Original Article

Preoperative Cardiopulmonary Resuscitation is the Only Predictor for Operative Mortality of Type A Acute Aortic Dissection: A Recent 8-year Experience

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Objective: Several reports have been published on the surgical outcome for type A acute aortic dissection (AAD) with follow-up extending 10-20 years. However, many factors have markedly changed during this long time interval, influencing the outcome. The aim of this study was to review our recent 8-year experiences and to analyze the impact of complicating factors on outcome.

Methods: Emergency surgical intervention was carried out in 80 patients in the recent eight years. Average age was 64.2 years, ranging from 19 to 90. We used similar techniques for all patients as follows: deep hypothermic circulatory arrest and antegrade selective cerebral perfusion were employed for cerebral protection. The aortic stump was fixed by gelatin resorcin formalin glue and securing Teflon felt strips. Ascending aorta or hemiarch replacement for primary tear excision was employed as much as possible. We evaluated actuarial survival and re-operation free rates. Independent predictors for operative mortality were also examined.

Results: Overall hospital mortality was 6.3% (five patients). Late death was indicated in 10 patients. Actuarial survival rates at 1, 5, 8 years were 85.5%, 75.9%, and 59.2%, respectively. Five patients required re-operation during follow-up. Re-operation free rate at 1 and 8 years were 98.2% and 85.6%, respectively. Multivariate analysis showed that preoperative cardiopulmonary resuscitation (CPR) was the only significant predictor for operative mortality (p=0.001, odds ratio: 2.7).

Conclusion: Recent 8-year results of emergency surgical intervention for AAD showed satisfactory early and late mortality. However, it is still very hard to rescue patients requiring preoperative CPR. (Ann Thorac Cardiovasc Surg 2004; 10: 101–5)

Key words: aortic dissection, aorta, aortic surgery

Introduction

The mortality of emergency surgical intervention for acute aortic dissection (AAD) has been variously reported as 15-30%. These findings are often derived from series spanning 10-20 years.[1-5] Recent advances in surgical techniques, anesthesia, and perioperative medical management are likely to have lowered the mortality of emergency operation over the last few years. On the other hand, the complexity of patients undergoing this procedure, in terms of age, co-morbidities and concomitant procedures, is ever increasing and may negate the impact of the beneficial advances. The aim of this study was to review our experience in emergency surgical intervention for AAD over the recent eight years, and to analyze the impact of complicating factors on outcome.

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Patients and Methods

Between July 1995 and February 2003, 114 patients with AAD were hospitalized at our institution. Elective sur-

Table 1. Patient profile

July 1995 to February 2003	
Total No. of emergency intervention for AAD	80
Average age	64.2±14.6 (19-90)
Male/female	41/39
Marfan's syndrome	7 (8.8%)
Thrombosed occlusion type	16 (20%)
Myocardial ischemia	4 (5.0%)
Hemopericardium	43 (53.8%)
Moderate aortic regurgitation	7 (8.8%)
TIA	19 (23.8%)
Coma	7 (8.8%)
Cardiac tamponade	21 (26.3%)
Cardiopulmonary resuscitation	5 (6.3%)
Liver chrosis	1 (1.3%)
Renal failure	1 (1.3%)

AAD, type A acute aortic dissection; TIA, transient ischemic attack.

gery was carried out in 17 patients (10 with thrombosed occlusion type and seven with delayed diagnosis). Another 17 patients were non-operatively managed because of thrombosed occlusion.

