American Journal of Emergency Medicine 35 (2017) 391–396

Contents lists available at ScienceDirect

American Journal of Emergency Medicine

journal homepage: www.elsevier.com/locate/ajem

Original Contribution

Does the number of emergency medical technicians affect the neurological outcome of patients with out-of-hospital cardiac arrest?

Shuichi Hagiwara, MD *, Kiyohiro Oshima, MD, Makoto Aoki, MD, Dai Miyazaki, MD, Atsushi Sakurai, MD, Yoshio Tahara, MD, Ken Nagao, MD, Naohiro Yonemoto, MD, Arino Yaguchi, MD, Naoto Morimura, MD, SOS-KANTO 2012 Study Group

ARTICLE INFO

Article history:
Received 3 October 2016
Received in revised form 7 November 2016
Accepted 8 November 2016

Keywords:
Emergency medical technician (paramedic)
Advanced life support
Prehospital
Out-of-hospital cardiac arrest

ABSTRACT

Background: It is unclear whether the number of paramedics in an ambulance improves the outcome of patients with out-of-hospital cardiac arrest (OHCA) or not.

Methods and Results: This study was a prospective, observational study conducted on patients with OHCA. Patients were divided into the One-paramedic group (Group O) and the Two-or-more-paramedic group (Group T) and we analyzed the differences. Patients who were treated with only basic life support during transportation, and whose cause of cardiac arrest were extrinsic cause such as trauma and poisoning were excluded. Good neurological outcome was defined as cerebral performance category (CPC) 1 or 2.

In Group O, there were 1516 patients (male/female, 922/594). In Group T, there were 2932 patients (male/female, 1798/1134). Return of spontaneous circulation (ROSC) was obtained in 528 patients (34.8%) in Group O and 1058 patients (36.1%) in Group T ($p = 0.589$). 320 patients (21.1%) in Group O and 656 patients (22.4%) in Group T were admitted to hospital after ROSC ($p = 0.461$). At 90 days, there were 57 survivors (3.8%) in Group O and 114 survivors (3.9%) in Group T ($p = 0.873$). At 90 days, 14 patients (0.9%) in Group T had a CPC of 1 or 2, while 30 patients (1.0%) in Group T did so ($p = 0.87$). From the results of logistic regression analysis, age [odds ratio (OR): 0.983, 95% confidence interval (CI): 0.952–0.993], witnessed OHCA (OR: 4.583, 95% CI: 1.587–13.234), and shockable rhythm as first documented (OR: 19.67, 95% CI: 9.181–42.13) were associated with good outcome.

Conclusion: The number of paramedics in an ambulance did not affect the outcome in OHCA patients.

1. Introduction

Out-of-hospital cardiac arrest (OHCA) is one of the greatest healthcare problems of community and public health. The correct and timely identification of cardiac arrest is critical to ensuring [1] the appropriate dispatch of a high-priority response, [2] the provision of telephone cardiopulmonary resuscitation (CPR) instructions, and [3] activation of community first responders carrying automated external defibrillators (AEDs) [1]. Optimizing emergency medical service (EMS) dispatch is likely to be one of the most cost-effective solutions to improving the outcome of OHCA [1]. Before arriving at the hospital, the key persons who perform advanced life support are emergency medical technicians (EMTs) or paramedics; therefore, it is assumed that the procedures that EMTs perform greatly influence the outcome of patients with OHCA.

The Fire and Disaster Management Agency in Japan recommends that EMTs receive off-the-job training in basic life support and this agency maintains the operational system of EMT services with the goal of ensuring that at least one EMT is regularly present in all emergency services (one EMT among 3 members) [2]. The Utstein Osaka Project reported that an ambulance with three EMTs was associated with good outcome of patients with OHCA [3]. However, the number of patients included in that study was not large. The importance of the number of EMTs in the ambulance for patients with OHCA is still controversial.

The Survey of Survivors of OHCA in the Kanto district of Japan 2012 study (SOS-KANTO 2012 study) was performed by the Japanese Association for Acute Medicine in the Kanto district between January 2012 and March 2013, and included 67 emergency hospitals and emergency medical services units. The SOS-KANTO 2012 study was a prospective, multicenter, observational study on patients with OHCA. We hypothesized that the number of EMTs in the ambulance affects the neurological outcome of patients with OHCA. In this study, we evaluated this hypothesis with the data of the SOS-KANTO 2012 study.

* Corresponding author at: Department of Emergency Medicine, Gunma University Graduate School of Medicine, 3-39-22 Showa-machi, Maebashi, Gunma 371-8511, Japan.
E-mail address: shuhagiwara@gunma-u.ac.jp (S. Hagiwara).

http://dx.doi.org/10.1016/j.ajem.2016.11.020
0735-6757/

2. Methods

The SOS-KANTO 2012 study was a prospective, observational study conducted on patients with OHCA who were transported to 67 emergency hospitals (36 academic centers) in Kanto district between January 2012 and March 2013. The emergency hospitals that participated in the SOS-KANTO 2012 study are listed in the *Acknowledgments*. The protocol of the SOS-KANTO 2012 study was approved without the need for informed consent by the research ethics board of Yokohama City University Medical Center (Yokohama, Kanagawa, Japan; D1402005). The results of various aspects of the SOS-KANTO 2012 study have been published in several journals [4-8].

