

Surgical Results in Acute Type A Aortic Dissection

Motomi Shiono, Mitsumasa Hata, Akira Sezai, Nanao Negishi, and Yukiyasu Sezai

Currently international registry data present the patient mortality with acute type A aortic dissection managed non-surgically to be 58%, and managed surgically to be 26%. Many articles consistently report the hospital mortality exceeding 20% in western countries. Many factors, such as cardiac tamponade and dissection-related organ malperfusion, contribute to hospital mortality and morbidity. In Japan, the number of patients enrolled in the annual reports has been increasing and the surgical results have been improving year by year. In-hospital mortality has decreased to less than 20% since 1999.

Since the beginning of our aortic program, a total of 98 patients underwent emergency operations, and the operative mortality and in-hospital mortality were 5.1% and 6.1%, respectively. In a recent series since 2001, the operative and in-hospital mortalities were remarkably low; 2.8% and 3.2% respectively. We were able to benefit greatly by various innovative technologies which include open distal anastomosis using hypothermic circulatory arrest with antegrade cerebral perfusion, gelatin-resorcin-formaldehyde (GRF) glue, branched presealed Dacron graft, and antegrade arterial perfusion. Our tear-oriented surgery could be justified in many patients in order to improve the surgical results. In patients with preoperative organ malperfusion, it is still challenging to improve the mortality and morbidity. (*Ann Thorac Cardiovasc Surg* 2005; 11: 29–34)

Key words: acute type A aortic dissection, tear-oriented surgery, GRF glue

Introduction

Acute type A aortic dissection is a lethal aortic disease with extremely poor prognosis, even when surgical treatment has been performed. Many factors, such as cardiac tamponade and dissection-related organ malperfusion, contribute to hospital mortality and morbidity. Delayed diagnosis and referral may result in an advanced state of deterioration due to prolonged hemo-pericardium/tamponade or malperfusion, and will cause multiple organ failure. It is now generally accepted that patients with acute type A dissection require emergency

surgery to prevent hospital death after the onset of dissection. In recent years, technical improvements in emergency surgery for acute aortic dissection, associated with better perioperative and postoperative management of the patients, have resulted in an acceptable decline in operative and hospital mortality. However, overall surgical results still remain unsatisfactory in many institutions, and most articles published during the last decade report a hospital mortality rate of about 15% to 25%. In this article, we review the recent progress in surgical treatment for acute type A dissection and describe our 9 years experience since the aortic program was introduced at Nihon University Itabashi hospital.

From Department of Cardiovascular Surgery, Nihon University School of Medicine, Tokyo, Japan

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Address reprint requests to Motomi Shiono: Department of Cardiovascular Surgery, Nihon University School of Medicine, 30-1 Oyaguchi-kamimachi, Itabashi-ku, Tokyo 173-8610, Japan.

Presentations from IRAD database

The International Registry of Acute Aortic Dissection (IRAD) from multi-institutional experiences expresses the conception of acute aortic dissection well. According to

