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Chapter 3

LONG TERM RESULTS AFTER 27 YEARS SURGICAL TREATMENT
OF ACUTE TYPE A AORTIC DISSECTION

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Abstract

Background.
This study investigates the determinants of long–term outcome and modalities of late death after surgical treatment of acute type A dissection.

Methods.
Between 1974 and 2001, 315 consecutive patients were operated on for acute type A aortic dissection. Operative mortality was 22.9%. A series of 243 survivors of surgical treatment were followed for up to 27 years. End points were death, cardiovascular reoperation and neurological events. Median follow-up was 4.5 years. Follow-up was 99.6% complete.

Results.
Cumulative survival of discharged patients was 96.4±1.3%, 67.7±4.7% and 39.4±12.0% at 1, 10 and 20 years respectively. During follow-up 47 patients died. Cause of death was cardiac failure in 7, haemorrhage due to rupture of the distal aorta in 7 and stroke in 4 patients. Multivariate analysis revealed advanced patients age and postoperative haemodialysis as peri-operative indicators of late death (p<0.05).

Freedom from cardiovascular reoperation was 90.7±2.0% at 1 year, 60.9±5.1% at 10 years and 41.9±15.0% at 20 years. A total of 58 patients required 86 cardiovascular reoperations; aortic root or ascending aorta replacement was performed in 20, distal ascending aorta and arch replacement in 13, descending aorta replacement in 6, thoracoabdominal aorta replacement in 7, abdominal aorta replacement in 7 and miscellaneous reoperations in 6 patients. Multivariate analysis revealed male gender and left coronary artery dissection as significant determinants for late cardiovascular reintervention (p<0.05). Cumulative incidence of stroke after 20 years was 3.8%.

Conclusions.
Acute type A dissection represents an emergency situation with acceptable long-term results for discharged survivors of surgical treatment.
Introduction

The long-term survival of patients after surgical repair for type A aortic dissection has improved since the early reports of Hirst [1] and Anagnostopoulos [2]. However, the early mortality rates remain still as high as 40% [3]. We have previously reported on our short-term results after surgery for acute type A aortic dissection [4]. The purpose of this retrospective study is to report our experiences in the surgical treatment of patients with acute type A dissection over a 27-year period, with special emphasis on long-term outcome and modalities of late death.

Material and methods

Between November 1974 and December 2001, 315 consecutive patients (205 men and 110 women) were operated on for acute type A aortic dissection at the St. Antonius Hospital, Nieuwegein, The Netherlands. The mean patient age was 58±12 years. If chest pain or other symptoms occurred less than 14 days before operation, the dissection was defined as acute [5]. The type of the aortic dissection was considered, according to the Stanford classification, to be type A if the ascending aorta was involved [6]. The diagnosis of type A aortic dissection was confirmed by either aortography especially in the early experience, transoesophageal echocardiography (64%, n=203), computed tomography (29.8%, n=94), magnetic resonance imaging, or operative exploration. The present study reports on our experience of a series of 243 patients, who survived surgical treatment for acute type A dissection and were discharged from the hospital, to establish the long-term outcome and modalities of late death after emergency operation for acute dissection. Ten patients in this series had Marfan’s syndrome. All patients were anticoagulated postoperatively with coumadin for 3 months and were then switched to antiplatelet therapy unless they were in atrial fibrillation or had undergone a Bentall procedure or separate aortic valve replacement.

Surgical technique

Throughout the years of the study, there was a substantial variability in cardiothoracic surgeons (15) and, due to changed insights, in surgical technique. The following reflects our general approach. The operation was performed using femoral artery cannulation, venous return through the right atrium, median
sternotomy approach, total cardiopulmonary bypass, and cardiac arrest with cold oxygenated crystalloid cardioplegia. A left ventricular drain was inserted through the right upper pulmonary vein. After administration of cardioplegia, the ascending aorta was opened and the aortic valve was inspected. Whenever possible, attempts were made to repair the aortic valve. The aortic arch was explored under circulatory arrest and if an intimal tear was present, parts of or the complete aortic arch were replaced. The brain was protected either by deep hypothermia or antegrade cerebral perfusion. The segment of aorta containing the intimal tear was usually resected and replaced with a Dacron prosthesis and, frequently, the aortic stumps were reinforced with Teflon strips. Gelatin-resorcinol-formalin (GRF) adhesive (Colle biologique, Fii, Saint Just Malmont, France) or fibrinous glue (Tissu-col, Immuno AG, Vienna, Austria) were not routinely used. In the later years, if the aorta was cross-clamped, the clamping region was always replaced.

