Journal of Advances in Medical and Biomedical Research | ISSN:2676-6264

The Aassociation between Pre-Cardiac Arrest Comorbidity and Unsuccessful Cardiopulmonary Resuscitation in Patients with Cardiac Arrest

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Article Info

10.30699/jambs.31.144.40

Received: 2021/09/28;
Accepted: 2022/07/26;
Published Online: 12 Dec 2022;

Use your device to scan and read the article online

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ABSTRACT

Background & Objective: Patients suffering from cardiac arrest (CA) have poor prognosis and survival. The association of pre-arrest comorbidity with unsuccessful resuscitation in patients with CA is far from clear. The aim of the present study was to investigate the association between pre-existing comorbidity and unsuccessful resuscitation following CA in Iranian patients.

Materials & Methods: Data of all the patients with CA (1320 patients) who were admitted to Baqiyatallah Hospital (Tehran, Iran), and underwent cardiopulmonary resuscitation (CPR) from 2018 to 2020 were retrospectively reviewed. We analyzed the association of comorbidity data with the mortality rate and unsuccessful CPR.

Results: In the present study, 794 (60.2%) patients were female. Most CAs occurred in the hospital (1289). The case fatality rate (CFR) of CA was 69.92%. Additionally, of the 1320 patients, CPR was unsuccessful in 1271 (96.3%) patients. Our data analysis revealed that gender had no significant relationship with the mortality rate and unsuccessful CPR. However, age was significantly associated with mortality, but not with unsuccessful CPR. CA, respiratory distress, and impaired consciousness were significantly associated with mortality. Furthermore, cardiomyopathy, coronary artery bypass grafting (CABG), renal disease (P=0.032), and poisoning had a significant correlation with mortality. In addition, CABG and congestive heart failure (CHF) were significantly correlated with the unsuccessful CPR.

Conclusion: The present study suggested that CABG and CHF had a significant relationship with unsuccessful resuscitation. Furthermore, cardiomyopathy, CABG, renal disease, and poisoning were significantly associated with mortality.

Keywords: Cardiac arrest, CPR, Comorbidity

Introduction

Cardiac arrest (CA) is the most common cause of death with poor prognosis, and remains a major public health burden globally (1). CA is characterized as the sudden cessation of spontaneous cardiac mechanical activity, pulmonary ventilation, and circulating blood flow (2). Based on where they occurr, CAs are divided into two types, including out-of-hospital arrests and in-hospital arrests. It is reported that the mortality rate is higher in out-of-hospital arrests than in-hospital arrests (1). Cardiopulmonary resuscitation (CPR) is an attempt to restore cardiac electrical and mechanical activity via various interventions, including early pharmacological interventions, airway interventions, and chest compressions (2, 3). However, survival with good quality of life is rare following CA (3). Hence, clarifying the predictors of CA survival could improve decision making for clinicians when considering the appropriate application of CPR interventions (3). Furthermore, it is critical that patients with poor chance of survival receive high quality care (4). Today, the association between pre-CA comorbidity and the CA outcome in different populations is still unclear. For example, Hirlekar et al., (2018) reported that the most common comorbidities in patients with CA were a history of congestive heart failure (CHF), myocardial infarction, and diabetes (4). It has been established that patient comorbidity can affect the outcome after CA. Therefore, identifying the risk factors of CA is imperative. Several investigations revealed that pre-CA comorbidity is related to complications following CA with higher mortality rates (5-8). For instance,

Andrew et al., evaluated the effect of the Charlson Comorbidity Index (CCI) on survival to hospital discharge of patients with out-of-hospital CA. They reported that reduced odds of survival were associated with increased CCI (1). However, there are conflicting studies in this area. For example, in a prospective study, Beesems et al., found that there was no effective association between pre-history comorbidity and the survival/neurological outcome in older patients with out-of-hospital CA (9). Therefore, to date, the effects of pre-CA comorbidities on the outcomes have not been fully understood (1). The aim of the present study was to investigate the association of pre-existing comorbidity with the mortality rate and unsuccessful CPR (worse outcomes) in all the CA patients (1320 patients) who were admitted to Baqiyatallah Hospital (Tehran, Iran), and underwent CPR from 2018 to 2020. We also evaluated the association of demographic data (gender and age) with mortality and unsuccessful CPR.

