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Investigating the Prognostic Factors in ROSC Following Cardiopulmonary Resuscitation-A Cohort Retrospective Study

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Abstract

Cardiac arrest is defined as the absence of a palpable pulse and unresponsiveness or apnea (agonal breathing) due to the cessation of mechanical function of the heart. Cardiopulmonary resuscitation involves measures to restore the vital functions of the heart and lungs and maintenance of blood circulation and respiration until the return of spontaneous circulation. Considering the critical nature of the issue, this study aimed to determine the factors affecting ROSC (Return of spontaneous circulation at least 4 hours following cardiopulmonary resuscitation) in a referral tertiary hospital in west of Iran.

Patients who underwent cardiopulmonary resuscitation due to in-hospital and out-of-hospital cardiac arrest from 2021 to 2022 were included. Basic demographic and clinical data of the patients, as well as additional information on outcomes, hospitalization, and chronic conditions, were extracted from patient data file. The data were analyzed using SPSS v25.

A total of 1200 patients were included in this study. The results showed that there was a significant relationship between the outcome of CPR (survival) and IHCA(p=0.000), Unwitnessed (p=0.042),History of diabetes (p=0.024), cardiovascular disease (p=0.016) and Non-asystole as the initial rhythm (p=0.014).

Based on the results of this and similar studies, the importance of early detection of the initial rhythm in cardiac arrest and especially in developing countries, public education and retraining of prehospital personnel in performing resuscitation measures according to guidelines and early detection of arrhythmia could be emphasized.

Key words: *Cardiopulmonary resuscitation, OHCA, IHCA, CPR outcome*

1. Introduction

Cardiac arrest is the absence of a palpable pulse and unresponsiveness or apnea (agonal breathing) due to cessation of mechanical cardiac function. This definition distinguishes cardiac arrest from respiratory arrest, which is characterized by apnea and a palpable pulse [1]. Cardiac arrest is often divided into two distinct groups based on location: in-hospital

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cardiac arrest (IHCA) and out-of-hospital cardiac arrest (OHCA). This distinction dates back decades and is based on anticipated differences in patient characteristics, provider characteristics, and timing of interventions. Despite the distinction between IHCA and OHCA patients, few studies have directly compared the two. However, international guidelines for the treatment of IHCA and OHCA are almost identical and therefore patients generally receive the same treatment regardless of the location of cardiac arrest [2].

Prognosis and survival after OHCA are influenced by two main processes: prehospital and hospital care. Prehospital treatment includes early recognition of cardiac arrest, early initiation of cardiopulmonary resuscitation (CPR), rapid defibrillation (for a shockable rhythm), and rapid transport to hospital. The sooner these measures are taken, the better the patient's chances of survival. Hospital care includes continued CPR, temperature management, use of extracorporeal membrane oxygenation (ECMO), coronary artery catheterization, and intensive care unit (ICU) monitoring [3,4].

The most common initial cardiac rhythm observed during out-of-hospital cardiac arrest is ventricular fibrillation (VF) or ventricular tachycardia (VT). Survival rates from out-of-hospital cardiac arrest range from 2% to 26%, with this wide range of variation being due to the different populations studied and the type of medical response to these patients, as well as the early availability of defibrillators and bystander CPR. Other cardiac rhythms in out-of-hospital cardiac arrest include PEA (Pulseless Electrical Activity) and asystole [5,6].

In-hospital cardiac arrest (IHCA) is a common problem. The global incidence of IHCA varies widely. There is a growing incidence of IHCA among adults, with 292,000 cases occurring each year in the United States. This rate is 15,200 for children and is not increasing. Deaths that occur within the hospital are often related to severe underlying diseases [7].

