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Calculated Reduction Aortoplasty for Dilatation of the Ascending Aorta Associated with Aortic Valve Replacement

George Stavridis MD FETCS, Dimitris Zarkalis FETCS, Louis Louca MD FETCS, Loukas Tsourelis, Peter Alivizatos MD FACS

1st Department of Cardiac Surgery and Transplantation, Onassis Cardiac Surgery Center, Athens, Greece

ABSTRACT

Background: Previous studies have advocated reduction aortoplasty to normalize the diameter of a moderately dilated ascending aorta associated with aortic valve disease. One of the reported techniques is the shawl lapel aortoplasty, which we have adopted and modified by setting a simple set of calculations. We present our midterm results.

Methods: Between February 1996 and February 2004, 25 patients underwent reduction aortoplasty during replacement of their aortic valves. Concomitant cardiac procedures were performed in 11 patients. Eighteen patients had predominantly severe aortic valve stenosis and 7 patients moderate to severe aortic valve insufficiency. Ascending aortic aneurysm size ranged from 43 to 50 mm, measured echocardiographically. In one small sized patient the aorta was 38 mm. Following their discharge patients were instructed to have control echocardiograms every 6 months for the first postoperative year and then annually. They were interviewed by telephone annually to date.

Results: There were no hospital deaths. Twenty-four patients were alive at follow-up, at 2 to 96 months (average 2.9 years). There was one late death, 2 years postoperatively. The first follow-up transthoracic echocardiogram performed at a mean of 6.2 months postoperatively (range, 1-11 months), as well as the subsequent annual echocardiograms in all patients, showed no evidence of further enlargement of the ascending aorta, compared to the reduced diameter obtained during the initial operation. The first 3 patients of this study remained essentially unchanged postoperatively, with only a minor reduction of their aortic diameter.

Conclusions: The shawl lapel technique based on simple calculations, used as a diameter-reduction strategy for ascending aortic dilatation encountered during aortic valve replacement, is an efficacious method with excellent medium-term results.

INTRODUCTION

Dilatation (ectasia) of the ascending aorta, encountered during an aortic valve operation, poses a dilemma to the surgeon, whether to perform replacement or aortoplasty of the ascending aorta, leaving the former option for an unquestionably aneurysmal aorta. The distinction between dilatation and aneurysm is based mainly on empirical criteria. Localized aortic enlargement less than twice the diameter of a normal aorta with good quality thickness, texture, and resiliency is indicative of dilatation [Najafi 1997]. In such cases, a less radical operation may be performed concomitantly with the valvular procedure, without fear of redilatation or aneurysmal formation. In this article we present medium-term results and revisit the shawl lapel aortoplasty technique based on a simple mathematical equation.

MATERIALS AND METHODS

Between February 1996 and February 2004, 25 patients underwent reduction aortoplasty during replacement of their aortic valves. Concomitant procedures were performed in 11 patients: coronary artery bypass grafting in 8 patients, Dor endoaneurysmoplasty in 2 patients, and radiofrequency ablation for atrial fibrillation in 1 patient.

There were 19 men and 6 women in the patient group, with a mean age of 67 years (range, 27-89 years) and without any morphologic features attributed to Marfan's syndrome. None of the patients had undergone previous cardiac surgery, 20 were known to be hypertensive, and 3 were diabetic. One patient had undergone previous stenting of the anterior descending coronary artery, and 1 patient had dialysis-dependent renal failure. Symptoms included angina pectoris in 8 patients and congestive heart failure in 17 patients. Eighteen patients had predominantly severe aortic valve stenosis, and 7 patients had moderate-to-severe aortic valve insufficiency. Echocardiographic measurement results indicated that ascending aortic aneurysm size ranged from 43 to 50 mm. In 4 patients additional size confirmation was obtained by computed tomography. In one small-sized patient the aorta was 38 mm.

In all patients the aortic valve was tricuspid in appearance, with normal sinuses of Valsalva and distance of coronary ostiae from the aortic annulus, with the exception of one elderly patient (78 years old) and another patient with concomitant Dor procedure and low ejection fraction of the left ventricle, who had moderate cephalad displacement of the coronary ostiae.

Following discharge the patients were instructed to have control echocardiograms every 6 months for the first postoperative year and then annually. They have been interviewed annually by telephone to date. One patient was lost to follow-up because of an unavailable new contact number.

