Role of Non-invasive Cardiac Imaging in the Management of Coronary Artery Disease

Announcer: Welcome to the Mayo Clinic Cardiovascular Continuing Medical Education podcast. Join us each week to discuss the most pressing topics in cardiology and gain valuable insights that can be directly applied to your practice.

Dr. Bell: I'd like to welcome all of our listeners and viewers today for another in our series of Interviews with the Experts. I'm Malcolm Bell from Department of Cardiovascular Medicine. I'm gonna be your host today. It gives me great pleasure to welcome Dr. Gosia Wamil, who's a consultant cardiologist at our Mayo Clinic Healthcare London site in the UK, who is going to be discussing the role of non-invasive cardiac imaging in the management of coronary artery disease. Gosia, welcome.

Dr. Wamil: Thank you very much for inviting me. It's a great pleasure.

Dr. Bell: Yeah, so we're thrilled to have one of our London consultants participate in these interviews here. And I'm just gonna go start off immediately just with a question of why is non-invasive imaging to be considered in assessing patients with corona artery disease?

Dr. Wamil: So this is a very important question. As we know, we've got in Europe, so European Society of Cardiology Guidance, in States, there are also a clinical guidance supported by different societies. So cardiac MRI, cardiac CT, echocardiographic societies, and all those guidance support these days the use of non-invasive approaches to evaluation and assessment of patients with known or suspected coronary artery disease. So for many, many years we used to consider an invasive coronary angiography as the gold standard, and it remains a gold standard. However, over the last decade, we managed to develop techniques and different modalities, so imaging modalities to this level where we can provide a full comprehensive assessment from both anatomical and functional side. So in most cases, so we need to do it by using different imaging modalities in a form of sequential single tests done in a row to get all the information. But sometimes, these days, we also start using so-called hybrid approaches, where the anatomical and functional tests can be combined in one. So the main advantage of using non-invasive cardiac imaging in assessing patients with history of chest pain is the fact that those tests are non-invasive, and that's a major, major benefit.

Dr. Bell: As someone who has been practicing cardiology for maybe too long, I guess I was always under the impression that, you know, we were still, I mean, always been using non-invasive testing for patients with corona artery disease. And maybe just to make it very clear to our listeners and viewers, we're really talking about elective patients, patients who present with chest pain. We're not talking about acute coronary syndrome. So we're very much talking about the patient who comes to your office, you know, complaining of chest pain. So, you know, we've thought about your, I mean, your treadmill exercise testing has been around for a long time, without imaging. Various nuclear and echo stress imaging studies are available. It does seem though, in more recent years, that there are more and more or different types of stress imaging that we could select for our patient. So when we think about all of those choices, what do we need to consider when choosing the right test for a specific patient? Because obviously we have a lot to choose from today compared to even 10 years ago, let alone 20, 30 years or so ago.

Dr. Wamil: Yes, you're absolutely right. So there are multiple factors that one need to consider and those will involve the clinical setting. We also need to consider the patient's characteristics. So the age of the patient, the risk factors, especially the cardiovascular risk factors. We also take into account comorbidities and that becomes more and more important in our population of patients, older patients with multiple comorbidities. The decision also takes into account an expertise of a particular center. Obviously, those tests, sometimes even, especially when done in a sequence, when there are two or three tests required, those will come with a significant price as well. So all those factors we need to consider when choosing the right test for the right patient.

Dr. Bell: So maybe we'll just start off with the plain treadmill exercise test without any imaging. There's still a role for that in in patients, you know, those who have a normal ECG and can exercise.

Dr. Wamil: Well, obviously we still use treadmill tests and they have been with us for a very long time. However, we are building strong scientific evidence that in imaging modalities such as CT coronary angiography or functional tests, so-called stress tests such as perfusion stress MRI, stress echo, sort of dobutamine stress echo will probably have, will give us a more reassurance or will identify the obstructive significant, obstructive disease better than our initial approach with the treadmill test. So in Europe, we moved away from using treadmill tests in clinical pathways when we assess patients with chest pains and those that have coronary artery disease. So these days we use CT coronary angiography as the first line assessment for patients, especially those who are not known to have a coronary artery disease. Also, for those that would be in a low or intermediate risk group. For patients in a higher risk groups based on the risk factors, we would rather choose one of the stress or functional imaging approaches. And those would be, so either in the stress echo, stress cardiac MRI. These days we also have perfusion CT and the NUCALA medicine. So there is a variety of dose tests and we start believing that to be able to choose between the test and to provide all the information and support the choice of the right test for the right patient, you need to become an expert in multimodality imaging because only those clinicians who would have a full understanding of all the pros and cons of those different imaging modalities will be able to distinguish between the different factors that need to be taken into account when choosing the test.

