

# 432 Radiology Team



## (9): Common brain diseases (2)

\* Many thanks to 431 team for their helpful notes \*



**Done By:**  
Noor AlZahrani  
Manar AlEid

**Reviewed By:**  
Noor AlZahrani  
Manar AlEid  
Othman.T.Almutairi

جامعة  
الملك سعود  
King Saud University



**COLOR GUIDE:** • Females' Notes • Males' Notes • Important • Additional • 431 team

# Objectives

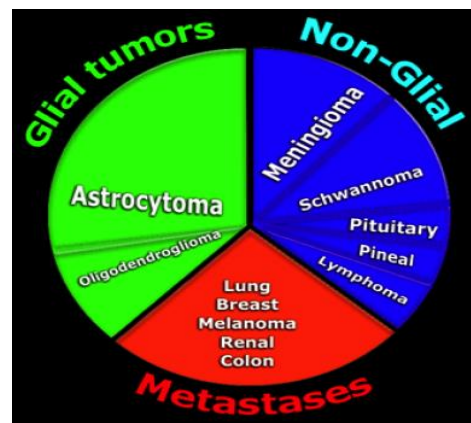
1. Identify the common brain tumors and their different pattern on CT and MRI.
2. Identify the common inflammatory diseases of the brain and their imaging features.
3. Identify the common CNS infections and their different imaging patterns and imaging of their complications.

# Brain Tumors “pathological classification”

\*Radiological approach of brain tumors:

A) Multiple masses > narrow DDx

- ♣ Metastases
- ♣ Lymphoma or Leukemia
- ♣ Multicentric GBM “Glioblastoma multiforme” can be either solitary or multiple.
- ♣ Gliomatosis cerebri
- ♣ Tumor with seeding “primary brain tumor that seeds to other parts of the brain”
- ♣ Multiple tumors in phacomatoses as neurofibromatosis type2 > as meningioma and schwannom



B) Solitary tumor > wide DDx >>Localize the site first!

- ♣ Supratentorial “Cerebrum”/infratentorial “Brainstem & cerebellum”> in relation to Tentorium cerebelli.
- ♣ Intra axial “Brain Parenchyma”/ extra axial “Meninges or other coverings”
- ♣ Specific anatomic area “sellar and parasellar, perneal gland , cerebellopontine angle” since they have certain types of tumors
- ♣ CT/MRI texture, pattern of enhancement
- ♣ Age!!!

## Common Intra-Axial Tumors in Pediatric:-

Supratentorial “ <u>AP2GD</u> ”	Infratentorial “ <u>BEJAM</u> ”
<ul style="list-style-type: none"> <li>• <u>A</u>strocytoma</li> <li>• <u>P</u>leomorphic xanthoastro (PXA)</li> <li>• <u>G</u>anglioglioma</li> <li>• <u>P</u>NET Primitive neuroectodermal tumor</li> <li>• <u>D</u>NET Dysembryoplastic neuroepithelial tumour</li> </ul>	<ul style="list-style-type: none"> <li>• <u>B</u>rainstem astrocytoma</li> <li>• <u>E</u>pendymoma</li> <li>• <u>J</u>uvenile pilocytic astrocytoma</li> <li>• <u>A</u>typical teratoid/rhabdoid tumor</li> <li>• <u>M</u>edulloblastoma</li> </ul>

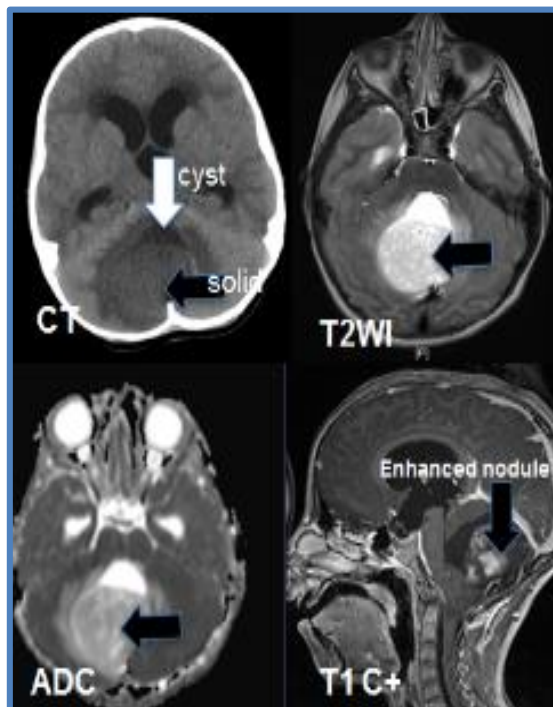
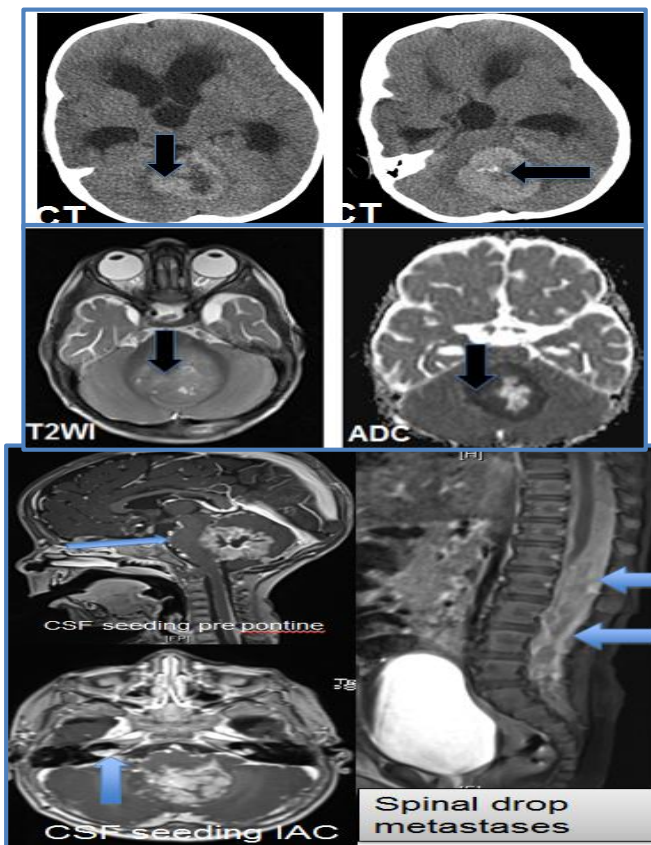
**Common Intra-Axial Infra tentorial Tumor in Pediatric:**

**Medulloblastoma:**

- ♣ PNET
- ♣ In the posterior fossa
- ♣ WHO IV
- ♣ Midline >85% 4<sup>th</sup> Ventricle
- ♣ Age incidence < 10 y, second peak 20-40y
- ♣ **Hyperdense on CT "White"**
- ♣ Cysts 40% **Dark area within the mass**
- ♣ Ca++ 20-25% more Hypredense
- ♣ **Low / intermediate signal on T2WI**
- ♣ **Diffusion restriction "bright on DWI and dark in ADC"**
- ♣ **Enhances post contrast injection** >solid part "main bulk" is white
- ♣ **CSF seeding** >some cells metastasize through the CSF to some area as prepontine area, auditory canal
- ♣ **Drop metastases** in the spine

**Pilocytic astrocytoma:**

- ♣ Low grade I
- ♣ Age incidence 5-15 years
- ♣ **Cyst with enhancing nodule**  
Most are cyst with solid mural nodule
- ♣ **Low density on CT**  
cystic part contains CSF "dark" > the white arrow , while the solid "hypodense"
- ♣ **High signal on T2WI**
- ♣ **No diffusion restriction "Bright"**
- ♣ **Enhanced solid mural nodule** while the cyst is not



