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Paper — MRI (Magnetic - Resonance Imaging)
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Q-1:→

Proton MR Imaging:→

An Atom consist of nucleus in which proton and neutron are present. Proton having positively charged while neutron have neutral.

→ Proton having positively charged and move around them called Spin Movement.

→ This Spin movement of Proton -

P-T-O.

produce an electric current and every current has accompained by magnetic field.

→ So in every electrical current there would be a magnetic field.

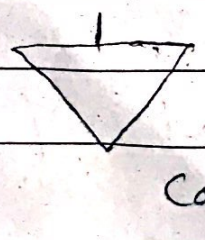
→ Inlithout applying any external magnetic field protons in the patient body move randomly in any direction.

→ Inlhen external magnetic field is applied (patient is placed in magnet) there randomly moving proton allign and spin in the direction of external magnetic field.

→ Some of them allign parallel and Some anti-parallel to the external magnetic field. (opposite direction)

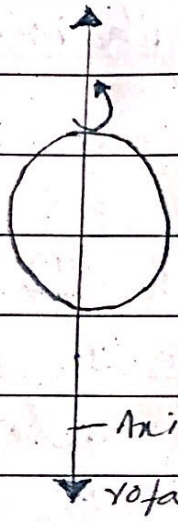
→ Inlhen proton allign, not only they rotate around themselves called Spin but also they rotate to their axis of rotation moves such that it form 'Cone'.

Anti-Parallel — Higher energy are required.
→ less proton.
→ opposite direction.

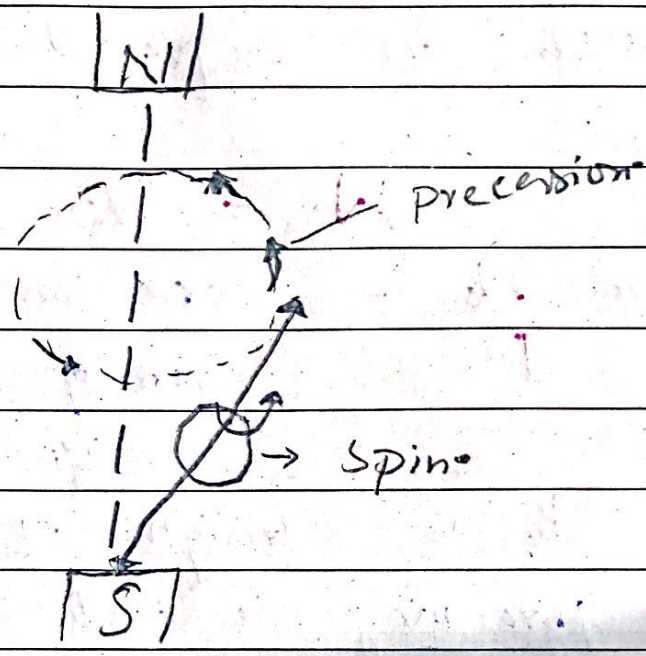


Parallel — lower energy are requi having more proton.

→ This movement is called precession:



Spin rotation of proton around its axis.



precession.

→ Proton have Special type of movement Called precession. (wobbling type of motion.

→ It is not constant depend on magnetic field.

→ And its measured by Precessional frequency.

→ Precession frequency is directly proportional to the Strength of magnetic field.

→ Stronger the magnetic field, higher will be the Precession frequency which is expressed by Larmor equation.

$$W_0 = \gamma B_0$$

where W_0 = Precession frequency in HZ.

γ = ~~Gyromagt~~ Gyromagnetic ratio which is specific to particular nucleus.

B_0 = Strength of external magnetic field.

→ Gyro-magnetic Ratio is different for different mag materials.

