Dr. Malcom Bell: Well, welcome again our listeners and viewers. I'm Malcolm Bell. I'm the host in another of our series of interview with the experts. And joining me today is Dr. Panithaya Chareonthaitawee who will be sharing her expertise in PET myocardial Imaging. Dr. Chareonthaitawee is a professor of medicine. She's the director of our nuclear cardiology laboratory and also is now the president elect of the American Society of Nuclear Cardiology. So Panithaya welcome.

Dr. Panithaya Chareonthaitawee: Thank you so much, Malcolm, for the warm welcome. I'm, I'm really delighted to be here to discuss some important topics in nuclear cardiology.

Dr. Malcom Bell: So Panithaya you know, for our, the benefit of our viewers and, and our listeners, could you just describe, you know, briefly what PET myocardial perfusion imaging is and explain how this is different to the typical myocardial perfusion imaging that we have been used to for many decades coming out of the nuclear lab?

Dr. Panithaya Chareonthaitawee: Yes, so a great question. So pet myocardial imaging is, is different from, I think what you're referring to is spect, myocardial perfusion imaging and PET myocardial imaging previously was kind of more of a research tool, but it's become a key diagnostic and kind of prognostic tool in patients with suspected or known ischemic heart disease and how it differs. How PET differs from SPECT is really by certain technical characteristics. First of all, what we call coincidence detection, which is a very state of the art precise way of measuring the radioactivity in, in the body as well as what's called what's robust built in attenuation correction. And so what this translates to is that PET really offers superior image quality, particularly very crucial now with increasing challenges of imaging larger patients and those with specific body types. And it also translates to higher interpretive certainty than with SPECT imaging with more sort of clearer results compared to other methods. And in in head-to-head studies, PET really yields more definitive results with less equivocal findings and it has very high diagnostic accuracy as compared to SPECT sensitivity above 90%. In addition to that, it has lower patient radiation dose because of the shorter physical half-life of pet tracers for perfusion imaging as compared to tracers. And so it translates also to more efficient imaging and then it allows us to measure myocardial blood flow, which is a very unique feature of PET that is very robust.

Dr. Malcom Bell: Just to highlight, you know, one of the things you mentioned there is, you know, decrease their radiation dose and that's always gonna be well received by, you know, people who are providing that service. But particularly from the patient's point of view, just with respect to measuring myocardial blood flow, I mean we are really talking about absolute quantification of myocardial blood flow, you know, compared to the typical SPECT imaging that we're doing where things are really sort of relative of a visual thing. Could, could you maybe just elaborate on that?

Dr. Panithaya Chareonthaitawee: Yeah, so this

Dr. Malcom Bell: Is something really unique, isn't it?

Dr. Panithaya Chareonthaitawee: It is, it is unique in its robustness and its accuracy and reproducibility. So with SPECT, a lot of what we do relies on relative perfusion and with pet myocardial perfusion imaging, we can perform relative visual assessment of the images, but we can also quantify absolute myocardial blood flow. And PET has these technical characteristics that give us that fidelity to, to do it with higher accuracy and robustness. spect, myocardial perfusion imaging now has the ability to do, to do some flow quantification, but I think as compared to pet, this is again in its sort of infancy. And so I think this is more unique to pet and I think measuring a flow with PET is, you know, has great importance for many reasons. You know, it can validate relative perfusion imaging or identify discrepancies. And while relative perfusion might suggest single vessel disease, the flow quantification could reveal multi-vessel involvement. So this distinction is really vital for determining appropriate treatment of patients or flow quantification results can also decrease the likelihood of multi-vessel disease as well. It can also help us detect microvascular dysfunction and this is something that is increasingly recognized now and I think PET is part of the standard diagnosis of microvascular disease according to the valdis criteria as well. So a lot of different reasons to be performing myocardial blood flow quantification with pet, and I think emerging data show also some potential in monitoring cardiac allograft vasculopathy, post heart transplants as well.

Dr. Malcom Bell: Well that's a, that's a lot of disease states that you've just gone through there and you can see why, you know, you're very excited by this and you've been in this field for for many, many years. This is not something really new. So what has the growth of pet myocardial imaging been like? I mean it, how, how accessible is this, you know, around the country in, in terms of your nuclear cardiology labs?

Dr. Panithaya Chareonthaitawee: Right. So if you look at around the United States, there are probably 5,000 sites that perform spec myocardial perfusion imaging. And so compare and contrast probably around up to maybe three to 400 sites that perform spect pet, pet myocardial perfusion imaging. And, but this is growing rapidly. When we talk to industry, there are probably at least two to three pet systems being installed around the country at least, you know, every few weeks or so. And so the growth has, you know, been a little bit slower. If we look, I've probably been, we've been over the last few decades working on bringing pet myocardial perfusion imaging into the mainstream, but we've been limited by a number of different issues. One is the cost. I think they're high capital costs associated with PET imaging in general. And much of the, the pet work has been kind of focused on oncology and that tends to drive the purchase of scanners and scheduling of patients. And so there's been less accessibility of PET scanners for cardiac work, cardiac imaging. And so this has been one of the things that I think has limited the use more widespread use of pet

myocardial perfusion imaging. And then in addition to that, reimbursement has been an issue in several parts of the country where there may be issues with insurance private payers not maybe reimbursing for PET MPI and for MBF, but that is changing now. And in Medicare is covering the pet myocardial perfusion imaging and myocardial blood flow quantification also has its own category one code and this is being reimbursed as well. And so I think we, I think it's moved into the mainstream and it's part of the routine clinical practice now such that if we're performing pet myocardial perfusion imaging, we should really be routinely performing pet myocardial blood flow quantification.

