



# Special Radiological Procedures Of The Head ,Breast And Respiratory System

## MRI Of The Brain 2

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قسم تقنيات الاشعة والسونار

.3. Stage

المرحلة 3

محاضرة رقم 2

الجانب النظري

Lecture No.2

Theoretical

تدريسي المادة : م.م خيرات رحيم لهمود

## *Indications For MRI Brain*

- Transient ischaemic attack (TIA), cerebrovascular attack (CVA)
- Infection, inflammation, meningitis, encephalitis, HIV, AIDS, TB
- Cognitive decline, neurodegenerative disorders, dementia
- Demyelinating disease, multiple sclerosis
- Loss of consciousness, seizures, epilepsy
- Brain tumour, metastases, abscess
- Cerebellar lesion, brainstem lesion
- Congenital abnormalities
- Post-operative follow-up
- Vascular pathologies
- Headaches
- Haemorrhage
- Trauma
- Ataxia
-

# *Contraindications*

- Any electrically, magnetically or mechanically activated implant (e.g. cardiac pacemaker, insulin pump biostimulator, neurostimulator, cochlear implant, and hearing aids)
- Intracranial aneurysm clips (unless made of titanium)
- Pregnancy (risk vs benefit ratio to be assessed)
- Ferromagnetic surgical clips or staples
- Metallic foreign body in the eye
- Metal shrapnel or bullet

# *Patient Preparation For MRI*

## *Brain*

- Ask the patient to **remove all metal objects** including keys, coins, wallet, cards with magnetic strips, jewellery, hearing aid and hairpins
- If possible **provide a chaperone** for claustrophobic patients (e.g. relative or staff)
- **The exam must be explained to the patient** before the scan
- Before injecting **Gadolinium** make sure that the patient has normal kidney function tests (**Blood urea and serum creatinine levels**) (normal GFR)

# *Positioning For MRI Brain*

- Head first supine
- Position the head in the head coil and **immobilise with cushions**
- Give **cushions under the legs** for extra comfort
- **Centre** the laser beam localiser over the glabella

