Thoracic aortic replacement in type-B aortic dissections: midterm results

Tip-B aort disseksiyonlarında torasik aort replasmanı: Orta dönem sonuçlar

Ali Kubilay Korkut,[1] Gürkan Çetin,[1] Emin Tireli[2]

[1]Department of Cardiovascular Surgery, İstanbul University Haseki Cardiology Institute, İstanbul
[2]Department of Cardiovascular Surgery, Medicine Faculty of İstanbul University, İstanbul

Background: Surgical management of acute and chronic type-B aortic dissections is controversial. Acute type-B aortic dissections complicated by uncontrollable pain, visceral ischemia, malperfusion, and risk for rupture require intervention. We evaluated midterm results of aortic dissections treated surgically.

Methods: The study included 29 patients who underwent surgery for acute (n=14; 12 males, 2 females; mean age 53 years; range 34 to 65 years) and chronic (n=15; 11 males, 4 females; mean age 62 years; range 37 to 74 years) type-B aortic dissections. The patients were evaluated by multislice computed tomography within a mean follow-up period of three years (range 1 to 7 years). Abdominal and descending aortic diameters were measured, and patency of the false lumen, enlargement of the aorta and the false lumen were analyzed.

Results: Two patients from each group died in the early postoperative period. In the acute aortic dissection group, the false lumen was patent in two patients with an enlargement of 8 mm in diameter, but none required reoperation. In the chronic aortic dissection group, the false lumen was patent in eight patients, of which distal anastomosis was performed to both the true and false lumens in six patients, and to the true lumen in two patients. Enlargement of the false lumen was 5 mm in six patients. In this group, three cases in which both the true and false lumens were patent required a subsequent thoracoabdominal aortic replacement because the aortic diameter exceeded 6 cm.

Conclusion: Surgical treatment should be considered in chronic type-B aortic dissections with thoracic aortic diameter measuring 5.5 cm or above. False lumen patency has an adverse influence on the prognosis after surgical treatment of type-B aortic dissections.

Key words: Anastomosis, surgical; aneurysm, dissecting/surgery; aortic aneurysm/surgery; tomography, X-ray computed.

Amaç: Akut ve kronik tip-B aort disseksiyonlarının cerrahi tedavisi halen tartışmalıdır. Kontrol edilemeyen ağrı, visseral iskemi, dolaşım bozukluğu ve yırtılma ihtimali yüksek akut tip-B aort disseksiyonlu hastalara müdahale gereklidir. Bu çalışmada aort disseksiyonu tanısıyla ameliyat edilen hastaların orta dönem sonuçları değerlendirildi.

Çalışma planı: Çalışmaya aort disseksiyonu tanısıyla ameliyat edilen 29 hasta alındı. On dört hastada (12 erkek, 2 kadın; ort. yaş 53; dağılım 34-65) akut, 15 hastada (11 erkek, 4 kadın; ort. yaş 62; dağılım 38-74) kronik tip-B aort disseksiyonu vardı. Hastalar ortalama üç yıl (dağılım 1-7 yıl) olan takip süresi içinde çokkesitli bilgisayarlı tomografi ile değerlendirildi. Abdominal ve inen aort çapları ölçüldü; yalancı lümen açıklığı ve aort ve yalancı lümendeki büyümeler değerlendirildi.

Bulgular: Her iki gruptan ikişer hasta ameliyat sonrası erken dönemde kaybedildi. Akut aort disseksiyonu grubunda, iki hastada yalancı lümen açık bulundu; çapları 8 mm ölçüldü, bu hastaların ikisinde de yeniden ameliyat gerekmedi. Kronik aort disseksiyonu grubunda ise yalancı lümen sekiz hastada açık bulundu; bunların altısında hem gerçek hem de yalancı lümene, ikisinde ise gerçek lümene distal anastomoz yapılmıştı. Bu hastaların altısında yalancı lümen çapı 5 mm idi. Bu grupta, hem gerçek hem de yalancı lümenin açık bulunduğu üç hastada, aort çapı 6 cm'yi geçtiği için torakoabdominal aort replasmanı yapılması gerekti.

