

# Radiology Team 429

Radiology of Common  
Brain diseases  
Tumor, Inflammation,  
Infection



**Dr. Tajuddin Malabarey, MD**

Radiology and medical imaging department

**RAD course 365**



# Radiology Team 429

In this team we used the outlines from the:

Doctor's slides

Lecture notes are in red boxes

427 Radiology team

Diagnostic Imaging –PETER  
ARMSTRONG – 6<sup>Th</sup> Edition

Sorry we don't hold responsibility for any missing information or perhaps – perhaps -wrong material.

We tried our best to present this lecture in the best way, and we hope what we wrote is enough to cover the subjects.

**Team Leaders:**

Abdulmajeed Al-Sadhan, Ibrahim Al-Sadhan, Sarah Mahasin

**Team Members:**

Mashail Al Towairqi

**Best Wishes : )**

# Objectives

- **Some Common Brain diseases**
- **Brain tumor:** A brain tumor, (defined as an *abnormal growth of cells*) within the brain or the central spinal canal
- **Inflammation** is a protective attempt by the organism to remove the injurious stimuli and to initiate the healing process.
- **Infection** is the invasion of body tissues by disease-causing microorganisms.
- **Inflammation is not synonymous with infection**  
Without inflammation, wounds and infections would never heal

# Intracranial Tumors Classification A Framework

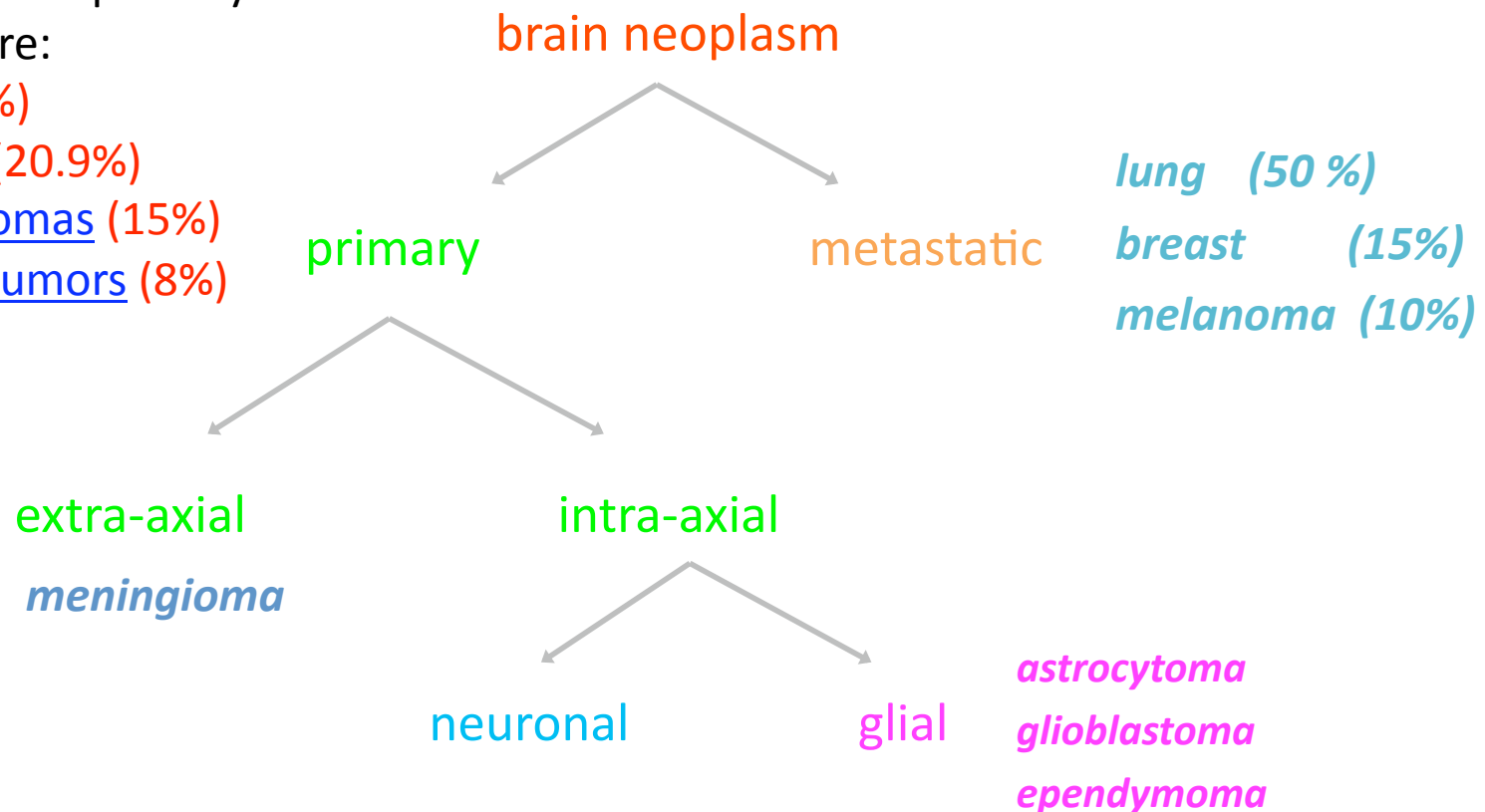
The most common primary  
brain tumors are:

Gliomas (50.3%)

Meningiomas (20.9%)

Pituitary adenomas (15%)

Nerve sheath tumors (8%)



\* *benign vs. malignant* distinction less clinically relevant for  
intracranial tumors  
(mass effect, infiltration preventing removal, critical location)

Extra-axial: outside the  
brain parenchyma  
Intra-axial: inside the brain  
parenchyma

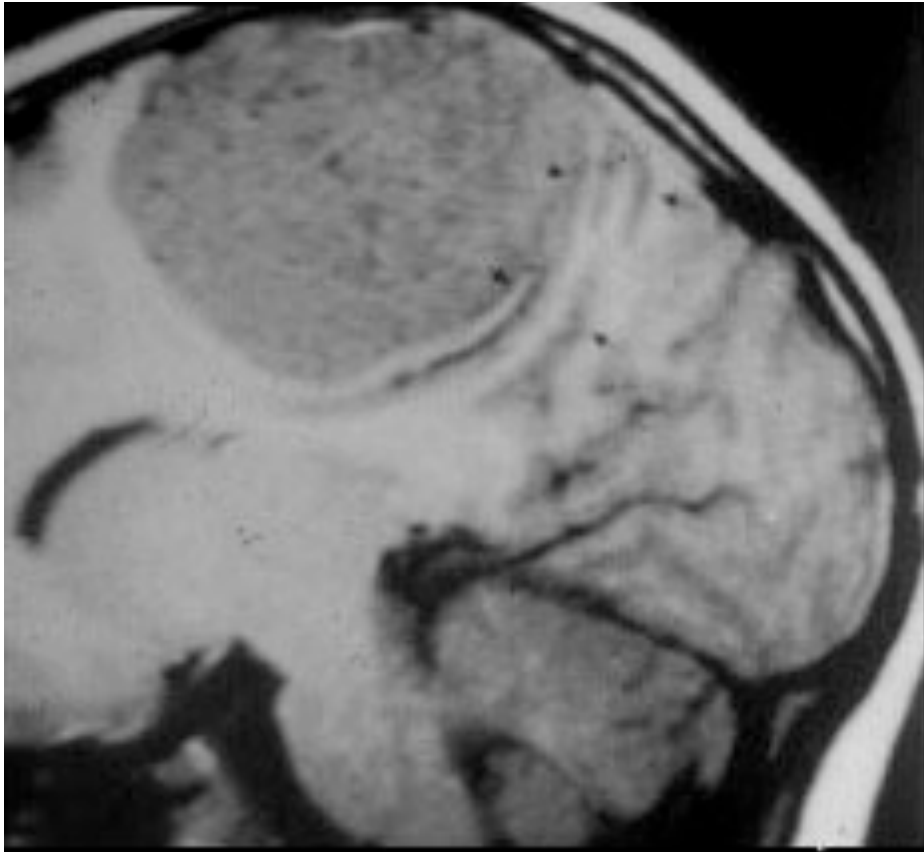


# Primary Brain Tumors

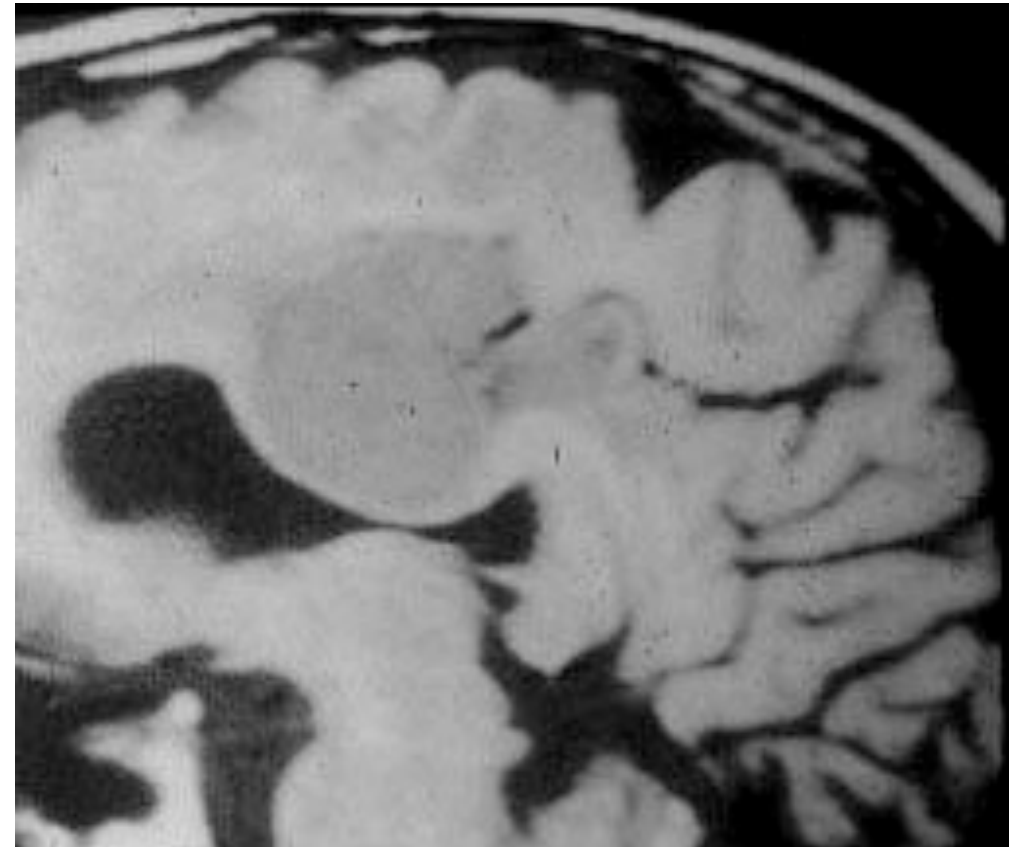
- Primary brain tumors are classified by the type of tissue in which they begin.
- The most common brain tumors are gliomas, which begin in the glial (supportive) tissue. There are several types of gliomas:
  - Astrocytomas arise from small, star-shaped cells called astrocytes.
  - Brain stem gliomas
  - Ependymomas usually develop in the lining of the ventricles.
  - Oligodendrogliomas arise in the cells that produce myelin, the fatty covering that protects nerves
  - Glioblastoma multiforme (GBM) accounts for about 50% of all astrocytomas



