A Rapid Bedside D-Dimer Assay (Cardiac D-Dimer) for Screening of Clinically Suspected Acute Aortic Dissection

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Background  A rapid laboratory test for diagnosis of acute aortic dissection (AAD) has not been available. We performed this prospective study to determine the utility of a rapid bedside D-dimer (DD) assay for detection of AAD.

Methods and Results  Patients with suspected AAD were recruited and their DD levels were measured by rapid bedside assay. They were divided into 2 groups according to enhanced computed tomography findings: an AAD group (n=30) and a non-AAD group (n=48). The median DD level was higher in the AAD group (1.80 g/ml) than in the non-AAD group (0.42 g/ml) (p=0.000). The rapid bedside DD assay showed 100% sensitivity, 54% specificity, 58% positive predictive value and 100% negative predictive value for detection of AAD with a normal DD level of up to 0.5 g/ml. The combination of DD level >0.5 g/ml and systolic blood pressure ≥180 mmHg showed 86% positive predictive value for detection of AAD.

Conclusions  We conclude that the rapid bedside DD assay is a highly sensitive method for early exclusion of AAD in patients with chest and/or back pain suggestive of AAD. Acute aortic dissection is highly probable if a rapid DD assay shows the elevated DD level with systolic blood pressure ≥180 mmHg on admission. (Circ J 2005; 69: 397–403)

Key Words:  Acute aortic dissection; D-dimer; Elevated blood pressure; Rapid bedside assay

Acute aortic dissection (AAD) can be fatal and should be diagnosed as early as possible. Without treatment, mortality increases by 1% per hour during the first 48 h! Acute aortic dissection has traditionally been diagnosed by computed tomography (CT) because a rapid laboratory test has not been available. However, if the possibility of AAD could be ruled out, contrast-enhanced CT, which is time-consuming and impairs renal function with contrast media, would be unnecessary. Both the coagulation and fibrinolytic systems are reportedly activated in cases of AAD? Weber et al found that assay of D-dimer (DD), a specific degradation product of cross-linked fibrin, had 100% sensitivity but only 69% specificity for detection of AAD. A rapid bedside DD assay (Cardiac D-dimer, Roche Diagnostics, Mannheim, Germany) was recently developed for detection of pulmonary embolism and deep vein thrombosis. One characteristic of patients with AAD is elevated systolic blood pressure! and we hypothesized that elevated blood pressure could serve as a diagnostic indicator in cases of suspected AAD. Therefore, the first goal of the present study was to show the utility of rapid bedside DD assay in the detection of AAD. The second goal was to clarify whether positive predictive value could be increased if the rapid bedside DD assay value and blood pressure reading upon admission were used in combination.

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(Circ J 2005; 69: 397–403)

Methods

Patients

The study group included consecutive patients in whom AAD was suspected or not ruled out, who were admitted to the coronary care unit during the period November 2002 through June 2004 and in whom the DD level was determined by rapid bedside assay. Acute aortic dissection was suspected in patients with sudden onset of chest and/or back pain and no definitive electrocardiographic findings of

Fig 1. The D-dimer (DD) level is determined by the Cardiac reader (Roche Diagnostics). The test strip is inserted into the slot of the Cardiac reader, and sample (150 μL heparinized blood) is placed on the window of the test strip. The DD level is displayed 10 min after the sample is added.
myocardial ischemia. The condition of AAD was diagnosed by enhanced CT, and the patients were divided accordingly into an AAD group and a non-AAD group. The non-AAD patients were further classified as those with rupture or impending rupture of a thoracic or abdominal aortic aneurysm (TAA/AAA subgroup) and others (other subgroup). To determine the accuracy of the rapid bedside DD assay, consecutive patients who were admitted to the coronary care unit during the same period were recruited separately as a reference group. The DD levels were measured in all these patients by simultaneous rapid bedside assay and latex agglutination assay. When the DD level of the patient was <0.1 µg/ml or >4.0 µg/ml, the patient was excluded from the reference group.

