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Acute type A dissection in octogenarians: does emergency surgery impact in-hospital outcome or long-term survival?†

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Abstract

OBJECTIVES: Surgical therapy for acute aortic dissection type A (AADA) in octogenarians carries high morbidity and mortality. The role of isolated medical treatment in this setting is controversial. The aim of this study is to determine whether risk of surgery for AADA outweighs risk of death from medical treatment only.

METHODS: From 2002 to 2015, 90 consecutive octogenarians (mean age, 83.5 ± 3 years) were treated for AADA at three institutions: 67 patients underwent surgery, 23 patients received medical treatment. Analysis of early and late outcome was performed.

RESULTS: Patients in the medical treatment group were significantly older than in the surgical group (84.9 ± 3.7 vs 83 ± 2.5 years, $P = 0.008$) and in a more critical state. In patients undergoing surgical repair, perioperative mortality was 14.9% ($n = 10$). Rate of prolonged ventilation (63.2% vs 5.9%; $P < 0.001$) and renal failure (35.1% vs 5.9%, $P = 0.029$) was significantly higher in the surgical group. Thirty-day survival was impaired in the medical treatment group (34.8% vs 61.2% in the surgical group; $P = 0.032$). Coronary artery disease (OR 3.95, 95% CI 1.16–13.49; $P = 0.029$) and complicated dissections (OR 5.28, 95% CI 1.48–18.88; $P = 0.010$)—composite variable of preoperative resuscitation, neurological injury and malperfusion—emerged as independent risk factors for 30-day mortality in the surgical group. There was no difference in long-term survival.

CONCLUSIONS: Emergency surgery for AADA in octogenarians is associated with relatively high intraoperative mortality and may reasonably be avoided in patient with complicated presentation. Despite better immediate survival after surgery, long-term survival does not differ between medical and surgical patients, reflecting the extremely advanced point in life cycle octogenarians.

Keywords: Octogenarians • Type A aortic dissection • Surgery • Medical treatment • Survival benefit

INTRODUCTION

The steadily increasing life expectancy carries substantial increase of octogenarians in Western society (up to 3-fold by 2050, according to recent data of the US Census Bureau) [1]. Concurrently, the number of elderly patients undergoing elective as well as emergent cardiac surgical procedures is increasing. A population-based study by Howard *et al.* [2] predicts a proportion of patients over the age of 75 suffering from aortic dissection of over 50% in future years. Surgical therapy for acute aortic dissection type A (AADA) in octogenarians carries high morbidity and mortality. In order to improve the outcome of such advanced age patients, a modified surgical treatment towards a less invasive replacement has been suggested [3]. Although the literature still considers surgery as the primary option, little is known about outcome of AADA in octogenarians when treated medically [4–7]. Therefore, this study compares early and late outcome in octogenarians suffering from AAD undergoing either medical or surgical treatment. The aim of this study is to determine whether risk of surgery for AADA outweighs risk of death from medical treatment only.

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MATERIALS AND METHODS

Study design

Three institutional surgical databases (Department for Cardiac Surgery, Medical University Innsbruck/Austria, Department for

