Neuroradiology

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УНИВЕРЗИТЕТ
У КРАГУЈЕВЦУ

Objectives

- Examination techniques, X-ray, CT and MR
- Neurotrauma,
- Tumors of the CNS,
- CNS infections

Imaging modalities

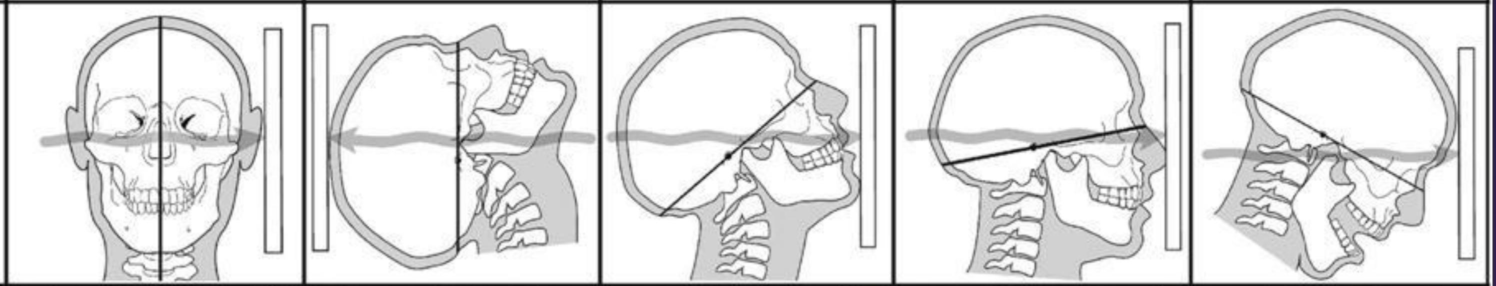
- Radiography
- CT
- MRI
- DSA

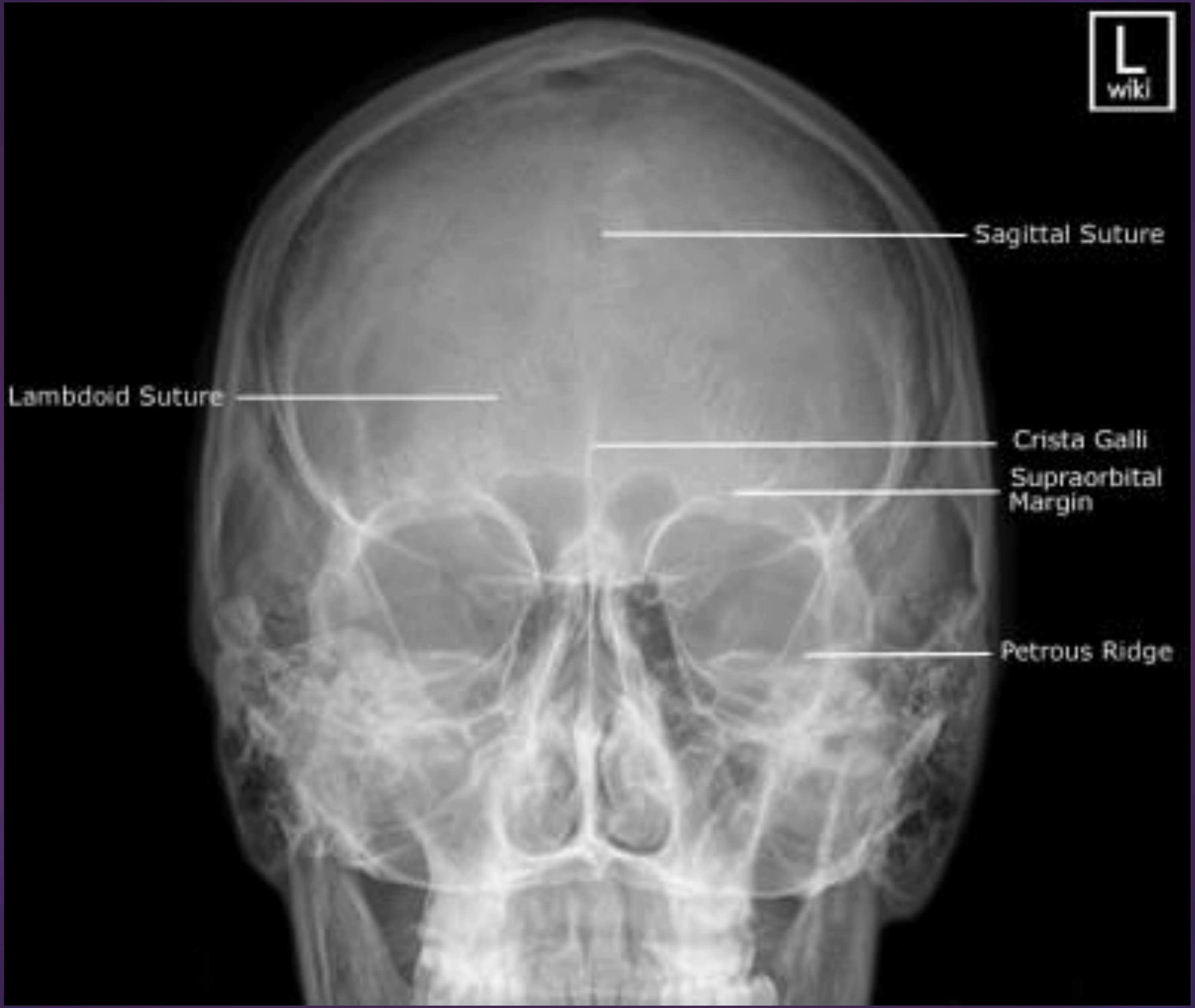
Skull radiography

- Skull radiography is the radiological investigation of the skull vault and associated bony structures. Seldom requested in modern medicine, plain radiography of the skull is often the last resort in trauma imaging in the absence of a CT.
- **Indications:**
- trauma
- magnified technique to evaluate palpable bony lesions on the scalp
- to exclude the presence of metallic foreign bodies contraindicated to MRI
- skeletal survey

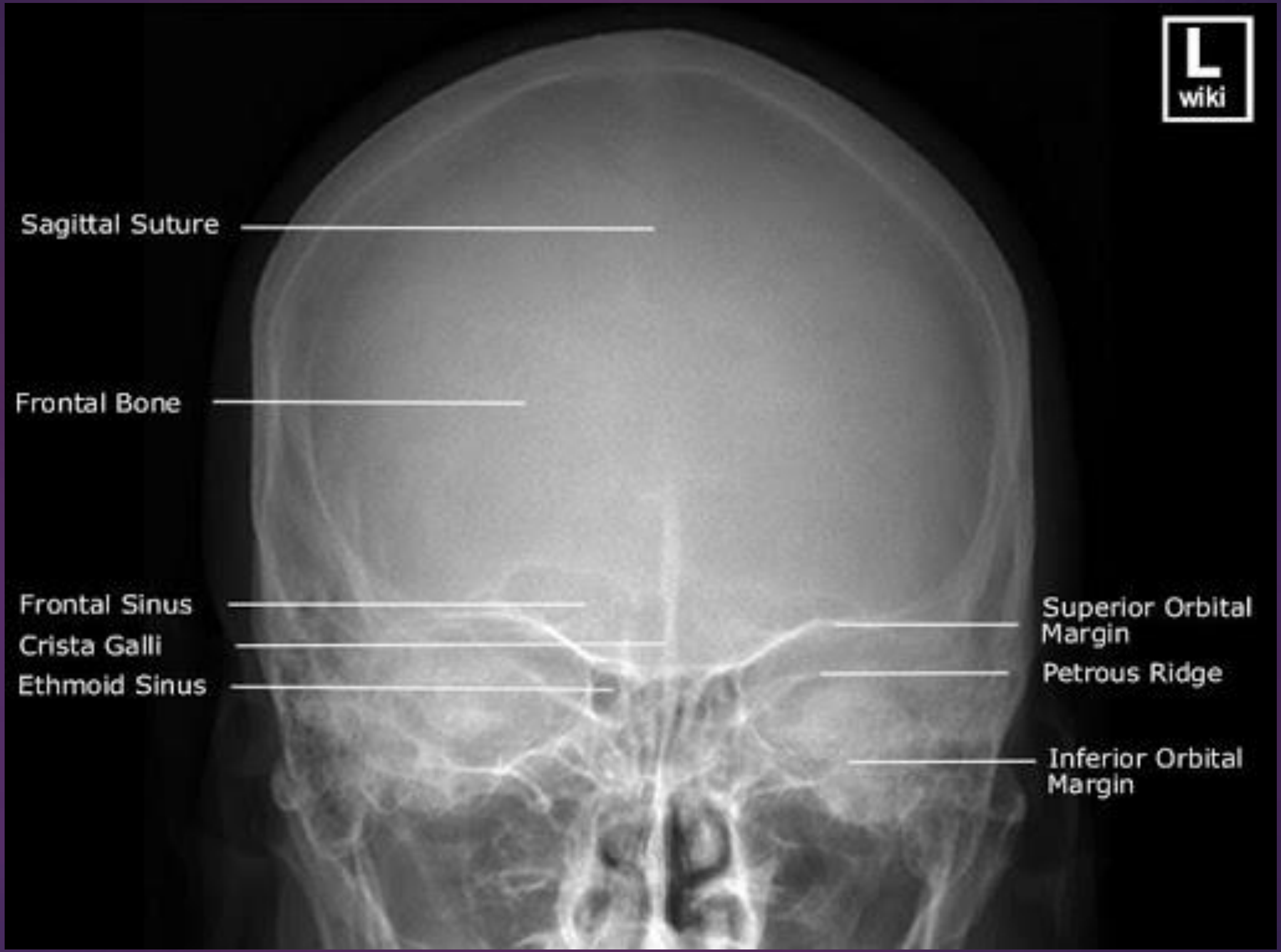
Standard projections

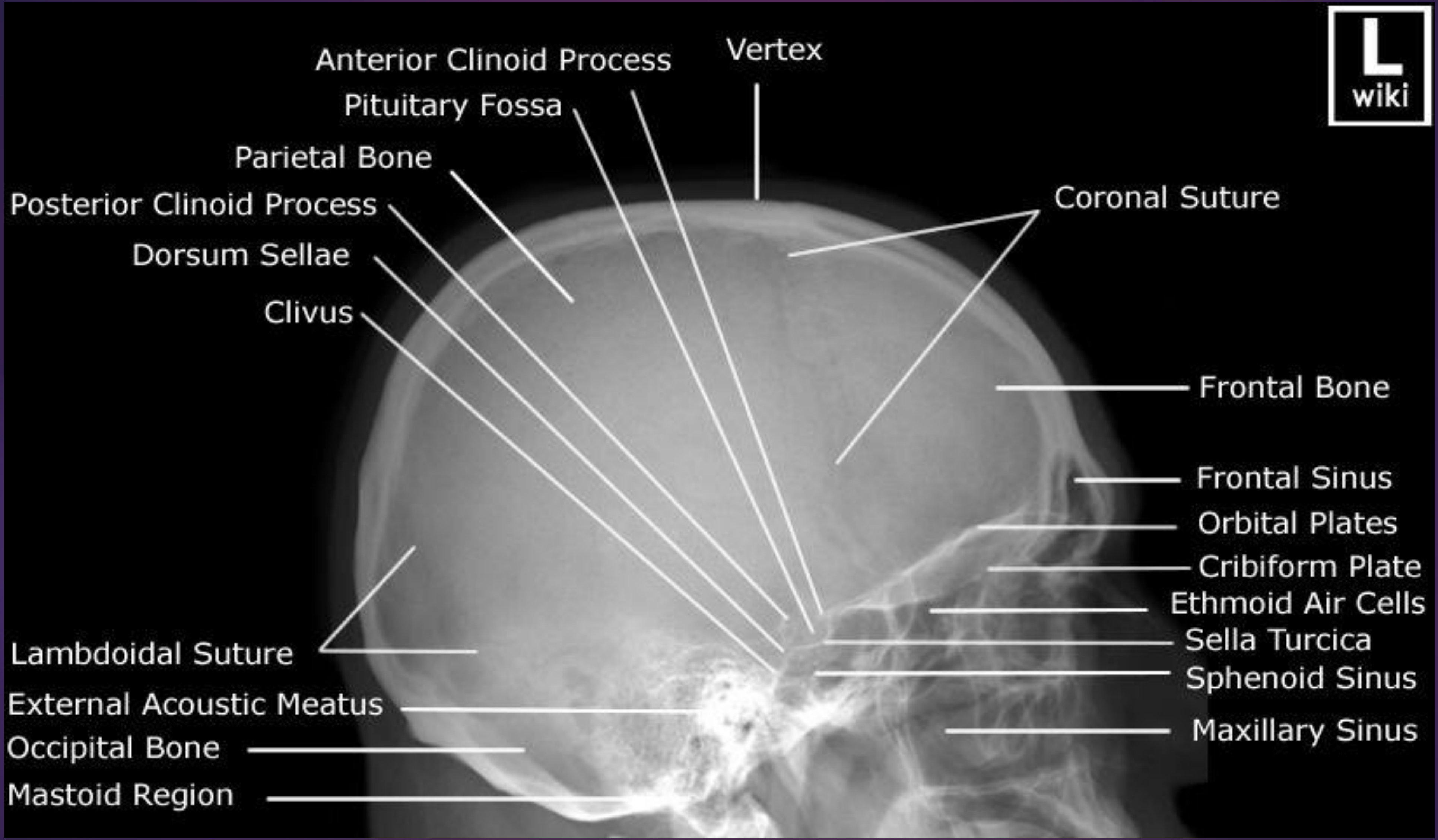
- AP or PA
- lateral
- Towne
- Caldwell
- Waters

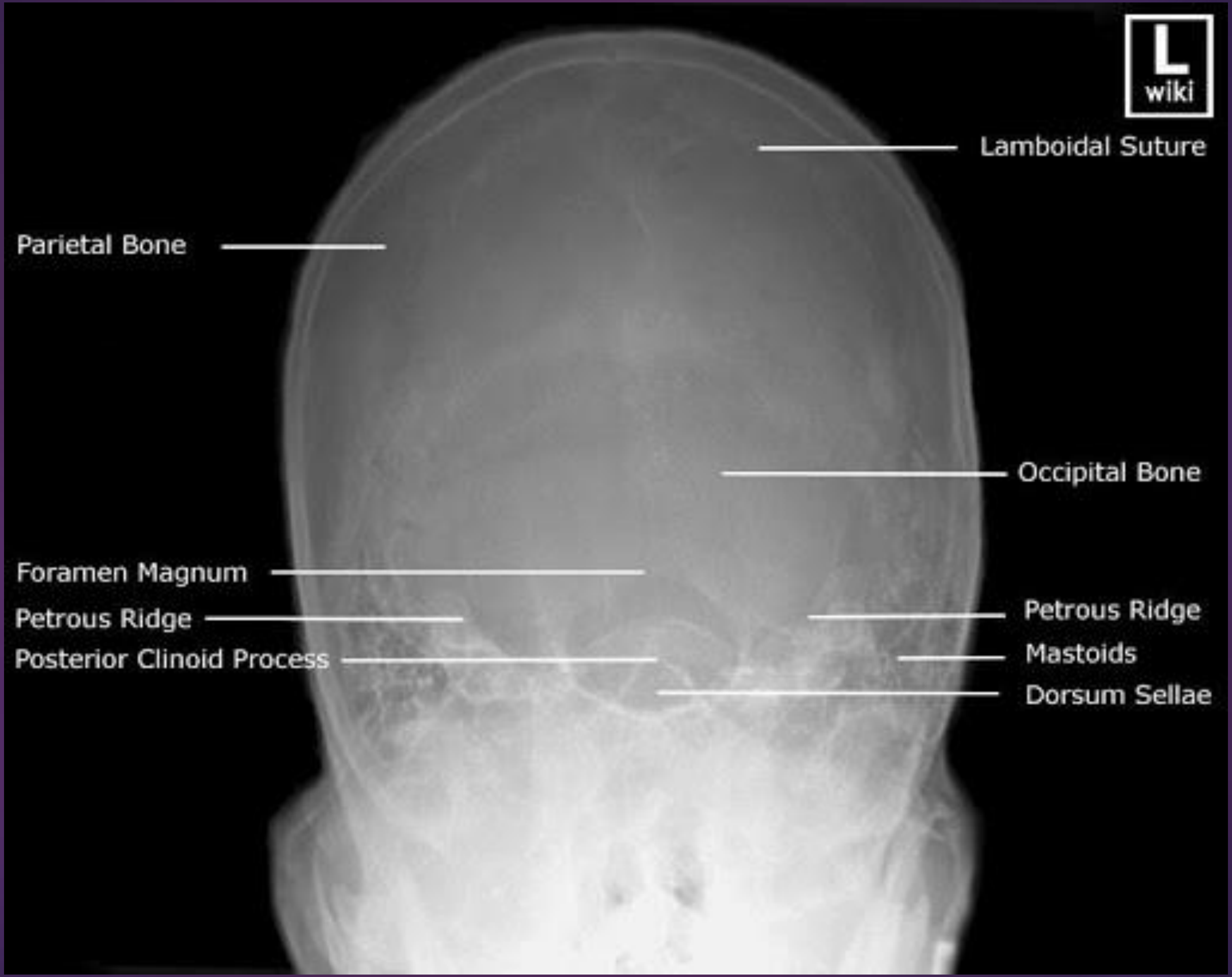
	LATERAL CEPH	SMV	WATERS	PA CEPH	REVERSE TOWNE
Patient placement	Film parallel to midsagittal plane	Canthomeatal line parallel to film	Canthomeatal line at 37° with film	Canthomeatal line at 10° with film	Canthomeatal line at –30° with film
Central beam	Beam perpendicular to film	Beam perpendicular to film	Beam perpendicular to film	Beam perpendicular to film	Beam perpendicular to film
Diagram of patient placement					
Illustration of patient placement					



L wiki
Sagittal Suture
Lambdoid Suture
Crista Galli
Supraorbital Margin
Petrous Ridge


L wiki
Sagittal Suture
Frontal Bone
Frontal Sinus
Crista Galli
Ethmoid Sinus
Superior Orbital Margin
Petrous Ridge
Inferior Orbital Margin


Anterior Clinoid Process
Vertex
Pituitary Fossa
Parietal Bone
Posterior Clinoid Process
Dorsum Sellae
Clivus
Coronal Suture
Frontal Bone
Frontal Sinus
Orbital Plates
Cribiform Plate
Ethmoid Air Cells
Sella Turcica
Sphenoid Sinus
Maxillary Sinus
Lambdoidal Suture
External Acoustic Meatus
Occipital Bone
Mastoid Region
L wiki



L wiki
Lamboidal Suture
Parietal Bone
Occipital Bone
Foramen Magnum
Petrous Ridge
Posterior Clinoid Process
Petrous Ridge
Mastoids
Dorsum Sellae

Head CT

- computed tomography examination of the brain and surrounding cranial structures.
- Indications:
- altered mental status in specific scenarios such as intracranial hemorrhage, mass, infection, or infarct or else
- cerebrovascular disease
- dementia, initial imaging
- head trauma
- acute head trauma, short-term follow-up imaging:
- pediatric abusive head trauma suspected due to the presence of neurologic signs or symptoms, apnea, complex skull fracture, other fractures, or other injuries highly suspicious for child abuse
- headache
- seizures
- **The administration of intravenous contrast media may improve the sensitivity for detecting brain neoplasms or infections.**

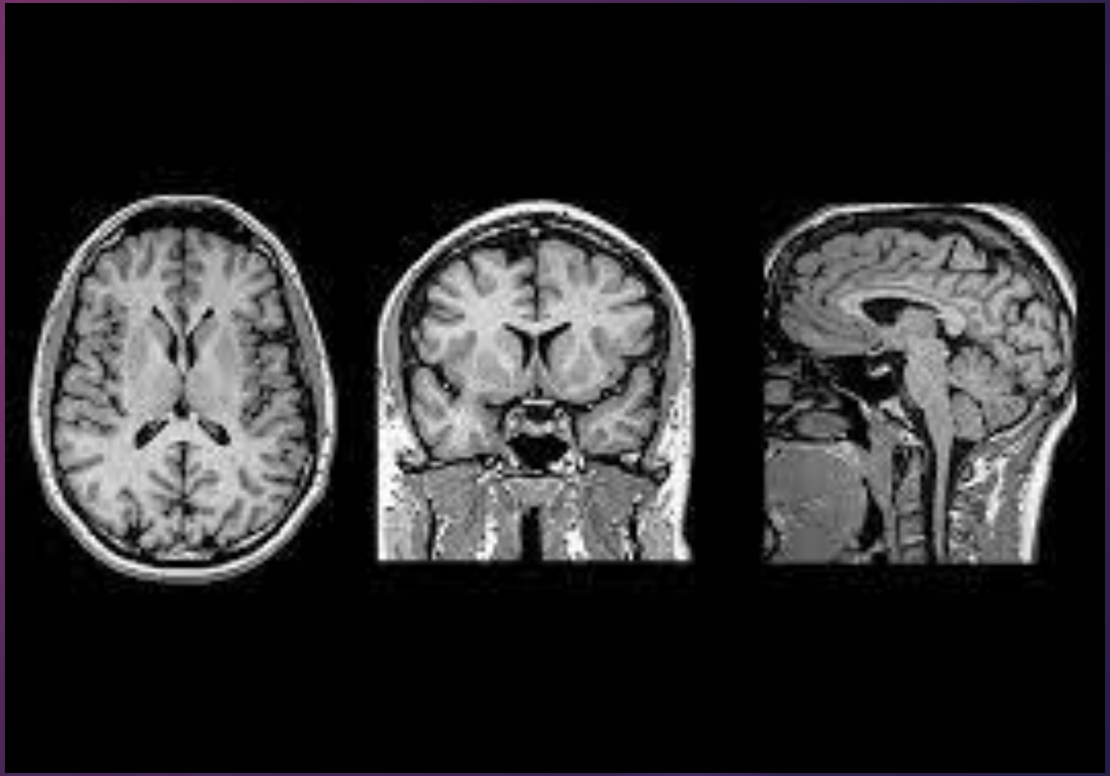
Head CT

MRI of the brain

- MRI brain is a specialist investigation that is used for the assessment of a number of neurological conditions. It is the main method to investigate conditions such as multiple sclerosis and headaches, and used to characterize strokes and space-occupying lesions.

Indications:

- confirmation of stroke
- assessment of intracranial tumor
- chronic headache
- seizure disorder



Appearance and Density of Tissues on Cranial CT

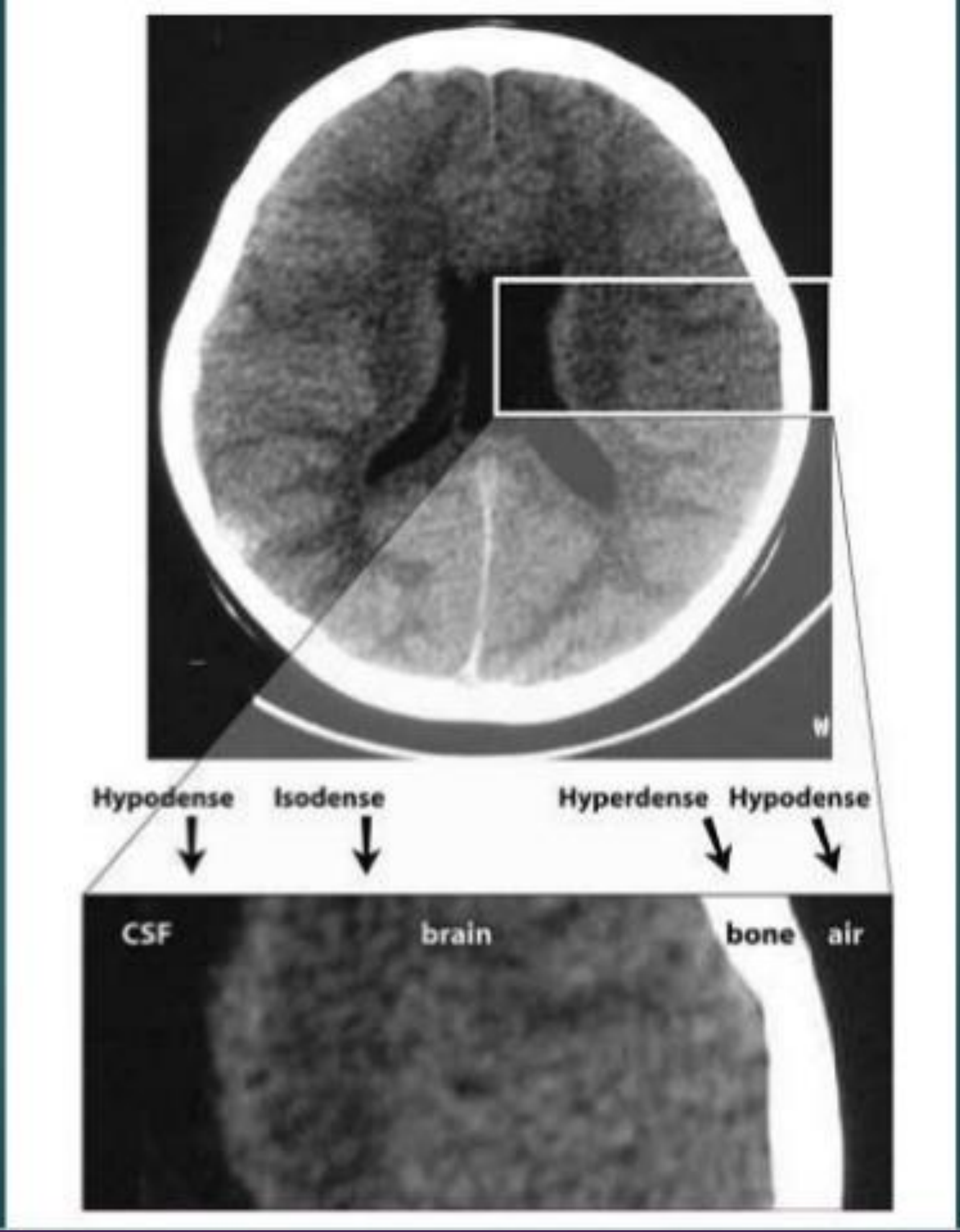
Appearance

- Black →→ →→ →→ →→ →→ White
- –1000 HU →→ →→ →→ →→ +1000 HU
- Air, fat, CSF, white matter, gray matter, acute hemorrhage, bone