# Extra-axial vs Intra-axial



widens CSF space  
displaces brain deeper  
lesion has a broad base toward dura  
<http://radiopaedia.org/articles/extra-axial>



narrows CSF space  
displaces cortex toward periphery  
<http://radiopaedia.org/articles/intra-axial>

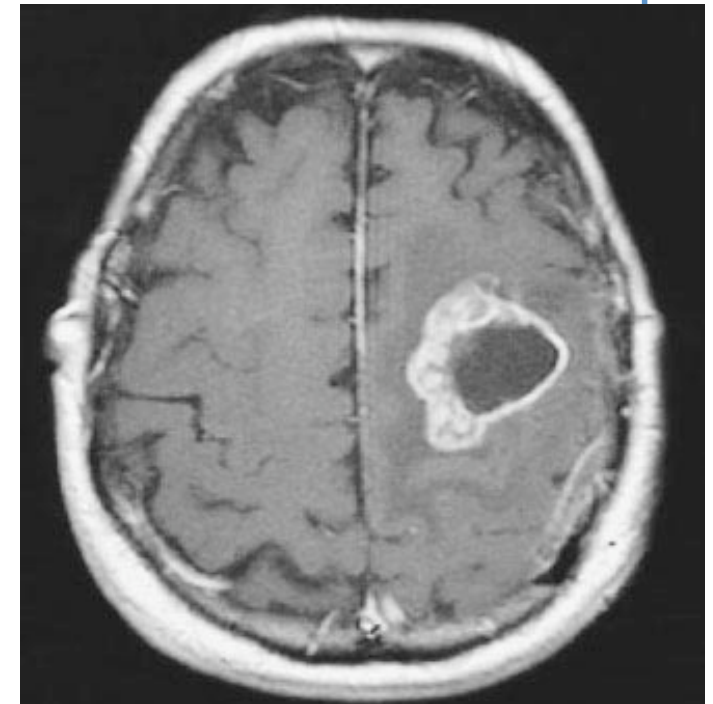


# 1. Glioblastoma multiforme

- MRI is the imaging modality of choice
- The presentation is a heterogeneous mass in the supratentorial white matter with hemorrhage, necrosis, and mass effect.

• The differential for ring-enhancing lesion on MRI includes

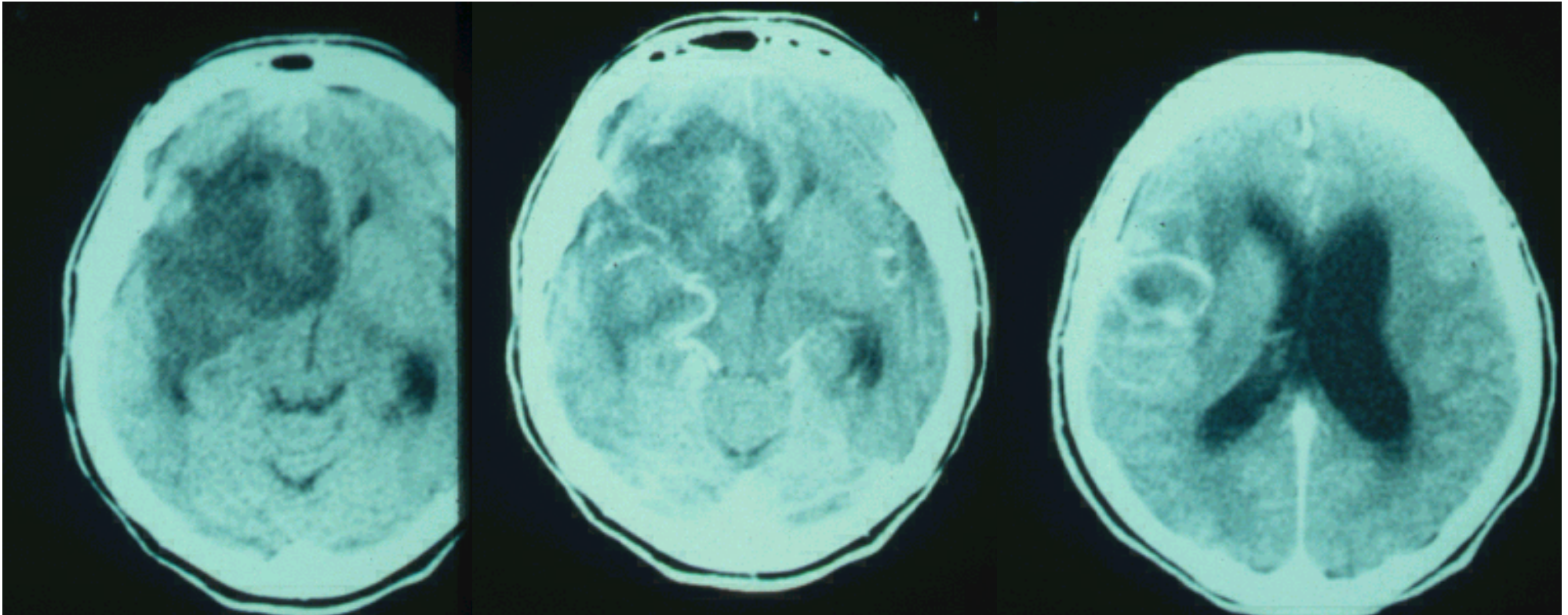
- metastasis,
- abscess
- glioma/granuloma
- demyelinating disease
- and resolving hematoma



- Irregular, Heterogeneous ,dense contrast enhancement
- Ring enhancement common, irregular and nodular, often around necrosis
- Infiltrative, can involve WM and cross midline



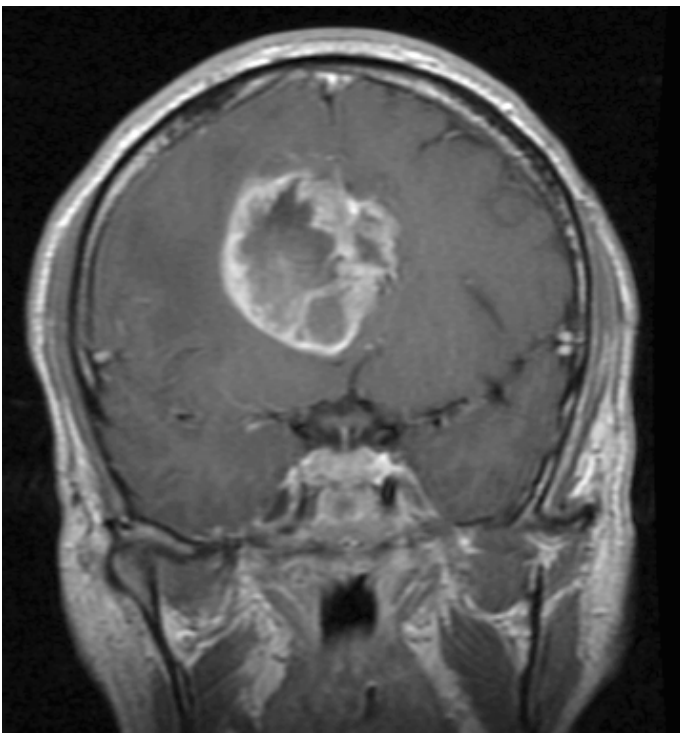
# 1. Glioblastoma Multiforme



MRI is more sensitive than CT for detecting brain tumors. CT is superior for detecting calcifications within the lesion.

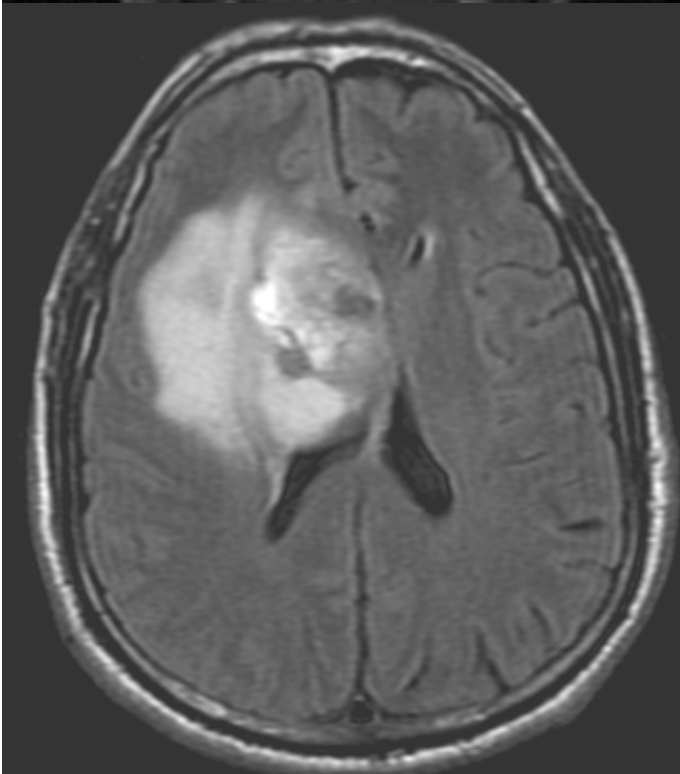
T2 is best to demonstrate edema of the brain + outline the tumor  
When the tumor extends to the other side of the brain it's called butterfly tumor  
WM: white matter

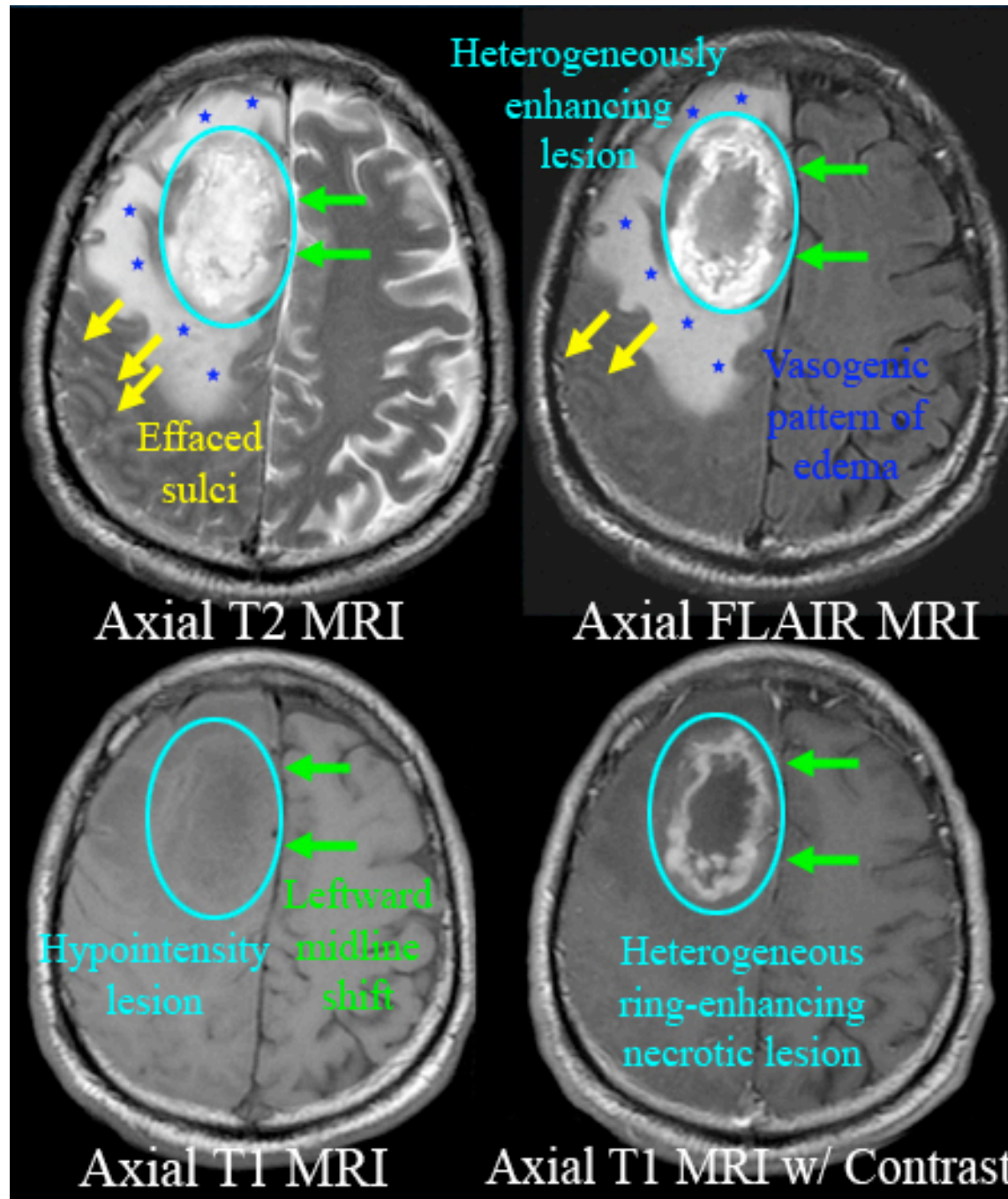




Post contrast

- Irregular, dense contrast enhancement
- Ring enhancement common, irregular and nodular, often around necrosis
- Infiltrative, can involve WM and cross midline







