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Magnetic Resonance Imaging (MRI) in Anatomical study

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MRI is a non invasive imaging technology that gives detailed pictures of internal structures. MRI is used to evaluate Head trauma (assess for bleeding or swelling). Neurologic symptoms suggestive of cerebral aneurysm, stroke, tumor and suspected spinal cord lesion or injury. Cardiac or major blood vessel disease (vena cava obstruction, renal vein thrombosis, renal arterial obstruction, portal vein obstruction aneurysms). Renal disease (hydronephrosis, glomerulonephritis, acute tubular necrosis). Cancer of the pancreas, adrenal glands, and gall bladder. Biliary disease, lymphadenopathy and staging of prostate, uterine or bladder cancer. Musculoskeletal disorders including problems with joints, soft tissues or bones.

MRI generally is not helpful in evaluating small and large bowel function. MRI scans produce very detailed images of body structures. The images look similar to CT scan images but MRI scans are done without using ionizing radiation. (Ionizing radiation which is used in conventional X rays and CT scans is radiation with enough energy to completely remove an electron from its orbit. Ionization can be destructive to living tissues and increases the risk of developing cancer).

In addition to producing images of structures MRI is also used to see the physiology of the body through techniques such as Functional MRI (fMRI). For example fMRI can show which parts of the brain are functioning during various activities. This is accomplished by asking the patient to perform certain tasks (tapping fingers, answering simple questions) during imaging

MR angiography (MRA) Produces 3-D reconstructions of blood vessels, is noninvasive and doesn't require contrast, MR spectroscopy (MRS) reveals the biochemistry of specific organs or tissues.

How MRI Works? The body contains millions of hydrogen atoms in all types of tissue. MRI is based on the fact that hydrogen atoms found throughout the body in water can be affected by a magnetic field. The net result is that an MRI image shows differences in the water content and distribution in various body tissues.

The MRI machine looks like a large cylinder with a table that can advance in to the bore or opening of the cylinder. The cylinder contains the powerful magnet.

After proper preparation and positioning the patient is placed in the MRI machine and in to the strong electromagnetic field generated by the magnet..

In response to this magnetic pull the hydrogen atoms in the body align with the magnetic field, either in the same direction or opposite to the direction of the field.

A powerful radio signal is then sent through the patients body at the desired level or slice. This result in the hydrogen atoms being raised to a higher state of energy. When the radio signal is turned off the hydrogen atoms return to their original energy state and the extra energy or the resonance is released in the form of radio waves. This resonance is picked up by radio receivers in the MRI machine and transmitted to a computer. These energy differences end up appearing as different shades of gray on the MRI image. Through a series of complex calculations the computer constructs an image derived from the magnetic resonance and displays it on a screen. It is then photographed and recorded on x-ray film.

Different tissues resonate at different frequencies which is the basis for how the detailed images are produced. Current MRI machines generate these images as 3-D projections. A 3-D MRI image can be "sliced" and examined in detail, which has been described as 'virtual" exploratory surgery.

Safety issues Associated with MRI

Several injuries and a few deaths have occurred during MRI because of the powerful magnets used. Not only are the magnets capable of attracting metal objects quite a distance from the magnet, but the magnetic field also interferes with the operation of certain devices. Overall five hazards associated with MRI have been identified.

Flying projectiles Metallic objects are forcefully pulled by the magnet, becoming airborne and hurtling toward the opening of the MRI machine. Several patients have been killed or Injured by oxygen tanks, scissors, IV poles, tractions weights, stethoscopes and other magnetic objects, which can reach speed up to 40 miles per hour.

Twisting or movement of metallic implants Such as aneurysm clips in response to the strong magnetic fields of the MR equipment.

Burns anything with metal in it can become hot and cause burns. Burns from various sources including contact with an electrically conductive cable, tattoos heating up due to the iron oxide content, ECG or pulse oximeter leads conducting currents and patient contact with the magnet bore have been recorded.

Malfunction of devices including PCA pumps, ventilators, and pacemakers, leading to serious patient harm or death. Undetected artifact from various sources leading to change in MRI image and possible misdiagnosis.

MRI is contraindicated in the presence of the following patient conditions or treatment modalities.

1. Cardiac pacemaker
2. Implanted cardiac defibrillator
3. Aneurysm clips
4. Carotid artery vascular clamp
5. Neurostimulator
6. Insulin or Infusion pump
7. Implanted drug infusion device.
8. Bone growth fusion stimulator
9. Cochlear or ear implant
10. IUD or diaphragm

MRI contrast

Contrast is used in MR studies to help differentiate diseased tissue from healthy tissue. In conventional X-rays and CT scanning contrast media weaken X-rays as they pass through the body. In MRI contrast works by altering the time it takes for hydrogen atoms to return to their original energy state. Because the time factor is changed, the contrast enhanced tissues send out different signal intensities, which cause them to appear much brighter on the final image. Contrast also enables detection of smaller sized tissue changes. For example tumors >1-2 cm in size will show up fairly clearly without contrast enhanced studies may reveal even smaller tumors.

Most MRI contrast media contain 'gadolinium, a heavy metal (chemical symbol Gd). Other agents those with organ specificity, are also available. MRI contrast agents are administered intravenously by the MRI technician during the test. Unlike iodinated contrast agents, patients do not experience any flushing, itching or metallic taste when MRI contrast is administered.

Although reactions to MRI contrast are much rarer than reactions to iodinated contrast agents, the possibility of a reaction including serious anaphylactoid or cardio vascular reactions should always be considered especially in those patients with a known clinical hypersensitivity, a history of asthma or other allergic respiratory disorders.

Since contrast is largely excreted by the kidneys, renal function should be monitored when patients with impaired renal function receive contrast. Patient with sickle cell anemia and other hemoglobin disorders may have an increased risk of vaso-occlusive complications.

Pretest Patient Preparation for MRI

Tell the patient that he or she will change into a hospital gown. There are no food or fluid restrictions prior to MRI. Occasionally the patient may be asked to restrict food or liquids. Explain that the patient will have to remove jewellery, watch, hairpins or hairclips, keys, coins, wallet, credit cards, eyeglasses, hearing aid, removable dental work, belts and buckles or other objects suspected of containing metal.

The patient must be thoroughly screened for internal metallic objects. Ask the patient about prosthetic valves or joints, implanted infusion devices, shrapnel, bone screws, metal plates, etc. All imaging centers will have a screening form for this

purpose that must be completed. Explain that the technologist will start an IV if contrast is used.

Procedure for MRI

After positioning the patient on the table the technologist places an apparatus called a surface coil (a special radio antenna) around the area of interest. The table is advanced into MR gantry (opening). The technologist will leave the room, but the patient can communicate with the technologist via the intercom.

A mild sedative can be given prior to the MRI scan to help control anxiety and claustrophobia. The patient will here knocking noises as the MR sequences are run. Most scans require two to six different sequences, each lasting 2-15 min. The patient must lie completely still during scanning. The MRI scanning time ranges from 30 to 90 min..

Post test care After MRI After the study is complete, the patient will be asked to wait until the images are reviewed. Once it is determined that the images are adequate, the patient can leave. Tell the patient when the results will be available and whom he or she should contact with questions. No physical posttest care is required.

References

1.Guide to lab and Diagnostic Tests By Tracey B. Hopkins.
2. Davis's notes.
3. Clinical pocket guide
4. Medical Assistant's pocket guide.