Table 1: Baseline characteristics and preoperative data

Variable	Surgical treatment (*n* = 67)	Medical treatment (*n* =23)	*P*-value
Age (years)	83.0 ± 2.5	84.9 ± 3.7	**0.008**
Male sex	33 (43.3)	10 (43.5)	0.809
Body mass index (m^2)	26.1 ± 5.3	28.1 ± 7.8	0.211
Comorbidities			
Hypertension	54 (80.6)	19 (82.6)	1.000
Diabetes	15 (22.4)	2 (9.1)	0.221*
Coronary artery disease	18 (26.9)	9 (40.9)	0.285
Hyperlipidaemia	24 (37.3)	12 (54.5)	0.213
Peripheral vascular disease	9 (13.4)	0 (0)	0.105*
Preoperative creatinine level	1.4 ± 1	1.4 ± 1	0.959
Previous cerebrovascular accident	6 (8.9)	4 (18.2)	0.260*
COPD	8 (11.9)	7 (31.8)	**0.047***
De Bakey classification			
Type I	36 (53.7)	15 (65.2)	0.465
Type II	31 (46.3)	8 (34.8)	0.465
Malperfusion syndrome	11 (16.7)	7 (30.4)	0.226*
Neurological symptoms at presentation	6 (9.1)	6 (26.1)	0.069*
Preoperative intubation	5 (7.6)	5 (21.7)	0.116*
Pericardial effusion	24 (35.8)	17 (73.9)	**0.003**
Tamponade	20 (29.9)	4 (17.4)	0.287
Preoperative CPR	5 (7.6)	1 (4.3)	1.000*
Redo surgery	8 (11.9)	4 (17.4)	0.494*

COPD: chronic obstructive pulmonary disease; CPR: cardiopulmonary resuscitation. Results are given in mumber (%) or mean ± standard deviation. Significance level (for bold values) was $P < 0.05$.
*P-value based on Fisher's exact test.

Cardiac Surgery, Leipzig Heart Centre/Germany, Yale Aortic Institute, New Haven/USA) were retrospectively reviewed to identify patients aged older than 80 years suffering from AADA between 2002 and 2015. Patients' charts and imaging data were analysed and survival follow-up was evaluated. The institutional review boards approved this study.

Between January 2002 and August 2015, a total of 90 octogenarians (mean age, 83.5 ± 3 years) were admitted due to AADA to three international institutions. Patients were divided into two groups based on the treatment ($n = 67$ surgical treatment, $n = 23$ medical therapy). Patient characteristics are listed in Table 1.

Treatment groups

All patients were evaluated by a cardiac surgeon. The decision for surgical or medical treatment was primarily driven by the patient's condition at presentation and comorbidities. After evaluation of imaging studies and risk assessment, risks and benefits of surgical treatment were explained to the patients and their families and a final decision was made.

If surgical treatment was therapy of choice, the patient was taken to the operation room and induction of anaesthesia was performed immediately. Once cardiopulmonary bypass (CPB) was established, systemic cooling was initiated. Depending on the extent of the dissection and the surgeon's consideration, the distal anastomosis was either performed via aortic cross clamping or in an open fashion during circulatory arrest. After careful evaluation of the primary entry site, replacement of the aortic root, the ascending aorta, the aortic arch or a combination of these structures was performed. Aortic arch replacement was performed in case of a pre-existing arch aneurysm or an entry tear or ulceration located in the convexity of the aortic arch, which could not be excluded by partial arch replacement.

In case of medical therapy, all patients were initially shifted to the intensive care unit. Once haemodynamic monitoring was instituted, hypertensive patients received intravenous vasodilators and beta-blockers in order to decrease blood pressure and vascular stress. In addition, pain medication or light sedation was administered to achieve maximal comfort for the patient.

Outcome and follow-up analysis

Patients who died intraoperatively or within 24 h postoperatively were defined as early deaths ($n = 16$, 17.8%). Renal failure was defined as the need for either haemofiltration or dialysis due to acute renal insufficiency. Tracheotomy was performed in patients with prolonged ventilator support and failure to be weaned from the respirator. Postoperative neurological injury was defined as permanent new neurological deficit and/or brain injury detected on computed tomography (CT) or magnetic resonance imaging (MRI) scan. Follow-up information was obtained using Social Security Death Index, telephone interviews or outpatient clinic visits.

Statistical analysis

Statistical analysis was performed using SPSS 23.0 (SPSS Inc., Chicago, IL, USA). Categorical variables are expressed as frequency distributions and percentages; continuous variables are expressed as mean ± standard deviation. Chi-square test was used for categorical variables. If observed frequencies were <5, Fisher's exact test was used for categorical variables. Student's *t*-test was applied for continuous variables.

