MEDICAL SCIENCE

Prognostic factors of cardiac arrest in the emergency department

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To Cite:
Alanazi MM, Alanazi FM, Abdulqader OA, Alduraywish DA, Alotaibi SB, Alqahtani SMY, Aljarbou AM, Almuhaydib MN, Ahmed MA, Alharbi LY, Alharbi FKA. Prognostic factors of cardiac arrest in the emergency department. *Medical Science* 2023; 27: e157ms2941.
doi: https://doi.org/10.54905/disssi/v27i133/e157ms2941

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Peer-Review History
Received: 02 March 2023
Reviewed & Revised: 06/March/2023 to 16/March/2023
Accepted: 18 March 2023
Published: 20 March 2023

Peer-review Method
External peer-review was done through double-blind method.

Medical Science
pISSN 2321–7359; eISSN 2321–7367

ABSTRACT

Background: Cardiac arrest is a problem that has gotten surprisingly little attention in the ER. ER Patients are more likely (29%) than patients in the intensive care unit (25%) or on telemetry (25%), to encounter an initial ventricular fibrillation rhythm or pulseless ventricular tachycardia. Our research aims to identify the prognostic factors for cardiac arrest in the ER at KSMC. *Method:* From January 2022 to Jun 2022, a retrospective study was done in the tertiary care hospital KSMC in Riyadh, Saudi Arabia. The ministry of health introduced and oversees the hospital records system, which was used to collect data, in 2015. All persons over the age of 18 who experienced an in-hospital resuscitation attempt after cardiac arrest were eligible to take part in the study. *Results:* We included 98 people who received resuscitation techniques after suffering ER cardiac arrest. Patients who had ER cardiac arrest had an average age of 69.5 + 23.4 years. Overall, 60.2% of the patients were men. The two most common concurrent comorbidities were hypertension (43.8%) and coronary artery disorders (41.8%). The average time spent performing CPR was 22 minutes (IQR 11–49 minutes). When the factors influencing the success of resuscitation were determined using multiple regression analysis, resuscitation lasting fewer than 30 minutes was the most component that could predict the restoration of spontaneous circulation. *Conclusion:* Our study concluded that ER cardiac arrest more common in male gender. About one third of patients affected with ER cardiac arrest discharged home well.

Keywords: Cardiac arrest, CPR, intensive care unit, Ventricular fibrillation.

1. INTRODUCTION

In the ER, cardiac arrest received surprisingly little research. In a recent article

published in ER cardiac arrest, Kaysers study Andréasson et al., (1998) evaluated the outcomes of cardiac arrest that happened in the ERs of more than 400 hospitals reporting over a 6-year period starting on January 1, 2000, using data from the National CardioPulmonary Resuscitation Registry data, which is sponsored by the American Heart Association (AHA). The main conclusion was that ERs at hospitals had the highest rate of cardiac arrest survival. The survival rate for ERs was 26%, compared to 20% for inpatient, non-intensive care unit, heart monitoring units, 16% for intensive care units. Following ER cardiac arrest, neurologic outcomes were also at their best (Kayser et al., 2008).

ER Patients are more likely to experience an initial cardiac ventricular fibrillation rhythm or ventricular tachycardia 29% than are patients in the intensive care unit (25%) or on telemetry (25%). According to numerous studies conducted in various contexts, cardiac arrests caused by Ventricular fibrillation or ventricular tachycardia have a significantly greater survival probability than cardiac arrests caused by asystole or electrical activity without a pulse (Sandroni et al., 2007; Atwood et al., 2008; Holmberg et al., 2000). There were also variations in other patient features. Compared to patients in other units of the hospital, ER patients were significantly more likely to experience an acute myocardial infarction (MI). Therefore, it is anticipated that ER patients will present with a higher percentage of VF/VT, leading to higher survival rates. However, compared to telemetry or other patients, but not ICU patients, ER patients had a higher rate of shock and hypotension. Compared to cardiac arrest in hospitalized patients, ER cardiac arrest patients were younger if compared to cardiac arrest occurring in other parts of the hospital, they also had less previous illnesses recorded (Holmberg et al., 2000; Mitchell et al., 2020; Johnson et al., 2112). Our study used retrospective data aiming to explore the prognostic factors to cardiac arrest which occurs in the ER in KSMC (KSMC) in the period from Jan 2022 to Jun 2022.

2. METHOD

A retrospective observational study was conducted in the tertiary care medical facility KSMC in Riyadh, Saudi Arabia from Jan 2022 to Jun 2022. Data were gathered via the hospital records system, which has been introduced and managed by the ministry of health since 2015. Following system implementation, the on-call physicians and nurses input the pertinent data into the web-based system. The variables and results in the database are organized in a uniform manner. All adults over the age of 18 were qualified to participate in the study if they underwent an in-hospital resuscitation attempt following cardiac arrest. Our exclusion criteria include patients with orders to prohibit resuscitation and cardiac arrests that occurred outside of a hospital. The study was authorized by the institutional review board of KSMC and informed consent was obtained.

