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Original Article

Prognostic factors for survival outcome after in-hospital cardiac arrest: An observational study of the oriental population in Taiwan

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Abstract

Background: In-hospital cardiac arrest (IHCA) is a catastrophic complication for patients while admitted in a medical institution. The outcome of IHCA remains poor, and understanding of the prognostic factors for survival outcome after IHCA is lacking, specifically in an oriental population.
Methods: A retrospective observational cohort study of 382 patients with IHCA who required resuscitation was conducted in an urban tertiary hospital in Taiwan. Return of spontaneous circulation (ROSC) and survival to hospital discharge were the primary outcome measures.
Results: The incidence of IHCA was 3.25 per 1000 admissions. These patients had a mean age of 67.2 ± 21.7 years and were mostly men (66.5%). The rate of successful ROSC was 66%, and the rate of survival to hospital discharge was 11.8%. A stepwise decrease in ROSC was observed with additional resuscitation efforts. Independent predictors for survival to hospital discharge were being female, a resuscitation duration of <20 minutes, and no use of epinephrine during resuscitation. A 68% ROSC success rate and an 84% survival to discharge rate was recorded in patients receiving resuscitation for <30 minutes. Young patients seemed the most likely to benefit from longer resuscitation attempts (>30 minutes), as observed in survival to hospital discharge.
Conclusion: Based on data from a single hospital registry in East Asia, a shorter duration of resuscitation was demonstrated to be a predictor of immediate survival with ROSC and survival to hospital discharge.

Keywords: Asia; cardiopulmonary resuscitation; in-hospital cardiac arrest; resuscitation; survival

1. Introduction

In-hospital cardiac arrest (IHCA) is a catastrophic complication for patients while admitted in a medical institution. There have been approximately 200,000 hospitalized patients per year treated for cardiac arrest in the United States, with a reported survival to hospital discharge rate of 7–26%.[1–3] IHCA patients tend to be sicker, with increased comorbidities, as well as demonstrating a higher rate of non-shockable rhythms [pulseless electrical activity (PEA) or asystole].[2,4] Therefore, it is crucial for clinicians to have a thorough understanding of the factors affecting the outcome of inpatient cardiopulmonary resuscitation (CPR).

Several factors, including the initial rhythm, resuscitation duration, underlying comorbidities, time of day, and initial resuscitation effort, may be related to the resuscitation outcome.[1,2,5–7] The majority of the IHCA literature includes participants from Western countries. There is a paucity of IHCA data in the Asian population,[8] which currently ranks as the world's second highest population, behind only

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Caucasians. Patient outcomes following IHCA are influenced by several variables, including ethnicity, socioeconomic status, health status, and utilization of healthcare resources.[9] Compared with white patients, survival after IHCA has been shown to be reduced in black patients.[9,10] The exiting validated risk model for IHCA from North America may not be suitable to different healthcare systems in an oriental society.[11] Therefore, we conducted this investigation to determine the independent predictors for resuscitation outcomes after IHCA focusing on an oriental population.

2. Methods

2.1. Hospital setting

A retrospective observational study at Taipei Veterans General Hospital (VGH), a 2700-bed, tertiary care medical center in Taipei, Taiwan, was performed. The VGH offers a variety of specialties, while serving an average of 250 emergency department visits and 320 admissions daily. All physicians and nurses are required to receive Advance Cardiac Life Support training, as well as obtain recertification every 3 years, to ensure their ability to resuscitate patients.

2.2. Study population and data collection

Data were recorded from a web-based IHCA registry system, implemented and directed since 2011 by the Center for Medical Quality Management of Taipei VGH. Following an IHCA, the nurse on duty records the applicable data to the web-based IHCA registry system. The database contains variables and outcome following the standardized Utstein-style definitions.[12] From January 1, 2012 to December 31, 2012, all adult (≥18 years) and pediatric (<18 years) patients who received an in-hospital resuscitation attempt after cardiac arrest were eligible for study inclusion. The exclusion criteria were cardiac arrests from out of hospital, patients with a do-not-resuscitate (DNR) order, and IHCAs occurring in visitors, outpatients, or hospital employees. The institutional review board of Taipei VGH approved the study and waived the requirement for informed consent.

Patient demographic data, event date and time, and patient outcomes were retrospectively extracted from the registry database and hospital records. These data were subsequently verified by two different attending physicians. The Charlson comorbidity index score was used to calculate and estimate the severity of comorbid disease.[13] IHCA time was documented as daytime (08:00−19:59) or nighttime (20:00−07:59). In the case of multiple IHCAs in the same patient within 48 hours, only data from the first episode was included to avoid the confounding effects between events. The duration of resuscitation was defined as the time from the onset of cardiac arrest to the termination of resuscitation efforts, or patient death. Primary outcome measures were immediate survival with return of spontaneous circulation (ROSC) and survival to hospital discharge. The secondary outcome was patient evaluation using the cerebral performance category scale at hospital discharge. A favorable neurological status was defined as a score of 1 or 2.

2.3. Statistical analysis

Results are expressed as n (%) for categorical variables. Descriptive statistics were reported as mean ± standard deviation, or median [interquartile range (IQR)] for continuous variables. Continuous variables were assessed using the Mann−Whitney U test for independent samples. Analysis of categorical variables was performed using Pearson's chi-square test or Fisher's exact test, as appropriate. A multivariable logistic regression model with conditional backward selection was performed to identify independent variables associated with resuscitation outcomes. Statistical analyses were performed using the Statistics Package for Social Sciences software (SPSS) 19.0 version. Odds ratios (ORs) and 95% confidence interval were reported to determine the prognostic factors that were independently associated with survival. A two-tailed $p < 0.05$ was considered significant.

3. Results

We identified a total of 382 patients with IHCA who received resuscitation attempts during the study period. The total number of hospital admissions during this period was 117,529, which translates to an incidence of 3.25 IHCAs per 1000 hospital admissions. The mean age of patients with an IHCA was 67.2 ± 21.7 years. Overall, 66.5% of patients were men. The most common comorbid diseases were hypertension (44.5%) and cardiovascular diseases (42.7%). The initial rhythm for patients identified with IHCA was as follows: ventricular fibrillation (n = 11; 3.7%), pulseless ventricular tachycardia (n = 45; 11.8%), PEA (n = 190; 49.7%), and asystole (n = 133; 34.8%). Intensive care units (ICUs) accounted for 188 (49.2%) of the total. A greater number of events occurred during the daytime (57.1%) and weekdays (64.4%). The median duration of resuscitation was 28 minutes (IQR 10−50 minutes). Extracorporeal membrane oxygenation (ECMO) was applied on 36 patients with suspected cardiac origin (9.4%) in whom duration of ischemia (collapse to ECMO) was 70.5 ± 32.5 minutes. The overall rate of successful ROSC was 66%, and the rate of survival to hospital discharge was 11.8%. Among the patients who survived to hospital discharge, 21 (46.7%) had favorable neurologic status. Patient demographic data and survival data are shown in Table 1.

The clinical variables associated with resuscitation outcome are summarized in Tables 2 and 3. Patients with initial shockable rhythms, shorter resuscitation duration, and incidence of cardiac arrest in the ICU or emergency department had increased chances of ROSC. However, female sex, initial shockable rhythm, and shorter resuscitation duration were the factors that significantly influenced survival to hospital discharge rates. Epinephrine use had a negative impact on immediate survival with ROSC and survival to hospital discharge. ECMO-assisted CPR resulted in a 91.7% (33 out of