Acute Type A Intramural Hematoma  
Analysis of Current Management Strategy

Anthony Estrera, MD; Charles Miller III, PhD; Taek-Yeon Lee, MD; Paola De Rango, MD; Saad Abdullah, MD; Jon-Cecil Walkes, MD; Dianna Milewicz, MD, PhD; Hazim Safi, MD

Background—Management of acute type A intramural hematoma (IMH) remains controversial, varying from immediate surgery to medical management only. Conversion to typical dissection remains a concern. We analyzed our experience managing acute type A IMH.

Methods and Results—Between October 1999 and May 2008, 251 patients with acute type A aortic dissection were treated, including 36 (14.3%) with type A IMH. Seven IMH patients (19%) were repaired immediately, 28 (80%) managed initially with optimal medical management and eventual repair and 1 (3%) with medical management only. End points analyzed were early mortality and conversion to typical dissection (flow in the false lumen of the ascending aorta). Time (hours) from onset of symptoms defined initiation of IMH. Early mortality for acute type A IMH was 8.3% (3/36): 14.3% (1/7) with immediate repair and 7.1% (2/28) when optimal medical management with eventual repair was undertaken (P=0.69). The 1 medically managed Asian patient survived with resolution of the IMH. Conversion to type A IMH to typical dissection occurred in 33% (12/36) of cases. No conversions were observed within 72 hours. Aortic diameter did not predict conversion. In actuarial analysis among the initially medically managed group with eventual repair, the hazard conversion to typical dissection increased significantly at 8 days from the onset of symptoms (P<0.05).

Conclusions—Despite optimal medical management, conversion of type A IMH to typical dissection still remains a concern, with the most significant risk beyond 8 days. In our patient population, timely surgical repair is recommended. (Circulation. 2009;120[suppl 1]:S287–S291.)

Key Words: aorta ▪ surgery ▪ hematoma

First described by Krukenberg1 in 1920 as aortic dissection without intimal flap, the management of intramural hematoma (IMH) of the aorta remains controversial. Consensus regarding the management of acute IMH involving the descending thoracic aorta (type B) exists, consisting primarily of medical management with anti-impulse therapy.2–6 In contrast, there is less agreement regarding the management of acute type A IMH. Several groups have advocated medical management alone, reporting complete resolution of the IMH,3,6–8 whereas others have recommended immediate surgical repair because nonoperative repair led to excessive mortality and morbidity resulting from conversion to typical dissection and associated rupture and malperfusion.5,6,9,10 Still others have recommended selective repair in type A IMH for those at higher risk for conversion to typical dissection as identified by a larger false channel diameter or aortic diameter.6,11

Although our early experience involving urgent surgical repair of acute type A IMH was influenced by the Stanford group,5 several of our patients underwent delayed repair due to associated comorbidities. Ultimately, our approach to acute type A IMH has evolved into expeditious but not immediate repair for most patients. Thus, this study set out to analyze our results with the management of acute type A IMH, to compare acute type A IMH with typical acute aortic dissection, and to validate our approach to the management of acute type A IMH.

Methods

The Committee for the Protection of Human Subjects at the University of Texas Houston Medical School approved review of the data collected for this study.

Patients

Between October 1999 and May 2008, we repaired 251 patients with acute type A aortic dissection. Of these, 36 patients (14%, 36/251) presented with acute type A intramural hematoma. Mean patient age was 62 years (range, 21 to 91). Sixty-four percent (n=161) were men. Ethnicity distribution is depicted in Figure 1.

Operative Approach

Patients managed surgically were repaired via a median sternotomy, using full heparinization, cardiopulmonary bypass, and profound
hypothermic circulatory arrest with retrograde cerebral perfusion. Arterial cannulation was accessed via the femoral (n=239), axillary, (n=8), or ascending aorta (n=4). Open distal anastomosis was performed under circulatory arrest. Electroencephalograms were used to monitor cerebral function and determine time to initiate circulatory arrest. For typical dissection, obliteration of the false channel was performed with resection of the tear if feasible. For IMH, evacuation of all hematoma from the false channel with subsequent obliteration of the false channel was performed.

Patients were managed with immediate surgical repair (7 patients, 19%), eventual repair with optimal medical management (28 patients, 8%), and medical only (1 patient, 3%). All patients were admitted to the cardiovascular intensive care unit and begun on anti-impulse therapy with maintenance of blood pressure less than 120 mm Hg (systolic).

