Supracommissural Aortic Replacement: A Reliable Option for Acute and Chronic Aortic Type A Dissection

Suprakomissural Aort Replasmanı: Akut ve Kronik Tip A Aort Disseksiyonu İçin Güvenilir Bir Seçenek

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ABSTRACT Objective: To review early and late results of supracommissural aortic replacement in patients with acute and chronic type A dissection. **Material and Methods:** From February 1985 to October 2005, 162 patients with acute and chronic aortic dissection underwent supracommissural aortic graft replacement. A retrospective clinical review was undertaken using hospital records, clinical and echocardiographic data, and telephone interviews with patients. **Results:** There were 23 (14.1 %) operative and eight (6.4 %) late deaths. The most common causes of hospital death were intraoperative complications related to hemorrhage (n= 9), and respiratory failure (n = 6), and the other cause was multiorgan failure (n= 5). The hospital mortality rate for patients with chronic type A dissection was 6.25% (3/48). The causes of death were respiratory failure (n= 2) and multiorgan failure (n= 1). The modes of hospital deaths were not related to residual aortic insufficiency (AR) in any case since early postoperative transthoracic echocardiography did not show grater than grade II in these patients in early postoperative or follow-up period, transthoracic echocardiography did not show aortic regurgitation grater than grade II in any case. All survivors were in New York Heart Association class I or II at the last visit. **Conclusion:** Supracommissural aortic graft replacement provides satisfactory results for many patients with ascending aortic dissection. The function of the preserved aortic valves remained unchanged in the majority of the patients during the first five years of follow-up.

Key Words: Aorta; aortic valve insufficiency; aortic valve

ÖZET Amaç: Suprakomissural aort replasmanı uygulanan akut ve kronik Tip A aort disseksiyonlu olguların erken ve geç dönem sonuçlarının gözden geçirilmesi. **Gereç ve Yöntemler:** Şubat 1985 ile Ekim 2005 tarihleri arasında akut ve kronik disseksiyonu olan 162 olguya suprakommissural aort gretf replasmanı uygulandı. Klinik bulgular retrospektif olarak hasta kayıtları, klinik ve ekokardiyografik bulgular ve hastalarla telefon görüşmeleri ile sağlandı. **Bulgular:** Yirmi üç (%14.1) operatif, sekiz (%5.8) geç dönem mortalitesi mevcuttu. En sık ölüm nedenleri, intraoperatif komplikasyonlara bağlı olarak, kanama (n=9), solunum yetmezliği (n= 6) ve diğer sebep olarak da multiorgan yetmezliği (n= 5) idi. Kronik tip A disseksiyon olgularında hastane mortalitesi 6.25% (3/48) idi. Ölüm sebepleri; solunum yetmezliği (n=2) ve multiorgan yetmezliği (n= 1) idi. Ölümlerin hiçbiri rezidüel aort yetmezliğine bağlı değildi. Yaşayan olguların erken postoperatif ve uzun dönem takip süresince transtorasik ekokardiyografilerde ikinci dereceden daha fazla rezidüel aort yetmezliğine rastlanmadı. **Sonuç:** Suprakommissural aort greft replasmanı birçok asendan aort disseksiyonlu olgularda tatmin edici sonuçlar sağlar. Beş yıllık bir izlemde olguların çoğunda korunan aort kapaklarda herhangi bir patoloji tespit edilmemiştir.

Anahtar Kelimeler: Aort; aort kapağı yetmezliği; aort kapağı

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It is generally agreed that the goals of the operation for ascending aortic dissection are establishing a competent aortic valve, replacing the aortic segments in which the primary intimal tear has occurred, prevent-

ing antegrade flow into the false lumen when the dissection is acute, and having the patient survive the operation. However, it is still debated whether the aortic valve has to be replaced or preserved.