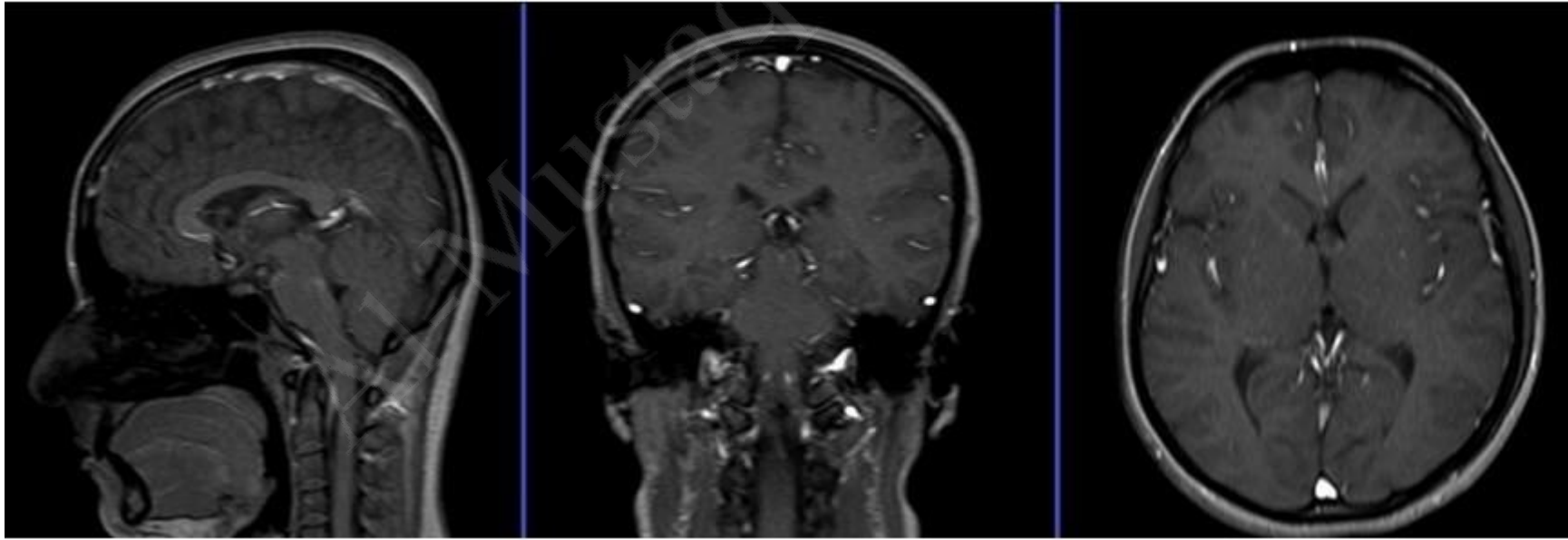


# *Suggested Protocols, Parameters And Planning*

## *Localiser*

A three plane localizer must be taken in the beginning to localise and plan the sequences. Localizers are usually less than 25sec.

T1 weighted low resolution scans.



# T1 SE Coronal

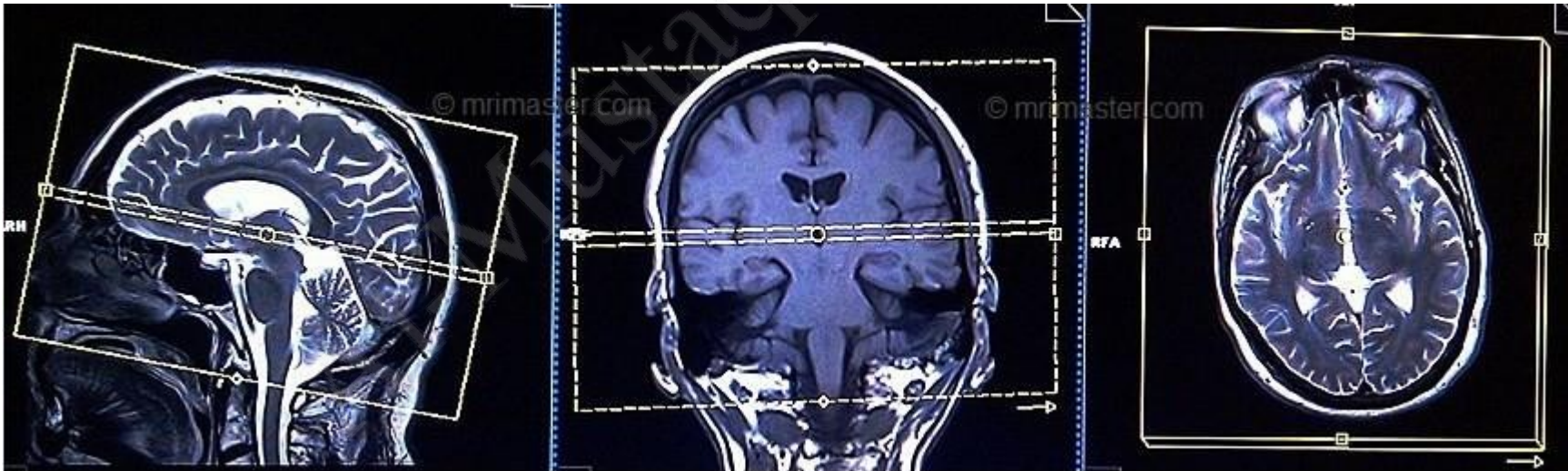
Plan the coronal slices on the sagittal plane; angle the position block perpendicular to the corpus callosum. Check the positioning block in the other two planes. An appropriate angle must be given in the axial plane on a tilted head (perpendicular to mid line of the brain). Slices must be sufficient to cover the whole brain from the frontal sinus to the line of the occipital protuberance.



