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Aneurysms, rupture and dissection of the descending thoracic aorta: surgical results and treatment strategies

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Aneurysma, Ruptur und Dissektion der thorakalen Aorta descendens: Operationsergebnisse und Behandlungsstrategien

Zusammenfassung. *Grundlagen:* Aortendissektionen Typ B nach Stanford, Ruptur und Aneurysmen der thorakalen Aorta descendens sind lebensbedrohliche Krankheiten. Aber auch die chirurgische Therapie dieser Erkrankungen ist mit einer deutlichen Morbidität und Mortalität verbunden. Aorten-Stentgrafts stellen eine in den letzten Jahren zunehmende Behandlungsalternative dar.

Methodik: An 47 Patienten wurden 48 thorakale Aorta-descendens-Ersätze durchgeführt. 81 % der Patienten waren männlich und das Alter betrug 45 (16–75) Jahre. Die Diagnosen waren Aortendissektion (31 %), degenerative Aneurysmen (10 %), posttraumatische Aneurysmen/Rupturen (44 %), und andere (15 %).

Ergebnisse: 50 % waren Akut-Operationen und 17 % Reoperationen. Die Intensivaufenthaltsdauer betrug 6 (1–37) Tage. Kein Patient hatte eine postoperative Paraplegie. Die Hospitalmortalität betrug 14,6 %.

Von den präoperativen Variablen war nur die Akutoperation signifikant mit der Hospitalmortalität assoziiert (p = 0,047), wohingegen Alter, Geschlecht und Aortendissektion nicht signifikant waren. Die Überlebensraten betrugen 76 % nach 1 Jahr, 70 % nach 5 und 70 % nach 10 Jahren.

Schlussfolgerungen: An unserer Klinik werden symptomatische akute oder chronische Aortendissektionen Typ B und Hochrisiko-Patienten mit degenerativen Aneurysmen in erster Linie mit Aorten-Stentgrafts versorgt. Bei Niedrigrisiko-Patienten mit Aorta-descendens-Aneurysmen, Patienten mit traumatischer Aortenruptur (bei denen keine Kontraindikation für eine Operation mit extrakorporaler Zirkulation besteht), und Patienten, bei denen Stentgrafts nicht anwendbar sind oder nicht erfolgreich durchgeführt wurden, stellt die operative Sanierung eine Behandlungsoption mit guten Langzeitergebnissen dar.

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Schlüsselwörter: Aortendissektion, deszendierende thorakale Aorta, Aorten-Stentgraft, Aortenruptur.

Summary. *Background:* Aortic dissections type B, rupture and aneurysms of the descending thoracic aorta carry the risk of life-threatening complications. But also surgical intervention in these pathologies is associated with significant morbidity and mortality. Aortic stent grafting is a novel important tool in the therapeutic armamentarium of these diseases

Methods: 47 patients underwent 48 times replacement of the descending thoracic aorta. 81 % were male, the mean age being 45 (16–75) years. The diagnosis was aortic dissection (31 %), degenerative aneurysm (10 %), posttraumatic aneurysm/rupture (44 %), and others (15 %).

Results: 50 % of the operations were acute cases and 17 % were reoperations. The length of ICU stay was 6 (1–37) days. There was no case of postoperative paraplegia. The hospital mortality was 14.6 %.

From preoperative patient-related variables, operations performed as acute cases were significantly associated with hospital mortality (p = 0.047), whereas age, sex and aortic dissection were not. Survival rates were 76 % after 1 year, 70 % after 5 and 70 % after 10 years.

Conclusions: At our hospital the first-line therapy for symptomatic acute or chronic aortic dissections type B and for high-risk patients with degenerative aneurysms is aortic stent grafting. In low-risk patients with descending aortic aneurysm, patients with traumatic aortic rupture (with no contraindication for surgery using extracorporeal circulation), and patients where stent grafting is not applicable or not successful, surgical treatment is an option with good long-term results.

Key words: Aortic dissection, descending thoracic aorta, aortic stent graft, aortic rupture.

Introduction

Aneurysms of the descending thoracic aorta may involve serious complications [1–4]. Since the operative treatment is also risky, especially regarding postoperative paraplegia and hospital mortality, criteria for resection based on the diameter have been defined [5–7]. Aortic

stent grafting has developed as new first-line therapy in many cases of descending aortic disease [8–11].

