Disappearance of Aortic Intramural Hematoma and Its Significance to the Prognosis

Kazuhiro Nishigami, MD; Takeshi Tsuchiya, MD; Hiroyuki Shono, MD; Yoko Horibata, MD; Takashi Honda, MD

Background—An aortic intramural hematoma (IMH) is a form of aortic dissection (AD). IMHs regress with time or completely disappear in some patients, whereas they progress to overt AD in other patients. The purpose of the present study was to investigate how IMHs change serially during a follow-up period.

Methods and Results—We analyzed 44 consecutive medically treated patients with IMHs, in whom transesophageal echocardiography (TEE) was performed serially at both 1 and 6 months after the onset. After TEE, the patients were followed with interviews (mean follow-up 1552 ± 539 days). IMHs disappeared at 6 months in 21 patients (48%) (disappearance group), whereas IMHs were still demonstrated at 6 months in 20 patients (45%) (persistent group); in the disappearance group, IMHs disappeared at 1 month in 8 patients (18%). In 3 patients (7%) in whom an IMH was demonstrated at 1 month, overt AD occurred until 6 months. The disappearance group was younger than the persistent group (64 ± 11 versus 72 ± 8 years, P < 0.01), and the maximum diameter of the aorta was smaller in the disappearance group than in the persistent group (33 ± 5 versus 42 ± 7 mm, P < 0.01). During the long-term follow-up, overt AD occurred at 7 and 11 months in 2 patients, and progressive aortic dilatation that required surgical treatment occurred at 12 and 24 months in 2 of the persistent group patients, whereas neither overt AD nor progressive aortic dilatation occurred in the disappearance group. In the patients in whom overt AD occurred, the maximal aortic diameter was > 45 mm and an IMH was demonstrated at 1 month. On the other hand, those with a maximal aortic diameter of < 45 mm or a disappeared IMH did not have overt AD.

Conclusions—IMHs disappeared until 1 month in 18% and until 6 months in 48% of patients with IMHs. The disappearance of IMHs was related to the maximum diameter of the aorta and age. Both a disappeared IMH and a maximal aortic diameter of < 45 mm suggest a good prognosis. (Circulation. 2000;102[suppl III]:III-243-III-247.)

Key Words: aorta ■ echocardiography ■ follow-up studies

A n aortic intramural hematoma (IMH) is a form of aortic dissection, and it may cause a potentially catastrophic clinical event, including the occurrence of overt aortic dissection and the rupture of aorta.1–11 Medical management with serial imaging studies is thus required to follow these patients. It has been reported that an IMH might regress with time or even completely disappear during a follow-up period in some patients, whereas it might progress to overt aortic dissection in other patients.1–11 It remains unclear, however, how an IMH changes serially during a follow-up period and what the significance of the disappearance of IMH is to the prognosis. Transesophageal echocardiography (TEE) provides high-resolution images of the aorta, with which both the wall structure and the blood flow pattern are clearly shown.4,9,10,12 The purpose of the present study was to investigate how an IMH changes serially during a short-term period with the use of TEE and to perform a long-term follow-up with an interview.
Treatment
During the acute phase, antihypertensive agents, including β-adrenergic receptor blockers, calcium channel antagonists, and nitroglycerin, were administered intravenously to patients in the intensive care unit to control systolic blood pressure between 100 and 120 mm Hg. After the antihypertensive treatment with these agents, oral antihypertensive drugs, including β-adrenergic receptor blockers, calcium channel antagonists, ACE inhibitors, or α-adrenergic receptor blockers, were administered in combination (or solely) to achieve adequate systolic blood pressure of <120 mm Hg.

TEE Imaging
TEE was performed with commercially available 5-MHz transesophageal transducers attached to electronic sector scanners (SSH 230A; Toshiba). TEE was performed with the patient under sedation with intravenous diazepam (5 to 10 mg).4 With TEE, images of the ascending aorta, aortic arch, and descending thoracic aorta were obtained of conventional transverse and longitudinal sections.4,9,10,12 The maximum aortic diameter and the maximum size of the IMH were measured at the level of the maximal size of the hematoma as previously reported4,13 (Figure 1).

