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RAPID COMMUNICATION

Increased Incidence of Tachyarrhythmias and Heart Failure Hospitalization in Patients With Implanted Cardiac Devices After the Great East Japan Earthquake Disaster

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Background: After the East Japan Earthquake disaster there may have been a deterioration of patients with cardiovascular diseases.

Methods and Results: We examined the data from 189 consecutive patients implanted with cardiovascular devices for the 6-month period before and after the Earthquake. In 170 patients with defibrillators, the number who experienced tachyarrhythmias increased significantly after the Earthquake (28±5 vs. 34±3 patients/month, P<0.05). In 74 patients with biventricular pacemakers, the number of heart failure hospitalizations significantly increased after the Earthquake (1.2±1.0 vs. 2.7±1.2 patients/month, P<0.05).

Conclusions: The East Japan Earthquake disaster unfavorably affected patients implanted with defibrillators or biventricular pacemakers. (*Circ J* 2012; **76:** 1283–1285)

Key Words: Arrhythmias; Cardiac implantable devices; Heart failure; The Great East Japan Earthquake

The Great East Japan Earthquake on March 11, 2011 was one of the most catastrophic disasters on record, devastating the northeastern coast region of Japan and also affecting people in the surrounding area. Patients with cardiovascular disease (CVD) in this area may have been particularly adversely affected by the disaster because of both physical and psychological stress.[1–3] In this study, as one of the cardiovascular centers in the disaster area, we examined the effects of the Earthquake on CVD in patients implanted with a defibrillator (ICD) or a biventricular pacemaker (cardiac resynchronization therapy [CRT]), with a special reference to the occurrence of tachyarrhythmias and hospitalization because of worsening of heart failure (HF).

Methods

We examined 189 consecutive patients implanted before the Earthquake with ICD (n=114) or CRT with (CRT-D, n=62) or without (CRT-P, n=13) a defibrillator function and who had survived the disaster (**Data S1**). Their clinical characteristics are shown in **Table S1**. First, we analyzed the device records of tachyarrhythmias for the 6-month period before and after the Earthquake in 170 patients implanted with defibrillators. We defined tachyarrhythmia as sustained or non-sustained ventricular tachycardia (VT), ventricular fibrillation (VF) or supraventricular tachycardia. Second, we examined the effect of the disaster on HF status in 74 HF patients with CRT devices. In order to examine HF worsening in this population, we calculated the monthly number of HF hospitalizations normalized by that of the patients on follow-up in the corresponding period from 5 years before to 6 months after the Earthquake. The monthly number of HF hospitalization per follow-up patients was averaged for every 6-month period before and after the Earthquake. CRT responders were defined as patients who showed left ventricular reverse remodeling at 6 months after CRT based on recent reports.[4,5]

Statistical analysis was performed using 1-factorial ANOVA and post-hoc comparisons or unpaired t-test to compare the changes in the occurrence of tachyarrhythmias and HF hospitalization for the 6 months before and after the disaster. All results are expressed as mean±standard deviation (SD).

Results

The incidence of tachyarrhythmias significantly increased after the Earthquake followed by a gradual decrease to the pre-earthquake level (**Figure 1A**). The monthly average of the number of patients who experienced tachyarrhythmias significantly

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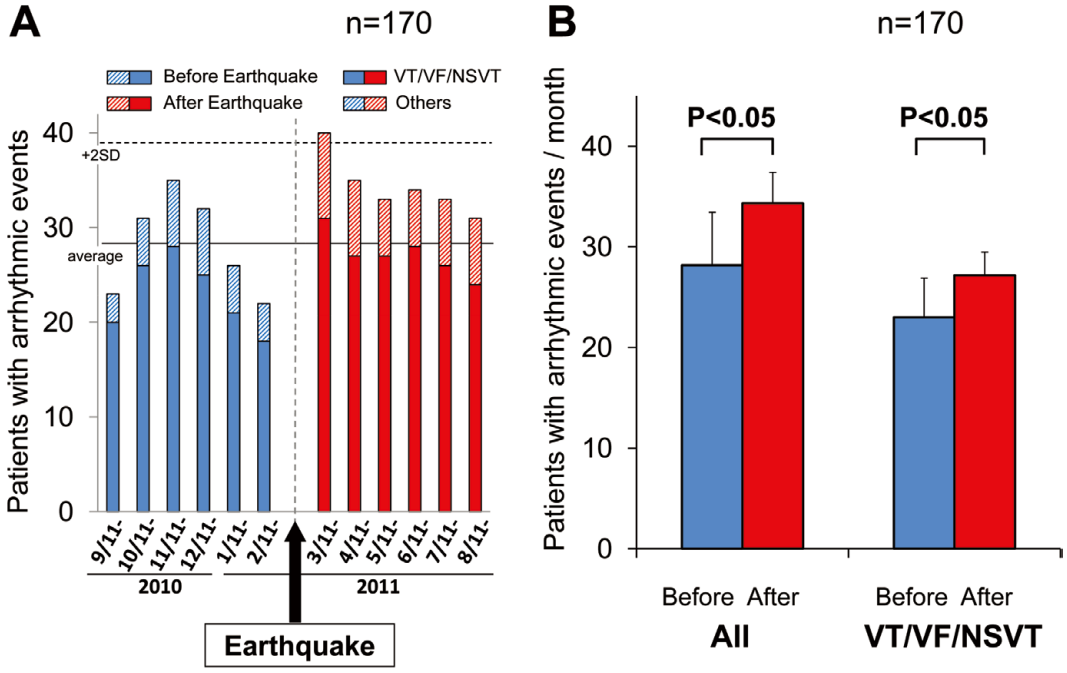

