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02) ------- ?

CONTRAST MEDIUM & ITS EFFECT ON IMAGE

Definition: is defined as substance which is introduced into the part of the body to improve visualization of internal structures and tissue of body is → contrast medium.

HISTORY In beginning years, thought was that MRI dont need contrast medium but soon it was found contrast medium improves detection, characterisation and interpretation. Physiological & dynamic studies like perfusion can be done nowadays.

CLASSIFICATION:

⇒ Oral & Parenteral contrast media
⇒ Paramagnetic & super-paramagnetic
⇒ Generalized contrast organ
⇒ Specific contrast
⇒ Positive & negative contrast
⇒ Exogenous & endogenous contrast.

Parenteral contrast (based on relaxivity & ~~susceptibility~~)

Positive contrast | Negative contrast

POSITIVE RELAXATION AGENTS: T_1-agents, reducing T_1 of tissue resulting in increase in signal intensity on T_1-W images.

EXAMPLE Gadolinium, Mn-DPDP

NEGATIVE AGENTS (T_2-): Reducing T_2 of the tissues, resulting in reduction of signal intensity on T2-W images.

P.T.O

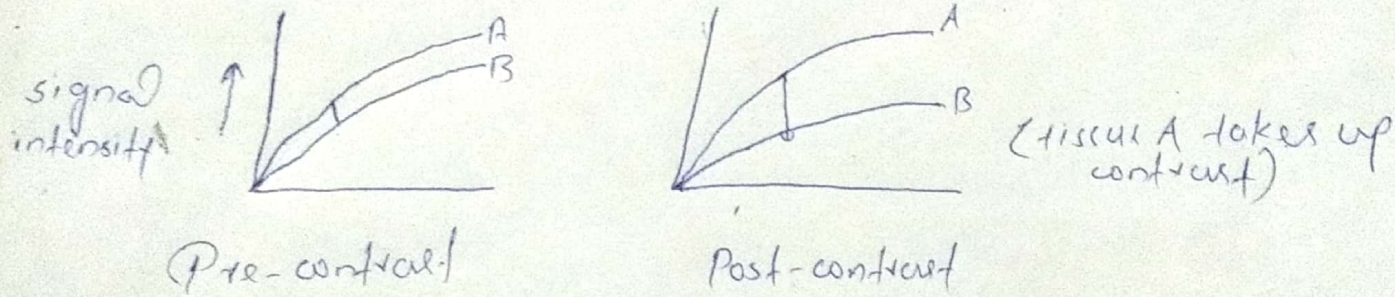
EXAMPLE Iron oxide and gadad gadolinium.

PARAMAGNETIC CONTRAST Gadolinium is paramagentic agents. Usually a positive agent but in high dose results in T-2 shortening and decreased signal on T-2-WI images.

SUPER-PARAMAGNETIC AGENTS: are negative agents and cause spin dephasing → T-2 shortening and reduce signal. e.g Iron-Oxide.

MECHANISM OF CONTRAST MEDIUM: In X-ray/CT contrast is related to one factor. but in MR the mechanism is multi-factorial include relaxivity, susceptibility, diffusion & perfusion of contrast agent.

GRAPHICAL REPRESENTATION:



GADOLINIUM: Gadolinium rare earth metal, accumulate in body and not excreted so require chelating agents for excretion. Gadolinium leads to both T_1 & T_2 relaxation T_1 effects more commonly used for clinical effects

Usual dose = 0.1mmol/kg

OTHER MR-CONTRAST AGENTS Iron oxids, MnDPDP, barium

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CONTRAST EFFECT ON IMAGE

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=) substantial improvement in lesion identification

=) CNS neoplasm improves identification, invasion in brain tumours

=) Metastases can appear isointense.

POST-Treatment-Tumour: contrast very useful to differentiate recurrence from necrosis.

CNS-infection: Acute and chronic infection lesion differentiation. Disease progression/regression monitoring by contrast.

=) Enchanced MRI (contrast) is more superior to enhanced CT. in meningeal enhancement.