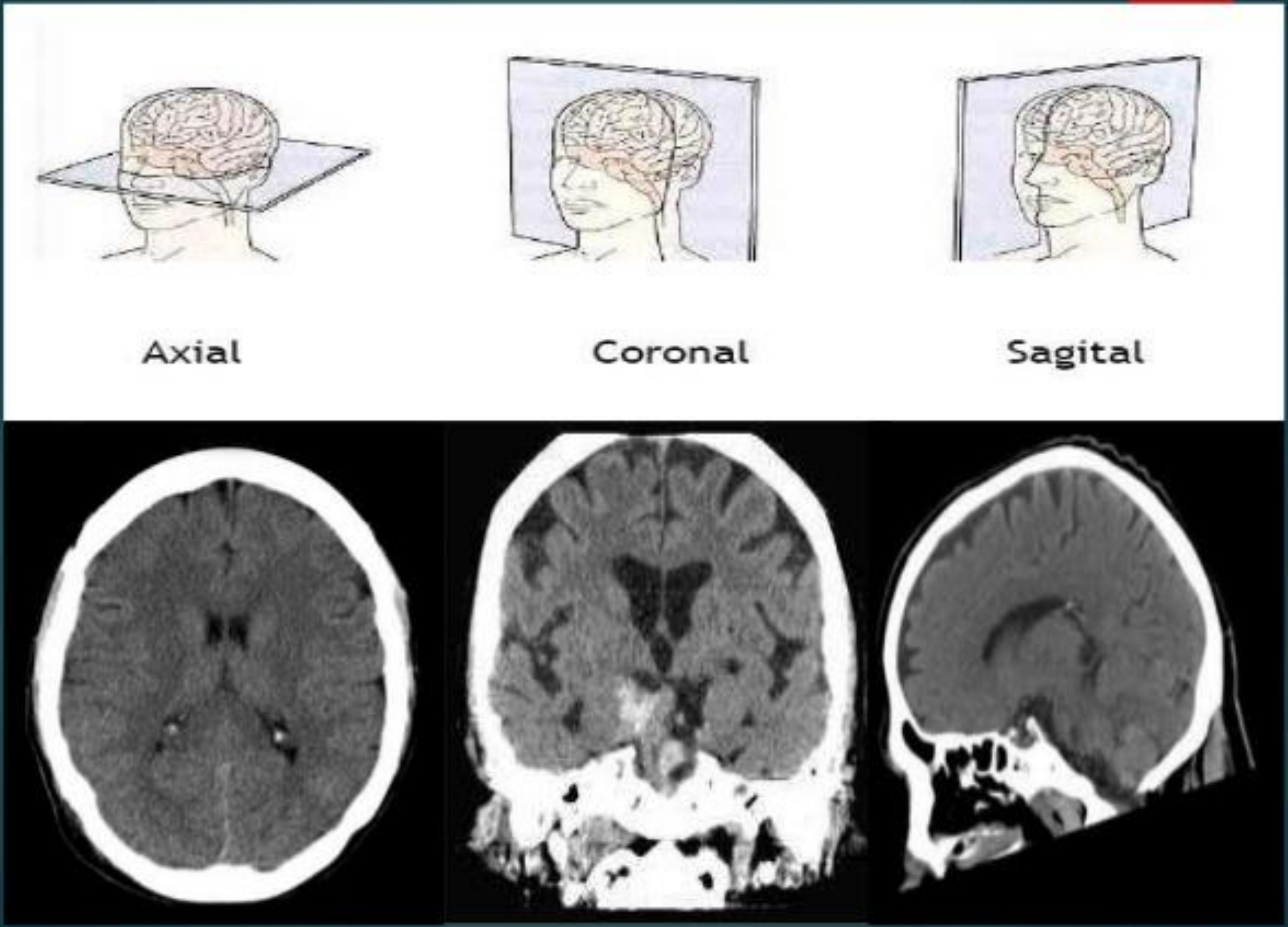
Important Densities

- Air = –1000 HU
- Water = 0 HU
- Bone = +1000 HU

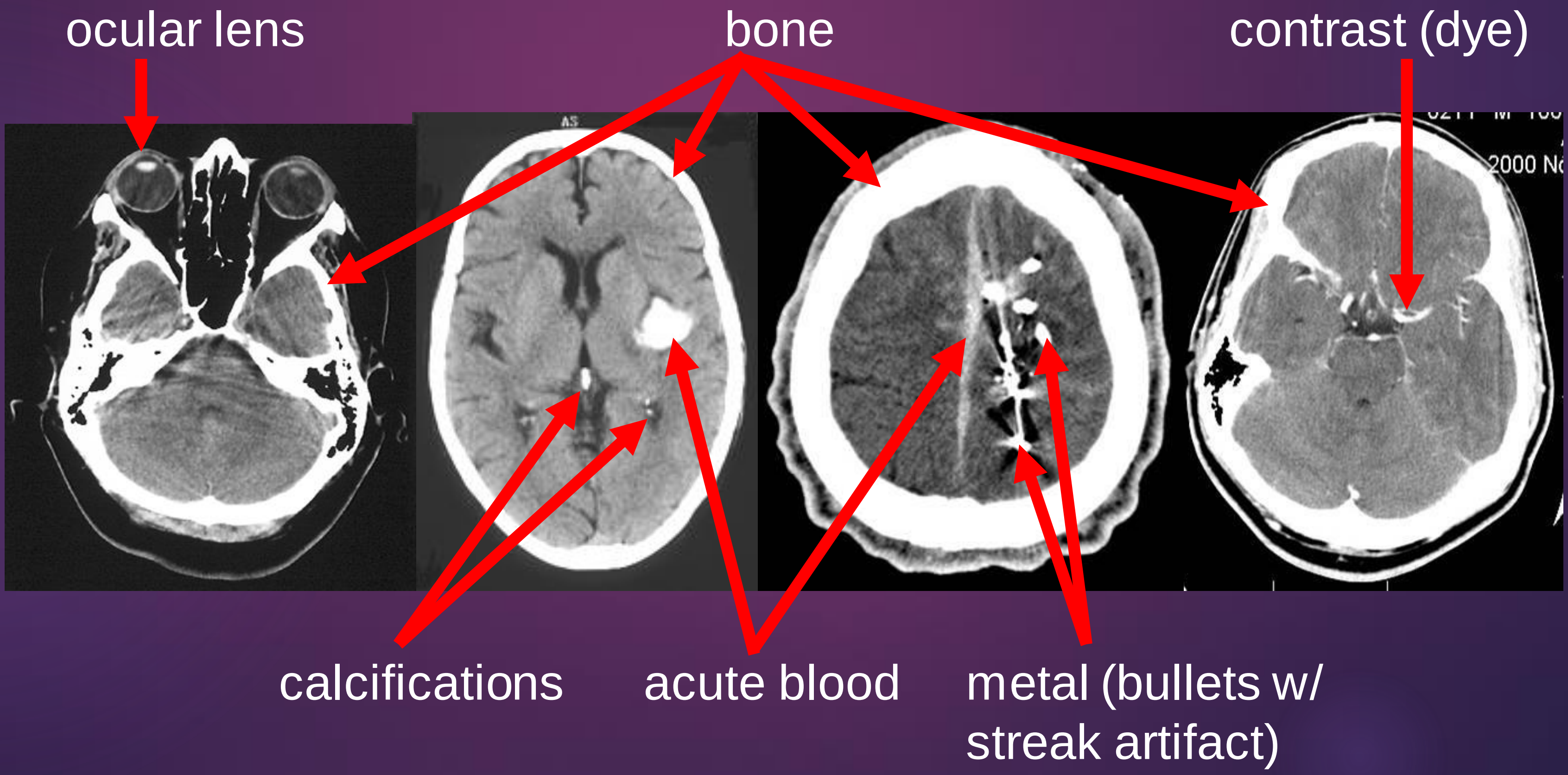
Structure/ Tissue	Hounsfield units
Air	-1000 to -600
Fat	-100 to -60
Water	0
CSF	+8 to 18
White matter	+30 to 41
Gray matter	+37 to 41
Acute blood	+50 to 100
Calcification	+140 to 200
Bone	+600 to 2000

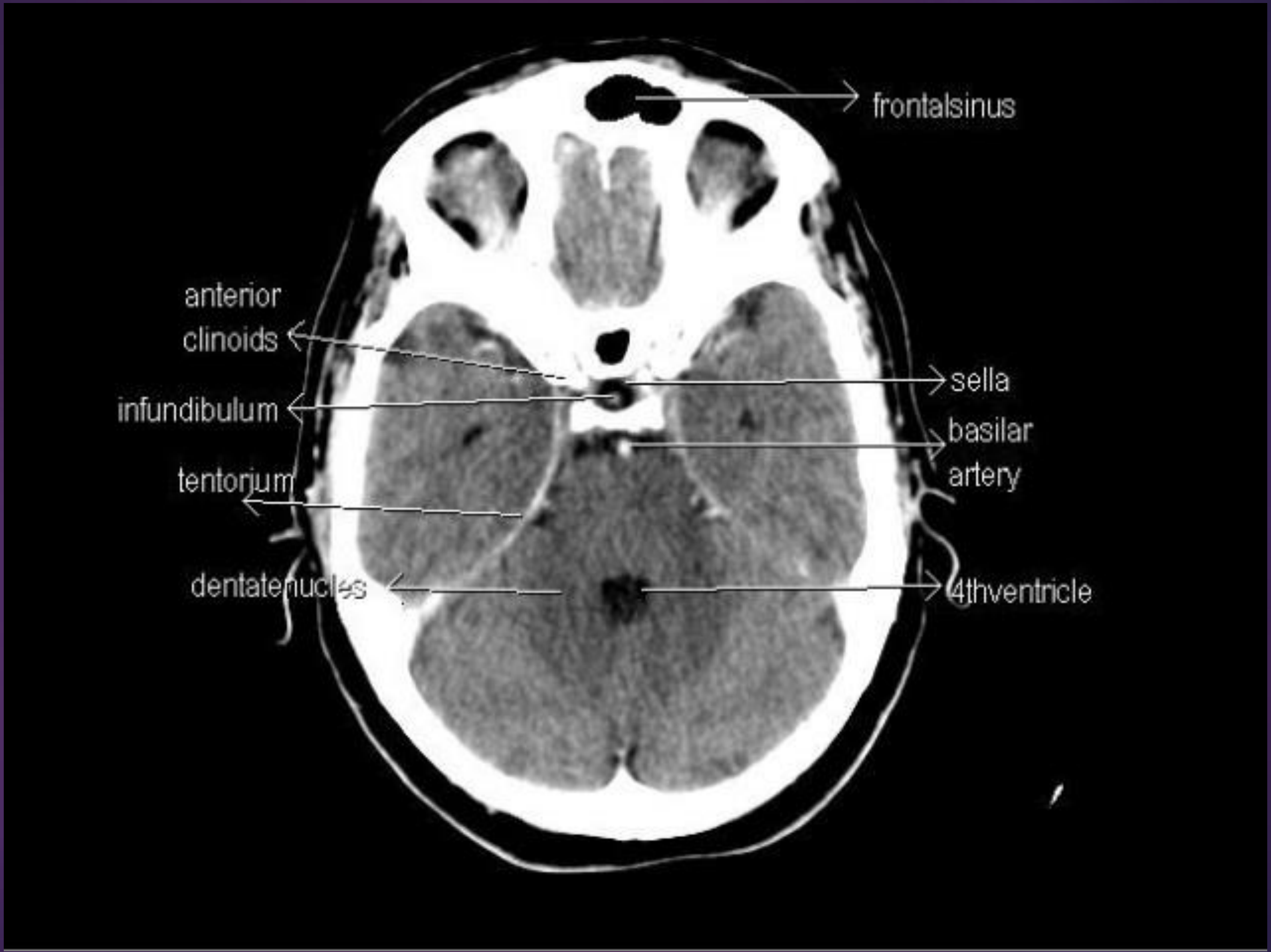

Hypodense
Isodense
Hyperdense
Hypodense
CSF
brain
bone
air

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

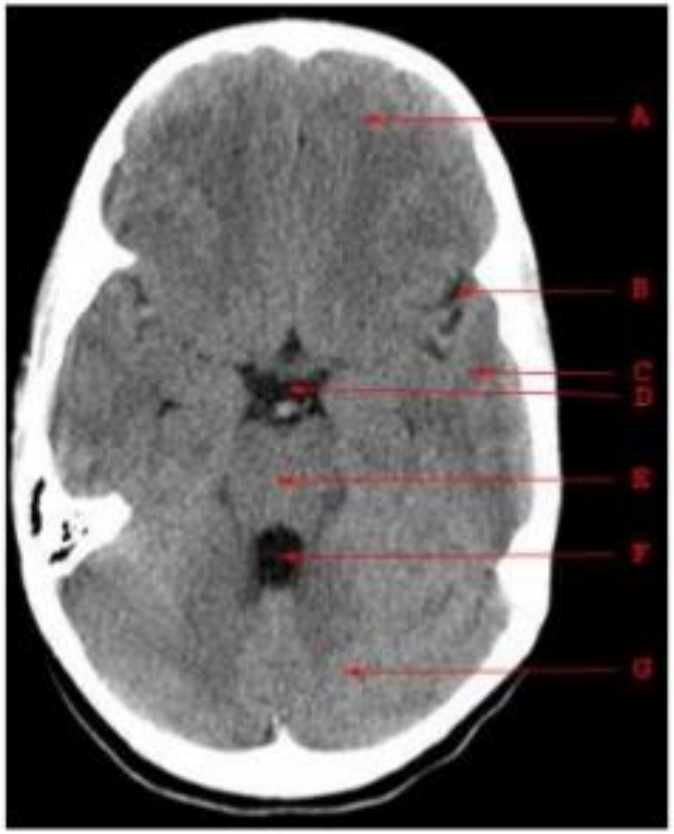

Axial
Coronal
Sagital

Hiperdense on CT

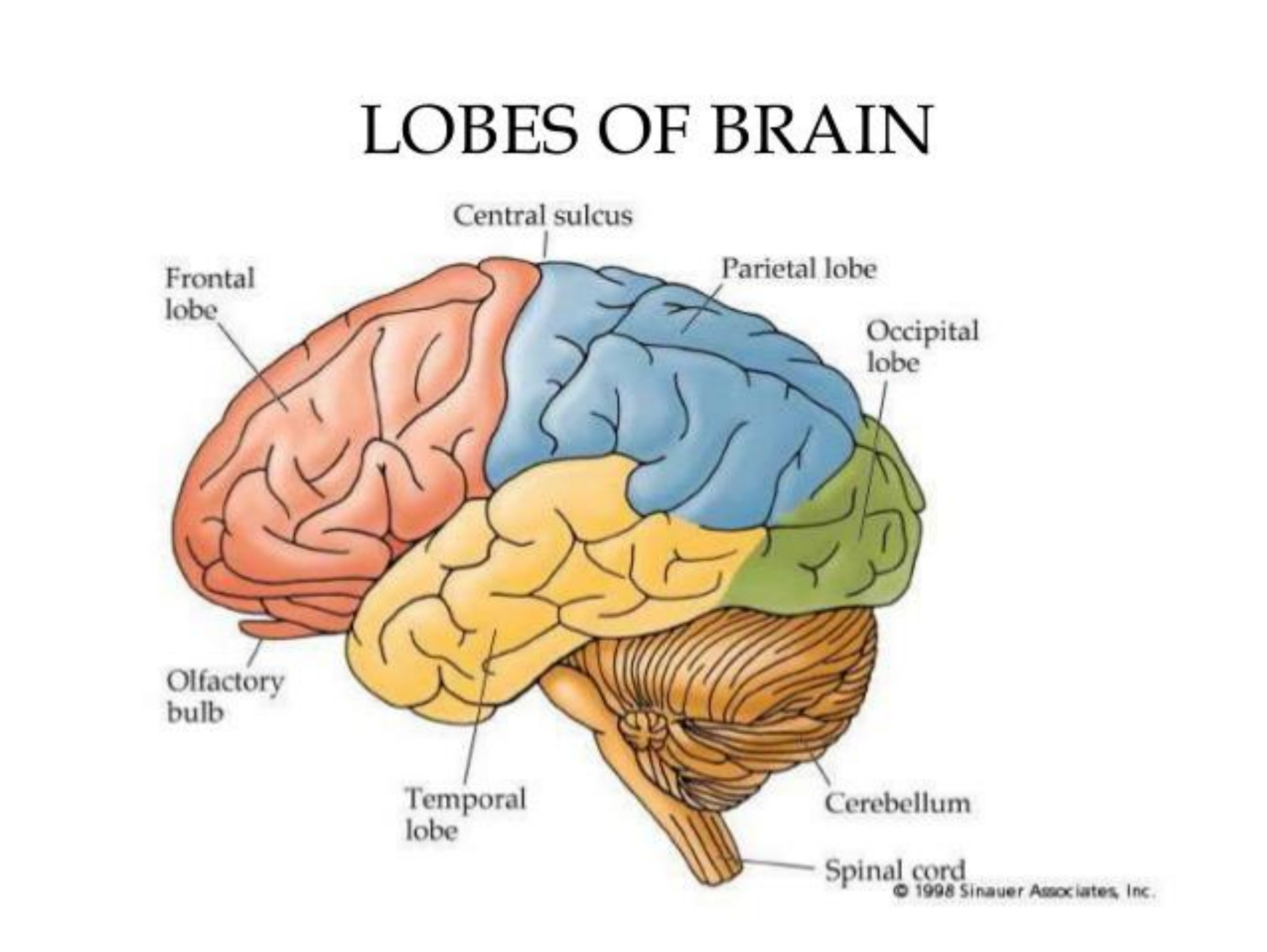



frontalsinus
anterior
clinoids
sella
infundibulum
basilar
artery
tentorium
dentatenucles
4thventricle

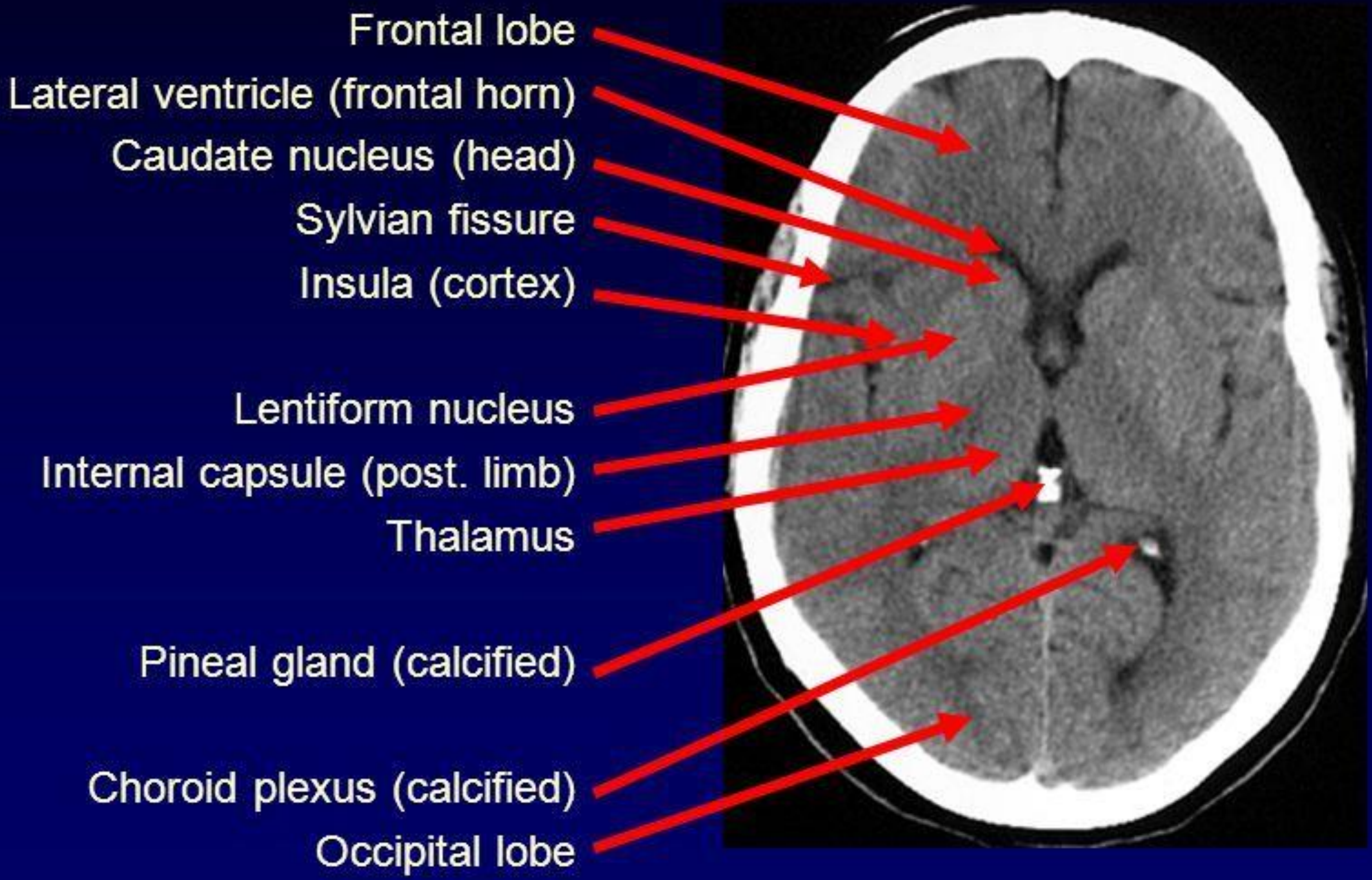
NORMAL ANATOMY…….

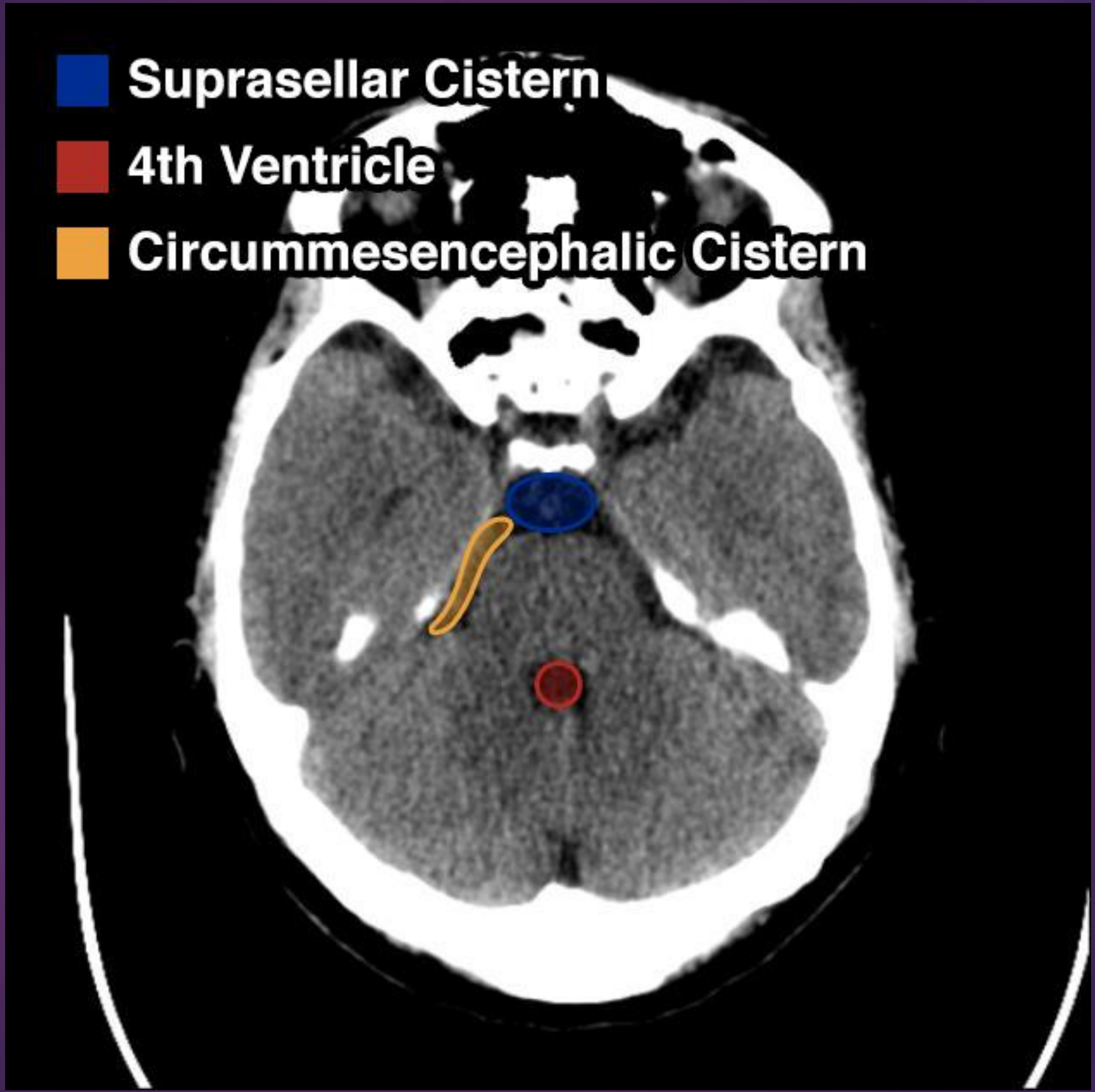


A=FRONTAL LOBE B= SYLVIAN FISSURE C=TEMPORAL LOBE
D=SUPRASELLAR CISTERN E=MIDBRAIN F=FOURTH VENTRICLE
G= CEREBELLAR HEMISPHERE

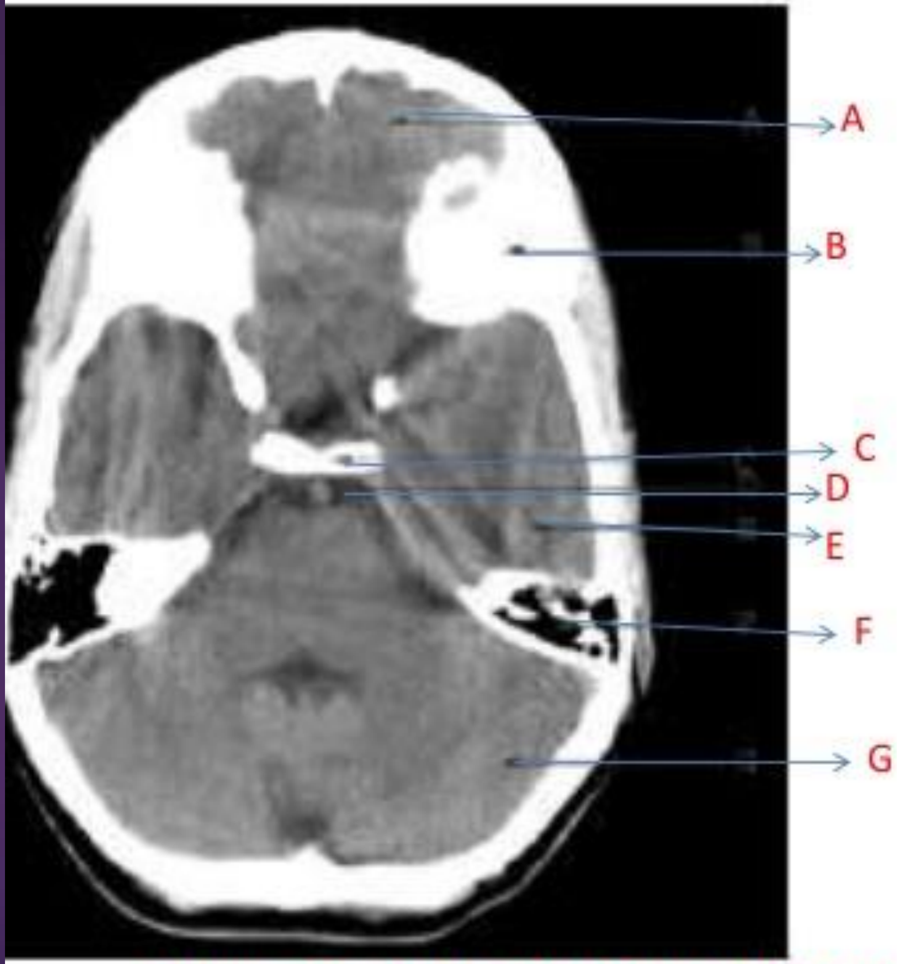

LOBES OF BRAIN
Central sulcus
Frontal lobe
Parietal lobe
Occipital lobe
Olfactory bulb
Temporal lobe
Cerebellum
Spinal cord
© 1998 Sinauer Associates, Inc.

