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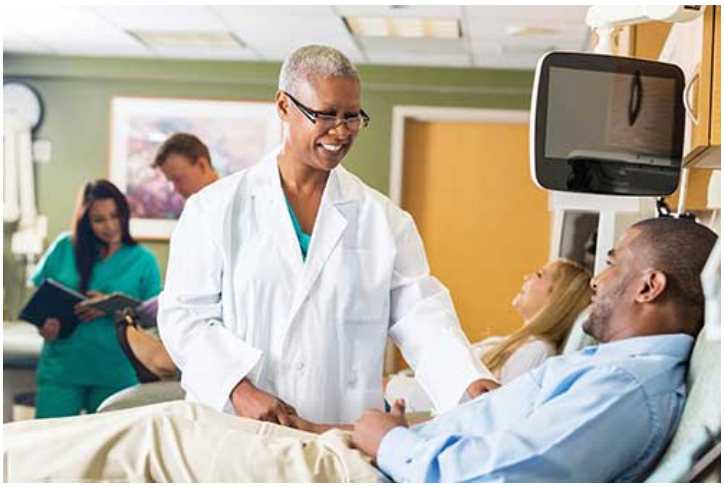
Ultrasound- and MRI-Guided Prostate Biopsy



Ultrasound- and MRI-guided prostate biopsy uses imaging guidance and a needle to remove tissue from the prostate in order to examine it for disease. The ultrasound probe used in prostate biopsies is about the size of a finger. Once the probe is placed in the rectum, the biopsy is performed with a spring-driven needle core biopsy device, or biopsy gun. The MRI-guided biopsy can be performed with an endorectal approach or a transperineal approach. For the endorectal biopsy, the patient is usually lying on his stomach. The biopsy device has a built in endorectal coil to aid in visualization and a guidance slot for biopsy needle insertion. For the transperineal biopsy, the patient is usually lying on his back and the biopsy is generally performed with a guidance grid placed against the perineum (just below the scrotum). Biopsy is currently the only way to definitively diagnose prostate cancer. It is also used to differentiate between cancer and benign prostatic hyperplasia, a common condition in older men.

Your doctor will instruct you based on the type of biopsy being performed. Tell your doctor about any medications you're taking, including aspirin and herbal supplements, and whether you have any allergies – especially to anesthesia. Your physician will advise you to stop taking aspirin or blood thinner seven to 10 days before your procedure. You may be told to eat light meals before your procedure and asked to clear your bowel. Leave jewelry at home and wear loose, comfortable clothing. You may be asked to wear a gown.

What is Ultrasound- and MRI-guided Prostate Biopsy?

Ultrasound- and MRI-guided prostate biopsies are performed to collect tissue samples from the prostate gland for examination by a pathologist to determine whether or not the tissue is cancerous.

Biopsies are most commonly performed under ultrasound guidance. During the procedure, a special biopsy needle is inserted into the prostate gland through the wall of the rectum to remove several small samples of tissue for pathologic analysis. This method is known as transrectal ultrasound (TRUS) guided biopsy.

The prostate may also be accessed through the perineum (the area of skin between the base of the penis and the rectum). This method is known as the transperineal approach and may be used for one of several reasons:

- if cancer is suspected at the front of the prostate gland too far away from the rectum for TRUS
- if transrectal ultrasound is not feasible due to prior rectal surgery
- for some mapping biopsies
- by physician choice

Prostate biopsies can also be performed utilizing information from MR imaging, which provides more detailed images of the prostate than is possible with ultrasound. Before the biopsy, prostate MR images are examined, sometimes also with the help of computer-aided detection (CAD) software to pinpoint specific areas that may require further evaluation. MRI-guided in-bore biopsy can be performed using either a transperineal or transrectal approach. Both methods typically utilize software to guide the course of the needle to the desired position within the prostate.

Finally, a hybrid imaging method can be used in which the MR images are fused with the real-time ultrasound images — an approach known as MRI/TRUS fusion biopsy. This approach has the advantage of using the superior imaging of the MRI coupled with easier-to-use ultrasound guidance and can be done in the office setting.

What are some common uses of the procedure?

A prostate biopsy is currently the only way to definitively diagnose prostate cancer. It also helps differentiate cancer from benign prostatic hyperplasia or nodular enlargement of the prostate, a very common condition in middle-aged and older men that requires a different treatment approach than that of cancer.

A prostate biopsy may be ordered if the physician detects a nodule or other abnormality on the prostate during a digital rectal examination (DRE), a common prostate cancer screening test.

A biopsy also may be ordered when a blood test reveals elevated levels of prostate-specific antigen. (PSA) While there are several reasons for an elevated PSA level, higher PSA levels are sometimes associated with cancer. PSA trends over time may trigger your physician to order a biopsy.

