

Circulation

JOURNAL OF THE AMERICAN HEART ASSOCIATION



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Circulation 2003;107;100-102

DOI: 10.1161/01.CIR.0000069328.40940.27

Circulation is published by the American Heart Association, 7272 Greenville Avenue, Dallas, TX 75214

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Exercise Testing and Nuclear Scanning

Marcelo F. Di Carli, MD; Sharmila Dorbala, MD



Coronary artery disease is the leading cause of death in the United States. It usually results from the build-up of fatty deposits within the blood vessel wall, which leads to narrowing of the coronary vessels and a reduction in the blood supply to the heart muscle. This reduced blood supply may in turn result in impaired cardiac function and sometimes in a heart attack. An insufficient blood supply to the heart muscle often manifests itself as symptoms of chest pain and/or shortness of breath. However, these symptoms are not always indicative of heart disease. Exercise testing and nuclear scanning are common tools that are used to diagnose the presence of obstructions in the coronary vessels and to evaluate their severity.

What Is Nuclear Scanning?

Nuclear scanning uses small amounts of radioactive substances (for example, thallium-201, Cardiolite [sestamibi; Bristol-Myers Squibb Medical Imaging, Inc], and Myoview [tetrofosmin; Amersham Health]) that are injected into a vein to produce images of the heart. These images are used to assess the blood supply to the heart muscle (myocardial perfusion) at rest and during exercise or medicine-induced stress. The most common nuclear test of the heart is known as a myocardial perfusion scan. Myocardial perfusion images are obtained while the patient is lying

COMMON REASONS FOR EXERCISE OR PHARMACOLOGICAL NUCLEAR SCANNING

- To evaluate chest pain or angina
- To assess if the heart can withstand the stress of anesthesia and long surgery before non-cardiac surgery
- To evaluate the damage suffered from a heart attack
- To evaluate symptoms after treatment for coronary artery disease (that is, after medical therapy, coronary angioplasty with stents, and coronary artery bypass surgery)

down under a special camera or scanner (known as single-photon emission computed tomography [SPECT] or positron emission tomography [PET]) that generates a picture of the radioactivity coming from the heart (Figure 1). When there is a significant blockage of a coronary vessel, the heart muscle may not get adequate blood supply during exercise or stress temporarily induced by medication administered during the test. Decreased blood flow

to the heart muscle can be detected on the images as a perfusion defect (Figure 2). Myocardial perfusion scans can localize the obstructed coronary vessel(s), demonstrate the extent of the heart muscle area with reduced blood flow, provide information about the heart's pumping function, and identify areas of the heart muscle that are scarred from a heart attack. Thus, they are superior to routine exercise stress testing (without imaging) and provide information necessary to help identify patients with an increased risk for a heart attack who may be candidates for invasive procedures, such as coronary angiography, angioplasty, and heart surgery.

EXERCISE OR PHARMACOLOGICAL NUCLEAR SCANNING

- Uses a small amount of radioactive material to assess blood supply to the heart muscle.
- The radiation exposure during a nuclear scan is small and safe.

What Should I Expect When My Doctor Orders an Exercise Nuclear Scan?

The purpose of an exercise nuclear scan is to assess the regional blood supply to the heart muscle at rest and during exercise to

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(*Circulation*. 2003;107:e100-e102.)

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Circulation is available at <http://www.circulationaha.org>

DOI: 10.1161/01.CIR.0000069328.40940.27

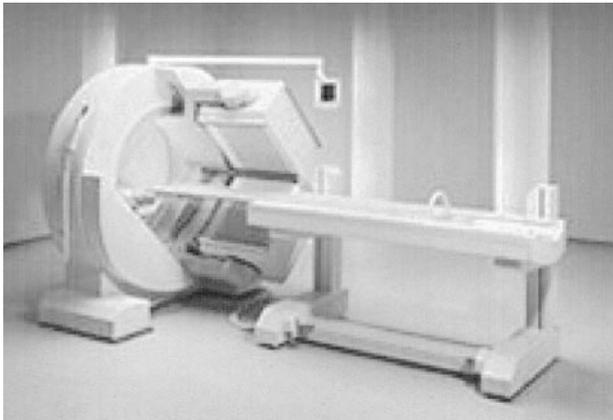


Figure 1. Picture of camera used for cardiac nuclear scanning.

detect coronary artery blockages. After explaining the test to you and obtaining your written consent, the staff will place a small needle in a vein of your arm to give you the necessary radioactive injections during the test. You will usually have two sets of images taken, one at rest and one after exercise, each preceded by a separate radioactive injection. For the resting images, you will receive an injection of radiotracer and may be imaged 30 to 45 minutes later. For the exercise study, small pads called electrodes will be placed on your chest to monitor your ECG. You will then be asked to walk on a treadmill or ride a stationary bicycle while having your ECG and blood pressure monitored by a qualified staff person. During the exercise test, you may experience shortness of breath, chest or arm pain or discomfort, difficulty walking, fatigue, or other symptoms. It is important for you to let the person performing the test know if you are experiencing any symptoms so that they can respond as needed. At peak exercise, you will receive another radioactive injection to evaluate the blood supply to the heart muscle under maximum stress. The intravenous needle will be removed from your vein after completion of the test. It takes 15 to 30 minutes to take each set of pictures, depending on the scanner that is used.

What Happens if I Am Unable to Exercise?