Sonuç: Torasik aort çapının 5.5 cm veya üzerinde olduğu kronik tip-B aort disseksiyonlarında cerrahi tedavi düşünülmelidir. Tip-B disseksiyonu olan hastalarda ameliyat sonrası yalancı lümen açıklığı prognozu olumsuz etkilemektedir.

Anahtar sözcükler: Anastomoz, cerrahi; anevrizma disseksiyonu/cerrahi; aort anevrizması/cerrahi; bilgisayarlı tomografi.

Received: September 21, 2005 *Accepted*: February 9, 2007

Correspondence: Dr. Ali Kubilay Korkut. İstanbul Üniversitesi Haseki Kardiyoloji Enstitüsü, Kalp ve Damar Cerrahisi Bölümü, 34096 Haseki, İstanbul. Tel: 0212 - 224 49 50 e-mail: kubilaykorkut@superonline.com

Surgical management of type-B aortic dissections is controversial. Although medical therapy is the preferred approach in acute type-B aortic dissections, uncontrollable pain, visceral ischemia, malperfusion, and risk for rupture are indications for intervention. Endovascular stent-grafting is the noninvasive intervention with good results in selected patients.

Surgical treatment is indicated in chronic type-B aortic dissections with thoracic aortic diameter of 5.5 cm or above during the chronic phase.[1] Replacement of the proximal 2/3 of the descending aorta is necessary, because this is the part presenting the highest risk for rupture. The length of the thoracic and thoracoabdominal aorta for replacement is still under debate. In this study, we evaluated the midterm results of thoracic aortic replacements.

PATIENTS AND METHODS

Replacement of the thoracic aorta was performed in 29 patients with a diagnosis of type-B aortic dissection between 1996 and 2003.

Acute type-B aortic dissection. Fourteen patients (12 males, 2 females; mean age 53 years; range 34 to 65 years) had acute type-B aortic dissection. The patients were operated on within 10 days (mean 3.8 days; range 6 hours to 10 days) after the onset of symptoms. Diagnosis was made with computed tomography (CT) in all the patients preoperatively. There was persistent pain in six patients and uncontrolled hypertension despite intensive medical treatment in three patients. The remaining patients had visceral and peripheral ischemia. Chronic obstructive lung disease was detected in five patients and diabetes mellitus in three cases.

Chronic type-B aortic dissection. Fifteen patients (11 males, 4 females; mean age 62 years; range 38 to 74 years) had chronic type-B aortic dissection. Five patients had back pain, four patients had waist pain, one patient had hoarseness, while five patients were asymptomatic. Diagnosis was made with CT in 10 patients, with magnetic resonance imaging (MRI) in three, and with catheterization in two cases. The diameter of the proximal descending aorta varied between 5.4 cm and 9 cm (mean 6.2 cm) in asymptomatic five patients. False lumen thrombosis was detected in six patients (Fig. 1). Both true and false lumens were intact in nine patients. Of these, four patients had false lumen perfusion to the visceral organ. The diameter of the abdominal aorta varied between 3.3 cm and 6 cm (mean 4.1 cm) on thoracoabdominal CT scans. Chronic obstructive lung disease was present in four patients, diabetes mellitus in four, and chronic renal disease in two patients. Previously, two patients had coronary artery bypass operation, one patient had abdominal aortic aneurysm repair with graft interposition, and one patient had replacement of the ascending aorta.

Surgical technique in acute aortic dissections. Arterial pressure monitoring was employed by cannulation of both the right radial artery and the dorsalis pedis artery during operation. A double-lumen endotracheal tube was used for single-lung ventilation. Following preparation of the left femoral artery and the femoral vein, a left posterolateral thoracotomy approach was performed through the fifth intercostal space. Distal archus aorta, including the left carotid and the left subclavian arteries were prepared. One-third of the middle descending aorta was liberated for cross-clamping.