# Contrast Enhancement

## Ring lesions

- **M** Metastasis, MS
- **A** Abscess/cerebritis
- **G** Glioma/Granuloma
- **I** Infarct
- **C** Contusion
- **D** Demyelination
- **R** Resolving Hematoma





## 2. Meningioma

- Meningioma is the most common type of **extra-axial neoplasm** and accounts for 14 - 20% of intracranial neoplasm's.
- It is a non-glial 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

In the past, meningioma used to be diagnosed by Angiogram.

The **dural tail sign** occurs as a result of thickening of the dura and, in the majority of cases, is associated with meningioma formation. Through T1 MRI



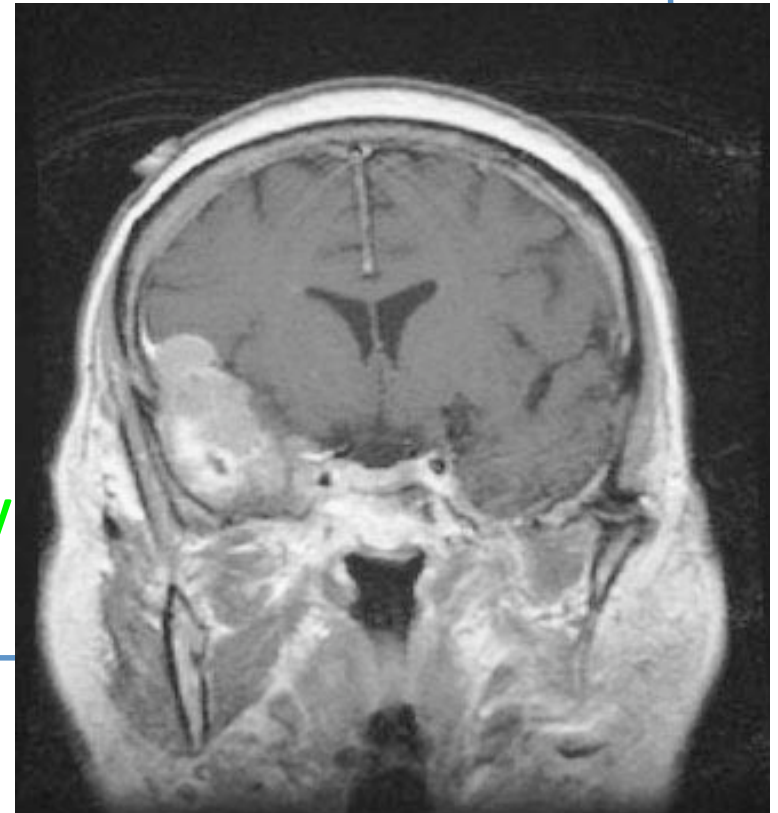
## 2. Meningioma

### Plain film

- enlarged menigeal artery grooves
- hyperostosis or lytic regions
- Calcification

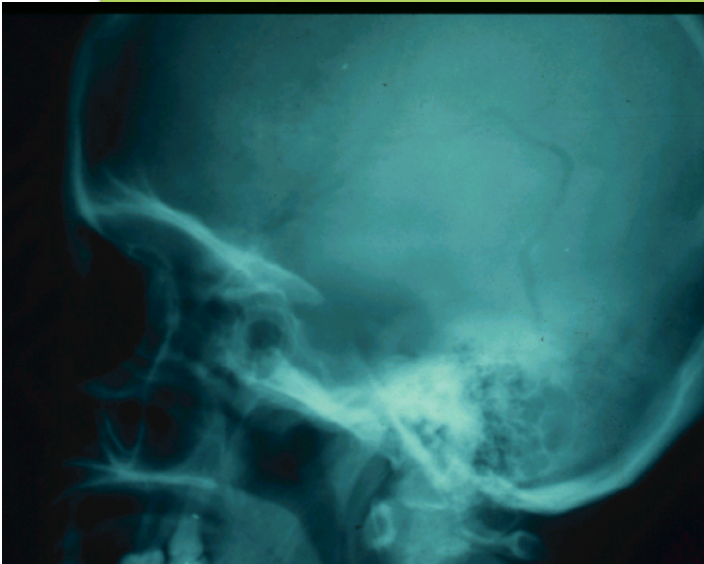
### Image:

- Base of skull (parasellar), cerebral convexities
- Adjacent to bone, 'dural tail'
- Characteristic diffuse pattern of enhancement
- Slow growing, little edema, histologically benign

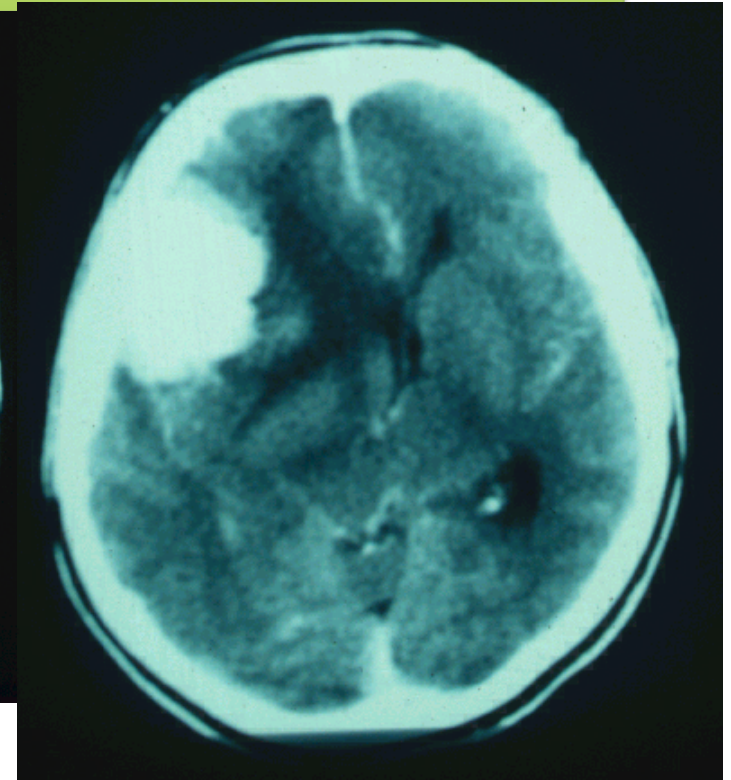
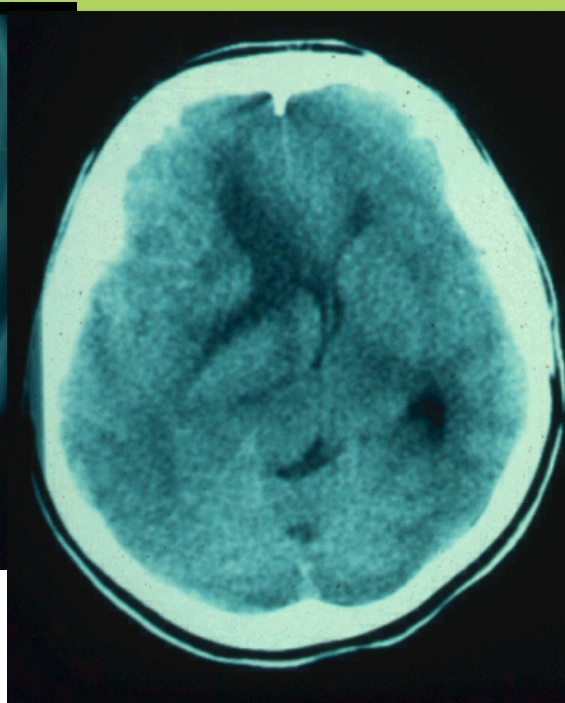




# Meningioma CT



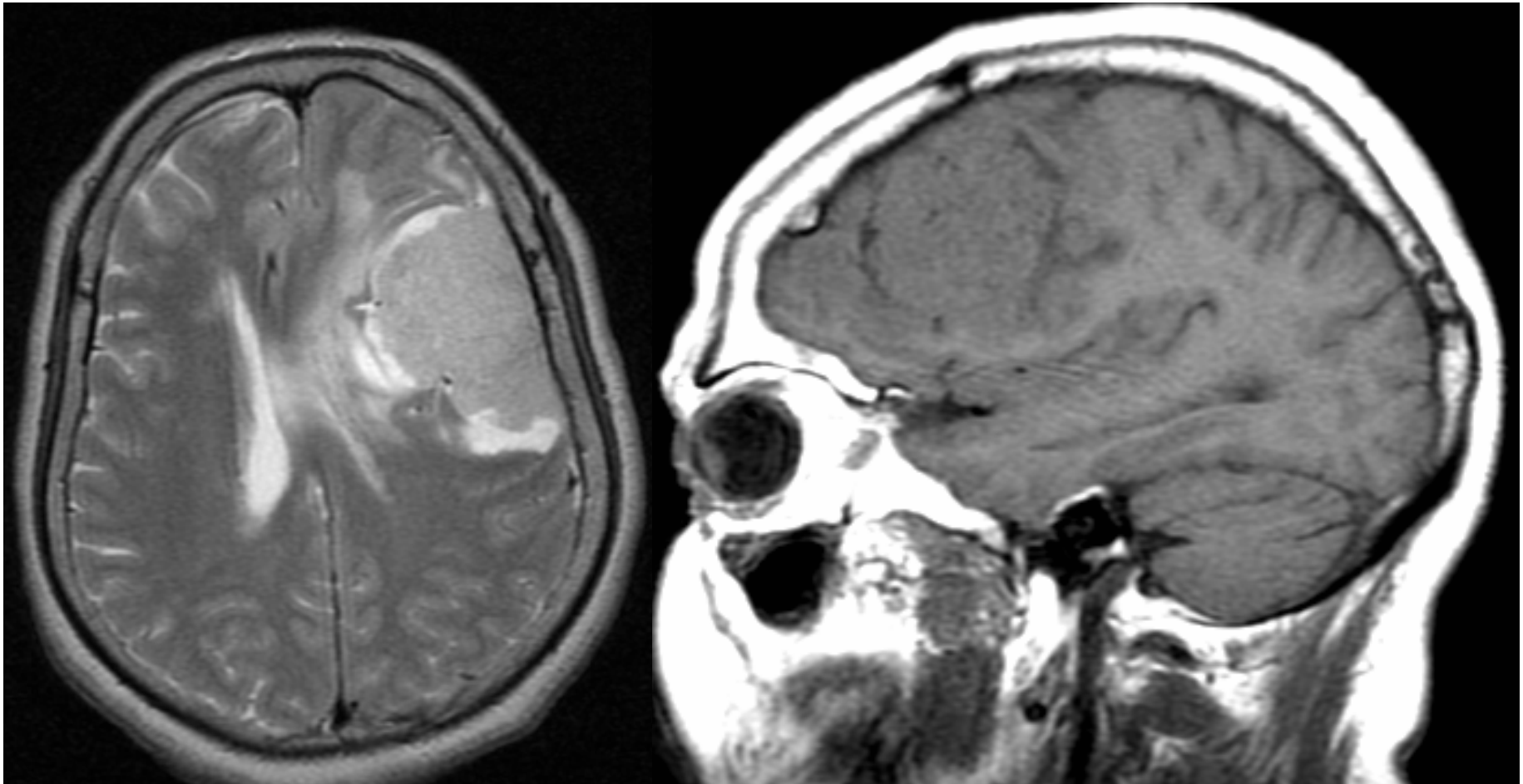
Angiogram



**CT** 60% slightly hyperdense to normal brain  
20 - 30% have some calcification <sup>8</sup>  
72% brightly and homogeneously contrast  
enhance



