



## Ultrasound - Venous (Extremities)

Venous ultrasound uses sound waves to produce images of the veins in the body. It is commonly used to search for blood clots, especially in the veins of the leg – a condition often referred to as deep vein thrombosis. Ultrasound does not use ionizing radiation and has no known harmful effects.

On occasion, you may be asked not to eat or drink anything but water for six to eight hours beforehand. Otherwise, little or no special preparation is required for this procedure. Leave jewelry at home and wear loose, comfortable clothing. You may be asked to wear a gown.



## What is Venous Ultrasound Imaging?

Ultrasound is safe and painless, and produces pictures of the inside of the body using sound waves. Ultrasound imaging, also called ultrasound scanning or sonography, involves the use of a small transducer (probe) and ultrasound gel placed directly on the skin. High-frequency sound waves are transmitted from the probe through the gel into the body. The transducer collects the sounds that bounce back and a computer then uses those sound waves to create an image. Ultrasound examinations do not use ionizing radiation (as used in x-rays), thus there is no radiation exposure to the patient. Because ultrasound images are captured in real-time, they can show the structure and movement of the body's internal organs, as well as blood flowing through blood vessels.

Ultrasound imaging is a noninvasive medical test that helps physicians diagnose and treat medical conditions.

Venous ultrasound provides pictures of the veins throughout the body.

A Doppler ultrasound study may be part of a venous ultrasound examination.

Doppler ultrasound, also called color Doppler ultrasonography, is a special ultrasound technique that allows the physician to see and evaluate blood flow through arteries and veins in the abdomen, arms, legs, neck and/or brain (in infants and children) or within various body organs such as the liver or kidneys.

## What are some common uses of the procedure?

The most common reason for a venous ultrasound exam is to search for blood clots, especially in the veins of the leg. This condition is often referred to as deep vein thrombosis or DVT. These clots may break off and pass into the lungs, where they can cause a dangerous condition called pulmonary embolism. If the blood clot in the leg is found early enough, treatment can be started to prevent it from passing to the lung.

A venous ultrasound study is also performed to:

- determine the cause of long-standing leg swelling. In people with a common condition called “varicose veins”, the valves that normally keep blood flowing back to the heart may be damaged, and venous ultrasound can help identify the damaged valves and abnormal blood flow.
- aid in guiding placement of a needle or catheter into a vein. Sonography can help locate the exact site of the vein and avoid complications, such as bleeding or damage to a nearby nerve or artery.
- map out the veins in the leg or arm so that pieces of vein may be removed and used to bypass a narrowed or blocked blood vessel. An example is using portions of vein from the leg to surgically bypass narrowed heart (coronary) arteries.
- examine a blood vessel graft used for dialysis if it is not working as expected; for example, the graft may be narrowed or blocked.

In children, venous ultrasound is used to:

- 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 a 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 suddenly form in the arm due to compression of the vein at the inlet of the chest or in the left leg due to compression of the vein on the left side by an artery in the abdomen.

Doppler ultrasound images can help the physician 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
- greater than normal blood flow to different areas, which is sometimes seen in infections

## How should I prepare?

You should wear comfortable, loose-fitting clothing for your ultrasound exam. You may need to remove all clothing and jewelry in the area to be examined.

You may be asked to wear a gown during the procedure.

A period of fasting is necessary only if you are to have an examination of veins in your abdomen. In this case, you will probably be asked not to ingest any food or fluids except water for six to eight hours ahead of time. Otherwise, there is no other special preparation for a venous ultrasound.

## What does the equipment look like?

Ultrasound scanners consist of a console containing a computer and electronics, a video display screen and a transducer that is used to do the scanning. The transducer is a small hand-held device that resembles a microphone, attached to the scanner by a cord. Some exams may use different transducers (with different capabilities) during a single exam. The transducer sends out high-frequency sound waves (that the human ear cannot hear) into the body and then listens for the returning echoes from the tissues in the body. The principles are similar to sonar used by boats and submarines.

The ultrasound image is immediately visible on a video display screen that looks like a computer or television monitor. The image is created based on the amplitude (loudness), frequency (pitch) and time it takes for the ultrasound signal to return from the area within the patient that is being examined to the transducer (the device placed on the patient's skin to send and receive the returning sound waves), as well as the type of body structure and composition of body tissue through which the sound travels. A small amount of gel is put on the skin to allow the sound waves to travel from the transducer to the examined area within the body and then back again. Ultrasound is an excellent modality for some areas of the body while other areas, especially air-filled lungs, are poorly suited for ultrasound.

## How does the procedure work?

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.

Doppler ultrasound, a special application of ultrasound, 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 be positioned lying face-up on an examination table that can be tilted or moved. Patients may be turned to either side to improve the quality of the images.

A clear water-based gel is applied to the area of the body being studied to help the transducer make secure contact with the body and eliminate air pockets between the transducer and the skin that can block the sound waves from passing into your body. The sonographer (ultrasound technologist) or radiologist then places the transducer on the skin in various locations, sweeping over the area of interest or angling the sound beam from a different location to better see an area of concern.

Doppler sonography is performed using the same transducer.

When the examination is complete, you may be asked to dress and wait while the ultrasound images are reviewed.

This ultrasound examination is usually completed within 30 to 45 minutes. More complex exams may take a longer period of time.

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

Ultrasound examinations are painless and easily tolerated by most patients.

After you are positioned on the examination table, the radiologist or sonographer will apply some warm water-based gel on your skin and then place the transducer firmly against your body, moving it back and forth over the area of interest until the desired images are captured. There is usually no discomfort from pressure as the transducer is pressed against the area being examined.

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

If a Doppler ultrasound study is performed, you may actually hear pulse-like sounds that change in pitch as the blood flow is monitored and measured.

Once the imaging is complete, the clear ultrasound gel will be wiped off your skin. Any portions that are not wiped off will dry quickly. The ultrasound gel does not usually stain or discolor clothing.

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

## Who interprets the results and how do I get them?

A radiologist, a physician specifically trained to supervise and interpret radiology examinations, will analyze the images and send a signed report to your primary care physician, or to the physician or other healthcare provider who requested the exam. Usually, the referring physician or health care provider will share the results with you. In some cases, the radiologist may discuss results with you at the conclusion of your examination.

Follow-up examinations may be necessary. Your doctor will explain the exact reason why another exam is requested. 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 examination may also be necessary so that any change in a known abnormality can be monitored over time. Follow-up examinations are sometimes the best way to see if treatment is working or if a finding is stable or changed over time.

## 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 other imaging methods.
- Ultrasound imaging is extremely safe and does not use any ionizing radiation.
- Ultrasound scanning gives a clear picture of soft tissues that do not show up well on x-ray images.
- Venous ultrasound helps to detect blood clots in the veins of the legs before they become dislodged and pass to the lungs. It can also show the movement of blood within blood vessels.
- Compared to venography, which requires injecting contrast material into a vein, venous ultrasound is accurate for detecting blood clots in the veins of the thigh down to the knee. In the calf, because the veins become very small, ultrasound is less accurate. However, potentially dangerous venous clots are typically lodged in the larger veins.

### Risks

- For standard diagnostic ultrasound, there are no known harmful effects on humans.

## What are the limitations of Venous Ultrasound Imaging?

Veins lying deep beneath the skin, especially small veins in the calf, may be hard to see.

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