Heparin was given in 150 units/kg for maintaining the activated clotting time for about 300 seconds. Partial cardiopulmonary bypass was established with cannulation of the left femoral artery and the left femoral vein. In three cases, pulmonary artery cannulation was used instead of the femoral vein. Distal aortic blood perfusion was achieved with a flow rate of 750-1500 ml/m^2/min. The distal archus aorta was clamped between the left

Fig. 1. A preoperative MRI scan showing false lumen thrombosis in chronic type-B aortic dissection.

carotid artery and the left subclavian artery. Another clamp was placed at the middle of the descending aorta. Both the false and true lumens were incised. All the intercostal arteries were ligated. The distal archus aorta was transected totally to achieve end-to-end anastomosis with a Dacron graft. Anastomosis was performed continuously with a Teflon felt using a 4/0 polypropylene suture. Anastomosis was placed just distal to the left subclavian artery in 10 patients. In the remaining four patients, anastomosis was achieved distal to the left carotid artery, followed by end-to-side anastomosis of the left subclavian artery to the graft.

The distal clamp at the middle of the descending thoracic aorta was removed to control whether the distal perfusion flow was through the true or false lumen. The distal perfusion was through the true lumen in 10 patients, and through both false and true lumens in four patients who had fenestration in the distal aorta. After a Teflon felt was placed inside the false lumen, another Teflon felt was used to cover the whole aorta. Then the false lumen was closed with a 4/0 polypropylene suture using the two Teflon felts. The distal end of the Dacron tube graft was anastomosed to the reconstructed true lumen of the aorta with end-to-end technique. One-third of the proximal descending aorta was replaced with this technique. Partial cardiopulmonary bypass was finished and the cannulae were removed.

Surgical technique in chronic aortic dissections. Preoperative preparation and anesthetic management were the same as described above. A left thoracotomy or thoracoabdominal incisions were preferred depending on the replacement of the aortic segment. Thirteen patients underwent a left posterolateral thoracotomy incision through the fifth intercostal space with resection of the fifth costal rib in six. Thoracoabdominal incision was performed from the sixth intercostal space in two cases. The diaphragm was cut circular until the aorta. The left kidney was rotated to the medial side. The distal archus aorta, left carotid, and left subclavian arteries were prepared. Partial cardiopulmonary bypass was established between the left femoral artery and femoral vein, and distal aortic perfusion was achieved. The distal archus aorta was clamped between the left carotid and the left subclavian arteries. Another clamp was placed about 5 cm above the diaphragm. The thoracic aorta was replaced with a Dacron tube graft. In these patients, we did not use a Teflon felt at the proximal anastomosis. The proximal 2/3 of the descending aorta was substituted with a Dacron graft in 10 patients undergoing thoracic aorta replacement. In three patients, the thoracic aorta was replaced until 5 cm above the diaphragm. Distal thoracic aortic anastomoses were made to the true lumen in six patients, in whom the true lumen supplied the visceral arteries on CT scan. In these cases, the blood flow through the false lumen was very low after transient removal of the distal clamp before distal anastomosis. Distal anastomoses were made both to the true and false lumens in seven patients, with resection of the rim between the true and false lumens. Teflon felt was used in all the patients at the distal anastomosis. In three cases, in which the thoracic aorta was replaced until 5 cm above the diaphragm, intercostal arteries were reimplanted to the graft. In the other patients intercostal arteries were not reimplanted.

In two cases, thoracic aortic replacement was performed under total circulatory arrest. The enlarged distal archus aorta was out of control in these cases. Besides the femoral cannula, another venous cannula was inserted through the pulmonary artery to achieve total cardiopulmonary bypass. The patients cooled down to 20 °C. A vent cannula was placed through the apex of the left ventricle. Following distal archus anastomosis, total circulatory arrest was finished and distal thoracal aortic anastomosis was made using partial cardiopulmonary bypass.

