University of Al-Mustaqbal
College of Science
Department of Medical Physics

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Ultrasound imaging principles

Ultrasound is a diagnostic medical tool that uses sound waves to produce images of the inside of your body. It also can be used to treat certain conditions. Also called sonography, ultrasound images are usually taken from outside your body, but some are taken with devices inserted inside the body.

Ultrasound scans, or sonography, are safe because they use sound waves or echoes to make an image, instead of radiation.

It is suitable for use during pregnancy.

Ultrasound scans are used to evaluate fetal development, and they can detect problems in the liver, heart, kidney, or abdomen. They may also assist in performing certain types of biopsy.

The image produced is called a sonogram.

Fast facts on ultrasound scans

- Ultrasound scans are safe and widely used.
- They are often used to check the progress of a pregnancy.
- They are used for diagnosis or treatment.
- No special preparation is normally necessary before an ultrasound scan.

Concept

Ultrasound scans are carried out by a sonographer.

The person who performs an ultrasound scan is called a sonographer, but the images are interpreted by radiologists, cardiologists, or other specialists.

The sonographer usually holds a transducer, a hand-held device, like a wand, which is placed on the patient's skin.

Ultrasound is sound that travels through soft tissue and fluids, but it bounces back, or echoes, off denser surfaces. This is how it creates an image.

The term "ultrasound" refers to sound with a frequency that humans cannot hear.

For diagnostic uses, the ultrasound is usually between 2 and 18 megahertzTrusted Source (MHz).

Higher frequencies provide better quality images but are more readily absorbed by the skin and other tissue, so they cannot penetrate as deeply as lower frequencies.

Lower frequencies penetrate deeper, but the image quality is inferior.

How does it capture an image?

Ultrasound will travel through blood in the heart chamber, for example, but if it hits a heart valve, it will echo, or bounce back.

It will travel straight through the gallbladder if there are no gallstones, but if there are stones, it will bounce back from them.

The denser the object the ultrasound hits, the more of the ultrasound bounces back.

This bouncing back, or echo, gives the ultrasound image its features. Varying shades of gray reflect different densities.

Ultrasound transducers

The transducer, or wand, is normally placed on the surface of the patient's body, but some kinds are placed internally.

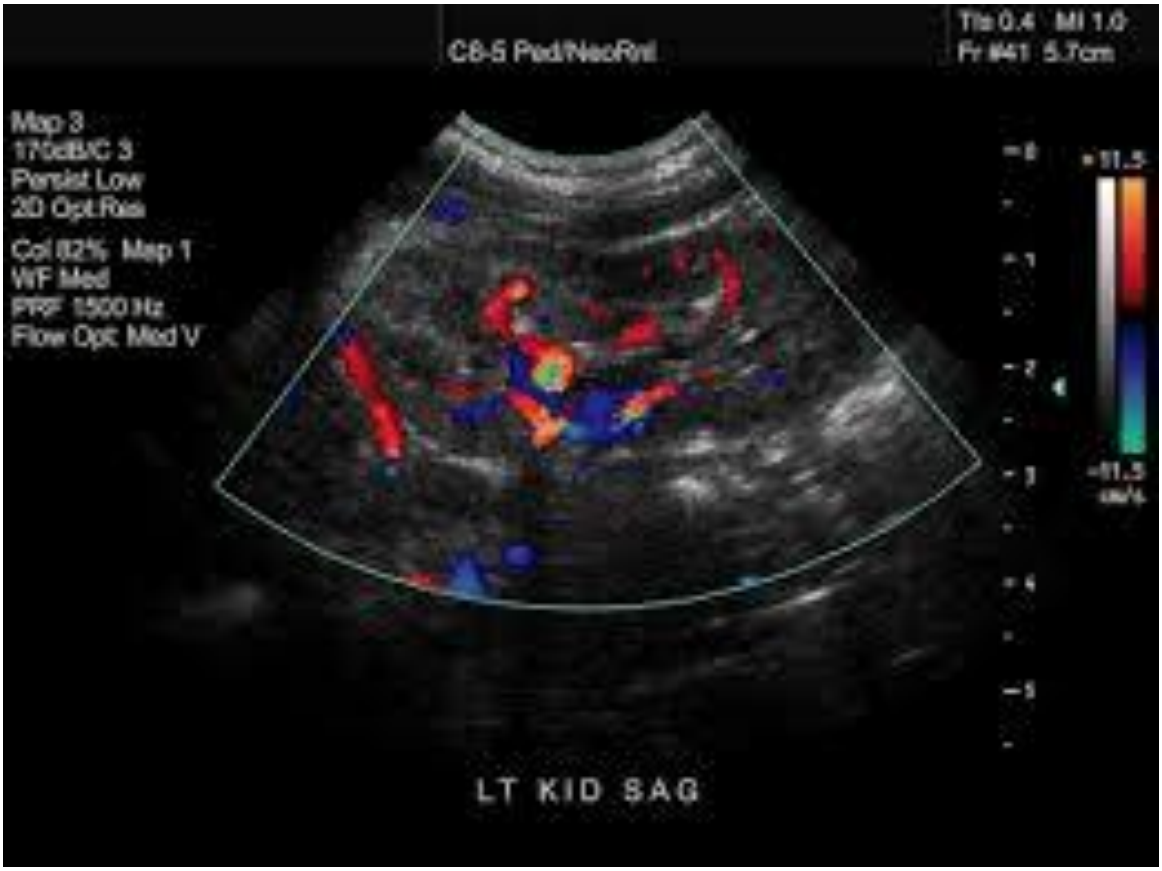
These can provide clearer, more informative images.

