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Clinical paper

Implementation of a bundle of Utstein cardiopulmonary resuscitation programs to improve survival outcomes after out-of-hospital cardiac arrest in a metropolis: A before and after study★

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ABSTRACT

Introduction: The study aimed to determine the effect of community implementation of a bundles of cardiopulmonary resuscitation (CPR) programs on outcomes in out-of-hospital cardiac arrest (OHCA).
Methods: A before- and after-intervention study was performed in a metropolis. Emergency medical services (EMS)-treated adults and cardiac OHCAs were included. Three new CPR programs was implemented in January 2015: 1) a high-quality dispatcher-assisted CPR program (DACPR), 2) a multi-tier response (MTR) program using fire engines or basic life support vehicles, and 3) a feedback CPR (FCPR) program with professional recording and feedback of CPR process. The outcomes (cerebral performance category 1 or 2, good CPC) and survival to discharge) were compared between study period (2015–2016) and control period (2013–2014).
Results: Overall, 6201 and 6469 patients were included in the control period and the study period, respectively. During the post-intervention period, the proportion of OHCA patients who underwent three types of cardiopulmonary resuscitation programs increased significantly compared to those in the pre-intervention period. DACPR increased from 38.3% to 44.3%, MTR increased from 0.0% to 37.5%, and FCPR increased from 25.3% to 61.5%. (All p values < 0.001). Good neurological recovery and survival to discharge were significantly increased from 5.4% to 6.8%, and from 9.6% to 10.9%. The adjusted odds ratio (95% confidence intervals) of the study period was 1.45 (1.12–1.87) for good CPC, and 1.31 (1.09–1.58) for survival to discharge.
Conclusions: The citywide implementation of a bundle of UTIS CPR programs was associated with significantly better OHCA outcomes.

Introduction

Out-of-hospital cardiac arrest (OHCA) is a significant public health burden with low survival [1,2]. It has been reported that there are significant regional variations in the outcomes of OHCA [3,4].

Recently, the Utstein Ten-step Implementation Strategy (UTIS) was proposed to improve outcomes in OHCA as a core public health CPR program: 1) cardiac arrest registry, 2) telephone CPR, 3) high-performance CPR, 4) rapid dispatch, 5) measurement of professional resuscitation, 6) automatic external defibrillator (AED) programs for first responders, 7) smart technologies for CPR and AED, 8) mandatory training for CPR and AED, 9) accountability, and 10) Culture of excellence [5]. Although each of the UTIS programs is consensus-based and evidence-based to a different degree, the association between the implementation of a bundle of UTIS programs in a community and improved outcomes of OHCA is unclear.

The Seoul Fire Department implemented the following bundle of three CPR programs among the UTIS CPR programs in Jan. 2015: 1) a

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high-quality dispatcher-assisted CPR program (DACPR), 2) a multi-tier response (MTR) program using fire engines or basic life support vehicles in addition to routine ambulance service, and 3) a feedback CPR (FCPR) program with professional recording and feedback of CPR process using defibrillators with feedback function.

This study aims to describe the process and results of the implementation of a bundle of UTIS program in Seoul Metropolitan City and to evaluate whether the use of these programs improved the survival outcomes for OHCA patients.

Methods

Study design and setting

This study was a before and after study of the implementation of a bundle of UTIS CPR programs in Seoul Metropolitan City. The before phase was defined as January 2013 through December 2014 and included a historic control population. The after phase was defined as January 2015 through December 2016.

Seoul has approximately 10 million inhabitants per 605 km^2. The SMFD provides fire-based and public service under 24 EMS agencies with 140 ambulances with a single unified dispatch center, with approximately 300,000 transports per year including 4800 OHCAs. EMS providers can provide care comparable to an intermediate emergency medical technician (EMT-I) level in the United States. EMTs cannot declare death or stop CPR in the field unless a return of spontaneous circulation (ROSC) occurs. Therefore, all patients with OHCA are transported to emergency departments (EDs) while receiving CPR in an ambulance [6]. The EMS CPR protocols were revised on the 2010 and 2015 International guidelines [7].

In Seoul, a DACPR program was implemented in 2010 and has been in effect for all calls suspected to involve cardiac arrest. The dispatch center has a standard protocol for DACPR with two steps; 1) screening potential OHCAs by primary call dispatcher (PCD) and 2) providing telephone CPR instruction by medical call dispatcher (MCD) [8]. Prior to 2015, Seoul was covered by a single-tiered EMS service to respond to OHCA events. A nearest and available ambulance was dispatched to an OHCA event. Of the 140 ambulances, only 27 (23.3%) were equipped with a defibrillator with a feedback function until December 2014. However, there was no active feedback CPR training as a feedback to EMTs after review of the CPR records by medical directors.