Thoracoabdominal aortic replacement was performed in two cases, in which abdominal aortic diameter was 6 cm. There was blood flow through both the true and false lumens in these cases. Partial cardiopulmonary bypass was instituted with the left femoral artery and vein. Following a thoracic incision through the sixth intercostal space, the diaphragm was cut circular and the left kidney was deviated to the medial side. Distal archus aorta anastomosis was made with femora-femoral distal perfusion. Then the intercostal arteries in the diaphragmatic area were anastomosed to the graft. The celiac, mesenteric superior and right renal arteries were implanted as an island to the graft, whereas the left renal artery was implanted separately.

Replaced segments of the thoracic aorta and the type of distal anastomoses in acute and chronic dissections are shown in Table 1 in Table 2, respectively.

The patients were evaluated by multislice CT once a year. Abdominal and descending aortic diameters were measured and patency of the false lumen, enlargement of the aorta and the false lumen were analyzed. The mean follow-up period was three years (range 1 to 7 years).

Table 1. Replaced segments of the thoracic aorta in acute and chronic type-B dissections

	Acute dissection 14 patients	Chronic dissection 15 patients
1/3 proximal segment	14	–
2/3 proximal segment	–	10
Complete descending thoracic aorta	–	3
Thoracoabdominal aorta	–	2

Table 2. Types of the distal anastomoses performed

	True lumen	Both true and false lumens	Thoracoabdominal replacement
Acute type-B dissection (n=14)	14*	–	–
Chronic type-B dissection (n=15)	6	7**	2***

Mortality in the postoperative period: *Two patients; **1 patient; ***1 patient.

RESULTS

Early results. Of 14 patients with acute type-B dissections, two were lost in the early postoperative period. One of them was in cardiogenic shock caused by rupture in the preoperative period and died on the postoperative eighth day because of multiorgan failure. The other patient died on the postoperative 25th day because of chronic obstructive lung disease.

In the chronic type-B dissection group, two patients died in the early postoperative period. One died on the sixth postoperative day due to low cardiac output, and the other died on the 28th postoperative day due to multiorgan failure, following thoracoabdominal aortic replacement.

Operation time varied between 220 and 320 min (mean 260 min). Partial bypass time varied between 40 and 85 min. The mean intensive care unit stay was four days (range 2 to 25 days).

Postoperative neurological complications included transient monoparesis (n=1), recurrent nerve paralysis (n=2), and diaphragm paralysis (n=1). There was no paraplegia. Transient cerebral edema was seen in one patient. Following subclavian-subclavian bypass, one patient developed ischemic changes in the left arm due to dissection of the left subclavian artery.

There was no intra-abdominal organ malperfusion in the early postoperative period. One patient developed acute renal failure which recovered spontaneously. Hemodialysis was necessary in another patient, who died on the 25th postoperative day due to multiorgan failure.

Midterm results. Data on obliteration and patency of the false lumen in acute and chronic cases are shown in Table 3.

The false lumen was patent in two of 12 patients with acute aortic dissections (Fig. 2). In these two patients, enlargement in the false lumen diameter was 8 mm in two-year follow-up period, none of them requiring reoperation.

The false lumen was patent in eight of 12 patients with chronic aortic dissections. Of these eight patients, distal anastomosis was performed to both the true and false lumens in six patients (Fig. 3), and to the true lumen in two patients. Enlargement of the false lumen was 5 mm in a year in six patients with patent false lumen on CT. In the chronic aortic dissection group, three cases in which both the true and false lumens were patent required reoperation because aortic diameter exceeded 6 cm. These patients underwent thoracoabdominal aortic replacement.

Six chronic type-B dissection patients with distal anastomosis to the true lumen were evaluated postoperatively. Of these, the false lumen was obliterated in four patients, and patent in two patients.