Since the description of the reconstruction of the aortic layers and interposition of a Teflon graft in the ascending aorta for acute type A dissection by Daily and colleagues, the preservation of the native aortic root has been modified by many surgeons to date.[1-7] This approach was mainly based on the avoiding thromboembolism and anticoagulation-related complications related to prosthetic heart valves as well as saving the patient's life by a more simple operation. However, preservation of the native aortic root may have the potential of long-term changes of both aortic valve and root such as secondary aortic regurgitation with or without progressive root dilatation.[5,8] This late complication is particularly apparent in patients with the Marfan syndrome and annuloaortic ectasis.[9] For these patients, some groups favor a more aggressive approach, such as Bentall type operations to the aortic valve and root pathology to eliminate the need for reoperation.[10-12]

Regarding chronic type A aortic dissection, the sinotubular junction and/or aortic annulus can be more enlarged and the aortic valve leaflets could be elongated due to long-standing aortic regurgitation, so the surgical strategy would be altered more radically as opposed to aortic regurgitation with acute type A aortic dissection.[13-15]

We reviewed our experience in patients with both acute and chronic type A aortic dissections retrospectively to elucidate the validity of the supracommissural ascending aortic replacement with early and long-term results.

MATERIAL AND METHODS

PATIENTS

Between February 1985 and November 2005, 162 patients underwent operation for aortic dissection with the preservation of the aortic valve using supracoronary tube graft implantation in Koşuyolu Heart and Research Hospital, İstanbul, Turkey. Supracommissural ascending aortic replacement was performed in 88 (54.3%) patients; in the remaining patients ascending aortic graft was extended to aortic arch partially (in 39 pts, 24%) and to the proximal descending aorta (in 35 pts, 21.6%). Patient demographics as well as cardiac and aortic pathologies are listed in Table 1. Diagnosis was made by transesophageal echocardiography (TEE), aortagraphy, computed tomography (CT), or magnetic resonance imaging. If CT or TEE showed an acute Stanford type A aortic dissection, operation was initiated without any further diagnostic procedures. Aortic dissections were classified as acute if symptoms occurred less than 14 days earlier and chronic if more than 14 days earlier. All of patient information was obtained by retrospective review of hospital records, and long-term follow-up was obtained by regular recall of the patients to our hospital or phone interview. The current follow-up was completed in 90.7% of the patients and extended upto 20 years (mean, 4.2 ± 2.9 years).

The mean age of patients with acute dissection was 58.4±8.6 years, with a range of 32 to 76 years. The patients with Marfan's syndrome were excluded from the study. Dissections occurring intraoperatively or during cardiac catheterization were excluded. All patients with acute dissections underwent operations on an emergency basis.

All patients had preoperative and/or intraoperative echocardiographic examinations. Data regarding aortic insufficiency (AR) were obtained by retrospective analysis of transthoracic echocardiography. Postoperative evaluation at the first month and late follow-up were carried out by transthoracic echocardiography in the majority of the pa-

TABLE 1: Clinical characteristics of the patients

Variables	Acute	Chronic
Number (patients)	114	48
Gender (male/female)	72/42	29/19
Mean age (years)	62.8±2.6 (54-72)	62.1±2.6 (55-69)
DeBakey type		
I	97 (85%)	(54.1%)
II	15 (13.1)	22 (45.8%)
III (retro)	2 (1.7%)	-
Cardiac shock	4 (3.5%)	-

tients. The degree of AR was evaluated by pulse-Doppler echocardiography and/or Doppler color-flow mapping. AR was assessed as follows: 0, none; I, minimal; II, mild; III, moderate; and IV, severe.

SURGICAL TECHNIQUE

Patients routinely underwent median sternotomy, and total cardiopulmonary bypass was established with femoral artery cannulation, whereas in recent series, cannulation with the axillary artery was chosen depending on the anatomy of the dissection. A vent catheter was placed into the left atrium through the right superior pulmonary vein, the ascending aorta cross-clamped and incised in standard fashion. Continuous retrograde blood cardioplegia via coronary sinus was used for myocardial protection. Hypothermia to 15˚C to 20˚C and circulatory arrest were used in all operations involving replacement of the aortic arch and the proximal descending aorta, and the aortic arch was inspected carefully to allow accurate construction of the distal anastomosis. Brain protection was achieved by hypothermia only in 23 patients (1985-1993) and selective retrograde cerebral perfusion technique in 139 patients (1994-2005) during circulatory arrest. Our general approach to the proximal end of the ascending aorta has been to preserve the aortic valve whenever possible. The decision of preserving or replacing the aortic valve depended on the underlying disease, such as Marfan's syndrome and annuloaortic ectasia, coexistent aortic valve disease and the degree of valvular destruction due to dissection. The root was transected above the level of the commissures and inspected carefully. Diameters of sinotubular and aortoventricular junction were measured within the true lumen. If the aortic valve showed significant degenerative changes, composite replacement of aortic valve and root was carried out. If the aortic valve was structurally normal and the diameter at the level of the sinotubular junction did not exceed 30 mm, supracommissural ascending aortic replacement was performed in a standard fashion. This study was included only the patients who underwent this type of operations.

