

Abdominal Aortic Aneurysm Repair in Octogenarians: Outcomes and Predictors

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Objectives. This study was undertaken to evaluate predictors and outcomes of octogenarians who underwent abdominal aortic aneurysm repair.

Design. A prospective observational study.

Materials and methods. Between January 1st, 1997 and April 15th, 2005, 31 octogenarians were admitted to our Department with the diagnosis of abdominal aortic aneurysm. Mean follow-up time was 53.7 ± 27.2 months. All patients were in good clinical condition and represented a selected healthy group of octogenarians.

Results. The overall perioperative (30-days) mortality rate was 3.1%. The total in-hospital morbidity rate was 22.6%. Overall survival estimates at 48 and 96 months were $81 \pm 8\%$ and $46 \pm 21\%$, respectively. The actuarial freedom from aneurysm-related death at 48 and 96 months was $96 \pm 4\%$ and $96 \pm 4\%$, respectively. The actuarial freedom from aneurysm-unrelated death at 48 and 96 months was $84 \pm 7\%$ and $48 \pm 21\%$. Only coronary artery disease was a significant predictor of survival using multivariate stepwise logistic regression analysis.

Conclusions. In this series, AAA surgery was carried out in selected octogenarians without affecting long-term survival.

Keywords: Octogenarians; Aortic aneurysm, abdominal; Surgery; Follow-up studies.

Introduction

Older age is commonly considered a risk factor for major surgery¹ and octogenarians are generally approached with reserve when surgical management of abdominal aortic aneurysm (AAA) is concerned. Survival is increasing in all the industrialized countries and nowadays an octogenarian has a life expectancy of 6–8 years.² The diameter of the abdominal aorta clearly increases with age and the prevalence of aneurysms of the abdominal aorta in older adults is relatively high.^{3–6}

Aneurysm rupture is one of the most common causes of death for patients with untreated AAA, even when these patients have significant comorbidities and older age.⁷ One of the most reliable predictors for rupture is aneurysm size^{7–10} and larger aneurysms are generally diagnosed in older patients.^{3–6} Moreover,

improvement in surgical management and postoperative care has decreased mortality and morbidity rates in high-risk patients.¹¹ These data suggest that AAA repair should be considered for each patient, even for octogenarians. Endovascular aortic aneurysm repair is reported to have lower mortality and morbidity rates.¹ However, this option cannot be used in all patients.¹²

This study was designed to evaluate predictors and outcomes of octogenarians who underwent open abdominal aortic aneurysm repair.

Materials and Methods

Between January 1st, 1997 and April 15th, 2005, 837 patients were admitted to the Department of Cardiovascular Surgery with the diagnosis of abdominal aortic aneurysm. Eight hundred and fifteen (97.4%) were scheduled for elective AAA and 22 (2.6%) were admitted for emergency repair of a ruptured AAA. Thirty-one patients (26 males and five females, mean age 82.2 ± 2.8 years, age range 80–91 years) were

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octogenarians. Thirty octogenarians (96.8%) were scheduled for elective AAA, one (3.2%) was admitted for a ruptured AAA.

Data were collected prospectively. Preoperative, perioperative and postoperative data were derived from our institutional database and reviewed using a standard data collection form.

Preoperative patient evaluation included routine history, physical examination, and laboratory tests. In order to define the cardiac risk, cardiovascular history was carefully assessed and resting electrocardiogram (ECG) and trans-thoracic Doppler echocardiography were performed in all cases. ECGs were considered abnormal if Q waves or ST-T segment ischemic irregularities were noted. Echocardiograms were considered abnormal if dysfunction in wall motion or left ventricular ejection fraction was noted.

Dobutamine echo stress test was performed in all elective patients by a cardiologist. We routinely perform echo-stress test only in patients older than 70 years because CAD risk is high and echo-stress test has good accuracy to identify patients with significant angiographic CAD.¹³ In patients younger than 70 years, the stress test is performed as second step if history, ECG and/or echocardiography are positive.

Patients with previous history of coronary artery disease, symptoms related to CAD or electrocardiographic/echocardiographic/stress test abnormalities were evaluated with coronary angiography. Patients without echocardiographic/stress test abnormalities were considered fit for surgery.

