Chronic dissection of the ascending aorta: surgical results during a 20-year period (previous surgery excluded)

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Abstract

Objective: We study here the surgical results of chronic dissection involving the ascending aorta over the last 20 years. Patients with previous cardiac surgery, or proximal aortic repair, were excluded. The patients survived an acute dissection, undiagnosed as pauci- or asymptomatic. The aorta was normal or pathological (atheromatous aneurysm in 15 cases, Marfan’s disease in 12 cases, and annuloectasic disease in 18 cases). Two patients had a bicuspid aortic valve. Methods: Between January 1981 and December 2001, 77 patients (mean age 48 ± 15) underwent surgery for chronic dissection of the ascending aorta; 60 patients had severe aortic regurgitation, 12 had Marfan syndrome, and 18 had annuloaortic ectasia. Only the ascending aorta was dissected in 37 patients, the ascending aorta and arch in 26, and the whole aorta in 14. Coronary artery disease occurred in five patients. Statistical analysis was performed using SAS software. Different surgical procedures were used. The aortic arch was repaired in 40 cases; selective antegrade cerebral perfusion and partial circulatory arrest were used. Total aortic replacement was performed on four patients. Results: In-hospital mortality was 10%. The only risk factor was the extent of the dissection. The rate of neurologic stroke was 2.5%. Late survival rate was 42 ± 7.5% at 12 years for all the patients; it was 71 ± 10% when only the ascending aorta was dissected, 44 ± 11% when the ascending aorta and arch were dissected, and 33 ± 15% when the whole aorta was dissected (p = 0.0329). The extent of the dissection was the only risk factor for late mortality. Reoperation was required for one proximal and five distal problems. Conclusion: In chronic aortic dissection, in-hospital and late mortality were related to the extent of the dissection; in-hospital mortality remained unchanged during the operative period.

Keywords: Aortic dissection; Aortic surgery

1. Introduction

In this paper, we analyze retrospectively the surgical results of chronic dissection involving the ascending aorta over the last 20 years. Patients with a history of previous cardiac surgery or proximal aortic repair have been excluded; their clinical presentation and management are different and they carry a higher operative risk [1].

The patients in the study group survived an acute dissection; this dissection was in all the cases undiagnosed as pauci- or asymptomatic. The aorta was normal or pathological (atheromatous aneurysm, Marfan’s disease, annuloectasic disease). Two patients had a bicuspid aortic valve. The patients consulted later, most commonly, for a symptomatic aortic insufficiency.

2. Patients and methods

2.1. Patient population

Between January 1981 and December 2001, 77 patients (mean age 48 ± 15) underwent surgery in our team for chronic dissection of the ascending aorta. There were 48 men and 29 women. Eight patients were 70 years and older. Twelve patients had Marfan’s disease and 25 hypertension. Sixty patients had severe aortic regurgitation, 15 none or mild, 2 aortic stenosis; 49 were in class I or II of the NYHA and 28 in class III or IV. Two patients had a transient neurological deficit. Fifteen patients were followed for aortic aneurysm.

Diagnostic evaluation was made with one or more imaging methods: transthoracic echocardiography and aortography in the first 10 years, and more recently transesophageal echocardiography and spiral computed tomography. Only the ascending aorta was dissected in 37 patients (18 had...
annuloectasia, 15 atherosclerotic aneurysms); the diagnosis of aortic dissection was not made preoperatively in 20 cases. The ascending aorta and the arch were dissected in 26 cases and the whole aorta in 14 cases; the diagnosis of aortic dissection was always made in these 40 cases.

Ejection fraction was known in 64 patients: <40% in 2, between 40 and 50% in 17, and >50% in 45 patients.

Coronary arteriography was performed in 29 cases because of age or angina; significant coronary stenoses occurred in five patients.

