Surgical Treatment of the Disease Involving Ascending Aorta

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=Abstract=

From February 1985 to February 1993, 18 operations were performed in 17 patients for treatment of aneurysmal disease (n = 12) and / or dissection of the ascending aorta (n = 6). The ages ranged from 26 to 69 years (mean 44.3 ± 11.0 years).

The proposed operations include composite graft replacement of aortic valve and ascending aorta with coronary reimplantation in 11, graft replacement of ascending aorta alone in 5, aortic valve replacement and supracoronary graft replacement in 1 and ascending aorta to abdominal aorta bypass with thromboexclusion of descending aorta in one patient. Both Bentall (n = 6) and Cabrol (n = 5) technique were utilized for reimplantation of coronary arteries. Concomitant replacement of aortic arch and arch vessel reconstruction was necessary in two patients. Hypothermic circulatory arrest was utilized in 6 patients. Recently, four patients were managed on warm blood continuous cardioplegia via retrograde route.

There were no operative deaths. No significant postoperative complications were noted. Postoperative follow up was complete in 15 patients from 1 month to 72 months. Redo operation was necessary in one patient who had suffered from distal recurrence of dissection 5 years after successful Bentall operation. The other patients were all in excellent clinical condition.

From our early experience with those 17 cases, we assume that satisfactory operative result could be achieved with a variety of surgical techique including hypothermic circulatory arrest. In addition, continuous perfusion of warm blood cardioplegia via retrograde route is supposed to be beneficial in selected cases.

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Key words : 1. Aortic aneurysm, ascending
2. Myocardial protection
3. Surgery method

INTRODUCTION

A variety of surgical technique has been developed for the treatment of aneurysmal dilation of the aortic root and ascending aorta or the dissection involving the ascending aorta, mainly in regard of aortic valve replacement or cor-

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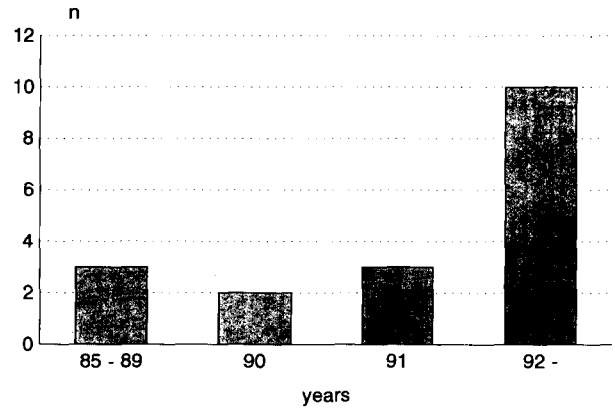

Fig. 1. Annual case (n = 18) from Feb '85 to Feb '93

Fig. 2. The MRI finding of a saccular syphilitic aneurysm at the ascending aorta.

onary reimplantation[1~5].

Here, we evaluated early surgical results of various operations for the ascending aorta in the heterogenous group of patients and compared each other.

PATIENTS

From February 1985 to February 1993, 18 operation were performed in 17 patients for the treatment of aneurysmal dilatation of the aortic root and ascending aorta (n = 12) and/or dissections involving the ascending aorta. The

Table 1. Patient Characteristics (Feb. 85~Feb. 93)

	Dissection	Aneurysm	Total
n	6	11	17
Agr (yr)	51.0±10.2	40.6±9.7	44.3±11.0
range			26~69
Sex (M/F)	1/5	10/1	11/6
Marfan syndrome	1	5	6
Syphilis	0	2	2
AR	2	10	12

AR: Aortic Regurgitation

cases increased by year and more than half of the operations were performed during 1992 (Fig. 1).

The mean age was 44.3 ± 11.0 years ranging from 26 to 69 years. 11 patients were male and 6 petients were females. Typical findings of Marfan syndrome were combined in 6 patients; 1 in aortic dissection and 5 in aortonnuloectasia with ascending aorta aneurysm. 2 patients were turned out to have syphilitic aneurysm; one diffuse type and the other saccular (Fig. 2). Grade III or IV aortic regurgitation was combined in 12 patients (70.6%) necessitating aortic valve replacement; 2 in aortic dissection and 10 in aortaannuloectasia and ascending aorta aneurysm (Table 1). As for aortic dissection, 3 cases were acute dissection and another 3 cases were chronic dissection; all acute cases belonged to DeBakey Type I while 2 out of 3 chronic cases belonged to Type I and remaining one case to Type II.

SURGICAL METHODS

All surgical procedures were done under cardiopulmonary bypass except one case of ascending aorta to abdominal aorta bypass graft and thromboexclusion of descending aorta by way of partial clamping of the aorta.