Figure 1. Tachyarrhythmias in patients with an ICD. (**A**) Time course of the number of patients with tachyarrhythmias before (blue bar) and after (red bar) the Earthquake. Horizontal lines show the monthly average (solid line) and +2SD (dotted) of the number of patients with any tachyarrhythmia for the 6-month period before the Earthquake. VT and VF, sustained ventricular tachycardia and fibrillation; NSVT, non-sustained VT. Others includes any tachyarrhythmic event except VT, VF and NSVT. (**B**) Number of patients with any tachyarrhythmia (**Left**) and ventricular arrhythmias (**Right**) detected by the device recording. ICD, implantable cardiac defibrillator.

increased after the Earthquake compared with before for any tachyarrhythmia (21±3 vs. 26±3, P<0.05) and for ventricular tachyarrhythmias (23±4 vs. 27±2, P<0.05) (**Figure 1B**). Most of the tachyarrhythmias recorded were ventricular arrhythmias, probably because undistinguishable tachyarrhythmias were recognized by the single-chamber device as ventricular in origin. In contrast, the incidence of appropriate and/or inappropriate defibrillator shocks, including anti-tachycardia pacing, was comparable before and after the Earthquake (appropriate shock: 9.2±2.5 vs. 9.0±1.4 patients/month). The storm of defibrillator shocks did not increase after the Earthquake.

In 74 CRT patients, we noted that 11 patients had 16 HF hospitalizations after the Earthquake, whereas 7 had 7 hospitalizations before the Earthquake. The incidence of HF hospitalization significantly increased after the Earthquake, followed by a gradual decrease to the pre-earthquake level (**Figure 2A**). The number of HF hospitalizations normalized by that of the patients on follow-up in the corresponding period significantly increased for the 6-month period after the Earthquake as compared with the preceding 6-month or 5-year average (both P<0.05) (**Figure 2B**). The hospitalized patients, as compared with the patients who were not hospitalized after the Earthquake, were characterized by several factors, including higher plasma B-type natriuretic peptide (BNP) levels (780±765 vs. 255±419 pg/ml; P<0.01), fewer CRT responders (45 vs. 80%; P<0.05) and a past history of more HF hospitalizations (1.9±2.0 vs. 0.27±0.75 HF hospitalizations for the previous 5 years, P=0.02). Data for intrathoracic impedance monitoring (OptiVol) were available only in 17 CRT patients, in whom the Optivol fluid index significantly increased after the Earthquake (cut-off ≥100 ohm; 2/17 vs. 8/17; P<0.05); however, no correlation was noted between the increase in the fluid index and clinical HF worsening. In this CRT population, 6 patients died during the 6 months after the Earthquake, including HF worsening in 4, cerebral hemorrhage in 1, and tsunami death in 1.

Discussion

This is the first study to demonstrate the clinical impact of the East Japan Earthquake on patients implanted with cardiac devices such as ICD and CRT. It has been reported that the incidence of CVD, such as hypertension, coronary artery disease, pulmonary embolism, ventricular arrhythmias and sudden cardiac death, increases after an earthquake.[1–3] Because almost all the study patients with ICD or CRT lived in the City of Sendai or the surrounding area, where the disaster affected ordinary life for more than 1 month, we were able to closely follow them even after the Earthquake. Importantly, in the present study, the recordings of the ICD/CRT device for most of the patients were available to examine the changes in cardiac rhythm abnormalities.

