

## **Interview with David Djang, MD On PET Scan in Oncology: Principles and Practice**

**By Howard (Jack) West, MD  
May, 2009**

Dr. West: Hello and welcome to the GRACE audio podcast on PET scanning. This one is with Dr. David Djang, who is the Director of Nuclear Medicine at Swedish Medical Center in downtown Seattle. My name is Jack West; I'm a medical oncologist here at Swedish and also the President and CEO of GRACE, the Global Resource for Advancing Cancer Education. Thanks for joining me.

Dr. Djang: Thanks for having me.

Dr. West: A transcript as well as a PDF file with copies of figures associated with this program are available at [www.cancergrace.org/GRACEcasts](http://www.cancergrace.org/GRACEcasts).

So let's just start with a basic question of what is the basic principle behind PET scans. What do they do?

Dr. Djang: So, PET scan stands for "positron emission tomography", and the tracer that is most commonly used for PET scans is FDG, called fluorodeoxyglucose. And just to put it in simple terms, fluorodeoxyglucose is just a glucose analog that's radioactive. So, you can think of it as sugar that glows in the dark. So, you inject people with this tracer, this "hot sugar" if you will. The PET scan is a specially designed scanner to pick up where there is hot sugar localizes. The idea in use for oncology is that the cancer cells, because they're very active, growing, they eat up more sugar than a non-cancerous cell and so the cancer cells will collect this tracer and then on the scan they will appear brighter than a normal tissue will.

Dr. West: How does a patient prepare for a PET scan? What's the actual procedure like for them?

Dr. Djang: Typically, we'll have them fast from roughly midnight on the night before the scan and then no breakfast that morning. The idea is that if you're eating, anything that you eat is going to have at least some sugar or carbohydrates in it and that sugar can compete with the tracer that we're giving you. So we want you to come in on an empty stomach. We ask you not to do any vigorous exercise for a couple days before the PET scan. Any vigorous exercise would stimulate the muscles to soak up the sugar or carbohydrates that are already in your body. So, again, we try to prepare you as best we can to get the PET scan under the best conditions possible.

And then on the day of the scan, you simply come in, all you need is an IV started. It's only a small amount of pain or inconvenience. Then the tracer is given. After that we want you to relax and lie comfortably for maybe 45 minutes or an hour that lets the tracer circulate in your body. And then after that you lay down on the scanner. The scanner itself it's a ring scanner so it does look like you're going through donut, so to speak, but its not the, if anyone's ever had an MRI, that's actually a long tube. The MRI can actually be somewhat claustrophobic for people sometimes. We really don't get those complaints on the PET scanner.

Dr. West: How long is the time line from coming in to completing a PET scan?

Dr. Djang: For the actual time of being in the facility, you should probably plan on a few hours.

Dr. West: We get reports from PET scans that describe an SUV. What is that, and how is that used in interpreting what the scan means?

Dr. Djang: The SUV stands for "standardized uptake value" and it's just a number, the number we give in reports, maybe 4, maybe 10, maybe 12, something like that. In the end, all the SUV really represents is it's just a way for me to tell how bright the tissue is on the scan that I'm measuring. It's just a measure of how bright its showing up on the scan. It lets me quantify it.

Dr. West: Is there any threshold number that can clarify what represents cancer versus inflammation or infection?

Dr. Djang: This has been a very well studied question. The bottom line is no. There are people that have been looking at this for maybe 15 years. All kinds of people with great aspirations worldwide that would love to have their name associated with the magic number for SUV that would tell us that, "yes this is cancer", or, "no, this is not cancer". In the end, what we found over time is that there just is not a magic number. Typically, the higher the number you do worry about it more, but it's much more cognitive than that.

