Outcomes in the current surgical era following operative repair of acute Type A aortic dissection in the elderly: a single-institutional experience


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Abstract

OBJECTIVES: We reviewed our single-centre experience with emergent operative repair of Stanford Type A aortic dissections, with particular attention to outcomes in the elderly.

METHODS: Consecutive adult patients undergoing emergent operative repair of acute Type A aortic dissections between February 2004 and December 2011 at a single institution were identified. Patients were stratified into elderly (≥70 years) and control cohorts (<70 years). Kaplan–Meier analysis was used to evaluate survival.

RESULTS: A total of 117 patients undergoing emergent repair of Type A aortic dissection were identified during the study period, including 31 (26.5%) elderly and 86 (73.5%) control patients. The mean age in the elderly cohort was 78.0 ± 4.7 years, with 41.9% (13 of 31) being 80 years or older. The elderly and control groups were well matched with regard to preoperative comorbidities (each \( P > 0.05 \)) and the presence of malperfusion at presentation (elderly: 19.4 vs controls: 27.9%, \( P = 0.35 \)). The most common site of tear involved the proximal ascending aorta (elderly: 83.9 vs controls: 84.9%), with fewer cases affecting the aortic arch (12.9 vs 14.0%; \( P = 0.75 \)). Operative data, including cardiopulmonary bypass and aortic cross-clamp time, concomitant aortic valve procedures and arch replacement were also similar between cohorts. Fewer elderly patients underwent hypothermic circulatory arrest (67.7 vs 90.7%, \( P = 0.002 \)). Overall survival to discharge was 87.2% (n = 102), with no difference in the elderly (83.9%; n = 26) vs controls (88.4%; n = 76; \( P = 0.52 \)). The 30-day (elderly: 82.8 vs controls: 86.2%), 90-day (elderly: 79.0 vs controls: 84.8%) and 1-year (elderly: 75.4 vs controls: 84.8%) survivals were also comparable.

CONCLUSIONS: Excellent operative outcomes can be achieved in elderly patients undergoing emergent repair of Type A aortic dissections. Advanced patient age should therefore not serve as an absolute contraindication to operative repair in this high-risk cohort.

Keywords: Aortic dissection • Elderly • Great vessels

INTRODUCTION

The accurate and timely diagnosis of a Type A aortic dissection (AAD) is critical in impacting the ultimate natural course of the disease process. Although AAD is rare—estimated at an incidence of roughly 3 cases per 100 000 person years—it is often lethal, with an in-hospital mortality rate ranging between 16 and 83% [1–9]. There is a 1% per hour risk of death, and prompt operative intervention reduces the risk of mortality by over half [2,10].

Despite the establishment of the International Registry of Acute Aortic Dissection (IRAD) to gain ‘new insights into an old disease’, much debate and controversy still exist. Specifically, are there any patients for whom an operative intervention should not be offered—either due to advanced age or advanced presentation with malperfusion? What is the best optimal technique for cerebral protection? Should all AAD be treated in a tertiary-care centre with a multidisciplinary emphasis? And, what is the best method for preventing patent false lumens with chronic aneurysmal deformation of the aorta? [2,11–17].

In our present study, we sought to investigate whether or not a definitive age criterion should be set for surgical repair—simply, is it reasonable to offer surgery to patients who are >70 years of age? Conclusions from previous studies have ranged from not offering surgical therapy to patients >80 years of age to offering surgical intervention to all patients regardless of age [3, 5, 7, 8]. It has been our institutional bias to perform surgical repair for all patients as long as the comorbidities are not prohibitive, and it is the patient’s or patient’s representatives wish whether to proceed; a good quality of life is expected post-repair. In this study, we examine our contemporary single-centre results with surgical repair of AAD in the elderly.
MATERIALS AND METHODS

Study population

We retrospectively reviewed the medical records of 117 consecutive adult patients who underwent emergent operative repair of acute AADs between 1 February 2004 and 1 December 2011 at our institution. The study was approved by the institutional review board at the Ohio State University with a waiver of need for individual consent. Acute Stanford AAD was defined as the presence of a dissection flap in the ascending aorta proximal to the left subclavian artery presenting within 14 days of the onset of symptoms. Diagnosis was made based on clinical history and imaging and confirmed by intraoperative surgical record. Patients younger than 18 years of age were excluded from the study.

