A cute Stanford type A aortic dissection (AD) is typically presented by antegrade AD from a primary intimal tear in the proximal ascending aorta extending to the arch and the downstream distal aorta. Urgent aortic replacement surgery is regarded as the gold standard therapy for this type of AD because the natural course of untreated acute type A AD has been reported to be dismal.1–3 Acute AD, however, may also develop in a retrograde fashion by a primary intimal tear located in the descending aorta causing retrograde extension of the AD into the ascending aorta. The prevalence of this type of AD is reported to be 7% to 25% of acute type A AD.1–3 Management of this subtype of acute AD, also referred as retrograde type A AD or type III-D AD,4 is controversial, especially when the false lumen (FL) of the ascending aorta is completely thrombosed in patients who are often clinically stable. Although several groups have suggested implementing the standard approaches to treat acute antegrade type A AD in these patients, the distal location of the primary intimal tear in the ascending thoracic aorta warrants more extensive aortic replacement with higher surgical risks of mortality or morbidity through a median sternotomy. Conversely, confining the surgical extent to the proximal aorta leaves the risks of complications related to the residual tear in the distal aorta untreated.3,5–7 Meanwhile, Kaji et al1 advocated a more conservative approach consisting of initial medical management with timely surgical repair in selected patients with retro-A AD. However, the propriety of generalizing their study results, which have been derived from a limited sample size, has been questioned.1 In this study, we sought to evaluate the long-term outcomes of initial medical therapy in selected patients with acute retro-A AD and compare the outcomes with those who were initially treated by urgent surgery.

Methods

Patients

From January 1999 through October 2011, 538 patients were diagnosed as having spontaneous acute AD at the Asian Medical Center, Seoul, Korea. Of these, we identified 49 patients who had primary intimal tear in the descending thoracic aorta. The diagnosis of retro-A AD...
was made based on computed tomographic images at the initial presentation and intraoperative findings. All the patients who showed widely patent FL in the ascending aorta underwent urgent surgery, and the diagnosis of the retro-A AD was confirmed intraoperatively. Initial medical management was attempted in selected patients (n=16; MED group) who were clinically stable and had thrombosed FL of the ascending aorta with acceptable aortic sizes (<55 mm; Figure 1). For these patients, transesophageal echocardiography was conducted to ensure the absence of intimal tear in the ascending aorta. Initial medical management involved rigorous blood pressure and pain control, and short-term follow-up imaging evaluations of the aorta were conducted (within 3–7 days) using either echocardiography or computed tomography. Timely intervention was performed if there were any signs of clinical deterioration or aortic expansion during the hospitalization. The remaining 33 patients underwent urgent aorta replacement surgery (SURG group) similar to patients with antegrade type A AD. The surgical extent, cardiopulmonary bypass strategy, and brain protective methods were left to the attending surgeon’s discretion.

This study was approved by our institutional ethics committee/review board, which waived the requirement for informed consent because of the retrospective nature of the study.

**Follow-Up**

Clinical follow-ups were performed at 3- to 6-month intervals through outpatient clinic visits or by telephone interviews. To validate all information on mortality, data on vital status and the dates and causes of death were obtained up to February 31, 2013, from the Korean National Registry of Vital Statistics. Adverse aortic events were defined as any of the following events during follow-up: (1) requirements for aortic surgery or endovascular stenting, (2) aortic rupture, and (3) aortic aneurysm formation at any aortic segment defined as ≥55 mm in diameter.

**Statistical Analysis**

Categorical variables, presented as frequencies and percentages, were compared using the χ² test or Fisher exact test. Continuous variables, expressed as means±SD or median with range, were compared using the Student unpaired t test or the Mann–Whitney U test, as appropriate. Kaplan–Meier curves were used to delineate the survival rates or aortic event–free survival rates. Log-rank tests were used to compare between-group differences in these rates. Changes in native aortic diameter between initial presentation and the latest follow-up were evaluated by Wilcoxon signed-rank test. All reported P values were 2-sided, and a value of P<0.05 was considered statistically significant. SPSS software version 14.0 (SPSS Inc, an IBM Company, Chicago, IL) was used for statistical analyses.

