Early and Late Outcomes of Surgical Repair for Stanford A Acute Aortic Dissection in Octogenarians

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Background: Because increased age is a strong independent predictor of mortality and morbidity, surgery for octogenarians with Stanford type A aortic dissection (AAD) may be avoided.

Methods and Results: From 2005 to 2015, 158 patients underwent surgical repair for AAD via a median sternotomy. We compared 24 (15.2%) octogenarians (83±3 years) with 134 (84.8%) patients aged ≤79 years (62±13 years), based on retrospectively collected clinical data. Octogenarians were predominantly female (79.2% vs. 44.8%, P=0.0033). Ascending aortic replacement was more frequently performed in the octogenarians (95.8% vs. 65.7%, P=0.0015) and total arch replacement in the younger patients (4.2% vs. 26.9%, P=0.0165). There were 14 hospital deaths among the younger patients, none among the octogenarians (0% vs. 10.4%, P=0.1303), and major morbidity rates were comparable. There were 3 late deaths among the octogenarians and 9 deaths among the younger patients. The respective 1-, 3-, and 5-year survival rates were 94.4%, 81.5%, and 81.5% in the octogenarians and 86.9%, 85.6%, and 83.9% in the younger patients, with no significant differences.

Conclusions: Surgical repair for AAD in octogenarians showed favorable results when compared with a younger patient cohort, with low hospital mortality rate and excellent late outcomes. Therefore, this technique should not be disregarded just because the patient is an octogenarian. (Circ J 2016; 80: 2468–2472)

Key Words: Aortic dissection; Late outcomes; Octogenarians

The increasing life expectancy of the population will be accompanied by a rise in the incidence of cardiovascular diseases, including aortic dissection and aneurysm. Because the Stanford type A aortic dissection (AAD) extending to the ascending aorta is a condition that has an extremely poor prognosis, immediate surgical intervention is indicated once it has been diagnosed. The current AAD hospital mortality rates remain between 15% and 30%, despite gradual improvement over time. Increased age is a strong independent predictor of hospital death following cardiovascular interventions, including the surgical repair of AAD. Surgery for octogenarians with AAD may be avoided or denied because of the high surgical morbidity and mortality reported in elderly patients. A recent meta-analysis of 10 publications from 2001 to 2011 showed an overall mortality rate of 36.7% (111/308) in octogenarians, a 2.6-fold higher mortality risk than that in younger patients. In contrast, some reports have demonstrated satisfactory surgical outcomes of AAD in octogenarians. A recent report also demonstrated that although the number of surgical deaths significantly increased with increased age, it was still better than that with non-surgical therapy. Thus, the effect of age alone on emergency surgery for AAD is not entirely understood. Furthermore, the long-term outcome of surgery for AAD in octogenarians remains uncertain. Therefore, we reviewed the surgical outcomes to investigate and compare the validity of surgery for AAD in octogenarians and younger patients.

Methods
We reviewed our surgical outcomes for patients who underwent surgical treatment for AAD via a median sternotomy at the Department of Cardiovascular Surgery, Fujita Health University, Toyoake, Japan, from 2005 to 2015. According to the Japanese guidelines for aortic dissection, surgery performed within 14 days after the onset of dissection was defined as the acute phase, whereas surgery performed within 48 h was defined as the very acute phase.

We retrospectively reviewed clinical records and data on patient demographics, results of imaging studies, details of medical and surgical treatments, and patients’ outcomes. We...
compared the early and late outcomes following surgical treatment for AAD in 2 groups: octogenarians and a younger group of patients aged ≤79 years. The endpoint was all-cause death. The 30-day mortality and hospital mortality rates were defined as deaths from any cause within 30 days and during hospital stay in Fujita Health University. Follow-up data were obtained from hospital charts, referring physicians of the follow-up institutions, or by direct telephone interviews with the patients or their families. The mean follow-up period was 3.4±3.0 years and was 100% complete. The primary follow-up endpoint was also death from any cause.

Exclusion criteria were patients with a traumatic AD, those who did not receive surgical treatment for AAD, and those who underwent stent grafting or endovascular treatment for descending aorta without a median sternotomy for retrograde dissection from the descending aorta. The institutional review board approved this retrospective observational study, and the approval included a waiver of informed consent.

### Surgical Indications and Technique

We indicated surgical treatment for all patients with AAD requiring surgery according to the following criterion. When a patient or the family refused an operation because the patient was already bedridden because of dementia or paralysis, we did not operate. Otherwise we indicated surgical treatment for all patients.

