

## Ultrasound - Vascular

Vascular ultrasound uses sound waves to evaluate the body's circulatory system and help identify blockages in the arteries and veins and detect blood clots. A Doppler ultrasound study – a technique that evaluates blood flow through a blood vessel – is usually part of this exam. Ultrasound does not use ionizing radiation, has no known harmful effects, and provides images of soft tissues that don't show up on x-ray images.

Little or no special preparation is required for this procedure. However, you may occasionally be asked to fast beforehand. Leave jewelry at home and wear loose, comfortable clothing. You may be asked to wear a gown.



### What is Vascular Ultrasound?

Ultrasound imaging is a noninvasive medical test that helps physicians diagnose and treat medical conditions. It is safe and painless. It produces pictures of the inside of the body using sound waves. Ultrasound imaging is also called sonography. It uses a small probe called a transducer and gel placed directly on the skin. High-frequency sound waves travel from the probe through the gel into the body. The probe collects the sounds that bounce back. A computer uses those sound waves to create an image. Ultrasound exams do not use radiation (x-rays). Because ultrasound captures images in real-time, it can show the structure and movement of the body's internal organs. The images can also show blood flowing through blood vessels.

Vascular ultrasound provides pictures of the body's veins and arteries.

A Doppler ultrasound study is usually part of a vascular 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.

### What are some common uses of the procedure?

Sonography is a useful way of evaluating the body's circulatory system. Vascular ultrasound is performed to:

- help monitor the blood flow to organs and tissues throughout the body.
- locate and identify blockages (stenosis) and abnormalities like plaque or emboli and help plan for their effective treatment.
- detect blood clots (deep venous thrombosis (DVT) in the major veins of the legs or arms.
- determine whether a patient is a good candidate for a procedure such as angioplasty.
- evaluate the success of procedures that graft or bypass blood vessels.
- determine if there is an enlarged artery (aneurysm).
- evaluate varicose veins.

In children, ultrasound is used to:

- aid in the placement of a needle or catheter into a vein or artery to help avoid complications such as bleeding, nerve injury or pseudo-aneurysm (abnormal outpouching of an artery with the risk of rupture).
- evaluate a connection between an artery and a vein which can be seen in congenital vascular malformations (arteriovenous malformations or fistula) and in dialysis fistula.

If a line is placed in an artery or vein of the legs or arms, there is a much higher chance of developing a clot around it due to the smaller vessel size (especially in infants and young children). In some instances, a clot can form in the arm or in the left leg with the latter extending into major veins in the abdomen.

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

## 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.

If your abdominal vessels are being examined, unless the examination is performed on an urgent basis, it is best to fast before the procedure.

Ultrasound exams are very sensitive to motion, and an active or crying child can prolong the examination process. To ensure a smooth experience, it often helps to explain the procedure to the child prior to the exam. Bring books, small toys, music, or games to help distract the child and make the time pass quickly. The exam room may have a television. Feel free to ask for your child's favorite channel.

## 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 technologist applies a clear water-based gel to the body area under examination. This helps the transducer make secure contact with the body. It also helps eliminate air pockets between the transducer and the skin that can block the sound waves from passing into your body. The technologist or radiologist places the transducer on the skin in various locations, sweeping over the area of interest. They may also angle the sound beam from a different location to better see an area of concern.

Doctors perform Doppler sonography with the same transducer.

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

This ultrasound examination is usually completed within 30 to 45 minutes. Occasionally, complex examinations may take longer.

## **What will I experience during and after the procedure?**

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

After you lie on the exam table, the radiologist or sonographer will apply some warm, water-based gel on your skin and then place the transducer firmly against your body. They will move it back and forth over the area of interest to capture the desired images. There is usually no discomfort from pressure as they press the transducer against the area under examination.

If scanning is performed over an area of tenderness, you may feel pressure or minor pain from the transducer.

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.

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.

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.

### Risks

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

## What are the limitations of Vascular Ultrasound?

- Vessels deep in the body are harder to see than superficial vessels. Specialized equipment or other tests such as CT or MRI may be necessary to properly visualize them.
- Smaller vessels are more difficult to image and evaluate than larger vessels.
- Calcifications that occur as a result of atherosclerosis may obstruct the ultrasound beam.
- The test is specialized and is best performed by a technologist and physician with experience in vascular ultrasound imaging.

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