Research Paper Clinical Research

# Comparative Analysis of Surgical Outcomes for Patients With Acute Aortic Dissection


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**ABSTRACT**

Introduction: The aim of the paper was to analyze the outcome of the surgical treatment for patients with different types of acute aortic dissection admitted in our service.

Material and Method: We collected the descriptive and temporal parameters, the postoperative results and comparative statistics for the 48 cases of acute aortic dissection operated over a period of 7 years (2006 – 2012). The diagnosis was established by transthoracic and transesophageal echocardiography, and contrast enhanced computed tomography. The emergency surgical treatment consisted in the replacement of the affected aortic segment eventually associated with aortic valve replacement.

Results: The postoperative overall mortality was 41.6%. In the early postoperative period, the main complications were: acute renal failure
(31.25%), neurological complications (25%), early postoerative bleeding (23%), and multiple system and organ failure (MSOF) (12.5%).

Conclusions: The acute aortic dissection represents a major emergency, and a continuous challenge for the cardiovascular surgeon.



**KEYWORDS** Acute aortic dissection, Surgical outcome, Neurologic complications, Mortality


## Introduction

The acute aortic dissection (AAD) represents a major cardiovascular surgery emergency, with a high morbidity and mortality rate in the absence of imediate medical and / or surgical treatment. The incidence of AAD is estimated between 5 and 30 cases / 1 million / year, being more frequent in patients aged 40 to 70 years, and three times more frequent in males. [1,2] Patients with AAD type Stanford A have a mortality of 50% in the first 48 hours, while type B AAD in the Stanford classification is considered to have a more benign character than type A AAD; most studies estimate a total mortality rate of 50% in the absence of treatment. [1,3,4] Aortic dissection is considered acute in the first 14 days from onset; patients who survive this period may stabilize in time; between 2 weeks and 2 months it is defined as "sub-acute", and over 2 months, it becomes "chronic". [1] According to these facts, we tried to analyze the results of surgical treatment of AAD in our clinic.

## Material and Method

In a period of 7 years (2006 – 2012), a number of 48 consecutive patients were admitted and operated in our hospital for acute aortic dissection. Patients data were colected from operative protocols, electronic health records and the institution's data base. For statistical analysis we used Microsoft Office suite, the Excel aplication, charts and graphs.

We assessed the following parameters: descriptive parameters – the type of dissection (Stanford classification), gender, age, investigations used (echocardiography – transthoracic and / or transesophageal; CT-angiography; MRI), type of surgery, arterial canulation site; temporal parameters: time passed from admittance to the time of surgery, time of extra-corporeal circulation (ECC), aortic cross-clamping time, circulatory arrest time; parameters of post-operative results: number of deaths, neurological complications; parameters of comparative statistics: femural artery vs. axilary artery as arterial canulation sites (from the perspective of post-operative neurological complications), the relationship between dissection type and post-operative mortality, the connection of aortic cross-clamping time and ECC time respectively with the incidence of neurological complications.

At admission, 35 patients (73%) were hemodinamically unstable, requiring inotropic drugs (dopamine, norepinephrine and epinephrine); in this group, the mean blood pressure was 89/49 mmHg, and the pulse rate varied between 91 and 144.

All the 48 patients were investigated by trans-thoracic and trans-esophageal echocardiography, and in 85% of cases we also performed the CT-angiography. The mean time from hospital admission to the surgical intervention was 4 hours and 5 minutes (a minimum of 22 minutes and a maximum of 20 hours). The surgical techniques used were diverse, adapted to the clinical situation, but we mainly performed the replacement of the ascending aorta in supra-coronary position with a synthetic prosthesis (Table 1).

