CHARANJIT RIHAL: Hi. I'm Dr. Charanjit Rihal, chair of the Division of cardiovascular diseases at Mayo Clinic, Rochester. Welcome to Mayo Clinic's collaboration with [INAUDIBLE]. Today we're going to have an exciting panel discussion about novel options for revascularization for multivessel coronary artery disease. Joining me today are my colleagues Dr. Rajeev Gulati, interventional cardiologist here at Yale. Rajeev, welcome.

RAJEEV GULATI: Thank you.

CHARANJIT RIHAL: And Dr. Alberto Pochettino, my colleague from the Division of Cardiovascular surgery here at Mayo. Alberto, welcome.

ALBERTO POCHETTINO: Thank you.

CHARANJIT RIHAL: Alberto, let me start with you. What would you say are the most important recent advances in coronary revascularization?

ALBERTO POCHETTINO: I think one of the most important transition, it's not necessarily new, is the use of arterial conduits more frequently. The tradition has been for many years to use it to the left and to the [INAUDIBLE] only, and it's been shown that use of multiple arterial conduit to other territory does have a benefit, and I think that has been the transition that I've seen throughout the cardiovascular practice.

CHARANJIT RIHAL: How often is total arterial revascularization being done now?

ALBERTO POCHETTINO: Well, if you look at the national trend, it is still a minority. If you exclude [INAUDIBLE] where that is done routinely in most places, any additional arterial conduit, you using the STS database as a measure, is still in the 10% to 15% rate. So it's still very low. The penetrance to the general practice of cardiac surgeons has not been as good as it should be.

CHARANJIT RIHAL: What's the holdup? Is pump times longer? Is it more technically challenging? Or what's the hold up there?

ALBERTO POCHETTINO: It's a good question, and I think there are at least two factors. The first one is the real issue is that [INAUDIBLE] is more difficult to do. And in a real world, cardiac surgeons don't like to

make their life, like anybody else, more difficult than they have to. The second one is you wouldn't guess, at first-- we, as cardiac surgeons, like everybody else, are being judged on our results. And most of the focus of the results is short term focus-- 30 day mortality, infection rate, hospital stay.

And clearly, introduction of bilateral mammary increases all of those risk factors. So there is a disincentive on the part of the regulators, if you want to look at like that, that if your risk of starting an infection goes from 1% to 2%, which it does when you use bilateral internal mammary in a non-diabetic, that is a strike against you. And as a surgeon, you don't want that strike. If you use it in a diabetic, bilateral mammary, it may go as high as 10%. Which surgeon wants to add their infection rate 10%?

Now, if you look at long term results, clearly that's where the benefit is. But we are judged on short term results, and there is an incentive of not doing something that, short term, increases your risk, that lowers your result. And I think that's a big drive that has been very difficult for cardiac surgeons, especially in a small institution, to get over.

CHARANJIT RIHAL: This was a very important observation. Rajeev, in the field of interventional cardiology, what would you say have been the most important advances in multi-vessel revascularization in recent years?

RAJEEV GULATI: I think in recent times, probably three things have changed, or continue to change. The change in drug eluting stents from the first generation to the second generation, I think, has been a real advance. We weren't sure at first. We thought there was going to be an incremental change. But now with data, we're really recognizing that the first generation drug eluting stents were a problem. They were the ones that were plagued with this risk of late and very late stent thrombosis that we're all now very in tune with.

But the transition to the second generation stents has really been a paradigm shift, I would say. We now know, with data, that the second generation drug eluting stents have a much better safety profile. The rate of late stent thrombosis of these stents is lower than bare metal stents. That's a big shift. And the rate of very late stent thrombosis doesn't seem to be a concern with these second generation drug eluting stents.

I think the second thing is a growing understanding of the role of clinical characteristics and patient values and preferences and choices of revascularization. We are seeing a lot more elderly patients now with complex calcific disease but also with major comorbidities that may

influence the choice of revascularization for many patients. Stroke is a concern-- procedure-related stroke, time out of hospital recovery time. And these are the factors that are often influencing our decision to go with PCI perhaps more than bypass in some circumstances.

