Table 3. **Cardiac F-18 FDG PET**

Parameter	Recommendation
Tracer dose (mCi)	5-10 (3D mode); 10-15 (2D mode)
Delay after injection (min)	45-60 (nondiabetics); 60-90 (diabetics)
Patient positioning	Supine position (arms up preferred)
Imaging mode	2D or 3D; list, gated or static
Image duration (min)	10-30 (depends on count rate and dose)
Attenuation correction	Before or immediately after emission scan using radionuclide or CT transmission imaging
Reconstruction method	FBP or OSEM
Reconstructed pixel size	2-5 mm

FBP = Filtered back projection, OSEM = Ordered subset expectation maximization (iterative reconstruction)

magnitude of ischemia, scar, and hibernation, but also factors such as low baseline LV ejection fraction, dilated LV volume, delayed time to revascularization, and large scar which may adversely affect the recovery of function post revascularization.

SUGGESTED READING

Dilsizian V, Bacharach SL, Beanlands RS, et al. Imaging guidelines for nuclear cardiology procedures: PET myocardial perfusion and metabolism clinical imaging. J Nucl Cardiol 2009;16:doi: 10.1007/s12350-009-9094-9.

ASNC thanks the following members for their contributions to this document: Writing Group: Sharmila Dorbala, MD (Chair); Ron Blankstein, MD; Fabio Esteves, MD; Maria Sciammarella, MD. Reviewers: Vasken Dilsizian, MD; Edward P. Ficaro, PhD; Christopher L. Hansen, MD.

Table 4. **Elements of a comprehensive FDG report**

Sections	Information included
Demographics	• Patient demographics • Study indications • Coronary anatomy if known
Methods	• Technique and radiotracer dose for perfusion and FDG imaging • Stress test hemodynamic information (when available) • Glucose loading technique (glucose load and insulin)
Findings: MPI and FDG	• Size, severity, and location of the stress (when available) and rest perfusion defects • The magnitude of reversible/fixed perfusion defects • Magnitude of FDG uptake in segments with rest perfusion defects and abnormal wall motion. Describe perfusion-metabolism pattern (match, mismatch, non-transmural match)
Gated MPI	• Left ventricular ejection fraction • Regional wall motion • Left ventricular volumes
Conclusions	• Overall interpretation of the findings (scar, reversible perfusion defects, hibernation, or combined findings) for each affected vascular distribution. • A statement about estimated likelihood of recovery of function based on combining all available pertinent data from study.

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Cardiac F-18 FDG PET

OVERVIEW

The purpose of this document is to specifically identify the critical steps involved in performing and interpreting a myocardial viability study with F-18 labeled fluoro-deoxyglucose (FDG) positron emission tomography (PET). This document will cover **indications, patient preparation, testing procedure, interpretation, and reporting for FDG PET**.

BACKGROUND

The detection of dysfunctional, hibernating myocardium that can be improved by revascularization is important in the management of patients with ischemic heart disease. Hibernating myocardium results from the functional adaptation of the myocardium to reduced resting myocardial perfusion. PET with F-18 FDG is widely used in the evaluation and management of patients with suspected ischemic left ventricular (LV) systolic dysfunction.

INDICATIONS

FDG PET imaging is indicated for patients with LV dysfunction due to coronary artery disease who are eligible for coronary revascularization and have resting myocardial perfusion defects in order to differentiate viable (i.e., hibernation) from non-viable myocardium (i.e., scar).

PATIENT PREPARATION

The test should be performed following a 6- to 12-hour fast followed by a glucose load. Under glucose-loaded conditions, FDG uptake by the normal myocardium is maximized, resulting in superior image quality and reduced regional variation in FDG uptake. There are several approaches to stimulate myocardial glucose uptake following oral or intravenous (IV) glucose loading. The most common method is to use 25-100 g of oral glucose followed by supplemental IV insulin as needed (Tables 1 and 2). Use of IV insulin (even in non-diabetic patients) is desirable whenever feasible in order to promote maximum uptake of FDG by the normal myocardium and optimal image quality. Following FDG injection, monitoring of the patient's glucose levels should be continued until a stable glucose level is ensured and the patient is asymptomatic.

Diabetic Patients: Diabetic patients have a limited ability to produce endogenous insulin and are less responsive to insulin. For these reasons, standard glucose loading techniques may be less effective in such patients. The use of higher doses of insulin accompanied by the close monitoring of blood glucose (Table 2) can yield satisfactory results. Alternative protocols such as the euglycemic hyperinsulinemic clamp or the use of acipimox are listed in the *ASNC Imaging Guidelines for Nuclear Cardiology Procedures*.

TEST PROCEDURE

1. Gated rest myocardial perfusion single photon emission computed tomography (SPECT) or PET should always precede FDG cardiac PET imaging so that areas of hypoperfusion are identified. ECG-gated myocardial perfusion imaging (MPI) can also provide additional useful information regarding the LV volumes. A severely dilated left ventricle is unlikely to recover global function even if FDG uptake is present in segments with contractile dysfunction.
2. Unless contraindications for stress testing exist, it is suggested that stress MPI be performed to identify the presence and amount of reversible perfusion defects. This is because patients with moderate-to-severe

(>10%) reversible perfusion defects will likely benefit from revascularization. When possible, the rest/stress perfusion images should be interpreted prior to initiating the FDG study because if there are moderate-to-large reversible perfusion defects or normal rest perfusion, then the need for FDG PET imaging may be obviated.

