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Impact of the number of on-scene emergency life-saving technicians and outcomes from out-of-hospital cardiac arrest in Osaka City☆

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ABSTRACT

Backgrounds: In Japan, ambulance staffing for cardiac arrest responses consists of a 3-person unit with at least one emergency life-saving technician (ELST). Recently, the number of ELSTs on ambulances has increased since it is believed that this improves the quality of on-scene care leading to better outcomes from out-of-hospital cardiac arrest (OHCA). The objective of this study was to evaluate the association between the number of on-scene ELSTs and OHCA outcome.
Methods: This was a prospective cohort study of all bystander-witnessed OHCA patients aged ≥18 years in Osaka City from January 2005 to December 2007 using on an Utstein-style database. The primary outcome measure was one-month survival with favorable neurological outcome defined as a cerebral performance category ≤2. Multivariable logistic regression model were used to assess the contribution of the number of on-scene ELSTs to the outcome after adjusting for confounders.
Results: Of the 2408 bystander-witnessed OHCA patients, one ELST group was present in 639 (26.5%), two ELST were present in 1357 (56.4%), and three ELST group in 412 (17.1%). The three ELST group had a significantly higher rate of one-month survival with favorable neurological outcome compared with the one ELST group (8.0% versus 4.5%, adjusted OR 2.26, 95% CI 1.27–4.04), while the two ELST group did not (5.4% versus 4.5%, adjusted OR 1.34, 95% CI 0.82–2.19).
Conclusions: Compared with the one on-scene ELST group, the three on-scene ELST group was associated with the improved one-month survival with favorable neurological outcome from OHCA in Osaka City.

1. Introduction

Sudden cardiac arrest (SCA) is one of the leading causes of death and an important public health problem in the industrialized world.[1,2] In Japan, approximately 60,000 out-of-hospital cardiac arrests (OHCAs) of cardiac origin occur every year, and this number has been steadily increasing.[3] Despite continuous improvements

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in the "chain of survival," survival from OHCA remains low.[1–4]

In Japan, the Emergency Medical Service (EMS) system response mostly consists of a single tiered ambulance system that is dispatched to the scene of all OHCA. Each ambulance is staffed with a 3-person unit including at least one emergency life-saving technician (ELST). ELST are trained to perform advanced airway management and may also administer adrenaline under on-line medial command.[5] The number of trained ESLTs has been steadily increasing in Japan,[5] which might improve the quality of care delivered on scene and lead to improved outcomes from OHCA. However, the benefits of having multiple higher trained providers on critical EMS calls for OHCA patients remain controversial.[6,7]

In 1998, the Osaka Municipal Fire Department launched a population-based registry of OHCA in Osaka City, a large urban community with approximately 2.7 million inhabitants. Using this database, we collected approximately 2400 bystander-witnessed OHCAs from January 1st, 2005 to December 31st, 2007. The aim of this study was to evaluate the association between the number of ELSTs on scene and outcomes from OHCA.

2. Methods

2.1. Study design, population, and setting

The present study was carried out within the Utstein Osaka Project, a prospective, population-based cohort study of all persons with OHCA treated by EMS personnel in Osaka prefecture, Japan. This study included all OHCA patients in Osaka City aged 18 years or older who were presumed to be of cardiac and non-cardiac origin, witnessed by bystanders, and transported to medical institutions from January 1, 2005 through December 31, 2007. Osaka City is the third largest city in Japan with a population of 2.7 million residents (2005) in an area of 222 km^2.[8] Cardiac arrest was defined as the cessation of cardiac mechanical activities as confirmed by the absence of signs of circulation.[9,10] An arrest was presumed to be of cardiac etiology unless it was caused by trauma, drowning, drug overdose, asphyxia, exsanguination, or by any other non-cardiac causes determined clinically by a physician in charge, working in collaboration with the EMS.

This study was approved by the Ethics Committees of the Kyoto University Graduate School of Medicine. The requirement to obtain individual informed consent for the review of patient outcome was waived by the Personal Information Protection Law and the National Research Ethics Guidelines of Japan.

2.2. The EMS system in Osaka City

The municipal EMS system is the same as in other areas of Osaka Prefecture, and has been described previously.[4,11,12] The EMS system is operated by the Osaka Municipal Fire Department and is activated by dialing 119 on the telephone. During the study period, there were 25 fire stations (60 ambulances) and a single dispatch center in Osaka City.[13] Life support is available there 24 h every day.

Each fire ambulance has three EMS personnel with at least one ELST, a highly-trained prehospital emergency care provider. ELSTs are authorized to use an automated external defibrillator, to insert an intravenous line, and to place advanced airway management devices for OHCA patients under on-line medical control direction. Specially trained ELSTs have been permitted to insert tracheal tubes since July 2004 and to administer intravenous epinephrine since July 2006. In Japan, EMS personnel are not permitted to terminate resuscitation in the field and all patients on whom resuscitation is attempted are transported to the hospital. Until September 2006, all EMS providers performed CPR according to the Japanese Guidelines based on the American Heart Association, European Resuscitation Council, and the International Liaison Committee on Resuscitation 2000 Guidelines using a 15:2 compression-to-ventilation ratio. After September 2006, they switched to a ratio of 30:2 based on the 2005 Guidelines.[14] Public-access defibrillation programs have been promoted in Japan since July 2004.[14]

2.3. ELST certification

There are two options to becoming certified as an ELST in Japan.[11] The first is through the educational system within the fire department itself. To become an Emergency Medical Technician (EMT), all fire department personnel are required to have received fundamental medical education in emergency care for 250 h through a training academy. After being actively engaged in pre-hospital setting as an EMT for more than 5 years or 2000 h, EMTs must pass the national examination of ELST after having received at least one additional year of medical education and training at the fire academy. The second way is through the education system in an accredited EMT school or college. To become an ELST, candidates must pass the national examination of ELST after receiving medical education and training in emergency care at the certified EMT school or college for at least two years. The cumulative number of ELSTs has increased gradually in Osaka City and reached to 508 in 2007 since the ELST system started in 1991.[13]

2.4. Data collection and processing

Data were prospectively collected using a data collection tool designed by the project steering committee. Included were all core data elements recommended in the Utstein style for OHCA,[9,10] including age, sex, etiology, first documented rhythm, resuscitation time-course, bystander-initiated CPR, location of arrest, advanced airway placement, adrenaline administration, year, field return of spontaneous circulation (ROSC), total ROSC, hospital admission, and one-month survival and neurological status at one month after the event as well as the number of on-scene ELSTs. Resuscitation time-course included a series of EMS-related times such as call, the initiation of CPR, departure at the scene, and hospital arrival. ROSC was defined as the restoration of a sustained spontaneous perfusing rhythm.[9,10] The data sheet was filled out by the EMS personnel in cooperation with the physicians in charge of the patient. It was then transferred to the Information Center for Emergency Medical Services of Osaka and reviewed by the investigators. If the information provided on the data sheet was unclear or incomplete, it was returned to the appropriate EMS personnel for completion.

2.5. Methods of measurement

All survivors were followed for up to one month after the event, and the neurological outcomes were determined by the physician responsible for the care of the patient. Neurological status was determined 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.[9,10] Neurologically favorable survival was defined as a CPC category 1 or 2.[9,10] The primary outcome measure was one-month survival with favorable neurological outcome. Secondary outcomes included field ROSC, total ROSC, hospital admission, and one-month survival.

2.6. Primary data analysis

Patient characteristics, EMS characteristics, and outcomes among bystander-witnessed OHCA patients were evaluated after grouping the EMS scene personnel based on the number of ELSTs