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Original Contributions

THE CONTRIBUTIONS OF EMERGENCY PHYSICIANS TO OUT-OF-HOSPITAL CARDIOPULMONARY ARREST: AN ANALYSIS OF THE NATIONAL UTSTEIN REGISTRY DATA

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☐ **Abstract—Background: Emergency physicians are likely to play an important role in the "chain of survival." The relationship between the number of emergency physicians and out-of-hospital cardiopulmonary arrest (OHCA) prognosis is not well understood. Objective: We assessed the impact of the number of emergency physicians on the outcomes of OHCA. Methods: In a nationwide, population-based, observational study, we enrolled 120,721 adults aged ≥18 years with OHCA, from January 1, 2010 to December 31, 2010. We used the countrywide Utstein Registry database coupled with health statistics data surveyed by the Ministry of Health, Labour and Welfare. The primary endpoint was favorable neurological outcomes 1 month after OHCA. Results: During the study period, OHCA occurred in 25,580 people (21.2%) in an area with the number of emergency physicians/100,000 population <1.5, in 62,299 people (51.6%) in an area with ≥1.5 and <3.0 emergency physicians/100,000 population, in 30,948 people (25.6%) in an area with ≥3.0 and <4.5 emergency physicians/100,000 population, and in 1894 people (1.6%) in an area with ≥4.5 emergency physicians/100,000 population. Patient prognosis became more favorable as the number of emergency physicians increased (1-month survival: 5.08% vs. 5.81% vs. 5.90% vs. 8.82%, $p < 0.0001$; and favorable neurological outcomes: 2.64% vs. 2.84% vs. 3.23% vs. 3.54%, $p < 0.0001$; for emergency physicians/100,000 population of <1.5, ≥1.5 and <3.0, ≥3.0 and <4.5, and ≥4.5, respectively). The adjusted odds ratio for favorable neurological outcomes per increase of one emergency physician/100,000 population was 1.06 (95% confidence interval 1.01–1.11, $p = 0.0163$). Conclusion: An increased number of emergency physicians/100,000 population is likely to be associated with improved outcomes.** © 2015 Elsevier Inc.

☐ **Keywords—out-of-hospital cardiac arrest; cardiopulmonary resuscitation; emergency services; health policy; database**

INTRODUCTION

Out-of-hospital cardiopulmonary arrest (OHCA) has one of the worst prognoses, and it occurs in 125,000, 275,000, and 375,000 people annually in Japan, Europe, and the United States, respectively (1–3). Although the rate of survival after OHCA has been increasing with advances in care throughout the "chain of survival," it is still low (4,5). The "chain of survival" consists of early access to emergency medical care, early cardiopulmonary resuscitation (CPR), rapid defibrillation, early advanced life support, and integrated postcardiac arrest care (6). For the last two elements in the chain (advanced life support and postcardiac arrest care), in particular, more specialized and advanced medical care is sometimes performed, such as extracorporeal cardiopulmonary resuscitation (ECPR), targeted temperature management (TTM), and postresuscitation percutaneous coronary intervention (PCI) (7–10). Emergency physicians who

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specialize in resuscitation are considered to play an extremely important role in these procedures.

In previous studies, the relationships of hospital characteristics, such as hospital volume or hospital bed size, and the prognosis of OHCA have been examined (11–13). However, no studies have examined the relationship between the number of emergency physicians and the prognosis of OHCA.

The purpose of this study was to examine the contribution of the number of emergency physicians to the prognosis of OHCA, using the Japanese Utstein Registry database coupled with health statistics data surveyed by the Ministry of Health, Labour and Welfare.

METHODS

Study Design and Participants

We used the data from the Japanese Utstein Registry of the Fire and Disaster Management Agency (FDMA), which is a prospective, nationwide, population-based database of all OHCA patients using Utstein-style data collection (14). This study was a population-based cohort study using the data from the Japanese Utstein Registry coupled with health statistics data surveyed by the Ministry of Health, Labour and Welfare. The analysis of this study was conducted retrospectively using prospectively collected data.

This study included all adults aged 18 years or older who suffered an OHCA and for whom resuscitation was attempted by emergency medical services (EMS) personnel with subsequent transport to an emergency hospital from January 1, 2010 to December 31, 2010. Patients whose data and information regarding the onset date, call receipt time, hospital arrival time, airway management status, or the usage status of a public access automated external defibrillator (AED) were missing or unknown were excluded from the analysis.

The FDMA and the Institutional Review Board of the University of Tokyo approved the study with waiver of informed consent due to the anonymous nature of the data.

Study Setting

Japan has an area of approximately 378,000 km^2 and is comprised of 47 prefectures (15). The population of Japan was approximately 128 million in 2010, including approximately 107 million people aged 18 years or older (15).

The EMS system in Japan has been described previously (16–21). EMS was provided by municipal governments through 802 fire stations with dispatch centers in 2010 (1,16,21). All EMS personnel performed CPR in accordance with the Japanese CPR guidelines, which are consistent with the guidelines from the American Heart Association and the International Liaison Committee on Resuscitation (22–24). An ambulance crew usually consists of three EMS personnel, including at least one emergency lifesaving technician. Emergency lifesaving technicians have completed extensive training, and some of them are authorized to secure infusion lines, administer epinephrine, perform endotracheal intubation, perform defibrillation, and lead CPR administration (1,16,21,22). Advance directives, living wills, or do-not-attempt-resuscitation orders are not generally accepted in Japan (16,21,22,25). EMS providers in Japan are not allowed to terminate resuscitation out of the hospital except for specific situations, such as decapitation, rigor mortis, livor mortis, or decomposition. Therefore, most patients who have an OHCA treated by EMS personnel are transported to an emergency hospital (16,20,21,25).

Data Collection and Quality Control

The data regarding OHCA were collected with an Utstein-style data form that included questions on patient sex, age, etiology of arrest, bystander witness status, bystander CPR status, initial cardiac rhythm, usage of a public-access AED, presence of an emergency lifesaving technician or physician in the ambulance, administration of epinephrine, and airway management technique.

Cardiac arrest was defined as the end of cardiac mechanical activity determined by the absence of signs of circulation (14,26). Bystander CPR was defined as CPR that was performed by a bystander regardless of a witness before EMS personnel reached the patient (1,14,22). The etiology of arrest was presumed to be cardiac unless evidence suggested cerebrovascular diseases, respiratory diseases, malignant tumors, external causes (such as trauma, drowning, burn, asphyxia, and intoxication), or any other noncardiac cause. The designation of cardiac or noncardiac cause was made by the attending physicians in the emergency department in collaboration with EMS personnel.

The time series of EMS call receipt, vehicle arrival at the scene, contact with the patient, initiation of CPR, and hospital arrival were recorded by the clock carried by each EMS provider.

The outcome measures included not only the return of spontaneous circulation (ROSC) prior to hospital arrival, but also the 1-month survival and neurological status 1 month after OHCA.

To collect 1-month follow up data, the EMS provider taking charge of each patient with OHCA queried the medical control director at the hospital and received a written response. The neurological status of the patient