## Common Intra-Axial Tumors in Adults:-

Supratentorial	Infratentorial “uncommon”
<ul style="list-style-type: none"> <li>• <b>Metastases</b></li> <li>• Gliomas:               <ul style="list-style-type: none"> <li>✓ Diffuse astrocytoma &gt; Low grade</li> <li>✓ Anaplastic</li> <li>✓ Glioblastoma Multiforme &gt; grade IV</li> <li>✓ oligodendroglioma :can be Diffuse, Anaplastic or High grade</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• <b>Metastases</b></li> <li>• Hemangioblastoma</li> <li>• Astrocytoma</li> <li>• 50% of the brain tumors are metastases</li> </ul>

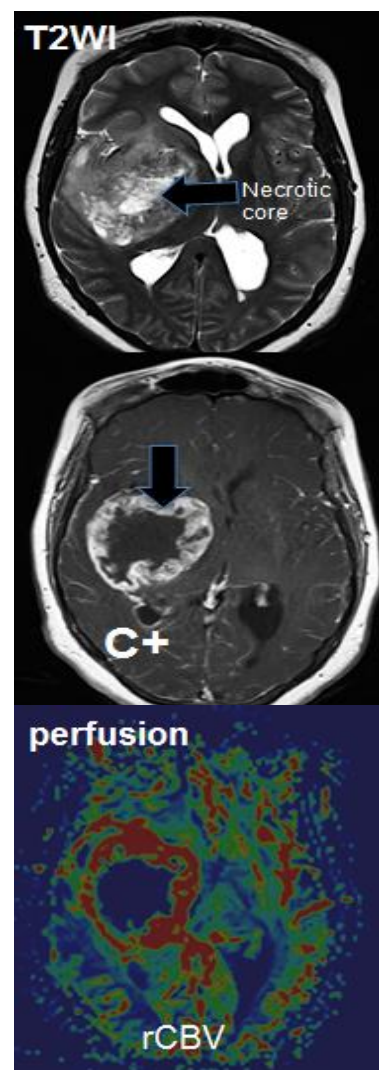
### Common Intra-Axial Supra tentorial Tumor in Adult

#### Glioblastoma Multiforme (GBM)

- ◆ WHO grade IV.
- ◆ **Most common primary brain tumor and most malignant.**
- ◆ 60-75% of astrocytoma.
- ◆ Peak age 45-75 years
- ◆ Can occur at any age even neonates and infants
- ◆ Cerebral hemisphere (subcortical, periventricular and across compact tract). Basal ganglia and thalamus.
- ◆ **It's Intra axial means it is within the parenchyma surrounded always by white matter**
- ◆ **Heterogeneous complex mass (solid with necrotic core) sometimes hemorrhagic**
- ◆ **Thick irregular nodular peripheral enhancement. Necrotic parts won't enhance post-contrast.**
- ◆ **High perfusion value > more red more perfusion more high grade.**
- ◆ **Mass effect > midline shift**
- ◆ **Usually High-signal T2. If higher grades it will be Low\intermediate.**
- ◆ **In the CT: complex, variable low density lesions “necrosis is dark”.**

#### Extra Axial tumors:

- Meningioma < most common
- **Metastases** (calvarial, dural and leptomeningeal) **Dural** (breast, lung, prostate, melanoma, neuroblastoma, lymphoma and leukemia) **leptomeningeal** ( CSF seeding from GBM, AA, medulloblastoma and ependymoma)
- Schwannoma
- Epidermoid

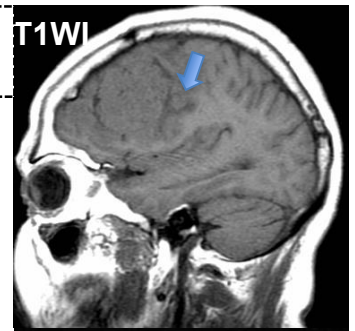


- Dermoid
- Arachnoid cyst

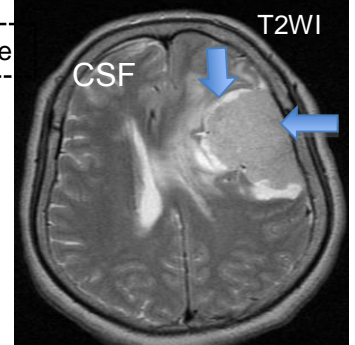
**Signs of Extra-Axial Location**

- **CSF cleft** < CSF pushed by the tumor inside and surrounded it
- **Broad dural base**
- **Cortical gray matter between mass and white matter**
- **Displaced subarachnoid vessels**
- **The mass is iso-intense, around it is dark**  
 "Cleft of CSF" and also it is surrounded by "Grey matter".

Gray matter between mass and white matter



Broad dural base



**Meningioma:**

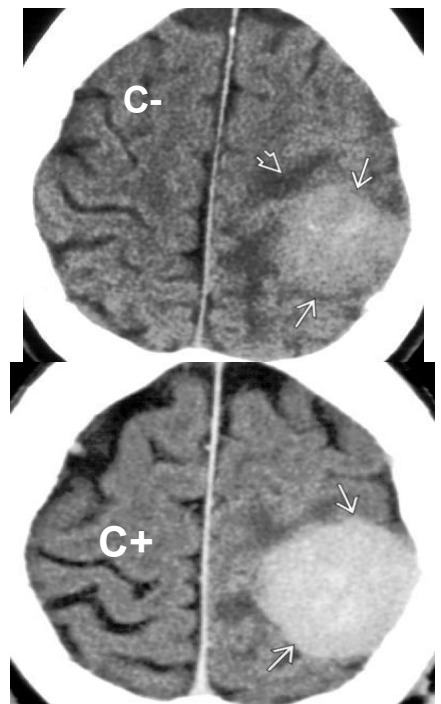
Meningioma is the most common type of extra-axial neoplasm and accounts for 14 - 20% of intracranial neoplasms. It is a non-gliar neoplasm that originates from the arachnoid cap cells of the meninges.

**Location**

- 85 - 90% **supratentorial**.
- 45% parasagittal, convexities
- 15 - 20% sphenoid ridge
- 10% olfactory groove / planum sphenoidale
- 5-10% juxtaseilar

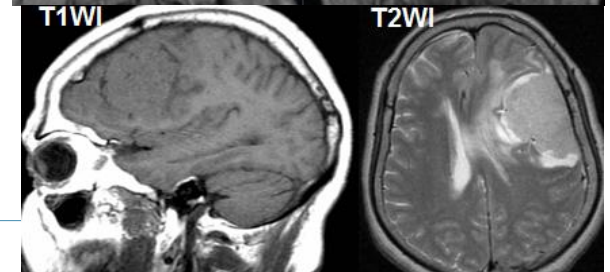
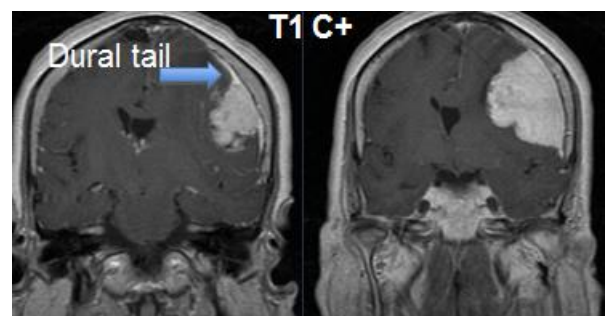
**CT:**

- ✓ 60% mild-moderate **hyperdense** to normal brain  
 "high cellular packed"
- ✓ 60% peri tumoral vasogenic edema
- ✓ 20 - 30% have some calcification
- ✓ Vast majority of meningioma post-contrast **enhance strongly** and uniformly



