

Mid-term Results of Aortoplasty for Dilated Ascending Aorta Associated with Aortic Valve Disease

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Backgrounds: Dilatation of the ascending aorta concomitant with aortic valve disease is occasionally associated with progressive enlargement of the ascending aorta or acute aortic dissection (AAD). However, surgical procedure of choice for the aorta and its indication are controversial.

Patients and Methods: From July 1995 to August 2001, 10 patients with a moderately dilated ascending aorta (mean diameter, 52 ± 4.8 mm) underwent concurrent aortic valve replacement (AVR) and aortoplasty. The aortic valve was bicuspid in eight patients. To tailor the ascending aorta 30-35 mm in diameter, the aortic wall was partially resected along the aortotomy, and the aorta was directly closed.

Results: Operation time and most of other perioperative variables were comparable to those of patients who underwent isolated AVR. The aortic diameter was reduced to 36.1 ± 4.1 mm. Nine patients survived to hospital discharge uneventfully, but one patient developed disruption of the suture line in the aorta and died. During follow-up, no patient suffered AAD but redilatation was observed in one patient. In the two problematic patients, the ascending aorta was larger than 55 mm, and its media was histologically abnormal.

Conclusion: In patients with dilated ascending aorta less than 55 mm in diameter, aortoplasty can be a procedure of choice. However, a prosthetic graft replacement is recommended when the diameter of the ascending aorta is larger than 55 mm. (*Ann Thorac Cardiovasc Surg* 2003; 9: 253-6)

Key words: dilated ascending aorta, aortoplasty, tailoring, aortic valve replacement

Introduction

Dilatation of the ascending aorta concomitant with aortic valve disease is occasionally associated with progressive enlargement of the ascending aorta or acute aortic dissection (AAD) after aortic valve replacement (AVR).¹⁾ If the ascending aorta is obviously aneurysmal, a prosthetic graft replacement is indicated. In patients with a moderately dilated ascending aorta (40-55 mm in diameter),

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however, it is controversial whether the ascending aorta should be treated or not. In such patients, we have concurrently performed AVR and aortoplasty of the ascending aorta. Early and mid-term results of this strategy are described herein.

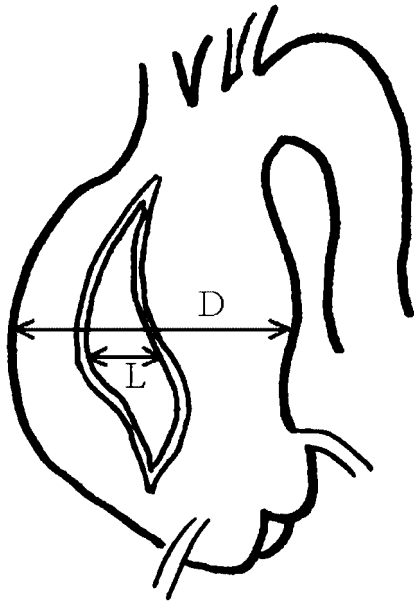
Patients and Methods

From July 1995 to August 2001, 10 patients underwent concurrent AVR and aortoplasty at our institution. Demographics of the patients are shown in Table 1. Patients with Marfan syndrome were not included.

Midline sternotomy was carried out in all patients. Mean diameter of the ascending aorta, which was measured during the operation, was 52.0 ± 4.8 mm (range, 45-58 mm). To facilitate aortoplasty, the aortic cannula was

Table 1. Patient demographics

Gender	Male: 7, female: 3	
Age (years)	58±12 (44-78)	
Aortic valve morphology	Regurgitation	1
	Stenosis	4
	Stenosis and regurgitation	5
Etiology of valve disease	Congenitally bicuspid	8
	Rheumatic	1
	Calcific	1
LVEF (%)	70.0±11.6 (57-85)	
Diameter of the ascending aorta (mm)	52.0±4.8 (45-58)	