Standard median sternotomy was preferred approach in most cases; transverse transsternal approach was used in one patient in whom arch replacement was anticipitated before operation. In one patient, median sternotomy was extended far below umbilicus for additional intraabdominal procedure.

Most of the arterial cannulation was placed to femoral artery; cannulation into distal ascending aorta or aortic arch was made in only 2 patients in whom aneurysmal di-

Table 2. Operative Methods

	Dissection (n=7)	Aneurysm (n=11)	Total (n=18)
Incision			
Sternotomy	11	5	16
Transverse transsternal	1	0	1
Sternotomy+midline laparotomy	1	0	1
Arterial cannulation			
FA	8	7	15
aAo/aortic arch	0	2	2
Retrograde cardioplegia	1	4	5
Retrograde warm cardioplegia	0	3	3
Hypothermic circulatory arrest	4	2	6

FA; Femoral artery

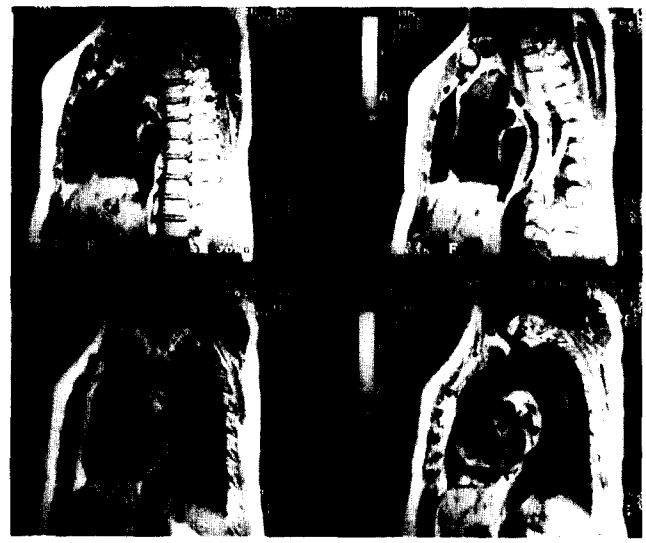

Fig. 3. The MRI finding of an aortic dissection involving whole segment of aorta with intimal tear at the level of aortic isthmus.

latation was confined to aortic root and proximal ascending aorta. Venous drain was maintained via single two stage venous cannula into right atrium after opening the chest. In cases having larger aneurysm with high risk of rupture on entering the chest, the chest was opened after establishing partial cardiopulmonary bypass by femoral artery to femoral vein.

Blood cardioplegics had been used all the way on except some earlier cases. Retrocardioplegia had been used intermittenly since 1990 and now, antegrade induction of cardioplegia and retrograde maintenance by continuous perfusion of blood cardioplegics became our standard method of myocardial protection during surgery of the disease involving ascending aorta. It is noteworthy that more recently, four patients with limited degree of aneurysmal dilatation of aortic root and ascending aorta and marginal left ventricular funtion were managed with continuous retrograde perfusion of normothermic cardioplegics and no systemic cooling.

Hypothermic circulatory arrest at 18~20℃ was necessary in 6 patients for exploration and/or repair of distal ascending aorta and aortic arch (Table 2).

Due to aortoannuloectasia and resultant aortic regurgitation (n=9) or dissection extending to aortic valve annulus (n=2), replacement of both aortic valve and ascending aorta using composite graft was necessary in 11 patients. Seperate replacement of arotic valve and ascending aorta leaving coronary ostium in situ was performed in one earlier case. Replacement of ascending aorta alone was performed in 5 patients.

Total arch replacement as a combined procedure was performed in 2 patients; one chronic aortic dissection involving whole segments of aorta with intimal tear at the level of aortic isthmus (Fig. 3), and the other diffuse aneurysm involving ascending aorta, aortic arch and proximal part of descending aorta (Fig 4).

In cases using composite graft, Bentall technique was used in earlier 5 patients and Cabrol technique in later 5 patients. Inclusion method for right coronary artery and button for left coronary artery were used simultaneously in one patient.

Inclusion of aortic graft and subsequent aorta wrapping were employed in 6 patients (35.3%); among them, Cabrol shunt (aneurysmoatrial shunt) was placed in 3 patients due to uncontrollable bleeding.

The operations were perfomed at the emergency base in 4 patients (23.5%) including one patient with actual cardiac arrest preoperatively (Table 4).

