Original Article

Factors Associated with Survival Rate after Cardiopulmonary Resuscitation

Sanaz Amini[1], Mohammad Taghi Moghadamnia[2*], Ezzat Paryad[2], Ehsan Kazem Nezhad Leyli[3]

[1]Nursing(MSN), Heshmat Educational – Medical Center, School of Nursing and Midwifery, Guilan University of Medical Sciences, Rasht, Iran
[2]Social Determinants of Health Research Center (SDHRC), Instructor, Guilan University of Medical Sciences, Rasht, Iran
[3]Social Determinants of Health Research Center (SDHRC), Bio-Statistics, Associate Professor, Guilan University of Medical Sciences, Rasht, Iran

*Corresponding author: Mohammad Taghi Moghadamnia, School of Nursing and Midwifery, Rasht
E-mail: Moghadamnia@gums.ac.ir

Received: 20/08/2015; **Accepted**: 26/12/2015

Abstract

Introduction: Cardiovascular disease is considered as the most important cause of mortality among men and women throughout the world. This condition causes sudden cardiac arrest in more than half of the cases. To reduce mortality due to this disease, cardiopulmonary resuscitation (CPR) and the determinants of its success are the focus of researchers.
Objective: The aim of this study was to determine the survival rate of CPR and its associated factors in patients with in-hospital cardiac arrest in a teaching medical center in Rasht.
Materials and Methods: The present descriptive-analytic cross-sectional study investigated 100 patients undergoing CPR during spring-summer 2014 at Specialized Cardiology Center in Rasht. The instrument of this study was the standard checklist of Utstein-Style that included information on age, gender, cause of cardiac arrest, rhythm, work shift, CPR place, interval of cardiac arrest until arrival of CPR team, interval of cardiac arrest until shock, interval of cardiac arrest until intubation, interval of cardiac arrest until CPR termination, short-term and long-term outcomes of CPR, and brain function status until discharge from the hospital. Data was analyzed using descriptive statistics (mean, standard deviation) and analytic analyses (T-test, Fisher's exact test, analysis of variance, and logistic regression).
Results: A total of 53% of subjects were male and mean age of the patients was 68.6 ± 14.4 years; 30% of patients who underwent CPR had short-term survival, and 11% were discharged with appropriate brain status with Glasgow Coma Scale (GCS=15). Multiple logistic regression (Backward LR method) revealed that only gender (p=0.008, OR=6.46, CI95%: 1.63-25.5) and electric shock (p=0.03, OR=4.1, CI95%: 1.1-15.14) were statistically significant predictors of short-term survival.
Conclusion: According to the results of this study, time is an important factor in CPR outcome and increasing the survival rate and timely use of electric shock can be an effective measure in shockable rhythms. Appropriate planning, training staff, and using appropriate facilities, as well as establishment of a primary warning system for calling CPR team in health centers can increase the success rate of CPR.
Keywords: **Heart Arrest, Cardiopulmonary Resuscitation, Survival Rate, Inpatients**

Please cite this article as: Amini S, Moghadamnia MT, Paryad E, Kazem Nejad Leili E; Factors Associated with Survival Rate after Cardiopulmonary Resuscitation.J Holist Nurs Midwifery. 2017;27(3):1-7

J Holist Nurs Midwifery. 2017;27(3)

Introduction

Cardiovascular disease is considered as one of the most important factors of mortality in the world [1]. It leads to sudden cardiac arrest in more than half of cases [2]. The incidence of in-hospital cardiac arrest due to heart disease is on the increase [3]. Given that the final presentation of many patients with heart disease is death, considering Cardio Pulmonary Resuscitation (CPR) and determinants of its success is the focus of researchers to reduce mortality rate of these diseases [4]. According to the National Registration Center for cardiopulmonary resuscitation in the United States, about 370,000-750,000 in-hospital CPRs are performed annually [5]. The number of patients admitted to the specialized cardiac teaching center which is a referred hospital since April to December 2013 was 8272 cases, including 169 CPR cases.

