MRI

INTRODUCTION

- An *imaging modality* – uses *non ionizing radiation* to create useful diagnostic images.
- MRI consists of *large, powerful magnet* [in which the patient lies] – *radio wave antenna*, sends signals to the body and *radiofrequency receiver* detects the emitted signals – converted into images by the computer [attached to the scanner]
- Imaging of any part of the body can be done, in any plane.

ADVANTAGES

- Ability to image without using ionizing radiation – reducing radiation exposure.
- Images can be acquired in multiple planes [*AXIAL, CORONAL, SAGITTAL*], WITHOUT repositioning the patient.
- Demonstrates superior soft tissue contrast.
- Some angiographic images can be obtained without using contrast material.
- Advanced techniques – DIFFUSION, PERFUSION AND SPECTROSCOPY – allow for precise tissue characterization.

ADVANTAGES.. ctd

- Provides better differentiation than CT for water, iron, fat and blood, using biochemical and physical characteristics of tissues imaged.
- Provides high resolution details of POSTERIOR FOSSA, SKULL BASE AND ORBITS as compared to CT.
- Can detect tumors as small as 0.3 mm, which otherwise cannot be picked up any other imaging modality.
- Also good for detecting early pathologies involving CRANIAL NERVES.

DISADVANTAGES

- More expensive than CT scan
- MRI scans take significantly longer time for image acquisition and also may cause claustrophobia to patient.
- Images are subject to unique artifacts, that must be recognized.
- Not safe for patients with IMPLANTS.

MRI sequences

A. T1, T2 Relaxation Times
B. Inversion recovery Phases:
    1.FLAIR,
    2. STIR,
C. Diffusion-weighted imaging (DWI)
    1.DWI(Uses T2)
    2. Apparent diffusion coefficient (ADC)
D. Other sequences:
    1. Diffusion Tensor Imaging (DTI),
    2. Perfusion-Weighted MRI (PWI)
    3. Susceptibility-Weighted Imaging (SWI) etc.
E. Flow sensitive
    1. MR angiography
    2. MR venography
F. Miscellaneous
    1. MR spectroscopy
    2. MR perfusion
    3.Functional MRI
    4. Tractography

TI-W

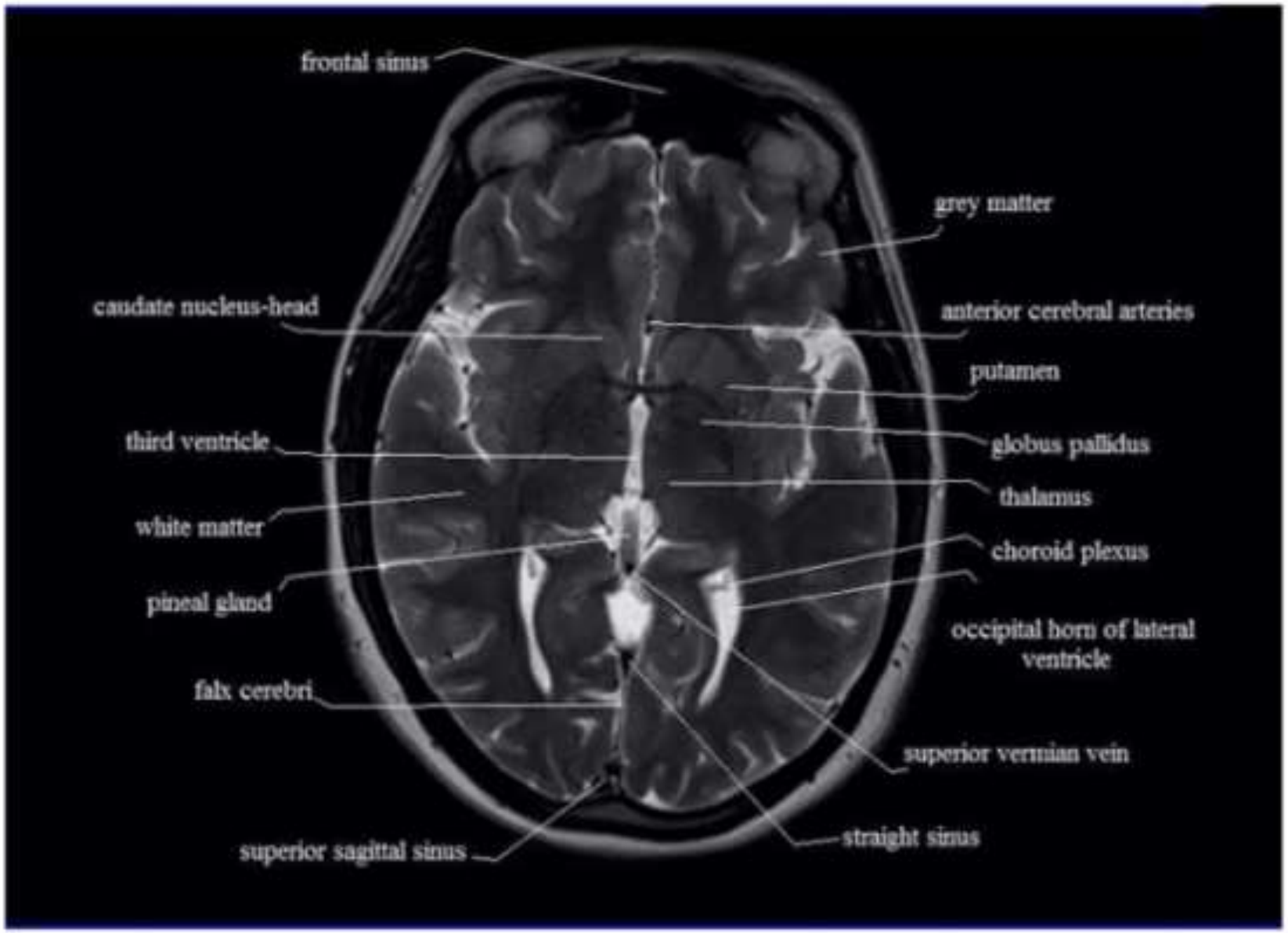
- Provides most anatomically – relevant images.
- FLUIDS [in csf and orbits] – DARK
- Grey matter is ***darker*** than White matter
- USE:-
  1. Anatomy: ***superior soft tissue details***(brain,spine,joint)
  2. Hemorrhage: detects ***subacute haemorrhage***
  3. Fat containing lesion: ***lipoma,dermoids***

T2-W

- Standard sequence
- FLUID – BRIGHT
- White matter is ***darker*** than Grey matter.

  - **Edema** (e.g., stroke, trauma)
  - **Tumors**
  - **Infections**
  - **Inflammation**
  - **White matter lesions** (e.g., MS)
  - **Joint effusions**

Axial T2


frontal sinus
grey matter
caudate nucleus-head
anterior cerebral arteries
putamen
third ventricle
globus pallidus
thalamus
white matter
choroid plexus
pineal gland
occipital horn of lateral ventricle
falx cerebri
superior vermian vein
straight sinus
superior sagittal sinus

FLAIR

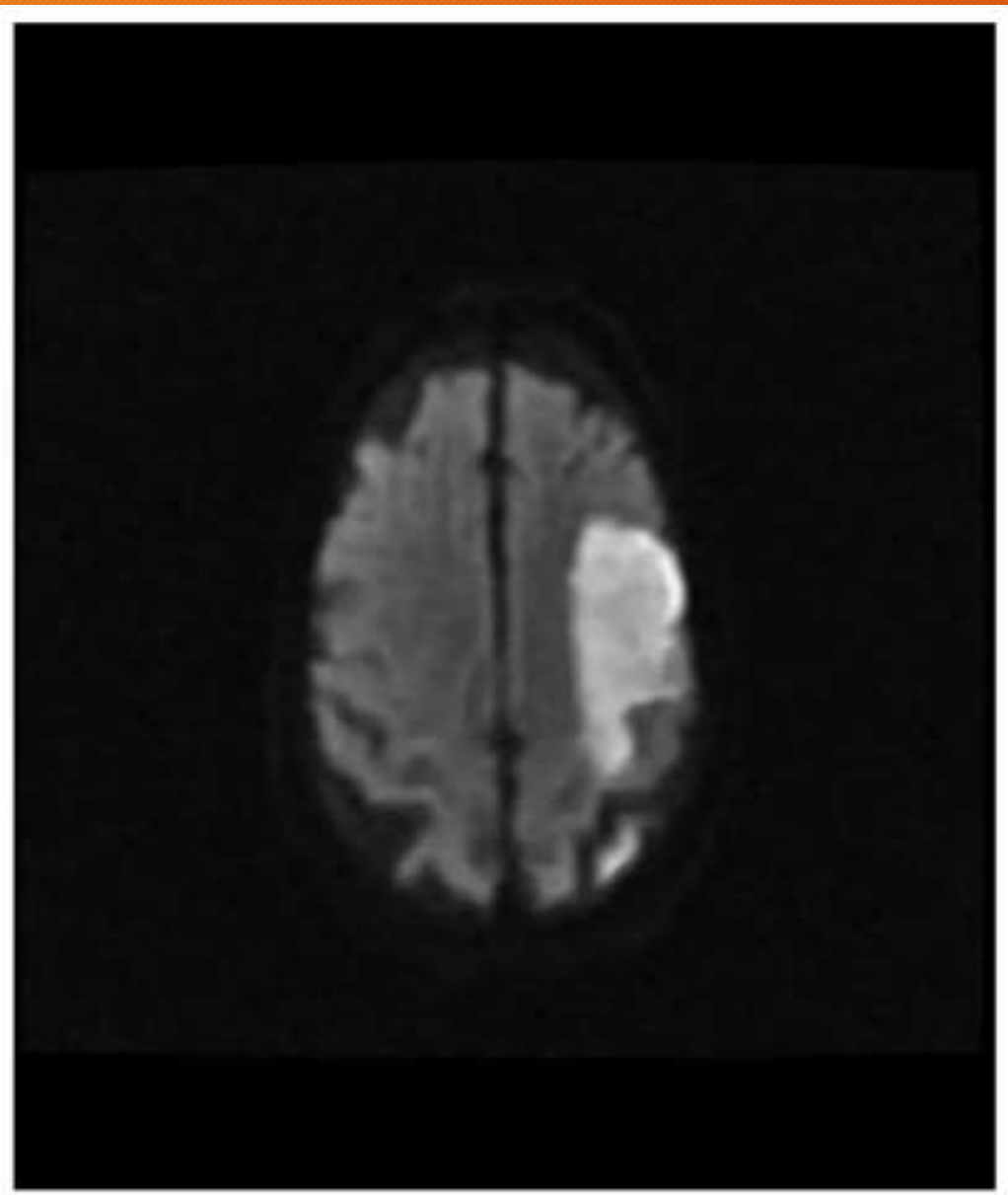
- Commonly used sequence.
- Similar to T2, but the fluid is ***DARKER or SUPPRESSED***.
- Useful for areas of ***EDEMA AND INFLAMMATION***.
- Used to identify PLAQUES in MULTIPLE SCLEROSIS [PERIVENTRICULAR REGION]

