Survival after out-of-hospital cardiac arrest, Viet Nam: multicentre prospective cohort study

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Objective To investigate factors associated with survival after out-of-hospital cardiac arrest in Viet Nam.

Methods We did a multicentre prospective observational study of people (> 18 years) presenting with out-of-hospital cardiac arrest (not caused by trauma) to three tertiary hospitals in Viet Nam from February 2014 to December 2018. We collected data on characteristics, management and outcomes of patients with out-of-hospital cardiac arrest and compared these data by type of transportation to hospital and survival to hospital admission. We assessed factors associated with survival to admission to and discharge from hospital using logistic regression analysis.

Findings Of 590 eligible people with out-of-hospital cardiac arrest, 440 (74.6%) were male and the mean age was 56.1 years (standard deviation: 17.2). Only 24.2% (143/590) of these people survived to hospital admission and 14.1% (83/590) survived to hospital discharge. Most cardiac arrests (67.8%; 400/590) occurred at home, 79.4% (444/559) were witnessed by bystanders and 22.3% (124/555) were given cardiopulmonary resuscitation by a bystander. Only 8.6% (51/590) of the people were taken to hospital by the emergency medical services and 32.2% (49/152) received pre-hospital defibrillation. Pre-hospital defibrillation (odds ratio, OR: 3.90; 95% confidence interval, CI: 1.54–9.90) and return of spontaneous circulation in the emergency department (OR: 2.89; 95% CI: 1.03–8.12) were associated with survival to hospital admission. Hypothermia therapy during post-resuscitation care was associated with survival to discharge (OR: 5.44; 95% CI: 2.33–12.74).

Conclusion Improvements are needed in the emergency medical services in Viet Nam such as increasing bystander cardiopulmonary resuscitation and public access defibrillation, and improving ambulance and post-resuscitation care.

Abstracts in عربي, 中文, Français, Русский and Español at the end of each article.

Introduction

Out-of-hospital cardiac arrest is one of the leading causes of death and disability worldwide[1,2] and contributes to as much as 10% of the total mortality in low- and middle-income countries.[3–5] Out-of-hospital cardiac arrest is defined as the loss of functional cardiac mechanical activity in association with an absence of systemic circulation, occurring outside of a hospital setting.[6,7] The exact public health burden of out-of-hospital cardiac arrest is not known because a considerable number of cases are not attended by emergency medical services and wide variations exist between different regions, races and continents in both reporting systems and survival outcomes.[3,8–11]

In Asia-Pacific countries, emergency medical services systems are underdeveloped and vary considerably.[12] Survival outcomes for out-of-hospital cardiac arrest in Asia differ considerably and these variations may be related to differences in the patients and the emergency medical services system.[10] These differences suggest that survival outcomes in many countries can be improved with interventions to enhance emergency medical services, such as increasing bystander cardiopulmonary resuscitation through community-based cardiopulmonary resuscitation training programmes, increasing availability of public access defibrillators and improving post-resuscitation care.

In Viet Nam, pre-hospital services are not well developed. In 2008, the Government of Viet Nam introduced a nationwide policy on the emergency medical services system; however, only a few places, such as urban areas, have a functioning emergency medical services system. Moreover, the ambulances, trained and accredited medical staff, and life-saving equipment available are limited, and medical oversight and regular monitoring of quality indicators are uncommon. As a result, staff of the emergency medical services are often overworked and not able to respond promptly to emergencies.[13,14] Furthermore, although national health insurance was established in 1992 to improve access to health care and mitigate the negative impact of user fees introduced in 1989, neither emergency medical nor private ambulance services are currently covered by the health insurance.

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Data are lacking on evidence-based performance measures for emergency medical services in Viet Nam, particularly emergency response time.[14] A previous study has shown that only 4% (3/75) of injured patients were transported to the hospital by ambulances.[15] Most patients are brought by taxi, private vehicle or motorbike, usually with no first aid having been provided.[13,15–17] People who have an out-of-hospital cardiac arrest are also not often taken to hospital by ambulance; indeed many may not be taken to hospital at all. Thus, basic and advanced life support treatment is often delayed for people with life-threatening illnesses or injuries until they arrive at the hospital.

Understanding the country-specific causes, risk and prognosis of out-of-hospital cardiac arrest is important to reduce mortality in Viet Nam. The aim of this study therefore was to investigate the survival rate from out-of-hospital cardiac arrest and the factors associated with survival in the country.

Methods

Study design and setting

This multicentre prospective observational study is part of the Pan-Asian Resuscitation Outcomes Study, Clinical Research Network, which collects data on patients with out-of-hospital cardiac arrest admitted to hospital emergency departments in countries of Asia.[18,19] In this study, we used only data for Viet Nam. The hospitals in Viet Nam participating in the Pan-Asian study are three public sector tertiary hospitals in the three largest cities of the country: Hanoi (northern Viet Nam) which serves an estimated 10 million people; Hue (central Viet Nam) which serves 1.154 million people; and Ho Chi Minh City (southern Viet Nam) which serves 13 million people. The hospitals receive patients from all parts of each city. The reasons for selecting these hospitals were: (i) these hospitals are the largest teaching hospitals of each region and they receive most of the cases attended by the emergency medical services; and (ii) together, these three hospitals serve a varied population of differing socioeconomic status and ethnicity. This hospital-based sample is largely representative of the general urban population in the country.

Several ambulance services are available in Viet Nam, but only one emergency service has an emergency number (i.e. 115), trained and accredited medical staff, life-saving equipment, medical oversight and quality indicators that are regularly monitored. Several other private organizations provide so-called emergency transportation but with limited medical interventions at the scene or during transportation.[20] For this study, we categorized type of pre-hospital transportation into two groups: emergency medical services, which refers to ambulances dispatched by an emergency medical services dispatch centre; and non-emergency medical services, which refers to private ambulances, own or private transport, or public transport. We defined a private ambulance as an ambulance that was not dispatched by an emergency medical services dispatch centre. Own or private transport includes transport in vehicles of family members, relatives, neighbours or passers-by. Public transport includes taxis, buses or other types of public transport.

Participants

This study included all patients (older than 18 years) presenting with out-of-hospital cardiac arrest to the emergency departments of the three hospitals. People with cardiac arrest caused by traumatic injury were excluded. We defined a case of out-of-hospital cardiac arrest as a person who was unresponsive, not breathing and without a pulse outside the hospital setting.[21–23] A physician confirmed the diagnosis either in the ambulance or in the emergency department. We excluded patients for whom resuscitation was not attempted by staff of the emergency medical services or private ambulance at the scene or on the way to hospital and who were immediately pronounced dead (because of rigor mortis, lividity and do not resuscitate orders) at the emergency department. However, we included patients on whom resuscitation was attempted but who were later pronounced dead before they reached hospital.

