



Clinical paper

Dispatcher-assisted bystander cardiopulmonary resuscitation in rural and urban areas and survival outcomes after out-of-hospital cardiac arrest



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ABSTRACT

Objectives: We investigated the impact of dispatcher-assisted bystander cardiopulmonary resuscitation (DA-BCPR) on survival outcomes after out-of-hospital cardiac arrests (OHCAs) that occurred in rural and urban areas.

Methods: This study was a cross-sectional study using nationwide emergency medical services (EMS)-based OHCA registry in Korea. All EMS-treated adults with OHCAs and with presumed cardiac etiology were enrolled between 2012 and 2015, excluding cases witnessed by an EMS provider. BCPR was categorized into 3 groups: BCPR-with-DA, BCPR-without-DA, and No-BCPR. The endpoint was good neurologic recovery at discharge. We compared the effects of BCPR on outcomes between rural and urban areas, using a multivariable logistic regression with an interaction term.

Results: A total of 53,240 patients (36.3% BCPR-with-DA and 12.8% BCPR-without-DA) were included. Among OHCAs that occurred in rural areas (32.3% BCPR-with-DA and 14.0% BCPR-without-DA) and urban areas (36.9% BCPR-with-DA and 12.5% BCPR-without-DA), good neurological recovery was demonstrated in 1.6% and 6.8% of the patients in rural and urban areas, respectively ($p < 0.01$). The patients with OHCAs who received BCPR in both rural and urban areas were more likely to have good neurologic recovery than the No-BCPR group (AORs, 3.53 (1.84–6.77) BCPR-with-DA and 2.56 (1.23–5.32) BCPR-without-DA in rural; and 1.59 (1.41–1.79) BCPR-with-DA and 1.37 (1.18–1.60) BCPR-without-DA in urban). The effects of the measures of BCPR-with-DA on the outcome were more apparent in rural areas compared to urban areas.

Conclusions: BCPR, regardless of DA, was associated with improved neurologic recovery after OHCA in rural and urban areas. However, the effect of BCPR-with-DA was prominent for OHCA that occurred in rural areas.

Introduction

Early bystander cardiopulmonary resuscitation (CPR) provision before emergency medical services (EMS) arrival is associated with better survival outcomes after out-of-hospital cardiac arrest (OHCA) [1–3], and dispatcher-provided CPR instruction via telephone is one of the crucial community interventions to increase bystander CPR provisions for OHCA patients [4–6]. The effect of CPR performed by a layperson with dispatcher assistance on survival outcomes is comparable to the effect of bystander CPR performed by a competent person without dispatcher assistance [6]. Bystander CPR rate was improved in various regions by implementing community interventions, including dispatcher-provided telephone CPR instruction [6–8]. However, there

are disparities in the effects of the community interventions on improving bystander CPR and survival outcomes after OHCA according to the characteristics of neighborhood and resources near the incident location of arrest [6,9].

In rural areas, the population densities are relatively low compared to those in urban areas, and EMS response time is often prolonged due to sparse resources [9–11]. Therefore, the integrated community response system and network for OHCAs were suggested to enhance the neighborhood's resuscitative efforts and to improve survival outcomes after cardiac arrest in rural areas [9,12]. The provision of bystander CPR, including defibrillation by an EMS caller with dispatcher assistance before the arrival of EMS providers, would be one of the effective community interventions that may compensate for the prolonged EMS

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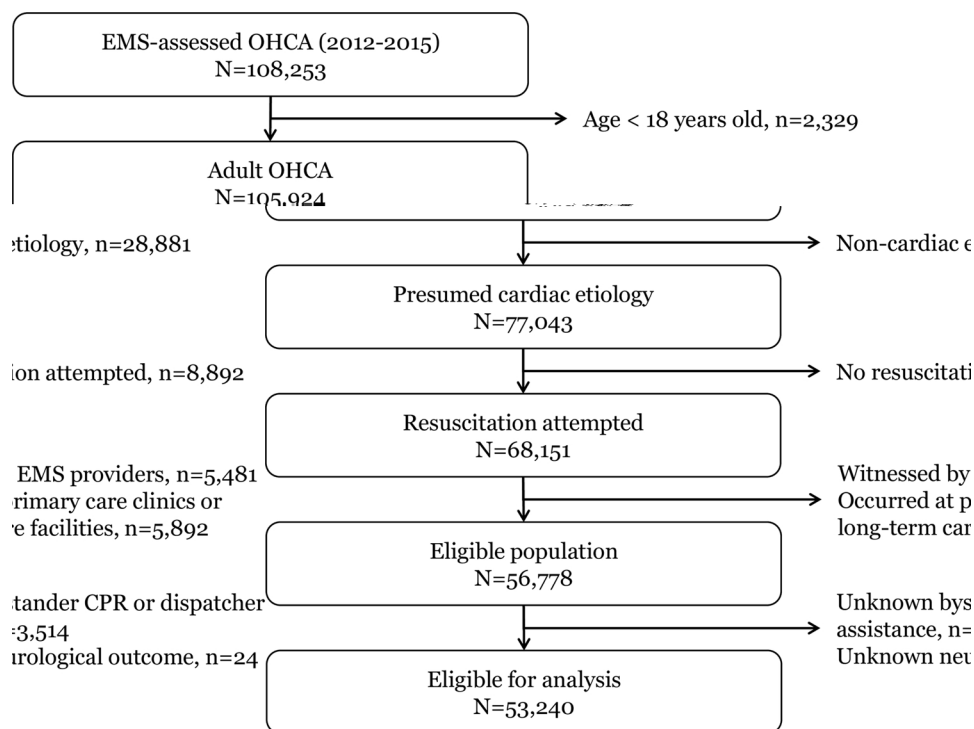