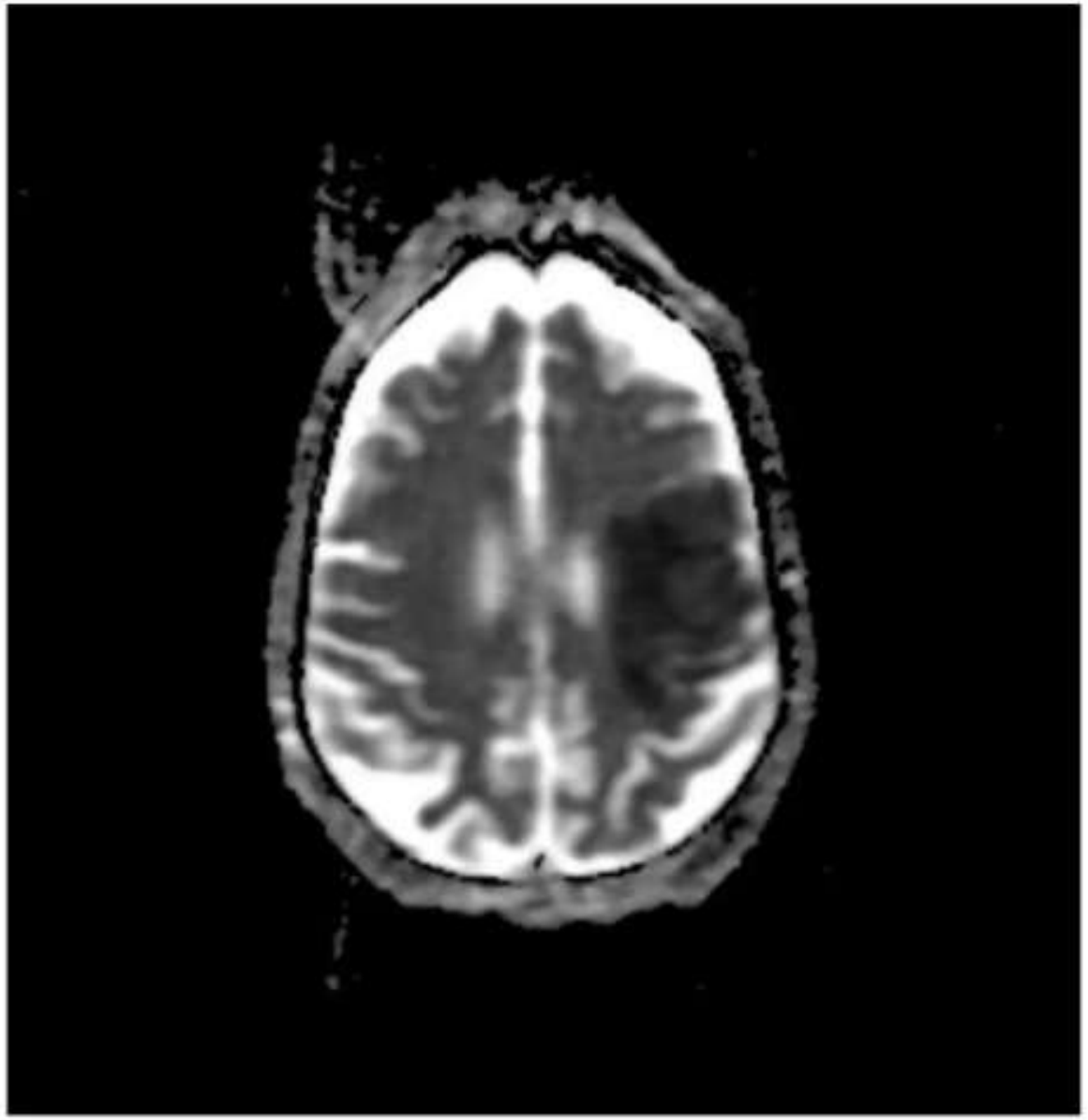
FLAIR imaging is instrumental in identifying and evaluating:

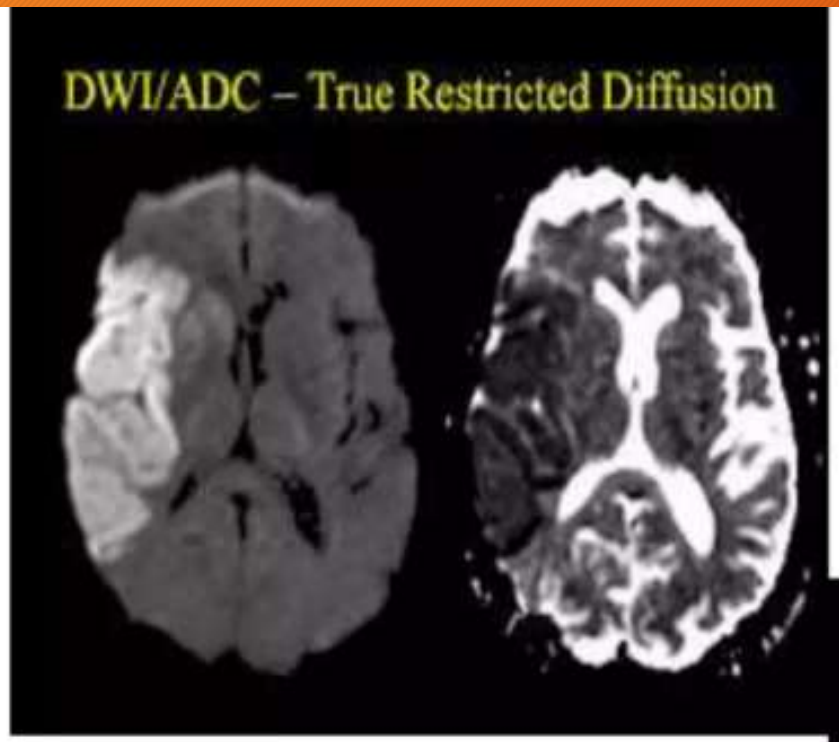
- ***Multiple Sclerosis (MS):*** FLAIR enhances the visibility of periventricular and juxtacortical MS plaques by suppressing the bright signal of adjacent CSF, making lesions more conspicuous.
- ***Subarachnoid Hemorrhage:*** In acute settings, FLAIR can detect subarachnoid hemorrhage by highlighting blood products in the subarachnoid space, which appear hyperintense against the suppressed CSF background.
- ***Head Trauma and Meningitis:*** FLAIR aids in identifying cortical contusions, diffuse axonal injuries, and meningeal inflammations by providing clear contrast between pathological tissues and suppressed CSF

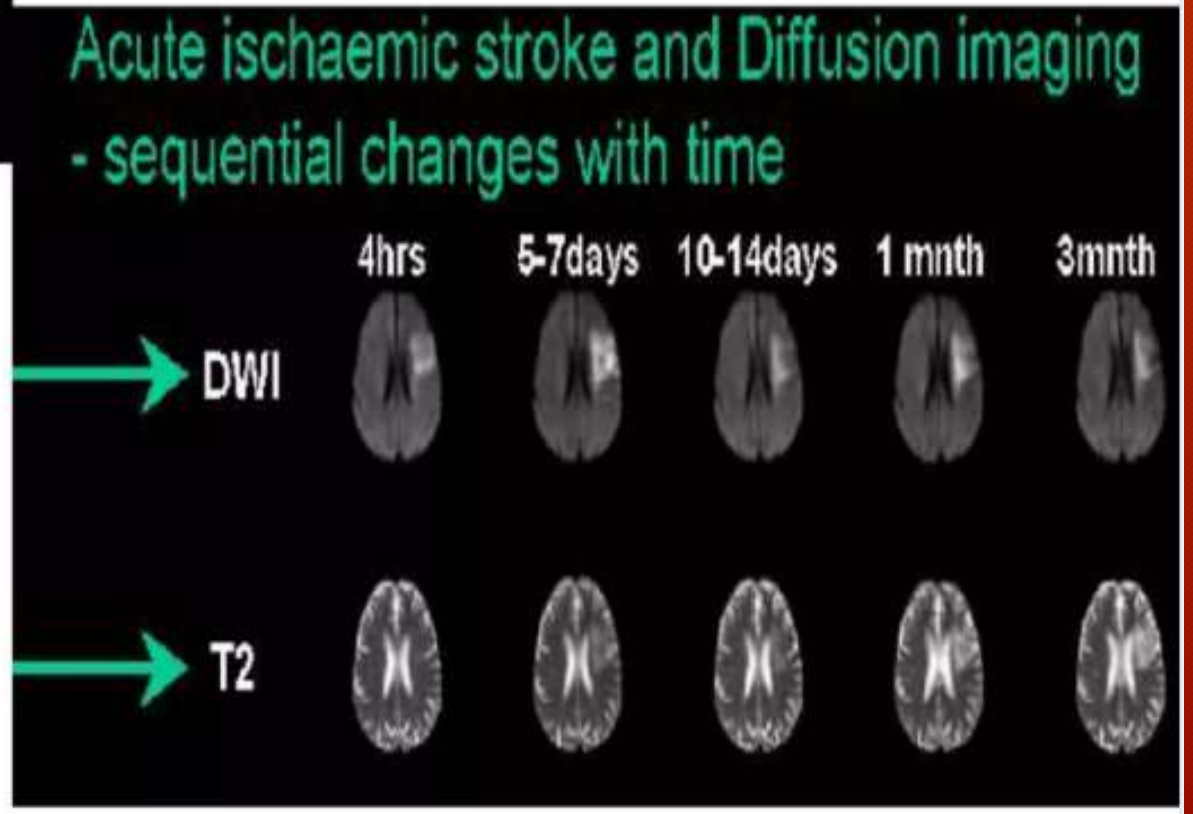
DWI & ADC

- These “blocky” images show how easily water moves around.
- Restriction diffusion occurs – STROKE, ABSCESS AND CELULLAR TUMORS.
- Commonly performed sequence in cases of ACUTE ISCHEMIC STROKE [sensitive in detecting small infarcts].
    - **Acute stroke** – Most sensitive in first few minutes!
    - **Abscesses** – Shows restricted diffusion due to pus.
    - **Tumors** – High cellularity causes diffusion restriction (e.g., lymphoma, medulloblastoma).
    - **Metastasis** – Can detect small or early lesions.
    - **Demyelinating diseases** – May show variable findings.









