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Clinical Paper

The duration of cardiopulmonary resuscitation in emergency departments after out-of-hospital cardiac arrest is associated with the outcome: A nationwide observational study☆

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ABSTRACT

Aim of the study: The appropriate duration of cardiopulmonary resuscitation (CPR) for patients who experience out-of-hospital cardiac arrest (OHCA) remains unknown. This study aimed to evaluate the duration of CPR in emergency departments (EDs) and to determine whether the institutions' median duration of CPR was associated with survival-to-discharge rate.

Methods: A cohort of adult patients from a nationwide OHCA registry was retrospectively evaluated. The main variable was the median duration of CPR for each ED (institutional duration), and the main outcome was survival to discharge. Multivariable logistic regression analysis was performed to adjust for individual and aggregated confounders.

Results: Among the 107,736 patients who experienced OHCA between 2006 and 2010, 30,716 (28.5%) were selected for analysis. The median age was 65 years, and 67.1% were men. The median duration of CPR for all EDs was 28 min, ranging from 11 to 45 min. EDs were categorized into 3 groups according to their institutional duration of CPR: groups A (<20 min), B (20–29 min), C (≥30 min). The observed survival rates of the 3 groups were 2.11%, 5.20%, and 5.62%, respectively. Compared with group B, the adjusted difference (95% confidence interval) for survival to discharge was 3.01% (1.90–4.11, $P < 0.001$) for group A, and 0.33% (−0.64 to 1.30, $P = 0.51$) for group C.

Conclusion: The duration of CPR varied widely among hospitals. The institutional duration of CPR less than 20 min was significantly associated with lower survival-to-discharge rate.

1. Introduction

The prompt initiation and maintenance of high-quality cardiopulmonary resuscitation (CPR) is critical for patients who experience out-of-hospital cardiac arrest (OHCA).[1] In addition, focused care must be provided from the field to the emergency department (ED), and the quality of care in the ED becomes more important when CPR is performed in the ambulance. Although studies have shown that resuscitation during transport is of poor quality,[2,3] CPR is often performed during transport, for legal, cultural, or ethical reasons.[4–8]

Once the patient arrives at the ED, one of the most difficult questions that faces the attending physicians is when to terminate resuscitation.[5,9] However, there have been few studies regarding the optimal duration of resuscitation efforts[10–13] and even fewer studies that focus directly on the duration of resuscitation in the ED.[10] Therefore, there is wide variation in practice among EDs regarding the specific duration of resuscitation efforts.

The aims of this study were to evaluate the duration of CPR in EDs and to determine whether the median duration of CPR in the ED was associated with the survival of patients who experienced OHCA.

2. Methods

2.1. Design and setting

This nationwide, retrospective study was performed using data from the Cardiovascular Disease Surveillance Project of the Korea

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Centers for Disease Control and Prevention. The purpose of this project was to create a cohort of patients with emergency medical services (EMS)-assessed OHCA.[14,15] For this study, we enrolled patients in this cohort who experienced OHCA between 2006 and 2010.

2.2. Study population

The study population consisted of adult patients who experienced OHCA that was presumed to be of cardiac origin. Patients who were transferred to an ED with a low patient volume (<12 patients/year) were excluded, as data from these institutions were considered outliers. Patients who were transferred from the initial ED to another facility were also excluded because of the lack of necessary information. We also excluded patients who did not receive CPR in the ED.

2.3. Variables of interest

The selected factors were based on the Utstein style. We also included the EMS response interval and the transport interval. The duration of CPR for each patient (individual duration) was calculated as the interval from his or her arrival in the ED to the termination of CPR. The median duration of CPR for each ED (institutional duration) was calculated as the median duration in patients who did not experience return of spontaneous circulation (ROSC).

2.4. Statistical analysis

The patients' baseline characteristics were analysed according to the individual duration of resuscitation, which was divided into 6 categories using 5 cut-off values: 10, 20, 30, 40, and 50 min. The *P*-value for trend was calculated for each factor using univariate linear regression analysis. We used the Kruskal–Wallis and χ^2 tests to examine the baseline differences and clinical characteristics across the groups based on the duration of resuscitation.

The primary factor studied was the institutional duration of CPR for each ED, which was divided into 3 groups (A, B, and C) using cut-off values of 20 and 30 min. Group B was selected as the reference group. The main outcome was survival to discharge, and the Utstein variables and EMS time intervals were considered potential confounders.