# Meningioma MRI

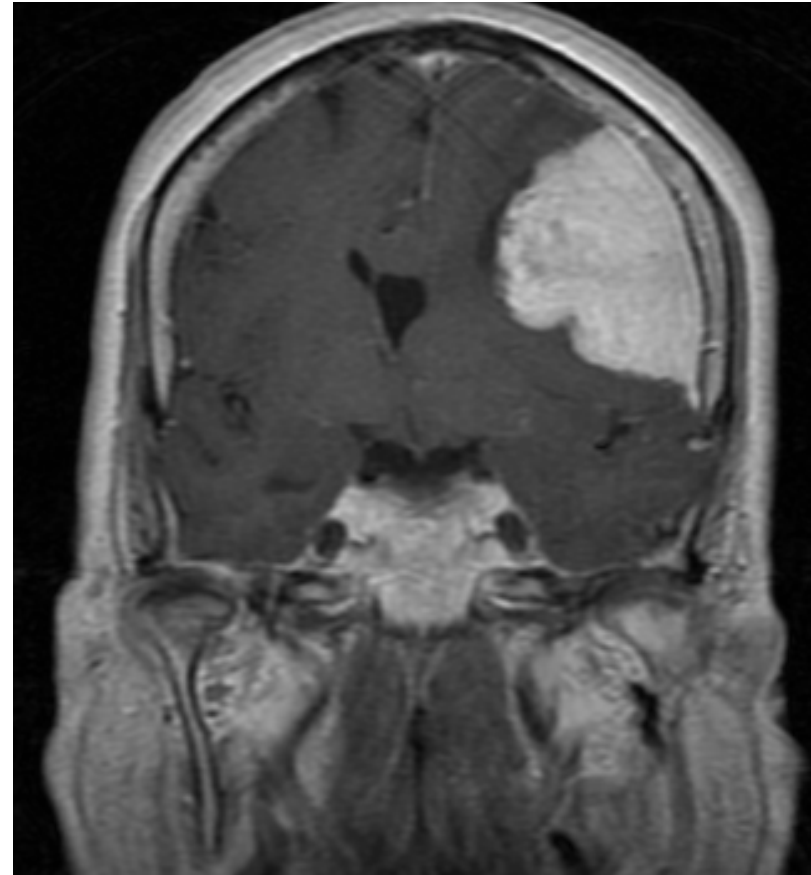
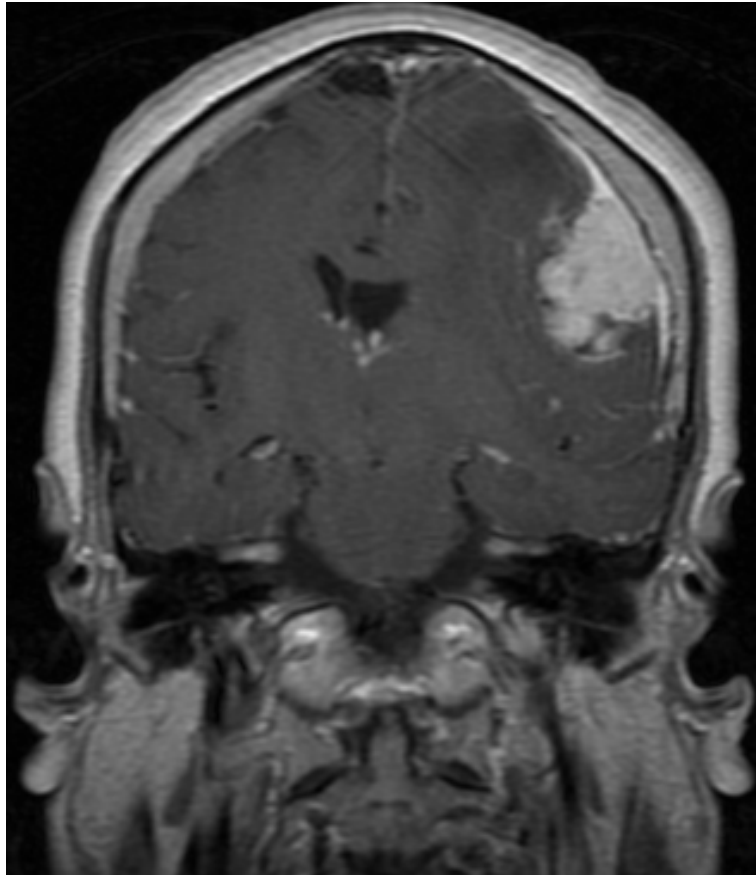


**Specific signs:** CSF Cleft sign, **Dural tail** seen in 60 - 72% <sup>2</sup> (note that a Dural tail is also seen in other processes)





# Meningioma MRI



**MRI: T1** : Isointense ; : ~ 60 - 90% isointense

**T1 C+ (Gd)** : usually intense and homogenous enhancement

T2: isointense : ~ 50%

hyperintense : ~ 35 - 40%



### 3. Patterns of Edema

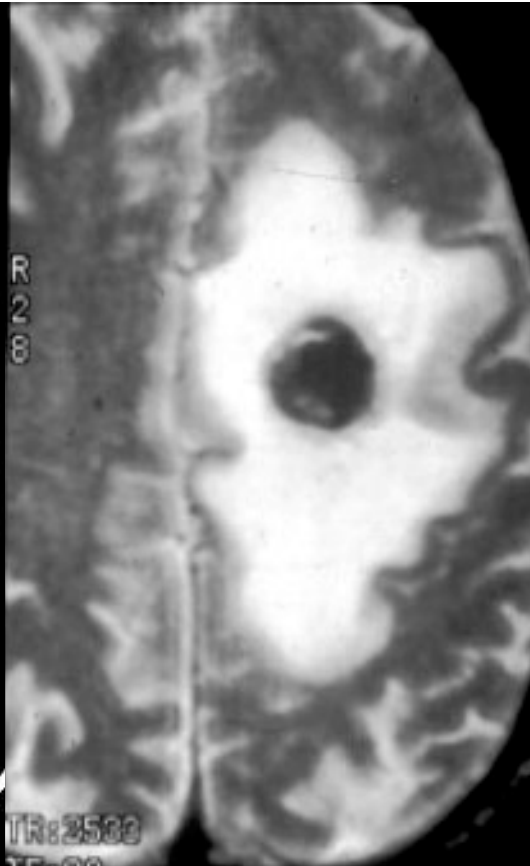
- Edema: Increase in tissue water
- **CT** - decreased density
- **MR - T1W** - decreased signal
- **MR - T2W** - increased signal



