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Clinical paper

Public-access AED pad application and outcomes for out-of-hospital cardiac arrests in Osaka, Japan☆

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ABSTRACT

Background: Actual application of public-access automated external defibrillator (AED) pads to patients with an out-of-hospital cardiac arrest (OHCA) by the public has been poorly investigated.
Methods: AED applications, prehospital characteristics, and one-month outcomes of OHCAs occurring in Osaka Prefecture from 2011 to 2012 were obtained from the Utstein Osaka Project registry. Patients with a non-traumatic OHCA occurring before emergency medical service attendance were enrolled. The proportion of AED pads that were applied to the patients' chests by the public and one-month outcomes were analysed according to the location of OHCA.
Results: In total, public-access AED pads were applied to 3.5% of OHCA patients (351/9978) during the study period. In the multivariate analyses, OHCAs that occurred in public places and received bystander-initiated cardiopulmonary resuscitation were associated with significantly higher application of public-access AEDs. Among the patients for whom public-access AED pads were applied, 29.6% (104/351) received public-access defibrillation. One-month survival with a favourable neurological outcome was significantly higher among patients who had an AED applied compared to those who did not (19.4% vs. 3.0%; OR: 2.76 [95% CI: 1.92–3.97]).
Conclusion: The application of public-access AEDs leads to favourable outcomes after an OHCA, but utilisation of available equipment remains insufficient, and varies considerably according to the location of the OHCA event. Alongside disseminating public-access AEDs, further strategic approaches for the deployment of AEDs at the scene, as well as basic life support training for the public are required to improve survival rates after OHCAs.

Introduction

Approximately 120,000 out-of-hospital cardiac arrests (OHCAs) are documented every year in Japan,[1] making them a critical issue for public health. In addition to implementation of cardiopulmonary resuscitation (CPR), early defibrillation using an automated external defibrillator (AED) is important to improve the outcomes associated with OHCAs.[2–4] In July 2004, it became legally permissible in Japan for non-medical persons to use an AED

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for OHCA patients.[1] The number of public-access AEDs rapidly increased thereafter, reaching over 500,000 throughout Japan in 2013.[5] Previous studies have reported that nationwide dissemination of public-access AEDs allowed earlier shock treatment by bystanders and increased survival rates following OHCAs.[6–8]

However, the actual use of public-access AED pads by the public has been poorly investigated. Such information would provide important indicators for organising efficient AED deployment strategies. Most previous studies have focused only on OHCA patients who have received AED shocks[8–10] because there is a lack of information about whether or not public-access AED pads were attached to patients' chests. Therefore, issues surrounding the proper deployment of public-access AEDs are still under debate.[7,8,11,12]

The Utstein Osaka Project has collected detailed information on the utilisation of public-access AED pads by bystanders since 2011. Using these data, this study aimed to reveal how public-access AED pads are utilised by bystanders for OHCA patients in Osaka Prefecture, Japan.

Methods

Data collection

The Utstein Osaka Project is a large, prospective, population-based registry of OHCAs. The project covers approximately 8.8 million people living in Osaka Prefecture, the second largest prefecture in Japan. Data collection for this registry has been conducted based on the globally standardised Utstein-style reporting guidelines for cardiac arrests.[13,14] There are 34 fire stations with emergency dispatch centres managing the emergency medical service (EMS) in Osaka Prefecture. These services operate 24 h-a-day. Of the 34 stations, 32 are single-tiered (paramedics only) and two are two-tiered (paramedics and physicians). Since do-not-resuscitate orders (or living wills) are not generally accepted in Japan, EMS providers are not permitted to terminate resuscitation in the field. Therefore, almost all OHCA patients treated by EMS personnel are transported to hospitals and registered in the Utstein Osaka Project, excluding cases of decapitation, incineration, decomposition, rigor mortis, or dependent cyanosis. The EMS in Osaka Prefecture has been described in detail elsewhere.[15]