Supracommissural aortic root repair and aortic valve resuspension were performed as follows: The reapproximation of the two aortic layers was carried out with continuous sutures buttressed by outer and inner layer bands of Teflon felt, and the commissures were resuspended with additional pledgetted stitches when necessary. The gelatin-resorcin-formalin (GRF) glue was not used in any case.

Once a nasopharyngeal temperature of 18˚C to 21˚C was reached, extracorporeal circulation was interrupted, the aortic clamp removed, and the arch inspected carefully for additional entries. The distal aortic anastomosis was constructed according to the extent of the intimal tear. If the intimal tear was localized to the ascending aorta, the distal aortic anastomosis was constructed just proximal to the innominate artery. If the intimal tear extended into or originated in the aortic arch, aortic replacement extended into the arch or proximal descending aorta. All performed procedures were shown in Table 2. When the false lumen extended beyond the site of aortic replacement in acute dissections, two layers of felt were used to reconstruct the aorta to prevent antegrade flow into the false lumen.

CHRONIC TYPE A AORTIC DISSECTION

The mean age of patients with chronic dissection was 62.1 ± 2.6 years, with a range of 55-69 years. All patients with chronic dissection underwent elective operations. The operative techniques were basically the same as in acute dissection. In the repair of the proximal end of the ascending aorta, the aortic valve was preserved whenever possible. Reapproximation of the two layers was carried out with continuous sutures buttressed by outer and inner layer bands of Teflon felt unless the visceral arteries drained mostly from the false lumen, and the commissures were resuspended with additional pledgeted stitches (n= 7) when necessary.

TABLE 2: Aortic reconstructions in all patients.

Procedure	Acute (n=114)	Chronic (n=48)
Supracommissural replacement	63 (55.2%)	25 (52%)
Ascending/hemiarch	27 (23.6%)	12 (25%)
Ascending/total arch	24 (21%)	11 (22.9%)

Statistical Analysis

Continuous variables are expressed as mean ± standard deviation. All data analysis was performed with SPSS 11.5 for Windows (SPSS Inc, Chicago, IL). Statistical comparisons between categorical parameters were performed by x^2 contingency analysis. A value of P less than 0.05 was considered significant.

RESULTS

Preoperative diagnosis of acute dissection type A was confirmed intraoperatively in all cases. The site of primary entry tearing was as follows: The ascending aorta in 88 patients, the concavity of the arch in 39 patients, and the distal arch/proximal descending aorta in 35 patients (Table 2). The aortic root diameters were considered normal (sinotubular junction less than 30 mm) in all patients. Intraoperative variables are listed in Table 3. The overall hospital mortality rate was 14.1% (23/162) in patients with acute type A dissection. The modes of death were shown in Table 4. The most common causes of hospital death were intraoperative complications related to either hemorrhage (n = 9) or respiratory failure (n= 6), and the other cause was multiorgan failure (n= 5). The hospital mortality rate for patients with chronic type A dissection was 6.25% (3/48). The causes of death were respiratory failure (n= 2) and multiorgan failure (n=1). The modes of hospital deaths were not related to residual AR in any case since early postoperative transthoracic echocardiography did not show AR grater than grade II in these patients. The requirement of revision for active bleeding was encountered in 12 (3.5%) patients with acute aortic dissection in early postoperative hours or days. In all patients, hemorrhagic foci were found easily and controlled without any major complications. Likewise, four patients with chronic aortic dissection underwent revision for active bleeding postoperatively. In none of the patients, there was major bleeding focus and the bleeding controlled easily. Ventilation support more than 72 hours was needed in eight patients with acute aortic dissection and in three patients with choronic aortic dissection. All of these patients were weaned successfully from the ventilation with no complications with a mean time of 119±19.4 hours (range, 96-156 hours). Postoperative transient renal failure (serum creatinin level ≥1.5 mg/dl) was encountered in two (1.7%) patients with acute aortic dissection whereas it was occurred in one patient (2.08%) with chronic aortic dissection. Postoperative cerebrovascular accident (CVA) was encountered only in two (1.7%) patients with acute aortic dissection. The neurologic attacks were transient and both patients recovered spontaneously without any neurologic symptoms. In acute dissection (n = 114), 87 (76.3%) patients had AR grade II and 14 (12.2%) patients had grade III AR, preoperatively (Table 5). The aortic valves were preserved in all patients without any need for replacement. In first postoperative month, 12 patients still had grade II AR (Table 6), while at late follow-up, eight patients had grade II AR; in none of them AR deteriorated to grade III (Table 7). Thus, no operation has been required so far. In chronic dissection (n = 48), 36 (75%) patients had grade II AR and 12 (25%) patients had grade III AR, preoperatively (Table 5). In the first postoperative month, seven patients still had grade II AR (Table 6), while at late follow-up,