Indications for operation were the severity of aortic regurgitation (N = 60 cases), the progressive dilatation of the aorta, or an ascending aorta exceeding 6 cm (N = 15 cases). Mean size of the ascending aorta was 8 ± 0.8 cm. Operation was performed electively on 74 patients. Three patients presented emergently with pulmonary edema.

2.2. Surgical management

- When only the ascending aorta was dissected, femoral or axillary arterial cannulations were used. Myocardial protection was provided by systemic hypothermia at 25—27 °C with antegrade administration of cardioplegia solution, and more recently by cold retrograde blood perfusion.

  When the aortic sinuses and the valve were not involved, a tubular graft replacement was performed. When the aortic valve was stenotic or incompetent, and the sinuses were normal, valve resuspension or separate valve replacement and tubular graft replacement were performed. When the sinuses were dilated or diseased, composite valve graft with reimplantation of the coronary ostia was performed.

- When the aortic arch was dilated, or when the intimal tear was localized in the arch, it was replaced. Multiple arterial cannulations were necessary, partial circulatory arrest with antegrade perfusion of the supra aortic vessels was used [2,3]. The femoral arterial line was connected to the cerebral line by the use of a Y-shaped connector. Cannulas were inserted into the innominate and the left common carotid arteries (or into both the carotid arteries) and linked to the cerebral line. Ascending aortic replacement was performed under hypothermia at 25 as usual. At the end of the procedure, supra aortic vessels were clamped; selective perfusion of the carotid arteries was started, while the femoral arterial line was clamped. The aortic arch was then repaired. The mean duration of the circulatory arrest was 20 ± 2 min.

- When the whole aorta was excessively dilated, a total replacement was performed in a single operation. The approach was a median sternotomy extended by a midline abdominal incision.

  One patient had the implantation of an elephant trunk. Surgical procedures are listed in Table 1. Concomitant coronary artery bypass grafts were performed in five cases. Fifty-seven patients underwent mechanical aortic valve replacement (two had a bicuspid aortic valve).

  No patient underwent valve preserving aortic root reconstruction.

The mean durations of aortic clamping and total cardiopulmonary bypass (CPB) were 77.2 min (13–142 min) and 123 min (75–300 min), respectively.

2.3. Statistical methods

Statistical analysis was performed using SAS software. The checklist of the variables is shown in Appendix A. Univariate (logistic regression model) and multivariate analyses were used to identify predictors of in-hospital mortality. Kaplan–Meier survival curves were used for analysis of long-term survival, and compared with the log-rank test. The Cox proportional hazard model was used for the late mortality analysis.

3. Results

In-hospital mortality was 10.4% (N = 8). In-hospital mortality remained unchained during the operative period: 12.9% from 1981 to 1991; 8.7% from 1991 to 2001, p = 0.7. The causes of death were hemodynamic failure (two cases), stroke (one case), sepsis (one case), and multiple causes in four cases. Univariate analysis (logistic regression model) is shown in Table 2. Only the extent of the dissection was an operative risk factor. Some variables—ejection fraction, duration of CPB, duration of aortic clamping—could not be tested by the logistic regression model, because of the size of the groups; all patients (N = 2) with an ejection fraction ≤ 40% died during operation, and there was no operative death among patients.
with duration of CPB $\leq 90$ min ($N = 14$) or with duration of aortic clamping $\leq 60$ min ($N = 23$).

There were three severe neurological complications: one stroke resulting in death, one paraplegia (it was the case of the patient with the elephant trunk), and one transient neurological deficit. Six patients had hemorrhagic complications and needed re-exploration for bleeding.