Data collection

Patients identified for this study were stratified into elderly (≥70 years) and control cohorts (<70 years). All preoperative, intraoperative and postoperative variables were collected retrospectively for both groups, and analysis was conducted through chart review and subsequent statistical evaluation.

Statistical methods

Pre- and intraoperative variables, including demographics, comorbidities, presence of malperfusion, cannulation technique, location and extent of tear, type of operative repair and length of cross-clamp time, cardiopulmonary bypass and/or hypothermic circulatory arrest were obtained. Primary outcomes were survival to discharge, postoperative renal failure requiring dialysis and stroke. Secondary outcomes included 30-day, 1-year and 5-year survival. An additional secondary outcome was the need for aortic reoperation.

The pre- and intraoperative variables listed above were initially compared between the elderly and control cohorts. Primary and secondary outcomes were also compared between groups. In addition, Kaplan–Meier survival analyses were conducted with end-points of 30 days, 1 year and 5 years, and survival at these time points for elderly and control patients were compared using the log-rank test. The Student’s t-test was used to compare continuous variables, and the Fisher’s exact test or χ² was used for categorical data. All statistical analyses were performed using STATA statistical software version 11 (StataCorp LP, College Station, TX, USA).

RESULTS

Patient preoperative characteristics

The baseline characteristics of the 117 patients in our study are summarized in Table 1. The mean age of the study population was 60.1 ± 13.4 years. Of these patients, 31 (26.5%) were aged 70 years or older. The mean age in the elderly cohort was 78.0 ± 4.7 years, including 13 of 31 (41.9%) patients who were aged 80 years or older. In the total study population, 85 (72.6%) were males and 32 (27.4%) were females. African-American patients constituted 18.8% of the patients who underwent surgery. The mean body mass index (BMI) was 30.8 ± 6.3 kg/m².

A significant number of patients in our study had associated comorbidities at the time of admission. The most common comorbidity was hypertension, comprising 110 of 117 (94%). Diabetes mellitus was present in 32 (27.4%) patients, hyperlipidaemia in 48 (41%) and peripheral arterial disease in 12 (10.3%). Malperfusion at the time of admission was present in 30 (25.6%) patients. A majority (53.8%) of the patients also had a history of smoking. The elderly and control groups were well matched with regard to preoperative comorbidities. There was no significant difference in presentation of concomitant disease (Table 1, all P > 0.05) or the presence of malperfusion (elderly: 19.4 vs controls: 27.8%; P = 0.35).

Intraoperative characteristics

Operative data for all patients are presented in Table 2. Blood in the pericardium was present in 33.3% of cases. Overall, the most common site of tear involved the proximal ascending aorta (84.6%). There was no significant difference in origin of the dissection between the elderly (83.9%) and control (84.9%) groups. Several cases also had aortic arch involvement (13.7%), but there was no significant difference between the two groups (elderly: 12.9 vs control: 14.0%; P = 0.75). Retrograde dissection involving the ascending aorta was observed in 2 (1.7%) patients.

Replacement of the ascending aorta with a tube graft constituted the vast majority of procedures (98.3%), with concomitant
aortic valve procedures conducted in 35.9% of cases and arch replacement in 19.7%. Axillary cannulation was most commonly employed (51.3%), followed by femoral cannulation (35.9%). Cardiopulmonary bypass and aortic cross-clamp time, concomitant aortic valve procedures and arch replacement were similar between cohorts, except that fewer elderly patients underwent hypothermic circulatory arrest (elderly: 67.7% vs control: 90.7%; \( P = 0.55 \)).

### Postoperative outcomes

Overall, 33% of patients developed a major complication following surgery. Both cohorts showed similar rates of morbidity (elderly: 38.7% vs control: 31.4%; \( P = 0.51 \)). Stroke was a common complication (overall: 16.2%). Reoperation was warranted in 16.2% of cases, with median survival being the most common procedure. Postoperative renal failure requiring haemodialysis was observed in a minority of patients (control: 5.8% vs elderly: 3.2%; \( P = 0.58 \)). There were no significant differences between the cohorts for rates of stroke, early reoperation or renal failure.

