European Review for Medical and Pharmacological Sciences 2013; 17: 912-916

Clinical characteristics of hypertension among victims in temporary shield district after Wenchuan earthquake in China

X.-C. SUN, X.-F. ZHOU, S. CHEN, Y.-X. LIU, Y.-J. WANG, W. ZHANG, Y.-C. GAO

Geriatrics Department, Sichuan Provincial Hospital, Sichuan Academy of Medical Sciences, Chengdu, China

Abstract. – AIM: The frequency of hypertension events increases after a strong stress, but the mechanism has not been fully investigated. This study aimed to investigate its prevalence and risk factors after the Wenchuan earthquake (8.0 on the Richter scale), so as to provide a scientific basis for the prevention of hypertension in natural disasters or unforeseen accidents.

SUBJECTS AND METHODS: Victims staying in temporary shelter for more than 1 year between March to May 2009 were randomly selected by multistage stratified cluster sampling method. And predetermined questionnaire survey and physical examination were carried out. In this study, all participants signed informed consent form.

RESULTS: A total of 3230 victims aged over 20 years participated in this study, and the prevalence rate of hypertension among those victims was 24.08% (778/3230), most of whom had first-level hypertension; and the standardized rate was 18.44%. Moreover, the rates of hypertension awareness, dosing and controlling was only 34.58%, 53.43% and 17.84%, respectively. Among this cohort, the prevalence rate of hypertension increased with age ($p < 0.01$), but its distribution was similar between male and female victims (25.0% versus 23.58, $p > 0.05$). Logistic regression analysis showed that age, family history of hypertension, sleep quality, waist-to-hip ratio, body mass index and blood glucose level were risk factors of earthquake-induced hypertension among victims in temporary shield district, but mental stress was not.

CONCLUSIONS: Though mental stress was not a risk factor of hypertension in this study, earthquake-induced hypertension should not be ignored. For victims after earthquake, the education of the prevention and treatment of hypertension should be strengthened.

Key Words:
Earthquake, Victim, Hypertension, Prevalence rate, Risk factor.

Introduction

On May 12, 2008, an 8.0-magnitude earthquake shook in Sichuan province of China, and left 69,227 people dead, more than 374,000 people injured, and approximately 5 million people homeless (as of 25 September, 2008)[1]. Currently, how to reduce the number of disaster-related deaths and restore the normal medical system are two main goals of disaster medicine[1,2].

At the time of a disaster, there is a chronology in the onset of diseases[3]. From the day of the disaster over a period of several months, possible hypertension-related diseases increased, including stroke, myocardial infarction, angina, aortic dissection, heart failure[3-6]; and the risk of these hypertension-related diseases increases approximately 1.5- to 3-fold after an earthquake[3,7]. Additionally, the elevated risk also could persist for a long period[8]. At present, more and more evidences indicated that a large percentage of disaster related deaths would be caused by hypertension-related cardiovascular diseases. And of them, the increased blood pressure and hypercoagulability were two major mechanisms that triggered the occurrence and development of cardiovascular disease[7].

Since the first report of hypertension in the victims of the Texas City Disaster in 1948[9], hypertension after disaster events had been widely concerned and it had become an important research focus of disaster medicine[5,8,10]. And the increasing of hypertension after a disaster had been presented in majority of previous studies in past decades[8]. The degree of hypertension in those studies differed according to the severity of the disaster-induced damage and the time of the study relative to the disaster.

In attempt to reveal the clinical characteristics and risk factors of earthquake-induced hypertension among victims, present study was designed and performed among victims staying in temporary shelter for more than 1 year after earthquake. By understanding the prevalence and risks of disaster-related hypertension, early preventing the onset of diseases and reducing the number of disaster-related deaths would be more effectively.

