What is an MRI?

Magnetic Resonance Imaging is a non-invasive imaging technique, which uses magnetic fields and radio waves to produce images of the body. It is different from ordinary x-rays and CT scans because it produces these images without any radiation.

MRI has much better soft tissue contrast than other diagnostic modalities. There are no known adverse side effects of MRI if the patients are screened appropriately for a limited number of contraindications.

Some patients are claustrophobic making the study difficult for them because of the limited space available in the scanner.

MRI provides clinical information that cannot be obtained in any other way.

The MRI Exam

There are no special preparations required for the examination. The patient may wear simple clothing, which they wear or bring with them. The patient is asked to remove all metal containing materials such as dentures, jewelry, watches, and hairpins. The patient is assisted onto the scan table and then is centered in the cylinder shaped magnetic and the exam begins.

The technologist performs sequences of images at different tonal levels and communicates with the patient in between sequences. Earplugs are usually provided, as during the sequences there is a fairly loud clanging noise.

If a scan requires contrast the pre-contrast sequences are imaged and the patient is then given an IV and placed back in the magnet for the post-contrast images.

Contrast Agents

The most commonly used MRI contrast agent is Gadopentetate, dimeglumine (GAD). This is a paramagnetic agent and does not contain iodine. Contrast is often used to enhance the evaluation of metastatic tumors, pituitary tumors, acoustic neuromas, abdominal abnormalities, and post-surgical lumbar spine problems.

Contraindications for MRI

Although there is no special patient preparation, a patient is screened for metallic objects that may interfere with the test and may need to have x-rays to verify these objects are not present. X-rays of the orbits of the eyes are done if there is a history or possibility of metallic fragment in the eye for example, from a work-related injury.

The following is a list of the most commonly screened metallic devices for MRI:

- Surgically repaired heart valves

- Metal fragments such as shrapnel
- Implanted pumps such as insulin and chemotherapy
- Cochlear implants or stapes implants

MRI scans are not performed on patients with:

- Pacemakers
- Surgical aneurysm clips in the brain
- ACLS equipment such as a life pack or respirator

New Applications

There have been some upgrades in MRI software, which are now available to provide MR angiography of the renal arteries and peripheral MRI of the lower extremities and enhanced abdominal scanning.

MRI Scan of the Lumbar Spine

MRI examination of the lumbar spine has almost replaced computed tomography, save for an acute traumatic event as the imaging modality of choice. The examination is fast and efficient for imaging disc herniations, arthropathies, tumors, and vascular malformations. Unlike CT where radiation is necessitated and the limited area of the lumbar spine is evaluated, with MRI the exam is non-invasive, utilizes no radiation and the entire lumbar spine and usually lower thoracic spine are included in the diagnostic portion of the study.

MRI Scan of the Ankle and Foot

MRI examination of the ankle and foot has dramatically increased in its utilization in recent years. The osseous structures, ligaments, tendons, and soft tissues as well as vessels can be very well imaged.

Plantar fasciitis, soft tissue masses, traumatic pathology, osteomyelitis or cell changes are very well visualized utilizing MRI.

MR Cholangiography

Magnetic resonance cholangiography is a rapid, accurate and non-invasive alternative to endoscopic retrograde cholangiography in the evaluation of biliary tract disease.

Common bile duct stones as small as 2.0mm can be detected with MR Cholangiography and neoplastic processes and strictures are well delineated as well as aberrant ducts, choledochal cysts and congenital abnormalities.

Multiple Sclerosis

MRI examination of the brain is the closest thing to histopathologic diagnosis for multiple sclerosis.

While the diagnosis needs to be confirmed with cerebral spinal fluid studies, the MRI study has become virtually diagnostic. The number of cases of multiple sclerosis which are diagnosed and can now be effectively treated, has increased dramatically since the advent of MRI of the brain.

MRI represents the non-invasive, non-radiating imaging modality of choice for the central nervous system.

MRI of the Knee

MRI examination of the knee was basically the first application of musculoskeletal imaging to be utilized widely and gain acceptance as the non-invasive imaging modality of choice for evaluation of internal derangement.