Rapid Bedside DD Assay

The DD assay was performed with the Roche Cardiac D-dimer system, which comprises a Cardiac reader (Fig 1) and test strip (Fig 2). The Cardiac reader is an instrument that measures the DD level in blood. The test strip is placed on the Cardiac reader, and 150 µl of whole blood with heparin is applied on the window of the test strip. After 10 min, a DD reading ranging from 0.1 to 4.0 µg/ml is displayed. If the DD level is out of the measurement range, the Cardiac reader displays the level as <0.1 µg/ml or >4.0 µg/ml. This rapid bedside DD assay is based on an antigen-antibody reaction. The sandwich complex, which is formed by DD and 2 different antibodies; biotinylated anti-DD and gold labeled anti-DD, is taken up by the streptavidin line in the detection zone of the test strip via the biotinylated antibody. The gold-labeled antibody is responsible for color formation during the assay period. The reddish signal line is quantitatively recorded on the basis of its reflectance by a camera inside the Cardiac reader. The intensity of the red line is converted to a DD reading by a diode (555 nm).

Comparison of the Rapid Bedside and Latex Agglutination Assays

In the reference group, the DD level was simultaneously measured by means of the rapid bedside assay and a second-generation latex agglutination assay. The measurements were compared to determine the accuracy of the rapid assay. The latex agglutination assay used at our institution is LIAS-AUTO-D-dimer (Kokusai-shiyaku, Hyogo, Japan).

Patient Characteristics and DD Assay

The final diagnosis for each patient was reviewed, and patient characteristics were examined: age, sex, time from onset of symptoms to DD assay, blood pressure prior to the start of anti-hypertensive therapy, creatinine clearance upon admission, and the DD level as measured by the rapid bedside assay. In the AAD group, the DD levels obtained by rapid bedside assay were compared between patients with Stanford type A and type B dissection and between patients with a thrombosed vs a patent false lumen.

Accuracy of the Rapid Bedside DD Assay for Diagnosis of AAD

Accuracy of the rapid bedside DD assay for diagnosis in patients with suspected AAD was evaluated in terms of sensitivity, specificity, negative predictive value, and positive predictive value. We next evaluated the diagnostic accuracy of systolic blood pressure ≥150 mmHg and systolic blood pressure ≥180 mmHg as indicators of AAD. Finally, we evaluated the diagnostic accuracy of the DD level combined with systolic blood pressure ≥180 mmHg.

Definitions

Our patients with suspected AAD did not have myocardial ischemia diagnosed by electrocardiography upon admission. Myocardial ischemia was evaluated as electrocardiography with ST-segment elevation or depression ≥1 mm in 2 or more contiguous leads. Acute aortic dissection was diagnosed on the basis of CT findings of an intimal flap. Patency of the false lumen was assessed by enhanced CT upon admission. A patent false lumen was identified by contrast medium opacification of at least a portion of the false lumen. A thrombosed false lumen was identified by complete occlusion of the false lumen by a thrombus. A DD level of up to 0.5 µg/ml was considered normal, and when the rapid bedside assay showed a DD level of >0.5 µg/ml, the assay was considered positive. When the DD level obtained with the rapid bedside assay was >4.0 µg/ml or <0.1 µg/ml, the DD level was recorded as 4.0 µg/ml or 0.1 µg/ml, respectively. Creatinine clearance was determined according to the formula for predicting creatinine clearance from serum creatinine:6 Creatinine clearance in male patients was calculated as (33–0.065×age–0.493×body mass index)×body weight×creatinine+14.4. Creatinine clearance in female patients were calculated as (21–0.030×age–0.216×body mass index)×body weight×creatinine+14.4. Body mass index was calculated as body weight (kg)+height (m)2. Blood pressure upon admission was measured with a sphygmomanometer prior to the start of therapy. The cut-off systolic blood pressure values were set at 150 mmHg, which was defined as an elevated systolic blood pressure in previous epidemiological reports related to AAD1,7 and 180 mmHg, which was defined as severe hypertension by World Health Organization-International Society of Hypertension guidelines8