TABLE 3: Intraoperative data of the patients.

Variables	Acute (n= 114)	Chronic (n= 48)	p
ACC time (min.)	61.6 ± 5.3	50.6 ± 8.3	0.0001
CPB time (min.)	102.7 ± 8.1	90.08 ± 9.9	0.0001
Circulatory arrest (min.)	32.7 ± 8.5	21.8 ± 3.04	0.0001

ACC = Aortic cross clamp; CPB = Cardiopulmonary bypass.

TABLE 4: Morbidity and mortality following aortic repair in all patients.

Complication	Acute (n=114)	Chronic (n=48)	p
In-hospital mortality	20 (17.5 %)	3 (6.25 %)	0.003
Intraoperative bleeding	9 (45 %)	-	
Acute Respiratory Failure	6 (30 %)	2 (4.1 %)	
MOF	5 (25 %)	1 (2.08 %)	
Late mortality (≥30 days)	6 (5.2 %)	2 (4.1 %)	0.770
Revision for bleeding	12 (3.5 %)	4 (8.3 %)	0.672
Respiratory failure (≥ 72 Hours)	8 (7.01 %)	3 (6.25 %)	0.860
Transient CVA	2 (1.7 %)	-	
Transient renal failure	5 (4.3 %)	1(2.08 %)	0.482
Reoperation for AR	-	-	

AR = Aortic regurgitation; CVA = Cerebrovascular accident; MOF = Multiorgan failure

TABLE 5: Preoperative degrees of aortic valve regurgitation assessed by echocardiography.

	Acute (n= 114)	Chronic (n= 48)	p
AR ≥ II	87 (76.3%)	36 (75%)	0.861
AR ≥ III	14 (12.2%)	12 (25%)	0.075
Unknown	13 (11.4%)	-	

AR = Aortic regurgitation

TABLE 6: Echocardiographic assessed aortic valve regurgitation at the postoperative first month.

	Acute (n= 94)	Chronic (n= 45)	p
AR = I	82 (87.2%)	38 (84.4%)	0.926
AR = II	12 (12.7%)	7 (15.5%)	0.657
AR ≥ III	-	-	

AR = Aortic regurgitation

TABLE 7: Late postoperative aortic valve regurgitation detected by echocardiography.

	Acute (n= 86)	Chronic (n= 38)	p
AR = I	78 (90.6%)	34 (89.4%)	0.833
AR = II	8 (9.3%)	4 (10.5%)	0.833
AR ≥ III	-	-	

AR = Aortic regurgitation

four patients had grade II AR; in none of them AR deteriorated to grade III (Table 7).

FOLLOW-UP

Fifteen patients were lost to follow-up (139/15; 10.7 %). Total follow-up was 478.7 patient-years with the mean follow-up time of 3.8 ± 2.7 years, with a minimum being 1 month and maximum being 12 years. Clinical follow-up was performed either by direct patient examination in the hospital or by telephone interview of the patient with one of our assistant surgeons. During the follow-up period, eight patients (6.4%) died of noncardiac or unknown reasons. The vast majority of patients presented with a favorable exercise tolerance at the last visit. None of the survivors required reoperation for severe AR. Among the survivors, 112 (90.3%) patients and 12 (9.6%) patients were in New York Heart Association class I or II, respectively. Neither thromboembolic events nor bleeding complications were noticed in any patient during follow-up.

