Embracing 3D - The Fight with Tradition in Medicine

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. Friedman: Hello, my name is Paul Friedman. I'm chair of the Department of Cardiovascular Medicine at Mayo Clinic and I'm delighted to be joined by my colleague, Dr. Sorin Pislaru, chair of the Division of Structural Heart Disease as well as echocardiographer and expert imager. And today we're gonna talk about 3D imaging and its pertinence to the management of patients today in terms of making diagnoses and guiding procedures. So first of all, Dr. Pislaru, thank you for joining me.

Dr. Pislaru: Oh, thank you so much for the invitation. It's always a pleasure to talk about 3D, a little obsessed about that particular topic, but I guess it goes with the territory, you know.

Dr. Friedman: It's very exciting. Now, this is a podcast and so I just want our listeners to know that we will have images available as well. When they first joined the podcast, they may wanna look at those. And in the meantime we'll also describe it. But why don't we start with just some of the basics? And that is, you know, technological breakthroughs. We like to think that they're rapidly adopted in clinical practice. That is as a big advance. It helps us, we use it right away. But that may not be the case. What's been the experience in imaging?

Dr. Pislaru: Well, so I'm going to talk about the echo. You know, you have lemons, you make lemonade. So it's a topic familiar to me and really it goes to show that not everything that's new and shiny is instantly recognized as being of value. So if you look back, it's in 1953, that Edler, who's physician interested in mitral stenosis talks with Hertz who happens to have two Nobel Prize winners in his family and who's an engineer physicist and they talk about imaging the heart. And that's the first time an A-mode was done in 1953. And then as soon as they developed that technology kind of goes on life support 'cause, you know, people are not really interested in that. It's presented, but no embracing. And it takes to 1965 when Harvey Feigenbaum starts being interested in echocardiography in US it's just then that the technology takes off. And for 2D, it's kind of the same story. Early '70s they start developing these imaging tools and the first attempts are really giving cut and paste a new meaning because it's literally a 35 millimeter film that's cut in stripes. So it's an M mode film that's synchronized and cut and you have these tiny little thin slices that you put together and that will produce a 2D image. And really the 2D wouldn't have taken off if people didn't have this initiative of modifying an electric toothbrush to create the first transducer that's usable to generate a 2D image. And that's back in 1975/76 by Eggleton and Weyman. But it still takes about 10 years to the '80s for 2D to be embraced. And the story with 3D is just about the same. So two groups, one at Duke, one in Rotterdam, and they both have 3D technology in the early '90s, 1991 and 1994. But it's mid-2000 by the time technology is embraced. So I would say technology-wise in echo it's the rule of tens. You report it, it's 10 years before people start realizing what that's good. And maybe it's a little bit of the story of Henry Ford. If people ask him what they want, they would say. If he would ask his customers what they want, they would say they need a faster horse. So maybe it's the same with cardiologists all over the place, you know? People don't understand the value of things first time on.

Dr. Friedman: We live in a 3D world that's in constant motion. Should our imaging tools be in 3D? What are the practical advantages of 3D?

Dr. Pislaru: I mean, to me, everything should be 3D. But the question is can you implement that in everything and everywhere? And, of course, cost is an issue, availability is an issue, standardization is an issue. But the field has progressed so much over the last 10, 15 years. And really if you look at the rendered image that the group in Rotterdam produced in 1994, it's kind of a grainy scale image. It's just, you can see some 3D rendering you can sense there's a 3D dimensionality to the image, but it's really only the development of rendering technologies to bring out the information that's hidden in the 3D dataset that existed there in 1990 and existed there today. And I have to say, you know, I wish that we could claim we're all great inventors and developers, but the reality this is all driven by the gaming industry. So each time your kid ask to buy them a Nintendo or PlayStation, just buy that. You're contributing to developing medical technologies of the future, you know? So it's important to do that. So yeah, that makes a huge difference.