Statistical Analysis

All continuous variables are expressed as median values (25th percentile, 75th percentile). The Mann–Whitney U-test was used to analyze differences in factors between the AAD group and the non-AAD group, patients with a patent false lumen and those with a thrombosed false lumen, and patients with type A dissection and those with type B dissection. Bonferroni correction was applied for comparison of DD levels between the AAD group, TAA/AAA subgroup, and other subgroup. Differences in percentages were evaluated by Fisher’s exact test. Spearman’s rank correlation coefficient was used to calculate the strength of association between paired factors: DD levels obtained by rapid bedside assay and by latex agglutination assay, DD level obtained by rapid bedside assay and serum creatinine.
clearance value upon admission, DD level obtained by rapid bedside assay and patient age, DD level obtained by rapid bedside assay and time from onset of symptoms to measurement of DD. SPSS (11.0) software (SPSS Inc, Chicago, IL, USA) was used for all statistical analyses. A p-value <0.05 was considered statistically significant.

Results

Patients

There were 78 patients (men 46, women 32, median age 68 (61, 75) years) in whom AAD was suspected or had not been ruled out, and all underwent rapid bedside DD assay. According to the CT findings, these 78 patients included 30 patients with AAD (AAD group) and 48 patients without AAD (non-AAD group). The non-AAD group comprised 48 patients, 7 in the TAA/AAA subgroup and 41 in the other subgroup. Recruitment and enrollment of patients are summarized in Fig 3. The final diagnoses of patients in whom AAD was suspected or not ruled out are listed in Table 1.

Comparison of the Rapid Bedside and Latex Agglutination Assays

The DD level was measured with both rapid bedside and latex agglutination assays in 50 reference patients. The final diagnoses of these 50 patients included unstable angina (n=17), acute myocardial infarction (n=15), congestive heart failure (n=5), pericarditis (n=3), pulmonary embolism (n=2), hypertrophic cardiomyopathy (n=2), and other disorders (n=6). Results of the 2 assays were well correlated (r=0.938, p=0.000) (Fig 4).

Table 1 Final Diagnoses of 78 Patients With Suspected AAD or AAD Not Ruled Out

<table>
<thead>
<tr>
<th></th>
<th>AAD group (n=30)</th>
<th>Non-AAD group (n=48)</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Type A/B</td>
<td>TAA/AAA subgroup (n=7)</td>
</tr>
<tr>
<td></td>
<td>Thrombosed/patent</td>
<td>Thoracic aortic aneurysm</td>
</tr>
<tr>
<td></td>
<td>A-P/A-T/B-P/B-T</td>
<td>Abdominal aortic aneurysm</td>
</tr>
<tr>
<td></td>
<td>De Bakey I/II/III</td>
<td>Other subgroup (n=41)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Unstable angina</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Acute myocardial infarction</td>
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<tr>
<td></td>
<td></td>
<td>Acute gastric mucosal lesion</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Paroxysmal atrial fibrillation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Pulmonary embolism</td>
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<tr>
<td></td>
<td></td>
<td>Other</td>
</tr>
</tbody>
</table>

AAD, acute aortic dissection; A-P, type A with patent false lumen; A-T, type A with thrombosed false lumen; B-P, type B with patent false lumen; B-T, type B with thrombosed false lumen; TAA/AAA, thoracic aortic aneurysm or abdominal aortic aneurysm.

Fig 3. Patient groups. AAD, acute aortic dissection; TAA/AAA, thoracic aortic aneurysm or abdominal aortic aneurysm.