MRI-guided prostate biopsy may be used in patients who have a rising PSA level yet a negative ultrasound-guided biopsy. It also may be used in situations where a diagnostic prostate MRI performed due to rising PSA demonstrates a very small abnormality that may not be easily targeted by ultrasound. MRI is also useful in patients who have previously undergone a biopsy and want to improve the sensitivity of the procedure and the precision of the biopsy.

A biopsy not only detects cancer; it also provides information on the aggressiveness of the cancer and helps to guide treatment decisions.

How should I prepare?

Prior to a prostate biopsy, you should provide your physician with a list of all the medications you are taking, including herbal supplements. Tell your doctor if you have any allergies, especially to anesthesia. Also, inform your physician about recent illnesses or other medical conditions.

You may be asked to stop or curtail the use of blood thinning medications for seven to 10 days before the procedure to prevent excessive bleeding during and after the biopsy. A blood test may be required to check your blood clotting on the day of the procedure. Consult your physician and the hospital radiology clinic or department for more information.

You may be advised to take antibiotic pills for a day or two before the biopsy, and on the morning of the procedure, to help prevent infection.

If you are undergoing an MRI-guided biopsy, you will be asked to wear metal-free clothing and remove any metallic objects, such as jewelry, watches, and hearing aids.

A technologist will walk through an MR imaging safety checklist with you. Make sure to inform your technologist of prior surgeries or metal implants, such as pacemakers, aneurysm clips, or joint replacements.

For the MRI-guided procedure, you will receive intravenous contrast material called gadolinium. Because gadolinium does not contain iodine, it can be used safely in patients with contrast allergies.

Your MR imaging exam may involve the use of an endorectal coil, a thin wire covered with a latex balloon and placed inside the end of the rectum. If you are allergic to latex, you need to let the MR technologist know so that they may cover the coil with a latex-free balloon.

You should eat light meals on the day prior to and on the day of your exam. This will help make it easier to insert the ultrasound probe or endorectal coil. You may also be asked to use an enema preparation prior to your exam. An enema involves injecting liquid into your rectum to help clear the bowel. Enema kits or saline laxatives can be bought over-the-counter.

The physician should also know if you have any serious health problems, or if you have recently had surgery. Some conditions, such as severe kidney disease, may prevent you from being given contrast material for an MR exam. If there is a history of kidney disease, it may be necessary to perform a blood test to determine whether the kidneys are functioning adequately.

If you are sedated for the procedure, you will want to have a relative or friend accompany you and drive you home afterward.

What does the equipment look like?

Ultrasound equipment:

Ultrasound scanners consist of a console containing a computer and electronics, a video display screen and a transducer or probe that is used to do the scanning. The transducer sends out inaudible high frequency sound waves into the body and then listens for the returning echoes. The principles

are similar to sonar used by boats and submarines.

The ultrasound image is displayed on a video screen that looks like a computer or television monitor. The resulting image is based on the amplitude (loudness) and frequency (pitch) of the signal. The ultrasound image makes an image taking into account signal travel time, tissue composition, and type of body structure through which the sound travels.

The ultrasound probe used in prostate biopsies is about the size of a finger. Once the probe is placed in the rectum, the biopsy is performed with a spring-driven needle core biopsy device, or biopsy gun. The handheld device includes a long but very thin needle specially designed to open inside the prostate, take the sample and then close.

MRI equipment:

The traditional MRI unit is a large cylinder-shaped tube surrounded by a circular magnet. You will lie on a moveable examination 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 size patients or patients with claustrophobia. Other MRI machines are open on the sides (open MRI). Open units are especially helpful for examining larger patients or those with claustrophobia. Newer open MRI units provide very high quality images for many types of exams. Older open MRI units may not provide this same image quality. Certain types of exams cannot be performed using open MRI. For more information, consult your radiologist.

The computer workstation that processes the imaging information is located in a separate room from the scanner.

The MRI-guided biopsy can be performed with an endorectal approach or a transperineal approach. For the endorectal biopsy, the patient is usually lying on his stomach. The biopsy device has a built in endorectal coil to aid in visualization and a guidance slot for biopsy needle insertion. For the transperineal biopsy, the patient is usually lying on his back and the biopsy is generally performed with a guidance grid placed against the perineum (just below the scrotum). The appropriate needle path is selected for biopsy needle insertion. Both MR biopsy techniques utilize software to fuse the biopsy needle guides with the MR images to obtain a more accurate needle placement.

How does the procedure work?