The registration database and hospital records were used to retroactively extract patient demographic information, event date and time and patient outcomes. Two different attending physicians confirmed these findings. The severity of comorbid diseases was calculated and estimated using the Charlson comorbidity index score (Charlson et al., 1987). Time was recorded as either night (07:00-18:59) or day (19:00–06:59). Only data from the first episode was included when there were numerous records for the same patient within a 48-hour period to prevent confounding effects between occurrences. The time between the beginning of cardiac arrest and the end of resuscitation efforts, or patient death, was referred to as the duration of resuscitation. The immediate survival with spontaneous circulatory recovery and survival to discharge was the primary outcome indicators. Patient evaluation using the cerebral performance category scale upon hospital release was the secondary result. A score of 1 or 2 was regarded as having a favorable neurological state.

For categorical variables, results are presented as a combination of numbers and percentages. For continuous variables, descriptive statistics were presented as mean plus standard deviation or median interquartile range. The appropriate Fisher's exact test or Pearson's chi-square test was utilized to analyze categorical variables. For Independent samples, the Mann-Whitney U test was utilized to evaluate continuous variables. To find independent factors linked to successful resuscitation outcomes, a multivariable logistic regression model with conditional backward selection was used. Version 24 of the Statistics Package for Social Sciences program was used to conduct statistical analyses. In order to identify prognostic parameters that were independently linked with survival, odds ratios and a 95% confidence interval were given. A two-tailed p value of 0.05 or less was regarded as significant. This study was approved by KSMC ethical review board under IRB number H1RI-08-Jan23-07.

3. RESULT

We located 98 individuals who experienced ER cardiac arrest (EDCA) and underwent resuscitation procedures during the research period. The average age of EDCA patients was 69.5 + 23.4 years. 60.2% of patients were men overall. Cardiovascular illnesses (41.8%) and hypertension (43.8%) were the most prevalent concomitant diseases. The initial rhythms for patients with EDCA were asystole (n = 34; 34.6%), pulseless ventricular tachycardia (n = 11; 11.2%), ventricular fibrillation (n = 4; 4.08%) and pulse less electronic activity (n = 49; 50.0%). There were more incidents on weekdays (82.6%) and during the day (57.1%). The average

resuscitation time was 22 minutes (IQR 11–49 minutes). Overall, 74.4% of patients successfully regained spontaneous circulation and 34.6% discharged well. 27 (79.5%) of the patients who made discharged had a good mental and neurologic status. Table 1 displays demographic and survival information about the patient.

Table 2 and Table 3 provide summaries of the clinical factors connected to resuscitation outcomes. Patients with shorter resuscitation times and early shockable rhythms had higher probability of spontaneous circulation returning. However, the characteristics that mainly affected the survival rates were female sex, initial shockable rhythm and shorter resuscitation period. Use of epinephrine had a deleterious effect on both survival to hospital discharge and immediate survival with recovery of spontaneous circulation. The use of ECMO led to an 81.8% (9 out of 11) recovery of spontaneous ventricular beating and a marginal survival advantage at 14 days (p value = 0.053, data not given), but it did not show a survival advantage at hospital discharge (p = 0.632).

Resuscitation lasting less than 30 minutes was the sole factor to predict recovery of spontaneous circulation when the determinants of resuscitation outcome were identified using multiple regression analysis (Tables 4 and 5). Every extra 10 minutes of resuscitation time resulted in a progressive decrease in the likelihood of spontaneous circulation returning. However, for survival to hospital release, female sex, resuscitation lasting less than 20 minutes and no use of epinephrine during resuscitation were independent outcome predictors.

Table 1 Characteristics of patients

Characteristics	N= 98
Age (mean and SD)	69.5 (23.4)
Male n and %	59 (60.2)
Major comorbidity	
Hypertension	43 (43.8)
Cardiovascular disease	41 (41.8)
Diabetes mellitus	31 (31.6)
Renal insufficiency	24 (24.4)
Malignancy	23 (23.4)
Initial rhythm	
Ventricular fibrillation	4 (4.08)
Pulse less ventricular tachycardia	11 (11.2)
Pulse less electrical activity	49 (50)
A systole	34 (34.6)
Time of day, n (%)	
07:00 - 18:59	56 (57.1)
19:00 - 06:59	42 (42.8)
Time of week, n (%)	
Week day	81 (82.6)
Week end	17 (17.3)
Resuscitation duration, median (interquartile range)	22 (11-49)
ECMO use	
ROSC use	
Survival to discharge	34 (34.6)
Age (mean and SD)	69.5 (23.4)
Male n and %	59 (60.2)
Major comorbidity	
Hypertension	43 (34.8)

