Valve-sparing aortic root replacement: Surgeon and patient factors contribute to long-term durability

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In 1979, acting on the observation that many patients presenting for aortic root replacement have normal aortic valve morphology, Sir Magdi Yacoub developed a strategy for aortic root replacement (the “remodeling procedure”) in which the aortic valve is preserved.¹ In 1988, Dr Tirone David introduced a different technique for valve-sparing aortic root replacement, the reimplantation procedure, which in contrast to the remodeling procedure stabilizes the aortic valve annulus with a subannular row of horizontal mattress sutures attached to the Dacron polyester fabric graft encasing the valve.² The remodeling procedure is easier to perform, but time has shown that, especially in patients with annuloaortic ectasia, the operation will fail in many cases because of development of aortic valve insufficiency as the unprotected annulus continues to remodel and dilate.

The degree of success afforded by the reimplantation modification is showcased in this issue of *The Journal of Thoracic and Cardiovascular Surgery*, in which David and colleagues³ present their series of 333 patients during a 23 year period, all of whom underwent a valve-sparing root replacement with the implantation (David) technique. The mean follow-up was more than 10 years, and it extended to 15 years for 39 patients. Patients were young (mean age was 46 ± 5 years) and predominantly male (78%). The aortic root aneurysm was associated with Marfan syndrome in 124 of the patients (37%), and a congenitally bicuspid aortic valve was present in 45 patients. Twenty-eight patients had type A aortic dissections. The aortic degree of aortic insufficiency was moderate or severe in 144 patients. There were 4 early deaths (<90 days, 0.1% mortality) and 35 late deaths. Survivals at 15 and 20 years were $77.9\% \pm 2.9\%$ and $72.4\% \pm 3.8\%$, respectively. Only 11 patients had development of moderate or severe aortic regurgitation during the follow-up; with interval censoring, $96.2\% \pm 1.0\%$ were free from this event at 15 to 20 years. Six patients underwent reoperations on the aortic valve, for a freedom from reoperation at 15 to 20 years of $96.9\% \pm 1.3\%$.

These are the best results in the world for this operation. The US National Marfan Foundation has suggested as a

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Central Message

Outstanding surgical results with the reimplantation technique of valve-sparing aortic root replacement are presented.

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standard that valve-sparing aortic root replacement operations should only be performed at centers where the operative mortality is less than 1% and the 10-year freedom from valve reoperation exceeds 90%.⁴ Most centers will not attain these lofty recommendations, but some, such as the Toronto³ and Stanford⁵ programs, have achieved this mark and beyond. The keys to superlative results such as these include appropriate patient referrals and the performance of the operation by highly skilled surgeons who have great experience with this procedure. As David and colleagues³ discuss in their article, the ideal patient has a relatively small (<55 mm) aortic root and grossly normal cusps on surgical inspection. The ability to operate on these patients depends on cardiologists who are well educated in the importance of early referral to achieve the best results, and an important factor in these referrals is the degree of confidence that referring cardiologists have in the capabilities of their surgeon. A collaborative, multidisciplinary consideration of these patients on both the medical and surgical sides is thus critical to having the optimal patient taken to the operating room for best results.

I have written in the past on how this operation can be modified in several places to make it more user friendly,⁶ especially to facilitate resident teaching, but the fact remains that this operation is a highly complex geometric exercise that alters the shape and diameter of the aortoventricular junction, the shape of the aortic valve cusp attachments to the aorta, and the valve commissural

heights when the Dacron polyester fabric graft is implanted, and the resultant impact on the geometry and coaptation of the valve cusps must be anticipated, identified, and repaired when appropriate. This is precisely where the “art” of this procedure lies. Some years ago, after having performed around 50 valve-sparing root reimplantation operations myself, I visited Dr David in Toronto to observe his technique. I recall one particular operation during this visit where, after placement of the Dacron polyester fabric graft and suturing of the pericusp aorta to the graft, the valve seemed to sit perfectly to my eye. Yet Dr David was not satisfied. He remarked to me that one cusp coapted just slightly lower than the others and that overall he was concerned that there would not be a sufficient coaptation distance (>5 mm is ideal) for the operation to be durable. What ensued was another 20 to 30 minutes in which Dr David made subtle modifications to the cusps to produce the ideal result in his mind. The valve worked perfectly, with a low gradient and no aortic insufficiency. I took much from that day and have used his teachings fastidiously. Surely, observations and repairs such as these made by Dr David during the years have contributed greatly to his group’s results.

This article by David and colleagues³ will likely change my practice of using polytetrafluoroethylene sutures to reinforce and elevate the aortic cusp free margin (which was shown with univariable analysis to predict development of moderate to severe aortic insufficiency) in favor of cusp plication. I was also interested in their finding that surgically created neo-aortic sinuses in the Dacron polyester fabric graft were associated with development of late significant regurgitation. I personally have always used a straight Dacron polyester fabric graft and will continue to do so. The presence of a congenitally bicuspid aortic valve usually requires that some sort of intervention be performed on the valve cusps after the Dacron polyester fabric graft is placed, especially the

conjoined cusp, which tends to prolapse in to the left ventricular outflow tract after the Dacron polyester fabric graft is implanted. In this series of David and colleagues,³ however, bicuspid aortic valve did not contribute as a predictor of aortic insufficiency. The excellent results reported here are supported by similarly favorable outcomes in this patient population at other experienced centers.^{7,8}

To conclude, the reimplantation technique of valve-sparing aortic root replacement has positively affected the lives of many young people all over the world with aortic root annuloaortic ectasia. Those of us who perform this operation must read this article carefully and absorb its messages. I would also recommend a visit to Toronto to see Dr David perform these operations—you will not regret this decision!

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