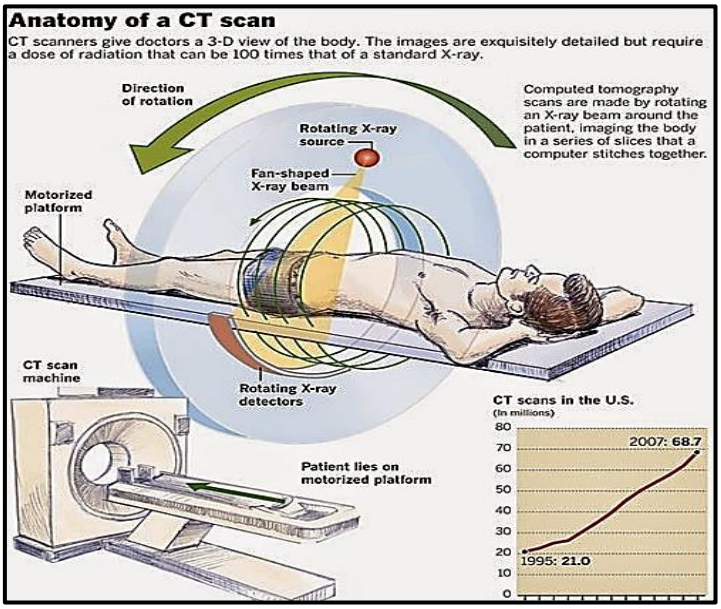
CT scan (Computed Tomographic scan)

1- Table with a motor moves a patient into a hollow opening of the CT imaging system.
2- As a patient passes through the CT imaging system, x-rays flow from the *rotating x-ray beams*, then they passed through the body.
3- *Rotating x-ray detector* record the x-ray existing the patient's body.
4- When x-ray fall on the detector it produce electrical signal.
5- The signal passed to *the data equation unit* to store these signals temporarily.
6- After this, the *image reconstruction unit* receive these signal and process it, after processing signals it make **3-D (three dimensional)**images of internal structure of the body.

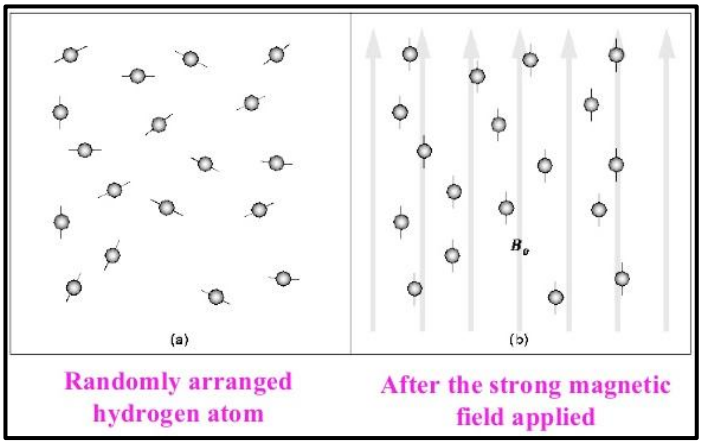


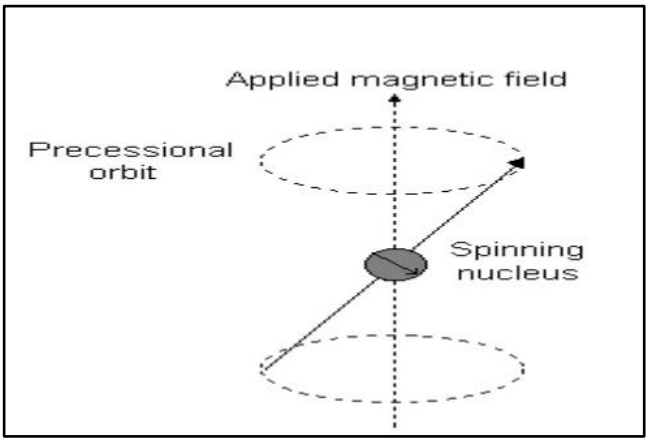
It has more recently been used for preventive medicine or screening for disease, for example

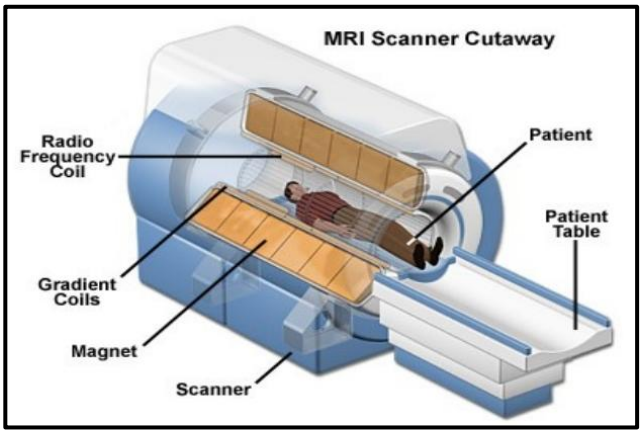
- CT colonography for people with a high risk of colon cancer.
- full-motion heart scans for people with high risk of heart disease.
- CT scanning of the head is typically used to detect infarction, tumors, calcifications, haemorrhage and bone trauma.
- CT scan can be used for detecting both acute and chronic changes in the lung**.**
- CT is an accurate technique for diagnosis of abdominal diseases.

