Initial Medical Treatment for Acute Type A Intramural Hematoma and Aortic Dissection

Shun Watanabe, MD, Michiya Hanyu, MD, Yoshio Arai, MD, PhD, and Atsushi Nagasawa, MD, PhD
Department of Cardiovascular Surgery, Kokura Memorial Hospital, Kokura Northern Ward, Kitakyushu, Fukuoka, Japan

Background. There are contradictory reports on outcomes of patients treated for Stanford type A acute intramural hematoma (IMH) and acute aortic dissections (AAD) with thrombosed false lumens. We evaluated short-term clinical outcomes and predictors of adverse outcomes.

Methods. We retrospectively analyzed 59 symptomatic patients with type A acute IMH and AAD with thrombosed thoracic false lumens who initially received treatment. Survival, aortic death (death from aortic events and sudden deaths), and aortic event-free survival rates were investigated. False lumen thickness ratios (FTR [false lumen thickness/aortic diameter]) were measured by computed tomography scan and the relationship with aortic events was evaluated.

Results. Survival, aortic death-free survival, and aortic event-free survival rates at 2 years were 90.0%, 96.6%, and 55.8%, respectively. Ascending aortic diameters, false lumen thickness of the ascending aortas, and rate of penetrating aortic ulcers in the ascending aortas were higher among patients with aortic events. The FTR of the ascending aorta (FTRA)/FTR of the descending aorta (FTRD) was also higher in these patients (1.3 ± 0.9 versus 0.8 ± 0.5, p = 0.0021). Multivariate analysis revealed FTRA/FTRD greater than 0.98 (odds ratio 5.35; 95% confidence interval: 0.05 to 1.72; p = 0.0431) as an independent predictor of aortic events. An FTRA/FTRD greater than 0.98 predicted aortic events with 87.1% sensitivity and 58.4% specificity.

Conclusions. High aortic event rates were seen after treatment for type A acute IMH and AAD with thrombosed thoracic false lumens. Nevertheless, short-term survival rates were favorable. An FTRA/FTRD greater than 0.98 may be a highly sensitive predictor for aortic events.


Aortic intramural hematomas (IMH) were first described in 1920 as “dissections without intimal tears” by Krukenberg and associates [1]. Recently, the development of computed tomography (CT) and magnetic resonance imaging confirmed that clots and hematomas fill false lumens, clarifying the steps in the progression of hematomas. This type of dissection is widely known as thrombosed dissection or IMH [2]. However, the ideal treatment policy, emergent surgery or medical treatment, remains controversial. In previous reports, medical treatment alone was insufficient to manage all type A IMH and acute aortic dissection (AAD) patients, and nearly half of the patients needed surgical intervention. Conversely, emergent surgical repair was not necessary for all patients to achieve favorable surgical outcomes [3]. Some reports have shown that predictors of worse clinical course are associated with initial medical treatment [2]. This study evaluated the short-term clinical outcomes of initial medical treatment for acute type A IMH and AAD with thrombosed false lumens and investigated the predictors of adverse outcomes.

Patients and Methods
The Institutional Review Board of Kokura Memorial Hospital approved this study and waived the individual consent because of the study’s retrospective design. Between March 2004 and March 2012, 59 symptomatic patients with Stanford type A acute IMH and AAD with thrombosed false lumens of the ascending aorta, who initially received medical treatment, were included in this study. All diagnoses were confirmed by contrast CT. The presence of a hematoma within the aortic wall, recognizable as a crescent or circular local aortic wall thickening, and the absence of a visible intimal flap or tear were prerequisites for the diagnosis of IMH. The Stanford classification of aortic dissection was used to categorize IMH and AAD according to the location of disease. Type A indicates involvement of the ascending aorta. A penetrating aortic ulcer (PAU) was defined as a deep,
ulcerated lesion in the thickest part of the IMH, within the involved aorta. Acute aortic dissection with thrombosed false lumen of the ascending aorta was defined as a lesion that did not display enhanced contrast media in the false lumen of the ascending aorta during contrast CT and where the thoracic descending aortic false lumen was partially thrombosed. Based on these definitions, there were 35 patients with IMH unaccompanied by PAU, 15 patients with IMH associated with PAU, and 9 patients with AAD with thrombosed false lumens of the ascending aorta.

Initial CT, performed within 48 hours after onset of the initial symptoms, the maximal thickness of the false lumen, the maximal diameter of aorta, and the false lumen thickness (FT) ratio (FTR [false lumen thickness/aortic diameter]) were measured at the ascending and descending aorta (Fig 1). For the descending aorta, measurements were taken near the level of the bifurcation of the left and right pulmonary arteries.