And the third is a move in the anatomic subsets that we're now more comfortable with dealing with PCI. I would say left main. Increasingly now there's data supporting PCI in left main and certain anatomic subsets. And now perhaps most recently is chronic total occlusions with newer techniques learned from overseas and finessed in the US. Our rates of success in getting across and successful results in chronic total occlusions are much higher than before. And our ability really to complete revascularization I think has changed significantly over the last two years and will continue to improve over the next few years.

CHARANJIT RIHAL: Rajiv, you talked about the second generation stents and how they are much better than the first generation drug-eluding stents, which I think we would all concur with. Do you think they are quite ready yet to take on bypass surgery head to head? We do have some new trials addressing that question. I'd like to ask both of you what you think of that.

RAJIV GULATI: Yes, it's interesting philosophically. We see a trial come out comparing PCI with bypass surgery and then we have the response, well, gosh, we have better standards than we did back in the day when we did that trial. It seems to be an ongoing thing. And it will continue to be an ongoing thing. We do have some recent studies-- one large registry comparison between two registries and also one randomized trial from East Asia comparing the second generation drug-eluding stents in multi-vessel disease with bypass grafting. And really, to be fair, bypass grafting still came out on top in terms of the composite end point. So I don't think we're able to say that the second generation drug-eluding stents have completely changed the way we approached multi-vessel disease.

CHARANJIT RIHAL: Let me turn now to you, Alberto. Now that you've heard this discussion about how these-- every generation these stents are getting better and better and the differences and outcomes between multi-vessel bypass surgery and multi-vessel PCI are narrowing, what are the key clinical and anatomic factors that you use in counseling patients as to which technique may be best?

ALBERTO POCHETTINO: When I think of using bypass surgery in a patient, I think of long-term benefit because short term it's pretty clear that a good drug-eluding stent, it can do as well as surgery. So I talk to the patient-- there may be technical issues, but let me just start from more of a long-term

issue. So a young individual, who may have risky interventional bifurcation lesion or something like that, where I could offer a better long-term result with, of course, the price of surgery, which, of course, we all know about, especially if I have available arterial conduits. So that's the way I'm thinking.

If it's a person that would not get that benefit, say a very elderly individual who has all sort of comorbidity, I would only address that patient surgically if there is such technical difficulty in addressing it with a drug-eluding stent or with another intervention technique that the risk of such a technique would make surgery sense. So that's where I'm looking at.

So the first class of patient or young individual that when I have a good long-term lifestyle benefiting as well as survival benefit. And then of course there are technical issues related to which targets, can we get them one way or the other, what's the risk of one versus the other? So those are technical issues that we often have to talk about. What makes most sense? That's the way I think of it.

CHARANJIT RIHAL: Thank you. Rajiv, what are the technical and clinical characteristics are you using in counseling patients?

RAJIV GULATI: I think increasingly clinical features-- so diabetes. Every trial of diabetes and multi-vessel disease favors bypass grafting. And I think the freedom trial moves recently supports that. And I think increasingly it is really hard to make an argument for PCI in multi-vessel disease in a diabetic who's otherwise doing OK even with straightforward PCI. But a mortality benefit with bypass grafting is really quite clear there. So I think one has to be strongly persuaded to do PCI in that population.

And then the extent of disease. I think the diffuse multi-vessel disease we know in every trial does not well with PCI. Patients come back with MI mortality concerns repeat revascularization. Diffuse multi-vessel disease I think is the domain of the surgeons. And we learned a lot from the older syntax trial. In that regard, the patients with the high syntax scores, complex diffuse disease really do better with surgery.

CHARANJIT RIHAL: So as patients are getting older with more complicated disease, what is the role of hybrid approaches to this complex disease? Alberto, do you see any role for this, or is it just too complicated logistically?