Dr. Friedman: What are some of the practical advantages? I wanna just delve into that a little bit more. And, again, for our listeners, what we're looking at is a crude early still 3D image on the left. And on the right, we see an active mitral valve. And in one view we see a regurgitation a little bit via Doppler. And what's striking is that it's an anatomical view. In some ways better than what a surgeon would see because you actually see it in its functionality and it is a striking and compelling image. What do you think it will help us do that we can't do now? Why do we need to learn to use it? And then I'll ask you about the learning curve. If you're an imager now, how hard is it to learn to acquire these gorgeous images? 'Cause I can tell you, for the non imager it's immediately more accessible and intuitive. You can see the valve, you can imagine where murmurs are coming from and where there are lesions. So tell me about the impact on patients.

Dr. Pislaru: I think, you know, once you start seeing anatomy in its reality you can do two things. First of all, you can understand just what you said. Where does the murmur come from? So we have a flail mitral valve so that's on the video and you can clearly see that the involved leaflet is the posterior one, it's the middle scallop. So you can tell the surgeon before they go on pump that's where the lesion is. And our surgeons really appreciate that. We do that in every single patient. But more importantly now for the cath lab procedures, you know, because you need to show exactly where the problem is located. A lot of things that we can measure these days that are going to be important in deciding what kind of intervention you're going to make. And as for the experience, how long does it take to learn how to image in 3D? It's shorter and shorter. The good thing is that the technologies have developed so much, the software and the hardware on existing scanners have progressed so much over the last few years that what it took a lot of experience, a lot of fine tuning, now it's available at your fingertips. So you just hit a button and it's going to happen. So it's becoming less of an issue. I encourage everybody just hit the button for 3D and you'll see what happens. You may be mesmerized.

Dr. Friedman: And these certainly are readily accessible images. The power is huge. It's true that if a picture paints 1,000 words, a video paints, you know, so many more times that. There have been some challenges raised in terms of cost and accessibility. Do you wanna address those?

Who pays for the, you know, more expensive equipment? Does that impact the cost of procedures? And how widespread are these tools at the present time?

Dr. Pislaru: So we perform 3D in almost every single transesophagealic echocardiogram that we do today. We try to perform 3D imaging, not for for beautiful pictures, but for quantitation in most of our transthoracic studies. So everybody is kind of slowly moving towards that. And the reason for that is it's not try to increase the cost or pass the cost to anybody. It is just, there's additional information in the 3D space that you do not have with the 2D. And more importantly, there's a accuracy in the 3D measurements that is superior to the accuracy of measurements in today. So that's the reason to do it. Now, who should pay for that? For now, there is actually a covered 3D reimbursement code for echocardiograms if there is a very specific indication. And one of the indication that's accepted is for assessing mitral regurgitation that is otherwise not being well assessed by 2D technology. So there is a reimbursement in place. Now, availability, yes, there's cost with every new scanner, but as with, you know, everything that's computer related the costs come to be lower and lower as the new generation of scanners are being developed. So it becomes more affordable.

Dr. Friedman: We've also seen that with enhanced imaging and a number of procedures get transformed from overnight hospital stay to same day dismissal. I'm thinking of somewhere instead of TEE, we're using transthoracic or intracardiac echo. So just to reinforce your comments that as the technology becomes more widespread, we get better at what we do with the imaging guiding procedures for example. What's the future of this technology? Where does it go once we start to learn how to use it?

Dr. Pislaru: Well, so several places that you can use it. So, you know, we had actually when I first started 3D imaging in the cath lab, we had Maki Lee, who's one of our interventionists, tell us what he wants for measurements before transcatheter HH repair, or clipping of the mitral valve. And he was very, very casual about giving us about 20 parameters that he wanted measured. And I thought, oh my goodness gracious, you're not going to get that Mak, just get two or three. But what if the 3D technology can do that automatically for you? And really the current platforms from many vendors, it's not just one single vendor that we have, they are really fast. So I had one of our nurses record me how long it takes to get the full measured mitral valve. It's about 20 some seconds. And I would argue that it can be done even faster than that in a very, very critical fashion.