Several factors influence resuscitation outcomes including gender, age, type of arrest, initial rhythm, early defibrillation, baseline neurological status, hospital ward where cardiac arrest occurs, availability of monitoring, timely response of the resuscitation team, duration of resuscitation, no need for mechanical ventilation after resuscitation, white race, recent surgeries, trauma, internal pacemaker, taking antiarrhythmic drugs, comorbidities like renal failure, cancer, and resuscitator experience. Successful CPR includes achieving ROSC, survival to discharge with optimal neurological function [9]. The aim of this study was to investigate the probable factors affecting ROSC (persistent vital signs for at least 4 hours in emergency room or other wards) following cardiorespiratory arrest in our center.

2. Methods

This descriptive-analytical retrospective study was conducted at an academic tertiary hospital in west of Iran to identify relation between patient-related factors and clinical outcomes of CPR in patients with cardiorespiratory arrest during January 2021-December 2021.

The initial cardiac rhythm was defined as shockable and non-shockable. Baseline demographic data, clinical characteristics of the patients, additional information on outcomes, hospitalization, and chronic conditions were also obtained from the patients' data file. All patients with cardiac arrest were included in the study and patients with missing data or under 18 years of age were excluded.

By referring to patients' clinical records, information based on demographic characteristics, clinical characteristics of the patients, additional information on outcomes, hospitalization, and chronic conditions were obtained and documented in a questionnaire by trained research assistant. The patients' charts were filled by emergency attending or fellow physician. This questionnaire was approved by the first executor of the project as an expert. In case of incomplete file, the patient was removed from the study.

The data was computerized and statistically analyzed using SPSS v25. To examine the relationship between variables, the chi-square test as well as univariate and multivariate logistic regressions with a 95% confidence interval were used. P value < 0.05 was considered to be statistically significant.

The design was approved by the Ethics Committee of University of Medical Sciences.

3. Results

Of 1200 patients included,715 cases (59.58%) were men and 485 cases (40.41%) were women. The mean and standard deviation of age were 65.8 and 16.31 respectively.

460 of 715 men (64.33%) and 288 of 485 women (59.38%) had unsuccessful resuscitation. According to the chi-square test, there was a significant relationship between the outcome of CPR (survival) and Non-asystole as the initial rhythm (p=0.014) IHCA (p=0.000), Unwitnessed (p=0.042), Diabetes (p=0.024), Cardiovascular disease (p=0.016) but the variables gender (p=0.149), HTN (p=0.524), kidney disease (p=0.856) ,age (p=0.299), and BMI (p=0.440) had no significant difference in resuscitation outcome, table 1.

Table 1- Frequency of variables based on resuscitation outcome (successful/unsuccessful)

Initial result / ***Individual characteristics***		***Successful***		***unsuccessful***		***P-value***
		number	Percent (% of total)	number	Percent (% of total)	
Gender	Male	255	20.5	460	39.5	0.149
	female	197	15.4	288	24.7	
Age	< 50	79	6.58	119	9.91	0.299
	≥50	351	29.25	651	54.25	
Location	OHCA	22	1.83	88	7.33	0.000
	IHCA	408	34	682	56.83	
Witnessed	NO	37	3.08	63	5.25	0.042
	Yes	402	33.5	698	58.16	
HTN	No	298	24.83	545	45.41	0.524
	Yes	132	11	225	18.75	
DM	NO	334	27.83	635	52.91	
	Yes	96	8	135	11.25	
Renal disease	No	379	31.58	679	56.58	0.024
	Yes	51	4.25	91	7.58	
Cardiovascular Disease						0.856
	No	333	27.75	635	52.91	
	Yes	97	8.08	135	11.25	
BMI						0.016
	< 18.5	17	1.41	47	3.91	
	18.5-24.9	210	17.5	378	31.5	0.440
	25-29.9	138	11.5	230	19.16	
	>29.9	65	5.41	115	9.58	
Initial Rhythm	Asystole	396	33	759	63.25	
	PEA	22	1.83	6	0.5	0.014
	VT	6	0.5	5	0.41	
	VF	6	0.5	0	0	

4. Discussion

The findings of our study showed that there is a significant relationship between the CPR outcome (survival) and the variables of IHCA (p=0.000), non-asystole as the initial rhythm (p=0.014) and surprisingly Unwitnessed(p=0.042), History of diabetes (p=0.024), cardiovascular disease (p=0.016) but there is no significant relationship between CPR outcome and gender (p=0.149), HTN (p=0.524), Kidney-disease (p=0.856), Age (p=0.299), and BMI Group (p=0.440).