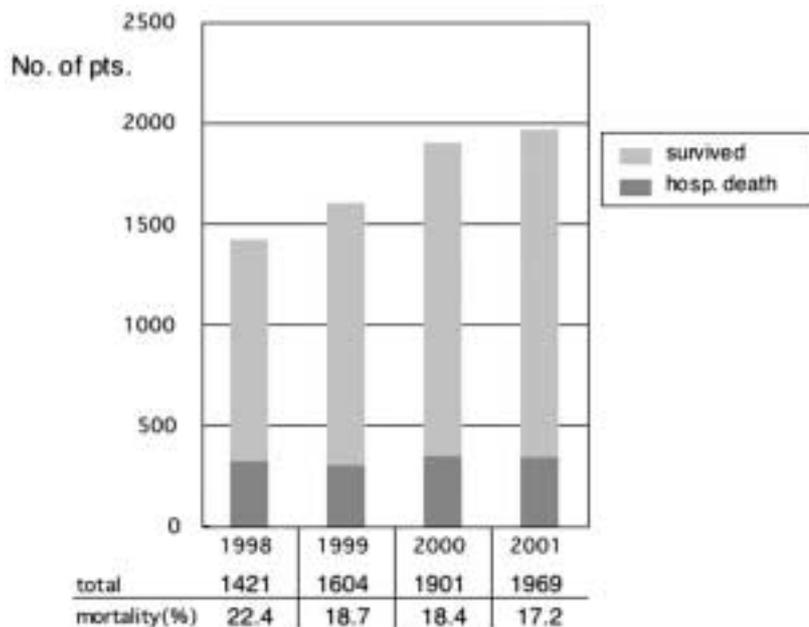


Fig. 1. Changes in the number of surgery and in hospital mortality by year. The number of patients has been increasing and the hospital mortality has been improving year by year. In-hospital mortality has decreased to less than 20% since 1999.

the IRAD database between January 1996 and December 1999 enrolling 547 patients, overall in-hospital mortality rate was 32.5% in type A dissection. In-hospital complications (neurological deficits, altered mental status, myocardial or mesenteric ischemia, kidney failure, hypotension, cardiac tamponade, and limb ischemia) were increased in patients who died compared with survivors. Logistic regression identified the following variables as predictors of death: age ≥ 70 years, abrupt onset of chest pain, hypotension/shock/tamponade, kidney failure, pulse deficit, and abnormal ECG.¹⁾ These data show that dissection-related organ malperfusion contributes to high rate of hospital mortality.

In another series of patients enrolled between January 1996 and December 1998, consisting of 12 international referral centers, there was a total of 464 patients, 62.3% of whom had type A dissection. Classic physical findings such as aortic regurgitation (AR) and pulse deficit were noted in only 31.6% and 15.1% of patients, respectively, and initial chest radiograph and electrocardiogram were frequently not helpful. CT scan was the initial imaging modality used in 61.1%. Overall in-hospital mortality was 27.4%. Mortality of patients with type A dissection managed surgically was 26%; among those not receiving surgery (typically because of advanced age and comorbidity), mortality was 58%. Acute aortic dissection presents with a wide range of manifestations, and classic findings are often absent. They conclude that a high clinical index of suspicion is necessary, and in-hospital mortality rates re-

main high despite recent advances. These data support the need for continued improvement in prevention, diagnosis, and management of acute aortic dissection.²⁾

Many articles consistently report hospital mortality exceeding 20% in western countries.

Acute Type A Dissection in Japan

Based upon annual reports from Japanese Association for Thoracic Surgery, a substantial number of patients have been treated by various types of surgical modalities³⁻⁶⁾(Fig. 1). The number of patients enrolled in the reports has been increasing and the surgical results have been improving year by year. In-hospital mortality decreased to less than 20% since 1999. It is noteworthy that operative death defined as mortality within 30 days after surgery was 13.1% in 2001 although hospital mortality was 17.2%. Mortality rates from operations have steadily decreased due to recent advances in preoperative recognition, surgical techniques and perioperative management of the patients. However, patients with acute type A dissection are still associated with high mortality rates, mostly related to perioperative complications.

Risk factors for in-hospital death were preoperative shock, renal/mesenteric ischemia due to organ malperfusion, and possibly myocardial ischemia/infarction requiring concomitant coronary artery bypass grafting (CABG). Thus, it was apparent that patients' preoperative conditions were the main variables affecting the

