The Great East Japan Earthquake Disaster and Cardiovascular Diseases

Hiroaki Shimokawa, MD, PhD; Tatsuo Aoki, MD, PhD; Yoshihiro Fukumoto, MD, PhD.

Department of Cardiovascular Medicine, Tohoku University Graduate School of Medicine

The authors have no financial conflicts of interest to disclose concerning the presentation.
The Great East Japan Earthquake attacked the Miyagi prefecture on March 11, 2011.

Miyagi prefecture (2.3 million)

Dead: 15,857
Missing: 3,057
Previous Earthquakes and CVDs

<table>
<thead>
<tr>
<th>Place of the Earthquake (Country)</th>
<th>Year</th>
<th>Magnitude</th>
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</table>

No information was 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 (1)

Study Period and Object


2. Ambulance transport records obtained from all 12 fire departments in the Miyagi prefecture (2.3 million), in collaboration with the Miyagi Medical Association.

3. All diagnoses, which were made by attending doctors, were obtained from the ambulance records (N=124,152).
Methods (2)

Japanese emergency medical system

1. Doctors in emergency rooms write diagnoses on the ambulance records, which are then collected and stored in each fire department.

2. In the Miyagi prefecture, the 12 fire departments transfer patients to the 57 hospitals equipped with emergency rooms.

3. Among the 57 hospitals, all (100%) have full-time physicians and 38 (67%) full-time cardiologists.

4. The diagnostic accuracy of ACS in emergency rooms is 83.4% in Japan. (*Circ J.* 2011;75:2813-20.)
Methods (3)

The diseases examined in this study
1. Heart failure (HF)
2. Acute coronary syndrome (ACS; AMI and UAP)
3. Stroke (cerebral infarction and intracranial hemorrhage)
4. Cardiopulmonary arrest (CPA)
5. Pneumonia

The covariates used in subgroup analyses
1. Age (≥75 vs. <75 yrs.)
2. Sex (male vs. female)
3. Residence area (seacoast area vs. inland area)
Methods (4)
-Comparison of diagnostic rates-

Cases without confirmed diagnoses

Cases with confirmed diagnoses

<table>
<thead>
<tr>
<th>Year</th>
<th>Cases without confirmed diagnoses</th>
<th>Cases with confirmed diagnoses</th>
</tr>
</thead>
<tbody>
<tr>
<td>2008</td>
<td>56.7%</td>
<td>56.6%</td>
</tr>
<tr>
<td>2009</td>
<td>56.6%</td>
<td>56.2%</td>
</tr>
<tr>
<td>2010</td>
<td>56.2%</td>
<td>55.5%</td>
</tr>
<tr>
<td>2011</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(Cases)
Result (1)
-Weekly occurrences of the 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 (Cardiopulmonary causes) (Cases/w)
N=789 in 2011

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

↓ : The Great East Japan Earthquake (magnitude of 9.0, March 11, 2011)
↓ : The largest aftershock (magnitude of 7.0, April 11, 2011)

(*P<0.05, **P<0.01)
Result (2)
-Daily occurrences of the diseases-

A. HF  
\(N=83\) in 2011

B. ACS  
\(N=33\) in 2011

C. Stroke  
\(N=184\) in 2011

D. CPA (All cause)  
\(N=130\) in 2011

E. CPA (Cardio-pulmonary causes)  
\(N=104\) in 2011

F. Pneumonia  
\(N=149\) in 2011

\(\downarrow\): The Great East Japan Earthquake (magnitude of 9.0, March 11, 2011)  
\((*P<0.05, **P<0.01)\)
Result (3)
-Subgroup analysis of stroke-

A. Cerebral infarction
(B) Intracranial hemorrhage

\(N=1016\) in 2011
\(N=525\) in 2011

\(\downarrow\): The Great East Japan Earthquake (magnitude of 9.0, March 11, 2011)
\(\downarrow\): The largest aftershock (magnitude of 7.0, April 11, 2011)