I do think we have to get away, just because the SUV is reported as a number much like say a lab value, like a sodium level or diabetics check their glucose level, that's a much simpler phenomenon. For example, if a diabetic has a glucose of 200 or 250, then pretty much for any human being we can say that that glucose is high. So, it's much more objective. But the SUV is not quite that easy even though it is also a number, its only one of the things that we take into account when we're reporting for the PET scan. Certainly, the higher the number we do worry about it more, but it also depends on what shape is the abnormality, where is it; is it in a part of the body that you often see collections of glucose, for example, the heart or the brain, those normal tissues soak up a lot of glucose or sugar as part of their

normal activities. So if we see a high SUV in the heart, for example, we know that that's just normal and no one ever reports that out as being worrisome for cancer. So, again, it depends on, we look at the SUV, we look at where the abnormality is, we look at what is its shape, what is its configuration; and we try to put it all together with the clinical history and give our best impression on whether something is worrisome for cancer or not.

Dr. West: Is there a lot of variability in your interpretation compared to someone else at a different institution in terms of agreeing on what is worrisome for cancer in a lymph node or in a part of the body like the colon where we sometimes see physiologic or normal metabolic activity?

Dr. Djang: In theory, you should be able to take the same scan and show it to ten different readers and in theory, in a perfect world, you would get perhaps the exact same impression all ten times. But in practice, that isn't actually what happens. From time to time you do get different interpretations from the same scan. It's very typical that you would have two different doctors reach different conclusions about anything, not necessarily just a scan, so it does happen. I think it does make a difference if you're getting the PET scan at an institution where the people specialize in that versus an institution where the readers do not specialize in that.

Dr. West: What are the limitations in PET scanning in terms of locations it can assess, or the size of the lesions it can assess, or anything else that you can think of that make PET scan problematic in certain situations?

Dr. Djang: I'd have to say that some of the things we have to be aware of are, maybe, number one is what is the cell type, what is the cancer type, in other words. Certain cancers really do not show up that well on PET scans. Renal cell cancer, for example; it really has been proven to not be a good cancer type for imaging with PET scan that we currently have. Most other cancer types do show up very well—lung cancer, breast cancer, for example, colon cancer, lymphoma—these all have a very high accuracy rate of being diagnosed well with PET scans. Maybe other pitfalls are sometimes if you have a tumor in the brain because the brain tissue itself is soaking up a lot of sugar normally as it is, the background activity is much higher. So in most cases, I would not recommend a PET scan to image a brain tumor. I think an MRI for that choice is much better. There is one particular instance in trying to figure out if the tumor is tumor recurrence versus radiation necrosis, then a PET scan can be helpful, but otherwise, certainly an MRI is the way to go.

And then on top of that you do have the normal variances that you see some of which we've already touched upon, the brain, the heart, people's bowels just because they're active can have very variable amounts of sugar

activity in them. Sometimes there are benign causes of activity as well. Diverticulitis, for example, diverticulosis, both of which are associated with some inflammation in the colon, these are relatively common phenomenon and those can also collect sugar more than normal tissue would, but it's not an indicator of cancer.

Dr. West: One thing that several of the people following on the website are interested in, and it's also an interest of mine, is bronchioloalveolar carcinoma (BAC). How does PET scan perform for BAC?

Dr. Djang: BAC is difficult for sure. It's just the nature of the BAC tumors that they're wispy. They're not very dense. They kind of slope along the lung tissue when they don't form large or thick or dense nodules. And that definitely does affect the PET scan. The resolution of the PET scan is such that if you don't a solid collection of tissue, then the PET scan will be less sensitive for detecting cancer in many; it won't pick up the cancer as well. So definitely the smaller the nodule in the lungs or the wispiest or less dense in a sense of that nodule which is often the case with BAC, then the PET scan will not be as good.

Dr. West: What kind of size resolution do you feel confident about these days?

