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RESEARCH ARTICLE

SURVIVAL RATE OF INCOMING PATIENTS WITH CARDIAC ARREST AT THE CARDIOLOGY INFIRMARY OF THE EMERGENCY DEPARTMENT OF A PUBLIC HOSPITAL IN GREECE

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Abstract

Introduction: Cardiac arrest is an urgent situation that, despite the improved resuscitation capabilities, the survival rate of out-of-hospital cardiac arrest victims remains low.
Aim: To investigate the survival rate of the incoming patients with cardiac arrest in the cardiology infirmary of the emergency department of a public hospital.
Material-Method: The study included 210 patients who were transferred pulseless and breathless at the cardiology infirmary of the emergency department of "Tzaneio" Hospital, Piraeus, during the period April 2017 - November 2018. Data was collected from the National Center of Emergency Dispatch's printed forms, as well as from the patients' admission book of the emergency department.
Results: More than 10% (11.9%) of patients with cardiac arrest returned to spontaneous circulation in the emergency department, of which 16% was discharged. Patients with known cardiac history, ($p=0.002$), with a shockable rhythm ($p<0.001$), and especially ventricular fibrillation ($p<0.001$) upon arrival at the emergency room, and patients who were defibrillated at the ambulance during admission and at the emergency room, were more likely to survive ($p<0.001$). No statistically significant correlation was found between the factors studied and survival after cardiac arrest, in the group of patients that were discharged.
Conclusions: The survival rate of the incoming patients with cardiac arrest at the emergency department of "Tzaneio" Hospital, Piraeus, was low. As for most health systems, this issue constitutes a fairly complex public health problem. Cardiopulmonary resuscitation and corresponding guidelines require further improvement in order for the survival rates of out-of-hospital cardiac arrest patients to increase.

Key words: : Cardiac arrest, resuscitation, survival, emergency department.

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INTRODUCTION

Cardiac arrest is considered worldwide, one of the most serious and most important causes of sudden death, and is defined as the cessation of mechanical activity of the heart, which is confirmed by the absence of central pulse and normal breathing.[1] As an incident, cardiac arrest occurs mainly outside the hospital.[2] For most health systems, it is a fairly complex public health problem, and despite developments in both urgent treatment and improvement of guidelines, the survival rate of out-of-hospital cardiac arrest patients still remains low.[3] Both surviving and death rate is high enough, resulting in poor neurological prognosis, and reduced neurological benefits for the sufferers.[4] The Emergency Department staff conducts coordinated and organized actions based on a specific protocol, following the algorithm of Advanced Cardiopulmonary Resuscitation, with the main objective of resuscitating the victim and treating the possible reversible causes of the arrest.[5] Van de Glind and his colleagues showed a survival rate of patients with a rate of arrest ranging from 0% to 20%, which has not improved over the past 30 years.[6] Additionally, Houssein Youness et al. in their own research study, revealed a survival rate of 5% of patients transferred at the Emergency Department with out-of-hospital cardiac arrest.[7]

A large number of scientists have investigated the survival rate of patients coming to the Emergency Department after a cardiac arrest outside the hospital, over the last five years (2012-2017), with most analysis showing a low survival rate following a cardiac arrest incident. In particular, in most of the published research studies, there is evidence of good quality of chest compressions, the presence of witnesses in cardiac arrest incident, airway management, the use of an automatic external defibrillator and the known history of heart disease, in conjunction with the improved survival rate after the arrest.[8-19] In 2014, Kuocw et al. in their research study, which involved 712 patients with out-of-hospital cardiac arrest, showed a 17.8% who returned to systemic circulation, a 16.3% surviving during their incoming to the Emergency Department, and only 1.4% who managed to get discharged from the hospital.[20]

In Greece, two studies dealt with the survival rate of the incoming patients at the Emergency Department with rates of arrest, as well as their stay time until their discharge. In particular, Galatianou et al. reported a 15.5% of patients who came at the Emergency Department and returned to systemic circulation, entered the intensive care unit and remained on average 6.7 ± 4.9 days.[21] Subsequently, Karagiannis et al., in a research study they carried out at the Nicosia General Hospital of Cyprus, reported a 44% return of victims to automatic circulation in the Emergency Department, after cardiac arrest.[22] The survival rates of the two surveys differ, although both are low, as well as at a global level. However, there is no Greek study recording survival rates at the Emergency Department, in relation to the times of arrest and resuscitation, both for shockable and non-shocable rhythms.