Diffusion-weighted MRI (DWI)

NORMAL ANATOMY AND BRAIN STRUCTURES

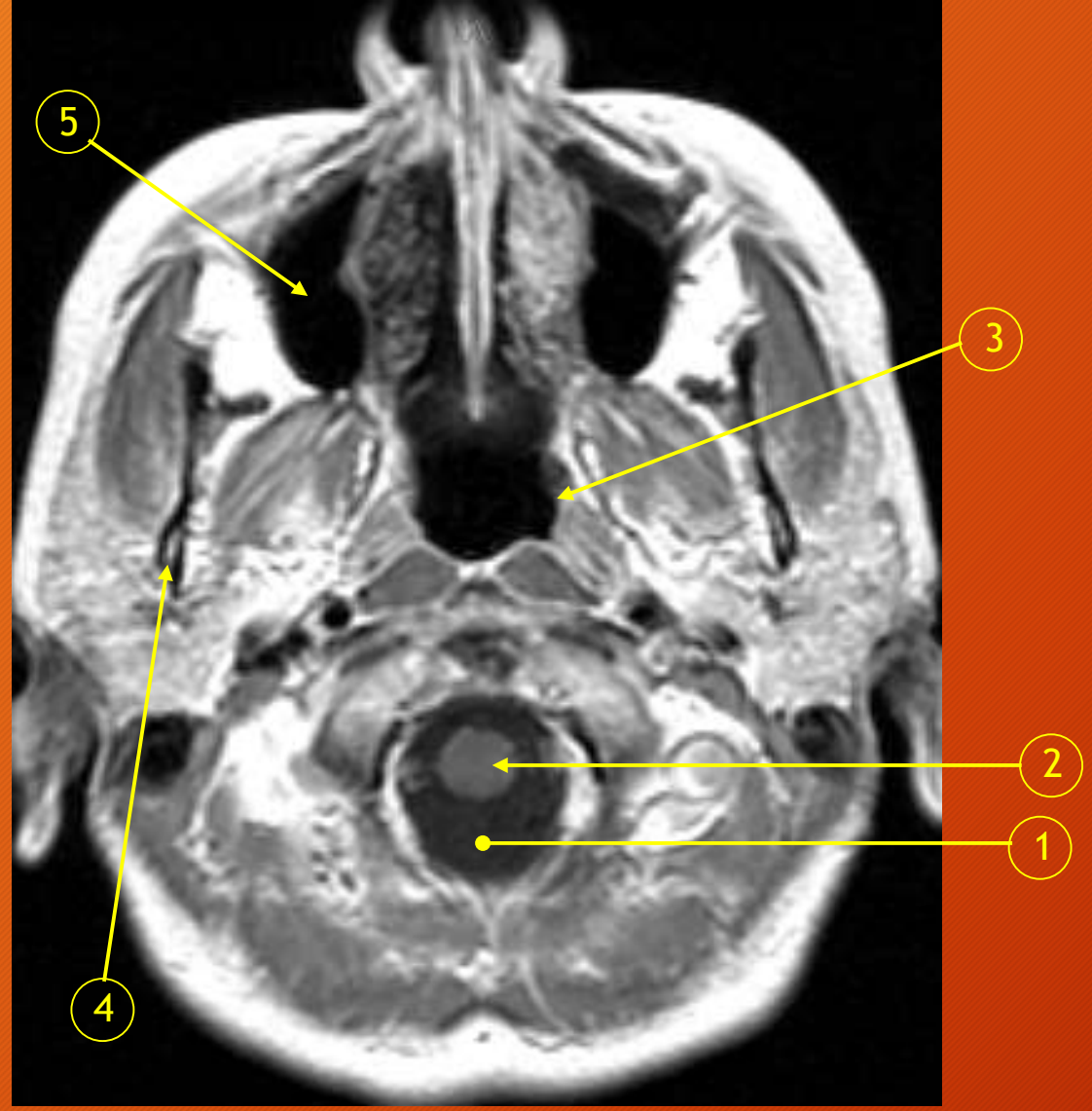


Fig. 1.1 Post Contrast Axial MR Image of the brain

Post Contrast sagittal T1 Weighted M.R.I.
Section at the level of Foramen Magnum

Answers

1. Cisterna Magna
2. Cervical Cord
3. Nasopharynx
4. Mandible
5. Maxillary Sinus

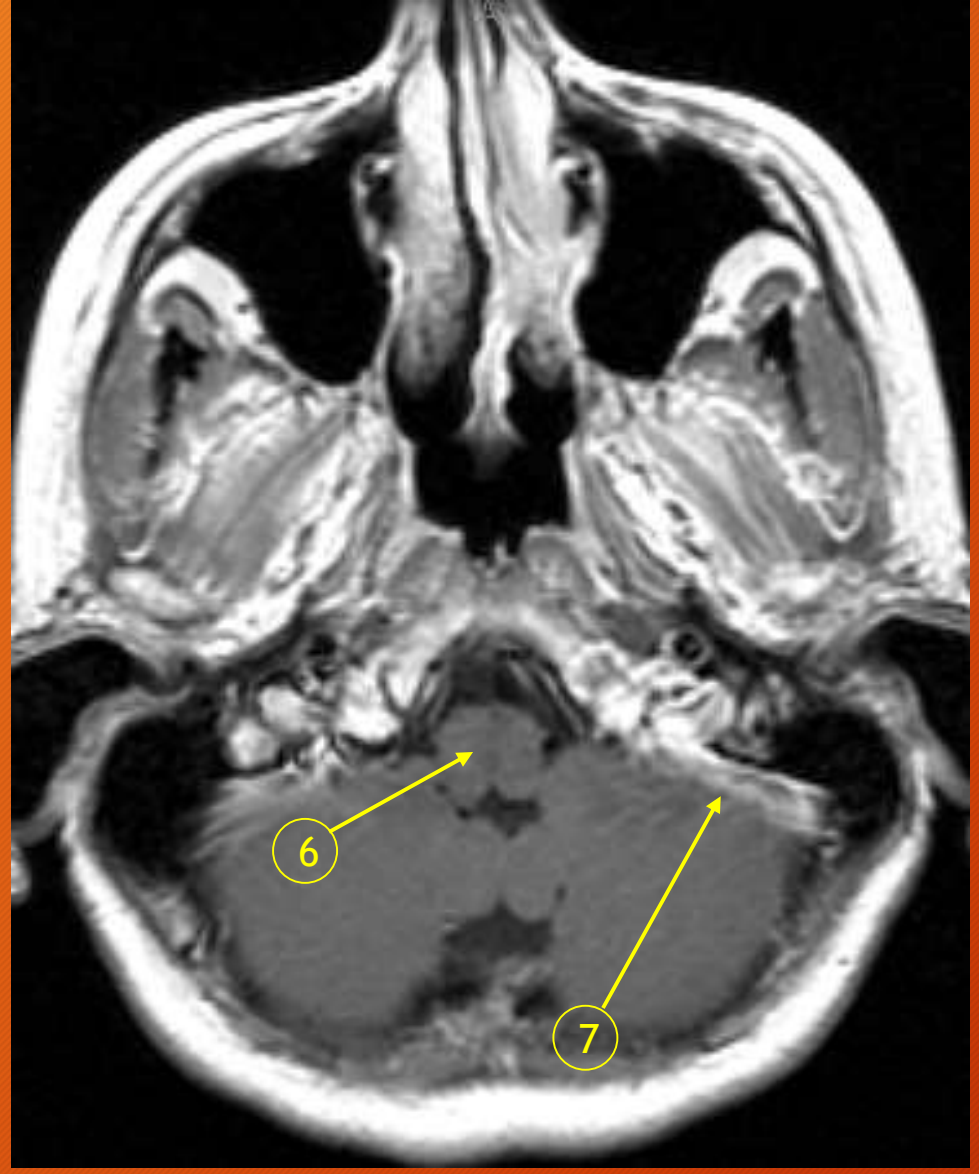
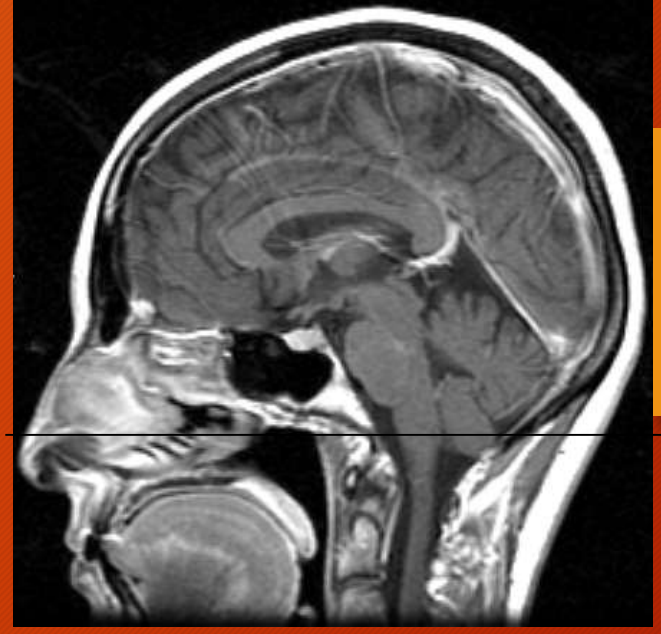