Demographic and preoperative data are detailed in Table 1. Five patients (16.1%) had a previous history of acute myocardial infarction, three of them underwent previous primary coronary angioplasty. Two patients (6.5%) complained of breathlessness and chest pain (NYHA III class) and had ischemic abnormalities in electrocardiogram and echocardiogram. These seven (22.6%) patients had abnormalities during dobutamine stress echocardiography and were evaluated with coronary angiography. In two cases, significant CAD was diagnosed and patients underwent coronary artery bypass grafting (three grafts) and physical rehabilitation before AAA repair. At echocardiogram, valvular disease was detected in five patients (16.1%).

In all cases, the surgical procedure was performed using standard techniques. A midline transperitoneal approach were used. Conventional exposure and clamping of the infrarenal aorta were performed when possible. A suprarenal cross-clamping was employed when a juxtarenal aneurysm was present. A Dacron tube was used in all cases. When the aneurysm involved the common iliac arteries, a bifurcated graft was employed.

Table 1. Demographic and preoperative data

Parameter	Number or mean \pm SD	Percentage or range
Number of patients	31	100%
Age (years)	82.2 \pm 2.8	80–91
Gender		
Male	26	83.9%
Female	5	16.1%
Medical history		
Smoking	14	45.2%
Hypertension	16	51.6%
Hypercholesterolemia	8	25.8%
Hypertriglyceridemia	11	35.5%
Diabetes mellitus	9	29.0%
Chronic obstructive pulmonary disease*	6	19.3%
Chronic renal insufficiency [†]	3	9.7%
Coronary artery disease	7	22.6%
Previous acute myocardial infarction	5	16.1%
Previous coronary artery bypass grafting	2	6.5%
Electrocardiogram		
Sinus rhythm	24	77.4%
Atrial fibrillation	6	19.4%
Pacemaker	1	3.2%
Echocardiogram		
Aortic valve disease	5	16.1%
Mitral valve disease	3	9.7%
Ejection fraction (%)	52.9 \pm 13.0	35–73
Ejection fraction (%) > 50%	27	87.1%

* 50% < FEV1 < 80% predicted; FEV1/FVC < 70%. FEV1, forced expiratory volume in 1 s; FVC, forced vital capacity.

[†] Serum creatinine > 1.5 mg/dL.

The postoperative course was strictly monitored and all the complications were registered. The main in-hospital outcomes were in-hospital mortality, postoperative complications and length of in-hospital stay.

Patients follow-up

Data were obtained annually by means of direct visits and telephone interviews. Follow up of survivors was last collected between April 26th and May 10th, 2005. Cumulative follow-up time was 1612 patients-months and was 100% complete. Median follow-up time was 47.5 months and mean follow-up time was 53.7 \pm 27.2 months (range 6–99 months).

Statistical analysis

Continuous variables were expressed as mean \pm standard deviation, as they were normally distributed. Discrete variables were expressed as numbers and proportions. Actuarial life table estimates were constructed with the Kaplan–Meier method. Significant predictors of death were investigated by examining

the association between various preoperative and operative variables and survival in univariate analysis, followed by a stepwise logistic regression analysis on factors demonstrated to be significant in univariate analysis. Multivariate analysis was performed to determine the independent predictors of death. Odds ratios could not be precisely assessed as the small number of patients led to high confidence interval. A $P < 0.05$ was considered statistically significant. Statistical analysis was performed using SPSS 9.0 software (SPSS, Inc., Chicago, IL).

Results

Operative data

Operative data are detailed in Table 2. In all cases, degenerative aneurysms were detected at surgical inspection. In three cases (9.7%), a juxtarenal aneurysm was discovered and a suprarenal aortic cross-clamping was required to allow aneurysm repair. In all the other patients, a good infrarenal aortic 'neck' permitted a conventional infrarenal aortic cross-clamping. The patients were extubated immediately after surgery and were discharge to postoperative unit without ICU stay.