3. If myocardial perfusion SPECT was performed without attenuation correction or gating, consider obtaining another resting perfusion study with Rubidium-82 or N-13 ammonia PET to ensure that the SPECT perfusion defects are not artifactual from soft-tissue attenuation. If PET MPI is not available, SPECT perfusion images should be interpreted in conjunction with regional wall motion assessment to ensure that attenuation artifacts are not interpreted as perfusion defects. When available, correlation with ventricular function assessment by other modalities such as echocardiography or cardiac magnetic resonance imaging may also be useful.
4. FDG PET acquisition parameters are described in Table 3.

INTERPRETATION

1. The interpretation of FDG images typically includes a comparison of myocardial perfusion to myocardial metabolism.
2. FDG uptake is assessed in regions with reduced perfusion and regional wall motion abnormality.
3. Three major patterns of perfusion metabolism comparisons can be seen and quantified (Figure 1).
   a. Reduced myocardial perfusion with preserved FDG uptake is a mismatch pattern and represents hibernating myocardium. This is the classic pattern associated with a high likelihood of functional recovery following revascularization.
   b. Absent myocardial perfusion with absent FDG uptake is called a match pattern and represents transmural scar. This is the classic pattern associated with a low likelihood of functional recovery following revascularization.
   c. Partially reduced myocardial perfusion with concordant FDG uptake is a non-transmural match pattern representing non-transmural scar. This pattern is unlikely to recover function unless there is associated stress-induced reversibility.

REPORTING

1. A comprehensive FDG report includes distinct sections on demographics, methods, findings, and conclusions as shown in Table 4.
2. The conclusions typically include a statement about the estimated likelihood of recovery of function (e.g., low, intermediate, or high) following adequate revascularization to the jeopardized segments. This statement should be based on integrating all pertinent information from the study—including not only the

Figure 1. **Patterns of perfusion and metabolism**

Myocardial perfusion using Rubidium-82 (left) and myocardial FDG uptake (right) in the corresponding segments.

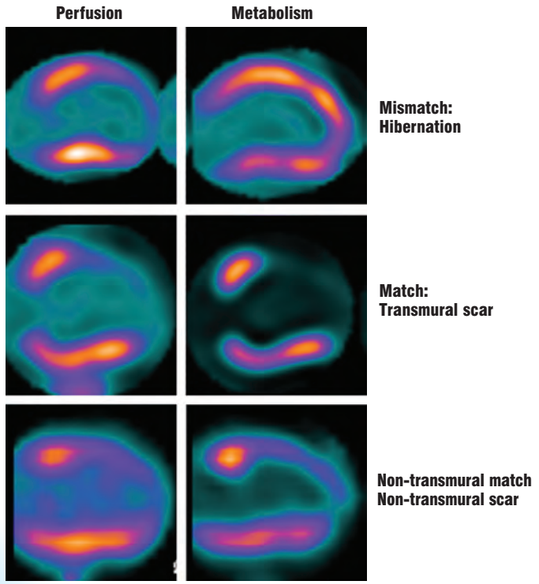

Table 1. **Patient preparation guidelines: an overview of oral glucose loading protocol**

PROCEDURE	STEPS	TECHNIQUE
Fasting period	STEP 1: Fast patient 6-12 hrs STEP 2: Check blood glucose (BG) and then glucose load IF: fasting BG < ~ 250 mg/dL* → oral glucose loading (25-100 g orally) IF: fasting BG >~ 250 mg/dL* → no glucose loading necessary STEP 3: Insulin administration (see Table 2)	Preferred Standard Standard
FDG injection	STEP 4: Administer 5-15 mCi of FDG if blood glucose is <150 mg/dL (preferable)	Standard
Begin PET imaging	STEP 5: Imaging acquisition IF: quantification of glucose rate is desirable: initiate imaging immediately following FDG injection (dynamic or list mode) IF: qualitative analysis assessment is desirable: initiate imaging 45-90 minutes after FDG injection (use gating whenever feasible)	Standard Standard Standard
Check image quality	STEP 6: Image quality assessment If increased blood pool activity is present in the images, additional IV insulin may be administered and FDG images can be reacquired 20-30 minutes later	Standard

*250 mg/dL = 13.9 mmol/L

Table 2. **Guidelines for blood glucose maintenance (e.g., after oral glucose administration)**

BG at 45-90 minutes after administration	Possible restorative measure
130-140 mg/dL (7.22-7.78 mmol/L)	1U regular insulin IV*
140-160 mg/dL (7.78-8.89 mmol/L)	2U regular insulin IV
160-180 mg/dL (8.89-10 mmol/L)	3U regular insulin IV
180-200 mg/dL (10-11.11 mmol/L)	5U regular insulin IV
>200 mg/dL- (>11.11 mmol/L)	Notify physician

BG = blood glucose
IV = intravenous
U = unit

*Optional, may consider if total amount of insulin administered is low.