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Postoperative complications of surgically treated ascending aortic dissection

Complicações pós-operatórias de pacientes com dissecção de aorta ascendente tratados cirurgicamente

ABSTRACT

Objectives: Ascending aortic dissection has a poor prognosis if it is not promptly corrected surgically. Even with surgical correction, postoperative management is feared because of its complicated course. Our aim was to describe the incidence of postoperative complications and identify the 1 and 6-month mortality rate of our ascending aortic dissection surgical cohort. Secondarily, a comparison was made between ascending aortic dissection patients and paired-matched patients who received urgent coronary artery bypass graft surgery.

Methods: A retrospective analysis of a prospectively-collected database from February 2005 through June 2008 revealed 12 ascending aortic dissection and 10 elective ascending aortic aneurysm repair patients. These patients were analyzed for demographic and perioperative characteristics. Ascending aortic dissection patients were compared to paired-matched coronary artery bypass graft surgery patients according to age (± 3 years), gender, elective/urgent procedure and surgical team. The main outcome was in-hospital morbidity, defined by postoperative complications, intensive care unit admission and hospital length of stay.

Results: Twenty-two patients received operations to correct ascending aortic dissections and ascending aortic aneurysms, while 246 patients received coronary artery bypass graft surgeries. Ascending aortic dissection patients were notably similar to ascending aortic aneurysm brackets, except for longer mechanical ventilation times and lengths of stay in the hospital. After matching coronary artery bypass graft surgery patients to an ascending aortic dissection group, the following significantly worse results were found for the Aorta group: higher incidence of postoperative complications (91% vs. 45%, p=0.03), and longer hospital length of stay (19 [11-41] vs. 12.5 [8.5-13] days, p=0.05). No difference in mortality was found at the 1-month (8.3%) or 6-month (16.6%) postoperative care date.

Conclusion: Ascending aortic dissection correction is associated with an increased incidence of postoperative complications and an increased hospital length of stay, but 1 and 6-month mortality is similar to that of paired-matched coronary artery bypass graft surgery patients.

Keywords: Aorta; Dissection; Thoracic surgery; Prognosis; Morbidity; Mortality

Study conducted at the Intensive Care Unit, Casa de Saúde São José - Rio de Janeiro (RJ), Brazil.

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INTRODUCTION

Aortic dissection is potentially fatal for patients with atherosclerosis and congenital diseases, such as Marfan's syndrome.[1,2] Thoracic aortic dissection is an important disease process in the differential diagnosis of acute coronary syndrome. Patients present with acute thoracic pain that may radiate to the neck and back and may be associated with peripheral pulse amplitude asymmetry and eventually shock. Ascending aortic involvement is often

associated with acute aortic valve insufficiency, which can lead to acute left ventricular failure. Therefore, ascending aortic dissection (AAD) has an ominous prognosis if not promptly surgically corrected, due to a risk of impending rupture and a high mortality rate (1% per hour if left untreated).[3,4]

Surgical procedures for AAD must be instituted as soon as possible and consist of closing the aortic wall flap, inserting an internal prosthesis, and repairing the aortic valve if it is insufficient. Despite timely surgical intervention is crucial to abort its rupture, AAD has been associated with high morbidity and mortality rates (10-20%).[5] The outcomes of surgically corrected AAD were not compared with proper controls, while its complications are similar to other cardiac surgeries, such as coronary artery bypass grafts (CABGs). Whether or not AAD patients suffer from higher rates of postoperative complications and short- and long-term mortality is a controversial matter. AAD correction is generally performed on an urgent basis, and other urgent cardiac surgeries are also associated with a higher incidence of complications and poorer outcomes.[5,6] To search for better control patients, patients with ascending aortic aneurysms should be compared with patients who have the same anatomical site of surgery and have a similar severity of illness.[6] CABG surgeries are considered to be a standard type of cardiac procedure/surgery with known rates of postoperative complications (~25-40%) and low mortality rates (1-4%). Patients with CABG can serve as a basis of comparison with rarer types of cardiac surgeries.[7]

To perform a detailed analysis of surgically treated AAD and elective aortic aneurysm repair outcomes, we used our clinical database to describe the morbidity and mortality of this selected group. Secondarily, we compared these patients with CABG patients by matching them according to age, gender and urgent need of surgery.

