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Clinical Paper

A comparison of outcomes of out-of-hospital cardiac arrest with non-cardiac etiology between emergency departments with low- and high-resuscitation case volume☆

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ABSTRACT

Objectives: It is unclear whether outcome after out-of-hospital cardiac arrest (OHCA) of non-cardiac etiology (NCE) is associated with the volume of patients with OHCA received annually at the emergency department (ED) where they receive treatment. This study evaluated whether the volume of patients treated is associated with better outcomes for non-cardiac OHCA patients.

Methods: This study was performed in an emergency medical service (EMS) system with a single-tiered basic-to-intermediate service level and approximately 410 destination hospitals for eligible OHCA cases. A nationwide OHCA database (2006–2008), constructed from EMS run sheets, and a hospital medical record review were used. OHCA was defined as pulseless and unresponsive in the field. Included in the study were cases treated with OHCA whose etiology was non-cardiac. Excluded were cases with unknown hospital outcome. The cutoff number for a high volume (HV) versus a low volume (LV) of cardiopulmonary resuscitation (CPR) cases was calculated using a threshold model. The primary end points were survival to admission and survival to discharge. The adjusted odds ratios (ORs) and 95% confidence intervals (95% CIs) for the endpoints were calculated, adjusting for potential predictors.

Results: There were 10,425 eligible patients (trauma 5735; drowning 98; poisoning 684; asphyxia 1413; and hanging 1605). The survival-to-admission and the survival-to-discharge rates of the study participants were 9.6% and 2.4%, respectively. The cutoff number for case volume was 38 per year. The rates of survival to admission and survival to discharge were significantly higher in the HV (18.6% and 5.1%, respectively) group when compared to the LV group (5.9% and 1.3%, respectively). For the treated, non-cardiac OHCA patients, the adjusted ORs in the HV group compared to the LV group were 2.16 for survival to admission (95% CI: 1.84–2.55) and 2.58 for survival to discharge (95% CI: 1.90–3.52). The survival-to-discharge rate was significantly higher in the HV group than in the LV group for each cause: trauma 2.1% vs. 0.6%, drowning 6.8% vs. 1.9%, poisoning 8.6% vs. 1.7%, asphyxia 13.5% vs. 3.8%, and hanging 5.2% vs. 1.3%, respectively.

Conclusion: This national cohort study suggests that greater survival to admission as well as discharge for patients with OHCA of NCE is associated with greater annual volume of patients with OHCA treated at that hospital.

☆ A Spanish translated version of the abstract of this article appears as Appendix in the final online version at doi:10.1016/j.resuscitation.2012.02.002.

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1. Introduction

1.1. Background

Recent strategies for improving the outcomes of out-of-hospital cardiac arrest (OHCA) with cardiac etiology have included regional modeling, such as designating cardiac arrest centers, giving optimal therapy-intensive bundles of post-resuscitation care, and active intervention for specific interventions.[1–3]

OHCA with non-cardiac etiology (NCE) has a much lower incidence and a poorer outcome than OHCA with cardiac etiology, and cardiopulmonary resuscitation (CPR) is sometimes regarded as futile in this subgroup.[4–7] In particular, OHCA with NCE requires more complex and definite resuscitation efforts during CPR, such as tube thoracotomy, transfusion, use of antidote, ventilator care and the creation of a surgical airway. These concrete CPR efforts are frequently unavailable in the field or during transport, even though the emergency medical service (EMS) level may be advanced and include intravenous fluid infusion and some medication.[8,9] In these environments, resuscitation efforts for OHCA with NCE have resulted in poor outcomes, with a few exceptions from physician-run EMS systems.[10,11]

The outcomes of OHCA with NCE are strongly related to the sequential performances of the community, the EMS, and hospital care. In addition to minimizing response times, the EMS is generally encouraged to transport victims to the closest emergency department (ED), presumably to expedite a hospital level of care and improve the chances of return of spontaneous circulation (ROSC).[1] The specific capabilities or high-quality performances of the receiving ED and hospital have not been addressed to improve the outcomes of OHCA with NCE; instead, cases of OHCA with cardiac etiology are encouraged to be transported to a regional designated cardiac arrest center.[1–3] Studies supporting this regionalization strategy have reported high-quality intensive care, higher therapeutic hypothermia care and reperfusion therapy, a benefit from the higher CPR volume, and the safety of bypassing community hospitals.[12–14]