Ultrasound procedure:

Ultrasound imaging is based on the same principles involved in the sonar used by bats, ships and fishermen. When a sound wave strikes an object, it bounces back, or echoes. By measuring these echo waves, it is possible to determine how far away the object is as well as the object's size, shape and consistency (whether the object is solid or filled with fluid).

In medicine, ultrasound is used to detect changes in appearance, size or contour of organs, tissues, and vessels or to detect abnormal masses, such as tumors.

In an ultrasound examination, a transducer both sends the sound waves into the body and receives the echoing waves. When the transducer is pressed against the skin, it directs small pulses of inaudible, high-frequency sound waves into the body. As the sound waves bounce off internal organs, fluids and tissues, the sensitive receiver in the transducer records tiny changes in the sound's pitch and direction. These signature waves are instantly measured and displayed by a computer, which in turn creates a real-time picture on the monitor. One or more frames of the moving pictures are typically captured as still images. Short video loops of the images may also be saved.

MRI procedure:

Unlike conventional x-ray examinations and computed tomography (CT) scans, MRI does not utilize ionizing radiation. Instead, radiofrequency pulses re-align hydrogen atoms that naturally exist within the body while you are in the scanner without causing any chemical changes in the tissues. As the hydrogen atoms return to their usual alignment, they emit different amounts of energy that vary according to the type of body tissue from which they come. The MR scanner captures this energy and creates a picture of the tissues scanned based on this information.

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

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

Frequently, the differentiation of abnormal (diseased) tissue from normal tissues is better with MRI than with other imaging modalities such as x-ray, CT and ultrasound.

The endorectal coil used in an MRI-guided prostate biopsy helps provide more detailed images from the prostate and surrounding structures. It also enables your radiologist to perform MR spectroscopy, which can provide additional information on the chemical makeup of cells present in the prostate gland. Additionally, prostate MRI can measure the motion of water molecules (called water diffusion) and blood flow (called perfusion imaging) within the prostate to help differentiate abnormal (diseased) tissue from normal prostate tissue.

How is the biopsy procedure performed?

Ultrasound-guided biopsy procedure:

The ultrasound-guided prostate biopsy is carried out by a radiologist or urologist, assisted by a sonographer and often a nurse who helps look after the patient.

You may have a small enema inserted into your rectum half an hour or so before the procedure to clean out your bowels and clear the rectum of feces so that the prostate may be seen more clearly with the ultrasound and to lower the risk of infection.

You may also be given antibiotics just before the procedure as an additional safeguard against infection. You also may receive medication for pain and anxiety. Sometimes an injection of local anesthetic or sedative will be given in the area of the rectum to minimize discomfort during the procedure.

The procedure is often carried out after you have been given a light general anesthetic, which means you will be asleep or sedated during the procedure. If the procedure is carried out using an anesthetic, an anesthesiologist will be present.

During the procedure, you will be asked to lie on your left side with your legs bent.

The physician will first carry out a DRE with a gloved finger.

An ultrasound probe will then be inserted into your rectum. The probe is sterilized, covered with condoms to ensure protection from any infection or contamination, and lubricated to help it glide easily into your rectum.

After examination of your prostate with the ultrasound, the physician will perform the biopsy. Pictures or images the physician can see on the ultrasound screen are used to guide a very fine needle, through the wall of your rectum into the prostate and take a sample of tissue. With continuous ultrasound imaging, the physician is able to view the biopsy needle as it advances to the prostate in real time.

This biopsy sampling is repeated to ensure coverage of the visible abnormal area and many times biopsy samples are also taken in more normal-appearing areas to ensure the there is no other cancer hiding. Usually, between six and 14 individual samples will be taken during the ultrasound-guided procedure and sent to a laboratory for analysis by the pathologist.

After the biopsy samples are taken, the probe is removed and, if you have had a general anesthetic, you are awakened. You are then given a small pad to wear in case of any bleeding. You will be kept under observation until the physician or nurse is satisfied with your condition.

The entire ultrasound-guided biopsy procedure is usually completed within 45 minutes or less.

MRI-guided biopsy procedure:

A radiologist will perform the MRI-guided procedure with the assistance of a nurse and an MR imaging technologist. As with the ultrasound procedure, you may receive antibiotics, sedatives and pain medication before the biopsy.

The MRI-guided procedure may use contrast material to further aid in the detection or diagnosis of potential abnormalities. A nurse or technologist will insert an intravenous (IV) catheter into a vein in your hand or arm. For an MRI-guided transrectal biopsy, you will lie face-down on a cushioned table. After the biopsy guide is gently inserted into the rectum, the biopsy needle will be guided into

position with the help of the MR images and the biopsy sample will be acquired. For a MRI-guided transperineal biopsy, you will lie on your back and a guidance grid will be placed between your legs. Under imaging guidance, the biopsy needle is advanced through the guidance grid into the targeted prostate tissue. MRI-guided biopsies may require two to 14 biopsy samples, depending on whether a focal area is targeted or a mapping biopsy is being performed. The MRI-guided prostate biopsy takes 30 to 90 minutes, with post-procedure monitoring for 45 to 60 minutes.

