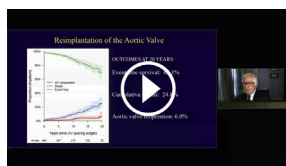


## Webcast

You can watch a Webcast of this AATS meeting presentation by going to: <https://aats.blob.core.windows.net/media/20AM/Presentations/Reimplantation%20of%20the%20Aortic%20Valve%20i.mp4>.



## Conflict of Interest Statement

The authors reported no conflicts of interest.

The *Journal* policy requires editors and reviewers to disclose conflicts of interest and to decline handling or reviewing manuscripts for which they may have a conflict of interest. The editors and reviewers of this article have no conflicts of interest.

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**Key Words:** aortic valve-sparing operation, reimplantation of the aortic valve, David operation, aortic root aneurysm, aortic insufficiency

## Discussion

### Presenter: Dr Tirone E. David



**Dr Ismail El-Hamamsy** (New York, NY). Thank you. It is my privilege to discuss this paper by Dr David and the Toronto group. This series is notable not only for the excellent short- and long-term results, but importantly for the quality and the completeness of patient follow-up, both clinical and echocardiographic, despite the 30-year span of the study. This serves as an example to all surgeons, young or established, illustrating the critical role of longitudinal assessment of surgical results to advance science and improve our outcomes.

This is all the more significant when the target population is a young one, such as for reconstructive root surgery. It will never be enough to talk about 30-day or 1-year results. Long-term outcomes represent the truly relevant questions for these patients, and systematic follow-up is the only means to attain that, as Dr David continues to demonstrate.

Furthermore, your study clearly shows that achieving excellent surgical outcomes is a combination of 2 things: meticulous surgical technique and careful patient selection.

Over a 30-year period, 465 patients underwent reimplantation procedures by 3 surgeons at the Toronto General Hospital. While these were carefully selected, nevertheless 33 patients were acute type A dissections, 27 were redo operations, and 177 patients had a connective tissue disorder.

In addition, 63% of the cohort had more than mild aortic insufficiency preoperatively. With that in mind, your results provide further confirmation that aortic valve reimplantation is an excellent operation. At the same time, your data highlight 2 important points. The first is the continued risk of acute aortic dissections in the downstream aorta, especially in patients with connective tissue disorders.

Second, your reported rate of stenosis in patients with bicuspid aortic valves undergoing reimplantation: of the 67 patients with bicuspid aortic valves, 5 developed stenosis. While the numbers are too small to draw any definitive conclusions, it certainly gives pause and sheds some light as to potential modes of failure.

I have 3 questions. My first is: Your data clearly confirm that valve-sparing reimplantation is associated with excellent long-term clinical outcomes in selected patients. Based on these results, would you agree or disagree that it is justified to be a bit more liberal in the patient selection process to avoid prosthetic valve complications?

In other words, do you think that reoperation is the main metric to measure the success or failure of choosing reimplantation, or should we accept a slightly greater rate of reoperation if survival and quality of life can be close to normalized?



**Dr Tirone E. David** (*Toronto, Canada*). I don't know the answer to this question. However, every time you develop something new, you better be very careful what you say and what you publish. I've been extremely careful—and to be quite honest, until some 10 years ago, I was extremely selective.

I would not do this operation in many patients that I watched other surgeons doing without reservation.

I had been highly conservative, and perhaps that's why the results are the way they are. We have been more liberal lately. We are including patients with minor calcification in bicuspid aortic valves, and more defective tricuspid aortic valves. I can tell you that one technique that surprised me (and on which we are planning to publish a paper) is Gore-Tex in the free margin, particularly in patients with Loey's–Dietz syndrome or Marfan—provides great results at 15 and 20 years.

In other words, in young people (17, 18 years old) with a defective tricuspid aortic valve, it's a tragedy to put in a mechanical valve in that age group. So, we have saved many of them and, to my surprise, 15 years later, those valves are

working as well as those that are defect-free. So that's the only area where I extend the indication.

But you're probably right, now as we have a reoperation rate of 6% at 20 years, which is probably lower than with mechanical valves, we should be more liberal in the use of this operation and include patients with diseased cusps.

The input from Laurent would be important because Gebrine El Khouy has been more liberal with this operation and I would ask Laurent to make a comment in this regard.



**Dr Laurent De Kerchove** (*Brussels, Belgium*). The Gore-Tex technique maybe a better technique than what we usually thought. We actually think that it may favor calcification in bicuspid valve and we stopped using it in this indication. But in tricuspid, we have not the same impression, and

we showed in our presentation today that it reduced the occurrence of aortic insufficiency, and it's probably a good technique to explore more for the tricuspid valve.

**Dr David.** But maybe it's important to mention something about technique. Gebrine changed the way he learned with us. We weave the Gore-Tex suture along the free margin by passing in and out the leaflet. The Gore-Tex becomes part of the body of the cusp. Gebrine runs over and over. Isn't this the reason for the calcification? If you expose a Gore-Tex to the trauma of the cardiac cycle, in other words, every time the aortic valve opens and closes, it will be banging against the Gore-Tex. I use 7-0 Gore-Tex to reinforce these cusps.