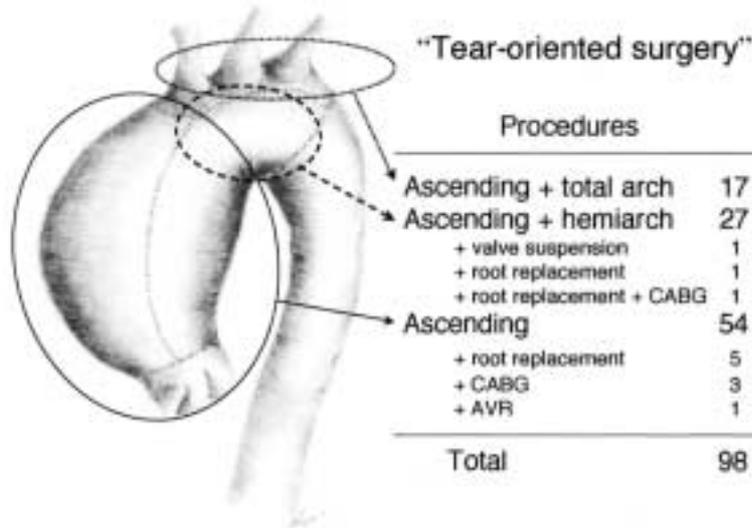


Fig. 2. Location of the primary intimal tear and extent of the graft replacement. The extent of replacement has been decided according to the location of intimal tear, which is called “tear-oriented surgery”. Concomitant root replacement was performed in 7 patients.

CABG; coronary artery bypass grafting, AVR; aortic valve replacement (Numerals = number of patients)

surgical outcome of acute dissection.⁷⁾

Experience at Nihon University Itabashi Hospital

Since introduction of the aortic surgery program on July 1995, 185 patients with acute type A dissection were hospitalized in our institution. A total of 98 patients underwent emergency operations. Surgical procedures used in this consecutive series are shown in Fig. 2. Sixty three patients had DeBakey type I, 23 patients type II, and 12 patients type III (IIb-R; retrograde dissection).

Operative techniques were as follows; Cardiopulmonary bypass (CPB) was initiated via femoro-femoral cannulation for the patients in preoperative shock. A two-staged venous cannula was inserted through the right atrium in cases with stable hemodynamic condition. In all patients deep hypothermic circulatory arrest (DHA) and antegrade selective cerebral perfusion (SCP) were employed for brain protection and the heart arrested with cold crystalloid cardioplegia (St. Thomas solution). Under deep hypothermia below 20 degree Celsius, the ascending/arch aorta was opened longitudinally, and the aortic segment including the intimal tear was resected. Gelatin-resorcin-formaldehyde (GRF) glue was applied to both the proximal and distal dissected ends of the false lumen and then the glued stumps were reinforced with Teflon strips and the resected aorta was replaced with a presealed woven Dacron graft. Antegrade arterial circulation was established through a side branch of the Dacron graft after completion of an open distal anastomosis. In cases where the intimal tear could not be found, only ascending aortic replacement was performed for avoiding

serious complications.

Our policy of emergency surgery for acute type A dissection was primary intimal tear excision and avoidance of serious dissection-related complications, such as cardiac tamponade, severe aortic incompetence, and coronary impairment. Ascending aorta or hemiarch replacement for intimal tear excision was performed in 83% of the patients (81/98) (Fig. 2). Resection of the primary intimal tear could be performed successfully in 89 patients (91%). The operative mortality and in-hospital mortality were 5.1% and 6.1%, respectively. In recent cases since 2001, the operative and in-hospital mortalities were remarkably low; 2.8% and 3.2% respectively. Univariate or multivariate analysis showed that preoperative shock requiring cardiopulmonary resuscitation was an independent risk factor for operative mortality. Actuarial survival rate at 1, 5, 9 years were 85.6%, 78.5% and 62.4%, respectively (Fig. 3). Reoperation free rates at 1 and 9 years were 98.5% and 90.0%, respectively. Persistent rate of the false lumen after surgery was 17% in the entire aorta and 13% in the partial segment of the aorta, respectively. Residual AR was seen in 4% of the patients who had AR preoperatively. A total of 7 patients required reoperation; replacement of the distal aortic arch in 2 patients, replacement of the entire arch in 1, aortic root replacement in 1, and aortic valve replacement (AVR) with CABG in 1.