Data collection

We used a standardized classification and case record form to collect data on common variables. The data dictionary of the Pan-Asian Resuscitation Outcomes Study is available as an online supplement of a previously published paper.[10] We extracted data from emergency dispatch records, ambulance patient case notes, and emergency department and in-hospital records. Data were entered into the database of the Pan-Asian Resuscitation Outcomes Study by the electronic data-capture system. Patient identifiers were not entered in the database to protect patient confidentiality. We then merged the data sets for the three hospitals. Each hospital contributed 5 years of data from February 2014 to December 2018.

Variables

We included variables based on Utstein recommendations,[24] such as information on: (i) bystander cardiopulmonary resuscitation; (ii) availability of public access defibrillator; (iii) response times; (iv) provision of advanced life support (e.g. intravenous drugs, advanced airway management including endotracheal intubation, or alternative airway devices); (v) cause of the arrest (a cardiac arrest was presumed unless it was known or likely that the arrest had a non-cardiac cause (e.g. asthma, terminal illness, cerebrovascular accident, drug overdose, suicide, drowning or trauma)); and (vi) specialized post-resuscitation care (hypothermia or extracorporeal membrane oxygenation). We also collected data on the location of the out-of-hospital cardiac arrest (e.g. home, public area). We collected data on system variables which are available in the data repository.[25]

Outcomes

The primary outcome was survival to hospital admission. We also examined the following secondary outcomes: return of spontaneous circulation, survival to hospital discharge and neurological status on discharge from hospital.[26]

Statistical analyses

We used IBM® SPSS® Statistics 25.0 (IBM Corp., Armonk, United States of America) for data analysis. We report data as number and percentages for categorical variables and median and interquartile range or mean and standard deviation (SD) for continuous variables. We compared death before hospital admission and survival to admission according to type of pre-hospital care using the χ^2 test or Fisher exact test for categorical variables and the Mann–Whitney U test, Kruskal–Wallis test, one-way analysis of variance, paired *t*-test, or Wilcoxon signed-rank test for continuous variables. We assessed factors

associated with survival using logistic regression analysis and included independent variables related to the patient (age, sex and past medical history), the cardiac arrest event (location, time of day, presence of a witness, cause of the cardiac arrest and first arrest rhythm), the emergency medical services system (type of pre-hospital transportation and resuscitation attempt), therapy provided (e.g. pharmacotherapy, pre-hospital intervention, defibrillation and airway management) and return of spontaneous circulation if the *P*-value was < 0.05 in the bivariate analysis between non-survival and survival to admission. We used a step-wise method to select variables and then used the forced entry method with these variables. We present odds ratios (ORs) and 95% confidence intervals (CIs). For all analyses, significance levels were two-tailed, and we considered $P < 0.05$ as statistically significant.

Ethical issues

The Bach Mai Hospital Scientific and Ethics Committees approved this study (approval number: 1785/QD–BM; research code: BM-2015–72). We also obtained permission from the heads of institutions and departments of all participating hospitals and their respective institutional review boards wherever available. The study was conducted according to the principles of the Declaration of Helsinki. The committees waived written informed consent for this non-interventional study, and public notification of the study was made by public posting. The authors who did the data analysis kept the data sets in password-protected systems and we present anonymized data.

Results

Data on 779 patients with out-of-hospital cardiac arrest were submitted to the database of the Pan-Asian Resuscitation Outcomes Study during the study period. Of these patients, we excluded 31 patients aged 18 years or younger, and 109 with traumatic injury. We also excluded 30 patients (4.69%; 30/639) because of long pre-hospital time (i.e. longer than one day), which might imply simple input errors or specific pre-hospital circumstances. In addition, we excluded some patients because of missing or unknown data: one without sex data (0.16%; 1/639), 10 without date and time data of arrival at the emergency department (1.56%; 10/639), five without pre-hospital information (0.78%; 5/639) and three without outcome data (0.47%; 3/639).

Fig. 1. **Flowchart of transportation to hospital, treatment and outcome of people with out-of-hospital cardiac arrest included in the study, Viet Nam, February 2014–December 2018**

