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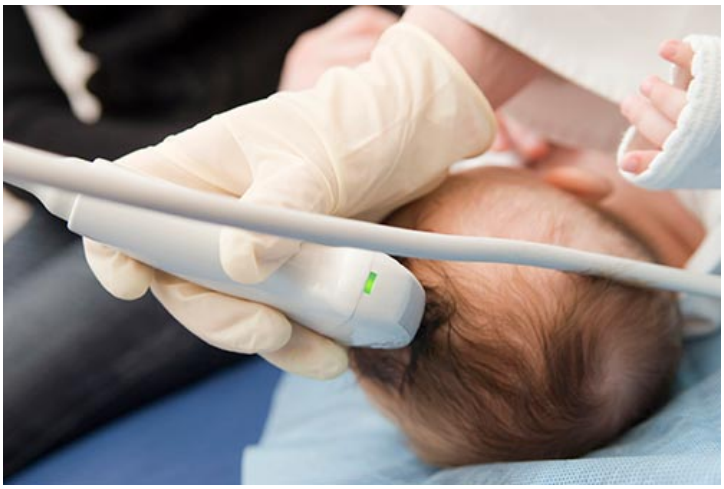
Cranial Ultrasound/Head Ultrasound



Ultrasound imaging of the head uses sound waves to produce pictures of the brain and cerebrospinal fluid. It is most commonly performed on infants, whose skulls have not completely formed. A transcranial Doppler ultrasound evaluates blood flow in the brain's major arteries. Ultrasound is safe, noninvasive, and does not use ionizing radiation.

This procedure requires little to no special preparation. Your doctor will instruct you on how to prepare, including whether adults undergoing the exam should refrain from using nicotine-based products that may cause blood vessels to constrict. Leave jewelry at home and wear loose, comfortable clothing. You may be asked to wear a gown.

What is cranial ultrasound?

Head and transcranial Doppler are two types of cranial ultrasound exams used to evaluate brain tissue and the flow of blood to the brain, respectively.

Head Ultrasound

A head ultrasound examination produces images of the brain and the cerebrospinal fluid that flows and is contained within its ventricles, the fluid filled cavities located in the deep portion of the brain. Since ultrasound waves do not pass through bone easily, this exam is most commonly performed on infants, whose skulls have not completely formed. The gaps between those skull bones provide a "window," allowing the ultrasound beam to freely pass into and back from the brain. The ultrasound probe and some gel are placed on the outside of the head in one of those regions without bone.

Transcranial Doppler

A transcranial Doppler (TCD) ultrasound evaluates both the direction and velocity of the blood flow in the major cerebral arteries of the brain. This type of ultrasound exam is also used during surgical procedures to monitor blood flow in the brain. TCD may be used alone or with other diagnostic exams

such as magnetic resonance imaging (MRI), magnetic resonance angiography (MRA) and computed tomography (CT) scans.

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.

What are some common uses of the procedure?

Head ultrasound is a routine exam for infants who were born prematurely. The procedure is used to screen for brain conditions associated with prematurity, such as bleeding or brain tissue damage as described below. If detected, follow-up ultrasound exams will be performed.

In infants, head ultrasound is used to:

- evaluate for hydrocephalus, or an enlargement of the ventricles, a condition that can have a number of causes.
- detect bleeding within the brain tissue or the ventricles. The latter condition is called intraventricular hemorrhage (IVH).
- assess whether there is damage to the white matter brain tissue surrounding the edges of the ventricles, a condition known as periventricular leukomalacia (PVL).
- evaluate for congenital abnormalities.
- locate the site of an infection or tumor.

In adults, head ultrasound is used to locate and evaluate tumor masses during brain surgery, facilitating their safe removal.

Transcranial Doppler ultrasound is used to assess the risk of stroke in adults and children with sickle cell disease. It is also used to measure conditions affecting blood flow to and within the brain, such as:

- Stenosis: a narrowing of a segment of a vessel, most commonly due to atherosclerosis (hardening of the arteries).
- Vasospasm: a temporary narrowing of a vessel, usually a reaction to blood being present in the spinal fluid spaces surrounding the brain. This condition is known as subarachnoid hemorrhage (SAH).

How should I prepare?

No special preparation is required prior to head or transcranial Doppler ultrasound exams. However, the patient should wear comfortable, loose-fitting clothing

Adults may be asked to stop using nicotine-based products 30 minutes to two hours prior to a transcranial Doppler ultrasound exam. Products with nicotine may cause blood vessels to constrict and give inaccurate results.

Your doctor will provide specific instructions for you or your child prior to the exam.

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?

Head Ultrasound

A head ultrasound is performed in the neonatal intensive care unit (NICU) at the infant's bedside. The infant is positioned lying face-up. A clear, water-based gel is applied to the transducer to help the transducer make secure contact with the body and eliminate air pockets that can block the sound waves from passing into the body. The sonographer (ultrasound technologist) or radiologist then gently presses the transducer against the fontanelle (soft spot of the infant's head, which has no bone to block the passage of the sound waves).

If head ultrasound is used during brain surgery, a portion of the skull will be removed and the exposed brain examined for brain masses with the use of a transducer.

Transcranial Doppler

During a transcranial Doppler ultrasound, the patient is either positioned on his or her back on an examination table or seated upright in an examination chair. A clear water-based gel is applied on the back of the neck, above and lateral to the cheek bone, in front of the ear or over the eyelid, as these are sites for blood vessels that supply the brain. The transducer is gently pressed over one of these areas to measure the direction and speed of the flowing blood.

The patient will need to remain still during the examination, which may take up to 35 minutes. However, if the patient needs to adjust his or her position on the examination table, there is usually no problem in pausing for that time. If the examination is being performed on an infant, a nurse or radiologic technologist may assist with keeping the infant still to ensure the best imaging quality.

What will I experience during and after the procedure?

Ultrasound examinations are painless and easily tolerated by most patients.

There may be minimal discomfort from pressure, as the transducer is pressed against the area being examined. If the gel is not warmed prior to contact with the skin, it could produce a cold sensation.

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.

Risks

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

What are the limitations of cranial ultrasound?

Ultrasound examinations are very sensitive to motion, and an active or crying child will slow the examination process.

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.

Exam results could be altered, due to:

- an open wound or recent surgical incision near the area being imaged.
- changes in blood flow pattern as a result of heart disease or irregular heart rhythms.

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