**FDG PET/CT Patient Preparation & Scanning (Rev. 6-11-24)**

**From ACR-ACNM-SNMMI-SPR Practice Parameter for Performing FDG-PET/CT in Oncology**

[**https://www.acr.org/-/media/ACR/Files/Practice-Parameters/FDG-PET-CT.pdf**](https://www.acr.org/-/media/ACR/Files/Practice-Parameters/FDG-PET-CT.pdf)

The major goals of preparation are to minimize radiopharmaceutical uptake in normal tissues, such as the myocardium, skeletal muscle, and brown fat, while maintaining uptake in target tissues (neoplastic disease). The preparation should include, but not be limited to, the following:

1. Prior to appointment:
	1. Instruct patients to avoid strenuous activity 24 hours prior to FDG injection.
	2. Recommend low-carbohydrate meals for 24 hours prior to FDG injection.
	3. No caffeine, alcohol, or nicotine 12 hours prior to FDG injection.
	4. Provide fasting instructions (a minimum of 4 hours) with no parenteral nutrition or oral/intravenous fluids containing sugar or dextrose for the same period. No candy, mints, gum, or over-the-counter medicines containing sugar. Even “sugar-free” items may contain traces of sugar.
	5. Encourage oral hydration with a goal of 1 L (34 oz) in 2 hours prior to appointment.
	6. Prescription medications should be taken as directed.
	7. Discontinue metformin 48 hours before the study.
	8. Determine whether there is a history of iodinated contrast allergy and determine renal function if a contrast-enhanced CT portion of the examination has been requested.
	9. If a patient requires sedation or general anesthesia, individual institutional policies should be followed.
2. Prior to FDG injection [20,31,32]:

Perform pregnancy testing when appropriate and in accordance with institutional policies (see the [ACR–](https://www.acr.org/-/media/ACR/Files/Practice-Parameters/Pregnant-Pts.pdf?la=en) [SPR Practice Parameter for Imaging Pregnant or Potentially Pregnant Patients with Ionizing Radiation](https://www.acr.org/-/media/ACR/Files/Practice-Parameters/Pregnant-Pts.pdf?la=en)) [20].

* 1. Review the patient’s history with attention to:
		1. Reason for examination (symptoms, diagnoses, and recent imaging examinations)
		2. Treatment (surgical, radiation, and/or chemotherapy)
		3. Medications
		4. Recent trauma/exercise
		5. Presence of concurrent infection
		6. Presence of diabetes
		7. Specific details and dates should be obtained whenever possible.
	2. Consider premedications:
		1. Anxiolytics can be administered in patients with claustrophobia or anxiety. Oral alprazolam (0.5 mg given 10–60 minutes prior to FDG injection) is an option. Patients must be counseled against driving given the medication’s sedative and motor-impairing effects, and it is recommended that the patient should sign a form agreeing to this.
	3. Oral beta-blockers (such as propranolol 20 mg) can be administered 60 minutes prior to injection or benzodiazepines (such as diazepam 5 mg) 10–30 minutes prior to injection to help minimize physiologic brown fat uptake. For pediatric patients, 0.10 mg/kg of oral diazepam or 1 mg/kg oral propranolol can be given, but the combination of warming blankets and propranolol in this patient population best reduces brown fat uptake [33]. Keep the patient warm:

The patient should be advised to remain warm 24 hours prior to FDG injection. In addition, the patient can be kept warm with warming blankets prior to and after FDG injection. This helps minimize physiologic brown fat and may be preferable to giving the patient medications for this purpose.

* 1. Serum glucose analysis performed immediately prior to FDG administration (<200 mg/dL acceptable)
		1. If the serum glucose is >200 mg/dL, but <300 mg/dL, contact the interpreting physician for further instructions. If the serum glucose is >300 mg/dL, then the patient should be rescheduled. Of note, if the patient did in fact properly follow fasting instructions, the referring physician may need to be informed about testing the patient for diabetes and/or consider referring the patient to urgent care or the emergency department in cases of extremely high blood glucose levels.
	2. Diabetic patient guidelines:
		1. PET scan should be scheduled early in the morning (if possible) as this is the time that most diabetic patients have the lowest glucose level. However, some diabetic patients may have lower glucose levels in the afternoon, and for these patients an afternoon appointment is preferable.
		2. Diabetic patients should take their usual insulin the day before. After midnight, patients should fast (except for water).
		3. A low- or no-carbohydrate diet the evening prior to the PET/CT may improve glycemic control.
		4. On the morning of the PET scan, hold all insulin if FDG injection is scheduled in the early morning.
		5. Oral diabetic medications can be taken as prescribed (see prior comments on metformin).
		6. If PET scan is scheduled after 10 AM, patient should eat a low-carbohydrate breakfast at least 4 hours before the injection and should receive half of the usual regular (short-acting) insulin. Do not use long-acting or mixed (70/30) insulin after midnight.
		7. If the patient is on an insulin pump, it is preferred that it is turned off 4 hours prior to the study, but if unable to, the setting should be on the night/basal setting during the PET scan. After the PET scan, settings can be adjusted as prescribed.
		8. After completion of the PET scan, patients should be encouraged to eat a meal immediately. It may be advisable for patients to take half of the usual morning dosage of insulin with the post- PET meal.