Fig. 1.2 Post Contrast Axial MR Image of the brain



Post Contrast sagittal T1 Wtd M.R.I.
Section at the level of medulla

Answers

6. Medulla
7. Sigmoid Sinus

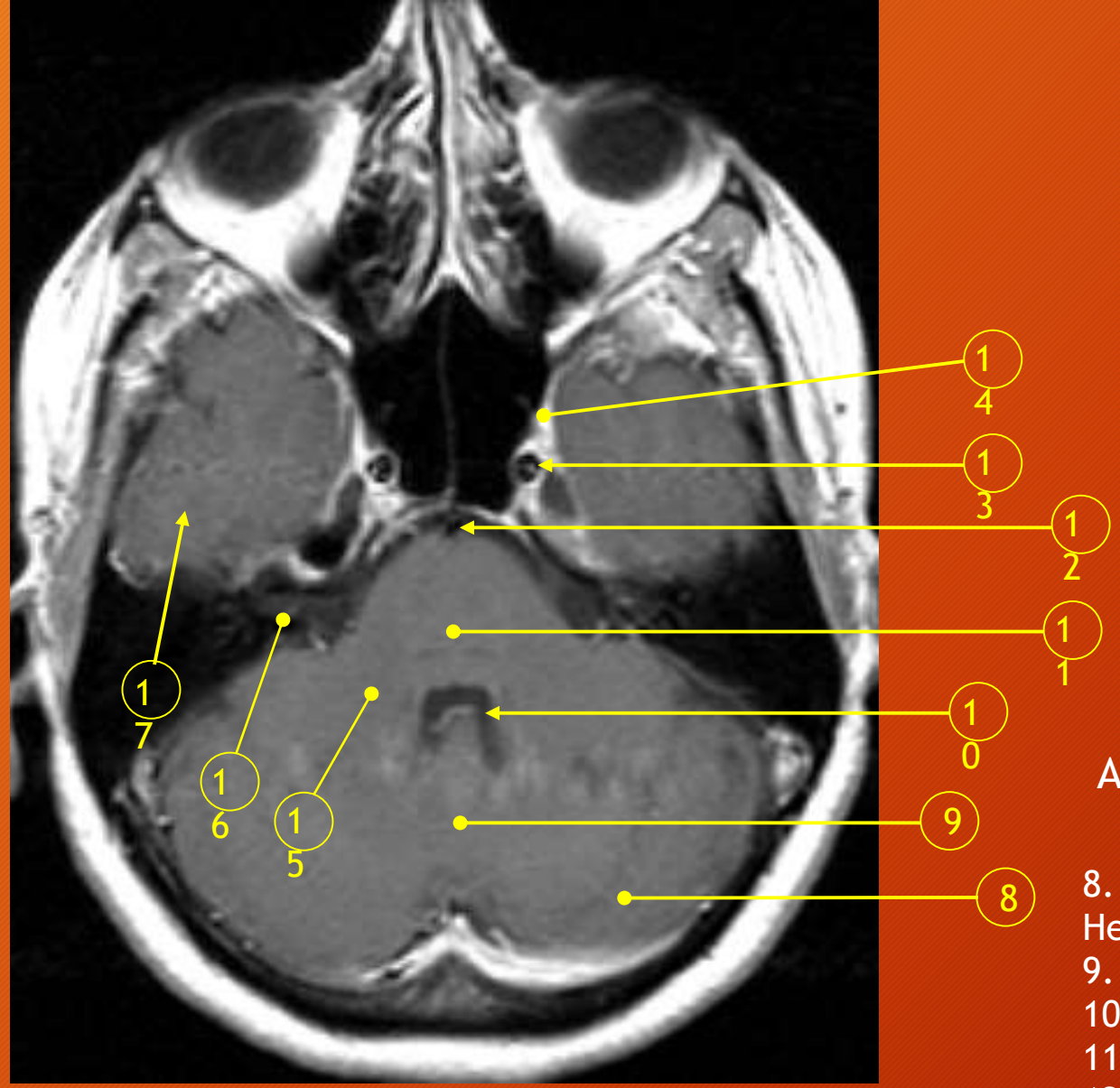


Fig. 1.3 Post Contrast Axial MR Image of the brain

Post Contrast sagittal T1 Wtd M.R.I.
Section at the level of Pons

Answers

8. Cerebellar Hemisphere
9. Vermis
10. IV Ventricle
11. Pons
12. Basilar Artery
13. Internal Carotid Artery
14. Cavernous Sinus
15. Middle Cerebellar Peduncle
16. Internal Auditory Canal
17. Temporal Lobe