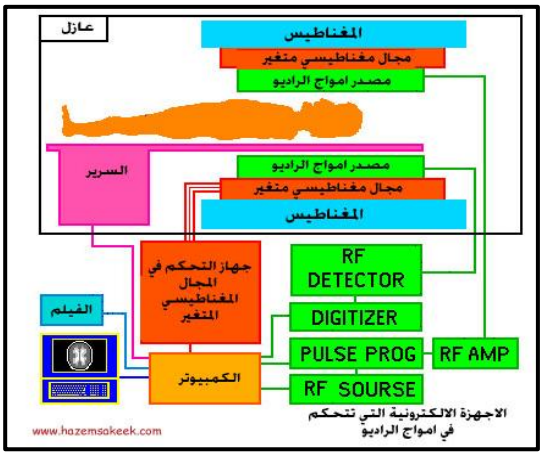
MRI scan (Magnetic Resonance Imaging scan)

- MRI makes use of the magnetic properties of certain atomic nuclei.
- Hydrogen nucleus (single proton) present in water molecules, and therefore in all body tissues.
- The hydrogen nuclei partially aligned by a strong magnetic field in the scanner.
- The nuclei can be rotated using radio wave, and they subsequently oscillate in the magnetic field while returning to equilibrium.
- Simultaneously they emit a radio signal.
- This is detected using antennas (coils).
- Very detailed images can be made of soft tissues.









MRI uses

- most MRI scans essentially map the location of water and fat in the body.
- MRI include most cardiac pacemakers.
- shrapnel and metallic bodies in the eyes.
- Neuroimaging.
- and radiosurgery for treatment of intracranial tumors.
- arteriovenous malformations.
- myocardial ischemia and viability.
- cardiomyopathies.
- iron overload.
- vascular diseases and congenital heart disease.

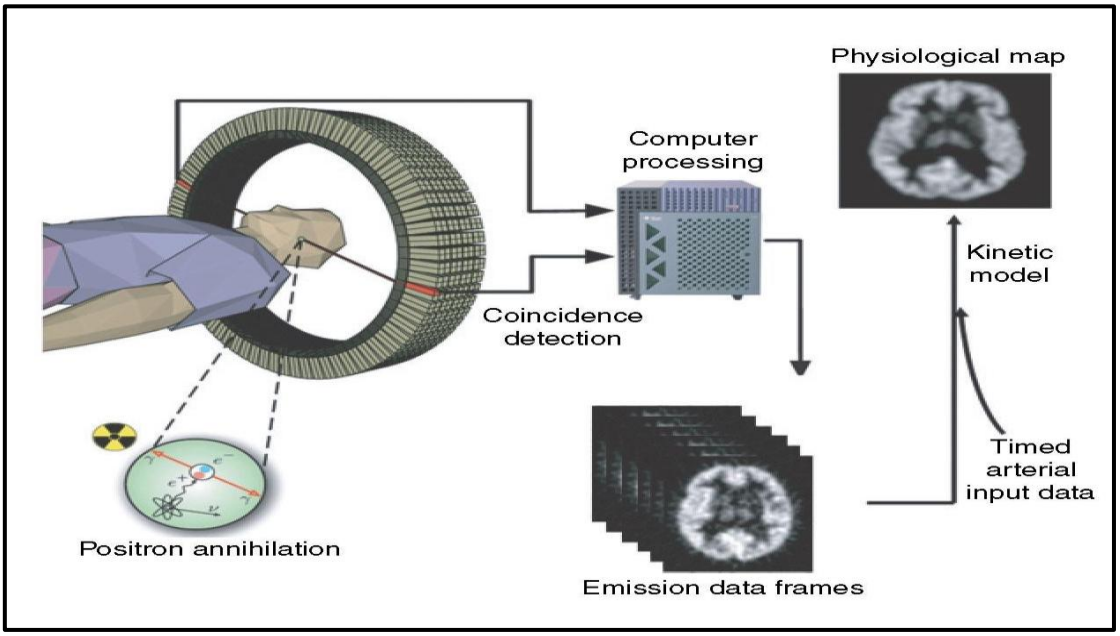
NOTE MRI scanners use strong magnetic fields, radio waves, and field gradients to generate images of the organs in the body. MRI does not involve x-rays, which distinguishes it from computed tomography (CT or

CAT).