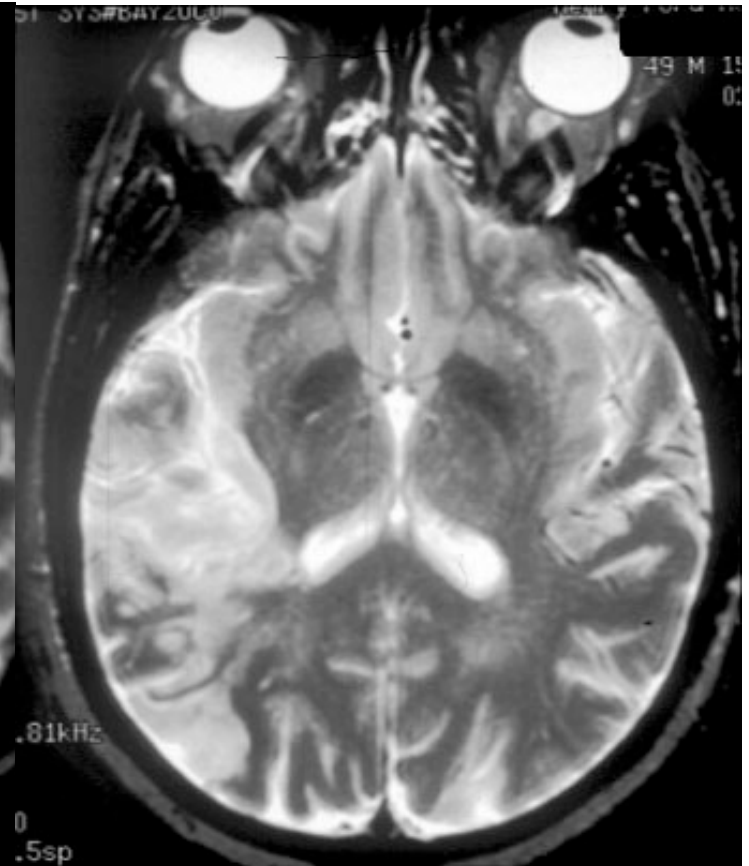
# Patterns of Edema



**Vasogenic:** (interstitial) white matter only



Neoplasm abscess



**Cytogenic:** (intracellular) both gray and white matter infarction





## 4. Pituitary Adenoma

- **Pituitary adenomas**

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.**



# Pituitary Adenoma



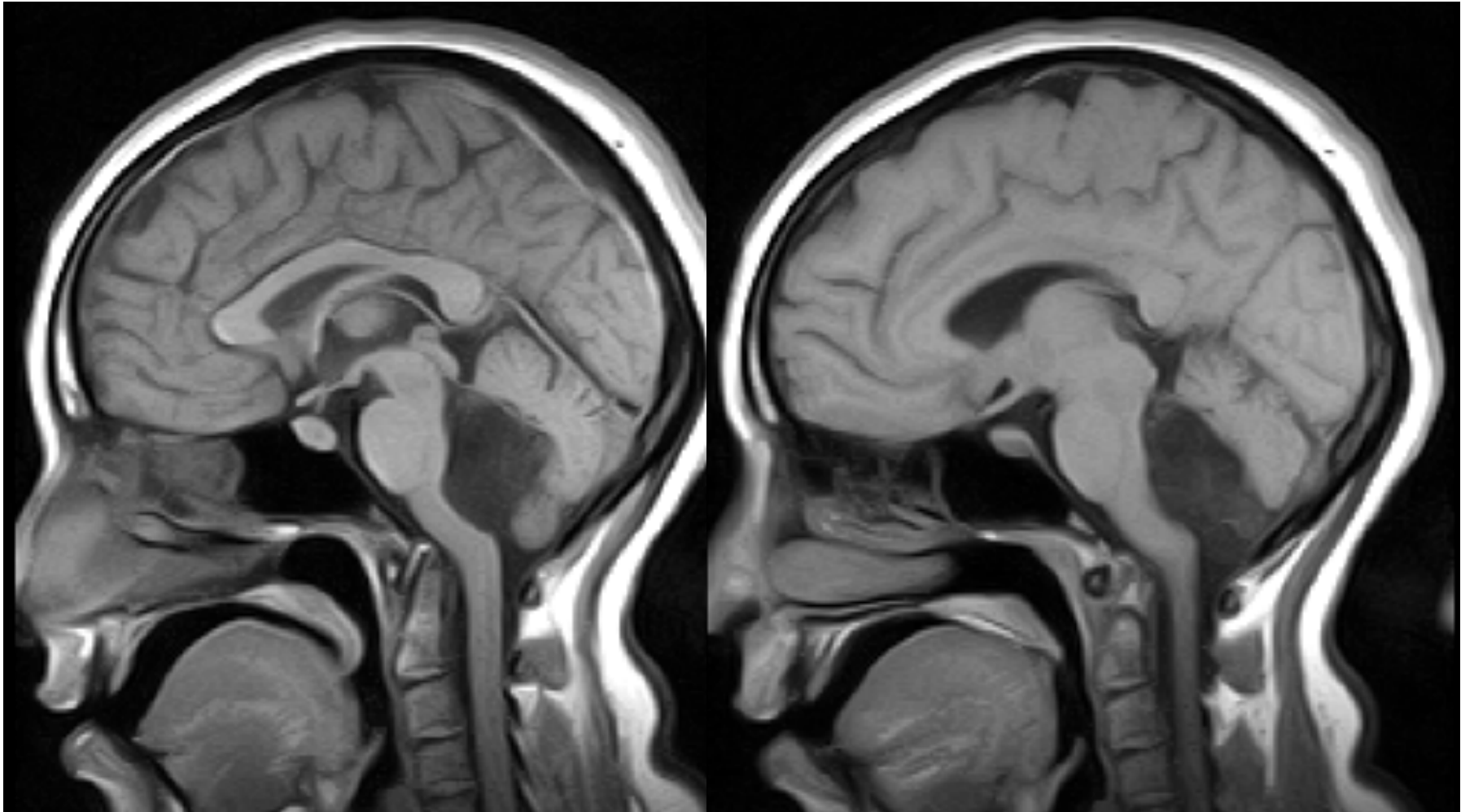
**NORMAL PITUITARY**



**PITUITARY MACROADENOMA**



# Pituitary Adenoma





## 5. Craniopharyngioma

- They derive from remnants of the **craniopharyngeal duct**
- arises in the **sellar / suprasellar** region. They account for ~ **1 - 5 %** primary brain tumours

The heterogeneity of the tumor depends on the consistency



# Craniopharyngioma CT



## CT

- Typically seen as a heterogeneous mass in the suprasellar region.
- Overall, calcification is very common, but this is only true of the adamantinomatous subtype (90% are calcified).
- The pattern of calcification is typically stippled and often peripheral in location.
- Cysts are seen in 70 - 75% of cases and are a more dominant feature of the adamantinomatous type.

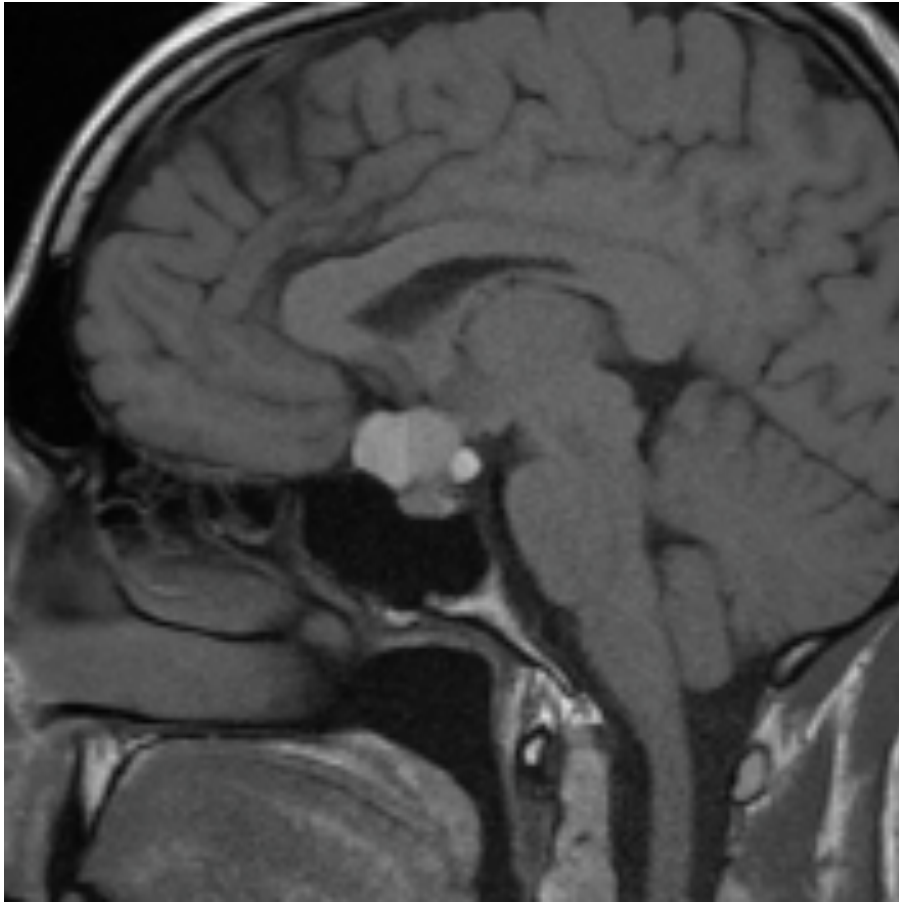


# Craniopharyngioma MRI

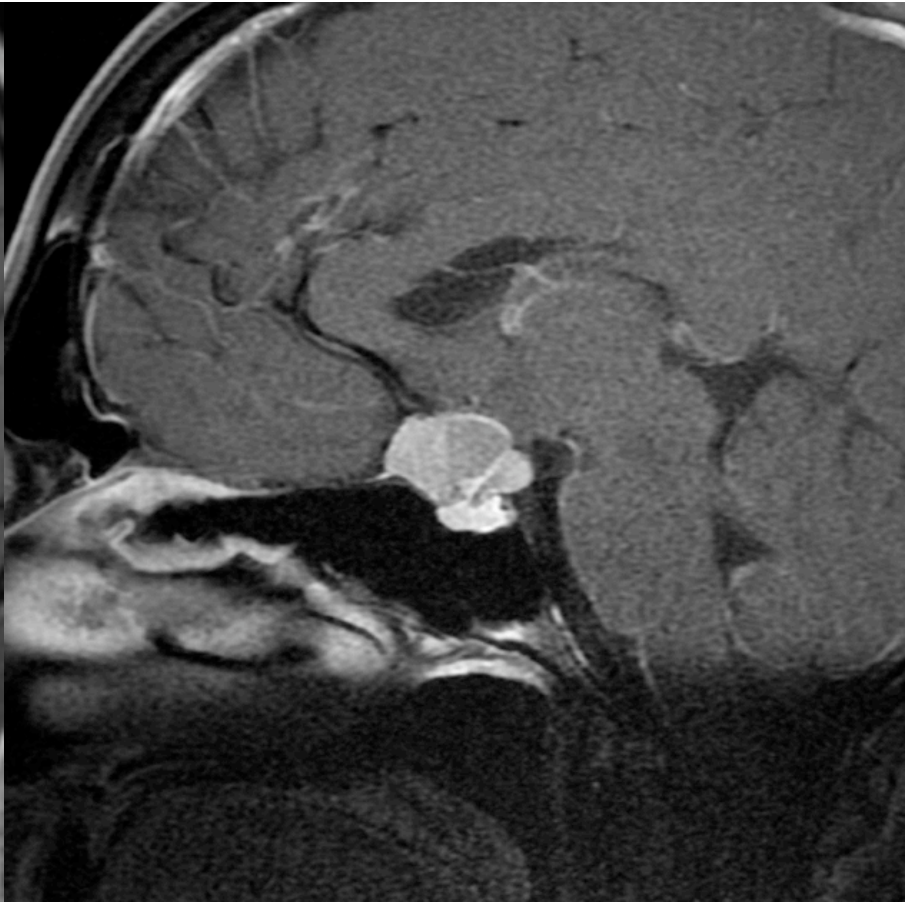
- MR features can significantly vary depending on the histological subtype and on the size and content of the cysts.
- **T1** : signal intensity varies depending on cyst contents, and can appear hyper intense due to protein, blood products, and / or cholesterol
- **T1 C+ (Gd)** : contrast enhancement is typical, with thin enhancement of the cyst wall, or diffuse heterogeneous enhancement of the solid components.
- **T2** : signal is high in both solid and cystic components, but is variable depending on content of fluid