Emergency surgical intervention was carried out in 80 patients (70.2%). Forty-one patients (51.3%) were male, and the average age was 64.2±14.6 years, ranging from 19 to 90. Seven patients had Marfan's syndrome. All patients had a history of hypertension. Patients' profiles are summarized in Table 1. Contrast computed tomography (CT) was performed on all patients as soon as they were brought to the hospital. No patient had preoperative angiography. Transthoracic echocardiography was then applied to assess aortic valve regurgitation (AR) and cardiac function. The patients were then transferred to the operative theater as soon as they were determined to have AAD. All patients had emergency surgery within 6 hours after arrival at the hospital. Femoral arterial cannulation for cardiopulmonary bypass (CPB) was employed in all patients. A two-stage venous drawing cannula was inserted into the right atrium, except for patients complicated by preoperative shock (less than 60 mmHg of systolic blood pressure), requiring cardiopulmonary resuscitation (CPR). If a patient had evidence of shock due to cardiac tamponade, femoro-femoral circulatory assistance was initiated before the chest was opened. We used similar techniques for all patients as follows: deep hypothermic circulatory arrest (DHA) and antegrade selective cerebral perfusion (SCP) were employed for cerebral protection. Each patient was cooled to approximately 20°C rectal temperature. The ascending aorta and/or aortic arch were then opened longitudinally under DHA. The ascending aorta containing the intimal tear was resected, and SCP was established by introducing balloon cannulas to three arch vessels. We used gelatin resorcin formalin (GRF, Pharmacie Central du CHU, Besancon, France) glue, applied between two cylinders to the false lumen of both the distal and proximal sides of aorta, and clamped to fix the aortic wall circumferentially about 5 minutes by forceps. Furthermore, the aortic walls were reinforced by securing Teflon felt strips to both the inside and outside of the aorta. Antegrade systemic circulation was established with the side branch of a Dacron prosthesis after completion of open distal anastomosis. Fibrin glue was applied to anastomosed stitches from the outside of the aorta. Ascending aorta or hemiarch replacement for primary tear excision was employed (86.3%) as much as possible. We evaluated actuarial survival and re-operation free rates. Independent predictors for operative mortality were also examined.

The mean duration of follow-up was 33.2 months, ranging from 1 to 89 months. Data were collected retrospectively from operative records, hospital charts, and clinical follow-up notes. Follow-up information was obtained on all patients. Patients or their referring local doctors were contacted by telephone or mail. Independent predictors for hospital mortality were also examined using the univariate analysis with a chi-square test and the multivariate analysis with logistic regression model from 20 parameters, including age (>75), sex, Marfan's syndrome, thrombosed occlusion type, preoperative myocardial ischemia, hemopericardium, cardiac tamponade, moderate AR, transient ischemic attack (TIA), coma, CPR, concomitant aortic root replacement, extended total arch replacement, postoperative renal failure, re-exploration, temporally neurological dysfunction (TND), stroke, pneumonia, and tracheostomy. Actuarial survival rate was also calculated with the Kaplan-Meier method. Statistical significance was defined as a P value of less than 0.05.

Results

Ascending aorta or hemiarch replacement for primary tear excision was employed (86.3%). Extended arch replacement was required in 12 patients (15%), including six Marfan's patients, because the intimal tear was located in the aortic arch. Aortic root replacement was required in seven patients (8.8%), including five Marfan's patients. CPB duration, SCP time, and cardiac arrest time were 211.9±58.0 min, 72.6±35.9 min, and 125.4±42.2

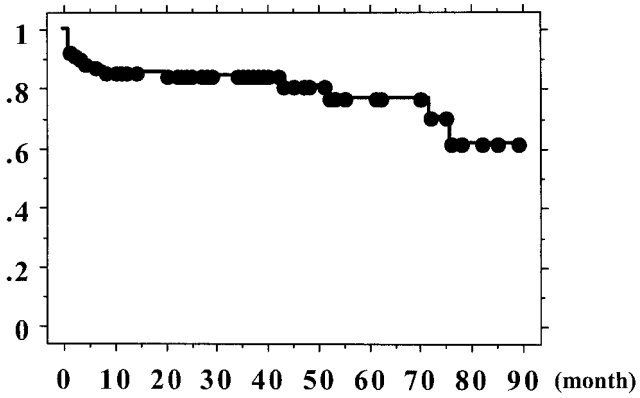

Fig. 1. Actuarial survival curve.
Actuarial survival rates at 1, 5, 8 years were 85.5%, 75.9%, and 59.2%, respectively.