Discussion

Previously, 90% of the patients with acute aortic dissection would die within 2 weeks, when treated non-surgi-

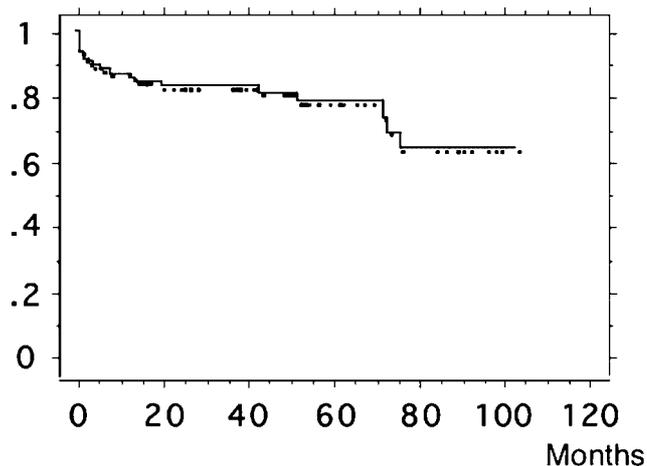


Fig. 3. Actuarial survival curve. Actuarial survival rate at 1, 5, 9 years were 85.6%, 78.5% and 62.4%, respectively.

cally. Currently IRAD presents the patient mortality with type A dissection managed non-surgically to be 58% because of advanced age and comorbidity. Over the last few decades, there have been a number of remarkable advances in surgical strategy and technique for acute type A aortic dissection. Recent advances in early recognition of the disease with non-invasive diagnostic modalities, such as CT scans, and earlier referral to the surgical units have been providing an increasing number of surgical experiences and improvements of the surgical procedures for this lethal disease.

Since hypothermic circulatory arrest was successfully introduced for aortic arch replacement and modified,^{8,9)} DHA enables the surgeon to perform the operation on the aortic arch without placing a clamp on the aortic wall, avoiding clamp injury of the fragile dissected aortic tissue. The “open” distal anastomosis allows better exploration of the aortic arch and an easier and more extensive aortic repair in a dry and motionless field. Hypothermic circulatory arrest affords adequate cerebral protection if the arrest period is kept less than 60 minutes. However, hypothermic circulatory arrest alone without the lack of cerebral perfusion could not diminish the high rates of brain damage and mortality rates.¹⁰⁾ In their series under hypothermic circulatory arrest with additional cerebral perfusion antegradely or retrogradely, hospital mortality rate and incident rate of neurologic deficits were significantly reduced to 14.6% and 11.1%, respectively, both significantly lower than the rates found among patients with hypothermic circulatory arrest alone. Antegrade cerebral perfusion has the advantage of being more physiologic with a supposed unlimited time to perform the distal

aortic repair, despite the possible risk of air or atheromatous embolization from arterial cannulation. Retrograde cerebral perfusion through the superior vena cava is easier to perform than antegrade perfusion and has the advantage of debris and emboli removal from cerebral circulation. But there is still a time limit for brain protection. Whether retrograde perfusion is of benefit because of its cerebral perfusion capability, removal of cerebral waste products, or by ensuring a better distribution of cold to the brain, remains unclear.¹¹⁾ Bachet et al. have reported mortality rate and postoperative neurologic deficit of approximately 20% and 9%, respectively.^{11,12)} Since the beginning of the aortic program, we have adopted an antegrade cerebral perfusion because of its physiology and time limitation for brain protection. DHA + antegrade perfusion allow us to perform meticulous inspection and more complex and complete operations of the aortic arch for further intimal tears.

In addition to the excision of the intimal tear resulting in decompression of the false lumen, another objective of the operation is to restore competence of the aortic valve. Several authors have been reporting the necessity of preserving the native aortic valve whenever possible. Valve-related reoperations are rare, therefore preservation or repair of the aortic valve can be recommended in the majority of patients with acute type A dissection.^{13,14)} Glue-aided repair of the aortic valve and dissected aortic wall is simple, fast, and easily reproducible. Our policy supports a conservative tear-oriented approach presented by Westaby et al.¹⁵⁾ However, some reports are describing the tissue toxicity of formaldehyde.¹⁶⁾ The use of biologic glues for reapproximating the layers of the dissected aortic root is associated with a certain amount of risk of aortic wall necrosis. Therefore, care should be taken to ensure proper use of these glues.¹⁷⁾ In our series, all patients underwent a GRF glue-aided repair for the aortic valve and the dissected aortic wall, and reoperation was performed in 5 patients (5%) and full-root replacement was required in 1 patient, and AVR + CABG in 1 patient. Reoperation-free rate at 1 and 9 years was 98.5% and 90.0%, respectively, which is superior to the 60% to 80% reported previously.^{7,18,19)} Deteriorated AR was seen in 4% of the patients (2/45). Proper use of GRF will decrease the morbidity after the aortic repair. The important role of the glue is to strengthen the aortic wall and to avoid a leakage from needle holes. To enforce the glued aortic wall, we have been placing the Teflon strips inside and outside the aortic stumps. This additional procedure is secured to provide a relatively low reoperation-free rate.

