Symposium: Clinical Research

Endovascular stent-grafts for acute and chronic type B aortic dissection: comparison of clinical outcomes

Quanming Jing,1 Yaling Han,1 Xiaozheng Wang,1 Jie Deng,1 Bo Luan,1 Hongxu Jin,2 Xiaojiang Liu,1 Fei Li,1 Ying Liu1

1Department of Cardiology, General Hospital of Shenyang Military Region, Shenyang, China
2Liaoning Medical College, China

Objective To evaluate the early and mid-term results of endovascular repair for acute and chronic type B aortic dissection, and to compare the clinical outcomes between the 2 groups.

Methods From May 2002 to December 2006, 50 patients with type B aortic dissection were treated by endovascular stent-graft. There were 23 patients in the acute aortic dissection (AAD) group and 27 patients in the chronic aortic dissection (CAD) group. All patients were followed up from 1 to 54 months (average, 17±16 months). The immediate and follow-up clinical outcomes were documented and compared between the 2 groups.

Results Placement of endovascular stent-grafts across the primary entry tears was technically successful in all 50 patients. Compared to the CAD group, the AAD group had a higher percentage of pleural effusion (17.4% vs. 0%, \( P=0.04 \)) and visceral/leg ischemia (26.1% vs 3.7%, \( P=0.04 \)). Procedure related complications, including endoleak and post-implantation syndrome, occurred more frequently in the AAD group than in the CAD group (21.7% vs 3.7% and 30.4% vs 11.1%, respectively; \( P=0.08 \) and \( P=0.04 \)). Kaplan–Meier analysis showed no difference in the survival rate at 4 years between the 2 groups (86.4% vs 92.3%, \( P=0.42 \) by log-rank test). However, the event-free survival rate was higher in patients with chronic dissection than in patients with acute aortic dissection (96.2% vs 73.9%; \( P=0.02 \) by log-rank test). Conclusions Endovascular repair with stent-graft was safe and effective for the treatment of both acute and chronic type B aortic dissection. However, both immediate and long term major complications occurred more frequently in patients with acute dissection than in those with chronic dissection. (J Geriatr Cardiol 2007;4:67-71.)

Key Words aortic dissection; endovascular repairing; stent-graft

Aortic dissection is a longitudinal split or partition in the media of the aorta. The peak incidence of aortic dissection is in the sixth and seventh decades of life, and advanced age and hypertension are two of the most important risk factors. According to its duration, defined as the length of time from symptom onset to medical evaluation, aortic dissection can be classified into acute and chronic phases. A dissection that is present for less than 2 weeks is defined as “acute” whereas those present for 2 weeks or more are defined as “chronic”. Acute aortic dissection is a potentially catastrophic condition. Left untreated, mortality would be as high as 1 percent per hour within the first days of symptom onset. During the chronic phase, there is a continuing risk of expansion and rupture of the affected aortic section, and more than 90 percent of patients would die within 1 year.

For patients with acute Stanford type A dissections, surgical intervention is still considered to be the treatment of choice. However, the optimal treatment strategy for patients with aortic dissection confined to the descending aorta (Stanford type B) remains controversial. Despite remarkably improved operative techniques, surgical resection of the descending thoracic aorta is still associated with high morbidity and mortality. The current mortality rate among patients who receive medical therapy for type B dissection remains about 20 percent. In 1999, the concept of endovascular stent-graft closure of the proximal entry tear was introduced as a novel treatment option for patients with type B aortic dissection. Since then, many reports have demonstrated the feasibility of this management strategy. In this study, we report the clinical results of 50 Chinese patients with type B aortic dissection treated by endovascular stent-graft placement in a single medical center, and compare the clinical outcomes of patients in acute and chronic phases.

Patients and methods

Patient selection

Between May 1999 and December 2006, 56 consecu-
tive patients with Stanford type B aortic dissection were admitted into the General Hospital of Shenyang Military Region. All patients underwent chest radiography and cross-sectional imaging of the chest and abdomen by spiral computed tomography (CT) and/or magnetic resonance imaging (MRI). For stent-graft placement, patients were required to meet the following criteria: a definite diagnosis of type B aortic dissection, an entry site at least 0.5 cm distal to the left subclavian artery, suitable access with no substantial iliac tortuosity, at least one femoral or iliac artery without dissection, and no severe aortic regurgitation. The protocol was approved by the institutional review boards of our hospital, and written informed consent was obtained from each patient. Intravenous beta-blockade and sodium nitroprusside were used to control blood pressure within the 120/70 mm Hg range and heart rate at 60-70 bpm during the pre-procedure period. Patients were divided into acute aortic dissection (AAD, <2 weeks) and chronic aortic dissection (CAD, >2 weeks) groups according to time interval from onset of symptoms to treatment.