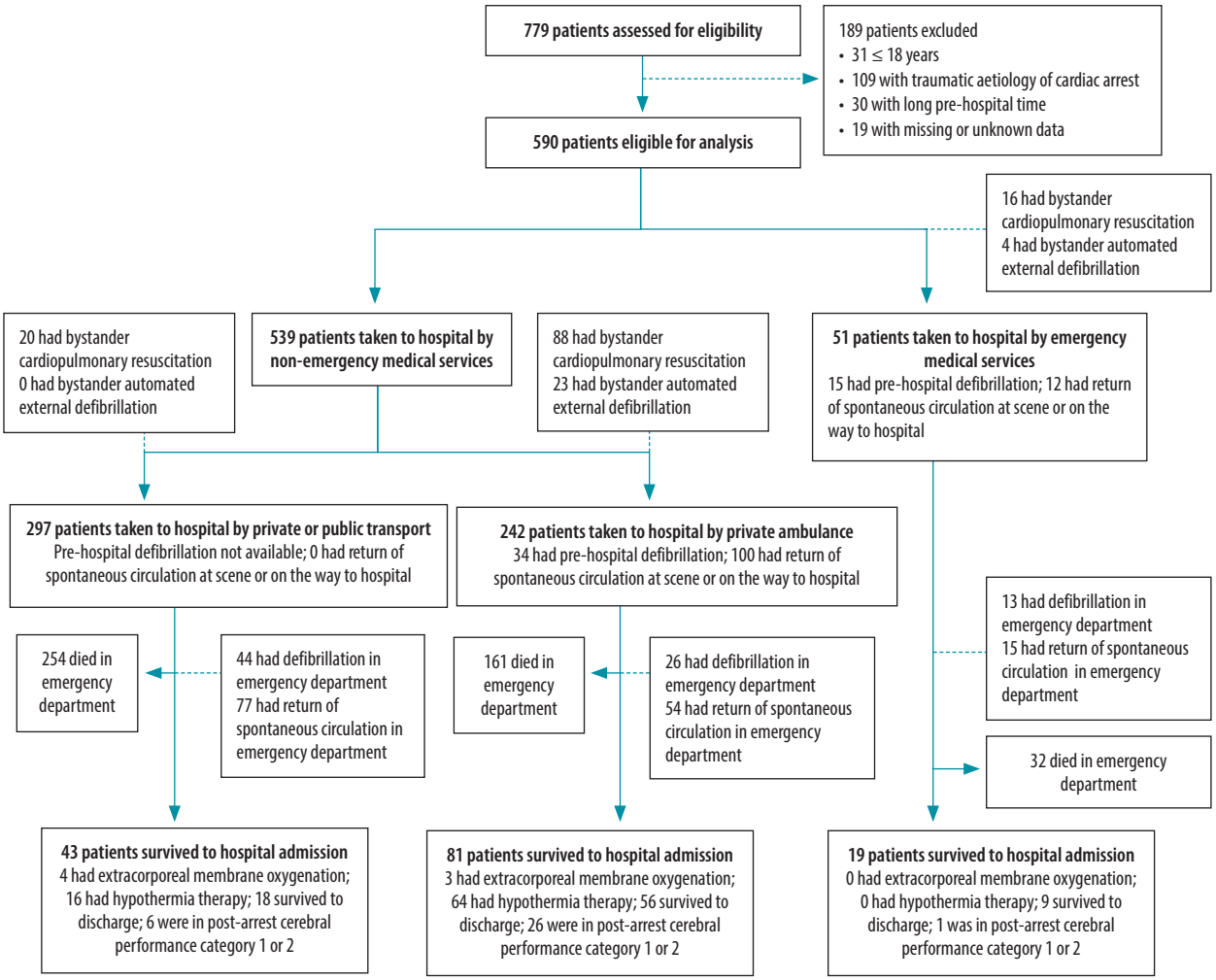

Table 1. **Characteristics, management and outcomes of patients with out-of-hospital cardiac arrest according to type of transportation to hospital, Viet Nam, February 2014–December 2018**

Variable	All cases	Private or public transport	Private ambulance	Emergency medical services ambulance	*P*[a]
Hospital taken to, no. (%)	*n* = 590	*n* = 297	*n* = 242	*n* = 51	< 0.001
Bach Mai	425 (72.0)	185 (62.3)	226 (93.4)	14 (27.5)	
Hue	52 (8.8)	43 (14.5)	6 (2.5)	3 (5.9)	
Cho Ray	113 (19.2)	69 (23.2)	10 (4.1)	34 (66.7)	
Patient related					
Age in years, mean (SD)	56.1 (17.2)	57.5 (17.5)	54.7 (17.1)	54.5 (15.2)	0.130
Sex (male), no. (%)	440 (74.6)	214 (72.1)	187 (77.3)	39 (76.5)	0.364
Past medical history, no. (%)	*n* = 519	*n* = 250	*n* = 222	*n* = 47	
Heart disease	92 (17.7)	43 (17.2)	34 (15.3)	15 (31.9)	0.024
Diabetes	69 (13.3)	29 (11.6)	31 (14.0)	9 (19.1)	0.349
Cancer	39 (7.5)	32 (12.8)	4 (1.8)	3 (6.4)	< 0.001
Hypertension	124 (23.9)	52 (20.8)	53 (23.9)	19 (40.4)	0.015
Renal disease	42 (8.1)	20 (8.0)	15 (6.80	7 (14.9)	0.177
Respiratory disease	84 (16.2)	39 (15.6)	41 (18.5)	4 (8.5)	0.228
Hyperlipidaemia	6 (1.2)	1 (0.4)	0 (0.0)	5 (10.6)	< 0.001
Stroke	17 (3.3)	11 (4.4)	6 (2.7)	0 (0.0)	0.244
HIV	1 (0.2)	1 (0.4)	0 (0.0)	0 (0.0)	> 0.999
Event related					
Place cardiac arrest occurred, no. (%)	*n* = 590	*n* = 297	*n* = 242	*n* = 51	< 0.001
Home	400 (67.8)	231 (77.8)	133 (55.0)	36 (70.6)	
Health-care facility	57 (9.7)	19 (6.4)	34 (14.0)	4 (7.8)	
In emergency medical services or private ambulance	66 (11.2)	2 (0.7)	59 (24.4)	5 (9.8)	
Industrial area[b]	5 (0.8)	4 (1.3)	1 (0.4)	0 (0.0)	
Nursing home	2 (0.3)	2 (0.7)	0 (0.0)	0 (0.0)	
Place of recreation	4 (0.7)	1 (0.3)	2 (0.8)	1 (2.0)	
Public or commercial building	7 (1.2)	5 (1.7)	1 (0.4)	1 (2.0)	
Street or motorway	20 (3.4)	9 (3.0)	8 (3.3)	3 (5.9)	
Transport centre[c]	2 (0.3)	2 (0.7)	0 (0.0)	0 (0.0)	
Other	27 (4.6)	22 (7.4)	4 (1.7)	1 (2.0)	
Cardiac arrest occurred between 08:00 and 20:00, no. (%)	197/347 (56.8)	83/158 (52.5)	91/143 (63.60	23/46 (50.0)	0.094
Witness to the cardiac arrest, no. (%)	*n* = 559	*n* = 267	*n* = 241	*n* = 51	< 0.001
Not witnessed	115 (20.6)	75 (28.1)	39 (16.2)	1 (2.0)	
Bystander (lay person)	25 (4.5)	15 (5.6)	7 (2.9)	3 (5.9)	
Bystander (family member)	79 (14.1)	11 (4.1)	62 (25.7)	6 (11.8)	
Bystander (health-care provider)	276 (49.4)	166 (62.2)	95 (39.4)	15 (29.4)	
Emergency medical services or private ambulance	64 (11.4)	0 (0.0)	38 (15.8)	26 (51.0)	
Cause of cardiac arrest, no. (%)	*n* = 590	*n* = 297	*n* = 242	*n* = 51	0.163
Presumed cardiac cause	266 (45.1)	129 (43.4)	105 (43.4)	32 (62.7)	
Respiratory cause	138 (23.4)	69 (23.2)	62 (25.6)	7 (13.7)	
Drowning	7 (1.2)	2 (0.7)	4 (1.7)	1 (2.0)	
Electrocution	12 (2.0)	8 (2.7)	3 (1.2)	1 (2.0)	
Other	167 (28.3)	89 (30.0)	68 (28.1)	10 (19.6)	
First arrest rhythm, no. (%)	*n* = 152	NA	*n* = 123	*n* = 29	< 0.001
Ventricular tachycardia	12 (7.9)	NA	4 (3.3)	8 (27.6)	
Ventricular fibrillation	34 (22.4)	NA	29 (23.6)	5 (17.2)	
Unknown shockable rhythm	64 (42.1)	NA	58 (47.2)	6 (20.7)	
Unknown unshockable rhythm	20 (13.2)	NA	18 (14.6)	2 (6.9)	
Pulseless electrical activity	5 (3.3)	NA	2 (1.6)	3 (10.3)	
Asystole	17 (11.2)	NA	12 (9.8)	5 (17.2)	