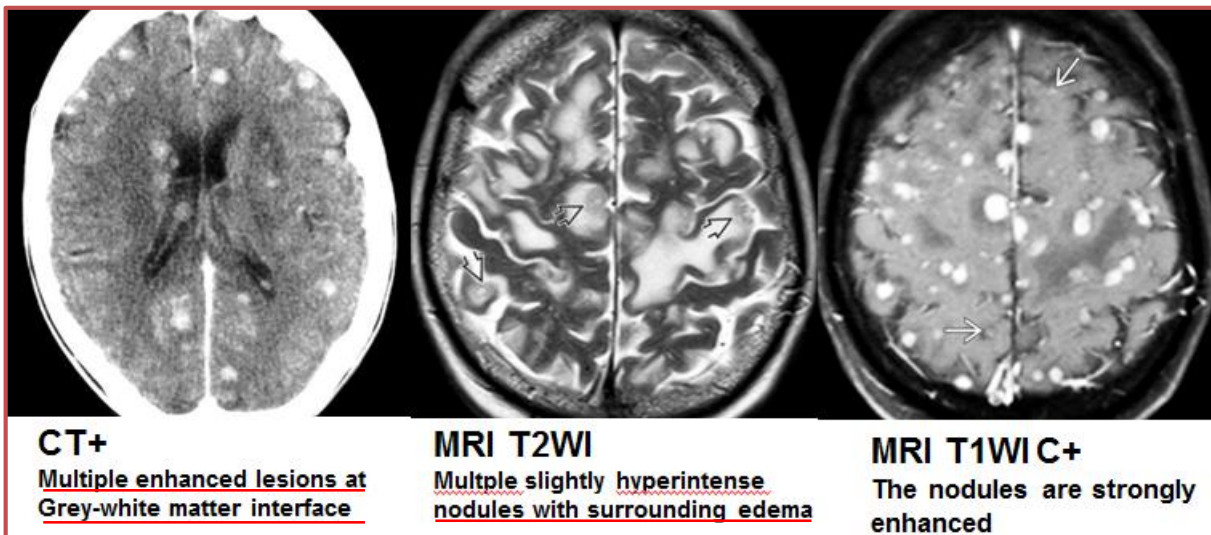
**MRI:**

- ✓ T1 : Isointense ; : ~ 60 - 90%
- ✓ T2: isointense : ~ 50%
- ✓ T1 C+ (Gd) : usually **intense** and homogenous enhancement.
- ✓ Dural tail seen in 60-70% "not specific"



### Secondary Brain Tumors (Brain Metastases):

- ◆ Metastatic brain tumors are the **most common brain tumors**.
- ◆ The primary cancer is usually in the lung, breast, colon, kidney, or skin (melanoma), but can originate in any part of the body.
- ◆ Most are located in the **cerebrum**, but can also develop in the cerebellum or brain stem. **The common thing is all secondary are enhancing post-contrast.**
- ◆ More than half of people with metastatic tumors have **multiple** lesions (tumors)



### Sellar and Parasellar masses:

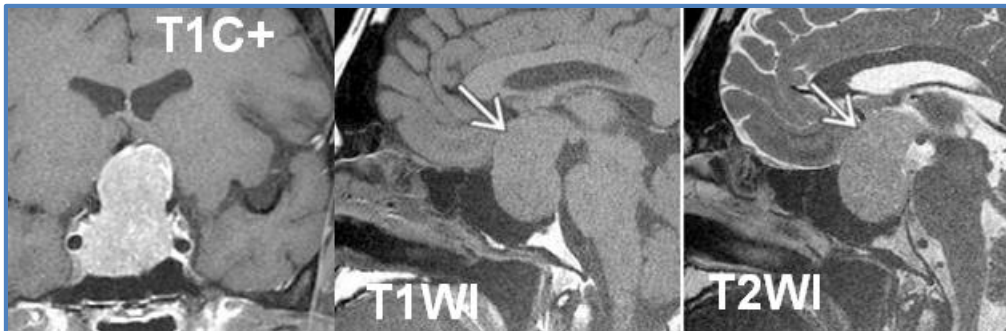
Adult	Children
<ul style="list-style-type: none"> <li>• Adenoma</li> <li>• Meningioma</li> <li>• Aneurysm <i>“not tumor but mimics it”</i></li> </ul>	<ul style="list-style-type: none"> <li>• Craniopharyngioma <i>“most common”</i></li> <li>• Hypothalamic/optic chiasm pilocytic astrocytoma</li> </ul>

*\*Other less common*

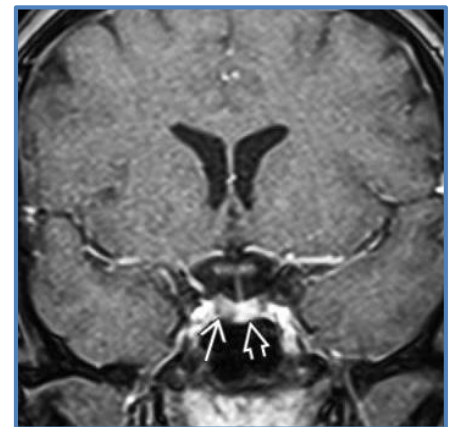
- Metastasis
- Lymphoma
- Hypothalamic hamartoma
- Rathke cleft cyst
- Arachnoid cyst
- Epidermoid
- Dermoid
- Germinoma

## A) Pituitary adenomas:

- ❖ Pituitary adenomas are accounting for 10-15% of primary intracranial neoplasms.
- ❖ All are WHO grade I tumors.
- ❖ Macroadenomas are defined as tumors larger than 10 mm in diameter.
- ❖ Macroadenomas are usually **isointense** with cortex on T1WI and T2WI.
- ❖ **Cysts and hemorrhage** are common.
- ❖ Most macroadenomas **enhance strongly** but heterogeneously on T1 C+



- ❖ Relation to surrounding structures; Optic chiasm thinning (reversible post-surgery), invasion of the cavernous sinuses or not.
- ❖ Microadenomas are defined as tumors  $\leq 10$  mm in diameter. Harder to diagnose!
- ❖ **Dynamic contrast-enhanced** study usually used for detection of small microadenomas “within certain time”
- ❖ Early coronal image from a dynamic contrast-enhanced sequence shows the intensely, rapidly enhancing normal gland (white open arrow). The mass enhances more slowly and so appears relatively hypointense (white arrow). **Normally, enhances more after 20 seconds. If less enhancement > adenoma as filling defect.**



## B) CRANIOPHARYNGIOMA:

- ❖ Benign (WHO grade I) neoplasm.
- ❖ Arises in the sellar / suprasellar region. (Craniopharyngiomas are primarily suprasellar tumors (75%). A small intrasellar component is present in 20-25% of cases)
- ❖ They account for  $\sim 1 - 5$  % primary brain tumours.
- ❖ They derive from remnants of the **craniopharyngeal duct** (narrowing which separates Rathke's pouch from the primitive oral cavity), and can occur anywhere along the **infundibulum** (from floor of the third ventricle, to the pituitary gland).
- ❖ Two **types** of craniopharyngiomas are recognized: **Adamantinomatous 90%** Papillary 10%.



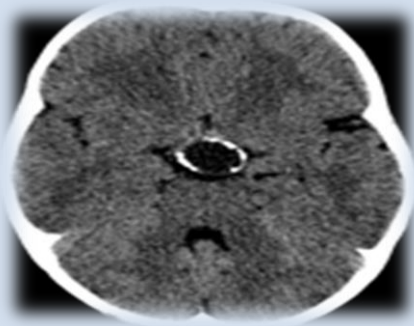


- ♣ (craniopharyngioma has two peaks in children and in adults. Adamantinomatous is more common in the children while papillary is more common in the adults)
- ♣ Cysts are seen in 70 - 75% of cases and are a more dominant feature of the adamantinomatous type.
- ♣ Adamantinomatous type has different components; cystic and solid components
- ♣ Papillary types has only solid components.