In order to adjust for selection bias a regression model was created for 30-day mortality as well as overall mortality: all factors showing significant difference between the two treatment groups in univariable analysis or $P < 0.10$ were considered for multivariable analysis. Multivariable analysis did not remain statistically significant after adjusting for the following factors: age, chronic obstructive pulmonary disease (COPD), pericardial effusion and preoperative neurology (Table 2).

Factors influencing 30-day mortality in the surgical group were explored by separate univariable analysis in a first step. Factors showing significant influence or clinical relevance were then taken to multivariable analysis using logistic regression. For description of long-term survival Kaplan–Meier curves were calculated; groups were tested by log-rank and Gehan–Breslow–Wilcoxon test to determine differences in early and long-term survival. Differences in survival rates during the early period are reflected by Gehan–Breslow–Wilcoxon test, whereas P-value of log-rank test is based on differences in long-term survival.

For comparing survival after discharge with expected survival of an age- and gender-adjusted normal population, each patient was individually matched and followed according to life-table survival data from the Centers of Disease Control and Prevention for intercensal years 2000 [8]. A single-sample log-rank test was employed for assessing the difference between operative and expected survivals. The life-table year was selected to correspond to the mean and median year of surgery.

RESULTS

Patient characteristics

Female gender was predominant in both treatment groups. Patients in the medical treatment group were significantly older than surgical patients. In terms of risk factors and comorbidities groups only differed in rate of COPD. Patients in the medical treatment group were in a more critical state at point of admission with significantly higher rates of pericardial effusion and a strong trend towards more neurological symptoms. Details are given in Table 1.

Surgical therapy

Out of 67 patients in the surgical treatment group, three patients (4.5%) died from aortic rupture during induction of general anaesthesia and before initiation of CPB could be performed.

In most patients, arterial cannulation was performed through the right axillary artery ($n = 32$, 50%) or the femoral artery ($n = 22$, 34.4%). The ascending aorta was used for cannulation only in rare cases ($n = 10$, 15.6%). In most patients ($n = 52$, 81.3%), deep (18–21 °C) or moderate (24–27 °C) hypothermic circulatory arrest was performed in order to allow an open distal anastomosis. Mean circulatory arrest time was 25.3 ± 18.5 min. In 12 patients (18.8%), a less invasive quick replacement was performed via aortic cross clamping. Most of these patients ($n = 8$, 66.7%) presented with De Bakey type II dissections. For all patients, mean aortic cross clamp time was 90 ± 48.6 min, mean CPB time was 177.6 ± 69.1 min. An isolated ascending replacement was performed in most patients ($n = 52$, 81.3%). Root replacement was necessary in six patients (9.4%) and six more patients (9.4%) needed supplemental aortic valve replacement. Aortic arch replacement was limited to eight patients (12.5%) and coronary artery bypass grafting to 10 (15.6%).

In-hospital outcome

Overall 16 patients (17.8%) died within 24 h after admission to the hospital with no difference between the treatment groups (surgical $n = 10$, 14.9% vs medical $n = 6$, 26.1%; $P = 0.342$). Table 3 gives details on causes of early deaths. In the remaining 74 survivors, prolonged ventilation (more than 48 h) was more frequently necessary in patients undergoing surgical therapy ($n = 36$, 63.2% vs medical $n = 1$, 5.9%; $P < 0.001$); 11 patients (19.3%) underwent tracheotomy after surgical treatment due to weaning

Table 3: Causes of early deaths

Variable	Surgical treatment ($n = 10$)	Medical treatment ($n = 6$)
Aortic rupture	4 (40)	2 (33.3)
Heart failure	4 (40)	3 (50)
Diastolic failure due to tamponade	1 (10)	3 (50)
Coronary malperfusion	3 (30)	0
Hypovolaemic shock	1 (10)	0
Uncontrollable bleeding	2 (20)	0
Multiorgan failure	0	1 (16.7)

Results are given in number (%) or mean ± standard deviation.