The flow diagram of the present study is shown in Fig. 1. First, we selected OHCA patients whose age was 18 years old or older. We excluded patients who were transferred by an ambulance with an unknown number of EMTs or no EMT, those who received only chest compression and rescue breathes, and those in whom advanced airway management or taking intravenous line was not performed during transportation because to reduce the selection bias. Patients whose etiology of cardiac arrest was trauma, burn, toxicosis, hypothermia, drowning, and neck hanging, were also excluded (detailed numbers of patients are shown in Fig. 1). We divided the patients into two groups according to the number of EMTs. Group O included patients with OHCA in which there was only one EMT in the ambulance when the patient was transferred to the hospital, and Group T included OHCA patients in which there were two or more EMTs in the ambulance.

We analyzed the rate of return of spontaneous circulation (ROSC), admission after ROSC, and 90-day survival and neurological status, and compared these results between the two groups. Neurological status was described with the cerebral performance category (CPC): 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]. Good neurological outcome was defined as CPC1 and CPC2.

Finally, we conducted logistic regression analysis in which the dependent variable was good neurological outcome or survival, and objective variables were prehospital procedures and findings.

2.1. Statistical Analysis

Age and time are shown as the mean ± standard deviation. The significance of differences between the two groups was analyzed with Student's *t*-test and the χ^2 test. Survival curves were drawn by the Kaplan-Meier method and were compared with the log-rank test. Logistic regression analysis was performed to model the concurrent effects of age, sex, witnessed, bystander CPR, and other factors on the outcome.

IBM SPSS Statistics 22 (IBM Corporation; Endicott, NY, USA) and EZR (Saitama Medical Center, Jichi Medical University, Saitama, Japan) were used for statistical analyses. EZR is a graphical user interface for R (The R Foundation for Statistical Computing, Vienna, Austria). More precisely, it is a modified version of R commander designed to add statistical functions frequently used in biostatistics [11]. Statistical significance was assumed to be present at $p < 0.05$.

3. Results

During the study period, 16,452 patients with OHCA were enrolled in the SOS-KANTO 2012 study. Among them, 4448 patients with OHCA met the criteria of the present study. There were 1516 patients in Group O and 2932 patients in Group T (Fig. 1).

The patients' characteristics are summarized in Table 1. There were 922 males (60.8%) in Group O and 1798 males (61.3%) in Group T ($p = 0.892$). The mean age was 73.4 ± 14.2 years in Group O, and 73.5 ± 14.3 years in Group T ($p = 0.973$). There were no significant differences in the male/female ratio and age between the two groups.

There were 792 patients (52.2%) whose cardiac arrest was witnessed in Group O, and 1585 patients (54.1%) in Group T ($p = 0.543$). Regarding by-stander CPR, 563 patients (37.1%) in Group O received by-stander CPR, while 1164 patients (39.7%) in Group T received by-stander CPR ($p = 0.282$). The percentage of witnessed patients was more than 50% in both groups, and by-stander CPR was performed in about 40% of patients with OHCA in both groups with no significant differences.

The number of patients whose initial electrocardiogram (ECG) waveform (i.e., ECG waveform monitored by EMTs in the ambulance) was ventricular fibrillation was 139 (9.2%) in Group O and 270 (9.2%) in Group T ($p = 1$). The number of patients whose initial ECG waveform was pulseless ventricular tachycardia was 2 (0.1%) in Group O and 1 (0.0%) in Group T ($p = 0.561$). The number of patients whose initial ECG waveform was pulseless electrical activity was 386 (25.5%) in Group O and 732 (25.0%) in Group T ($p = 0.807$). The number of patients whose initial ECG waveform was asystole was 925 (61.0%) in Group O and 1805 (61.6%) in Group T ($p = 0.882$). There were 860 patients (56.7%) whose etiology of cardiac arrest was cardiac in Group O,

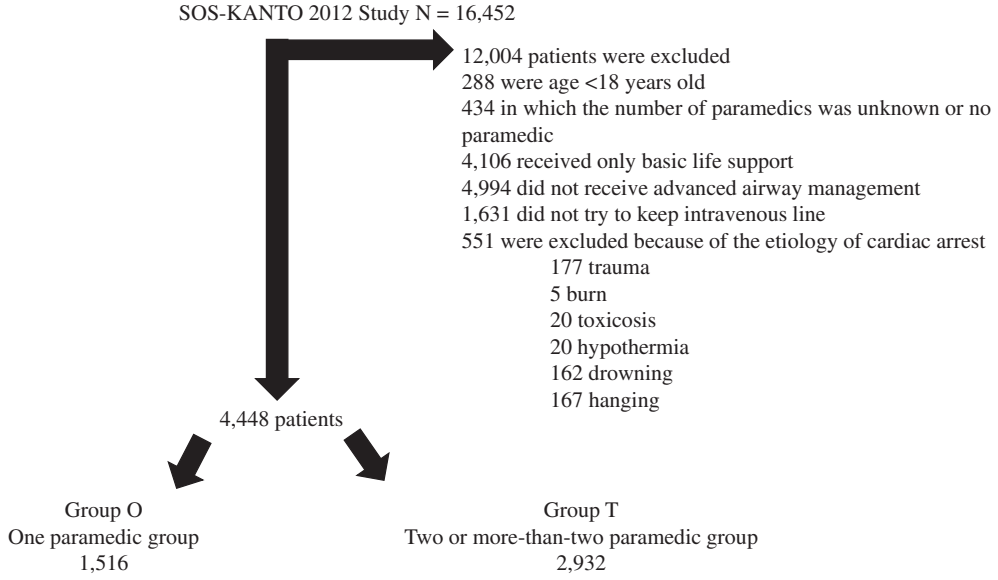

Fig. 1. The study flow diagram that shows the patients with out-of-hospital cardiac arrest that were included in the present study.