AIM

The aim of this study was to investigate the survival rate of patients who were transferred to the emergency cardiology infirmary of a public hospital due to cardiac arrest, and also to explore possible correlations between demographics, time periods of cardiac arrest-transfer time-resuscitation time and survival rates.

MATERIAL

The studied population consisted of 227 patients who came sequentially in the Emergency Cardiology Infirmary of the Emergency Department of the "Tzaneio" General Hospital of Piraeus, where they were transferred due to cardiac arrest, between April 2017 and November 2018.

Of the 227 patients, seventeen cases (7.5%) were excluded from the study because they were transported exclusively for the purpose of asserting death in the infirmary without the use of resuscitation during transfer or at the Emergency Department. The final sample of the study consisted of 210 patients.

METHOD

A specially formatted registration form was used to collect the data, which included data from the National Emergency Center Rescuers' Form, the hospitalization book of the cardiology infirmary of the Emergency Department, as well as the Secretariat of the Cardiology Unit and the Cardiology Clinic.

The questionnaire consisted of five parts. First, the demographic characteristics of the study population were recorded (gender and age). The second part included data on the patient's history, where whether the patient had a known heart disease and its type were recorded. Time periods in relation to the process of resuscitation as well as the transfer of the patients were recorded in the third part. Specifically, the time of the onset of the arrest, the time of the onset of the resuscitation, the time of the patient's transfer to the Emergency Department and the end of the resuscitation period were recorded on a 24-hour basis (00:00 - 23:59). From the recorded time points, the time from the detection of the arrest to the end of resuscitation, the time of the resuscitation in the ambulance, the resuscitation time in the infirmary and the total resuscitation time (both in the ambulance and the hospital) were calculated in minutes. The fourth part included data on the cardiac arrest and in particular the arrest rhythm on admission to the Emergency Department, if defibrillation was given during the transfer, if defibrillation was given to the Emergency Department and how many times. In the fifth part, data on the outcome of the patients was recorded. In particular, whether the patients survived the arrest, whether they eventually died or got discharged from the hospital, as well as the total survival time until the discharge or the death (in days) were recorded.

ETHICS

All ethical rules and anonymity of the participants were respected during the data collection and process. The study was carried out with the written approval of the Scientific Council of the hospital (approval number: 38 / 2-5-2017).

STATISTICAL ANALYSIS

Categorical variables are presented as absolute (n) and relative (%) frequencies, while quantitative variables are presented as mean value (standard deviation) or as median (interquartile range). The Kolmogorov-Smirnov test and normality plots were used to test for normal distribution of quantitative variables.

X^2 test (chi-square test), t test (student's t-test) and Mann-Whitney test were used in order to investigate the existence of the relationship between two categorical variables, between a quantitative variable and a dichotomous variable (when the quantitative variable followed normal distribution) and a quantitative variable and a dichotomous variable (when the quantitative variable did not follow normal distribution), respectively. The two-sided level of statistical significance was set equal to 0,05. Data analysis was performed with IBM SPSS 20.0 (Statistical Package for Social Sciences).

RESULTS

1. Demographic characteristics of patients incoming with cardiac arrest in the Emergency Department

The study population consisted of 210 consecutive cases of patients who were transferred with cardiac arrest at the Emergency Department. Seventy one percent (n = 149) of the patients were males. The average age of the patients was 66,6 years (SD = 15,4), with the largest age group being 61 to 70 years old (n = 51, 24,3%) (Table 1).

2. History of heart disease

Twenty nine point five percent (n = 62) of the patients had a known history of heart disease, most of whom had coronary artery disease (n = 41, 19,5%) (Table 2).

3. Data in relation to the cardiac arrest

Ninety eight point one percent (n = 206) of the patients were transferred to the hospital by National Emergency Center. In the majority of participants, the rate of arrest was asystole (n = 183, 87,1%). Defibrillation in the ambulance was given to the 7,1% of patients, while in the Department it was given to the 7,6%. The total number of defibrillations and the average times of transfer and resuscitation are recorded in Table 3. Indicatively, as recorded in the study, the average time from the detection of arrest to the end of resuscitation was 54,6 minutes (SD = 19,9), while the median overall resuscitation time (ambulance + hospital) was 40,5 minutes (IR = 21,0).

