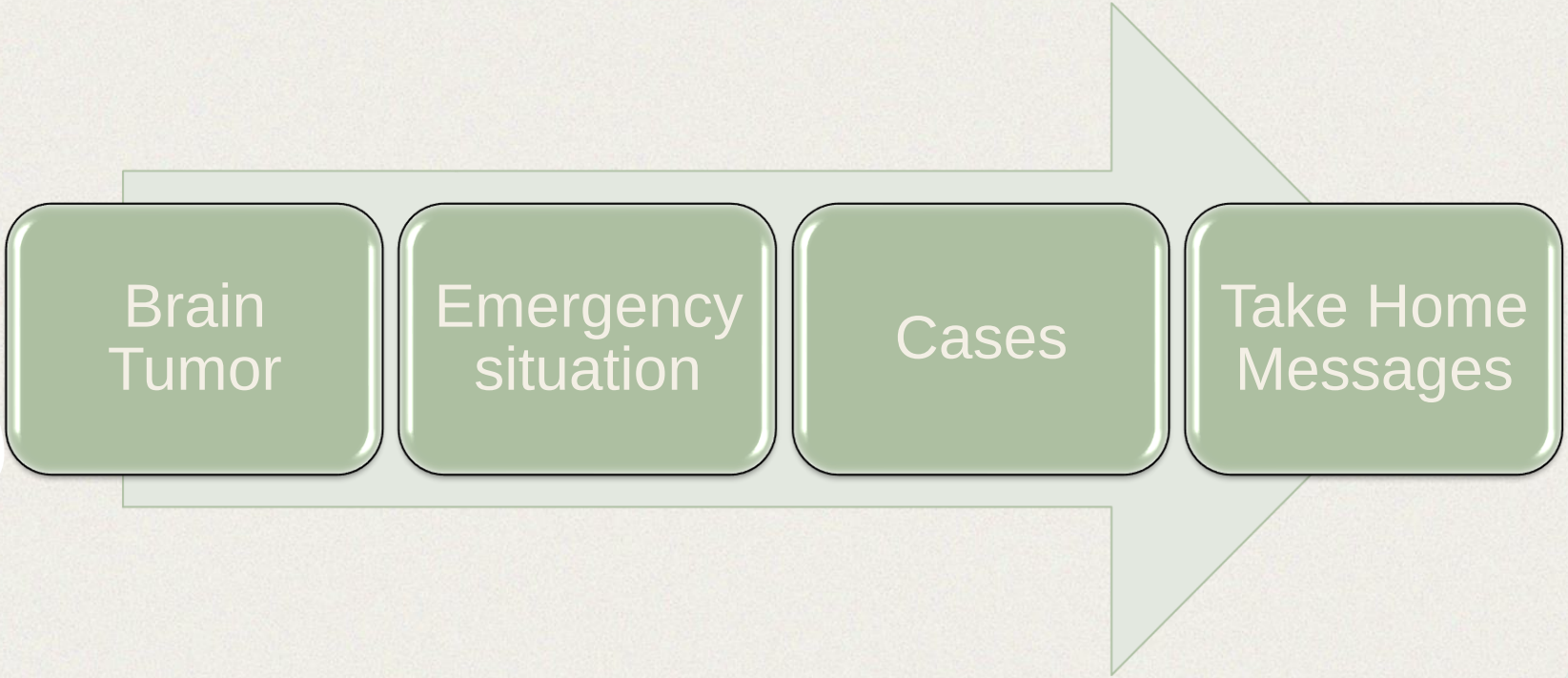
Emergence of Brain Tumor: Role of Imaging

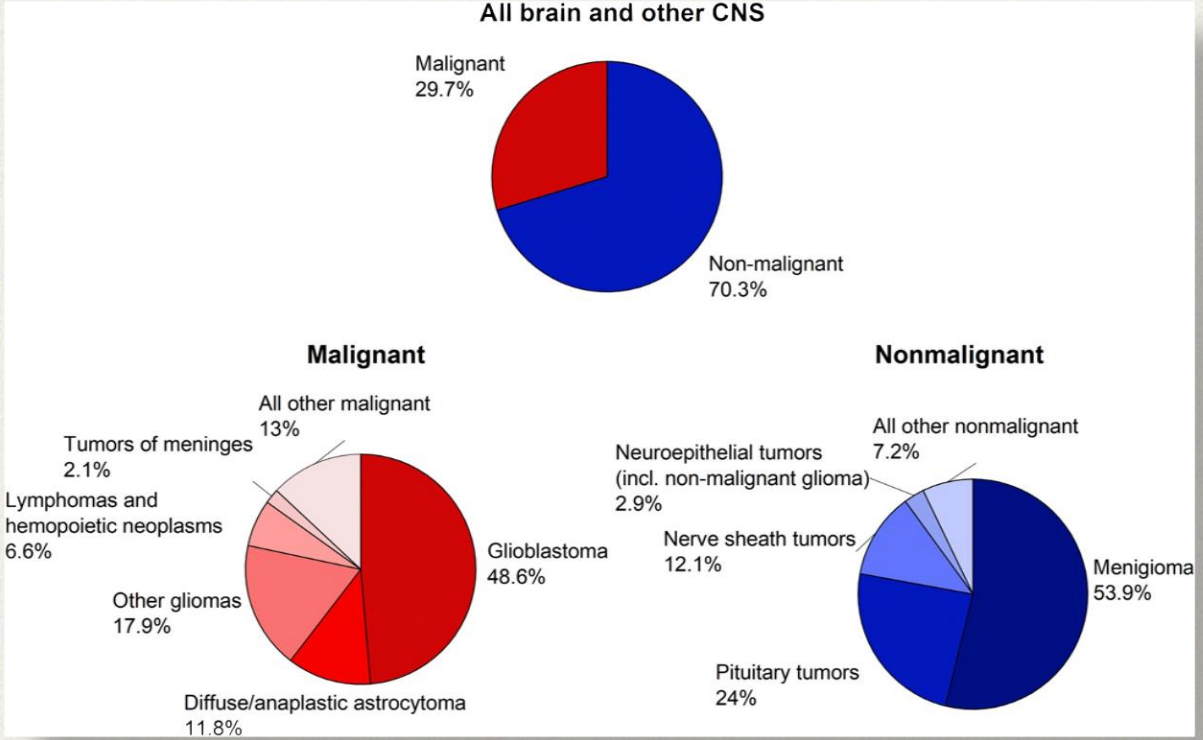
Yuyun Yueniwati
Radiology Department, Faculty of Medicine
Universitas Brawijaya Malang

Overview



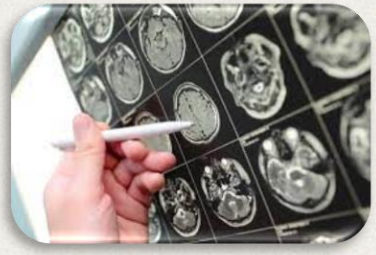
Brain Tumor

Arise from the normal constituents of the brain and its coverings (meninges)



Brain and other central nervous system tumor statistics, 2021

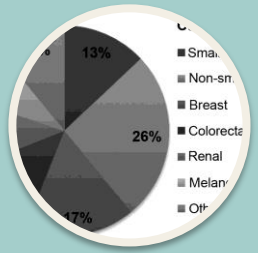
Difference



Malignant tumors are cancerous and can spread rapidly into other parts of the brain, sending cancerous cells into surrounding tissue.

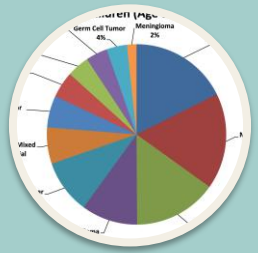
Benign tumors can grow but do not spread.

Facts



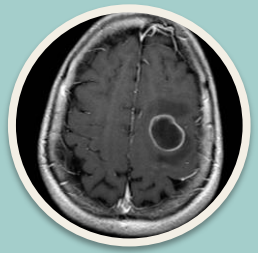
Overall incidence:

5-13 cases per 100,000

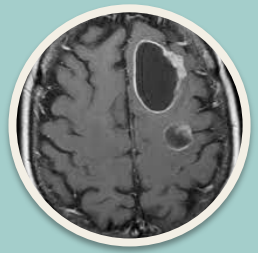


Incidence in children:

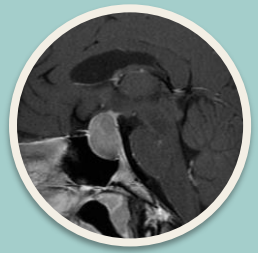
2-4 cases per 100,000



80% of all intracranial tumors are supratentorial



40% are metastases



70% of tumors in 1-year-olds to adolescents are in the posterior fossa

Modalities

CT Scan

MRI

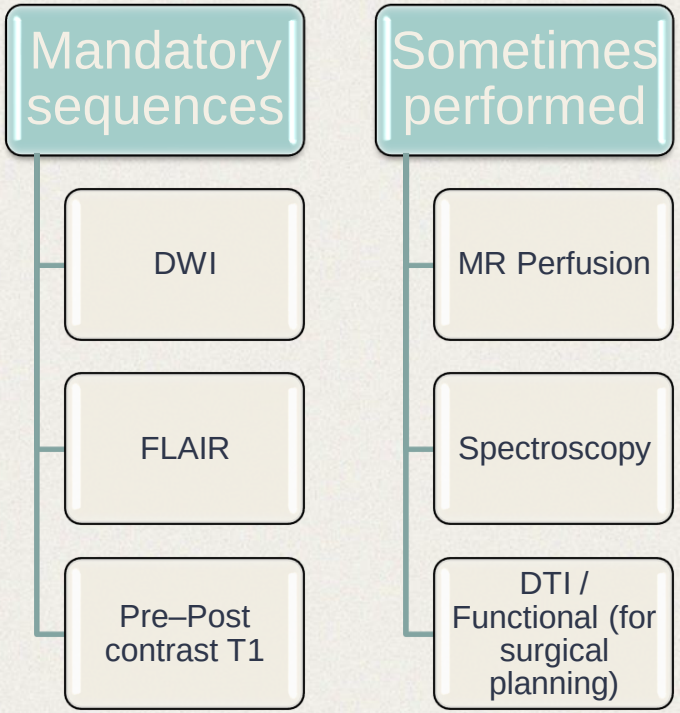
CT is the screening tool for initial identification of a **potential mass** and then evaluating **complications** such as

- hemorrhage,
- edema,
- mass effect,
- hydrocephalus,
- and herniation.