ISCHEMIC-CNS-DISEASES: =) Intravascular enhancement is seen in 1st week after infarction. Intravascular enhancement help in differentiating from infarct from other condition.

POST-OPERATIVE-SPINE: contrast medium is very useful in post-operative spine to differentiate b/w scar and disc. Scar enhances while disc does not enhance.

=) contrast medium helps in differentiating b/w tumour syrinx from congenital syrinx.

=) contrast helps in differentiating b/w benign & malignant tumour.

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Q3)----?

SLICE THICKNESS DETERMINATION

INTRODUCTION: slice thickness can be determined by following two ways:

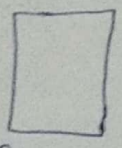
(i) Radiofrequency pulse (RF) [with wide ranges of frequencies]

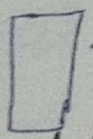
(ii) slope of the gradient field.

(i) Radiofrequency Pulse: slice thickness can be determined by radiofrequency pulse involving wide range of frequencies.

=) wide frequency range = thicker will be the slice

=) narrow/smaller frequency range = less thick will be the slice.

EXAMPLE: If we use frequency range 64-65mHz, slice thickness will be  .

but if we use frequency range 64-64.5mHz then slice thickness will be  .

ii) Gradient Field: slice thickness can be determined by gradient field involving resonant/Precessing frequencies b/w 60mHz (feet) and 68mHz (at head).

EXAMPLE: By using same radiofrequency range, we can get different slice thickness by varying gradient field i.e

=) steeper gradient field with 64-65mHz = thick slice

=) shallow gradient field with 64-65mHz = thin slice.

CONCLUSION: so by same radiofrequencies slice thickness can be modified by slope of gradient field.

P.T.O

SIGNAL SOURCE: Signals basically come from, application of Rf-pulse interaction with protons in slice area.

EXAMPLE If we have 6 protons in slice area and by Rf-pulse, 6-protons will precess with same frequencies. Precession with same frequencies means protons are in-phase.

Gradient-Field: Now if we apply different gradient field which decreases from right → left then the precessions of protons will also decreases from right to left. and protons will emit signals to these different frequencies. so gradient applied here also called frequency encoding gradient.

MAGNETIC FIELD: Now if we apply magnetic field along proton columns then according to magnetic field strength precessions of protons will speed up.
Higher magnetic field strength, higher will be proton precessions.

FOURIER-Transformation: By means of computer & Fourier transformation, we can analyze how much signal of specific frequency and phase is coming out.

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Q1)-----?

MR-SPECTROSCOPY & CLINICAL USES

Definition: magnetic resonance spectroscopy is a specialized technique associated with MRI (magnetic resonance imaging.)

EXPLAINATIONS: As spectroscopy requires very homogenous magnet with high field strength and can only be performed with MR units (superconducting magnets) as other magnets cannot do both imaging & spectroscopy. It is used as an analytical tool as it identify various chemical states of certain elements without sample destruction.

In-vivo information: useful in obtaining in-vivo information about chemistry & metabolism in specific locations.

Disease evaluation and therapy effects: These measurements can be repeated without any harm and follow up studies of cell are possible and helpful in disease evaluation and effects of therapy.

PRINCIPLE: Basic principle is electron distribution in an atom cause nuclei in different molecules to experience slightly different magnetic field, resulting in slightly different resonant frequency which in turn return slightly different signal.
MR also called NMR.

P.T.O

CLINICAL APPLICATIONS:

1. Brain tumours
2. Cerebral infarction & ischemia
3. Trauma
4. Infectious diseases
5. Pediatric metabolic disorders
6. Hepatic encephalopathies
7. Alzeihmers diseases
8. Epilepsy
9. **Ischemia, Hypoxia & brain related injuries:**
   - => acute ischemic stroke
   - => cardiac arrest
   - => global hypoxia
   - => near-drowning
   - => Ischemia in neonates.

NOTE MR-spectroscopy very important for brain tumours and its related injuries and disorders.