Technologist should inform the interpreting physician if the patient has hyperglycemia >200 mg/dL or hypoglycemia with symptoms. In these situations, waiting approximately 20 to 30 minutes and repeating a finger-stick glucose measurement should be considered prior to rescheduling the patient.

1. Following injection (uptake period) [34,35]:
	1. Have the patient remain seated or recumbent in a quiet room during uptake period (decreases muscle uptake). Additionally, in adult patients with head and neck cancer, oral alprazolam 0.5 mg given immediately after FDG injection reportedly can reduce skeletal muscle uptake that can impede lesion detection and confound scan interpretation [35].
	2. The uptake room should be dimly lit if the patient is to undergo brain imaging.
	3. Patients should void immediately prior to being positioned on the PET/CT table for imaging. In special circumstances, intravenous hydration, diuretic administration, and/or bladder catheterization can be used to reduce radiation burden and artifacts related to accumulated physiologic radiopharmaceutical activity in the ureters and urinary bladder.
	4. Consider use of sedation as necessary in younger children or developmentally delayed patients (see the [ACR–SIR Practice Parameter for Minimal and/or Moderate Sedation/Analgesia](https://www.acr.org/-/media/ACR/Files/Practice-Parameters/Sed-Analgesia.pdf?la=en) [34]).
2. Lactating Patients
	1. Nursing mothers should express/pump milk prior to the study.
	2. Per recent Advisory Committee for Medical use of Isotopes (ACMUI) guidelines, nursing should be interrupted for 4 hours following 18-F FDG injection [36].

C. Radiopharmaceutical

**For adults, the generally accepted range for administered activity of FDG is 185 to 740 MBq (5-20 mCi)** [37]. However, the administered activity could be below 5 mCi with a weight-based approached or depending upon the type of PET detector being used.

For children, the administered activity of FDG should be determined based on body weight and should be as low as reasonably achievable (ALARA) for diagnostic image quality.2 Per the 2016 Update of the North American Consensus Guidelines, pediatric FDG administered activity should be 3.7–5.2 MBq/kg (0.10-0.14 mCi/kg), a minimum of 26 MBq (0.7 mCi) for body and 3.7 MBq/kg (0.10 mCi/kg, a minimum of 14 MBq (0.37 mCi) for head [38].

The specific administered activity typically depends upon the local imaging protocol. The local protocol may require a standard activity, or the activity may vary as a function of various parameters, such as patient size, scanning mode (2-D versus 3-D), percentage of scan bed (slice) overlap, or clinical indication. For variable dosages, other means of determining the administered activity can be based upon a combination of factors, for example, as outlined in European Association of Nuclear Medicine guidelines [29], which use the patient’s weight, duration of bed positions in minutes, and percent bed position overlap in certain PET/CT systems (some systems do not use bed positions). The variable dose calculation’s goal is to optimize a personalized dosage with the ALARA principle. Without a dedicated dosage injector with the ability to precisely elute a calculated dosage, a fixed dose with a range may be more practical for adults.

With PET/CT, the radiation dose to the patient is the combination of the dose from the PET radiopharmaceutical and the dose from the CT portion of the examination. Lower administered activities or changes in CT parameters resulting in decreased radiation dose may be appropriate with advances in PET/CT technology.

When feasible, the radiopharmaceutical should be injected intravenously at a site away from sites of known or suspected disease. If peripheral IV access is not achievable, a central line can be used but must be sufficiently flushed with normal saline.