Normal Brain Anatomy




Suprasellar Cistern
4th Ventricle
Circummesencephalic Cistern

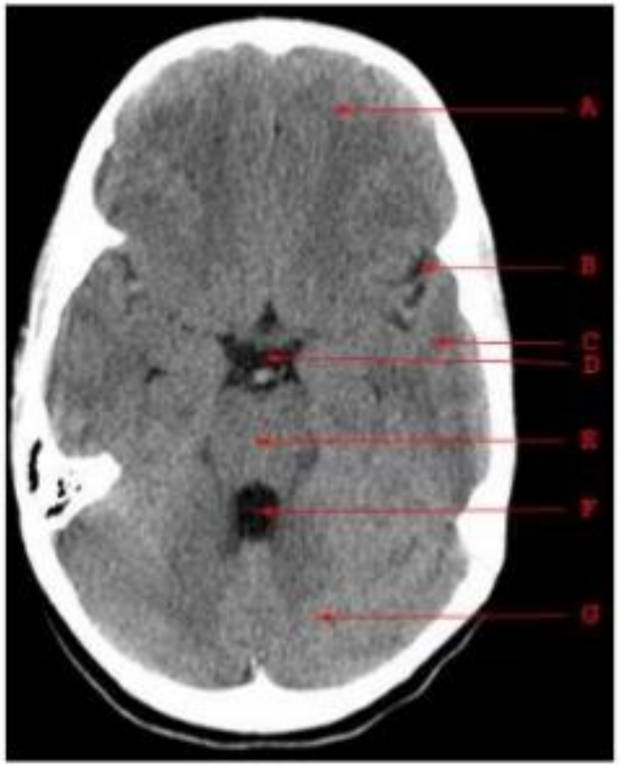
CT ANATOMY OF BRAIN



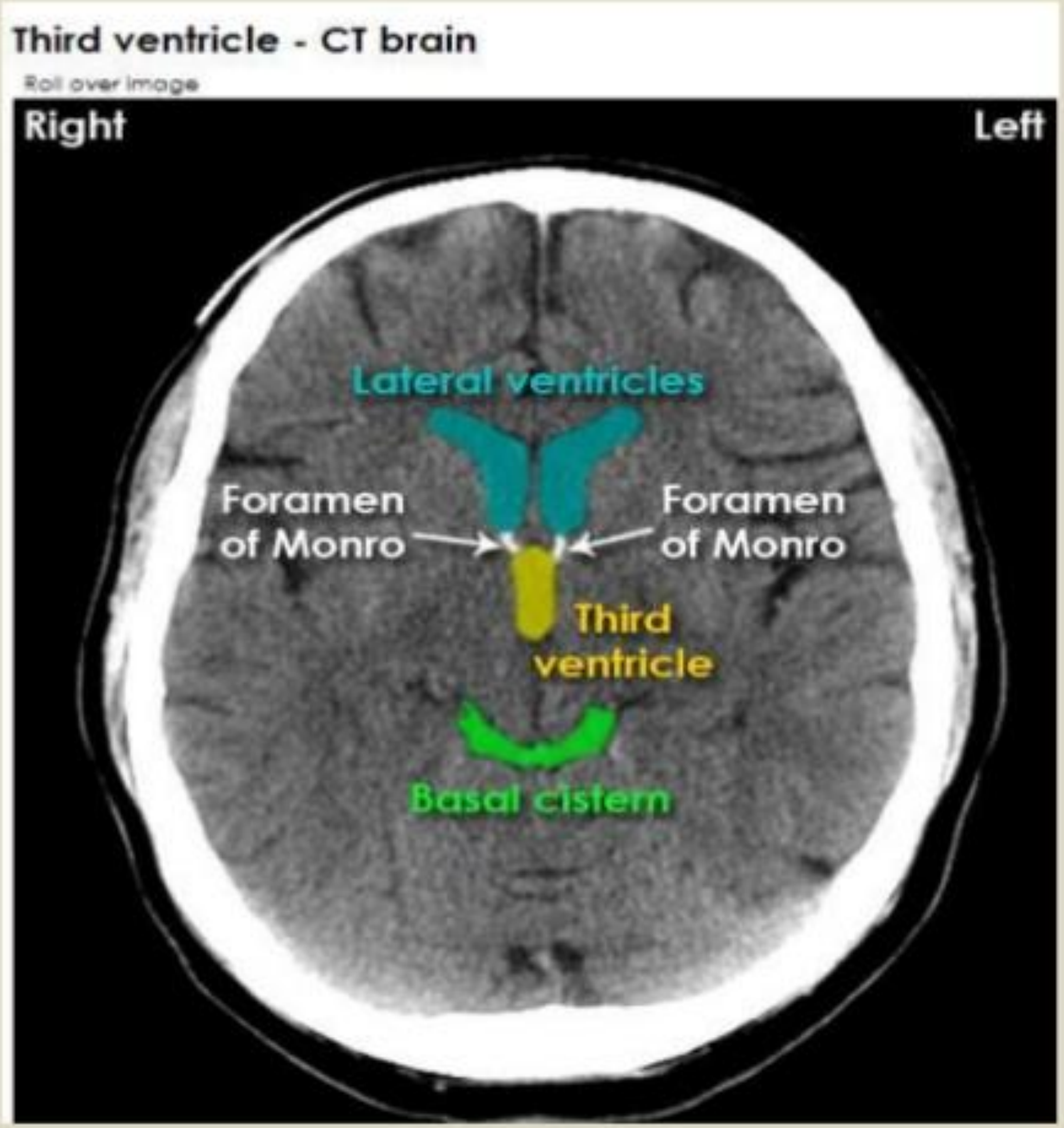
A – frontal lobe
B – orbital roof
C – dorsum sellae
D – basilar artery
E – temporal lobe
F – mastoid air cells
G - cerebellum

ABOVE THE LEVEL OF FORAMEN MAGNUM

NORMAL ANATOMY…….



A=FRONTAL LOBE B= SYLVIAN FISSURE C=TEMPORAL LOBE
D=SUPRASELLAR CISTERN E=MIDBRAIN F=FOURTH VENTRICLE
G= CEREBELLAR HEMISPHERE

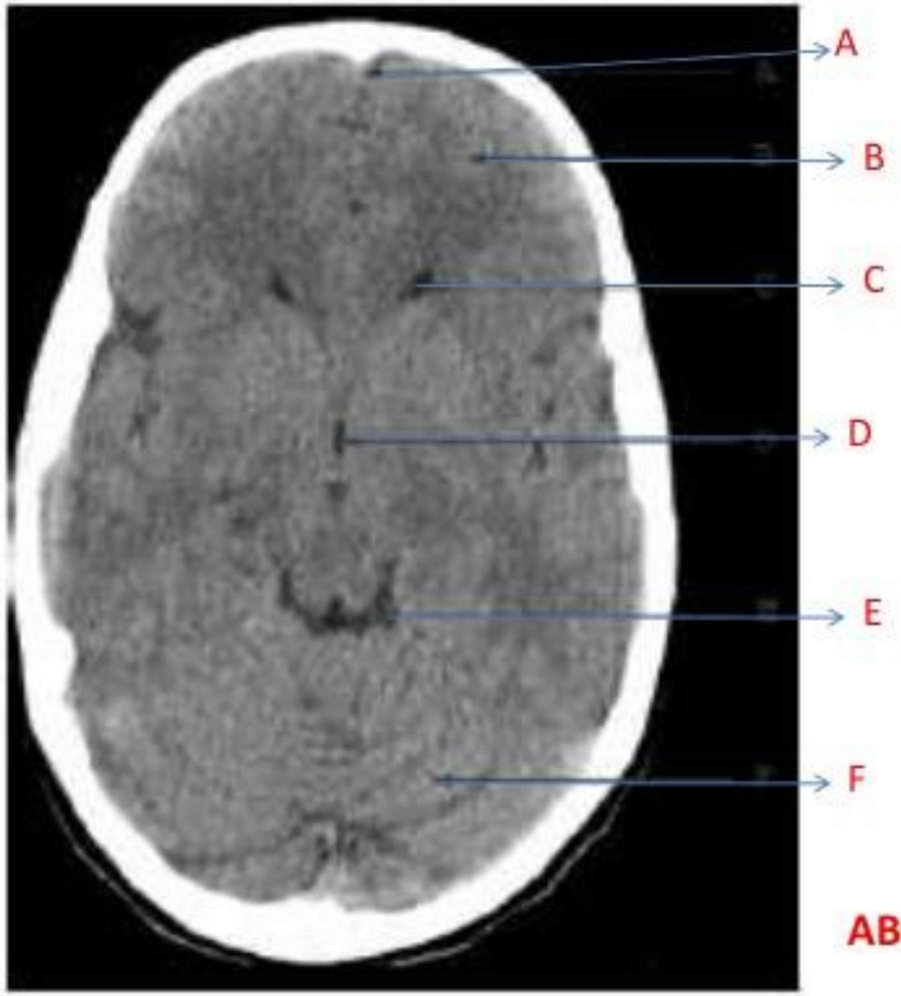


Third ventricle

The third ventricle is located centrally

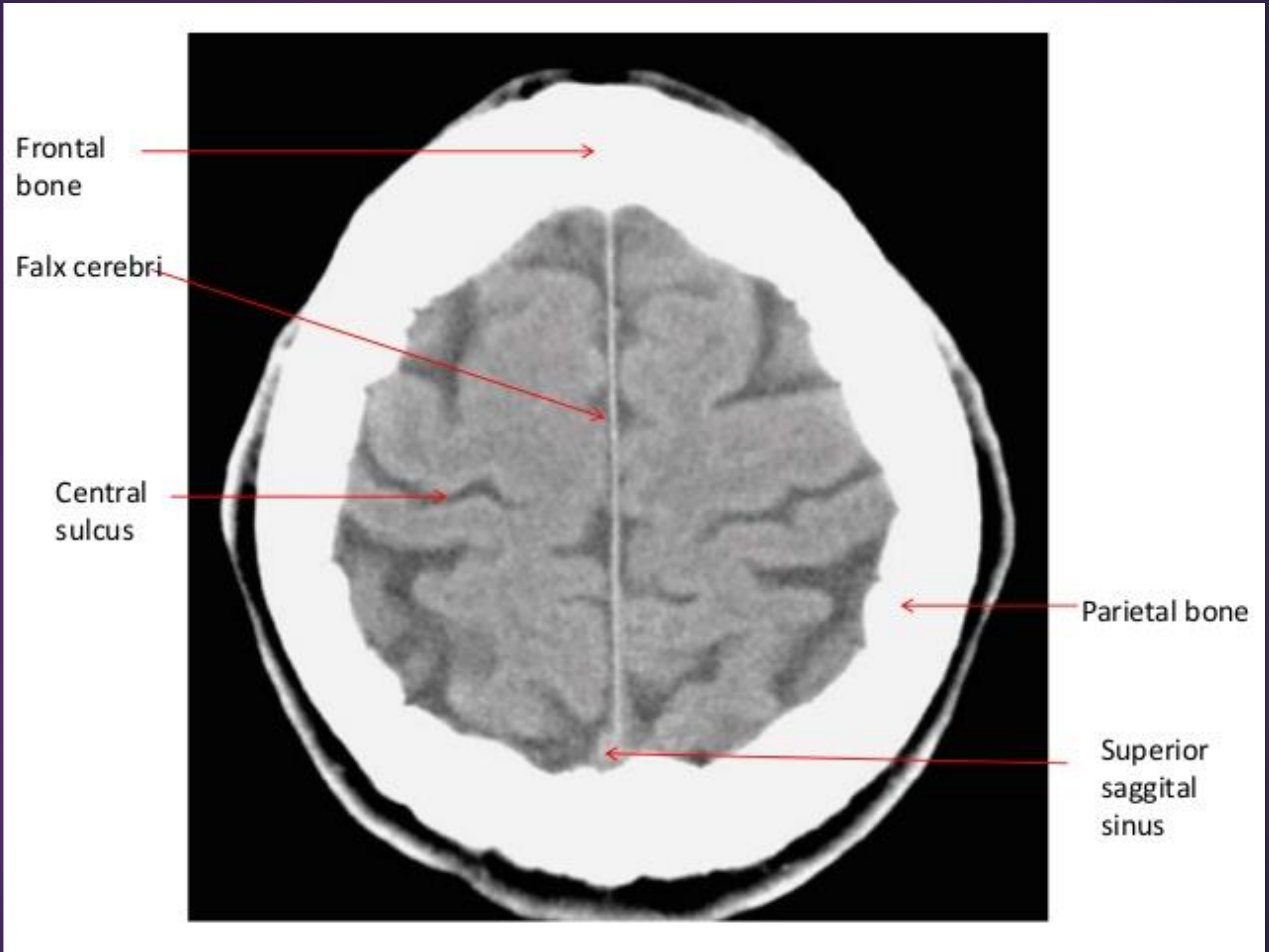
The lateral ventricles communicate with the third ventricle via small holes (foramina of Monro).

CT ANATOMY OF BRAIN



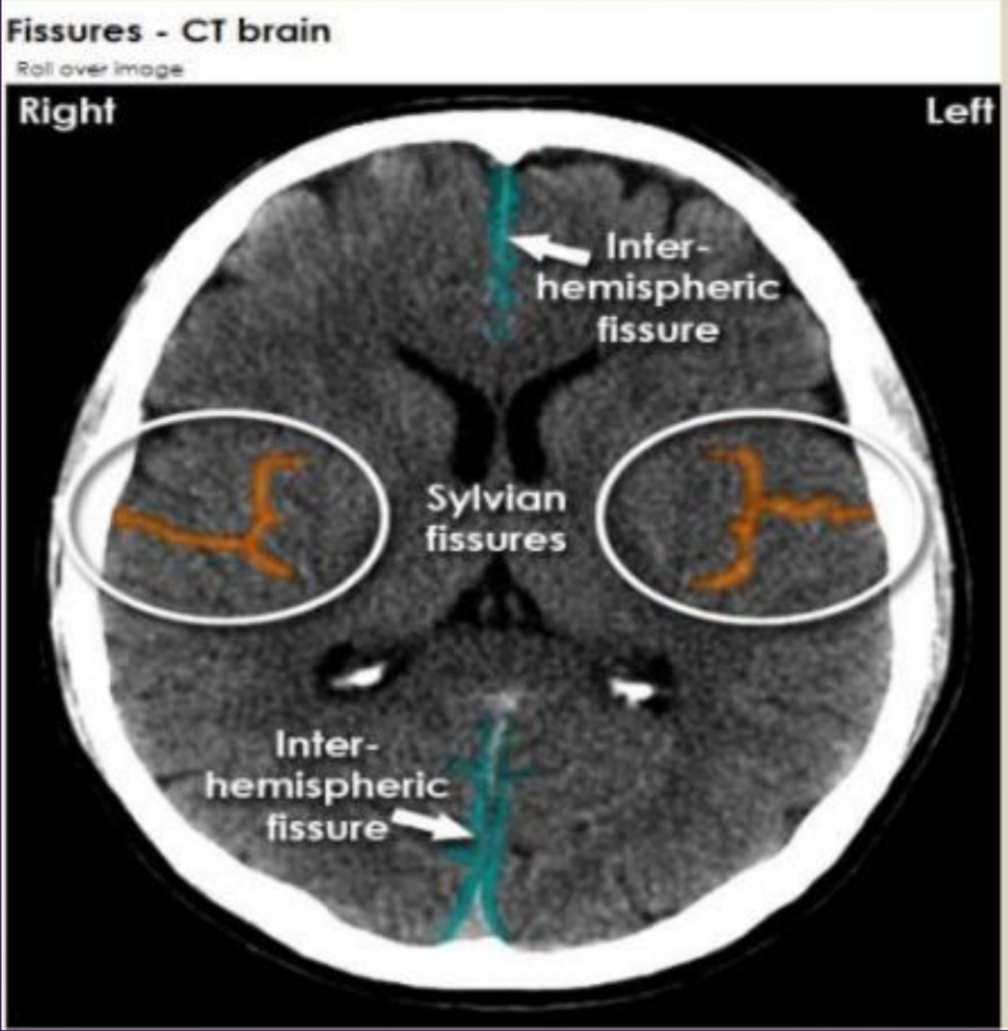
A – falx cerebri
B – frontal lobe
C – anterior horn lateral ventricle
D – aqueduct of Sylvius
E – quadrigeminal cistern
F - cerebellum

ABOVE THE LEVEL OF FOURTH VENTRICL


Frontal bone
Falx cerebri
Central sulcus
Parietal bone
Superior saggital sinus

Fissures.

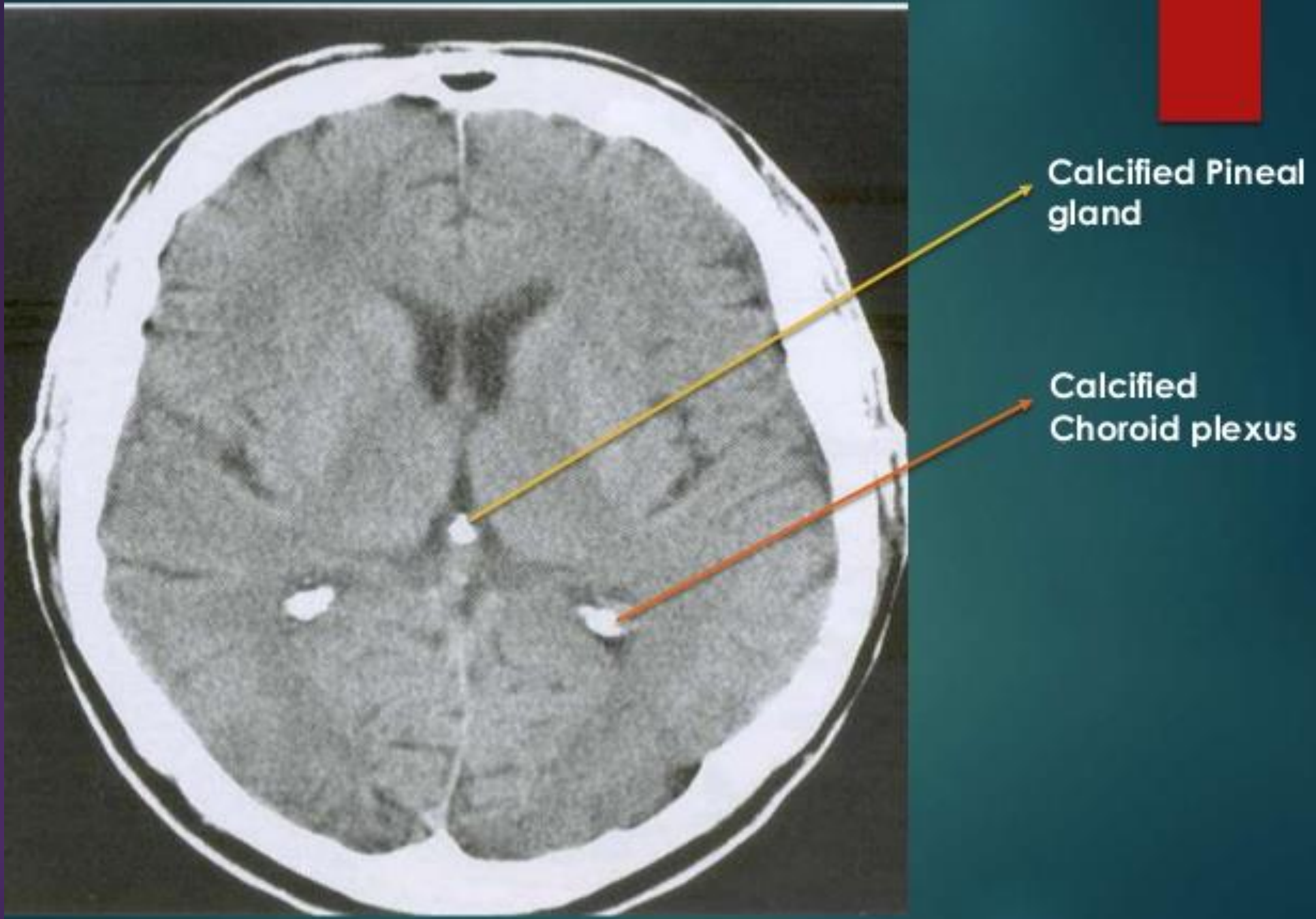
The fissures are large CSF-filled clefts which separate structures of the brain.



Fissures.

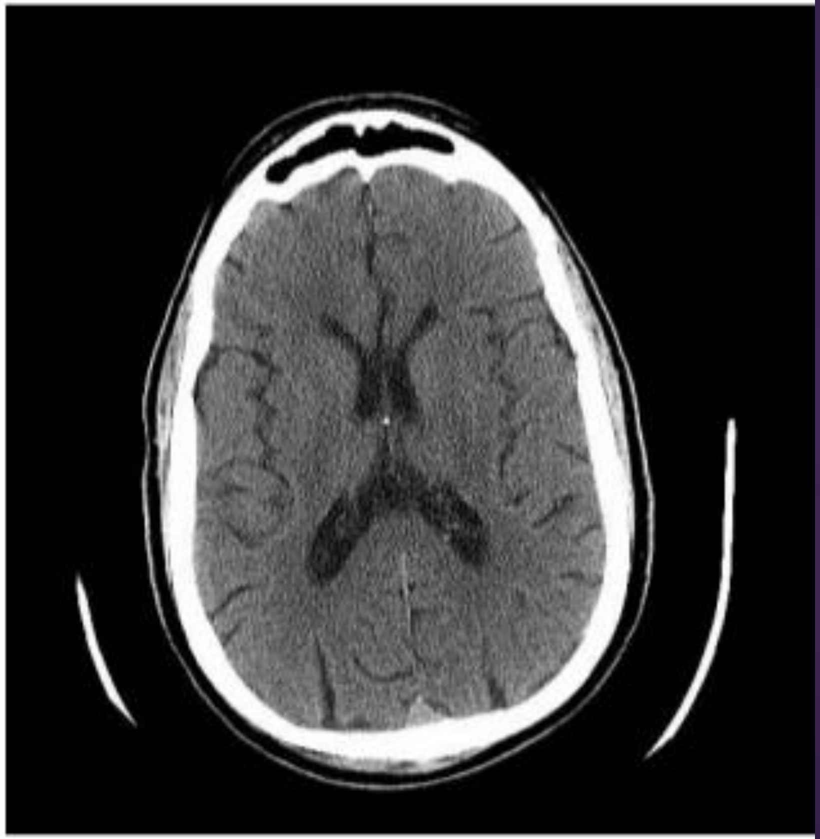
The interhemispheric fissure separates the cerebral hemispheres - the two halves of the brain

The Sylvian fissures separate the frontal and temporal lobes.


Calcified Pineal gland
Calcified Choroid plexus

Normal CT of Brain

- Ventricles are normal sized, the grey versus white distinction is clear.
- Midline is straight.
- Sulci are symmetrical on bothsides.
- Skull is intact with no scalp edema.



MRI of the brain

benefits

- multiplanar assessment of the brain
- exceptionally detailed images of the brain
- different sequences allow assessment of different pathology
- no ionizing radiation (especially important in children)

- limitations
- much longer investigation (20-40 minutes)
- less available (longer waiting list)
- patients may be claustrophobic
- contraindicated in patients with some metallic implants
- most pacemakers are not MRI-compatible

procedure

- patient positioned on the MRI couch
- head coil positioned over their head
- patient moved into the center of the magnet
- sequences acquired

MRI sequences

- Unlike CT where we describe "density", images are described by signal intensity ("hyper-" bright, "hypo-" dark).