Medical Treatment

Our treatment strategy for type A IMH and AAD with thrombosed false lumens involved medications. Nevertheless, it was accompanied by pericardial effusion and dilation of the ascending aorta. Rupture and uncontrollable malperfusion cases received immediate surgical intervention. If the patient demonstrated cardiac tamponade, we performed percutaneous drainage. Patients who were diagnosed with acute type A IMH or AAD with a thrombosed false lumen were admitted to the intensive care unit for monitoring with a continuous arterial pressure monitor. Antihypertensive therapies, including intravenous beta-blockers and calcium-channel blockers, were initiated to control systolic blood pressure to less than 110 mm Hg. Patients underwent serial contrast CT follow-up on days 1, 3, and 5, and weekly thereafter. If the CT findings did not deteriorate, the patient continued antihypertensive therapy. Patients who did not experience an aortic event were discharged 1 month after onset of the dissection. These patients received annual CT follow-up in the outpatient clinic.

Indications for Surgery

When aortic dilation, PAU enlargement, or redissection were observed in the follow-up CT scans, elective surgery was performed if the patient’s vital conditions were stable.

Study Endpoints

The primary clinical endpoint was freedom from aortic events and death. Aortic events were defined as redissection, recanalization, rupture, PAU enlargement, and aortic surgery. Aortic death was defined as death from an aortic event and sudden death. We investigated the predictors of adverse outcomes based on the initial CT findings.

Statistical Analyses

Categorical variables were compared using the χ² test or Fisher’s exact test. Continuous variables were analyzed using Student’s t test. Multiple stepwise logistic regression analysis was used to identify independent predictors of adverse outcomes. Factors with p values less than 0.5 were included in a multivariate analysis. A receiver-operating characteristics curve analysis was performed to determine the best cutoff value for predicting adverse outcomes. Survival and event-free survival were analyzed using the Kaplan-Meier method. All analyses were conducted using SAS software, JMP version 10 (SAS Institute, Cary, NC).

Follow-Up

Follow-up was obtained by means of a direct telephone questionnaire or at the outpatient clinic. The CT follow-ups were conducted annually. The median duration of follow-up was 25.6 ± 20.6 months (range, 0 to 89); the follow-up rate was 100%.

Results

Patient Characteristics

The patients’ baseline clinical characteristics are summarized in Table 1. Eleven patients showed pericardial effusion, and 4 of the 11 patients were treated with percutaneous drainage. All of the drainage patients’ hemodynamic states stabilized after drainage. There was no clinical evidence of cardiac tamponade after drainage.

Kaplan-Meier Analysis

The 2-year survival, aortic death-free survival, and aortic event-free survival rates were 90.0%, 96.6%, and 55.8%,
respectively (Figs 2–4). Two patients died of aortic causes, the one of an aortic rupture 13 days after onset and the other of redissection and rupture 65 days after onset. Both patients were recommended for surgery because their aortic diameters enlarged to 56 mm and 81 mm, respectively; however, they refused surgery. Therefore, the patients were treated conservatively. A total of 27 patients had aortic events (Table 2) and were recommended for surgery. However, half of them refused surgery. Operations were performed on 15 patients after medical treatment. There were no operative deaths or complications in these cases. The average time to the occurrence of an aortic event was 50 days (range, 4 to 1,146).

**Predictors of Aortic Events Based on Initial CT Findings**

The results of the univariate analysis are shown in Table 3. Aortic diameter, the presence of PAU at the ascending aorta, FT, and FTR of the ascending aorta (FTRA)/FTR of descending aorta (FTRD) were higher in patients who experienced aortic events. The results of the multivariate analysis are shown in Table 4. An FTRA/FTRD greater than 0.98 (odds ratio 5.35; 95% confidence interval: 0.05 to 1.72; \( p = 0.0431 \)) was an independent predictor of aortic events in the multivariate analysis. An FTRA/FTRD greater than 0.98 predicted aortic events with a sensitivity of 87.1% and a specificity of 58.4%. The area under the curve in the receiver-operating characteristics curve was 0.72446 (Fig 5).

**Comment**

Emergent surgery for classic type A aortic dissections with patent false lumens is widely accepted. However, whether surgical or medical treatment is the better policy for acute type A IMH and AAD with thrombosed false lumens is still unclear. Some reports indicate good clinical outcomes after medical treatment of AAD with thrombosed false lumens. Kaji and associates [7] reported excellent clinical outcomes after medical treatment of type A IMH. The survival rate was 90% at 5 years and in-hospital mortality was 7%, but 13 of 29 patients demonstrated progression to AAD or increases in the size of the hematoma [7].