\(*P<0.05, \quad **P<0.01\)
### Result (4) Analysis of covariates

<table>
<thead>
<tr>
<th>Condition</th>
<th>Variable</th>
<th>OR (95% CI)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHF</td>
<td>High age (≥75 yrs)</td>
<td>0.86 (0.49-1.50)</td>
<td>0.691</td>
</tr>
<tr>
<td></td>
<td>Male Sex</td>
<td>1.38 (0.86-2.20)</td>
<td>0.177</td>
</tr>
<tr>
<td></td>
<td>Residence in seacoast area</td>
<td>1.24 (0.77-2.02)</td>
<td>0.359</td>
</tr>
<tr>
<td>ACS</td>
<td>High age (≥75 yrs)</td>
<td>0.76 (0.31-1.87)</td>
<td>0.538</td>
</tr>
<tr>
<td></td>
<td>Male Sex</td>
<td>0.61 (0.21-1.60)</td>
<td>0.382</td>
</tr>
<tr>
<td></td>
<td>Residence in seacoast area</td>
<td>0.62 (0.24-1.53)</td>
<td>0.300</td>
</tr>
<tr>
<td>Stroke</td>
<td>High age (≥75 yrs)</td>
<td>1.29 (0.94-1.77)</td>
<td>0.118</td>
</tr>
<tr>
<td></td>
<td>Male Sex</td>
<td>1.21 (0.88-1.67)</td>
<td>0.237</td>
</tr>
<tr>
<td></td>
<td>Residence in seacoast area</td>
<td>0.76 (0.55-1.05)</td>
<td>0.083</td>
</tr>
<tr>
<td>CPA</td>
<td>High age (≥75 yrs)</td>
<td>1.23 (0.82-1.85)</td>
<td>0.321</td>
</tr>
<tr>
<td></td>
<td>Male Sex</td>
<td>1.17 (0.79-1.74)</td>
<td>0.443</td>
</tr>
<tr>
<td></td>
<td>Residence in seacoast area</td>
<td>0.84 (0.57-1.25)</td>
<td>0.390</td>
</tr>
<tr>
<td>Pneumonia</td>
<td>High age (≥75 yrs)</td>
<td>0.73 (0.45-1.17)</td>
<td>0.185</td>
</tr>
<tr>
<td></td>
<td>Male Sex</td>
<td>1.08 (0.74-1.57)</td>
<td>0.716</td>
</tr>
<tr>
<td></td>
<td>Residence in seacoast area</td>
<td>1.54 (1.06-2.26)</td>
<td>0.023*</td>
</tr>
</tbody>
</table>

*Significant at the 0.05 level.
Discussion

Earthquake disaster

- Physical & mental stresses (Environmental change, Trauma, Sleep disorder, etc.)

- Insufficiency of medicines
- Insufficiency of fresh foods

- Increased salt-intake

- SNS and RAAS activation

- Arrhythmias (VT/VF, AF)

- HT, Thrombosis

- Increased occurrences of CVDs

- Cold weather

- Infection
## Previous Earthquakes and CVDs

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<td>Northridge (US)</td>
<td>1994</td>
<td>6.7</td>
<td>19/9</td>
<td>57</td>
<td>5,400</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>
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TC: takotsubo cardiomyopathy, PE: pulmonary embolism
Study limitations

1. The diagnosis process was not standardized.

2. All emergency patients were not referred to CAG.

3. We have no data how many patients visited hospitals without the use of ambulance.

4. We have no data how many people had moved from the seacoast area to the inland area.
Summary and Conclusion

1. CVDs and pneumonia were significantly increased after the Great East Japan Earthquake.

2. HF and pneumonia were then gradually decreased, whereas ACS, stroke and CPA were rapidly decreased as compared with HF and pneumonia.

3. CVDs were increased independent of age, sex or residence area.

The present findings will help us improve disaster cardiovascular medicine in the world.
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   Teruo Sugahara, Toshiji Omatsu, Yasushi Shiga.

4. Tohoku University
   Eiko Ishida, Mazuho Takahashi, Ayako Tsunoda
The Great East Japan Earthquake Disaster and cardiovascular diseases

Tatsuo Aoki¹, Yoshihiro Fukumoto¹, Satoshi Yasuda¹, Yasuhiro Sakata¹, Kenta Ito¹, Jun Takahashi¹, Satoshi Miyata¹, Ichiro Tsuji², and Hiroaki Shimokawa³

¹Department of Cardiovascular Medicine, Tohoku University Graduate School of Medicine, 1-1 Seiryo-machi, Aoba-ku, Sendai 980-8575, Japan, and ²Department of Public Health, Tohoku University Graduate School of Medicine, Sendai, Japan.

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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 centre of the disaster area, during the periods 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 the rapid increase followed by a sharp decline, whereas those of HF and pneumonia showed a prolonged increase for more than 6 weeks and those of stroke and CPA showed 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 north-east 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 15,841 dead, 3,218 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, gymnasium halls, and scholastic institutions in North-east Japan. Since the Earthquake occurred with its epicentre located at 37° latitude, 142° longitude (Figure 1A), where there was the largest amount of damage and number of victims, including 9,512 dead, 13,819 missing persons, and 23,255 destroyed houses as of 8 May 2012,²,³ and most of the damage was observed in the seacoast area, including 94,539 dead (95.8%), 15,787 missing persons (99.8%), and 227,980 destroyed houses (95.8%).

It has been previously reported that the occurrences of ACS, stroke, pulmonary embolism, and takotsubo cardiomyopathy were increased after the large earthquakes in Japan (Table 1).⁴–⁷ Furthermore, it has been reported that the occurrences of sudden cardiac death and haemodynamically unstable ventricular tachyarrhythmias were increased after the Northridge Earthquake in California, USA, and the Wenchuan Earthquake in China, respectively (Table 1).⁹ 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

* Corresponding author. Tel.: +81 22 717 7011; fax: +81 22 717 7136; Email: shimo@cardio-med.tohoku.ac.jp
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