4. Outcome

Eleven point nine percent (n = 25) of the patients survived the arrest, of which 16% (n = 4) got discharged from the hospital, 68% (n = 17) died and 16% (n = 4) was transferred to another

hospital (Table 4).

5. Correlations

5.1. Survival from the arrest

Following the bivariate analysis a statistically significant relationship occurred at the level of 0,05 (p <0,05) between the survival from the arrest and 5 independent variables (Table 5):

- Most of the patients who survived had known history of heart disease, while the majority of patients who did not survive the arrest had no known history of heart disease (p = 0,002).
- Most of the patients who survived the arrest had a shockable rhythm, while the majority of patients who did not survive the arrest had no shockable rhythm (p <0,001).
- The majority of the patients who survived had ventricular fibrillation as a rhythm of arrest, while the majority of patients who did not survive the arrest had asystole (p <0,001).
- Of all patients who received defibrillation, the largest percentage survived the arrest, while of all patients who did not receive defibrillation, the majority did not survive the arrest (p <0,001).
- Most of the patients who survived the arrest received defibrillation during resuscitation in the Department, while the majority of patients who did not survive the arrest did not receive defibrillation during the resuscitation in the Department (p <0,001).

5.2 Survival and discharge from the hospital

None of the independent variables showed a statistically significant correlation with survival and discharge from the hospital.

DISCUSSION

Based on the results of this study, the percentage of patients with return of circulation after the arrest was low (n=25, 11,9%). The percentage of patients who recovered from cardiac arrest and got discharged from the hospital (n=4, 1,9%) was lower, while it was not possible to determine survival with discharge for patients transferred to other hospitals (n=4, 1,9%). Similar results of low survival rates were reported by El Sayed et al., in their own research study in Lebanon, where in a total of 205 cases of cardiac arrest outside hospital, only 5,5% survived.[23] Similarly, Fan et al. showed a low survival rate in Hong Kong after a cardiac arrest incident, which mounted 2,3% and only 1,5% with good neurological benefits.[24]

From the results of the statistical analysis, in the present study, five statistically significant factors related to the survival from the arrest were found: The known history of heart disease, the defibrillation rate, ventricular fibrillation as the rate of arrest and the out-of-hospital and in the Emergency Department defibrillation.

In particular, patients who came to the Emergency Department with a known history of heart disease, were more likely to survive than those without known heart disease (p = 0,002). In Boyce et al. research, it was shown that the survival rate after cardiac arrest could rise to 43%, taking into account factors such as immediate onset of Cardiopulmonary Resuscitation by witnesses in the event, early defibrillation, and the known history of heart disease. It was also found that 76% of cardiac arrest victims were of cardiological origin, with a known history of heart disease.[25] Respectively, Lee et al., in the research study which they carried out in 7 Asian countries from 2009 to 2012, found a correlation between the known history of heart disease - as a single factor in their statistical analysis - and the increase in survival rates following cardiac arrest. However, when this factor was associated with age and chronic health problems, the survival rate was low.[26]

In the results of this study it was also found that the majority of the patients who survived cardiac arrest had a shockable rhythm, unlike those who did not (p <0,001). This finding is consistent with a relative study of Blom et al., who correlating the improvement of survival rate following cardiac arrest with the use of an automatic external defibrilator, showed an increased survival rate with good neurological benefits in patients with shockable rhythms, unlike with those who had no shockable rhythms.[27] Strömsöe et al. also came to a similar result, in Sweden, where they found an increased rate of survival and return of spontaneous circulation in patients transferred to the Emergency Department with a shockable rhythm versus patients with non-shockable rhythm.[28]

According to this study, the majority of patients who survived,

had ventricular fibrillation as an arrest rhythm, while the majority of patients who did not survive the arrest had asystole (p<0,001). Bhandari et al. concluded in their study that the shockable rhythms, such as ventricular fibrillation, shows a double survival rate after cardiac arrest, which reaches the 46%, over non-shockable rhythms, such as asystole, which has a survival rate of about 20%.[29] Subsequently, Boyce et al. in a relative survey, showed a correlation between the known history of heart disease and the shockable rhythms, while they concluded that 52% of patients who had been transferred with ventricular fibrillation as an arrest rhythm, had an improved survival rate.[25] Accordingly, Capucci et al. were led to the conclusion that shockable rhythms such as ventricular fibrillation, do not only improve survival rates, but also neurological deficits following an incident of arrest.[18]