Cardiac arrest was defined as the cessation of mechanical activity confirmed by the absence of signs of circulation.[13,14] The arrest was presumed to be of cardiac origin unless there was an obvious non-cardiac cause, such as an external injury, respiratory disease, malignant tumour, or stroke. These diagnoses were defined clinically by the physicians in charge in collaboration with EMS personnel. Data forms were completed based on the Utstein-style, and the data was transferred and integrated into the registry system at the Information Center for Emergency Medical Services of Osaka. The data was then checked by the investigators. These data include location of OHCA, gender, age, ability to perform activities of daily living (ADLs) before cardiac arrest, origin of cardiac arrest, witness status, bystander-initiated CPR, defibrillations by public-access AEDs, and time of resuscitation by bystanders and EMS. In addition to the above items, information about whether or not the bystander applied the AED pads to the patient's chest was obtained. Here, correct application of the AED pads was defined as 'two pads were directly attached to the patient's skin in an appropriate position'.[2–4] When incomplete data were found, the EMS personnel in charge were asked to complete the datasheet.

All OHCA survivors were followed up for up to one month after the event. Neurological outcomes were determined by the physician in charge using the cerebral performance category (CPC) scale: category 1, good cerebral performance; category 2, moderate cerebral disability; category 3, severe cerebral disability; category 4, coma or vegetative state; and category 5, death.[13,14]

For this study, OHCA data were obtained for the period between 1 January 2011 and 31 December 2012.

Public-access AEDs in Osaka prefecture

Osaka Prefecture is the largest urban city in western Japan, with an area of 1892 km^2 and a population of 8.8 million. The cumulative sales of public-access AEDs reached 30,173 in 2013, which ranked third among the 47 prefectures in Japan, and the number of public-access AEDs per unit area was 15.87 per km^2 (ranked second).[5]

Study subjects

All OHCA patients registered during the study period were enrolled in this study. Exclusion criteria were as follows: patients for whom resuscitation was not attempted; an OHCA that occurred after EMS arrival; an OHCA caused by a traumatic event, such as a traffic accident, falling, and hanging; and an OHCA that occurred in a healthcare facility such as a nursing home (because medical professionals, such as doctors and nurses, are stationed at these facilities).

Outcome measures

The primary outcome measure was one-month survival with favourable neurological outcome after an OHCA. A favourable neurological outcome was defined as CPC category 1 or 2.[13,14] The application of public-access AED pads to the patient's chest by bystanders, public-access defibrillation (PAD) after AED pad application, prehospital return of spontaneous circulation (ROSC), and one-month survival rates were also assessed.

Statistical analyses

The proportion of public-access AED pad applications among all eligible OHCA patients was calculated according to the location of the event. Locations were divided into home or public.[7] Public locations were further divided into the following groups: roads, workplaces, schools, railway stations, airports, sports facilities, public institutions (e.g., Japanese pinball parlours, shopping malls, public bathhouses, and public buildings), and other public places (e.g., car interiors, parking areas, prisons, and rice fields).[9] Multivariate logistic regression models were used to investigate potential factors associated with public-access AED application. Odds ratios (ORs) and their associated 95% confidence intervals (CIs) were calculated. The explanatory variables considered in the analyses included location of OHCA event, gender, age, ADLs, origin of arrest, witness status of event, bystander-initiated CPR, day of the week, time of EMS call by bystanders, and year. Among the patients to whom public-access AED pads were applied, the proportion of PAD was assessed by the location of the event. Additionally, prehospital ROSC, one-month survival, and one-month survival with favourable neurological outcome were analysed according to the status of public-access AED application and the location of the event. Furthermore, multivariate logistic regression models were used to examine the differences between each survival outcome according to public-access AED application. The ORs and 95% CIs were estimated adjusting for the same variables as listed above. All statistical analyses were conducted using SPSS v20.0 J (IBM Corp., Armonk, NY).