**Dr El-Hamamsy.** So are you suggesting that the Gore-Tex would be a better tool to correct leaflet prolapse than just central plications?

**Dr David.** Overstretched leaflets may contain large stress fenestration; they are not congenital. I believe these cusps are better repaired with Gore-Tex than central plications.

**Dr El-Hamamsy.** Looking at the aortic dissection figure, as you mentioned, the inflection point occurs about 8 to 10 years after surgery. If any of these patients had imaging leading to the dissection, were these the current normal aortic diameters, or where they dilated at the time of surgery?

**Dr David.** I'm sorry to say we don't have this information; we tried to collect, because there are other papers showing similar outcomes after Bentall, and they correlate well with size of the descending thoracic aorta. Twenty-seven millimeters was the cut-off for patients with Marfan syndrome. Patients with a descending thoracic of 27 or larger had a greater risk of dissection.

We don't have sequential magnetic resonance imaging and computed tomography scans to give this answer. We have been collecting this information since Maral

Ouzounian joined in the past 5 years. But it's going to take another 5 or 10 years to get the answer.

**Dr El-Hamamsy.** Finally, the notion that bicuspid aortic valve preservation can result in stenosis in the long-term obviously gives some pause. In a separate series, the Homburg group also shows the cumulative incidence of about 8% at 15 years, not unlike your results. Do you want to comment on possible anatomical or technical factors that may predict or prevent the occurrence of stenosis, and do you think that this is enough reason to be less liberal with the use of reimplantation in this setting?

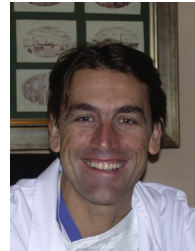
**Dr David.** Just like our results in tricuspid are unique, so are Hans-Joachim Schäfers' long-term results in bicuspid. He must know something that the rest of us don't. I don't know why in bicuspid aortic valve he has so few failures. No stenosis. Is it patient selection, or is he doing something that we may not have grasped yet? I can tell you that in reimplanting a bicuspid aortic valve, the results are very different, and largely dependent on the phenotype. In my hands, very small number of cases; I've done maybe 40 of the 67 reported. If the cusps were oriented at 180°, I have no failures at 15 years. The moment you start taking bicuspid aortic valve with tricuspid phenotype, in other words, commissures at almost 120° from each other, the results are not as good. But this reflects from personal experience. Again, I think Gebrine has the largest experience on reimplantation of bicuspid aortic valve, and Laurent may have a comment to complement what I said.

**Dr De Kerchove.** Anyone who pushes the limits in bicuspid valve repair will experience long-term stenosis. The Homburg group achieved 15-, 20-year follow-up, and they reported 10% of stenosis after 15 years follow-up and that's what we observed, too.

In the patients we operated on for bicuspid valve at the age of 40 years due to regurgitation, we saved the valve from being replaced, but approximately 15% of those valves, after 15 to 20 years, will become stenotic and that is part of the natural history of the bicuspid valve. With a strict patient selection, exactly as Tirone says, repairing only symmetric valve and discarding the very asymmetric ones, we may reduce this rate of long-term stenosis.

Also, to reduce risk of stenosis, as explained earlier in the discussion, we have stopped using Gore-Tex in the bicuspid valve. And the third important aspect is that when you do a repair, you have to take care that the fused cusp repaired with central plication is still moving. If it's not moving, it will create a gradient that will continue to increase following the operation.

Finally, avoid patch repair, and avoid repairing bicuspid valves that already have calcification may also of course reduce the risk of late stenosis.



**Dr Ruggero De Paulis** (*Rome, Italy*).

The last paper on this subject was published together, by the group from Brussels and Schäfers in Homburg. They just demonstrated that in the asymmetric group, the result was exactly as Tirone David was saying now. I think, with respect to the first initial years, we are learning much more how to treat the bicuspid valve and how to select it; this will probably change over time. For instance, I started to treat bicuspid valves more or less about 14 years ago, and I can tell you that in the last 5 or 6 years, the technique has already changed. So today, we are much more confident even in the long-term results.

Another point: we certainly do not have a huge number of cases, but still around 50 cases and we don't have yet a reoperation for stenotic bicuspid valve so far, but of course we have to consider that the long-term follow-up is only around 10 years.



**Dr Vaughn A. Starnes** (*Los Angeles, Calif.*).

Tirone, such a great experience with the patients with Marfan syndrome. Are there some patients that you don't do—some cusp size, annular size, in that Marfan group?

**Dr David.** Yes, of course. On the basis of age, Laurent made a good point: if the patient is 20, 30, 40 years old, the alternative to valve-sparing would be a Bentall with a mechanical valve. We don't do very well with mechanical valves in Toronto. Our population is very heterogeneous, and anticoagulation in our patients is not simple.

If the patient is highly educated yes, we don't repair and use a mechanical valve. But these are the cases in the past decade we are now repairing more and more. That's why I mentioned Gore-Tex. You can take a cusp that is literally flat and create convex-concave again by weaving a double layer of Gore-Tex suture and free margin is shortened at the same time. In those patients, if they are younger than 40 years, we repair. If they are over 40 or 50 years, we tend to replace them. We simply don't have a good alternative to mechanical valves in young patients.