Fig 4. Correlation between D-dimer (DD) levels assessed by Cardiac D-dimer and by latex agglutination assay (r=0.938, p=0.000).
Patient Characteristics

Characteristics of the AAD patients and non-AAD patients are shown in Table 2. The median time from onset to the measurement of DD levels in the AAD group was 4.5 h (3.0, 8.6). Both systolic blood pressure and diastolic blood pressure were higher in the AAD group than in the non-AAD group. In particular, the percentage of patients with systolic blood pressure ≥180 mmHg was greater in the AAD group (n=12, 40%) than in the non-AAD group (n=4, 8%) (p=0.001). Median systolic blood pressure was lower in patients with type A dissection (142 mmHg (118, 162)) than in patients with type B dissection (181 mmHg (159, 201)) (p=0.007). Systolic blood pressure <150 mmHg was observed in 10 patients in the AAD group, and 8 of these (80%) had type A dissection. In the AAD group, there were no patients with cardiac tamponade, 2 with aortic rupture, 10 who underwent surgery in the acute period, and 4 who died in the hospital.

DD Assay Values

The DD levels were determined in each study group (Table 3). A DD level >0.5 μg/ml was found in 3 AAD patients and in 1 non-AAD patient, and these levels were regarded as 0.5 μg/ml. In the AAD group, time from onset of symptoms to measurement of DD did not correlate significantly with the DD levels (r=–0.266, p=0.155). The time from the onset of symptoms to the measurement of DD was as short as 1 h in 2 patients, and both had a DD level >0.5 μg/ml (1.8 μg/ml and >4.0 μg/ml). The median DD level was higher in the AAD group than in the non-AAD group (p=0.000) and in the other subgroup (p=0.000). However, the DD level was not significantly different between the AAD group and the TAA/AAA subgroup. No differences were observed in the DD level between type A and type B, or thrombosed and patent. No correlations were observed between DD level and creatinine clearance (r=0.227, p=0.227), or DD level and age (r=0.067, p=0.727).

Accuracy of the Rapid Bedside DD Assay for Diagnosis of AAD

The DD levels of all patients in the AAD group were >0.5 μg/ml. The diagnostic value of a positive rapid bedside DD assay result and blood pressure readings above the cut-off levels is shown in Table 4. The rapid bedside DD assay showed 100% sensitivity and 100% negative predictive value for diagnosis of AAD in our patients with suspected AAD, but it showed 54% specificity. The positive predic-

Table 2 Patient Characteristics per Study Group

<table>
<thead>
<tr>
<th></th>
<th>AAD group (n=30)</th>
<th>Non-AAD group (n=48)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>70 (60, 76)</td>
<td>67 (61, 74)</td>
<td>0.554</td>
</tr>
<tr>
<td>Men/women</td>
<td>19/11</td>
<td>27/21</td>
<td>0.638</td>
</tr>
<tr>
<td>Time from onset to D-dimer assay (h)</td>
<td>4.5 (3.0, 8.6)</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td>Blood pressure before therapy</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Systolic (mmHg)</td>
<td>163 (140, 188)</td>
<td>141 (127, 163)</td>
<td>0.008</td>
</tr>
<tr>
<td>≥150 mmHg, n (%)</td>
<td>20 (67)</td>
<td>18 (38)</td>
<td>0.019</td>
</tr>
<tr>
<td>≥180 mmHg, n (%)</td>
<td>12 (40)</td>
<td>4 (8)</td>
<td>0.001</td>
</tr>
<tr>
<td>Diastolic (mmHg)</td>
<td>86 (77, 100)</td>
<td>70 (67, 90)</td>
<td>0.015</td>
</tr>
<tr>
<td>Creatinine clearance (ml/min)</td>
<td>65 (55, 100)</td>
<td>87 (65, 112)</td>
<td>0.086</td>
</tr>
</tbody>
</table>

Data are expressed as median values (25th percentile, 75th percentile) unless otherwise noted. p-values were analyzed by Mann–Whitney U-test and Fisher’s exact test. AAD, acute aortic dissection.