In order to analyse the correlation between institutional survival rate and institutional CPR duration, Spearman's correlation was calculated. For determining the association between individual survival and institutional CPR duration, we used an unadjusted logistic regression analysis model and a multivariable logistic regression model with cluster effect for the final analysis. We calculated the adjusted difference of survival (with group A as reference) using the adjrr command of STATA 13 (StataCorp., College Station, TX).[14,15]

2.5. Sensitivity analysis

In order to determine the effect of population setting and grouping on the result, we performed the same regression analysis for different settings. First, regression analysis was performed only for EDs with at least 1 survivor, which could have minimized the effect of poor quality of care. Second, regression analysis with different cut-off points (20, 25, 30, and 35) was performed.

3. Results

The patient selection process is illustrated in Fig. 1. In total, 107,736 patients in the cohort experienced OHCA between 2006 and 2010, and 71,519 (66.4%) of these cases were presumed to be of cardiac origin with documented outcome. A total of 35,752 patients (33.2%) underwent CPR in an ED, and 30,691 of these patients (28.5%) were selected for the final analysis.

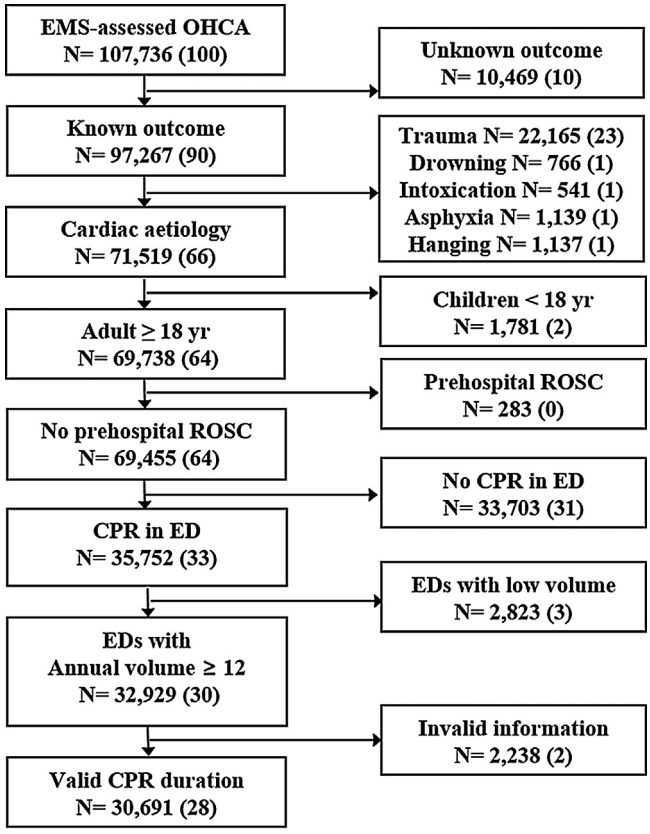

Fig. 1. Cardiac arrests from January 1, 2006 through December 31, 2010. Subject selection process. EMS, Emergency medical service. CPR, Cardiopulmonary resuscitation. OHCA, Out-of-hospital cardiac arrest. ED, Emergency department. ROSC. Return of spontaneous circulation.

The median patient age was 65 years (interquartile range [IQR]: 53 to 76 years), and 20,577 (67.1%) were men. In total, 3513 cases of OHCA (11.5%) occurred in a public place, 16,779 (54.7%) were witnessed, and 1114 (3.63%) involved a bystander performing CPR. The median response time was 6 min (IQR, 5–8 min), the median transport time was 13 min (IQR, 9–17 min), and the median individual duration of CPR in ED was 27 min (IQR: 15–38 min). The point and cumulative distributions of patients over individual duration of CPR are shown in Figs. 2 and 3.

The basic characteristics of the patients and their individual durations of resuscitation are shown in Table 1. For the ROSC group, gender, place, bystander CPR, initial rhythm, and response time were associated with longer duration of CPR. For the no ROSC group, long resuscitation time was associated with factors that are generally known to be good prognostic signs.

In total, 337 EDs were included in the study, and the institutional duration of CPR ranged from 11 to 45 min, with a median duration of 28 min (IQR, 24–31 min). The average survival rate for each ED ranged from 0 to 0.17 (median 0.02). The institutional duration and survival rate showed a positive correlation of statistical significance (Spearman's rho = 0.15, $P = 0.004$). The survival rates in the 3 groups (A, B, and C) were 2.11%, 5.20%, and 5.62%, respectively.

Risk factors were re-assessed with institutional duration of resuscitation (Table 2). There was no statistically significant difference among groups with respect to age, sex, witness, and initial rhythm. There was a small but significant difference with respect to the place of arrest, response interval, and transport interval.