ALBERTO I think it has a role. And the role is in a complex patient with multiple difficult targets if you look

POCHETTINO: at it in those terms as well as lack of conduits. It is not unusual for a 70-, 80-year-old to have very poor veins. You only have two mammaries, and the question is how are you going to use both mammary or maybe just one. The radial are typically not usable. There is vascular disease that late in life affects the radial. So you're limited to what you can offer that would work long term.

CHARANJIT RIHAL: Yes

ALBERTO POCHETTINO: So you do the best you can with what you have, and then having available other technique to address some of the other territory makes sense in that setting. In a young patient that has available conduits that would benefit them long term that you know you're going to rely on and they're going to do well, then I would say the pendulum is more on the surgical side, but those patients are not as many as we would like. There-- a lot of the patients are in that complex no conduit or marginal conduit situation with a lot of disease. So that's where the hybrid approach would make sense.

CHARANJIT RIHAL: I think we're all in agreement that patients with a large burden of atherosclerotic disease, severe three-vessel disease, or diffuse disease, for example, are best served with bypass surgery. But, Rajiv, one of the advances and observations in recent years has been patients with isolated left main disease, who appear to do equally well with PCI. Is that why-- is that because we don't have as much atherosclerosis overall or what? And what do you think is the role of left main PCI now?

RAJIV GULATI: Yes, I suspect that is that. That's most likely mechanistic explanation that is an isolated left main lesion with not much atheroma elsewhere. It can be the most straightforward of PCIs. It can be a two-minute PCI. And we know that-- we can infer from the benefits of surgery, which are always fewer myocardial infarctions and fewer repeat revascularizations, that if you don't have that atheroma burden to begin with, you're not going to achieve the benefit from surgery of fewer MIs and fewer revascularization repeats. So I think PCI probably is favorable for left main or at least as good as [INAUDIBLE] bypass grafting in the absence of a ather--

CHARANJIT RIHAL: For carefully selected left main--

RAJIV GULATI: For carefully selected left main-- anatomic left main disease and lack of severe diffuse disease elsewhere.

CHARANJIT RIHAL: Albert, what do you think of that?

ALBERTO POCHETTINO: It-- I think it's very interesting that isolated left main disease as well with an interventional approach. To me, it makes me think that a lot of isolated left main disease is ultimately a extension of aortic atherosclerotic, not coronary atherosclerotic. And the perfect example with [INAUDIBLE]. I've seen a number of patients-- I've operated on a few-- where they're only coronary diseases right at the ostium of the right and the left. And beyond that there is nothing that is abnormal.

So I mean obviously that's the extreme. But there is such an entity as aortic disease and certainly the left main relies on the aorta as significant component of what its substrate is. So in that setting, it makes sense that it would behave differently than your standard coronary disease where disease is much further downstream.

CHARANJIT RIHAL: Let me ask you another technical type question. What's the role of off-pump bypass surgery? A lot of us are concerned that some of the morbidity associated with bypass surgery is actually due to the pump. So what about eliminating the pump. What's your feeling on that? What's the role of off-pump surgery?

ALBERTO POCHETTINO: It's an interesting question on a personal level. When I started my practice in the late 90s as a young surgeon, this is the beginning of off pump. I embraced the off-pump technology. And I was, in fact, the first surgeon at the time-- I was in Philadelphia-- doing off-pump CABG in Philadelphia. And I developed quite a large practice. Eventually, I realized that I was mostly treating myself and my referrals.

When I looked at my results-- and I did it for about five years, and then I retrospected to my result, they were really no different compared to on pump, both in terms of length of stay, peri-operative events, whether neurologic event. And I think it almost became a inside argument among surgeons and cardiologists. And the patient was an innocent bystander that was allowing us to do our thing as it were.

And I came to the personal realization that my priority is to do the best job that would get the best long-term result. There was no question in my mind, having done many hundreds of off-pump CABGs that the technical ability of doing a perfect anastamosis with it still hard is better. Again, I've done 100 off-pump CABGs. There's no doubt in my mind.