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Variable	All cases	Private or public transport	Private ambulance	Emergency medical services ambulance	*P*[a]
System related					
Resuscitation attempted by emergency medical services or private ambulance team (*n* = 288), no. (%)	149 (51.7)	NA	120 (49.8)	29 (61.7)	0.153
Time to cardiopulmonary resuscitation at scene in minutes (*n* = 93), mean (SD)	7.3 (8.7)	NA	7.8 (8.0)	5.9 (10.3)	0.325
Time to defibrillation at scene in minutes (*n* = 26), mean (SD)	9.1 (4.5)	NA	10.0 (3.8)	3.8 (4.8)	0.008
Therapy related					
Pre-hospital intervention, no. (%)					
Bystander cardiopulmonary resuscitation	124/555 (22.3)	20/264 (7.6)	88/241 (36.5)	16/50 (32.0)	< 0.001
Pre-hospital defibrillation	49/152 (32.2)	NA	34/123 (27.6)	15/29 (51.7)	0.016
Bystander automatic external defibrillation performed	17/288 (5.9)	0 (0.0)	13/241 (5.4)	4/47 (8.5)	0.494
Pre-hospital advanced airway management	120/590 (20.3)	0/297 (0.0)	99/242 (40.9)	21/51 (41.2)	< 0.001
Pharmacotherapy, no. (%)	*n* = 590	*n* = 297	*n* = 242	*n* = 51	
Epinephrine (at scene)	134 (22.7)	0 (0.0)	116 (47.9)	18 (35.3)	< 0.001
Epinephrine (at emergency department)	539 (91.4)	272 (91.6)	232 (95.9)	35 (68.6)	< 0.001
Defibrillation at emergency department, no. (%)	83/589 (14.1)	44/296 (14.9)	26/242 (10.7)	13/51 (25.5)	0.020
Advanced airway management at emergency department, no. (%)	349/590 (59.2)	221/297 (74.4)	103/242 (42.6)	25/51 (49.0)	< 0.001
Immediate coronary angiography on admission to hospital, no. (%)	*n* = 590	*n* = 297	*n* = 242	*n* = 51	
Emergency percutaneous coronary intervention	32 (5.4)	9 (3.0)	13 (5.4)	10 (19.6)	< 0.001
Emergency coronary artery bypass grafting	2 (0.3)	0 (0.0)	2 (0.8)	0 (0.0)	0.333
Post-resuscitation care provided, no. (%)					
Extracorporeal membrane oxygenation therapy	7/588 (1.2)	4/295 (1.4)	3/242 (1.2)	0/51 (0.0)	0.709
Hypothermia therapy	80/590 (13.6)	16/297 (5.4)	64/242 (26.4)	0/51 (0.0)	< 0.001
Outcomes					
Return of spontaneous circulation, no. (%)	*n* = 590	*n* = 297	*n* = 242	*n* = 51	
At scene or on way to the hospital	112 (19.0)	0 (0.0)	100 (41.3)	12 (23.5)	< 0.001
In emergency department	146 (24.7)	77 (25.9)	54 (22.3)	15 (29.4)	0.451
Outcome of patient at emergency department, no. (%)	*n* = 590	*n* = 297	*n* = 242	*n* = 51	< 0.001
Died in emergency department	447 (75.8)	254 (85.5)	161 (66.5)	32 (62.7)	
Admitted to hospital	143 (24.2)	43 (14.5)	81 (33.5)	19 (37.3)	
Patient status, no. (%)	*n* = 590	*n* = 297	*n* = 242	*n* = 51	< 0.001
Died in hospital	42 (7.1)	12 (4.0)	20 (8.3)	10 (19.6)	
Still in hospital 30 days after admission	3 (0.5)	2 (0.7)	1 (0.4)	0 (0.0)	
Discharged alive within 30 days of cardiac arrest	83 (14.1)	18 (6.1)	56 (23.1)	9 (17.6)	
Cerebral performance category 1 and category 2 after cardiac arrest, no. (%)	33/590 (5.6)	6/297 (2.0)	26/242 (10.7)	1/51 (2.0)	< 0.001

HIV: human immunodeficiency virus; NA: not available; SD: standard deviation.
[a] Comparison between emergency medical services, private ambulance and private or public transport.
[b] Industrial premises, construction sites, factories, warehouses, shipyards and docks.
[c] Bus stations or terminals, train or subway stations, ferry terminals and airports.

Thus, we included 590 patients in our analyses (Fig. 1 and Table 1). Of these patients, 74.6% (440/590) were men and the mean age was 56.1 years (SD: 17.2). Less than a fifth of the patients (17.7%; 92/519) had a past medical history of heart disease. Most out-of-hospital cardiac arrests occurred at home (67.8%; 400/590) and during the day (56.8%; 197/347), and 68.0% (380/559) were witnessed by bystanders who included lay people, family members and health-care providers. A cardiac condition was the presumed cause of the cardiac arrest in 45.1%

Table 2. **Characteristics, management and outcomes of patients with out-of-hospital cardiac arrest according to survival to hospital admission, Viet Nam, February 2014–December 2018**

Variable	Died	Survived	*P*
Hospital taken to, no. (%)	*n* = 447	*n* = 143	0.041
Bach Mai	329 (73.6)	96 (67.1)	
Hue	32 (7.2)	20 (14.0)	
Cho Ray	86 (19.2)	27 (18.9)	
Patient related	*n* = 447	*n* = 143	
Age in years, mean (SD)	58.1 (16.8)	50.0 (17.2)	< 0.001
Sex (male), no. (%)	328 (73.4)	112 (78.3)	0.270
Past medical history, no. (%)	*n* = 391	*n* = 124	
Heart disease	75 (19.0)	17 (13.7)	0.179
Diabetes	52 (13.2)	17 (13.7)	0.876
Cancer	36 (9.1)	3 (2.4)	0.014
Hypertension	94 (23.8)	30 (24.2)	0.928
Renal disease	38 (9.6)	4 (3.2)	0.023
Respiratory disease	52 (13.2)	32 (25.8)	0.001
Hyperlipidaemia	2 (0.5)	4 (3.2)	0.031
Stroke	16 (4.1)	1 (0.8)	0.058
HIV	1 (0.3)	0 (0.0)	> 0.999
Other	89 (22.5)	10 (8.1)	< 0.001
Event related			
Place cardiac arrest occurred, no. (%)	*n* = 447	*n* = 143	0.003
Home residence	298 (66.7)	102 (71.3)	
Health-care facility	44 (9.8)	13 (9.1)	
In emergency medical services or private ambulance	59 (13.2)	7 (4.9)	
Industrial area[a]	2 (0.4)	3 (2.1)	
Nursing home	0 (0.0)	2 (1.4)	
Place of recreation	1 (0.2)	3 (2.1)	
Public or commercial building	6 (1.3)	1 (0.7)	
Street or motorway	13 (2.9)	7 (4.9)	
Transport centre[b]	2 (0.4)	0 (0.0)	
Other	22 (4.9)	5 (3.5)	
Cardiac arrest occurred between 08:00 and 20:00 (*n* = 347), no. (%)	127 (53.1)	70 (64.8)	0.047
Witness to the cardiac arrest, no. (%),	*n* = 428	*n* = 131	0.001
Not witnessed	105 (24.5)	10 (7.6)	
Bystander (lay person)	17 (4.0)	8 (6.1)	
Bystander (family member)	60 (14.0)	19 (14.5)	
Bystander (health-care provider)	201 (47.0)	75 (57.3)	
Emergency medical services or private ambulance	45 (10.5)	19 (14.5)	
Cause of cardiac arrest, no. (%)	*n* = 447	*n* = 143	< 0.001
Presumed cardiac cause	198 (44.3)	68 (47.6)	
Respiratory cause	91 (20.4)	47 (32.9)	
Drowning	5 (1.1)	2 (1.4)	
Electrocution	5 (1.1)	7 (4.9)	
Other	148 (33.1)	19 (13.3)	
First arrest rhythm, no. (%)	*n* = 71	*n* = 81	< 0.001
Ventricular tachycardia	5 (7.0)	7 (8.6)	
Ventricular fibrillation	6 (8.5)	28 (34.6)	
Unknown shockable rhythm	44 (62.0)	20 (24.7)	
Unknown unshockable rhythm	2 (2.8)	18 (22.2)	
Pulseless electrical activity	5 (7.0)	0 (0.0)	
Asystole	9 (12.7)	8 (9.9)	