Corresponding Author: Xiao-Fang Zhou, MD; e-mail: xfzhou028@163.com

Subjects and Methods

Subject and Study Design

By multi-stage stratified cluster sampling method, a total of 20 thousand victims, staying in temporary shelter for more than 1 year from Beichuan and Dujiangyan, between March to May 2009, were randomly screened. And 3230 victims aged more than 20 years were finally included and received predetermined questionnaire survey and physical examination. All victims participated in this study signed informed consent form.

Questionnaire Survey and Physical Examination

The survey forms were completed by physicians, who were rigorously trained for the research approach, investigational content, quality control, and filling of survey form.

The following data were collected according to our pre-designed survey form with a series of answers and responses: demographic information (including age, gender, race, occupation, educational level, household income, et al), diagnose and treatment of personal important chronic diseases (such as hypertension, high cholesterol, diabetes, stroke, coronary heart disease, et al), personal habits (including salt intake, smoking, alcohol consumption, et al), and family disaster situation (including availability of labor, housing property damage, casualties, mental stress, et al).

Physical examination was completed by professionally physicians, and data of blood pressure, height, chest circumference, abdominal circumference and hip circumference were collected according to unified protocol. The blood pressure was determined by mercury sphygmomanometer. The body mass index (BMI) and the waist-to-hip ratio (WHR) were calculated according to generally accepted mathematical formula.

Diagnose Criteria

Hypertension was diagnosed according to WHO/ISH guideline[11]: systolic blood pressure (SBP) ≥ 140 mmHg and/or diastolic blood pressure (DBP) ≥ 90 mmHg (1 mmHg equal to 0.133 Kpa). In this study, if participants had previous diagnosis of hypertension or nearly two weeks taking blood pressure medicine, they should be regarded as hypertension even blood pressure was normal at the time of physical examination.

Obesity was defined by an increasing of BMI according to following criteria: BMI ≥ 24.0 but < 27.9 kg/m^2 for overweight; BMI ≥ 28.0 kg/m^2 for obesity. The central obesity was determined by waistline ≥ 90 cm for male and ≥ 80 cm for female.

Quality Control and Statistical Methods

A double entry of data was performed using EPI info6.0 software, and a standard cross check of the data was carried out to ensure the accuracy and reliability of the data. The age/sex-adjusted standardized prevalence rate of hypertension was calculated using 2002 Beichuan County and Dujiangyan census data. Comparison of quantitative was performed using the paired t test or One-way ANOVA, comparison of qualitative variables was performed using Chi-square test or Fisher's exact test, and risk factor of hypertension was analyzed by logistic regression analysis. The p-value which was less than 0.05 (two-tailed) was considered to indicate a significant difference. All statistical analyses were performed using the SPSS software package version 15.0 (SPSS Inc., Chicago, IL, USA).

Results

Overall Prevalence of Hypertension and Distribution Characteristics

As Table I showed that 3230 victims that were consisted of 1144 male and 2086 female victims participated in this study, and 778 victims among them were diagnosed as hypertension. The age of participants ranged from 20 to 88 years, with a media age of 58 years. Additionally, there were 2106 participants with Han race and 1124 participants with Qiang race.

In this study, the prevalence and standardized prevalence rate was 24.08% (Table II) and 18.44%, respectively. The prevalence rate of hypertension was increased with age, but distributed similarly between male and female (Table II). The classification of blood pressure of those victims was ranged from grade 1 to grade 3, and majority of those victims were graded as grade 1 (15.76% (509/3230) for grade 1; 6.41% (207/3230) for grade 2; and 1.91% (62/3230) for grade 3).

The Impact of the Earthquake Disaster on the Prevalence of Hypertension

After Wenchuan earthquake, the surviving victims suffered varying degrees of mental stress

Table I. Hypertension distribution among victims participating in this study.

