Health problem addressed

MRI is primarily used to identify diseases of the central nervous system, brain, and spine and to detect musculoskeletal disorders. It is also used to view cartilage, tendons, and ligaments. MRI can also be used to image the eyes and the sinuses. MRI can be used to help diagnose infectious diseases; to detect metastatic liver disease; to display heart-wall structure; to stage prostate, bladder, and uterine cancer; to evaluate kidney transplant viability; and to study marrow diseases.

Product description

An MRI unit consists of a magnet, shimming magnets, an RF transmitter/receiver system with an antenna coil, a gradient system, a patient table, a computer, display monitors, and an operator console. They typically have static magnetic fields ranging from 0.064 to 3.0 T (as measured in the center of the magnet bore). For comparison, the earth’s magnetic field is approximately 0.00006 T. Three basic magnet designs are available for diagnostic MRI applications: the permanent magnet, the resistive magnet, and the superconducting magnet. Most systems today use a superconducting magnet. A standard MRI suite comprises three main rooms: the procedure room, the equipment room, and the control room.

Principles of operation

MRI units use strong electromagnetic fields and radio-frequency radiation to translate the distribution of hydrogen nuclei in body tissue into computer-generated images of anatomic structures. MRI depends on the magnetic spin properties of certain atomic nuclei in body tissue and fluids and their behavior in the applied magnetic field. These nuclei are normally aligned randomly in tissue until an external magnetic field is applied and the nuclei align themselves with that field.

Operating steps

During an MRI scan the patient is moved into the bore of the MRI magnet while the operator adjusts the controls depending on the section(s) of the anatomy being scanned. Before the procedure begins patients are checked for metal jewelry or other metal objects which can distort the image or cause injury. Images are processed by the MRI system’s computer and are generated for viewing and diagnosis. Images are typically transferred to a picture archiving and communication system.

Reported problems

Although the number of adverse incidents is relatively low, numerous reports of injuries in MRI centers and a few reports of deaths. Most of these incidents can be attributed to the presence of ferromagnetic devices and equipment (including implants) in the MR environment. Ferromagnetic objects have become projectiles and injured or killed patients. Several incidents have occurred in which patients undergoing MRI studies sustained second- and third-degree burns when their skin contacted surface coils or monitoring cables.

Use and maintenance

User(s): Radiologists, MRI technicians
Maintenance: Medical staff; technician; biomedical or clinical engineer
Training: Initial training by manufacturer and manuals

Environment of use

Settings of use: MRI suite or clinic; operating room
Requirements: Stable power source; shielded room and control room

Product specifications

Approx. dimensions (mm): 2500 x 2500 x 2500
Approx. weight (kg): 5,500
Consumables: NA
Price range (USD): 150,000 - 3,100,000
Typical product life time (years): 8-10
Shelf life (consumables): NA

Types and variations

Extremity, full body, mammographic, neurosurgical; various field strength systems; open or closed