What will I experience during and after the biopsy?

If you receive IV contrast for the MRI-guided procedure, you may feel coolness and a flushing sensation for a minute or two when the contrast material is injected. The intravenous needle may cause you some discomfort when it is inserted and you may experience some bruising once it is removed.

Rarely, patients may experience side effects from the MR contrast material, including nausea and local pain, hives, itchy eyes or other reactions. If you experience allergic symptoms, a radiologist or other physician will be available for immediate assistance.

When the ultrasound probe or endorectal coil is inserted into the rectum, you will feel pressure and may have some temporary discomfort.

You will hear a clicking noise when the biopsy needle samples the prostate, and you may feel a stinging or burning sensation in the area.

Some patients find it uncomfortable to remain still during MR imaging. Others experience a sense of being closed-in (claustrophobia). Therefore, sedation can be arranged for those patients who anticipate anxiety.

If you feel heating on your skin at any time during MR imaging, the MR technician should be notified so that they can perform a closer examination of the area.

Some patients experience a small amount of bleeding from the rectum or perineum immediately after the biopsy procedure. If this occurs, it will cease with gentle pressure.

If you have not been sedated, no recovery period is necessary. If you have had a light general anesthetic or sedation, you may feel groggy for a day or so.

You may feel pain and discomfort in the area of the prostate for a day or two after the biopsy, particularly when you are seated.

Who interprets the results and how do I get them?

A pathologist examines the removed tissue specimens and makes a final diagnosis. The results usually are available to your physician within a few days of the procedure. The time it takes may vary based on the complexity of the examination, preparation time for the specimens, need for a second opinion and other factors.

What are the benefits vs. risks?

Benefits

- Ultrasound- and MRI-guided prostate biopsies help accurately diagnose abnormalities in the prostate and speed the initiation of appropriate treatment.
- Biopsies help distinguish between cancer and BPH.
- Ultrasound is widely available, easy-to-use and less expensive than other imaging methods.
- Ultrasound and MR imaging do not rely on ionizing radiation, which has been associated with an increased risk of cancer.
- Recovery time for both procedures is brief and patients can soon resume their usual activities.
- MR images of the prostate are clearer and more detailed than with other imaging methods, making it a valuable tool in early diagnosis and evaluation of the extent of tumors.

Risks

- Blood in the sperm and urine is common in the days after the procedure, but usually goes away within a week or two.
- Blood in the feces is fairly common in the days after the procedure.
- Infection is very rare, but can be severe if untreated. If you experience signs of infection such as fever and chills within a few days of the procedure, notify your physician immediately or go to the nearest hospital emergency department.
- While internal hemorrhage is very rare, it may require surgery or a catheter procedure if severe.
- Rarely, urine retention, or the temporary inability to pass urine, can occur due to blockage of the urethra. This is relieved by the insertion of a sterile rubber tube known as a catheter into the urethra to relieve the blockage.
- Implanted medical devices that contain metal may malfunction or cause problems during an MR imaging exam.
- There is a very slight risk of an allergic reaction if contrast material is injected. Such reactions usually are mild and easily controlled by medication. If you experience allergic symptoms, a radiologist or other physician will be available for immediate assistance.
- Nephrogenic systemic fibrosis is currently a recognized, but very rare, complication of MR imaging believed to be caused by the injection of high doses of gadolinium contrast material in patients with very poor kidney function.

What are the limitations of Ultrasound-and MRI-guided Prostate Biopsy?

A biopsy can only show if there is cancer in the samples taken, so it is possible that cancer in unsampled areas of the prostate might be missed.

For MRI-guided biopsies, high-quality images are assured only if you are able to remain perfectly still 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, and the resulting images may not be of sufficient quality to be useful as a diagnostic tool.

Likewise, the presence of an implant or other metallic object sometimes makes it difficult to obtain clear MR images. A person who is very large may not fit into the opening of certain types of MRI machines.

MR imaging cannot always distinguish between cancer tissue and inflammation or the presence of blood products within the prostate, which sometimes occurs related to a prostate biopsy. To avoid confusing the two on imaging, prostate MR imaging may be performed six to eight weeks after prostate biopsy, if possible, to allow any residual bleeding to resolve itself.

MRI typically costs more and may take more time to perform than other imaging modalities.

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