

Stress Tests (MPI, ECG, ECHO)

What is a stress test?

Stress testing is usually requested by your doctor to evaluate any heart abnormalities, including heart blockages (known as coronary artery disease), but it also may be used to assess generally how your heart works during stress conditions.

A physician may recommend a stress test if you have:

- angina or chest pain that is becoming more severe or occurring more often
- had a heart attack, angioplasty (stenting) or a heart bypass surgery
- existing heart disease or certain risk factors, such as diabetes, smoking, obesity, high blood pressure ... and you are beginning a new exercise program
- heart rhythm changes during exercise
- a heart valve problem (such as aortic valve or mitral valve stenosis)

Please ask your doctor for other reasons specific to you for performing a stress test.

Most commonly, three types of stress tests may be performed clinically:

- Nuclear stress test (also called Myocardial Perfusion Imaging, MPI)
- ECG stress test
- Stress echo test

** Note: The nuclear stress test (MPI) is the only test using nuclear medicine technology.*

Nuclear Stress Test (MPI)

How is a nuclear stress test performed?

A nuclear stress test, also referred to as a myocardial perfusion imaging (MPI) study, is a type of stress test that uses an imaging contrast agent known as a radiotracer to take pictures of your heart during stress and rest conditions. A PET or SPECT camera is used for imaging of your heart. The nuclear medicine expert will look for changes in your images between stress and rest. These may be indicative of heart blockages (coronary artery disease).

Imaging of your heart will occur before and after stress to determine the effects of stress on blood flow through the coronary arteries and the heart muscle.

The three-dimensional images produced by this study are called perfusion images because they show which areas of the heart muscle are perfused, or supplied with blood.

Other names commonly used for this test are a sestamibi or thallium cardiac scan.

A physician may perform a nuclear stress study to:

- assess the overall function of the heart muscle and the function of individual muscle walls
- assess damage to the heart muscle following a heart attack
- diagnose symptoms of coronary artery disease (CAD), such as shortness of breath or chest pain - abnormal perfusion scans are highly indicative of CAD
- determine the extent of coronary stenosis, a narrowing of arteries that supply blood to the heart

- determine whether a patient is a candidate for revascularization, a surgical procedure that restores blood flow
- manage the treatment of coronary artery disease by evaluating the results of:
 - revascularization procedures
 - medical or drug therapy

In order to create "stress" conditions for your heart, the nuclear medicine expert may use one of two techniques:

- Exercise on a treadmill
- Injection of a medication that simulates stress conditions, also called pharmacological or chemical stress testing

The choice of the stress technique will depend on your physical condition and your other medical problems.

For the exercise portion of the test, you will be asked to walk or run on a treadmill in order to elevate your heart to its peak rate.

Chemical stress testing, on the other hand, can be performed using medications that mimic stress either by dilating your coronary vessels or by increasing your heart rate. You will receive an intravenous injection of a radiotracer—sestamibi/tetrofosmin for SPECT or ammonia/rubidium for PET—which accumulates in the heart muscle. This accumulation is dependent on the amount of blood flow and whether your heart muscle is still functioning. Other less common radiotracers are occasionally used. Next, you will be moved to an imaging suite, where images of the heart will be taken with a SPECT or PET camera. Shortly thereafter, you will be imaged again for the rest study.

There is usually a waiting period between radiotracer injection and scanning.

It is not uncommon for some patients to get only one study—the stress test or the rest test. This is at the discretion of the physician caring for you.

The order in which these tests are performed can vary from one stress lab to another (stress then rest or vice versa), and they can occasionally be done on different days.

Who benefits from nuclear stress tests?

Your physician will ensure the nuclear stress test is appropriate by:

- carefully evaluating your clinical characteristics, coronary artery disease (CAD) risk factors, prior history of CAD and heart function (specifically left ventricle: left side of your heart).
- applying Appropriate Use Criteria (AUC) and guidelines developed and endorsed by Society of Nuclear Medicine and Molecular Imaging (SNMMI), the American Society of Nuclear Cardiology (ASNC) and other professional societies based on a large body of scientific evidence including studies on thousands of patients.
- using the ALARA principle (As Low As Reasonably Achievable) to carefully select the amount of radiopharmaceutical that will provide an accurate test with the least amount of radiation exposure.

Advantages of nuclear stress testing

This study is:

- the most accurate test available for diagnosing coronary artery disease (CAD) early in patients who may be at risk for a heart attack
- has a proven risk-stratification capability: Abnormal perfusion scans are highly indicative of CAD. Research has also shown that patients with normal MPI scans have less than a 1 percent risk of heart attack or cardiac death for up to five years. Your specific risk can be better assessed and explained by your doctor.
- is sensitive to even the most modest changes in blood flow to the heart
- offers improved diagnostic accuracy over exercise treadmill testing (also called an ECG stress test).

IMPORTANT: Please follow your specific lab instructions on how to prepare for the test, including how to modify your diet and medications if specified.

ECG Stress Test

How is an ECG stress test performed?

To perform an ECG Stress Test, (also called exercise treadmill testing), electrodes are placed on the patient's chest and attached to an electrocardiography (ECG) machine that measures the electrical activity of the heart.

The patient exercises by walking or running on a treadmill or pedaling on a stationary bicycle, first slowly and then faster and possibly on an incline. Blood pressure readings are taken during the test, which typically involves 10-15 minutes of exercising. The ECG records the heart rate and rhythm, as well as the strength and timing of electrical signals as they pass through each part of the heart during rest and exercise.

Patients who have an abnormal exercise stress test will usually require additional testing, such as an Echo Stress Test, or a nuclear stress test and/or coronary angiography (heart catheterization).

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Stress Echo Test

How is a stress echo test performed?

In an Echo Stress Test, your heart is imaged with echocardiography while you are resting and immediately following exercise. Echocardiography or a heart ultrasound is an imaging technology that uses ultrasound vibrations echoed from the heart structures to create a moving picture of the heart.

A Stress Echo begins with a resting echocardiogram. Next, you'll walk on a treadmill or ride a stationary bike until the target heart rate is reached. At that point, another echocardiogram is taken. If you are unable to exercise, you may receive an intravenous injection of a medication that makes your heart beat faster and harder. Throughout the procedure, your blood pressure and heart rhythm (ECG) are monitored.

The images reveal how well your heart's chambers and valves are working when it is under stress. The echocardiogram may identify areas of poor blood flow, dead heart muscle tissue and abnormal muscle contractions.

IMPORTANT: Please follow your specific lab instructions on how to prepare for the test, including how to modify your diet and medications if specified.

About SNMMI

The Society of Nuclear Medicine (SNMMI) is an international scientific and medical organization dedicated to raising public awareness about nuclear and molecular imaging and therapy and how they can help provide patients with the best health care possible. With more than 18,000 members, SNMMI has been a leader in unifying, advancing and optimizing nuclear medicine and molecular imaging since 1954.

The material presented in this pamphlet is for informational purposes only and is not intended as a substitute for discussions between you and your physician. Be sure to consult with your physician or the nuclear medicine department where the treatment will be performed if you want more information about this or other nuclear medicine procedures.