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For patients

Magnetic Resonance Imaging (MRI) - Prostate

Magnetic resonance imaging (MRI) uses a magnetic field, radiofrequency pulses, and a computer to produce detailed pictures of the body. Doctors use Prostate MRI to evaluate the extent of prostate cancer and determine whether it has spread. They may also use it to help diagnose infection, conditions you were born with, or an enlarged prostate. Some exams may use an endorectal coil, a thin wire covered with a latex balloon. The doctor inserts the coil a short distance into the rectum. Prostate MRI does not use radiation. It provides images that are clearer and more detailed than other imaging methods.

Tell your doctor about any health problems, recent surgeries, or allergies. The magnetic field is not harmful. However, it may cause some medical devices to malfunction. Most orthopedic implants pose no risk. Always tell the technologist if you have any devices or metal in your body. Guidelines about eating and drinking before your exam vary between facilities. Take your regular medications as usual, unless your doctor tells you otherwise. Leave jewelry at home and wear loose, comfortable clothing. You may need to wear a gown. If you have claustrophobia or anxiety, ask your doctor for a mild sedative prior to the exam.

What is MRI of the Prostate?

Magnetic resonance imaging (MRI) is a noninvasive test used to diagnose medical conditions.

MRI uses a powerful magnetic field, radio waves and a computer to produce detailed pictures of internal body structures. MRI does not use radiation (x-rays).

Detailed MR images allow doctors to examine the body and detect disease. The images can be reviewed on a computer monitor. They may also be sent electronically, printed or copied to a CD, or uploaded to a digital cloud server.

Multiparametric (Mp-MRI) is an advanced form of imaging. It uses three MRI techniques to provide anatomical pictures and information on the function of the prostate gland.

Mp-MRI assesses water molecule motion (called water diffusion) and blood flow (called perfusion imaging) within the prostate. This helps your doctor tell the difference between diseased and normal prostate tissue.

The prostate is part of the male reproductive system. It sits in front of the rectum, above the base of the penis, and below the bladder. The prostate surrounds the first part of the urethra. It helps make the milky fluid called semen. Semen carries sperm out of the body when a man ejaculates. Your doctor will most commonly use ultrasound or MRI to image the prostate. *See the Prostate Ultrasound page (http://www.radiologyinfo.org/en/info/us-prostate) for more information.*

What are some common uses of the procedure?

Your doctor uses MRI to evaluate prostate cancer and see if it is limited to the prostate. Mp-MRI provides information on how water molecules and blood flow through the prostate. This helps determine whether cancer is present and, if so, whether it is aggressive and if it has spread.

Occasionally, MRI of the prostate is used to evaluate other prostate problems, including:

- infection (prostatitis) or prostate abscess.
- an enlarged prostate, called benign prostatic hyperplasia (BPH) (http://www.radiologyinfo.org/en/info/bph) .
- abnormal conditions present at birth.
- complications after pelvic surgery.

How should I prepare?

Your MRI exam may use an endorectal coil, a thin wire covered with a latex balloon. The doctor places the coil a short distance into the rectum. The rectum is located immediately behind and up against the prostate. Placing the coil into the rectum so close to the prostate helps generate more detailed images. It also enables your radiologist to perform magnetic resonance (MR) spectroscopy. MR spectroscopy can provide additional information on the chemical makeup of cells in the prostate. Additionally, prostate MRI may examine water molecule motion (water diffusion) and blood flow (perfusion imaging) within the prostate to help differentiate between diseased and normal prostate tissue.

Your doctor will typically use an endorectal coil with low-field (1.5 Tesla) MRI magnets if you have a metal orthopedic implant. Metal implants may interfere with imaging when using a high-field magnet MRI. The doctor will typically not use an endorectal coil with high-field (3 Tesla) MRI units.

You may need to wear a hospital gown. Or, you may be allowed to wear your own clothing if it is loose-fitting and has no metal fasteners.

Guidelines about eating and drinking before an MRI vary between specific exams and facilities. Unless you are told otherwise, take food and medications as usual.