Table 2: Multivariate regression analysis for 30-day mortality and Cox regression model for overall survival

	30-Day mortality			Overall survival		
	OR	95% CI	P-value	HR	95% CI	P-value
Surgical treatment	0.62	0.19–2.02	0.426	0.88	0.42–1.82	0.722
Age	1.18	0.99–1.40	0.60	1.09	0.99–1.20	0.068
Pericardial effusion	1.48	0.57–3.82	0.418	1.30	0.74–2.29	0.368
Preoperative neurology	2.49	0.60–10.31	0.208	0.69	0.30–1.58	0.377
COPD	0.98	0.29–3.37	0.980	1.30	0.65–2.61	0.458

CI: confidence interval; COPD: chronic obstructive pulmonary disease; HR: hazard ratio; OR: odds ratio.

Table 4: In-hospital complications

Variable	Surgical treatment	Medical treatment	*P*-value
Ventilation > 48 h	36 (63.2)	1 (5.9)	**<0.001**
Tracheotomy	11 (19.3)	0 (0)	0.059*
Low output syndrome	12 (20.7)	9 (40.9)	0.066
Multiorgan failure	11 (19)	0 (0)	0.060*
Sepsis	5 (8.8)	0 (0)	0.583*
Stroke	11 (20)	2 (10.5)	0.498*
Haemofiltration/haemodialysis	20 (35.1)	1 (5.9)	**0.029***

Results are given in number (%). Significance level (for bold values) was $P < 0.05$.
*P-value based on Fisher's exact test.

failures. Also, rate of renal failure requiring haemofiltration or haemodialysis was significantly higher in the surgical group [$n = 20$, 35.1% vs $n = 1$, 5.9%; $P = 0.029$ (according to Fisher's exact test)]. In 11 patients (19.3%) in the surgical group imaging (CT or MRI scans) revealed strokes. Three of these patients had neurological abnormalities at admission before surgery. Mean ICU as well as in-hospital stay was longer in the surgical group (10.5 ± 1.3 vs 3.8 ± 0.8 days in the medical group; $P = 0.015$ for ICU stay, 15.7 ± 14.2 vs 5.4 ± 4.3 days in the medical group; $P = 0.001$ for in-hospital stay).

Further morbidities are listed in Table 4.

In-hospital mortality did not differ significantly between the groups (32.8% for surgical vs 47.8% for medical treatment; $P = 0.218$). However, 30-day mortality was significantly higher in the medical treatment group (65.2% vs 38.8% in the surgical group; $P = 0.032$).

Age-adjusted multivariable analysis identified coronary artery disease (OR 3.95, 95% CI 1.16–13.49; $P = 0.029$) and complicated AADA (OR 5.28, 95% CI 1.48–18.88; $P = 0.010$)—defined as a composite variable including preoperative cardiopulmonary resuscitation, preoperative neurological injury or preoperative malperfusion syndrome—as independent risk factors for 30-day mortality in patients undergoing surgical treatment.

Late survival

Mean follow-up period was 19.6 ± 32.2 months. Overall survival of octogenarians suffering from AADA, regardless of treatment, was 42.7 ± 5.3%, 33.1 ± 5.4% and 26 ± 5.6% at 1, 3 and 5 years. Figure 1 illustrates impaired overall survival in octogenarians suffering from AADA when compared with an age- and gender-matched control.

Surgical treatment leads to improved survival when compared with medical treatment (Breslow $P = 0.030$), with 1- and 3-year survival of 48.5 ± 6.2% and 37.5 ± 6.5% for the surgical group and 25.4 ± 9.2% and 19 ± 8.8% in the medical group. Beyond 5 years, survival does not differ between the two treatment groups (log-rank $P = 0.077$). Further details are shown in Fig. 2.