Patients and methods

Between 1980 and 2002, 47 patients underwent 48 times replacement of the descending thoracic aorta at the department of cardiac surgery. 39/48 patients (81 %) were male, and the median age was 45 (16–75) years. The diagnosis was aortic dissection in 15/48 (31 %) (chronic type A dissection in 4, chronic type B dissection in 4 and acute type B dissection in 7 cases), degenerative aneurysm in 5/48 (10 %), posttraumatic aneurysm/rupture in 21/48 (44 %), hypoplasia of the aortic arch in 2/48 (4 %), tumor infiltration in 3/48 (6 %) (sarcoma in 2 and bronchus carcinoma in 1 case), recurrent aortic isthmus stenosis in 1/48 (2 %) and prosthetic infection in 1/48 (2 %) cases. Additional operations were partial or complete replacement of the aortic arch in 7/48 (15 %), replacement of the ascending aorta and David operation in 1/48 (2 %) and pneumonectomy in 1/48 (2 %) cases.

All clinical data were obtained by reviewing the hospital records.

Surgical technique

Partial (femoro-femoral) cardiopulmonary bypass was performed in the majority of cases. In 16/48 (33 %) cases, a left heart bypass (left atrium-femoral artery) using a centrifugal pump was used.

Access was gained via posterolateral thoracotomy to expose the descending thoracic aorta. After cross clamping of the aorta, the aneurysm was opened longitudinally and resected. A Dacron graft with the diameter of the native aorta was interposed end-to-end with 4/0 Prolene running sutures.

Follow-up

Patients were followed up in our outpatient department by means of CT scans and physical examinations. To obtain actual information patients or their referring physicians were interviewed via telephone.

Statistical analysis

The SPSS software (SPSS 10.0) for windows was used for statistical analysis. Categorical variables are given as percentages, continuous variables are presented as median and range. In univariate analysis qualitative variables were analyzed using chi-square tests. For survival rates the Kaplan–Meier curve was used. Results were considered statistically significant at p values of less than 0.05.

Results

In 47 operations, a Dacron tube graft was interposed and in 1 case a homograft was used after an infected prosthesis had to be removed. 24/48 (50 %) of the operations were performed as acute cases and 8/48 (17 %) were reoperations. Two patients (4 %) had Marfan's syndrome. The cardiopulmonary bypass time was 105 (30–432) minutes and aortic cross clamp time was 50 (21–214) minutes. Deep hypothermic circulatory arrest at 18°C (as determined by urinary bladder thermocatheter) was necessary in 20/48 (42 %) cases with a duration of 41 (26–71) minutes.

The median length of ICU stay was 6 (1–37) days and the postoperative length of stay at our department was 16 (7–59) days.

Postoperative complications are shown in Table 1. There was no postoperative paraplegia.

Hospital mortality was 7/49 (14.6 %). Causes of death are listed in Table 2.

From preoperative patient-related variables, operations performed as acute cases were significantly associated with hospital mortality (the hospital mortality was 25 % in acute cases vs. 4 % in elective cases; $p = 0.047$), whereas age, sex and aortic dissection were not significantly associated with hospital mortality.

The follow-up was complete for 39/40 hospital survivors and a total of 234 patient-years.

At the time of follow-up 8/40 late deaths occurred. Three of these late deaths were related to preexisting tumors (1 patient died 3 months p.o. from bronchus carcinoma, 2 patients 4 and 8 months p.o. from sarcoma). Two deaths in the first postoperative year were related to the aorta (1 patient 3 months p.o. with redissection into the aortic arch, 1 patient 7 months p.o. with rupture of the abdominal aorta). One death was due to respiratory failure 3 months postoperatively. One patient died because of congestive heart failure 23 months postoperatively and one patient died because of a stroke 40 months postoperatively.

From 31 patients alive at follow-up 29 (94 %) were in NYHA class I and 2 (6 %) were in NYHA class II. Major adverse clinical events were: cerebrovascular accident in 1/31 (3 %), but no myocardial infarction or thromboembolic event except stroke. One patient required a reoperation on the aorta distally from the previously operated portion.

The survival rates (excluding the 3 malignoma patients) were: 76 % after 1 year, 73 % after 2 years, 70 % after 3 years, 70 % after 5 years, 70 % after 7 years, and 70 % after 10 years (Fig. 1).