T1

- provides the most anatomically-relevant images
- fluid (in CSF and orbits) is dark
- grey matter is darker than the white matter

T2

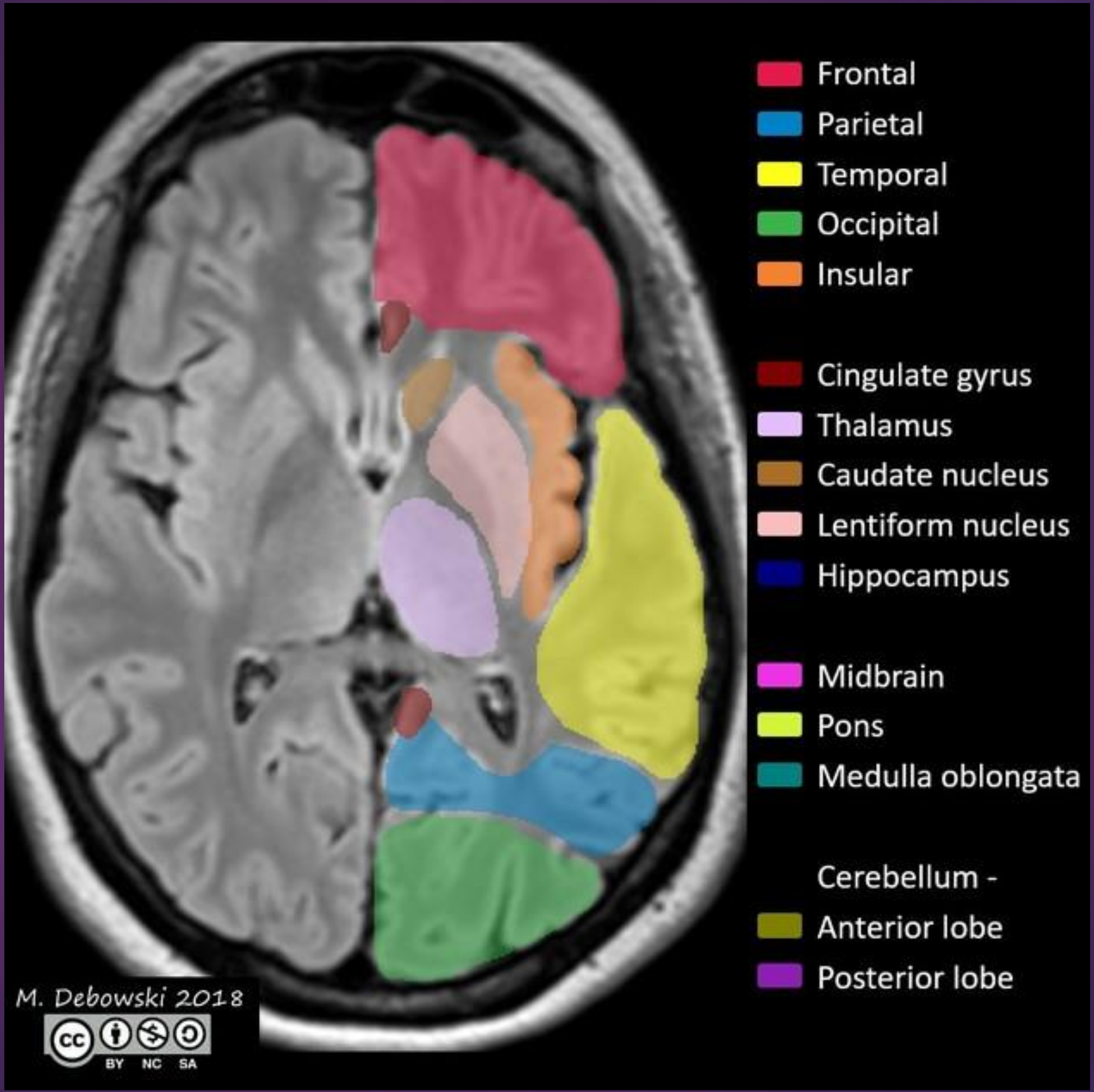
- standard sequence
- fluid is bright
- white matter is darker than grey

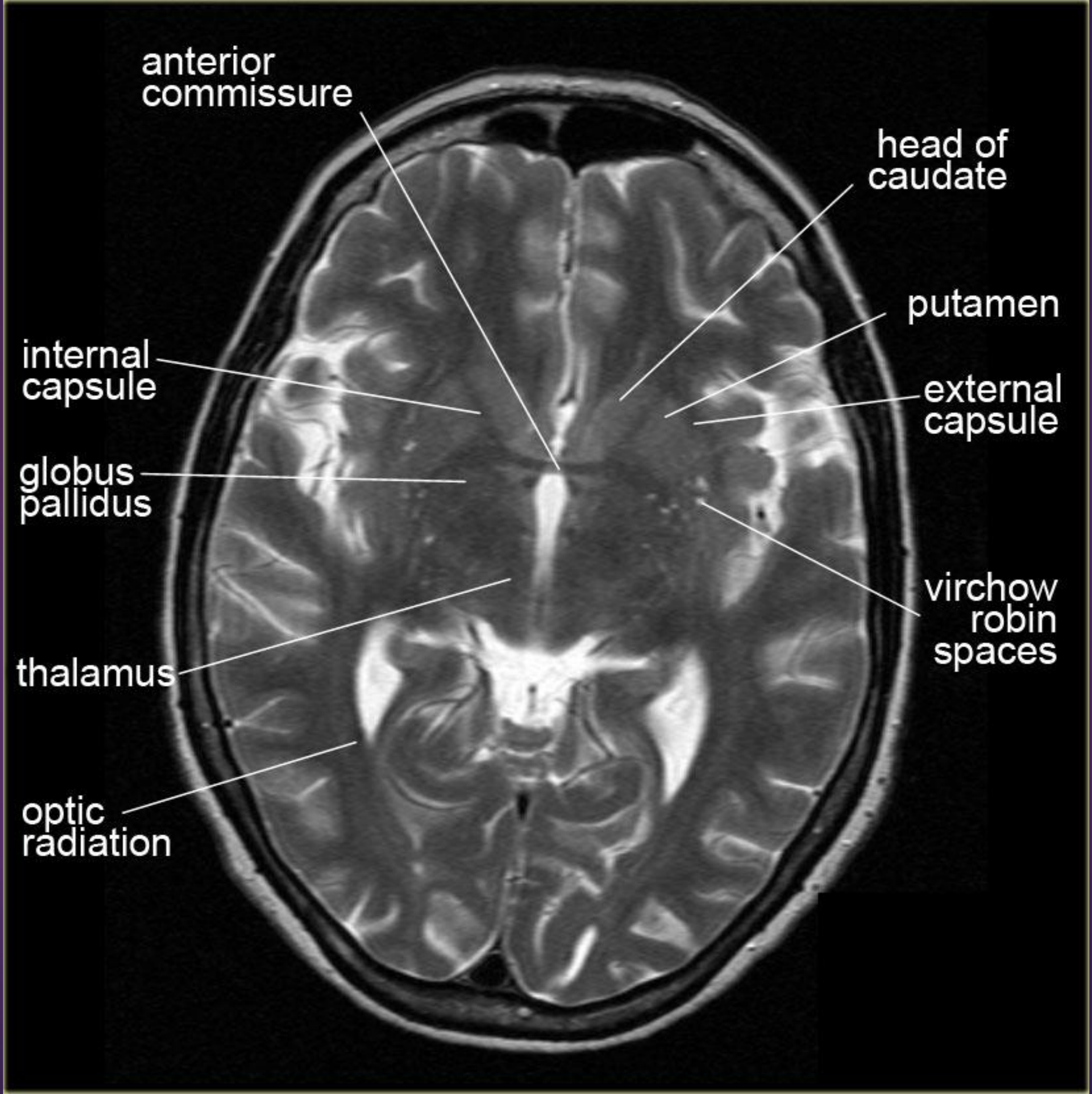
FLAIR (fluid attenuation inversion recovery)

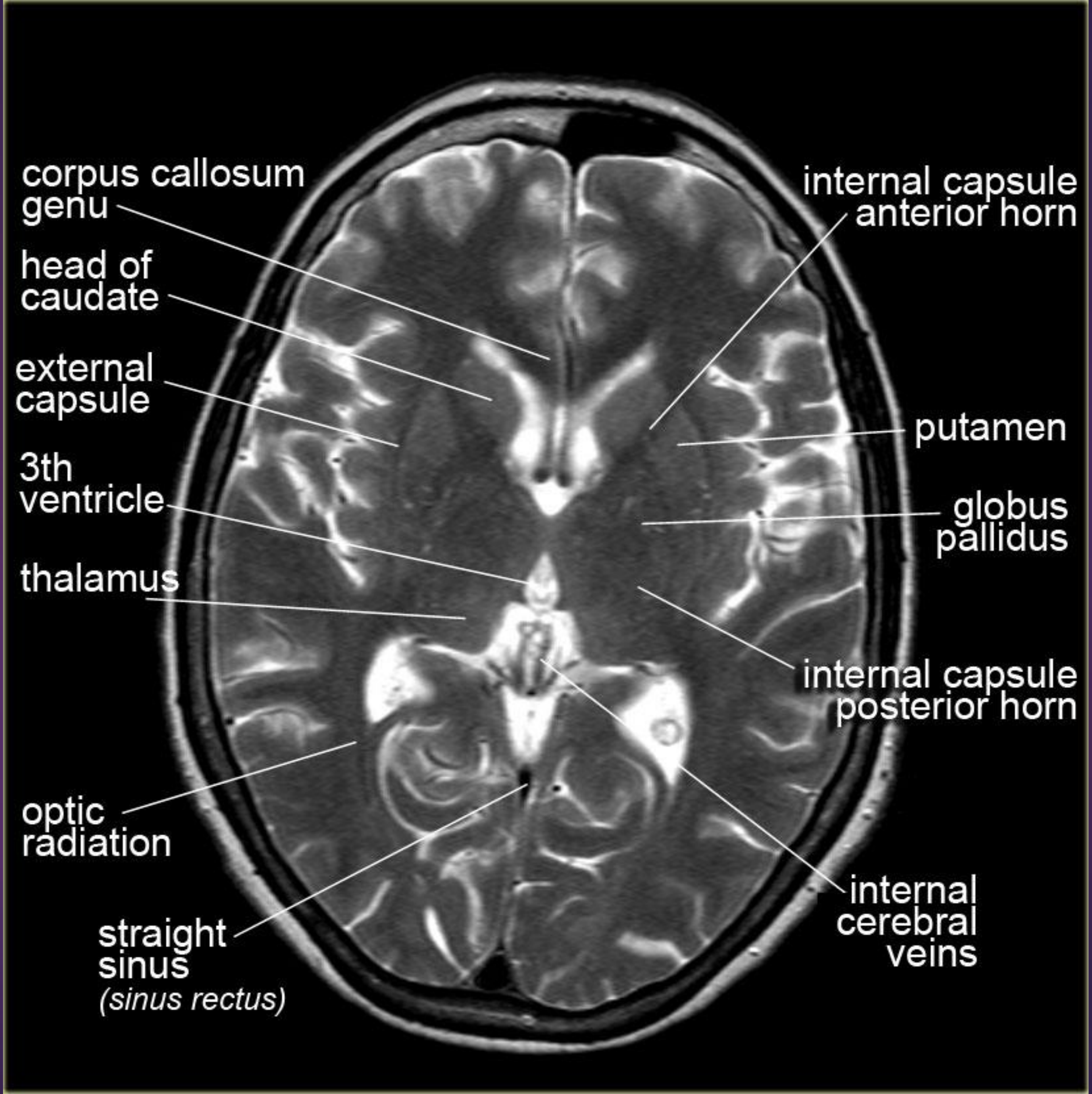
- commonly used sequence
- similar to T2, but the fluid is darker or "suppressed"
- useful for areas of edema or inflammation
- used to identify plaques in multiple sclerosis (especially periventricular)

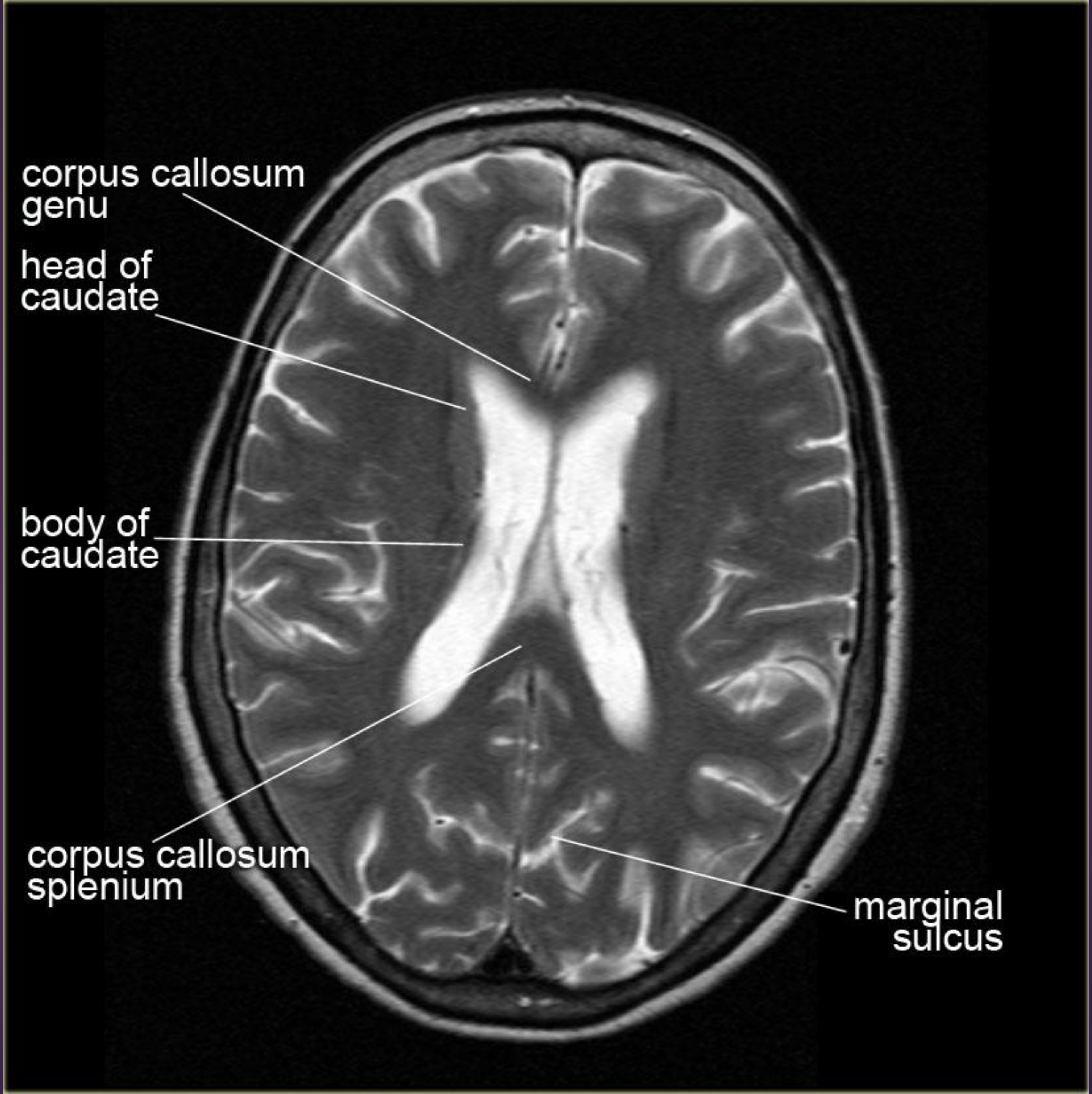
DWI and ADC (diffusion-weighted imaging and apparent diffusion coefficient)

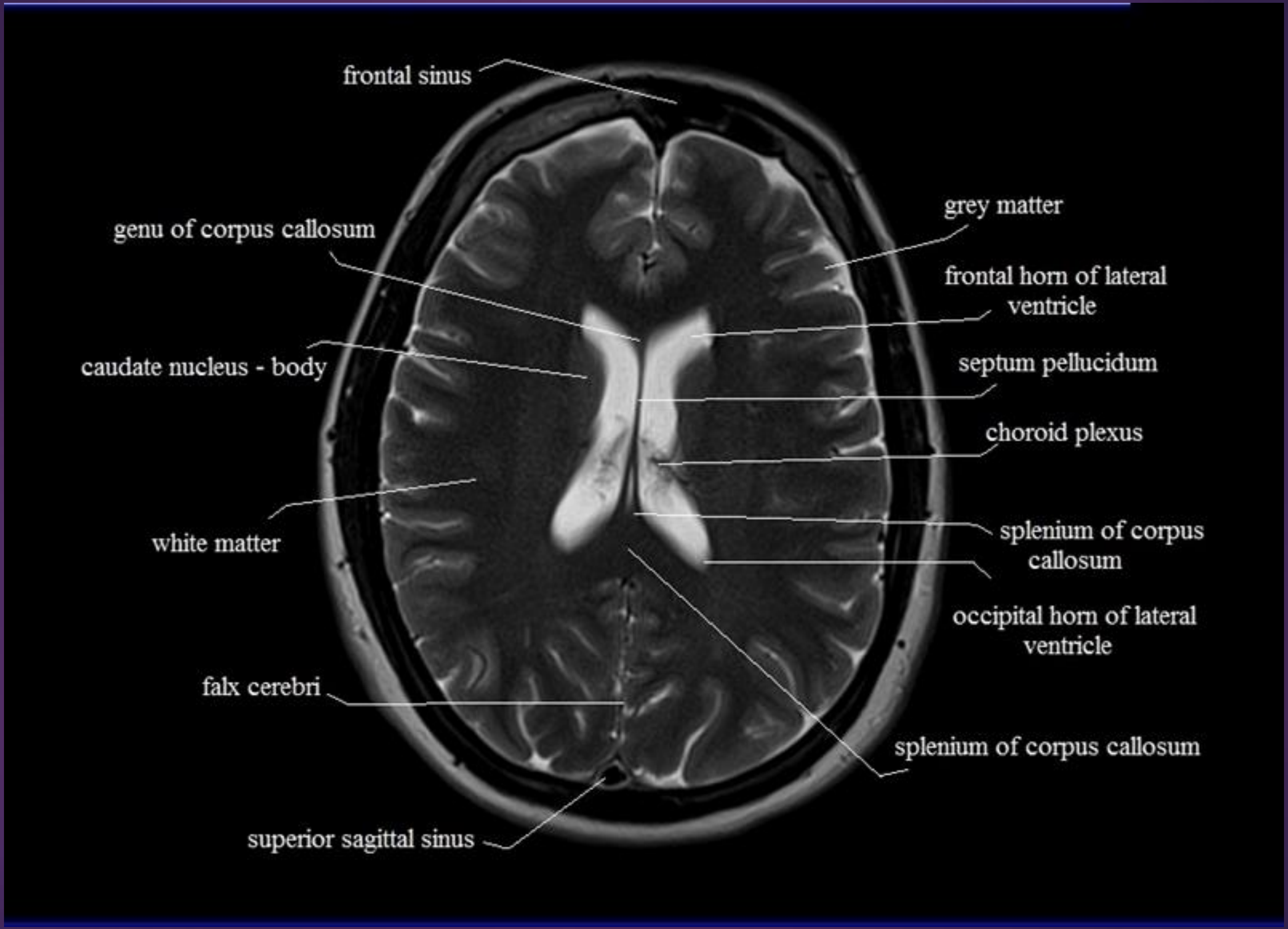
- these "blocky" images show how easily water moves around
- restricted diffusion occurs in stroke, abscesses and cellular tumors


Frontal
Parietal
Temporal
Occipital
Insular
Cingulate gyrus
Thalamus
Caudate nucleus
Lentiform nucleus
Hippocampus
Midbrain
Pons
Medulla oblongata
Cerebellum -
Anterior lobe
Posterior lobe
M. Debowski 2018
BY NC SA


anterior commissure
head of caudate
putamen
internal capsule
external capsule
globus pallidus
virchow robin spaces
thalamus
optic radiation


corpus callosum genu
head of caudate
external capsule
3th ventricle
thalamus
optic radiation
straight sinus
(sinus rectus)
internal capsule anterior horn
putamen
globus pallidus
internal capsule posterior horn
internal cerebral veins

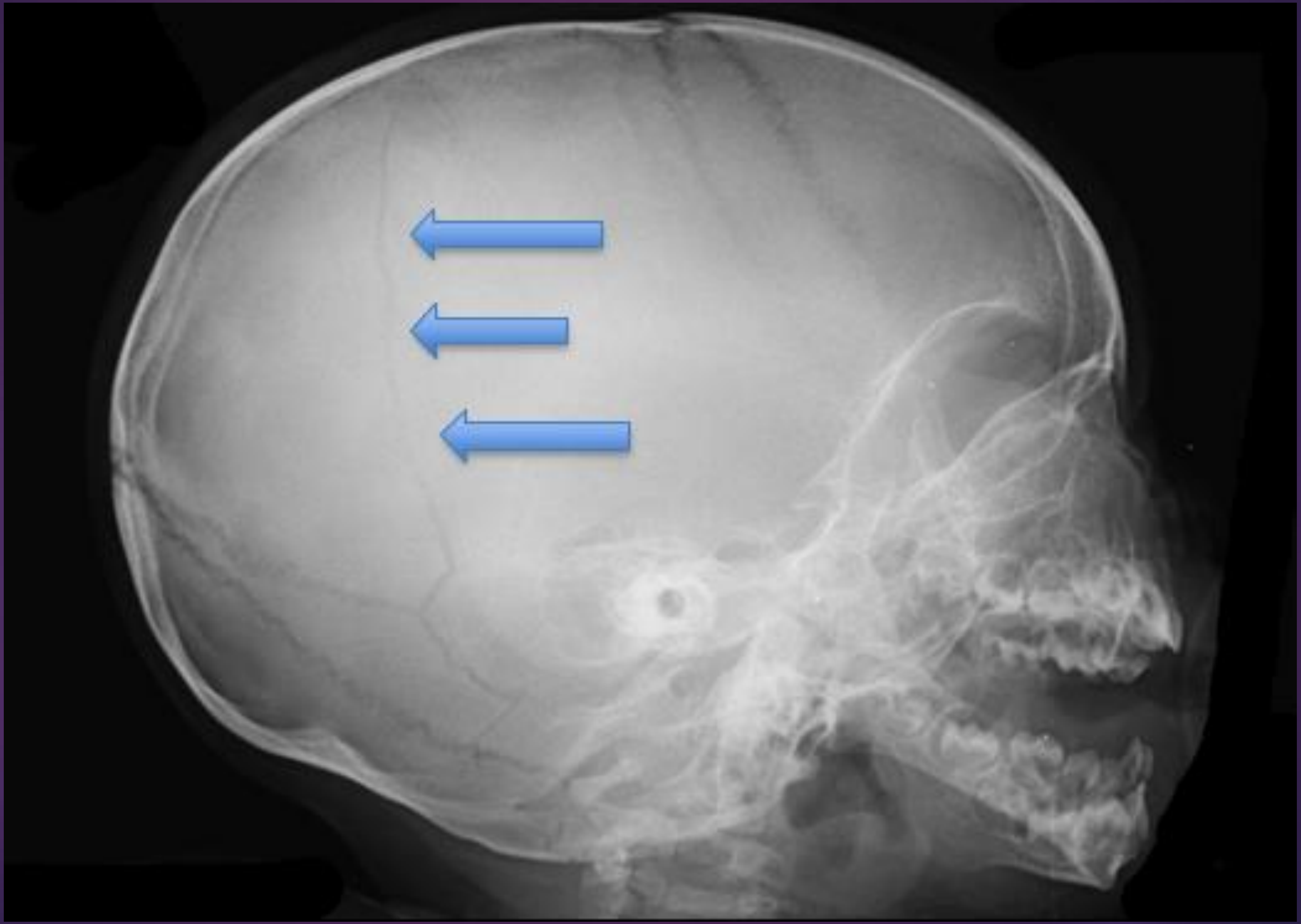

corpus callosum genu
head of caudate
body of caudate
corpus callosum splenium
marginal sulcus


frontal sinus
genu of corpus callosum
caudate nucleus - body
white matter
falx cerebri
superior sagittal sinus
grey matter
frontal horn of lateral ventricle
septum pellucidum
choroid plexus
splenium of corpus callosum
occipital horn of lateral ventricle
splenium of corpus callosum

Traumatic brain injury

- Traumatic brain injuries (TBI) are common and come with a large cost to both society and the individual. The diagnosis of traumatic brain injury is a clinical decision, however, imaging, particularly CT, plays a key role in diagnostic work-up, classification, prognostication and follow-up.
- They can be broadly divided into closed and penetrating head injuries

Fracture

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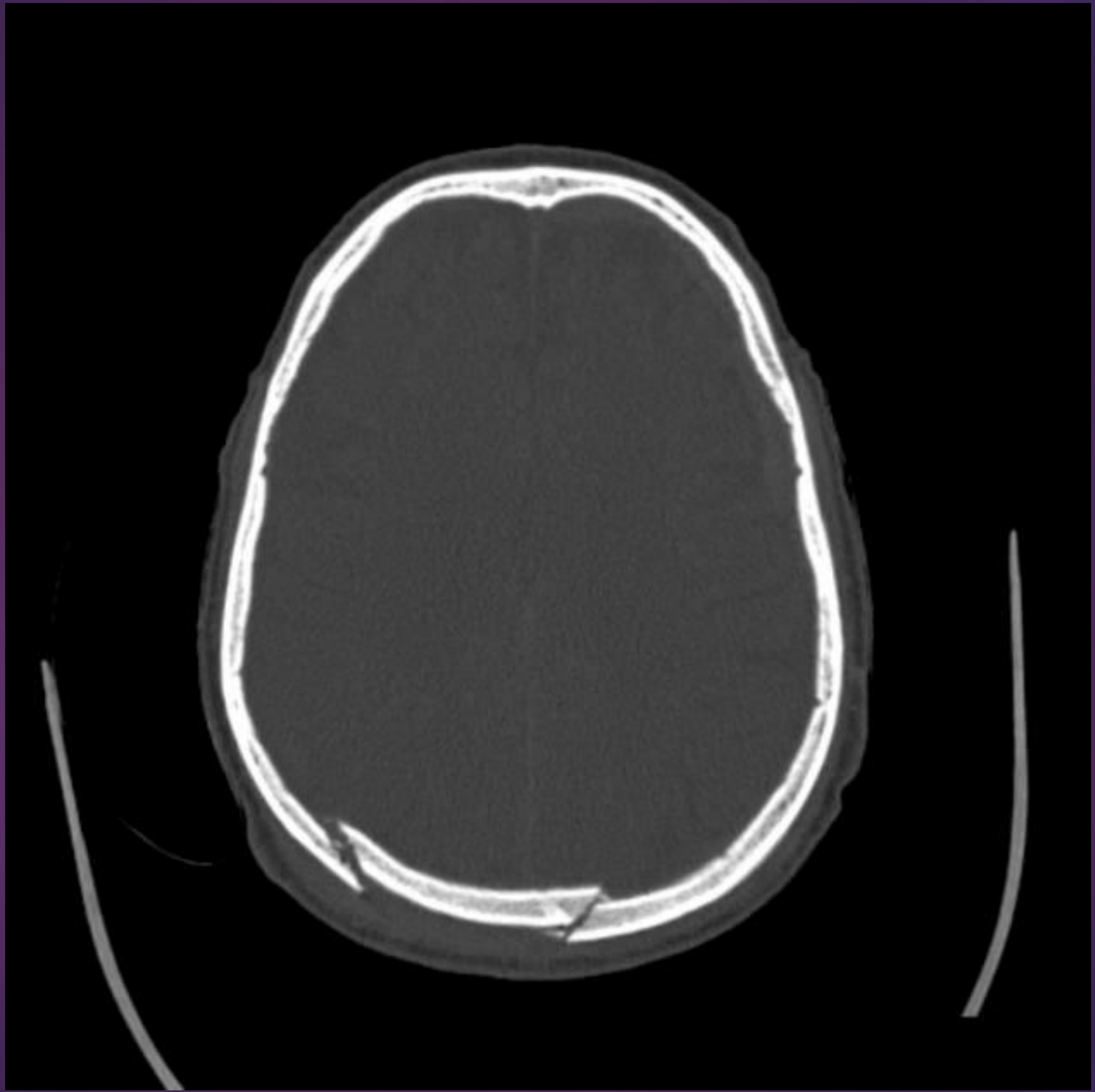
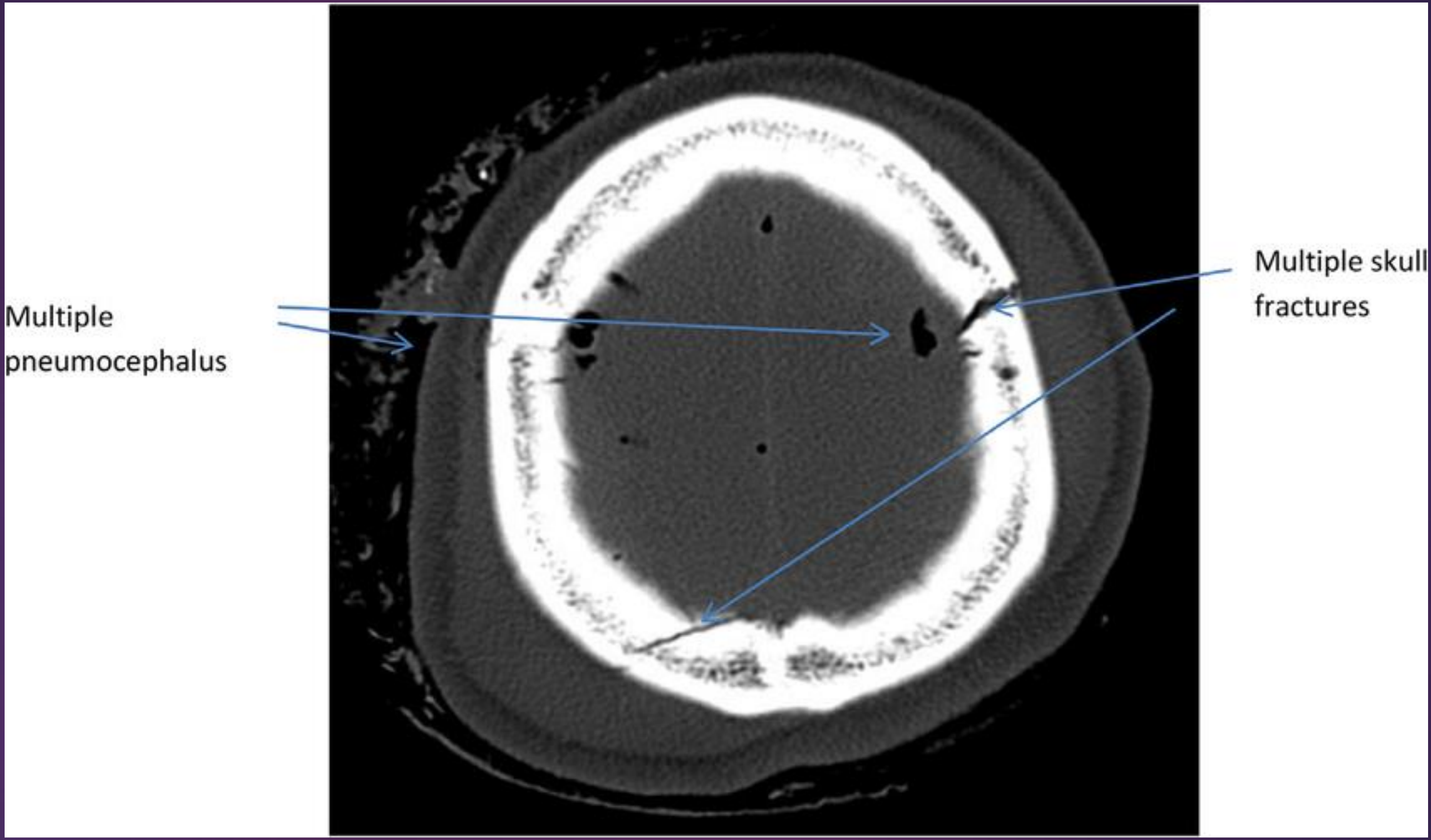
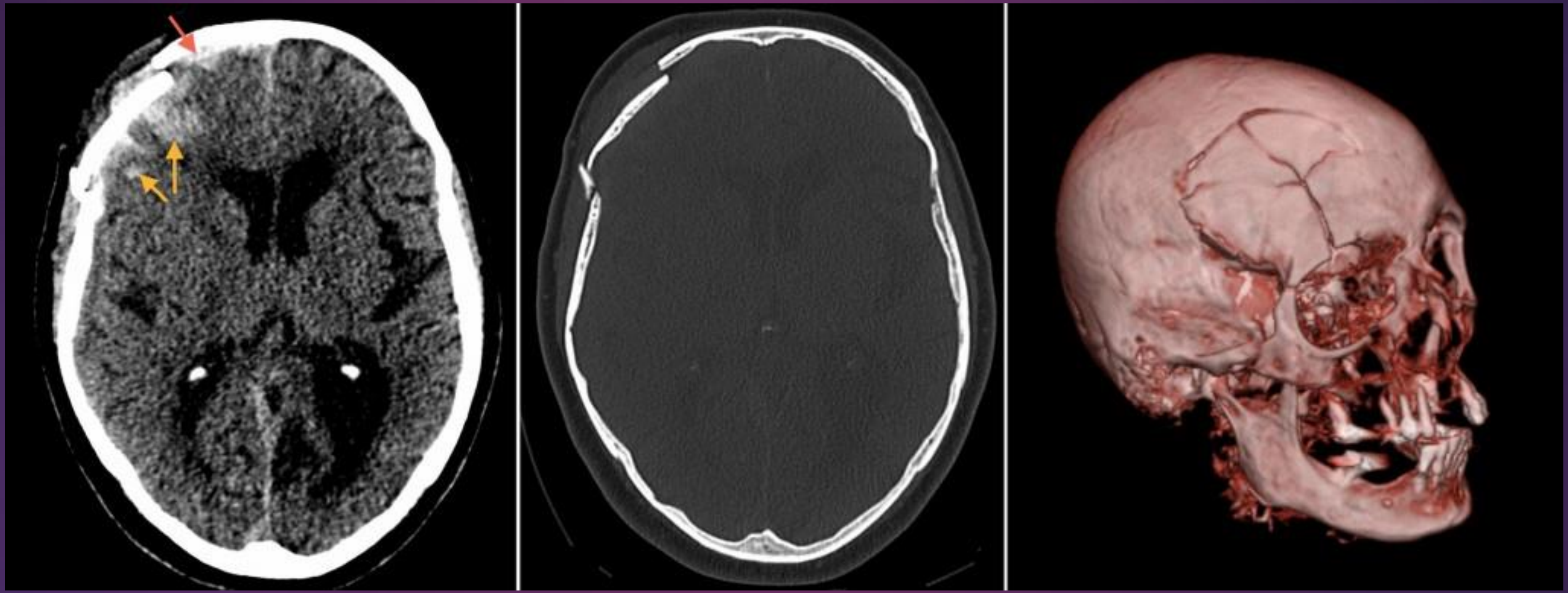



