International Journal of Cardiology 198 (2015) 102–105

Contents lists available at ScienceDirect

International Journal of Cardiology

journal homepage: www.elsevier.com/locate/ijcard

Increased prevalence of atrial fibrillation after the Great East Japan Earthquake: Results from the Fukushima Health Management Survey

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ARTICLE INFO

Article history:
Received 12 May 2015
Received in revised form 23 June 2015
Accepted 27 June 2015
Available online 2 July 2015

Keywords:
Atrial fibrillation
Earthquake
Alcohol
Obesity

ABSTRACT

Background: Previous studies have shown that control of cardiovascular risk factors deteriorates among residents after a natural disaster. This study assessed the hypothesis that the prevalence of atrial fibrillation (AF) increased among residents in the evacuation zone of Fukushima prefecture after the Great East Japan Earthquake.
Methods and results: This longitudinal study examined subjects aged 40–90 years using data collected from 26,163 participants (11,628 men and 14,535 women) sourced from general health checkups conducted in twelve communities, including the evacuation zone specified by the government, between 2008 and 2010. The study obtained 12-lead ECG tracings and conducted follow-up examinations from June 2011 to the end of March 2013. A total of 12,410 participants (5704 men and 6706 women, follow-up proportion: 47%) received follow-up examinations after the earthquake, with an average follow-up of 1.4 years. The prevalence of AF increased among participants after the earthquake (before: 1.9% vs. after: 2.4%, $P < .001$). During the follow-up period, 79 incidences of AF occurred among participants. Excess ethanol intake (≥44 g/day) and obesity showed associations with an increased risk of AF after the earthquake, with multivariable-adjusted hazard ratios (95% confidence interval) of 3.07 (1.55–6.08) and 1.87 (1.19–2.94), respectively.
Conclusions: The prevalence of AF increased among residents in the evacuation zone of Fukushima prefecture after the Great East Japan Earthquake, with excess alcohol intake and obesity associated with an increased risk of AF.

1. Introduction

The Great East Japan Earthquake that occurred on March 11, 2011, and the subsequent tsunami and Fukushima nuclear accident caused physical and mental stress among the residents of Fukushima Prefecture [1,2]. Previous studies found that stress after natural disasters could trigger cardiovascular events, such as myocardial infarctions, strokes, and pulmonary embolisms [3–6]. In addition, we recently showed that the number of hospitalizations due to decompensated heart failure increased after the Great East Japan Earthquake [7,8]. However, little is known about the association between the incidence of arrhythmias and catastrophic disasters.

Atrial fibrillation (AF) is the most common sustained clinical arrhythmia and is associated with an increased risk of stroke and

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http://dx.doi.org/10.1016/j.ijcard.2015.06.151
0167-5273/

heart failure [9]. Accordingly, it is significant to investigate whether the natural disaster increases the prevalence of AF, which may influence the rate of cardiovascular events such as stroke and heart failure. Recently, AF has emerged as a potential world health problem of epidemic proportions due to the incidence of AF increasing with age [10–12]. Epidemical studies identified several risk factors for AF, including hypertension, diabetes mellitus, heart failure, obesity, and heavy alcohol intake [13–15]. The disaster in Fukushima prefecture forced many residents from the government-designated evacuation zone to change aspects of their lifestyle such as physical exercise, diet, smoking, and alcohol habits. Therefore, evacuees may have developed risk factors for AF, such as hypertension, diabetes mellitus, and obesity, after the Great East Japan Earthquake.

The purpose of this study was to determine whether the Great East Japan Earthquake and its subsequent disasters increased the prevalence of AF among residents in the evacuation zone of Fukushima prefecture. Furthermore, it examined the association between AF risk factors, including hypertension, diabetes mellitus, obesity, alcohol consumption, and AF incidence.

2. Methods

2.1. Study subjects and design

The subjects of this study were residents living in the evacuation zone in Fukushima prefecture, which included Tamura City, Minamisoma City, Kawamata-machi, Hirono-machi, Naraha-machi, Tomioka-machi, Kawauchi-mura, Okuma-machi, Namie-machi, Katsurao-mura, Iitate-mura, and Date City. In these communities, annual health checkups focusing on metabolic syndromes have been conducted since 2008 for insured persons/dependents aged 40 years or older according to Health Care Insurers. This study limited all analyses to men and women aged 40–90 years. Between 2008 and 2010, 40,223 individuals (18,204 men and 22,019 women, mean 67 years) in these communities participated in health checkups. Of these 40,223 participants, this study enrolled 26,163 subjects (11,628 men and 14,535 women, mean 68 years) who were conducted for 12-lead ECG examinations.

The study conducted follow-up examinations from June 2011 to the end of March 2013 as part of the Comprehensive Health Check (CHC) in the Fukushima Health Management Survey (FHMS). A previous study described detailed methods of the CHC and the FHMS[1]. As a result, 12,410 participants (5704 men and 6706 women, follow-up proportion: 47%) received follow-up examinations after the disaster, with an average follow-up of 1.4 years.

This study obtained informed consent from community representatives to conduct an epidemiological study based on the guidelines of the Council for International Organizations of Medical Science [16]. The Ethics Committee of the Fukushima Medical University approved this study (#1916).