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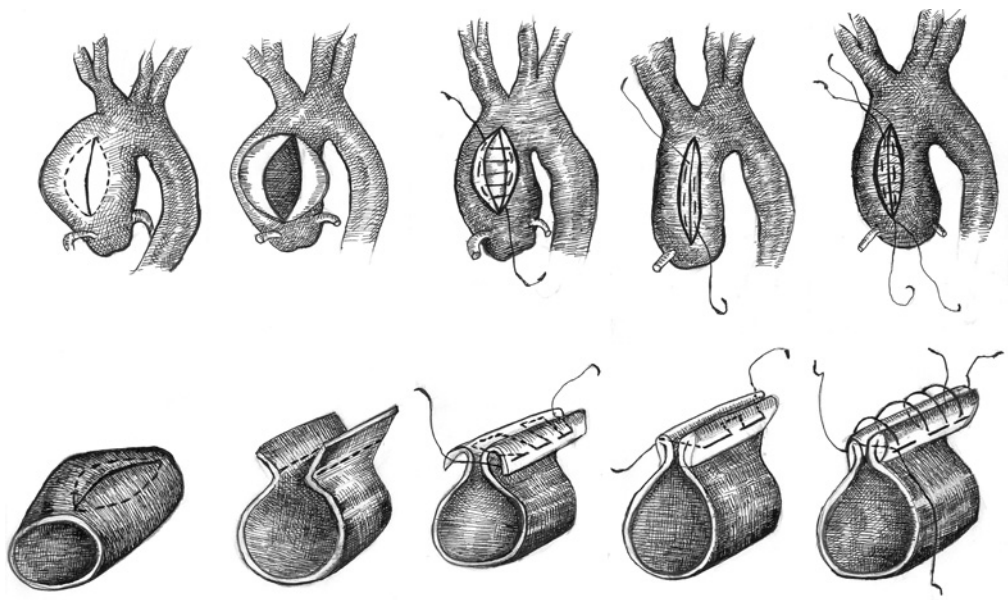
Address correspondence and reprint requests to: George Stavridis, 356 Sygrou Ave, 17674 Athens, Greece; 210-9493000; fax: 210-9493332 (e-mail: gstavridis@hol.gr).



The shawl lapel reduction aortoplasty [Harrison 1996] with the addition of our calculations. Each step is represented by a full aortogram (upper row) and the corresponding oblique, cross-section views of the aorta (lower row). The 5 steps from left to right are:
- Line of the initial incision and marking by pen of the width of the eversion on the dilated aorta, following the $c = \pi d$ equation.
- Creation of the 2 everted edges.
- The first running horizontal mattress suture is placed as the first layer, using a double-armed, 5-0 polypropelene suture on a 16-mm needle.
- Approximation of the everted edges.
- Another suture, as describe above, reinforces the suture line, using an over and over technique.

OPERATIVE METHOD

The shawl lapel reduction aortoplasty was performed as described previously [Harrison 1996] with the addition of our calculations, as illustrated in detail in the Figure. In order to avoid inadequate reduction of aortic diameter or pseudo-coarctation, attention has to be directed to the width of the eversion of the aortic edges, along the initial incision.

The rule of thumb we follow is to evert 30 mm of aortic tissue across each aortic edge, thereby excluding a total of approximately 60 mm of aortic perimeter, resulting in a near normal aortic radius ($2\pi r = \pi d = c$, where r is the aortic radius, d the aortic diameter, c the aortic perimeter, and π represents the mathematical value of 3.14). In order to reduce the diameter by 2 cm we have to reduce the perimeter by approximately 6 cm. In case of dilatation, which is frequently encountered in combination with long-standing aortic valve disease, care should be taken to evert more aortic tissue on the right of the midline and less to the left, following the greater curvature of the aorta, because these fusiform dilatations tend to expand toward the right, away from the pulmonary artery [Barnett 1995].

RESULTS

There were no hospital deaths. Intraaortic balloon pump support was used in 1 patient. One patient underwent reexploration for postoperative bleeding due to coagulopathy. Another patient developed left-sided hemiplegia as a result of a stroke, with significant improvement on the 10th postoperative day and no residual disability prior to discharge.

Twenty-four patients were alive at follow-up at 2 to 96 months (average, 2.9 years). There was 1 late death, 2 years postoperatively, as a result of advanced prostate malignancy in a 78-year-old patient. The first follow-up transthoracic echocardiograms, performed at a mean of 6.2 months postoperatively (range, 1-11 months), as well as the subsequent annual echocardiograms in all patients, showed no evidence of further enlargement of the ascending aorta compared to the reduced diameter obtained during the initial operation. The first 3 patients of this study remained with a minor reduction of their aortic diameter postoperatively, probably due to our initial, unjustified concern for an iatrogenic coarctation in case of excessive aortic edge eversion.

DISCUSSION

Once the distinction is made between a dilated and an aneurysmal ascending aorta during aortic valve replacement, performance of the less radical procedure of reduction aortoplasty is sensible, especially when treating elderly or high-risk patients.

We consider an ascending aorta to be dilated if the diameter is more than 20 mm/m^2 of body surface area. For a dilated aorta up to 50 mm in diameter, we perform the aortoplasty technique. For larger aortas, we prefer to replace the diseased segment with a Dacron tube graft.

Our preference, the shawl lapel aortoplasty [Harrison 1996] guided by calculations, allows a predetermined reduction in diameter of the ascending aorta without removal of an elliptical segment or employment of foreign material to externally support the plasty, as suggested by Robicsek [1981] and Egloff et al [1982]. Their intention was to completely fulfill the Laplace criteria, of both restoring a normal aortic diameter by the aortoplasty technique and reducing the circumferential stress by restoring aortic wall thickness and thus preventing further dilatation by the external banding method.

An alternative reduction plasty has been proposed, for which an S-shaped incision is performed, with subsequent excision of the S curves [Baumgartner 1998].