MRI is the mainstay of tumor evaluation, used to

- assess tumor type,
- tumor progression,
- tumor details.

MRI


Mandatory sequences
DWI
FLAIR
Pre–Post contrast T1
Sometimes performed
MR Perfusion
Spectroscopy
DTI / Functional (for surgical planning)

Emergency condition (clinical)

Acute neurological deterioration [life-threatening decrease in GCS or functional deterioration (motor or visual function)]

Significant midline shift in Brain CT-Scan (< 1cm)

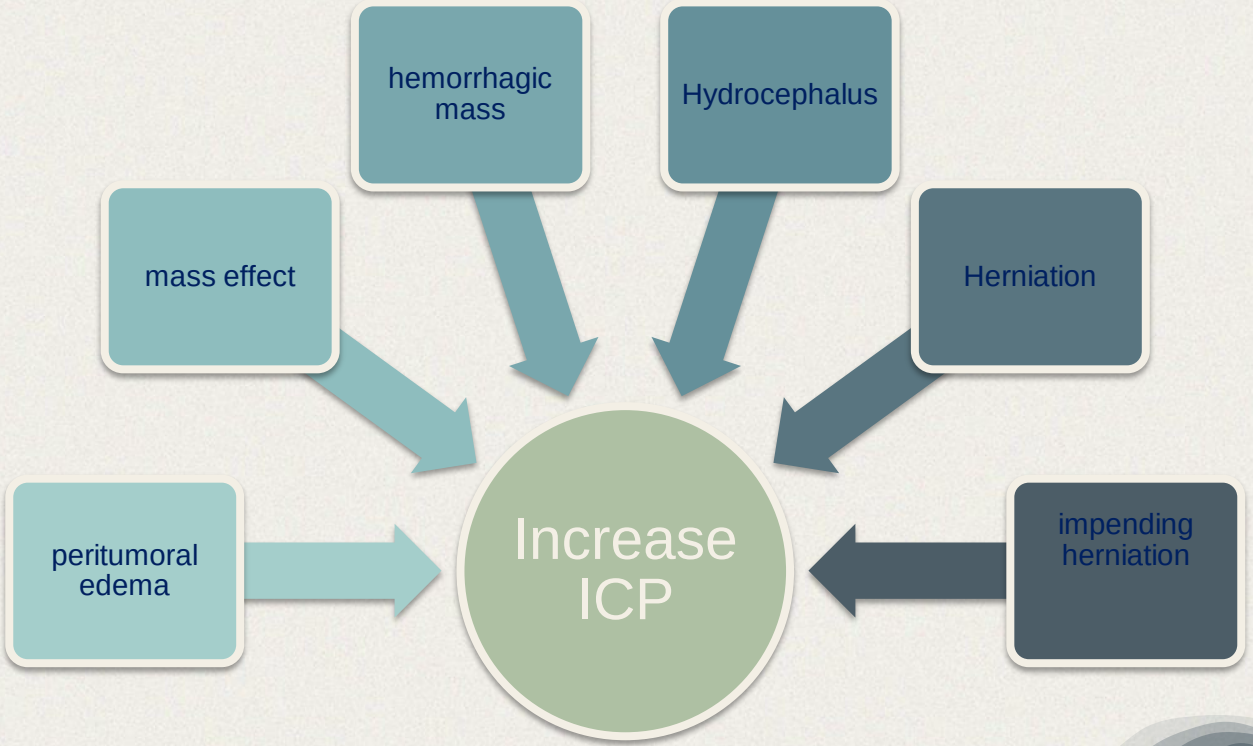
The response to medical therapy trial to decrease ICP is either unexpected or failed

The tumor mass is the main cause of deterioration:

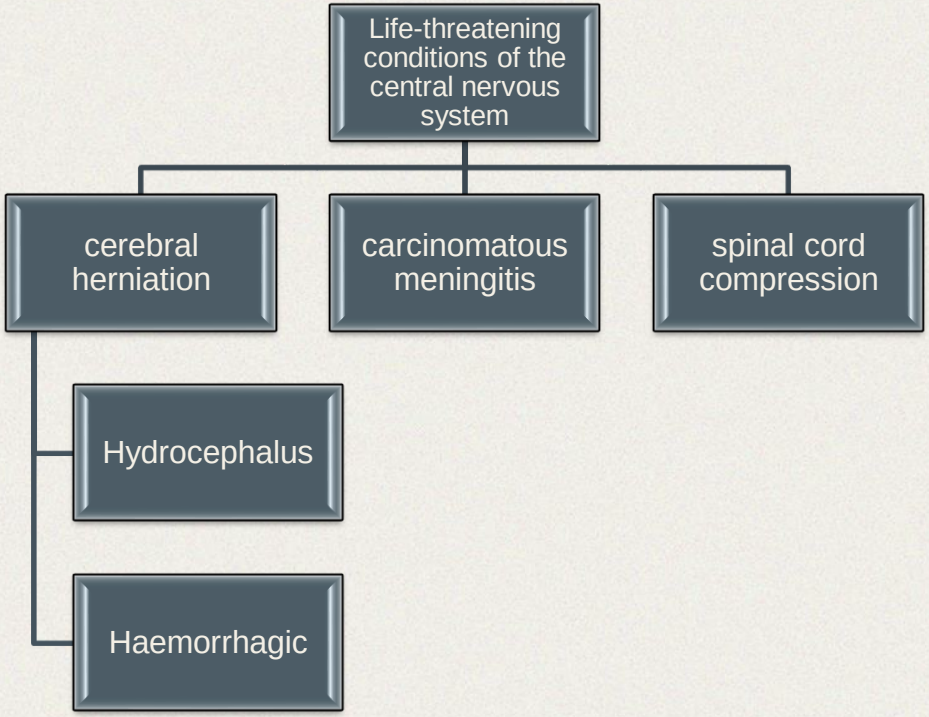
- Strong indication: tumor size maximum diameter > 4 cm or tumors that involve or compress the temporal lobe
- Relative Indication: haemorrhagic tumors

Clinical presentation and epidemiology of brain tumors firstly diagnosed in adults in the Emergency Department: a 10-year, single center retrospective study, 2017

Emergency condition (radiology)



Clinical - Radiology Emergencies

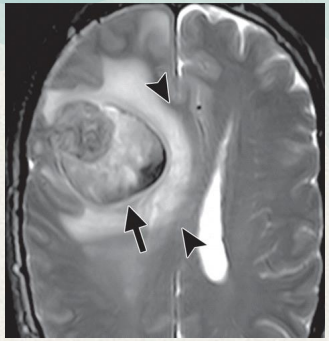


Brain tumor emergencies

Directly related to the tumor

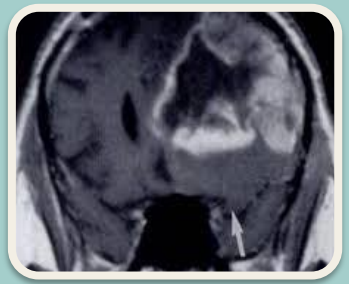
Related to radiation therapy

Related to surgical procedure

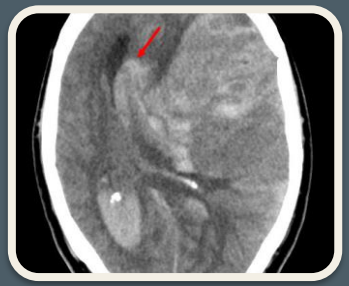


Directly related to the tumor

Brain (cerebral) herniation

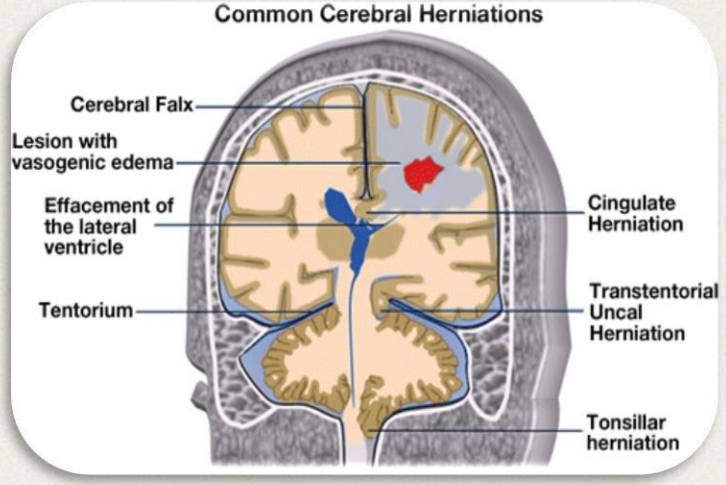


shift of brain tissue from its normal location, into an adjacent space as a result of mass effect

