David Kandzari: Hello and welcome to Paris, France at the EuroPCR interventional cardiology meeting. I'm Dr David Kandzari from the Scripps Clinic in La Jolla, California, and it's my pleasure to welcome you to this editorial discussion entitled "The Japanese approach to coronary CTOs." This discussion follows a program from earlier this year that examined coronary chronic total occlusion revascularization from an international perspective, and today I am happy to focus exclusively on the approach to coronary CTO revascularization from a Japanese perspective. And to do this I am joined by two of the leaders in the field of coronary CTO revascularization, two interventional cardiologists who in many ways are recognized throughout the world as two of the most complex interventional operators, especially with regard to the perspective of chronic total occlusions. Specifically, I am joined by Dr Etsuo Tsuchikane, who is codirector of cardiology at the Toyohashi Heart Center, in Tokyo, Japan, and also another long-standing colleague, Dr Masahiko Ochiai who is professor at the division of cardiology and cardiac catheterization laboratories, Showa University Northern Yokohama Hospital. Etsuo, Masahiko, welcome, and thank you for being part of this program.

So, over the past five to 10 years there's been an increasing amount of enthusiasm for treating coronary CTO revascularization, and I think many of us recognize that whether it's at meetings like here in Europe or in the United States or in Asia, and Asia Pacific, that's it's been oftentimes led by Japanese interventionalists paving the way with new techniques and new technologies for coronary CTO revascularization, and yet from an outsider's perspective, outside of Japan, that is, I think a lot of us have a great deal of curiosity, interest, and enthusiasm for how you attempt these procedures, how you select these patients, and is it any different from the way that we're beginning to learn from you in our own geographies, in our own institutions? Let me begin, Etsuo, with an overview--what is the rationale in Japan for CTO revascularization? Is it any different from the United States or Western Europe?

Etsuo Tsuchikane: Maybe first of all it depends on history of CTO intervention in Japan because we have already more than 25 years of history in CTO procedures, and we have many old CTO "masters" who show us how we can attack CTOs and how we can get success. So that basically, maybe the important issue is procedure success rate, and we have a relatively high success rate because of our long history, so that generally in Japan PCI for CTO is acceptable because of our high success rate, but of course some patients are still sent to bypass surgery, but generally first we attempt PCI for CTO.
DK: Etsuo, I want to return to the success rate in more detail, too, but you've raised an important point that there is the long-standing history in Japan of CTO revascularization. Masahiko, how did that interest begin and evolve in Japan with early operators performing such complex procedures, whereas in many other geographies, especially in the era of balloon angioplasty and bare-metal stent, this was certainly a less common procedure?

Masahiko Ochiai: I think our ancestors started CTO procedures in the late 1980s or early 1990s; at that time the first generation of dedicated CTO wires became available, and we thought that this is a way to save the patient from bypass surgery, and that's the beginning of the story.

DK: Along those lines, recognizing from many other studies that the presence of a chronic total occlusion, as we've discussed in other THO programs, is the most common reason for referral to bypass surgery, how does the threshold for decision-making on attempting the CTO vs referring to bypass surgery--how does that differ in Japan from other countries?

MO: I think in Japan, especially in experienced centers, PCI is the first choice, because in Japan, if we use a couple of gears they will be reimbursed, and IVUS is reimbursed. However, if the patient has a CTO and the left system is ultra super complex, including very calcified left main disease, we should consider bypass surgery. So our policy is first treatment strategy is PCI, and if the PCI can be done safely with very definite success rate, we go. But if in every point of view, CTO PCI seems high risk, we will send the patient to surgery. Of course, if the patient has concomitant valvular disease, it's nonsense to fix only coronary arteries, we should treat valves as well.

DK: One of the other issues that you bring up is that with chronic total occlusions, typically, these are much longer lesions than nonocclusive disease; it involves greater stent lengths, and I think it should be noted that many of the patients that you treat in Japan clinically too are some of the most complex patients--that is, you have a much higher frequency of diabetes in your PCI population, over 40%; I believe, a much higher rate of chronic kidney disease as well. Do you also have concerns using drug-eluting stents in such complex disease about stent thrombosis, for example, or dual antiplatelet therapy adherence?
ET: Of course, now we put drug-eluting stents in almost all patients, especially for CTO regions and, maybe we, because of dual antiplatelet therapy, rarely fear late stent thrombosis in the CTO region, so long-term patency is now not so bad.