1.2. Importance

Several studies have related a regional cardiac arrest system with better performance and outcome in OHCA of presumed cardiac etiology.[12–14] However, it is unclear whether transporting OHCA cases of NCE to a designated high-quality care facility is associated with better outcomes. Hospital performance can be optimized when there is appropriate case experience to maintain skill, knowledge, and a team approach. Multiple studies have described higher rates of mortality at hospitals with low volumes of specific procedures (low-volume hospitals), like surgery or intervention, and resuscitation for OHCA with presumed cardiac etiology.[15–17] Resuscitation of OHCA with NCE is labor- and resource-intensive, and it requires more complex treatment options. A high patient volume may help maintain a team approach and adherence to protocol and thereby improve outcomes for patients in cardiac arrest.

1.3. Goals of this investigation

We aimed to determine whether the annual volume of all patients with OHCA treated at receiving EDs is associated with survival benefits in patients with OHCA of NCE.

2. Methods

This study was one of a series from a nationwide, population-based, and EMS-assessed OHCA and CPR surveillance study in Korea.[15,18–20] The study was approved by the Institutional Board of Review at the study institution. This study was financially supported by the Seoul Metropolitan City Government (2008) and the Korean Centers for Disease Control and Prevention (2009–2010).

2.1. Data source

The cardiovascular disease surveillance (CAVAS) database is a large-scale, nationwide, observational database of patients with confirmed OHCA in Korea. The database is a population-based, EMS-assessed OHCA for the whole country population. Cases were captured from ambulance run sheets where OHCA was coded, and data from January 2006 to December 2008 were used for this study. Ambulance run sheets are electronically stored in each provincial EMS headquarters, operated by the fire department. Trained medical record reviewers visited the study hospitals and reviewed medical records to complete information related to risks and outcomes according to the Utstein style.[21] All reviewers were formally trained and provided with the operation manual to correctly abstract the data from the medical records and transcribe the data onto case report forms. When reviewers could not determine information (for example, the initial ECG), an emergency physician who provided quality control in this study reviewed and confirmed the case using the faxed medical record or ECG sheet.

2.2. Setting

The Korean EMS system is single tier and government provided, and a basic-to-intermediate service level of ambulance services are operated by 16 provincial headquarters of the national fire department. Ambulance crews can give CPR at the scene and during transport and, in limited areas, can provide care comparable to the intermediate emergency medical technician (EMT) level in the US, including intravenous fluids and endotracheal intubation or laryngeal mask airway (LMA) insertion under direct medical oversight.[19,20] However, medication for advanced cardiac life support (ACLS) is not widely available; in most areas, advanced cardiac life support is only available in hospitals.[15] The EMTs cannot declare death or stop CPR in the field or during transport without consultation with a physician and about 0.8% of all OHCA patients had prehospital ROSC. Therefore, all patients with OHCA should be transported to the nearest hospital EDs. There was no public-access defibrillator program until 2008. Most defibrillation in the prehospital stage was given by the ambulance crew. Every ambulance has an automatic external defibrillator, which can be used by all levels of EMS provider. A withdrawal guideline for use in unsalvageable cases, such as evidence of rigor mortis, was included in the EMS act, but the validity of such decision making was not fully studied. There are approximately 1350 ambulance stations over the nation, which cover approximately 48.6 million people residing over an area of approximately 100,000 square kilometers. The annual run volume of the prehospital service is slightly larger than 1.4 million. Two or three crews usually ride along each ambulance.

All emergency departments are formally designated as level 1–3 by the government. The designation is based on the ED's human resources, essential instruments and equipment, and service levels, such as the availability of certain specialists. Wilderness areas and isolated islands usually have no designated ED, and here, most patients with OHCA are transported to the community health care centers or non-emergency hospitals (non-ED facilities). These facilities can give CPR followed by minimal primary care for patients with OHCA. From these non-ED facilities, we also collected the same information on OHCA even though there were extremely poor outcomes. Most level 3 EDs are basically equipped and are usually served by general physicians. However, by law, the level 1 and level 2 EDs must be covered by emergency physicians 24 h a day. There are 20 regional EDs (level 1) in Korea, 120 local EDs (level