METHODS

We conducted a retrospective analysis of a prospectively-collected database from a 30-bed intensive care unit (ICU) of a tertiary hospital with 230 beds. This study was appropriately approved by the institutions' ethics committee. Six cardiac surgical teams work at this hospital and are responsible for referring patients to the ICU. All cardiac surgeries were consecutively included in the database. Data from AAD and aneurysm correction surgeries were gathered from February 2005 to June 2008. The following demographic data were collected: age, gender, current weight and height (to calculate body mass index - BMI) and presence of comorbidities, such as arterial hypertension, diabetes mellitus, chronic obstructive pulmonary disease, previous stroke, presence of stable or unstable angina and previous acute myocardial infarction (AMI). The following risk factors for arterial coronary disease were also recorded: family history of coronary disease, lipid disorders, prolonged smoking history (more than 20 packs/year), physical activity (metabolic equivalent expenditure), and former venous thrombosis. Baseline renal dysfunction was defined as a creatinine serum level higher than 2 mg/dL. Former coronary bypass procedures, surgical as well as percutaneous angioplasty, and the presence of coronary stents were assessed. The Teicholz method was used to recover the ejection fraction while reviewing echocardiograms before CABGs.

The indication for surgery was defined as elective or urgent (to be operated upon within one week). The following surgical characteristics, considered to be risk factors for severity, were analyzed: reoperation and combined valve replacement. Data recorded from the intra-operative period were total time of surgery, use of a bypass device, on-pump time, urine output, fluid balance, and transfusion of packed red blood cells (PRBC).

After surgery, all patients were immediately transported to the ICU while on mechanical ventilation with central venous pressure monitoring and an invasive arterial line. Patients were early-extubated (preferentially within 4 hours after surgery) if they were conscious, had stable hemodynamics, and did not present with significant bleeding. Mediastinal and pericardial drainage was monitored hourly to identify abnormal bleeding that would require the use of blood products and/or surgical re-intervention. A beta-blocker and aspirin were administered as soon as clinical and laboratory parameters allowed. Postoperative complications were defined as significant thoracic bleeding (more than 500 mL per day), reoperation, prolonged time of mechanical ventilation (more than 12 hours), pneumothorax, large pleural effusion (more than 500 mL estimated at imaging exam and/or requiring thoracocentesis and/or drainage) atrial fibrillation or flutter, ventricular arrhythmias, AMI, peripheral arterial insufficiency, nosocomial infections (presenting the following infections after 48 hours of admission: pneumonia, urinary tract infection, catheter-related bacteremia, sternal wound infection, mediastinitis), stroke, seizures, acute renal dysfunction (defined as a serum creatinine increase higher than 50% or a serum creatinine greater than 2.0 mg/dL or urine

output below 0.5 mL/kg/hour and need of diuretics) and death during hospital stay.

Prognostic scores for cardiac surgeries (Euroscore and Ontario score) were calculated with preoperative data.[8,9] An Acute Physiological and Chronic Health Evaluation II (APACHE II) was calculated for each patient in the first 24 hours of admission to the ICU.[10]

Initially, all CABG patients were compared to surgically-corrected ascending Aortic aneurysm AAA and AAD patients. The statistical analysis showed a huge imbalance between both groups, and we decided to use a paired-matched analysis. Patients were divided into the following 3 groups for analysis: AAD, elective correction of AAA and isolated CABG surgeries. The AAD group was compared to the AAA group, and then the AAD group was compared with the concurrent paired-matched CABG control patients. We chose the following parameters for matching the cases: age (± 3 years), gender, elective/urgent procedure and surgical team. Whenever 2 more control patients were matched with an ascending aorta patient (either AAD or AAA), we narrowed the control patient matches according to surgical team and similar age to ensure that only 1 control patient would be paired with the ascending aorta patient. The main outcomes were the incidence of postoperative complications, ICU admission and hospital length of stay, and 1 and 6-month mortality rates. The authors were blinded to the mortality outcome when they selected the control patients.