DISCUSSION

The surgical approach for acute type A dissection involving the aortic root remains controversial. This retrospective study shows that supracommissural aortic replacement in acute type A dissection can be performed with low perioperative morbidity and mortality and favorable short- and long-term results. In addition, this study demonstrated that throughout the follow-up period of 10 years, the performance of preserved native aortic valves left in situ was adequate.

Although the safety of operation for acute type A dissection has improved during the last 20 years, this pathologic entity remains a serious condition. Emergent surgery is necessary to prevent the catastrophic natural course with very high rates of deaths occurring within two weeks. The surgical options in the management of acute type A dissection vary. Three different techniques are applied: Composite replacement of aortic valve, root and ascending aorta; supracommissural replacement of the ascending aorta after reconstruction of dissected layers of root using Teflon felt or glue; and valve sparing techniques such as remodeling or reimplantation methods.

Generally, valve sparing techniques have several advantages such as excellent hemostasis, complete removal of diseased aortic root tissue and avoidance of lifelong anticoagulation post-operatively. In addition, these techniques may provide optimal hemodynamic performance of the native aortic valve. Thus, valve sparing aortic root replacement represents an attractive alternative. Despite the valve sparing techniques have proven their usefulness in elective cases of root aneurysm, remodeling or reimplantation techniques can also be applied in acute type A dissection with acceptable results.[3,17-22] However, Leyh and coworkers, and recently Bethea and colleagues reported that aortic remodeling was associated with a high failure rate within the first four years after initial operation, ultimately requiring reoperation.[23,24] In

addition, under emergency conditions, prolonged operation times for valve reconstruction and the demanding technique may bear an additional risk for the patient. Thus, we and others believe that our first job is to produce a live patient in this lethal condition.[25,26] As Elefteriades stated, if the patient survives the acute episode, this constitutes a success regardless of later onset of further aortic problems.[25]

In the surgical management of the acute type A dissection, although valve-sparing techniques are widely used by many surgeons, the standard procedure, namely, supracoronary replacement of the dissected ascending aorta with Teflon felt or glue reconstruction of the dissected aortic root is still attractive because of its simplicity, short operation time and reduced mortality rates.[25-28] This technique has been proven by several authors inasmuch as the freedom from reoperation for aortic valve dysfunction was 91% to 82% after 10 years.[8,28] The major drawback of this technique is the need of reoperation due to sinus of Valsalva aneurysm. Our results are not similar to that study since our patients did not need a reoperation. Unquestionably, there are many certain technical truths regarding the surgical management of acute type A dissection. First, performance of a composite graft replacement on an acutely dissected aorta is a dangerous procedure, best avoided if possible. Mobilization and connection of acutely dissected coronary artery buttons is potentially dangerous and problematic. Second an open distal anastomosis permits a more satisfactory technical result. Besides these technical truths, there is a pertinent physiologic truth: mild to moderate aortic insufficiency is well tolerated. Many patients are left with mild to moderate aortic insufficiency after type A dissection repair and do well for many years. Although Casselmann and colleagues reported that supracommissural tube graft technique has a high reoperation and redissection rate,[29] the mechanism of the development of secondary aneurysmatic dilatation of the aortic root after supracommissural replacement is still unclear and may be multifactorial. In most cases of acute type A dissection, the aortic valve can be left alone, or the commissures can be resuspended. Only if the aortic insufficiency is 3+ or more, then the aortic valve needs to be replaced. Intraoperative transesophageal echocardiography provides an accurate assessment of the severity of the aortic insufficiency. The severity of aortic insufficiency can be improved even with the simple tube graft replacement of the aorta, which brings the aortic valve leaflets closer to coapitation. The technical approach to acute type A aortic dissection that we follow in our institution is supported by many other authors.[12,24-30] We recommend the use of a simple tube graft replacement in most cases except for Marfan syndrome, other known connective tissue disorders, or frank annuloaortic ectasia. The vast majority of patients with acute type A aortic dissection can be treated appropriately with a simple supracommissural tube graft.

In conclusion, this study clearly showed that supracommissural aortic root reconstruction provided effective early and long-term results in non-Marfan patients with type A dissection who had normal sinuses and a normal aortic valve.

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