Follow-up was obtained in all patients. Survival was ascertained by direct patient contact or by the Social Security Death Index. Surveillance protocol included yearly radiographs, either computed tomography or MRI.

Definitions
Intramural hematoma was defined as aortic dissection without identifiable intimal tear and lack of flow in the false lumen of the aorta. This was confirmed radiographically by both computed tomography scan and transesophageal echocardiography. Acute dissection was defined as dissection occurring within 2 weeks of presentation. Conversion to typical dissection was determined by either operative examination or radiographic examination before surgery. Time from the initial onset of pain (in hours) determined the onset of IMH. Time to operative repair was defined as time from onset of pain to operative repair. In addition, time from admission to our hospital to operative repair was determined. Primary end points included early mortality and conversion to typical dissection. Typical, also known as classic, dissection was dissection with free flow into the false channel. This was determined by operative exploration.

Statistics
Comparisons of descriptive statistics and for short-term outcomes between groups were made by univariate unpaired tests and multivariable logistic regression. In-hospital hazard of conversion from IMH to classic dissection was estimated using hazard function analysis computed by life-table method. Hazard represents the probability that an event will occur within a specified time interval and is interpreted as the instantaneous probability of an event at any given time during follow-up. Long-term survival was estimated by the product-limit method of Kaplan and Meier. All computations were performed using SAS version 9.1.3 (SAS Institute Inc, Cary, NC).

Table 1. Comparisons Among Classic, Typical Dissection, and Type A IMH

<table>
<thead>
<tr>
<th></th>
<th>IMH</th>
<th>Classic</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, y</td>
<td>63±13.5</td>
<td>58±14.9</td>
<td>0.06</td>
</tr>
<tr>
<td>Male</td>
<td>24/36 (66)</td>
<td>153/215 (71)</td>
<td>0.72</td>
</tr>
<tr>
<td>CP</td>
<td>36/36 (100)</td>
<td>191/215 (88)</td>
<td>0.04</td>
</tr>
<tr>
<td>Abdominal pain</td>
<td>2/36 (6)</td>
<td>22/215 (10)</td>
<td>0.59</td>
</tr>
<tr>
<td>Stroke</td>
<td>2/36 (6)</td>
<td>19/215 (9)</td>
<td>0.79</td>
</tr>
<tr>
<td>Paraplegia</td>
<td>1/36 (3)</td>
<td>11/215 (5)</td>
<td>0.93</td>
</tr>
<tr>
<td>Hypotension (BP &lt;90 mm Hg)</td>
<td>3/36 (8)</td>
<td>48/215 (22)</td>
<td>0.07</td>
</tr>
<tr>
<td>Tamponade</td>
<td>2/36 (6)</td>
<td>34/215 (16)</td>
<td>0.16</td>
</tr>
<tr>
<td>Al &gt;moderate</td>
<td>4/36 (11)</td>
<td>62/215 (38)</td>
<td>0.002</td>
</tr>
<tr>
<td>Asc. Diameter</td>
<td>5.2±0.8</td>
<td>5.0±0.8</td>
<td>0.17</td>
</tr>
<tr>
<td>Operative</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total arch</td>
<td>5/35 (14)</td>
<td>12/215 (6)</td>
<td>0.07</td>
</tr>
<tr>
<td>Root replaced</td>
<td>1/35 (3)</td>
<td>13/215 (6)</td>
<td>0.45</td>
</tr>
<tr>
<td>Cannulation (F/A/C)</td>
<td>32/1/2</td>
<td>207/3/6</td>
<td>0.08</td>
</tr>
<tr>
<td>Peripheral bypass</td>
<td>1/36</td>
<td>2/215</td>
<td>0.73</td>
</tr>
<tr>
<td>CABG</td>
<td>3/35</td>
<td>10/215</td>
<td>0.34</td>
</tr>
<tr>
<td>Postoperative</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MI</td>
<td>2/35</td>
<td>15/215</td>
<td>0.78</td>
</tr>
<tr>
<td>Stroke</td>
<td>0/35</td>
<td>2/215</td>
<td>0.99</td>
</tr>
<tr>
<td>TND</td>
<td>3/36 (9)</td>
<td>22/215 (10)</td>
<td>0.73</td>
</tr>
<tr>
<td>Bleeding</td>
<td>0/35</td>
<td>15/215 (7)</td>
<td>0.13</td>
</tr>
<tr>
<td>Mortality</td>
<td>3/36 (8.3)</td>
<td>27/215 (12.6)</td>
<td>0.68</td>
</tr>
</tbody>
</table>

Data are presented as mean±SD or n (%). CP indicates chest pain; BP, blood pressure; Al, aortic insufficiency; Asc, ascending aortic; F/A/C, femoral, axillary, central (ascending); CABG, coronary artery bypass grafting; MI, myocardial infarction; TND, temporary neurological deficit.