**Note(s):****Q-how to differentiate between pituitary adenoma and craniopharyngioma ?**

*By presence of **calcification** which is very likely to be seen in **craniopharyngioma**.  
And CT scan is more sensitive in detecting calcification than MRI.*

- ♣ Calcification: is very common, but this is only true of the **adamantinomatous** subtype (90% are calcified).
- ♣ Pattern of calcification : stippled and peripheral
  - In the cyst: usually calcification surrounds cyst
  - In solid component: calcification is heterogeneous and

## CT vs. MRI

Modality	CT	MRI
image		<p><b>TW1</b></p>  <p><b>T1C+ (post contrast)</b></p> 

**Comment** Typically seen as a heterogeneous mass in the suprasellar region.  
(cyst appears black in the CT)

MRI features can significantly vary depending on the histological subtype and on the size and content of the cysts.

**T1WI** : signal intensity varies depending on cyst contents, and can appear hyper intense due to protein, blood products, and cholesterol

**T1 C+ (Gd)** : contrast enhancement is typical, with thin enhancement of the cyst wall, or diffuse heterogeneous enhancement of the solid components.

**T2WI**: signal is high in both solid and cyst but is variable depending on content of fluid

### Note(s):

#### Craniopharyngioma

**T1W1 sequent:** here signal intensity is depending on the contents of the tumor, so if the cyst contains a dark fluid like CSF, it will appear hypo-intense. On the other hand, if it consists of blood or protein, it will be very bright (hyper-intense)

#### What are the roles of radiology in neuro-oncology ?

- 1-to diagnose the tumor itself
- 2-to differentiate it from other tumor mimics (such as aneurysm, infarction,,etc)
- 3-for treatment plan (surgery/radiotherapy).
- 4-for follow up (after surgery/radiotherapy).

# Demyelinating and Inflammatory Diseases:

- ❖ What is the difference between infection and inflammation?

**-Inflammation:** is the response of tissues to a variety of pathogens (which may or may not be infectious microorganisms). The inflammatory "cascade" is complex and multifactorial. It involves the vascular system, immune system, and cellular responses such as microglial activation, the primary component of the brain's innate immune response.

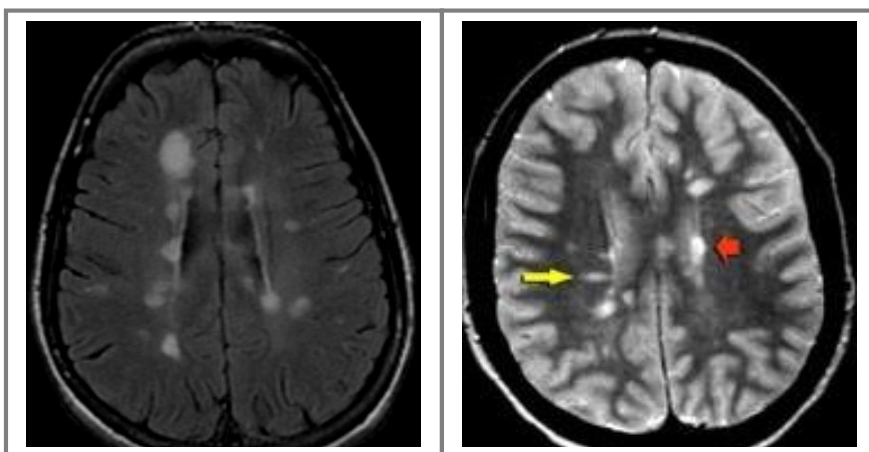
**-Infection:** is the presence of the micro-organism.

- ❖ Imaging plays a central role in the identification and follow-up of neuroinflammatory disorders.

## A) Multiple Sclerosis :

Is a chronic, persistent inflammatory-demyelinating disease of the central nervous system, characterized pathologically by areas of inflammation, demyelination, axonal loss and gliosis scattered throughout the CNS.

- ❖ **Etiology:** unknown (autoimmune-mediated demyelination).
- ❖ **Age:** 20-40 years, female preponderance in young
- ❖ **McDonald criteria for diagnosing MS:** requires an evidence of lesions disseminated in time and space. As a consequence there is an important role for MRI in the diagnosis of MS, since MRI can show multiple lesions (dissemination in space), some of which can be clinically occult and MRI can show new lesions on follow up scans (dissemination in time).
- ❖ We consider the 1<sup>st</sup> MRI as a baseline.
- ❖ MRI is the most important modality for diagnosing MS while CT-scan's role is limited here.



The most common lesions are

- Multiple
- Discrete ovoid/round  $\pm$  some confluence
- Bilateral asymmetrical
- Preferentially located along lateral ventricles

**Very important:****Q1: How does the MS appear in different MRI sequences?****T1WI (no contrast)**

lesions are typically iso to hypo intense (chronic)

**T2WI (no contrast + and all the lesions are enhanced here)**

lesions are typically hyper intense

**FLAIR :**

lesions are typically hyper intense

when arranged perpendicular to long axis of lateral ventricles/corpus callosum, extending radially outward (best seen on parasagittal images) they are termed Dawson fingers

**T1 C+ (Gd) : (with contrast)**

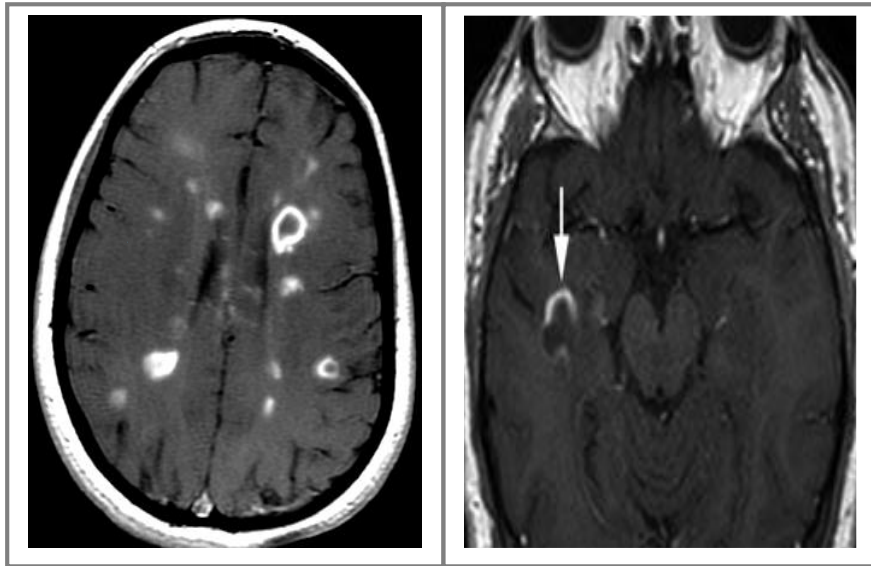
active lesions show enhancement

enhancement is often incomplete around the periphery (open ring sign)

**Q2: what are the characteristic locations for the MS lesions?**

- Corpus callosum,
- U fibers (juxtacortical)
- Periventricular (Dawson's fingers) (is the commonest site, the lesion here is next to the Lat.ventricle)
- Temporal lobes
- Brainstem
- Cerebellum
- Spinal cord.