Dr. Malcom Bell: And, and you already highlighted the number of the disease states, you talked about multivessel disease, even microvascular disease. Is this why it's, you know, critical that the blood flow actually be measured in, in, in a quantitative fashion? Are there any other reasons that you should be measuring myocardial blood flow?

Dr. Panithaya Chareonthaitawee: Right, absolutely. So if you look at a SPECT image, for example, and you know, SPECT is still our workhorse when we are looking at relative perfusion imaging, we could have a study that appears to be normal at rest and normal with stress, but there could be several things going on with that study. For example, the patient could be a non-responder. We deal with this probably every day where everyone seems to be very addicted to caffeine and we use vasodilator stress and we know that the vasodilator stress affects can be counteracted by caffeine. And so if the patient has consumed caffeine, what appears to be a normal study, a normal stress study may just be perhaps another REST study. And so we could potentially be missing ischemia because the patient didn't achieve maximal hyperemia. The other potential very important scenario would be, for example, balance ischemia with relative perfusion imaging. We don't know the exact rate of balance ischemia with SPECT imaging. And it's possible that we could have multi-vessel disease and all areas of flow or perfusion are reduced. And what we might see is an, when we normalize and look at relative perfusion imaging is a normal stress study. And so this would be another reason to, to be looking at these images very carefully and to quantify myocardial blood flow with pet. Because when we quantify flow, we can clearly see that the flow increases if the patient has an appropriate response to vasodilator stress. And if we do not see the augmentation in flow, then in certain scenarios it's very clear that the patient is a non-responder or has consumed caffeine.

Dr. Malcom Bell: I I, I think we see enough examples of balanced ischemia over the years that, you know, it, it's a real thing. And so this office, you know, you know, great advance on that but, but let me just make sure that I'm understanding and hearing you correctly, when you're doing the PET scanning, are you routinely measuring blood flow, quantifying blood flow? I mean that's just part of the package. That's what you're gonna be doing every single time. And then also you talked about pharmacologic stress testing. I, my understanding is for PET scanning we're still sort of restricted the pharmacologic you, you know, stress rather than being able to put them on a treadmill.

Dr. Panithaya Chareonthaitawee: Right. Great. So two, I think two questions. One is we are, are we routinely measuring myocardial blood flow? So yes, I think if we're performing pet myocardial perfusion imaging, it's anticipated that we should be routinely measuring myocardial blood flow with pet. And in order to do this, we need obviously the PET or pet CT scanner and most modern PET CT and CT scanners, PET CT scanners can now perform quantification of myocardial blood flow. We need the tracer and we can use any of the FDA approved tracers, either the N 13 ammonia or rubidium 82 and soon to be FDA approved flurpiridaz, that is, F18 flurpiridaz. And so we can quantify flow with any of these tracers and then we need the stress agent. And lastly, we need software and most of the software that we have available for imaging for viewing the images have a flow quantification package that sometimes can be purchased separately. So as long as you have all the pieces that I mentioned, you should be able to quantify myocardial blood flow routinely with all of the PET studies if you're performing LIS mode acquisition and have the software package to do the flow.

Dr. Malcom Bell: So you've got all of that in. So compared to spec imaging and the procedure, does it take longer?

Dr. Panithaya Chareonthaitawee: No, there's no additional time. It's actually shorter in terms of let's say how long the patient is in the laboratory. The scanning is shorter, generally the acquisition time we call it, and the whole protocol rests and stress is going to be shorter. Take for example, PET MPI with flow quantification with RUBIDIUM 82, that is going to be completed within 30 minutes. Rest stress and N 13 pneumonia could take longer, but we have a program that can help to reduce the decay time between rest and stress so that it could take just 30 to 45 minutes. In comparison, a SPECT MPI study, the patient performing a rest stress study will be with us longer, maybe an hour and a half or so. So compared that to 30 minutes. I think the other question was exercise, right? Yes, exercise is, it's feasible with PET MPI, but it is very challenging because the, the tracers have very short physical half life. And so in order to quantify flow, we need to capture the bolus injection and the patient needs to be in the scanner as we capture that and we as we start scanning. And so there are a couple of ways to, to try to do this and I've done it, we've had patients do a cycle, a supine cycle exercise in the scanner. But I think this is challenging and there tends to be upper body movement and it can affect image quality. So really ideally it should, these studies with PET MPI and MBF should be performed with pharmacologic stress and preferably with a vasodilator stress, regadenoson or adenosine, et cetera.