In people who are unable to exercise, the stress portion of the test is induced by the intravenous administration of a medicine

(for example, Persantine [Bristol-Myers Squibb Medical Imaging, Inc], Adenoscan [Fujisawa Healthcare, Inc], or Dobutamine

[Anakena Pharma]). This is known as a pharmacological stress test. During the infusion of any of these medicines, you may experience shortness of breath, chest pain, palpitations, headache, or flushing.

How Should I Prepare for an Exercise or a Pharmacological Nuclear Scanning?

You will be asked to not eat for a few hours before your test. The length of time will vary depending on the type of test you are having, the time of day of the test, and your medical conditions, such as diabetes. You should not consume any caffeine-containing products for at least 24 hours before

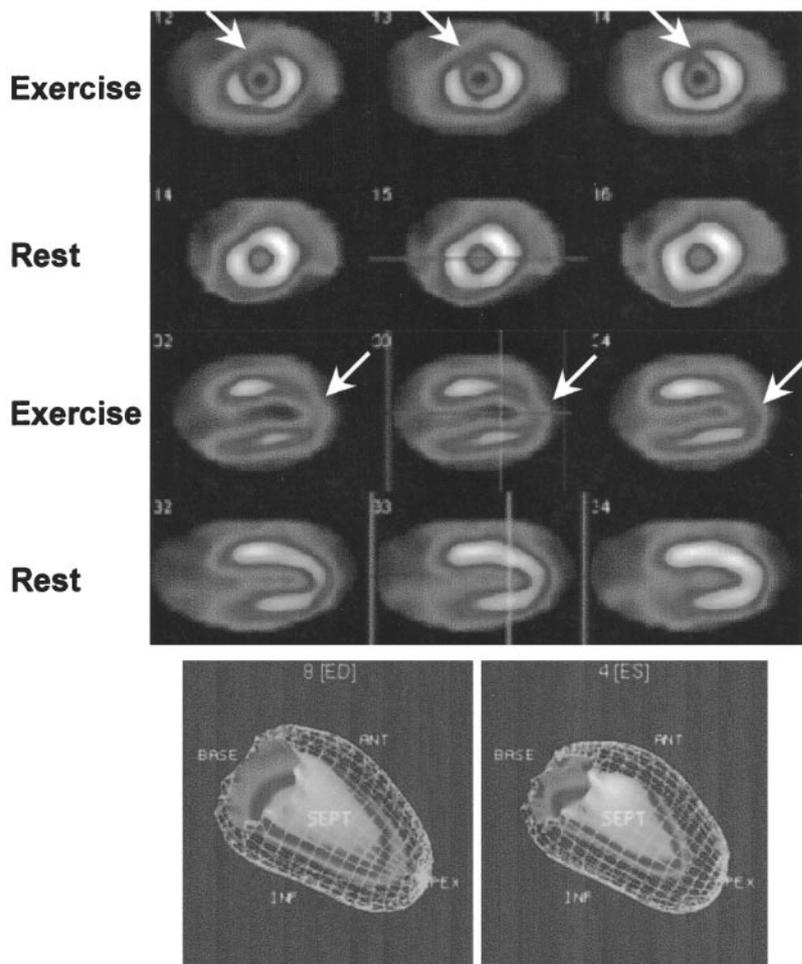


Figure 2. Top, Images of the heart showing a deficit in the blood supply to the anterior portion (arrows) of the heart during exercise. Bottom, Images of the heart demonstrating the pumping function of the heart at rest.

the test, including coffee, tea, soft drinks containing caffeine, and chocolate. Most stress laboratories will also provide you with instructions on how to handle medications you may be taking. You should wear comfortable, loose clothing and walking or running shoes.

PREPARATION BEFORE EXERCISE OR PHARMACOLOGICAL NUCLEAR SCANNING

- Do not eat or drink for 4 hours.
- Avoid intake of caffeine-containing products for 24 hours.
- Wear loose, comfortable clothing and walking shoes.
- Check with your doctor about your medications.
- Notify your doctor if you are pregnant or suspect you may be or are a nursing mother.
- Allow 3 to 4 hours for the entire test, including preparation, the stress test, and imaging

What Are the Risks Associated With Exercise or Pharmacological Nuclear Scanning?

Exercise and medicine-induced stress tests used in combination with nuclear scanning are generally safe. When patients are screened appropriately, the risk of serious complications such as heart attack or irregular heartbeat (arrhythmias) is very low. The nuclear scanning portion of the study involves radiation exposure from the administration of a diagnostic radioactive drug. The typical total amount of radiation from both sets of images (ie, rest and stress) is approximately equivalent to 30% to 40% of the annual safe radiation dose allowed for individuals who work with radiation. Pregnant women or women of childbearing potential should discuss the risks and benefits of undergoing nuclear scanning with their doctor.

What Happens After I Complete the Test?

The ECGs from the exercise or medicine-induced stress and the images

obtained during the test are read by a physician experienced in interpreting this type of test. The findings and conclusions of the test are included in a report that is sent to the doctor who ordered the test. Occasionally, you may be asked to wait before leaving the nuclear medicine stress laboratory, while the physician discusses the findings of the test with your doctor to determine whether treatment or further diagnostic testing is required in light of the nuclear scan findings.

Acknowledgments

We are grateful to Cindi M. Johnson for her assistance with the preparation of this manuscript.

Additional Information

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