PET scan (Positron Emission Tomography scan)

- A patient lies in a PET scanner after being injected with radioactive-labeled substance (typically water or glucose).
- Because more blood goes to active brain regions, there is more radioactivity in those brain regions. the scanner detects the unique radioactive decay of positrons.
- These tiny, positively charged, radioactive particles emerge from the radioactive water (or glucose) that was injected. After being emitted they are attracted to nearby negatively charged electrons.
- When positrons and electrons come together, they are annihilated, and energy is released in the form of two photons (particles of light, no charge) that leave the point of annihilation in exactly opposite directions.

- The PET scanner is set up to detect arrival of pairs of photons. The location of the positron-electron annihilation is determined by which pair of detectors are simultaneously active.



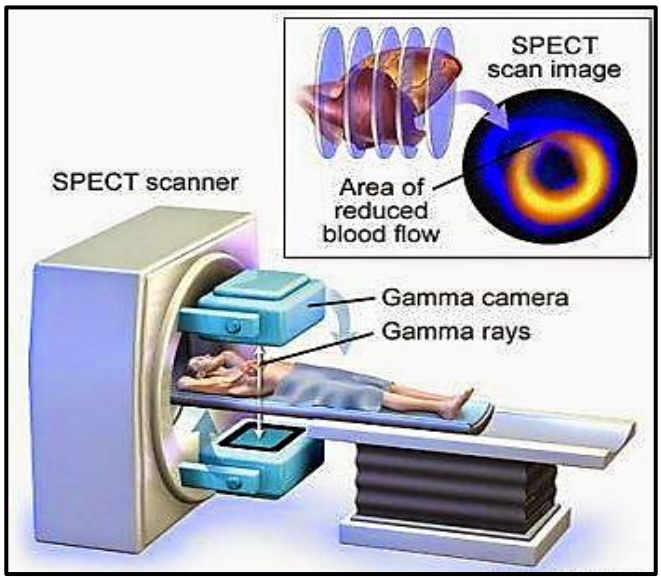
PET uses

- It is used heavily in clinical oncology.
- and for clinical diagnosis of certain diffuse brain diseases such as those causing various types of dementias.

SPECT (Single-photon Emission Computed Tomography)

- is a nuclear medicine tomographic imaging technique using gamma rays. It is very similar to conventional nuclear medicine planar imaging using a gamma camera.
- Where the patient is injected with a radiopharmaceutical which will emit gamma ray (photons that are much higher in energy than visible light and can pass out of the body).
- By collecting the gamma rays in detectors placed around the patient, we can build up a picture of where they came from, locating the tumor position and shape.
- A computer is then used to apply a tomographic reconstruction algorithm to the multiple projections, yielding a 3-D data set.

- This data set may then be manipulated to show thin slices along any chosen axis of the body, similar to those obtained from other tomographic techniques, such as magnetic resonance imaging (MRI), X-ray computed tomography (X-ray CT), and positron emission tomography (PET).



SPECT uses

- tumor imaging.
- infection (leukocyte) imaging.
- thyroid imaging.
- it can be used to provide information about localized function in internal organs, such as functional cardiac or brain imaging.

FMRI (Functional magnetic resonance imaging)

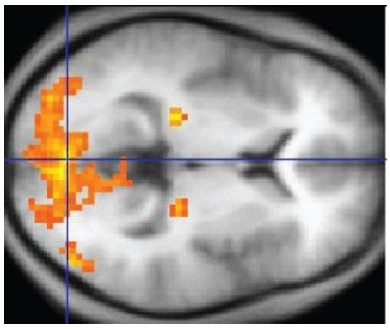
- is a functional neuroimaging procedure using MRI technology that measures brain activity by detecting changes associated with blood flow. This technique relies on the fact that cerebral blood flow and neuronal activation are coupled.
- All atoms and molecules have magnetic resonance, emitting tiny radio wave signals with movement, because they contain protons. Different molecules have different magnetic resonance and two components of blood are tracked to observe brain activity.
- Haemoglobin in the blood carries oxygen; oxyhaemoglobin, around the brain and when it is used up, it becomes desoxyhaemoglobin.

Where the oxygen is being ‘used up’ shows the site of activity in the brain.

- The picture is made by monitoring the ratio of the tiny wave frequencies between these two states.
- An fMRI scan is painless and harmless and can, therefore, be carried out at regular intervals to monitor the progress of a patient under treatment.

FMRI uses

- This is useful to plan for surgery and radiation therapy of the brain.
- Clinicians also use fMRI to anatomically map the brain and detect the effects of tumors, stroke, head and brain injury, or diseases such as Alzheimer's.



An fMRI scan showing regions of activation, including the primary visual cortex.