Further, several studies have compared the results of medical and surgical treatments. Motoyoshi and associates [3] treated 26 uncomplicated IMH patients medically...
and reported a cardiovascular event-free survival rate of 65.6% at 2 years; 2 patients died of cardiovascular causes. Conversely, Hata and associates [2] reported 171 type A IMH patients who were divided into three groups according to complication status. The emergent surgical outcomes were good, and the mortality rate in medically treated patients was 25.8%; 5 of 66 medically treated patients experienced new onset cardiac tamponade. However, there was no difference in the actual survival at 10 years between the groups [2].

Compared with our results, the observed mortality rate was much higher than in our patient population. Among our patients, only 2 died of aortic causes within 2 years. The actual overall survival rate at 2 years was 90%, and none of the patients had new onset cardiac tamponade. The reason for these differences might be the differences in the frequency of follow-up CT scans. However, this issue was not discussed by Hata and associates [2]. We performed contrast CT scans on post-onset days 1, 3, 5, and 7, and weekly thereafter for a month. That was done to detect changes in the false lumen status before it becomes critical and to plan surgical interventions accordingly.

Similar to our results, most studies regarding medical treatment have shown that nearly 50% of patients have an adverse aortic event within 1 year of onset [2, 3, 7]. The event-free survival curve showed its steepest declines just after onset and 1 year after onset. Therefore, appropriate care just after onset is most important, and appropriate surgery should be recommended for high-risk patients. Hence, reliable predictors are needed.

In the analysis of predictors of adverse outcome, FTRA/FTRD greater than 0.98 was identified as the only independent predictor in our study. In previous reports, an hematoma thickness of more than 11 mm [4], an association with PAU [5], and a maximal aortic diameter over 50 mm [6] were reported as predictors of aortic events. These factors were significant in the univariate analysis in our study, but were not independent predictors in the multiple stepwise logistic regression. The cutoff values of aortic diameter and FT, which were determined from the receiver-operating characteristics curve analysis, were somewhat lower than in previous reports.

The present study had several limitations. This study was not a prospective, randomized study, and the sample size was small. Further, it had a short follow-up period. Hence, the evaluation of a larger number of patients will be necessary.

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**Table 2. Details of Aortic Events**

<table>
<thead>
<tr>
<th>Aortic Event</th>
<th>n = 59 (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recanalization</td>
<td>15 (25.4)</td>
</tr>
<tr>
<td>Rupture</td>
<td>1 (1.69)</td>
</tr>
<tr>
<td>Penetrating aortic ulcer enlargement</td>
<td>11 (18.6)</td>
</tr>
<tr>
<td>Operation</td>
<td>15 (25.4)</td>
</tr>
</tbody>
</table>

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**Table 3. Univariate Analysis for Predictors of Aortic Events in Initial Computed Tomography Findings**

<table>
<thead>
<tr>
<th>CT Findings</th>
<th>Event+ (n = 27)</th>
<th>Event− (n = 32)</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>AscAo diameter</td>
<td>48.7 ± 1.1</td>
<td>44.2 ± 1.0</td>
<td>0.0063</td>
</tr>
<tr>
<td>FT of AscAo</td>
<td>11.7 ± 0.9</td>
<td>9.1 ± 0.8</td>
<td>0.0349</td>
</tr>
<tr>
<td>DesAo diameter</td>
<td>33.0 ± 0.8</td>
<td>32.3 ± 0.7</td>
<td>0.5508</td>
</tr>
<tr>
<td>FT of DesAo</td>
<td>7.3 ± 1.0</td>
<td>10.0 ± 1.9</td>
<td>0.0609</td>
</tr>
<tr>
<td>FTR of AscAo (FTRA)</td>
<td>24%</td>
<td>21%</td>
<td>0.1915</td>
</tr>
<tr>
<td>FTR of DesAo (FTRD)</td>
<td>23%</td>
<td>29%</td>
<td>0.1382</td>
</tr>
<tr>
<td>FTRA/FTRD</td>
<td>1.39</td>
<td>0.78</td>
<td>0.0021</td>
</tr>
<tr>
<td>PAU in ascending aorta</td>
<td>8 (29.6%)</td>
<td>2 (6.3%)</td>
<td>0.0156</td>
</tr>
<tr>
<td>AscAo diameter &gt;44 mm</td>
<td>17 (63.0%)</td>
<td>9 (28.1%)</td>
<td>0.0048</td>
</tr>
<tr>
<td>FT of AscAo &gt;11 mm</td>
<td>19 (70.4%)</td>
<td>12 (37.5%)</td>
<td>0.0019</td>
</tr>
<tr>
<td>FTRA/FTRD &gt;0.98</td>
<td>14 (51.9%)</td>
<td>4 (12.5%)</td>
<td>0.0005</td>
</tr>
</tbody>
</table>