Materials and Methods

Ethical considerations

The current retrospective study was approved by the Research Ethics Committee, Hospital (Tehran, Iran) (Ethical code: IR.BMSU.REC.1399.009).

Data collection

Data of all the admitted CA patients, who underwent CPR [according to the standard method of resuscitation (11)] from 2018 to 2020 were retrospectively reviewed. We extracted the demographic data (age and gender), as well as information regarding the location of CA, causes of CPR, comorbidities, and frequency of mortality and unsuccessful CPR. Additionally, we analyzed the association of comorbidity data with mortality and unsuccessful CPR. We also investigated the relationship of the demographic data (gender and age) with mortality and unsuccessful CPR.

Statistical analysis

The present data were analyzed using SPSS software (version 16.0). Qualitative variables were evaluated using Pearson's chi-square test. Quantitative variables were examined using Pearson's regression. For the quantitative variable (age), data are presented as mean ± standard error of the mean (SEM). For qualitative variables data are presented as frequency and percentage. In the present study, a p-value of 0.05 or lower is considered statistically significant.

Results

Demographic characteristics of patients

A total of 1320 patients were included in the present study, from 2018 to 2020 (study period: two years). The average duration of CPR in all the patients was 34.18 ± 0.38 min (the minimum duration was 30 min and the maximum duration was 210 min). CPR was performed at least once and a maximum of four times for patients. The mean age of all the patients was 65.60 ± 0.426 (mean± SEM) years (minimum=1 years and maximum=108 years). Most of the patients were in the age group of 70 to 79 years (N=330). In the present study, 794 (60.2%) patients were men, 517 (39.2%) patients were women, and 9 (0.7%) had missing data (total=1320). Most CAs occurred in hospital (1289), of these, 782 of patients were men and 507 of patients were women. Of the 1320 patients, 923 died and 396 patients survived (Figure 1, missing data=1). The case fatality rate (CFR) of CA was 69.92%.

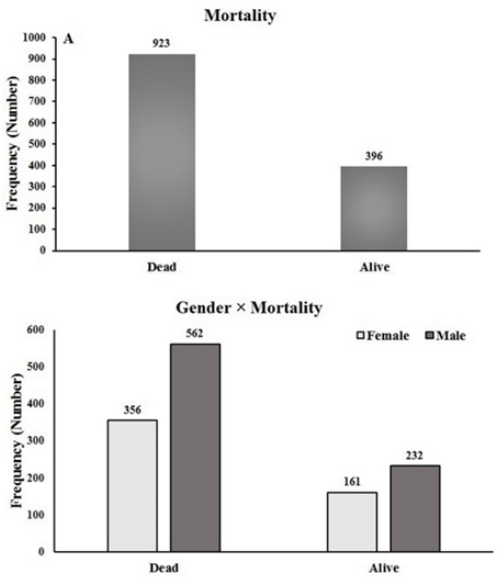

Figure 1. The mortality rate of all patients. (A) The frequency of patients' mortality (missing data=1); (B) the frequency of patients based on gender× mortality following CA (cross tabulation, missing data=9).

Of the 1320 patients, CPR was unsuccessful in 1271 (96.3%). Of 1271 patients with unsuccessful CPR, 502 patients were female and 760 s were male (Figure 2).

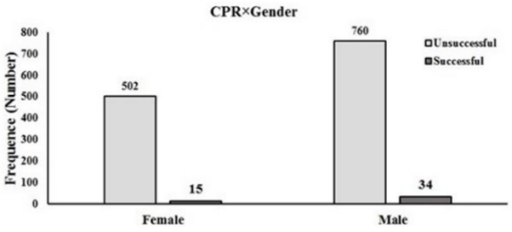

Figure 2. The frequency of patients based on gender× successful CPR following CA (cross tabulation, missing data=9).