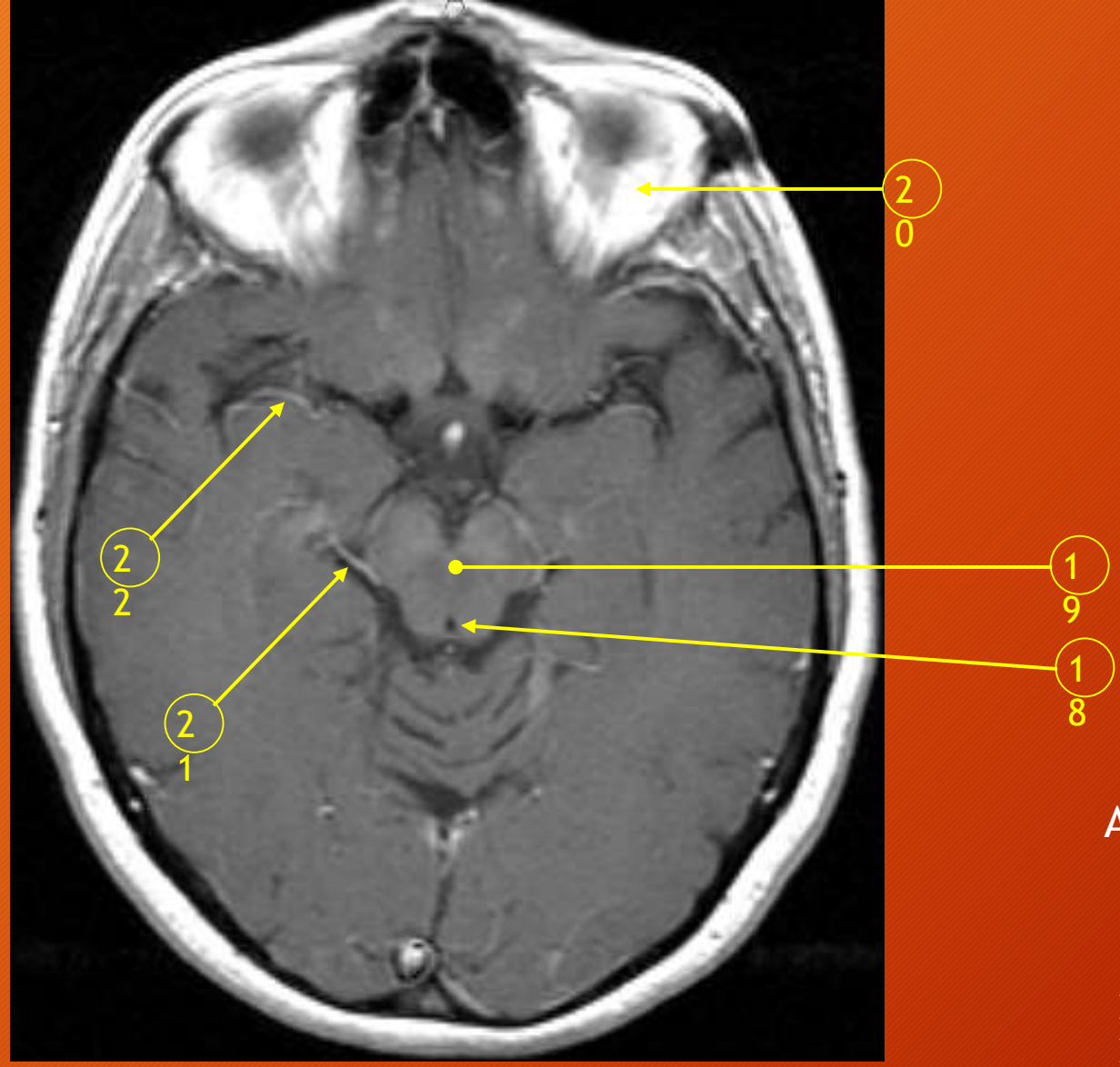


Fig. 1.4 Post Contrast Axial MR Image of the brain

Post Contrast sagittal T1 Wtd M.R.I.
Section at the level of Mid Brain

Answers

18. Aqueduct of Sylvius
19. Midbrain
20. Orbits
21. Posterior Cerebral Artery
22. Middle Cerebral Artery

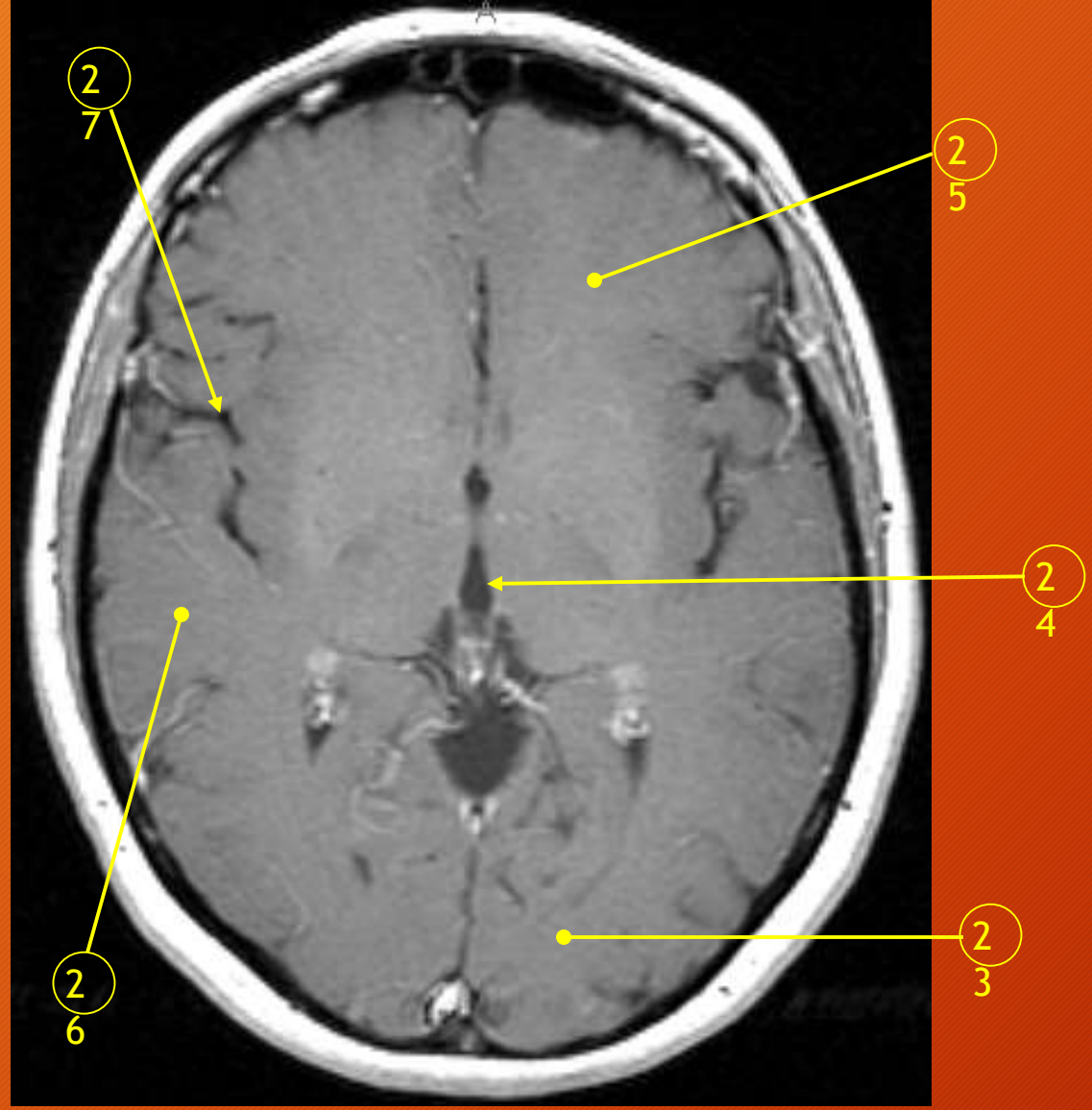


Fig. 1.5 Post Contrast Axial MR Image of the brain

Post Contrast sagittal T1 Wtd M.R.I.
Section at the level of the III Ventricle

Answers

23. Occipital Lobe
24. III Ventricle
25. Frontal Lobe
26. Temporal Lobe
27. Sylvian Fissure

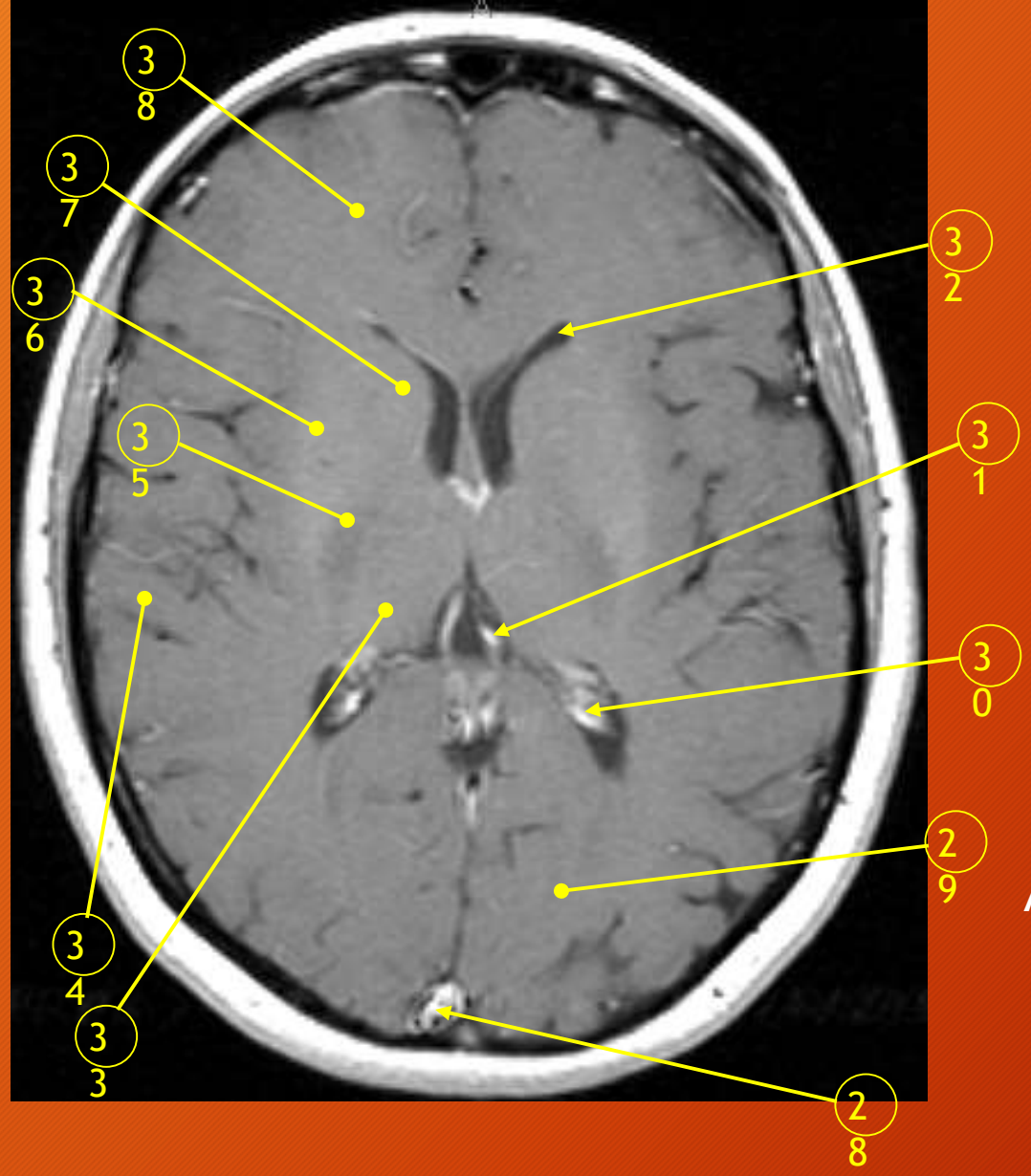


Fig. 1.6 Post Contrast Axial MR Image of the brain

Post Contrast sagittal T1 Wtd M.R.I.
Section at the level of Thalamus

Answers

28. Superior Sagittal Sinus
29. Occipital Lobe
30. Choroid Plexus within the occipital horn
31. Internal Cerebral Vein
32. Frontal Horn
33. Thalamus
34. Temporal Lobe
35. Internal Capsule
36. Putamen
37. Caudate Nucleus
38. Frontal Lobe