Some MRI exams use an injection of contrast material. You may be asked if you have asthma or allergies to iodine contrast material, drugs, food, or the environment. MRI exams commonly use a contrast material called gadolinium. Gadolinium can be used in patients with iodine contrast allergy. A patient is much less likely to be allergic to gadolinium contrast than to iodine contrast. However, even if the patient has a known allergy to gadolinium, it may be possible to use it after appropriate pre-medication. *For more information on allergic reactions to gadolinium contrast, please consult the ACR Manual on Contrast Media (https://www.acr.org/Clinical-Resources/Contrast-Manual)* .

Tell the technologist or radiologist if you have any serious health problems or recently had surgery. Some conditions, such as severe kidney disease, may require the use of specific types of gadolinium contrast that are considered safe for patients with kidney disease. You may need a blood test to determine whether your kidneys are functioning normally.

If your exam uses an endorectal coil, tell the technologist whether you are allergic to latex. If so, the technologist will cover the endorectal coil with a latex-free condom. To prepare for an MRI with the endorectal coil, eat light meals on the day prior to and on the day of your exam. This will help make it easier to insert the coil. Your doctor may ask you to use an enema before your exam to help clear your bowel. Enema kits or saline laxatives are available over the counter. Prior to your exam, take your usual medications, unless your doctor says otherwise.

If you have claustrophobia (fear of enclosed spaces) or anxiety, you may want to ask your doctor to prescribe a mild sedative prior to your exam.

Leave all jewelry and other accessories at home or remove them prior to the MRI scan. Metal and electronic items can interfere with the magnetic field of the MRI unit, and they are not allowed in the exam room. They may cause burns or become harmful projectiles within the MRI scanner room. These items include:

- jewelry, watches, credit cards and hearing aids, all of which can be damaged
- pins, hairpins, metal zippers and similar metallic items, which can distort MRI images
- removable dental work
- pens, pocket knives and eyeglasses
- body piercings
- mobile phones, electronic watches and tracking devices.

In most cases, an MRI exam is safe for patients with metal implants, except for a few types. People with the following implants may not be scanned and should not enter the MRI scanning area without first being evaluated for safety:

- some cochlear (ear) implants
- some types of clips used for brain aneurysms
- some types of metal coils placed within blood vessels
- some older cardiac defibrillators and pacemakers

Tell the technologist if you have medical or electronic devices in your body. These devices may interfere with the exam or pose a risk. Many implanted devices will have a pamphlet explaining the MRI risks for that particular device. If you have the pamphlet, bring it to the attention of the scheduler before the exam. MRI cannot be performed without confirmation and documentation of the type of implant and MRI compatibility. You should also bring any pamphlet to your exam in case the radiologist or technologist has any questions.

If there is any question, an x-ray can detect and identify any metal objects. Metal objects used in orthopedic surgery generally pose no risk during MRI. However, a recently placed artificial joint may require the use of a different imaging exam.

Tell the technologist or radiologist about any shrapnel, bullets, or other metal that may be in your body. Foreign bodies near and especially lodged in the eyes are very important because they may move or heat up during the scan and cause blindness. Dyes used in tattoos may contain iron and could heat up during an MRI scan. This is rare. Tooth fillings, braces, eyeshadows and other cosmetics usually are not affected by the magnetic field. However, they may distort images of the facial area or brain. Tell the radiologist about them.

What does the equipment look like?

The traditional MRI unit is a large cylinder-shaped tube surrounded by a circular magnet. You will lie on a table that slides into the center of the magnet.

Some MRI units, called short-bore systems, are designed so that the magnet does not completely surround you. Some newer MRI machines have a larger diameter bore, which can be more comfortable for larger patients or those with claustrophobia. "Open" MRI units are open on the sides. They are especially helpful for examining larger patients or those with claustrophobia. Open MRI units can provide high quality images for many types of exams. Certain exams cannot be performed using open MRI. For more information, consult your radiologist.