Unfortunately, despite high frequency of CPRs, the survival rate does not seem to be proper [6]. About 25 to 67% of patients die within 24 h after CPR, even with successful CPR [5]. In developed countries, the in- and out-patient survival rate of cardiopulmonary arrest were less than 30 and 10%, respectively [7]. The success rate of CPR in Iran is reported to be 10 - 18% [8]. In the study by Salari et al, it was shown that only 7.2% of patients were discharged alive from the hospital after resuscitation, only 2.8% of whom had good brain function [6]. In the study by Krittayaphong et al., spontaneous return of circulation was 49.8% and survival until discharge was 7.4% [9]. In another study by Setayesh et al at a hospital affiliated to Tehran University of Medical Sciences, Iran, the results revealed that the percentage of successful CPR was high in this study, but compared to the statistics in other studies, only a few number were alive after resuscitation procedure [10]. Different researches have identified different factors as predictors of CPR outcome, expressed with diverse intensities [4, 6, 11-13].

In many studies, patient-related variables play very important roles in the success rate of CPR, including age [5, 13-15], and gender [5,13] and some studies, in addition to patient-associated variables, have suggested incident-related variables, such as interval of cardiac arrest until CPR [2, 5, 16], initial cardiac rhythm [4, 5, 10, 13, 17, 18], duration of the intervention period [5, 13], location of cardiac arrest in the hospital [5 , 19], time of CPR [5, 8].

Considering various factors affecting CPR outcome with different effects [9] and also the role of physical environment, equipment, and human resources in CPR outcome, as well as few studies on survival rate after in-hospital CPR, we aimed to study the determinants of survival rate after CPR, and related factors in patients with in-hospital cardiac arrest. Considering the role of physical and environmental factors on outcome, the findings of this research can shed light on predictive value of each of these factors and help provide appropriate solutions to improve CPR outcomes.

Materials and Methods

This descriptive cross-sectional study was on the survival rate after CPR, and factors associated with in-hospital cardiac arrest during spring and summer 2014 in specialized cardiac center of Rasht Teaching Medical Center. After approval by the Ethics Committee of Guilan University of Medical Sciences (06/02/2014, by the code: 2930111202), out of 192 CPRs performed during the study period, 100 cases were included in the present study based on convenient sampling method. The inclusion criteria for this study included patients with in-hospital cardiac arrest, GCS>14 at arrival,

as well as patients without history of CPR. The sample size was calculated at 100, to determine the survival-associated factors, based on the study by Krittayaphong et al. [9], which showed survival rate of 21% after CPR, with a probability of 95% and power of 90%.

The research environment included cardiac and intensive care units, emergency department, and internal-cardiac ward of Rasht Teaching Medical Center. The instrument used in this study was the standard international checklist for CPR, Utstein-Style, used previously in an Iranian study by Salari et al. [6]. The collected data includes three parts: the patient-related factors, such as age, sex, cause of cardiac arrest, and heart rhythm; the incident-related factors, such as work shift, and CPR place; and time-related factors, such as interval of cardiac arrest until arrival of CPR team, interval of cardiac arrest until shock, interval of cardiac arrest until intubation, interval of cardiac arrest until CPR termination, the short- and long-term outcomes of CPR, and brain function status until discharge from the hospital. Results of CPR were considered unsuccessful (death of the patient) in less than 20 min from CPR onset; short-term survival was considered as spontaneous return of circulation from 20 min until 24 h after CPR; and long-term survival was considered from the second 24 h until discharge. For data collection, the researcher referred to patients after CPR announcement (performed by the present personnel) and recorded initial heart rhythm of the patient, the cause of cardiopulmonary arrest, interventions before the arrival of CPR team, time of CPR onset, and the first shock, time and cause of CPR termination, announced by CPR leader team, a resident cardiac specialist. Demographic information of patients were extracted from medical records and in patients with spontaneous circulation return, the time of circulation return and patient's condition until discharge were recorded. If the patient was discharged from the hospital alive, the neurologic status (GCS) and brain function were evaluated. Given that the researchers might have not been present in the hospital at all hours of CPR, two other persons were educated to collect data, and the consistency between the three were estimated, using Pearson correlation coefficient, showing correlation of more than 96%.

Data was analyzed by SPSS software Version 16 using descriptive [mean, standard deviation (SD)], and analytic tests (Independent T-test, Fisher, and logistic regression by Backward LR multiple logistic method, and input and output of variables at 0.05, and 0.1, respectively).

Results

Results of this study showed that mean age of the studied patients was 68.6 ± 14.4 years with an age range of 20 to 93 years; 51% of CPR cases occurred at night.