It has been previously reported that arrhythmic events deteriorate after an earthquake[2,3] or similar large-scale disaster.[6] In the present study, although defibrillator shocks were not increased, the device recordings clearly showed a significant increase in tachyarrhythmias after the Earthquake. Importantly, this phenomenon was sustained for a few months after the Earthquake, when the effect of aftershocks, deteriorated quality of life and physical/mental stress might have been involved.

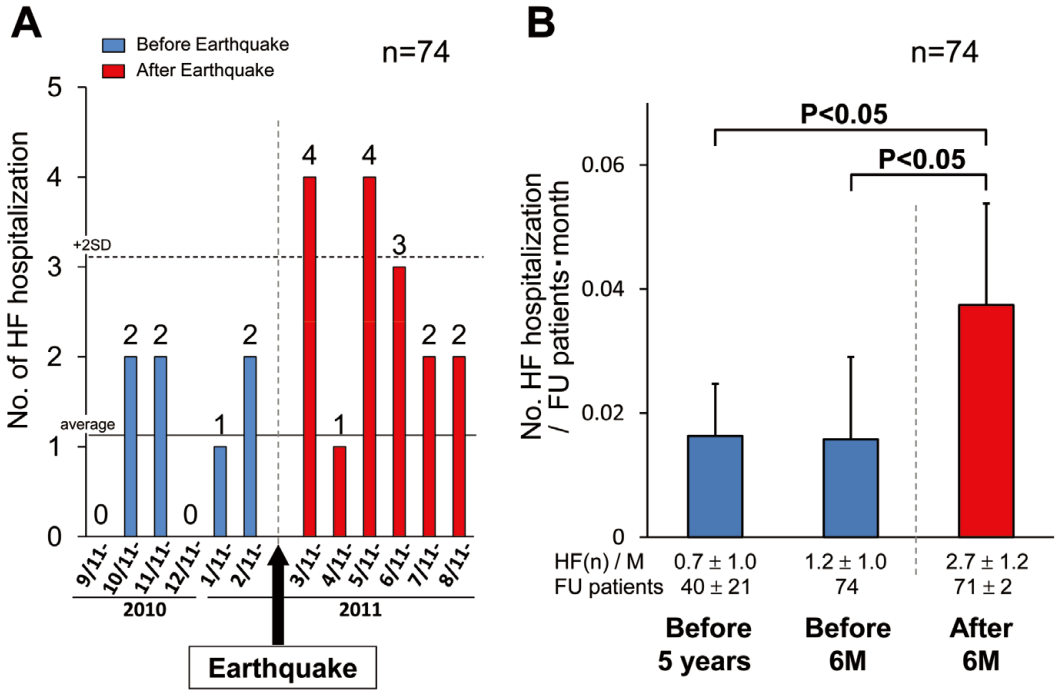

Figure 2. Heart failure (HF) hospitalization in patients with biventricular pacemakers (cardiac resynchronization therapy [CRT]). (**A**) Time course of the number of HF hospitalizations before (blue bar) and after (red bar) the Earthquake. Horizontal lines show the monthly average (solid line) and +2SD (dotted) of the number of patients with HF hospitalization for the 6-month period before the Earthquake. (**B**) Normalized monthly number of HF hospitalizations. The mean numbers of monthly HF hospitalization and follow-up patients are shown under the panel (mean±SD).

There has been no report on HF development and/or worsening after an earthquake. However, several causes related to a great earthquake could worsen clinical scenarios in patient with heart diseases, leading to the development and/or worsening of HF, including high-salt diet with preserved food and elevated blood pressure because of physical/mental stress, although drug withdrawal was less noted in the present study.

We observed an unfavorable effect of the Earthquake on HF worsening because we selected CRT patients who were prone to develop HF worsening. The present results suggest that CRT non-responders[4,5] and HF hospitalization repeaters are a high-risk population for cardiovascular events after an earthquake or other disaster.

Several limitations of the present study should be mentioned. First, it is retrospective and observational in design, which is inevitable for this type of study of a rare disaster. Second, the number of ICD or CRT patients examined was relatively small. Third, the diagnosis of tachyarrhythmias was based on the device report and depended on the device's settings.

In conclusion, we were able to demonstrate that the East Japan Earthquake disaster unfavorably affected patients with an ICD or CRT. We believe that the present results will contribute to the improvement of disaster medicine in the future.

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Disclosure

There is no financial support to disclose in this study.

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Supplemental Files

Supplemental File 1

Data S1. Methods

Table S1. Patients' Characteristics

Please find supplemental file(s);
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