Multiple pneumocephalus
Multiple skull fractures



Traumatic brain injury

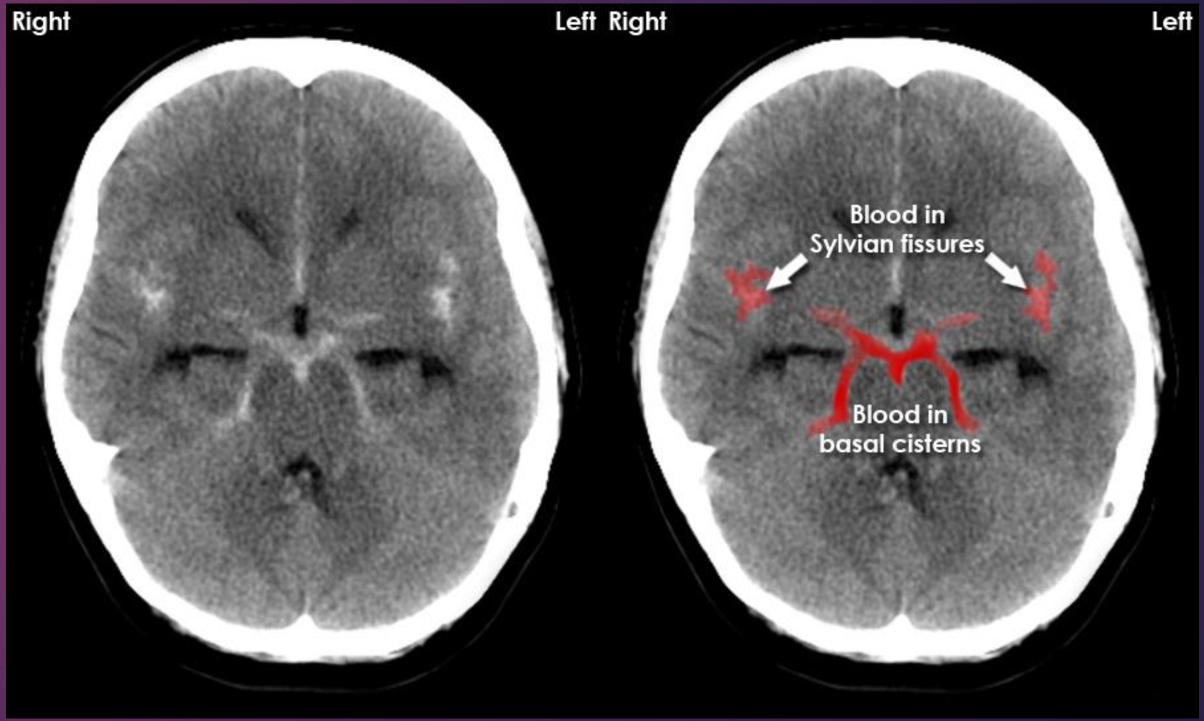
- In the acute setting patients can present with primary brain damage:
- traumatic subarachnoid hemorrhage (tSAH)
- subdural hematoma (SDH)
- extradural hematoma (EDH)
- intraventricular hemorrhage
- cerebral hemorrhagic contusion
- intermediary injury
- diffuse axonal injury (DAI)

Traumatic subarachnoid hemorrhage

- Traumatic subarachnoid hemorrhage is more commonly seen in the cerebral sulci than in the Sylvian fissure and basal CSF cisterns. When in the basal cisterns, it has an affinity for the quadrigeminal cistern and ambient cistern. tSAH is also commonly seen adjacent to skull fractures and cerebral contusions
- Causes of tSAH include :
- direct extravasation of blood from an adjacent cerebral contusion
- arterial dissection
- direct damage to small veins or arteries
- sudden increase in intravascular pressures leading to rupture

tSAH

- Often a small amount of blood is seen filling a few sulci, sometimes with an adjacent cerebral contusion. Small amounts of blood can also sometimes be appreciated pooling in the interpeduncular fossa, appearing as a small hyperdense triangle, or within the occipital horns of the lateral ventricles.
- Occasionally, and worrying for an underlying arterial dissection or an aneurysmal hemorrhage that preceded trauma, larger amounts of blood may be seen around the circle of Wilis and within the posterior fossa.



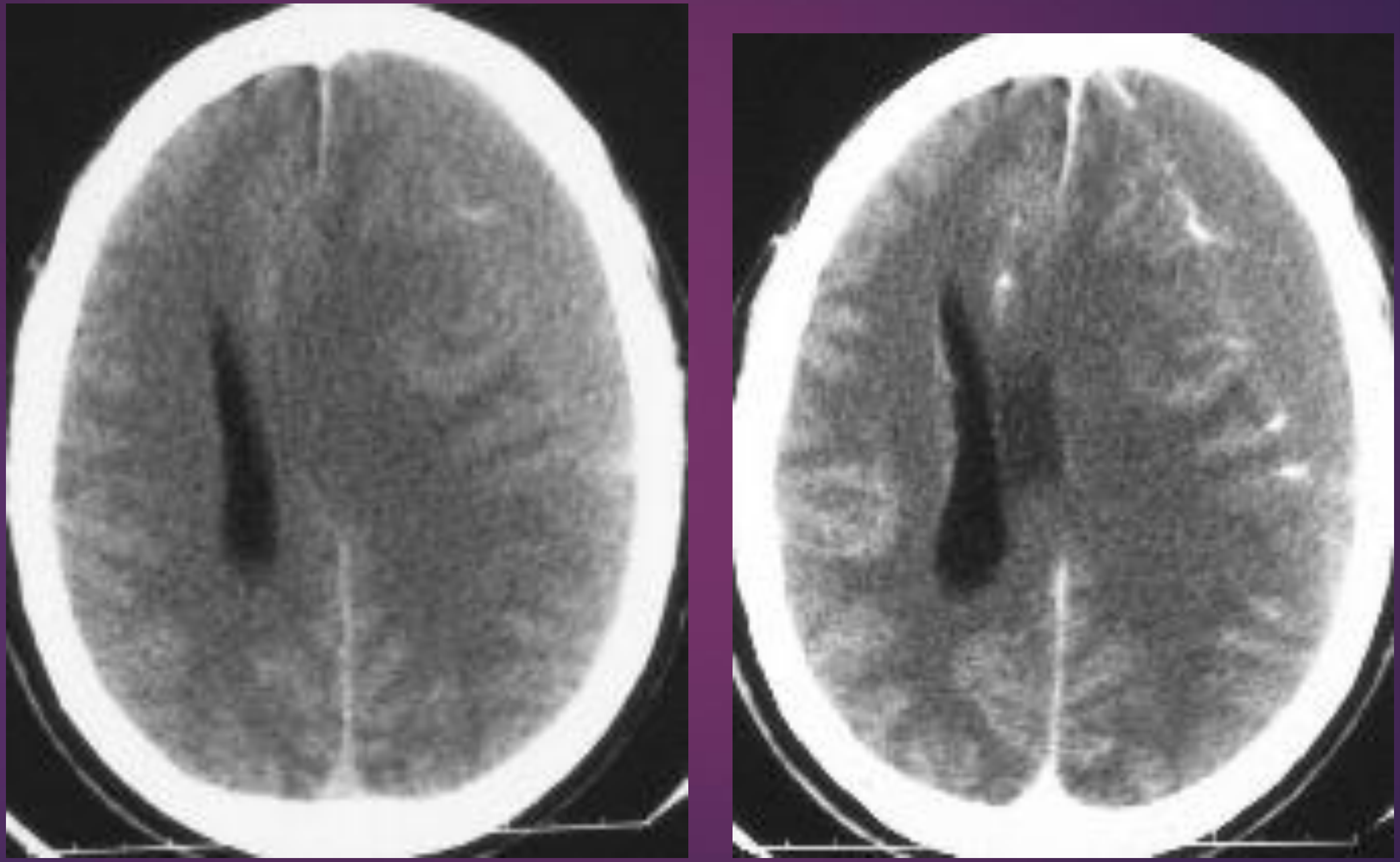
Subdural hematoma (SDH

- It is a collection of blood accumulating in the subdural space, the potential space between the dura and arachnoid mater of the meninges around the brain.
- Subdural hemorrhages are believed to be due to stretching and tearing of bridging cortical veins as they cross the subdural space to drain into an adjacent dural sinus. These veins rupture due to shearing forces when there is a sudden change in the velocity of the head. The arachnoid may also be torn, creating a mixture of blood and CSF in the subdural space.

SDH on CT

- Hyperacute- first hour or so, relatively isodense to the adjacent cortex, with a swirled appearance due to a mixture of the clot, serum and ongoing unclotted blood
- Acute- rescent-shaped homogeneously hyperdense extra-axial collection that spreads diffusely over the affected hemisphere. As the clot starts to retract the density increases typically to >50-60 HU and is thus hyperdense relative to the cortex
- Subacute - between 3 and 21 days (typically 10-14 days), the density will drop to ~ 35-40 HU and become isodense to the adjacent cortex,
- Chronic- at least 3 weeks old. The subdural collection becomes hypodense to the adjacent cortex and can reach ~0 HU and be isodense to CSF

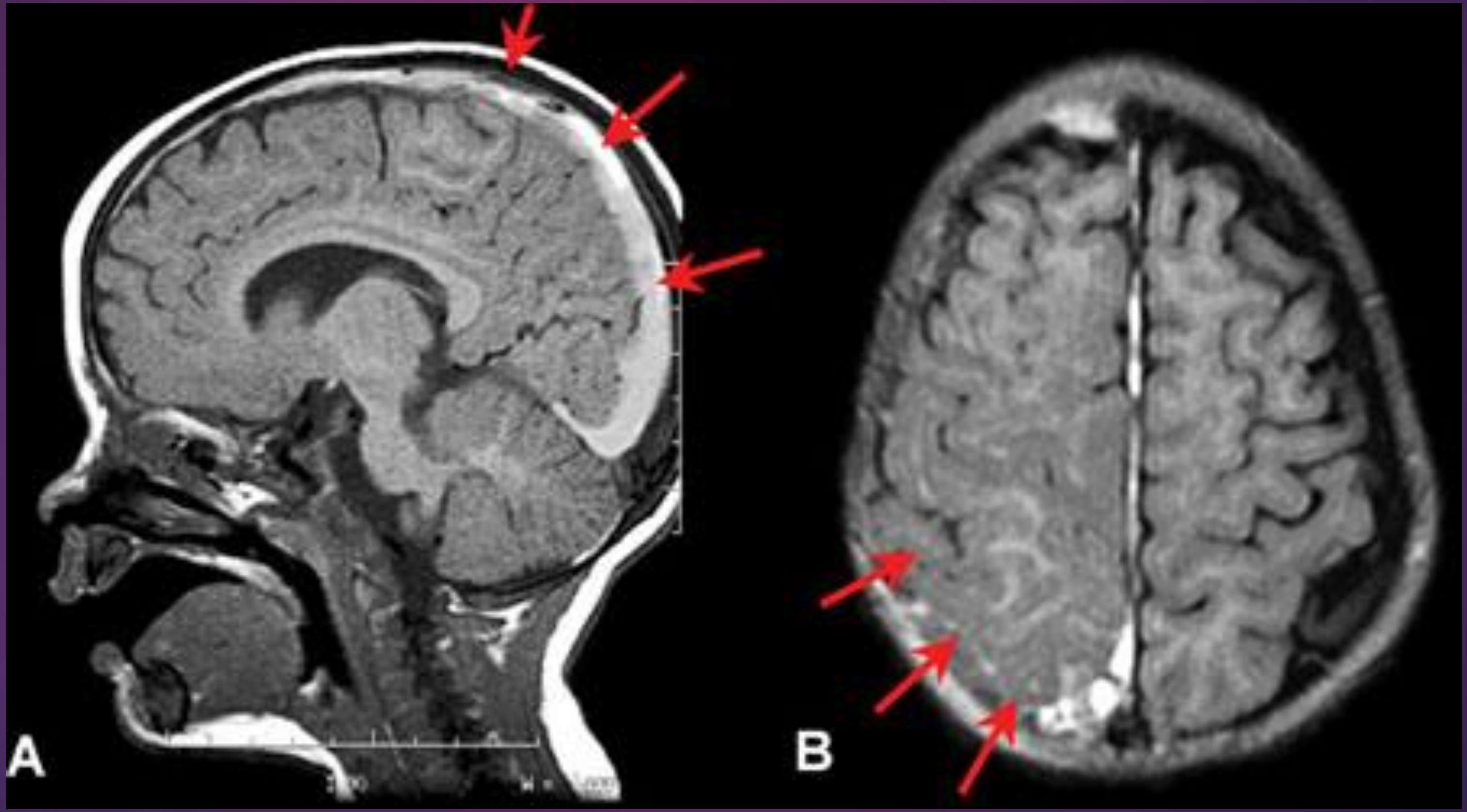
Subdural hematoma



Isodense, left frontoparietal

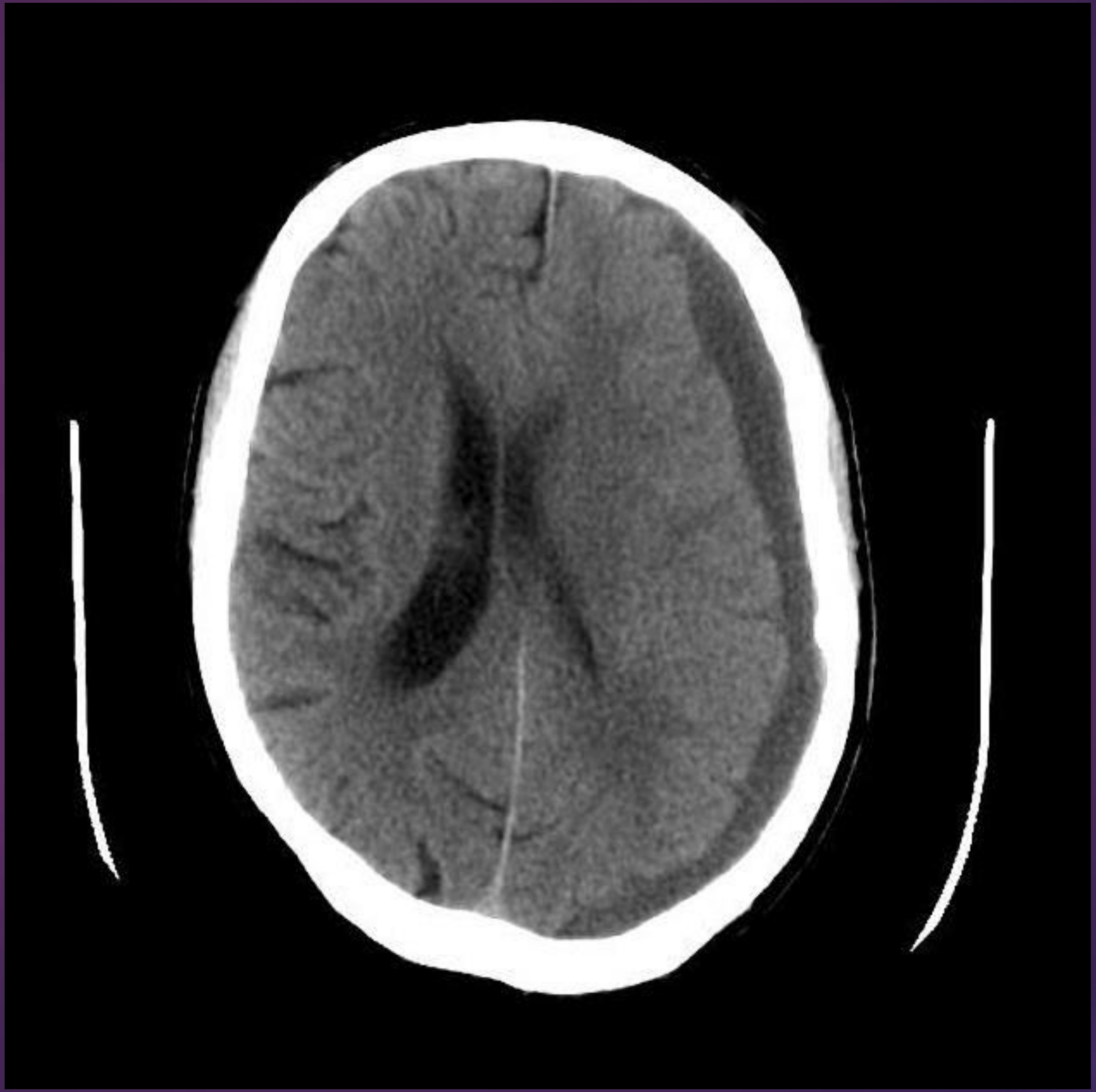
Subdural hematoma

Subdural hematoma



SDH and SAH

Chronic subdural hematoma

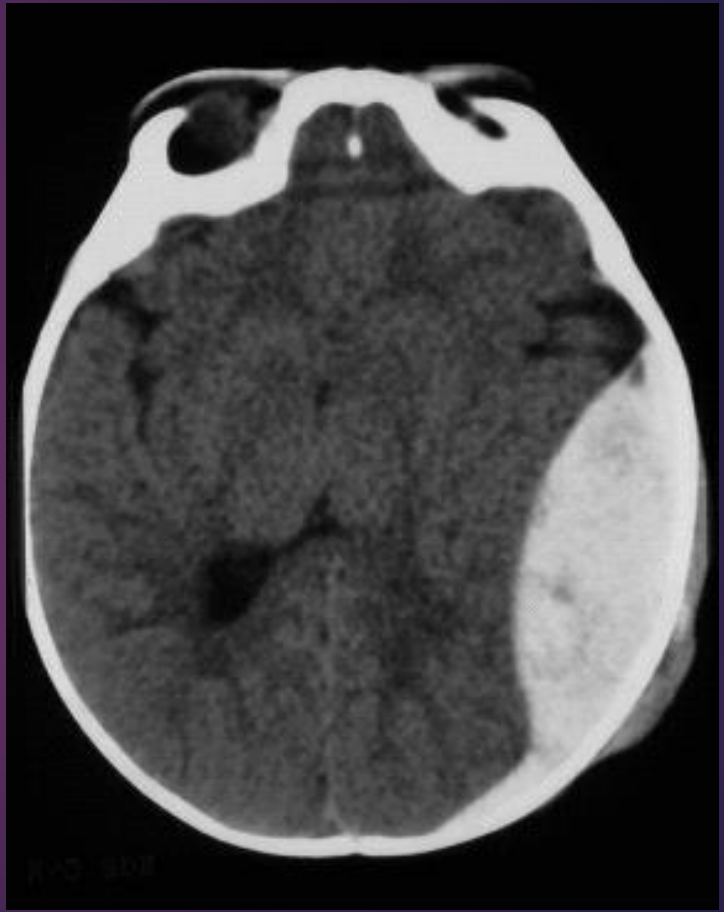


Epidural hematoma

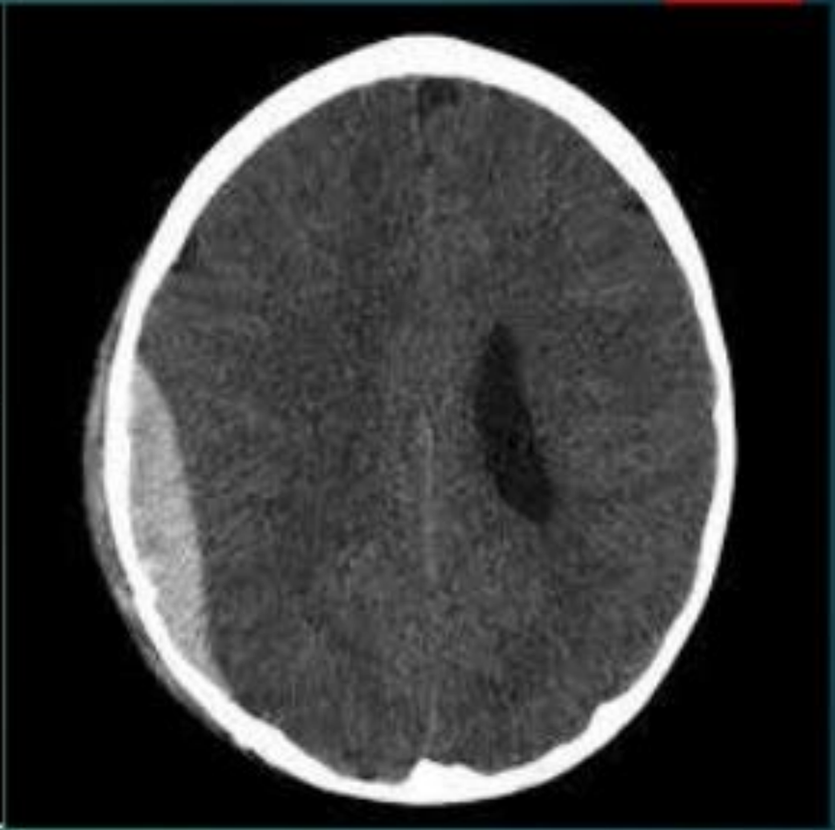
- collection of blood that forms between the inner surface of the skull and outer layer of the dura, which is called the endosteal layer. They are usually associated with a history of head trauma and frequently associated skull fracture. The source of bleeding is usually arterial, most commonly from a torn middle meningeal artery.
- Extradural hematomas are typically biconvex in shape and can cause a mass effect with herniation. They are usually limited by cranial sutures, but not by venous sinuses. Both CT and MRI are suitable to evaluate extradural hematomas. When the blood clot is evacuated promptly (or sufficiently small to be treated conservatively), the prognosis of extradural hematomas is generally good.

EDH on CT

- They are typically bi-convex (or lentiform) in shape, and most frequently beneath the squamous part of the temporal bone. EDHs are hyperdense, somewhat heterogeneous, and sharply demarcated. Depending on their size, secondary features of mass effect (e.g. midline shift, subfalcine herniation, uncal herniation) may be present.
- When acute bleeding is occurring at the time of CT scanning the non-clotted fresh blood is typically less hyperdense, and a swirl sign may be evident.
- Postcontrast extravasation may be seen rarely in case of acute extradural hematoma and peripheral enhancement due to granulation and neovascularization can be seen in chronic extradural hematomas.

