Abdominal Contrast Enhanced Ultrasound (CEUS)

Abdominal contrast-enhanced ultrasound, also called CEUS, is an ultrasound examination that uses gas-filled microbubbles to better visualize organs and blood vessels within the abdomen and pelvis, including the liver, spleen, kidneys, pancreas, bowel and bladder.

This procedure requires little to no special preparation. Your doctor will instruct you on how to prepare, including whether you should not eat or drink beforehand. Wear loose, comfortable clothing. You may be asked to wear a gown.

What is Abdominal Contrast Enhanced Ultrasound?

Abdominal contrast-enhanced ultrasound (CEUS) combines ultrasound of the abdomen and/or pelvis regions with a special type of intravenous contrast agent to improve the visualization of blood vessels and organs. It helps the sonographer (the technologist performing your ultrasound) and the radiologist (the doctor reading your ultrasound) see abnormalities in the organs or blood vessels. The same contrast agent has been used to better assess the heart for many years.

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.

In abdominal CEUS, a small amount of contrast agent made up of gas-filled microbubbles is injected through an intravenous (IV) line into the body before ultrasound imaging. These tiny microbubbles travel

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in the blood to the organs. The microbubbles improve the visualization of organs and blood vessels in our body like the other forms of intravenous contrast agents used in CT scans and MRI. Abdominal CEUS is useful for patients who may have kidney failure, as the microbubbles can be safely given in all patients including those with severe kidney disease or those patients on dialysis. Microbubble contrast agents for CEUS are also safe to use in patients with a history of allergy to other contrast agents such as those used in CT and MRI. During a CEUS you can also safely receive more than one injection of contrast agent during the same exam, which allows your sonographer to examine multiple lesions or multiple organs during the same session if needed.

What are some common uses of the procedure?

Abdominal CEUS is performed to evaluate the:

- liver
- kidneys
- spleen
- pancreas
- bowel
- bladder
- blood vessels of the abdomen

Abdominal CEUS is used to help diagnose a wide variety of abdominal/pelvic conditions, such as:

- liver lesions discovered during routine ultrasound
- blood flow abnormalities in the liver
- cirrhosis of the liver
- kidney lesions
- traumatic injuries to the abdomen
- lesions of the spleen

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.

Preparations depend on the type of ultrasound you are having.

- For most exams, you do not need any kind of preparation
- For an exam of the pancreas, you may be asked to fast up to 4 hours before
- For a bowel exam, it may be best to avoid carbonated drinks up to 4 hours before

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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.

CEUS is often used instead of non-contrast ultrasound because it can show the difference between normal and diseased tissues. In the case of cancers, this difference is primarily due to cancers having more blood flow, so they may appear brighter than normal tissue or clear the blood faster than the surrounding normal part on CEUS. However, expertise is required in interpreting these images, as noncancerous conditions may also have a similar contrast pattern.

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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 or asked to lie face-down 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.

After the initial ultrasound scan is completed, you will receive a small injection of contrast agent, equivalent to about a few drops of liquid, through an intravenous (IV) catheter placed in the arm or hand.

You will then be asked to lie still for several minutes while the sonographer or radiologist uses the transducer to capture images of the bubbles traveling through the organ and/or blood vessel of interest. Occasionally, the injection will need to be repeated.

After about 10 minutes, all the bubbles will have popped harmlessly and the small amount of gas they contain is removed from the body through normal breathing.

What will I experience during and after the procedure?

You may experience some pain from the insertion of the intravenous catheter into your hand or arm.

There is usually no discomfort from pressure as the transducer is pressed against the area being examined. However, if scanning is performed over an area of tenderness, you may feel pressure or minor pain from the transducer.

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

The entire CEUS procedure will generally take less than 30 minutes, although the time may vary.

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

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

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analyze the images and send a report to the doctor who requested the exam. Sometimes the radiologist will discuss the results with you after the exam, otherwise you can get the results from the doctor who ordered the exam.

Follow-up exams 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 another radiology test. A follow-up exam may also be necessary so that a known abnormality can be monitored over time for any changes. Follow-up exams are sometimes the best way to see if a treatment is working or if an abnormality is changing over time.

What are the benefits vs. risks?

Benefits

- An ultrasound exam may occasionally be uncomfortable, but it is rarely 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 radiation.
- Ultrasound scanning gives a clear picture of many organs that do not show up well on a regular x-ray.
- Abdominal CEUS may eliminate the need for other tests such as CT and/or MRI. This can be especially helpful for patients who have claustrophobia or a hard time laying still.

Risks

- The contrast agents used in abdominal CEUS carry a very small risk of an allergic reaction. This risk is low—similar to the risk of an allergy from many antibiotics—and is lower than the risk of allergic reactions to contrast agents used in CT and MRI scans.

What are the limitations of Abdominal Contrast Enhanced Ultrasound?

Ultrasound waves are disrupted by air; therefore ultrasound may be limited when looking at the bowel if it is full of air. It also does not image inside our lungs well for the same reason.

Large or obese patients are more difficult to image by ultrasound because greater amounts of tissue weaken the sound waves as they pass into the body.

Usually only one region of the body can be examined per injection, and only a few areas can be examined in one exam. Because of this, CEUS is not always suitable for looking at multiple organs at once.

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