The MRI evaluation of the knee has practically revolutionized our diagnostic ability in orthopaedic surgery. While it does not uncover every pathological finding that can exist in the knee, it is extremely helpful in diagnosis and we now rarely perform arthroscopic surgery on a knee that has not been subjected to MRI examination.

Menisci, cruciate ligaments, collateral ligaments and the quadriceps and patellar tendons are well delineated with MRI.

The osseous structures as well as vascular and neural elements are also well defined in this non-invasive evaluation.

It is projected that in this era of increasing life span and active lifestyles, evaluation of knee pain due to injuries and degenerative processes will only increase.

Open MRI Evaluation

In our experience with patients one of the limiting aspects of MRI evaluation is the claustrophobic factor.

I had no idea how many people were claustrophobic until we started to use MRI frequently in our practice. While most of us would not be bothered by the closeness of the MRI chamber walls, for those patients who are claustrophobic the situation is intolerable. I have had many patients tell me that they have great difficulty even being on an elevator. Sometimes even sedation is not enough to allow the MRI study to be completed.

Open MRI technology has been available for more than 15 years, but it has encountered much resistance and skepticism in the medical community.

Open MRI units are needed however because of the claustrophobic factor and also

because not all patients will fit into the closed tubes of conventional MRI scanners.

There are some in between units, which have a shorter cylinder, but still require the patient to be inside a tube. However it has a somewhat flared opening and is roomier than a conventional MRI tube.

Open systems eliminate the tube altogether, but have hardware and software that operate differently than the closed tube machines.

The MRI uses magnetism and radio waves to peer inside the human body and produce clear images of human anatomy.

Magnetic fields produced by the MRI are measured on a tesla scale named after an electrical engineer Nikola Tesla. The strength of the magnetic field determines the amount of time necessary to produce the image.

The higher the field strength the faster the image is produced. Conventional closed MRI equipment has a high field strength of 1.5 tesla.

The early open systems had a field strength of only .25 tesla, whereas the new open systems have a middle to high field strength of .6 to .7.

Expense for an open MRI is comparable to the cost of a conventional MRI scan.

MRI technology has been used to detect problems within the brain and other organs for years. We are using it more and more in our practice to evaluate problems particularly in knees and shoulders but also in hips, backs, and necks.

Addendum

The detailed views of organs, tissues and bone captured by magnetic resonance imaging (MRI) helps us diagnose illnesses, offering more precise information than traditional x-rays.

The technology however, does have its limits. Some studies have found that this expensive technology can lead to unnecessary surgery.

For example, in a condition that I deal with almost on a daily basis, MRI studies pick up incidental problems that lead to consultations and frequently land patients in an operating room for spinal surgery.

Some studies have shown that in the end the technology neither saved money nor assured that patients fared better than they would have with old fashioned x-rays.

Any physician familiar with MRI knows that MRI can produce false positive findings that can lead to invasive and unnecessary surgery.

X-rays produce plain, simple, anatomical images using radiation.

The densest tissues absorb the most radiation and appear lightest, for example, bone.

MRI uses radio waves and a strong magnetic field to scan the body. A computer translates the information into cross sectional views.

An MRI requires a very highly trained radiologist to interpret the images. This interpretation can be difficult and radiologists often disagree on what the images show.

MRI therefore must be used cautiously.

Many doctors are ordering very expensive MRIs out of fear that if they miss a disorder they could eventually be sued. They know that the most common reason to file a malpractice suit is “failure to diagnose.”

However, no amount of imaging and no imaging tool can substitute for physician judgment and a good clinical history and exam. Trouble starts when doctors rely exclusively on imaging.

A main contributor to spiraling healthcare costs is that physicians are relying less and less on clinical judgment and more and more defaulting to imaging studies.

I am seeing this very frequently in patients referred to my office for a variety of conditions such as neck problems, shoulder pain, knee pain and lower back disorders. In fact, it is not uncommon to see patients come to the office for consultation having had a $1000 MRI examination of their knee and no plain x-rays taken prior to the MRI study. The cost of plain x-rays of the knee would, in most cases, be far less than $100.

Do you see why healthcare costs are spiraling?
Information has very recently come across my desk indicating that Medicare is beginning to look at this problem very carefully and probably will encourage those companies that administer Medicare programs to implement some type of preauthorization program for many diagnostic imaging studies such as MRI, CT and bone scans.

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