Examples are:

- an endovaginal transducer, for use in the vagina
- an endorectal transducer, for use in the rectum
- a transesophageal transducer, passed down the patient's throat for use in the esophagus

Some very small transducers can be placed onto the end of a catheter and inserted into blood vessels to examine the walls of blood vessels.

Uses



Ultrasound images are made from reflected sound, and a diagnosis can then be made.

Ultrasound is commonly usedTrusted Source for diagnosis, for treatment, and for guidance during procedures such as biopsies.

It can be used to examine internal organs such as the liver and kidneys, the pancreas, the thyroid gland, the testes and the ovaries, and others.

An ultrasound scan can reveal whether a lump is a tumor. This could be cancerous, or a fluid-filled cyst.

It can help diagnose problems with soft tissues, muscles, blood vessels, tendons, and joints. It is used to investigate a frozen shoulder, tennis elbow, carpal tunnel syndrome, and others.

Circulatory problems

Doppler ultrasound can assess the flow of blood in a vessel or blood pressure. It can determine the speed of the blood flow and any obstructions.

An echocardiogram (ECG) is an example of Doppler ultrasound. It can be used to create images of the cardiovascular system and to measure blood flow and cardiac tissue movement at specific points.

A Doppler ultrasound can assess the function and state of cardiac valve areas, any abnormalities in the heart, valvular regurgitation, or blood leaking from valves, and it can show how well the heart pumps out blood.

It can also be used to:

- examine the walls of blood vessels
- check for DVT (deep vein thrombosis) or an aneurysm
- check fetal heart and heartbeat
- evaluate for plaque buildup and clots
- assess for blockages or narrowing of arteries

A carotid duplex is a form of carotid ultrasonography that may include a Doppler ultrasound. This would reveal how blood cells move through the carotid arteries.

Ultrasound in anesthesiology

Ultrasound is often used by anesthetists to guide a needle with anesthetic solutions near nerves.

An ultrasound can be done at a doctor's office, at an outpatient clinic, or in the hospital.

Most scans take between 20 and 60 minutes. It is not normally painful, and there is no noise.

In most cases, no special preparation is needed, but patients may wish to wear loose-fitting and comfortable clothing.

If the liver or gallbladder is affected, the patient may have to fast, or eat nothing, for several hours before the procedure.

For a scan during pregnancy, and especially early pregnancy, the patient should drink plenty of water and try to avoid urinating for some time before the test.

When the bladder is full, the scan produces a better image of the uterus.

The scan usually takes place in the radiology department of a hospital. A doctor or a specially-trained sonographer will carry out the test.

External ultrasound

The sonographer puts a lubricating gel onto the patient's skin and places a transducer over the lubricated skin.

The transducer is moved over the part of the body that needs to be examined. Examples include ultrasound examinations of a patient's heart or a fetus in the uterus.

The patient should not feel discomfort or pain. They will just feel the transducer over the skin.

During pregnancy, there may be slight discomfort because of the full bladder.

Internal ultrasound

If the internal reproductive organs or urinary system need to be evaluated, the transducer may be placed in the rectum for a man or in the vagina for a woman.

To evaluate some part of the digestive system, for example, the esophagus, the chest lymph nodes, or the stomach, an endoscope may be used.

A light and an ultrasound device are attached to the end of the endoscope, which inserted into the patient's body, usually through the mouth.

Before the procedure, patients are given medications to reduce any pain.

Internal ultrasound scans are less comfortable than external ones, and there is a slight risk of internal bleeding.

Safety

Most types of ultrasound are noninvasive, and they involve no ionizing radiation exposure. The procedure is believed to be very safe.

However, since the long-term risks are not established, unnecessary "keepsake" scans during pregnancy are not encouragedTrusted Source. Ultrasound during pregnancy is recommended only when medically needed.