كلية التربية
القرمة الرابعة
فيزياء

Physics 425
Magnetic Resonance Imaging

Types of magnets used in MRI :

There are four types of magnets :

1- Air- Cored magnets (not in use now).
2- Iron - Cored electromagnets
3- Permanent magnets
4- Superconducting magnets.

For Clinical use the strength of the magnetic field is between 0.2 and 3.0 T

2- Iron - Cored electromagnets :
Use Coils around soft iron pole pieces. When electric current pass through the Coils, the iron becomes magnetized. This gives higher magnetic fields compared to air- Cored magnets.

3- Permanent magnets :
These are materials that produce magnetic fields without the need to current. Materials used are Samarium Cobalt ($SmCo_5$) and neodymium - iron- boron (Nd-Fe-B).

4- Superconducting magnets:

These are materials that have no electrical resistance at very low temperatures. Current flows in a superconducting coil without resistance. Superconducting magnets can produce fields as high as 8 T.

Biological Effects of MRI

1- Radiofrequency effects:

The electromagnetic fields deposit energy which leads to tissue heating which may affect the body in particular heat-sensitive organs e.g the eyes.

وعنوع استخدام الرنين المغناطيسي في الحالات الآتية:
أ- المرضى المثبت لهم أجهزة لتنظيم ضربات القلب.
ب- المرضى المعالجين بأجهزة إلتقاط الصناعي.
ج- المرضى الذين أجريت لهم جراحات تطبيق تثبيت أجزاء معدنية في الجسم.

الآلة تقرأ قيمة SAR

SAR: Specific Absorption Rate

For a uniform Conducting medium, of Conductivity σ, the current density $\vec{J}$ is related to the electric field by:

$$\vec{J} = \sigma \vec{E}$$

Now the power density is:

$$P = \vec{J} \cdot \vec{E} = \sigma E^2 \quad \frac{W}{m^3}$$

The SAR is defined by:

$$SAR = 0.5 \frac{\sigma E^2}{\rho} \qquad (\text{units } \frac{W}{kg})$$

where ρ is the density of the tissue.

Using Faraday's law of induction:

$$\oint \vec{E} \cdot d\vec{l} = -\frac{d\Phi_m}{dt}$$

we find that E is proportional to:
- the magnetic field (a.c field).
- the area
- the frequency.

$\therefore E^2 \propto (\text{area})^2 B^2 \omega^2$

So SAR increases with ω, B and the patient size.

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