Echocardiographic Evaluation of Serial Changes in IMHs at 1 and 6 Months
TEE was performed serially at both 1 and 6 months in 41 (93%) of the 44 study patients. Based on the TEE findings at 6 months, the patients were divided into 2 groups; those in whom the IMH completely disappeared (disappearance group, n=21) and those in which the IMH was still demonstrated (persistent group, n=20). Clinical characteristics and TEE findings were compared between the 2 groups. Three patients were excluded from this grouping because overt aortic dissection occurred at 36, 40, or 44 days after the onset.

Long-Term Follow-Up
After 6 months, further follow-up information was obtained with telephone interviews with the patient or the patient’s family or physician (mean follow-up 1552±539 days). The cardiovascular event-free rate was compared between the disappearance and persistent groups.

Analysis of Clinical Outcome With Regard to the Location of IMH
Clinical outcomes, including survival, occurrence of overt aortic dissection, and progressive aortic dilatation that required surgical treatment, were compared between patients with type A IMH and type B IMH.

Statistical Analysis
All values are expressed as mean±SD. Univariate analysis was performed on all clinical and morphological variables with χ² test used for categorical variables and Student’s t test used for continuous variables. The cardiovascular event-free rate was estimated by Kaplan-Meier analysis. A value of P<0.05 was considered to be statistically significant.

Results
Serial Changes in the Echocardiographic Images of IMHs at 1 and 6 Months
Figure 2 shows serial change in the echocardiographic images of IMHs at 1 and 6 months. At 1 month, IMHs disappeared in 8 of 44 patients (18%) and were still demonstrated in the remaining 36 patients (82%). In 3 of these 36 patients with IMHs demonstrated at 1 month, overt aortic dissection occurred at 36, 40, and 44 days (Table 1). In 13 of the

<p>| Table 1. Characteristics of the Patients in Whom Aortic IMH Progressed to Overt Aortic Dissection |
|---------------------------------|----------------|----------------|-----------------|-----------------|</p>
<table>
<thead>
<tr>
<th>Age, y/Sex</th>
<th>Stanford Classification</th>
<th>Maximum Aortic Diameter, mm</th>
<th>Occurrence of Overt Aortic Dissection</th>
<th>Treatment/Consequence</th>
</tr>
</thead>
<tbody>
<tr>
<td>59/F</td>
<td>Type B</td>
<td>47</td>
<td>11 mo</td>
<td>Surgery/alive</td>
</tr>
<tr>
<td>60/F</td>
<td>Type A</td>
<td>50</td>
<td>7 mo</td>
<td>Surgery/alive</td>
</tr>
<tr>
<td>79/M</td>
<td>Type A</td>
<td>50</td>
<td>44 d</td>
<td>Medication/Death</td>
</tr>
<tr>
<td>72/M</td>
<td>Type B</td>
<td>45</td>
<td>36 d</td>
<td>Surgery/Death</td>
</tr>
<tr>
<td>66/F</td>
<td>Type B</td>
<td>45</td>
<td>40 d</td>
<td>Surgery/alive</td>
</tr>
</tbody>
</table>
remaining 33 patients, IMHs disappeared at 6 months. As a result, IMHs disappeared in 21 patients (disappearance group) and IMHs were still demonstrated in the remaining 20 patients (persistent group) among whom TEE was performed at 6 months. Aortic ulcer was not detected with TEE and contrast-enhanced CT at admission in any patient, but it was newly observed within the IMH at 1 month after the onset in 3 patients (Figure 3). In all of these patients, the size and configuration of the aortic ulcer remained unchanged and IMHs were still demonstrated at 6 months, but no overt aortic dissection occurred.

Table 2 shows comparisons of the clinical characteristics and TEE findings between the disappearance and persistent groups. There was no statistical significance for sex, systolic blood pressure at discharge, medications, Stanford classification, frequency of aortic regurgitation, frequency of pleural or pericardial effusion, or localization, circumferential extension, and maximum size of the IMH between the 2 groups. The disappearance group was younger than the persistent group (64 ± 11 versus 72 ± 8 years, \(P < 0.01\)), and the maximum aortic diameter measured with TEE was significantly smaller in the disappearance group than in the persistent group (33 ± 5 versus 42 ± 7 mm, \(P < 0.01\)).