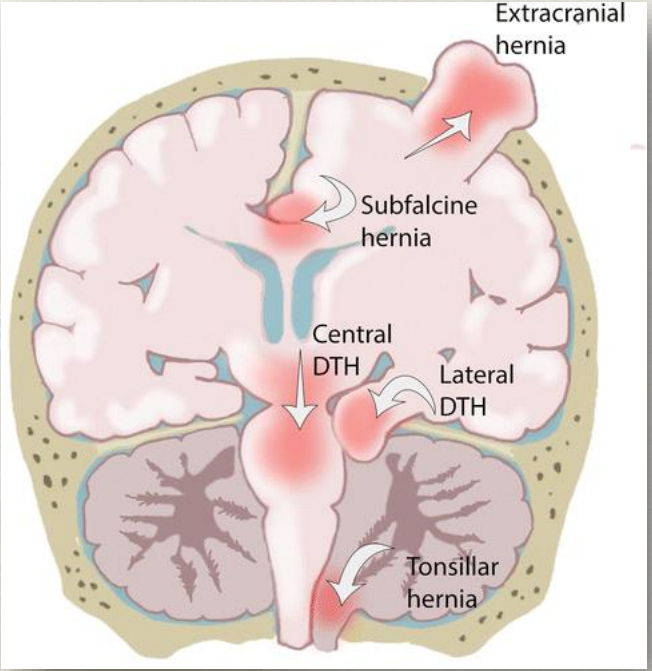


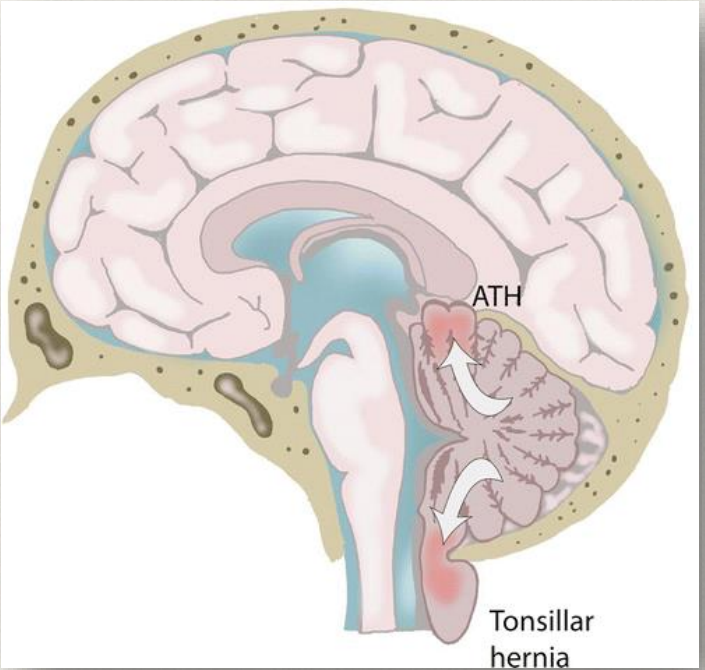
life-threatening condition that requires prompt diagnosis

Type of Hernia	Clinical Information and Neurologic Syndromes	Anatomic Landmarks	Direction of Mass Effect	Displaced Structure(s)	Indirect Signs
Subfalcine	Anterior cerebral artery syndrome	Midline, falx cerebri, cingulate gyrus, CC, and Monro foramen	Medial and anterior, beneath falx	Cingulate gyrus and CC	Dilatation of contralateral ventricle due to compression of contralateral foramen of Monro
Transtentorial descending	Paralysis of third nerve, compression of PCA and choroidal arteries (occipital and medial temporal infarction)	Tentorium, perimesencephalic cisterns	Downward from supratentorial compartment, through tentorial incisura	Anterior: uncus Posterior: parahippocampal gyrus, isthmus of fornical gyrus, and anterior portion of lingual gyrus Central: diencephalon, midbrain, and pons	Displacement, rotation, and elongation of brainstem Anterior or posterior: widening of contralateral ventricular atrium and temporal horn Central: hydrocephalus
Transtentorial ascending	Manifestations of increased ICP, brainstem and cerebellar compression PCA and SCA compression (occipital cerebral and superior cerebellar infarction)	Tentorium, superior cerebellar and quadrigeminal cisterns	Upward from posterior fossa through tentorial incisura	Superior cerebellar hemispheres and vermis, superior and inferior colliculi, midbrain	Obliteration of ipsilateral perimesencephalic and contralateral crural cisterns Anterior displacement of brainstem, hydrocephalus
Tonsillar	Manifestations of brainstem and cerebellar compression PICA compression (posterior inferior cerebellum, inferior cerebellar vermis, and lateral medulla infarction)	Foramen magnum (McRae line) Cerebellar tonsil	Downward through foramen magnum	Cerebellar tonsils Pons Medulla	Effacement of perimedullary CSF through foramen magnum Obliteration of cisterna magna and fourth ventricle Vertical orientation of folia of tonsil

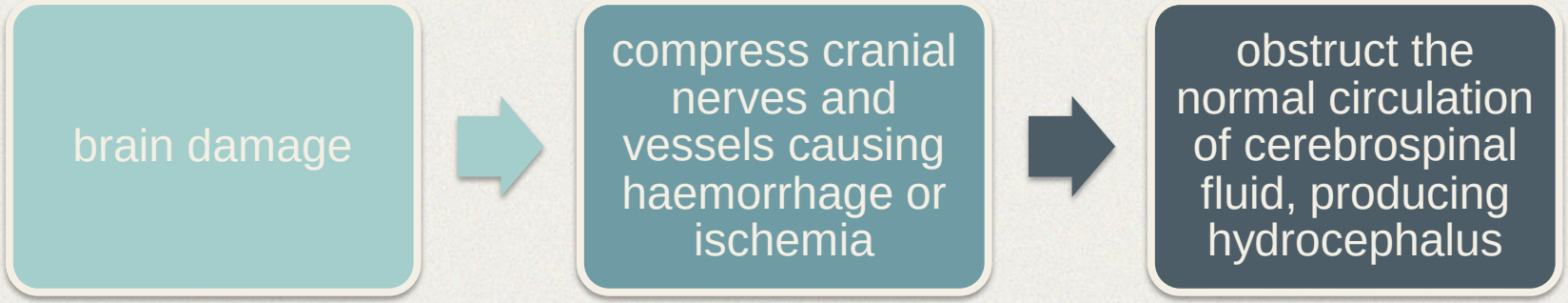


Types of Cerebral Herniation and Their Imaging Features, 2019

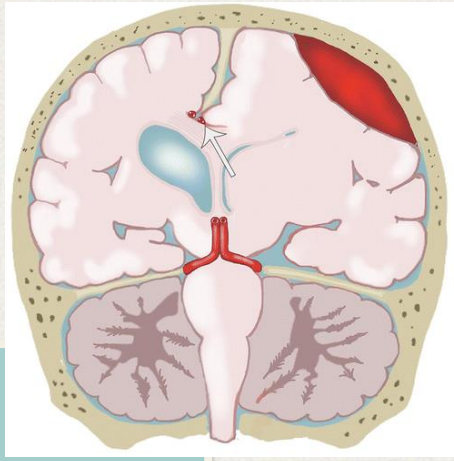

Extracranial hernia
Subfalcine hernia
Central DTH
Lateral DTH
Tonsillar hernia


ATH
Tonsillar hernia

Complications



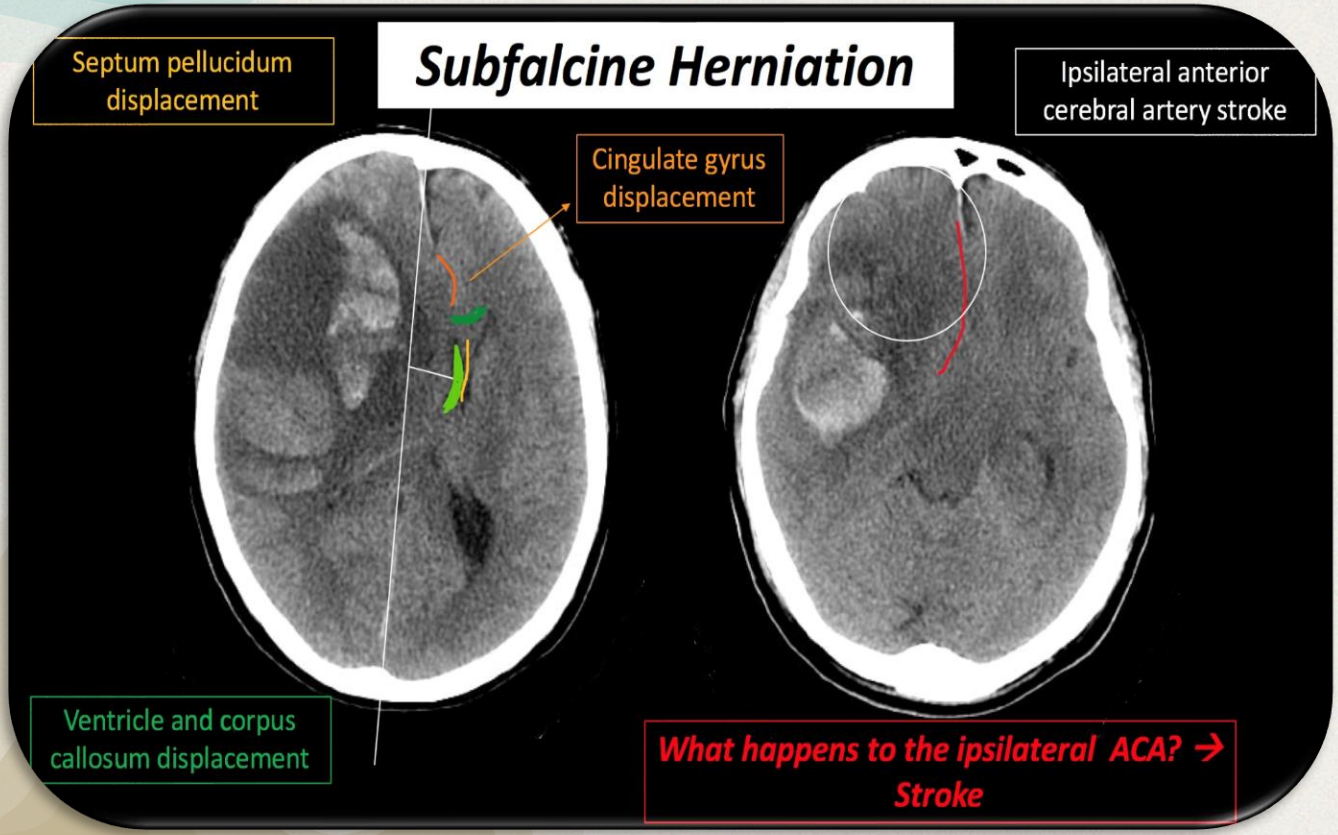
Subfalcine herniation



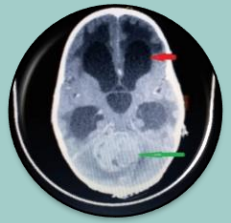
midline shift or cingulate hernia

most common cerebral herniation pattern

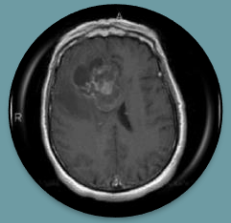
generally caused by unilateral frontal, parietal or temporal lobe disease that creates a mass effect with medial direction of the ipsilateral cingulate gyrus beneath the free edge of the falx cerebri due to raised intracranial pressure