Dr. Friedman: What kind of measurements, can you gimme some specific examples? I think people wanna understand just the amount of insight you can get. And again, if you can see the screen, or if you look at it afterwards, very compelling, very easy to see valves in motion. But what are the measurements?

Dr. Pislaru: So, for instance, if you are looking at, you know, transcatheter mitral repair, we understood fairly early on that you can make the valve stenotic if you're not careful with that. And one of the things we do measure is the mitral valve opening area. One of the things we are interested when we're going to the prosthesis, the mitral valve annulus area. So you can get those. Leaflet length is important. The angle between the aortic valve and the anterior mitral leaflet. So all these things take time. They take time if you were to measure them independently

on a workstation. But the software nowadays actually provides them to you in one single swoop, and that's fantastic. The other thing that we understand is the dynamics of the valves, you know. So turns out that both the mitral and tricuspid annulus move in time. So with systole there's contraction and with diastole there's relaxation and that ensures competence. So that's an important thing to understand and you wouldn't be able to do that unless you do have the measurements provided. Just eyeballing an image is not going to cut it.

Dr. Friedman: So really it's a combination of qualitative human education. 'Cause just looking at these images, I can immediately understand and comprehend what the valve is doing, but also automated numerous measurements that help us identify who should be treated surgically versus percutaneously. And then when percutaneously, what tools, sizes, the deployment angles. It is impressive. Oh, and you're now showing us. You've switched to a virtual world where you are immersed in a 3D environment, which is also very impressive looking. Do you wanna comment on this?

Dr. Pislaru: I mean, to me this is the future really, Paul. Because that opens tremendous opportunities for us. You know, all the measurements we have in the echocardiography are based on 2D or you go into the 3D dataset and you cut it and multiplay it and that's laborious. It takes time. And we have those gorgeous 3D rendered pictures. But if you think about it, your display is the 2D image no matter which way you cut it. No matter how beautiful it looks, it's still a 2D space. So you cannot select points in a 2D space. You need to be in the 3D space. And that's where the VR becomes very important. And not only that, but I think it's not only the diagnosis it's also the intervention. This is a company we're working with who has this holographic display that you can use during a procedure. It could be during an ablation, which should sound pretty good to you, Paul, or it can be during a left atrial appendage occlusion or maybe during a procedure on the tricuspid or the mitral valve. And that's fantastic addition to what you can do in the lab. And you can only imagine how you would apply that to teaching, to telemedicine. You know, you could be sitting in your office, in your virtual office or regular office, and help somebody do a procedure, you know, 1,000 miles or 10,000 miles away for that matter and just show them how to tweak and how to turn and how to rotate. It's, I think, really this is technology of the future and maybe it's going to take 10 years to embrace it. The rules of tens, right? But it's coming just.

Dr. Friedman: It's very, very impressive, very intuitive. You know, the images that are generated. How is it impacting medical education? Our current fellows are generating 3D images. They're comfortable with the technology.

Dr. Pislaru: Many times our 3D fellows are the first ones who run with it, you know? So you would see some of our colleagues who maybe are less attuned to doing 3D imaging work with our fellows. And the fellow is like, "Oh we need to get that 3D of the mitral valve. That's going to be cool." So, I think younger people tend to have a more open mind. They're less bound to tradition and then they're more easily to embrace technological advances really. That's my take on the whole topic.

Dr. Friedman: Very exciting. Really a glimpse of both the future and where the present meet the future to help us better diagnose and treat disease in less invasive, more convenient, lower risk

ways for patients. Having seen this in countless procedures from left atrial appendage occlusion to mitral regurgitation and aortic stenosis and many more. Thank you so much for sharing this with us. Fascinating topic. I appreciate the conversation.

Dr. Pislaru: Thank you so much, Paul. And, again, you know, send us emails, send us comments. If you have questions about really, we're always very happy to assist with anything and everything that you may find useful for you.

Dr. Friedman: And as you logged into the podcast there should be access to the images and videos which really tell so much of the story. So I'd encourage you to take a minute and look at them. And thank you for joining us today.

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