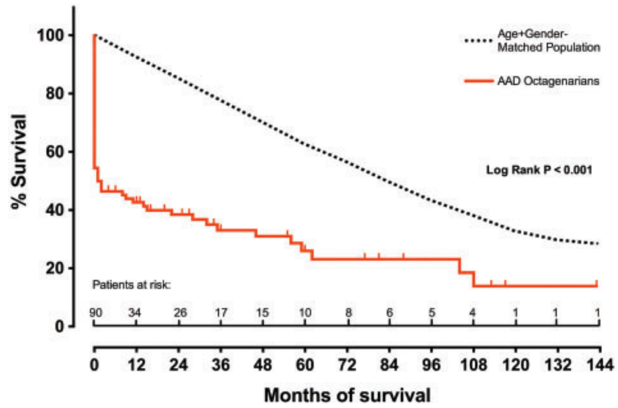

Figure 1: Actuarial survival of octogenarians suffering from acute aortic dissection type A compared with age- and gender-matched US population.

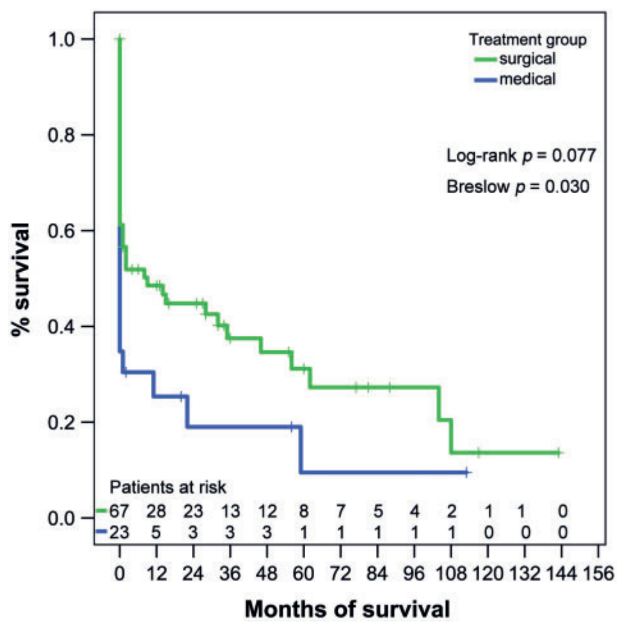

Figure 2: Overall survival of octogenarians suffering from acute aortic dissection type A undergoing surgical repair versus medical treatment.

DISCUSSION

This study presents the experiences of three large and specialized aortic centres in Europe and North America and thus reflects one of the largest octogenarian cohorts suffering such disease. The natural course and prognosis of AADA is known to be devastating; complications often occur before admission or in an early phase, frequently associated with fatal outcome.

Octogenarians with AADA are frequently in a severe clinical state when admitted to the hospital and carry a broad spectrum of comorbidities due to their age. A multicentre study by Piccardo *et al.* [6] reports a rate of complicated dissections (defined as neurological deficits, mesenteric ischaemia or cardiopulmonary resuscitation) of 20.2%. The extent of early complications is also confirmed by Neri *et al.* [7], showing high rates of organ malperfusion (up to 41%) or cardiac tamponade (in 62%) of octogenarians. The impact of organ malperfusion or haemodynamic instability is severe, even more so in this advanced age population [9, 10].

In this study, beside presence of coronary artery disease, complicated dissection emerged as independent risk factors for 30-day mortality after operative repair in this study, emphasizing the importance of the preoperative state of the patients. These factors reflect the surgeon's dilemma of finding a reasonable

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treatment for a fragile patient already suffering from complications of a lethal cardiovascular disease.

Although the role of surgical treatment of AADA in octogenarians has been controversial, most centres still promote surgery as the best treatment option for AADA in octogenarians based on the dismal natural history of the disease. However, surgical therapy for AADA is associated with high intra- or perioperative mortality in octogenarians, with in-hospital mortality rates up to 83% [7]. Almost 15% of patients expired during surgery in the present series, whereas other groups report even higher rates up to 33% [7]. High surgical mortality results most frequently from either aortic rupture or uncontrollable bleeding. Although survival is the primary aim of surgical treatment of AADA patients, surgeons need to recognize that aggressive therapy still leads to lethal outcome in many octogenarians. In patients at this age, the combination of preoperative conditions (comorbidities and complications), age and frailty themselves inflict poor early outcome.