	Surveyed	Diagnosed	Prevalence rate	*p*-value
Total population	3230	778	24.08%	
Male	1144	286	25.00%	> 0.05
Female	2086	492	23.58%	
Qiang Race	1124	258	22.95%	
Male	451	104	23.06%	> 0.05
Female	673	154	22.88%	
Han Race	2106	519	24.64%	
Male	943	242	25.66%	< 0.05
Female	1163	277	23.82%	

due to casualties, property losses and changes of living environment. In this study, we analyzed the impact of various event caused by earthquake on the occurrence of hypertension, and found that the factors of casualties, heavy housing damage, property damage, lower incomes, and new diseases were associated with occurrence of hypertension, but the difference between victims with or without hypertension was not statistically significant (Table III).

The Rates of Awareness, Treatment and Control of Hypertension

Among the 778 hypertensive patients, 269 patients were diagnosed before this study and the awareness rates of hypertension was 34.58%. Among those 269 patients who were diagnosed of hypertension before this study, 143 (53.43%) patients had medications for treating hypertension but only 89 patients took regular medications; and only 48 patients (17.84%) kept their blood pressure in the normal range.

Logistic Regression Analysis of Factors Related To Hypertension

The variables of age, sex, smoking, waist-to-hip ratio, body mass index, mental stress, sleep quality, food preferences, total cholesterol, blood sugar, family history of hypertension, history of stroke, history of coronary heart disease had been included in logistic stepwise multiple regression equation, but as Table IV showed only age (95% CI 1.643-2.268), family history of hypertension (95% CI 1.320-1.981), sleep quality (95% CI 1.036-1.189), waist-to-hip ratio (95% CI 1.208-1.661), body mass index (95% CI 1.008-1.721), blood glucose (95% CI 1.080-1.593) were finally enter the equation and identified as potent risk factors related to earthquake-induced hypertension.

Discussion

This study is the largest epidemiological survey of hypertension in disaster area after the devastating earthquake occurred in Sichuan, and we found that the prevalence rate of hypertension was 24.08%, and the standardized prevalence rate was 17.44% among victims in temporary shield district. Though the national hypertension census results from China showed that there was an aggravating trend of hypertension prevalence[12], the result of present study was consistent with previous studies in general population. For example in InterASIA research[13], representing the typical Chinese adult population, showed that the prevalence

Table II. The distribution of gender and age among victims participating in this study.

Age	Total victims (n, %)	Male victims (n, %)	Female victims (n, %)
20-29	2 (1.56)	1 (2.00)	1 (1.28)
30-39	11 (3.99)	4 (4.90)	7 (3.61)
40-49	86 (16.86)	33 (17.55)	53 (16.46)
50-59	197 (25.58)	61 (24.79)	136 (25.95)
60-69	298 (28.52)	103 (37.32)	195 (34.45)
70-79	158 (28.52)	73 (30.42)	85 (27.07)
80-	26 (17.33)	11 (17.74)	15 (17.04)
Total	25.0%	23.58%	24.08%
Standardized prevalence rate	17.95%	16.69%	17.44%

Table III. The impact of the damage caused by earthquake on the occurrence of hypertension.

	Hypertension	Non-hypertension	*p*-value
Casualties			
1-2/≥ 3 persons	446 (21.92)/193 (24.59)	1598 (78.08)/592 (75.41)	> 0.05
Housing damage			
Mild/Severe	236 (22.82)/542 (24.68)	798 (77.18)/1659 (75.32)	> 0.05
Property damage			
Mild/Severe	221 (22.41)/557 (24.82)	765 (77.59)/1687 (75.18)	> 0.05
Lower incomes			
No/Yes	113 (22.16)/665 (24.45)	397 (77.84)/2055 (75.55)	> 0.05
New diseases			
No/Yes	628 (23.93)/150 (24.75)	1996 (76.07)/456 (75.25)	> 0.05

rate of hypertension was 27.2%. We inferred that the no trends in the prevalence of hypertension among victims living in temporary shield district may be related to the following factors: (1) Victims received timely and proper resettlement, which reduced the stress in a certain degree; (2) The bases of living facilities were guaranteed, and the eating habits change after earthquake, especially for reducing salt intake; (3) Under the support of government, there were stable life and no significant lifestyle changes for majority of victims; (4) The basic medical facilities was guaranteed and improved in residential areas of the disaster victims.