Isolated ascending aorta replacement was performed in 132 patients (54.3%), hemiarch replacement in 45 (18.5%), total arch replacement in 12 (4.9%) and elephant trunk in one. Ten patients, in the earlier series, had primary repair of an intimal tear without graft replacement of the ascending aorta. The aortic valve was replaced in 16 patients (6.6%); a mechanical valve was implanted in 14 patients and a biological valve was used in the remaining two. In 104 patients (42.8%) it was possible to resuspend the aortic valve, in 9 patients aortic root remodeling was performed by reimplantation of the aortic valve in a tubular Dacron graft according to David [7] and in 2 patients according to the technique described by Yacoub. The native aortic valve remained untouched in the remaining 80 patients, while a Bentall procedure was performed in 31 patients. Concomitant coronary bypass grafting was necessary in 9 patients.

Deep hypotherm circulatory arrest (DHCA) was used in 96 patients (39.5%) to allow for an open distal anastomosis or for arch replacement. Antegrade selective cerebral perfusion (ASCP) was applied in 81 patients (33.3%) during circulatory arrest of the body [8, 9]. We have used retrograde cerebral perfusion (RCP) only once, while the remaining 65 patients (26.8%) have been operated upon with simple aortic cross-clamping without DHCA, ASCP or RCP.

Follow-up
From January to April 2002, we performed a cross-sectional follow-up of all
patients not known to be dead. Data were obtained by retrospective review of hospital records. Follow-up information was collected by written and telephone contacts with patients, relatives, or physicians. Follow-up was 99.6% complete. One patient remained untracked, due to emigration with unknown current address or relatives. Total cumulative follow-up extendend to 1292 patient-years with a median of 4.5 years.

Statistical Analysis
Statistical Analysis Software (version 8.2 for Windows, SAS Institute, Cary, NC) was used for all analyses. Univariate analysis of potential risk factors (see Appendix) was performed to identify statistically significant perioperative risk factors ($p<0.05$) for end-points as death, cardiovascular reoperation and neurological events. The univariate analysis was followed by logistic regression analysis (binary outcome) or Cox proportional hazard regression analysis (time related binary outcome) to determine independent perioperative risk factors. Kaplan-Meier life tables were constructed to estimate long-term survival rates for operative survivors. Groups were compared using log-rank tests. Continuous data are expressed as means ± SD.

Results

Survival
Overall operative mortality was 22.9%. 243 patients survived surgical treatment and were discharged from the hospital. Among the discharged patents, cumulative survival was 96.4±1.3%, 67.7±4.7% and 39.4±12.0% at 1, 10 and 20 years respectively (Figure 1). Median survival time was 16.0 years. During the follow-up period 47 patients died (19.3%). Seven patients died due to cardiac failure, 7 patients had fatal rupture of the distal aorta and 4 patients died due to a stroke (Table 1). Multivariate analysis of the operative survivors revealed advanced patients age at surgery and postoperative need for haemodialysis as predictors that were associated with late death (Table 2).
Figure 1. Survival of operative survivors

Table 1. Causes of late death

<table>
<thead>
<tr>
<th>Cause</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Respiratory insufficiency</td>
<td>4</td>
<td>1.6</td>
</tr>
<tr>
<td>Malignancy</td>
<td>2</td>
<td>0.8</td>
</tr>
<tr>
<td>Haemorrhage</td>
<td>7</td>
<td>2.9</td>
</tr>
<tr>
<td>Sepsis</td>
<td>3</td>
<td>1.2</td>
</tr>
<tr>
<td>Stroke</td>
<td>4</td>
<td>1.6</td>
</tr>
<tr>
<td>Cardiac failure</td>
<td>7</td>
<td>2.9</td>
</tr>
<tr>
<td>Unknown</td>
<td>20</td>
<td>8.2</td>
</tr>
<tr>
<td>Total</td>
<td>47</td>
<td>19.3</td>
</tr>
</tbody>
</table>
Late cardiovascular reoperation
During the follow-up period a total of 58 (23.9%) patients had to be reoperated. Some of the patients required multiple reoperations for a total of 86 reoperations. Four patients died at reoperation. The following reoperations were performed initially: aortic root and/or ascending aorta replacement in 20 patients, graft replacement of the transverse arch and ascending aorta in 13 patients and isolated descending aorta replacement in 6 patients. Graft replacement of the thoraco-abdominal aorta or the isolated abdominal aorta was necessary in respectively 7 and 7 patients. Miscellaneous reoperations were performed due to carotid disease in 1 patient, rupture and re-rupture of the ventricular septum in one same patient, sternal refixation in 1 patient and late tamponade in 2 patients. Freedom from cardiovascular reoperation was 90.7±2.0% at 1 year, 60.9±5.1% at 10 years and 41.9±15.0% at 20 years (Figure 2). Male gender and dissection of the left coronary artery seemed to be independent significant determinants for late cardiovascular reoperation (Table 3).