**Results**

**Baseline Characteristics**

The Table summarizes the baseline demographic and clinical characteristics of the patients. All patients who had malperfusion syndrome, pericardial effusion/hemorrhage, or coronary artery dissection received urgent surgical therapy. Although the presence of moderate-to-severe aortic insufficiency or involvement of the AD to the aortic root did not necessarily mean the requirement for an initial urgent surgery, these findings were more frequently observed in the SURG group compared with the MED group. Patent FL in the ascending aorta was regarded as an indication for urgent surgery; however, such finding was observed in 4 patients in the MED group while all these patients showed only focal enhancement of the FL limited to distal ascending aorta as shown in Figure 1B. Of the patients in the SURG group, 7 (21.2%) were confirmed as having retro-A AD by intraoperative findings. In the SURG group, cardiopulmonary bypass strategies involved deep hypothermic (<20°C) circulatory arrest with (n=18) or without (n=8) retrograde cerebral perfusion in 26 patients and moderate hypothermia (20°C–30°C) with unilateral antegrade cerebral perfusion in 7 patients. For patients undergoing deep hypothermic circulatory arrest, right femoral artery was used as the primary inflow route in most patients (n=25), whereas the right axillary artery was used for arterial cannulation in all the patients undergoing antegrade cerebral perfusion. The extents of aortic replacement comprised hemiarch replacement in 19 (57.6%) and total arch replacement in 14 (42.4%) patients. Combined surgeries included Bentall operation in 1, aortic valve replacement in 1, coronary artery bypass grafting in 2, and elephant trunk technique in 3 patients.

**In-Hospital Outcomes**

Outcomes of patients who received initial medical management are illustrated in Figure 2. One patient who had partially patent FL of the ascending aorta received hemiarch replacement on the 10th day because of significant ascending aortic expansion (48–58 mm) on follow-up computed tomography. Two other patients received stent graft insertion on the proximal descending aorta at the sixth and 14th day because of persistent back pain. The other 13 patients had uneventful hospital courses and were discharged. There was no in-hospital...
Table. **Baseline Characteristics of All Patients**

<table>
<thead>
<tr>
<th>Demographic and baseline risks</th>
<th>Medical Therapy (n=16)</th>
<th>Surgery (n=33)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, y</td>
<td>54.1±15.9</td>
<td>51.1±11.7</td>
<td>0.47</td>
</tr>
<tr>
<td>Female sex, n (%)</td>
<td>4 (25.0)</td>
<td>8 (24.2)</td>
<td>&gt;0.99</td>
</tr>
<tr>
<td>Diabetes mellitus, n (%)</td>
<td>0 (0.0)</td>
<td>1 (3.0)</td>
<td>&gt;0.99</td>
</tr>
<tr>
<td>History of CVA or TIA, n (%)</td>
<td>0 (0.0)</td>
<td>2 (6.1)</td>
<td>&gt;0.99</td>
</tr>
<tr>
<td>Hypertension, n (%)</td>
<td>14 (87.5)</td>
<td>23 (69.7)</td>
<td>0.29</td>
</tr>
<tr>
<td>Marfan syndrome, n (%)</td>
<td>0 (0.0)</td>
<td>2 (6.1)</td>
<td>&gt;0.99</td>
</tr>
<tr>
<td>Pre-existing type III aortic dissection, n (%)</td>
<td>1 (6.3)</td>
<td>1 (3.0)</td>
<td>0.59</td>
</tr>
</tbody>
</table>