Table 1. Frequency of cardiopulmonary resuscitation results based on the interval between cardiac arrest until CPR termination

Results / Mean Interval (min)	Unsuccessful CPR	Successful CPR until the first 24 hours	Sig*	Unsuccessful CPR	The second 24 hours until discharge	Sig*
Interval of cardiac arrest until CPR termination	48.43	36.57	0.019	47.19	26.09	0.001
Interval of calling CPR team until CPR termination	47.94	34.87	0.002	46.30	25.55	0.001
Interval of CPR start until CPR termination	45.47	32.6	0.003	43.84	23.55	0.001

*T test

Table 2. Frequency and distribution of cardiopulmonary resuscitation results in terms of gender, time, and place, witnessed cardiac arrest, heart rhythm, and electric shock

variable / Results		Unsuccessful CPR (%)	Successful CPR until the first 24 hours (%)	CPR of the second 24 hours until discharge (%)	Sig*
Sex	Male	56.6	43.4	17	0.042
	Female	85.1	14.9	4.3	
Work shift	Morning	77.3	22.7	13.6	0.891
	Afternoon	66.7	33.3	11.1	
	Night	69.6	31.4	9.8	
Place of cardiac arrest	CCU	83.3	16.7	6.7	0.623
	Emergency	65	35	13.3	
	Internal cardiac ward	60	40	10	
The cause of cardiopulmonary arrest	Coronary heart disease	67.5	32.5	12	0.746
	Respiratory	81.3	18.8	6.3	
Witnessed cardiac arrest	Yes	76.8	23.2	6.1	0.001
	No	38.9	61.1	33.3	
Cardiac rhythm	Ventricular fibrillation	40.9	59.1	22.7	0.98
	Ventricular tachycardia without pulse	80	20	0	
	Brady-asystole	77.9	22.1	8.8	
Electric shock	Yes	56	44	16	0.078
	No	74.7	25.3	9.3	
Age (mean±SD)		69.11±15.30	67.33±12.26	66.73±12.05	0.654

*Fisher Exact Test

The majority of CPRs were performed in the emergency department (60%). The cause of cardiac arrest was coronary heart disease in 84% of cases. The primary heart rhythm was Brady-asystole in the most of the patients studied (68%). In terms of interventions, chest compression was carried out in 69% of cases. In terms of advanced interventions during CPR, access to peripheral veins and intubation were performed in 99% of cases. Based on the results of the study, the interval of cardiac arrest until CPR start was 2.46 ± 1.64 min, interval of announcing CPR until arrival of CPR team was 2.1 ± 1.44 min, interval of cardiac arrest until announcing CPR was 0.45 ± 0.91 min, and the interval of cardiac arrest until end of CPR was 44.87 ± 20.03 min. Table 1 shows the distribution of CPR results according to time intervals of cardiac arrest until end of CPR.

Among those undergoing CPR, 30% had a short-term survival, and 11% were discharged from the hospital with a good brain condition and GCS>15. Table 2 shows the distribution and frequency of short- and long-term CPR outcome, based on sex, time, and place, witnessed cardiac arrest, cardiac rhythm, and electric shock.

J Holist Nurs Midwifery. 2017;27(3)

Table 3. Predictive factors of cardiopulmonary resuscitation in patients with short-term survival

Index / Variable	B	SE	Sig	OR	CI 95% for OR	
					Lower	Upper
Male sex	1.89	0.7	0.008	6.46	1.63	25.51
Electric shock	1.4	0.66	0.035	4.1	1.1	15.14
Results	-1.53	1.05	0.14	0.21		

* T test

Predictors of short-term survival after CPR are presented in Table 3 based on multiple logistic regression (Backward LR method) with the input and output of variables equal to 0.05, and 0.1, respectively. The low number of survival until discharge minimized the assessment of long-term predictive factors in this group.

Discussion

Overall, the results of this study showed that the survival rate was 30% and long-term survival was 11%, and all of them had good brain function. A study on this issue by Goldberger et al reported the rate of spontaneous circulation return in 48.5% and survival to discharge of 15.4% [12]. Song et al studied patients with in-hospital cardiac arrest and reported spontaneous circulation return and hospital discharge of 47 and 13.5%, respectively [20]. In the study by Salari et al, 28.4% of CPRs had short-term success and of these, only 7.2% had long-term survival after CPR and were discharged from hospital [6]. Comparing the number of successful and unsuccessful CPRs in various studies indicated the failure of CPR in most cases in all areas. It seems that CPR fails despite the impact of human factors, equipment, and drugs, although the patient's underlying disease, skills of CPR team, and the cause of cardiac arrest can also affect the success rate of CPR.