In this study, though more casualties in family, heavy housing damage, property damage, lower incomes, and new diseases were observed in victims with hypertension, the differences in those factors between hypertensive and non-hypertensive victims were not significantly. Indeed, these encouraging findings could not be separated from timely relief and support of government[14,15]. Additionally, majority of victims participating in this study had mental stress more or less, and 64.02% of the participants could accept the reality and carry out a proper living and working. Though the heavy mental stress resulted the increasing of hypertension, but the difference in mental stress between hypertensive and non-hypertensive victims was not significant. And we thought this result would be due to the positive psychological interventions by the government and community volunteers after the earthquake[16-18].

The results of logistic regression analysis in this study showed that family history of hypertension, diabetes, BMI, waist-hip ratio were potent independent risk factors of hypertension among victims after earthquake. And this result is also consistent with previous studies[19,20]. As we know, hypertension is a lifestyle disease, induced by long-term accumulation of a variety of risk factors. Thus, there is a long way to effectively prevent and treat hypertension in victims after the earthquake[21].

Conclusions

In summary, after earthquake disaster, though majority of the survivors were moved to temporary shield district and basic living conditions were guaranteed, because of the existence of significant mental stress and bodily injury, the prevention and control of chronic disease should be concerned. And the following experience could be drawn from this study: (1) we should strengthen the health education of hypertension preven-

Table IV. Logistic regression analysis of risk factors related to earthquake-induced hypertension.

Variable	Regression coefficient	*p*-value	OR value	95% CI
Age	0.054	0.000	2.146	1.643-2.268
Family history of hypertension	0.632	0.000	1.648	1.320-1.981
Sleep quality	0.104	0.003	1.110	1.036-1.189
Waist-to-hip ratio	0.597	0.002	1.406	1.208-1.661
Body mass index	0.376	0.004	1.318	1.008-1.721
Blood glucose	0.244	0.002	1.276	1.080-1.593

tion and treatment, raise the awareness of health, and increase the quality of life for victims after earthquake; (2) It is necessary and important to prevent and treat hypertension in victims after earthquake, especially those who are younger than 40 years old should be concerned; (3) Hypertension census and routine monitoring should be carried out so as to early prevent the onset of diseases and reduce the number of disaster-related deaths

Acknowledgements

We thank following Agencies and Departments for their support in this study: Health Department of Sichuan Province, Wenchuan County People's Hospital, Mianyang Central Hospital, People's Hospital of Beichuan Qiang Autonomous County, Qingchuan County People's Hospital, Dujiangyan City People's Hospital, and Affiliated Hospital of Chengdu Health School.