**Preoperative condition**

<table>
<thead>
<tr>
<th>Malperfusion, n (%)</th>
<th>0</th>
<th>4 (12.1)</th>
<th>0.29</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acute myocardial infarction</td>
<td>0</td>
<td>1 (3.0)</td>
<td></td>
</tr>
<tr>
<td>CVA</td>
<td>0</td>
<td>1 (3.0)</td>
<td></td>
</tr>
<tr>
<td>Visceral malperfusion</td>
<td>0</td>
<td>1 (3.0)</td>
<td></td>
</tr>
<tr>
<td>Limb ischemia</td>
<td>0</td>
<td>1 (3.0)</td>
<td></td>
</tr>
<tr>
<td>Pericardial effusion/ hemorrhage, n (%)</td>
<td>0</td>
<td>15 (45.5)</td>
<td>0.001</td>
</tr>
<tr>
<td>Aortic regurgitation</td>
<td>&gt; mild, n (%)</td>
<td>1 (6.3)</td>
<td>10 (30.3)</td>
</tr>
</tbody>
</table>

**Involvement of aortic dissection, n (%)**

<table>
<thead>
<tr>
<th>Aortic root</th>
<th>5 (31.3)</th>
<th>27 (81.9)</th>
<th>&lt;0.001</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coronary artery</td>
<td>0</td>
<td>2 (6.1)</td>
<td>&gt;0.99</td>
</tr>
<tr>
<td>Maximal diameter of descending aorta, mm</td>
<td>40.6±5.2</td>
<td>37.9±6.9</td>
<td>0.17</td>
</tr>
<tr>
<td>Maximal diameter of ascending aorta, mm</td>
<td>46.8±6.6</td>
<td>46.8±10.9</td>
<td>&gt;0.99</td>
</tr>
<tr>
<td>Patent false lumen in ascending aorta, n (%)</td>
<td>4 (25.0)*</td>
<td>23 (69.7)</td>
<td>0.005</td>
</tr>
<tr>
<td>Thickness of ascending aorta hematoma</td>
<td>12.6±6.7 (n=12)</td>
<td>16.7±5.1 (n=10)</td>
<td>0.15</td>
</tr>
</tbody>
</table>

CVA indicates cerebrovascular accident; and TIA, transient ischemic attack.

*These patients showed only partially patent false lumen of the ascending aorta.

mortality or morbidity (including neurological complications) in the MED group.

In the SURG group, early death (within 30 days or in hospital) occurred in 3 patients (9.1%). Causes of deaths were mediastinitis followed by perigraft rupture in 1, extensive myocardial damage because of pre-existing coronary malperfusion (myocardial infarction) in 1, and postoperative new-onset stroke in 1 patient. Permanent neurological damages occurred in 3 patients (9.1%), including 1 with pre-existing cerebral malperfusion, and 1 died in the early period. The higher rates of early mortality and neurological damages in the SURG group (5/33) compared with the MED group (0/16) did not reach statistical significance (P=0.16). The early mortality rate of the patients with retrograde AD (6.1%; 3/49) was comparable with those who were diagnosed as having acute type B AD (8.6%; 17/198; P=0.77) during the study period, whereas it was significantly lower than those with antegrade type A AD (18.2% [53/291]; surgical therapy, 13.7% [36/262]; medical therapy, 58.5% [17/29]; P=0.037).

Late Outcomes

Follow-up was complete in all patients (median, 61.4 months; Q1–Q3, 28.2–99.1 months). In the MED group, 2 patients required total arch replacement because of significant aneurysm formation, whereas 11 patients did not receive any aortic intervention throughout the follow-up period (Figure 2). Of these 11 patients, 2 patients reached surgical indications: 1 showed ascending aortic aneurysm (64 mm) at 6.4 years after initial presentation but refused to undergo surgery because of a diagnosis of stage IV colon cancer. He eventually died of cancer at 9.2 years. In another patient, the descending aorta had reached a size of 58 mm at 4.5 years, but the patient remained alive ≤5.9 years without any aortic intervention. Late death occurred in 4 patients. The causes of deaths were one each of thoracoabdominal aortic rupture, cancer, intracranial hemorrhage, and unknown cause (Figure 2).

