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Public access defibrillation and outcomes after pediatric out-of-hospital cardiac arrest☆

Tatsuma Fukuda[a,*], Naoko Ohashi-Fukuda[a], Hiroaki Kobayashi[a,b], Masataka Gunshin[c,d], Toshiki Sera[e], Yutaka Kondo[f,g], Naoki Yahagi[a]

[a] Department of Emergency and Critical Care Medicine, Graduate School of Medicine, The University of Tokyo, 7-3-1, Hongo, Bunkyo-ku, Tokyo 113-8655, Japan
[b] Stephen M. Ross School of Business at the University of Michigan, 701 Tappan Street, Ann Arbor, MI 48109-1234, USA
[c] Department of Disaster Medical Management, The University of Tokyo Hospital, 7-3-1, Hongo, Bunkyo-ku, Tokyo 113-8655, Japan
[d] The Johns Hopkins Bloomberg School of Public Health, 615 N. Wolfe Street, Baltimore, MD 21205, USA
[e] Department of Acute Critical Care and Disaster Medicine, Tokyo Medical and Dental University, 1-5-45, Yushima, Bunkyo-ku, Tokyo 113-8519, Japan
[f] Department of Emergency Medicine, Graduate School of Medicine, University of Ryukyus, 207, Uehara, Nishihara-cho, Okinawa 903-0215, Japan
[g] Division of Acute Care Surgery, Trauma, and Surgical Critical Care, Department of Surgery, Beth Israel Deaconess Medical Center, Harvard Medical School, 330 Brookline Avenue, Boston, MA 02215, USA

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ABSTRACT

Background: Use of automated external defibrillators (AEDs) has been recommended for pediatric out-of-hospital cardiac arrest (OHCA). However, there are no conclusive studies that elucidated the effectiveness of public-access defibrillation (PAD) in children.
Methods: This was a nationwide, population-based, propensity score-matched study of pediatric OHCA in Japan from 2011 to 2012, based on data from the All-Japan Utstein Registry. We included pediatric OHCA patients (aged 1–17 years) who received bystander cardiopulmonary resuscitation. The primary outcome was a favorable neurological state 1 month after OHCA (defined as a CPC score of 1–2).
Results: A total of 1193 patients were included in the final cohort; 57 received PAD and 1136 did not. Among 1193 patients, 188 (15.8%) survived with a favorable neurological status 1 month after OHCA. The odds of neurologically favorable survival were significantly higher for patients receiving PAD after adjusting for potential confounders: propensity score matching, OR 3.17 (95% CI 1.40–7.17), and multivariable logistic regression modeling, $OR_{adjusted}$ 5.10 (95% CI 2.01–13.70). Similar findings were observed for the secondary outcomes (i.e., neurologically favorable survival with a CPC score of 1, one-month survival, and prehospital return of spontaneous circulation). In subgroup analyses, there were no significant differences in neurologically favorable survival between the PAD group and non-PAD group in the unwitnessed cohort ($OR_{adjusted}$ 7.76 [0.75–81.90]) or the non-cardiac etiology cohort ($OR_{adjusted}$ 6.65 [0.64–66.24]).
Conclusions: PAD was associated with an increased chance of neurologically favorable survival in pediatric OHCA (aged 1–17 years) who received bystander CPR, except for in cases of unwitnessed or non-cardiac etiology.

Introduction

As the evidence supporting best practice for pediatric cardiopulmonary resuscitation (CPR) in out-of-hospital cardiac arrest (OHCA) is scarce, adult OHCA guidelines have commonly been extrapolated to pediatric care.[1–4] The use of an automated external defibrillator (AED) by lay rescuer for pediatric OHCA is one such example. Public-access defibrillation (PAD) is well known to be an important intervention for improving outcomes in adult OHCA.[5–11]

Abbreviations: AED, automated external defibrillator; CI, confidence interval; CPC, Glasgow–Pittsburgh cerebral performance category; CPR, cardiopulmonary resuscitation; DNR, do-not-resuscitate; EMS, emergency medical service; FDMA, Fire and Disaster Management Agency; OHCA, out-of-hospital cardiac arrest; OR, odds ratio; PAD, public-access defibrillation; PCPC, pediatric CPC; PEA, pulseless electrical activity; RCT, randomized controlled trial; ROSC, return of spontaneous circulation; SD, standard deviation; VF, ventricular fibrillation; VT, ventricular tachycardia.

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* Corresponding author. Fax: +81 3 3814 6446.
E-mail address: tatsumafukuda-jpn@umin.ac.jp (T. Fukuda).

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Outcomes from adult OHCA have steadily improved alongside the increased use of PAD.[12,13] In addition, as studies have suggested that AED use for pediatric OHCA is safe,[14–16] the recommended lower limit of age for AED has been lowered with each revision of the international CPR guidelines.[1–4] However, there are limited studies investigating the effectiveness of PAD for pediatric OHCA (especially for children aged <8 years), all involving patients with OHCA prior to 2010.[5,17] These historical findings may no longer be applicable owing to differences in CPR practices pre- and post-2010.

