

Patient page-sarcoidosis imaging

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Optimizing our imaging capabilities for patients with cardiac sarcoidosis is critical as it has diagnostic, prognostic, and therapeutic implications. ¹⁸F-DG PET/CT has the highest sensitivity for the detection of CS but requires specific dietary preparation that is difficult for patients to follow which may lead to ineffective suppression of physiologic ¹⁸F-DG uptake. This may result in inconclusive scan results in up to 30% of patients undergoing ¹⁸F-DG PET/CT imaging for CS. Therefore, it is imperative that we relay to our patients the importance of dietary preparation for CS PET imaging and then provide simple, easy to follow instructions for them. The current patient protocol is designed to achieve these two objectives. (J Nucl Cardiol 2019;26:222–6.)

Key Words: Cardiac sarcoid • PET • Patient protocol

Abbreviations

CS	Cardiac sarcoidosis
FDG	F-18 fluorodeoxyglucose

PET	Positron emission tomography
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INFORMATION ABOUT CARDIAC SARCOIDOSIS AND YOUR PET SCAN

Your health care team has asked that you have a PET scan for cardiac sarcoidosis. The team may suspect that you have cardiac sarcoidosis if you have sarcoidosis involving other organs, have symptoms of heart failure or damage to the heart muscle, or demonstrate an abnormal heart rate or rhythm. If this is your first PET scan, the scan results may help to make or to confirm a diagnosis of cardiac sarcoidosis, and to provide a baseline image before treatment is begun. On the other hand, if you already have a diagnosis of cardiac sarcoidosis, a PET scan may still be performed before starting treatment to provide a baseline, or may be repeated to help determine if your cardiac sarcoidosis is responding to treatment.

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WHAT IS CARDIAC SARCOIDOSIS?

Sarcoidosis is an inflammatory disease of unknown cause which can affect nearly every organ of the body. At any given point in time, about 140 per 100,000 U.S. African Americans and about 50 per 100,000 U.S. Caucasians have sarcoidosis.¹ Sarcoidosis occurs most commonly between the ages of 20 and 40 years. When sarcoidosis involves the heart, it is called cardiac sarcoidosis. We do not know with certainty how frequently cardiac sarcoidosis occurs in patients with sarcoidosis in other organs, but it is estimated to be higher than 20% in the USA and as high as 50% in Japan.¹ The inflammation from cardiac sarcoidosis can damage the heart in several ways, including weakening the heart muscle so that it cannot pump blood effectively (heart failure) and disrupting the electrical system of the heart resulting in a dangerously low or dangerously high heart rate (heart block or tachycardia, respectively). About 25% of sarcoidosis deaths in the United States are due to cardiac sarcoidosis. Therefore, it is very important that the diagnosis of cardiac sarcoidosis be made as soon as possible so that treatment can be started.

WHAT IS A PET SCAN FOR CARDIAC SARCOIDOSIS?

Until recently, cardiac sarcoidosis has been difficult to detect. Cardiac sarcoidosis is often missed in a

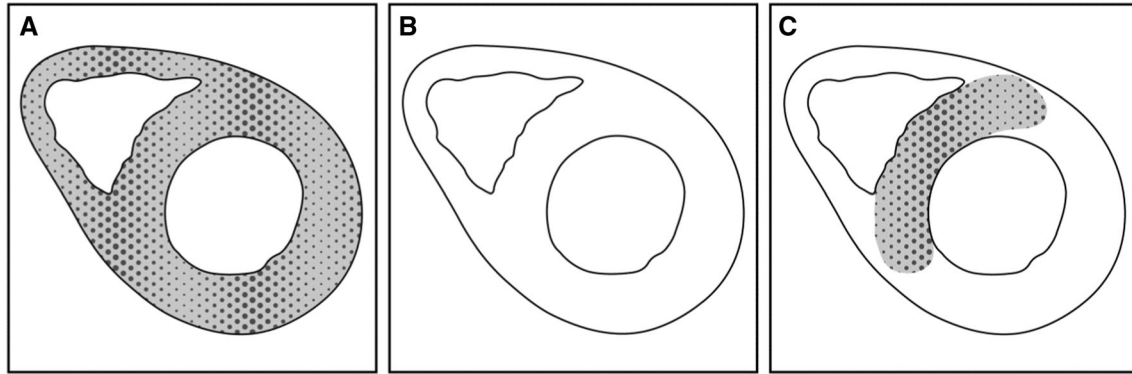


Figure 1. A The heart may take up glucose (and FDG) under normal conditions. The patterned areas in this illustration of the heart represent radioactivity uptake. If there is inadequate dietary preparation for the PET study for cardiac sarcoidosis, the heart may take up FDG in a diffuse pattern as shown in (A). This diffuse uptake will obscure any abnormal FDG uptake in the heart due to inflammation. B With strict dietary preparation for the PET study, a normal heart or a heart that has responded to treatment for cardiac sarcoidosis will demonstrate no heart uptake of FDG. C With strict dietary preparation for the PET study, a heart with cardiac sarcoidosis may demonstrate a focal area of FDG uptake as shown. This emphasizes the importance of the dietary preparation for this type of study.