Continuous variables were expressed as median and interquartile (25-75) intervals and were evaluated for normal distribution by the Kolmogorov-Smirnov test. Categorical and ordinal data were expressed as absolute values and percentages. If continuous variables did not present in a normal distribution, non-parametric tests were applied. Groups were compared using the Kruskall-Wallis test followed by the Dunn's post-test, as most variables demonstrated a non-parametric distribution. Comparisons between 2 groups were made using Student's t-test for continuous variables when variables presented in a parametric distribution and the chi-square test for categorical variables. Statistical significance was defined as a p value less than 0.05. The statistical program, SPSS 11.0 for Windows (SPSS Inc., Chicago, IL, USA), was used.

RESULTS

During the study period, 340 cardiac surgeries were performed in our center. There were 246 isolated CABG surgeries, 61 valvar replacements, 6 congenital cardiac malformations, and 5 cardiac tumor resections. There were 12 AAD and 10 ascending aortic aneurysm correction surgeries.

The 22 patients who underwent ascending aorta corrections (dissections and aneurysms) were younger (67 [59-74] versus 62 [50-71], p = 0.03) and had higher BMIs (28[25-29] versus 25.5 [24-28], p = 0.05), as compared to the CABG group (Table 1). Gender and preoperative left ventricular ejection fraction were similar in both groups. Severity of illness scores were significantly higher in the aorta group, as shown in the APACHE II (13.5 [11-17] versus 10[7-13] points, p = 0.005), Euroscore (8.5[7-11] versus 3 [2-6], p < 0.001), and Ontario score (6 [5-7] versus 2 [1-4], p < 0.001). Urgent procedures showed a tendency to be more common in the aorta than the CABG group (54 versus 39%, p = 0.14). Total perioperative time (6 [6-6.5] versus 5 [4-5.5] hours, p < 0.001) and on-pump time (113 [94-174] versus 85 [67-98] minutes, p < 0.001) were longer in the aorta group than in the CABG group. Transfusion of PRBC was also more common in the aorta group as compared to CABG patients (68 versus 35%, p = 0.005) and the former stayed longer on mechanical ventilation (11 [6-17] versus 4 [3-6] hours, p < 0.001). Postoperative complications, such as atrial fibrillation, bleeding, stroke and nosocomial pneumonia, were more prevalent in the aorta group compared to the CABG group (77 versus 36%, p < 0.001). These differences may account for a more prolonged ICU length of stay in the aorta group (3 [2-6] versus 2 [2-3] days, p = 0.001). When ICU mortality was analyzed, no difference between the aorta group and the CABG group was observed (4.5 versus 3.2%, p = NS).

When comparisons were made between AAD and AAA corrections, baseline body mass indices (26.5 [25-28] versus 28.5 [28-30.5], p = 0.04, respectively) and Ontario scores (7 [6-7.5] versus 5.5 [4-6] points, p = 0.002, respectively) were significantly different. Although AAD patients underwent more urgent procedures than AAA patients (91% versus 10%, p < 0.001), perioperative parameters were similar in both groups, as demonstrated by total operative and extracorporeal pump times, fluid balance, urine output, and PRBC transfusions. Mechanical ventilation time (16 [13-51] versus 5.5 [4-6] hours, p = 0.05) was longer, and there was a trend for more postoperative complications in the AAD group compared to the AAA group. Eleven out of

Table 1 – Baseline characteristics and outcomes of aortic surgical and coronary artery bypass graft patients