We also compared the risk of late aortic root reoperation for patients with a native aortic valve (196 patients) versus patients with an aortic valve replacement (16 isolated aortic valve prostheses and 31 Bentall procedures): there was no statistical significant difference (p=0.92) as shown in Figure 3.

Multivariate analysis of the patient cohort with an aortic valve replacement did not reveal significant variables for late aortic root reoperation. Multivariate analysis of
Figure 2. Freedom from late cardiovascular reintervention

Postoperative years

the cohort with a native aortic valve showed an aortic annulus >27 mm, dissection of the left coronary artery and the use of GRF adhesive for aortic root reconstruction as significant variables for late reintervention on the aortic root (Table 4).

Table 4. Multivariate determinants of late aortic root intervention

<table>
<thead>
<tr>
<th>Variable</th>
<th>p-value</th>
<th>Relative Risk</th>
<th>95% Confidence Limits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aortic annulus &gt;27 mm</td>
<td>0.002</td>
<td>6.0</td>
<td>2.0-18.2</td>
</tr>
<tr>
<td>Left coronary artery dissection</td>
<td>0.06</td>
<td>2.8</td>
<td>1.0-8.2</td>
</tr>
<tr>
<td>GRF-glue for aortic root</td>
<td>0.03</td>
<td>3.2</td>
<td>1.1-9.3</td>
</tr>
</tbody>
</table>
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Figure 3. Freedom from aortic root reintervention

Late neurologic events
Among the survivors 7 patients had late neurological deficits, which were permanent in all of them. The cumulative incidence of stroke after 20 years was 3.8%. Too few patients were available for proper multivariate analysis, therefore we also analysed the total group of patients with late neurologic events, consisting of the 7 patients with a stroke and 6 patients with a transient ischaemic attack (Figure 4). Only emergency sternotomy appeared to be a significant perioperative determinant for late neurologic event, p=0.03, RR 4.2, CL 1.14-15.1. Two patients with a stroke had undergone a Bentall procedure, all the remaining patients with a stroke or transient ischaemic attack had their native aortic valve and were not on coumadins.
Comment

We have reviewed the late results for 243 discharged patients who survived surgical treatment for acute type A dissection. The results indicate that the variables, found to influence the long-term results, were all associated with preoperative patient related factors and with a certain seriousness and extent of the disease which for the most part cannot be readily modified. This is similar to previous reports where late results were shown to depend upon both technical features of the operation and the basic condition of the patients [10, 16].

Previous reports on long-term survival after treatment for acute type A dissection have included follow-up data up to 20 years. According to these prior reports 10-years survival rates are 30-60% [11,12,13,14,15,16,17,18,20]. Although the
patient characteristics are not completely comparable, our long-term results seem comparable and acceptable. Operative techniques did not improve the long-term survival significantly. Other surgeons have advocated that only resection of the dissected ascending aorta is justified, because the principal goal of the operation is the survival of the patient. Their argument is that the risks of a more extensive operation, done by surgeons with inadequate experience with aortic dissection, with replacement of the arch outweighs the long-term benefit [18]. In our series, more extensive operations with arch replacements did not affect the late results, although all of our surgeons, some of them less trained in aortic surgery, contributed to all operations. On the other hand we agree with other authors, because a more advanced patients age at surgery is significantly influencing the late survival rate, that the potential benefit of extensive surgery on late survival has to be related to the limited life expectancy of patients at an advanced age [19]. However, we believe that surgery for acute type A dissection should not be denied on the sole consideration of advanced age.