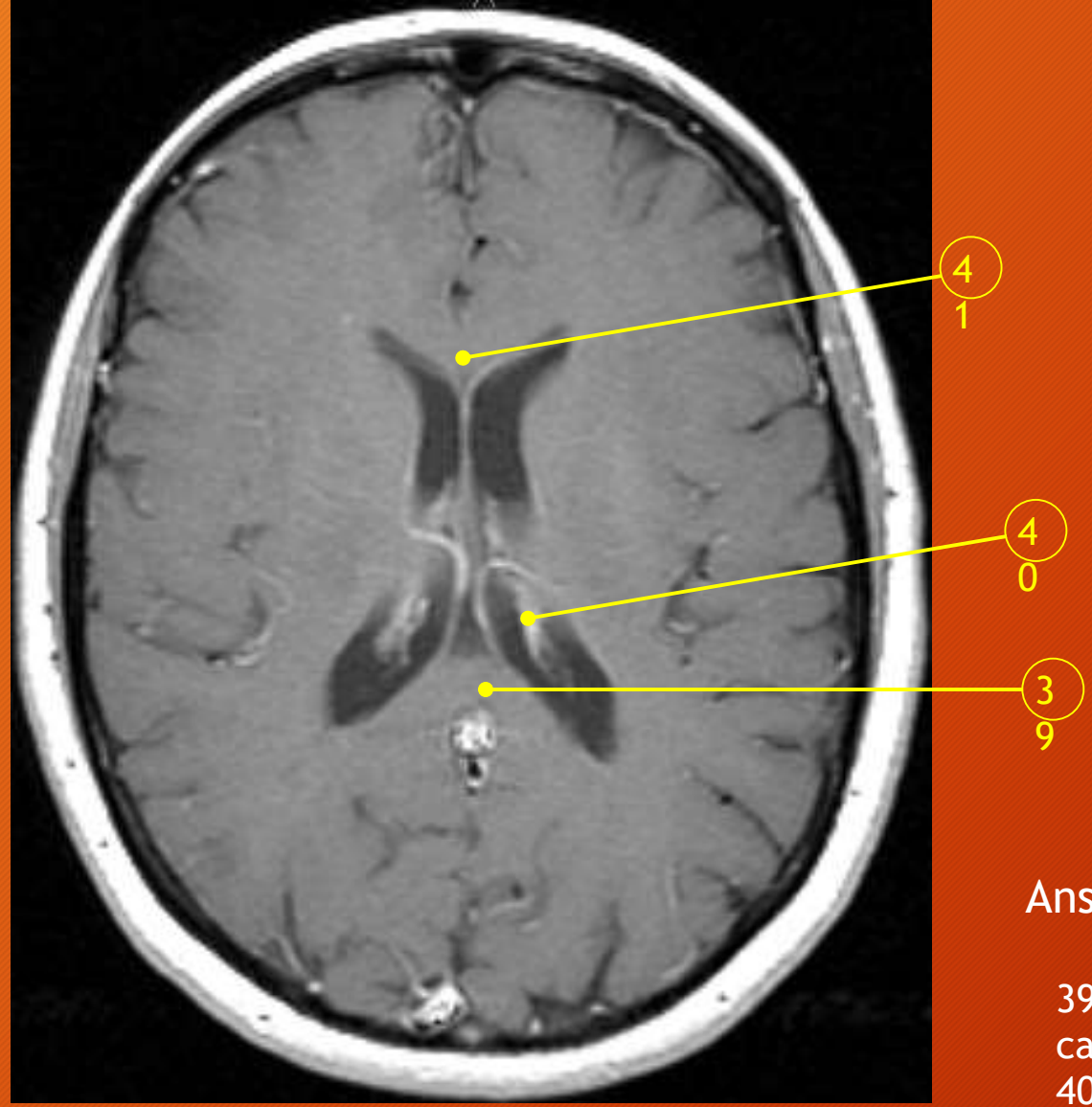


Fig. 1.7 Post Contrast Axial MR Image of the brain

Post Contrast sagittal T1 Wtd M.R.I.
Section at the level of Corpus Callosum

Answers

39. Splenium of corpus callosum
40. Choroid plexus within the body of lateral ventricle
41. Genu of corpus callosum

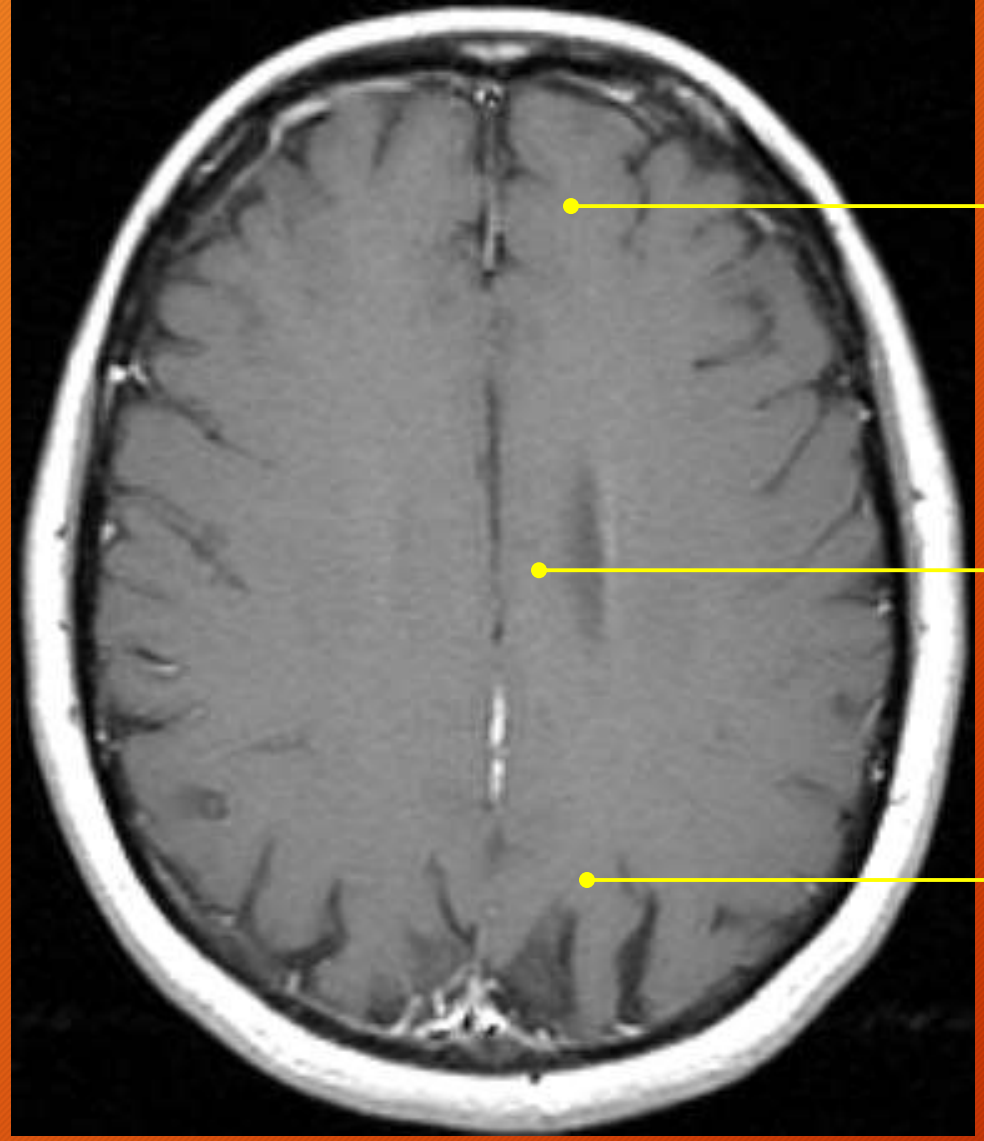
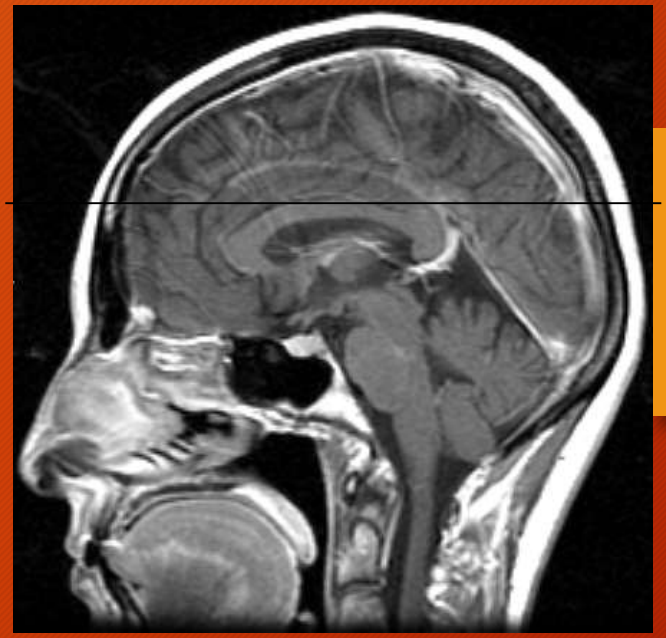


Fig. 1.8 Post Contrast Axial MR Image of the brain



Post Contrast sagittal T1 Wtd M.R.I.
Section at the level of Body of Corpus Callosum

Answers

42. Parietal Lobe
43. Body of the Corpus Callosum
44. Frontal Lobe

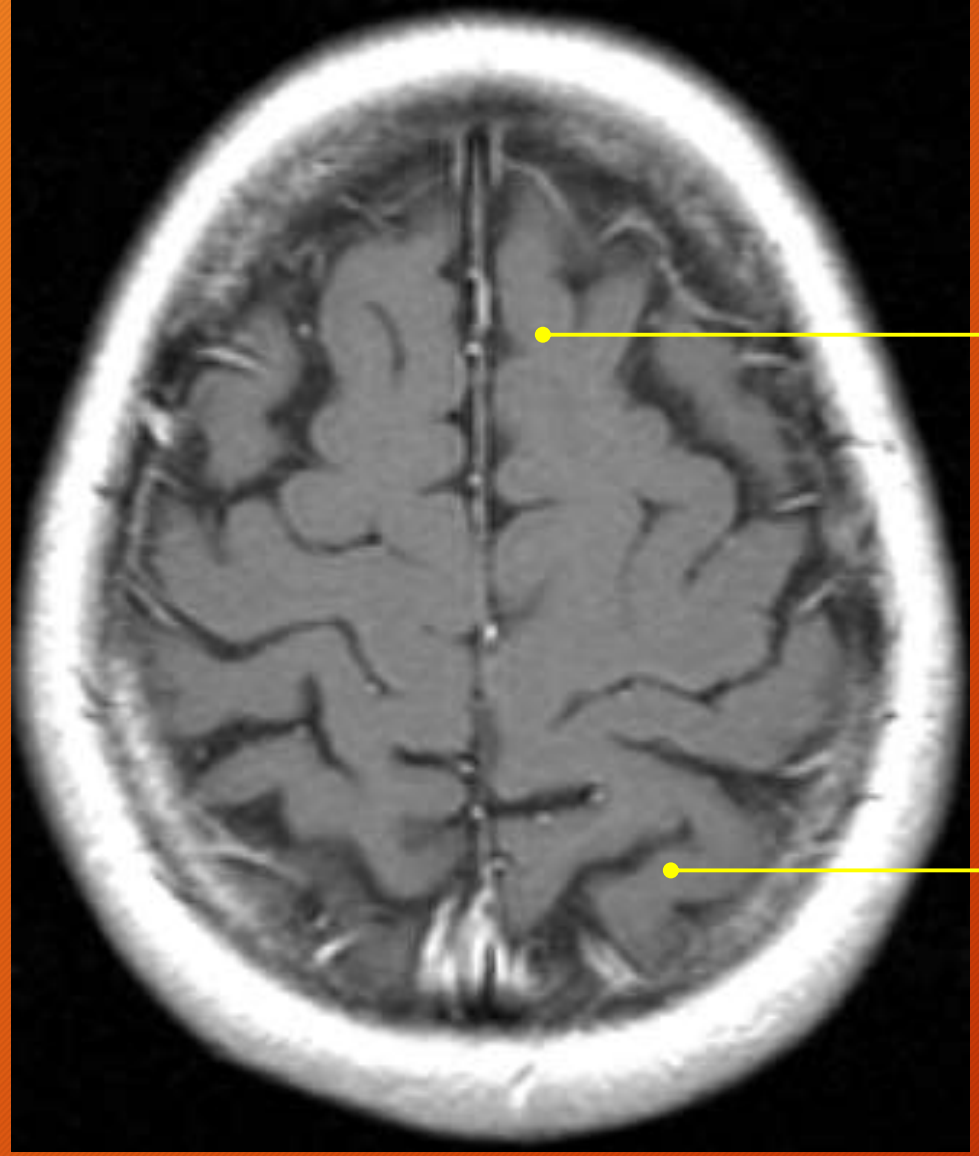
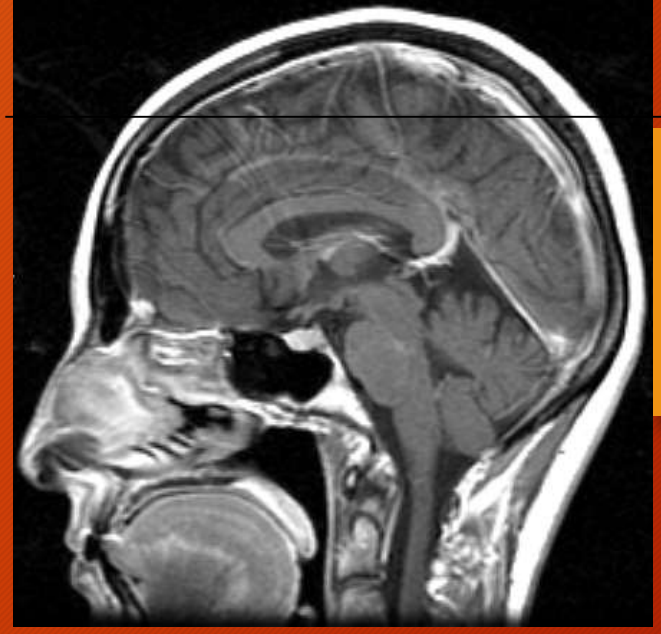