(*continues. . .*)

(266/590) of patients. Only 32.2% (49/152) of people with out-of-hospital cardiac arrest received pre-hospital defibrillation. Only 22.3% (124/555) of the patients received bystander cardiopulmonary resuscitation, and 5.9% (17/288) received bystander automated external defibrillation. Epinephrine was given to 22.7% (134/590) of people with cardiac arrest before reaching hospital and 20.3% (120/590) received pre-hospital advanced airway management. Hypothermia therapy was given to 13.6% (80/590) of patients with out-of-hospital cardiac arrest as part of post-resuscitation care, but only 1.2% (7/588) were given extracorporeal membrane oxygenation therapy. Of the 590 people with out-of-hospital cardiac arrest, 112 (19.0%) had return of spontaneous circulation at the scene of the cardiac arrest or on the way to hospital and for 146 (24.7%) people, spontaneous circulation returned in the emergency department. Overall, 24.2% (143/590) of people survived to hospital admission, and 14.1% (83/590) survived to discharge from hospital; 5.6% (33/590) survived with good neurological function (cerebral performance category score 1 and 2). Our results are also summarized in the Utstein-style template (available in the data repository).[25]

About half of the people with out-of-hospital cardiac arrest (50.3%; 297/590) were taken to hospital by private or public transport, 41.0% (242/590) were taken by private ambulance, and 8.6% (51/590) were taken by emergency medical services. There were statistically significant associations between type of transportation to hospital and: past medical history of heart disease, cancer, hypertension and hyperlipidaemia; place where the cardiac arrest occurred; whether the cardiac arrest was witnessed or not; the first arrest rhythm; administration of pre-hospital interventions; return of spontaneous circulation at the scene or on the way to hospital; outcome of the patient in the emergency department; and final status of patients admitted to hospital (Table 1; $P < 0.001$).

Table 2 compares the general characteristics, pre-hospital and in-hospital management, and outcome of people with out-of-hospital cardiac arrest who survived to hospital admission (143 people) or who died before reaching hospital or in the emergency department (447 people). The mean age of people

(. . .*continued*)

Variable	Died	Survived	*P*
System related			
Type of pre-hospital transportation, no. (%)	*n* = 447	*n* = 143	< 0.001
Emergency medical services	32 (7.2)	19 (13.3)	
Private ambulance	161 (36.0)	81 (56.6)	
Private or public transport	254 (56.8)	43 (30.1)	
Resuscitation attempted by emergency medical services or private ambulance team, no. (%)	70/189 (37.0)	79/99 (79.8)	< 0.001
Time to cardiopulmonary resuscitation at scene in minutes (*n* = 93), mean (SD)	5.8 (12.8)	7.9 (6.1)	0.270
Time to defibrillation at scene in minutes (*n* = 26), mean (SD)	5.0 (5.0)	9.6 (4.3)	0.098
Therapy related			
Pharmacotherapy, no. (%)	*n* = 447	*n* = 143	
Epinephrine (at scene)	61 (13.6)	73 (51.0)	< 0.001
Epinephrine (at emergency department)	416 (93.1)	123 (86.0)	0.011
Pre-hospital intervention, no. (%)			
Bystander cardiopulmonary resuscitation	87/425 (20.5)	37/130 (28.5)	0.071
Pre-hospital defibrillation	12/71 (16.9)	37/81 (45.7)	< 0.001
Bystander automatic external defibrillation	8/189 (4.2)	9/99 (9.1)	0.116
Pre-hospital advanced airway management, no. (%)	46/447 (10.3)	74/143 (51.7)	< 0.001
Defibrillation at emergency department, no. (%)	47/447 (10.5)	36/143 (25.2)	< 0.001
Advanced airway management at emergency department, no. (%)	285/447 (63.8)	64/143 (44.8)	< 0.001
Immediate coronary angiography on admission to hospital, no. (%)	*n* = 447	*n* = 143	
Emergency percutaneous coronary intervention performed	5 (1.1)	27 (18.9)	< 0.001
Emergency coronary artery bypass grafting	1 (0.2)	1 (0.7)	0.426
Post-resuscitation care provided, no. (%)			
Extracorporeal membrane oxygenation therapy	5/445 (1.1)	2/143 (1.4)	0.680
Hypothermia therapy	12/447 (2.7)	68/143 (47.6)	< 0.001
Return of spontaneous circulation, no. (%)	*n* = 447	*n* = 143	
At scene or on way to the hospital	35 (7.8)	77 (53.8)	< 0.001
In emergency department	73 (16.3)	73 (51.0)	< 0.001

HIV: human immunodeficiency virus; SD: standard deviation.
[a] Industrial premises, construction sites, factories, warehouses, shipyards and docks.
[b] Bus stations or terminals, train or subway stations, ferry terminals and airports.

who survived (50.0 years; SD: 17.2) was younger than that of people who died (58.1 years; SD: 16.8; $P < 0.001$). There was no significant difference between people who died and people who survived according to administration of cardiopulmonary resuscitation by a bystander ($P = 0.071$). Only a small number of people received pre-hospital defibrillation but with a significant difference between those who died (16.9%; 12/71) and those who survived (45.7%; 37/81; $P < 0.001$). The proportion of people in whom spontaneous circulation returned at the scene or on the way to hospital was significantly lower in people who died (7.8%; 35/447) than in people who survived (53.8%; 77/143; $P < 0.001$).