**Long-Term Follow-Up**

In the disappearance group, overt aortic dissection did not occur and surgical treatment was not required during long-term follow-up. In contrast, overt aortic dissection occurred in 2 patients at 7 and 11 months (Table 1), and surgical treatment was required due to the progressive dilatation of the aorta in an additional 2 patients at 12 and 24 months in the persistent group. No cardiovascular event occurred in any of the 3 patients with aortic ulcer during long-term follow-up. Cardiovascular event-free rates at 3 years in the disappearance and persistent groups were 100% and 80%, respectively (Figure 4).

**Analysis of Clinical Outcome With Regard to the Location of IMH**

Table 3 shows the comparisons of clinical characteristics, TEE findings, and prognoses between the type A and type B IMH groups. There was no statistical significance for the clinical characteristics and TEE findings, including systolic blood pressure at discharge, medications, frequency of aortic regurgitation, frequency of pleural or pericardial effusion, and localization, circumferential extension, and maximum size of the IMH.

### Table 2. Comparisons of the Clinical Characteristics and TEE Findings Between the Disappearance and the Persistent Group

<table>
<thead>
<tr>
<th></th>
<th>Disappearance Group (n=21)</th>
<th>Persistent Group (n=20)</th>
<th>(P)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, y</td>
<td>64±11</td>
<td>72±8</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Sex, F/M</td>
<td>7/14</td>
<td>6/14</td>
<td>NS</td>
</tr>
<tr>
<td>Antihypertensive therapy, %</td>
<td>100</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>(\beta)-Blocker</td>
<td>76</td>
<td>75</td>
<td></td>
</tr>
<tr>
<td>Ca(^{2+}) antagonist</td>
<td>76</td>
<td>80</td>
<td>NS</td>
</tr>
<tr>
<td>ACE inhibitor</td>
<td>52</td>
<td>45</td>
<td></td>
</tr>
<tr>
<td>(\alpha)-Blocker</td>
<td>29</td>
<td>40</td>
<td></td>
</tr>
<tr>
<td>Systolic blood pressure at discharge, mm Hg</td>
<td>118±10</td>
<td>119±16</td>
<td>NS</td>
</tr>
<tr>
<td>Maximum diameter of the aorta, mm</td>
<td>33±5</td>
<td>42±7</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Maximum size of the IMH, mm</td>
<td>10±4</td>
<td>12±4</td>
<td>NS</td>
</tr>
<tr>
<td>Stanford classification, type A/type B</td>
<td>2/19</td>
<td>4/16</td>
<td>NS</td>
</tr>
<tr>
<td>Localization of the IMH, 1/2 aortic portions</td>
<td>2/19</td>
<td>1/19</td>
<td>NS</td>
</tr>
<tr>
<td>Circumferential extension of the IMH, less/more than hemicircular</td>
<td>13/8</td>
<td>15/5</td>
<td>NS</td>
</tr>
<tr>
<td>Aortic regurgitation, presence/absence</td>
<td>5/15</td>
<td>8/12</td>
<td>NS</td>
</tr>
<tr>
<td>Pleural or pericardial effusion, presence/absence</td>
<td>8/13</td>
<td>11/9</td>
<td>NS</td>
</tr>
</tbody>
</table>

![Figure 3](image-url) TEE findings in transverse section of aortic arch. Left, IMH is observed, but vascular side of intima is relatively smooth and no tears are observed at admission. Middle, intima is disrupted, and an aortic ulcer is observed within IMH in image at 1 month after onset. Right, aortic ulcer remains unchanged, but IMH regresses at 6 months.

![Figure 4](image-url) Cardiovascular event-free curves in disappearance and persistent groups.
size of IMH. There also were no significant differences between the 2 groups in the parameters that related to the prognosis, including the occurrence of overt aortic dissection and progressive aortic dilatation that required surgical treatment. There were more women with type A IMH than with type B IMH (63% versus 25%, P<0.05), and the maximum aortic diameter measured with TEE was significantly smaller in type B IMH than in type A IMH patients (36±8 versus 44±4 mm, P<0.01).

Discussion

In the present study, IMHs disappeared within 1 month in 18% and within 6 months in 48% of all patients with an IMH. The disappearance of IMHs at 6 months was related to age and the maximum diameter of the aorta. In the long-term follow-up, no potentially catastrophic clinical event occurred in the disappearance group, whereas overt aortic dissection occurred in 2 patients and progressive aortic dilatation that required surgical treatment occurred in an additional 2 patients in the persistent group.