Fig. 1. Patient flow. EMS, emergency medical service; OHCA, out-of-hospital cardiac arrest; CPR, cardiopulmonary resuscitation.

response time for OHCA that occur in rural areas. However, there are limited studies reporting the effects of the dispatcher-assisted CPR program on bystander CPR provision and survival outcomes for OHCA patients who occur in rural areas.

The aims of this study were to compare the provision of bystander CPR and survival outcomes between OHCA that occurred in rural and urban areas and investigate whether the effect of bystander CPR with dispatcher assistance on survival outcomes differs between rural and urban areas. We hypothesized that the effect of bystander CPR with and without dispatcher assistance would be intensified for OHCA that occurred in rural areas compared with those in urban areas.

Methods

Study design and setting

This was a cross-sectional study using a nationwide, prospective, EMS-based OHCA registry in Korea.

Korea (with a total population of approximately 50 million) is comprised of 226 administrative counties (an average area of approximately 400 km²), of which 82 counties belong to rural areas in 2014. The median numbers of residents living in a county were 45,951 (range, 10,524 to 208,646) for rural areas and 278,942 residents (range, 40,957 to 1,148,157) for urban areas. The median population density was 73 people per square kilometer (range, 20–663) in rural areas and 3390 people per square kilometer (range, 60–27,938) in urban areas. Each county has its own healthcare authorities and administrative authorities who serve the population.

The EMS system in Korea is exclusively operated by the National Emergency Management Agency (the national fire department), and the EMS level is basic-to-intermediate. The EMS providers should perform CPR for all EMS-assessed OHCA patients unless there are definitive signs of death that are confirmed by direct medical control with a physician, and they cannot cease CPR for OHCA patients unless the patient regains a pulse in the field or during transport to an emergency department (ED). All EMS-assessed patients are transported to the nearest hospital.

The national fire department implemented a nationwide dispatcher-

assisted CPR program in October 2011 according to the 2010 American Heart Association guidelines [13]. All dispatch centers established a program for detecting OHCA, instructing bystander CPR via telephone, and reporting the process. Educational programs for dispatchers were implemented, and more than 90% of the dispatchers completed the course in 2011. An electronic dispatcher CPR registry was developed and implemented in all dispatch centers. This registry was used for quality assurance by a dispatch medical director who is a part-time emergency physician certified as a medical director by the Ministry of Health and Welfare. A detailed description of quality control of dispatcher-assisted CPR is described in an earlier study [6].

In Korea, public CPR training programs were developed in the early 2000s and have been disseminated by the Korea Centers for Disease Control and Prevention (CDC). The public CPR campaigns and training programs are provided by community healthcare authorities, provincial fire departments, hospitals, non-governmental organizations, and academic and scientific societies. The public access defibrillation (PAD) program began in 2009, but it was not widely accepted. The total number of PADs was 28,754 nationwide in 2016 (56 PAD per 100,000 persons), and bystanders rarely use AEDs in the current study setting [6,14].

Data source

The nationwide OHCA registry, which captures all incident cases of OHCA in the country, was retrieved from the following four sources: EMS run sheets for basic ambulance operation information, EMS cardiac arrest registry, dispatcher CPR registry for the Utstein factors [15,16], and the OHCA registry for hospital care and outcomes. The EMS providers record the EMS run sheets and EMS cardiac arrest registry for all EMS-assessed OHCA, and the dispatchers enter the data in the dispatcher CPR registry for all of the identified potential OHCA cases. All EMS registries for each patient are linked using ambulance dispatch numbers in the national fire department’s electronic database server and are integrated as a single episode. The medical record reviewers from the Korea CDC abstracted the recorded information on hospital care and outcomes from approximately 700 hospitals. Thirteen medical record review experts were trained to use Utstein guidelines to

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