Several factors were independently associated with survival to admission to hospital in people with cardiac arrest not caused by traumatic injury (Table 3), including pre-hospital defibrillation (OR: 3.90; 95% CI: 1.54–9.90) and return of spontaneous circulation in the emergency department (OR: 2.89; 95% CI: 1.03–8.12). In people with out-of-hospital cardiac arrest presumed to be caused by a heart condition, attendance by emergency medical services was inversely and independently associated with survival to hospital admission (OR: 0.20; 95% CI: 0.04–0.94; Table 3). The bivariate analysis of survival to hospital in these patients is given in the data repository.[25] Pre-hospital defibrillation (OR: 2.87; 95% CI: 1.24–6.67) and hypothermia therapy (OR: 5.44; 95% CI: 2.33–12.74) were independently associated with survival to hospital discharge in people with out-of-hospital cardiac arrest not caused by traumatic injury (Table 3).

Discussion

Of 590 people with out-of-hospital cardiac arrest included in our analysis, about a quarter (24.2%) survived to hospital admission, 14.1% survived to hospital discharge and 5.6% survived with good neurological function. We recognize that this cohort is likely to be highly selected as many people with out-of-hospital cardiac arrest in Viet Nam are not brought to hospital and might die outside of hospital.[15,17,27] Our figure for survival to hospital admission is in line with figures reported in the Pan-Asian Resuscitation Outcomes Study, 5.9–27.7%.[10] However, our proportions for survival to discharge and survival with good neurological function are higher than the rate reported in the Pan-Asian study (0.5–8.5% and 1.6–3.0%, respectively).[10] This difference could be due to selection bias in our study as we only had data on patients brought to the three highest-level public sector hospitals in Viet Nam, and these cases may not reflect all out-of-hospital cardiac arrests in the country.

In Viet Nam, as well as in other low- and middle-income countries, pre-hospital care and transportation systems are categorized into emergency medical services and non-emergency medical services (e.g. private ambulances, own or private transport, or public transport).[14,20] In our study, half of the people with out-of-hospital cardiac arrest were brought to hospital by private or public transport without life-support

Table 3. **Factors associated with survival of patients with out-of-hospital cardiac arrest, Viet Nam, February 2014–December 2018: logistic regression analyses**

Factors	OR (95% CI)[a]
Survival to hospital admission: non-traumatic cause	
Past medical history of respiratory disease	3.13 (1.20–8.17)
Pre-hospital defibrillation given	3.90 (1.54–9.90)
Attended by emergency medical services	0.51 (0.18–1.45)
Pre-hospital advanced airway management provided	3.44 (1.20–9.84)
Return of spontaneous circulation in emergency department	2.89 (1.03–8.12)
Constant	0.214 (0.002)
Survival to hospital admission: presumed cardiac cause	
Age ≥ 60 years	0.27 (0.07–1.03)
Cardiac arrest occurred at home	8.90 (1.55–51.13)
Cardiac arrest witnessed	36.11 (1.19–1097.34)
Attended by emergency medical services	0.20 (0.04–0.94)
Pre-hospital defibrillation given	6.37 (1.33–30.59)
Pre-hospital advanced airway management provided	3.46 (0.48–25.12)
Return of spontaneous circulation in emergency department	6.32 (1.01–39.74)
Constant	0.002 (0.004)
Survival to discharge: non-traumatic cause	
Past medical history of heart disease	0.37 (0.09–1.55)
Pre-hospital defibrillation given	2.87 (1.24–6.67)
Hypothermia therapy given	5.44 (2.33–12.74)
Return of spontaneous circulation in emergency department	2.07 (0.77–5.55)
Constant	0.180 (< 0.001)

CI: confidence interval; OR: odds ratio.
[a] *P*-value is given for the constant.

equipment or trained personnel. Pre-hospital care is for the most part left to bystanders and usually the injured or sick person is simply carried quickly to the nearest vehicle large enough to accommodate him or her.[13,15,20] In such situations, bystander first aid is crucial to improve outcomes of people with out-of-hospital cardiac arrest,[28] however, bystander chest compression is not often done in Viet Nam.[13] Furthermore, the use of automatic external defibrillation by a bystander before arrival of the emergency medical services in shockable out-of-hospital cardiac arrest is associated with better survival and functional outcomes.[29] However, in our study, use of defibrillation by a bystander did not improve survival to hospital admission. Lack of knowledge and skills as well as fear of doing harm to people may prevent bystanders from using such techniques and using them effectively.[30] Thus, to improve bystander first aid, more lay people should be trained in first aid and to be able to train others through a recognized emergency first-aid programme.[31,32]

Economic and political reforms have spurred rapid economic growth in Viet Nam.[33] However, health-care providers still have difficulty in delivering essential initial care for patients with out-of-hospital cardiac arrest because of low resources and inadequate infrastructure for emergency medical care, such as dispatch centres for emergency medical services.[14,34] In addition, telecommunication staff do not have the ability to identify a possible case of cardiac arrest and provide cardiopulmonary resuscitation instructions to callers.[14] In our study, few patients with out-of-hospital cardiac arrest were attended to and taken to hospital by emergency medical services. However, the proportions of people who had spontaneous circulation return at the scene or on the way to the hospital and who survived to hospital discharge were significantly lower in those taken to hospital by the emergency medical services than those taken by private ambulance. Because of the small number of trained and qualified medical emergency staff and the limited amount of life-saving equipment, these staff are overworked and underequipped and the medical emergency services centres are overburdened. These factors may in part explain why outcomes of patients were poorer in those attended by the emergency medical services. At the same time, the staff may not be sufficiently well trained or experienced to be able to recognize out-of-hospital cardiac arrest in their patients and provide the required initial care.[34]

In view of the limited emergency medical services in Viet Nam, private ambulance services with capability for cardiopulmonary resuscitation, life-saving drugs, defibrillators or at least a medical professional trained to deal with emergencies have therefore been established. In 2011, the health ministry gave these services licences for first-aid or patient transportation[35] and the policy has not changed since then.

In our bivariate analysis, return of spontaneous circulation at the scene or on the way to hospital and return of spontaneous circulation in the emergency department were significantly associated with survival to hospital admission. However, in the logistic regression analysis, only return of spontaneous circulation in the emergency department was independently associated with survival to hospital admission. In a Japanese study, shortening the time from receipt of the call for emergency medical services to return of spontaneous circulation was the only important independent factor associated with good neurological outcome in patients with post-cardiac arrest syndrome.[36] Our study shows that the rates of return of spontaneous circulation at the scene or on the way to hospital and survival of people with out-of-hospital cardiac arrest were highest in those transported by private ambulance.

Our study also shows that hypothermia therapy, as part of post-resuscitation care, was most often given to patients brought by private ambulance. Almost all of the people with out-of-hospital cardiac arrest brought by private ambulance were brought to Bach Mai Hospital and hypothermia therapy was only available in this hospital, which may explain this finding.[25] Furthermore, hypothermia therapy was independently associated with survival to discharge from hospital. Hypothermia therapy has been shown to reduce neurological injury after cardiac arrest and is a cornerstone of post-cardiac ar-

rest care.[37] The higher survival rate to discharge in patients brought to hospital by private ambulance than in patients brought by other types of transport may be explained by the greater use of hypothermia therapy in these patients.