# Craniopharyngioma MRI



**T1**



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



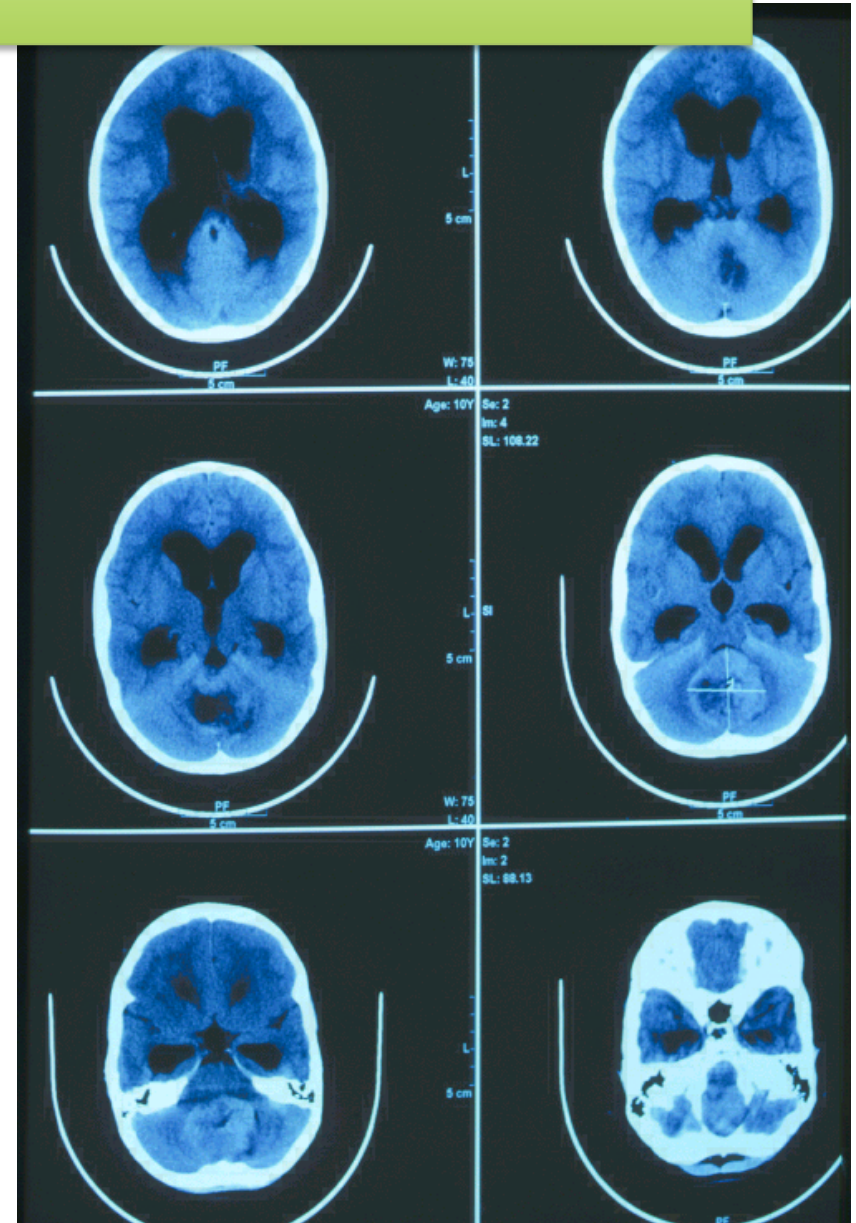
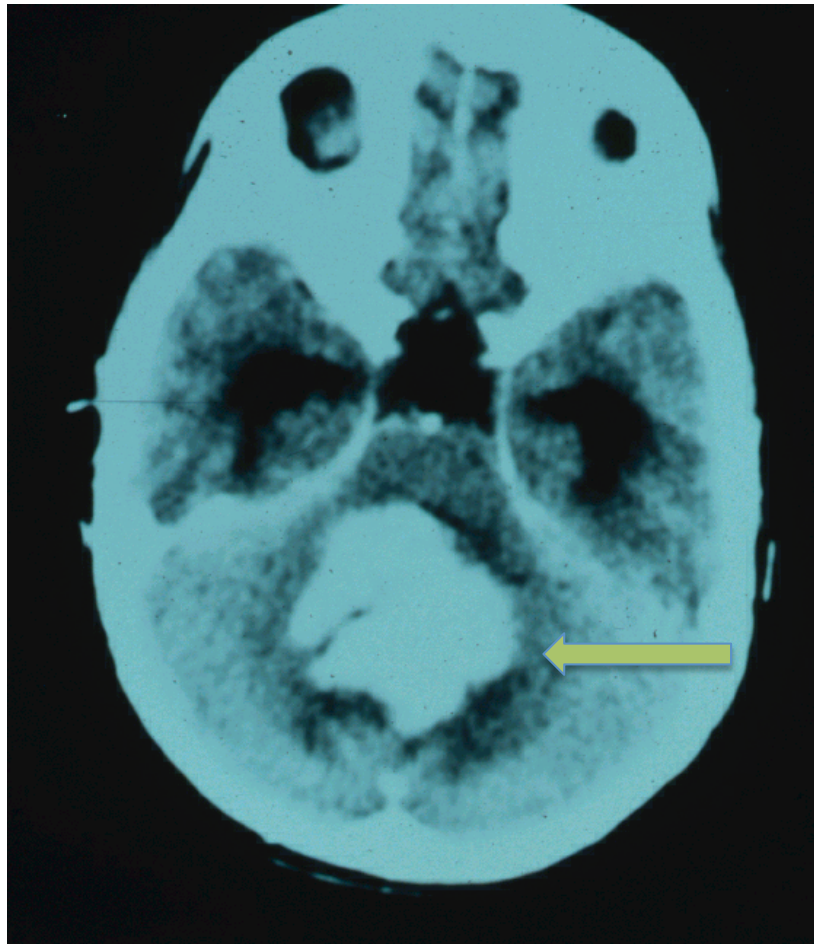


## 6. Medulloblastoma

- is the most common **pediatric posterior fossa** tumor and accounts for **30 - 40%**
- CT: On CT, appear as a mass arising from the vermis, resulting in effacement of the fourth ventricle / basal cisterns and obstructive hydrocephalus
- **Enhancement** is present in over **90%** of cases and is usually prominent



# Medulloblastoma CT



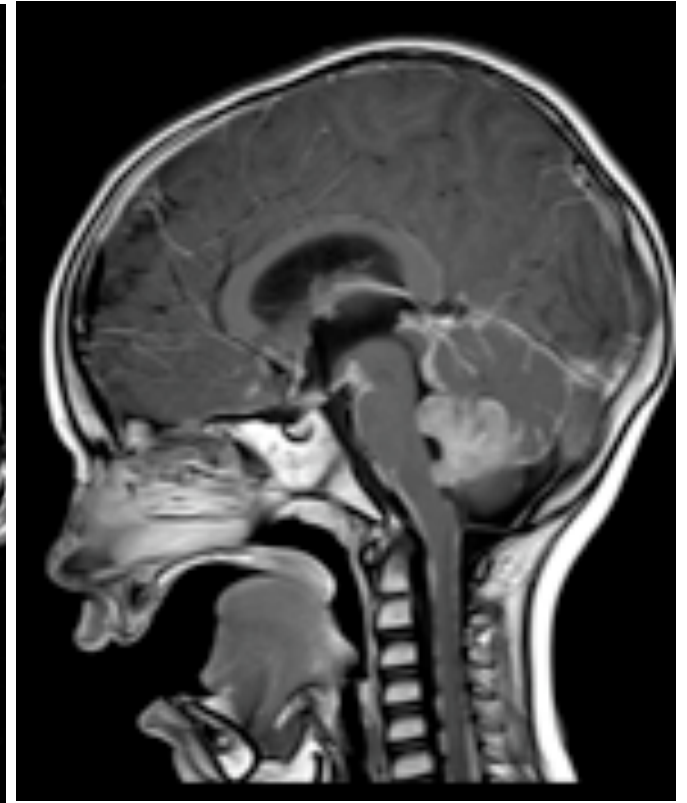
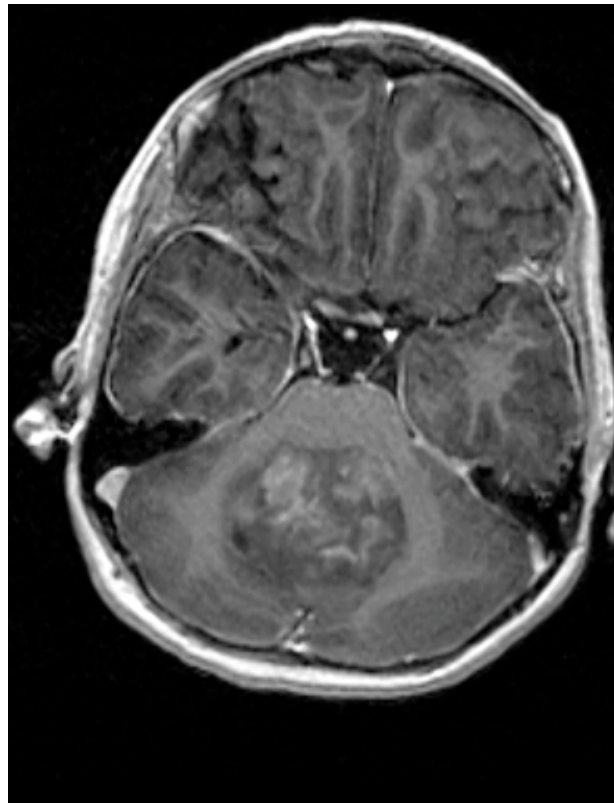


# Medulloblastoma MRI

- **T1** : hypointense to grey matter
- **T1 C+ (Gd)** : 90% enhance, often heterogeneously
- **T2**
  - heterogeneous due to calcification, necrosis and cyst formation
  - overall are iso to hyperintense to grey matter



# Medulloblastoma MRI





## 7. Multiple Sclerosis

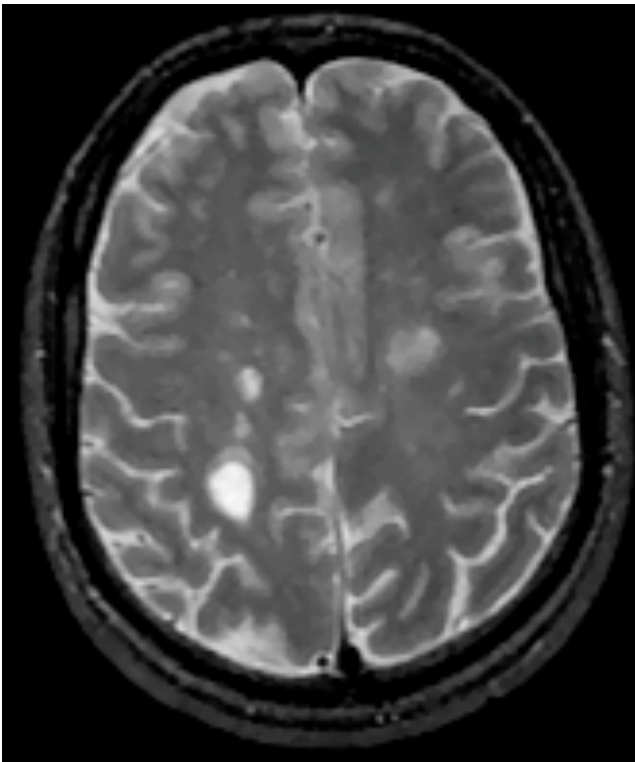
- **Multiple sclerosis (MS)** is a relatively common acquired chronic relapsing **demyelinating** disease
- **MRI** has revolutionised the **diagnosis** and the **follow-up** scans can assess response to treatment and try and determine the disease pattern.

"**Dawson's Fingers**" is the name for the multiple sclerosis lesions around the ventricle-based brain veins[1][2] of Multiple Sclerosis patients.

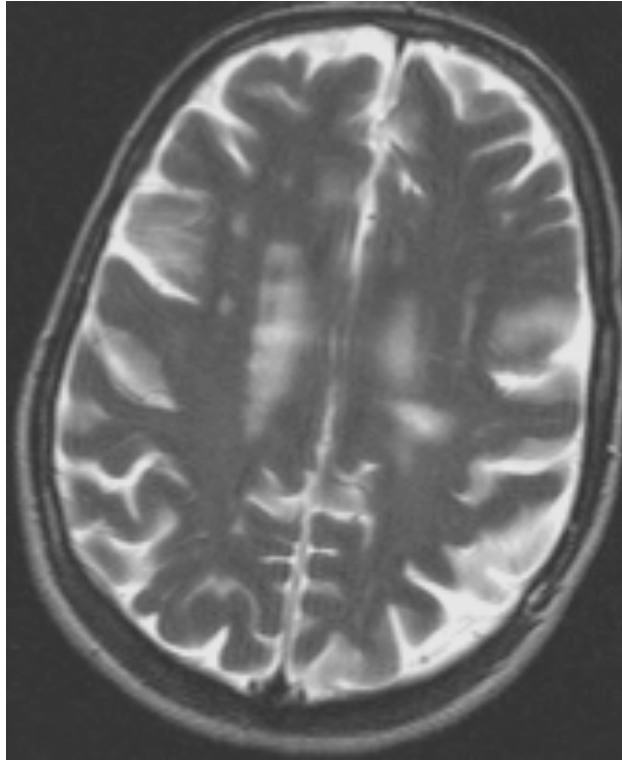




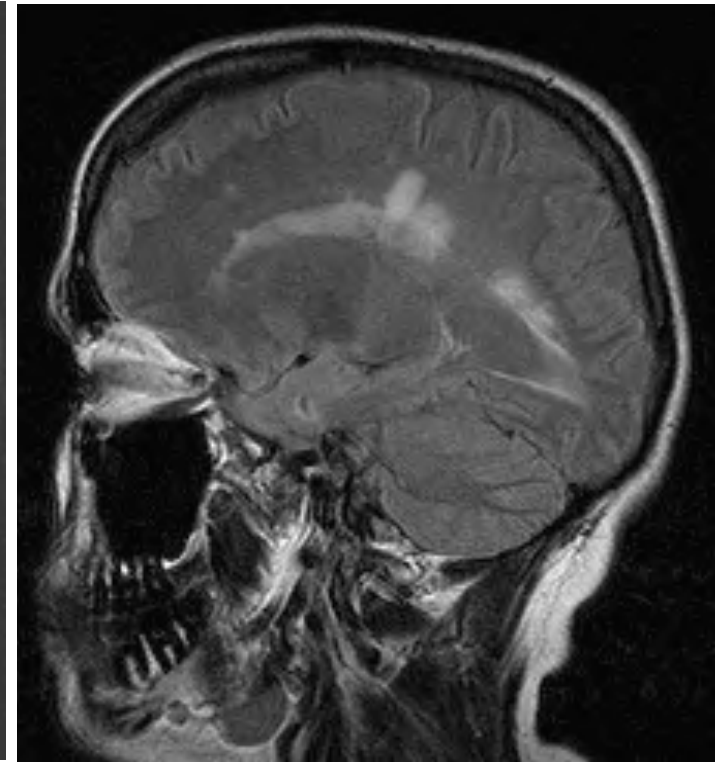
# Multiple Sclerosis MRI



- Multiple lesions in periventricular white matter
- Hypointense on T1, hyperintense on T2
- T2 images extremely sensitive for MS plaques