Current follow-up was obtained by written communication with the patient and the referent cardiologist; it was completed in June 2005. Six patients were lost. During the follow-up, there were 27 late deaths; six patients were 80 years or older at the time of death. Death could be attributed to cardiovascular disease in five cases (one young patient with a prosthetic aortic valve died of stroke, four died of cardiac insufficiency), to aortic pathology in nine cases (reoperation in one case; rupture in eight cases), to other causes in two, and remained unknown in 11 cases. Among the nine deaths due to aortic pathology, six patients had a residual aortic dissection and we observed a rupture in eight patients: four patients were not followed up, two were waiting for reoperation, and two were excluded because of the operative risk. The Cox model uni- and multivariate analyses for late mortality are shown in Tables 3 and 4; the extent of the dissection was the strongest predictor of late death.

Actuarial survival rate (in-hospital mortality included) was $42 \pm 7.5\%$ at 12 years for all the patients (Fig. 1). At 8 years it was $71 \pm 10\%$ when only the ascending aorta was dissected, $44 \pm 11\%$ when the ascending aorta and arch were dissected, and $33 \pm 15\%$ when the whole aorta was dissected ($p = 0.0329$; Fig. 2). Six patients have been reoperated, five for distal aneurysm, and one

Table 3
Univariate predictors of late mortality (Cox analysis)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Hazard ratio</th>
<th>95% CI</th>
<th>$p$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age $\geq 70$</td>
<td>2.1</td>
<td>0.7–6.1</td>
<td>0.1716</td>
</tr>
<tr>
<td>Gender (F)</td>
<td>1.0</td>
<td>0.5–2.1</td>
<td>0.9590</td>
</tr>
<tr>
<td>NYHA (III, IV)</td>
<td>0.9</td>
<td>0.4–1.9</td>
<td>0.8576</td>
</tr>
<tr>
<td>Duration of CPB $&gt; 90$ min</td>
<td>1.1</td>
<td>0.4–3.2</td>
<td>0.8489</td>
</tr>
<tr>
<td>Duration of aortic clamping $&gt; 60$ min</td>
<td>1.4</td>
<td>0.6–3.3</td>
<td>0.4152</td>
</tr>
<tr>
<td>Coronary artery disease</td>
<td>0.8</td>
<td>0.2–3.5</td>
<td>0.7889</td>
</tr>
<tr>
<td>Marfan</td>
<td>1.0</td>
<td>0.4–2.6</td>
<td>0.999</td>
</tr>
<tr>
<td>Extent of the dissection</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 segments</td>
<td>1.9</td>
<td>0.8–4.4</td>
<td>0.1151</td>
</tr>
<tr>
<td>$\geq 3$ segments</td>
<td>3.1</td>
<td>1.3–7.5</td>
<td>0.0126</td>
</tr>
<tr>
<td>Surgical procedure</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arch</td>
<td>1.4</td>
<td>0.7–2.8</td>
<td>0.3558</td>
</tr>
<tr>
<td>Total replacement</td>
<td>0.7</td>
<td>0.1–5.8</td>
<td>0.7771</td>
</tr>
</tbody>
</table>

Table 4
Multivariate predictors of late mortality (Cox analysis)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Hazard ratio</th>
<th>95% CI</th>
<th>$p$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age $\geq 70$</td>
<td>2.2</td>
<td>0.7–6.5</td>
<td>0.1507</td>
</tr>
<tr>
<td>Extent of the dissection</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arch</td>
<td>1.9</td>
<td>0.8–4.3</td>
<td>0.1360</td>
</tr>
<tr>
<td>$\geq 3$ segments</td>
<td>3.2</td>
<td>1.3–7.7</td>
<td>0.0105</td>
</tr>
</tbody>
</table>

Fig. 1. Late survival rate ($N = 77$), operative mortality included.

Fig. 2. Late survival rate according to the extent of the dissection.

4. Discussion

Chronic dissection of the ascending aorta is a relative infrequent disease. Fann et al. [4] and Svensson et al. [5], respectively, report 106 and 219 surgical cases of chronic dissection of the ascending aorta over a period of 30 years, but they include patients with previous cardiac surgery.

