



Original article

Heart attacks triggered by huge mud slides in mountain regions and severe flooding in inhabited areas



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ABSTRACT

Background: On July 12, 2012, heavy rains struck southwest Japan, particularly in the Mount Aso area. Huge mud slides in the mountains destroyed houses, and heavy rains caused severe flooding in the inhabited areas. We investigated the incidence of cardiovascular events after the disaster.

Methods: We investigated patients who were admitted to the emergency department (ED) from July 12 to August 31 in 2012. We reviewed all patients with cardiovascular events, including acute myocardial infarction (AMI), angina attack, worsening of congestive heart failure (CHF), cardiopulmonary arrest (CPA), arrhythmias, tako-tsubo cardiomyopathy (TC), and symptomatic venous thromboembolism (VTE).

Results: The total number of cardiovascular events was 28 (14 supraventricular arrhythmias, 3 angina attacks, 1 AMI, 1 VTE, 4 CHF, 1 TC and 4 CPA). There was a significant increase in cardiovascular events during the follow-up period in 2012 in comparison with the average number of these events over the same time period during the prior 2 years (16.8 vs. 5.1/month, $p < 0.01$). There was a sharp increase in cardiovascular events in the first week after the disaster. A second peak was observed 7 weeks after the disaster. Two patients with angina attack were previously diagnosed as having vasospastic angina. The incidence rate of AMI did not increase.

Conclusion: An increase in cardiovascular events was observed after severe rainfalls and mud slides. Prevention of disaster-induced cardiovascular events should be a priority regardless of the magnitude of the disaster.

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Introduction

On July 12, 2012, heavy rains struck southwest Japan, particularly in the Mount Aso area, where approximately 30,000 people inhabited. The heavy rain was described by the Japan Meteorological Agency (JMA) as, "Such a heavy rain that has not been experienced before this." Heavy hourly rainfall exceeding 80 mm continued for four hours. Huge mud slides in the mountains, so-called "mountain tsunamis," destroyed houses, and heavy rains caused severe flooding in the inhabited areas.

More than 2000 people were forced to evacuate to temporary accommodation for a month.

Several studies have reported an association of natural disasters with cardiovascular events, such as acute myocardial infarction (AMI), stroke, pulmonary embolism, tako-tsubo cardiomyopathy, and heart failure [1–8]. Aoki et al. [9] reported that the incidences of all types of cardiovascular diseases were increased in somewhat different time courses after the Great East Japan Earthquake Disaster. We investigated the incidence of cardiac events, including arrhythmia, after a natural disaster in a rural area.

Methods

We analyzed the records of patients admitted to the emergency department (ED) at Aso Central Hospital from July 12 to August 31, 2012. We compared the numbers of patients with cardiac events

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Fig. 1. Pictures of mud slides and flooding. Severe rain caused mud and rock slides, which destroyed houses. The scars left by these huge mud slides were seen on the slopes of the mountain. Aso city was inundated with flood water.

before the disaster (from June 1 to July 11, 2012) to after the disaster (July 12–August 31, 2012). We also reviewed all records of patients admitted to the ED during the same period in the previous 2 years (July 12–August 31 in 2010 and 2011) as a control. To investigate patients transferred to other hospitals, we examined all ambulance transport records in the Aso area during the study period.

Definition of the diseases

We reviewed the records of all patients with cardiovascular events, including AMI, angina attack, worsening of congestive heart failure, cardiopulmonary arrest (CPA), arrhythmias, tako-tsubo cardiomyopathy, and symptomatic venous thromboembolism. The diagnoses were made by attending doctors in the ED. All records and definitive diagnoses were confirmed by a cardiologist. The definitive diagnoses were based on physical examination, laboratory findings, electrocardiogram, echocardiography, chest X-ray, and computed tomography. Patients with tentative diagnoses were excluded. The diagnosis of AMI required the presence of the following: (1) history of chest discomfort lasting >30 min; (2) typical electrocardiogram changes (i.e. ST segment elevation >0.1 mV in at least one standard or two precordial leads, ST segment depression >0.1 mV in at least two leads); and (3) an increase in creatine kinase and/or cardiac troponin T levels to more than twice the upper limit of normal. Angina attack was defined as chest discomfort relieved by nitroglycerine in patients previously diagnosed as having organic or vasospastic angina. The diagnosis of vasospastic angina was made based on the Guidelines for Diagnosis and Treatment of Patients with Vasospastic Angina of the Japanese Circulation Society [10]. A drug-induced spasm provocation test was performed in patients who were suspected to have coronary artery vasospasm. Worsening of heart failure was defined as worsening acute heart failure signs and symptoms requiring additional therapy. The diagnostic criteria for tako-tsubo cardiomyopathy were according to the diagnostic criteria proposed by Mayo Clinic [11]. CPA was defined as the need for cardiopulmonary resuscitation performance regardless of the causes.

Statistical analysis

All data are expressed as the mean \pm standard deviation (SD). For the statistical analysis, the number of patients after the disaster was compared with the average of the previous 2 years under a Poisson distribution, with the mean value taken as the mean number for the previous 2 years. The number of patients before the disaster (from June 1 to July 11, 2012) to after the disaster (July 12 to August 31, 2012) was compared as well. Values of $p < 0.05$ were considered to be statistically significant.

Results

The floods and mud slides caused extensive damage, including 23 deaths and 1498 destroyed houses, as of September 14, 2012 (Fig. 1). The total number of patients admitted to the ED (our hospital or other advanced medical centers) during the period from July 12 to August 31 in 2010, 2011, and 2012 was 583 (472/111),

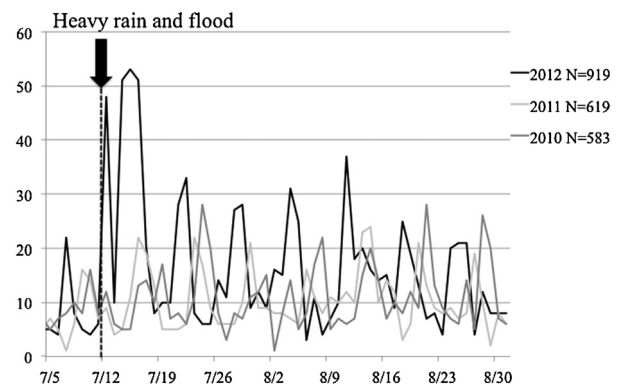


Fig. 2. Total number of patients admitted to the emergency department (ED) after the disaster. The total number of patients admitted to the ED in 2012 was about 1.5-fold higher than that in the prior 2 years. The number of patients peaked on the first weekend after the disaster. An initial increase in patients admitted to the ED was observed on the day the disaster occurred. Subsequent spikes indicated increases in patients admitted to the ED on the weekend.

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