Subfalcine Herniation
Septum pellucidum displacement
Cingulate gyrus displacement
Ipsilateral anterior cerebral artery stroke
Ventricle and corpus callosum displacement
What happens to the ipsilateral ACA? → Stroke

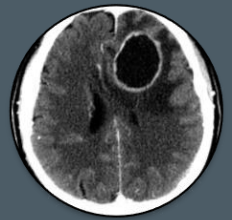
Complication



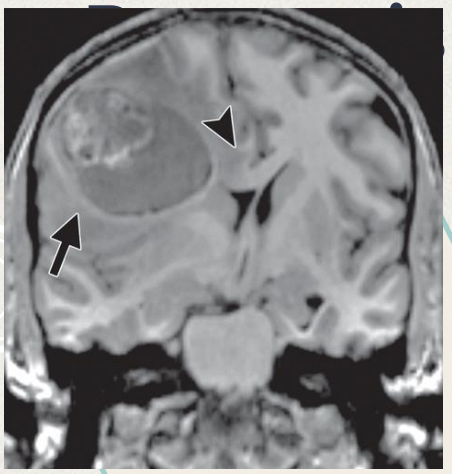
hydrocephalus due to obstruction of the foramen monro



ACA territory infarct due to compression of ACA branches, specifically the pericalossal artery

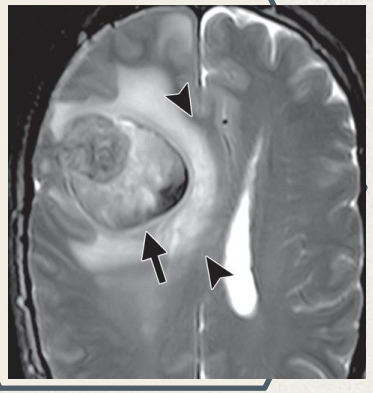


focal necrosis of the cingulate gyrus due to direct compression against the falx cerebri



< 5 mm → good outcome

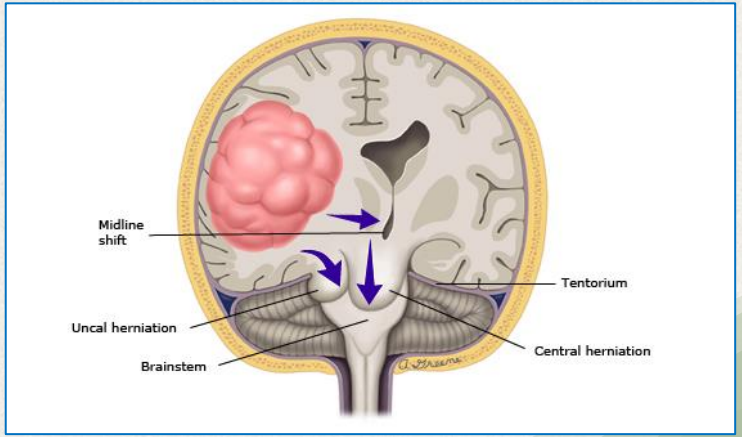
> 15 mm → poor outcome

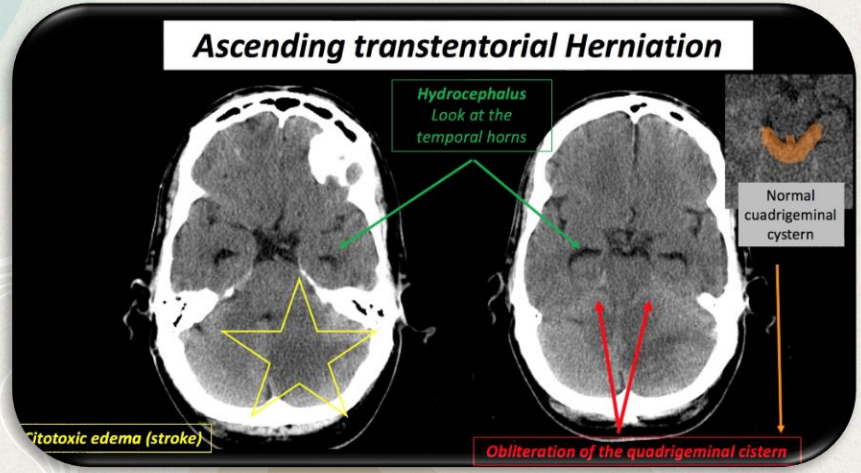


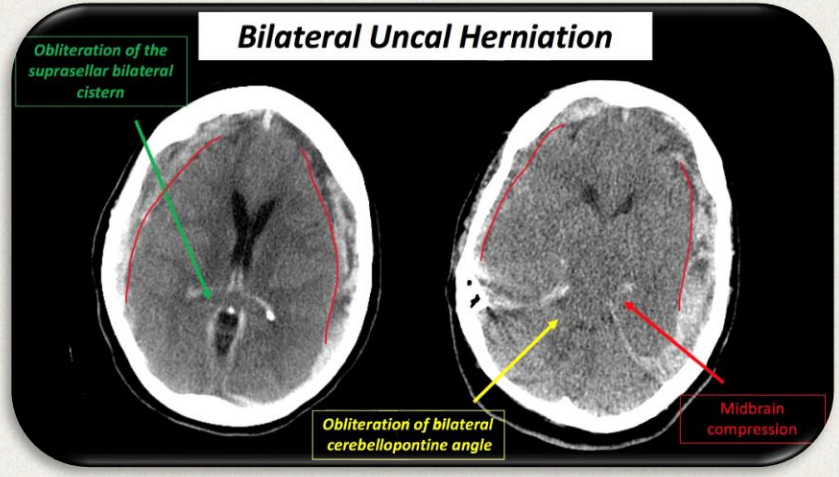
Trans tentorial herniation

type of brain herniation broadly divided into two major types based on the direction of herniation:

- downwards due to supratentorial mass effect
- upward due to infratentorial mass effect




Ascending transtentorial Herniation
Hydrocephalus
Look at the
temporal horns
Normal
cuadrigeminal
cystern
Obliteration of the quadrigeminal cistern


Bilateral Uncal Herniation
Obliteration of the
suprasellar bilateral
cistern
Obliteration of bilateral
cerebellopontine angle
Midbrain
compression

Downward trans tentorial herniation

Lateral Herniation

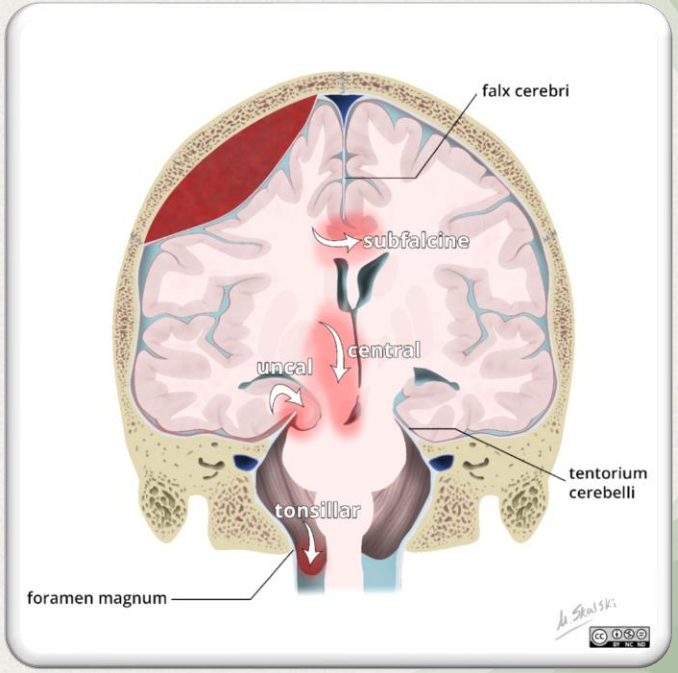
unilateral or asymmetric mass effect

- predominantly anterior (uncal herniation)
- posterior (posterior parahippocampal gyrus and anterior part of the lingual gyrus)