Our study has some limitations. Our data are from a highly selected population of cases who were brought to the three highest level public sector hospitals in Viet Nam. Therefore, the number of people with out-of-hospital cardiac arrest is likely to be considerably higher. In addition, data were missing for many variables, e.g. in only 152 patients was it recorded if defibrillation was given or not. Moreover, in our study, a significant proportion of patients with out-of-hospital cardiac arrest came to hospital in private transport rather than in emergency medical services or private ambulances. Some of these people might be attended to by primary health-care providers, may be pronounced dead at home or might not be brought to hospital at all. These factors resulted in incomplete enrolment of patients into the database of the study, which may have introduced selection bias.[38] These limitations might account for some differences in figures reported from other countries.

To improve survival outcomes in people with out-of-hospital cardiac arrest, the emergency medical services system in Viet Nam needs to be enhanced through, for example: increasing bystander cardiopulmonary resuscitation; making public access defibrillators more available; increasing the number of emergency medical service ambulances; improving post-resuscitation care; and increasing the use of private ambulances, as well as developing a standard emergency first-aid programme for both health-care personnel and the community. ■

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ملخص

البقاء على قيد الحياة بعد السكتة القلبية خارج المستشفى، فييت نام: دراسة أترابية مستقبلية متعددة المراكز

الغرض تقصي العوامل المرتبطة بالبقاء على قيد الحياة بعد السكتة القلبية خارج المستشفى في فييت نام.

الطريقة قمنا بإجراء دراسة مستقبلية قائمة على الملاحظة متعددة المراكز للأشخاص (الأكبر من 18 عامًا) الذين يعانون من سكتة قلبية خارج المستشفى (ليس بسبب إصابة في الحوادث) في ثلاثة مستشفيات من الدرجة الثالثة في فيتنام، من فبراير/شباط 2014 إلى ديسمبر/كانون أول 2018. قمنا بجمع بيانات عن الخصائص، والإدارة، ونتائج المرضى الذين يعانون من السكتة القلبية خارج المستشفى، ومقارنة هذه البيانات حسب نوع النقل إلى المستشفى والبقاء على قيد الحياة حتى الدخول إلى المستشفى. قمنا بتقييم العوامل المرتبطة بالبقاء على قيد الحياة حتى الدخول إلى المستشفى والخروج منها باستخدام تحليل التحوّف اللوجيستي.

النتائج من بين 590 شخصًا مؤهلاً مصابًا بالسكتة القلبية خارج المستشفى، كان 440 (74.6%) منهم من الذكور، وكان متوسط العمر 56.1 عامًا (الانحراف المعياري: 17.2). استمر 24.2% فقط (590/143) من هؤلاء الأشخاص على قيد الحياة حتى الدخول إلى المستشفى، واستمر 14.1% (590/83) على قيد الحياة حتى الخروج من المستشفى. حدثت معظم حالات السكتة القلبية (67.8%؛ 590/400) في المنزل، وحدثت 79.4% (559/444) من الحالات أمام المارة في الشارع، وحصل 22.3% (555/124) من الحالات على الإنعاش القلبي الرئوي من أحد المارة. تم نقل 8.6% فقط (590/51) من الأشخاص إلى المستشفى بواسطة خدمات الطوارئ الطبية، وحصل 32.2% (152/49) على عملية إزالة الرجفان قبل دخول المستشفى. عملية إزالة الرجفان قبل دخول المستشفى (نسبة الاحتمالات: 3.90؛ فاصل الثقة 95%: 1.54 إلى 9.90) وعودة الدورة الدموية التلقائية في قسم الطوارئ (نسبة الاحتمالات: 2.89؛ فاصل الثقة 95%: 1.03 إلى 8.12) ارتبطت بالبقاء على قيد الحياة حتى دخول المستشفى. ارتبط علاج انخفاض حرارة الجسم أثناء الرعاية اللاحقة للإنعاش بالبقاء على قيد الحياة حتى الخروج من المستشفى (نسبة الأرجحية: 5.44؛ فاصل الثقة 95%: 2.33 إلى 12.74).

الاستنتاج هناك حاجة إلى تحسينات في الخدمات الطبية الطارئة في فييت نام، مثل زيادة عمليات الإنعاش القلبي الرئوي من جانب المارة، وإمكانية حصول العامة على عملية إزالة الرجفان، وتحسين خدمات الإسعاف والرعاية بعد الإنعاش.

摘要

越南院外心脏骤停存活率：跨中心前瞻性队列研究

目的 研究越南院外心脏骤停存活率的相关因素。

方法 我们针对越南三家三级医院在 2014 年 2 月至 2018 年 12 月期间接收的院外心脏骤停（非创伤引起）患者（> 18 岁）进行了跨中心前瞻性观察研究。我们收集了与院外心脏骤停患者的特征、诊治情况以及疗效相关的数据，并根据送至医院时采用的交通方式以及存活入院率对这些数据进行了比较。我们使用逻辑回归分析方法评估与存活入院率和存活出院率相关的因素。

结果 590 名参加调查的院外心脏骤停患者中，440 名 (74.6%) 为男性，平均年龄为 56.1 岁（标准偏差：17.2）。这些人中仅 24.2% (143/590) 存活入院，

14.1% (83/590) 存活出院。心脏骤停多发生于家中 (67.8%; 400/590)，其中有旁观者目击的情况占 79.4% (444/559)，旁观者介入实施心肺复苏术的情况占 22.3% (124/555)。其中仅 8.6% (51/590) 通过紧急医疗服务送至医院，32.2% (49/152) 接受了院前除颤。院前除颤（优势比，OR：3.90；95% 置信区间，CI：1.54 – 9.90）和急诊室自主循环恢复 (OR: 2.89; 95% CI: 1.03 – 8.12) 与存活入院率有关。复苏后护理期间的低温疗法与存活出院率相关 (OR: 5.44; 95% CI: 2.33-12.74)。

结论 越南需要提升紧急医疗服务，如增加旁观者介入实施心肺复苏术的比例、普及公众除颤以及改善救护车和复苏后护理服务。

Résumé

Survie après un arrêt cardiaque hors hôpital au Viet Nam: étude de cohorte prospective multicentrique

Objectif Examiner les facteurs associés à la survie après un arrêt cardiaque hors hôpital au Viet Nam.