Dr. Djang: It's a gradient. If you want to have just a simple rule of thumb, you can say a centimeter. But truly it's a gradient. If you have a tumor that's three centimeters, then I can more confidently call that as malignant or non-malignant versus the two or one centimeter tumor. Conversely, if I see a 0.6 centimeter tumor that is hot on the PET scan, then if I'm seeing a bright spot on something that is so small, then I know that I need to worry about that even more because it's so small but still showing up bright on my scan, then that worries me more that its cancerous.

Dr. West: Can you discriminate between a malignant pleural effusion and a benign cause for fluid collection outside of the lung?

Dr. Djang: So, for the pleural effusion or the fluid collection around the lung, if there are enough cancer cells in it, then certainly it will show up hot on the PET scan. If there are only some cancerous cells in it, then there is a chance that it would not show up as hot on the PET scan and the PET scan could give you a wrong diagnosis. Certainly, you would always have to be worried about what's termed *micrometastatic* disease, whether that's for pleural effusion or for more commonly for a lymph node; there is no imaging study—PET, PET/CT, MRI, anything—that will be able to pick up a few cancerous cells in a lymph node. If there are only a few cancer cells in a lymph node, it is still clinically important, but there is no imaging study that will be able to diagnose that.

Dr. West: What can we conclude from the standard uptake value? Does the degree of uptake, the metabolic activity give us a window of the clinical behavior of that cancer?

Dr. Djang: I think it does. Certainly, the greatest utility or use of PET, PET/CT is in achieving the most accurate staging. But in actually looking at the SUV itself, there are several good studies that have shown that the hotter the tumor, the worse the prognosis and the dimmer the tumor, if you will, then the prognosis is better. Right now, current staging systems mainly worry about three things: 1) the tumor size; 2) is the cancer in the lymph nodes and if so, where; and 3) is there distant metastatic disease or in other words has the lung cancer, that's what we're talking about, has the lung cancer spread beyond the patient's chest. But there are a couple of good studies that have shown that you could consider that there is a fourth category in there and that is actually the SUV itself. People with tumors that are very hot have been proven to have a worse prognosis over time than people with tumors that are not so hot.

Dr. West: A faster progression in general.

Dr. Djang: Faster and worse progression, correct.

Dr. West: You had mentioned staging and that's certainly the core place where PET scans are most commonly used.

Dr. Djang: Yes.

Dr. West: Ten years ago, we did not routinely obtain PET scans and relied on CAT scans and x-rays and a bone scan. How much does a PET scan add to the CAT scan-type workup?

Dr. Djang: It's very significant. This has been studied for over 15 years. Definitely a lot of the research predated the clinical use; but that's always how it is because something has to be proven to be effective. Most studies that have looked at this show that getting the PET or PET/CT to stage the patient will improve your understanding of that patient to the accuracy of the stage by about 25%-30% roughly. In other words, patients that do not have the PET or PET/CT added into their evaluation, roughly 25%-30% of them will not be staged accurately.

Dr. West: That's quite a big difference.

Dr. Djang: It's a significant difference.

Dr. West: We don't get bone scans as often as we used to. Does a PET scan replace a bone scan or does the bone scan still provide some useful information above and beyond a PET?

Dr. Djang: That's a good question. The best way to look at this is based on the cancer cell type. For patients with lung cancer, there are a couple studies out that show that as long as you get the PET or PET/CT, that in most cases the bone scan really doesn't add very much. So, I think in most cases, if it's a person with lung cancer, they probably don't need a bone scan. If the patient has breast cancer, then it has actually been proven very well that certain kinds of metastatic disease will show only on a PET scan but not on a bone scan. And other kinds will show only on a bone scan but not a PET scan. So I think in patients with breast cancer, it's very important to obtain both. Another very common type of cancer is prostate cancer and for this type it's actually been proven that bone scans are more effective than PET scans.

Dr. West: So, cancer-specific answer

Dr. Djang: It's a cancer-specific answer, exactly.

Dr. West: For patients with lung cancer, some patients will start by getting chemo or chemo and radiation before potential surgery. Is a PET scan helpful in assessing the response beyond what a CT scan does? And secondly, does the radiation add a problem in interpreting the PET scan?