In the SURG group, 1 patient received thoracoabdominal aorta replacement 4 months after the initial surgery. The aortic diameter in 3 other patients (9.1%) had reached surgical indications (descending aortic diameter of 60.7 mm, 56.3 mm, and 61.9 mm, respectively), but they had not undergone aortic intervention. Late deaths occurred in 9 patients in the SURG group. The causes of deaths were complications related to postoperative stroke in 2, subarachnoid hemorrhage in 1, and unknown in 6 patients.

The 5-year survival rate in the MED group was 100%, and this rate was higher than that in the SURG group (81.2±7.0%; P=0.080), in those with surgically treated antegrade acute type A AD (74.5±2.8%; P=0.038), and in those with acute type B AD (75.3±3.3%; P=0.045; Figure 3A). Aortic event–free survival at 5 years was 52.7±14.8% and 69.6±8.0% in the MED and SURG groups, respectively (P=0.98; Figure 3B).

Fate of Surgically Untreated Aorta

Late computed tomographic follow-up analysis was conducted in the 11 MED group patients who had not undergone aortic intervention (median, 3.3 years; range, 1.2–16.3 years). In this group, 3 patients had partially patent FL of the ascending aorta. During the follow-up, 2 patients showed stationary aortic size, whereas 1 showed expansion of the ascending aorta ≤64 mm (the patient who died of cancer). The remaining 8
patients had completely thrombosed FL in the ascending aorta at initial presentation and subsequently showed complete FL resolution. A typical example of this resolution is shown in Figure 4. The maximal diameter of the ascending aorta had regressed from 45.3±7.6 to 41.6±9.6 mm during the follow-up (P=0.028), whereas the maximal diameter of the descending aorta remained similar (39.8±5.6 to 41.9±10.2 mm; P=0.53).

**Discussion**

The results of this study suggest that optimal medical therapy with timely intervention may be a reasonable treatment strategy for selected patients with spontaneous acute retro-A AD. Suitable patients should be hemodynamically stable and the ascending aortic FL thrombosed while the ascending aorta is preferably not severely dilated (ie, <5.5 cm). Recently, there has been a plethora of studies on retro-A AD occurring secondarily to thoracic endovascular aortic repair, but the literature on spontaneous acute retro-A AD, which is a distinct entity, is limited. Previous studies were mostly conducted on small patient cohorts or mentioned through case reports. Studies directly comparing the outcomes of initial medical treatment with timely intervention and surgery are even more limited. Therefore, additional data are needed to validate current practices and to develop an optimal management strategy regarding this entity.

In the present study, there was generally less extensive ascending AD and greater FL thrombosis in the medical therapy arm than in the surgery arm. Significantly fewer sinus dissection involvements in the medical therapy group were observed as well. Although the general consensus for the treatment of acute type A intramural hematoma is similar as in acute type A AD, a small number of carefully conducted studies have argued in favor of initial medical management in selected patients with timely surgical intervention. The inciting mechanisms or clinical features in acute retro-A AD and acute type A intramural hematoma are dissimilar, but the similarities in the features and clinical behavior of the thrombosed FL suggest that a comparable strategy for the treatment of acute type A intramural hematoma may be suitable for selected patients with acute retro-A AD as shown in our series and by Kaji et al. In the present series, 16 patients were deemed suitable for initial medical management, of which 3 had crossed over to surgery or thoracic endovascular aortic repair during their hospitalization. There were no early deaths among these patients, and the remaining 13 patients were uneventfully discharged. However, during the follow-up, 2 patients had subsequently required surgery among which 1 patient experienced a late death later on because of surgically unrelated cause. This left 11 patients who continued on with medical therapy alone, and the outcomes of these patients represented the fate of the
unrepaired aorta. In all these patients, the ascending aortic intramural hematoma had completely resolved with commensurate reduction in the aortic diameter. The descending aorta distal to the tear site showed persistent FL patency with an insignificant tendency to increase over time. Therefore, of the original 16 patients who were assigned to the medical therapy group, there were no aorta-related deaths that would have been otherwise preventable by an initial proximal aortic surgery, and none of the patients who had crossed over to surgery or thoracic endovascular aortic repair had experienced an early mortality as a result of the strategy of watchful treatment and timely intervention. Although there were 2 additional late deaths among the 11 unoperated patients, they were both because of nonaortic causes. Therefore, it is remarkable that from an intention-to-treat perspective, there were no early deaths in the medical therapy group and no deaths up to the intermediate-term 5-year follow-up period. Furthermore, no aortic death because of failure to receive timely surgery while on medical care was observed. There were 2 patients who had developed significant aortic enlargements during the follow-up, but they did not undergo further surgery and had remained alive throughout the duration of this study. Therefore, the present study reasserts the suggestions by Kaji et al that treating selected patients with acute retro-A AD with initial medical treatment and timely intervention is safe and effective. However, vigilant monitoring should be accompanied by regular imaging studies as a result of the potential risk of these patients developing serious adverse aortic complications in these patients.