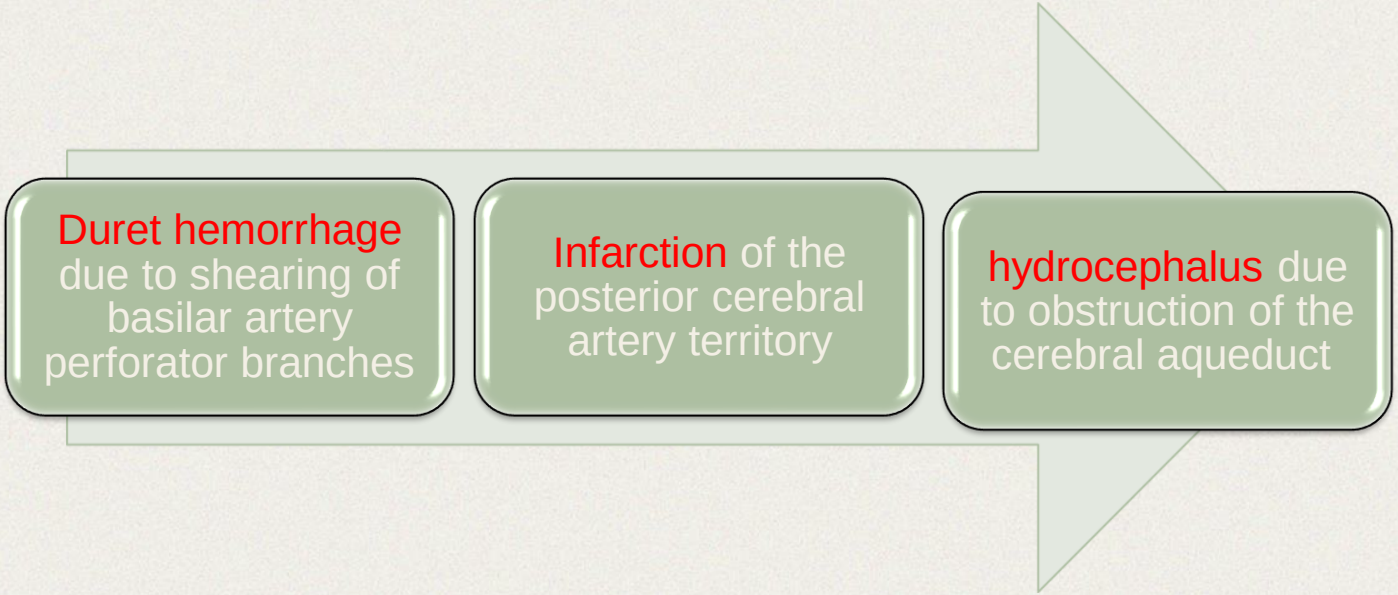
Anterior and posterior herniation can occur separately or together

Central Herniation

Symmetric or severe mass effect resulting in downward displacement of the thalami and midbrain

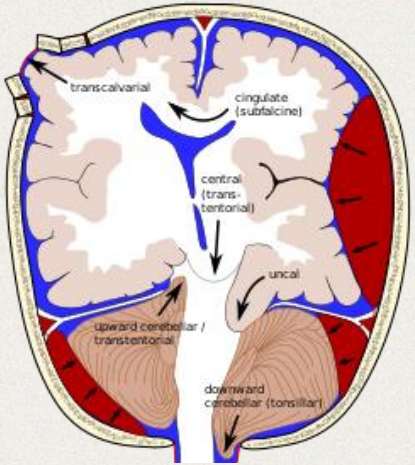


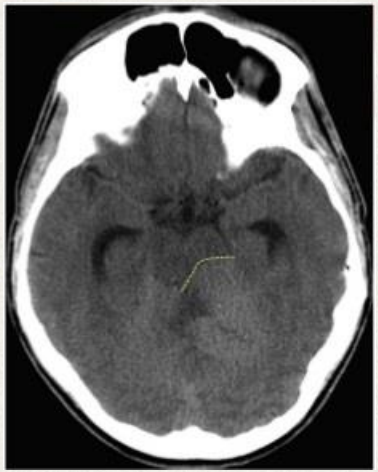
Complication



Upward trans tentorial herniation

- situation where space-occupying lesions in the posterior cranial fossa cause superior displacement of superior parts of the cerebellum through the tentorial notch





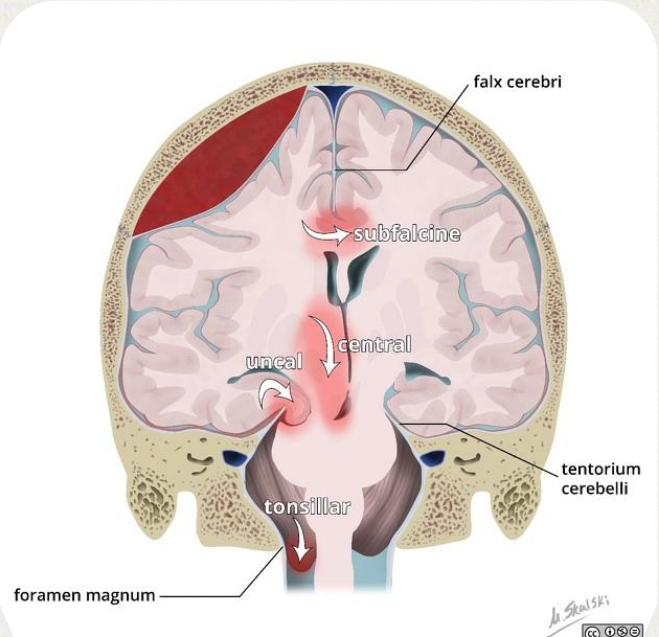
Radiographic features

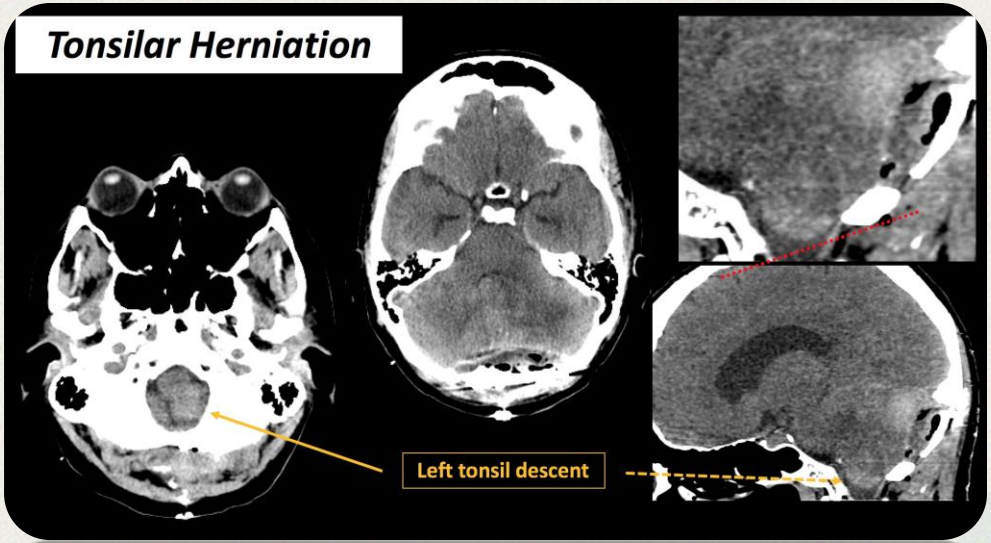
General imaging features include:

- flattening or reversal of the smile-shaped quadrigeminal cistern
- "spinning top" appearance of midbrain due to bilateral compression of the posterior aspect of the midbrain
- may be associated with an infarct in the territory of posterior cerebral and superior cerebellar arteries due to arterial compression
- hydrocephalus as the result of the pressure of the cerebellum on the cerebral aqueduct

Tonsilar Herniation

- characterized by the inferior descent of the cerebellar tonsils below the foramen magnum >3 mm .
- Clinically, the presence of tonsillar herniation is often called **coning**.





Carcinomatous Meningitis

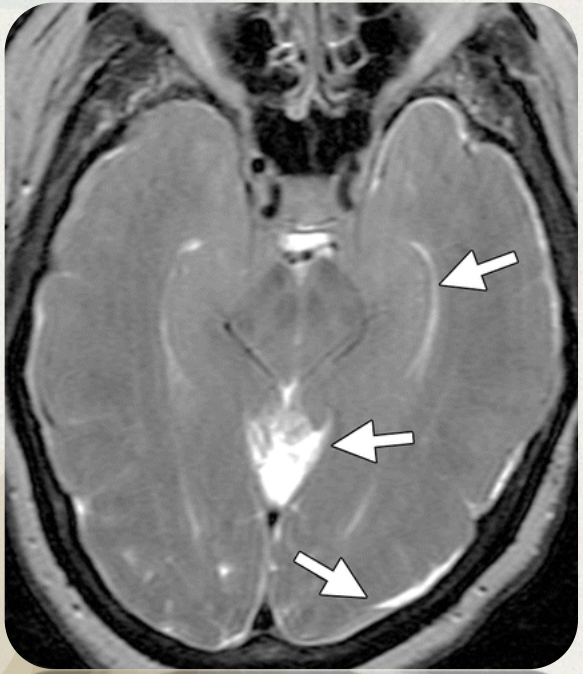
Metastatic involvement of the leptomeninges occurs in approximately 8% of cancer patients

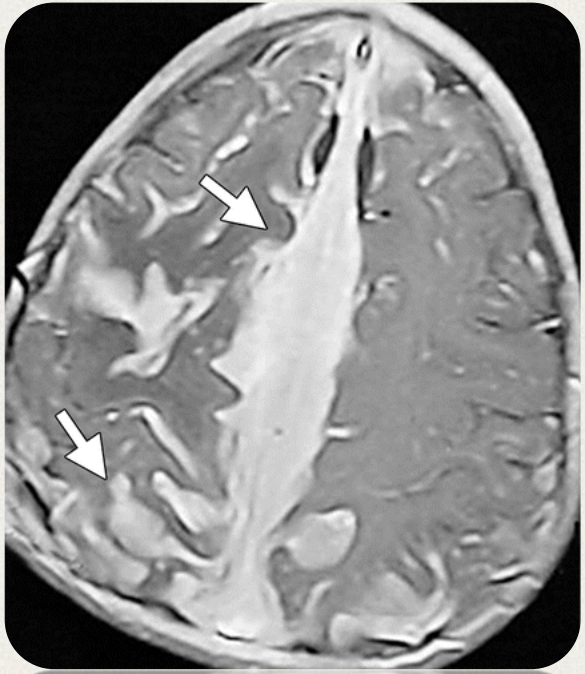
>> Ca Mamma

- lung,
- melanoma,
- non-Hodgkin lymphoma,
- leukemia

Up to two-thirds of patients with carcinomatous meningitis may demonstrate abnormal findings at contrast material–enhanced MR imaging

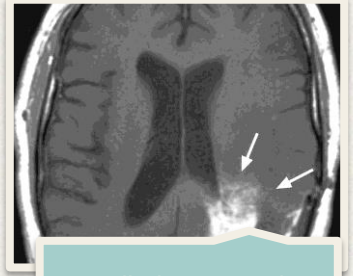
- linear or nodular enhancement of the sulci,
- cisternal spaces, and ventricles with associated effacement;
- diffuse or asymmetric nodular enhancement;
- hydrocephalus;
- cranial nerve enhancement



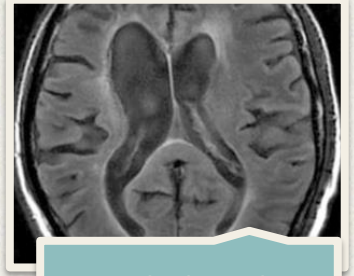


Carcinomatous meningitis represents advanced-stage disease and usually has a dismal prognosis.