Dr. Malcom Bell: Well, we've just got about a, a minute or so left here. I just have two practical questions. You already referred your and made reference, you know, to that larger patient and when we're all so used to seeing that. And, and so maybe you could just give a just a, a very brief guideline at at, at what BMI or weight would you think that SPECT imaging is really that the accuracy that's

really be so jeopardized that you really should be doing PET scan? I mean, could you just give us a number?

Dr. Panithaya Chareonthaitawee: Yeah, I actually think that I, I I don't look at the body habit as as much because we have one of the newer spec scanners that's also state of the art and that type of scanner, it's got the CCT camera systems and it has multi-position imaging doesn't quantify, it can quantify flow, but I think again, it's not as robust as with pet. So I, I don't use pets specifically for patients of larger body habitus only. Okay. So I I think it should be used in the appropriate patient, in the patient in whom you have a suspicion perhaps for more multi-vessel disease or in whom you suspect some issue with their microvascular health or micro perhaps microvascular dysfunction or even cardiovascular health, the diabetic patient in whom you suspect, you know, metabolic syndrome and associated abnormalities of perfusion. So I kind of don't just go by the weight. I know this is not the exact answer you're looking for. No, that's okay.

Dr. Malcom Bell: Well, I I'm, I'm, I'm gonna, I'm gonna push you even further then, and maybe this will be simpler. I think for people who are not familiar with, you know, the quantification of myocardial blood flow, what numbers are you going to, is it gonna be flow reserve is a ratio or is it going to be mils per gram per minute? What, what, what are the numbers that our listeners, you know, could just hang on to as what's normal?

Dr. Panithaya Chareonthaitawee: Yeah, great. Well, so just a little background. We measure flow at rest and then we measure it again at peak stress. And then we calculate myocardial flow reserve using the equation stress flow divided by rest flow. And it's the global myocardial flow reserve for the whole heart that has, I think, the greatest diagnostic and prognostic value. And I think it follows very similar patterns kind of to the invasive coronary flow reserve measurements. So values clearly above 2.5 indicate low risk, two to 2.4 is maybe borderline and below two is signaling higher risk. So it's also important to look at the absolute stress flow itself as well. And that I think when you get into the 1.8 range of absolute stress flow, there could be some issues. And I also look at regional flows as well as resting flow global as well as regional because when resting flow is high, it's going to make that flow reserve flow. So there could be perhaps a need to look at the patient's workload, resting heart rate and blood pressure to see whether there's an issue there. But integrating all of these data really helps provide kind of a comprehensive assessment of the status of cardiovascular health. And there are some caveats to this. You know, there may be, if flow is one flow and flow reserve is like if flow reserve is 1.1 or one across the board and the patient has no perfusion deficits at all and has no coronary calcification, that could be a non-responder, a patient who consume caffeine, for example. So lots of things to look at, but two might be a good number to remember just like with CFR.

Dr. Malcom Bell: Right. But do, are you measuring, I mean, you've seen the absolute quantification, I mean, these are ratios that you're talking about?

Dr. Panithaya Chareonthaitawee: No, we look at stress

Dr. Malcom Bell: When you're looking at the data, you'll be looking at the absolute flow.

Dr. Panithaya Chareonthaitawee: We do, we look at this, the flow reserve, stress flow and rest flow. And we look at them globally, but also in regions.

Dr. Malcom Bell: Okay. And maybe last question, and this is just a really a yes no answer or maybe, and that is, do you see a a, a day coming that PET scanning would just replace spect?

Dr. Panithaya Chareonthaitawee: Oh, it's already happened in some parts. I mean, completely replaced CO in some parts of the world. So I visited a site in the Middle East this year where they actually do not perform any spect myocardial perfusion imaging at all now. And they're, they're only performing pet myocardial perfusion imaging with flow quantification. With that happen here, I think that there's still, you know, patients who, who can exercise where I, I might actually, the, the exercise data is very important to me and I would like to see what happens to the perfusion with exercise. And so in those patients, I am sometimes willing to maybe sacrifice a flow data, but it's always a hard, you know, hard thing to weigh. Well,

Dr. Malcom Bell: Maybe that day will come when you actually can do the exercise, you know, with PET scan. So with, with that,

Dr. Panithaya Chareonthaitawee: Well we can with flurpiridaz which is gonna be FDA approved later this year, thank you. But we might not be able to measure flow at the same time. Okay. So

Dr. Malcom Bell: Yeah, well, I mean obviously the great advances and you, who knows what the future holds. So Pita, thank you so much for sharing that experience and your expertise. I, I think this is obviously, again, when you talk about the proportion of labs actually have this available, this is gonna be new to many, many people, but they should really stay tuned for, for more advances in this and for greater penetration of these scanners. So thank you so much.

Dr. Panithaya Chareonthaitawee: Thank you so much for having me. It's been great to, to really talk to you about pet myocardial flow and flow reserve. Thank you.

Dr. Malcom Bell: Thank you to our listeners and viewers for joining us, and I look forward to seeing you again in the near future.