Fig. 1.9 Post Contrast Axial MR Image of the brain



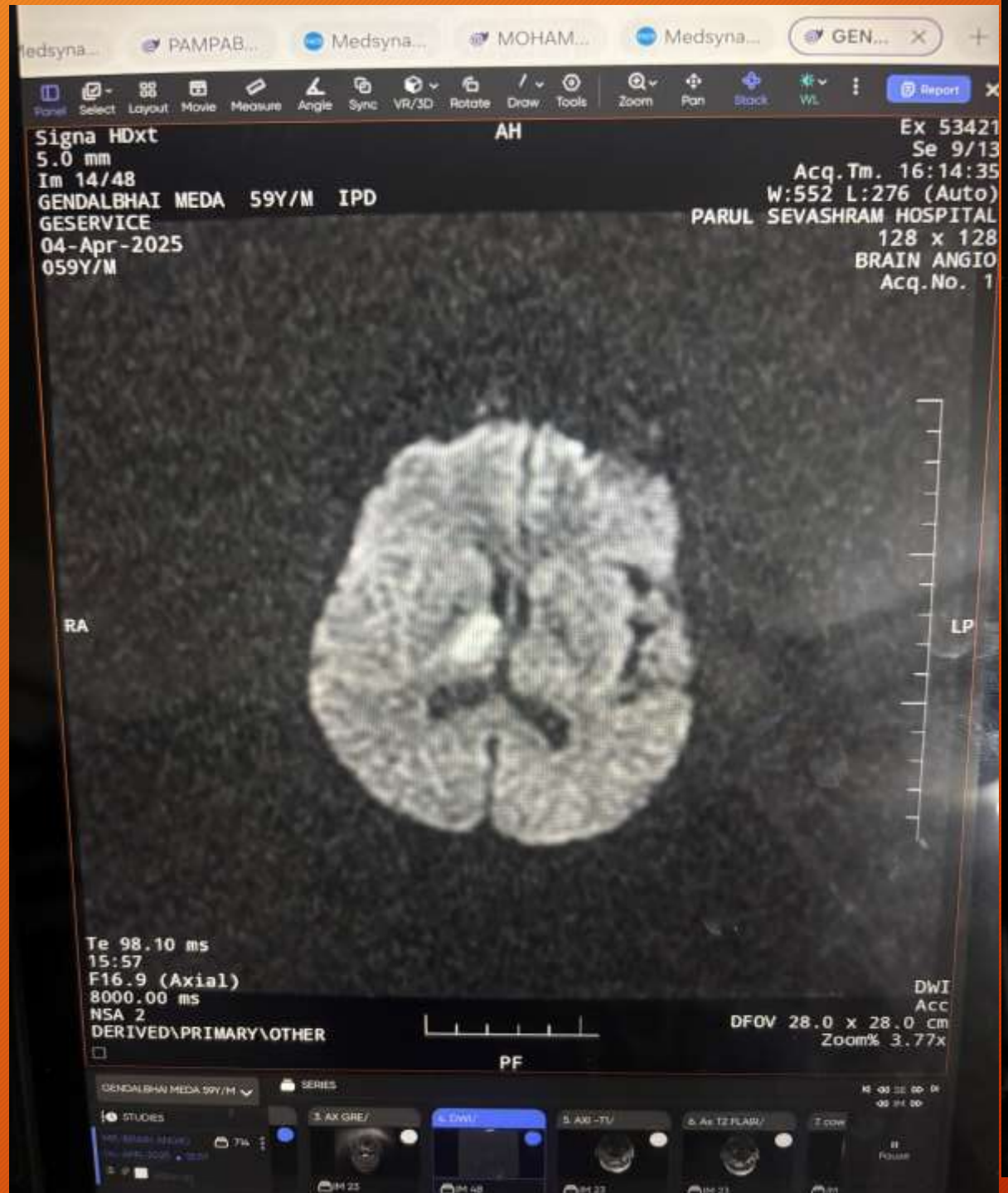
Post Contrast sagittal T1 Wtd M.R.I.
Section above the Corpus Callosum