DISCUSSION

The clinical outcome of patients with acute type-B dissections is debatable.[1] Suzuki et al.[2] reported 384 patients with acute type-B aortic dissections enrolled in the International Registry of Acute Aortic Dissection (IRAD) study. The overall in-hospital mortality rate was 12.8% and most deaths occurred within the first week, being 32.1% in surgically treated patients and 9.6% in medically treated patients. Approximately two-thirds of the patients initially presented elsewhere and were transferred to an IRAD center for further assessment and management.

The benefit of urgent operation for acute type-A aortic dissections is established, but management of acute type-B dissections remains controversial. In general, medical treatment is advocated for patients with acute type-B aortic dissections without complications and surgery is reserved for patients with complicated dissections. Patients with symptomatic and compromised aor-

Table 3. False lumen patency following repair of acute and chronic dissections

	Acute dissection repair (n=12)	Chronic dissection repair (n=12)	
	Distal anastomosis to the true lumen	Distal anastomosis to both true and false lumens	Distal anastomosis to the true lumen
False lumen patency	2	6	2
Obliterated false lumen	10	–	4

Fig. 2. False lumen patency in acute aortic dissection in the midterm follow-up period.

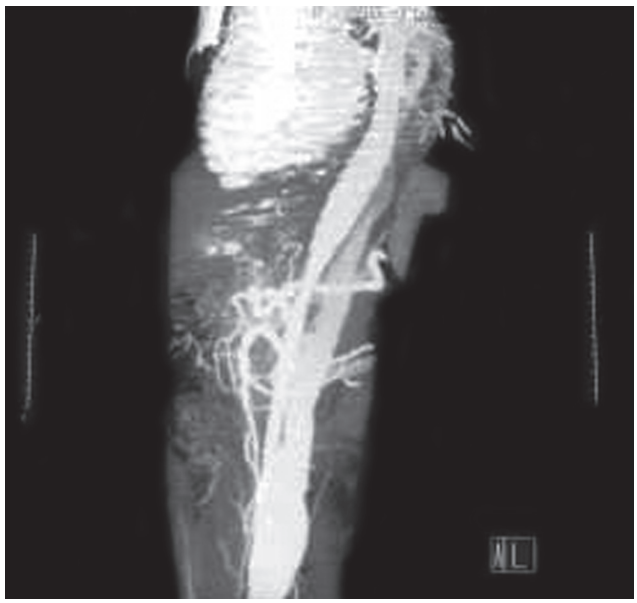

Fig. 3. False lumen patency in chronic aortic dissection in the midterm follow-up period. Distal anastomosis was performed to both true and false lumens.

tic branch have a significantly higher mortality rate.[2,3] In the IRAD study, 15% of all deaths were related to mesenteric ischemia. Optimal surgical management of such patients remains controversial with respect to both the techniques of intervention (open surgery or endovascular procedure) and the timing of surgical intervention. Some authors advocated consideration of early operation for selected patients with acute type-B aortic dissections, irrespective of the presence or absence of complications[4] Marui et al.[5] suggested that the presence of a maximum aortic diameter of 40 mm and a patent false lumen at onset predicted a high incidence of aortic enlargement during the chronic phase of type-B acute aortic dissections, and recommended surgery during the subacute or early chronic phase due to the difficulties associated with surgery during the late chronic phase. We recommend the consideration of early surgery for patients with a maximum aortic diameter of 50 mm but a closed false lumen. We also recommend surgical intervention in asymptomatic patients with an aortic diameter of ≥60 mm in acute aortic dissections. In complicated acute aortic dissections, surgical intervention should be performed regardless of the size of the aortic diameter. However, patients with a maximum aortic diameter of 40 mm and a closed false lumen should continue to receive hypotensive therapy because of the low probability of aortic enlargement and a high likelihood of a satisfactory course of recovery of the dissected aorta.[2] Patients with a maximum aortic diameter of 40 mm and a patent false lumen can also be treated medically with more careful observation of the aortic dissection.[2] Some authors recommended medical approach in acute type-B dissections, which has as good results as surgery in the midterm follow-up period. In these patients, false lumen patency was the major factor affecting prognosis.[6] Our midterm results showed false lumen patency in two of 12 patients who underwent proximal descending aortic replacement for acute dissections. Growth rate of the false lumen and reoperation risk (16.7%) was high in our patients in whom distal anastomosis was performed to both lumens for chronic dissections.