Patients with a communicating-type AAD with a patent false lumen underwent emergency surgical treatment. Patients with a non-communicating-type AAD with a crescent-shaped thrombosed false lumen were conservatively treated for as long as they were hemodynamically stable. An emergency operation was planned for cardiac tamponade, severe aortic insufficiency, rupture of the aorta, and/or organ malperfusion, even with a non-communicating-type AAD. For the non-communicating type, repeated computed tomography examinations were conducted with contrast medium at 1, 3, 7, 10, and 14 days after the onset of AAD. An urgent operation was scheduled when there was an increased diameter of the ascending aorta (>50 mm) or a thrombosed false lumen (>15 mm) or an ulcer-like projection appeared in the ascending aorta.

The chest was opened via a median sternotomy under general anesthesia. In most cases, the right axillary artery and right or left femoral artery were exposed for arterial cannulation. Cardiopulmonary bypass was established with the above arterial cannulation and cava drainage. The patient was cooled down to 25°C, followed by lower body circulatory arrest with deep hypothermia. Antegrade selective cerebral perfusion was established by axillary perfusion with a clamped brachiocephalic artery and direct cannulation of the left common carotid and subclavian arteries. The main purpose of the operation was to exclude the entry of the dissection. If the entry of the dissection was located in the ascending aorta, we performed an ascending aortic or hemiarch replacement. If the entry was not observed in the ascending aorta, a total arch replacement was selected. In some cases, the “elephant trunk” technique, in which a 5–7-cm prosthetic graft was inserted into the descending aorta, was applied as a total arch replacement. We have been using a commercially available stent graft since 2015 (J-Graft Open Stent Graft; Japan Lifeline Co, Ltd, Tokyo, Japan) in the frozen elephant trunk technique.

### Statistical Analysis

Continuous variables are expressed as mean±standard deviation. Group comparisons were performed with an unpaired two-tailed Student’s t-test for continuous variables, a χ² test for categorical variables, and a Fisher’s χ² test if expected frequencies fell below 5. Survival curves were obtained by the Kaplan-Meier life table method (Mantel-Cox), and statistical analysis was performed using the log-rank test. A P value <0.05 was considered statistically significant. Data were analyzed using StatView 5.0 for Windows (SAS Institute, Inc, Cary, NC, USA).

### Results

#### Patient Demographics (Table 1)

From 2005 to 2015, a total of 158 patients underwent surgical treatment for AAD. Of them, 24 (15.2%) were octogenarians and 134 (84.8%) were aged ≤79 years. The average age was 83±3 (80–89) years and 62±13 (31–79) years, respectively. The proportion of female patients was significantly higher in the octogenarian group compared with the younger group (79.2% vs. 44.8%, P=0.0033). Although there were no differences in the type of dissection (communicating type 66.7% vs. 82.8%, P=0.0913) and proportion of DeBakey type 2 (37.5% vs. 20.1%, P=0.0699) between the 2 groups, octogenarians presented more frequently with the non-communicating-type aortic dissection from the descending aorta.

#### Demographics of Patients Undergoing Repair of Stanford Type A Aortic Dissection

<table>
<thead>
<tr>
<th>Variable</th>
<th>Age ≥80 years</th>
<th>Age ≤79 years</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>24 (15.2)</td>
<td>134 (84.8)</td>
<td></td>
</tr>
<tr>
<td>Age (years)</td>
<td>83±3 (80–89)</td>
<td>62±13 (31–79)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Female</td>
<td>19 (78.2)</td>
<td>60 (44.8)</td>
<td>0.0033</td>
</tr>
<tr>
<td>Timing of surgery after onset</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Within 14 days</td>
<td>23 (95.8)</td>
<td>126 (94.0)</td>
<td>&gt;0.9999</td>
</tr>
<tr>
<td>Within 48 h</td>
<td>17 (70.8)</td>
<td>105 (78.4)</td>
<td>0.4333</td>
</tr>
<tr>
<td>DeBakey type 2</td>
<td>9 (37.5)</td>
<td>27 (20.1)</td>
<td>0.0699</td>
</tr>
<tr>
<td>Communicating type</td>
<td>16 (66.7)</td>
<td>111 (82.8)</td>
<td>0.0913</td>
</tr>
<tr>
<td>Marfan syndrome</td>
<td>0</td>
<td>5 (3.7)</td>
<td>&gt;0.9999</td>
</tr>
<tr>
<td>Redo/history of cardiac surgery</td>
<td>0</td>
<td>3 (2.2)</td>
<td>&gt;0.9999</td>
</tr>
<tr>
<td>Shock</td>
<td>4 (16.7)</td>
<td>20 (14.9)</td>
<td>0.7639</td>
</tr>
<tr>
<td>Coma/loss of consciousness</td>
<td>2 (8.3)</td>
<td>16 (11.9)</td>
<td>&gt;0.9999</td>
</tr>
<tr>
<td>Organ malperfusion</td>
<td>0</td>
<td>13 (9.7)</td>
<td>0.2202</td>
</tr>
</tbody>
</table>