**T2 weighted images**  
CSF is Bright  
On T2, demyelinated areas are bright



**Periventricular Region**  
“**Dawson's** fingers” represent lymphocytic infiltration along periventricular medullary veins.



## 8. Brain Abscess

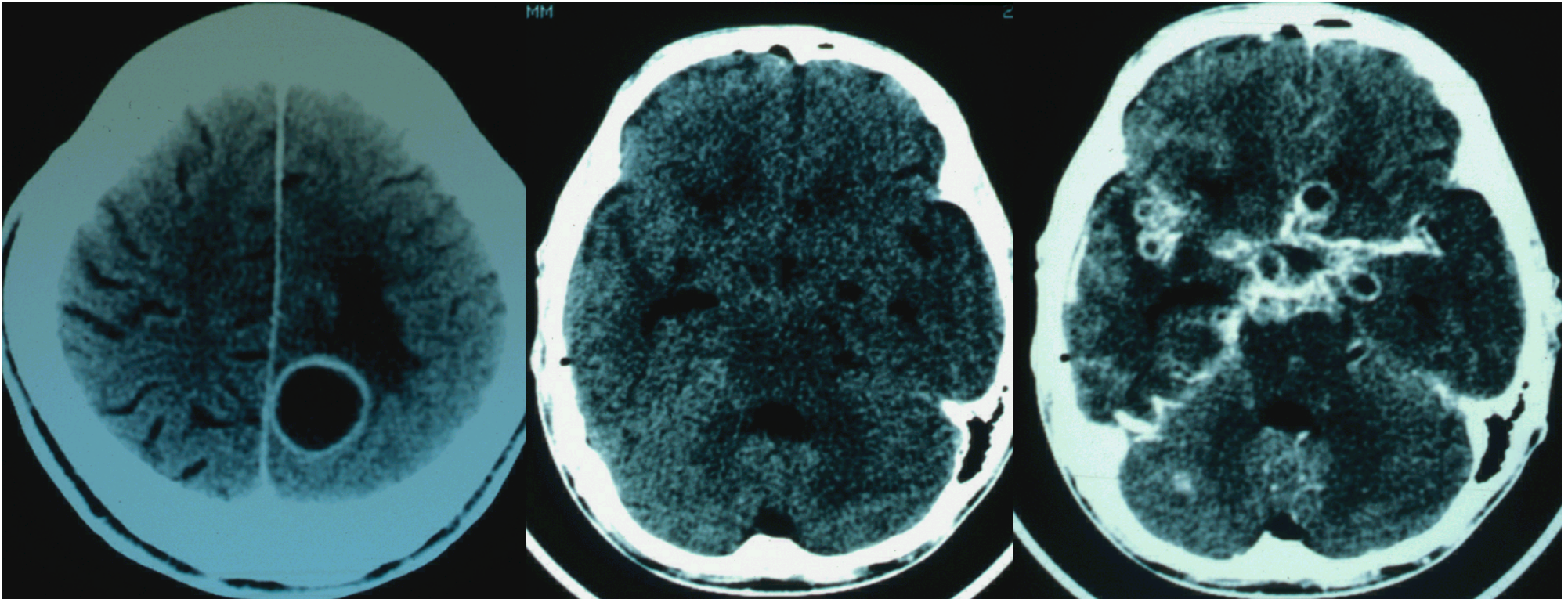
### CT Brain

- central low density
- iso / hyperdense ring
- peripheral low density (vasogenic oedema)
- Ring enhancement
- Ventriculitis may be present, in which case hydrocephalus will commonly also be seen





# Brain Abscess



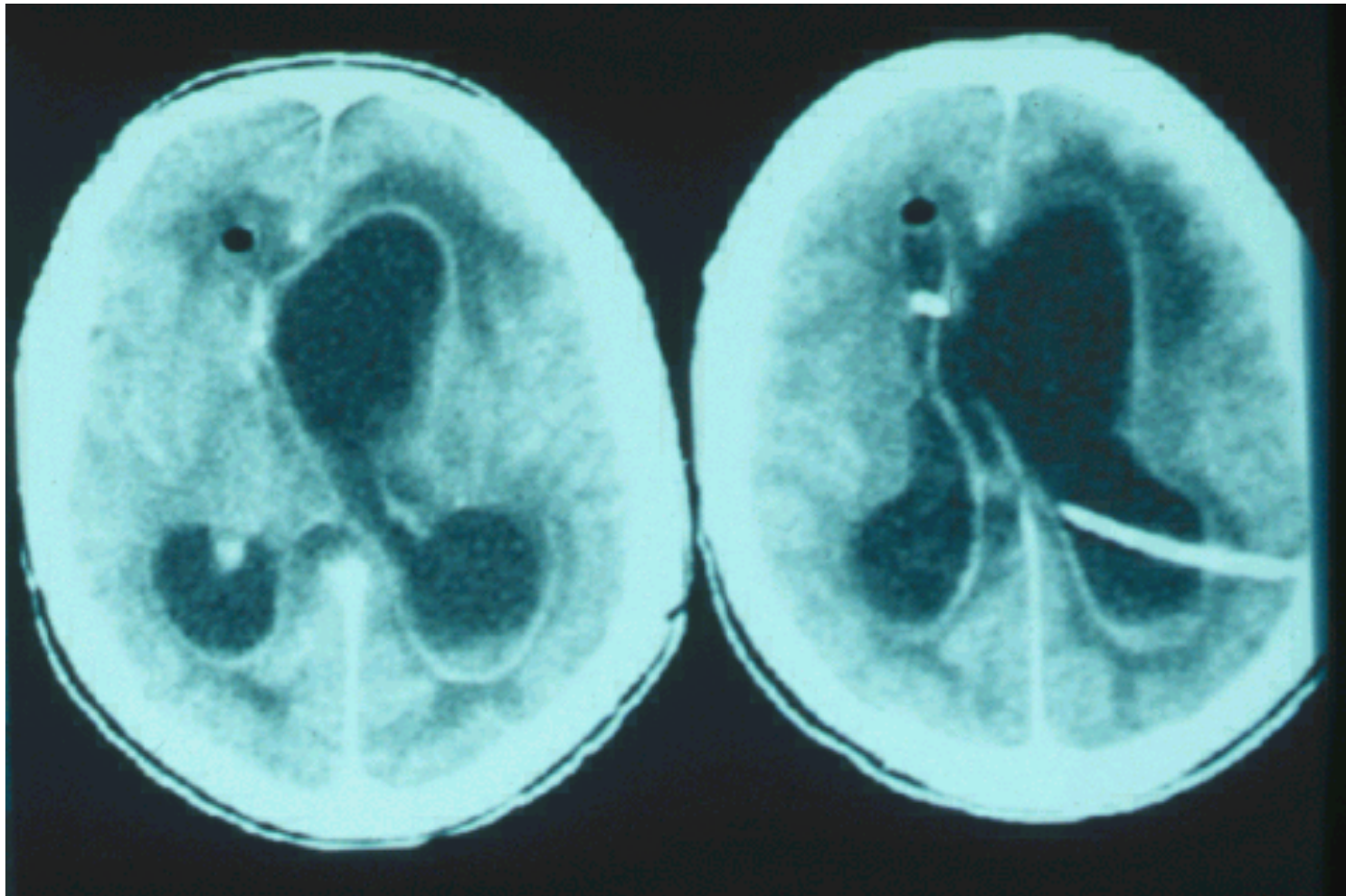
Bacterial abscess

Abscess due to TB  
Several Rings

**Ring enhancing lesion, thin rim with uniform enhancement**



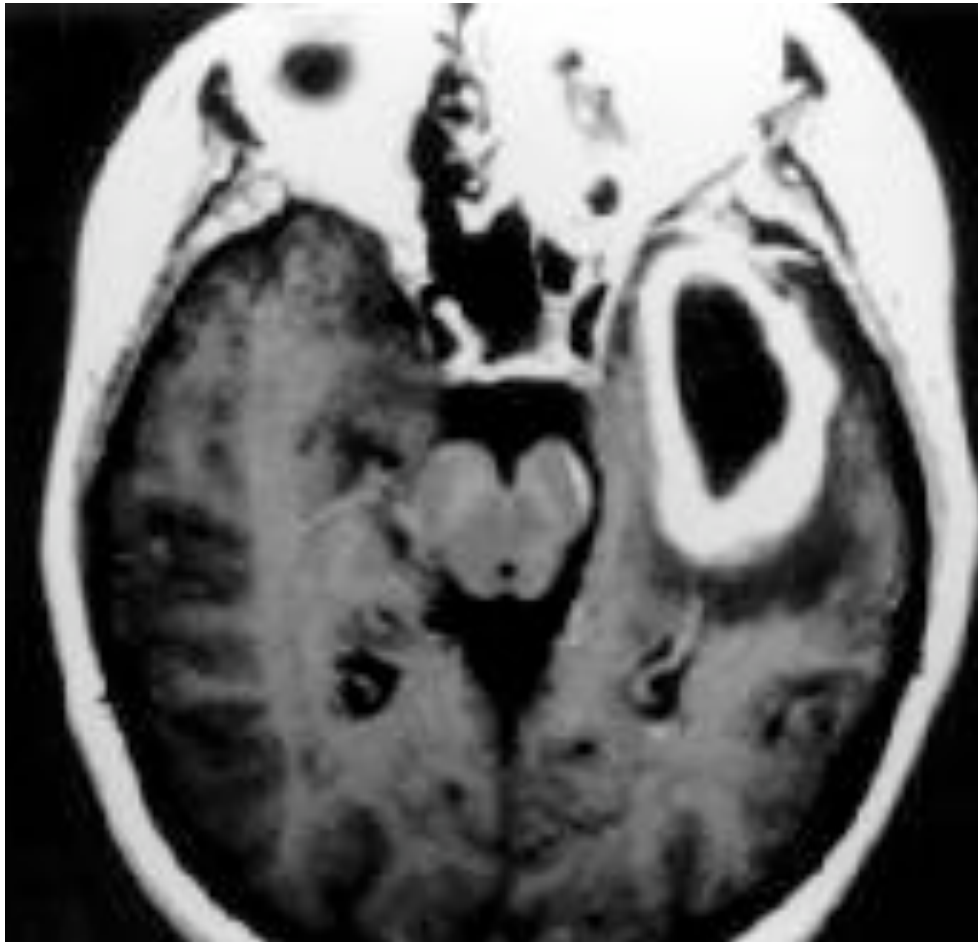
# Brain Abscess



Ventriculitis may be present, in which case hydrocephalus will commonly also be seen as a complication of Brain abscess