Association between demographic data (gender and age) and mortality/ unsuccessful CPR

Our data analysis (using the chi-square test) revealed that gender (odds ratio [OR] 0.913; 95% CI 0.717–1.161, P-value=0.458) had no significant relationship with mortality. Similarly, gender (OR: 0.668, 95% CI 0.360–1.239, P-value=0.198) showed no significant relationship with the unsuccessful CPR. Furthermore, our data analysis (using Pearson Regression) revealed that age (R = 0.64, R square =0.004, P-value=0.023) was significantly associated with the mortality, however, age (R=0.026, R square=0.001, P-value=0.354) had no significant association with unsuccessful CPR.

Association between causes of CPR and mortality

According to our results, CA (903, 68.4%), respiratory arrest (506, 38.3%), impaired consciousness (283, 21.4%), respiratory distress (244, 18.5%), and arrhythmia (195, 14.8%) were the main causes of CPR in the patients (Table 1). It was found that CA (OR 4.170; 95% CI 3.24–5.26, P-value=0.000), respiratory distress (OR 0.25; 95% CI 0.19–0.34, P-value=0.000), and impaired consciousness (OR 0.35; 95% CI 0.27–0.47, P-value=0.000) were significantly associated with mortality (Table 1).

Table 1. The primary causes of CPR in all patients (1320)

Cause of CA	Frequency (%)	Mortality (N)	P-Value
Arrhythmia	195 (14.8%)	142	0.348
Cardiac Arrest	903 (68.4%)	720	**0.000**
Respiratory Arrest	506 (38.3%)	369	0.054
Respiratory Distress	244 (18.5%)	108	**0.000**
Impaired Consciousness	283 (21.4%)	146	**0.000**
Others	7 (0.5 %)	4	0.458

The data are presented as numbers and percentages (%). The P-values demonstrated a statistically significant association between the primary causes of CPR and mortality.

Association between comorbidities and mortality

In the current study, we assessed 11 common comorbidities in all the patients. Our analysis showed that the most common comorbidities were cancer (28.9%), respiratory disease (14.3%), and renal disease (10.4%) (Table 2). Cardiomyopathy (OR 0.371; 95% CI 0.133–1.029, P-value=0.048), coronary artery bypass grafting (CABG) (OR: 0.421, 95% CI 0.193–0.916, P-value=0.025), renal disease (OR 0.671; 95% CI 0.465–0.969, P-value=0.032), and poisoning (OR 0.142; 95% CI 0.15–1.370, P-value=0.049) were significantly associated with mortality (Table 2).

Table 2. The association of comorbidities with mortality and unsuccessful CPR.

Comorbidities-Frequency (total patients:1320)	Frequency	Mortality	Successful CPR	P-Value Comorbid×mortality	P-Value Comorbid×CPR
Heart-related disease	15 (1.1%)	7	1	0.048	0.543
• **Cardiomyopathy**	7 (0.5%)	3	1	0.117	0.138
• **Valvular Heart Disease**	26 (2.0%)	13	5	0.025	0.000
• **CABG**	65 (4.9%)	41	7	0.213	0.002
• **CHF**	45 (3.4%)	27	2	0.137	0.791

Comorbidities-Frequency (total patients:1320)	Frequency	Mortality	Successful CPR	P-Value Comorbid×mortality	P-Value Comorbid×CPR
• **AMI**	67 (5.1%)	50	1	0.394	0.324
Cerebrovascular arrest	42 (3.2%)	24	2	0.065	0.715
Hypertension	62 (4.7%)	41	2	0.498	0.836
Diabetes mellitus	189 (14.3%)	121	4	0.054	0.210
Respiratory disease	137 (10.4%)	85	7	0.032	0.361
Renal disease	38 (2.9%)	26	1	0.832	0.721
Liver disease	5 (0.4%)	3	0	0.626	0.660
Electrolyte disorder	382 (28.9%)	277	10	0.200	0.180
Cancer	4 (0.3%)	1	0	0.049	0.694
Poisoning	122 (9.2%)	89	1	0.460	0.076
Sepsis					

CABG: coronary artery bypass grafting, CHF: congestive heart failure, AMI: acute myocardial infarction.