- Enhancement pattern:
- Nodular solid -70%
  - Thick complete ring - 20%
  - C-shaped or incomplete ring-10%(although it is rare, but it is very characteristic for MS and other demyelinating disease like ADEM)
  - Thin irregular marginal

1<sup>st</sup> pic: it is a nodular solid lesion  
2<sup>nd</sup> pic: it is an incomplete ring lesion

# CNS infections:

## I. Classification

### **A-Viral Infection:**

- Herpes virus
- Varicella
- HIV
- SSPE
- Creutzfeldt-Jakob disease
- ADEM(Acute Disseminated Encephalomyelitis)
- Rasmussen Encephalitis

### **B-Bacterial Infection:**

- Pyogenic
- Spirochetes
- T.B

### **C-Fungal Infection**

### **D-Parasitic Infection:**

- Toxoplasma
- Cysticercosis
- Amoeba
- Hydatid

## II. Classification



### A-Congenital/Neonatal:

-TORCH

(Toxoplasmosis, Rubella,  
Cytomegalovirus, Herpes)

-HIV



### B-Acquired

-Meningitis

-Pyogenic parenchymal infection:  
encephalitis/cerebritis/abscess

-Encephalitis T.B, fungal, parasitic

**A-Meningitis:** Most common form of CNS infection.

Types:

- 1) Acute pyogenic (bacterial).(commonest)
- 2) Lymphocytic (viral).
- 3) Chronic: T.B and coccidioidomycosis.

### 1) -ACUTE PYOGENIC MENINGITIS:

#### Pathology:

Purulent exudates in basal cisterns and subarachnoid spaces.

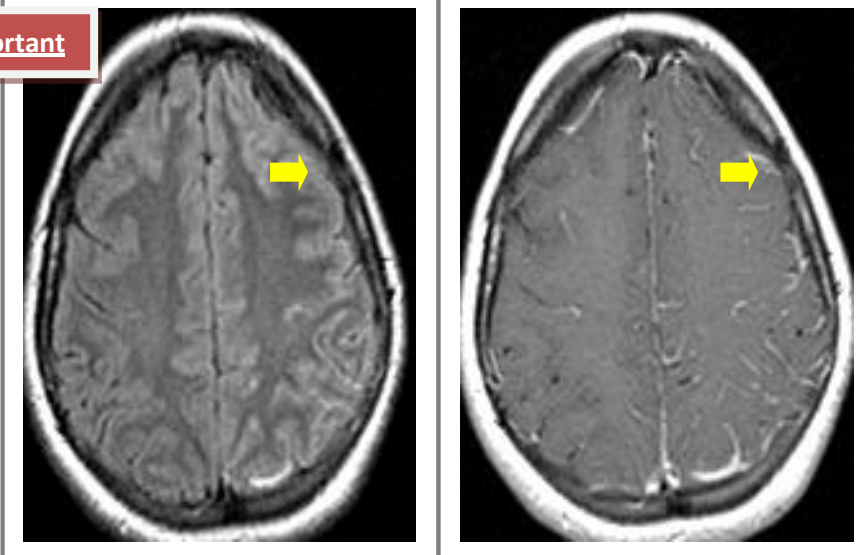
#### Imaging:

- ♣ Most common finding is normal scan.
- ♣ Mild ventriculomegaly (early).
- ♣ Effacement of basilar and convexity cisterns.(effacement of sulci)
- ♣ Enhancing meninges.
- ♣ Increased signal of subarachnoid space on FLAIR.

Role of imaging here isn't to diagnose but to monitor the complications or to support the diagnosis because:

- 1- It is usually diagnosed clinically (+ Lumbar puncture)
- 2- Most of the time, CT and MRI are normal here unless the patient has developed the complications.

**Important**

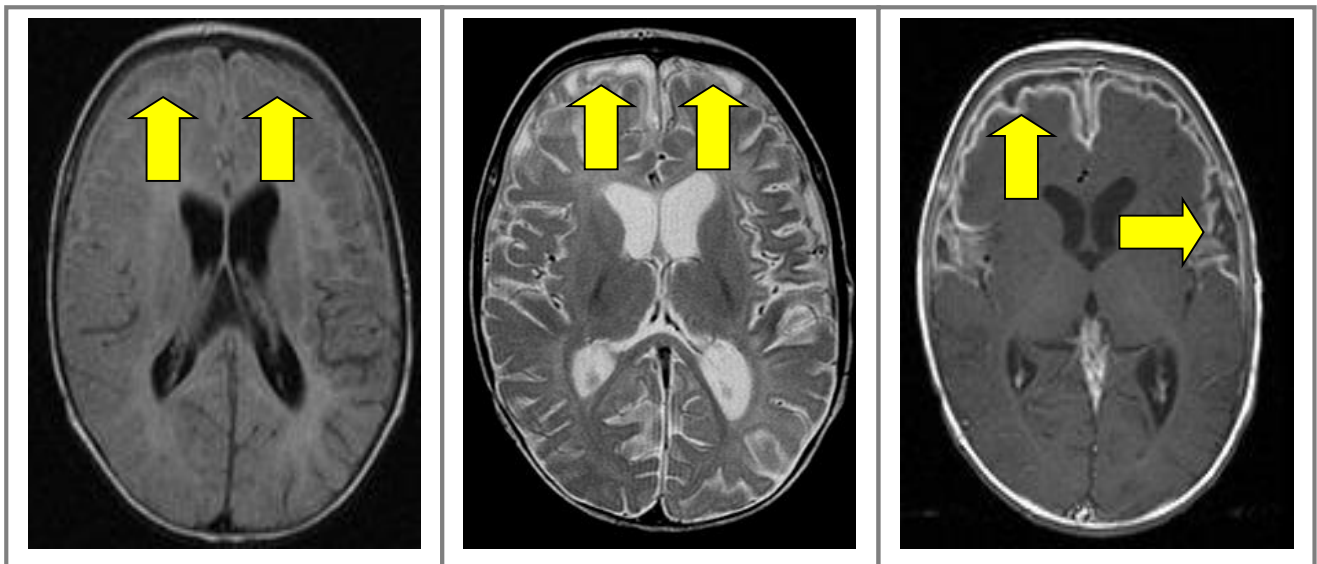


- Left image(axial flair): **Increased signal at subarachnoid space**  
Flair: fluid attenuation, here CSF appears black unlike in the T2 sequence. Also, sulci should appear black here.
- Right image(Axial T1 C+): Enhancing meninges (high signals=white sulci = PYOGENIC MENINGITIS)

**Complications of ACUTE PYOGENIC MENINGITIS:**

- ❖ Hydrocephalus and ventriculitis
- ❖ Subdural effusion (subdural fluid; clear="effusion" or pus="empyema")
- ❖ Empyema
- ❖ Cerebritis and abscess
- ❖ Cerebrovascular complication

**SUBDURAL EMPYEMA\***



**Axial T1WI**

Widening of bi-frontal subdural space

**Axial T2W1**

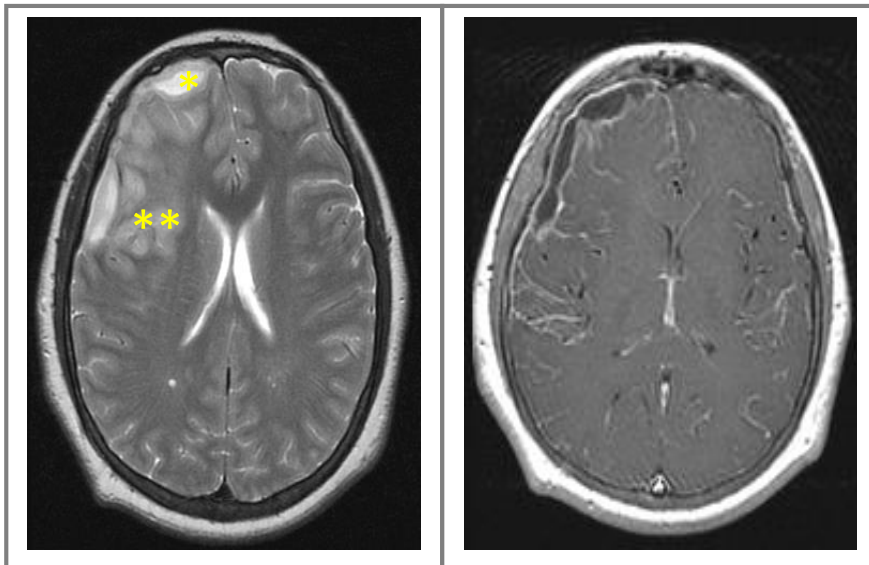
**Axial T1 C+**

Thick enhanced

**Note(s):**

*In the above 3 images:*

- In **T1W1**: fluid is **not clear** (because it is not black)
- In **T2W1**: fluid will always appear **hyper-intense** here, so it is not helpful that much here except that it shows widening of subdural space.
- In **T1C+**: it shows **intense enhancement** of the surrounding meninges