Discussion

Surgery of the descending aorta is known to be associated with a considerable morbidity and mortality es-

Table 1. Postoperative complications after replacement of the descending thoracic aorta

Complication	Number of patients (%)
Hemorrhage requiring revision	12/48 (25)
Low cardiac output syndrome	11/48 (23)
Renal failure requiring hemofiltration	9/48 (19)
Sepsis	10/48 (21)
Multisystem organ failure	8/48 (17)
Prolonged ventilation requiring tracheostomy	8/48 (17)
Postoperative encephalopathy	6/48 (13)
Phrenic nerve lesion	2/48 (4)
Recurrent nerve lesion	6/48 (13)

Table 2. Causes of hospital deaths after replacement of the descending thoracic aorta

Patient nr.	Cause of death
1	Aortic dissection, low cardiac output, sepsis
2	Aortic dissection, low cardiac output, hemorrhage, sepsis, pneumonia
3	Aortic dissection, low cardiac output, pneumonia
4	Chronic posttraumatic aneurysm, hypoxia requiring ECMO implantation
5	Aortic rupture, mors in tabula, hemorrhage
6	Traumatic aortic rupture, hemorrhage, low cardiac output
7	Aortic aneurysm with rupture, mors in tabula, myocardial infarction

pecially in aortic dissections type B. In acute aortic dissections the reported hospital mortality varies from 0 % to 21 % and over 30 % [3, 4, 12]. In chronic aortic dissections the hospital mortality is described as being between 8 % and 15 % [3, 4]. Borst and coworkers describe a surgical hospital mortality of 3 % in a mixed patient group of dissections and aneurysms of the descending thoracic aorta [13]. Takigami and coworkers found an early mortality of 14 % in patients undergoing replacement of descending thoracic aortic aneurysms [2]. The hospital mortality in our series lies at 14.6 % within the ranges given in the literature.

Aortic stent grafting was an important innovation for the treatment of descending thoracic aortic diseases. However, there is also a hospital mortality rate in the range of 2.9 %, 6.8 %, 8 %, and 10.4 % described in the literature for stent grafting of the descending thoracic aorta [8–11].

Due to the development and routine application of aortic stent grafts the treatment strategies for aneurysm, rupture and dissection of the descending thoracic aorta at our institution are the following:

1. Acute aortic dissection type B:

a) Rupture or acute expansion → try aortic stent graft: if not applicable or unsatisfying result (e.g., significant endoleak) → surgery.

b) Uncomplicated dissection: medical treatment (beta blocker, after load-reducing drugs).

2. Chronic aortic dissection type B: Indication for intervention if symptomatic (back pain, chest pain, abdominal pain, lower extremity ischemia) or enlargement of diameter to >6.5 cm → try aortic stent graft: if not applicable or unsatisfying result (e.g., significant endoleak) → surgical treatment.

3. Aneurysm of the descending thoracic aorta: since the major pathology of this disease is atherosclerosis in elder patients aortic stentgrafting is considered in patients with high risk of surgical mortality. In low-risk patients replacement of the descending thoracic aorta is performed. The indication for intervention (both stent graft or operation) is an enlargement of the aneurysm diameter to >6.5 cm.

4. Traumatic rupture of the descending thoracic aorta (typically at the proximal part where the Botalli ligament inserts): if there are contraindications for an operation with the use of the heart lung machine or left heart bypass requiring systemic heparinisation (e.g., polytrauma with high bleeding risk) aortic stent grafting is considered. If there are no contraindications for operation surgical replacement of the descending thoracic aorta can be performed with relatively low risk in these often young patients. Regarding the younger age of this patient group the long-term behaviour of the aortic stentgrafts has to be considered. Real long-term results of 10 years or more are not yet available.

