

Listen to the associated podcast episodes available at theradiologyreview.com or on your favorite podcast directory.

What are some basic ways to tell between a general nuclear medicine scan (using gamma cameras) and a PET scan?

PET scans are higher quality, a maximal intensity projection (MIP) image means you are looking at a PET scan, a planar image means you are looking at a general nuclear medicine (gamma camera) scan. Note that fused images can be SPECT/CT or PET/CT (or PET/MR) and the fusion alone does not mean it is a PET scan.

What type of general nuclear medicine scan is characteristic on board exams for having a super-hot spleen?

Tagged white blood cell scan. Note that tagged WBC scans can be Tc or In111. Tc may be preferred in kids (shorter half-life—lower dose and higher quality imaging of smaller anatomy). In111 offers advantage of more delayed imaging and less bowel uptake (indium WBC scan best for inflammatory bowel disease evaluation). An octreotide scan can also have really hot spleen but generally has more counts (looks like a higher quality study) and also has robust kidney uptake without bone uptake. If they show you tagged In111 WBC scan with really hot kidneys you should consider pyelonephritis or causes of renal inflammation that may include recent chemotherapy.

Tc WBC scan: 4 and 24 hour imaging common, has renal and GI activity. Lungs hot on 4 hour imaging, GI tract hot on 24 hour imaging.

In111 WBC scan: No renal and no GI activity for contamination, lower count study (due to longer half-life and lower injected doses, also less optimal energies for gamma camera imaging).

For whole body iodine scans with I131 or I123 what is the expected uptake in the liver, in the heart, and in the bones/marrow?

I131 and I123 scans are not expected to have uptake in the heart, kidneys or bones/marrow. Liver uptake is not present normally on a pre-treatment iodine body search but can be seen on a post-therapy scan. See here for more info: <https://pubmed.ncbi.nlm.nih.gov/9255147/> You can have some slight gastric and bowel uptake with salivary secretion of iodine and normal nasopharyngeal uptake. Of course, you expect thyroid uptake and uptake in any potential thyroid cancer metastases.

Bonus: What is the next step if you see a negative whole body iodine scan in a patient with history of thyroid cancer with a rising, elevated thyroglobulin level?

Get an FDG-PET/CT scan. Concern for de-differentiated thyroid cancer that no longer takes up iodine but would then be expected to be aggressive and glucose hungry—thus FDG avid.

What are key features of a gallium 67 scan?

Lacrimal gland uptake. Bone uptake. Lack of splenic and renal uptake. Count poor study due to non-optimal energies for gamma camera imaging (roughly 100, 200, 300, 400 keV) and long half-life (78 hours) meaning the injected dose needs to be lower to minimize radiation exposure.

Listen to the associated podcast episodes available at theradiologyreview.com or on your favorite podcast directory.

Key nuclear medicine point: The shorter the half-life, the higher the dose that can be safely injected, and the higher quality the imaging will be. Longer half-life radiopharmaceuticals generally result in count poor studies as injected doses have to be lower to maintain lower radiation exposures to patients.

Beyond a gallium 67 scan, what other general nuclear medicine scan can demonstrate hot lacrimal glands?

Tc-99m Pertechnetate scan (aka free tech). Can distinguish from a gallium scan because it will be a higher count/higher quality study and show some splenic uptake

What areas are expected to show physiologic uptake on a sulfur colloid scan?

Sulfur colloid scan aka bone marrow scan (as well as many other scans)—expect bone uptake. Additional characteristic feature is splenic uptake roughly equal to hepatic uptake (or sometimes liver slightly above spleen). Note that colloid shift means the spleen has more uptake than the liver due to increased portal venous pressure—thus the normal colloid pattern has “shifted” towards increased splenic (and bone marrow uptake) and this is a sign of portal hypertension/end stage liver disease. With colloid shift the spleen is also often bigger than the liver.

What are characteristic areas of uptake on a free technetium scan (aka Tc pertechnetate)?

Salivary gland, thyroid gland, and gastric uptake are key signs that free technetium is present. Sometimes free tech is intentionally used as the primary imaging agent (such as for a Meckel’s diverticulum scan), other times it is a contaminant (such as on a bone scan, tagged RBC scan, or any other study where Tc99m is supposed to be bound to a pharmaceutical).