Postoperative outcomes are summarized in Table 3. Overall survival to discharge was 87.2% \((n = 102)\), with no difference \((P = 0.52)\) in the elderly \((83.9%; n = 26)\) vs controls \((88.4%; n = 76)\). The overall average length of hospitalization was 15.7 ± 11.6 days, with no difference between the cohorts. Overall, 30-day, 1-year and 5-year survival rates were 85.5, 79.8 and 53.3%, respectively. Kaplan–Meier analysis (Fig. 1) indicated comparable 30-day (elderly: 82.8 vs controls: 86.2%), 90-day (elderly: 79.0 vs controls: 84.8%) and 1-year (elderly: 75.4 vs controls: 84.8%) survival \((P = 0.25)\). Late reoperation was needed in several cases, most commonly to address pseudoaneurysms, but there was no significant difference between the two groups (elderly: 6.5 vs control: 8.1%, \( P = 0.99 \)).

### COMMENT

As the population ages worldwide and in the USA, the limits of when to offer a particular intervention are being thrust into the forefront of the surgical literature. The threshold of age and whether or not this alone should serve as a contraindication to high-risk procedures are not well defined in many instances, including AAD. As such, it is important to evaluate outcomes of emergent operative repair for AAD in the elderly. We are able to demonstrate that, even in the elderly population, an excellent 1-year postoperative survival (75.4%) can be attained. Indeed, one of the early conclusions drawn from the first IRAD paper was the importance of age ≥70 years as a predictor of in-hospital death \([4]\). Since this reporting in 2002, there have been a handful of reports concentrating on the significance of age as it relates to expected mortality from surgical repair \([3, 5–7, 16, 18–21]\). Although initially in favour of not operating on octogenarians, the surgical pendulum has shifted towards an operation being satisfactory in both the immediate and mid-term periods in the elderly population \([8, 16, 21]\).

In one of the earlier papers on the topic, Neri et al. \([3]\) looked at AAD repairs in octogenarians \((n = 24)\) and concluded that a 30-day hospital mortality of 83% and an in-hospital mortality of 33% were too high, and that older patients should not be offered surgical repair. Subsequently, age >70 as an independent predictor of in-hospital mortality with an odds ratio of 1.7 has been shown in two separate analysis of the IRAD database by Mehta et al. \([4]\) and Trimarchi et al. \([6]\). Interestingly, the same analysis showed a decreased in-hospital mortality of 37.9 vs
Table 3: Postoperative outcomes comparing the control group (age <70 years old) and the elderly (age ≥70 years old)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Controls (N = 86)</th>
<th>Elderly (N = 31)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall major complications</td>
<td>27 (31.4%)</td>
<td>12 (38.7%)</td>
<td>0.51</td>
</tr>
<tr>
<td>Stroke</td>
<td>13 (15.1%)</td>
<td>6 (19.4%)</td>
<td>0.58</td>
</tr>
<tr>
<td>Renal failure requiring dialysis</td>
<td>5 (5.8%)</td>
<td>1 (3.2%)</td>
<td>0.58</td>
</tr>
<tr>
<td>Reoperation</td>
<td>13 (15.1%)</td>
<td>6 (19.4%)</td>
<td>0.78</td>
</tr>
<tr>
<td>Mediastinal re-expansion</td>
<td>6 (7.0%)</td>
<td>3 (9.7%)</td>
<td></td>
</tr>
<tr>
<td>Lower extremity embolectomy</td>
<td>3 (3.5%)</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Femoral cannulation site</td>
<td>2 (2.3%)</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Bowel resection</td>
<td>2 (2.3%)</td>
<td>2 (6.5%)</td>
<td></td>
</tr>
<tr>
<td>Pulmonary embolectomy</td>
<td>0</td>
<td>1 (3.2%)</td>
<td></td>
</tr>
<tr>
<td>Length of hospitalization (days)</td>
<td>14.0 ± 12.1</td>
<td>15.9 ± 9.7</td>
<td>0.43</td>
</tr>
<tr>
<td>Survival to discharge</td>
<td>76 (88.4%)</td>
<td>26 (83.9%)</td>
<td>0.52</td>
</tr>
<tr>
<td>Mean follow-up (years)</td>
<td>2.7 ± 2.5</td>
<td>2.7 ± 2.5</td>
<td>0.99</td>
</tr>
<tr>
<td>Late reoperation</td>
<td>7 (8.1%)</td>
<td>2 (6.5%)</td>
<td>0.99</td>
</tr>
<tr>
<td>Pseudoaneurysm</td>
<td>4 (4.7%)</td>
<td>1 (3.2%)</td>
<td></td>
</tr>
<tr>
<td>Endocarditis/root abscess</td>
<td>1 (1.2%)</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Distal aortic tear</td>
<td>1 (1.2%)</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Aortic valve replacement</td>
<td>1 (1.2%)</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Aortic arch repair</td>
<td>0</td>
<td>1 (3.2%)</td>
<td></td>
</tr>
</tbody>
</table>

A P-value ≤0.05 was considered to be statistically significant.

