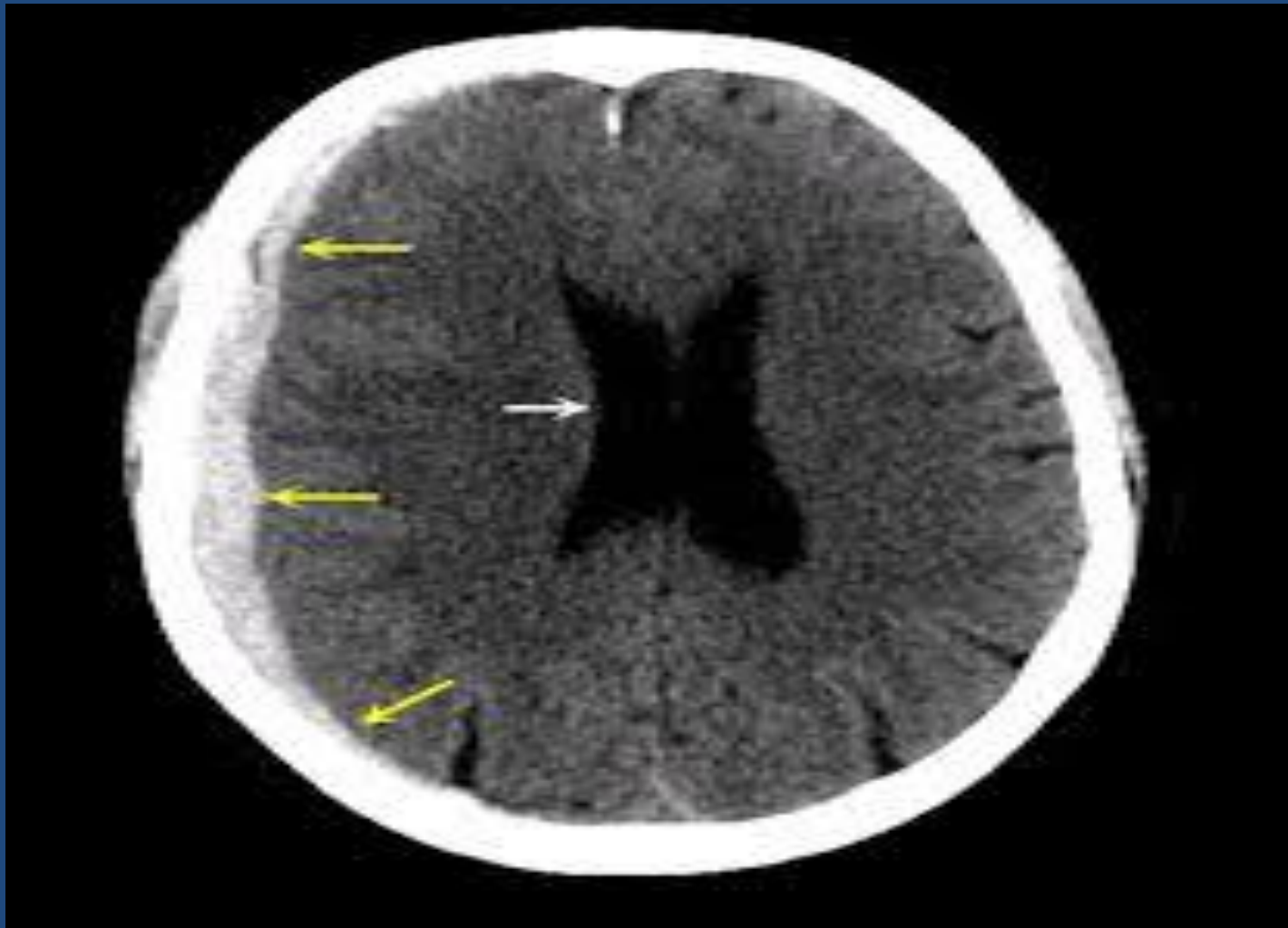


# EDH

Warning: Not for diagnostic use



# SDH



# Lobar hemorrhage



# Tumor with ICH