→ Precession frequency for Hydrogen proton 1 Tesla

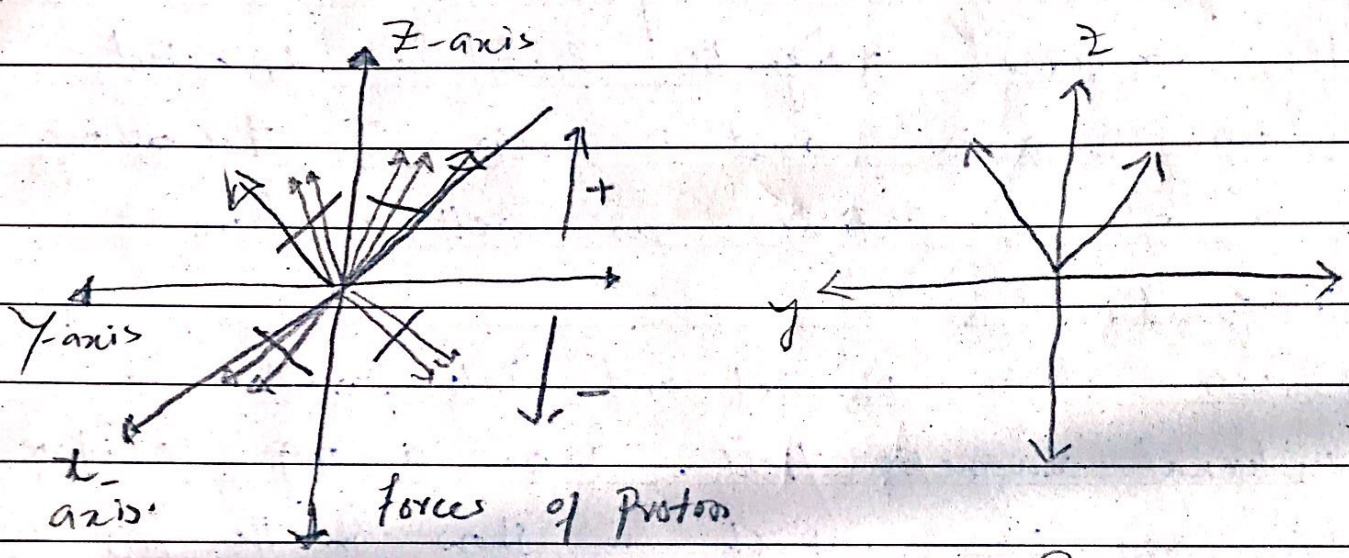
H proton 1 Tesla = 42 MHZ.

1.5 Tesla = 64 MHZ.

END

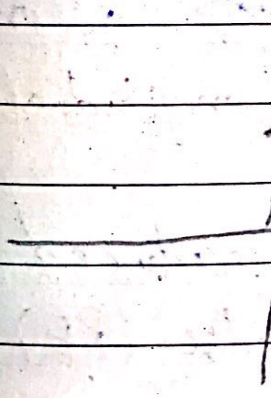
Q-2

Differentiate between Transverse and Longitudnal magnetization.



→ Forces of Proton Z on positive and negative side cancel each other.

Remain on Z-axis.



Longitudnal magnetization.

→ RF Pulse (Switched off).

→ Proton Forces added on z axis and form Longitudnal magnetization.

→ And Due to RF Pulse off This can Create.

Longitudnal Magnetization :→

→ For the Orientation in Space Consider x-y and z axes System.