There were two redo cases. The first case was a patient who had received aortic valve replacement and aneurysmorrhapy as a primary operation elsewhere. He received Bentall operation due to increased size of aneurysm and paravalvular leakage 37 months after primary operation. The

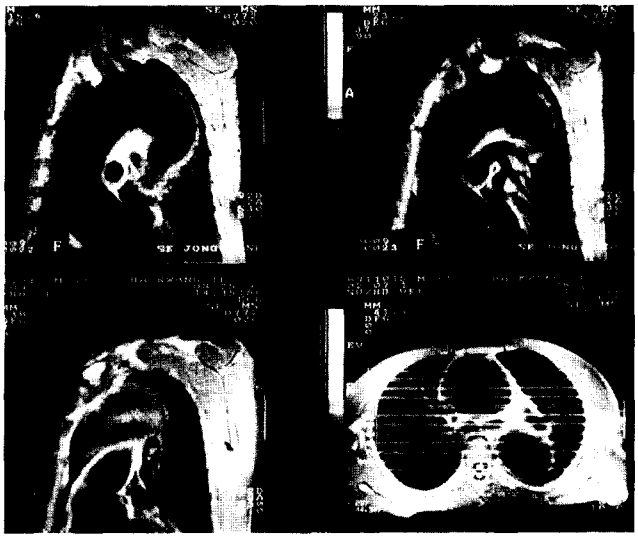

Fig. 4. The MRI finding of a diffuse aneurysm involving ascending aorta, aortic arch and proximal descending aorta necessitating total arch replacement.

Table 3. Type of Operation (I)

	Dissection (n=7)	Aneurysm (n=11)	Total (n=18)
Composite valve graft	2	9	11
Ascending aorta alone	4	1	5
AVR & supracoronary replacement	0	1	1
Ascending aorta-Abd. aorta bypass w/thromboexclusion	1	0	1
Combined procedure			
Total arch replacement	1	1	2
Innominate a reimplantation	0	1	1
Tricuspid annuloplasty	0	1	1

AVR: Aortic Valve Replacement
Abd.: Abdominal
W/: with

second case was a patient who had received Bentall procedure for chronic Type A dissection. He received thromboexclusion of descending aorta and ascending aorta bypass to abdominal aorta bypass due to distal progression of dissection 58 months after primary operation.

The mean pump time was 199.4 ± 65.0 minutes and clamp time 104.4 ± 41.4 minutes. The mean circulatory arrest time was 23.7 ± 13.5 minutes with a range of 3 to 39 minutes.

Table 4. Type of Operation (II)

	Dissection (n=7)	Aneurysm (n=11)	Total (n=18)
Coronary Reimplantation	2	9	11
Benall	1	4	5
Cabrol	1	4	5
Bentall + button	0	1	1
Wrapping	1	5	6(35.3%)
Cabrol shunt	0	3	3(17.7%)
Emergency	3	1	4(23.5%)
Redo	1	1	2

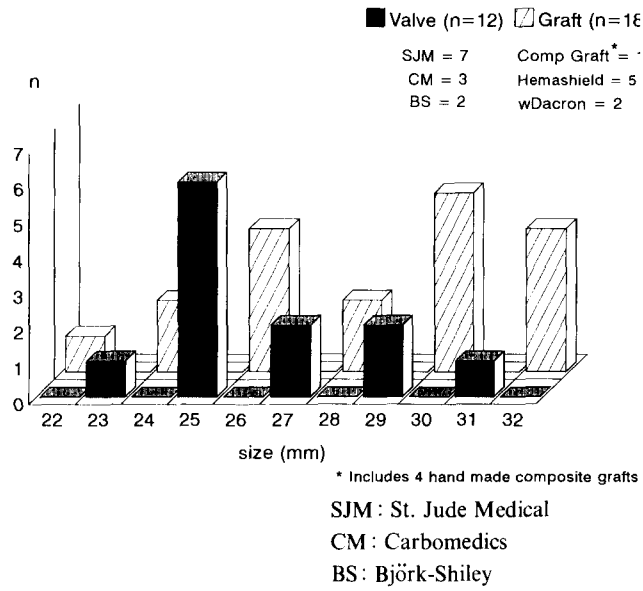

Fig. 5. Valve & Graft aterial & Size

The most commonly used graft and valve material and size was shown in Fig. 5.

RESULTS

All 17 patients survived the operation. Postoperative low cardiac output was encountered in one patient necessitating IABP support. Transient hemiparesis and mental obtundation were found in two patients respectively. Those neurologic dysfunction resolved without sequale (Table 5).

Postoperative follow up was complete in 15 patients from 1 to 72 months (mean 20.1 ± 24.3 months). There were no late deaths. Redo operation was necessary in one

Table 5. Results (n = 18)

	n
Op mortality	0
Postop LCO & IABP	1
Neurologic dysfxn	2
···Hemiparesis	1
···Mental obtundation	1
Lt diaphragm palsy	1

LCO: Low Cardiac Output
IABP: Intra-aortic Balloon Pump
Lt: left

patient 58 months after Bentall procedure due to distal progression of dissection. Late valve related thromboembolism with resultant aphasia occurred on the same patient. Otherwise, all the patients were shown to be in good functional class.