Table 3 D-Dimer Levels in Each Group Determined by Rapid Bedside Assay

<table>
<thead>
<tr>
<th></th>
<th>n</th>
<th>D-dimer level (μg/ml)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>AAD group</td>
<td>30</td>
<td>1.80 (1.07, 2.73)</td>
<td></td>
</tr>
<tr>
<td>Type A/B</td>
<td>12/18</td>
<td>1.25 (0.98, 2.75)/1.80 (1.28, 2.88)</td>
<td>0.368</td>
</tr>
<tr>
<td>Thrombosed/patent false lumen</td>
<td>11/19</td>
<td>2.50 (1.50, 3.50)/1.30 (0.99, 2.60)</td>
<td>0.134</td>
</tr>
<tr>
<td>Non-AAD group</td>
<td>48</td>
<td>0.42 (0.20, 1.38)</td>
<td>0.000*</td>
</tr>
<tr>
<td>TAA/AAA subgroup</td>
<td>7</td>
<td>2.40 (1.40, 3.50)</td>
<td>0.227</td>
</tr>
<tr>
<td>Other subgroup</td>
<td>41</td>
<td>0.28 (0.16, 0.85)</td>
<td>0.000†</td>
</tr>
</tbody>
</table>

D-dimer level is expressed as median value (25th percentile, 75th percentile). p-values were analyzed by Mann–Whitney U-test and by Mann-Whitney U-test with Bonferroni correction. AAD, acute aortic dissection, TAA/AAA, thoracic aortic aneurysm or abdominal aortic aneurysm. *D-dimer level was greater in the AAD group than in the non-AAD group. †D-dimer level was greater in the AAD group than in the Other subgroup.

Table 4 Value of Each Diagnostic Method in Patients With Suspected AAD or AAD Not Ruled Out

<table>
<thead>
<tr>
<th>Method</th>
<th>Sensitivity (%)</th>
<th>Specificity (%)</th>
<th>PPV (%)</th>
<th>NPV (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>D-dimer &gt;0.5 μg/ml</td>
<td>100</td>
<td>54</td>
<td>58</td>
<td>100</td>
</tr>
<tr>
<td>Systolic blood pressure ≥150 mmHg</td>
<td>67</td>
<td>63</td>
<td>53</td>
<td>75</td>
</tr>
<tr>
<td>Systolic blood pressure ≥180 mmHg</td>
<td>40</td>
<td>92</td>
<td>75</td>
<td>71</td>
</tr>
<tr>
<td>D-dimer &gt;0.5 μg/ml and systolic blood pressure ≥180 mmHg</td>
<td>40</td>
<td>96</td>
<td>86</td>
<td>72</td>
</tr>
</tbody>
</table>

AAD, acute aortic dissection; PPV, positive predictive value; NPV, negative predictive value.
Rapid D-Dimer Assay in Acute Aortic Dissection

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**Discussion**

We found that a rapid bedside DD assay (Cardiac D-dimer), which provides a result in just 10 min, was useful for the screening of AAD with 100% negative predictive value in patients with chest and/or back pain suggestive of AAD. Furthermore, the combination of the DD assay result and systolic blood pressure value upon admission increased the positive predictive value for detection of AAD.

Blood DD is the only known biochemical marker of AAD for which a rapid assay is available. Smooth muscle myosin heavy chain and elastin have been proposed as specific markers of AAD, but rapid measurement systems are not clinically available. In general, DD is used in cases of suspected coagulation activation and in all clinical conditions with ongoing fibrinolysis, such as disseminated intravascular coagulation, liver cirrhosis, fulminant hepatitis, malignancy, burn, aortic aneurysm, pulmonary embolism, deep vein thrombosis, and acute coronary syndrome. D-dimer is a useful diagnostic marker for pulmonary embolism and deep vein thrombosis because of the high negative predictive value.

ten Cate et al explained the mechanism of coagulation and fibrinolytic system activation in AAD as follows: Once false lumen formation occurs, factor XII is activated by the exposure of subendothelial tissue, such as collagen in the vessel wall, to blood flow. In addition, the activation of factor VII by tissue thromboplastin derived from the aortic wall activates the coagulation system. The fibrinolytic system is activated by discharge of the plasminogen activator, which exists in the aortic outer wall; plasmin and DD are produced from plasminogen and stabilized fibrin, respectively. As a result, the fibrinolytic and coagulation systems are both activated in AAD. Thus, the DD level is elevated in patients with AAD.