Dr. Djang: The first question the answer is definitely yes. The PET and PET/CT have been proven to be an extremely accurate predictor of who is responding to chemotherapy and/or chemoradiation therapy. It's been proven that if your SUV or the brightness of your tumor decreases significantly after your initial round of treatment, then you would be a very good surgical candidate. And it's been proven that the people who respond on PET and PET/CT to the initial round of treatment often are helped by surgery and that it is worthwhile to go through the difficulty of having a thoracotomy.

Conversely, it's been proven that patients who do not respond on a follow-up PET scan to their initial round of chemotherapy or chemoradiation therapy, those are the patients who probably are not going to be helped by surgery. Their survival is not going to be helped by surgery. Thoracotomy is a very significant surgery; never to be undertaken lightly. And it's been proven that those patients will not benefit from that surgery.

And then to answer your second question, it is interesting to ask about the addition of the radiation therapy. Certainly, my answer today is different than what it would have been 5-6 years ago. When I was in training, we definitely felt like the radiation therapy made the PET scan harder to read.

The radiation therapy does its job well usually. It's a very destructive force for the tissue that it targets. But sometimes the tissue around the tumor and the tumor itself sometimes can be hot just as a result of inflammation from the radiation therapy, from the damage that the therapy is doing and is supposed to be doing. There have been a good number of studies over the last few years that have actually looked at this problem specifically and they've actually proven that even if someone has chemotherapy and high-dose radiation therapy during their initial trial period, that the PET scan is still very useful in determining who would benefit from surgery and who would not.

Dr. West: Is there an optimal time to obtain a PET scan after completing radiation?

Dr. Djang: That's a good question. There is a single article that addresses that question specifically by a physician who has made a name for himself on this topic in general, and he looked at the question in a very meticulous fashion and his answer was that at approximately one month after the completion of the last dose of radiation, that is the best time to get the follow-up PET and then that's when your question will be answered as far as whether or not surgery would be appropriate or not.

Dr. West: In the metastatic setting for lung cancer specifically, clinical trials include CT scans to assess response or progression. Do you believe that the PET scan adds significantly to that or can we do as well with CT scans basically showing shrinkage or enlargement of known disease?

Dr. Djang: Definitely the PET scan has been proven to be more accurate in the setting of metastatic disease. I think what it comes down to is that if the treatment is working, if the chemotherapy, chemoradiation therapy is working, the first change that you're going to see is a decrease in the metabolic activity of the tumor cells. That can only be measured with a PET scan and that change will come first. The CT can only measure response to therapy by looking at tumor size. That takes time. It takes time, at least some time for a tumor to grow or to shrink if the therapy is successful. If you have a car that has stopped running, the engine will become cool long before the body of the car starts to degrade. So in the same concept, the metastatic deposit will cool off on the PET scan before it shrinks.

Dr. West: So a PET scan may be especially valuable in getting some early feedback about whether your treatment is likely to be helpful or not?

Dr. Djang: Early and more accurate, yes.

Dr. West: Are there any changes that you know of coming around in PET scan technology either refinements in the machine or the tracer or anything like

that that could lead to a real change in how we use PET scan and how helpful they are?

Dr. Djang: I think the main thing to look forward to in the next 5-10 years, there are going to be a lot of new, or at least several new tracers that are utilized. Right now, if someone says the word/phrase "PET scan," they typically mean the FDG PET scan which is the one we've been talking about. Again, it's the tracer that is like hot sugar. The PET scanner itself can be used along with any number of different kinds of tracers. Those tracers can be tailored to many different things, look at different types of diseases, answer different types of questions. And so, I think over the next 5-10 years, there will be several new tracers available that will be able to answer a variety of different problems.

Dr. West: Well, thank you very much for taking the time. I really appreciate it.

Dr. Djang: Thanks for having me, I appreciate it.