Association between comorbidities and unsuccessful CPR

Present data revealed that CABG (OR 6.764; 95% CI 2.438–18.769, P-value=0.000), and CHF (OR 3.486; 95% CI 1.501–8.093, P-value=0.002), were significantly associated with the unsuccessful CPR (Table 2).

Discussion

The major finding in the present study was a significant positive association of CABG and CHF with unsuccessful resuscitation in patients with CA. In the current study, the most common comorbidities were cancer, respiratory disease, and renal disease. Additionally, our data analysis revealed that cardiomyopathy, CABG, renal disease, and poisoning were markedly associated with the mortality. Our results indicated that CA, respiratory arrest, impaired consciousness, respiratory distress, and arrhythmia were the main leading causes of CPR in the patients. We also found that CA, respiratory distress, and impaired consciousness were significantly related to mortality, but not respiratory arrest and arrhythmia. It is reported that CA has a yearly incidence of approximately 50-110 per 100,000 people worldwide (2). The association of various comorbidities with mortality or successful resuscitation is poorly understood. Therefore, identifying patient at risk for CA and identification of the factors that predict fatal cases remains a major challenge. CAs are categorized in to two groups according to where they occur, including out-of-hospital and in-hospital arrests (1). In the present study, most CAs occurred in the hospital. Additionally, our data analysis demonstrated that the case fatality rate (CFR) of CA was 69.92%. The results of our study are in line with those of other studies that show an association between pre-existing comorbidity and survival. For example, Andrew et al., evaluated the effect of the Charlson Comorbidity Index (CCI) on survival to hospital discharge of 15953 patients with out-of-hospital CA. They reported that reduced odds of survival were associated with increasing CCIand suggested that pre-existing chronic disease may assist prognostication decisions for patients with CA (1). However, there are also contradicting findings in this area. For example, in a prospective study, Beesems et al., found that there was no effective association between pre-history comorbidity and survival/neurological outcomes in older patients with out-of-hospital CA (9). Similarly, Nayeri et al., reported that there was no considerable association between pre-existing medical comorbidity and neurological outcomes/survival in comatose out-of-hospital CA patients (11). Additionally, Soholm et al., indicated that there was no significant relationship between the comorbidity/gender/employment status and the outcome of a total of 2527 attempted resuscitations (12). One of the possible explanations for this inconsistency in the results may be difference in the sample size in various studies. Another explanation might be the duration of follow-up or the location of CAs (eg. Out-of-hospital vs in-hospital arrests). Furthermore, the results of different population across the studies may affected by several factors including genetic, cultural, and psychosocial factors (13). Hirlekar et al., reported that among the pre-existing chronic disease, diabetes mellitus was linked to a lower chance of 30-day survival in all patients (13). However, in the present study CABG and CHF were markedly associated with unsuccessful resuscitation in patients with CAs. The strength of the present study was the comprehensive collection of pre-existing comorbidities with almost no missing data from 2018 to 2020. The present study, also had some limitations, e.g., we had no information on the severity and the duration of the pre-existing chronic disease.

Conclusion

The present study suggested that pre-arrest comorbidities, including CABG and CHF were associated with the unsuccessful resuscitation. Although, differences between individual studies makes comparisons difficult. However, comorbidity appears to be an important predictor of survival from CA. It is suggested that the results of different population across the studies may affected by several factors including genetic, cultural, as well as psychosocial factors. According to the American heart association (AHA) guidelines **(14)** that confirm our results, it is strongly recommended to focus more on patients who have the mentioned comorbidities. Hence, we should prevent any medical reasons that lead to CA. On the other hand, more preventive policies in high-risk groups could help the physicians to save the facilities in a medical setting.

Acknowledgments

Thanks to financial support, guidance and advice from the "Clinical Research Development Unit of Baqiyatallah Hospital (Tehran, Iran) ".

Conflict of Interest

Authors declared no conflict of interests.

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How to Cite This Article:

Mehdizadeh H, Bahari Z, Zekriamir S, Shahriary H, Behzadnia M J. The association between pre-cardiac arrest comorbidity and unsuccessful cardiopulmonary resuscitation in patients with cardiac arrest. J Adv Med Biomed Res. 2023; 31(144): 40-5.

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