TEST

Transcranial doppler ultrasound

A transcranial Doppler ultrasound measures blood flow through arteries inside the brain.

WHAT IT MEASURES
Speed and direction of blood flow in brain arteries

SAMPLE
None; ultrasound imaging through the skull

FASTING NEEDED?
No, unless your imaging service gives special instructions

HOW LONG IT TAKES
Usually 30 to 60 minutes

RESULTS IN
Often same day; turnaround varies by laboratory or imaging service

USED FOR
Screening and monitoring, sometimes supporting diagnosis

MAIN LIMITATION
Thick skull bone can block a reliable ultrasound signal

Overview

A transcranial Doppler ultrasound, often shortened to TCD, measures how blood moves through major arteries inside your brain. It uses high-frequency sound waves rather than radiation.

A small handheld probe sends sound waves through thinner areas of the skull, usually near the temples, behind the head, or around the eye socket. Moving blood cells reflect these waves. A computer uses the reflections to estimate the speed and direction of blood flow.

TCD mainly measures blood flow rather than showing detailed pictures of an artery. A related test called transcranial colour-coded duplex ultrasound can provide images as well as flow measurements.

The test may be performed once or repeated over time. Repeated measurements can show whether blood flow is stable, improving, or changing.

Why the test is ordered

TCD can help answer several different questions about blood flow in the brain.

It may be ordered to:

After a subarachnoid haemorrhage, which is bleeding into the space around the brain, arteries can tighten or narrow. This is called vasospasm. Daily or repeated TCD tests may help the hospital team watch for this complication.

For sickle cell disease, TCD is used within a structured screening programme. The method, equipment, age of the child, previous results, and treatment history all affect how the measurement is interpreted.

- Screen children with sickle cell disease for an increased risk of stroke
- Monitor for artery narrowing after bleeding around the brain
- Look for reduced, blocked, or unusually fast blood flow
- Detect tiny particles or clots moving through brain arteries
- Assess blood flow before or during certain procedures
- Help investigate a possible passage allowing blood to bypass the lungs
- Support specialised assessment of whether brain circulation has stopped

Who should have the test

TCD is usually offered when there is a specific reason to examine or monitor blood flow in the brain. It is not generally used as a routine stroke screening test for healthy adults without symptoms or risk factors.

You may be offered the test if you have sickle cell disease, bleeding around the brain, known narrowing of a brain artery, or a condition that may send clots into the bloodstream. It may also be used during surgery or alongside other tests for stroke and circulation problems.

A TCD does not replace emergency brain imaging. If you develop sudden facial weakness, arm or leg weakness, trouble speaking, loss of vision, severe loss of balance, or an abrupt severe headache, seek emergency medical help rather than waiting for an ultrasound appointment.

How to prepare

Most TCD examinations need little preparation. You can usually eat, drink, and take your regular medicines as normal.

Follow the instructions from your imaging service. Some centres may ask you to avoid

caffeine, nicotine, alcohol, or strenuous exercise for a period before the test because these can temporarily change blood flow.

Do not stop prescribed medicines unless the clinician responsible for them has told you to do so. Tell the person performing the test about your medicines, recent blood transfusions, and any recent surgery or major illness.

Avoid applying heavy hair products around your temples or the back of your neck. Wear comfortable clothing that allows access to these areas.

If a "bubble study" is planned, you may receive separate instructions. This version requires a small intravenous line in your arm.

What happens during the test

You will usually lie on an examination couch or sit in a supported chair. The room may be kept quiet because movement and talking can interfere with the signals.

The sonographer or other trained professional places a small amount of water-based gel on your skin. They then hold an ultrasound probe against several areas, commonly:

You may hear a pulsing or rushing sound from the machine. This represents blood moving through an artery. You may be asked to stay still, hold your breath briefly, or change position.

For an emboli-monitoring study, the probes may be secured in place for longer while the machine listens for signals that could represent tiny particles moving in the bloodstream.

During a bubble study, agitated saline-a mixture of sterile salt water and tiny air bubbles-is injected through an intravenous line. You may be asked to cough or briefly strain. The test looks for bubbles reaching the brain circulation, which may suggest an abnormal passage through the heart or lungs.

- The temples
- The back of the head or upper neck
- The closed eyelid, using special low-power settings

Understanding your results

The report may describe blood-flow speed, direction, waveform shape, and differences between the left and right sides. It may also say whether all the required arteries could be examined.

Faster flow can occur when blood is forced through a narrowed artery. However, high flow can also result from fever, anaemia, pregnancy, or other changes in the circulation. Very low or absent flow may reflect severe narrowing or blockage, but it may also mean the ultrasound signal could not pass through the skull.