	Ascending aortic surgeries (22)	CABG (246)	p value
Age (years)	62 [50-71]	67 [59-74]	0.03
Age > 80 years	1 (4.5)	17 (7)	1.0
Male gender	14 (6.5%)	179 (73%)	0.36
BMI	28 [25-29]	25.5 [24-28]	0.05
Ejection fraction (%)	68.5 [61-70]	70 [62-70]	0.44
APACHE II (points)	13.5 [11-17]	10 [7-13]	0.005
Euroscore (points)	8.5 [7-11]	3 [2-6]	<0.001
Ontario score (points)	6 [5-7]	2 [1-4]	<0.001
On-pump time (minutes)	113 [94-174]	85 [67-98]	<0.001
Total perioperative time	6 [6-6.5]	5 [4-5.5]	<0.001
Perioperative blood transfusion	15 (68)	86 (35)	0.005
Fluid balance (ml)	1850 [1388-2650]	2000 [1250-2700]	0.77
Urine output (ml)	1000 [625-1500]	1100 [900-1600]	0.15
Urgent surgery	12 (54)	95 (39)	0.14
Mechanical ventilation time (h)	11 [6-17]	4 [3-6]	<0.001
More than 1 postoperative complication	17 (77)	90 (36)	<0.001
Atrial fibrillation	8 (37)	33 (13.5)	0.009
Postoperative bleeding	6 (27)	13 (5)	0.002
Renal dysfunction	4 (18)	21 (8.5)	0.13
Delirium	4 (18)	20 (8)	0.12
Stroke	3 (14)	4 (1.5)	0.01
Nosocomial pneumonia	4 (18)	8 (3)	0.01
ICU length of stay (days)	3 [2-6]	2 [2-3]	0.001
ICU mortality	1 (4.5)	8 (3.2)	0.54

CABG - coronary artery bypass graft; BMI – body mass index; APACHE – Acute Physiology and Chronic Health Evaluation; ICU – intensive care unit. Results are expressed in median and interquartile (25-75) intervals or as percentages. Student's t test and chi-square test were utilized for comparisons.

12 AAD versus 6 out of 10 AAA patients presented at least one postoperative complication (p = 0.13). Postoperative bleeding (50% versus 20%, p = 0.2) and nosocomial pneumonia (40% versus 0%, p = 0.09) were more common in AAD patients than in AAA patients, although this difference was not statistically significant.

Out of 246 CABG patients, 95 (38%) were identified as urgent during the study period. AAD patients were compared to paired-urgent CABG patients. As urgent CABG patients retained different characteristics as a heterogeneous group, we performed a paired-matched analysis between AAD and urgent CABG surgeries. AAD patients demonstrated significant differences in postoperative complications and hospital length of stay (Table 2). The matching process was designed to lessen the variable effects of age, gender, and surgical teams. The incidence of postoperative complications was significantly higher in the AAD patients compared to the CABG group (91% versus 41%, p = 0.03, respectively; odds ratio 15.4, CI 95% 1.5 to 161.1). Half of the AAD patients had significant postoperative bleeding compared to none of the CABG group (p = 0.01). Other complications were slightly more frequent in AAD patients but did not reach statistical significance, such as acute renal dysfunction and nosocomial pneumonia. Development of at least one postoperative complication was significantly more common in the AAD patients than in the CABG group. Finally, AAD patients showed a trend for a more prolonged hospital length of stay compared to the CABG group (19 [11-41] versus 12.5 [8.5-13] days, p = 0.05, respectively). Although poorer outcomes were expected in the AAD patients, ICU admission (1 patient, 8.3%), 1-month mortality (1 patient, 8.3%) and 6-month mortality (2 patients, 16.6%) was the same for AAD patients compared to the CABG group.

