



Short paper

Out-of-hospital cardiac arrests during exercise among urban inhabitants in Japan: Insights from a population-based registry of Osaka City



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ARTICLE INFO

Article history:

Received 10 March 2017

Received in revised form 10 May 2017

Accepted 22 May 2017

Keywords:

Out-of-hospital cardiac arrest

Exercise

Public-access defibrillation

Automated external defibrillator

ABSTRACT

Background: The patient characteristics, pre-hospital interventions, and outcomes of out-of-hospital cardiac arrests (OHCA) occurring during exercise, have not been sufficiently investigated among the general population.

Methods: OHCA data from 2009 to 2015 were obtained from the population-based OHCA registry in Osaka City, Japan. Patients who suffered OHCA, which occurred during exercise before the arrival of emergency medical service personnel, were included. The primary endpoint was one-month survival with a favourable neurological outcome after OHCA, defined using the Glasgow-Pittsburgh cerebral performance category scale 1 or 2.

Results: During the 7-year study period, 16,278 OHCA were observed, and 52 (0.3%) occurred during exercise (male, n = 41 [79%]; median age, 62 years). These incidents occurred mainly during running activities (n = 14), followed by swimming (n = 8), dance/social dance (n = 6), tennis (n = 4), and weight training (n = 3). Within these exercise-related OHCA, 47 (90%) were of cardiac origin, 45 (87%) were bystander-witnessed cardiac arrests, 49 (94%) received bystander-initiated cardiopulmonary resuscitation, and 30 (57%) received public-access defibrillation (PAD). Overall, 56% (29/52) had one-month survival with a favourable neurological outcome after OHCA, which was significantly higher among OHCA of cardiac origin with PAD (77%, 23/30) than among those of cardiac origin without PAD (35%, 6/17) and among those of non-cardiac origin (0%, 0/5) (p < 0.001).

Conclusion: In Osaka, OHCA during exercise represented a small subset of the overall OHCA burden, but occurred during a wide variety of exercise activities. Patients with OHCA of cardiac origin had a good prognosis, and PAD played an important role in improving patient outcomes.

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Introduction

Exercise has long-term benefits for physical fitness and for the prevention of cardiovascular disease, but it can also trigger an acute

cardiac event, which may precipitate sudden cardiac arrest (SCA) [1–5]. Unfortunately, cardiac arrests occurring in exercise settings may cast a negative light on exercise among the general public and may result in obscuring the overwhelming health benefits of habitual exercise. Therefore, an evidence-based strategy should be implemented to prevent sudden cardiac death occurring during exercise. A better understanding of the detailed epidemiology of exercise-related cardiac arrest should be helpful for planning appropriate preventive strategies; however, these cardiac incidents

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have not been sufficiently investigated among the general population. In the present study, using the data from the population-based out-of-hospital cardiac arrest (OHCA) registry of Osaka City, the third largest city in Japan with a population of approximately 2.6 million inhabitants, we aimed to investigate the incidence, patient characteristics, prehospital interventions, and outcomes of OHCA occurring during exercise.

Methods

Data collection

Detailed characteristics of emergency transport records and the emergency medical service (EMS) system in Osaka City have been described elsewhere [6–8]. Briefly, the Osaka Municipal Fire Department registers OHCA data according to the worldwide standardized Utstein style guidelines [9,10]. It is a prospective population-based registry, which covers all OHCA treated by EMS personnel in Osaka City. We obtained the patient and EMS characteristics, prehospital interventions, and outcomes of OHCA from the registry. We determined the type of exercise engaged in by patients at the time of cardiac arrest, obtained from documented records of interviews conducted with bystanders or with persons who called EMS. In the analysis, we included physical activities of relatively light exertion, such as dance/social dance, walking, and stretching. We also included OHCA occurring even in places where exercise would not usually be expected (e.g., nursing home and amusement arcade). The primary endpoint was one-month survival with a favourable neurological outcome after OHCA, which was defined as the Glasgow-Pittsburgh cerebral performance category (CPC) scale 1 or 2 [9,10].

Study subjects

OHCA data were obtained from the period between January 1, 2009 and December 31, 2015. OHCA occurring during exercise before the arrival of EMS personnel were included. Patients were excluded from the analyses in cases where resuscitation was not attempted by EMS personnel or bystanders, and where outcomes after OHCA were unknown.

Statistical methods

Each outcome was compared, according to whether the arrest was cardiac in origin and whether public-access defibrillation (PAD) was administered (i.e., OHCA of cardiac origin with PAD, OHCA of cardiac origin without PAD, and OHCA of non-cardiac origin), by using Fisher's exact test. All tests were two-tailed and a P-value of <0.05 was considered statistically significant. All statistical analyses were conducted using the SPSS statistical package ver. 20.0J.

Ethics

This study protocol was approved by the Ethics Committees of Kyoto University. The requirement of giving individual informed consent was waived by the application of the Personal Information Protection Law and the National Research Ethics Guidelines of Japan.

Results

A total of 16,278 OHCA occurring before the arrival of EMS personnel were observed during the study period. Of these, 52 (0.3%) occurred during exercise. The incidence of overall OHCA and the incidence of OHCA occurring during exercise was 870.9 and 2.8 per 1 million population per year, respectively. Table 1 shows the aetiologies of cardiac arrest according to the type of exercise. OHCA occurred mainly during running activities (n = 14), followed by swimming (n = 8) and dance/social dance (n = 6). Most OHCA occurring during exercise were of cardiac origin (n = 47, 90%). Table 2 shows the patient and EMS characteristics of OHCA occurring during exercise. Of these patients, 41 (79%) were male, 45 (87%) were bystander-witnessed arrests, 40 (77%) had ventricular fibrillation rhythm, 49 (94%) received bystander-initiated cardiopulmonary resuscitation, and 30 (57%) received PAD. The majority of OHCA occurred inside public institutions, such as sports facilities (n = 16), pools (n = 9), stadiums (n = 9), schools (n = 3), amusement arcades (n = 1), and nursing homes (n = 1). Table 3 shows the outcomes after OHCA according to the origin of arrest, that is, whether cardiac or not, and whether PAD was admin-

Table 1
Origin of out-of-hospital cardiac arrests that occurred during exercise

	Origin of cardiac arrest						Total
	Cardiac origin (n = 47)		Non-cardiac origin (n = 5)				
	VF	Non-VF	Subarachnoid hemorrhage	Pulmonary stenosis	Drowning	Injury	
Running activities (Marathon n = 8, Ekiden ^a n = 2, Other n = 4)	13	0	1	0	0	0	14
Swimming	5	2	0	0	1	0	8
Dance/Social dance	5	1	0	0	0	0	6
Tennis	3	0	1	0	0	0	4
Weight training	2	1	0	0	0	0	3
Walking	2	0	0	0	0	0	2
Basketball	2	0	0	0	0	0	2
Futsal	1	0	0	1	0	0	2
Aquatics	1	0	0	0	0	0	1
Aerobics	1	0	0	0	0	0	1
Kendo	1	0	0	0	0	0	1
Iaido	0	1	0	0	0	0	1
Warming-up	0	1	0	0	0	0	1
Stretching	1	0	0	0	0	0	1
Badminton	1	0	0	0	0	0	1
Boxing	0	0	0	0	0	1	1
Baseball	1	0	0	0	0	0	1
Unknown	1	1	0	0	0	0	2
Total	40	7	2	1	1	1	52

VF, ventricular fibrillation.

^a A term referring to a long-distance relay running race, typically on roads.

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