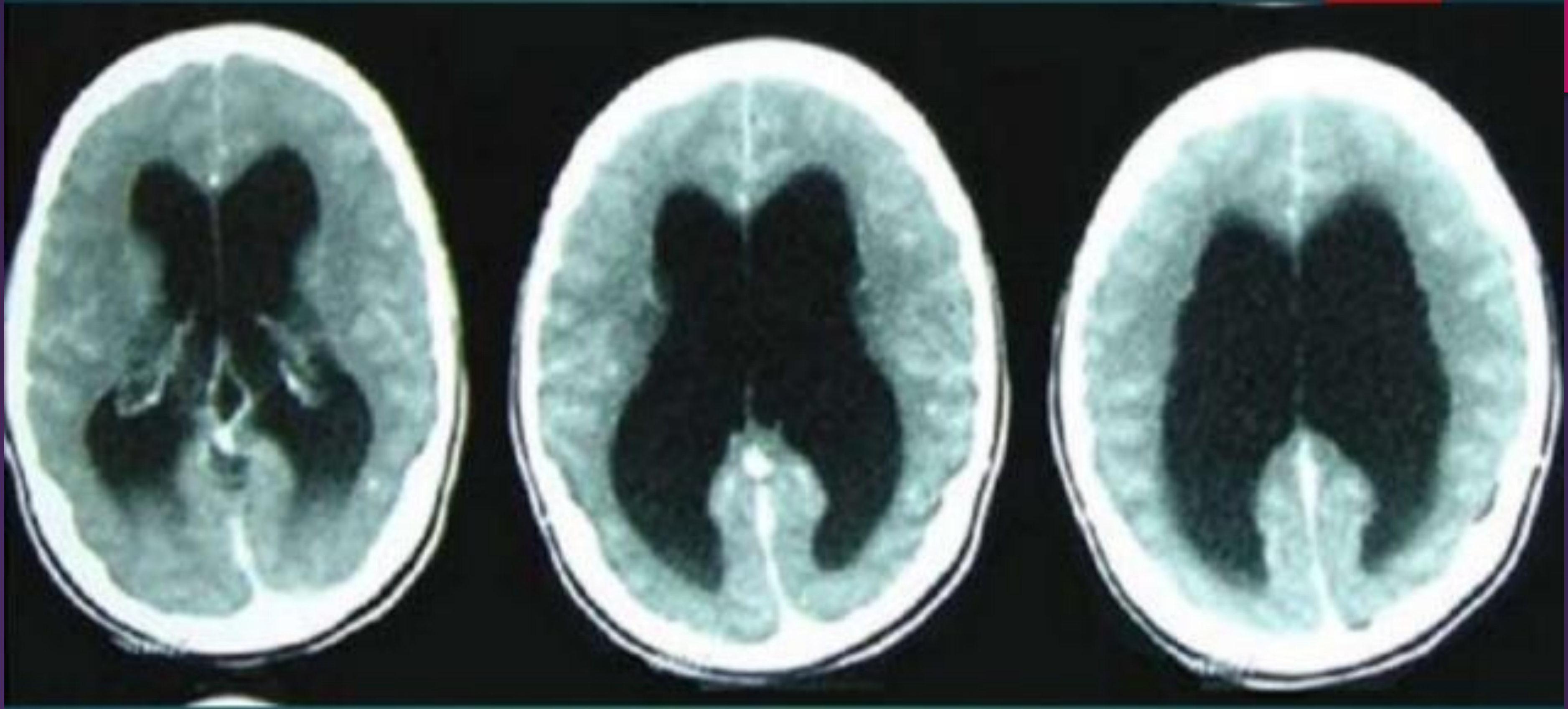


Peidural hematoma
Convex shape



Subdural hematoma
Cresent shape

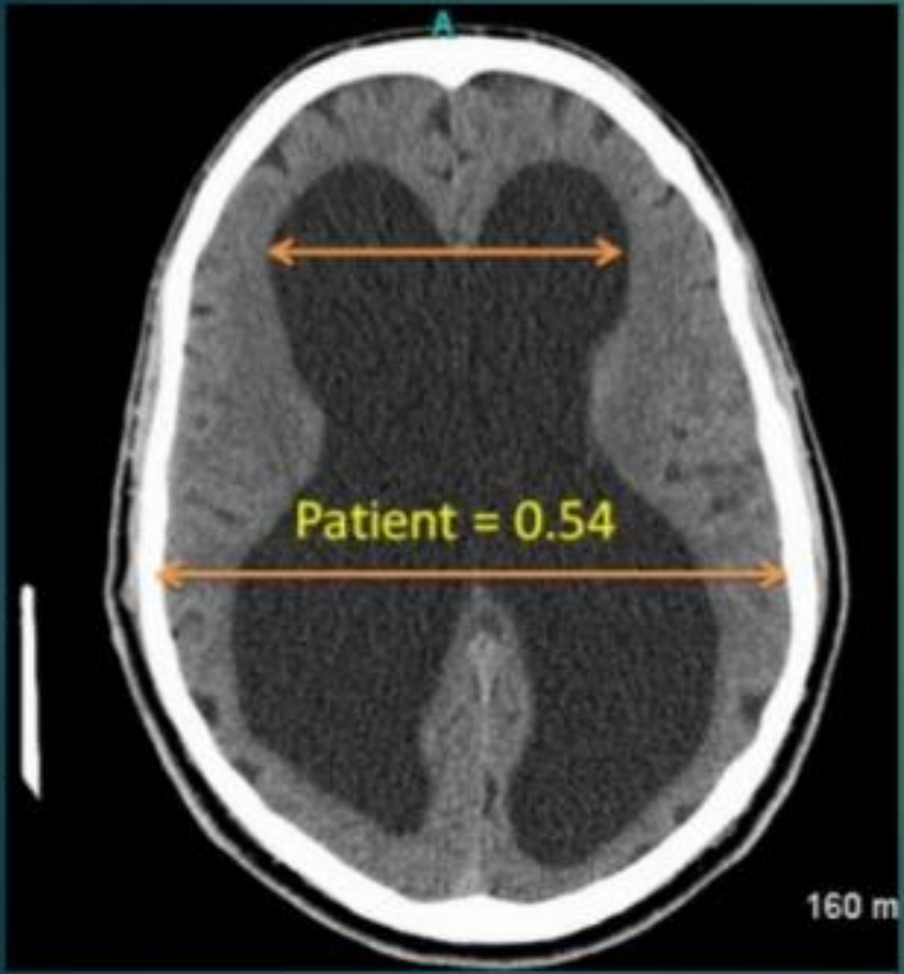
Intraventricular hemorrhage



Gross hydrocephalus, showing dilatation of frontal horns, body and occipital horns.

Evan's Index for Hydrocephalus

- Maximum transverse diameter of Frontal Horns divided by Maximum internal transverse diameter of cranium



If Index is **> 0.3** , suggests Hydrocephalus.

Brain tumours

EPIDEMIOLOGY

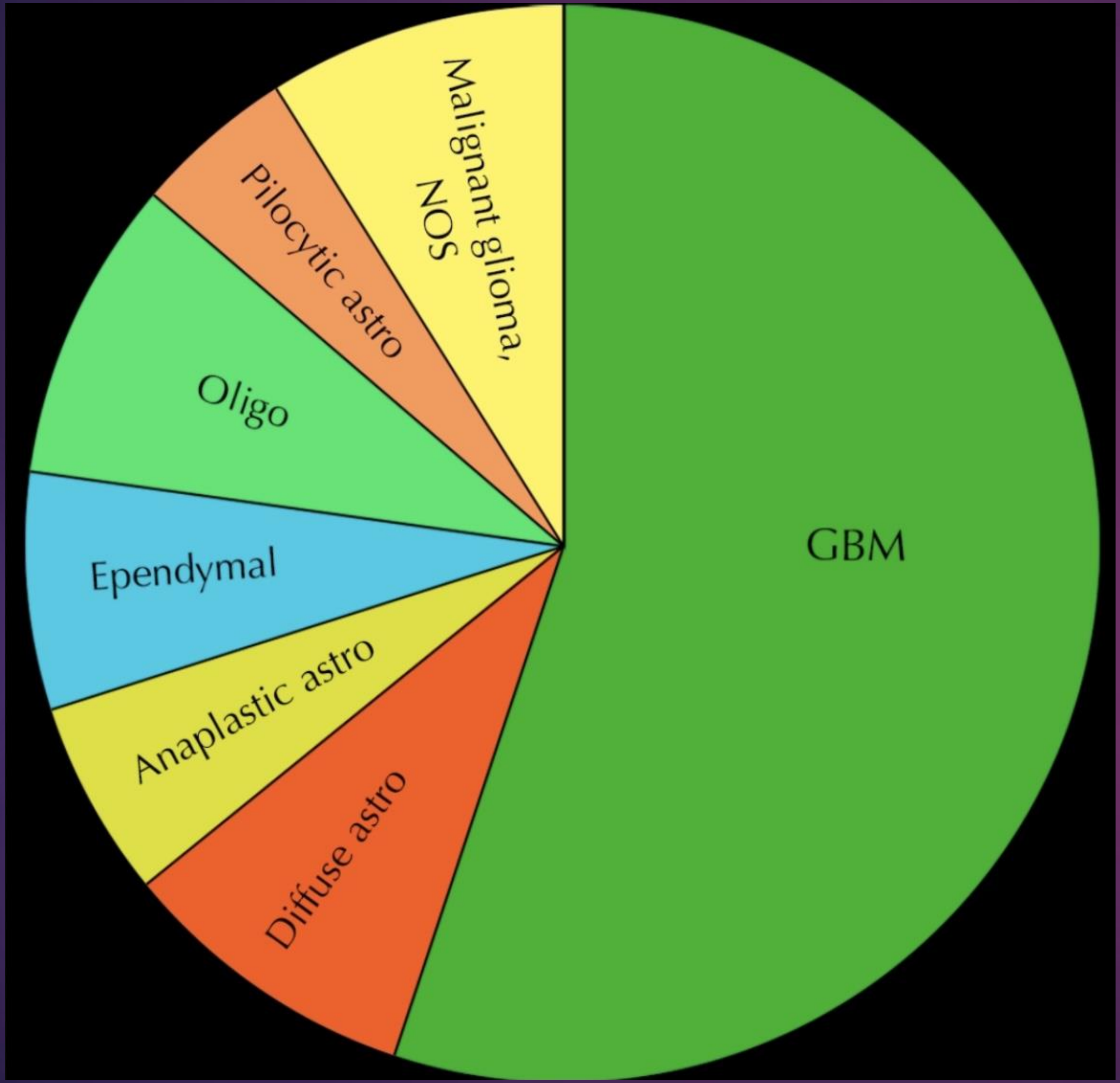


Figure 16-9 More than half of all CNS glial neoplasms are glioblastomas. Of the nonastrocytic gliomas, oligodendrogliomas are the most common subtype.

Osborn's Brain, 2018

CLASSIFICATION

WHO2016CNS
4° edition

Diffuse astrocytic and oligodendroglial tumours	
Diffuse astrocytoma, IDH-mutant	9400/3
Gemistocytic astrocytoma, IDH-mutant	9411/3
Diffuse astrocytoma, IDH-wildtype	*9400/3*
Diffuse astrocytoma, NOS	9400/3
Anaplastic astrocytoma, IDH-mutant	9401/3
Anaplastic astrocytoma, IDH-wildtype	*9401/3*
Anaplastic astrocytoma, NOS	9401/3
Glioblastoma, IDH-wildtype	9440/3
Giant cell glioblastoma	9441/3
Gliosarcoma	9442/3
Epithelioid glioblastoma	*9440/3*
Glioblastoma, IDH-mutant	9445/3*
Glioblastoma, NOS	9440/3
Diffuse midline glioma, H3 K27M–mutant	9385/3*
Oligodendroglioma, IDH-mutant and 1p/19q-codeleted	9450/3
Oligodendroglioma, NOS	9450/3
Anaplastic oligodendroglioma, IDH-mutant and 1p/19q-codeleted	9451/3
Anaplastic oligodendroglioma, NOS	*9451/3*
Oligoastrocytoma, NOS	*9382/3*
Anaplastic oligoastrocytoma, NOS	*9382/3*

WHO grades of select CNS tumours

Diffuse astrocytic and oligodendroglial tumours	
Diffuse astrocytoma, IDH-mutant	II
Anaplastic astrocytoma, IDH-mutant	III
Glioblastoma, IDH-wildtype	IV
Glioblastoma, IDH-mutant	IV
Diffuse midline glioma, H3 K27M–mutant	IV
Oligodendroglioma, IDH-mutant and 1p/19q-codeleted	II
Anaplastic oligodendroglioma, IDH-mutant and 1p/19q-codeleted	III
Other astrocytic tumours	
Pilocytic astrocytoma	I
Subependymal giant cell astrocytoma	I
Pleomorphic xanthoastrocytoma	II
Anaplastic pleomorphic xanthoastrocytoma	III

WHO2021CNS

5° edition

Table 1 Diffuse gliomas in WHO CNS 5

	CNS WHO grade
Adult-type diffuse gliomas	
Astrocytoma, IDH-mutant	2/3/4
Oligodendroglioma, IDH-mutant, and 1p/19q-codeleted	2/3
Glioblastoma, IDH-wildtype	4
Pediatric-type diffuse low-grade gliomas	
Diffuse astrocytoma, *MYB*-or *MYBL1*-altered	1
Angiocentric glioma	1
Polymorphous low-grade neuroepithelial tumor of the young	1
Diffuse low-grade glioma, MAPK pathway-altered	NA
Pediatric-type diffuse high-grade gliomas	
Diffuse midline glioma, H3 K27-altered	4
Diffuse hemispheric glioma, H3 G34-mutant	4
Diffuse pediatric-type high-grade glioma, H3-wildtype and IDH-wildtype	4
Infant-type hemispheric glioma	NA

NA not assigned

The 2021 WHO classification of tumors, 5th edition, central nervous system tumors: the 10 basic principles

Takashi Komori[1]

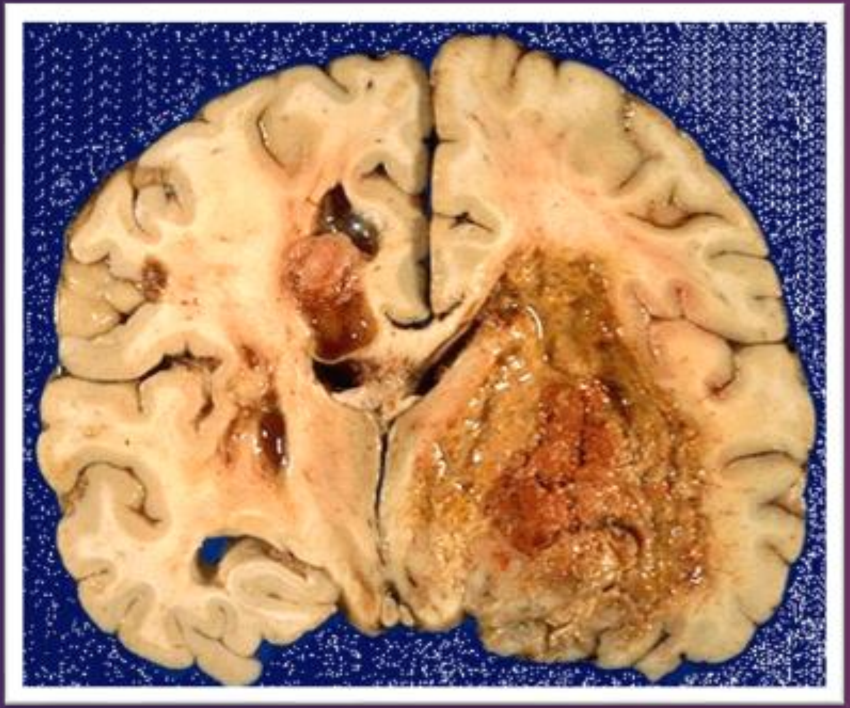
Table 2 An example of layered report structure

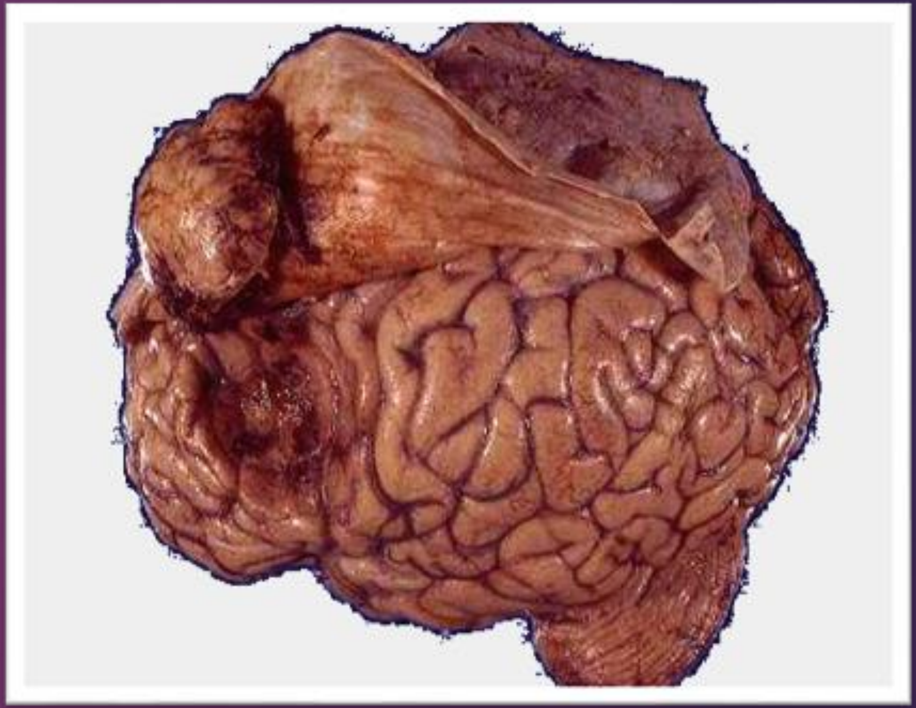
Cerebrum	
Integrated diagnosis	Diffuse high-grade glioma, IDH-wildtype, H3-wildtype, NEC
Histopathological diagnosis	Anaplastic oligoastrocytoma with microvascular proliferation
CNS WHO grade	Not assigned
Molecular information	IDH-wildtype, H3-wildtype, *TERT* promoter-wildtype, and *BRAF*-wildtype (Sanger sequencing), *BRAF* fusion-negative (Break apart FISH study), 1p/19q non-deleted (FISH study), *CDKN2A/B* non-deleted, *EGFR* not-amplified, and 7/10 chromosome copy number alterations-negative (MLPA)

Cf. This is an example of a right frontal mass with contrast enhancement on MRI in a 43-year-old male. Of note, the usage of NEC may differ according to the pathologist

CNS central nervous system, *FISH* fluorescence in situ hybridization, *NEC* not elsewhere classified

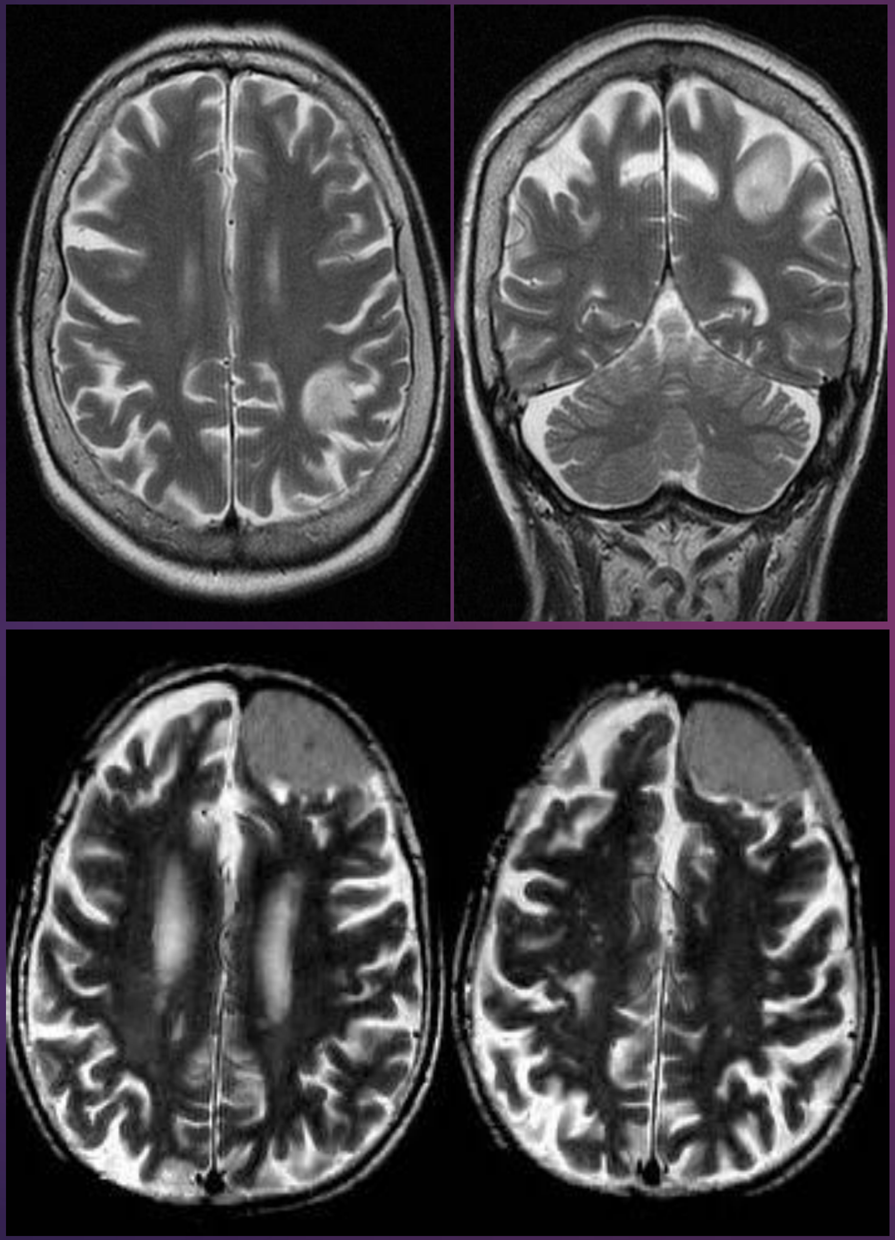
- INTRA-AXIAL
- EXTRA-AXIAL





INFLATE THE CIRCLES
FLAT THE SULCI

COMPRESS THE SULCI



- CORTEX DISLOCATION
- internal - external

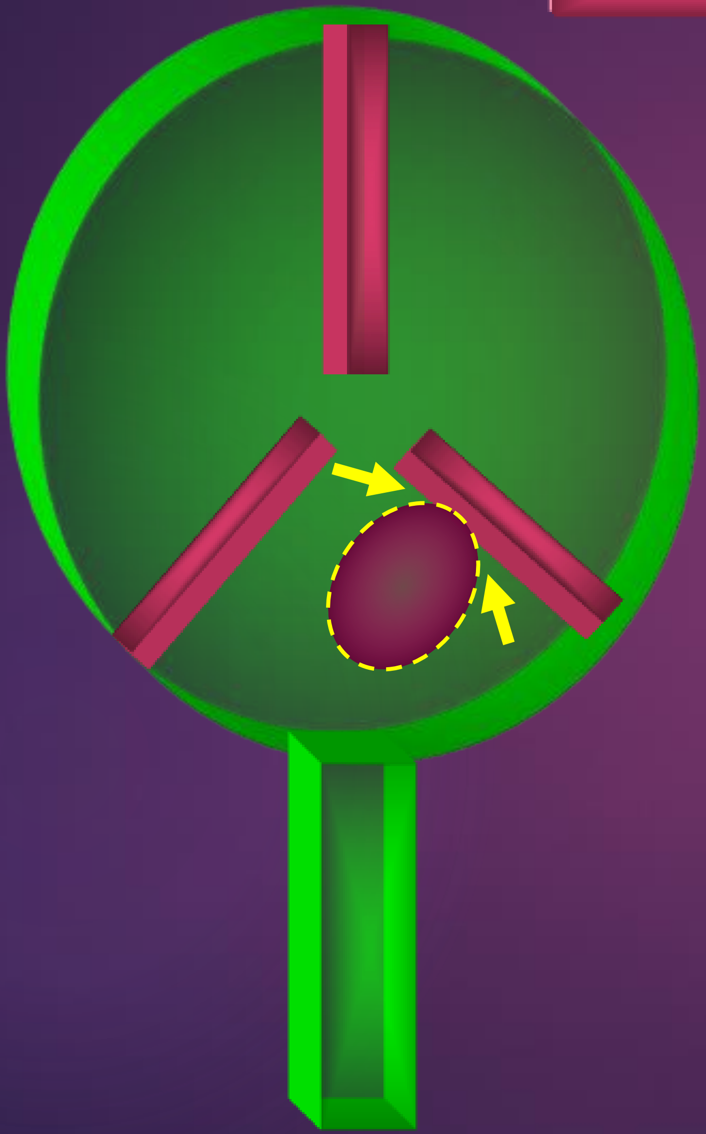
- ASPECT OF THE SP. SUBARACNOID
- internal - external

