Al-Mustaqbal University
College of Health and Medical Technologies
Radiological Techniques Department

Magnetic Resonance Imaging

First Semester

Lecture: MRI of the brain (12 & 13)

By

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Introduction :

Understanding brain MRI imaging is

1- essential for MRI technologist to perform MRI exams effectively,

2- interpret MRI results accurately, optimize MRI parameters, and

3- keep up-to-date with MRI technology.

Brain MRI imaging can provide information about **the brain's anatomy, detect abnormalities, and measure blood flow and diffusion in the brain.** MRI technologist can learn about brain MRI imaging through **MRI tech programs, continuing education courses, and on the job training.**

Anatomical overview

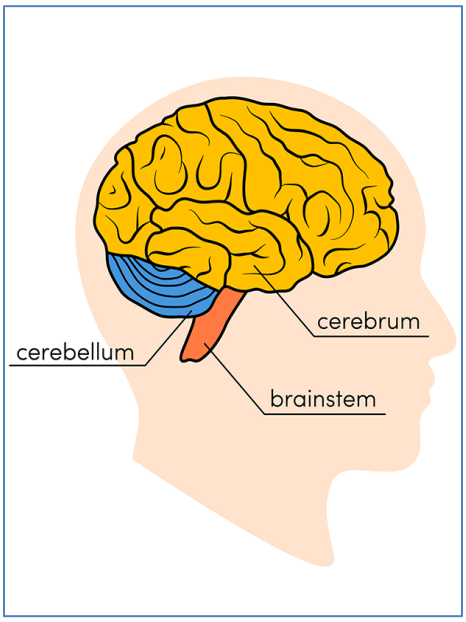
1- Nervous system is a complex network of nerves and cells that carry messages to and from the brain and spinal cord to various parts of the body.

•It was divided into: -

1- Central nervous system (CNS): - Which include the brain and spinal cord.

2- Peripheral nervous system (PNS): - It consist of the nerves that branch out from the brain and spinal cord. **These nerves form the communication network between the CNS and the body parts.**

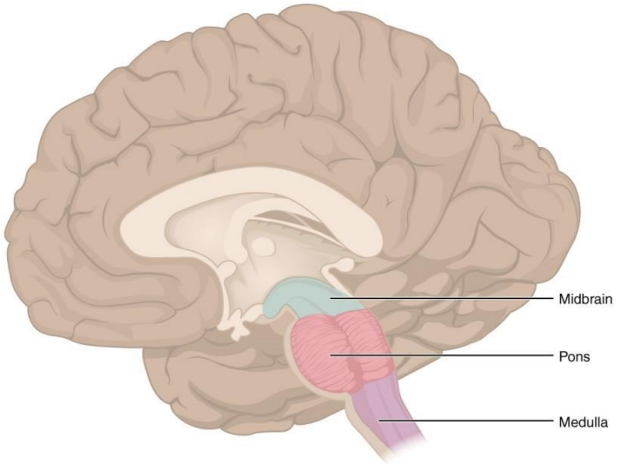
2-Brain: - It consists of three main parts:



A- Cerebrum: - It is the largest part of the brain; it consists of two hemispheres. **The cortex contains mostly nerve cell bodies and appears as grey matter**, **below the cortex**, nerve fibers traveling toward and away from the cortex forming **the white matter**.

B- Cerebellum: - The second largest part of the brain. It located in the **posterior cranial fossa**. Its outer layer containing a concentration of cell bodies (grey matter) and its deeper layers containing mostly cell processes and supportive cells (white matter). (fig.1)

C- Brain stem: - Which consist of the following parts: - (fig.2)



1-Midbrain: - The bundle of nervous tissue connecting the cerebrum with the cerebellum and spinal cord.

2- Pons: - Located anterior to the cerebellum. The enlarged portion of the brain stem where fibers from the cerebellum join those from the cerebrum and spinal cord.

3- Medulla oblongata: - Form the lower brain stem directly below the pons and contains all the ascending and descending tracts that communicate between the spinal cord and brain.