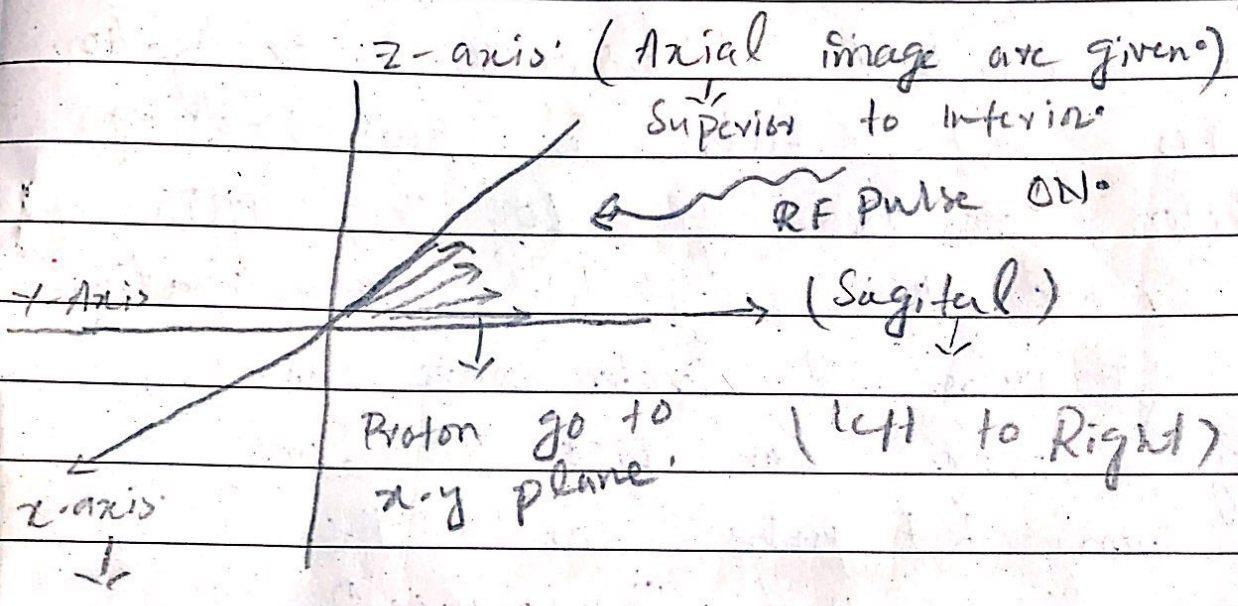
→ The external magnetic field is directed along z-axis. and z-axis is the along axis of the patient as well as bore of Magnet.

→ Proton align parallel and Anti-parallel to external magnetic field. i-e along positive and negative which is show in the figure. They cancel each other.

→ However Some proton remain on the positive side or parallel to z-axis which are not Canceled. forces of there proton add up together to form a magnetic veetor along z-axis- This is Culled Longitudnal Magnetization.

→ Longitudnal Magnetization is produced due to the Radiofrequency Pulse (RF) is switched off.

Transverse Magnetization :-



→ When Radio frequency (RF) Pulse is sent to the proton. Proton picks up some energy from RF Pulse.

→ Some of these proton go to higher energy level and some antiparallel.

→ Due to the Imbalance Proton go to x-y plane and create the transverse maguetization this is called transverse Magnetization.

→ And when RF Pulse is switched off the proton reverse go to the Z axis and create the longitudinal maguetization

→ When RF pulse and proton have same frequency proton can pick up some energy from RF pulse and the phenomena is called "Resonance"

Q-3 Gradient field :-

→ To localize the signals where in body signals are coming three more magnetic field are super imposed on main magnetic field.

→ These planes are x, y and z - planes.

z - axis → Superior - Inferior.

y - axis → Right - left.

x - axis → Anterio - posterior.

→ The variation in magnetic field is called gradient field.

→ The variation are due to coil.

→ The magnete field are produced due to coil.

There are three gradient field.

1- slice - selection - gradient

→ A graded changes in magnetic field is called gradients.

1.4T 1.45T 1.5T 1.56T

graded changes in magnetic field.

1- Slice-Selection gradient:-

→ These are made on along Z-axis
→ It determines the slice position.
i-e (Skull, C_4, T_1, L_4).
→ The Bandwidth frequency are responsible for slice position.
→ It tell us about the slice thickness.
→ When bandwidth frequency are wide the slice thickness would be thick (wide).

→ During Sending Radio frequency (RF) Pulse the Slice Selection gradient are ON.

2- Phase Encoding
3- frequency encoding gradient.

→ The phase encoding and frequency encoding are perpendecular to each other.
→ It tell us about the slice signals.

→ Localized that point from where the Signals are coming.

→ 2. The frequency encoding is ON at the time of Signal Reception.

→ 3- The Phase encoding is ON for a short time after Slice Selection gradient.

→ 01 read out the gradient.

→ And from these three phases information are send to the Computer.

End

Q-4

Four Basic Steps.