In the great majority of patients, a partial or hemiarch replacement is sufficient, as the intimal tear is generally located in the ascending aorta or the proximal aortic arch. In our series, 83% of the patients underwent ascending or ascending + hemiarch replacement. Transverse arch replacement was performed in 17 patients, and concomitant root replacement in 7 patients for Marfan syndrome or dilated root. Patency of the distal false lumen was found in 30% in our series, compared with 47.3% reported previously.²⁰⁾ In the treatment of acute type A dissections, operative strategy and anastomotic technique play an important role in reducing the incidence of patency and related complications of the distal false lumen. Both glue repair and reinforcement with felt strips greatly improve the suture-holding capacity of the dissected tissue, resulting in a relatively low incidence of reoperation and a patent false lumen. Despite of an aggressive aortic arch repair advocated in some selected patients,^{7,18,21)} it still remains questionable whether extended arch repair could reduce the risk of reoperation and improve the long-term surgical results. Extent of aortic replacement and period of operation have been reported as significant risk factors for in-hospital mortality in previous reports.²²⁻²⁴⁾ However, our series of arch repair, which required longer CPB time and consequently operation period, were performed in 17 patients and the mortality was zero. Because of the use of presealed Dacron graft and biological glues, and recent advance in perfusion technology including brain protection and antegrade arterial perfusion,^{25,26)} longer and more extended repair could be performed as a safe and easily reproducible operation. Intraoperative and postoperative coagulopathies in association with deep hypothermia and longer CPB time remain a major cause of complications and death. In our series, we have no perioperative mortality from uncontrollable hemorrhage.

Dissection-related organ malperfusion, such as neurologic disorder, mesenteric/renal and myocardial ischemia, is a major concern that will have an effect on in-hospital mortality and morbidity.^{2,7,26-28)} In acute aortic dissection malperfusion is insidious and dangerous, as the diagnosis is often delayed resulting in an irreversible and lethal condition. Aortic repair and decompression of the false lumen should be performed before malperfusion causes irreversible damage to the organs. In many patients, malperfusion disappears after aortic repair. However, preoperative or intraoperative irreversible malperfusion is lethal. Antegrade arterial perfusion provides a better solution for intraoperative malperfusion by femoral artery cannulation. In our series, we adopted an antegrade aor-

tic perfusion after completion of the open distal anastomosis, and did not have serious and lethal complications due to organ malperfusion.

Many factors contribute to hospital mortality in acute type A dissection. Some may relate to the surgeon. In some reports,^{7,15)} all the patients were operated on by one surgeon, which is called as a selection bias.²⁹⁾ It is possible that the results obtained by the most experienced surgeon are better than those of the whole group. The surgical procedures should be easy, safe and reproducible to many surgeons. In our series, 74 patients (76%) were operated on by the principal author (M.S.), and the other patients were operated on by young surgeons under a common surgical policy. Most articles published during the last decade report hospital mortality rate of approximately 15% to 25%. In our recent cases since 2001, the operative and in-hospital mortalities were remarkably low; 2.8% and 3.2% respectively. We could dramatically reduce the surgical mortality. Fortunately, since the beginning of our aortic program, we were able to benefit greatly from various innovative technologies which include open distal anastomosis using hypothermic circulatory arrest with antegrade cerebral perfusion, GRF glue, branched presealed Dacron graft, and antegrade arterial perfusion. A tear-oriented conservative surgery could be justified in many patients in order to improve the surgical results, and extended arch repair may be recommended in selected patients. In patients with preoperative organ malperfusion, it is still challenging to improve the mortality and morbidity.

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