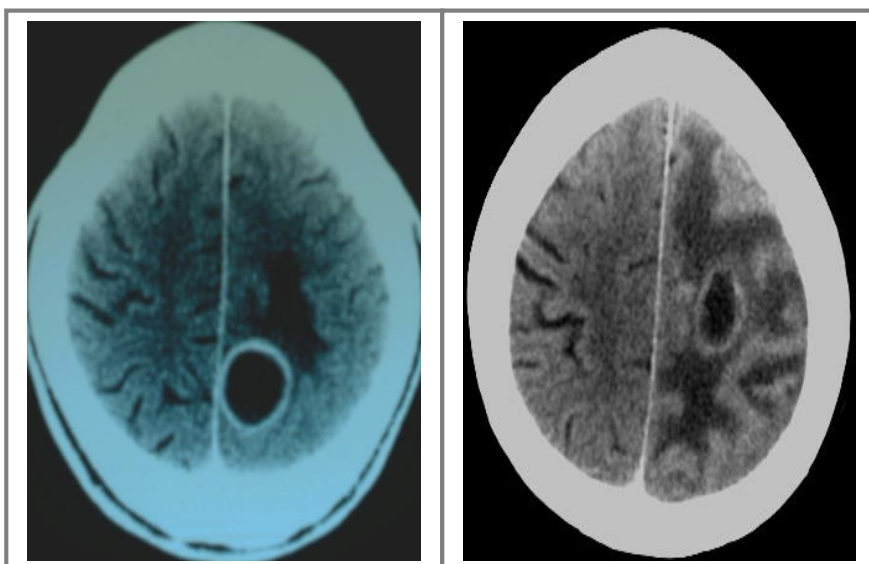
\*Subdural collection

\*\*Swollen cortex due to cerebritis

Left image: Axial T2WI

Right image: Axial T1C+  
(meningeal enhancement)

**B) BRAIN ABSCESS**



**CT Brain**

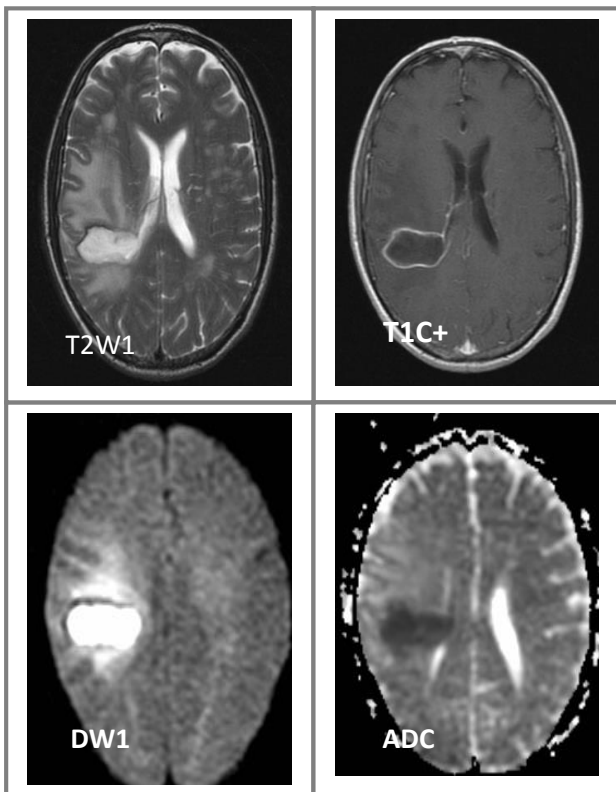
central low density

iso / hyperdense ring

peripheral low density (vasogenic oedema)

**Peripheral thin smooth regular ring enhancement**





**MRI Brain:**

**Important**

**T1WI:** Low signal intensity.

**T2WI:** high signal intensity surrounded with vasogenic edema.

**T1 C+:** peripheral thin smooth regular ring enhancement.

**DWI:** diffusion restriction.

(to say that there is a diffusion restriction, it must be a high DW1 and a low ADC)

Mild mass effect on the right lateral ventricle

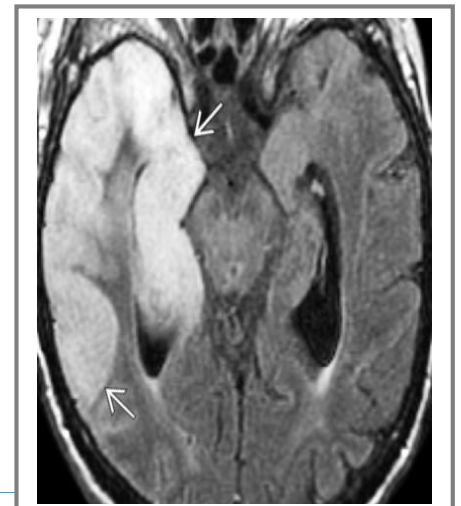
**C) ENCEPHALITIS:**

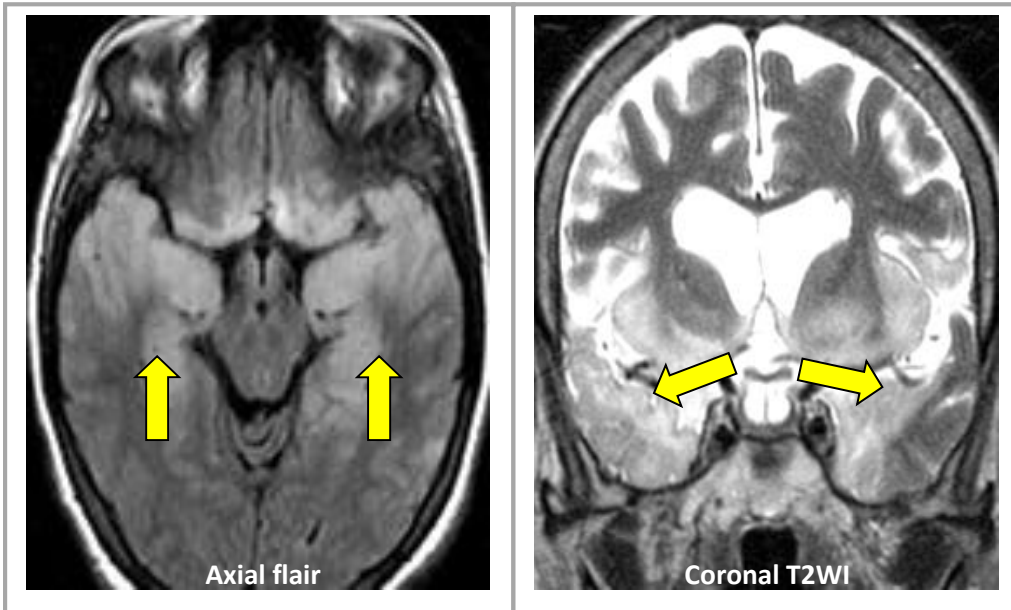
Diffuse non-focal parenchymal inflammatory disease that can be caused by broad spectrum of agents, the most common are viral. (Herpes is the commonest)

**HERPES SIMPLEX ENCEPHALITIS:**

- ❖ Most common viral encephalitis.
- ❖ HSV2 in neonates, HSV1 in children & adults.
- ❖ Transported along sensory fibers to olfactory nerve or gasserian ganglion.
- ❖ Location:
  - 1) predilection for limbic system
  - 2) Temporal lobe...insular cortex... subfrontal area and singulate gyrus.
  - 3) Unilateral then bilateral.