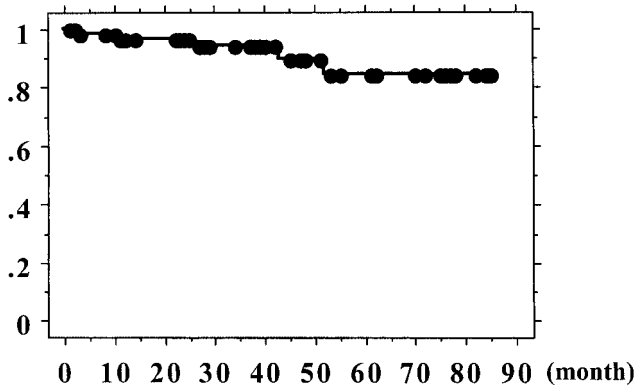

Fig. 2. Re-operation free rate.
Re-operation free rates at 1 and 8 years were 98.2% and 85.6%, respectively.

min, respectively. The incidence of postoperative re-exploration for bleeding was 10% (eight patients). Neurological morbidity, such as TND, stroke, and paraplegia were 13.8% (11 patients), 6.3% (five patients), and 1.3% (one patient), respectively. Pneumonia or acute renal failure were complicated in seven patients (8.8%), and 11 patients (13.8%), respectively. Tracheostomy was required in two patients (2.5%) due to respiratory failure. The postoperative hospital stay was 33.4±19.7 days. Overall hospital mortality was 6.3% (five patients). Late deaths were indicated in 10 patients. Two of these patients died of bleeding at the time of reoperation for AR and unstable angina, and thoracoabdominal aneurysm, respectively. Two patients died of spinal tumor and late mediastinitis, respectively. Another two patients died of pneumonia. Otherwise, one case each of cancer of gallbladder, rupture of abdominal aneurysm, stroke, and sudden death were indicated other patients. Five patients returned to the hospital to receive re-operation due to distal false lumen dilation, development of AR and angina, or re-dissection at the aortic root (thoracoabdominal aortic replacement in one Marfan's patient, distal arch replacement in two, aortic valve replacement and coronary bypass in one, and aortic root replacement in one). Actuarial survival rates at 1, 5, 8 years were 85.5%, 75.9%, and 59.2%, respectively (Fig. 1). Re-operation free rates at 1 and 8 years were 98.2% and 85.6%, respectively (Fig. 2). Univariate analysis detected preoperative coma (P=0.048) and CPR (P=0.0001) as independent predictors for operative mortality. Multivariate analysis showed that preoperative shock requiring CPR was the only significant predictor for operative mortality (p=0.001, odds ratio: 2.7) (Table 2).

Discussion

Currently available surgical techniques yield good immediate and long-term results with minimal risk in operations for AAD. Ehrlich and colleagues reported hospital mortality and long-term survival rates were 15.3% and 54% at 10 years, respectively from 15 years experience.[1] Bachet and colleagues reported that actuarial survival rates including hospital deaths were 71.5%, 66%,

Table 2. Risk analysis

Univariate: chi-square test	
Age>75	NS
Female sex	NS
Marfan's syndrome	NS
Thrombosed occlusion	NS
Myocardial ischemia	NS
Hemopericardium	NS
Cardiac tamponade	NS
Moderate aortic regurgitation	NS
Transient ischemic attack (TIA)	NS
Coma	P=0.048
Cardiopulmonary resuscitation (CPR)	P=0.0001
Aortic root replacement	NS
Total arch replacement	NS
Postoperative renal failure	NS
Hemodialysis	NS
Re-exploration	NS
Temporary neurological dysfunction (TND)	NS
Stroke	NS
Pneumonea	NS
Tracheostomy	NS
Multivariate: logistic regression analysis	
Preoperative CPR	P=0.001, odds ratio 2.7

NS: not significant.