Most prostate MRI exams use high-field MRI magnets (3 Tesla) because they provide higher-quality images. However, men with

metal implants may undergo low-field prostate MRI (1.5 Tesla) because the implants may otherwise interfere with imaging.

How does the procedure work?

Unlike x-ray and computed tomography (CT) exams, MRI does not use radiation. Instead, radio waves re-align hydrogen atoms that naturally exist within the body. This does not cause any chemical changes in the tissues. As the hydrogen atoms return to their usual alignment, they emit different amounts of energy depending on the type of body tissue they are in. The scanner captures this energy and creates a picture using this information.

In most MRI units, the magnetic field is produced by passing an electric current through wire coils. Other coils are located in the machine and, in some cases, are placed around the part of the body being imaged. These coils send and receive radio waves, producing signals that are detected by the machine. The electric current does not come in contact with the patient.

A computer processes the signals and creates a series of images, each of which shows a thin slice of the body. These images can be studied from different angles by the radiologist.

MRI is able to tell the difference between diseased tissue and normal tissue better than x-ray, CT and ultrasound.

How is the procedure performed?

MRI exams may be done on an outpatient basis.

You will be positioned on the moveable exam table. Straps and bolsters may be used to help you stay still and maintain your position.

Devices that contain coils capable of sending and receiving radio waves may be placed around or next to the area of the body being scanned.

MRI exams generally include multiple runs (sequences), some of which may last several minutes.

Your exam may use an endorectal coil. If so, a nurse or doctor will place a disposable cover over the coil. They will lubricate the assembly and insert the coil a short distance into your rectum. After insertion, the doctor inflates the circular balloon that sits around the coil and holds it in place during the exam. When the exam is complete, the doctor deflates the balloon and removes the coil.

If a contrast material is used, a doctor, nurse or technologist will insert an intravenous catheter (IV line) into a vein in your hand or arm that will be used to inject the contrast material.

You will be placed into the magnet of the MRI unit. The technologist will perform the exam while working at a computer outside of the room.

If a contrast material is used during the exam, it will be injected into the intravenous line (IV) after an initial series of scans. More images will be taken during or following the injection.

When the exam is complete, you may be asked to wait while the radiologist checks the images in case more are needed.

Your IV line will be removed after the exam is over.

The entire examination usually takes 45 minutes or less.

MR spectroscopy, which provides additional information on the chemicals present in the body's cells, may also be performed during the MRI exam. This may add about 15 minutes to the total exam time.

What will I experience during and after the procedure?

Most MRI exams are painless. However, some patients find it uncomfortable to remain still. Others may feel closed-in (claustrophobic) while in the MRI scanner. The scanner can be noisy. Sedation may be arranged for anxious patients, but fewer than one in 20 require it.

You may feel pressure while the doctor inserts the endorectal coil into your rectum. This is similar to that experienced during a digital rectal exam.

It is normal for the area of your body being imaged to feel slightly warm, but if it bothers you, notify the radiologist or technologist. It is important that you remain perfectly still while the images are being recorded, which is typically only a few seconds to a few minutes at a time. For some types of exams, you may be asked to hold your breath. You will know when images are being recorded because you will hear tapping or thumping sounds when the coils that generate the radiofrequency pulses are activated. You will be able to relax between imaging sequences, but will be asked to maintain your position as much as possible.

You will usually be alone in the exam room during the MRI procedure. However, the technologist will be able to see, hear and speak with you at all times using a two-way intercom. Many MRI centers allow a friend or parent to stay in the room as long as they are also screened for safety in the magnetic environment.

You may be offered or you may request earplugs to reduce the noise of the MRI scanner, which produces loud thumping and humming noises during imaging. Children will be given appropriately sized earplugs or headphones during the exam. MRI scanners are air-conditioned and well-lit. Some scanners have music to help you pass the time.