Interpretation is specific to why the test was performed. For example, sickle cell screening uses standardised methods and age-related thresholds. Monitoring after subarachnoid haemorrhage often focuses on changes over time and comparisons between different arteries.

There is no single universal normal range for every TCD measurement. Ranges and interpretation vary by laboratory, age, sex, pregnancy status, medicines, equipment, technique, and clinical context.

What affects the results

A technically correct measurement may still be misleading if temporary or personal factors alter blood flow.

Important influences include:

Kidney function does not usually affect a standard TCD directly because the test uses no injected dye. It may still matter to the wider clinical interpretation if kidney disease has affected blood pressure, anaemia, or overall circulation.

- Skull thickness: Bone can weaken or completely block the ultrasound signal
- Probe position and angle: Small changes can produce different speed estimates
- Movement or talking: These can make the signal difficult to follow
- Age and sex: These affect blood-flow patterns and the chance of obtaining a clear signal
- Blood pressure, fever, and carbon dioxide levels: Each can change brain blood flow
- Exercise, caffeine, nicotine, and alcohol: Recent use may temporarily alter circulation
- Anaemia, including iron deficiency: Reduced red blood cells can increase measured flow speed
- Pregnancy: Normal circulation changes can affect flow measurements
- Medicines: Sedatives, stimulants like methylphenidate or lisdexamfetamine , blood-pressure medicines, and medicines affecting blood vessels may alter results
- Recent transfusion: This is especially important when interpreting sickle cell screening

- Recent surgery or serious illness: These may change blood pressure and circulation

Accuracy and limitations

TCD is good at measuring blood-flow changes in major arteries that can be reached through an ultrasound window. It is portable, repeatable, and useful for tracking changes over time.

Its accuracy is strongly affected by the operator's technique and the quality of the signal. In some people, especially when skull bone is thick, no reliable signal can be obtained. This can cause the test to miss an artery problem even when one is present.

High flow does not always mean narrowing. Anaemia, fever, raised blood pressure, or increased blood flow throughout the brain can produce a similar result. This means TCD can sometimes suggest a problem that another test does not confirm.

TCD also provides limited detail about the artery's physical structure. CT angiography or MR angiography may be better for showing exactly where an artery is narrowed or blocked. Catheter angiography gives more detailed vessel images but is invasive and has greater risks.

A bubble TCD can detect blood bypassing the normal lung filter, but it cannot always show whether the passage is in the heart or lungs. An echocardiogram may be needed to identify its location.

There is no single figure for how often TCD misses a problem or gives a false alarm. Accuracy differs by the condition being investigated, artery, equipment, protocol, and experience of the examiner.

Risks and complications

A standard TCD is non-invasive and does not use radiation. Pressure from the probe may feel mildly uncomfortable, but complications are not expected.

If an intravenous line is needed for a bubble study, you may develop a small bruise or feel faint during insertion. The team will explain any additional risks before the study.

What happens next

A clinician will interpret the report alongside your symptoms, examination, medical history, and other test results. A single measurement is not usually considered in isolation.

Routine follow-up may include another TCD, discussion at your next appointment, or a

different scan such as CT angiography, MR angiography, or an echocardiogram. Repeated testing is common when monitoring vasospasm or following a sickle cell screening programme.

An unclear result does not necessarily mean something is wrong. It may simply mean that the ultrasound could not pass through the skull well enough for a dependable measurement.

Seek emergency help for new stroke-like symptoms, a sudden severe headache, collapse, seizure, or a major change in alertness. Do not wait for routine results or a follow-up appointment.

Common questions

Can I drink coffee before a transcranial Doppler ultrasound?

Usually, but follow your appointment instructions. Some services ask you to avoid caffeine because it can temporarily change blood-vessel tone and blood flow.

Does the time of day matter?

Usually not for a one-off examination. For repeated monitoring, the service may try to test you under similar conditions each time.

Can I exercise beforehand?

Gentle daily activity is generally acceptable. Strenuous exercise can temporarily affect blood pressure and brain blood flow, so ask whether you should avoid it before your appointment.

Can I take my usual medicines?

Usually, yes. Do not stop prescribed treatment without specific instructions. Bring an up-to-date medicines list because some medicines can influence blood flow.

Will I need to remove my hair or shave my head?

No. The probe is placed against selected areas of skin, and your hair may simply be moved aside.

Can I drive home afterward?

You can normally drive and return to usual activities after a standard TCD. If you are an inpatient, have received sedation for another procedure, or feel unwell, follow the advice of the hospital team.

Sources

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