Results
Comparison Between Typical Type A Dissection and IMH
Regarding clinical presentation, patients with IMH presented more frequently with chest pain and less frequently with moderate to severe aortic insufficiency when compared with typical dissection (P=0.04, P=0.002, respectively; Table 1). Approaching significance, patients with IMH were older and in less extremis condition on admission and with less hypotension and tamponade. Mean aortic diameters were similar between typical dissection (5.0±0.8 cm) and IMH (5.2±0.8 cm) (P=0.17). Procedures performed were similar between groups, although transverse arch replacement was performed more frequently in the IMH group and cannulation strategy. Valve replacement, coronary artery bypass, and root replacement were similar between groups (Table 1).

Mortality
Postoperative mortality and morbidity were similar between groups, with an overall mortality of 8% in the IMH groups and 13% in the typical dissection group (Table 1). Although not significant, there were fewer re-explorations for bleeding in the IMH group (0%) versus the typical dissection group (6%). Although observed mortality was higher in the immediately repaired group versus the purposefully delayed group,
at 14% versus 7%, this was not statistically significant ($P=0.69$) (Table 2).

### Conversion to Typical Dissection

In patients who converted from IMH to typical dissection (12 patients), operative exploration revealed the tear in the ascending aorta in 6 patients (50%), in the descending thoracic aorta in 2 patients (17%), and not identified in 2 patients (17%). Within the IMH group, 33% (12/36) were noted to have conversion to typical dissection. No significant difference was noted in aortic diameter between those with and without conversion to typical dissection (5.4 ± 0.74 versus 5.1 ± 0.78 cm, respectively, $P=0.29$). Moreover, the maximal hematoma thickness of the IMH in the ascending aorta did not significantly differ between the patients who had converted to typical dissection and those who did not convert (1.3 ± 0.6 cm versus 1.1 ± 0.3 cm, $P=0.19$).

Conversion to typical dissection was observed in 14% (1/7) of the immediately repaired group, which was not significantly different from the purposefully delayed group, in which 38% (11/28) had converted to typical dissection at the time of repair. Among this cohort, no conversions occurred within 3 days of acute presentation. Time periods from symptoms to surgery and from admission to surgery were longer in the purposefully delayed group, at 6.5 days and 5.3 days, respectively ($P<0.001$). Aortic size did not differ between groups (5.3 cm in the immediately repaired group versus 5.2 cm in the purposefully delayed group, $P=0.99$).

Reasons for immediate repair included persistent pain, syncope suggestive of cerebral malperfusion, paraparesis suggestive of spinal cord malperfusion, instability/hypotension, signs of coronary ischemia, and altered mental status suggestive of cerebral malperfusion. Reasons for delay included intended (or purposeful) delay, coagulopathy related to coumadin or recent clopidogrel use, initial patient refusal, or comorbidities significantly increasing the risk of open operative repair such as pneumonia, adult respiratory distress syndrome, coma, urosepsis, or leukocytosis from undiagnosed chronic lymphocytic leukemia.

### The Medically Managed Patient

The only medically managed patient resolved symptoms during his admission and ultimately declined operative repair, with an ascending aortic diameter of 4.9 cm. Late follow-up at 4 years revealed complete reabsorption of the hematoma without conversion to typical dissection (5.4

### Validity of Purposeful Delay

Determining the efficacy of purposeful delay required analyzing the safety of this approach. As a surrogate of outcome, we determined that conversion to typical dissection would be associated with the potential complications linked with acute type A aortic dissection, for example, rupture, pericardial tamponade, valvular insufficiency, and organ malperfusion. For this reason, the hazard plot for risk of conversion to typical dissection was constructed. This plot depicted the instantaneous risk for conversion to typical dissection. Moreover, this plot was compared with the instantaneous risk for those that converted and this was noted to be significantly different ($P<0.05$). In this plot (Figure 2), a small increase in risk for conversion occurred at 3 days from onset of symptoms but significantly increased up to 8 days, with the greatest risk occurring at 8 days from the onset of symptoms. This suggested that the risk of conversion to typical dissection was lower within 3 days of the onset of pain. This finding, combined with the observation that mortality was no different between the immediately repaired group and the purposefully delayed group, suggested that purposeful delay could be achieved with acceptable outcomes.