Kon [2002] and Lytle et al [1990] consider the replacement of the ascending aorta with a tube graft to be more reliable and less cumbersome compared to the reduction plasty, whether supported or not.

Neri et al [1999] oppose the external banding technique, apropos of a case report of 2 patients with late false aneurysms of the ascending aorta following a supported tailoring aortoplasty, concomitantly with aortic valve replacement. They observed thinning out of the aorta underlying the reinforcement cuff and histologically confirmed atrophic wall changes together with typical cellular and neovascular infiltration, as well as a foreign body reaction, all attributable to the external pressure of the Dacron cuff.

The main concern following unsupported aortoplasty, expressed by Mueller et al [1997] and echoed by Robicsek in his invited commentary [1995], is the high rate of recurrence of aneurysm, which occurred in 4 of 15 survivors after 7 years of follow-up. These authors, as did McCready et al [1979], correlated this adverse outcome to the original pathology of the replaced valve, suggesting supported aortoplasty if the associated disease is predominantly aortic insufficiency and leaving the option of the unsupported technique for aortic stenosis.

These reported high recurrence rates, compared to no recurrence in our patients, could be attributed to a cohort that included patients with aneurysms sized 50 to 60 mm. We deliberately place our cut-off point at 50 mm for aortic dilatation or ectasia, reserving the replacement option for dilatations larger than 50 mm in diameter, which we define as aneurysms. For the rare patient with Marfan's morphology or for those with a family history, we favor the replacement option even if the aortic dilatation is calculated to be less than 50 mm.

Bauer et al [2002] advocate reduction of the aortic diameter to a size less than 35 mm, supported externally or not, when dealing with a bicuspid aortic valve morphology (a situation that was not identified in any of our patients).

In our initial experience with 3 patients, we failed to achieve significant reduction of the diameter of the ascending aorta, because less aortic tissue was everted to avoid potential narrowing and an iatrogenic coarctation.

When applying the $c = \pi d$ formula to the unpressurized aorta, the false impression that excessive tissue has been excluded should not deter the surgeon from including wider, but not more than 30-mm, borders of aortic edges to the suture line.

This study shows that the calculated shawl lapel technique, as a diameter reduction strategy for ascending aortic dilatation encountered during aortic valve replacement, is an efficacious method with excellent medium-term results.

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REFERENCES

Barnett M, Fiore A, Vaca K, Milligan T, Barner H. 1995. Tailoring aortoplasty for repair of fusiform ascending aortic aneurysms. Ann Thorac Surg 59:497-501.

Bauer M, Pasic M, Schaffarzyk R, et al. 2002. Reduction aortoplasty for dilatation of the ascending aorta in patients with bicuspid aortic valve. Ann Thorac Surg 73:720-4.

Baumgartner F, Omari B, Pak S, Gintzon L, Shapiro S, Milliken J. 1998. Tailoring aortoplasty for moderately sized ascending aneurysms. J Card Surg. 13:129-32.

Egloff L, Rothlin M, Kugelmeier J, Senning A, Turina M. 1982. The ascending aortic aneurysm: replacement or repair? Ann Thorac Surg 34:117-24.

Harrison L Jr, Heck H Jr. Shawl lapel aortoplasty. 1996. Ann Thorac Surg 62:1867.

Kon N. 2002. Invited commentary on: Bauer M, Pasic M, Schaffarzyk R, Siniawski H, Knollmann F, Meyer R, Hetzer R. Reduction aortoplasty for dilatation of the ascending aorta in patients with bicuspid aortic valve. Ann Thorac Surg 73:720-4.

Lytle BW, Mahfood SS, Cosgrove DM, Loop FD. 1990. Replacement of the ascending aorta. Early and late results. J Thorac Cardiovasc Surg 99:651-8.

McCready RA, Pluth JR. 1979. Surgical treatment of ascending aortic aneurysms associated with aortic valve insufficiency. Ann Thorac Surg 28:307-16.

Mueller X, Tevaearai H, Genton C, et al. 1997. Drawback of aortoplasty for aneurysm of the ascending aorta associated with aortic valve disease. Ann Thorac Surg 63:762-6.

Najafi H. 1997. Invited commentary on: Mueller X, Tevaearai H, Genton C, Hurni M, Ruchat P, Fischer A, Stumpe F, von Segesser L. Drawback of aortoplasty for aneurysm of the ascending aorta associated with aortic valve disease. Ann Thorac Surg 63:766-7.

Neri E, Massetti M, Tanganelli P, et al. 1999. Is it only a mechanical matter? Histologic modifications of the aorta underlying external banding. J Thorac Cardiovasc Surg 118:1116-8.

Robicsek F. 1981. A new method to treat fusiform aneurysms of the ascending aorta associated with aortic valve disease: an alternative to radical resection. Ann Thorac Surg 34:92-4.

Robicsek F. 1995. Invited commentary on: Barnett M, Fiore A, Vaca K, Milligan T, Barner H. Tailoring aortoplasty for repair of fusiform ascending aortic aneurysms. Ann Thorac Surg 59:497-01.