# T2 Axial

Plan the axial slices on the sagittal plane; angle the position block parallel to the genu and splenium of the corpus callosum. Slices must be sufficient to cover the whole brain from the vertex to the line of the foramen magnum.

Check the positioning block in the other two planes. An appropriate angle must be given in coronal plane on a tilted head (perpendicular to the line of 3rd ventricle and brain stem).



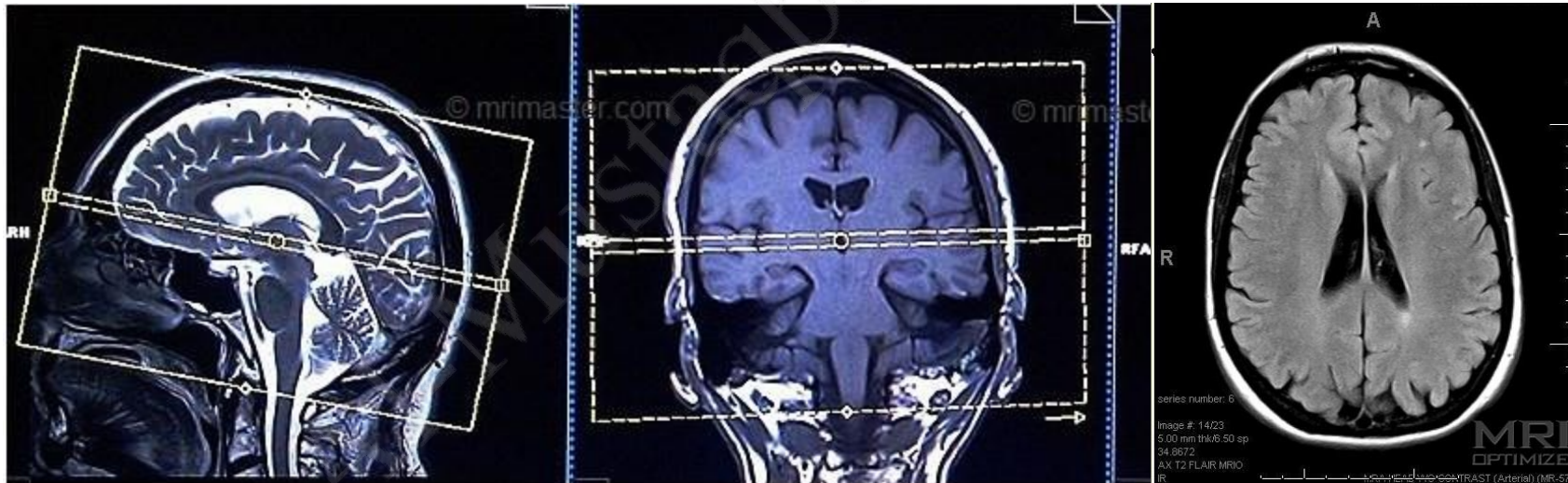
# T2 Sagittal

Plan the sagittal slices on the axial plane; angle the position block parallel to midline of the brain. Check the positioning block in the other two planes. An appropriate angle must be given in the coronal plane on a tilted head (parallel to the line along 3rd ventricle and brain stem). Slices must be sufficient to cover the brain from temporal lobe to temporal lobe.



# T2 FLAIR Axial

Plan the axial slices on the sagittal plane; angle the position block parallel to the genu and splenium of the corpus callosum. Slices must be sufficient to cover the whole brain from the vertex to the line of the foramen magnum. Check the positioning block in the other two planes. An appropriate angle must be given in coronal plane on a tilted head (perpendicular to the line of 3rd ventricle and brain stem).