Table 2. Operative data

Parameter	Number or mean \pm SD	Percentage or range
Emergency procedures	1	3.2%
Size of aneurysm (mm)	66.9 \pm 9.2	60.3–73.9
Type of aneurysm		
Infrarenal abdominal aneurysm	28	90.3%
Juxtarenal abdominal aneurysm	3	9.7%
Associated bilateral iliac aneurysm	3	9.7%
Duration of surgery (min)	137 \pm 43	118–193
Aortic clamping time (min)	37.8 \pm 13.9	20–71
Type of aortic cross-clamping		
Infrarenal aortic cross-clamping	28	90.3%
Suprarenal aortic cross-clamping	3	9.7%
Graft diameter (mm)		
18 mm	10	32.3%
20 mm	13	41.9%
22 mm	8	25.8%
Bifurcated grafts	3	9.7%
Operative requirement of homologous transfusions	5	16.1%

Table 3. Perioperative mortality and morbidity

Parameter	Number or mean \pm SD	Percentage or range
Operative mortality	0	0%
Perioperative mortality	1	3.2%
Perioperative morbidity	7	22.6%
Acute renal insufficiency	5	16.1%
Wound dehiscence	1	3.2%
Sepsis and MOF	1	3.2%

Postoperative and perioperative (30-days) mortality and morbidity

There was one in-hospital death. The patient initially developed abdominal sepsis secondary to colon ischemia, which was treated with intravenous antibiotics and subsequently multi-organ failure, which led to death. The overall perioperative mortality rate was 3.1%.

Five patients (16.1%) developed postoperative acute renal failure, no one requiring hemodialysis. One patients developed a wound infection (*Staphylococcus aureus*) treated with antibiotic therapy. The total in-hospital morbidity rate was 22.6% (Table 3).

Late mortality

There were eight late deaths at the time of follow-up. Overall survival estimates at 48 and 96 months were $81 \pm 8\%$ and $46 \pm 21\%$, respectively (Fig. 1). The mean age at death was 86.5 ± 3.7 years (range 82.0–93.3 years). There was one death related to abdominal surgery. The cause of death was the formation of infected pseudoaneurysm. The actuarial freedom from aneurysm-related death at 48 and 96 months was $96 \pm 4\%$ and $96 \pm 4\%$, respectively.

There were seven deaths unrelated to abdominal surgery. The first cause of death in this sub-group was

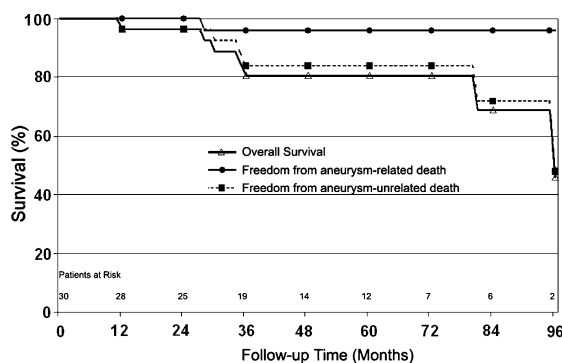


Fig. 1. The actuarial freedom from death, from aneurysm-related death and from aneurysm-unrelated death.

Table 4. Univariate analysis of preoperative parameters affecting survival

Variable	P value
Gender	0.4664
Age	0.2762
Smoking	0.8254
Hypertension	0.1127
Hypercholesterolemia	0.0394
Hypertriglyceridemia	0.9545
Diabetes mellitus	0.7462
Chronic obstructive pulmonary disease	0.6779
Chronic renal insufficiency	0.7840
Coronary artery disease	0.0373
Previous acute myocardial infarction	0.4621
Previous coronary artery bypass grafting	0.3774
Infrarenal abdominal aneurysm	0.8662
Juxtarenal abdominal aneurysm	0.8334
Associated bilateral iliac aneurysm	0.7253

tumor (four patients, 57.1%). Two (28.6%) late deaths were due to myocardial infarction, one (14.3%) to stroke. The actuarial freedom from aneurysm-unrelated death at 48 and 96 months was $84 \pm 7\%$ and $48 \pm 21\%$, respectively.

Predictors of survival

Univariate analysis. Table 4 outlines preoperative variables that were evaluated for their impact on survival using univariate analysis. The only two significant risk factors adversely affecting survival were hypercholesterolemia and CAD.

Multivariate analysis. Only CAD was a significant predictor of survival using multivariate stepwise logistic regression analysis (Table 5).

Discussion

Vascular surgeons are confronting with an increasing number of AAA in patients older than 80 years. This study was undertaken to understand if major vascular surgery can affect short term and long term mortality and morbidity in the octogenarians.

