Effect of the Hanshin-Awaji Earthquake on Home Blood Pressure in Patients With Essential Hypertension

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At 5:46 AM on January 17, 1995, the Hanshin-Awaji district of Japan was struck by a major earthquake. We investigated changes in home blood pressure (BP) of 36 hypertensive patients before and after the earthquake. In the 16 patients who lived within 50 km from the epicenter, the home BP on the day of the earthquake was significantly higher than that just before the earthquake (+11/+6 mm Hg; \( P < .01 \) for systolic BP and \( P < .05 \) for diastolic BP). It remained higher throughout the first week after the earthquake, then gradually returned to the baseline level within 4 weeks. The home BP did not change significantly in the 20 patients who lived farther than 50 km from the epicenter. The earthquake-induced stress increased the BP in these hypertensive patients; however, its pressor effect was not persistent.

KEY WORDS: Earthquake, home blood pressure, psychological stress, hypertension.

On January 17, 1995, at 5:46 AM, the Hanshin-Awaji district in Japan was struck by a major earthquake measuring 7.2 on the Richter scale. More than 5000 people were killed and more than 250,000 were made homeless.

It is known that acute psychological stress raises blood pressure (BP) in humans and experimental animals. However, the influence on BP of the stress experienced by those involved in major disasters such as earthquakes is not fully elucidated because of obvious study limitations. To our knowledge, no data have been obtained regarding the changes in BP just after an earthquake. It has, however, been shown that the incidence of sudden cardiac death increases after an earthquake, particularly on the day of the disaster.

The Hanshin-Awaji earthquake provided a unique, although unfortunate, opportunity to evaluate the effect of self-measured BP at home. Here, we report the changes in home BP of hypertensive patients monitored before and after the earthquake.

METHODS

We studied 36 hypertensive patients who kept daily records of their home BP. They had World Health Organization stage I or II hypertension and had no critical illness. Five patients were not receiving antihypertensive medication, and 31 were being treated with antihypertensive agents, the regimen of which remained the same throughout the study period. Patients were divided into two groups according to the distance of their residences from the epicenter of the earthquake.
Hanshin-Awaji earthquake. Sixteen of them lived within 50 km from the epicenter (group A) and 20 lived farther than 50 km (about 60 km) from it (group B). Most of the patients in group A suffered property damage due to the earthquake, whereas such damage was slight for the patients in group B.

Home BP was measured every day by the patients three times in the morning (before breakfast) and three times in the evening (2 to 5 hours after dinner) while in the sitting position. The automatic devices used for home BP measurement are based on the cuff oscillometric principal. Home BP records were reviewed for the 8-week period from December 20, 1994, to February 20, 1995. The home BP records were compared to those in the same period in 1993-1994.

Values are expressed as means ± SEM. The average systolic and diastolic BP values on 3 consecutive days were evaluated statistically by analysis of variance (ANOVA) for repeated measurements. The difference between the home BP on the day of the earthquake and the average home BP for the 3 consecutive days immediately before the earthquake was calculated by Wilcoxon rank-sum test. Differences between the two groups were calculated by Mann-Whitney U test. Analyses were performed using StatView software (Abacus Concepts Inc., Berkeley, CA), and a value of $P < .05$ was considered statistically significant.

RESULTS

There were no significant differences between the two groups in mean ages (66.2 ± 2.5 years old in group A; 63.4 ± 2.3 years old in group B), sex distribution (11 women and 5 men in group A; 10 women and 10 men in group B), and home BP before the earthquake (140 ± 3/83 ± 3 mm Hg in group A; 144 ± 3/83 ± 2 mm Hg in group B). In group A, the home BP on the day of the earthquake was 149 ± 5/90 ± 4 mm Hg (Figure 1). It was significantly higher (+11/+6 mm Hg, $P < .01$ for systolic BP and $P < .05$ for diastolic BP) than the average BP value of 3 consecutive days immediately before the earthquake (138 ± 3/84 ± 2 mm Hg). The home BP in group A remained higher during the first week after the earthquake (+6/+2 mm Hg, $P < .05$ for systolic BP and $P = NS$ for diastolic BP), and then gradually returned to the baseline level within the next 4 weeks (Table 1). Such changes in home BP were not observed in 1994. In group B, the home BP did not change significantly after the earthquake.

DISCUSSION

Recently, self-measurement of BP at home has gained increasing importance in clinical settings. It may be as valuable as 24-h ambulatory BP monitoring and is superior to office BP measurement in several respects.2-4 Many outpatients at the Hypertension Clinic of our institute, located 60 km from the epicenter of the Hanshin-Awaji earthquake, measure and record their home BP everyday. Altogether 46 of our patients lived within 50 km from the epicenter and all were subjected to the unusual psychological trauma caused by the earthquake. In these circumstances, only 16 of them were able to measure and record their home BP regularly. These data provided us a rare opportunity to appraise the effect of an earthquake on changes in BP.
In these patients, the home BP on the day of the earthquake was significantly higher than that just before the earthquake. It remained elevated during the first week after the earthquake, and then gradually returned to the baseline level within the next 4 weeks. These results demonstrate that the Hanshin-Awaji earthquake had the acute pressor effect on the BP of the hypertensive patients who suffered psychological stress.

The role of psychological stress in the development of hypertension remains uncertain. Kario et al observed, by using 24-h ambulatory BP monitoring, that three patients with white coat hypertension progressed to sustained hypertension after the Hanshin-Awaji earthquake and showed elevation of BP levels that persisted for at least 9 weeks. In our study, the home BP on the day of the earthquake was significantly elevated and then gradually returned to the baseline level within the next 4 weeks. No patient showed progression to sustained high blood pressure, although all patients had already been diagnosed as having essential hypertension and most of them were receiving antihypertensive agents. Thus, the pressor effect of the earthquake was not persistent, but transient. Freeman, after reviewing the literature, concluded that there is no satisfactory evidence that psychological stress leads to the elevation of the mean daily BP with its pathogenic connotations.

It is observed that psychological stress causes cardiovascular events. It has been reported that this stress experienced in the context of an earthquake results in increased morbidity and mortality from cardiovascular disease. Recently, Leor et al reviewed the records from the Department of the Coroner and reported that the Northridge earthquake, which struck the Los Angeles area, was a significant trigger of sudden death due to cardiac causes, particularly on the day of the disaster. Regarding the Hanshin-Awaji earthquake, Suzuki et al reported that the number of patients with acute myocardial infarction after the earthquake increased sharply in the first week and returned to normal from 4 weeks onward. It is possible that the psychological stress induced by an earthquake causes sympathetic nervous activation and BP elevation, and in turn, these contribute to the increased morbidity and mortality from cardiovascular disease.

Among the limitations of our study was the selection bias of subjects who exclusively had the resources to measure and record home BP regularly under such unusual circumstances. Therefore, the raised BP observed in this study does not necessarily represent, and may underrepresent, the magnitude of the pressor effect of the Hanshin-Awaji earthquake. However, it is meaningful that the elevation in BP was evaluated not by office BP readings but by self-measurements at home. Freeman has pointed out that many of the assumptions in the past concerning the ill effects of elevated BP were based on clinic or office readings. The relationship between stress and hypertension should be evaluated based on BP measurements obtained in nonmedical settings.

In conclusion, our study of home BP recording revealed that earthquake-induced stress increased BP in hypertensive patients. However, its pressor effect was not persistent.

### REFERENCES

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