

^1H atom nuclei (along with ^{13}C , ^{19}F , ^{23}Na , & ^{31}P among others) have a net spin and will align in a magnetic field. EM radiofrequency pulses applied perpendicular to the magnet field are absorbed and excite the nuclei and the nuclei then relax after a time characteristic of the nuclei and the environment (tissue) they are in.

Image Types

Relaxation times for protons vary and two times are commonly measured, known as T1 (slow) and T2 (fast). White matter is darker than grey matter in T1-weighted images and brighter than grey matter in T2-weighted images.

- T1-weighted images - Water gives low intensity signal. Fat, subacute haemorrhage give high intensity signals. Good brain white/grey matter differentiation (NB. white matter appears darker than grey).
- T2 - Water and fluid are bright, good for tissue oedema.
- T2* - used in functional MRI scanning
- Diffusion MRI - measures diffusion of water into tissues e.g. to study demyelination.
- Diffusion weighted imaging - detects areas where diffusion has become restricted, most commonly, in the setting of stroke.
- Magnetic Resonance Angiogram (MRA) and Venogram - MRI can be used to look for abnormalities in arteries and veins, such as stenosis or aneurysm formation.
- Functional MRI - this is a fairly recent technique. It allows visualisation of neural activity in the brain by detecting areas of increased blood flow.
- Contrast agents may be used with T1 images e.g. Gadolinium - expensive.

Common indications for MRI scanning

- Central nervous system - stroke, demyelinating disorders and tumours.
- MSK joint MRI scans are now widely used and MRI can detect minute ligament tears.
- Imaging arteries and veins.
- More novel uses of MRI: - coronary scans

Advantages of MRI scanning

- Harmless to patient (no radiation involved unlike CT scanning and conventional radiology).
- Excellent detail (esp neural tissue) making it similar/superior to CT scanning in some situations. Bone & air not imaged well.
- MRI contrast is usually gadolinium which is less allergenic than iodine based contrasts used in CT scanning. Also not nephrotoxic and safe in children.

Disadvantages of MRI scanning

- Limited availability - although this is rapidly improving.
- Lengthy procedure when have to lie still e.g. pituitary gland MRI scan can >20min.
- The cylindrical tube is tight, noisy, claustrophobic, and limited access if patient deteriorates (non metallic resus equip needed). Some open scanners now available.
- MRI scanning cannot be performed in the presence of metallic implants or FB e.g. pacemakers, aneurysm clips and some cardiac stents. However, stainless steel objects, such as those in hip prosthesis may be ok.
- Relatively expensive compared to other forms of imaging.
- May not be available "out-of-hours".