In the present study, the DD level was elevated to >0.5 μg/ml in all patients with all types of AAD (type A or B, patent or thrombosed). Additionally, the DD level was already increased to >0.5 μg/ml at 1 h after onset. We speculate that the coagulation and fibrinolytic systems are activated immediately after the onset of AAD. Thus, the rapid DD assay must be available for the detection of AAD during the acute phase. The DD level is reportedly elevated in cases of true aneurysm, which was confirmed in the present study, because the hematoma existing within the intima of a true aneurysm affects the patient’s fibrinolytic status. Therefore, it was difficult to discriminate AAD from true aneurysm on the basis of DD levels in the present study.

To our knowledge, there have been 2 studies that showed the usefulness of the DD level for detection of AAD. Perez et al conducted a retrospective study and reported that DD levels were elevated in all patients with AAD (type A or B, patent or thrombosed). Additionally, the DD level was already increased to >0.5 μg/ml at 1 h after onset. We speculate that the coagulation and fibrinolytic systems are activated immediately after the onset of AAD. Thus, the rapid DD assay must be available for the detection of AAD during the acute phase. The DD level is reportedly elevated in cases of true aneurysm, which was confirmed in the present study, because the hematoma existing within the intima of a true aneurysm affects the patient’s fibrinolytic status. Therefore, it was difficult to discriminate AAD from true aneurysm on the basis of DD levels in the present study.

Weber et al reported that the DD level was useful for detection of AAD. They measured DD in 24 patients with AAD.
by latex agglutination assay and reported that both sensitivity and negative predictive value were 100% and specificity was 69%. In the present study, sensitivity and negative predictive value were also 100%, and specificity was 54%. Therefore, we believe that the appropriate application of bedside DD assay is to exclude patients with AAD because of the assay’s high negative predictive value.

The current study differed from the previous study by Weber et al in some ways. First, DD levels in the present study were measured by a rapid bedside assay system, which gave us results in just 10 min. This rapid assay was indispensable for diagnosis of AAD because of the high mortality rate associated with AAD in the acute period. Second, we took renal function and aging into account when DD levels were evaluated. It was reported that the DD level increased with age in healthy people, and the average DD level was 0.53±0.17 μg/ml (normal value <0.4 μg/ml; n=17; Elisa D-dimer; Boehringer, Mannheim, Germany) in patients ≥70 years of age.25 Furthermore, DD levels correlate with creatinine clearance.23 In the present study, no correlation was observed between the DD level and age or the DD level and creatinine clearance in the AAD group. Therefore, the reason for DD elevation in patients with AAD was not impaired renal function or aging; rather, it was an effect of AAD.