Another finding was with regard to the administration of defibrillation in the ambulance. It appeared that most of the patients survived the arrest, in contrast to the patients who did not receive defibrillation in the ambulance (p <0,001). A similar conclusion was reached by the research study of Hasegawa et al. where they showed survival rate for one month in arrest victims who received 2 or less pre-hospital defibrillations, which reached 34,48%.[30] In the same conclusion came Garcia et al., in a study which they carried out at international airports of France and Spain. They highlighted the importance of early pre-hospital defibrillation in order to improve the survival rate in the Emergency Departments with good neurological benefits.[31]

Finally, according to the results of the present study, the arrest victims who were defibrillated in the Emergency Department showed a higher possibility of survival, as opposed to the patients who did not receive any defibrillation in the hospital (p <0,001). Both the American Cardiological Association, as well as the study by Pan et al. converge to the fact that during the advanced cardiopulmonary resuscitation in Emergency Department, a defibrillation by a biphasic defibrillator, the use of energy <200J and the defibrillation prior to cardiopulmonary resuscitation, improve the rate of return to spontaneous circulation.[32,33] The pathophysiology of shockable rhythms explains how direct current delivery to a cardiac arrest victim can restore spontaneous circulation and improve survival rate. In particular, at the initial stage of an evolving infarction, shockable rhythms, as pathological electrical activities, are due to transient arrhythmogenic effects in ischemic and occlusive tissue, such as abnormal automatic function, triggered activity and reentry circuits generated by the heterogeneous conduction and repolarization of ischemic cells. The sooner the current is given, by defibrillation, to the abnormal cells contributing to the mechanism of arrhythmogenesis, the higher the rate of return to an organized rhythm with cardiac output. On the other hand, the more delayed the defibrillation delivery, the lower the rates of success of return to an organized rhythm with cardiac output.[34]

Limitations

Despite attempts to minimize the limitations of the present research, however they could not be eliminated. The sample number is not particularly large so as to enable safe conclusions to be drawn for the survival rate in the general population, despite the fact that it is consistent with the international rates of other surveys. The small sample number also did not allow for possible correlations of the studied factors with survival rates discharged from the hospital. The studied sample derived from a single public hospital and specifically from the cardiology infirmary, where all the cases of cardiac arrests were transferred in order to be treated. Finally, it was not possible to find information related to the discharge survival rate when patients have been transferred to other hospitals of Attica (n = 4), after their return to spontaneous circulation.

FUNDING

No funding. The operating expenses were covered by the principal researcher.

CONCLUSIONS

The survival rate of the incoming patients with cardiac arrest at the emergency department of “Tzaneio” Hospital, Piraeus, was low. The known cardiac history, the presence of a shockable rhythm, ventricular fibrillation as a rhythm of arrest, defibrillation at the ambulance and at the Emergency Department were

strongly correlated with return of spontaneous circulation. None of the studied factors was found to correlate with survival and discharge from the hospital. As for most health systems, this issue constitutes a fairly complex public health problem. Cardiopulmonary resuscitation and corresponding guidelines require further improvement in order for the survival rates of out-of-hospital cardiac arrest patients to increase.

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ANNEX

TABLE 1. Demographic characteristics of incoming victims with cardiac arrest to Emergency Department

Characteristic	N (%)
Gender	
Female	61 (29,0)
Male	149 (71,0)
Age[a]	66,6 (15,4)
Age Groups	
<51 years old	38 (18,1)
51-60 years old	29 (13,8)
61-70 years old	51 (24,3)
71-80 years old	50 (23,8)
>80 years old	42 (20,0)

Values are expressed as absolute (N) and relative (%) frequency unless stated otherwise.

[a] Mean value (standard deviation)

TABLE 2. Characteristics according to the history of heart disease of incoming patients with cardiac arrest to the Emergency Department

Characteristic	N (%)
Known history of heart disease	
No	148 (70,5)
Yes	62 (29,5)
Type of heart disease	
Coronary Disease	41 (19,5)
Heart Failure	11 (5,2)
Acute myocardial infarction	9 (4,3)
Valvulopathy	1 (0,5)
Unknown history of heart disease	148 (70,5)