→ There are four basic steps are involved in the getting of MR imaging

P.T.O.

1- placing the patient in magnet.

2- Sending Radiofrequency (RF) pulse by the coil.

3)- Receiving the signals from the patient by coil.

4- Transmission of signal to the computer for getting the image.

End

value of TR, and TE.

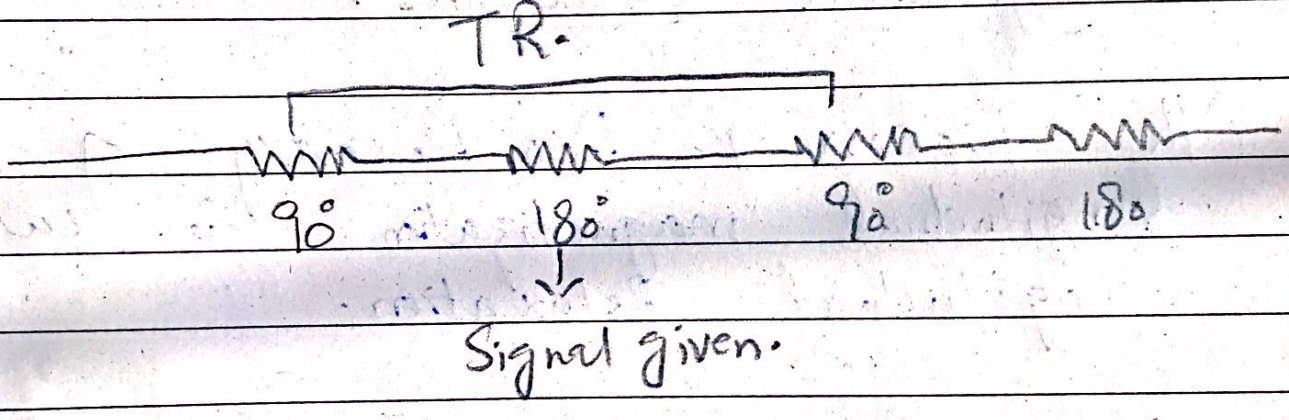
Qs:-

Spine Echo Sequence (SES)	Gradient Echo Sequence (GRE)
Short TR = 300 — 800.	< 50.
Long TR = > 2000.	>100.
Short TE = 10-95	1-5.
Long TE = >60	>100.
TR is always longer	than TE.

Q 6 Define

(a) TR Time To Reptition

Of the time interval of between the the start of one RF pulse to the start of next RF pulse.



(b) TE :- Time to Echo :-

Of the time interval of One RF Pulse and Reception of Signal Echo.

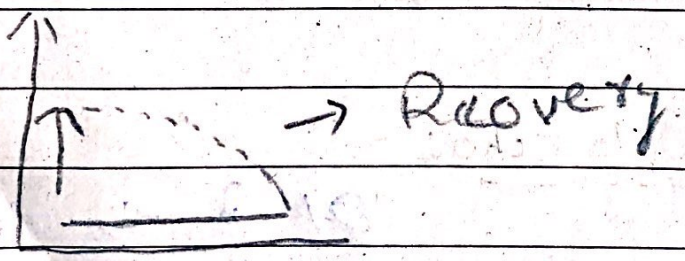
(c) Transverse Relaxation :-

The Reduction of transverse magnetization is called Transverse Relaxation.

→ It tell us about the strength of magnetic forces.
→ The energy is lost due to the spin movement of proton.
→ It is also called Spin-Spin-relaxation.

(d) Longitudnal Relaxation :→

The Process of Recovery of longitudnal magnetization is called logitudnal Relaxation.



→ The net magnetization vector will be on longitudnal magnetization.
→ Proton will release some energy and the energy is deposited in Crystal Lattice.

→ Therefore it is called the Spin-lattice relaxation.

e) T_1 weighted image..

↓

TR and TE, Both are Short.

(f) - T_2 - weighted image

TR & TE - Both are long.

(g) - Proton density images

TR long - TE short.

↓ ↓

To eliminate the T_1 - effect. To eliminate the T_2 effect.

End of Paper