### Late Survival

Median follow-up was 42 months. Late survival is depicted in Figure 3.

### Discussion

Much controversy regarding the management of acute type A IMH exists. Robbins et al first reported an experience of 13 patients with acute aortic IMH, of which 3 patients had IMH involving the ascending and transverse arch. In this series, those with ascending IMH had an associated mortality of 66%, leading the authors to recommend “early graft replacement” for these patients. Several ensuing studies of Asian cohorts with type A IMH, however, reported low early mortality with medical management alone, ranging from 0%
extensive systemic inflammatory response encountered during emergent surgery. This, however, is not supported by this study and remains only hypothetical.

Results of this study are comparable to the findings of others when comparing typical type A aortic dissection and IMH. We observed that patients with type A IMH tended to be older (63 years versus 58 years, P=0.06), presenting with more chest pain (100% versus 88%, P=0.04) and less frequently with hypotension (8% versus 22%, P=0.07), tamponade (6% versus 16%, P=0.16), and moderate or greater aortic insufficiency (11% versus 38%, P=0.002). The decreased incidence of malperfusion and tamponade with IMH as compared with typical dissection is not surprising because thrombosis of the false channel should decrease the risk of these events. Conversion to typical dissection was observed in 33% (12/36) of cases in this study, similar to previous studies reporting conversion in up to 40% of cases. Although not demonstrated in our study, previously reported risks factors for conversion have included initial aortic diameter >5.0 cm and adventitial thickness >12 mm.

Mean aortic diameters were similar between typical dissection (5.0±0.8 cm) and IMH (5.2±0.8 cm) (P=0.17). Moreover, no significant difference was noted in aortic diameter or maximal hematoma thickness between those with and without conversion to typical dissection.

Despite increasing experience with IMH, much still remains unknown. The influence of ethnicity on IMH and its management is interesting but unclear. Many studies on type A IMH have involved primarily Asian cohorts, with a majority of these series reporting good results with medical management alone. Why Asian cohorts may fare better with medical management remains unclear. It should be noted that the Asian cohort used serial scans to identify complications, which then determined the timing of operative intervention. Although our cohort has a variety of ethnicities, interestingly, the single patient managed medically was Japanese, who refused aortic replacement and whose aorta measured 4.9 cm.

In analyzing these data, before establishing a consistent strategy to the management of acute type A IMH, a number of patients were delayed in their repair for various reasons, including poor medical status or unknown neurological status. As such, this provided an opportunity to analyze the risk for conversion to typical aortic dissection, because almost all patients were eventually repaired and a thorough examination of the aorta could be performed. This resulted in the hazard plot, which provided the instantaneous risk for conversion to typical dissection at any given time during the patient’s clinical course. From this, we observed that no patients converted within 3 days of symptoms when surgery was purposefully delayed, but an increasing risk of conversion up to and beyond 8 days was noted. This strategy, however, assumed that optimal medical management was maintained. These data suggest that in our patient population, a significant risk of conversion to typical dissection ultimately existed and that eventual repair should be performed. Implications of these data suggest that those patients managed medically need close follow-up for at least 2 weeks and a regimen of routine long-term radiographic surveillance.
Limitations
As with any retrospective study, inherent limitations and biases exist. The series remains small and nonrandomized, thus having these inherent limitations. In addition, the diagnosis of IMH was made radiographically and confirmed using echocardiography, but a small tear not visualized could have been present and only discovered at surgery. Moreover, the hazard plot relied on the definitions of time from onset of symptoms to surgery. The time of conversion was made at surgery; thus, although computed tomography or transesophageal echocardiography may not have revealed a conversion during the hospitalization, the conversion could have occurred at any time between the radiographic diagnosis and the time of surgery. The hazard plot analysis assumed that the conversion occurred at the time of operative examination. Although we did not observe any conversions of IMH to typical dissection within 3 days, others have reported such events within 1 day. It must be taken into account that all patients in our series were placed on an anti-impulse therapy on admission to the intensive care unit, which is another variable to consider when discussing conversion.

In conclusion, despite optimal medical management, conversion of type A IMH to typical dissection still remains a concern, with the most significant risk beyond 8 days. In our patient population, patients with acute type A IMH may be individualized, allowing for safe purposeful delay. Because the risk of conversion remains significant, however, eventual surgery is still recommended.

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Disclosures
None.

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