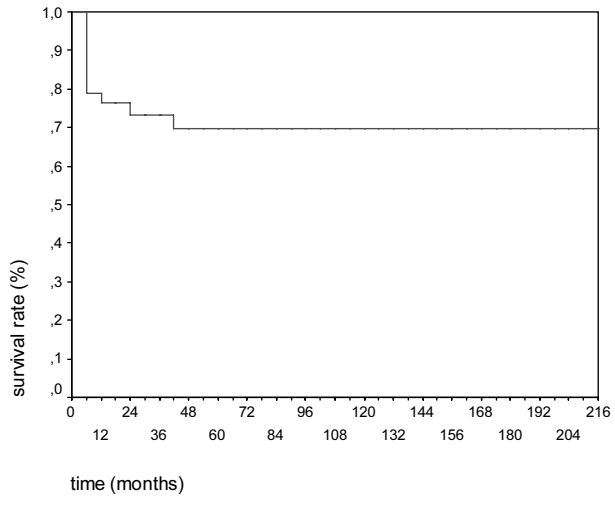

Fig. 1. Survival curve of 44 patients who underwent 45 times replacement of the descending thoracic aorta (3 of the original 47 patients with malignant tumors were excluded)

Conclusion

Treatment of aneurysms, rupture and dissection of the descending thoracic aorta involves aortic stent grafting and surgical treatment depending on diagnosis and comorbidity and on the success of aortic stent grafting. Thus treatment strategies are often interdisciplinary decisions.

References

1. Moreno-Cabral CE, Miller DC, Mitchell RS, Stinson EB, Oyer PE, Jamieson SW, Shumway NE (1984) Degenerative and atherosclerotic aneurysms of the thoracic aorta. J Thorac Cardiovasc Surg 88: 1020–1032
2. Takigami K, Kawasaki M, Yamauchi H, Watanabe M, Ishii K, Shiiya N, Murashita T, Sasaki S, Matui T, Sakuma M, Yasuda K (1995) The early and long term results of descending thoracic aortic aneurysm repair. Cardiovasc Surg 3: 55
3. Fann JI, Smith JA, Miller DC, Mitchell RS, Moore KA, Grunkemeier G, Stinson EB, Oyer PE, Reitz BA, Shumway NE (1995) Surgical management of aortic dissection during a 30 – year period. Circulation 92: 113–121
4. Gysi J, Schaffner T, Mohacsi P, Aeschbacher B, Althaus U, Carrel T (1997) Early and late outcome of operated and non-operated acute dissection of the descending aorta. Eur J Cardiothorac Surg 11: 1163–1170

5. Elefteriades JA, Lovoulos CJ, Coady MA, Tellides G, Kopf GS, Rizzo JA (1999) Management of descending aortic dissection. Ann Thorac Surg 67: 2002–2005
6. Coady MA, Rizzo JA, Hammond GL, Kopf GS, Elefteriades JA (1999) Surgical intervention criteria for thoracic aortic aneurysms: a study of growth rates and complications. Ann Thorac Surg 67: 1922–1926
7. Davies RR, Goldstein LJ, Coady MA, Tittle SL, Rizzo JA, Kopf GS, Elefteriades JA (2002) Yearly rupture or dissection rates for thoracic aortic aneurysms: simple prediction based on size. Ann Thorac Surg 73: 17–28
8. Herold U, Piotrowski J, Baumgart D, Eggebrecht H, Erbel R, Jakob H (2002) Endoluminal stent graft repair for acute and chronic type B aortic dissection and atherosclerotic aneurysm of the thoracic aorta: an interdisciplinary task. Eur J Cardiothorac Surg 22: 891–897
9. Buffalo E, da Fonseca JH, Souza JA, Alves CMR (2002) Revolutionary treatment of aneurysms and dissections of descending aorta: the endovascular approach. Ann Thorac Surg 74: 1815–1817
10. Lachat M, Pfammatter T, Witzke H, Bernard E, Wolfensberger U, Künzli A, Turina M (2002) Acute traumatic aortic rupture: Early stentgraft repair. Eur J Cardiothorac Surg 21: 959–963
11. Mitchell RS, Dake MD, Semba CP, Fogarty TJ, Zarins CK, Liddell RP, Miller DC (1996) Endovascular stentgraft repair of thoracic aortic aneurysms. J Thorac Cardiovasc Surg 111: 1054–1062
12. Lansman SL, Hagl C, Fink D, Galla JD, Spielvogel D, Ergin A, Griepp RB (2002) Acute type B aortic dissection: surgical therapy. Ann Thorac Surg 74: 1833–1835
13. Borst HG, Jurmann M, Bühner B, Laas J (1994) Risk of replacement of descending aorta with a standardized left heart bypass technique. J Thorac Cardiovasc Surg 107: 126–133