In our data we focused on patients without previous cardiac surgery, or proximal aortic repair; the incidence is somewhat lower because 80% of patients with untreated acute proximal aortic dissection die during the first two weeks [6,7]. Acute aortic dissection was not recognized in our
patients; aortic insufficiency was detected later, it was severe in 78% of the cases, as in other series [8]. Sixty-one percent of the patients had pre-existent aneurysms of the ascending aorta as confirmed at operation; 15.5% had Marfan’s disease, 23.3% annuloaortic ectasia, and 19.4% atherosclerotic aneurysm; but the majority of the patients were ill followed, or misdiagnosed, this may explain the large size of the ascending aorta in this series (mean diameter 8.0 cm). The diagnosis of localized dissection on the ascending aorta was not always made preoperatively.

Conservation of the aortic valve was seldom possible, although it was reported to be feasible in 48% of the cases by Pég-S-Fernandes et al. [8] and in 21% of the cases by Murashita et al. [9]. We think, as others [5], that the use of a composite valve graft avoids recurrent proximal problems, especially in patients with Marfan or annuloaortic ectasia and that the long-term results are good [3,5,10]. There was one serious complication related to aortic prosthesis in our series. We do not have the experience in this disease of valve preserving aortic root reconstruction as others [11,12].

When the arch must be repaired, we prefer whole body hypothermia at 25°C with selective cerebral perfusion and circulatory arrest for the rest of the body [2,13–15]. The incidence of permanent stroke was 2.5% in this series, same as the incidence of transient neurological deficit. It is comparable to the rate reported (1.1% of cerebrovascular accidents) by Estrera et al. [16] with retrograde cerebral perfusion.

When the whole aorta is very enlarged and life threatening, a total replacement of the aorta is discussed; in this series, in a single operation it was performed in four cases. We have reported these techniques before [17], and have not used the technique described by Kouchoukos et al. [18] because the abdominal aorta was enlarged. We did not have enough experience with the two-stage repair, using the elephant trunk technique [16,19]; perhaps the case of paraplegia at the beginning of our experience made us more reluctant to use it.

In-hospital mortality was 10.8%; similar operative rates were reported by others: 8.2% by Svensson et al. [5], 9% by Pég-S-Fernandes et al. [8], 17.4% by Fann et al. [4], and 14% by Sabik et al. [20], but these reports included patients with previous surgery. It remained stable throughout the entire 20-year period, as reported by others [5]. The only operative risk factor found in this series was the extent of the dissection. The number of replaced segments at surgery did not play a role either in the replacement of the arch or in the total replacement of the aorta, but there were only four cases [4]. Long-term survival rate was relatively low: 42 ± 7.5% at 12 years for all the patients; it was reported to be 45% at 10 years, and 27% at 15 years in Fann et al.’s data [5]. We found that it was related to the extent of the dissection; when the dissection involves only the ascending aorta, the late survival rate was 71 ± 10% at 12 years (p = 0.0329). Svensson et al. [5] had also shown that residual aneurysmal disease was the predictor of late death, likely related to complications (reopereation, rupture). During the follow-up, six patients had been reoperated (one operative death) for aortic pathology in our series; eight patients died of aortic rupture, but the cause of death could not be defined in 40% of the patients.

5. Conclusion

Patients with chronic aortic dissection of the ascending aorta have still high in-hospital mortality rate and poor long-term survival; both events are related to the extent of the dissection. One may hope that better recognition and management of aneurysmal disease and of acute dissection could prevent dissection and its progression in some cases.

References


Appendix A

Variables entered into statistical analysis: age, gender, NYHA dyspnea functional class, Marfan's disease, hypertension, ejection fraction, coronary disease, extent of the dissection (ascending aorta only, ascending aorta and arch, and whole aorta), operative technique (replacement of the ascending aorta only, reconstruction of the arch, and replacement of the whole aorta) duration of aortic clamping, duration of cardiopulmonary bypass (CPB), time window (1981—1991 to 1991—2001).