TEST

Nuclear ventriculography

Nuclear ventriculography uses a radioactive tracer and camera to measure how well the heart pumps blood

WHAT IT MEASURES
Heart chamber pumping and wall motion using tagged red blood cells

SAMPLE
None; gamma-camera imaging after blood draw and tracer injection

FASTING NEEDED?
No, unless combined with an exercise stress test

HOW LONG IT TAKES
Usually 1 to 2 hours

RESULTS IN
Same day to several days; varies by imaging laboratory

USED FOR
Measuring and monitoring heart pumping function

MAIN LIMITATION
Rhythm and processing errors can distort ejection fraction

Overview

Nuclear ventriculography is an imaging test that shows how the heart's lower chambers, called ventricles, fill with blood and pump it out. It is often called a multigated acquisition scan, or MUGA scan.

The test uses a small amount of radioactive material attached to your red blood cells. A gamma camera detects the radiation from these cells as they move through your heart. An electrocardiogram, or ECG, records your heartbeat so images can be matched to each part of the pumping cycle.

The main measurement is usually the left ventricular ejection fraction, or LVEF. This is the percentage of blood pumped out of the left ventricle with each heartbeat. The scan can also assess movement of the heart wall and, in some cases, right ventricular function.

Nuclear ventriculography does not show the coronary arteries in detail. It is also different from a nuclear myocardial perfusion scan, which looks mainly at blood flow to the heart muscle.

Why the test is ordered

The test is ordered when a reliable measurement of heart pumping function could affect care. Because the method can be repeated in a consistent way, it may be used to compare heart function over time.

Reasons for ordering it may include:

An echocardiogram is more commonly used for many of these purposes because it does not involve radiation and provides information about heart valves. Nuclear ventriculography may be selected when a particularly consistent ejection-fraction measurement is needed.

- Measuring heart function before or during certain cancer treatments
- Monitoring a known change in heart pumping ability
- Checking heart function after heart muscle injury
- Investigating possible abnormal movement of the heart wall
- Clarifying results when an echocardiogram is incomplete or difficult to interpret
- Measuring heart response during exercise, when a stress study is needed

Who should have the test

This test may be appropriate if your healthcare team needs to measure or monitor how effectively your heart pumps. The decision is based on your symptoms, medical history, previous imaging and the treatment being considered.

Tell the imaging team before the test if you are pregnant, may be pregnant or are breastfeeding. Radiation can affect decisions about whether the test should be delayed, replaced with another type of imaging or performed with extra precautions.

Also tell them if you have an irregular heartbeat, a cardiac device, difficulty lying flat or a previous problem during a nuclear medicine test. These do not always prevent testing, but they can affect how the scan is performed or interpreted.

How to prepare

For a standard resting scan, you can usually eat and drink normally. If the scan includes exercise or medicine-induced stress, you may receive separate instructions about food, caffeine and medicines.

Take your usual medicines unless the team arranging the test gives you different instructions. Bring an up-to-date medicine list. Some medicines change heart rate or pumping function, which may be relevant when comparing results.

Wear comfortable clothing and avoid metal around the chest if possible. You may need to change into a gown. ECG stickers must be placed directly on your skin, so lotions or oils on the chest can make them harder to attach.

Tell the imaging team about recent cardiac imaging and where it was done. Comparing scans made with the same method, equipment and processing approach may be more reliable than comparing different types of tests.

What happens during the test

A healthcare professional places ECG stickers on your chest. The ECG signal allows the camera to combine information from many heartbeats into moving images of one average heartbeat. This process is called ECG gating.

A small amount of blood may be drawn and mixed with a substance that helps a radioactive tracer attach to your red blood cells. Depending on the laboratory's method, some preparation may instead happen inside your bloodstream. The tagged cells are then given through a vein.

You lie on an imaging table while a gamma camera is positioned close to your chest. It does not produce the radiation; it detects radiation from the tracer. Images are taken from several angles, and you need to remain still.

Imaging commonly takes around 30 to 60 minutes, although the whole appointment may take 1 to 2 hours. It can take longer if extra images are required or if the red blood cells need to be prepared outside your body.

If an exercise study is planned, images may be recorded while you use a stationary bicycle or immediately after exercise. Staff monitor your heart rhythm, blood pressure and symptoms.

Understanding your results

Your report may give an ejection fraction as a percentage. It may also describe the size of the ventricles, how evenly the heart walls move and whether image quality affected the calculation.

There is no single number that should be interpreted in isolation. Reference ranges and interpretation vary by laboratory, age, sex, pregnancy status, medicines and clinical context.

Results may also differ between nuclear ventriculography, echocardiography, cardiac MRI and other imaging methods.

When the test is used for monitoring, the change from your earlier result may matter as much as the current number. The comparison is strongest when both studies used similar equipment, views and processing methods.

An ejection fraction that appears lower or higher than expected does not identify the cause by itself. Your healthcare professional considers it alongside symptoms, examination findings, blood tests and other heart imaging.