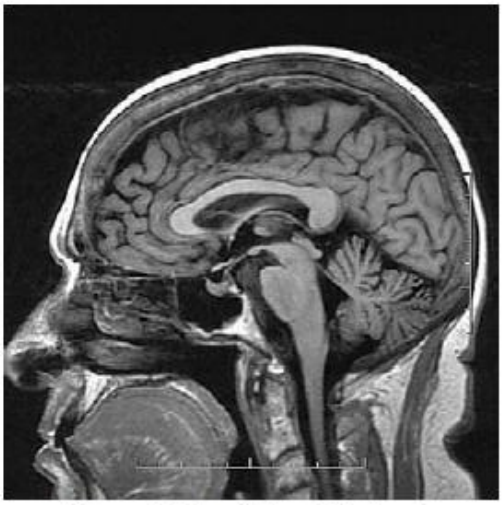


Figure 1-5 Sagittal-midline brain

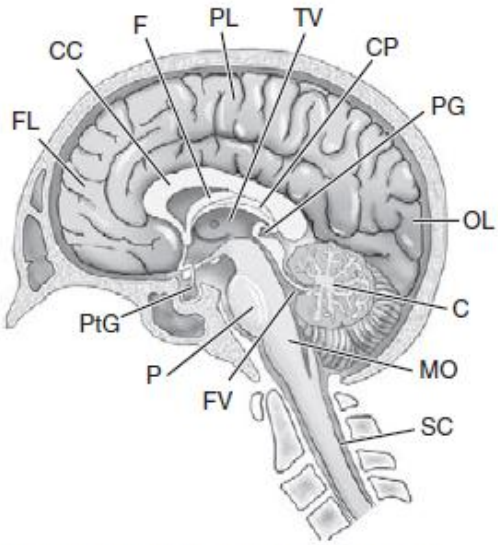


Figure 1-6 Sagittal anatomy-midline brain

KEY: **C**, cerebellum; **CC**, corpus callosum; **CP**, choroid plexus; **F**, fornix; **FL**, frontal lobe; **FV**, fourth ventricle; **MO**, medulla oblongata; **OL**, occipital lobe; **P**, pons; **PG**, pineal gland; **PL**, parietal lobe; **PtG**, pituitary gland; **SC**, spinal cord; **TV**, third ventricle.

•MRI brain is a specialist investigation that is used for the assessment of a number of neurological conditions. It is the main method to investigate conditions such as **multiple sclerosis and headaches, and used to characterize strokes and space-occupying lesions.**

•Indications of brain MRI: -

1- Tumors: in comparison with CT, MRI has **the advantage** of detecting lesions in the **posterior fossa**, at the edge of calvarium and is superior for lesions near the base of the skull and the pituitary fossa.

2-Hemorrhage-Ischemic stroke: Both these conditions are easily detected by MRI. For example, the detection of thrombosis/stenosis is a very promising **application of MR angiography.**

3-Trauma: In comparison with CT, MRI has **the advantage** of demonstrating the entire extent of the extracerebral collection plus superior evaluation of diffuse axonal injury and sequelae of trauma. **Disadvantages** include the longer scanning times and the inability to demonstrate the bony cranium.

4-Degenerative Diseases: MRI is extremely effective in diagnosing multiple sclerosis, subcortical arteriosclerotic encephalopathy, gliosis and syrinx.

MRI procedure:

•Patient position:

1- Patient should be in supine-position. (head first). (Fig.3)

2- Place the patient in the head coil.

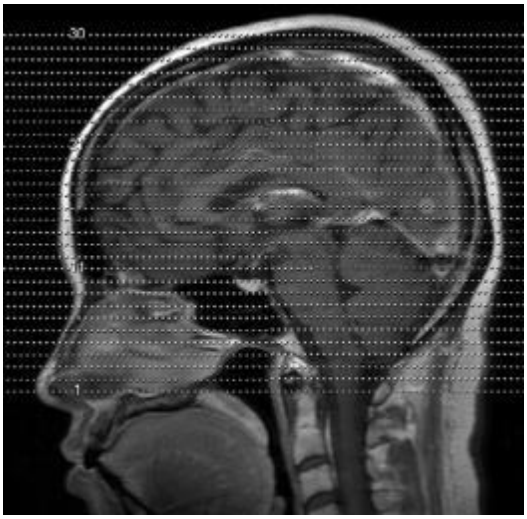
3- The patient should be well padded to prevent image degradation or malalignment due to head movement.

4- If the imaging coil has a mirror, ensure the patient is able to see out of the bore to alleviate claustrophobia.