**Axial FLAIR** shows striking hyperintensity, cortical swelling of the right temporal lobe (white arrow) due to Herpes simplex encephalitis





You can notice that , it starts to involve cingulate gyrus then insular cortex (this is the typical pattern of distribution of herpes simplex)

Bilateral temporal herpes encephalitis

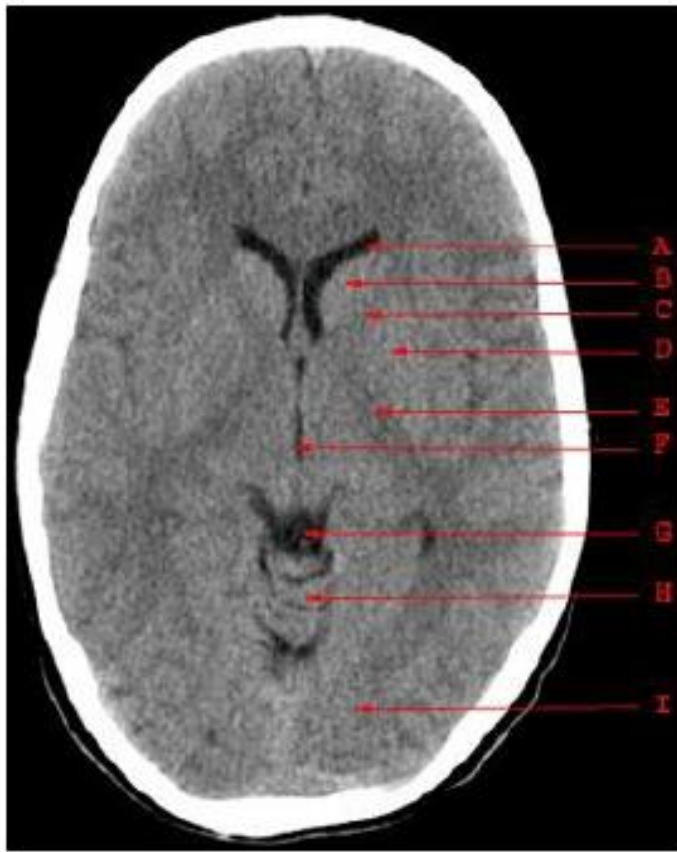
### SUMMARY(from 431 team work)

- 1) **Glioblastoma multiforme:**
  - The most common and most aggressive primary brain malignancy in adults.
  - MRI is the imaging modality of choice for diagnosis (definitive diagnosis by pathology).
- 2) **Meningioma:**
  - meningioma is the most common type of extra-axial neoplasm
  - Originates from the arachnoid cap cells of the meninges.
  - Specific signs:
    - CSF Cleft sign.
    - Dural tail seen in 60 - 72%. (Note that a dural tail is also seen in other processes)
- 3) **Vasogenic edema:**
  - Affects white matter only.
  - Can be seen in neoplasm and abscess.
- 4) **Cytogenic edema:**
  - Affects both gray and white matter.
  - Seen in infarction/stroke.
- 5) **Pituitary Adenoma:**
  - The majority are hormonally active.
  - The homogenous isointensity of the enlargement suggests pituitary macroadenoma.
  - Clinical correlation is important.
- 6) **Craniopharyngioma:**
  - They derive from remnants of the craniopharyngeal duct.
- 7) **Medulloblastoma:**
  - Common pediatric brain tumor.
  - Common location is posterior to the IV ventricle. Involving the vermis.
- 8) **Multiple sclerosis:**
  - "Dawson's fingers" represent lymphocytic infiltration along periventricular medullary veins.
- 9) **Brain abscess:**
  - Ring enhancing lesion, thin rim with uniform enhancement.
- 10) **Meningitis:**
  - Basal enhancing exudates.
  - Leptomeningeal enhancement. along sylvian fissures. tentorium.

### Cases from 430 final Exam MCQ:

CT scan of the head showing:

- A. Anterior Horn of the Lateral Ventricle
- B. Caudate Nucleus
- C. Anterior Limb of the Internal Capsule
- D. Putamen and Globus Pallidus
- E. Posterior Limb of the Internal Capsule (Internal Capsule is white matter)
- F. Third Ventricle
- G. Quadrigeminal Plate Cistern
- H. Cerebellar Vermis
- I. Occipital Lobe

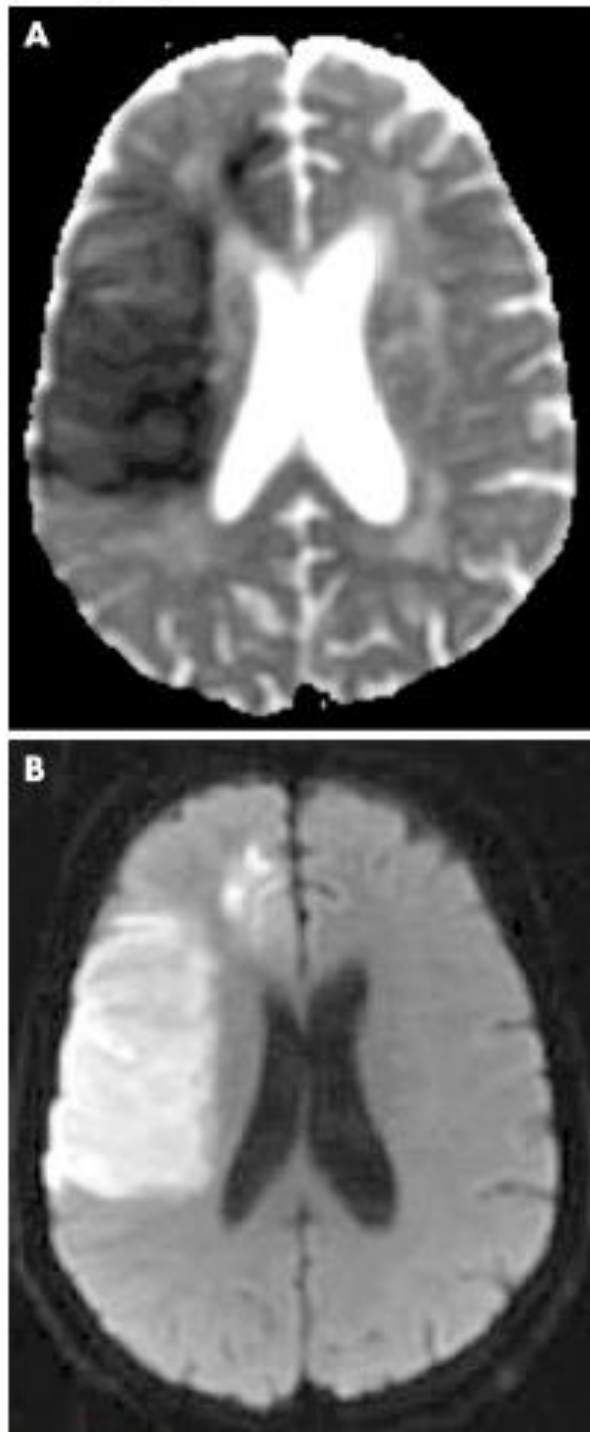


MRI diffusion is very helpful in the assessment and detection of: (This is not a question, it's a statement)

1. Early brain infarction. (important MCQ)
2. Brain abscess.
3. Certain types of brain tumor.

Image A: ADC (Apparent Diffusion Coefficient) map MRI

Image B: DWI (Diffusion Weighted) MRI



Q19: A patient presents with acute onset hemiplegia.