**Procedure of stent-graft placement**

Stent-graft placement was performed under general anesthesia in the catheterization laboratory. A 5-6 French pigtail catheter was introduced into the aortic arch through the left subclavian artery, via the left radial artery, for localization of the orifice of subclavian artery and intraprocedural aortography. Aortography was performed to confirm the primary entry tearing site. The diameter of the aorta was measured, at least 2 cm distal to the primary entry tearing site, to determine the target size of the stent-graft. In all the patients, the femoral or iliac artery was surgically exposed. A pigtail catheter was advanced with a soft wire into the true lumen under fluoroscopic guidance. Once the location inside the true lumen is confirmed, a special stiff wire was introduced. A stent-graft with a diameter 20-30% larger than the diameter of the aortic arch was selected. Three types of stent-grafts were used. The Talent (Medtronic, U.S.A.) were deployed in 23 patients, the Zenith (Cook, U.S.A.) in 4 patients, and the Aegis (Microport, China) in 23 patients. The stent-graft was deployed in the true lumen under fluoroscopic guidance. The stent-grafts were positioned to completely cover the entry tear. Before the stent–graft was unloaded, systolic blood pressure was titrated to 70-80 mm Hg with sodium nitroprusside; as soon as the blood no longer circulated through the false lumen, the stent was expanded by inflation of the balloon at 2 to 3 atm. When the web struts were fully extended and there was no flow into the false lumen, the infusion of sodium nitroprusside was discontinued to increase the systolic blood pressure to 100 mm Hg or higher. Aortography was performed again, to confirm the closure of the entry tear, and to observe whether the left subclavian artery was affected or an endoleak existed. All patients were sent to the CCU and monitored for blood pressure, heart rate, and other vital signs. Blood pressure was controlled to be around 100-120/80 mmHg. Anti-platelet therapy with aspirin (75 mg/ day) and clopidogrel (75 mg/day) was given immediately after deployment of the stent-grafts. Additional anti-coagulation with low-molecular-weight heparin was started immediately after the procedure and continued for 7 days.

**Clinical follow-up**

The patients were followed up once a month either through an outpatient clinic visit, or contacted by telephone or by mail. Blood pressure was monitored. A CT or MRI of the aorta was performed to determine the extent of thrombosis in the false lumen, the size of the true and false lumen, and blood flow through the branch vessels at 1, 3, 6, 9, and 12 months after discharge, and yearly thereafter. The mean duration of follow-up was 17 months, and the maximal duration was 54 months.

**Statistical Analysis**

Continuous variables are expressed as mean ±SD, and the values of the categorical variables were presented as percentages. Comparisons of continuous variables between the two groups were performed with paired t-tests. Differences between the groups in categorical variables were analyzed by the chi-square test or Fisher’s exact test. Rates of survival and event-free survival (defined as survival without death, paraplegia, stroke, distal embolization, side-branch occlusion, or infection) were studied with use of the log-rank test. A P value < 0.05 was considered statistically significant.

**Results**

Of the 56 patients with type B aortic dissection, 6 were excluded because they did not meet the inclusion criteria. As a result, 50 patients were enrolled into this study: There were 23 in the AAD group and 27 in the CAD dissection group. End organ ischemia was documented in 6 patients of the AAD group and in 1 patient of the CAD group (P=0.04). Pleural effusion was found in 4 of the AAD group but none of the CAD group. There were no other differences between the 2 groups in their demographic and clinical characteristics (Table 1).

**Procedural success**

Transfemoral stent-graft deployment was successful in 47 patients of the 2 groups. For the remaining 3 patients, 1 in the AAD group and 2 in the CAD group, stent-graft implantation was performed via iliac artery, because of the small diameter of the femoral artery. Complete sealing of the entry to the false lumen was documented by aortography. No severe procedure related complications, including death...
and stroke, were documented. The mean duration of procedure and fluoroscopic exposure time were longer in the AAC group than those in the CAD group (Table 2).

### In-hospital and 30 days outcomes

No patient died while in the hospital and within 30 days. Endoleak occurred in 5 patients of the AAD group, but in only 1 patient of the CAD group. New onset of renal insufficiency developed in 3 patients; 2 were in the AAD group and 1 was in the CAD group. Endoleak was found in 6 patients, 5 in the AAD group and 1 in the CAD group. Post-implantation syndrome, defined by fever, elevated C-reactive protein level, and leukocytosis, occurred in 8 patients of the AAD group and 3 patients of the CAD group; it lasted no more than 1 week. Two patients had wound infection, which improved after short term antibiotic therapy and local care. Three patients had mild to moderate back pain, which disappeared in a few days without specific treatment (Table 3).