Figure 1: A Kaplan–Meier survival curve for the control group (age <70 years old) vs the elderly group (age ≥70 years old).

55.2% for patients aged ≥80 who were treated surgically vs medically; however, this did not reach statistical significance (P = 0.19) [6]. Similar findings utilizing the German Registry for Acute Aortic Dissection Type A (GERAADA) were reported by Rybiski et al. [7]. They reported a 30-day mortality of 35% in the surgically treated group vs a 75% mortality in the non-operative octogenarian group (n = 83). In septuagenarians, a 16% 30-day mortality (n = 381) was reported, and their conclusion was that emergency operation is acceptable in septuagenarians, and individualized decisions should be made regarding octogenarians. Hata et al. [5] reported their experience at Nihon University of 58 octogenarians, 30 of whom underwent emergency surgery and 28 of whom underwent non-operative management. In-hospital mortality was 13.3% for the surgical group and 60.7% for the non-operative group. Their conclusion was that emergency surgery should be offered to these patients as long as there was consensus between the patient, family and surgeons with a well-defined understanding of expected outcomes and potential complications. Most recently, a meta-analysis of nine studies by Biancari et al. [8] found satisfactory immediate survival rates of 36.7% (n = 308) in those aged greater than 80 years, and concluded that more information is needed on the treatment burden and quality of life to make recommendations.

In looking at our retrospective review of patients, we identified a subgroup of patients who were in their ninth decade of life with a mean age of 82.8 ± 2.2 years (n = 13). Ten (76.9%) of the 13 patients survived to discharge at a hospital stay of 11.6 ± 6.5 days. Although this is a small sample, it adds to the literature regarding the feasibility of operating on this subgroup of elderly patients. Remarkably, all 10 patients were alive at 1-year follow-up.

This short-term benefit may be attributable in some way to the risk-averse nature of operating on patients over 80 years. Though there was no statistical difference between the nature of the operations with regard to cardiopulmonary bypass and aortic cross-clamp time, concomitant aortic valve procedures and arch replacement between the cohorts, there were fewer elderly patients undergoing reconstruction under ‘full’ hypothermic circulatory arrest (67.7 vs 90.7%, P = 0.002). To clarify, all patients, regardless of age, were cooled and the aorta opened under hypothermic arrest. However, there seemed to be a surgical decision to proceed with clamping and rewarming more often in the elderly patients rather than performing a ‘full’ open repair as in the younger cohort. This does allow the possibility of long-term consequences of leaving a residual false lumen and highlights the need for mid- and long-term survival data on these patients [22].

The decreased morbidity after AAD repair observed over the past several decades, regardless of age, can undoubtedly be attributed to an improved understanding of the pathophysiology of an acute aortic dissection, the significance of malperfusion and advancements in surgical neuroprotective strategies [23, 24].

In our contemporary review, we report a 30-day surgical mortality near 15% in all patients—lower than the previously reported mortality of ~25% [2]. Our patient population demonstrated the same ubiquitous comorbidity of hypertension (94%)
as reported in the IRAD database [2]. In addition, the mean age at presentation of 60.1 ± 13.4 years is also consistent with the literature. Our institutional approach has always been to offer surgical repair to any patient, regardless of age or presence of malperfusion, on presentation. Although we feel that there is no absolute contraindication with regards to comorbidities to offer operative repair, it is imperative to have a frank discussion with the patient and patient’s representatives. Among other things, the emergent nature of the procedure, the expected mortality rate, establishment of a patient’s baseline function and the patient’s wishes with regard to end-of-life issues should all ideally be discussed before proceeding to the operating room. We report statistically equivalent results with regard to immediate postoperative outcomes, survival and time to discharge in the elderly vs non-elderly cohorts. The favourable initial outcomes in the elderly group are preserved in the mid-term follow-up period with a 1-year survival rate of 75%. Our contemporary, single-institutional review of AAD surgical repair in the elderly adds to the current available literature that is largely derived from institutions outside of North America [3, 5–7, 16, 18–21, 25].