We report a low perioperative mortality in our study group (3.1%). It compares favorably with mortality reported in other studies that ranged from 0 to 9%.¹⁴⁻¹⁷ Only one patient died after surgery and the cause of death was sepsis. This result probably

Table 5. Factors affecting long-term survival using multivariate stepwise, logistic regression

Variable	P	95% CI	OR	SE
CAD	0.0499	1.00-40.06	6.33	0.9412
Hypercholesterolemia	0.1530	-	-	-

OR, odds ratio; CI, confidence interval; SE, standard error.

reflects the careful preoperative management of such high risk patients, focused in particular on coronary artery disease (CAD). CAD increases with age and it is diagnosed in 60% of patients with AAA.¹⁸ CAD is reported to be the first cause of death in older patients that underwent AAA surgical repair⁸ and some studies report that 5-year survival rate for patients with documented CAD at the time of AAA surgery is at least 10% less than patients without CAD.^{18,19} On this basis, the preoperative evaluation of cardiac function is essential to avoid cardiac morbidity and mortality after AAA surgery and we agree with authors who advocate aggressive treatment of coronary disease before AAA surgery to avoid any myocardial complication.¹⁸⁻²⁰ Our cardiac screening before surgery in high risk patients includes resting electrocardiogram (ECG) trans-thoracic Doppler echocardiography and echo stress test with dobutamine. The next step for patients with positive screening includes coronary angiography and subsequent medical or surgical therapy. This aggressive screening protocol reduced the perioperative cardiac mortality and morbidity in a cohort with coronary disease in 22.6% of patients. This number is lower than those reported in other studies on octogenarians but it probably reflects the selection made by physicians before referring patients to our Institute.²¹ All the octogenarians included in this study were in good health condition, with an active life and a perceived life expectancy higher than the octogenarians' average life expectancy. We think that physicians selected patients with a longer life expectancy, preferring medical therapy in patients with comorbidities and worst health conditions.¹⁵ However, 6.5% of patients were referred to cardiac surgery for myocardial revascularization prior to vascular surgery and in all these cases CAD was not diagnosed before. This underlines the important role of cardiac screening and an aggressive therapeutic approach.^{11,15-17,22} With careful case selection, surgery for AAA can be undertaken in octogenarians with operative mortality rates similar to those of patients under 80 years old.²²

Postoperative complications were registered in seven patients (22.6%). This figure is similar to those of other studies.^{8,21} The more common complication was acute renal failure, but in all cases, it required only medical therapy, without dialysis. Analysis of long-term follow up reveals that surgery for AAA did not affect long-term mortality. Survival was $84 \pm 7\%$ and $48 \pm 21\%$ at 48 and 96 months, respectively. This outcome compares favorably with other studies.^{8,22} Moreover, the actuarial freedom from aneurysm-related death was

96 ± 4% at 96 months which compares favorably with studies of conservative therapy.^{23,24}

Multivariate analysis of preoperative data demonstrated that the only independent risk factor for mortality in patients older than 80 years undergoing AAA surgery was coronary artery disease. In our study, only patients with a prior diagnosis of CAD had cardio-protective therapy including acetylsalicylic acid, beta-blockers or ACE inhibitors. Secondary and tertiary prevention of CAD are essential to slow the evolution of disease and control subsequent morbidity and mortality. Moreover, although cholesterol is not an independent risk factor in our cohort, we think that its strict medical control can help to prevent CAD and CAD progression.

The role of cardiac screening prior to AAA surgery was previously underlined.²⁵⁻²⁷ Patients at risk of developing cardiac complication have to be identified and the appropriate medical or surgical therapy has to be initiated before AAA surgery.²⁵⁻²⁷ Age greater than 70 years is a risk factor for cardiac events and for this reason we decided to choose an aggressive policy of cardiac risk assessment for octogenarians, screening with echocardiogram and echo stress test and reserving coronary angiography for patients with abnormalities.

This study is prospective but it is not randomized. Our cohort is composed of patients undergoing elective surgery in all but one case and it cannot represent the subgroup of patients undergoing emergency procedures. Bigger numbers of patients are required to more precisely assess the determinants of outcome in this age group.

In conclusion, we recommend surgical repair of AAA in selected octogenarians. To reduce cardiac mortality and morbidity it is necessary to carefully preoperative screen patients prior to surgery.

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