56.4%, and 46.3% at 1, 5, 10, and 15 years, respectively from 22 years experience.[2] Bernard and colleagues also documented that actuarial survival rates were 52%, 46%, and 37% at 1, 5, and 10 years, respectively, from 13 years experiences.[5] Like above, those findings are often derived from series spanning 10-20 years. In fact, many factors, such as surgical techniques, use of sealed prosthesis, access of CPB, cerebral protection techniques, and postoperative surveillance have markedly changed during this long-time interval, influencing the recently-improved surgical outcomes.[4-8] For example, open distal anastomosis to avoid aortic cross clamping and antegrade systemic recirculation after distal anastomosis have dramatically improved the early and late outcomes of surgery for AAD.[4,9] The aid of biologic glue enabled us to preserve the native aortic valve whenever possible and to avoid prosthesis-related and anticoagulation-related complications.[10,11] Even though cerebral metabolism was diminished by DHA, the risk of death would increase when the DHA time exceeded 60 minutes.[12] SCP has led us to perform the most appropriate cerebral protection to release fear of exceeding the "safe" period of circulatory arrest.[13] Furthermore, postoperative examination with magnetic resonance imaging can be done to determine the patency and dilatation in the false lumen in a later phase.[14] During the last eight years, we used such recently-available techniques that were relatively similarly among the patients.

In this series, the overall hospital mortality was 6.3% (5/80). This seems to be much better than those in the previous reports demonstrating a hospital mortality of 15 to 25%.[1-5] Westaby and colleagues also presented excellent surgical results, showing an overall hospital mortality of just 6.3% for AAD.[15] Their operative procedure was almost the same as ours, except for retrograde cerebral perfusion for cerebral protection during DHA. The first priority of our emergency surgical intervention for AAD is primary tear excision and avoidance of serious complications, such as cardiac tamponade, severe AR, and coronary impairment. Therefore, the majority (86.3%) of this series had only replacement of the ascending aorta or hemiarch. When the intimal tear is located in the aortic arch, total arch replacement should be carried out for entry closure. Westaby and colleagues also had the policy of primary tear excision; namely, "conservative pathology oriented approach" for such a high-risk condition.[15] Several investigators advocate systematic extended or total aortic arch resection for the initial surgical management of AAD, irrespective of the location of the intimal tear.[16,17] Although those provide satisfactory results, we have to always keep in mind that AAD is an inherently lethal condition. Such an extended approach will necessarily increase an already-high operative risk. Ehrlich and colleagues report that the site of the intimal tear does not influence the outcome, but the mortality rate is higher with more extensive resection.[1] In fact, Kazui and colleagues reported that the early mortality rate of emergency total arch replacement was 16%, and the freedom from reoperation was 77% at 5 years.[16] Even though the emergency intervention for primary tear excision was performed, our results showed that the freedom from reoperation was 85.6% at 8 years. Bachet and colleagues also showed that closure of the intimal tear entry site at initial emergency operation reduced the rate of reoperation.[18] We believe that extended surgery largely outweighs the relatively low incidence of reoperation and the associated operative risk.

Recent data from the International Registry examining AAD showed preoperative hypotension, shock, and cardiac tamponade to be independent predictors of operative mortality.[19] However, many investigators have described that cardiac tamponade and hemodynamic shock could be defined as a permanent deterioration in a systolic blood pressure to below 90 mmHg.[20,21] We think that preoperative hypotension with systolic blood pressure of less than 90 mmHg is quite common for AAD patients. In AAD, tamponade is present in most cases.[22] It does not always mean aortic rupture, but always threatens the patient's life and may be fatal, if not relieved. In the present study, patients with cardiac tamponade had a systolic blood pressure of less than 60 mmHg, and they were almost always brought to the operative theater within 24 hours after onset. We believe that such patients can be rescued by immediate surgical intervention, even though their preoperative systolic blood pressure is less than 60 mmHg. However, if CPR is required for shock with lack of arterial pulse and respiratory distress, malperfusion in the vital organs might have already developed during the resuscitation. Bayegan and colleagues reported that preoperative severe cardiac tamponade without palpable pulses were associated with preoperative death.[21] This might mean that most of patients requiring CPR could not reach even the operative theater in the previous AAD studies in the world.

Conclusion

Recent 8-year results of emergency surgical intervention

for AAD showed satisfactory early and late mortality levels. However, it is still very hard to rescue patients complicated by preoperative severe shock requiring CPR.

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