**Fig. 1.** The anterior aspect of the ascending aorta was incised longitudinally and curvilinearly.

placed in the distal portion of the ascending aorta, in the aortic arch or in the femoral artery. Venous cannula were placed in both vena cava. After the aorta was cross-clamped at moderate hypothermia, the anterior aspect of the ascending aorta was incised longitudinally and curvilinearly (Fig. 1), and AVR was carried out through this incision. To tailor the ascending aorta 30-35 mm in diameter, the aortic wall was partially resected along the incision, and the aorta was directly closed with sewing margins of 10 mm at both sides of the aortotomy. Therefore, the breadth of removal of the ascending aorta (L) was decided according to the following formula;

$$L \text{ (mm)} = (D - D') \pi - 10 \times 2$$

where D and D' were preoperative and postoperative di-

Table 2. Perioperative data

Operation time (min)	238.8±39.6 (165-305)
CPB time (min)	118.8±26.2 (74-162)
ACC time (min)	85.4±20.9 (49-115)
Rectal temp (°C)	28.4±2.4 (22.1-29.9)
ICU stay (day)	1.5±0.6 (1-2)
Hospital stay (day)	36±18 (32-71)
Blood transfusion	Yes: 5, No: 5

CPB, cardiopulmonary bypass; ACC, aortic cross clamp.

ameter of the ascending aorta, respectively. The aortotomy was closed in two layers (continuous mattress and over and over suture) in nine patients, and in single layer (continuous over and over suture) in one patient. The suture line was reinforced with Teflon felt strips in five patients, with some Teflon pledgets in four, and none in one. External support for the ascending aorta was not employed. Follow-up evaluation was performed by using computed tomography of the chest or echocardiography every six or 12 months.

Results

Perioperative variables are given in Table 2. All perioperative variables were comparable to those of patients who undergo AVR without aortic procedure (data not shown). The diameter of the ascending aorta of each case is shown in Table 3. Intraoperatively, the diameter was reduced from 52.0±4.8 mm (range, 45 to 58 mm), to 36.1±4.1 mm (range, 32 to 45 mm). Nine patients survived to hospital discharge uneventfully, but one patient (case 5) died of bleeding. In this case, the diameter of the ascending aorta was reduced from 57 mm to 35 mm, and the aortotomy was closed in one layer. Sudden bleeding occurred from the suture line in the aorta two days later, and the patient subsequently died.

The average follow-up period of nine operative survivors was 38.0 months (range, 6 to 79 months). The diameter of the ascending aorta was 36.0±6.4 mm (range, 30 to 49 mm) at latest follow-up. No patient suffered AAD, and clinical results of all but one patient were favorable. In case 2, redilatation of the ascending aorta was observed five months after the operation by follow-up echocardiography. In this patient, the preoperative diameter was 58 mm and it was reduced to only 45 mm intraoperatively.

Histologically, the aortic wall was almost normal in the majority of the patients. However, disruption of the

Table 3. Diameter of the ascending aorta

Case	Age/gender	Valve disease	Etiology	Diameter of ascending aorta		
				Preoperative	Postoperative	Follow-up
1	72/M	AR	Bicuspid	50 mm	35 mm	30 mm
2	44/M	AS	Bicuspid	58 mm	45 mm	49 mm
3	55/M	ASR	Bicuspid	52 mm	32 mm	33 mm
4	47/F	AS	Bicuspid	45 mm	35 mm	30 mm
5	78/M	AS	Calcific	57 mm	35 mm	–
6	45/M	ASR	Bicuspid	45 mm	32 mm	32 mm
7	54/M	ASR	Rheumatic	51 mm	40 mm	40 mm
8	69/F	AS	Bicuspid	55 mm	35 mm	36 mm
9	59/M	ASR	Bicuspid	55 mm	36 mm	38 mm
10	66/F	ASR	Bicuspid	45 mm	36 mm	36 mm

AS, aortic stenosis; AR, aortic regurgitation; ASR, aortic stenosis and regurgitation.

elastic fibers was demonstrated in two patients (cases 5 and 10), and severe myxoid degeneration was observed in one patient (case 2). In the two clinically problematic cases, therefore, the aorta was severely enlarged (>55 mm) and its wall was histologically abnormal.

