Enhanced Rho-Kinase Activity in Patients With Vasospastic Angina After the Great East Japan Earthquake

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Background: It remains unclear whether disease activity of vasospastic angina (VSA) is altered during a disaster.

Methods and Results: Before and after the Great East Japan Earthquake, we examined Rho-kinase activity in circulating neutrophils of 11 VSA patients and their mental stress with the post-traumatic stress disorder (PTSD) questionnaire. Rho-kinase activity was significantly increased at 6 months after the Earthquake, and was returned to baseline level at 12 months. Importantly, percent change in Rho-kinase activity was significantly correlated with the PTSD score.

Conclusions: These results indicate that the Rho-kinase activity of VSA patients was transiently enhanced associated with disaster-related mental stress. (Circ J 2012; 76: 2892–2894)

Key Words: Angina; Stress; Vasospasm

On March 11, 2011, we experienced the Great East Japan Earthquake in our Tohoku area. The Earthquake-related physical and psychological stress persisted for several months. Coronary vasomotor reactivity is known to be enhanced by stress1 and we have previously demonstrated that Rho-kinase plays a key role in the molecular mechanisms of vasospastic angina (VSA).2 We have also recently demonstrated that Rho-kinase activity in circulating neutrophils is a useful biomarker for the diagnosis and disease activity assessment of VSA.3 We thus examined whether Rho-kinase activity was increased in VSA patients after the Earthquake.

Methods

The protocol of the present study was approved by the Ethical Committees of Tohoku University and all patients provided written informed consent. In 11 patients with VSA, all of whom had been previously diagnosed based on spasm provocation test with acetylcholine in accordance with the Guidelines for Diagnosis and Treatment of Patients with Vasospastic Angina of the Japanese Circulation Society,4 we were able to measure Rho-kinase activity in circulating neutrophils at 3 time points: before and 6 and 12 months after the Earthquake. Rho-kinase activity was defined by the ratio of the phosphorylated form/total form of myosin-binding subunit, a substrate of Rho-kinase.3 We also quantified the extent of mental stress at 6 and 12 months after the Earthquake with the post-traumatic stress disorder (PTSD) questionnaire that is widely used for screening of PTSD.5 The PTSD questionnaire consists of 22 questions for major PTSD symptoms in order to categorize symptom severity into 5 different levels (0–4), where the cut-off value for PTSD is 25 points.5 All results are expressed as mean±standard deviation (SD) and P values <0.05 were considered to be statistically significant.

Results

The mean age of the 11 patients (8 males, 3 females) was 62±11 years. The prevalence of hypertension, diabetes mellitus and dyslipidemia was 55%, 27% and 91%, respectively. Their left ventricular ejection fraction was well-preserved (71±9%) and 2 of them continued to smoke after the Earthquake. All patients continued their medical treatment with calcium-channel blockers (CCBs) and although there was no change in the levels of serological markers after the Earthquake, including high-sensitivity C reactive protein and lipid profiles (Table), Rho-kinase activity in circulating neutrophils was significantly increased at 6 months after the Earthquake and was returned...
Enhanced Rho-Kinase Activity in VSA After the Earthquake

Among the 11 patients, 3 were directly hit by the tsunami and complained of increased frequency of angina attacks after the Earthquake. In these 3 patients, as compared with the remaining 8 patients without direct tsunami-hit or worsening symptoms after the Earthquake, both PTSD score (32±7 vs. 5±8, P=0.01) and the percent change in Rho-kinase activity from the baseline (268±232% vs. 55±40%, P<0.05) were significantly higher at 6 months after the Earthquake. Importantly, there was a significant positive correlation between the PTSD score and the percent change in Rho-kinase activity from the baseline at 6 months after the Great East Japan Earthquake (r=0.67, P<0.05) (Figure B). We also confirmed that elevated levels of PTSD score at 6 months after the Earthquake declined at 12 months, as in the case of Rho-kinase, although there was no significant correlation between the changes in the PTSD score and those in Rho-kinase activity from 6 to 12 months after the Earthquake (Table S1).