And ultimately, I changed my practice to-- the priority is, in my mind, especially in the world of drug-eluding stents aren't as good as they are to get the perfect anastamosis and get a perfect result technically. Now, there is a role for off-pump CABGs in patient with heavily-calcified aorta who have very severe cerebral vascular disease. So I still find a place for that technique in very advanced high-risk patient for neurologic events. So I think that's the role that I still accept.

But in patients that have your average run of the mill cerebral vascular risk-- we all have some risk-- my priority is to get the perfect job on [INAUDIBLE] anastamosis. And I think you can do a better job with it still hard. That's my personal approach.

If you look at the SDS database, there was an early enthusiasm for the technique that has plateaued. And if you look across the country, there hasn't been more than 15% of the CABGs done that have been at that level. Essentially, there are surgeons that learned that technique. They're comfortable, and they do it. And the rest of them don't.

So that's the way it's turned out. Personally, I think if that's what you do and that's your routine, then you should do it that way because you're going to do it poorly in a different way. You should not alternate it. That doesn't make sense, except for that high-risk population. That's my personal experience over a couple of decades.

CHARANJIT RIHAL: I think that's a great common sense approach answer to that question. Rajiv, as bypass surgery becomes lesser and lesser invasive, PCI appears to be getting more and more invasive. What's the role in your practice now of supported PCI. We've got-- I know in the cath lab you've got lots of different support devices from balloon pumps, ECMO TandemHearts, et cetera, et cetera. What is the role of some of these in high-risk PCI now?

RAJIV GULATI: Yes, on the one hand, PCI we're transitioning to the radial approach, thinking with minimally invasive, but they you're absolutely right in the complex high-risk, particularly elderly, patients with poor LV function, we're now increasingly using peri-procedural support with large bore transfemoral sheaths. The role I think still remains to be determined.

We're learning increasingly that there's probably less of a role for the good old-fashioned balloon pump in terms of support during a PCI. The hemodynamics don't really fit with particular benefit. The clinical outcomes either as good or not as good. They're certainly not better with balloon-pump supported PCI.

The real question is these more sophisticated devices, whether they're going to provide benefit. There's the Impella pump device. There are newer heart rate devices, ECMO TandemHeart as you say. I think in certain circumstances anecdotally I can say unquestionably patients have done better with them. They would have done poorly without them anecdotally.

But the aggregate data, I think it remains to be seen. One of the problems is how do you randomize patients who you perceive to be at such high risk that you want to put in a device? Do you say, gosh, can I say there's equipoise there or randomized because many of the trials have been done when the patients have not been so high risk. So I don't know if we'll ever get a randomized trial in the old-fashioned sense of the way of doing things that tell us exactly what to do. But I do believe there is a role-- an increasing role for peri-procedural support.

CHARANJIT RIHAL: Thank you. So joining me today have been Dr. Alberto Pochettino, my colleague from cardiovascular surgery, and Dr. Rajiv Gulati, my colleague from interventional cardiology, both here at Mayo Clinic. It's been a fascinating discussion. To sum up, we talked about multicultural revascularization and recent advances.

Both of my colleagues pointed out the critical role of angiographic anatomic and clinical characteristics in helping guide revascularization choices, particularly the extent and diffuse nature of coronary disease and the presence or absence of diabetes mellitus as the data all point and continue to point to the superiority or bypass surgery amongst the diabetic patients and those with diffuse three-vessel coronary disease.

Dr. Gulati then pointed out the increasing role and the favorable data supporting PCI for isolated left main disease, a procedure I believe is going to become increasingly commonplace here in the United States. Dr. Pochettino also talked about the role of off-pump bypass surgery and made some very cogent points about detaining the perfect anastamosis to attain the best long-term results.

Finally, Dr. Gulati talked about the role of mechanical circuitry support for high-risk PCI, a subset that's growing and will continue to grow as our patients get older and the LV functions get poorer and poorer. I hope this discussion was as enjoyable for you as it was for me. So again thank you, Alberto. Thank you, Rajiv. And thank you all for tuning in today.