D. Protocol for CT Imaging

2For more specific guidance on pediatric dosing, please refer to the *Pediatric Radiopharmaceutical Administered Doses: 2010 North American Consensus Guidelines.*

The CT performed as part of a PET/CT examination provides attenuation-correction information and diagnostic information that may be relevant to both PET interpretation and overall patient care. A variety of protocols exist for performing the CT scan in the context of PET/CT scanning. In some cases, low-dose CT scans are designed primarily to provide attenuation correction and anatomic localization. In other cases, the CT portion of the examination is performed with intravenous and/or oral contrast media and optimized CT parameters designed to lower image noise. If a diagnostic CT scan is requested as part of PET/CT, the CT protocol appropriate for the body region(s) requested should be used. Regardless of the CT technique used, a careful review of CT images is necessary for comprehensive interpretation of the PET/CT examination.

For a diagnostic CT scan of the abdomen and/or pelvis, intraluminal gastrointestinal contrast media may be administered to improve visualization of the gastrointestinal tract unless medically contraindicated or unnecessary for the clinical indication. This may be positive-contrast media such as a dilute (2%) solution of a water-soluble iodinated contrast agent–diluted barium sulfate or diatrizoic acid or negative-contrast media such as water [39]. Highly concentrated barium collections may result in an attenuation-correction artifact that may lead to overestimation of the regional FDG concentration and should be avoided. Dilute barium sulfate and oral iodinated contrast media cause less overestimation and are less likely to have an adverse impact on PET image quality [40- 42].

When indicated, the CT scan can be performed with intravenous contrast media using appropriate injection techniques. It has been shown that there is no statistically significant or clinically significant interference with standardized uptake values (SUVs) on PET/CT due to intravenous contrast administration [43].

Breathing patterns during CT acquisition should be optimized so that the positions of the diaphragm on the PET emission and the CT transmission images match as closely as possible.

If a single breath-hold technique is used for CT imaging, optimal alignment of the PET and CT images is obtained with respiration suspended in the quiet end-expiratory (end–tidal volume) phase. If respiration is not suspended during CT imaging, the patient should be coached on shallow/quiet breathing. To optimize breathing pattern, gating of the PET and/or CT can be performed in more modern PET/CT scanners.

E. Protocol for PET Imaging

Emission images are acquired immediately after CT and are generally obtained 60 minutes following radiopharmaceutical administration. However, this time period may be shorter (no less than 45 minutes) or longer for certain trials or unique clinical situations. Note that consistency of SUV measurements depends on strict observance of the uptake time [44].

Emission image acquisition time typically varies from 1–5 minutes or longer per bed position for body imaging and is based on the administered activity, patient body weight, and the sensitivity of the PET device (as determined largely by the detector composition and acquisition method). Acquisition time can be adjusted in certain clinical situations to provide higher count images in a given anatomic area.

Iterative reconstruction techniques have largely replaced filtered back projection, and when used with time of flight, image quality can be maintained while reducing administered FDG activity. Of note, new scanners may utilize artificial intelligence/machine learning–based reconstructions or Bayesian penalized-likelihood reconstruction algorithms as methods.

Semiquantitative estimation of FDG accumulation using the SUV is based on local radioactivity concentration measured on images corrected for attenuation and normalized for the injected activity and body weight, lean body mass, or body surface area. The accuracy of SUV measurements depends on the accuracy of the calibration of the PET device, among other factors. SUV is utilized in determining tumor response over time. Measures should be taken to minimize the factors that may affect it and should include using the same scanner configuration on subsequent examinations (including reconstruction algorithms, attenuation maps, etc), maintaining the same interval between injection and scanning, avoiding infiltration of injected activity, and using the same measurement.

**PET/CT Scan Technique**

1. Patient Positioning:

 - Supine, arms up.

2. Scan Coverage:

 - Skull-base to mid-thigh. (For melanoma cases, perform whole body scan from top or skull through feet)

3. CT Acquisition:

* Non-contrast, axial 3 mm low dose attenuation correction CT. This scan is not of diagnostic quality and is performed merely for attenuation correction.

 CT parameters:

 Slice thickness: 3mm

 Tube voltage: 120-140 kVp

 Tube current: 30-80 mA

4. PET Acquisition:

3D mode, 2–3-minute scan time/bed position or as per manufacturer parameters.

5. Image Reconstruction (To be sent to PACS):

* Ax PT non-attenuation corrected NAC
* Ax PT AC
* Cor PT NAC
* Cor PT AC
* Rotating 3D PT MIP (Full 360-degree rotation)
* Ax, Sag, & Cor Fused images.

**[Note: AC-Attenuation Corrected; NAC- Non-Attenuation Corrected]**