Discussion

Dilatation of the ascending aorta associated with aortic valve disease is a relatively common finding.²⁾ Hemodynamic stress to the ascending aortic wall caused by aortic valve disease is implicated as one of the contributing factors in the development of dilatation.^{3,4)} If the ascending aorta is left untreated during AVR, however, dilatation occasionally progresses after the operation. When such patients require AVR, therefore, concurrent replacement or repair of the ascending aorta is to be considered. However, there is no consensus of opinion about the surgical procedure of choice for dilated ascending aorta or its indication, especially when dilatation is moderate (40 to 50 mm in diameter).⁵⁻⁸⁾

At our institution, when the maximum diameter of the ascending aorta was less than 40 mm, we left it as it was. In patients with moderately dilated ascending aorta, we have performed concurrent aortoplasty, because this procedure can be carried out easily with almost negligible additional duration of cardiopulmonary bypass and aortic cross-clamp, and thus little changes the surgical invasiveness of isolated AVR. Actually, most perioperative variables appeared to be acceptable. On the other hand, prosthetic graft replacement usually requires much longer additional duration, and, in some cases, deep hypothermia or circulatory arrest. We believe that aortoplasty has advantages over graft replacement as to the surgical inva-

siveness and cost.

Nevertheless, we also believe that aortoplasty is applicable to only selected groups of patients. One important aspect is the preoperative size of the ascending aorta. In general, the wall of a severely dilated aorta is likely to be thin and fragile,³⁾ and can be histologically abnormal. When such patients undergo aortoplasty, early and late complications are of great concern. In two out of our 10 patients, the diameter of the ascending aorta was larger than 55 mm. Compared with the other eight patients, serious perioperative and postoperative problems occurred in these two patients, namely, disruption of the suture line and redilatation of the plicated aorta.

Another aspect is the histological change in the aortic wall, especially in the presence of bicuspid aortic valve. Bicuspid valve predisposes the development of acute aortic dissection and aneurysm of the ascending aorta.^{5,9)} Moreover, it is well known that this anomaly is closely associated with the histopathological abnormalities in the aortic wall, and the ascending aorta is dilated even in patients with a hemodynamically normal bicuspid valve.^{2-4,10)} When aortoplasty is performed in patients with a bicuspid aortic valve, possibly an abnormal aortic wall remains. In our eight patients with a bicuspid valve, we encountered one patient who had an abnormal aortic wall and showed redilatation of the ascending aorta during mid-term follow-up. Bauer et al.⁵⁾ reported that the ascending aorta should either be reduced to less than 35 mm in diameter or should be supported with a Dacron graft from outside in order to avoid redilatation after reduction aortoplasty. Their suggestions may be helpful to prevent some complications.

Other possible drawbacks of this procedure are that hemodynamic stress onto the aortic wall may be increased

by reduction of the diameter, and that tension and stress may be massed on the suture line. We lost one patient due to disruption of the suture line. This patient also had a large aorta with histological abnormality. The aortotomy may have to be closed in two layers with the reinforcement of Teflon felt strips. Wrapping with a prosthetic graft from outside of the aorta^{3,5)} may occasionally be appropriate.

The results of this study show that aortoplasty for a dilated ascending aorta associated with aortic valve disease is a procedure of choice in patients whose preoperative diameter of the ascending aorta is less than 55 mm. A prosthetic graft replacement is recommended when the ascending aorta is larger than 55 mm in diameter.

Mueller et al.⁴⁾ reported that recurrent aneurysms following previous aortoplasty developed after a mean period of 63 months, however, our mean follow-up period (38.0 months) might be shorter than their follow-up period. Therefore, we believe that periodic follow-up examinations are mandatory for patients who had undergone aortoplasty.

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