Discussion

The novel findings of the present study were that Rho-kinase activity in circulating neutrophils of patients with vasospastic angina (VSA) was changed dynamically in one year after the Earthquake and that the percent change in Rho-kinase activity from the baseline was positively correlated with the PTSD score in those patients. We have recently demonstrated that a ratio of 1.18 is the best cut-off level of Rho-kinase activity for the diagnosis of VSA and that medical treatment with CCBs ameliorated the level to below the cut-off value in VSA patients. In the present study, although all the patients continued to take CCBs and no significant changes were noted for coronary risk factors or sys-

Table. Changes in Serological Markers After the Great East Japan Earthquake

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Baseline (n=11)</th>
<th>6 months (n=11)</th>
<th>12 months (n=11)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>WBC (/μl)</td>
<td>4,900 (4,600, 6,100)</td>
<td>5,200 (4,600, 5,900)</td>
<td>4,500 (4,200, 7,100)</td>
<td>0.78</td>
</tr>
<tr>
<td>Hb (g/dl)</td>
<td>13.4±1.1</td>
<td>13.5±1.2</td>
<td>13.7±1.4</td>
<td>0.87</td>
</tr>
<tr>
<td>Ht (%)</td>
<td>39.2±3.2</td>
<td>39.5±3.5</td>
<td>39.4±4.1</td>
<td>0.98</td>
</tr>
<tr>
<td>hs-CRP (mg/dl)</td>
<td>0.084 (0.031/0.173)</td>
<td>0.046 (0.022/0.254)</td>
<td>0.052 (0.036/0.166)</td>
<td>0.86</td>
</tr>
<tr>
<td>LDL (mg/dl)</td>
<td>108±23</td>
<td>106±32</td>
<td>113±26</td>
<td>0.59</td>
</tr>
<tr>
<td>HDL (mg/dl)</td>
<td>46±13</td>
<td>50±16</td>
<td>48±10</td>
<td>0.45</td>
</tr>
<tr>
<td>TG (mg/dl)</td>
<td>169±81</td>
<td>171±92</td>
<td>123±54</td>
<td>0.23</td>
</tr>
<tr>
<td>Fasting serum glucose (mg/dl)</td>
<td>113±18</td>
<td>117±35</td>
<td>110±37</td>
<td>0.54</td>
</tr>
<tr>
<td>HbA1c (%)</td>
<td>5.7±0.6</td>
<td>5.8±0.6</td>
<td>5.8±0.8</td>
<td>0.83</td>
</tr>
</tbody>
</table>

Values are mean±SD or median (25th percentile/75th percentile). WBC, white blood cells; Hb, hemoglobin; Ht, hematocrit; hs-CRP, high-sensitivity C-reactive protein; LDL, low-density lipoprotein; HDL, high-density lipoprotein; TG, triglycerides.
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Disclosures
Conflicts of Interest: None.

References
7. Maseri A, Beltrame JF, Shimokawa H. Role of coronary vasospastic activity may have increased cardiovascular events, such as sudden cardiac death, fatal arrhythmia and heart failure hospitalization, after the Earthquake, as we have recently reported. Coronary spasm plays an important role in the pathogenesis of ischemic heart disease and other systemic disorders. Furthermore, it is conceivable that the transient enhanced coronary vasospastic activity may have increased cardiovascular events, such as sudden cardiac death, fatal arrhythmia and heart failure hospitalization, after the Earthquake, as we have recently reported. Disaster stress could cause activation of the sympathetic nervous system and exacerbation of risk factors including hypertension, blood viscosity and platelet aggregating activity. These disaster-related risk factors could also exacerbate VSA through Rho-kinase activation, although detailed mechanisms remain to be clarified in future studies.

The limitations of this study include the relatively small number of subjects and the lack of information on Rho-kinase activity in non-VSA subjects.

In conclusions, we were able to demonstrate the transient but significant increase in Rho-kinase activity in VSA patients after the Great East Japan Earthquake Disaster, in proportion to the extent of PTSD score, suggesting the importance of careful management of VSA patients after a disaster.

Supplementary Files

Supplementary File 1
Table S1. Rho-Kinase Activity and PTSD Score at 6 and 12 Months After the Great East Japan Earthquake
Please find supplementary file(s): http://dx.doi.org/10.1253/circj.CJ-12-1238