Data are n (%) or mean±standard deviation with ranges.
During the first 5 years (2005–2009), 62 patients underwent surgery for AAD and there were 10 hospital deaths (mortality rate, 16.1%). However, from 2010 to 2015, hospital deaths occurred in only 4 of 96 patients (mortality rate, 4.2%). The duration of stay of the surviving patients in the intensive care unit (7 ± 6 days vs. 10 ± 10 days, P=0.1645) and in the hospital (38 ± 20 days vs. 39 ± 33 days, P=0.9142) was similar in the 2 groups. The octogenarians showed no major complications, including reexploration for bleeding, renal insufficiency requiring hemodialysis, mediastinitis, respiratory failure requiring a tracheotomy, or post-surgical stroke, although this was not statistically significant.

Fifteen octogenarians (62.5%) were discharged from hospital back to their homes, and nine (37.5%) were transferred to other hospitals for rehabilitation. Of the 120 survivors in the younger group, 96 (80.0%) were discharged back to their homes and 24 (20.0%) were transferred to other hospitals (P=0.1070).

During the follow-up period of 3.4±3.0 years, there were 3 late deaths in the octogenarian group (1 each of a malignant tumor, pneumonia, and ruptured abdominal aortic aneurysm) and 9 deaths in the younger group, one of which was associated with a cardiovascular complication (P=0.3948). The Kaplan-Meier curves demonstrated no significant difference in late outcomes and DeBakey type 2 AAD. Marfan syndrome was only found in the younger group. There were no significant differences in the timing of surgery, rates of repeat surgery with a history of cardiac surgery, rates of preoperative shock, occurrence of coma or loss of consciousness, or frequency of organ malperfusion between the 2 groups.

### Surgical Procedures (Table 2)

Although not statistically significant, there was a higher trend of aortic root surgery (Bentall-type procedure in 12, partial remodeling in 4, and reimplantation in 2) in younger patients compared with octogenarians (0% vs. 13.4%, P=0.0771). Ascending aortic replacement was performed significantly more frequently in octogenarians (95.8% vs. 65.7%, P=0.0015) and total arch replacement in younger patients (4.2% vs. 26.9%, P=0.0165). The surgical time, cardiopulmonary bypass, aortic cross-clamping, and selective cerebral perfusion were significantly shorter in the octogenarian group than in the younger group.

### Early Outcomes (Table 3)

There were 14 hospital deaths in the younger group and none in the octogenarian group (0% vs. 10.4%, P=0.1303). Of the 14 deaths, 10 patients (7.5%) died within 30 days of surgery. Our study included 11-year outcomes following surgical treatment for AAD. During the first 5 years (2005–2009), 62 patients underwent surgery for AAD and there were 10 hospital deaths (mortality rate, 16.1%). However, from 2010 to 2015, hospital deaths occurred in only 4 of 96 patients (mortality rate, 4.2%). The duration of stay of the surviving patients in the intensive care unit (7 ± 6 days vs. 10 ± 10 days, P=0.1645) and in the hospital (38 ± 20 days vs. 39 ± 33 days, P=0.9142) was similar in the 2 groups. The octogenarians showed no major complications, including reexploration for bleeding, renal insufficiency requiring hemodialysis, mediastinitis, respiratory failure requiring a tracheotomy, or post-surgical stroke, although this was not statistically significant.

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### Late Outcomes (Figure)

During the follow-up period of 3.4±3.0 years, there were 3 late deaths in the octogenarian group (1 each of a malignant tumor, pneumonia, and ruptured abdominal aortic aneurysm) and 9 deaths in the younger group, one of which was associated with a cardiovascular complication (P=0.3948). The Kaplan-Meier curves demonstrated no significant difference in late outcomes.
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between the 2 groups (P=0.6788). The respective 1-, 3-, and 5-year survival rates were 94.4%, 81.5%, and 81.5% in the octogenarians and 86.9%, 85.6%, and 83.9% in the younger patients.