References

1) Zhang L, Liu X, Li Y, Liu Y, Liu Z, Lin J, Shen J, Tang X, Zhang Y, Liang W. Emergency medical rescue efforts after a major earthquake: lessons from the 2008 Wenchuan earthquake. Lancet 2012; 379: 853-861.
2) Schultz CH, Koenig KL, Noji EK. A medical disaster response to reduce immediate mortality after an earthquake. N Engl J Med 1996; 334: 438-444.
3) Kario K, McEwen BS, Pickering TG. Disasters and the heart: a review of the effects of earthquake-induced stress on cardiovascular disease. Hypertens Res 2003; 26: 355-367.
4) Schwartz BG, French WJ, Mayeda GS, Burstein S, Economides C, Bhandari AK, Cannom DS, Kloner RA. Emotional stressors trigger cardiovascular events. Int J Clin Pract 2012; 66: 631-639.
5) Leor J, Poole WK, Kloner RA. Sudden cardiac death triggered by an earthquake. N Engl J Med 1996; 334: 413-419.
6) Brown DL. Disparate effects of the 1989 Loma Prieta and 1994 Northridge earthquakes on hospital admissions for acute myocardial infarction: importance of superimposition of triggers. Am Heart J 1999; 137: 830-836.
7) Nishizawa M, Hoshide S, Shimpo M, Kario K. Disaster hypertension: experience from the great East Japan earthquake of 2011. Curr Hypert Rep 2012; 14: 375-81.
8) Kario K. Disaster hypertension–its characteristics, mechanism, and management. Circulation J 2012; 76: 553-562.
9) Ruskin A, Beard OW, Schaffer RL. Blast hypertension; elevated arterial pressures in the victims of the Texas City disaster. Am J Med 1948; 4: 228-236.
10) Satoh M, Kikuya M, Ohkubo T, Imai Y. Acute and subacute effects of the great East Japan earthquake on home blood pressure values. Hypertension 2011; 58: e193-194.
11) Whitworth JA. 2003 World Health Organization (WHO)/International Society of Hypertension (ISH) statement on management of hypertension. J Hypertens 2003; 21: 1983-9192.
12) Liu L. Cardiovascular diseases in China. Biochim Cell Biol 2007; 85: 157-163.
13) Wang X, Bai HF, Ma KM, Li B, Qi JH, Chen BJ, An N, Chen H, Duan XY, Sui H, Yu XW, Liu RK, Zuo HJ, Liu J, Wu YF. Relationship between the patients' knowledge on hypertension prevention and control and the rate on blood pressure control. Zhonghua Liu Xing Bing Xue Za Zhi 2003; 24: 1082-1085.
14) Shultz JM, Besser A, Kelly F, Allen A, Schmitz S, Hausmann V, Marcelin LH, Neria Y. Psychological consequences of indirect exposure to disaster due to the haiti earthquake. Prehosp Disaster Med 2012; 27: 359-368.
15) Lei BL, Zhou Y, Zhu Y, Huang XY, Han SR, Ma Q, He J, Li YQ. Emergency response and medical rescue in the worst hit Mianyang areas after the Wenchuan earthquake. J Evid Based Med 2008; 1: 27-36.
16) Wen J, Shi YK, Li YP, Yuan P, Wang F. Quality of Life, Physical Diseases, and Psychological Impairment among Survivors 3 Years after Wenchuan Earthquake: A Population Based Survey. PloS one 2012; 7: e43081.
17) Priebe S, Marchi F, Bini L, Flego M, Costa A, Galeazzi G. Mental disorders, psychological symptoms and quality of life 8 years after an earthquake: findings from a community sample in Italy. Social Psychiatry Psychiatr Epidemiol 2011; 46: 615-621.
18) Marshall M, Crowther R, Almaraz-Serrano A, Creed F, Sledge W, Kluiter H, Roberts C, Hill E, Wiersma D, Bond GR, Huxley P, Tyrer P. Systematic reviews of the effectiveness of day care for people with severe mental disorders: (1) acute day hospital versus admission; (2) vocational rehabilitation; (3) day hospital versus outpatient care. Health Technol Assess 2001; 5: 1-75.
19) Kario K, Matsuo T, Kobayashi H, Yamamoto K, Shimada K. Earthquake-induced potentiation of acute risk factors in hypertensive elderly patients: possible triggering of cardiovascular events after a major earthquake. J Am Coll Cardiol 1997; 29: 926-933.
20) Kario K, Matsuo T, Shimada K, Pickering TG. Factors associated with the occurrence and magnitude of earthquake-induced increases in blood pressure. Am J Med 2001; 111: 379-384.
21) Armenian HK, Melkonian AK, Hovanesian AP. Long term mortality and morbidity related to degree of damage following the 1998 earthquake in Armenia. Am J Epidemiol 1998; 148: 1077-1084.