# DWI Axial

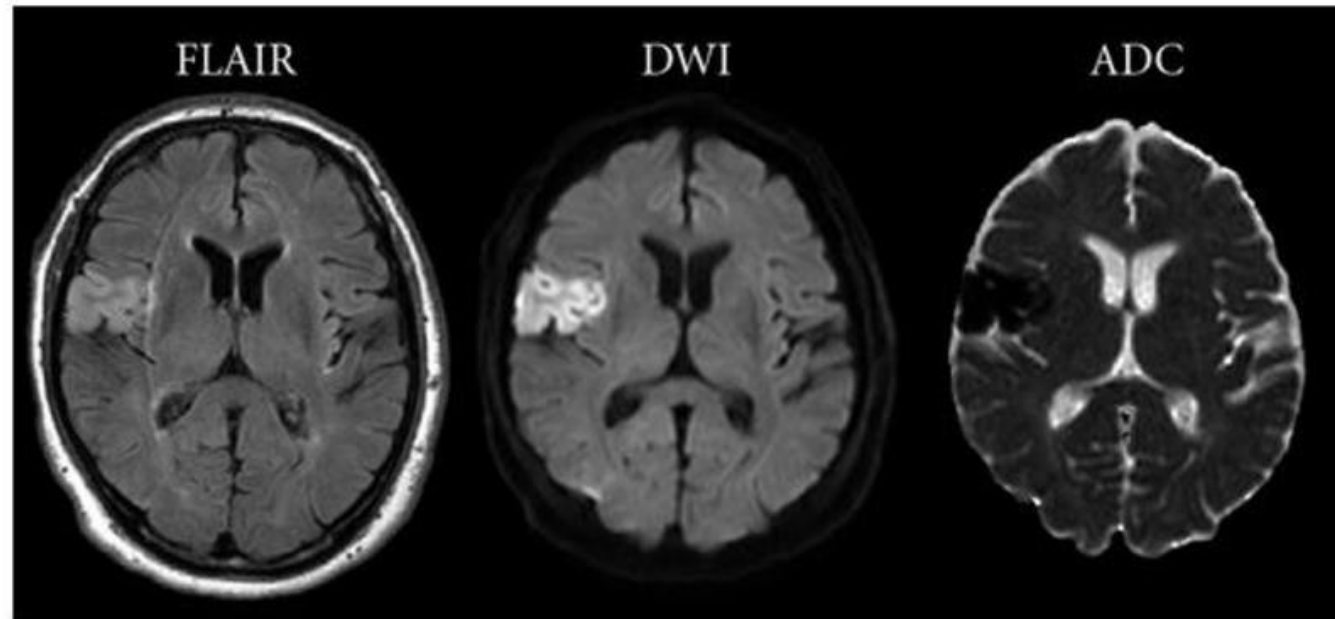
Plan the DWI axial slices on the sagittal plane; angle the position block parallel to the line from the glabella to the foramen magnum. *This angle will reduce air-bone interface artefacts from the Paranasal sinuses.* Slices must be sufficient to cover the whole brain from the vertex to the foramen magnum. Check the positioning block in the other two planes. An appropriate angle must be given in the coronal plane on a tilted head (perpendicular to the line of 3rd ventricle and brain stem).



# DWI Axial

What is the **Diffusion-Weighted Imaging**: The use of magnetic resonance DWI is recommended in the investigation of stroke and TIA (transient ischemic attack).

Related content : What is the ADC  
? What is the P -value of the DWI



# Indications For Contrast Enhancement Brain Scans

- Tumour, Metastases, Cranial nerve lesion, Indeterminate intracranial lesion, IAC mass
- Meningitis, Encephalitis, Leptomeningeal spread, Multiple Sclerosis, AVM, HIV, Infection, Abscess
- Leukodystrophies, Delayed development, Syringomyelia(Syrinx)
- Use T1 SE axial and coronal after the administration of IV *gadolinium DTPA* injection(copy the planning outlined above).  
The recommended dose of gadolinium injection is 0.1 mmol/kg, i.e. 0.2 mL/kg in adults, children and infants.