Some authors recommended endovascular stent-grafting in acute type-B dissections instead of surgical approach. With this approach, overall hospital mortality rates varied between 11% and 20% in type-B dissections.[7,8] Hospital mortality in our surgical series was 13.8% in type-B dissections. Following endovascular stent-grafting, leakage rate was reported as 3.5% and, in the midterm, false lumen thrombosis was 75% in acute dissection patients.[9] False lumen thrombosis in our acute dissection patients was 83.3%. The incidence of false lumen thrombosis is lower in medically treated type-B dissections.[9]

The segment of the thoracoabdominal aorta to be replaced is controversial in chronic aortic dissections. We replaced all the aortic segments that were more than 4 cm in diameter. Hospital mortality was 13.3%. Reoperation risk was high (25%) in these patients due to patency of the false lumen. Although early mortality and morbidity rates are low with endovascular stent-grafting of chronic dissections, long-term prognosis is still not known.[8]

In conclusion, false lumen patency affects the prognosis after surgery of type-B dissections. The incidence of false lumen thrombosis is high following surgery of acute type-B aortic dissections. Marfan's syndrome, the

length of the replaced segment of the aorta, and false lumen patency determine prognosis following surgery of chronic type-B dissections. Although endovascular stent-grafting promises good results in selected type-B dissections, long-term follow up and results in complicated patients remain to be elucidated.

REFERENCES

1. Crawford ES. The diagnosis and management of aortic dissection. JAMA 1990;264:2537-41.
2. Suzuki T, Mehta RH, Ince H, Nagai R, Sakomura Y, Weber F, et al. Clinical profiles and outcomes of acute type B aortic dissection in the current era: lessons from the International Registry of Aortic Dissection (IRAD). Circulation 2003;108 Suppl 1:II312-7.
3. Hagan PG, Nienaber CA, Isselbacher EM, Bruckman D, Karavite DJ, Russman PL, et al. The International Registry of Acute Aortic Dissection (IRAD): new insights into an old disease. JAMA 2000;283:897-903.
4. Schor JS, Yerlioglu ME, Galla JD, Lansman SL, Ergin MA, Griepp RB. Selective management of acute type B aortic dissection: long-term follow-up. Ann Thorac Surg 1996;61:1339-41.
5. Marui A, Mochizuki T, Mitsui N, Koyama T, Kimura F, Horibe M. Toward the best treatment for uncomplicated patients with type B acute aortic dissection: A consideration for sound surgical indication. Circulation 1999;100(19 Suppl):II275-80.
6. Sueyoshi E, Sakamoto I, Hayashi K, Yamaguchi T, Imada T. Growth rate of aortic diameter in patients with type B aortic dissection during the chronic phase. Circulation 2004; 110(11 Suppl 1):II256-61.
7. Eggebrecht H, Herold U, Kuhnt O, Schmermund A, Bartel T, Martini S, et al. Endovascular stent-graft treatment of aortic dissection: determinants of post-interventional outcome. Eur Heart J 2005;26:489-97.
8. Duebener LF, Lorenzen P, Richardt G, Misfeld M, Notzold A, Hartmann F, et al. Emergency endovascular stent-grafting for life-threatening acute type B aortic dissections. Ann Thorac Surg 2004;78:1261-6.
9. Dialetto G, Covino FE, Scognamiglio G, Manduca S, Della Corte A, Giannolo B, et al. Treatment of type B aortic dissection: endoluminal repair or conventional medical therapy? Eur J Cardiothorac Surg 2005;27:826-30.