Values are expressed as absolute (N) and relative (%) frequency

TABLE 3: Data in relation to the arrest

Characteristic	N (%)
Transfer by National Emergency Center	
No	4 (1,9)
Yes	206 (98,1)
Arrest rhythm at the arrival at Emergency Department	
Ventricular fibrillation	11 (5,2)
Abdominal Tachycardia without pulse	5 (2,4)
Asystole	183 (87,1)
Electrical Activity without pulse	11 (5,2)
Shockable rhythm	
No	194 (92,4)
Yes	16 (7,6)
Defibrilation in the ambulance	
No	195 (92,9)
Yes	15 (7,1)
Defibrilation in the Emergency Department	
No	194 (92,4)
Yes	16 (7,6)
Number of total defibrillations at the Emergency Department	
1	3 (1,4)
2	12 (5,7)
7	1 (0,5)
They didn't receive defibrilation	194 (92,4)
Time from detecting the arrest until the end of resuscitation (minutes)[a/b]	54,6 (19,9) / 51,0 (21,0)
Time of resuscitation in the ambulance (minutes)[a/b]	31,8 (115,7) / 18,0 (13,0)
Time of resuscitation in the hospital (minutes)[a/b]	22,7 (12,8) / 20,0 (14,0)
Total time of resuscitation (ambulance+hospital) (minutes)[a/b]	54,5 (117,6) / 40,5 (21,0)

Values are expressed as absolute (N) and relative (%) frequency unless stated otherwise.

[a/b] Mean value (standard deviation) / Median (interquartile range)

TABLE 4: Outcome

Characteristic	N (%)
Survival from the arrest	
No	185 (88,1)
Yes	25 (11,9)
Survival and discharge from the hospital	
No	17 (8,1)
Yes	4 (1,9)
We don't know (they were transferred to other hospital)	4 (1,9)

The rates are expressed as absolute N frequency and relative frequency (%).

Table 5: Bivariate correlations between demographic and other characteristics and the survival from the arrest

Characteristic	Survival from the arrest		Rate p
	No	Yes	
Gender			0,729[a]
Female	53 (28,6)	8 (32,0)	
Male	132 (71,4)	17 (68,0)	
Age[b]	66,2 (15,5)	69,5 (14,4)	0,315[c]
Known history of heart disease			**0,002**[a]
No	137 (74,1)	11 (44,0)	
Yes	48 (25,9)	14 (56,0)	
Type of heart disease			0,249[d]
Coronary Disease	33 (68,8)	8 (57,1)	
Heart Failure	9 (18,8)	2 (14,3)	
Acute myocardial infarction	6 (12,5)	3 (21,4)	
Valvulopathy	0 (0,0)	1 (7,1)	
Transfer by National Emergency Center			**0,070**[e]
No	2 (1,1)	2 (8,0)	
Yes	183 (98,9)	23 (92,0)	
Defibrilating rate			**<0,001**[e]
No	182 (98,4)	12 (48,0)	
Yes	3 (1,6)	13 (52,0)	
Arrest rate at the arrival at Emergency Department			**<0,001**[d]
Ventricular fibrillation	2 (1,1)	9 (36,0)	
Abdominal Tachycardia without pulse	1 (0,5)	4 (16,0)	
Asystole	175 (94,6)	8 (32,0)	
Electrical Activity without pulse	7 (3,8)	4 (16,0)	
Defibrilation in the ambulance			**<0,001**[e]
No	180 (93,3)	13 (6,7)	
Yes	4 (26,7)	11 (73,3)	
Defibrilation during resuscitation in the Emergency Department			**<0,001**[e]
No	182 (98,4)	12 (48,0)	
Yes	3 (1,6)	13 (52,0)	
Number of total defibrilations at the Emergency Department[f]	2,0 (0,0)	2,0 (0,0)	0,638[g]
Time from detecting the arrest until the end of resuscitation (minutes)[b]	54,3 (18,9)	57,3 (26,6)	0,587[c]
Time of resuscitation in the ambulance (minutes)[f]	13,0 (0,0)	14,0 (12,3)	0,632[g]

Time of resuscitation in the hospital (minutes)[f]	41,0 (0,0)	20,5 (5,5)	0,532[g]
Total time of resuscitation (ambulance+hospital) (minutes)[f]	57,0 (0,0)	35,5 (18,0)	0,937[g]

Values are expressed as n (%) unless stated otherwise.

[a] X^2 test

[b] Mean value (standard deviation)

[c] t test

[d] Monte-Carlo exact test

[e] Fisher's exact test

[f] Median (interquartile range)

[g] Mann-Whitney test