Dr. Bell: So maybe you could just explain the rationale for choosing an anatomical imaging study at, you know, CT is what you're talking about now versus a stress test with, you know, whether it's perfusion imaging or wall motion and you talked about the low risk patients, you know, for CT and then the higher risk for perfusion or other stress imaging studies. Why do you make that distinction and does it matter, you know, on the age of the patient?

Dr. Wamil: Yes, absolutely. So with regards to the anatomical images, so this is predominantly in a field of CT coronary angiography. So with the city coronary angiography, these days we are able to describe what we call the burden of plaque disease. And that becomes very, very important when assessing a future risk of cardiac event. So in the low intermediate risk groups in younger patients, when we are not expecting such a high degree of calcifications of the coronary arteries or multi-vessel disease and CT coronary angiogram, acts as the best, the very good first choice of a test. The reason why it has been been also supported by the clinical guidance by multiple societies these days to become the first choice is the fact that it has very high negative

predictive value. What it means that it's a very, very good test to exclude significant obstructive coronary artery disease and most importantly left main stem disease. So we share the understanding what it means to our patients. So within three minutes of the scan that is a non-invasive, we can exclude a significant disease that requires management with revascularization. On the other hand, the functional, so-called functional tests or stress tests, those are very important when we, together with colleagues, interventional cardiologists, when we make decisions about revascularization. So there are those groups of patients when, where we are, we already identified moderate to severe stenosis where we identify multi-vessel disease and we require some additional information about inducible ischemia and we want to quantify the percentage of myocardium that is ischemic, and those tests will provide those information. There will be some differences between different modalities. So for example, cardiac MRI stress perfusion on top of the assessment of inducible ischemia can also provide additional information about the size of the scar, the viability of the myocardium. It will assess biventricular systolic functions, extremely important in decision making when we consider a type or revascularization.

Dr. Bell: You know, you brought up... I think really what you were saying is, talking about the ischemic burden. And yet I think that the thinking may have changed with that, that maybe ischemic burden doesn't necessarily identify patients, you know, who may benefit from revascularization versus medical therapy. For some time, we were really following that, you know, a guideline or an algorithm if you saw a certain degree of, you know, ischemic burden that those people would benefit. But more recent trials have, you know, suggested that's not the case. It's not so simple as that. And maybe even the atherosclerotic burden which I think actually is very, very important. You know, it's a difference between, you know, single vessel disease, 90% lesion versus multiple, you know, 40, 50, 60% stenosis in other vessels. So in terms of, you've been talking about anatomical functional and when we talk about the anatomical study of CT tell us now how you're using that with respect to CT FFR. So now you have a, you know, a quasi, you know, physiologic measurement and that we see that reported frequently and I totally agree with you that, you know, the negative predictive value of that CT is so helpful, particularly in patients you really don't think need to have any further evaluation for obstructive coronary disease. So tell me how you're using CT FFR and in a patient that's been identified as having a significant lesion on CT and is accompanied by decreased FFR, what's your next step there? Is that now medical treatment or now do you need to do further imaging studies in your stress testing?

