Aortic valve haemodynamics after aortic valve-sparing operations

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Basically, there are two basic types of aortic valve-sparing operations: remodelling of the aortic root and reimplantation of the aortic valve [1]. After more than 2 decades of experience with these operations, we have concluded that they are not competitive procedures, but provide excellent long-term results when correctly matched to the aortic root pathology [2, 3]. Remodelling of the aortic root is physiologically superior to reimplantation of the aortic valve [4], but it does not address the problem of annular dilatation that often occurs in young patients with inherited aortic root aneurysms. As the dilatation of the aortic annulus can appear after the remodelling procedure, we believe that young patients are better served with reimplantation of the aortic valve. Remodelling of the aortic root is a good alternative to reimplantation of the aortic valve in older patients with normal aortic annulus and it is easier to perform.

Regardless of the type of aortic valve sparing, restoration of normal aortic cusps geometry is the most important technical aspect of these operations. A key element for long-term success is the level and area of cusps coaptation. At the end of the procedure, the coaptation of the cusps must be inside the aortic root and a few millimetres above the level of the nadir of the aortic annulus, and the cusps coaptation length must be at least 4 mm.

Remodelling of the aortic root has practically no adverse effect on systolic performance of the aortic valve because it does not change the diameter of the aortic annulus and has minimal effect on the movements of the aortic annulus during the cardiac cycle. In addition, the velocity of opening and closure of the cusps is only slightly increased [4]. Reimplantation of the aortic valve into a Dacron graft (straight tube or the Valsalva Graft by Vascutek Ltd, Renfrewshire, Scotland) alters every component of the aortic valve: the annulus, the cusps, the sinotubular junction and the aortic sinuses. The aortic annulus becomes rigid once sutured inside the Dacron graft. The degree of narrowing of the annulus will vary with the size of the graft used and the technique used for fixation of the annulus. The sinotubular junction is reduced and the aortic sinuses completely abolished when a straight tubular Dacron graft is used. The velocity of opening and closure of the aortic cusps is greatly increased in this operation [4], but it can be decreased by creating neo-aortic sinuses [5] or by using the Valsalva Graft [6]. Fixation of the aortic annulus and reduction of its diameter will invariably increase the impedance of blood flow to some degree that is not seen after remodelling of the aortic root. Actually, there is a case report of aortic stenosis after the reimplantation procedure because of purse stringing of the aortic annulus during its fixation in the tubular Dacron graft [7]. This is caused by a technical error that can be prevented by using grafts of adequate size and carefully tying the sub-annular sutures [2, 3].

In this issue of this journal, D’Ancona et al. [8] from Palermo, Italy, published a study that examined the haemodynamics of the aortic valve after the reimplantation technique in 17 patients and compared it with that of 18 matched controls. Aortic valve function was assessed by echocardiography at rest and during maximal exercise. Area of the left ventricular outflow tract and flow velocities were measured and the derivatives were calculated. Aortic valve area index at rest was $1.1 \pm 0.2$ cm$^2$/m$^2$ in the reimplantation group and $1.5 \pm 0.2$ cm$^2$/m$^2$ in the control group ($P = 0.0001$), and during maximal exercise it increased significantly to $1.4 \pm 0.2$ in the reimplantation group and to $1.7 \pm 0.2$ in the control group. There were no differences between the groups in peak and mean transvalvular gradients at rest and during exercise. Most patients in the reimplantation group had mild aortic
insufficiency and the degree of valve dysfunction did not change during exercise.

This is probably the first published study on systolic performance of the aortic valve after the reimplantation procedure into a straight Dacron tube in comparison with normal matched controls. Expectedly, the mean effective aortic valve orifice index after reimplantation of the aortic valve was smaller than that of matched controls, but the systolic performance was excellent and the aortic valve orifice increased in size during exercise. The size of the graft used for reimplantation certainly affects the aortic valve area. In D’Ancona’s study [8], the selection of the graft size was based on the diameter of the sinotubular junction, and grafts 26, 28 and 30 mm in diameter were used. The method used by these investigators to estimate the size of the graft is similar to our method, but we use grafts of >4–6 mm to create neo-aortic sinuses by placing darts in the graft in the spaces in between commissures where the valve is reimplanted [2, 3].

Intrigued by D’Ancona’s study [8], I reviewed the echocardiogram reports of 20 consecutive patients who had reimplantation of the aortic valve with creation of neo-aortic sinuses at the first postoperative year. The patients’ ages ranged from 19 to 54 years with a mean age of 45 years and the graft sizes ranged from 28 to 34 mm with a mean of 31.2 ± 2.0 mm. The aortic valve areas ranged from 1.9 to 3.0 cm² with a mean of 2.52 ± 0.31 cm² or 1.35 ± 0.22 cm²/m². The aortic valve orifices in these patients appear to be slightly larger than those reported by D’Ancona et al. [8]. The difference could be due to the fact that we used larger grafts and/or the presence of neo-aortic sinuses. The reality is, however, that the patients in the D’Ancona’s study [8] had more than adequate aortic valve areas and the effective orifices became larger during exercise. In our experience, which now spans beyond 2 decades, reimplantation of the aortic valve into a cylindrical Dacron graft has provided excellent long-term results [9]. Actually, this technique was used in our first 89 patients, all operated before 2000 and only 2 patients required reoperation, one was the second patient in this series and the other required reoperation at 9 years postoperatively. We now have 11 patients who have crossed the 20th anniversary of their operation and the aortic valve remains competent. The importance of creating aortic sinuses during this type of aortic valve sparing to enhance valve durability remains to be proven.

REFERENCES