procedure called a biopsy whereby a tissue sample of the heart is taken because sarcoidosis usually affects the heart in a patchy manner. A newer technique called cardiac positron emission tomography (PET) is now available in many medical centers to help to detect cardiac sarcoidosis without going into the heart to take a tissue sample. PET uses special cameras and small amounts of radioactive material called tracers that are injected into the vein to create heart pictures (also called images). For PET imaging of cardiac sarcoidosis, two tracers are usually used: (1) F-18 fluorodeoxyglucose, also called FDG, to detect inflammation in the heart and other organs, such as the lungs, the liver, the spleen, and the lymph nodes, and (2) a perfusion tracer, generally N-13 ammonia or rubidium-82, to measure blood flow to the heart muscle and also to detect scar. PET images can also show how well the heart is pumping and if the heart is enlarged. Because of PET's ability to find sarcoidosis in the heart and the rest of the body, PET is now recommended by several national and international medical organizations for use in patients with suspected or known sarcoidosis and cardiac sarcoidosis to help make the diagnosis of the disease and to guide treatment.^{1,2}

The PET tracer used to detect inflammation, FDG, is similar to glucose, a naturally occurring sugar in the body. In cardiac sarcoidosis, inflammation in the heart results in more glucose (and also more FDG) being taken up by heart tissue. However, normal heart muscle also takes up glucose (and also FDG). In order to distinguish FDG being taken up in inflamed heart tissue from FDG uptake in normal heart tissue, it is very

important to stop normal heart tissue taking up glucose and FDG (Figure 1). This is done by strictly following dietary and activity instructions which have been carefully designed to stop normal heart tissue from using glucose to enhance our ability to detect inflamed tissue by using PET and FDG.

PREPARING FOR YOUR PET SCAN FOR CARDIAC SARCOIDOSIS

For this type of PET scan, it is *critical* that you follow the dietary and activity instructions provided so that your PET scan will give the most accurate results. An example of a set of instructions is shown in [Appendix](#). Examples of acceptable meals the day before the PET scan for cardiac sarcoidosis are shown in [Figure 2](#). Deviation from the dietary preparation may result in your test being canceled or in a test that gives uncertain results.

TEST PROCEDURE

Once it is determined that you have successfully followed the instructions, an intravenous (IV) line will be placed and you will then lie flat on the bed in the PET scanner (Figure 3). A series of quick scans will be performed for positioning and reference. Then a radioactive tracer (either N-13 ammonia or rubidium-82) will then be injected into your IV. You will not feel any effects from this tracer. This tracer will travel from your veins to your heart and the first set of pictures representing blood flow in your heart muscle will be taken by



Figure 2. Sample meals for the day prior to the PET scan for cardiac sarcoidosis. At least two, preferably three high-fat, low-carbohydrate meals should be consumed before 5 pm the day before the PET scan. Meats should be fried in oil or butter. A list of items to avoid is available in [Appendix](#). Diabetic patients on insulin will need to contact their regular provider to work with the imaging specialists.