DK: I wanted to ask both of you, are CTOs being commonly performed at all hospitals in Japan? Or is it mostly at selective centers by very experienced operators like yourselves?

MO: I think in Japan that there is no regulation about CTO procedures, so almost all CTOs are done first at local hospitals.

ET: Yes, we have many cath labs in Japan and they can take a long time for one case . . .

MO: . . . And many young physicians are very interested in CTOs.

DK: That leads me to another issue, of educating a younger generation of interventional cardiologists. How is this achieved in Japan? Do you have physicians come to your institutions? Are the physicians trained at their own institutions about CTO procedures? Do you do them together? How does training occur?

MO: Generally speaking, young physicians learn by themselves . . .

ET: Yes.

MO: . . . and motivated physicians come to us or join some live sessions, and we don't have any standardized, sophisticated program to teach.

DK: Many interventionalists from other countries have gone to your institutions and spent time training under your guidance. Do you feel that there is a minimum number of CTO procedures to maintain proficiency for education?

MO: Of course.

DK: Is there a certain number [of procedures]?

MO: I think the number is similar to the guidelines of Euro CTO, at least 75 hopefully, or if I make some compromise, maybe at least 50 CTOs should be done by an operator per year. What do you think?
ET: Yes, basically I agree with you, between 50 and 75.

DK: Etsuo, you have described very well the history at Toyohashi Heart hospital of the success rates over more than a decade, and you briefly touched on this earlier. Tell us, have the success rates improved over time in Japan in the interventional community?

ET: Yes, in the last 10 years, each hospital has gradually improved its success rate, and especially by the introduction of several kinds of wiring techniques and CTO specific devices, and recently with the retrograde approach.

DK: What is the success rate that you would quote to a patient when considering CTO revascularization?

MO: If the patient comes to my outpatient clinic, I would say around 90%.

DK: So that's probably much higher than what many other interventionalists might cite in other countries. Is that including the first attempt at the CTO? Or do you often bring patients back for a second attempt if the initial procedure has failed?

MO: I sometimes bring back my patients.

DK: With regard to the retrograde approach, this has been one of the most advanced techniques in interventional cardiology; it's one that's been promoted by the Japanese interventionalists. In your practices, what procedures are still antegrade as opposed to retrograde?

ET: Basically we still first try the antegrade model because the retrograde approach always carries a risk of donor artery trouble. Basically the antegrade approach is safe, so in a majority of cases when we meet a very complex CTO case and if it has a good channel, we should first try the retrograde model, but basically the antegrade approach is still the first solution. In Toyohashi heart center last year we did only 20% of cases via retrograde approach--including reattempted cases.

DK: So overall, 20% of the cases were retrograde, including reattempts?

ET: Yes.
**DK:** How many CTO procedures are performed per year at that hospital?

**ET:** Around 130 to 140.

**DK:** Is that your experience as well, Masahiko?

**MO:** If the patient is a first attempt, it seems that the majority can be opened by antegrade approach. But in my practice, if the CTO looks very challenging, in terms of cellular and anatomical practice, I like to start from retrograde; it completely depends on my personal experience and judgment.

**DK:** What new complications have we learned from the retrograde approach?

**MO:** In the retrograde approach there are lots of complications, but fortunately there are lots of CTO meetings in Japan, so I can learn about complications in such meetings so I can do my very best to avoid complications. So in my practice, I have never experienced a donor artery dissection, a donor artery thrombus, because I learned how to prevent them. The personal case volume of retrograde approach is not so high, I don't think we have done more than 300 retrograde cases, in my life. More than 200, less than 300? What do you think?

**ET:** Yes, around 300.

**MO:** Around 300. Not 500. Not 1000. So it's very important to learn from the experience of our colleagues.

**DK:** Shared experience is one that I think cannot be underestimated: that we learn from one another from shared experiences, communication, through live cases, programs like this, as well. One of the other issues that I wanted to ask both of you about is: when do you have a CTO that you do not attempt? What types of cases do you not attempt for chronic total occlusion revascularization?