- DISLOCATION OF PIAL VESSELS
- internal - external

- CONTINUITY WITH THE DURA
- Yes No

- LOCAL BONE MODIFICATIONS
- hyperostosis – erosion – remodeling

- CONTIGUOUS MENINGEAL THICKENING
- dural tail yes - no



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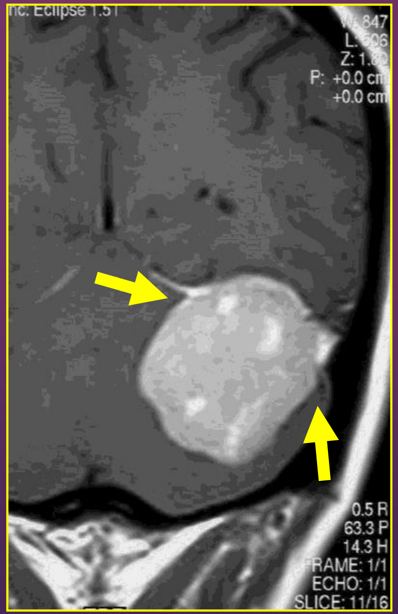
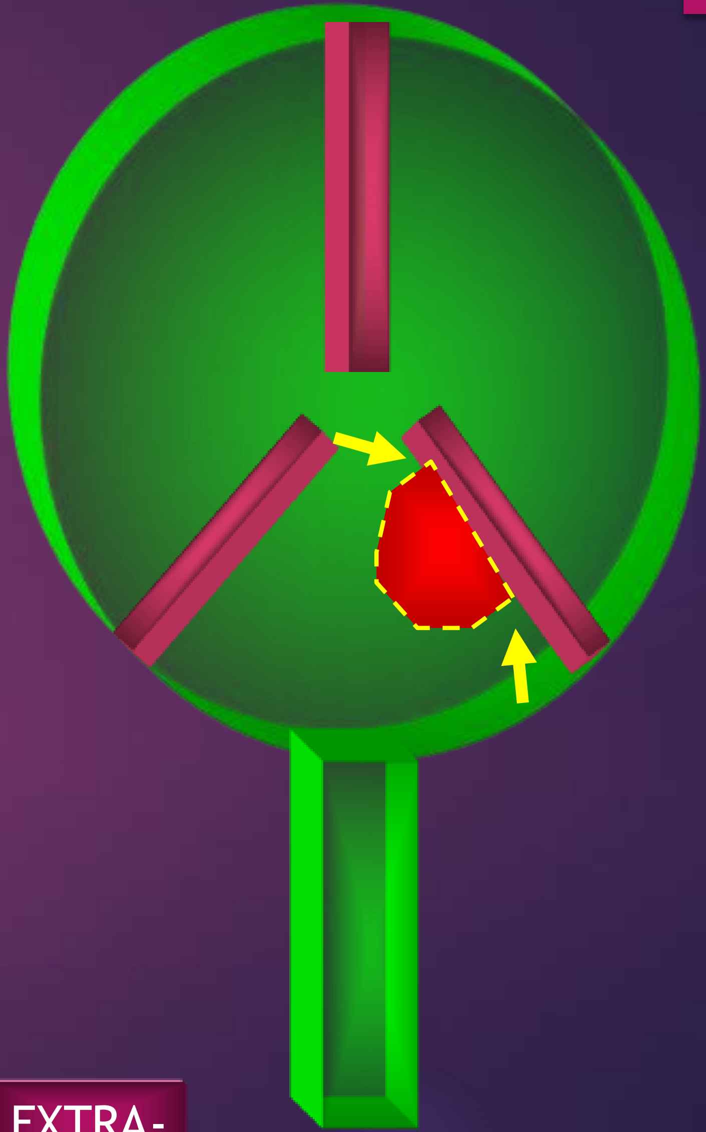
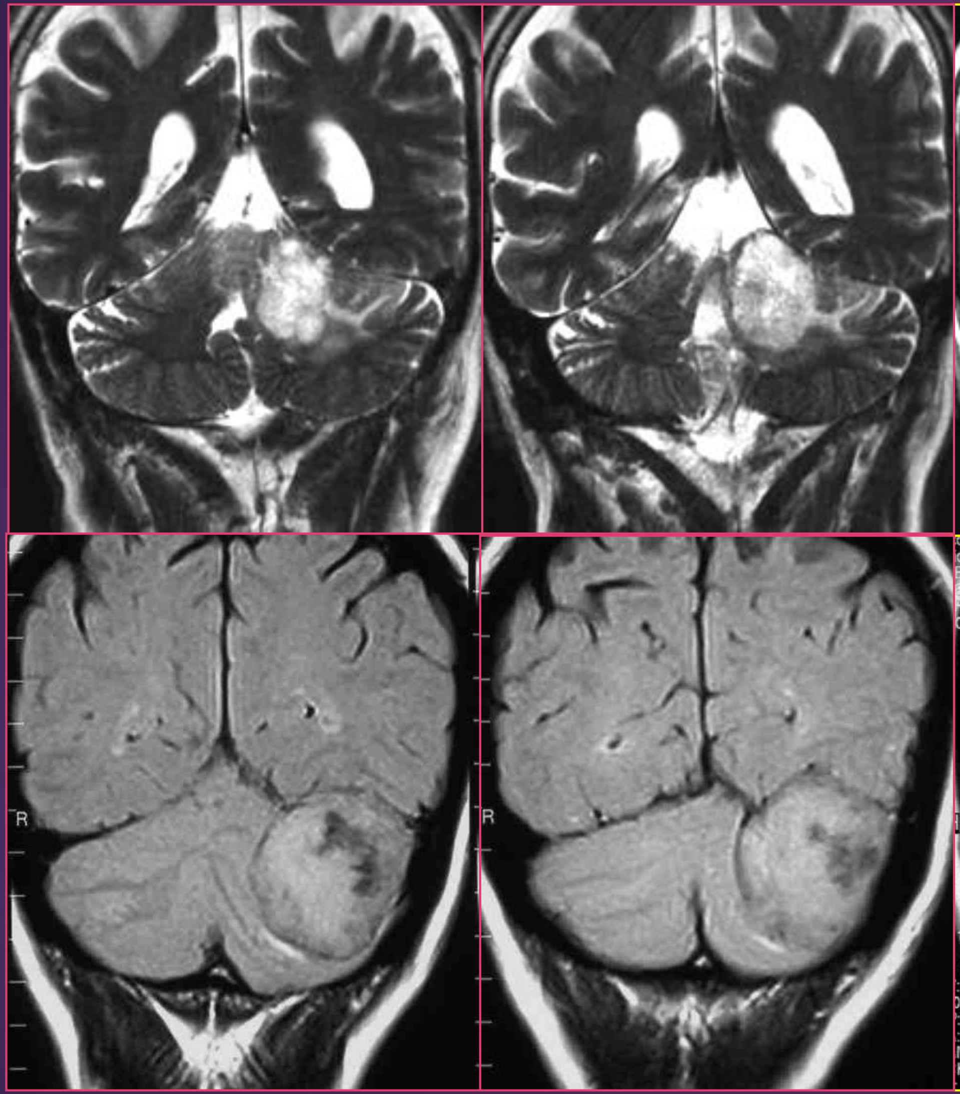
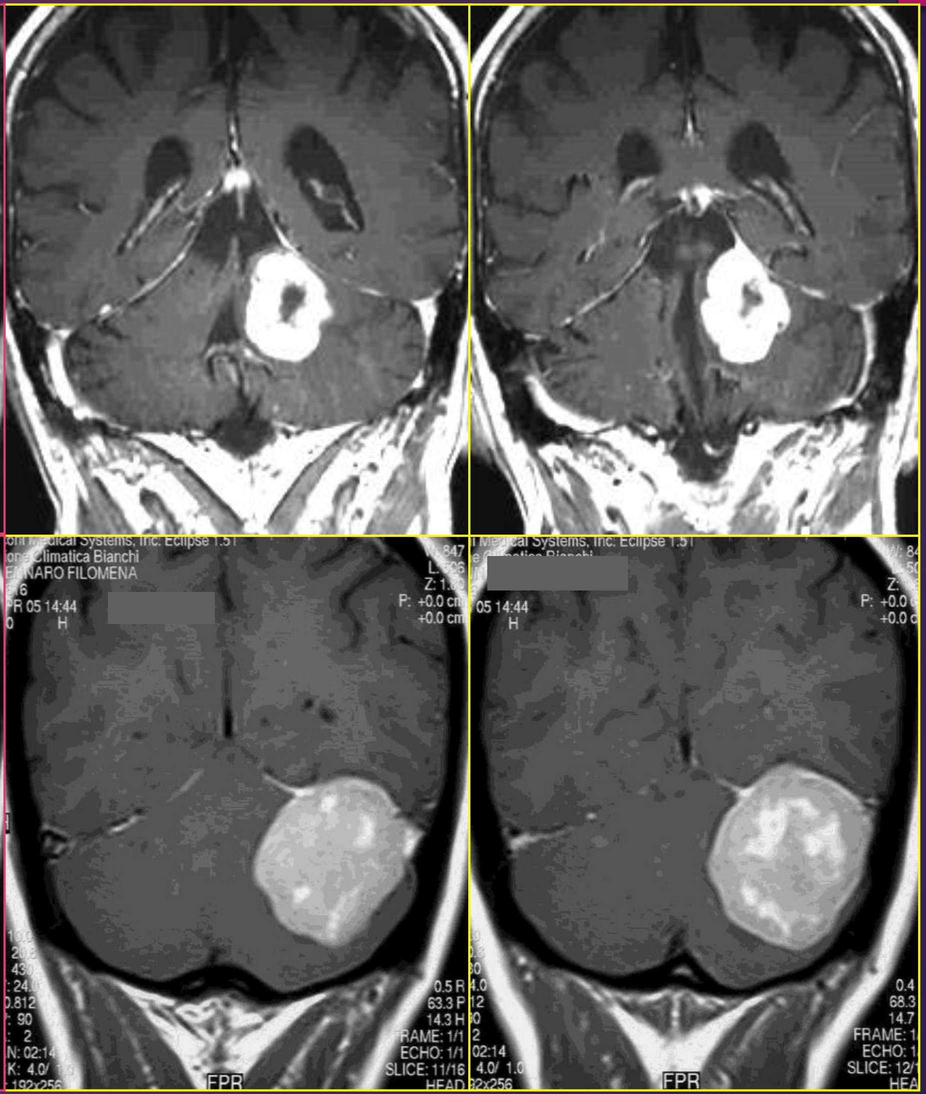


EXTRA-





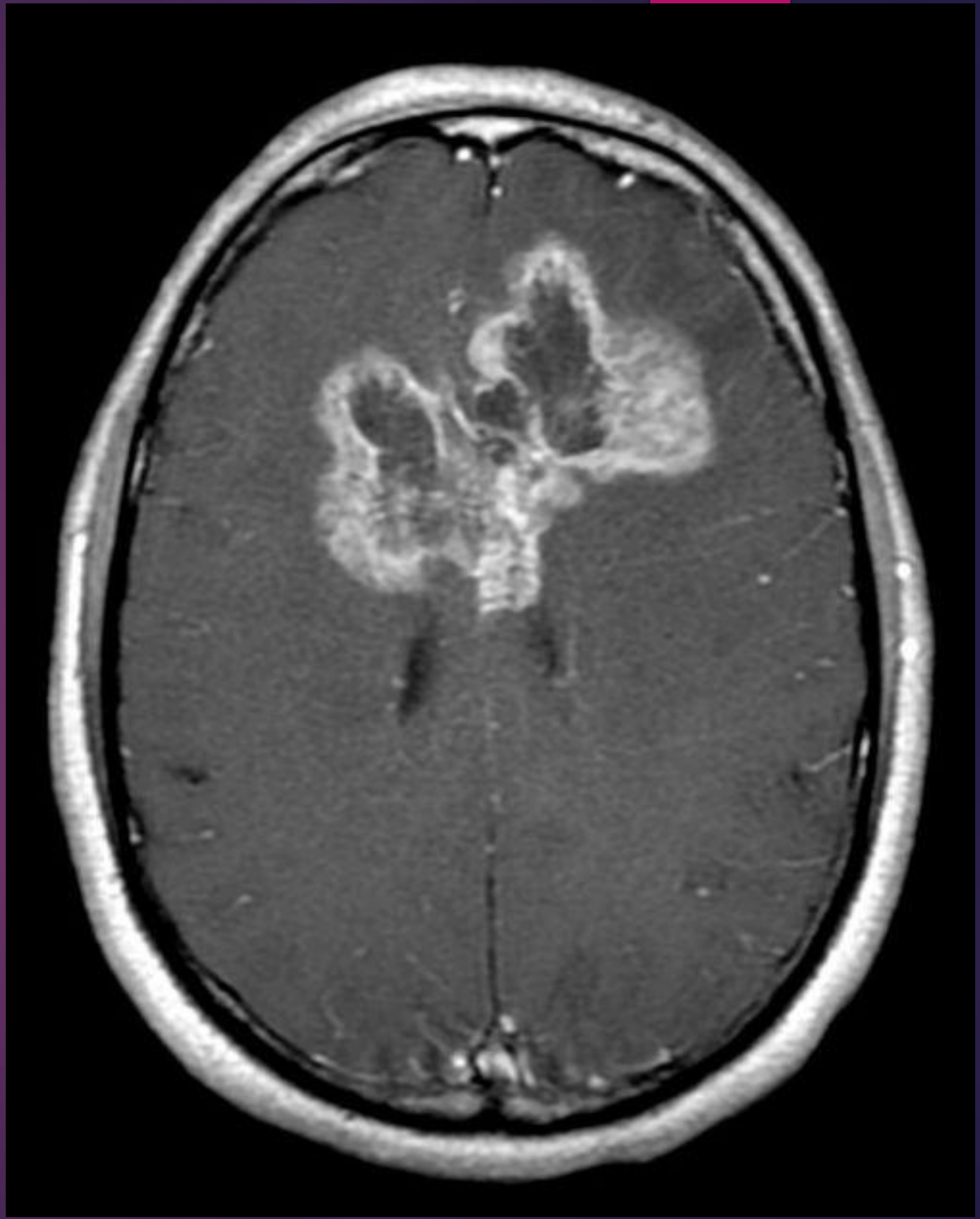


METASTASIS

MENINGIOMA

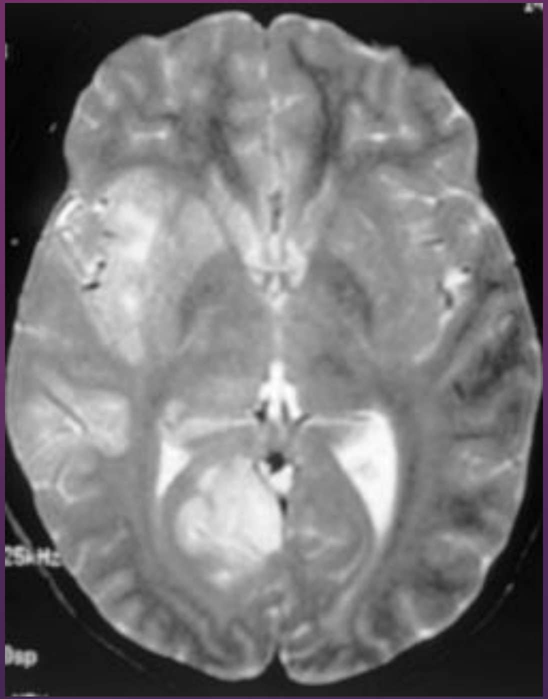
GLIOBLASTOMA

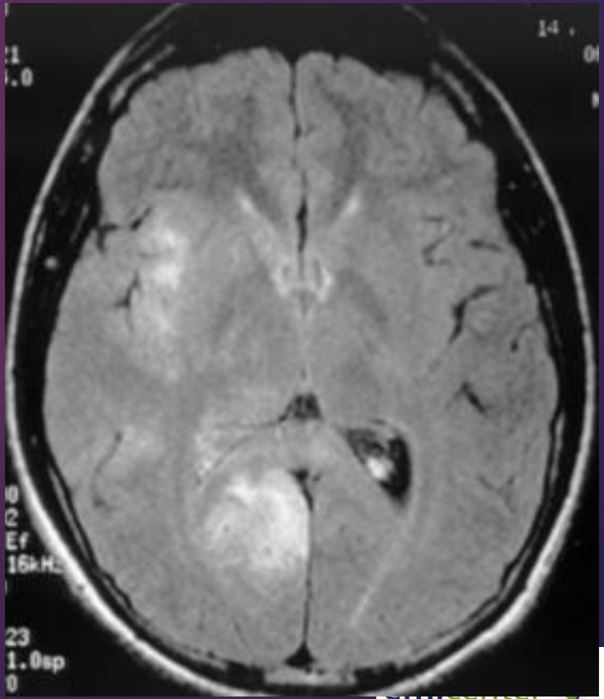
- Glioblastomas (GBM) are the most common adult primary brain tumor and are unfortunately aggressive, relatively resistant to therapy, and have a corresponding poor prognosis.
- They typically appear as heterogeneous masses centered in the white matter with irregular peripheral enhancement, central necrosis, and surrounding vasogenic edema.



GLIOMATOSIS

- Extreme form of diffusely infiltrating glioma involving
at least two cerebral lobes, with widespread volumetric increase of the brain and demyelination.
- MRI: heterogeneous finding with diffuse signal alteration (+T2) involving
nuclei, etc. without evidence of masses and without enhancement from m.d.c.





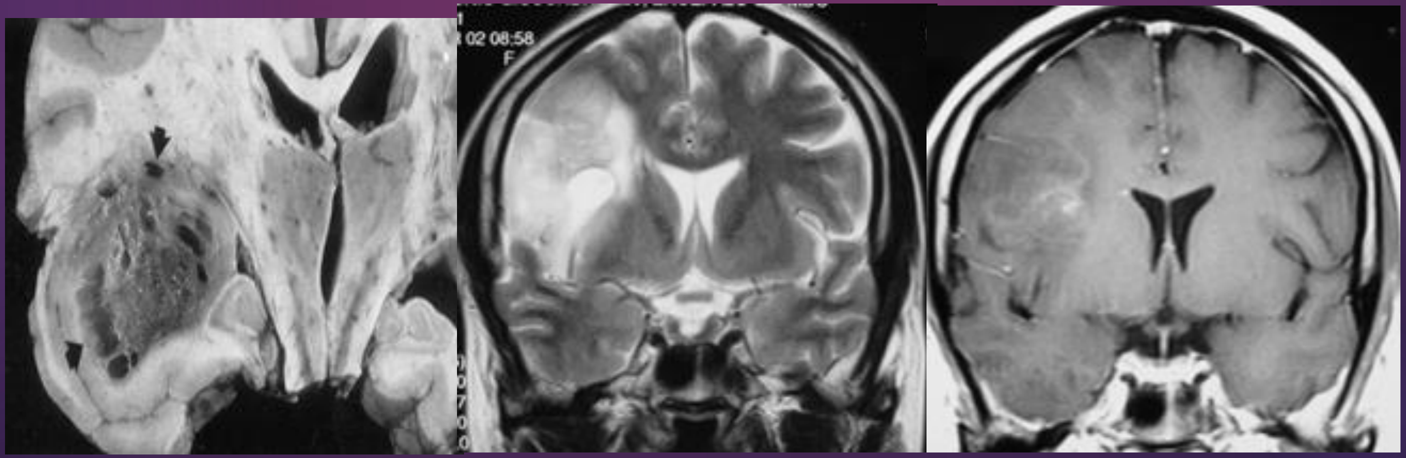
ANAPLASTIC ASTROCITOMA

Rarer than the GBM, they occupy an intermediate position between "low grade and GBM

Less defined and less homogeneous than the a. fibrillar (II degree), greater tendency to infiltration; possible bleeding areas.

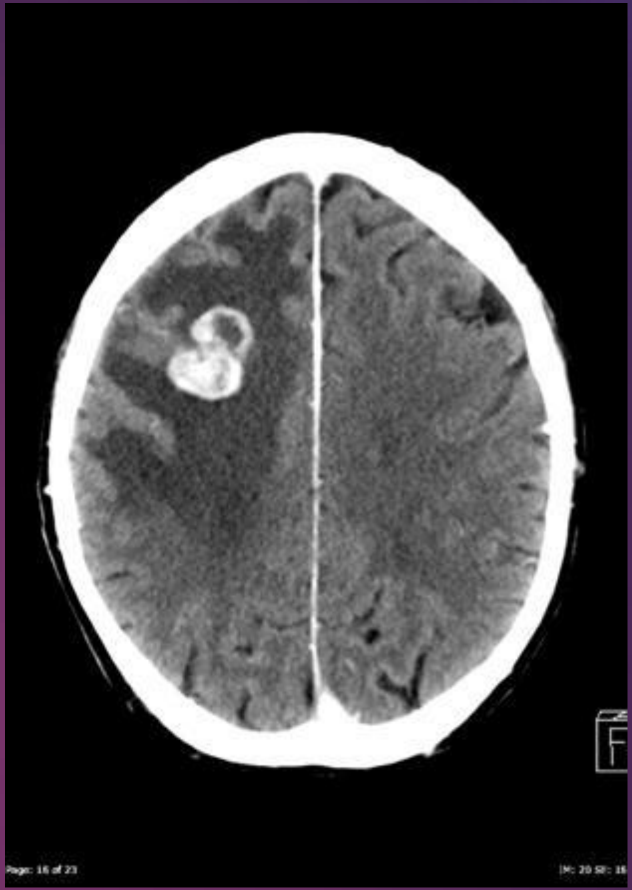
•MRI: poorly defined margins, with more or less diffuse extension along the bundles of white matter; discrete inhomogeneity for pseudocystic areas and solid; presence of edema.

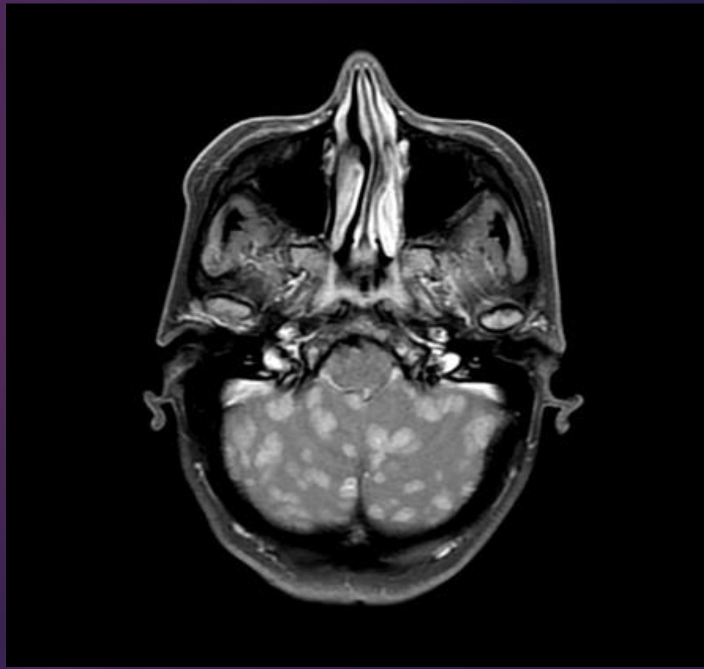
- Enhancement after m.d.c. usually in irregular pattern



BRAIN METASTASIS

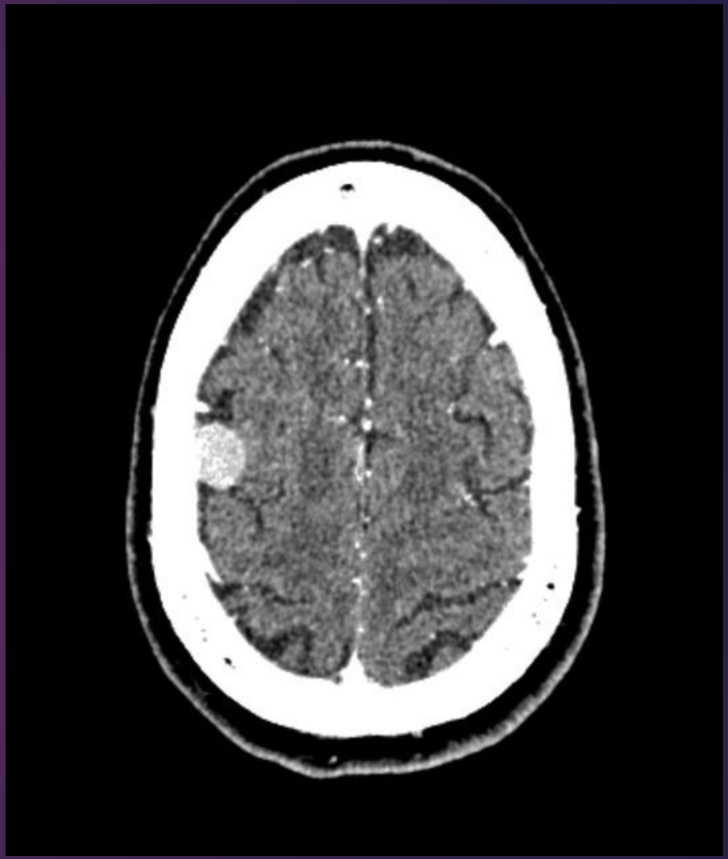
- estimated to account for approximately 25-50% of intracranial tumors in hospitalized patients
- On pre-contrast imaging, the mass may be isodense, hypodense or hyperdense (classically melanoma) compared to normal brain parenchyma with variable amounts of surrounding vasogenic edema.
- Following administration of contrast, enhancement is also variable and can be intense, punctate, nodular or ring-enhancing if the tumor has outgrown its blood supply.





MENINGEOMA

- Meningiomas are extra-axial tumors and represent the most common tumor of the meninges.
- non-contrast CT
- 60% slightly hyperdense to normal brain, the rest are more isodense
- 20-30% have some calcification 8
- >50% demonstrate variable adjacent edema (see below) 22
- post-contrast CT
- 72% brightly and homogeneously contrast enhance 8
- malignant or cystic variants demonstrate more heterogeneity/less intense enhancement



DIAGNOSIS

IMAGING

- CT
- MR
  - CONVENTIONAL IMAGING
  - ADVANCED IMAGING
    - Diffusion
    - Spettroscopy
    - Tractography
    - Perfusion

DIAGNOSIS

CT retains its role as an initial method
for the lower cost and greater availability compared to MRI

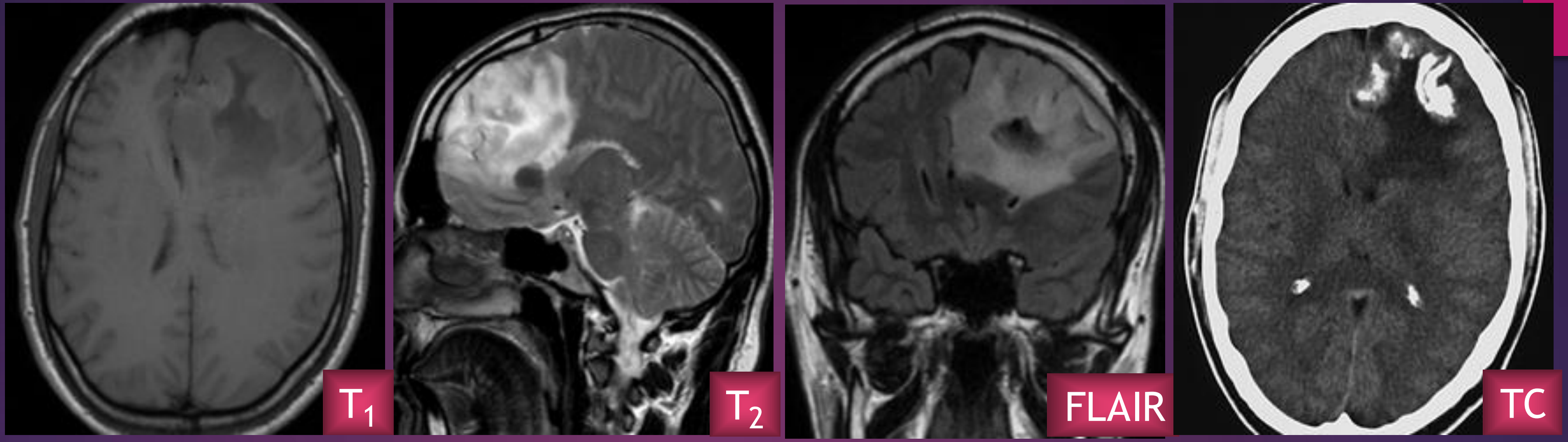
DIAGNOSIS

- MRI is the method with the highest possibility of accurate and complete diagnosis of the entire lesion for treatment

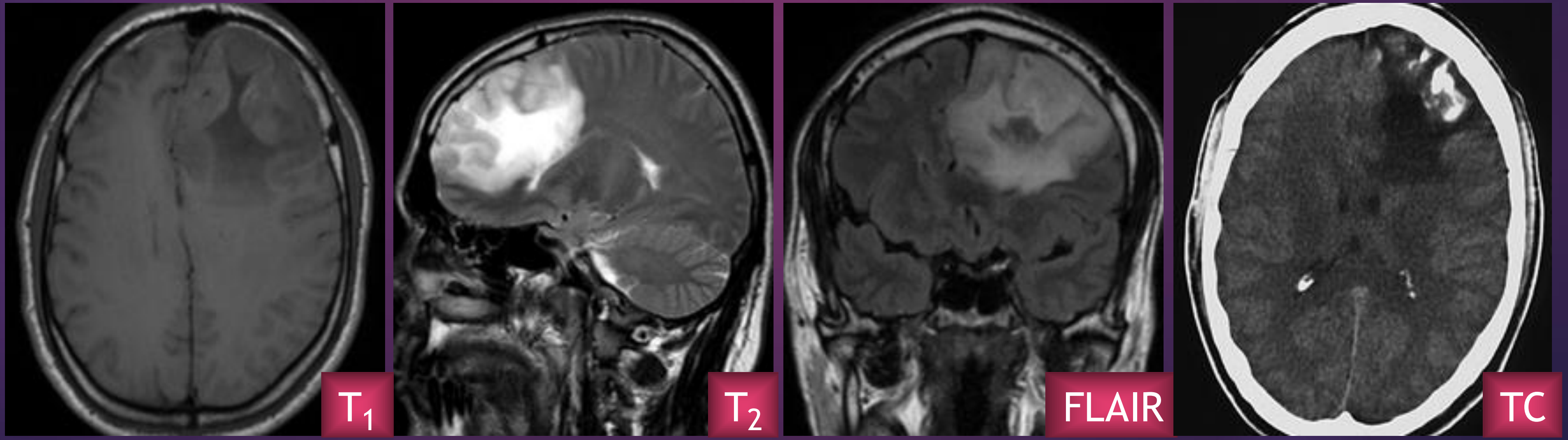
- High contrast resolution, multiplanar imaging offers high sensitivity in:
- - recognition
- Approach for the surgical or radiotherapy

- Multiparametricity allows an analysis of the structure, the differential diagnosis, the grading

