The Great East Japan Earthquake Disaster and cardiovascular diseases

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Received 1 July 2011; revised 3 August 2012; accepted 8 August 2012.

Aims
While previous studies reported a short-term increase in individual cardiovascular disease (CVD) after great earthquakes, mid-term occurrences of all types of CVDs after great earthquakes are unknown. We addressed this important issue in our experience with the Great East Japan Earthquake (11 March 2011).

Methods and results
We retrospectively examined the impact of the Earthquake on the occurrences of CVDs and pneumonia by comparing the ambulance records made by doctors in our Miyagi Prefecture, the center of the disaster area, during the period of 2008–11 (n = 124,152). The weekly occurrences of CVDs, including heart failure (HF), acute coronary syndrome (ACS), stroke, cardiopulmonary arrest (CPA), and pneumonia were all significantly increased after the Earthquake compared with the previous 3 years. The occurrences of ACS and CPA showed a rapid increase followed by a sharp decline; whereas those of HF and pneumonia showed a prolonged increase for more than 6 weeks and a second peak after the largest aftershock (7 April 2011). Furthermore, the occurrence of CPA was increased in the first 24 h after the Earthquake, followed by other diseases later on. These increases were independent of age, sex, or residence area (seacoast vs. inland).

Conclusion
These results indicate that the occurrences of all types of CVDs and pneumonia were increased in somewhat different time courses after the Earthquake, including the first observation of the marked and prolonged increase in HF, emphasizing the importance of intensive medical management of all types of CVDs after great earthquakes.

Keywords
Earthquake • Cardiovascular disease • Heart failure • Tsunami

Introduction
On 11 March 2011, the Great East Japan Earthquake hit the northeast part of Japan with a magnitude of 9.0 on the Richter scale, which was one of the largest ocean-trench earthquakes ever recorded in Japan (Table 1).¹ The Earthquake caused huge damage, including 15,861 dead, 3,018 missing persons, and 388,783 destroyed houses as of 6 June 2012.² It forced many people (~400,000) to be evacuated to temporary accommodation, such as public halls, gymnasia halls, and scholastic institutions in Northeast Japan. Since the Earthquake occurred with its epicenter located at 38° latitude, 19 min North, and 142° longitude, 22 min East, our Miyagi Prefecture with a population of 2,340,165 was the closest area to the epicentre (Figure 1A), where there was the largest amount of damage and number of victims, including 9,512 dead, 1,881 missing persons, and 232,553 destroyed houses as of 8 May 2012.³,⁴ and most of the damage was observed in the seacoast area, including 95% dead (95.8%), 1578 missing persons (99.8%), and 223,880 destroyed houses (95.8%).

It has been previously reported that the occurrences of acute coronary syndrome (ACS), stroke, pulmonary embolism, and tachycardia cardiomyopathy were increased after the large earthquakes in Japan (Table 1)⁵–⁹ Furthermore, it has been reported that the occurrences of sudden cardiac death and electromechanically unstable ventricular tachyarrhythmias were increased after the Northridge Earthquake in California, USA, and the Wenchuan Earthquake in China, respectively (Table 1).¹⁰ Thus, the previous reports have revealed that the occurrences of various cardiovascular diseases (CVDs) were increased after large earthquakes. However, these studies reported only the
Background and Study Design

1. The Great East Japan Earthquake attacked East Japan, including Miyagi prefecture, on March 11, 2011. (Dead: 15,857, Missing: 3,057)

2. To clarify the impact of the Earthquake on the occurrences of CVDs, we examined ambulance transport records in the Miyagi prefecture.
# Previous Earthquakes and CVDs

<table>
<thead>
<tr>
<th>Place of the Earthquake (Country)</th>
<th>Year</th>
<th>Magnitude</th>
<th>Temperature (°C, Hi/Lo)</th>
<th>No. of deaths</th>
<th>No. of injured</th>
<th>Diseases increased</th>
</tr>
</thead>
<tbody>
<tr>
<td>Northridge (US)</td>
<td>1994</td>
<td>6.7</td>
<td>19/9</td>
<td></td>
<td>57</td>
<td>Sudden deaths</td>
</tr>
<tr>
<td>Hanshin-Awaji (Japan)</td>
<td>1995</td>
<td>7.3</td>
<td>8/1.4</td>
<td>6,434</td>
<td>43,792</td>
<td>AMI, Pneumonia</td>
</tr>
<tr>
<td>Indian Ocean (Indonesia)</td>
<td>2004</td>
<td>9.1</td>
<td>32/25</td>
<td>Over 220,000</td>
<td>130,000</td>
<td>No data available</td>
</tr>
<tr>
<td>Mid-Niigata (Japan)</td>
<td>2004</td>
<td>6.8</td>
<td>26.4/22</td>
<td>68</td>
<td>4,805</td>
<td>TC, PE, Sudden deaths</td>
</tr>
<tr>
<td>Wenchuan (China)</td>
<td>2008</td>
<td>7.9</td>
<td>25.0/17</td>
<td>69,197</td>
<td>18,222</td>
<td>VT/Vf</td>
</tr>
<tr>
<td>East Japan (Japan)</td>
<td>2011</td>
<td>9.0</td>
<td>6.2/-2.5</td>
<td>15,845</td>
<td>5,894</td>
<td>?</td>
</tr>
</tbody>
</table>

No information is available on the occurrences of CVDs;  
1. A large population  
2. Longer follow-up period  
3. All major CVDs

TC: takotsubo cardiomyopathy, PE: pulmonary embolism
Methods

Materials and study period

1. Ambulance transport records obtained from all 12 fire departments in the Miyagi prefecture (2.3 million).


Diseases examined in this study

5 Major diseases; HF, ACS (AMI and UAP), Stroke, Cardiopulmonary arrest, Pneumonia
Main Results

-Weekly occurrences of the 5 diseases-

A. HF (Cases/w) N=957 in 2011

B. ACS (Cases/w) N=206 in 2011

C. Stroke (Cases/w) N=1541 in 2011

D. CPA (All cause) (Cases/w) N=957 in 2011

E. CPA (Cardio-pulmonary causes) (Cases/w) N=789 in 2011

F. Pneumonia (Cases/w) N=1158 in 2011

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\downarrow: \text{The Great East Japan Earthquake (magnitude of 9.0, March 11, 2011)}
\]
\[
\downarrow: \text{The largest aftershock (magnitude of 7.0, April 11, 2011)}
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(*P<0.05, **P<0.01)