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For patients

General Ultrasound

Ultrasound imaging uses sound waves to produce pictures of the inside of the body. It helps diagnose the causes of pain, swelling and infection in the body's internal organs and to examine an unborn child (fetus) in pregnant women. In infants, doctors commonly use ultrasound to evaluate the brain, hips, and spine. It also helps guide biopsies, diagnose heart conditions, and assess damage after a heart attack. Ultrasound is safe, noninvasive, and does not use radiation.

This procedure requires little to no special preparation. Your doctor will tell you how to prepare, including whether you should not eat or drink beforehand. Leave jewelry at home and wear loose, comfortable clothing. You may need to change into a gown.

What is General Ultrasound Imaging?

Conventional ultrasound displays the images in thin, flat sections of the body. Advancements in ultrasound technology include three-dimensional (3-D) ultrasound that formats the sound wave data into 3-D images.

A Doppler ultrasound study may be part of an ultrasound examination.

Doppler ultrasound is a special ultrasound technique that evaluates movement of materials in the body. It allows the doctor to see and evaluate blood flow through arteries and veins in the body.

There are three types of Doppler ultrasound:

- Color Doppler uses a computer to convert Doppler measurements into an array of colors to show the speed and direction of blood flow through a blood vessel.
- Power Doppler is a newer technique that is more sensitive than color Doppler and capable of providing greater detail of blood flow, especially when blood flow is little or minimal. Power Doppler, however, does not help the radiologist determine the direction of blood flow, which may be important in some situations.
- Spectral Doppler displays blood flow measurements graphically, in terms of the distance traveled per unit of time, rather than as a color picture. It can also convert blood flow information into a distinctive sound that can be heard with every heartbeat.

What are some common uses of the procedure?

Ultrasound exams can help diagnose a variety of conditions and assess organ damage following illness.

Doctors use ultrasound to evaluate:

- pain
- swelling
- infection

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Ultrasound is a useful way of examining many of the body's internal organs, including but not limited to the:

- heart and blood vessels, including the abdominal aorta and its major branches
- liver
- gallbladder
- spleen
- pancreas
- kidneys
- bladder
- uterus, ovaries, and unborn child (fetus) in pregnant patients
- eyes
- thyroid and parathyroid glands
- scrotum (testicles)
- brain in infants
- hips in infants
- spine in infants

Ultrasound is also used to:

- guide procedures such as needle biopsies, in which needles remove cells from an abnormal area for laboratory testing.
- image the breasts and guide biopsy of breast cancer (*see the Ultrasound-Guided Breast Biopsy (https://www.radiologyinfo.org/en/info/breastbius) page*.
- diagnose a variety of heart conditions, including valve problems and congestive heart failure, and to assess damage after a heart attack. Ultrasound of the heart is commonly called an "echocardiogram" or "echo" for short.

Doppler ultrasound helps the doctor to see and evaluate:

- blockages to blood flow (such as clots)
- narrowing of vessels
- tumors and congenital vascular malformations
- reduced or absent blood flow to various organs, such as the testes or ovary
- increased blood flow, which may be a sign of infection

With knowledge about the speed and volume of blood flow gained from a Doppler ultrasound image, the doctor can often determine whether a patient is a good candidate for a procedure like angioplasty.

How should I prepare?

Wear comfortable, loose-fitting clothing. You may need to remove all clothing and jewelry in the area to be examined.

You may need to change into a gown for the procedure.

Preparation for the procedure will depend on the type of exam you will have. For some scans, your doctor may tell you not to eat or drink for up to 12 hours before your exam. This timeframe is lower for babies and young children. For others, the doctor may ask you to drink up to six glasses of water two hours prior to your exam and avoid urinating. This will ensure your bladder is full when the scan begins.

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What does the equipment look like?

Ultrasound machines consist of a computer console, video monitor and an attached transducer. The transducer is a small hand-held device that resembles a microphone. Some exams may use different transducers (with different capabilities) during a single exam. The transducer sends out inaudible, high-frequency sound waves into the body and listens for the returning echoes. The same principles apply to sonar used by boats and submarines.

The technologist applies a small amount of gel to the area under examination and places the transducer there. The gel allows sound waves to travel back and forth between the transducer and the area under examination. The ultrasound image is immediately visible on a video monitor. The computer creates the image based on the loudness (amplitude), pitch (frequency), and time it takes for the ultrasound signal to return to the transducer. It also considers what type of body structure and/or tissue the sound is traveling through.

How does the procedure work?

Ultrasound imaging uses the same principles as the sonar that bats, ships, and fishermen use. 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 its size, shape, and consistency. This includes whether the object is solid or filled with fluid.

Doctors use ultrasound to detect changes in the appearance of organs, tissues, and vessels and to detect abnormal masses, such as tumors.