DIAGNOSI



1) identification 2) localization 3) Growth mode 4) caracerization



IMAGING GOALS:

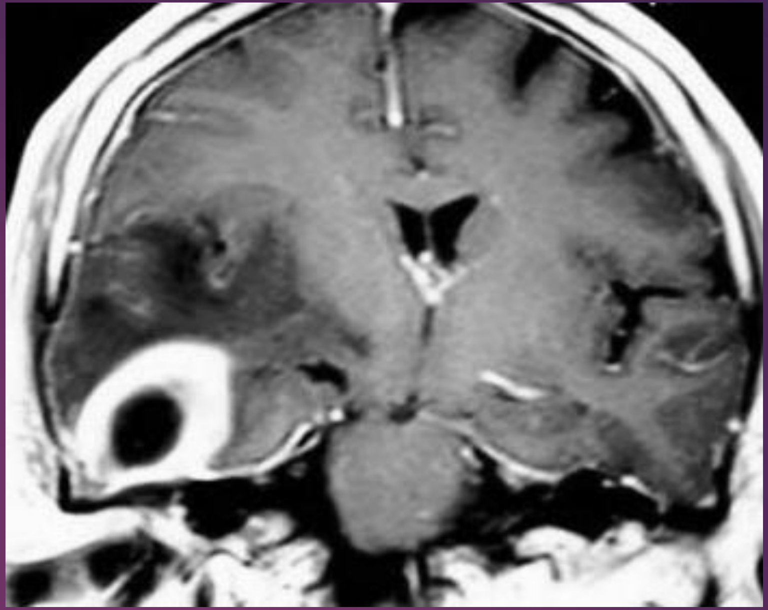
- MALIGNITY GRADE

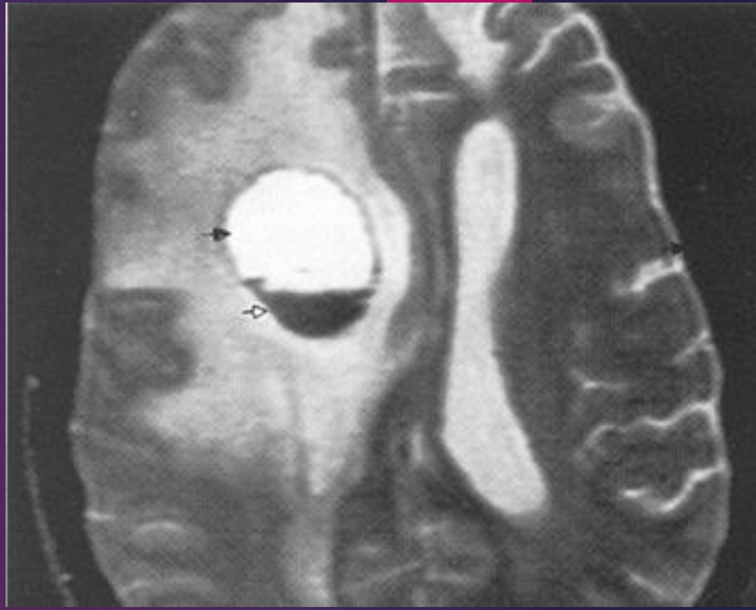
- NECROSIS
- HEMORRAGHE
- CONTRAST ENHANCEMENT
- EDEMA

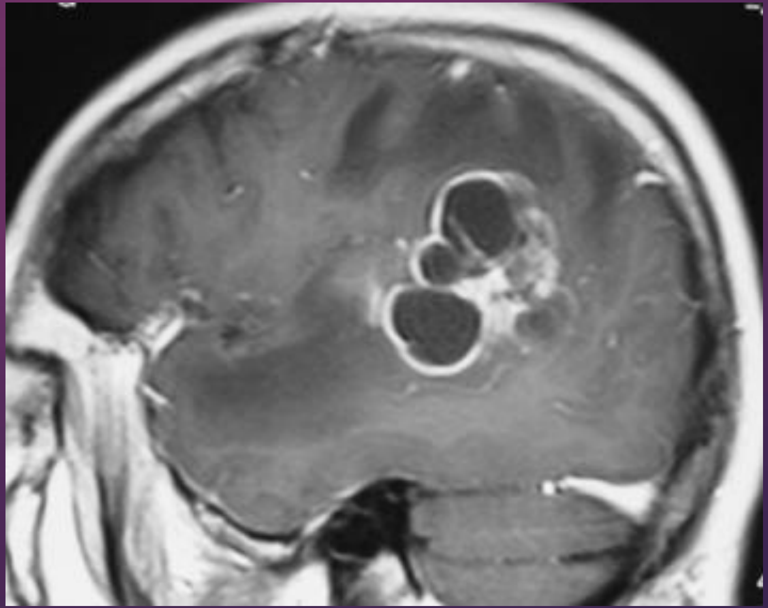
NECROSIS

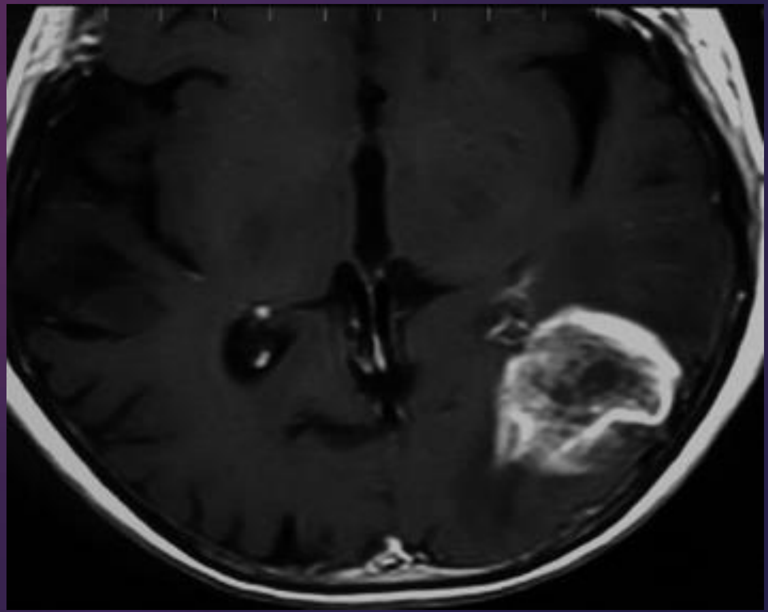
Negative prognostic element present in the more aggressive gliomas it is very significant for grading

- Ischemic
- Hemorragica
- Cystic









IMAGING CONVENZIONALE : L'EMORRAGIA

Micro-emorragie in tutti i gliomi.
Fino al 10% degli ematomi spontanei da neoplasie maligne.
Nel 14% delle metastasi e nel 5% dei gliomi:

1. GBM
2. Oligodendrogliomi

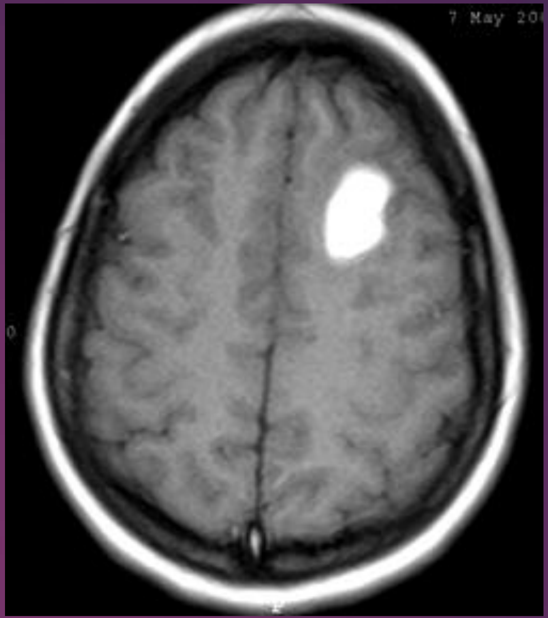
i

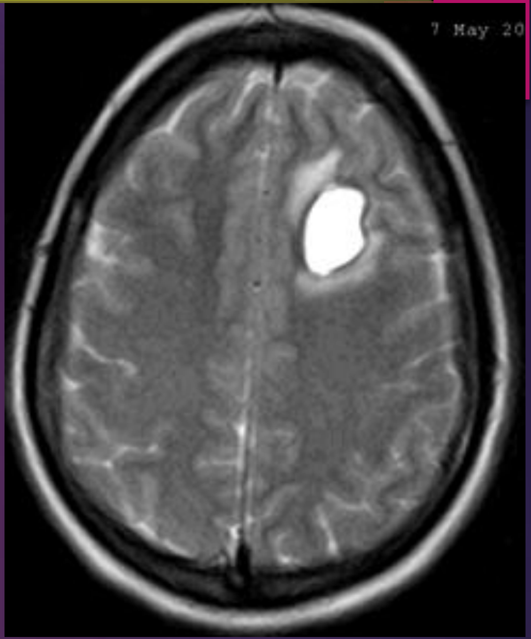
- Segnale eterogeneo (coesistenza di diversi stadi evolutivi per sanguinamenti ripetuti)
- Lenta evoluzione dell'ossidazione dell'Hb (ipossia tumorale)
- Livelli
- Scarsa emosiderina marginale
- Parti solide del tumore
- Edema ed effetto massa persistenti

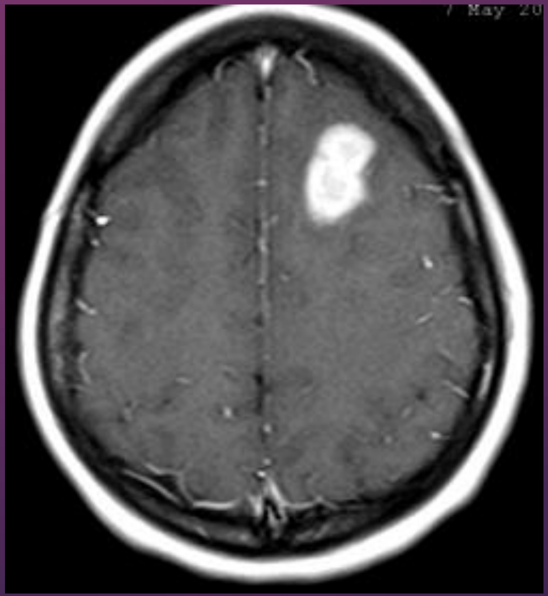
HEMORRHAGHE

- Micro-hemorrhages in all gliomas.
- Up to 10% of spontaneous hematomas from malignant neoplasms.
- In 14% of metastases and 5% of gliomas:

- GBM
- Oligodendrogliomas







CONTRAST ENHANCEMENT

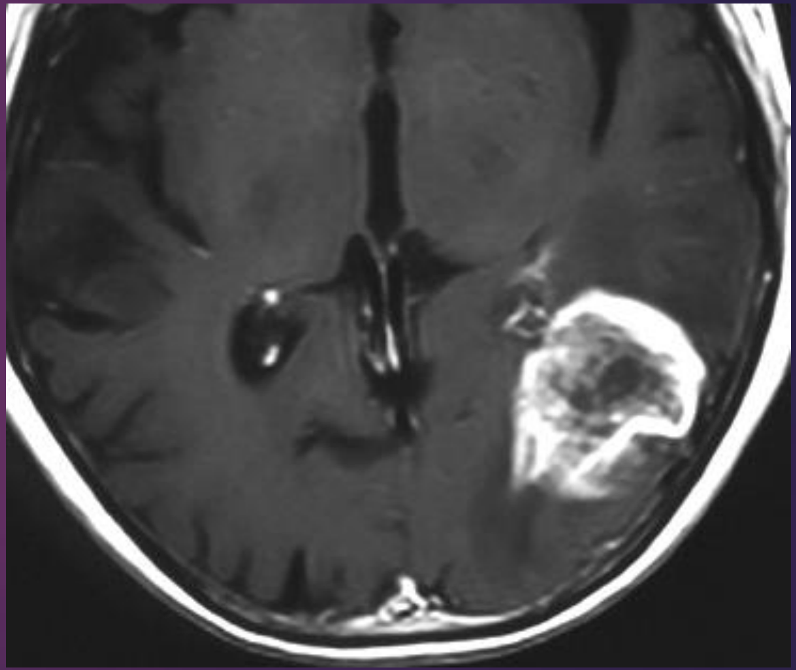
Depending on:

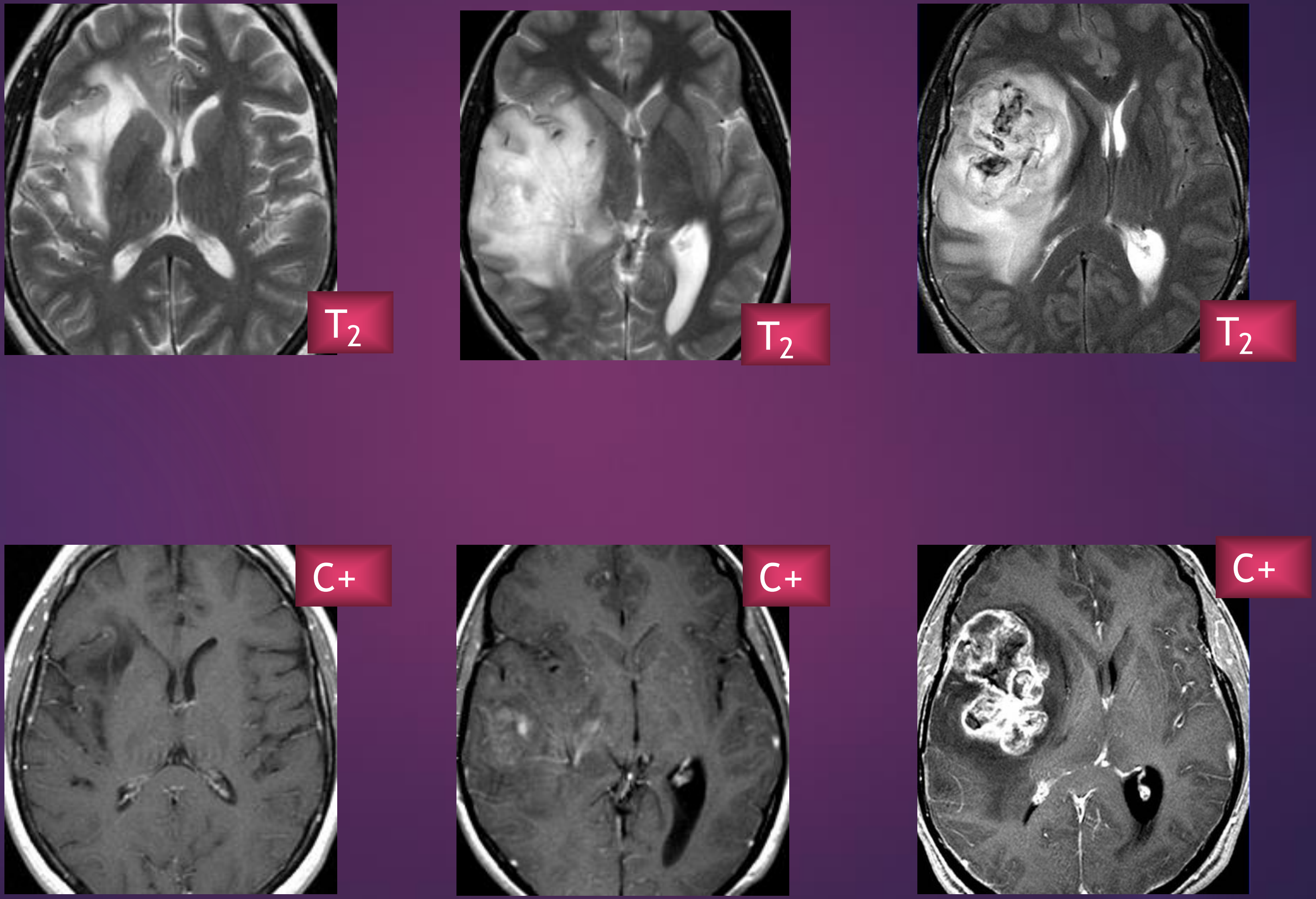
amount of tumor vascularization

state of the E-E barrier

size of the extravascular spaces

.

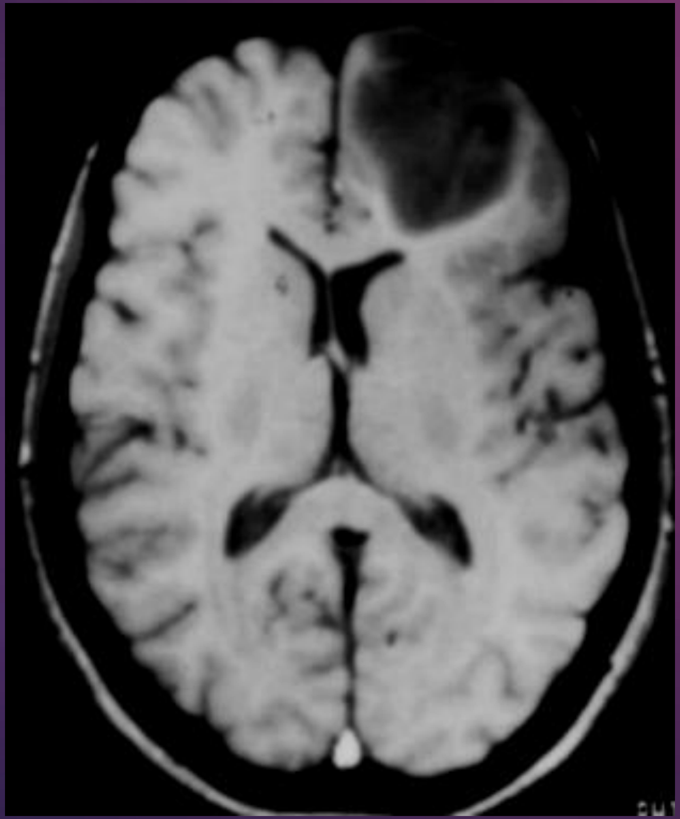


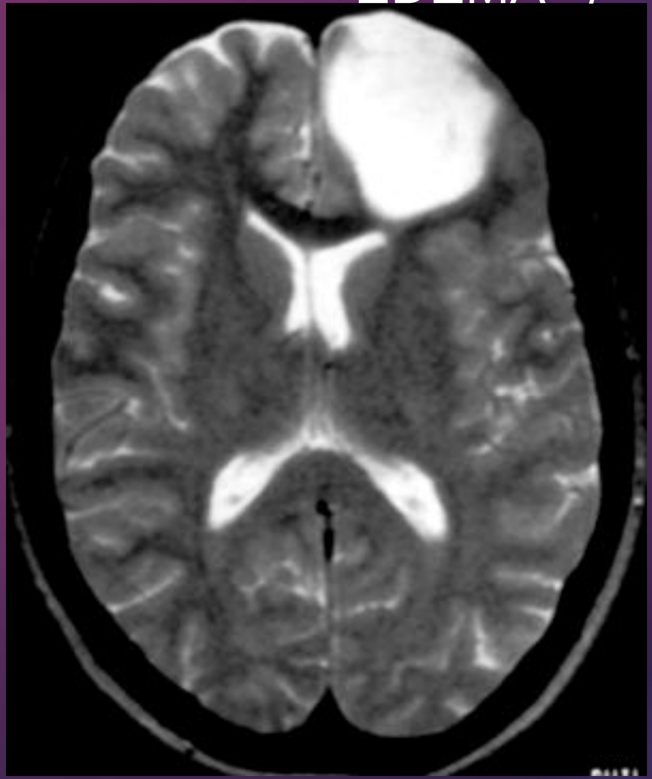

T_2
T_2
T_2
C+
C+
C+

EDEMA

LOW GRADE

LIMITS + DEFINED
SIGNAL + HOMOGENEOUS,
(microcysts poor cellularity)
EDEMA +/-

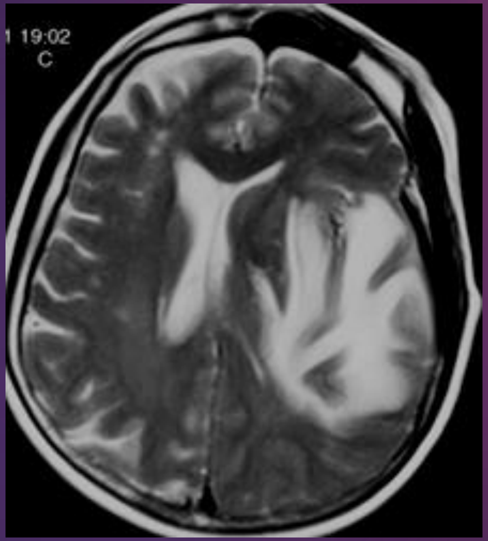


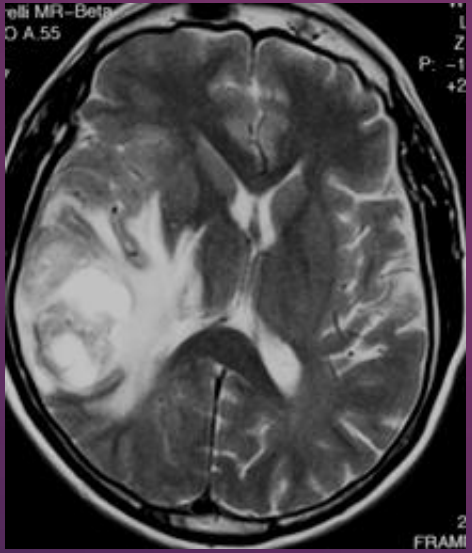


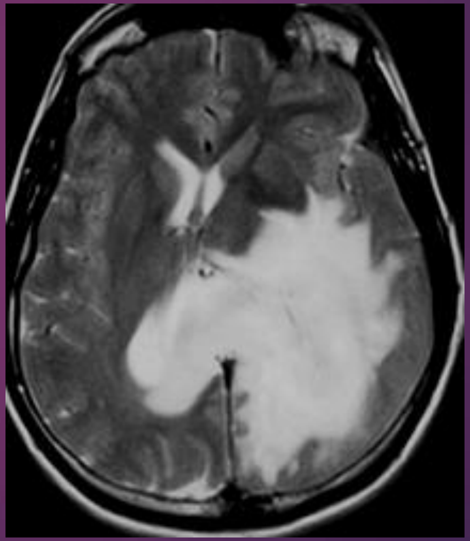
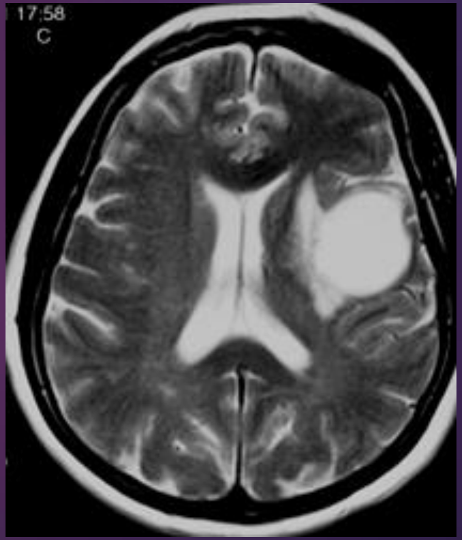
EDEMA

HIGH GRADE → DISHOMOGENEOUS

EDEMA: VASOGENIC +++





CNS INFECTIONS

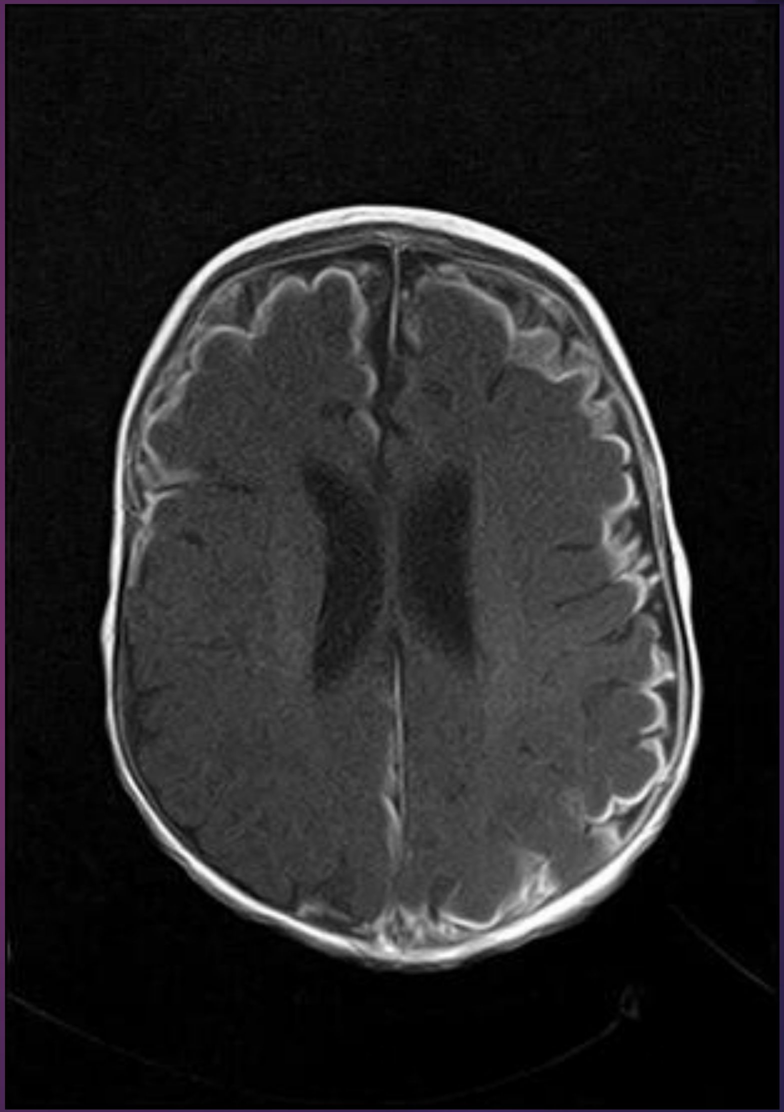
- Infections can involve any part of the CNS, including the meninges, ventricular system, brain parenchyma, cerebellum, brainstem, and spinal cord. Often, multiple parts of the CNS are involved at the same time (e.g. in meningoencephalitis).
- Bacterial, fungal, and parasitic pathogens are derived from living organisms and affect the brain, spinal cord, or meninges. Infections due to these pathogens are associated with a variety of neuroimaging patterns that can be appreciated at magnetic resonance imaging in most cases.
- Bacterial infections, most often due to Streptococcus, Haemophilus, and Neisseria species, cause significant meningitis, whereas the less common cerebritis and subsequent abscess formation have well-documented progression, with increasingly prominent altered signal intensity and corresponding contrast enhancement.

CEREBRAL ABSCESS

- Cerebral abscesses represent focal areas of infection within brain parenchyma, usually containing pus and having a thick capsule. They typically have enhancing walls and can mimic a number of other significant pathologies.
- CT
- first line imaging
- low-density lesion with peripheral enhancement
- surrounding low-density white-matter edema
- MRI
- more sensitive
- pus is bright on T2 weighted images
- the wall of the abscess typically enhances post contrast

BACTERIAL MENINGITIS

- a life-threatening CNS infectious disease affecting the meninges, with elevated mortality and disability rates.
- Reported CT findings include sulcal effacement and slight hyperattenuation on NECT but false positives are common .
- MRI
- On post-contrast MRI, the most common positive findings are thin and linear leptomeningeal enhancement (however, only seen in 50% of patients.



Thank You