These results may be due to critical condition of the witnessed cases and the presence of cardiac collateral vessels in patients with a history of diabetes and heart disease, along with older age.

In this study, the success rate of cardiopulmonary resuscitation was about 36%. In a cross-sectional analytical study by Nazri Panjki et al. in 2016, the results showed that 36.7% of cardiopulmonary resuscitation cases were successful [10]. In a descriptive-cross-sectional study by Jaberi in 2008, no significant relationship was reported between gender and the success rate of resuscitation [11]. These results were consistent with our study.

Another study by Goodarzi et al. in Iran examined the outcomes of in-hospital cardiopulmonary resuscitation. Of 1000 resuscitations, 220 (22%) had a return of spontaneous circulation and a 5.2% survival to discharge. Logistic regression analysis showed that age <50 years, initial rhythm, duration of resuscitation, Glasgow Coma Scale (GCS) after resuscitation, and witnessed or supervised cardiac arrest were significantly associated with patient discharge [8] which is consistent with our study only regarding rhythm and the contradiction in witnessing may be due to worse condition of witnessed patients of our referral center.

The impact of prehospital and hospital care on clinical outcomes in out-of-hospital cardiac arrest was investigated by Deri Y et al. In this retrospective study, data were collected on prehospital and hospital interventions. The association between prehospital and hospital interventions with ROSC, survival to discharge, and neurological outcomes was assessed. ROSC was achieved in 207 cases (32%), survival to discharge in 48 cases (7.4%), and survival with favorable neurological function in 26 cases (4%). Shockable rhythm, AED use, and STEMI treatment were significantly associated with good prognosis [9] which is consistent with our study regarding the prognostic impact of the initial rhythm.

Another study in Tokyo by Tanimoto A et al. investigated whether out-of-hospital cardiac arrest patients with an initial non-shockable rhythm could be candidates for out-of-hospital cardiopulmonary resuscitation. Adult OHCA patients treated with ECPR during 2011 to 2018 were included in the study. Patients were classified into two groups: primary shockable rhythm and non-shockable rhythm. The primary outcome was the cerebral performance category (CPC) score at hospital discharge. A CPC score of 1 or 2 was defined as a good outcome. A total of 186 patients were included. Of these, 124 had an initial shockable rhythm and 62 had an initial non-shockable rhythm. The rate of good outcomes at hospital discharge was not significantly different between the shockable and non-shockable groups (19% vs. 16%). Initial shockable rhythm was not significantly associated with good outcome. In the non-shockable group, patients with good outcomes had a higher rate of transient ROSC, and pulmonary embolism was the leading cause [5].

Another study by Yakar MN et al. examined the clinical outcomes of in-hospital cardiac arrest (IHCA) and factors associated with 28-day survival. In this retrospective study, patients who suffered IHCA at a tertiary hospital between July 2016 and April 2019 were included. A total of 254 patients (mean age 73 years, 58.3% male) underwent cardiopulmonary resuscitation (CPR). The ROSC rate was 47.5%. A total of 51 patients (mean age, 63 years, 54.9% male) were admitted to the inpatient intensive care unit. The 28-day survival rate was 31.4%. Independent risk factors were chronic kidney disease, chronic obstructive

pulmonary disease. Asystole as an initial rhythm, multiple shock-related complications and septic shock [7] which is consistent with our results regarding the initial rhythm.