2.2. Measurements and definitions

An interviewer obtained histories for cigarette smoking and weekly alcohol intake in units of "go" (a traditional Japanese unit of volume equating to 22 g of ethanol) and converted the figures to grams of ethanol per day. One go is 180 ml of sake, which equates to one bottle (500 ml) of beer, two single shots (60 ml) of whiskey, or two glasses (240 ml) of wine. Participants who drank ≥2 go per day were classified as being current excessive drinkers. The study measured height in stocking feet and weight in light clothing and calculated body mass index as weight (kg)/height (m^2), with obesity defined as body mass index ≥25 kg/m^2. Trained technicians measured systolic and 5th-phase diastolic blood pressure (BP) using a standard mercury sphygmomanometer on the right arm of participants in the seated position. The study defined hypertension as systolic BP ≥140 mm Hg, diastolic BP ≥90 mm Hg, or the use of antihypertensive medication, and diabetes mellitus as a fasting glucose level ≥126 mg/dl, HbA1c level ≥6.5% or the use of diabetes mellitus medication. The study estimated HbA1c values using a National Glycohemoglobin Standardization Program equivalent value, calculated using the equation HbA1c (%) = 1.019 × HbA1c (JDS) (%) + 0.30% [17]. The study obtained 12-lead ECG tracings with subjects in the supine position, with AF diagnosed if P-wave activity was not evident and the ventricular response was irregular.

2.3. Statistical analysis

Continuous variables are reported as mean ± standard deviation, and categorical variables are shown as percentages. The study determined differences in baseline characteristics between subjects with and without AF using unpaired *t*-tests for continuous variables and chi-square tests for categorical variables. A student's paired *t*-test or McNemer's test compared changes in data before and after the disaster. The hazard ratios (HRs) of the incidence of AF and 95% confidence intervals (CI) for risk factors were calculated with adjustment for age and other potential confounders using Cox proportional hazard model. SAS version 9.3 (SAS Institute, Cary, North Carolina, USA) was used to perform statistical analyses. All probability values for statistical tests were two-tailed, with *P*-values <.05 regarded as statistically significant.

3. Results

3.1. Characteristics of the participants

Table 1 shows baseline characteristics of the participants with and without AF. The prevalence of AF was higher in men than in women. The mean age, body mass index and the ration of obesity, as well as the prevalence of hypertension and diabetes mellitus, were higher among participants with AF than those without AF. There were no differences in the incidences of excess ethanol intake and current smoking between participants with and without AF.

3.2. Prevalence of AF before and after the earthquake

Table 2 shows changes in the prevalence of AF between before and after the earthquake. The prevalence of AF increased among the 12,410 participants (5704 men and 6706 women) after the earthquake (before: 1.9% vs. after: 2.4%, $P < .001$). The study then divided the 12,410 participants into two groups: the elderly group (70–90 years, $n = 5236$) and the young group (40–69 years, $n = 7174$). In the young group, the prevalence of AF in men significantly increased after the earthquake (before: 1.9% vs. after: 2.3% in men, $P = .01$; before: 0.3% vs. after: 0.4% in women, $P = .25$). On the other hand, the prevalence of AF in both men and women in the elderly group significantly increased after the earthquake (before: 4.3% vs. after: 5.7% in men, $P < .001$; before: 1.9% vs. after: 2.3% in women, $P = .02$).

During the follow-up period (mean 1.4 years), 79 incidences of AF occurred among the participants, with an incidence rate of 4.5/1000 persons per year. Excess ethanol intake (≥44 g/day), male gender, and obesity were associated with an increased risk of AF after the earthquake, with multivariable-adjusted hazard ratios (95% confidence interval) of 3.07 (1.55–6.08), 3.77 (2.17–6.53), and 1.87 (1.19–2.94), respectively (Table 3).

4. Discussion

The present study demonstrated that the prevalence of AF increased among residents in the evacuation zone of Fukushima prefecture after the Great East Japan Earthquake. In addition, excess alcohol intake and obesity were associated with an increased risk of AF. To our knowledge, this is the first study to show an association between an increased prevalence of AF and catastrophic disasters. Moreover, the findings in the present study suggest that lifestyle factors such as alcohol habits, overeating, and physical exercise should be carefully managed after catastrophic disasters, especially among evacuees, to prevent the development of cardiovascular diseases.

The presence of AF increases the risk of mortality and morbidity independently of impaired quality of life, stroke, and congestive heart

Table 1
Baseline characteristics of participants with and without atrial fibrillation: The Fukushima Health Management Survey.

Baseline characteristics	Atrial fibrillation	No atrial fibrillation	*P*-value[a]
n	231	12,179	
Age (years)	71.9 ± 7.6	66.8 ± 9.4	<.0001
Sex (men (%))	71.9	45.4	<.0001
Body mass index (kg/m^2)	24.6 ± 3.5	23.6 ± 3.3	<.0001
Obesity (≥25.0 kg/m^2 (%))	42.9	31.2	<.001
Excess ethanol intake (≥44 g/day (%))	4.8	4.7	.93
Currently smoking (%)	16.5	14.0	.28
Hypertension (%)	76.2	55.7	<.0001
Diabetes mellitus (%)	17.8	9.4	<.0001

[a] *P*-value: *t*-test or chi-square test.