Discussion

The present study demonstrated surprisingly excellent outcomes for all 24 octogenarians who underwent surgery for AAD, with no hospital deaths and late survival rates comparable to those of younger patients. According to a 2007 annual report by the Japanese Association for Thoracic Surgery (2005 data), operations for AAD were performed in 3,416 patients, with an overall hospital mortality of 13.9%. Although this had improved to 9.8% by 2012 (n=5,051 patients), the surgical mortality rate for AAD is still high.

The report from the International Registry of Acute Aortic Dissection revealed that the surgical mortality rate significantly increased with increased age. It was concluded that age ≥70 years was an independent predictor of death (odds ratio, 1.73), and the hospital mortality rate was significantly lower after surgery compared with medical management until the age of 80 years. Even for octogenarians, the hospital mortality rate appeared to be lower after surgical repair than after medical treatment (37.9% vs. 55.2%; P=0.188), although this result was not clinically significant owing to the limited patient numbers in this age group.

There were some discrepancies among the surgical outcomes of AAD in octogenarians. Some reports showed acceptable early results that range from 0% to 13%. In contrast, other reports revealed higher mortality rates ranging from 26% to 45.6% in octogenarians. Furthermore, the long-term outcomes of octogenarians who survived an AAD repair remain uncertain. Previous reports demonstrated a 5-year survival rate of 44–59.7%. Piccardo et al. reported a 5-year survival rate of 80% in discharged octogenarians, which was equivalent to the life expectancy of octogenarians in the general population. Our study showed 1-, 3-, and 5-year survival rates of 94.1%, 80.2%, and 80.2% in the octogenarians and 87.7%, 86.2%, and 84.6% in the younger patients, respectively.

The first explanation of our excellent outcomes may be related to the limited extent of aortic replacement and decreased surgical invasiveness. Of course, we decided the extent of replacement according to our strict criteria for all patients to exclude the entry of the dissection. If the entry of the dissection was located in the ascending aorta, we replaced the ascending aorta. If the entry of the dissection was located in the aortic arch, we decided to replace the entire arch even if the patient was an octogenarian. Although there was no statistical significance,
the octogenarians presented with a higher rate of DeBakey type 2 and non-communicating-type aortic dissections rather than did younger patients. Therefore, the rate of ascending aortic replacement was higher in the octogenarians. In this study, only one (4.2%) total arch replacement was performed, and no aortic root replacements were performed. Therefore, the surgical time, cardiopulmonary bypass, aortic cross-clamping, and selective cerebral perfusion were all significantly shorter in the octogenarian group than in the younger group. Although Castrovinci et al. reported that conservative and aggressive root management for AAD yielded similar results for early and late deaths, the extent of aortic replacement and duration of surgery have been reported as significant risk factors for hospital death in previous reports.

The second reason for our excellent outcomes may be the less complex aortic dissections with a lower frequency of organ malperfusion in the octogenarians. It is well known that acute AAD with organ malperfusion has higher postoperative mortality and morbidity rates. In our study, organ malperfusion (0% vs. 9.7%) and coma or loss of consciousness possibly associated with carotid artery ischemia (8.3% vs. 11.9%) were more likely to occur in younger patients, although there were no statistically significant differences between the groups. Our results coincide with previous reports demonstrating a lower frequency of organ malperfusion in octogenarians. A less complex presentation of AAD in octogenarians may allow for simpler and less aggressive surgical procedures in such fragile patients, leading to excellent outcomes.

Study Limitations
The findings of the present study should be viewed in light of the limitations. Data were retrospectively collected and subject to incomplete or missing reporting of events. This study included a small number of patients in a single center. Our study did not include non-surgical patients, medically treated patients with non-communicating-type AAD with a thrombosed false lumen or those who refused surgery for some reason. Therefore, we could not compare the surgical group with a medically managed group.

Conclusions
Surgical repair for AAD in octogenarians showed favorable results when compared with a younger patient cohort, with a low hospital mortality rate and excellent late outcomes. Surgery for AAD should not be disregarded just because the patient is an octogenarian.

Conflicts of Interest
All the authors have declared no competing interest.

References