Abbreviations; ECMO; extra corboral membrane oxygenation, ROSC; return of spontaneous circulation, SD; standard deviation

Table 2 Summaries of the clinical factors

	Yes	No	P value
Age (mean and SD)	69.5 (21.6)	67.1 (24.8)	0.845
Sex			0.478
Male n= 59	46 (63.0)	13 (52)	
Female n= 31	27 (36.9)	12 (48)	
Charlson comorbidity index	3.14 (2.56)	3.36 (2.74)	0.349
Initial rhythm n (%)			0.003
Ventricular fibrillation	3 (4.1)	1 (4)	
Pulse less ventricular tachycardia	8 (10.9)	3 (12)	
Pulse less electrical activity	41 (56.1)	8 (32)	
A systole	21 (21.4)	13 (52)	0.002
Resuscitation duration, median (interquartile range)	14 (28.7)	43 (29-61)	
Medication			
Epinephrine	72 (98.6)	22 (88)	0.025
Amidarone	9 (12.3)	4 (16)	0.187
Lidocaine	8 (10.9)	1 (4)	0.067
Week end	11 (15)	6 (24)	0.741
Day time	45 (61.4)	11 (44)	0.845
History of cardiovascular disease	29 (39.7)	12 (48)	0.028

Table 3 Association of variables to survival to discharge

	Yes	No	P value
Age (mean and SD)	64.5 (24.5)	86.6 (22.3)	0.245
Sex, n (%)			0.004
Male	21 (21.4)	38 (38.7)	
Female	13 (13.26)	31 (26.5)	
Charlson comorbidity index	3.09 (2.50)	3.19 (2.61)	0.665
Initial rhythm			0.001
Ventricular fibrillation	2 (2.04)	2 (2.04)	
Pulse less ventricular tachycardia	5 (5.1)	6 (6.12)	
Pulse less electrical activity	13 (13.26)	36 (36.7)	
Asystole	14 (14.2)	20 (20.4)	
Resuscitation duration, median (interquartile range)	8 (4-15)	21 (17-55)	0.001
Medication			
Epinephrine	31 (31.6)	63 (64.2)	0.002
Amidarone	5 (5.1)	6 (6.12)	0.311
Lidocaine	3 (3.06)	6 (6.12)	0.248
Week end	4 (4.08)	13 (13.2)	0.841
Day time	17 (17.3)	39 (39.7)	0.234
ECMO use	4 (4.08)	7 (7.14)	0.147

Abbreviation; ECMO; extra corporal membrane oxygenation

Table 4 Logistic regression analysis of spontaneous circulation return following cardiac arrest

	Yes, n=61	No, n=37	P	OR (95% CI)
Initial rhythm, n (%)				
Shockable	17 (23.2)	2 (8)	0.145	1.38 (2.15-3.58)
Non shokable	56 (76.7)	23 (92)		
Resuscitation duration				
Less than 10 minutes	22 (30.1)	1 (4)	0.001	12.39 (5.12-30.17)
10-19 minutes	18 (24.6)	2 (8)	0.001	5.80 (2.72-13.37)
20-29 minutes	6 (8.2)	1 (4)	0.001	6.85 (2.25-21.31)
30-59 minutes	14 (19.1)	14 (56)	0.007	0.7 (0.43-1.18)
More than or equal 60 minutes	13 (17.8)	7 (28)		
Medication, n (%)				
Epinephrine	70 (95.8)	24 (96)	0.342	0.59 (0.19-2.88)
History of cardiovascular disease	18 (24.6)	23 (92)		1.23 (0.77-1.82)

Abbreviations; CI; confidence interval, OR; odd ratio

Table 5 Logistic regression of prognostic factors in survival to discharge

	Yes n= 34	No n=64	P value	OR (95% CI)
Age (mean and SD)	64.5 (24.5)	86.6 (22.3)	0.284	0.98 (0.96- 1.11)
Sex, n (%)				
Male	21 (21.4)	38 (38.7)	0.001	0.43 (0.26-0.76)
Female	13 (13.26)	31 (26.5)		
Initial rhythm, n (%)				
Shockable	14 (41.1)	5 7.8)	0.087	1.88 (0.99-1.11)
Non shockable	20 (58.8)	59 (62.1)		
Resuscitation duration				
Less than 10 minutes	10 (29.4)	13 (20.3)	0.001	7.11 (3.15-16.25)
10-19 minutes	12 (35.2)	8 (12.5)	0.021	3.49 (1.42-8.79)
20-29 minutes	5 (14.7)	2 (3.1)	0.345	3.45 (0.66-9.81)
30-59 minutes	4 (11.7)	24 (37.5)	0.652	0.69 (0.22-2.94)
More than or equal 60 minutes	3 (8.8)	17 (26.5)		
Medication, n (%)				
Epinephrine	33 (97.0)	61 (95.3)	0.005	0.30 (0.17-0.69)
ECMO use	4 (11.7)	7 (10.9)	0.632	1.46 (0.57-3.99)