In an ultrasound exam, a transducer both sends the sound waves and records the echoing (returning) waves. When the transducer is pressed against the skin, it sends 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. A computer instantly measures these signature waves and displays them as real-time pictures on a monitor. The technologist typically captures one or more frames of the moving pictures as still images. They may also save short video loops of the images.

Doppler ultrasound, a special ultrasound technique, measures the direction and speed of blood cells as they move through vessels. The movement of blood cells causes a change in pitch of the reflected sound waves (called the Doppler effect). A computer collects and processes the sounds and creates graphs or color pictures that represent the flow of blood through the blood vessels.

How is the procedure performed?

For most ultrasound exams, you will lie face-up on an exam table that can be tilted or moved. Patients may turn to either side to improve the quality of the images.

The radiologist (a doctor specifically trained to supervise and interpret radiology exams) or sonographer will position you on the exam table. They will apply a water-based gel to the area of the body under examination. The gel will help the transducer make secure contact with the body. It also eliminates air pockets between the transducer and the skin that can block the sound waves from passing into your body. The sonographer places the transducer on the body and moves it back and forth over the area of interest until it captures the desired images.

There is usually no discomfort from pressure as they press the transducer against the area being examined. However, if the area is tender, you may feel pressure or minor pain from the transducer.

Doctors perform Doppler sonography with the same transducer.

Very rarely, young children may need sedation to hold still for the procedure. Parents should ask about this beforehand and be made aware of prior food and drink restrictions that sedation requires.

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Once the imaging is complete, the technologist will wipe off the clear ultrasound gel from your skin. Any portions that remain will dry quickly. The ultrasound gel does not usually stain or discolor clothing.

In some ultrasound exams, the doctor attaches a probe to the transducer and inserts into a body cavity. These exams include:

- **Transesophageal echocardiogram.** The doctor inserts the probe into the esophagus to obtain images of the heart.
- **Transrectal ultrasound.** The doctor inserts the probe into a man's rectum to view the prostate.
- **Transvaginal ultrasound.** The doctor inserts the probe into a woman's vagina to view the uterus and ovaries.

What will I experience during and after the procedure?

Most ultrasound exams are painless, fast, and easily tolerated.

Ultrasound exams that insert the transducer into a body cavity may produce minimal discomfort.

If the doctor performs a Doppler ultrasound exam, you may hear pulse-like sounds that change in pitch as they monitor and measure the blood flow.

Most ultrasound exams take about 30 minutes. More extensive exams may take up to an hour.

When the exam is complete, the technologist may ask you to dress and wait while the doctor reviews the ultrasound images.

After an ultrasound exam, you should be able to resume your normal activities immediately.

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 the doctor who requested the exam. Your doctor will then share the results with you. In some cases, the radiologist may discuss results with you after the exam.

You may need a follow-up exam. If so, your doctor will explain why. Sometimes a follow-up exam further evaluates a potential issue with more views or a special imaging technique. It may also see if there has been any change in an issue over time. Follow-up exams are often the best way to see if treatment is working or if a problem needs attention.

What are the benefits vs. risks?

Benefits

- Most ultrasound scanning is noninvasive (no needles or injections).
- Occasionally, an ultrasound exam may be temporarily uncomfortable, but it should not be painful.
- Ultrasound is widely available, easy to use, and less expensive than most other imaging methods.
- Ultrasound imaging is extremely safe and does not use radiation.
- Ultrasound scanning gives a clear picture of soft tissues that do not show up well on x-ray images.
- Ultrasound is the preferred imaging modality for the diagnosis and monitoring of pregnant women and their unborn babies.
- Ultrasound provides real-time imaging. This makes it a good tool for guiding minimally invasive procedures such as needle biopsies and fluid aspiration.

Risks

- Standard diagnostic ultrasound has no known harmful effects on humans.

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What are the limitations of General Ultrasound Imaging?

Ultrasound waves are disrupted by air or gas. Therefore, ultrasound is not an ideal imaging technique for the air-filled bowel or organs obscured by the bowel. Ultrasound is not as useful for imaging air-filled lungs, but it may be used to detect fluid around or within the lungs. Similarly, ultrasound cannot penetrate bone, but may be used for imaging bone fractures or for infection surrounding a bone.

Large patients are more difficult to image by ultrasound because greater amounts of tissue weaken the sound waves as they pass deeper into the body and need to return to the transducer for analysis.

Ultrasound has difficulty penetrating bone and, therefore, can only see the outer surface of bony structures and not what lies within (except in infants who have more cartilage in their skeletons than older children or adults). Doctors typically use other imaging modalities such as MRI to visualize the internal structure of bones or certain joints.

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