Evaluation of the effect of gender on CPR outcome showed that men had higher circulation return in the first 24 h after CPR and higher survival to discharge. However, Gershengorn et al. stated no significant relationship between sex and survival rate [21]. There seems to be no significant difference in CPR outcome between the two sexes and the significant difference in this study could be attributed to differences in the number of male and female patients.

According to the results, patients with witnessed cardiac arrest had higher short- and long-term chance of survival, which is in line with the results of several studies [6, 9] and underlie the fact that less time may be wasted to initiate primary survival care, CPR, and advanced life-saving measures in patients with witnessed cardiac arrest.

In this study, ventricular fibrillation had the highest frequency of the initial heart rhythm in successful CPR patients. The results of this study is consistent with the results of the study by Keyvan Pajouh et al. [8]. Another study by Salari et al. concluded that the survival rate of shockable rhythms was significantly higher than non-shockable rhythms with a significant relationship between the type of primary cardiac rhythm and shockability with CPR outcome [6]. In patients with Ventricular Fibrilation (VF), Ventricular Tachycardia (VT) without pulse, who respond quickly to electric shock and defibrillation, using this method can increase the chance of survival.

Considering factors predicting successful CPR during the first 24 h, only gender and electric shocks were statistically

significant predictors of short-term CPR, and the survival rate of men was 4.6 times greater than women, and electrical shock improved the chances of survival by 4.1 times. Similarly, Krittayaphong et al showed that female sex could predict cardiac arrest with shockable cardiac rhythms as the predictor of CPR outcome [9]. Considering that in this study, the highest rhythm observed was Brady-asystole, while in their study, most patients suffered from cardiac arrest due to Ventricular Fibrillation (VF) and Ventricular Tachycardia (VT), this difference in the cause of cardiac arrest could justify the difference in predicting CPR result.

In assessing the neurological status of patients who survived in the second 24 h until discharge, the results of this study showed that all patients were discharged with a GCS=15 and a good brain condition. Sandroni et al stated in their study that patients undergoing CPR in hospital are discharged with good brain function which is in line with the results of this study [5]. It seems that this good brain function in the patients studied in the present study is due to the rapid onset of initial life-saving measurements and rapid arrival of CPR team, which led to a reduction in brain hypoxia and associated damage.

The results of this study indicate the important role of time on CPR outcome, as well as the effect of timely use of electric shocks in increasing the survival rate, thus, reasonable planning, training the staff, and using appropriate facilities and warning system for calling CPR team at health centers can increase the success rate of CPRs. Also, due to the large difference between CPR rate within the first 24 h and the successful CPR until discharge, which indicate the death of some patients after the initial CPR, special attention should be paid to post-CPR care.

Acknowledgments
This article is the results of an approved project at Social Determinants of Health Research Center (SDHRC) and the Department of Research and Technology of Guilan University of Medical Sciences and part of a master's degree in nursing. The authors express their appreciation to the Research Center, as well as the Hospital officials of Dr. Heshmat Medical Center for their kind cooperation with the researchers.

Conflict of interest
No conflict of interest has been declared by the authors.

Author contributions
All authors have agreed on the final version and meet at least one of the following criteria [recommended by the ICMJE (http://www.icmje.org/recommendations/):
-Substantial contributions to conception and design, acquisition of data, or analysis and interpretation of data;

-Drafting the article or revising it critically for important intellectual content

References

1. Van der Ende MY, Hartman MH, Hagemeijer Y, Meems LM, de Vries HS, Stolk RP, et al. The Lifelines Cohort Study :Prevalence and Treatment of cardiovascular disease and Risk factors. Int J Cardiol. 2017 Feb 1;228:495-500. doi: 10.1016/j.ijcard.2016.11.061. Epub 2016 Nov 11.
2. Elliott D, Aitken L, Chabory w. ACCCN,S critical care nursing. USA: Elsevier; 2007.
3. Wallmuller C, Meron G, Kurkciyan I, Schober A, Stratil P, Sterz F. Causes of in-hospital cardiac arrest and influence on outcome. Resuscitation. 2012;83(10):1206-11.
4. Jaberi Y, Changizian L, Mazlomzadeh S. Predictors of outcome in in-hospital cardio-pulmonary resuscitation. ZUMS Journal. 2011;19(75):48-57. Persian
5. Sandroni C, Nolan J, Cavallaro F, Antonelli M. In-hospital cardiac arrest: incidence, prognosis and possible measures to improve survival. Intensive care medicine. 2007;33(2):237-45.
6. Salari A, Mohammadnejad E, Vanaki Z, Ahmadi F. Survival rate and outcomes of

cardiopulmonary resuscitation. Iranian Journal of Critical Care Nursing. 2010;3(2):45-9. Persian