Abbreviation; ECMO; extra corporal membrane oxygenation, SD; standard deviation, OR; odd ratio

4. DISCUSSION

The mean age of our study participants was 69.5 which is higher if compared to other studies in the same field such as mean age 55 (Oh et al., 2022) and mean age 51 (Pandian et al., 2016). In our study males constitute 60% of participants which is similar to the study of them (Pandian et al., 2016), cooper et al., (2006) (59%) (Ehlenbach et al., 2009) and herlitz et al., (2003) (69%). This fact show that men are at higher risk to develop cardiac arrest at the ER. In our study most of the participants 91% had co-morbidities, which is higher than study of them (83%) (Miranzadeh et al., 2016). Coronary artery disease proportion in our study was 41% which is higher than (17.1) (Bansal et al., 2016) and khan et al., (2008) (37%).

The current study population had a larger percentage of first nonshockable heart rhythms than expected (Peberdy et al., 2003; Shih et al., 2007; Shahreyar et al., 2017). Results from observed ventricular fibrillation are frequently favorable in contrast to generally poor results from a systole and PEA (Peberdy et al., 2003). Over the years, there is a rise in the frequency of both out-of-hospital cardiac arrest and nonshockable EDCA rhythm (Peberdy et al., 2003; Girotra et al., 2012). This implies that individuals with major comorbidities and a higher age will be met in the future. The univariate analysis showed that in our study sample, cardiac arrests in the ICU or ER had enhanced the likelihood of ROSC. The relative success of the resuscitation efforts was directly

correlated with survival and the location of the resuscitation within the hospital also had an impact (Andréasson et al., 1998). Despite the fact that all hospital staff must complete resuscitation protocol training, there is evidence that overall experience affects patient prognosis (Hou et al., 2007).

Other studies have shown that ECMO offers more advantages than traditional CPR for juvenile and adult patients with EDCA of cardiac etiology (Thiagarajan et al., 2007; Chen et al., 2008). Our study was unable to show that ECMO-assisted CPR increases survival to discharge. This could be due to our patients' substantially prolonged time of ischemia. With previously reported survival rates of more than 70% when resuscitation was initiated within 30 minutes of EDCA and less than 20% when initiated in 30 to 60 minutes of EDCA and 8% when initiated after 60 minutes of EDCA, the amount of time between cardiac arrest and ECMO flow is an important outcome determinant.

In EDCA with nonshockable rhythm, it has been noted that earlier epinephrine administration is linked to a higher likelihood of ROSC (Donnino et al., 2014). Our research, however, showed that epinephrine administration had no positive effects on ROSC and may even have negatively affected the rate of survival until hospital discharge. Given that adrenaline has vasodilatory effects, one explanation for this paradox may be that a vasopressor protects coronary perfusion pressure while having a marginally beneficial impact on immediate survival. Reduced peripheral organ perfusion is the cause of this, which also has detrimental long-term effects (Paradis et al., 1990; Friess et al., 2013).

A separate predictor of survival was female sex. Our findings agreed with those of earlier research (Herlitz et al., 2001). The current study also showed that immediate survival with spontaneous circulation return and survival were both predicted by shorter resuscitation duration. Previous studies have also demonstrated that patients who have cardiac arrest for a shorter period of time fare better (Nadkarni et al., 2006; Cooper et al., 2006). Longer resuscitation times indicate broad tissue hypoperfusion and hypoxic damage, but there is no data to inform clinicians about how long resuscitation attempts should last before giving up. Only 2% of people in whom resuscitation attempts lasted longer than 10 minutes succeeded in ROSC, according to a prior report (Schultz et al., 1996).

5. CONCLUSION

According to the results of our study, men are more likely than women to experience ER cardiac arrest. About one-third of ER cardiac arrest patients were successfully discharged to their homes. The use of epinephrine had a negative effect on both immediate survival with spontaneous circulation recovery and survival to hospital release. The ECMO use resulted in a marginal survival advantage at 14 days and an 81.8% (9 out of 11) recovery of spontaneous ventricular beating.

Author contributions

All the authors contributed equally.

Funding

This study has not received any external funding.

Conflict of interest

The authors declare that there is no conflict of interests.

Data and materials availability

All data sets collected during this study are available upon reasonable request from the corresponding author.

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