What will you use to detect infarction?

A: **MRI diffusion**

Best sequence to detect infarction/stroke is Diffusion MRI (can be detected as early as 2 hours), then Flair MRI, and lastly T2 MRI. However, in real life, CT is routinely done first.

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Q20: What do you see in the following head CT?



A: **Intraventricular Hemorrhage.**

Causes of IVH: Trauma (in adults and children) and Hypoperfusion (in infants, it usually occurs in the first 3 days after birth).

Other causes: hypertension, vascular malformation.

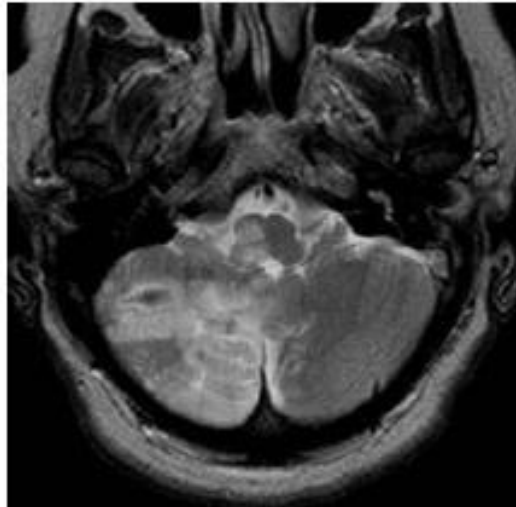
Blood is replacing the CSF.

#### Pneumocephalus

Is the presence of air or gas within the cranial cavity. It is usually associated with disruption of the skull: after head and facial trauma, tumors of the skull base, after neurosurgery or otorhinolaryngology, and rarely, spontaneously. Pneumocephalus can occur in scuba diving, but is very rare in this context.

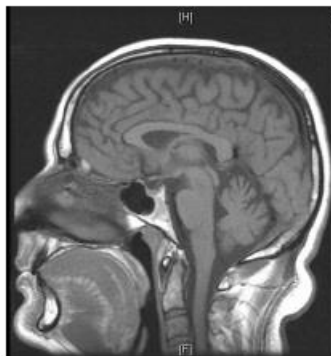


infarction due to PICA (posterior inferior cerebral artery) aneurysm:



Symptoms of PICA aneurysms are similar to those of subarachnoid hemorrhage, and develop due to rupture and the release of arterial blood; symptoms include a sudden onset severe headache (the suboccipital area in particular), mental change, syncope, and meningeal irritation

Normal Pituitary:



Pituitary Macroadenoma:

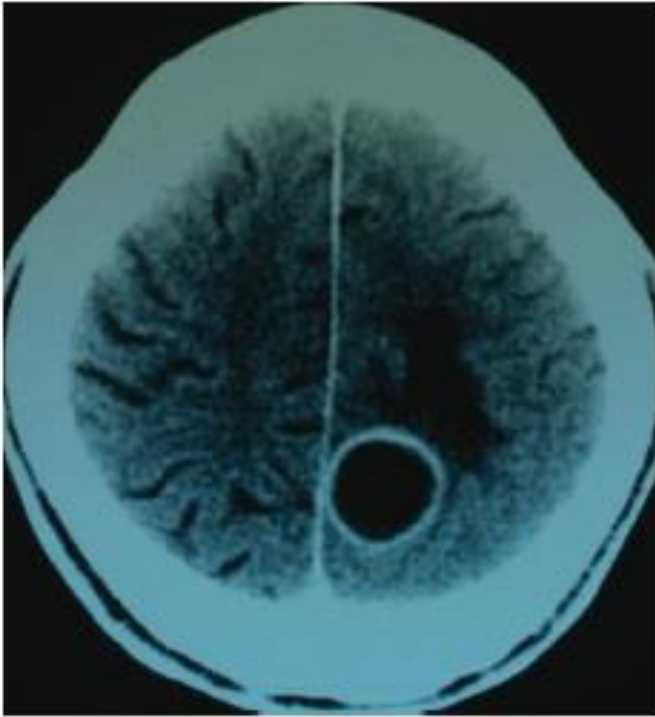


### Pituitary Adenoma

Comprise 10% of intracranial tumors. The majority are hormonally active. The homogenous isointensity of the enlargement suggests Pituitary Macroadenoma as opposed to cystic, vascular, or inflammatory lesions/enlargements. **Clinical correlation is important.**

The MRI scan demonstrates an isointense enlargement in the region of the Pituitary characteristic of a Pituitary Adenoma.

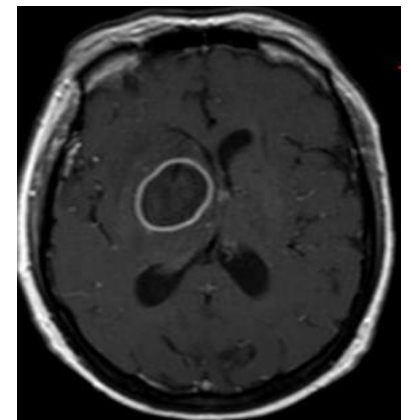
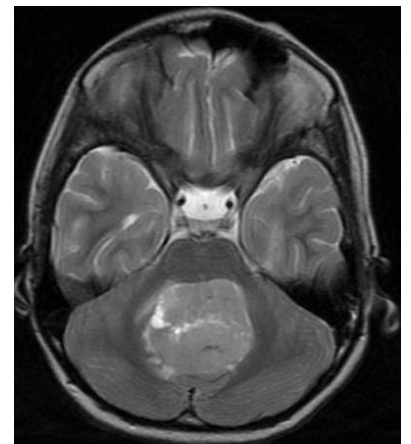
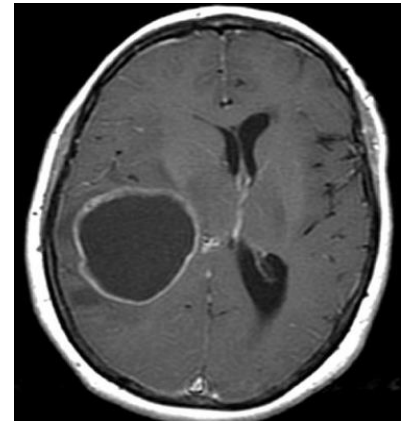
CT of the brain showing Brain Abscess with central low density, iso / hyperdense ring, peripheral low density (Vasogenic Oedema), **Ring enhancement**. Ventriculitis may be present, in which case Hydrocephalus will commonly be seen.





## Questions

- 1) 66-year old female with 2 weeks headache not alleviated by analgesic?
  - a. GBM
  - b. Brain abscess
  - c. Meningioma
  - d. MS.
  
- 2) 8-y female with raised ICP?
  - a. GBM
  - b. Macroadenoma
  - c. Medulloblastoma
  - d. Pilocytic astrocytoma
  
- 3) 55-y female with headache then, altered level of conscious. Diagnosed previously with bacterial endocarditis. MRI (post-contrast) shows:
  - a. GBM
  - b. Brain abscess
  - c. Medulloblastoma
  - d. MS.



The questions are from:  
[/http://radiopaedia.org](http://radiopaedia.org)

**432 Radiology Team Leader**

Eman AlBedaie  
 Emansaleh202@gmail.com



### Answers:

- 1st Questions: a  
 2nd Questions: c  
 3rd Questions: b