Earthquake and ambulatory blood pressure monitoring

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Abstract Major natural disasters can severely affect people's health. This paper examines the relationship between 3 earthquakes and ambulatory blood pressure monitoring (ABPM). Regarding elevated blood pressure (BP), similar data is evident in all three major earthquakes (Central Italy, China and Japan). The natural disaster spotlighted in this paper is the Great East Japan Earthquake, which occurred in north-east Japan on March 11, 2011 (magnitude 9.0 on the moment magnitude scale [MMS]). During this earthquake, thirteen patients were monitored by ABPM as part of this study, it was noted that participant BP was elevated; but it is worth noting that their home BP did not become elevated until the following day.

Keywords : earthquake, mental stress, natural disaster, ambulatory blood pressure monitoring (ABPM), blood pressure

Introduction

On March 11, 2011, the Great East Japan Earthquake (moment magnitude scale 9.0) hit the north-eastern part of Japan. Since it is known that blood pressure (BP) increased after such a natural disaster as this well-known major earthquake, this paper explains the relationship between a major earthquake and ambulatory blood pressure monitoring (ABPM).

Mental stress and blood pressure elevation

Mental stress from the Great East Japan Earthquake induced high BP. This phenomenon was diagnosed by casual BP measurement, home BP monitoring and ABPM. Its grade depended on mental stress levels and on the situation of the experience.

It is well known that anxiety and tension induce high BP. A major natural disaster such as the Great Hanshin-Awaji Earthquake (6.9 on the moment magnitude scale) on January 17, 1995, and the Great East Japan Earthquake (9.0 on the moment magnitude scale) on March 11, 2011, and related social events were included in the category as psychosomatic stress. Under exposure, disaster stress and BP levels were affected according to individualized adaptation capacity, cause of the stress and intensity of the stress.

Ambulatory blood pressure monitoring during an earthquake

Recently, some studies reported on BP during the earthquake using ABPM. In 1998, Parati G et al.¹⁾ reported on a female subject using ABPM during the earthquake (magnitude 4.7 on Richter Scale) in Central Italy on March 26, 1998. Before the earthquake, the patient's BP and heart rate (HR) were 130/85 mmHg and 83 beats/minute (bpm). After the strong quake, systolic BP (SBP) was elevated to 150 mmHg and a much higher elevation in diastolic BP (DBP), reaching 122 mmHg. BP elevation was accompanied by tachycardia (150 bpm). The BP effect was still evident after 30 minutes. On the other hand, HR returned to baseline in a much faster fashion.

Elevated blood pressure returned to the base level one hour after the earthquake. However, BP variability remained characterized by pronounced variability throughout the following 6 hours.

At 2:28 p.m. on May 12, 2008, an earthquake (magnitude 8.0 according to the Richter scale) struck Wenchuan of Sichuan Province, China, and Chen Y, et al.²⁾ reported ABPM in 9 hypertensive patients and in 2 normotensives. The average SBP 1 hour before the earthquake was 125.8 mmHg, and the average DBP was 72.1 mmHg.

After the earthquake, the mean BP rose rapidly to 150.5/98 mmHg, and elevated BP was sustained until 6 hours after the earthquake. The earthquake induced a significant increase mean HR in comparison with the pre-earthquake (94.6 vs. 75.1). The mean HR then declined

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rapidly to the pre-earthquake mean within 1 hour.

And, He S et al.³⁾ also reported BP and HR for 6 cases using ABPM. Mean SBP was elevated from 127 mmHg to 150 mmHg, and DBP was elevated from 80 mmHg to 98 mmHg, HR changed from 83 to 102 beats/min, respectively. Compared with Parati et al.'s report, He S et al.'s results showed abnormal BP elevation for a long time. This may be due to the strong earthquake (8.0 vs. 4.7) as their conclusion.

In 2009, April 6, an earthquake (magnitude 5.8 on the Richter scale) struck L'Aquila in Italy. Petrazzi L et al. reported 2 cases using ABPM during the earthquake. SBP was elevated from 145.1 mmHg to 159.8 mmHg and from 140.4 mmHg to 160.2 mmHg, and DBP was elevated from 81.5 mmHg to 92.5 mmHg⁴⁾.

The Great East Japan Earthquake (9.0 on the moment magnitude scale) hit the north-eastern coast of Japan at 2:46 PM on March 11, 2011. Satoh M, et al.⁵⁾ reported homed BP (HBP) at Sendai (about 150 km from the epicenter) on the monitoring of the day of the earthquake and for the following 3 consecutive days in 10 hypertensive patients. The differences in HBPs between the day of and the day after the earthquake were +11.6 mmHg ($P = 0.02$) for SBP, 3.9 mmHg for DBP ($P = 0.2$), and +4.7 bpm for HR ($P = 0.03$). However, their BP in the morning before the earthquake was not elevated⁵⁾. We had an opportunity to obtain different 24h/7day ABPM's near Tokyo (about 300 km from the epicenter)⁶⁾. Averages by clock hours from each of 13 subjects were expressed as a percentage of the 7-day mean for the days that happened to bracket the Friday March 11 2011, the Great East Japan Earthquake. Compared with Satoh W, et al. who reported homed SBP elevated on the next day of the earthquake, SBP increased on the day of the earthquake by ABPM and also one day before the earthquake.

It is worth noting that there was another significant earthquake 2 days before this major event (7.3 Richter scale, 11:45 AM, March 9 2011). Homed elevated BP was not detected for the March 9 earthquake.

People in the disaster area experienced elevated BP related to their personal damage, sleeplessness and the evacuation center's environment (ambient temperature, overcrowding, nutrition such as excess salt intake, and termination of medication). HBP did not detect elevated BP

during the earthquake effectively, compared with ABPM.

Conclusion

BP elevation in many hypertensive patients has been observed from the stress of major natural disasters such as mega earthquakes. Prolonged elevation of BP might be caused by stress from the earthquake experience itself, aftershocks, housing damage and/or family misfortune.

Excess dietary salt intake and cessation of medication might also have affected the chronic elevated of home BP – similar to ABPM. Since markedly sustained BP and HR elevation are a risk of cardiovascular events in the future, clinical practitioners must take measures to control the elevation of BP and HR after a natural disaster.

Conflict of Interests

The authors declare that there is no conflict of interests regarding the publication of this article.

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