|          | Short TR                                                                                     | Long TR                                                                                        |
|----------|----------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------|
| Short TE | <b>T1</b>  | <b>PD</b>   |
| Long TE  |           | <b>T2</b>  |

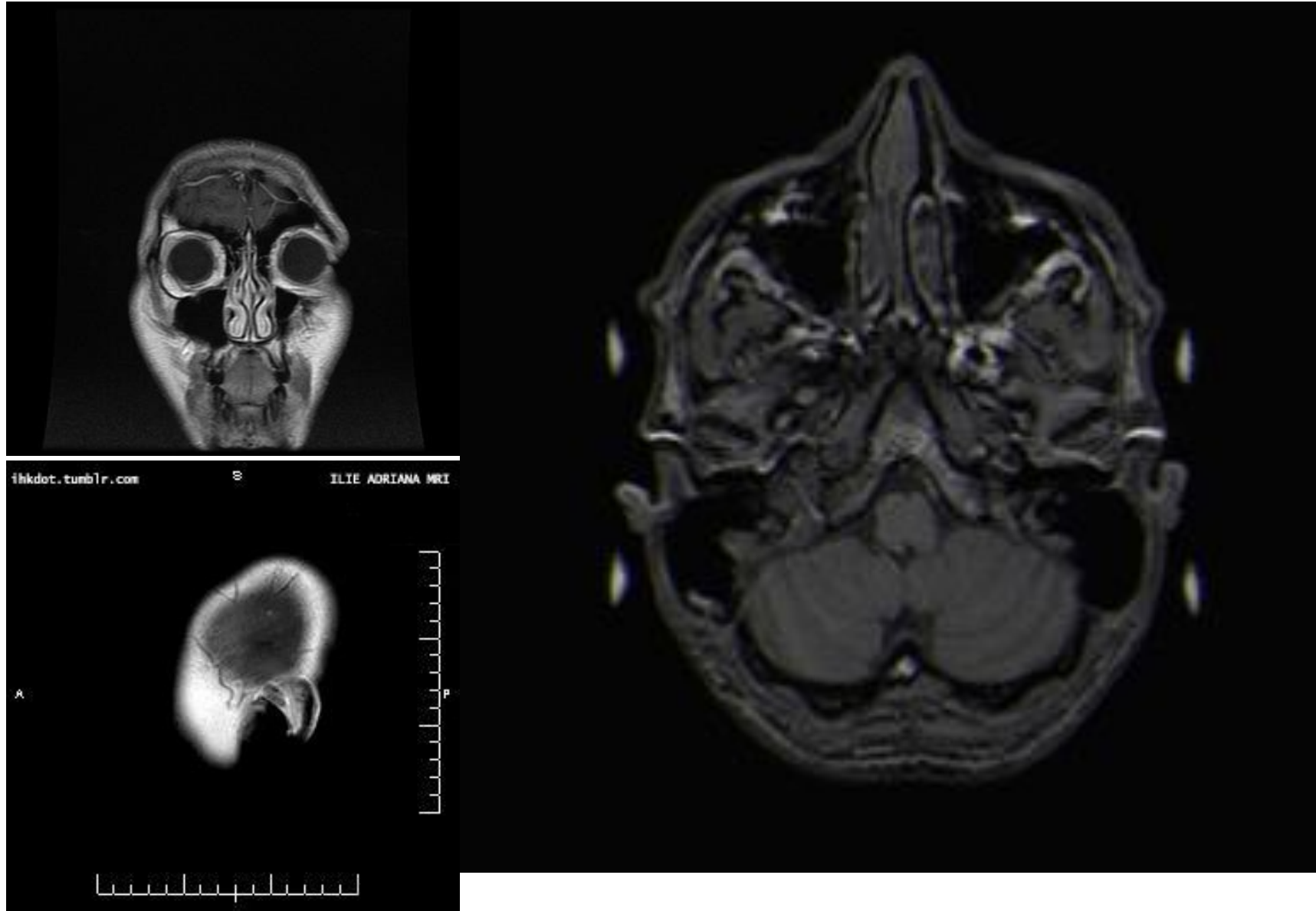
# TR & TE

- TE ( echo time) : Time interval in which signals are measured after RF excitation.
- TR (repetition time) : The time between two excitations is called repetition time.