What affects the results

Several factors can change the measurement without representing a true long-term change in heart function.

An irregular rhythm can interfere with ECG gating. If heartbeats vary greatly in length, the camera may reject some beats or combine beats that do not represent the same stage of the pumping cycle.

Other influences include:

Kidney function usually has less direct effect on this test than on tracers that depend heavily on kidney clearance. However, changes in fluid balance or overall health can alter the heart's actual performance on the day.

- Movement, deep breathing or difficulty lying in one position
- Incorrect ECG triggering or poor electrode contact
- Incomplete attachment of the tracer to red blood cells
- Overlap from nearby organs or soft tissue
- Camera angle, image quality and the outlines used during processing
- Changes in heart rate, blood pressure or hydration
- Recent strenuous exercise before a resting measurement
- Medicines that alter heart rate, blood pressure or heart contraction
- Using different scanners, software or imaging methods for comparison

Accuracy and limitations

Nuclear ventriculography can provide a repeatable measurement of ejection fraction, especially when follow-up scans use the same laboratory and technique. This is one reason it has been used to monitor treatments that may affect heart function.

It is not perfectly accurate. Poor ECG gating, body movement, low tracer counts or errors in drawing the heart's borders can produce a falsely low or falsely high result. Measurement variation can make a small decline appear when none has occurred, or hide a small real change.

The test can also miss problems that do not significantly affect overall pumping function. A normal ejection fraction does not rule out coronary artery disease, valve disease, intermittent rhythm problems or early changes in heart muscle.

A different test may be more useful in some situations. Echocardiography assesses valves and blood flow without radiation. Cardiac MRI can measure chamber volumes and examine heart muscle tissue in greater detail. Coronary CT, stress imaging or invasive angiography may be needed when the main question concerns coronary arteries rather than pumping function.

Risks and complications

The needle may cause brief discomfort, a small bruise or bleeding at the injection site. Some people feel faint during a blood draw or injection.

The test exposes you to a limited amount of ionizing radiation. The amount depends on the tracer and imaging protocol. Allergic reactions to the radiopharmaceutical are uncommon.

If you are pregnant or breastfeeding, tell the nuclear medicine team before receiving the tracer. Breastfeeding instructions vary with the product and local protocol.

During an exercise study, you may develop shortness of breath, chest discomfort, dizziness or an abnormal heart rhythm. You are monitored during the test. Tell staff immediately if you feel unwell.

What happens next

You can usually return to normal activities after a resting scan. Drinking fluids and emptying your bladder regularly may help remove tracer that is not attached to blood cells, unless you have been told to limit fluids.

A specialist reviews the images and sends a report to the healthcare professional who ordered the test. Routine follow-up may involve discussing the result at your next appointment, comparing it with an earlier scan or arranging another type of heart test.

Mild soreness or a small bruise at the injection site can usually be watched at home. Contact your healthcare team if the area becomes increasingly painful, swollen, red or warm.

Seek emergency care for severe chest pain, major difficulty breathing, fainting or symptoms of a serious allergic reaction. These symptoms are not expected after a routine scan and should not wait for a scheduled follow-up.

Common questions

Can I drink coffee before the test?

Usually yes for a resting scan. Avoiding caffeine may be required if exercise or medicine-induced stress is planned, so follow the instructions from the imaging unit.

Does the time of day matter?

Usually not. For repeat monitoring, similar timing and medicine use may make comparisons more consistent, particularly if your heart rate or blood pressure changes during the day.

Can I exercise beforehand?

Avoid strenuous exercise immediately before a resting measurement unless you are told otherwise. Exercise can temporarily change heart rate, blood pressure and pumping function.

Can I take my medicines?

Usually yes. Do not stop heart or blood-pressure medicines unless the team arranging the test specifically instructs you to do so.

Can I drive home afterward?

Most people can drive after a resting scan because it does not usually require sedation. Ask about transport if your study includes stress medicine or if you commonly feel faint after injections.

Will I be radioactive around other people?

The tracer gives off radiation for a limited time. Ordinary contact is usually acceptable, but follow any specific instructions about close contact with pregnant people or young children.

Sources

- Society of Nuclear Medicine and Molecular Imaging and European Association of Nuclear Medicine. "SNMMI Procedure Standard/EANM Guideline for Gated Equilibrium Radionuclide Angiography: 2020." Journal of Nuclear Medicine , 2020.

- MedlinePlus Medical Encyclopedia: Nuclear ventriculography . U.S. National Library of Medicine.
- RadiologyInfo.org: Cardiac Nuclear Medicine . American College of Radiology and Radiological Society of North America.
- Cleveland Clinic: MUGA Scan . Cleveland Clinic.
- U.S. Food and Drug Administration. UltraTag RBC: Kit for the Preparation of Technetium Tc 99m-Labeled Red Blood Cells-Prescribing Information .