(Fig.3) Patient position-head coil

•Scout slice placement: -

1- Sagittal localizer to obtain axial slices:



-Alignment:

Parallel to a line joining the splenium and genu of the corpus callosum.

-Coverage:

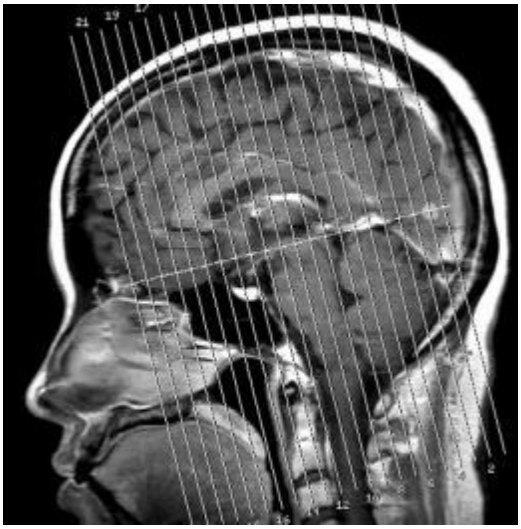
A- Superior to inferior: Craniocervical junction to vertex.

B-Lateral to medial: Temporal lobes on both sides.

C-Posterior to anterior: Occipital to frontal lobes.

-Note: We can use a coronal localizer to obtain axial slices also.

2- Sagittal localizer to obtain coronal slices:



-Alignment:

Parallel to the brainstem.

-Coverage:

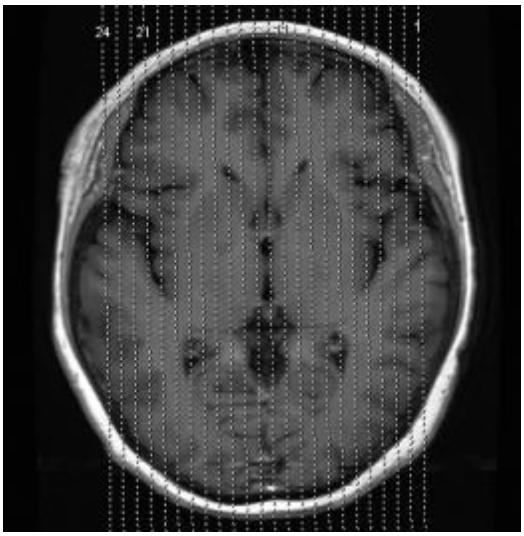
A- Superior to inferior: Craniocervical junction to vertex.

B-Lateral to medial: Temporal lobes on both sides.

C-Posterior to anterior: Occipital to frontal lobes.

Note: We can use axial localizer to obtain coronal slices also.

3-Axial localizer to obtain sagittal slices:



-Alignment:

Parallel to the falx (If midline shift is evident, a line of best fit should be used).

-Coverage:

A- Superior to inferior: Craniocervical junction to vertex.

B-Lateral to medial: Temporal lobes on both sides.

C-Posterior to anterior: Occipital to frontal lobes.

-Note: We can use a coronal localizer to obtain sagittal slices also.

MRI sequences (Routine brain):

Sequence	TR	TE	FA	ETL	Slice thickness
Sagittal (T1) (FSE)	500ms	Min	-	3-4	5mm
Coronal (T2) (FSE)	4550ms	102ms	-	13	5mm
Axial (DWI)	8000ms	84ms	-	-	5mm
Axial (T2) Flair	8000ms	135ms	-	35	5mm, TI=2000
Axial (T2) (FSE)	4000ms	129ms	-	27	5mm
Axial (SWI)	5000ms	Min	90	-	2.4mm
Coronal (T1) (FSE) (post GAD)	500ms	Min	-	3-4	5mm
Sagittal (T1) (FSE) (post GAD)	500ms	Min	-	3-4	5mm
Axial (T1) (FSE) (post GAD)	600ms	Min	-	3-4	5mm

Notes:

1-T1WI : provides the most anatomically-relevant images.

2-Flair images : useful for areas of edema or inflammation and used to identify plaques in multiple sclerosis.

3-DWI : was the preferable in case of **stroke, abscesses, and cellular tumors** since the restricted diffusion was occurs in these pathological conditions.

4- Susceptibility-Weighted Imaging (SWI):

Use: Detects hemorrhages, microbleeds, and venous abnormalities, useful in cases of head trauma and vascular disorders.