**MO:** In my practice it's mainly due to comorbidity, and the symptoms of the patient and the location of the CTO. If the patient is an 85-year-old lady with midcircumflex CTO without any symptoms with only documented ischemia by thallium scan and her creatine level is 2.5, I don't touch.
**ET**: Yes, of course.

**DK**: I think that's a very important point for viewers to recognize, that the cases you are selecting are based on solid clinical foundation, either documentation of large ischemia systems or maybe LV dysfunction as well. In the cases that are unsuccessful, what is the most common method of failure today in the Japanese approach to CTOs? Is it, for example, being able to cross the occlusion but not gain reentry? Is it simply not being able to cross the total occlusion? What are the modes of failure?

**ET**: Of course, unsuccessful wiring--both antegrade and retrograde, I think.

**MO**: In my case, the reason of failure of antegrade wiring . . . and strong bending and antegrade wiring cannot lead to the distal path, and then we switch to retrograde and if we can deliver polymer jacket wire and the Corsair into the distal coronary artery, a very high success rate can be guaranteed. So the pattern of my failure is that antegrade [approach] is unsuccessful and unfortunately I cannot find any suitable collateral which can be wired toward the distal coronary artery.

**DK**: So, not finding the collateral, for example, in a retrograde approach. Masahiko, you mention the Corsair catheter, which I think is one of the technologies that has helped revolutionized how we perform these procedures. I'll ask both of you, are there any technologies that you feel are necessary that are yet to be developed for improving procedural success?

**MO**: I think the most important thing is high-quality coronary angiograms. That means in the medium magnification without panning, with long filling time. This kind of high-quality angiogram is much more important than many people think. If we pan like this all of the important information regarding tiny channels can be lost, so I sometimes ask the referring physician to take the angiogram again and to send the CD to me.

**DK**: So, taking a very meticulous angiogram to survey the entire coronary tree . . .

**MO**: Without panning. Panning is the worst thing.

**DK**: That's a great suggestion.
MO: The second thing is the master CD.

DK: Do both of you commonly use multislice CT in your practice to identify patients?

MO: In my institution, 100% of patients. If the patient doesn't have any concomitant renal insufficiency.

DK: Etsuo, do you have guidelines for when you would stop a CTO procedure that so far has been unsuccessful? Do you have a limit on radiation exposure?

ET: Yes, basically contrast volume is highly dependent on kidney function, so we can calculate how much we can use it before the procedure. Now we rarely use high-volume contrast because we can use many kinds of markers like parallel wire and IVUS guidance and retrograde approach, so now we rarely use high-volume contrast.

MO: "High" means 1000?

ET: Now the average contrast volume is less than 300. Or 200 for retrograde.

DK: And what about radiation exposure? Is there a threshold or a cutoff in that regard?

MO: I always check the radiation dose on the monitor.

ET: Yes.

MO: And the radiation dose is highly dependent on the machine and the body size of the patient.

DK: In both cases, I think it's still very much individualized, what your parameters are for deciding when to stop.

MO: In my practice, if I can make no progress, after fluoro time of 60 minutes. If there's some progress, I should continue, and the total procedure time becomes very long.

ET: Yes.
DK: But there's always a little bit of progress, so you keep going. Finally, Etsuo and Masahiko, I'll ask you one final question. What, if anything, have the Japanese interventionalists, the experts in CTO revascularization, learned from non-Japanese interventional cardiologists?

ET: Probably nothing [laughs]. But they can create other CTO devices other than conventional, we only have the conventional wire, but they can produce other kinds of CTO devices like reentry devices or forward-looking IVUS, so maybe we have to learn . . .

DK: Outside of Japan you see possibly the development of new technologies.

MO: I learned some discipline, rather than procedures. For example, we should pay very close attention to radiation exposure or contrast volume. I think operators outside of Japan are more conscious about that, and I learned a lot, especially in my practice in the US.

DK: I know that both of you have performed CTO revascularization procedures in many countries all over the world, and I would say that it's a fair statement that we have learned a great deal more from you, just as in this program today. Etsuo, Masahiko, I want to thank you very much for sharing your perspectives as very experienced, expert Japanese CTO operators. Thank you very much.