### Follow-up results

All but 1 patient of the CAD group were followed up, with an average of 18±16 months for the AAD group, and 17±14 months for the CAD group. Two patients in the AAD group died during the follow-up, one from massive hemoptysis at 18 months, and one died suddenly at 7 months, presumably from dissection rupture. One patient in the CAD group died from multiple organ failure at 20 months. Endoleak disappeared in 5 of the 6 patients. In 1 patient in the AAD group, endoleak still remains 3 months after the procedure, and is still under observation. One patient in the AAD group developed new onset endoleak at 12 months, however the aneurysm did not progress. Paraplegia occurred in 1 patient of the AAD group at 6 months; CT examination showed no occlusion of the stent graft and no endoleak but there was a small tear in the abdominal aorta. In one patient of the AAD group, a new ascending aortic dissection was found by CT examination at 12 months. The patient was asym-
There was no difference of the 4 year survival rate between the AAD group and the CAD group (86.4% and 96.2%, \(P=0.42\)). However, the event-free survival, defined as survival without endoleak, paraplegia, stroke, and other major dissection related complications, was significantly higher in the CAD group than in the AAD group (96.2% and 73.9%, \(P=0.02\)). See Table 4, Figure 1 and Figure 2.
Discussion

The treatment of type B aortic dissection still presents a challenge for physicians. Surgical repair of the aorta was plagued with many severe respiratory, renal, and neurologic complications. The early surgical mortality rate was unacceptably high. Many groups have investigated the feasibility of using stent-grafts for aortic dissection, and their reported mortality rates ranged from 0% to 16%. Therefore, the endovascular stent-graft has become an attractive therapeutic option. In this present study of 50 patients with type B aortic dissection, we have shown that endovascular repair with a stent-graft is feasible and safe, at both of the acute and chronic phase. Procedural success rate was 100%, with no death at 30 days. Follow-up data showed excellent long-term survival rate for patients with acute as well as chronic type B aortic dissection, with only 3 deaths in the 2 groups. Our results were consistent with those reported by other authors.

A recent meta-analysis showed that patients undergoing stent-graft placement for acute dissections were at higher risk of death and major complications than those with chronic AD, despite their younger age. This difference was demonstrated again in our series. Although no in-hospital deaths occurred in both groups, endoleak occurred in 5 of the 23 patients in the AAD group, but in only 1 out of 27 patients in the CAD group. The reasons for this difference remain to be elucidated. It is assumed that in patients with acute AD, implantation of stent-grafts is often prompted by complications of the dissection, making the acute AD patients more prone to higher complications and lower survival in comparison to stable patients with chronic AD undergoing elective stent-graft placement. In our series, patients with acute aortic dissection had more severe complications, including dissection rupture, impending rupture, and end-organ ischemia. We think this is the major reason for higher incidence of in-hospital complications for patients with acute dissection.

On the other hand, emergent intervention for the acute patients is technically more demanding. Furthermore, in the acute phase, the edematous arterial intima might be fragile and vulnerable to injury from the wire or stent struts. This may lead to the occurrence of endoleak after stent-graft implantation. In contrast, in the chronic phase, fibrosis of the intima and adventitia, and thrombosis of the false lumen would make the arterial wall more resistant to trauma.

Post-implantation syndrome is a relatively mild but frequent complication in patients undergoing endovascular stent-graft deployment. The mechanism of this syndrome is not clear. Some authors even questioned whether this syndrome exists. In our series, we found that the post-implantation syndrome was more common in the AAD group than in the CAD group. This phenomenon also needs further elucidation. During follow-up, 2 patients in the AAC group and 1 in the CAD group died. One patient died from massive hemoptysis, implying the occurrence of dissection rupture. The causes of the other 2 deaths were not clear. There was no difference of long-term survival between the 2 groups, indicating endovascular repairing is effective for both acute and chronic type B aortic dissection.

In conclusion, endovascular stent-graft placement for both acute and chronic type B dissection is a reasonable alternative to surgical repair and medical management. Complete exclusion of the dissected false lumen was achieved with a remarkable technical success rate. Further studies are needed to determine the clinical and procedural factors requiring for success and lower postoperative morbidity and mortality. Long-term follow-up is also needed to clarify the fate of the thrombosed false lumen and the long-term efficacy of this technique of dissection exclusion by stent-graft.

References