**Table 1. Types of surgical procedures**

| Surgical Procedure | No. of Cases |
|---|---|
| Ascending aorta replacement with synthetic prosthesis in a supra-coronary position | 29 |
| Ascending aorta replacement with synthetic prosthesis in a supra-coronary position and aortic valve repair | 5 |
| Ascending aorta replacement with synthetic prosthesis in a supra-coronary position and aortic valve replacement with a mechanical valve | 3 |
| Ascending aorta and aortic arch replacement with synthetic prosthesis in a supra-coronary position | 5 |
| Ascending aorta replacement with synthetic prosthesis in a supra-coronary position and CABG | 2 |

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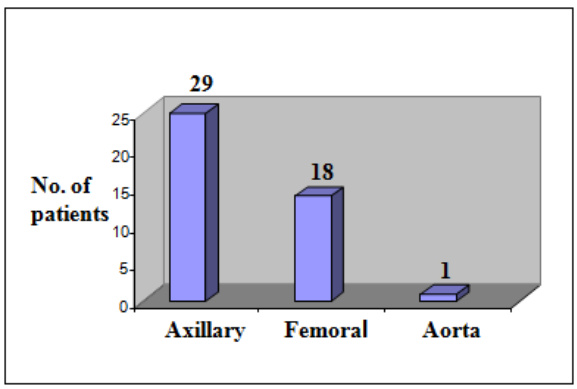
|---|---|
| Bentall procedure and aortic arch and branches replacement | 2 |
| Descending aorta replacement with synthetic prosthesis | 2 |

The arterial cannulation site for ECC was through the right axillary artery in most cases (29 patients – 60.5%), through the femoral artery in 18 patients (37.5%), and through the ascending aorta in one patient (2%) (Figure 1).

**Figure 1. The site of arterial cannulation for cardio-pulmonary bypass.**




The mean ECC time was 168 minutes, the mean aortic cross-clamping time was 118 minutes, circulatory arrest was used in 25 patients and the mean circulatory arrest time was 34 minutes (5 to 55 minutes).

**Results**

Of the total of 48 patients, 62% were males, and the ages varied between 40 and 77 years (average of 61 years). According to the Stanford classification, 95% of the cases were type A AAD, and 5% were type B AAD.

The post-operative complications were as follows: acute renal failure – 15 cases (31.25%) (of which 11 were treated medically and 4 undergone hemodialysis); multiple system organ failure (MSOF) – 6 cases (12.5%); early post-operative hemorrhage – 11 cases (23%) and 1 case of axillary hematoma (2%) (necessitating re-intervention); sternal wound dehiscence – 6 cases (12.5%) (without mediastinitis) and 1 case of femoral wound dehiscence which needed a secondary suture. Neurological complications were encountered in 12 cases (25%): 1 case of spastic tetraplegia, 1 case of paraplegia, 1 case of paraparesis, 1 case of right brachial paresis, and 8 cases of hypoxic encephalopathy and massive cerebral edema.

The total operative mortality was 41.6% (20 cases), of which 12.5% (6 cases) were intra-operative deaths and 29.1% (14 cases) were early post-operative deaths. The intra-operative deaths were determined by aortic rupture at the distal anastomosis site in 4 cases, and by acute cardiac failure (the impossibility of weaning the patient off ECC) in two cases. Unstable patients had a mortality of 45.7%, while stable patients had a mortality of 30.9%.

The highest rate of early postoperative mortality was determined by major neurological complications (massive stroke or hypoxic encephalopathy), the effective mortality rate in patients with important neurological complications being 62%. The incidence of post-operative neurological complications was significantly higher in patients with femoral artery cannulation (33.4% - 6 / 18 patients), in comparison to patients with axillary artery cannulation (20.7% – 6 / 29 patients).

The relationship between cross-clamping time and postoperative neurological complications showed a strong statistical significance (p-value = 0.019) (Table 2), the mean aortic cross-clamping time for the patients with neurological complications being 153 minutes, versus 103 minutes for the group without these complications. The ECC time had no significant influence (p-value = 0.07) on the development of neurological complications (Table 3).

**Table 2. The influence of aortic cross-clamp time on the incidence of neurological complications (t-Test: Two-Sample Assuming Unequal Variances).**

| Neurological complications | Mean time | Minimum time | Maximum Time |
|---|---|---|---|
| present | 153 min | 74 min | 234 min |
| absent | 103 min | 40 min | 190 min |

P-value = 0.019

**Table 3. The influence of ECC time on the incidence of neurological complications (t-Test: Two-Sample Assuming Unequal Variances).**

| Neurological complications | Mean time | Minimum time | Maximum Time |
|---|---|---|---|
| present | 211 min | 99 min | 399 min |
| absent | 146 min | 82 min | 298 min |

P-value = 0.073

In the group which developed neurological complications the mean ECC time was 211 minutes, and in the group of patients which didn't develop neurological complications the mean ECC time was 146 minutes.