Medical treatment as an alternative option for AADA is often preferred in patients with advanced age or multiple comorbidities but is associated with very poor outcome. In this study cohort, age was an important but not the only criteria for medical treatment. Factors influencing surgeons to recommend or choose medical treatment were either comorbidities or the patient's status at admission (neurological impairment, intubation or resuscitation before admission). In almost 30% it was the patient or the patient's family, who declined surgical repair. Survival rates of only 70–72% within the first 24 h after the event reflect the grave natural prognosis of the disease [11, 12]. Data from the International Registry of Acute Aortic Dissection revealed a 30-day mortality of 58% in patients treated medically, regardless of age [12]. The role of medical treatment especially in elderly patients has been investigated in very small cohorts only. Trimarchi *et al.* [5] reported an in-hospital mortality of 55% in 29 octogenarians receiving medical treatment. Slightly higher in-hospital death rates have been found by Yanagisawa (57%) and Hata (60.7%) as well as this study (65.7%) [13, 14].

However, in this study, we found 30-day survival was significantly better in the surgical group, although postoperative complications were high in surgical patients. In AADA and especially in older patients with limited capacity, the first few days after surgical repair seem to divide survivors from non-survivor. In-hospital outcome was dismal in both treatment groups and early postoperative mortality rates were tremendously high. Nevertheless, once surgical patients could be stabilized in the early postoperative phase, survival improved in contrast to patients receiving medical treatment. Thirty-day survival data reflect this trend in both treatment groups. Unfortunately, survival in surgical patients was accompanied with high rates of postoperative complications. In addition to a trend towards higher rates of strokes, more than 35% of patients in the surgical group suffered from renal failure requiring haemofiltration or dialysis. Obviously, these complications do significantly impact quality of life.

Although the usual measures of treatment outcome (postoperative morbidity, mortality and survival) favour surgical therapy, regenerative capacity also becomes a limiting and striking factor in the elderly. A complete restoration of autonomous life postoperatively is highly doubtful, as shown previously [15]. Given these circumstances and the finding of our study, conservative treatment for AADA in the elderly may be appropriate in many cases, especially with comorbidities or complicated initial presentation.

Limitations of the study

This study has a number of limitations. First, data acquisition and analysis in the different databases was done retrospectively. Second, despite the multicentricity of the study, the absolute number of patients remains small. Especially the group of octogenarians receiving medical treatment is limited. Therefore, uni- or multivariable calculations of risk factors for hospital mortality could only be performed for the surgical group. Third, only octogenarians who were admitted or referred to the three study centres alive were included. The hospital databases miss the substantial proportion of octogenarians suffering from AADA but expiring at home or on the way to the hospital. Fourth, follow-up period was limited due to the advanced age of the study population. Survival was the only study end-point evaluated in the follow-up period. Quality of life and functional outcome would be interesting factors to be evaluated. Most importantly, the choice of treatment—medical versus surgical—was not randomized. This certainly accounts for a strong selection bias in the study, reflecting the consulting surgeon's assessment of the patient's chances of surviving surgery and deeming the more seriously ill population into the medical treatment group.

CONCLUSIONS

We compared medical and surgical treatment of acute ascending aortic dissection in octogenarians. Surgical treatment is associated with lower 30-day mortality rates and better early survival when compared with medical treatment. Long-term survival beyond 5 years does not differ, reflecting the extremely advanced age point in the life cycle. Individualized preoperative evaluation and selection of these patients remain essential. Respecting and accepting the disease—acute ascending aortic dissection—as a potential mode of death should be considered, especially in complicated dissections. Medical treatment represents a reasonable option in octogenarians.

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