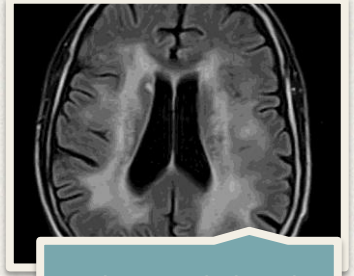
Related to Radiation Therapy



Radiation necrosis

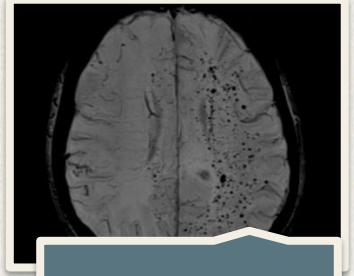


Cerebral atrophy

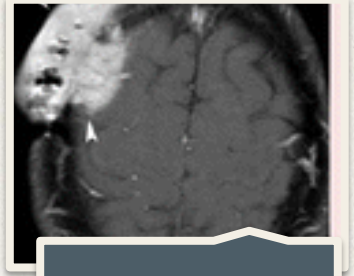


Leukoencephalopathy

Gliosis



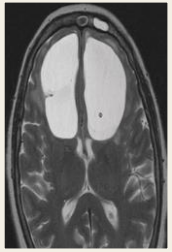
Vascular anomalies



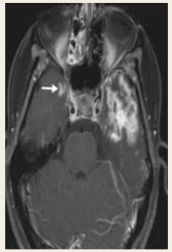
Secondary neoplasm

Cerebral Radiation Necrosis

radionecrosis refers to necrotic degradation of brain tissue following intracranial or regional radiation

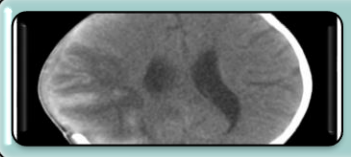


can occur when radiotherapy is used to treat primary CNS tumors, metastatic disease, or head and neck malignancies

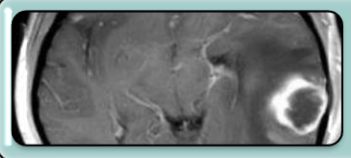


usually seen from 2 to 32 months after therapy, with 85% of cases occurring within 2 years

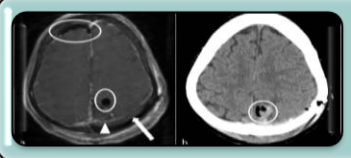
Related to Surgical Procedure



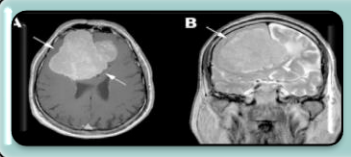
Cerebral edema



Herniation



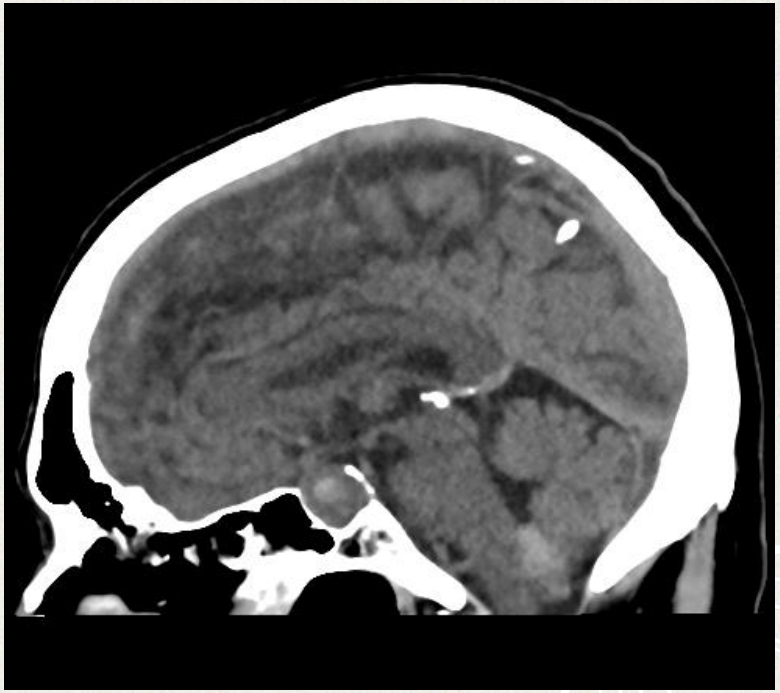
Hemorrhagic

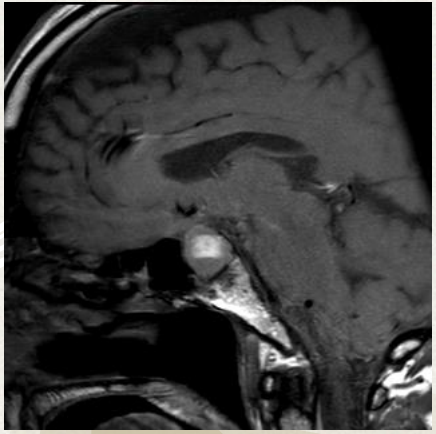


Infection

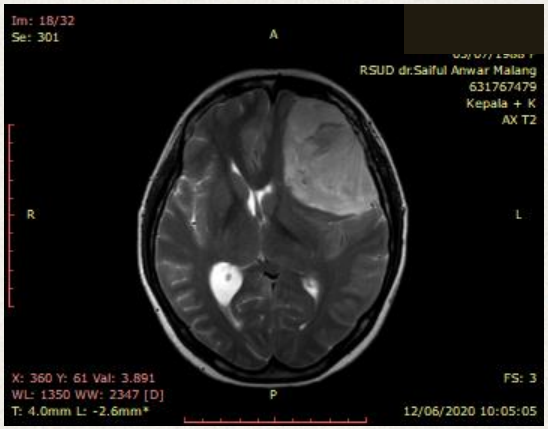
Cases

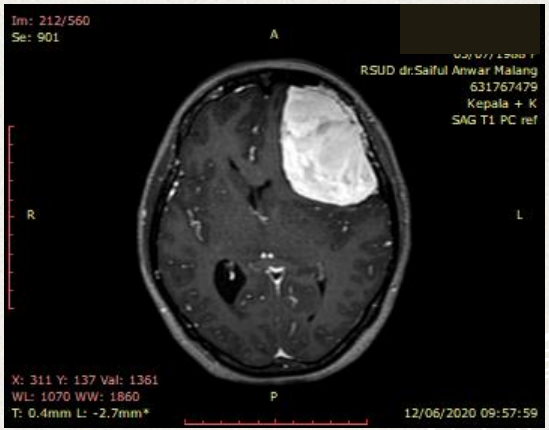
Female , 60 YO ; acute cephalgia; midriasis, acute visual defisit