In all patients, if the intimal tear is located in the ascending aorta, the ascending aorta should be totally replaced, and the aortic valve preserved whenever possible. When the intimal tear is located in, or extends into, the aortic arch, this segment should be partially or totally replaced [16]. Failure to resect the intimal tear and replace the transverse arch in those cases might predispose to late reoperation. However, in accordance with the results of other authors [10], also in our series male gender and coronary artery disease were determinants of late aortic reoperation, and the treatment method did not significantly influence the rate of late aortic reoperation. Thirtythree patients required late graft replacement of the remaining native distal aorta in order to exclude their postdissection aneurysm with patent false lumen. For this reason all survivors of type A should be treated with beta-adrenergic blocking agent, and require continued surveillance with annual CT or MR scans of the aorta [13, 15].

We showed that the long-term results regarding aortic root reoperation, between patients with a native aortic valve and patients with an aortic valve replacement were not significantly different (p=0.92). This is comparable with previously published results focusing on our relatively durable results of aortic valve preservation and root reconstruction in patients who underwent surgery for acute type A aortic dissection with involvement of the aortic root [20]. In the mentioned study, the use of fibrin glue (RR 8.7, p=0.03) and an aortic annulus >27 mm (RR 4.2, p=0.04) were identified as significant risk factors for aortic root
reoperation. Additionally in the same study, the use of GRF also seemed to compromise the long-term durability which is in accordance with the results of other authors who claimed that gluing dissected aortic wall tissue carries a high risk of redissection [21]. Therefore we might agree with Sabik et al [17] that aggressive routine complete aortic root replacement is not always justified.

Other authors have reported that patients receiving a mechanical prosthesis, and therefore indefinite anticoagulation, are threatened by potential catastrophe as a neurologic event [5]. However this has not been confirmed in our series; two patients with a Bentall procedure had late neurological deficits. Nevertheless we emphasize the desirability of preserving the native valve whenever possible.

Also in our series, there was no influence of year of operation on the late results although, of course, we still need to consider the retrospective, non-randomized nature of this study and its results of different surgeons using a variety of available techniques. Nevertheless we agree with Ehrlich and colleagues [18] that any other further reduction of mortality rate in patients with a predilection for dissection might come from earlier recognition of risk factors such as hypertension and aortic dilatation, followed by elective operation with its much lower mortality and morbidity. The multiple changes in operative techniques, methods of perfusion and cerebral protection have not substantially changed our long-term results.

Although acute type A aortic dissection is still considered to represent an emergency situation that requires immediate surgical treatment, it seems that for discharged survivors of surgical treatment the long-term results are good. The late survival rates may be enhanced in the future by closer surveillance of the aorta and earlier reintervention before the development of dissection-related complications.

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References


Appendix

Examined preoperative and perioperative patient related variables

Demographic characteristics. Gender, age.

Comorbidities. Diabetes mellitus, preoperative anticoagulantia.

Predisposing factors for dissection. Cardiac catheterization, previous cardiac surgery, Marfan syndrome.

Preoperative status. Acute pain at presentation, time onset to treatment, any neurologic dysfunction, peripheral neurologic deficit, central neurologic deficit, limb malperfusion, oliguria or anuria, cardiac tamponade, cardiogenic shock at presentation, cardiogenic shock at start surgery, cardiopulmonary resuscitation, preoperative pericardial drainage, preoperative serum creatinine, left ventricular function.

Aortic pathology. Aortic valve regurgitation, ruptured ascending aorta, location of entry tear, dissection of left coronary artery, dissection of right coronary artery, macroscopic normal aortic valve, calcified aortic valve, aortic annulus >27mm.

Procedure. Emergency sternotomy, date of operation, EEG at induction, hemopericardium, change of arterial cannulation site, deep hypothermic circulatory arrest, antegrade selective cerebral perfusion, diameter proximal aortic prosthesis, aortic valve resuspension, teflon felt, GRF glue, Blalock for distal anastomosis, fibrin glue, additional surgical procedure, aortic cross-clamping, antegrade re-perfusion distal prosthesis, Bentall procedure, ascending aorta replacement, aortic arch replacement, aortic valve replacement, end-to-end reanastomosis, extracorporeal circulation time, myocardial ischemia time, deep hypothermic circulatory arrest time, brain ischemia time, antegrade selective cerebral perfusion time, body ischemia time, blood temperature, rectal temperature, nasopharyngeal temperature.