7. Dabagh A, Fathi M, Kasraei F, Razavi S. Comparison of short survival rate in patient's after CPR in emergency ward of Ayatollah-Taleghani and Shahid Modares ,Tehran,2005. Journal of Gorgan medical science. 2010;2(12):58-62. Persian
8. Keyvanpajouh K, Rahimi rad MH, Farokh eslamlou H. CPR quality and outcome in therapeutic and educational center of Emam Khomeyni Uremia reporting upon Utstein Style. Journal of uremia medical. 2011;22(4):346-52. Persian
9. Krittayaphong R, Saengsung P, Chawaruechai T, Yindeengam A, Udompunturak S. Factors predicting outcome of cardiopulmonary resuscitation in a developing country: the Siriraj cardiopulmonary resuscitation registry. J Med Assoc Thai. 2009;92(5):618-23.
10. Setayesh A, Arhami Dolatabadi A, Farsi D, Hossein Nejad A, Zare M. Evaluation of cardiopulmonary and cerebral resuscitation (CPCR) outcome in emergency department of Hazrat Rasoul-e-Akram Hospital from June 2003 to April 2004. Razi Journal of Medical Sciences. 2006;13(52):135-44. Persian
11. Shin TG, Jo IJ, Song HG, Sim MS, Song KJ. Improving survival rate of patients with in-hospital cardiac arrest: five years of experience in a single center in Korea. Journal of Korean medical science. 2012;27(2):146-52.
12. Goldberger Z, Chan P, Berg R. Duration of Resuscitation Efforts and Survival After In-Hospital Cardiac Arrest: An Observational Study. Journal of vascular surgery. 2013;3(57):893.
13. Chang W-H, Huang C-H, Chien D-K, Su Y-J, Lin P-C, Tsai C-H. Factors analysis of cardiopulmonary resuscitation outcomes in the elderly in Taiwan. International Journal of Gerontology. 2009;3(1):16-25.
14. Bolandparvaz S, Mohammadzadeh A, Amini A, Abbasi H, Ahmadi M, Ghaffaripour S. Cardiopulmonary arrest outcome in Nemazee Hospital, southern Iran. Iranian Red Crescent Medical Journal. 2009;11(4):437. Persian
15. Berimnejad L, Rasouli M, Berim nejad V, samiei S. Freqency of effective refractory on CPR outcomes in Emam Khomeini Hospital of Tehran university of medical science , 2003. Journal of rafsanjan university of medical science. 2005;4(4):228-35. Persian
16. Dehghani H, Dehghani K, Eslami M, Nasiriani K, Dehghani A, Fatehi F, et al. The impact of the time elapsed between cardio-pulmonary resusctation code announcement and start of resuscitation on outcome. Iran Journal of Nursing. 2008;2(12): 58-62. Persian
17. Brunner LS, Smeltzer SCC, Bare BG, Hinkle JL, Cheever KH. Brunner & Suddarth's textbook of medical-surgical nursing. USA: Lippincott Williams & Wilkins; 2010.
18. Peberdy MA, Kaye W, Ornato JP, Larkin GL, Nadkarni V, Mancini ME, et al. Cardiopulmonary resuscitation of adults in the hospital: a report of 14 720 cardiac arrests from the National Registry of Cardiopulmonary Resuscitation. Resuscitation. 2003;58(3):297-308.
19. Tirkkonen J, Ylä-Mattila J, Olkkola KT, Huhtala H, Tenhunen J, Hoppu S. Factors associated with delayed activation of medical emergency team and excess mortality: An Utstein-style analysis. Resuscitation. 2013;84(2):173-8.
20. Song W, Chen S, Liu Y, He N, Mo D, Lan B, et al. A prospective investigation into the epidemiology of in-hospital cardiopulmonary resuscitation using the international Utstein reporting style. HK J Emerg Med. 2011;18(6):391-6.
21. Gershengorn HB, Li G, Kramer A, Wunsch H. Survival and functional outcomes after cardiopulmonary resuscitation in the intensive care unit. Journal of critical care. 2012;27(4):421. e9-. e17.