- By varying the TR and TE one can obtain T1WI and T2WI.
- In general a short TR (<1000ms) and short TE (<45ms) scan is T1WI.
- Long TR (>2000ms) and long TE (>45ms) scan is T2WI.

# T1 W Images

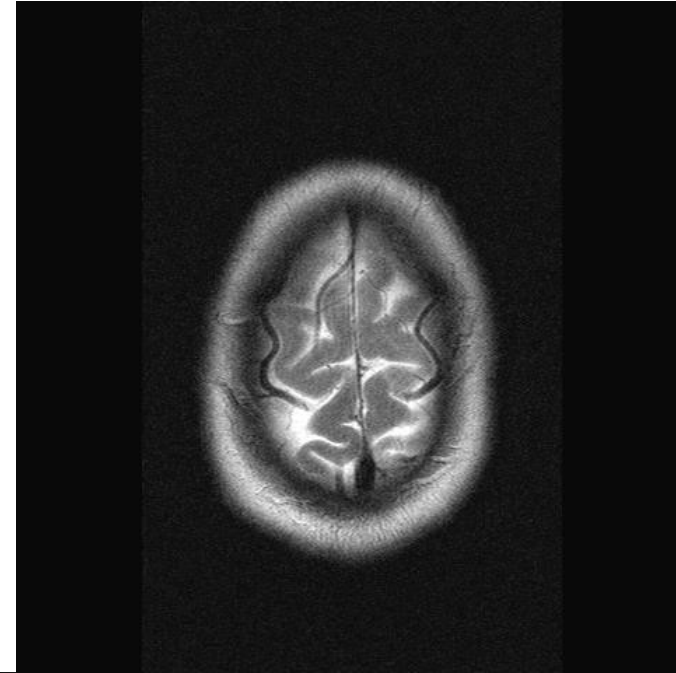
- Short TE
- Short TR
- Better anatomical details
- Fluids are dark
- Gray matter is gray
- White matter is white
- **Most Pathologies dark on T1**
- **Bright On T1**
- Fat
- Hemorrhage
- Melanin
- Early Calcification
- Protein contents (Colloid cyst/  
Rathke cyst)
- Posterior pituitary
- appears Bright on T1
- Gadolinium .