Elevated blood pressure is a clinical characteristic of AAD and is considered to be a causative factor. Reports indicate that 49–63% of AAD patients have systolic blood pressure ≥150 mmHg upon admission.1,7 In our AAD group, 67% of patients had systolic blood pressure ≥150 mmHg and 40% had systolic blood pressure ≥180 mmHg prior to anti-hypertensive therapy. In contrast, patients with pulmonary embolism, whose DD level may be high, usually do not have elevated systolic blood pressure.26 Thus, we may be able to differentiate pulmonary embolism from AAD in terms of blood pressure, although we could not distinguish TAA/AAA rupture or hypotension from AAD in the present study. Other diseases associated with DD elevation, such as disseminated intravascular coagulopathy, liver cirrhosis, fulminant hepatitis, malignancy, and burn, also do not always present with elevated systolic blood pressure. Accordingly, we compensated for the low positive predictive value of the DD assay alone by using it in combination with systolic blood pressure upon admission for higher probability of AAD. In the present study, the combination of DD >0.5 μg/ml and systolic blood pressure ≥180 mmHg showed 86% positive predictive value, but it showed only 40% sensitivity. In patients with AAD in a shock state, such as those with type A dissection with cardiac tamponade or aortic rupture, however, it is hard to detect AAD on the basis of elevated blood pressure. Actually, blood pressure is reportedly lower in patients with type A than in those with type B dissection.27 In the present study, there were no cases of cardiac tamponade and 2 cases of aortic rupture. Most of the patients (70%) with systolic blood pressure <150 mmHg had type A dissection. Therefore, the diagnostic sensitivity of systolic blood pressure ≥150 mmHg was 42% in type A and 83% in type B dissection. In addition, the diagnostic sensitivity of systolic blood pressure ≥180 mmHg was 17% in type A and 56% in type B dissection. Accordingly, the detected AAD by this combination system will be more likely type B than type A. Recently, elevation of hepatocyte growth factor in the patients with AAD was reported.28 Matsumori et al showed that both hepatocyte growth factor and DD were elevated in 78% of the patients with cerebral infarction.29 Accordingly, the combination assay of hepatocyte growth factor and DD might show high diagnostic specificity of AAD. To achieve high diagnostic specificity, other supplemental assays of DD should be searched.

Second-generation latex agglutination assay is as highly sensitive as enzyme-linked immunosorbent assay, and the assay time is short. An immunochromatographic method was recently developed that can measure DD in less time than the conventional enzyme-linked immunosorbent assay method. The rapid bedside Cardiac D-dimer assay is based on the immunochromatographic method. Dempfle et al reported that DD measurements obtained with Cardiac D-dimer showed good agreement with those of 2 enzyme-linked immunosorbent assays (Tina-quant D-dimer, Roche Diagnostics; and STA LIATEST, Diagnostica Stago, Asnieres, France).24 Bucak et al showed similar sensitivity, specificity, positive predictive value, and negative predictive value for these enzyme-linked immunosorbent assays in the diagnosis of deep vein thrombosis. In the present study, the Cardiac D-dimer was compared to the LIAS AUTO D-dimer, a second-generation latex agglutination assay, and the results of these 2 assays were well correlated (Fig 4). Our results confirmed that the rapid bedside Cardiac D-dimer assay was as reliable as the second-generation latex agglutination assay in AAD patients.

According to our results, rapid bedside DD assay is useful in prompt screening of AAD. In cases that a rapid bedside DD assay shows DD level elevation in patients with chest and/or back pain without myocardial ischemia, there will be possibility of AAD, TAA/AAA, pulmonary thromboembolism and so on. Acute aortic dissection is strongly suspected when systolic blood pressure is >180 mmHg on admission. In addition, we need to perform enhanced CT, transesophageal echocardiogram and angiography to confirm diagnosis of AAD. In cases that a rapid assay shows no DD level elevation, we can rule out AAD promptly and we can spare the time for unnecessary enhanced CT which impair renal function.

We cannot rule out AAD when the DD level is within normal range because our results are based on a small number of patients. Further investigation is needed to confirm that CT is unnecessary when the DD level is within normal range.

Study Limitations

Exact DD levels were not assessed in 9 patients (12%) when the Cardiac D-dimer reading was <0.1 μg/ml or >4.0 μg/ml. In the AAD group, there were 3 patients with DD >4.0 μg/ml and none with DD <0.1 μg/ml. In the non-AAD group, there was 1 patient with DD >4.0 μg/ml and 5 patients with DD <0.1 μg/ml. As a result, estimates of DD levels in the AAD group were probably low in comparison to estimates in the non-ADD group. However, we believe this did not affect our final results.

Conclusions

We found that a rapid bedside DD assay was useful for the screening of AAD in patients with chest and/or back pain suggestive of AAD. In addition, the combination of the DD assay result and systolic blood pressure value upon admission increased positive predictive value for detection of AAD.
Acknowledgments

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References