How do you tell an F18 sodium fluoride PET scan from a Tc99m MDP bone scan?

The distribution of uptake will be similar (bones with some renal and soft tissue uptake). However, the F18 sodium fluoride PET scan will look much higher quality than the MDP bone scan.

How can you tell an F18-FDG-PET/CT with bone marrow stimulation scan from an F18-sodium fluoride PET scan?

Probably the easiest thing is to look at the brain. If the brain is hot then you are looking at an FDG scan with bone marrow stimulation.

If you see cardiac uptake on a general nuclear medicine scan, what agents should you think of first?

Think sestamibi, thallium, or MIBG scan first. Cardiac uptake is not typically seen with gallium, indium, iodine, free tech.

What type of general nuclear medicine scan is most characteristic on board exams for having really high cardiac and kidney uptake?

Tc-99m sestamibi scan. Remember this is one of the myocardial perfusion agents so cardiac uptake would be expected. Other uses include molecular breast imaging for breast cancer imaging and parathyroid adenoma imaging. Bowel uptake is also common and can cause scaling artifacts in the inferior wall of the heart on a sestamibi myocardial perfusion scan. Thallium could show heart and

Listen to the associated podcast episodes available at theradiologyreview.com or on your favorite podcast directory.

kidney uptake as well but you would be much less likely to be shown a thallium scan of the whole body. MIBG has cardiac but not classic renal uptake.

What are key signs that a scan you are looking at is a fluciclovine PET/CT?

First step is to identify that you are looking at a PET scan by identifying the superior image quality compared to gamma camera imaging. Next, look for brain activity. If the brain is hot, you are likely looking at an FDG PET scan. If there is no brain activity, the next thing I do is look at the pancreas. If the pancreas is super-hot this is probably a fluciclovine study. Hepatic uptake and muscular uptake are also common with fluciclovine PET/CT studies. Fluciclovine scans start very soon after injection and start from the pelvis up so urinary and bladder activity should be at a minimum.

What are key signs that a scan you are looking at is a Dotatate PET/CT?

Similar to above, confirm that it is a PET scan and confirm lack of brain activity to exclude that it is an FDG PET scan. Dotatate PET scans do have normal pituitary region uptake and that is a first indication to me that this is a Dotatate PET scan. Next, I look for a super-hot spleen and kidney and liver uptake with lack of diffuse pancreatic uptake. If I see that pattern then I know this is a Dotatate PET scan. Note that Dotatate uptake is normal in the pancreatic uncinata process but will not be seen diffusely through the pancreatic body as in fluciclovine.

How do I tell the difference on a VQ scan between a xenon ventilation vs Tc-DTPA ventilation scan?

If you see multiple projections for ventilation it is a Tc-DTPA scan. If you see wash-in and washout-out images, and imaging in a single projection, it is a Xenon ventilation scan.

What is the normal distribution of a thallium 201 scan?

Thyroid, salivary gland, heart, lung, liver, spleen, skeletal muscle, bowel, kidneys, bladder. Basically, everything because it is a potassium analogue and normal tissues use potassium. However, don't expect a full-body scan for thallium. You would most commonly see a thallium scan of the heart for viability or the brain for toxoplasmosis (no uptake) vs lymphoma (has uptake) or necrosis (no uptake) vs tumor (has uptake), less likely a thorax scan for lung to heart ratio although that would be more likely on the nucs subspecialty exam or nucs section of a certifying exam.

If you are shown a CSF imaging study what is the likely radiopharmaceutical?

In-111 DTPA is the most common tracer injected for intrathecal use.

If you are shown a gastric emptying scan what is the most likely radiopharmaceutical?

Tc-99m sulfur colloid

What are some ways to tell the difference between a Tc-MAG3 vs Tc-DMSA scan?

MAG3: see renal cortical uptake, transit, and excretion into bladder. If you see time-activity curves it is MAG3. Tc-DMSA: renal cortical uptake only. Will not see excretion into bladder.