AscAo = ascending aorta; CT = computed tomography; DesAo = descending aorta; FT = false lumen thickness; FTR = false lumen thickness ratio; FTRA = false lumen thickness ratio of the ascending aorta; FTRD = false lumen thickness ratio of the descending aorta; PAU = penetrating aortic ulcer.

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**Table 4. Multivariate Analysis Results**

<table>
<thead>
<tr>
<th>CT Findings</th>
<th>OR</th>
<th>95% CI</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>PAU in ascending aorta</td>
<td>1.09</td>
<td>−1.04 to 1.19</td>
<td>0.9371</td>
</tr>
<tr>
<td>AscAo &gt;44 mm</td>
<td>2.81</td>
<td>−0.11 to 1.17</td>
<td>0.1101</td>
</tr>
<tr>
<td>FT of AscAo &gt;9 mm</td>
<td>2.63</td>
<td>−0.17 to 1.15</td>
<td>0.1458</td>
</tr>
<tr>
<td>FTRA/FTRD &gt;0.98</td>
<td>5.35</td>
<td>0.05 to 1.72</td>
<td>0.0431</td>
</tr>
</tbody>
</table>

AscAo = ascending aorta; CI = confidence interval; CT = computed tomography; FT = false lumen thickness; FTR = false lumen thickness ratio; FTRA = false lumen thickness ratio of the ascending aorta; FTRD = false lumen thickness ratio of the descending aorta; OR = odds ratio; PAU = penetrating aortic ulcer.

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**Fig 5. Receiver-operating characteristic curve analysis of the cutoff levels for predicting aortic events based on the false lumen thickness ratio of the ascending aorta (FTRA)/false lumen thickness ratio of the descending aorta (FTRD). (AUC = area under the curve.)**
In conclusion, high aortic event rates were observed after initial medical treatment for type A acute IMH and AAD with thrombosed false lumens of the ascending aorta. Nevertheless, short-term survival outcomes, after intensive medical treatment and frequent CT follow-up, were favorable. In the analysis of predictors of adverse aortic events, FTRA/FTRD greater than 0.98 seems to be a specific predictor of aortic events. This predictor may help in making the timely decision to operate on patients in stable clinical condition who have type A IMH and AAD with thrombosed false lumens.

References

INVITED COMMENTARY

There continues to be significant interest in the nonoperative management of intramural hematoma of the ascending aorta, particularly among centers in the Far East. These authors [1] have provided us a valuable glimpse into the natural history of this condition, because the preferred treatment algorithm in their center over the study interval was medical management. Only those with frank rupture or uncontrollable malperfusion underwent operation. Even tamponade was managed without operation!

The results were remarkably good—at least in the short term. Only 1 patient died within 30 days, and operation had been recommended but declined. A second patient died more than 2 months after admission, again after surgical intervention was recommended and declined. Still, in the long run, 27 of the 59 patients experienced an “aortic event” between 4 days and 3 years after diagnosis. If you see the “glass as half full,” that means that 55% of the patients were spared an operation; if your perspective is the converse, this approach only delayed the inevitable in the other 45%. Either way we are fortunate to have this data set.

What do their data mean to surgeons in the rest of the world? For those of us in North America, the appetite for a 1-month hospitalization and half a dozen computed tomographic scans will likely be modest except under the most extraordinary circumstances. Still there may be another lesson here. There are mounting data indicating that surgical outcomes in the treatment of acute aortic syndromes are superior in centers treating the condition more frequently and in the hands of surgeons who do the same [2]. The observation that no patient decompensated in less than 4 days with an intramural hematoma or thrombosed acute dissection supports the argument for regionalization of the treatment of this condition. It is likely that the low-volume dissection surgeon in the low-volume dissection hospital would be quite willing to transfer such patients absent the threat of medicolegal liability. In my opinion, the results of this study support such a practice.

Thoralf M. Sundt, III, MD
Division of Cardiac Surgery
Massachusetts General Hospital
55 Fruit St
Cox 652
Boston, MA 02114
e-mail: tsundt@partners.org

References