Serial Change in the Echocardiographic Images of IMHs

An IMH is essentially a contained hemorrhage within the medial layer of the aortic wall. Although the pathogenesis of IMH remains unclear, rupture of the vasa vasorum located within the medial layer of the aorta and rupture of an atherosclerotic plaque are considered to be the initiating events that lead to intramural hematoma.1,6,14 Limited aortic dissection with a thrombosed, or “closing,” false lumen is sometimes echocardiographically similar to an IMH but is recognized as a different entity.5 It was reported that aortic ulcer might be related to the initiation of aortic dissection.2 However, we are not sure whether it is related to the initiation, because in the present study, it was not detected at the admission but was newly observed within IMHs at 1 month after the onset in only 3 patients (7%). Furthermore, overt aortic dissection never developed in these patients during the long-term follow-up period. Although atherosclerotic penetrating ulcer is sometimes differentiated from the aortic ulcer in IMHs, it is believed that these 2 ulcers are different entities.7

An important echocardiographic finding of an IMH is the changing behavior of the hematoma4,9,10,12,13 (ie, the size of the IMH tends to vary with time1–13,15,16). Previous studies reported that spontaneous partial regression was observed during a short period and that even disappearance of the IMH was observed in 25% to 64% in patients with IMHs1,4,6,8–10,13,20–22 However, how IMHs change serially in the time course has not been fully examined. We performed TEE serially at 1 and 6 months in an attempt to clarify the dynamic nature of IMHs. We found that IMHs disappeared at 1 month in 18% and at 6 months in 48% of all patients and that the disappearance of an IMH was related to age and the maximum diameter of the aorta. Kaji et al23 reported that maximum aortic diameter was a changing feature of IMHs. Aortic enlargement might influence the distensibility or elasticity of the aortic wall and might affect the healing of IMHs.

Long-Term Follow-Up in Patients With IMHs

It was reported that the location of an IMH affects the prognosis in patients with IMHs, of whom those with type B IMH have a good prognosis but those with type A IMH have a poor prognosis.2–7 Medical treatment for type B IMH is accepted as a first-line therapy, but first-line therapy for type A IMH remains controversial. Nienabar et al6 reported that the 30-day mortality rate for patients with an IMH located in the ascending aorta was 80% (4 of 5 patients) with medical treatment. Mohr-Kahaly et al4 reported that 2 of 3 patients with type A IMH developed communicating dissection or outward rupture. However, Sueyoshi et al17 reported that 7 of
13 patients with type A IMH had a good quality of life and survival rate without surgical treatment. Kaji et al. reported that type A IMH might regress if the maximum aortic diameter was <50 mm, which might predict a good prognosis in these patients. Although only patients with a maximal aortic diameter of <55 mm were recruited in the present study, there was no significant difference between type A IMH and type B IMH in the parameters that related the prognosis, including the occurrence of overt aortic dissection and progressive aortic dilatation that required surgical treatment. Thus, the maximal aortic diameter might be a factor to predict the prognosis in patients with type A IMH.

During long-term follow-up, neither overt aortic dissection nor other cardiovascular events, including aortic rupture and progressive aortic dilatation, occurred in patients with a disappeared IMH. Thus, the disappearance of an IMH suggests a good long-term prognosis. In contrast, overt aortic dissection or progressive aortic dilatation occurred in 4 patients of the persistent group. Thus, a persistent IMH suggests a relatively poor prognosis compared with a disappeared IMH. A previous study suggested that intramural hematoma within the medial layer of the aortic wall resulted in a structural weakness of the medial layer, leading to fusiform aneurysm formation or overt aortic dissection, especially when a mechanical stress was added. Therefore, close follow-up is recommended in patients with a persistent IMH.

Clinical Implications
Overt aortic dissection occurred in patients with IMHs, in all of whom an IMH was still demonstrated for >1 month, and the maximum aortic diameter was >45 mm regardless of the location of the IMH. In contrast, overt aortic dissection never occurred in patients with a disappeared IMH or an aortic diameter of <45 mm. These findings might be helpful in the decision-making process regarding whether preemptive surgical intervention is appropriate for a particular patient.

Study Limitation
The findings of the present study are applicable only to patients with an aortic diameter of <55 mm. Further study is needed to clarify the natural course of IMHs, including marked aortic dilatation.

Conclusions
The rate of disappearance of IMH is 48% within 6 months after the onset. Patients with disappeared IMH should have a good long-term prognosis.

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References
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