When the contrast material is injected, it is normal to feel coolness and a flushing sensation for a minute or two. The intravenous needle may cause you some discomfort when it is inserted and once it is removed, you may experience some bruising. There is also a very small chance of irritation of your skin at the site of the IV tube insertion.

If you have not been sedated, no recovery period is necessary. You may resume your usual activities and normal diet immediately after the exam. A few patients experience side effects from the contrast material, including nausea and local pain. Very rarely, patients are allergic to the contrast material and experience hives, itchy eyes or other reactions. If you experience allergic symptoms, a radiologist or other physician will be available for immediate assistance.

Who interprets the results and how do I get them?

A radiologist, a doctor trained to supervise and interpret radiology exams, will analyze the images. The radiologist will send a signed report to your primary care or referring physician, who will share the results with you.

Follow-up exams may be needed. If so, your doctor will explain why. Sometimes a follow-up exam is done because a potential abnormality needs further evaluation with additional views or a special imaging technique. A follow-up exam may also be done to see if there has been any change in an abnormality over time. Follow-up exams are sometimes the best way to see if treatment is working or if an abnormality is stable or has changed.

What are the benefits vs. risks?

Benefits

- MRI is a noninvasive imaging technique that does not involve exposure to radiation.
- MR images of the body's soft-tissue structures are clearer and more detailed than those of other imaging methods. This detail makes MRI a valuable tool in early diagnosis and evaluation of the extent of tumors, such as prostate cancer.
- MRI has proven valuable in diagnosing a broad range of conditions, including cancer. It is also useful in diagnosing benign conditions such as an enlarged prostate and infection.

- Mp-MRI helps distinguish between low-risk/slow-growing and high-risk/aggressive prostate cancers. It also helps determine if cancer has spread beyond the prostate.
- MRI can detect abnormalities that might be obscured by bone with other imaging methods.
- The MRI gadolinium contrast material is less likely to cause an allergic reaction than the iodine-based contrast materials used for x-rays and CT scanning.

Risks

- The MRI exam poses almost no risk to the average patient when appropriate safety guidelines are followed.
- If sedation is used, there is a risk of using too much. However, your vital signs will be monitored to minimize this risk.
- The strong magnetic field is not harmful. However, it may cause implanted medical devices to malfunction or cause distortion of the images.
- Nephrogenic systemic fibrosis is a recognized, but rare, complication related to injection of gadolinium contrast. It usually occurs in patients with serious kidney disease. Your doctor will carefully assess your kidney function before considering a contrast injection.
- There is a very slight risk of an allergic reaction if contrast material is used. Such reactions are usually mild and controlled by medication. If you have an allergic reaction, a doctor will be available for immediate assistance.

What are the limitations of MRI of the Prostate?

High-quality images depend on your ability to remain perfectly still and follow breath-holding instructions while the images are being recorded. If you are anxious, confused or in severe pain, you may find it difficult to lie still during imaging.

A person who is very large may not fit into certain types of MRI machines. There are weight limits on the scanners.

Implants and other metallic objects can make it difficult to obtain clear images. Patient movement can have the same effect.

A very irregular heartbeat may affect the quality of images. This is because some techniques time the imaging based on the electrical activity of the heart.

MRI cannot always distinguish between cancer and inflammation or the presence of blood products within the prostate. Blood may sometimes appear due to a prostate biopsy. To avoid confusing any bleeding with cancer, your doctor may wait six to eight weeks after prostate biopsy to perform prostate MRI. This will allow any remnants of bleeding to resolve.

MRI typically costs more and may take more time to perform than other imaging methods. Talk to your insurance provider if you have concerns about the cost of MRI.

Which test, procedure or treatment is best for me?

- Prostate Cancer—Pretreatment Detection, Surveillance, and Staging (http://www.radiologyinfo.org/en/info/article-appropriateness-criteria#df5a5874e5d5486e99ab01c04f5a133c)
- Post-treatment Follow-up of Prostate Cancer (http://www.radiologyinfo.org/en/info/article-appropriateness-criteria#5eedc2e6d165483fadea3a551442d01a)

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