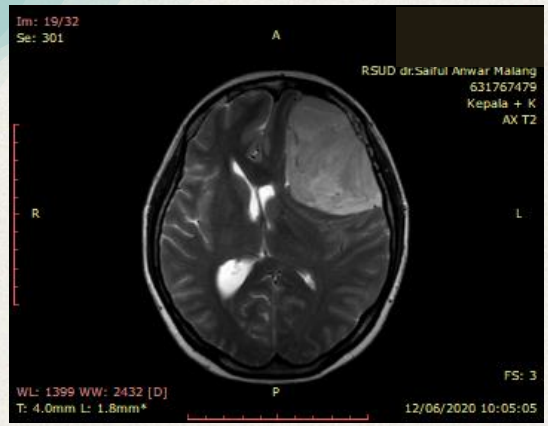


Female ; 33 YO; Chronic progressive headache






Im: 201/560
Se: 201
A
RSUD dr.Saiful Anwar Malang
631767479
Kepala + K
SAG T1 ref
R
L
P
X: 318 Y: 225 Val: 1028
WL: 1070 WW: 1860
T: 0.4mm L: 1.7mm*
12/06/2020 09:57:59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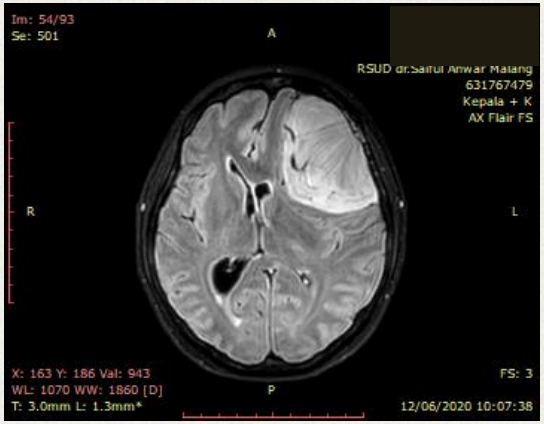
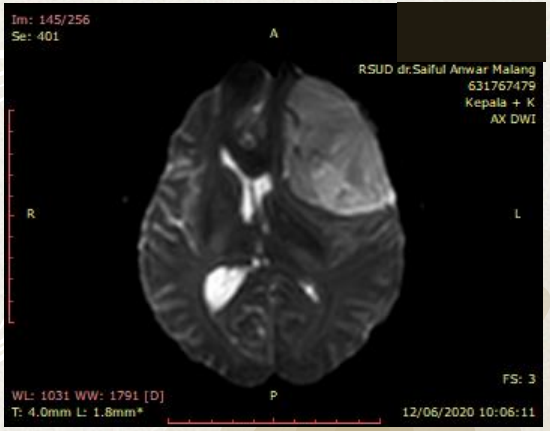
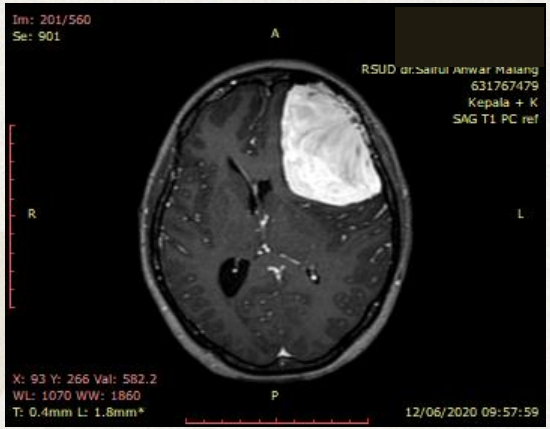
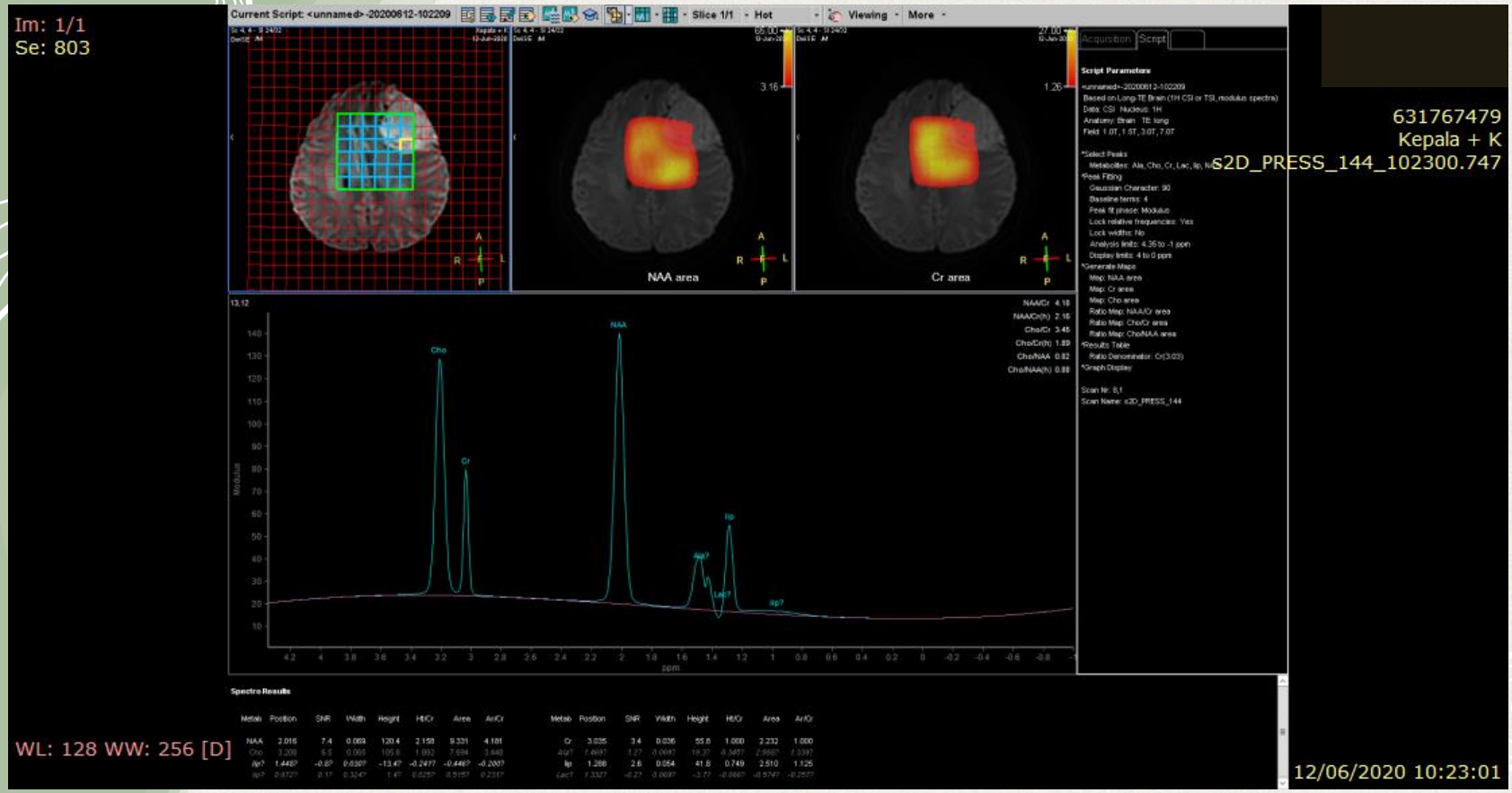
RSUD dr.Saiful Anwar Malang
631767479
Kepala + K
AX T2
R
L
P
FS: 3
WL: 1399 WW: 2432 [D]
T: 4.0mm L: 1.8mm*
12/06/2020 10:05:05


Im: 54/93
Se: 501
A
RSUD dr.Saiful Anwar Malang
631767479
Kepala + K
AX Flair FS
R
L
P
X: 163 Y: 186 Val: 943
FS: 3
WL: 1070 WW: 1860 [D]
T: 3.0mm L: 1.3mm*
12/06/2020 10:07:38


Im: 145/256
Se: 401
A
RSUD dr.Saiful Anwar Malang
631767479
Kepala + K
AX DWI
R
L
P
FS: 3
WL: 1031 WW: 1791 [D]
T: 4.0mm L: 1.8mm*
12/06/2020 10:06:11


Im: 201/560
Se: 901
A
RSUD dr.Saiful Anwar Malang
631767479
Kepala + K
SAG T1 PC ref
R
L
P
X: 93 Y: 266 Val: 582.2
WL: 1070 WW: 1860
T: 0.4mm L: 1.8mm*
12/06/2020 09:57:59


Im: 34/126
Se: 601
A
RSUD dr.Saiful Anwar Malang
631767479
Kepala + K
SWIp
R
L
P
X: 732 Y: 256 Val: 0
FS: 3
WL: 1033 WW: 1796 [D]
T: 3.8mm L: 3.7mm*
12/06/2020 10:09:26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Se: 803
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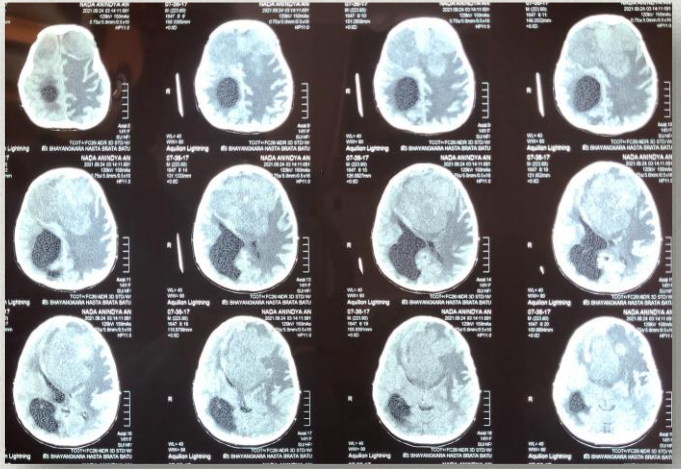
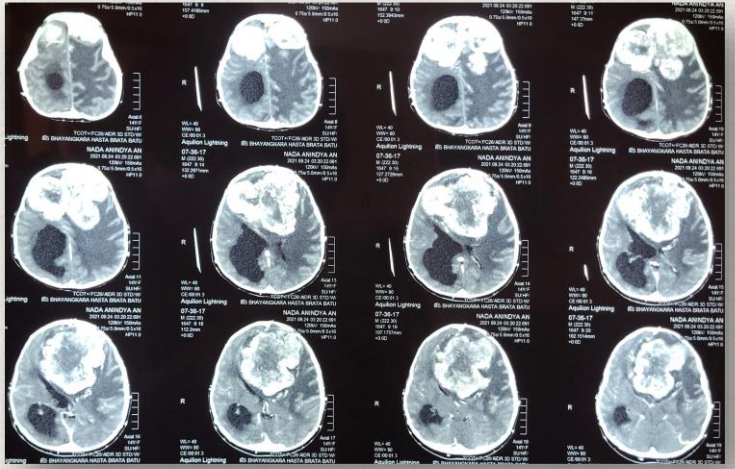
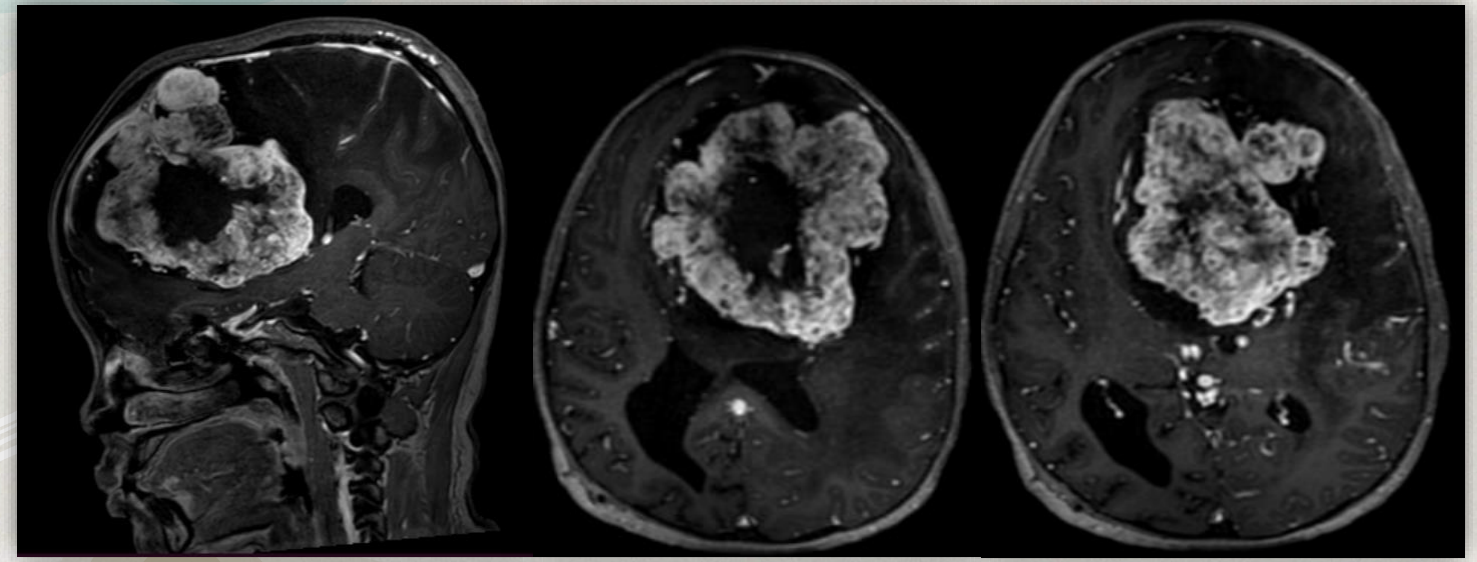
Slice 1/1
Hot
Viewing
More
NAA area
Cr area
Acquisition
Script
Script Parameters
631767479
Kepala + K
s2D_PRESS_144_102300.747
Cho
Cr
NAA
Ins
Asp?
Lac?
Glu?
ppm
Spectro Results
WL: 128 WW: 256 [D]
12/06/2020 10:23:01