Answers

45. Parietal Lobe
46. Frontal Lobe

CASE

- 59 year old male K/C/O DM/HTN came to PSH with C/O ALTERED SENSORIUM,GASPING BREATHING,LEFT UPPER LIMB AND LOWER LIMB WEAKNESS.
- On arrival vitals – BP-130/90,PULSE-104/MIN,SP02-92% WITH NP@2LIT/MIN
- O/E Pt was drowsy, not oriented to time ,place ,person
- Power left UL AND LL-0/5,PLANTER –LEFT-absent ,rt –flexor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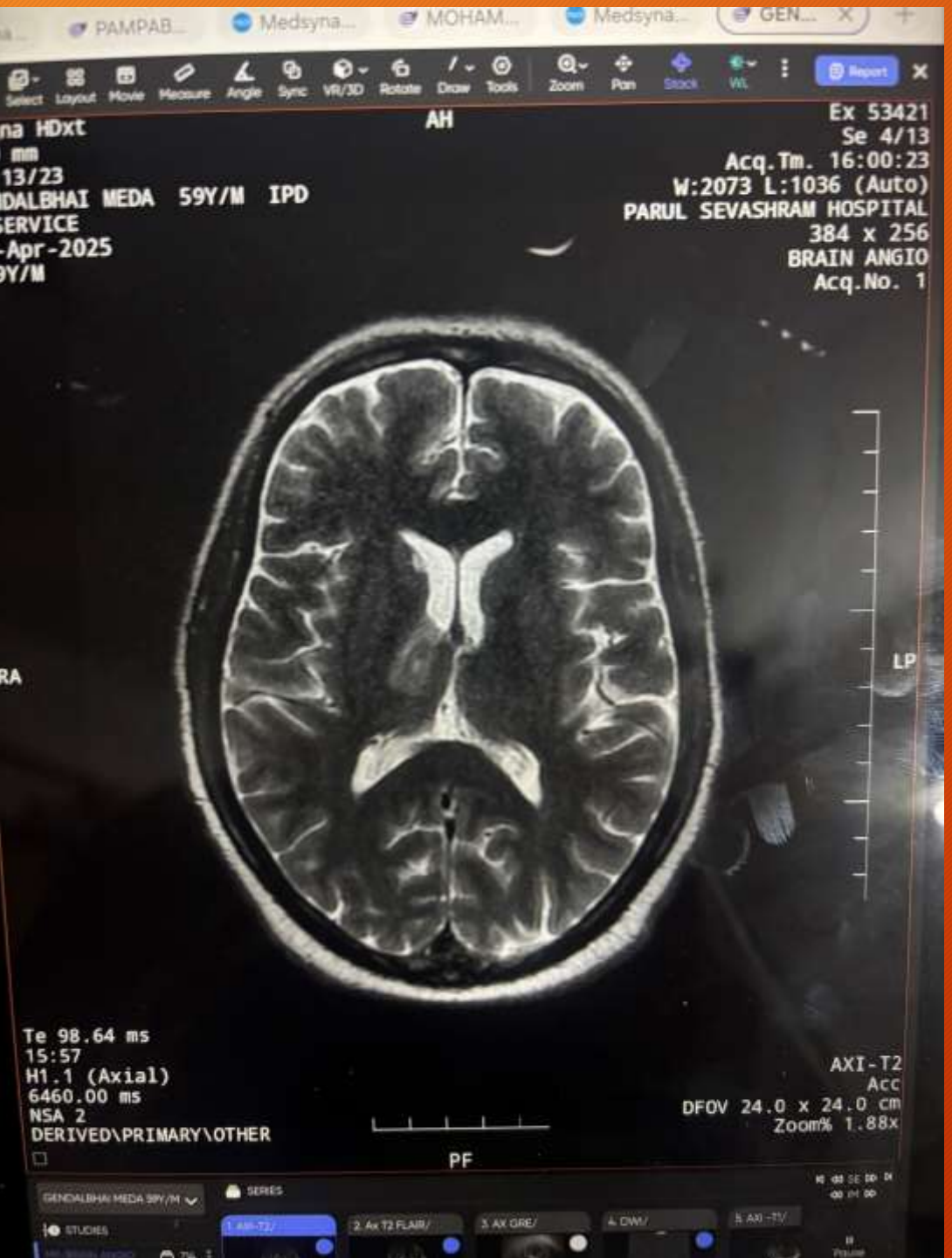
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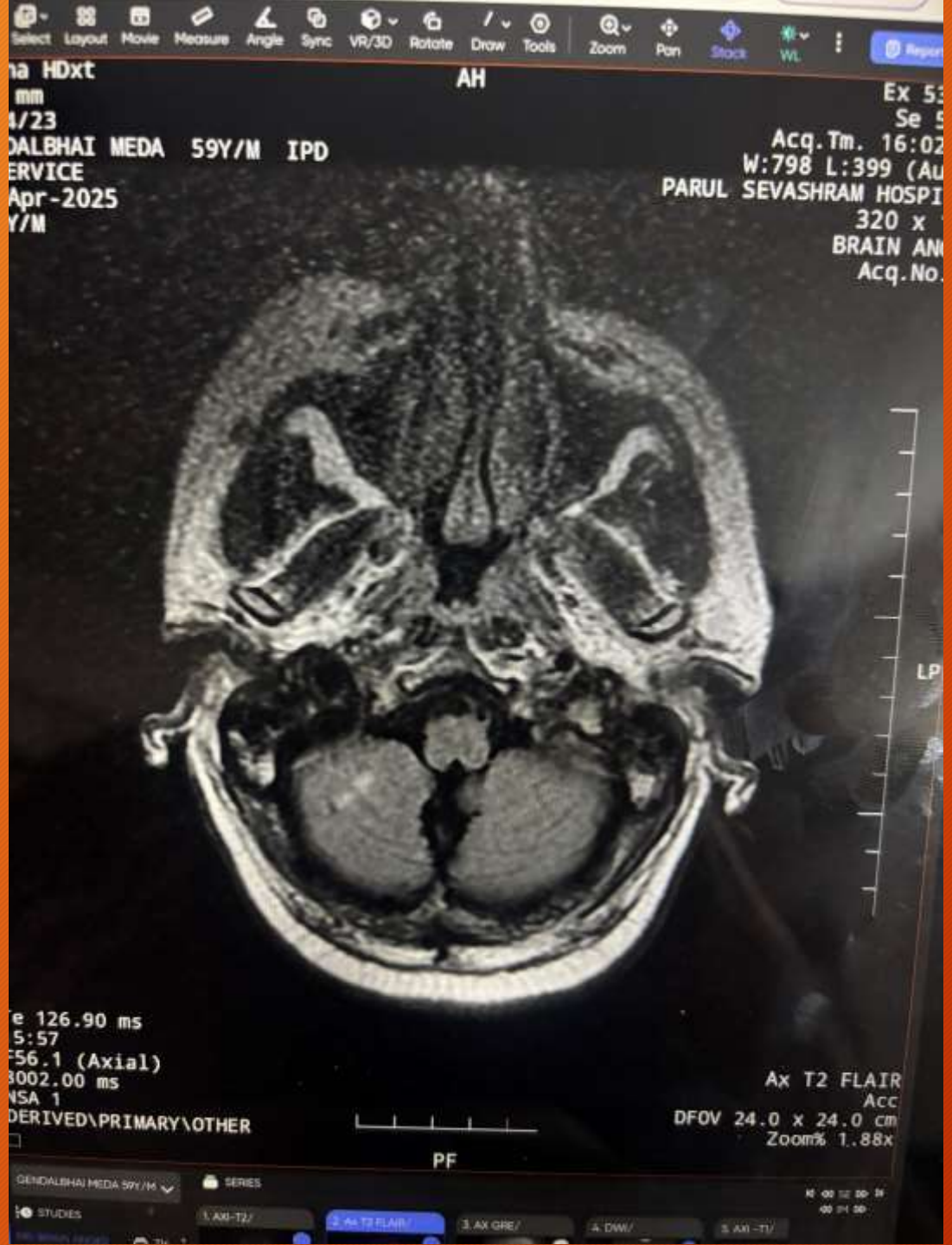
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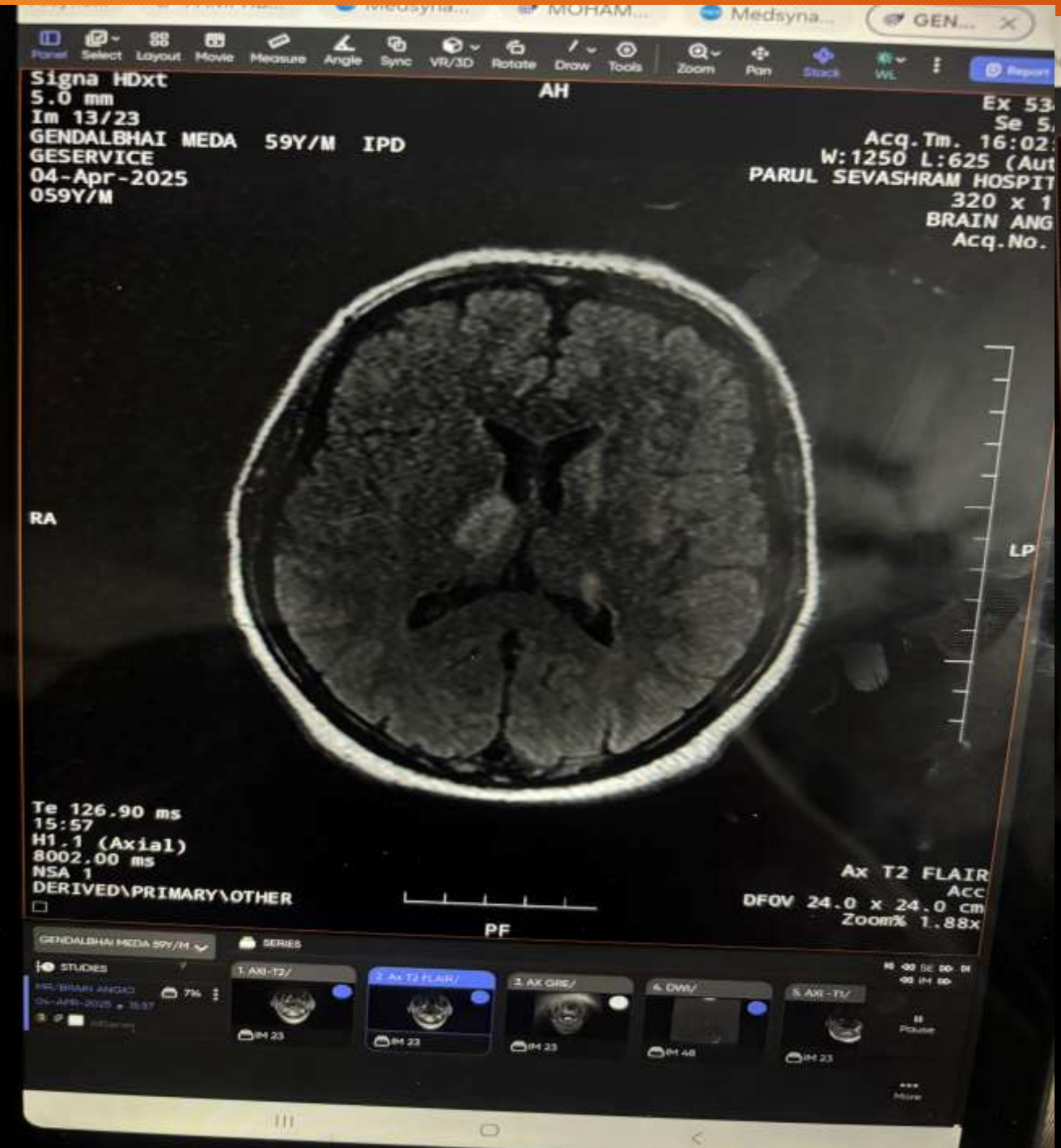
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MRI BRAIN FINDINGS

LARGE area of RESTRICTED diffusion with corresponding low ADC value appearing ***hyperintense on T2/FLAIR*** images noted involving **ventral aspect of pons**, **right thalamocapsular region** and **bilateral cerebellar parenchyma**

HOW TO READ A MRI

- First always check image and patient details.
- Check the time and date to ensure you are looking at the most up to date images.
- Check you are looking at the correct body part and the correct side.
- Check all image planes (axial,coronal,sagittal,or oblique)
- Look at the fat sensitive T1 images which often provide good anatomical details of the area being studied.
- Compare with the water sensitive image-such as T2 OR FLAIR image

- Check for abnormalities of MRI signal.
- Determine the nature of the signal change –abnormal fat or fluid
- Note the anatomical location, size, shape of abnormality.
- The combination of T1 image (fat sensitive), FLAIR image can be compared to know amount of fat and water within body part.

Contraindication of mri

Absolute Contraindications

These are situations where MRI should **not** be performed due to serious risks:

1. **Ferromagnetic implants or foreign bodies**, such as:
    1. Certain types of **aneurysm clips**
    2. **Cochlear implants** (non-MRI-compatible)
    3. Some **older pacemakers** or **ICDs** (implantable cardioverter defibrillators)
    4. **Metallic foreign bodies** in the **eye** (risk of movement or heating)
2. **Implanted neurostimulators** or **drug infusion pumps** (if not MRI-safe)
3. **Magnetic shrapnel or bullets** lodged in body

Relative Contraindications

These are situations where MRI might be performed with caution or modification:

1. **Claustrophobia** – may require sedation or open MRI
2. **Pregnancy (especially 1st trimester)** – generally avoided unless essential; gadolinium contrast is avoided unless absolutely necessary
3. **Renal impairment** – caution with **gadolinium-based contrast agents** due to risk of **nephrogenic systemic fibrosis (NSF)**
4. **Tattoos or permanent makeup** – can heat up or cause irritation
5. **Metallic implants or prosthetics** – if MRI-compatible, generally safe
6. **Dental work** – usually safe, but may distort images
7. **Body piercings** – must be removed if possible

Nrurological indication of mri

Neurological

- **Brain tumors**, cysts, or infections
- **Stroke** (especially in early detection)
- **Multiple sclerosis (MS)**
- **Hydrocephalus**
- **Aneurysms** or **vascular malformations**
- **Epilepsy workup**
- **Trauma** (brain injury, bleeding)
- **Pituitary or cranial nerve pathologies**