Méthodes Nous avons mené une étude d'observation prospective multicentrique sur des personnes (> 18 ans) ayant subi un arrêt cardiaque hors hôpital (non traumatique) et admis dans trois hôpitaux tertiaires au Viet Nam entre février 2014 et décembre 2018. Nous avons récolté des données sur les caractéristiques, la gestion et l'issue de ces patients, puis les avons comparés en fonction du moyen de transport vers l'hôpital et de la survie après leur admission. Enfin, nous avons mesuré des facteurs associés à la survie lors de l'admission et de la sortie de l'établissement à l'aide d'une analyse de régression logistique.

Résultats Sur les 590 patients éligibles ayant subi un arrêt cardiaque hors hôpital, 440 (74,6%) étaient des hommes et l'âge moyen s'élevait à 56,1 ans (écart type: 17.2). Seulement 24,2% (143/590) d'entre eux ont survécu à leur admission à l'hôpital, et 14,1% (83/590) à leur sortie. La plupart des arrêts cardiaques (67,8%; 400/590) ont eu lieu à domicile, 79,4% (444/559) se sont déroulés en présence de passants et 22,3% (124/555) ont fait l'objet d'une réanimation cardiopulmonaire pratiquée par un témoin. À peine 8,6% (51/590) des patients ont été emmenés à l'hôpital par les services médicaux d'urgence, et 32,2% (49/152) ont reçu une défibrillation avant d'arriver à l'hôpital. La défibrillation préhospitalière (odds ratio, OR: 3,90; intervalle de confiance de 95%, IC: 1,54–9,90) et le rétablissement d'une circulation spontanée aux urgences (OR: 2,89; IC de 95%: 1,03–8,12) allaient de pair avec la survie après admission. L'hypothermie thérapeutique administrée durant les soins post-réanimation était liée à un meilleur taux de survie au moment de la sortie (OR: 5,44; IC de 95%: 2,33-12,74).

Conclusion Des aménagements sont requis en matière de services médicaux d'urgence au Viet Nam, notamment pour encourager la pratique de la réanimation cardiopulmonaire auprès de la population, garantir l'accès à des défibrillateurs publics, mais aussi améliorer les soins en ambulance et en post-réanimation.

Резюме

Выживание после внебольничной остановки сердца, Вьетнам: многоцентровое проспективное когортное исследование

Цель Изучить факторы, связанные с выживанием после внебольничной остановки сердца во Вьетнаме.

Методы Авторы провели многоцентровое проспективное обсервационное исследование среди пациентов (старше 18 лет), поступивших с внебольничной остановкой сердца (не связанной с травмой) в три специализированные больницы во Вьетнаме с февраля 2014 г. по декабрь 2018 г. Были собраны данные о характеристиках и результатах лечения пациентов с внебольничной остановкой сердца, которые затем сравнивались по видам транспортировки в больницу и показателям выживаемости до момента госпитализации. Авторы оценили факторы, связанные с выживаемостью при поступлении в больницу и выписке из нее, используя анализ на основании модели логистической регрессии.

Результаты Из 590 человек с внебольничной остановкой сердца, отвечающих установленным критериям, было 440 (74,6%) мужчин, средний возраст которых составлял 56,1 года (стандартное отклонение: 17,2). Лишь 24,2% (143/590) из указанных пациентов выжили до поступления в больницу, а 14,1% (83/590) выжили до выписки из больницы. Большинство сердечных приступов (67,8%; 400/590) произошли дома, 79,4% (444/559) произошли на глазах у других людей, а 22,3% (124/555) пострадавших была проведена сердечно-легочная реанимация свидетелями происшествия. Только 8,6% (51/590) человек были доставлены в больницу службами скорой медицинской помощи, а 32,2% (49/152) была проведена догоспитальная дефибрилляция. Догоспитальная дефибрилляция (отношение шансов, ОШ: 3,90; 95%-й доверительный интервал, ДИ: 1,54–9,90) и спонтанное восстановление кровообращения в отделении скорой помощи (ОШ: 2,89; 95%-й ДИ: 1,03–8,12) ассоциировались с выживаемостью до госпитализации. Лечение с применением искусственного понижения температуры тела в постреанимационный период ассоциируется с выживанием после выписки (ОШ: 5,44; 95%-й ДИ: 2,33–12,74).

Вывод Необходимо совершенствовать работу служб неотложной медицинской помощи во Вьетнаме, в частности повысить вероятность оказания сердечно-легочной реанимации свидетелями происшествия и обеспечить общедоступность дефибрилляторов, а также совершенствовать работу машин скорой помощи и лечение в постреанимационный период.

Resumen

Supervivencia después de un paro cardíaco extrahospitalario en Vietnam: un estudio de cohorte prospectiva multicéntrico

Objetivo Investigar los factores relacionados con la supervivencia después de un paro cardíaco extrahospitalario en Vietnam.

Métodos Se realizó un estudio observacional prospectivo multicéntrico de personas (>18 años) que sufrieron un paro cardíaco extrahospitalario (no causado por traumatismo) en tres hospitales terciarios de Vietnam entre febrero de 2014 y diciembre de 2018. Se recopilaron los datos sobre las características, el tratamiento y los resultados de los pacientes con paro cardíaco extrahospitalario y se compararon según el tipo de transporte hasta el hospital y la supervivencia hasta el ingreso en el

hospital. Se evaluaron los factores de supervivencia hasta el ingreso y el alta hospitalaria mediante un análisis de regresión logística.

Resultados De las 590 personas que cumplían los requisitos y sufrieron un paro cardíaco extrahospitalario, 440 (74,6 %) eran hombres, cuya edad media era de 56,1 años (desviación estándar: 17,2). Solo el 24,2 % (143/590) de estas personas sobrevivieron al ingreso en el hospital y el 14,1 % (83/590) sobrevivieron al alta hospitalaria. La mayoría de los paros cardíacos (67,8 %; 400/590) ocurrieron en el hogar, el 79,4 % (444/559) fueron presenciados por transeúntes y el 22,3 % (124/555) recibieron reanimación cardiopulmonar por un transeúnte. Solo el 8,6 % (51/590) de las personas fueron trasladadas al hospital por los servicios médicos de emergencia y el 32,2 % (49/152) recibieron desfibrilación prehospitalaria. La desfibrilación prehospitalaria (oportunidad relativa, OR: 3,90; intervalo de confianza del 95 %, IC: 1,54-9,90) y la recuperación de la circulación espontánea en el servicio de urgencias (OR: 2,89; IC del 95 %: 1,03-8,12) se asociaron a la supervivencia hasta el ingreso hospitalario. La hipotermia terapéutica durante la atención posterior a la reanimación se asoció a la supervivencia hasta el alta (OR: 5,44; IC del 95 %: 2,33-12,74).

Conclusión Se necesitan mejoras en los servicios médicos de emergencia de Vietnam, como el aumento de las intervenciones de reanimación cardiopulmonar para transeúntes y de desfibrilación de acceso público, así como el mejoramiento de la atención en las ambulancias y de los cuidados posteriores a la reanimación.

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