We therefore conducted a study on the effectiveness of PAD for pediatric OHCA by using national administrative data from 2011 to 2012.

Materials and methods

Study design, setting, and participants

The All-Japan Utstein Registry is a Fire and Disaster Management Agency (FDMA) sponsored prospective nationwide population-based database of patients undergoing out-of-hospital resuscitation that utilizes Utstein-style data reporting.[18,19] The design of the All-Japan Utstein Registry and the system of emergency medical service (EMS) in Japan have been described in detail previously.[12,17,20–23] In principle, all OHCA patients, including those with do-not-resuscitate (DNR) orders, are transported to an emergency hospital in Japan because EMS personnel are not allowed to terminate out-of-hospital resuscitation, except in specific situations, such as decapitation, rigor mortis, livor mortis, and decomposition.

Data were collected from three sources (119 dispatch centers, fire stations, and receiving hospitals) using standardized Utstein-style templates for OHCA to facilitate uniform reporting and precisely defined variables and outcomes.[18,19] Data forms completed by EMS personnel were integrated into the All-Japan Utstein Registry system on the FDMA database server. The integrity, accuracy, and completeness of data are ensured through the rigorous certification by the FDMA and the logical internal checks using standardized software.

The cohort in this study was based on data submitted to the All-Japan Utstein Registry from January 1, 2011, to December 31, 2012. We included patients aged <18 years. Neonates and infants (<1 year old) were excluded because of the potential difference in physiological characteristics and etiology of arrest. In addition, patients who did not receive bystander CPR were excluded from the analysis. None of the patients in the final cohort had missing, incomplete, or inconsistent data (Fig. 1).

This study was conducted in accordance with the amended Declaration of Helsinki. This study was approved by the institutional review board of the University of Tokyo, with the waiver of informed consent because of the anonymous nature of the data used (No. 10096-1).

Data collection

Data regarding sex, age, bystander status (i.e., information on witnesses, lay rescuers, and bystander CPR), PAD, first documented rhythm, etiology of cardiac arrest, and prehospital advanced life support (i.e., information on intravenous access, epinephrine administration, and advanced airway management) were collected. A series of EMS times (call receipt, contact with patient, and hospital arrival) were also recorded. For patients who died shortly after hospital arrival, the etiology of cardiac arrest was determined by the attending physicians in the emergency department in collaboration with EMS personnel or coroners based on information from the witnessed situation, clinical course, and patient medical history, as well as the physical findings, examination findings, imaging, and

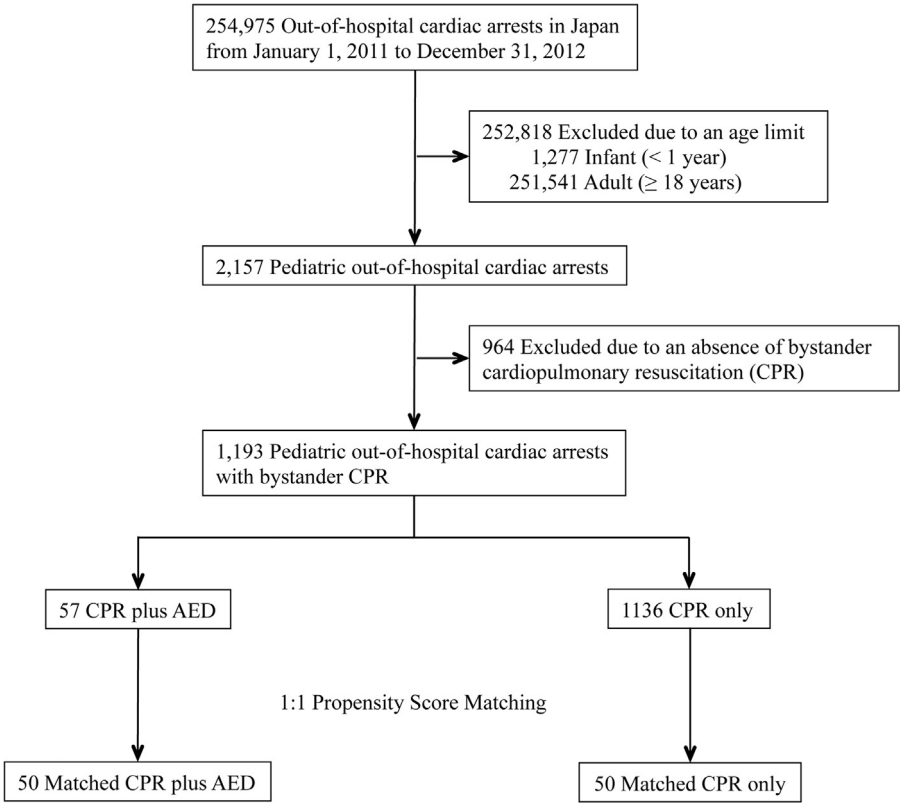

Fig. 1. Patient flow chart.
Abbreviations: CPR, cardiopulmonary resuscitation; AED, automated external defibrillator.