Table 2 – Comparison between ascending aortic dissection and paired-matched coronary artery bypass graft surgical procedures

	Case-matched CABG surgery (12)	Ascending aortic dissection (12)	p value
Age (years)	61.5 [57-73]	61.5 [53-72]	0.18
Male gender	8	8	-
BMI	25.5 [24-27]	26.5 [25-28]	0.66
Ejection fraction (%)	61 [49-70]	68.5 [64.5-70]	0.03
APACHE II (points)	12 [9.5-15]	15.5 [11-20]	0.10
Euroscore (points)	6 [3-7]	9 [8-11.5]	0.02
Ontario score (points)	4.5 [1-7]	7 [6-7.5]	0.01
On-pump time (minutes)	99.5 [85-108]	117 [90-136]	0.15
Total perioperative time	5 [4-6]	6 [6-7]	0.02
Perioperative blood transfusion	6	10	0.19
Fluid balance (ml)	2090 [930-2650]	1850 [987-2550]	0.78
Urine output (ml)	1100 [875-1450]	825 [475-1125]	0.39
Urgent surgery	11	11	-
Mechanical ventilation time (h)	5.5 [3.8-7.5]	16 [13-51]	<0.001
More than 1 postoperative complication	5	11	0.03
Atrial fibrillation	1	3	0.59
Postoperative bleeding	0	6	0.01
Renal dysfunction	0	3	0.22
Delirium	1	3	0.59
Stroke	0	2	0.47
Nosocomial pneumonia	0	4	0.09
ICU length of stay	2 [2-2.5]	4.5 [3-10]	0.01
Hospital length of stay	12.5 [8.5-13]	19 [11-41]	0.05
ICU mortality (days)	1	1	1.0
Hospital mortality	1	2	0.48
30-day mortality	1	1	1.0
6-month mortality	2	2	1.0

CABG - coronary artery bypass graft; BMI – body mass index; APACHE – Acute Physiology and Chronic Health Evaluation; ICU – intensive care unit. Results are expressed in median and interquartile (25-75) intervals or as percentages. Student's t-test and chi-square test were utilized for comparisons.

DISCUSSION

Although AAD surgical patients presented a higher incidence of postoperative complications and a longer length of hospital stay, 1-month and 6-month survival rates were similar in AAD patients compared to cardiac surgical control patients (elective AAA and urgent CABG patients).

Ascending aorta dissection is an ominous disease if not rapidly diagnosed and surgically treated.[11,12] In our study, AAD patients were compared to 2 different types of cardiac surgical controls: ascending aortic aneurysm elective repair and urgent CABG surgery. The former control group was similar to AAD patients according to demographics, site of surgery, and preoperative parameters, but the left ventricle ejection fraction was lower in elective aortic aneurysm repairs. Only durations of mechanical ventilation and lengths of hospital stay were higher in the AAD group.

The CABG group was matched to AAD patients according to age, gender, surgical team and urgent surgical indication. These parameters were chosen because they can be critical confounding parameters when cardiac surgical goals are analyzed. For example, older and male patients generally have poorer performance after cardiac surgeries,[13-16] and surgical teams can influence early postoperative outcomes, as technical expertise is important for avoiding common complications. In addition, the urgent need for cardiac surgeries can determine hemodynamic and inflammatory instability during the peri- and/or postoperative periods. AAD patients presented a higher incidence of postoperative complications, such as atrial fibrillation and major

postoperative bleeding. Gontijo Filho described a ten-year Brazilian series of 47 aortic arch dissection operations and presented a similar hospital mortality rate (12%) to our study. Postoperative complications was around 27%, but the list of possible complications was relatively smaller than our list. The incidence of respiratory insufficiency was similar to our study, although reoperation due to postoperative bleeding was higher in the previous study.[17] Our incidence of neurological deficits was notably similar to that of another study that analyzed thoracic aortic aneurysm surgeries in older patients (around 15%).[18]