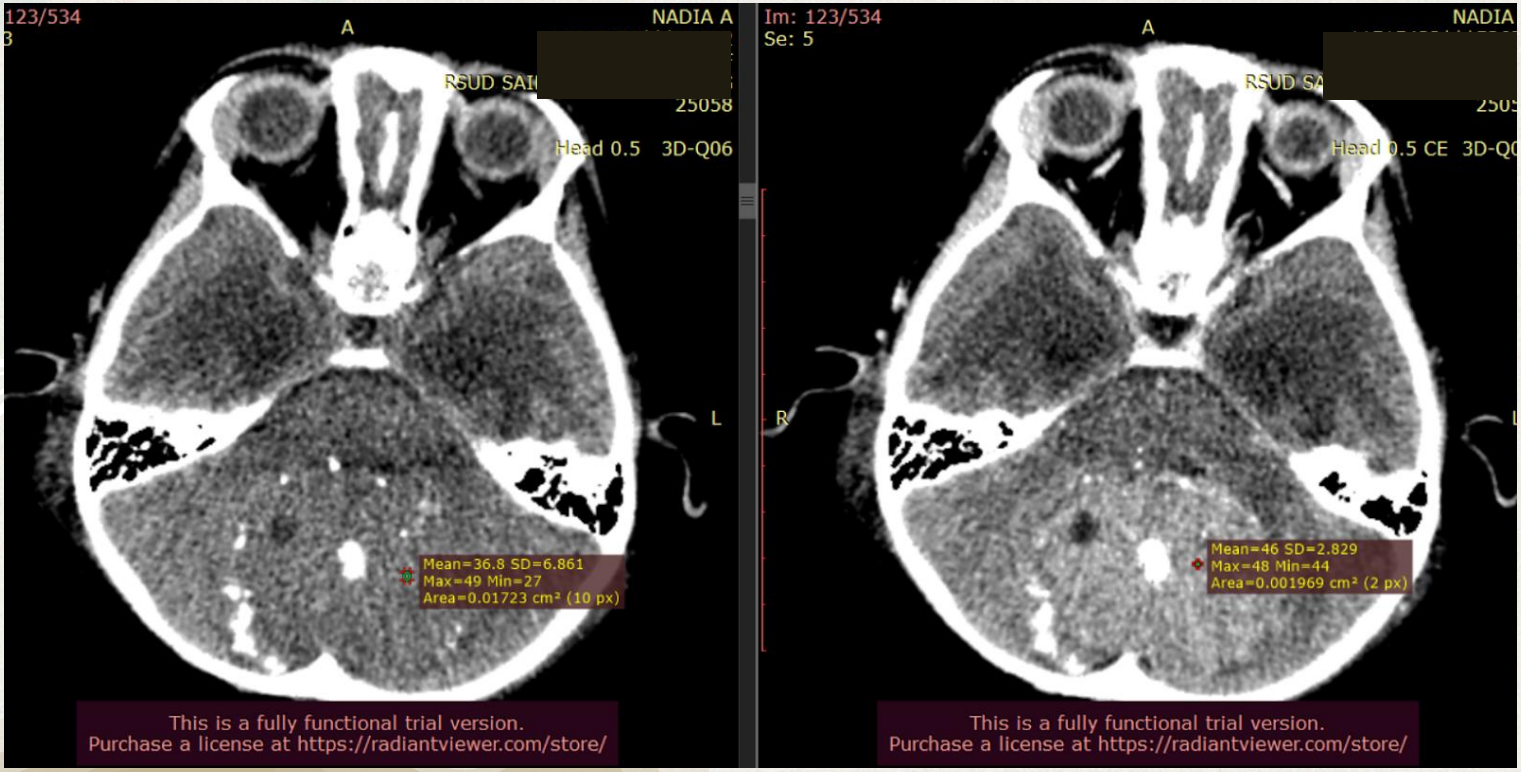
Female, 4 YO, acute DOC

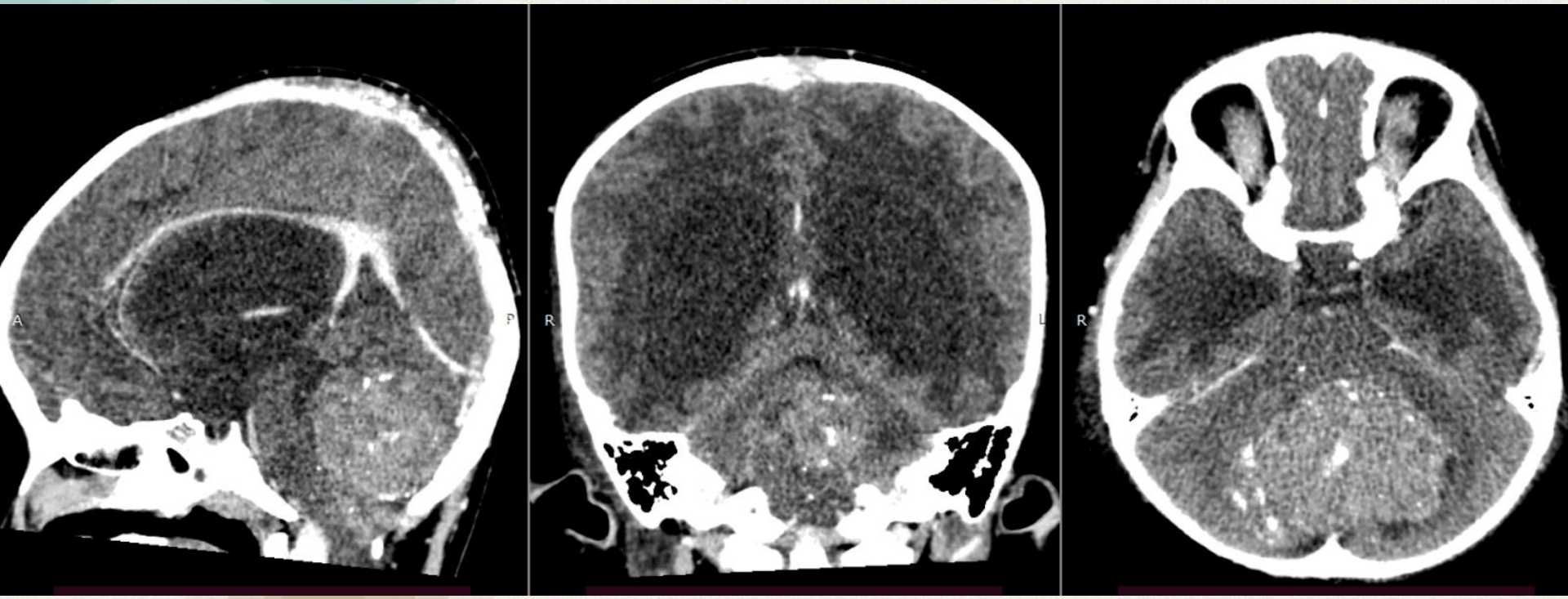






Female ; 5 YO ; acute DOC




A
R
R

Take Home Messages

Emergencies situation in brain tumor → Life-threatening conditions

Radiologist should always be aware of this possibility of emergencies imaging

Thank You