Intervention

A bundle of three UTIS CPR programs were implemented in Jan. 2015; 1) a high-quality DACPR program, 2) a rapid dispatch program using MTR, and 3) an FCPR program using defibrillators with feedback functions.

A high-quality DACPR program was implemented in 2015 in addition routine DACPR program. This program included monthly monitoring and evaluation of the quality of the call receiving and consulting stages by a medical director. Ten percent of the calls correctly identified as cardiac arrest and 10% of the calls not recognized as cardiac arrest were randomly selected based on the records from the ambulance run sheet. The audit reviews were performed in a standardized manner and recorded on an audio review evaluation sheet. Performance standard indicators were set, and feedback for the executive members, including the dispatch center officers and medical directors during the study period. Key performance standard indicators included OHCA detection rate by the PCD and proportion of calls given CPR instructions within 120 s. Monthly education conferences for dispatchers were conducted to get feedback of the performance standards per individual and per dispatch teams.

The rapid CPR program included a multi-tier response (MTR) using the nearest available fire engine or basic life support vehicle team in addition to routine ambulance dispatch. An MTR scene protocol was developed, and a train-the-trainer model was used to disseminate the protocol. Six education programs were conducted, and 141 (10.8% of all the EMS providers in Seoul) participants from 24 EMS agencies were trained as trainers in 2015. They conducted MTR CPR training programs for all the EMTs and firefighters in Seoul.

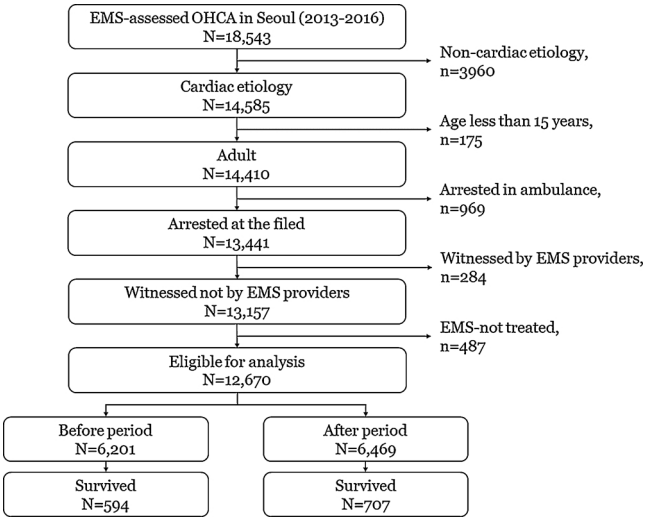

Fig. 1. Patient flow.
EMS, emergency medical services.
OHCA, out-of-hospital cardiac arrest.

The FCPR program included the distribution of defibrillators with feedback functions to each ambulance and EMT training program; EMS personnel were also strongly encouraged to use a defibrillator with a feedback function for professional recording of EMS-CPR, and the medical director provided feedback to the individual teams using these defibrillators. All CPR processes were recorded by these devices and uploaded by the EMTs after CPR to an electronic server of the SMFD to be reviewed by the EMS medical directors.

The MTR was a newly implemented program, but the other two programs were incomplete before 2015. It is a new attempt in this study to try to apply both programs (DACPR and FCPR) robustly and systematically to the whole city EMS.

Data sources and collection

We used the Korean OHCA Registry of by the Korea Centers for Disease Control and Prevention (CDC), which captures all incident cases of OHCA in the Seoul, was retrieved from the following four sources: the EMS run sheets for basic ambulance operation information, the EMS CPR registry, the dispatcher CPR registry, and the hospital OHCA registry for hospital care and outcomes. The medical record reviewers from the Korea CDC extracted the recorded information on the cause of arrest, hospital care and outcomes from approximately 700 hospitals. To ensure the quality of the medical record review process, a quality management committee of emergency physicians, epidemiologists, statistical experts, and medical record review experts analyzed the data every month while providing feedback to each medical record reviewer [9].

Study population

Patients with OHCA of presumed cardiac etiology who were 15 years of age or older and who used the EMS system in Seoul between January 2013 and December 2016 were included. Patients were excluded from the analysis if they did not receive resuscitative attempts, had their episode witnessed by EMS providers, or occurred at a primary care clinic or long-term care facility. Patients with missing information on neurologic outcomes at the time of discharge were also excluded.