Thirty-day and 6-month mortality rates of AAD patients were equal to the rates of the CABG surgical matched group. These mortality rates are similar to AAD surgical outcomes in other studies.[13,14,16,19-24] Contemporary surgical and ICU care allow relatively good outcomes for patients with AAD.[15,16,24-26] The availability of newer, noninvasive image diagnostic tests, such as transesophageal echocardiography and computed tomography angiography, is crucial for the early differential diagnosis of acute chest pain, and early diagnosis has been associated with improved surgical outcomes.[27,28] Surgical techniques have also become more efficient and have allowed for shorter surgical times. The use of an aortic plus valve prosthesis has improved surgical technique and shortened on-pump time.[29] As on-pump time can be reduced, systemic inflammatory response is blunted compared to longer surgeries.[30] A more recent adjunct therapy for cerebral protection during hypothermic arrest is the use of retrograde cerebral perfusion, which not only provides nutrients and oxygen to the brain but may also serve to flush out both air and particulate matter from the cerebral and carotid arteries that would otherwise embolize.[30,31] Finally, postoperative care has also improved over the years, thereby allowing for prompt detection of complications, such as arrhythmias and coronary graft thrombosis.

Small sample size is the main limitation of our study. The relatively low frequency of AAD in a community hospital during a limited period forced us to conduct a nested, case-control study design in which each case was controlled by two different control patients (one elective aortic aneurysm repair patient and another emergent/urgent CABG surgery patient). Our main objective was to record the prevalence of postoperative complications; thus, the evaluation of 1 and 6-month mortality is not suitable for prognostic purposes. By no means do we intend to extrapolate our results to every cardiac surgery center, but we do indicate the need for observational studies of AAD with larger sample sizes.

CONCLUSIONS

Contemporary care of the AAD patient may have similar outcomes to other cardiac surgeries, such as urgent CABG surgery and elective aortic aneurysm correction. Although AAD surgical correction is associated with an increased incidence of postoperative complications and an increased hospital length of stay, 1 and 6-month mortality rates are similar to those of paired-matched CABG patients.

RESUMO

Objetivos: A dissecção da aorta ascendente tem prognóstico ruim se não for corrigido cirurgicamente. Mesmo após a cirurgia, o manuseio pós-operatório é temido pelo seu curso complicado. Nosso objetivo foi descrever a incidência de complicações pós-operatórias e mortalidade em 1 e 6 meses de pacientes submetidos a cirurgia de correção de dissecção ou aneurisma da aorta ascendente; secundariamente a comparação foi realizada com pacientes pareados submetidos a revascularização miocárdica de urgência.

Métodos: Uma análise retrospectiva de banco de dados preenchido prospectivamente de Fevereiro de 2005 a Junho de 2008 revelou 12 pacientes com dissecção da aorta ascendente e 10 com aneurisma de aorta eletivos, analisando demografia e características per-operatórias. Pacientes com dissecção da aorta ascendente foram comparados a pacientes com revascularização miocárdica de acordo com idade (± 3 anos), gênero, procedimento urgente/eletivo e equipe cirúrgica. O principal desfecho foi morbidade (complicações pós-operatórias e tempo de permanência na unidade de terapia intensiva e no hospital).

Resultados: Vinte e dois pacientes foram operados para correção de dissecção da aorta ascendente e aneurisma de aorta eletivos, enquanto 246 pacientes foram submetidos à revascularização miocárdica. Pacientes com dissecção da aorta ascendente e aneurisma de aorta eletivos eram semelhantes, exceto pelo maior tempo de ventilação mecânica e de internação hospitalar. Depois do pareamento entre pacientes de revascularização miocárdica e dissecção da aorta ascendente, resultados significativamente piores foram encontrados para este ultimo grupo: maior incidência de complicações pós-operatórias (91 vs 45%, p=0,03) e maior tempo de permanência hospitalar (34,6 ± 35,8 vs 12,9 ± 8,5 dias, p=0,05). Não houve diferença na mortalidade em 1 mês (8,3%) e 6 meses (16,6%) entre os grupos.

Conclusão: A correção da dissecção da aorta ascendente está associada à incidência aumentada de complicações pós-operatórias e tempo de permanência hospitalar, mas a mortalidade em 1 e 6 meses é igual a de pacientes após revascularização miocárdica pareados.

Descritores: Aorta; Dissecção; Cirurgia torácica; Prognóstico; Morbidade; Mortalidade

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