

HOW TO GET THE MOST FROM FDG PET TUMOR IMAGING

Patient Preparation For FDG PET Imaging Studies

Patient preparation for FDG PET studies is perhaps more critical and more complex than for any other commonly performed imaging study. PET Imaging depends on the in vivo distribution of the glucose analog, F-18 Fluorodeoxy-D-glucose, in normal tissues and on the increased glucose uptake of neoplastic tissue.

As glucose is one of the key energy substrates for nearly every aspect of cellular function, the distribution of any tracer analog of glucose is complex. As the brain uses glucose as its sole energy source, it is not surprising that maximal FDG activity after IV injection is present in cerebral gray matter. In contrast, the myocardium is omnivorous. Under fasting conditions, fatty acids are the “preferred” substrate for myocardial metabolism but in some patients, glucose is utilized under such conditions. Other metabolically active organs utilize glucose to a substantially lesser degree than brain and heart. Hence, imaging after FDG injection reveals a complex FDG distribution pattern, that is useful in localizing sites of abnormal uptake, providing an “anatomic backdrop” in normal organs.

There are several differences between the uptake and metabolism of FDG compared with unlabeled glucose. Both molecules are transported into cells by the same glucose transporter proteins and phosphorylated by hexokinase. FDG, however, cannot be further metabolized and is trapped within the cell as a consequence of the phosphorylation, whereas glucose is either stored as glycogen or rapidly metabolized. Unlike glucose, FDG is not reabsorbed by the renal tubule, and is excreted; therefore, there is activity in the renal collecting system and bladder. Because of the renal excretion, good hydration prior to the study minimizes activity in the collecting system.

As a glucose analog, FDG competes with glucose for transport into cells. Consequently, hyperglycemia in diabetes or patients on steroids will competitively inhibit FDG uptake into both normal tissues and tumor, significantly decreasing FDG uptake. Blood glucose levels below 200 mg/dl are not felt to affect overall study sensitivity but it is possible that in patients with subtle or small lesions, even levels below 200 mg/dl may have some deleterious effect. Above 200 mg/dl, we will not go forward with the test and will refer the patient back to the referring physician for better diabetic control prior to imaging.

Insulin has a profound effect on FDG uptake. In patients with elevated insulin levels, either due to failure to fast or to recent administration of short-acting insulin or even earlier administration of long acting insulin, FDG is shunted to skeletal muscle and a lesser extent fat. FDG uptake in tumor may be dramatically reduced or even abolished. Insulin-dependent diabetics should hold insulin on the morning of the test where possible. Long acting insulin should be held at least overnight. As sulfonylureas may cause hypoglycemia in fasting patients with “mild” diabetes, it is generally preferable to hold them on the morning of the test. Other medications used to treat diabetes do not have this effect.

Other activities that may affect FDG distribution include exercise (increases glucose metabolism in muscles), tobacco use on the day of the test and caffeine (for brain studies). While there is variable FDG uptake in stomach and colon particularly (but occasionally in small bowel), it is not clearly understood how this uptake can be minimized. False positive FDG uptake can occur in a variety of inflammatory and infectious lesions as well as in cellular benign tumors and it is important that these factors, if known, be communicated to us at the time of the test scheduling.

FDG PET imaging is an easily-tolerated test for patients albeit a relatively lengthy one. Patients should wear comfortable clothes. If they are anxious or claustrophobic, benzodiazepines may be helpful. These drugs also are useful in anxious patients to prevent the often confounding FDG uptake in brown fat that may be seen in anxious or shivering patients.

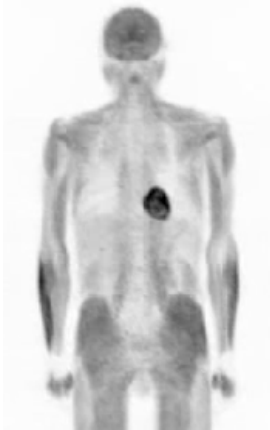
At the time of scheduling, our staff discusses the following instructions with the patients, but it is also important that you understand how these factors may affect test results. They are also outlined on the reverse side of our new Request forms. As always, if you have any questions, please do not hesitate to call.

Summary:

1. Patients should be fasting for at least 4 – 6 hrs. This must include chewing gum, diet soda, candies, cough drops and glucose-based syrup medications such as cough preparations.
2. Patients should be well hydrated with **water only** on the day of the test. One glass of water for every hour prior to the exam.
3. No glucose-containing IV fluids or enteral or parenteral nutrition for inpatients.
4. Patient should not exercise strenuously on the day before or on the day of the test.
5. Refrain from smoking on the day of the test.
6. In diabetics, moderate to good control is imperative such that blood glucose at the time of the test is below 200 mg/dl.
 - a. No short acting insulin, if possible, on the day of the test. Schedule diabetic patients early in the morning and ask them to bring medications with a small snack.
 - b. No long-acting insulin for at least 12 hrs prior to the study.
 - c. Hold anti-diabetic medications on morning of the study.

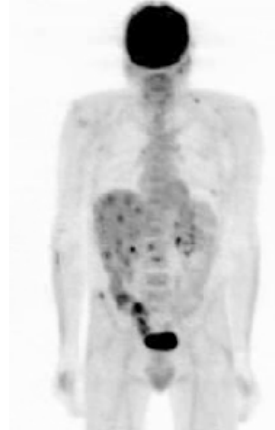
Below is a sample of a patient that was not properly prepped; then ten days later was properly prepped:

BAD PREP
Initial Study



There is increased FDG uptake in both skeletal and cardiac muscle. A PET scan can look like this if the patient ate, had glucose, insulin, or exercised prior to the study possibly hiding metastases.

GOOD PREP
10 Days Later



Multiple abnormal focal areas of uptake are identified that were not apparent on the earlier study. **Proper patient preparation is important to optimize lesion detection.**