Commentator Discussion: Type B Aortic Dissection in Marfan Patients after the David Procedure: Insights from Patient-Specific Simulation

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Disclosures: None

Dr. Duke Cameron (Baltimore, MD):

Dr. Chung, I congratulate you and your team on a provocative and very sophisticated study. Those of us involved in the care of Marfan patients have long been concerned about the disturbing appearance of type B dissection. And this is despite very successful lifesaving proximal aortic surgery. And we've been discouraged. It's as if our successful proximal surgery just kicks the can down the road and pushes aortic catastrophe downstream, both temporally and anatomically. You have provided, using Dr. David's extraordinary series of valve-sparing root surgery, some great insights into the pathogenesis of this problem after proximal root surgery. You've also given us insight into the frequency of it. 20% at 20 years is quite significant and this is a problem we absolutely have to address if we are truly going to restore life expectancy to normal in the setting of Marfan Syndrome.

There are a number of observations, measurements of the wall tension in particular, that are intriguing and somewhat counterintuitive. The wall tensions in the patients who did dissected were actually low before and after surgery, but when you looked not just at overall wall tension in the descending aorta but focused on the proximal descending aorta, it was a significantly increased wall tension in that area, exactly where the tears occur. And that increase was much,
much greater in the dissected patients than those who did not dissect. Your study suggests to me that this long-term debate of whether this is a problem relating from the procedure, the proximal root replacement, or some intrinsic vulnerability of the descending aorta, my take-home message of this is that it's still a matter of both, and I'm going to ask you to comment in just a second if you agree with that, because I think as a group of surgeons here, we'd love to hear that take-home message.

But I also want to mention I think what's most impressive of your study is the patient-specific simulation, your computational fluid dynamics analysis, which has really looked with a much better microscope at what's going on in the wall of the descending thoracic aorta. So here are my questions. Do you agree with the take-home message that type B dissection after proximal root surgery in Marfan Syndrome is a result of both factors, is hemodynamic changes imparted by proximal surgery and a particular vulnerability of the proximal descending aorta? My second question is could you address medications? Were most of these patients on the same medicine, similar doses? Might that have any impact? I was going to ask you about the oscillatory stress index and RRT, but you've defined that in the presentation. And by the way, this is a remarkably clear and beautiful presentation. But lastly, I'm going to ask you to speculate, based on what you've shown us here, how we might modify the proximal aortic operations of the future to minimize abnormal stress on the proximal descending aorta and reduce the risk of type B dissection?

Mr. Farshad Tajeddini (Toronto, ON, Canada):

Okay. Thank you, Dr. Cameron, for your questions and for reading our paper. So, addressing your first question which is whether the differences we see are both due to the surgery itself as well as the intrinsic differences between the patients. And yes, I would agree with you that that would be our take-home message because we do see differences even before the surgery had occurred, irrespective of the surgery. And then, we see these focal changes at the proximal descending thoracic aorta as a result of the surgery. So, it probably is a combination of the two.

And then addressing your second question regarding medications, we did go back and look, and a lot of the patients were on beta blockers or angiotensin receptor blockers. And then your third question was what I would speculate we could change in our original surgery, the valve sparing operation, to prevent these long-term complications. And that is the next phase of our study, that is exactly what we're planning to do to look at. We will run a number of simulations where we swap out the proximal geometry for a whole different variety of factors. And then we'll see what that effect is on the downstream aorta. And I know that Dr. David is very interested in the presence of sinuses or the creation of sinuses versus having the straight grafts.
Dr. Cameron:

Thank you very much.

Mr. Tajeddini:

Okay. Thank you.

Unidentified Speaker 1:

Thank you. And I have a question.

Dr. Marek Jasinski (Wroclaw, Poland):

Okay. Thank you very much, Laura. Marek Jasinski, Wroclaw, Poland. I mean it is very impressive presentation which actually represents huge interest at the moment, scientific and research, certainly research-wise interest in hemodynamics, in mechanical properties of the aorta, and the different root operations can trigger different hemodynamics postoperatively due to both [inaudible] stress and all those factors you presented so nicely. However, the most important take-home message may probably relate to what has been already alluded before, at the end of your answering to Professor Cameron, it is what geometric changes can trigger the hemodynamic consequences which may, as a result, produce such a complications with very well-proven hemodynamical consequences on the wall.

Now, in the beginning, you just showed that probably as simple as angles between access of the aortic root and the ascending aorta may probably be different invariably, and it may be a potential factor which has been clearly shown by other studies, CT studies of how really the 3D flow after the valve sparing operation really look like. It is not a 100% idea, we know that, because of certain geometrical limitations of reimplantation. So, what do you think? I mean, you already answered that, but as I'm just standing here, I have to ask the same question. What do you think? Is it looking like the simple geometric orientation in between those access may influence this rate of the type B dissection? Again, congratulations for fantastic study from Toronto group.

Mr. Tajeddini:

Thank you very much for your question. So, we are planning to look at angulation, size, length, the presence of sinuses, and all of these factors. And I think by having computer simulation, this is the only way that we can answer
this question. So, I think it's a little early for me to speculate, but hopefully, we'll have that answer for you in coming years.

Yeah. I hope that is going to be milestone in our sort of looking at valve sparing operations. I'm pretty sure.

Mr. Tajeddini:

Thank you very much.

Unidentified Speaker 1:

Thank you. May I have just one question and maybe you have one. So, we may speculate that the graft should be longer, shorter, bigger, smaller—

Mr. Tajeddini:

Angulated. Yeah.

Unidentified Speaker 1:

--more curved. Do you have any supposition to make already today prime time?

Mr. Tajeddini:

Well, I'd rather not so that I could have you quoted later on, but we really will do these simulations and so—

Unidentified Speaker 1:

Very quick.

Mr. Tajeddini:

Yeah.

Unidentified Speaker 1:
Thank you.

Mr. Tajeddini:

Sorry.

Unidentified Speaker 2:

Is it crazy to think that it has nothing to do with what you did to the root but it's a preexisting patient factor based on the shape and the flow through the aorta and maybe we think about doing something in addition to the root in these patients.

Mr. Tajeddini:

Yeah. Absolutely. I think you're right, and I think that was what Dr. Cameron was also trying to get out with his first comment, which is that it probably is a combination of the patient's preexisting factors as well as the surgery itself. And that's what actually we showed, and even before the surgery, there were anatomical differences between these patients. Thank you.

Unidentified Speaker 2:

Thank you.

Unidentified Speaker 1:

Thank you.

[applause]