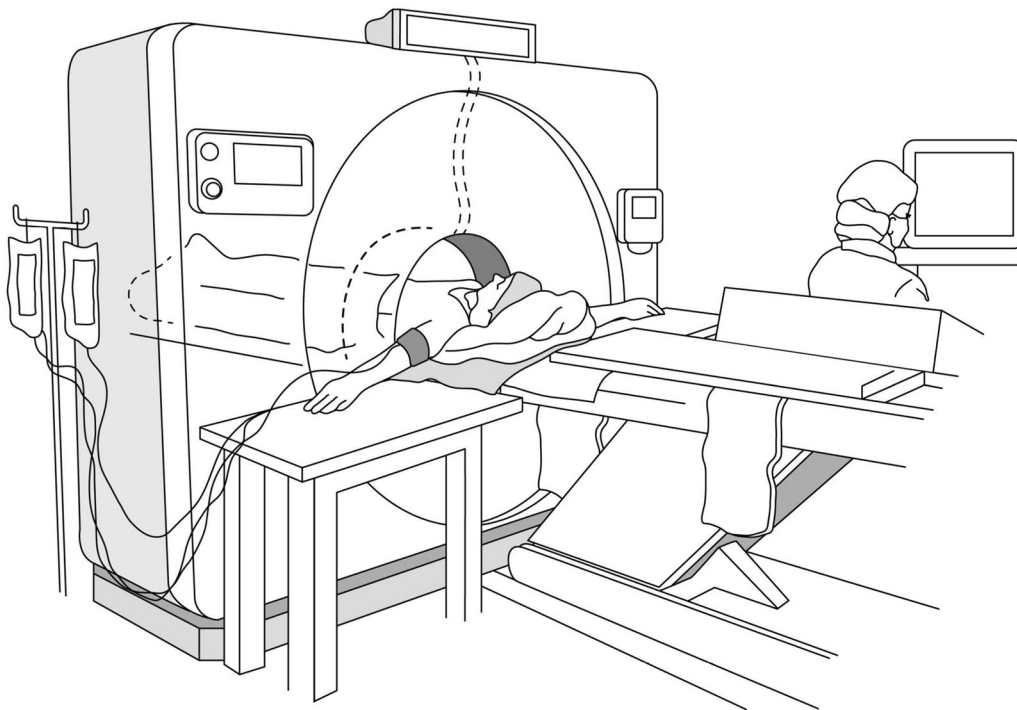


Figure 3. Illustration of PET scanning.

the PET camera. You will then come off the PET bed and go to another waiting area. After a period of waiting, you will receive the second radioactive tracer (FDG) in your IV. You will rest quietly for 60–90 minutes for the tracer to circulate. You will then return to the PET to have the second set of pictures taken by the PET camera to look for inflammation within the heart. Many patients will also undergo a third set of pictures by the PET camera to look for inflammation in other organs of the body without any additional injection of tracer.

UNDERSTANDING YOUR TEST RESULTS

The imaging specialist(s) will interpret your pictures. They will report areas of low blood flow (which may be secondary to permanent damage to the heart from scar or from reversible damage due to inflammation) as well as any areas of inflammation in the heart and in other organs. You and your provider will review these results and determine (1) if the test supports the diagnosis of cardiac sarcoidosis, (2) how active the disease is, and (3) what damage the disease has caused

to the heart. These results will then help inform you and your healthcare team in regards to treatment options.

carefully by your regular provider in conjunction with the specialists performing the PET studies.

RISKS OF THE TEST

This type of PET scan involves a small amount of radiation and has low risk of harmful effects. You should not feel any side effects from the PET tracers or the PET scans. In diabetics on insulin, there is a risk of low blood sugar with the dietary preparation and diabetes treatment such as insulin should be reviewed

Disclosures

The authors have nothing to disclose.

APPENDIX: SAMPLE DIETARY PREPARATION

Step 1->Keep a Log: In the booklet provided write down everything you eat and drink the day prior to the examination. This record will be reviewed prior to your PET scan to determine if the scan will be performed.

Step 2-> The Day Before Your PET scan: Eat at least two to three meals **high in fat** but with **NO carbohydrates** (see suggested meals below).

Suggested meals (choose one of the following for breakfast, lunch and dinner):

- 3 to 5 fatty sausage links fried in oil or butter
- 2 hamburger patties fried in oil or butter
- 3 to 5 fried bacon strips.
- Fried chicken or fatty fish fried in oil or butter. No breading.
- 8 oz. fatty steak fried in oil or butter.
- 3 eggs fried in oil or butter (**NO** milk or cheese).

Drink only water or clear liquids (tea, coffee **without sugar, cream or milk are acceptable**)

DO NOT EAT ANY OF THE FOLLOWING

- Vegetables, beans, nuts, fruits, juices, bread, grains, pasta, candy, or any baked goods.
- Sweetened, grilled or cured meats with additives that contain carbohydrates.
- All dairy products, except butter.
- Sweets, candy, gum, lozenges, and sugar.
- Alcoholic beverages, sodas that contain sugar, fruit juice and sports drinks.
- Mayonnaise, ketchup, tartar sauce, mustard and other condiments.

Step 3-> After 5 p.m. the Day Before Your Test: DO NOT EAT ANYTHING until you have completed your PET scan the following day. You may drink water.

Step 4-> DO NOT EXERCISE 24 hours BEFORE YOUR TEST

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