# T1 W Images

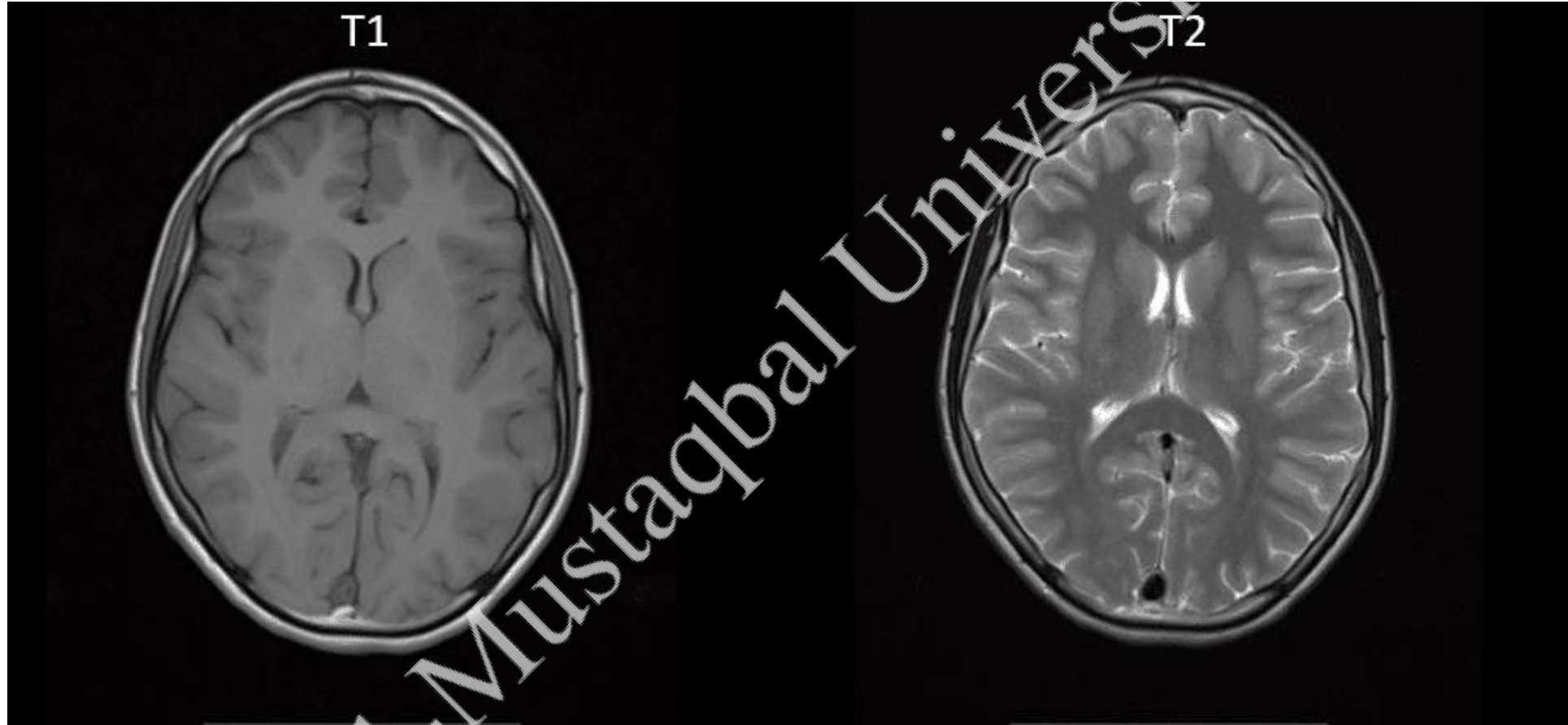


# T2 W Images

- Long TE
- Long TR
- Better pathological details
- Fluids are bright
- Gray matter is relatively bright
- White matter is dark