# Brain Abscess MRI



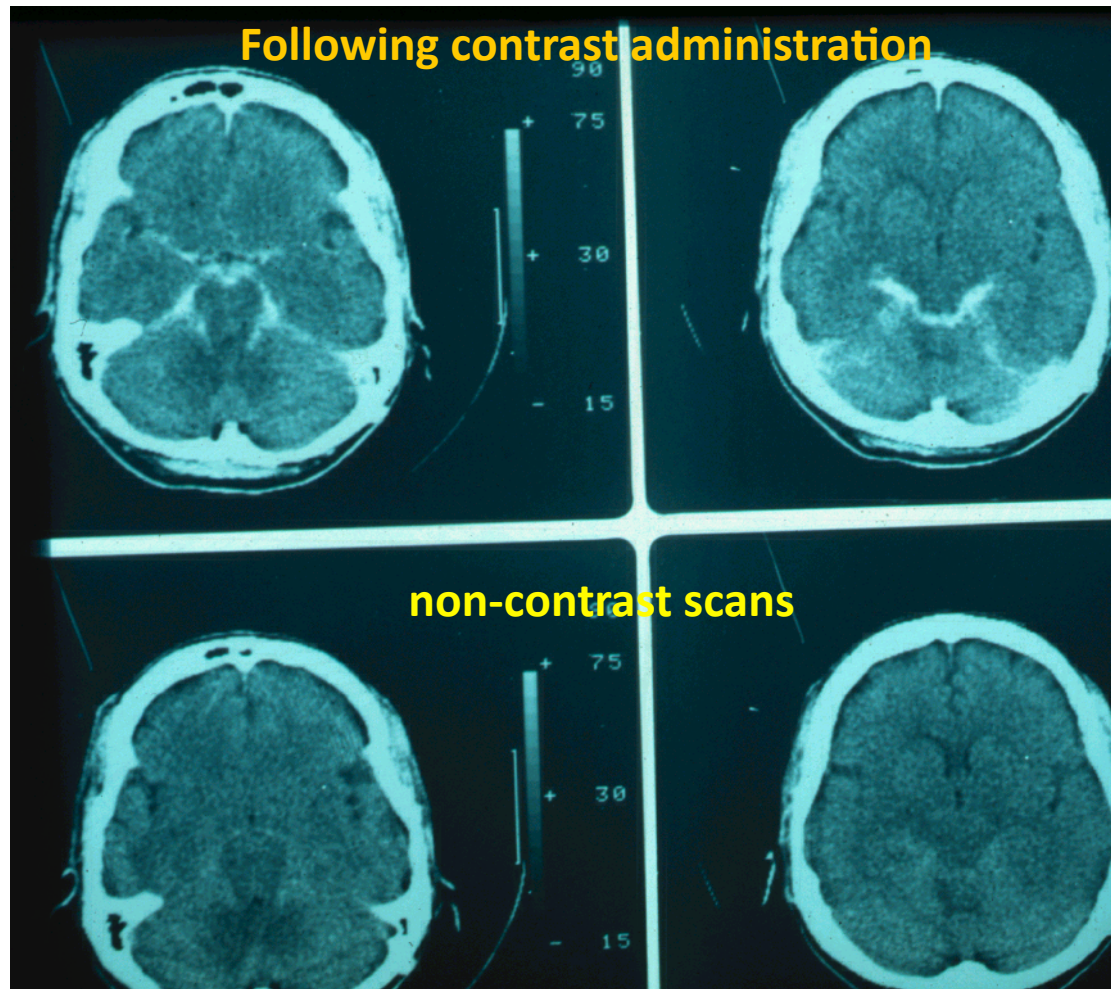
- **T1**
  - central low intensity (hyperintense to CSF)
  - peripheral low intensity (vasogenic oedema)
  - **ring enhancement**
  - ventriculitis may be present, in which case hydrocephalus will commonly also be seen
- **T2 / FLAIR**
  - central high intensity (hypointense to CSF, does not attenuate on FLAIR)
  - peripheral high intensity (vasogenic oedema)
  - the abscess capsule may be visible as a intermediate to slightly low signal thin rim.



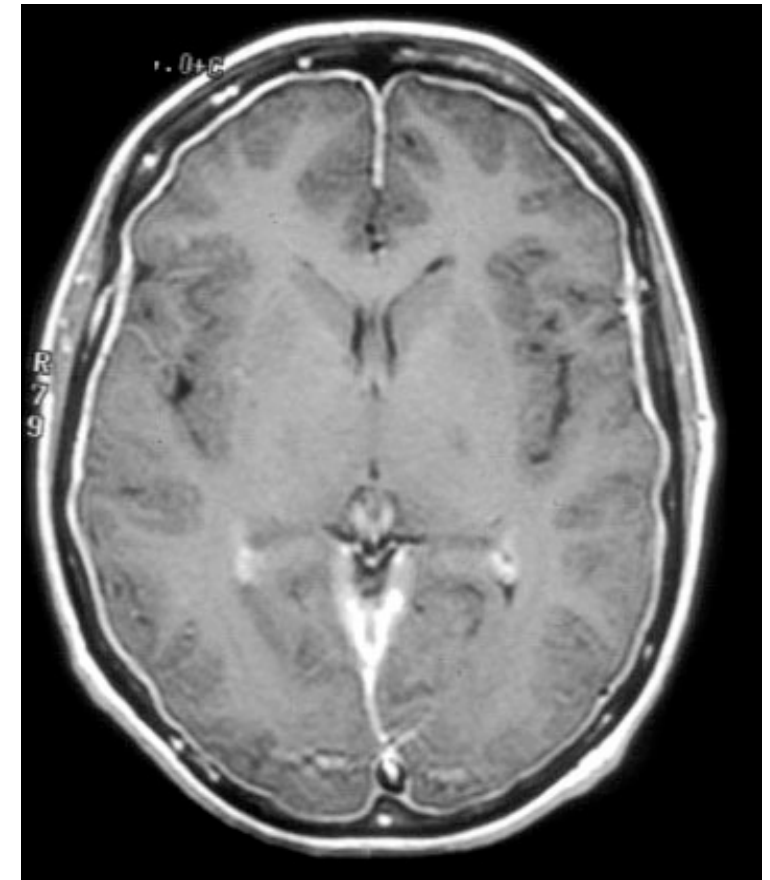


## 9. Meningitis

MRI enhances meninges in meningitis, as well as CT in certain cases.



basal enhancing exudates ,leptomeningeal enhancement, along sylvian fissures, tentorium



**Pachy-meningeal enhancement**

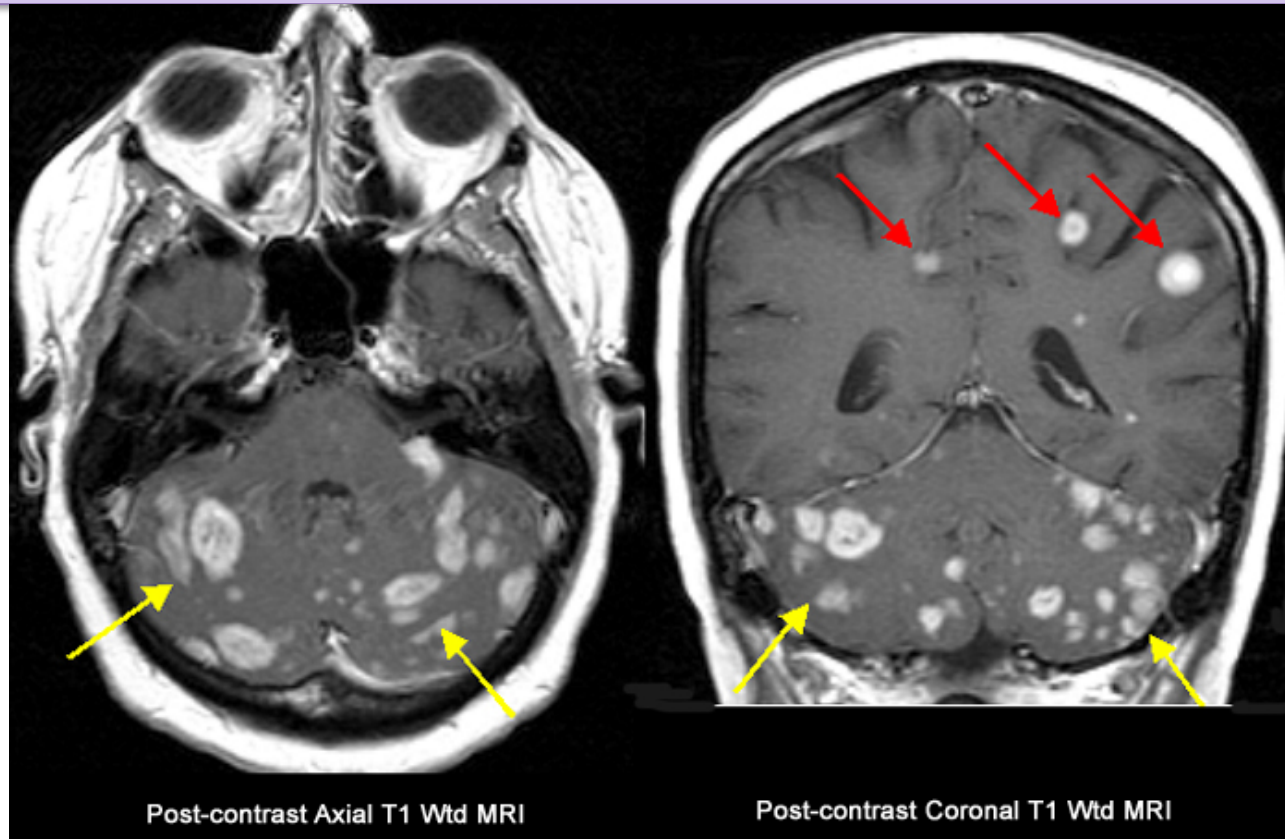
# Secondary Brain Tumors

- Secondary brain tumors are tumors caused from cancer that originates in another part of the body.





# Brain Metastases



- **Multiple Metastasis To The Brain From Breast Primary**
- 40-year old lady with a history of breast carcinoma diagnosed 6 years ago, presented with headache and ataxia.
- **Findings:** Shower of at least 30 metastatic enhancing lesions are seen closely packed together within both cerebellar hemispheres (yellow arrows), and few lesions also seen within both posterior fronto-parietal lobes (red arrows)
- [www.lumen.luc.edu/.../Mental\\_changes1.htm](http://www.lumen.luc.edu/.../Mental_changes1.htm)

# Intracranial Tumors

## Role of imaging in neurooncology

- Diagnosis
  - Ddx: tumor vs. infection vs. vascular
  - Clinical complications: parenchyma compromise, mass effects
- Treatment
  - Treatment planning
  - Localization for therapeutic modalities: RT, stereotaxic surgery
  - Evaluation
- Post-treatment surveillance
  - Tumor recurrence