**Discussion**

Despite technical progress, the surgical treatment of acute aortic dissection has a high perioperative mortality and morbidity risk. This fact is caused by the gravity of the disease process and also by the potential inadequate cerebral and visceral perfusion during ECC. The most employed imaging for diagnosis in AAD is CT-angiography. According to the IRAD study (2002) [5,6,7], 63% of all AAD were diagnosed by angio-CT, 32% by trans-esophageal ultrasound, 4% by aortic arteriography and 1% by angio-MRI. In our lot the diagnosis was suspected in all patients by ultrasound and confirmed in 85% of the cases by angio-CT. The latter method in now considered the "golden standard" in diagnosing AAD, with a sensitivity of 90% and a specificity of 85% [5,7], bringing important details regarding the type of AAD, the involvement of the aortic arch, it's branches, of the descending (thoracic or abdominal) aorta, and the site of entry point. In 15% of cases, the surgical intervention was performed without an angio-CT examination, the diagnosis being established by cardiac ultrasound, due to the patient instability or technical reasons. Only about half of the patients arrived at our hospital with a diagnosis set by CT-angiography, the rest had to be investigated after admission, which delayed surgery. Surgical treatment is the first choice in Stanford A AAD, and is indicated in Stanford B AAD only if they are symptomatic (persistent thoracic pain, peri-aortic hematoma, pleural effusion, signs of visceral malperfusion). Considering the high mortality in type A AAD (1% each hour), in these cases surgical treatment represents a major emergency. In our study the mean time from admission to the surgical procedure was 4 hours and 5 minutes, due to the necessity to complete the investigation of patients who were hemodinamically stable. Unstable patients were rushed to the OR directly. Surgical resolution of the AAD is complex, with a high degree of difficulty, implying open-heart surgery, ECC with axillary or femoral artery cannulation, deep hypothermia with or without circulatory arrest. In our study the surgical techniques differed according to the location of entry point, the involvement on the aortic valve, or the coronary ostia, varying from ascending aorta replacement with synthetic prosthesis in a supra-coronary position, partial or total aortic arch replacement, associated with aortic valve procedures (replacement or repair), or the Bentall procedure (composite graft replacement of the aortic valve, aortic root and ascending aorta, with re-implantation of the coronary ostia into the

graft). Despite adequate surgical treatment, experienced surgical centers report a mortality rate in AAD between 20 and 35% [3,8]. The mortality rate in our study was 41.6% (12.5% of which were intra-operative deaths and 29.1% post-operative). The main causes of postoperative death were: cerebral implication, hemorrhage, myocardial ischemia/cardiac failure and visceral malperfusion. The highest rate of post-operative mortality was found in the group of patients with major neurological complications (stroke, hypoxic encephalopathy). Out of the 48 patients included in the study, 25% presented neurological complications, with a mortality rate of 62%. The neurological complications can be explained by cerebral hypoxia caused by the dissection involving the major vessels, but also by a potential cerebral mal-perfusion during the surgical procedure. We can conclude from our study that the aortic cross-clamping time and possibly the ECC duration, are involved in the incidence on post-operative neurological complications. In patients where the axillary artery was used for arterial cannulation, performing an anterograde perfusion during ECC, and a selective cerebral perfusion during the circulatory arrest, the incidence the neurological complications was lower than in the group with femoral arterial cannulation which perform a retrograde perfusion and no possibility of cerebral perfusion during the circulatory arrest.

**Conclusions**

The AAD represents a major surgical emergency, a continuous challenge for the cardiac surgeon, with a high rate of mortality and morbidity, depending on the type of dissection, the patient's co-morbidities, the speed and the accuracy of the diagnosis, the time spent from onset to surgery, and on the aortic cross-clamping time and total ECC time, determined by the surgical team's experience.

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