DISCUSSION

Diseases involving ascending aorta can be divided into two groups; dissection involving ascending aorta and aneurysmal dilatation of aortic root and ascending aorta, most commonly degenerative. Due to the nature of ascending aorta in relation to aortic valve and coronary osteum, a variety of surgical technique have been developed mainly in regard of the management of aortic regurgitation and technique of coronary reimplantation[1~5].

Replacement of both aortic valve and ascending aorta using composite graft has been a long advocated method since the first successful report by Bentall and DeBono[1]. Its main advantage is known to remove nearly all diseased tissue of proximal aorta and thus to decrease the possibility of future aneurysm recurrence[6, 7]. Cabrol procedure using intermediate graft for coronary reimplantation is generally known to superior to Bentall procedure in respect to avulsion or compression and later psendoaneurysm formation of coronary anastomosis[8, 9]. At the same time, its main disadvantage is related to intermediate graft; graft kinking or graft failure. Now it is generally accepted that Cabrol procedure be reserved for difficult situations that make direct coronary reimplantation cumbersome[10]. In this study, the operations were performed by three different surgeons using each's favored technique, not by specific strategies regarding operative methods, and that made postoperative results rather comparable.

Aortic inclusion method and subsequent aorta wrapping was developed to control suture line and graft bleeding. On the contrary, complete resection of aortic tissue and open anastomosis is known to enable more precise anastomosis and less suture line bleeding and to prevent later psendoaneurysm formation from suture line as not infrequently seen in cases employing inclusion method. Recently, good results are being reported with open anastomosis with the aid of improvement of graft material, better knowledge of coagulopathy and its management and refinement of pump and surgical techniques as well[5, 10].

Retrograde continuous perfusion of warm blood cardioplegics is new method of myocardial protection enabling so called aerobic arrest of myocardium. We've got encouraging results adopting this method to recent four patients in whom circulatiory arrest was absolutely not necessary because the lesions were confined to proximal ascending aorta.

In conclusion, 1) A variety of surgical methods could be applied to the diseases involving ascending arota with lower risk and satisfactory early results. 2) Early results do not seem to depend on operative methods. 3) Retrograde warm continuous blood cardioplegia might be beneficial in selected cases with depressed left ventricular function when aneurysmal dilatation is confined to aortic root and proximal ascending aorta and arch exploration is absolutely not necessary.

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=국문초록=

상행 대동맥 질환의 외과적 치료

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저자들은 1985년 2월부터 1993년 2월까지 상행대동맥 질환을 가진 17례의 환자에서 총 18건의 수술을 시행하였다. 환자들의 질환은 동맥류가 12례, 대동맥박리증이 6례였으며 수술시 연령분포는 26세에서 69세 사이로 평균 44.3 ± 11.0세였다. 11례의 환자에서 복합도관(composite graft)을 이용한 대동맥 판막 및 상행 대동맥의 대체와 관상동맥 재접합술(coronary reimplantation)을 시행하였고, 그외 상행 대동맥만을 도관을 이용하여 대체한 경우가 5례, 대동맥 판막대체술 및 관상동맥상부대동맥 대체술(supracoronary graft replacement)을 같이 시행한 경우가 1례, 상행대동맥-복부대동맥 우회로 조성술및 하행대동맥의 혈전제외술(thromboexclusion)을 시행한 경우가 1례였다.

관상동맥의 재접합은 6례에서 Bentall 술식을, 5례에서는 중간도관(intramediate graft)을 사용하는 Cabrol 술식을 사용하였다. 2례의 환자에서 전대동맥궁 대체술(total arch replacement) 및 대동맥궁 분지 재건술(arch vessel reconstruction)을 함께 시행하였다. 저체온 순환정지(hypothermic circulatory arrest)가 필요하였던 경우는 6례였으며, 최근들어 온혈 심장수술(warm heart surgery)을 4례의 환자에서 시도하였다.

전례에서 수술사망은 없었으며 주요 술후 합병증도 보이지 아니하였다. 술후 추적은 15례의 환자에서 가능하였다. 추적기간은 1개월에서 72개월 사이였으며, 대동맥 박리증으로 Bentall 술식 시행 5년 후, 원위부 대동맥의 박리전파로 재수술이 필요하였던 1례를 제외하고는 모두 양호한 술후 경과를 보였다.

이상과 같이 저체온 순환정지를 비롯한 다양한 수술방법을 통하여 만족스러운 조기 수술성적을 얻을 수 있었으며, 특히 온혈 심정지액의 역행성 연속관류의 선별적 사용이 도움이 되었다.