Dr. Wamil: So I'm an imager, I will be biased in my response. But you are right that we are accumulating evidence from large randomized control tribes that will change the strategy of revascularization. We will be probably see observing a significant shift in the clinical guidance. And ischemia trial is an important trial that showed that optimal medical therapy in stable coronary artery disease, even in those patients who've got moderate, severe burden of ischemia still is as good as intervention. So in a patient where you have assessed with CT coronary angiography, so the burden of plaque disease, and you also added an additional assessment so functional assessment with FFR. These days, we can use that information as a standalone information. So full comprehensive assessment and hand it over to interventional colleagues to describe this is the anatomy, that's the plaque burden. We can identify a culprit lesion, unstable plaque with the advanced techniques and we can back it up with functional information. So that may be enough to hand it over to colleagues in the cath lab. However, sometimes, and again, so

that may be also related to our evolving experience with techniques such as CT FFR. So that's a computational algorithm based on AI that tries to perform as well as when you perform FFR in the cath lab setting. And obviously, this is now never going to be as good as the invasive type of assessment. So we take it into account. And when we get a positive result in CT FFR that doesn't really correspond to the clinical picture or to the assessment provided by the CTCA, so the imaging assessment, then we may question this and we may want to double check the significance of the findings by offering a different functional test such as stress echo or perfusion stress cardiac MRI. So there are those options that we can use in cases where we may question the significance of a positive CT FFR result.

Dr. Bell: Yeah, it's very interesting. I mean, you obviously have, you know, great experience with this particularly, you know, using CT and CT FFR, you know, now with the UK NICE guidelines and probably using it a little bit more frequently than we are here, but we're seeing an increasing, you know, penetration of the use of CT and CT FFR in our practice. And I think, you know, it really has changed the way we approach many patients. We've just got a minute or so left here. Do you wanna highlight any of the new innovations in terms of imaging, you know, putting these, you know, different studies that, you know, together and so called, you know, hybrid forms?

Dr. Wamil: So the main weakness of the current non-invasive cardiac imaging is the fact that we frequently end up doing sequential standalone tests. And this makes the patient's journey, the clinical journey too long. It also increases the cost of assessment of a patient with a coronary artery disease. So to address this, there are developments that will try to build hybrid approaches. So CT FFR is one of the well-known approaches of that sort where the anatomical and functional information is combined within one test in the CT field. Another very interesting approach is to use, a deep learning, artificial intelligence algorithms to try to get more information from the standard clinically-used CTCA by assessing what we call perivascular inflammation. So with a CT, we can look at the changes in the fat tissues surrounding coronary arteries. There have been quite a lot of evidence over the last few years showing that so-called fat attenuation index basically looking at the inflammation in the fat surrounding the coronary arteries. And by doing this, assessing the inflammation within the plaque disease and with those new biomarkers, it has been shown that we can not only pick up the vessel, the lesion that is most likely a culprit lesion, so-called unstable plaque and distinguishing from the highly-calcified stable plaque, but there have been also very interesting and encouraging reports that those type of assessments, so it's much better, has a higher predictive value than just an assessment of images on the CT angiography or assessing the risk of patients based on the risk factors. So those are very interesting developments. In the functional stress imaging tests, I think what we are observing is also an increased interest in hybrid approaches, for example, so CT PET is combined with MRI. There are attempts of providing a very good assessment for microvascular angina, which is such an important area when we talk about coronary artery disease. So lots of very interesting research. Some of this is already, has already translated into clinical practice and I believe we'll be observing over the next years a much more prominent role of non-invasive approaches to coronary artery disease.

Dr. Bell: Well, thank you very much. I think that, you know, our listeners and viewers will really appreciate you bringing us up to date with, you know, these new developments. But maybe just

to summarize, you mentioned earlier about making sure this still does correlate with the clinical picture and, you know, that clinical situation, you know, the characteristics of the patient are so important. Just putting us all together, make sure that the results of our tests really make sense. We talked about making sure that you are working with the expertise that's available at your institution, you know, whether it's CT or nuclear or ultrasound, and then making sure that we've got a streamlined process so that the studies, you know, can be done really all at once. As you said, make that patient's journey much more satisfying but also needs to be cost effective. But I think we're gonna hear a lot more at a time that we think that, you know, CTCA has really helped enormously, which it truly has, but we still have to work out where all these other non-invasive imaging studies fit into that algorithm. So, Dr. Wamil, thank you so much again for joining us this morning, and we look forward to some further contributions from you. I'm sure you have a lot more to share on, you know, ischemia and we didn't even talk about viability studies today, but we certainly have opportunities in the future. So thank you so much and thank you to everyone for joining us.

Dr. Wamil: Thank you very much for inviting me.

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