A recent development in the care of the patient with AAD has been the importance of centre volume as well as rapid evaluation and/or transfer to a facility with definitive therapeutic capabilities [9]. As such, within the past year, we have established a Level-1 emergency cardiovascular centre to further improve our outcomes from AAD. Our hope is that, by reviews such as this, we can gain a better understanding of our current institutional biases and outcomes. Through this combined with further subgroup analysis of our outcomes in the malperfused, moribund and sicker patients, we can continue to reduce our mortality and morbidity from this disease process. Preoperative factors that warrant immediate consideration of transfer to a specialized large tertiary-care centre include AAD in the elderly, those with evidence of malperfusion or primary intimal tear involving the aortic arch and those with severe comorbidities. The advantages of a tertiary-care centre lie not necessarily in a better operation, but the availability of ancillary services, including nephrology, respiratory therapy, advanced ventilatory management as well as a dedicated vascular surgery/interventional radiology team. We believe that these data can serve as internal and external benchmarks as endovascular options for the treatment of AAD are becoming available [12]. Furthermore, extrapolating from other aortic pathologies, the options of endovascular and less-invasive approaches would be particularly attractive in older and sicker patients.

Our next step is to ensure that short-term success leads to long-term improvements in survival and quality of life. As such, standardized postoperative surveillance aortic imaging and blood pressure control are imperative. At our institution, we employ computed tomography angiograms with the chest, abdomen and pelvis at time of discharge, 1-month postoperative, serially every 3 months for the first year and then every 6 months thereafter. The importance of serially monitoring and controlling blood pressure postoperatively to decrease $dP/dt$ and to mitigate aneurysmal deformation of any remaining false lumens is important to attain optimal long-term outcomes.

Certainly as we move forward, it will be important to obtain longer follow-up on these patients. It will also be important to obtain quality-of-life data. Finally, it will be interesting to observe what effects frequent surveillance and blood pressure control have in altering the natural disease process that affects so many of these patients after surgical repair.

**Limitations**

There are several limitations to our study. A principal limitation is that our analysis is a single-institution experience, with results that may not be translatable to other centres. Furthermore, the study is subject to Type II error and therefore, it will be important to confirm these findings with larger subsets of elderly patients as our experience grows. A potential discriminating factor between the two cohorts could be the underlying pathophysiology. That is, the younger group of patients may have undetected connective-tissue disorders, making their repair more difficult and the tissue more friable, and have an increased risk for future reinterventions on their aorta. We also did not include quality-of-life or functionality data, although these are certainly important outcomes, particularly with at-risk populations such as the elderly. Finally, there may be variables that could impact outcomes that were not included in our study such as individual surgeon experience, time of surgery as well as quality of housestaff, intensive care unit and nursing staff that contributed to the care of the particular patient.

**CONCLUSIONS**

With the rapidly growing elderly population in the USA, the number of elderly patients with aortic disease presenting for potential surgical intervention will undoubtedly increase. In this study, we reviewed our experience with surgical repair of AAD with a particular emphasis on outcomes in the elderly. We demonstrated that outcomes in patients aged 70 years or older were comparable to those younger than 70 years of age, with the former having a 1-year survival of 75%. These data are encouraging and confirm our intuition that age should not serve as an absolute contraindication to surgical repair of AAD. All patients, barring major comorbidities or an irreversible severe clinical condition, should be offered surgical intervention.

**Conflict of interest**: none declared.

**REFERENCES**


Conflict of interest: none declared.

References


[3] Rylski B, Suedkamp M, Beyersdorf F, Nitsch B, Hoffmann I, Blettner M et al. Operative predictors of mortality are shock at presentation, any pulse deficit and myocardial ischaemia. The German Registry for Acute Aortic Dissection Type A (GERAADA) [3], which gathered data from 44 German centres, also identified age as a predictor of increased mortality. In particular, octogenarians patients showed a significantly higher 30-day mortality rate (odds ratio, 3.23; confidence interval, 1.81-5.72).


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Another controversial and more problematic issue is the presence of brain injury at presentation. This question has recently been re-examined [5], the IRAD extracts solely the impact of brain injury on outcomes in this highly lethal condition. On logistic regression analysis, surgical repair was protective against mortality in patients with cerebral injury (odds ratio, 0.058; p<0.001). Moreover, cerebrovascular accident and coma resolved postoperatively in the majority of cases. According to their findings, the authors stated that patients with acute type A aortic dissection presenting with brain injury should not be contraindicated to surgery.

Considering the spontaneous mortality of the disease, I certainly share their conclusion. However, after the age of 80, surgery should be considered on an individual basis, and sophisticated procedures should be meticulously examined.