5. Conclusion

In our study, 95% of the initial rhythms were asystole, which is probably due to the fact that they were recorded after the patient arrived at the emergency room. Considering the effect of the location of cardiac arrest, witnessing, and initial rhythm on mortality in our study and similar studies, we can conclude that improving public education about CPR, as well as prehospital emergency equipment and training personnel on the increased use of AEDs and early detection of possible arrhythmias, can be effective in reducing mortality.

Ethical approval

All procedures performed in this study involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

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Declaration of competing interest

The authors deny any conflict of interest in any terms or by any means during the study.

Fig1. Frequency of patients by ward

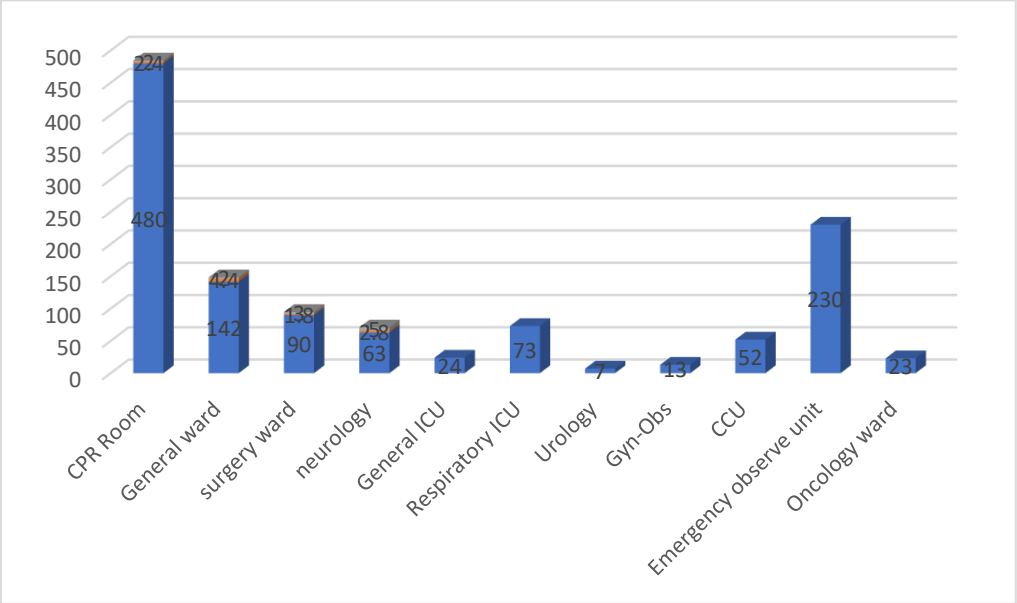


Fig2.Frequency of cases by underlying conditions

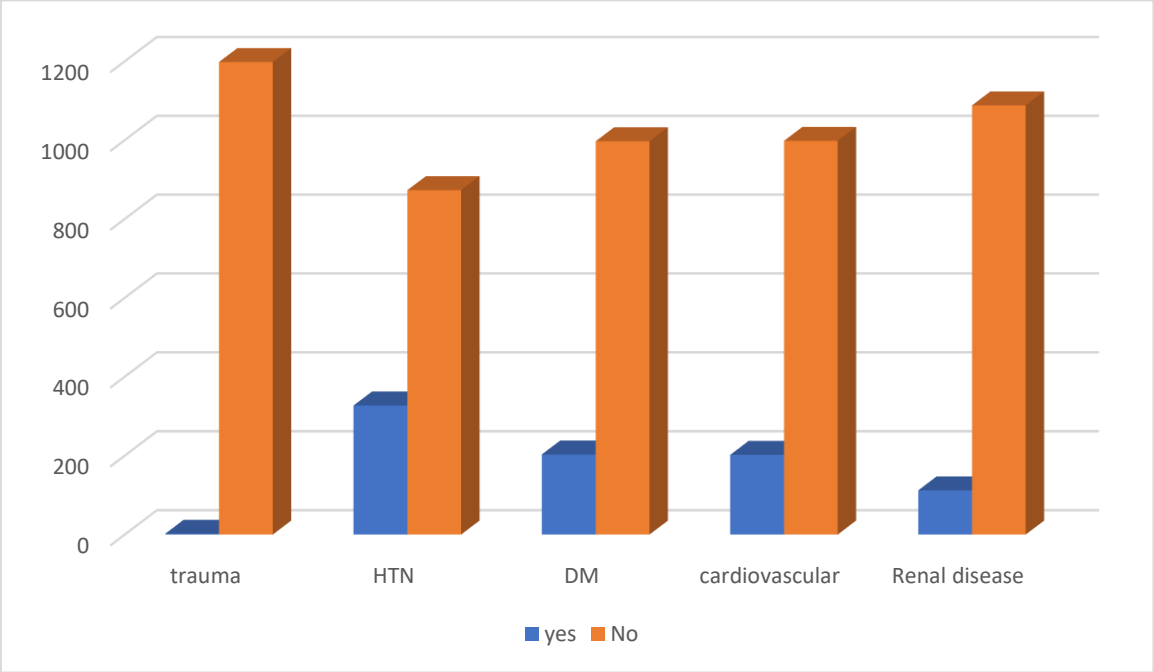
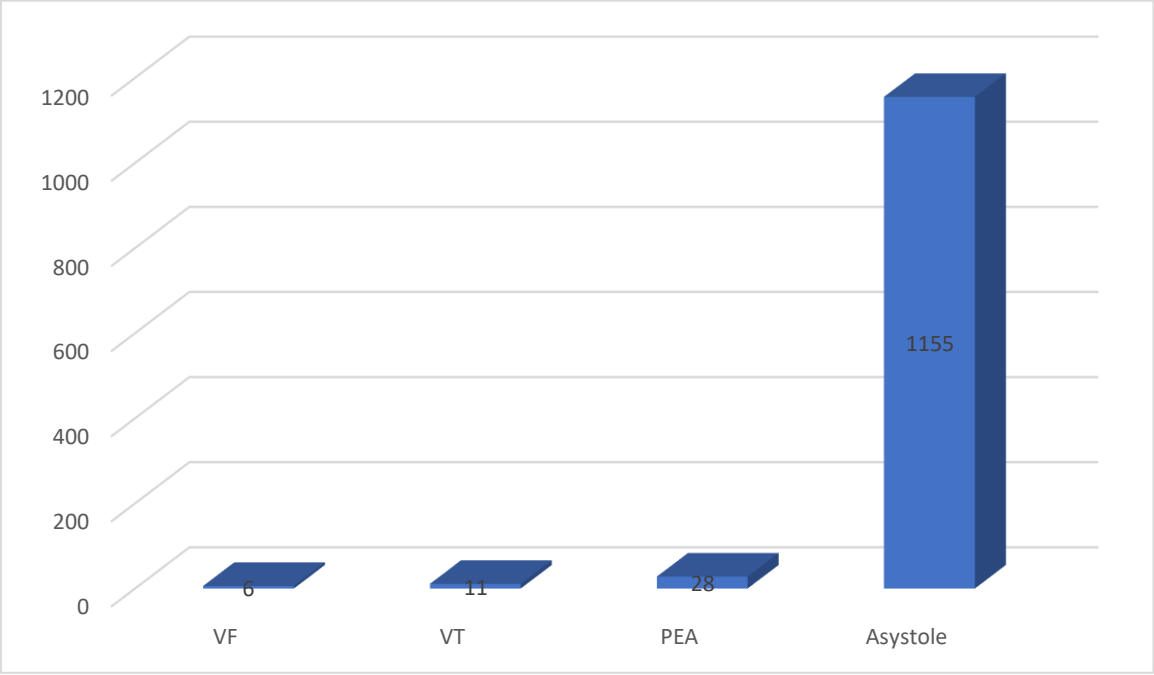


Fig3. Frequency of initial rhythms



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