Surgery was performed urgently for aorta-related complications. Consequently, all the patients with malperfusion signs or significant pericardial effusion received surgery, and all but 1 patient with greater than mild AR and the 2 patients with proximal coronary artery involvement received surgery. In addition, surgery was performed urgently for patients with patent ascending aortic FL as well. In the surgical patients with patent proximal FL, the diagnosis of retrograde type A AD was established intraoperatively. In the medical therapy group, findings of limited retrograde FL propagation to the distal ascending aorta facilitated diagnosis of retro-A AD. With regard to patients with connective tissue disease, surgery was always indicated in principle, irrespective of the early outcomes barring circumstances prohibiting this approach owing to the progressive nature of the aortic pathology in these patients. Therefore, in keeping with studies that have also demonstrated favorable durability and survival benefit of surgery in these patients, the 2 Marfan patients in the present series received surgery.

The reported hospital mortality for acute retro-A AD surgery ranged between 15% and 19%. A hemiarch replacement effectively addresses the immediate threat from the proximal aortic involvement but leaves the distal entry tear open. Total arch replacement with or without a frozen elephant trunk theoretically addresses this limitation more effectively, but significantly increases the risk of adverse outcomes related to the greater technical challenge and the more demanding nature of the surgery. Furthermore, a hybrid total arch and frozen elephant trunk procedure has consistently been reported to incur a greater risk of spinal cord ischemia. Therefore, the invasive nature of surgery does add non-negligible risks particularly to those with premorbid risk factors. Consequently, opting for the medical therapy-first strategy in patients who may benefit by an initial conservative approach should be further investigated through larger studies.

The present study suffered the usual limitations of a single-centered study conducted in a retrospective manner. Furthermore, as the patients were not randomized, the possibility of selection bias in the treatment assignment cannot be ruled out. Because of the relatively small study population, statistical adjustments were not possible to significantly validate the treatment recommendations suggested in this study.

In conclusion, excellent outcomes may be achieved with initial medical treatment in selected patients with acute retro-A AD combined with timely intervention. However, in the eligible patients, the hemodynamic and clinical condition should be stable, whereas the ascending aortic FL is thrombosed and the ascending aorta is not excessively dilated. These patients should be vigilantly monitored with regular follow-up imaging studies for detection of aortic events, which may warrant corrective intervention in a timely manner.

Disclosures
None.

References


Outcomes of Acute Retrograde Type A Aortic Dissection With an Entry Tear in Descending Aorta
Joon Bum Kim, Suk Jung Choo, Wan Kee Kim, Ho Jin Kim, Sung-Ho Jung, Cheol Hyun Chung, Jae Won Lee and Jae-Kwan Song

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