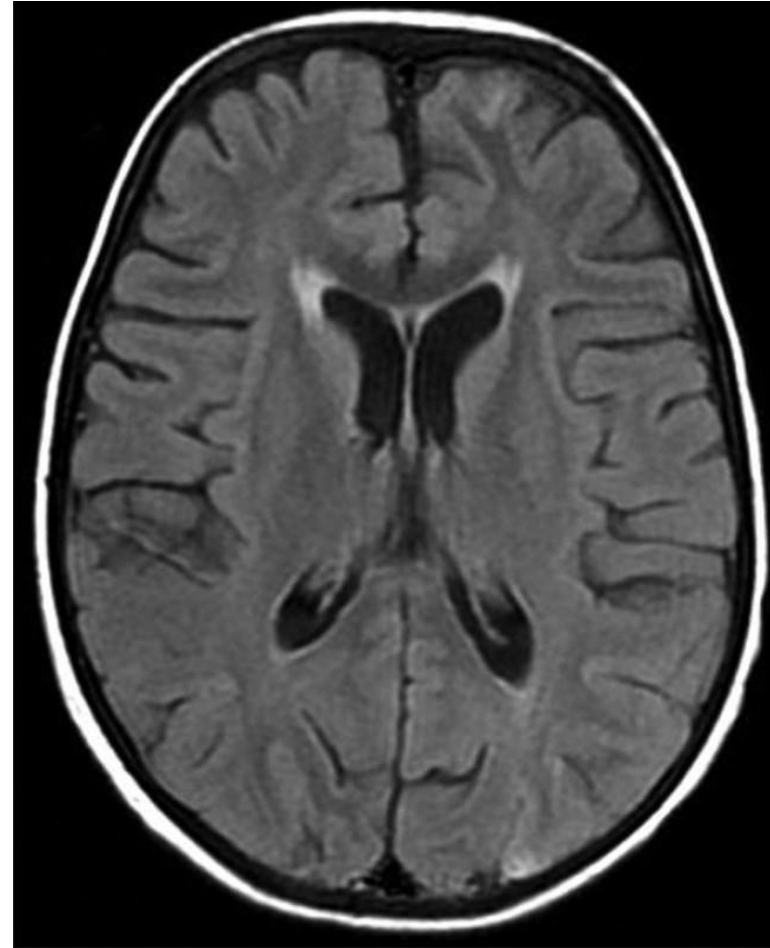
# T1 & T2 W Images



# T2 Flair – Fluid Attenuated Inversion Recovery

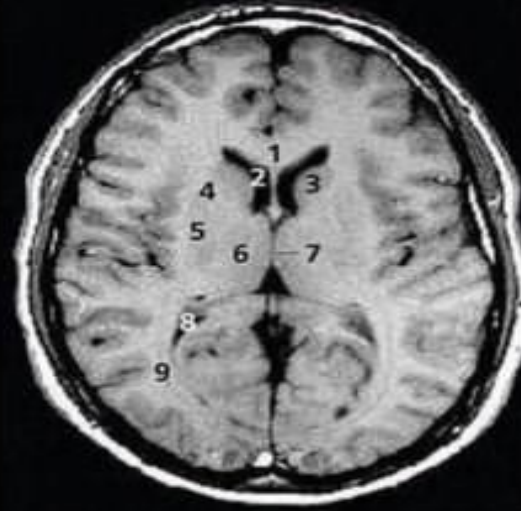
## Sequences

- Long TE
- Long TR
- ❖ Similar to T2 Except free water suppression (Inversion Recovery)
- ❖ Most pathology is Bright
- ❖ Especially good for lesions near ventricles or sulci (eg. Multiple sclerosis)



|       | T1W   | T2W  | Flair(T2) |
|-------|-------|------|-----------|
| TR    | Short | Long | Long      |
| TR    | Short |      | Long      |
| CSF   | Low   | High | Low       |
| Fat   | High  |      | Medium    |
| Brain | Low   | High | High      |
| Edema | Low   | High | High      |

**T1-weighted**



**T2-weighted**



CSF

Very black

Very white

Fat

White

Grey

Grey Matter

Dark grey

Light grey

White Matter

Light grey

Dark grey

1: Corpus callosum

4: Internal capsule

7: Third ventricle

2: Lateral ventricle (ant. horn)

5: Putamen

8: Lateral ventricle (post. horn)

3: Caudate nucleus (head)

6: Thalamus

9: Optic radiation

# QUIZ

1. Q: State Three Primary Indications For Performing A Brain MRI
2. Q: What Are The Most Important (Absolute) Contraindications For An MRI Scan?
3. Q: What Crucial Patient Preparation Step Must Be Taken Before Injecting Gadolinium Contrast Agent?
4. Q: How Is The Patient Generally Positioned For A Brain MRI Scan?
5. Q: When Planning The Axial Slices For A T2 Axial Scan, How Should The Position Block Be Angled On The Sagittal Plane?
6. What Is Diffusion-weighted Imaging (Dwi), And For The Investigation Of Which Condition Is Its Use Recommended?

Any questions?

*Thank  
You*