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The impact of changes in cardiopulmonary resuscitation practices on survival in in-hospital cardiac arrest patients during the COVID-19 pandemic

Behcet Varisli[1], Adem Cakir[2], Sinan Yildirim[2]

[1]Final University, Department of Emergency Medicine, Kyrenia, Cyprus
[2]Çanakkale Mehmet Akif Ersoy State Hospital, Department of Emergency Medicine, Çanakkale, Türkiye

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Abstract

The Covid-19 pandemic has caused changes in cardiopulmonary resuscitation applications as well as in all practices. In this research, we evaluated the effects of these changes on the management and outcomes of in-hospital cardiac arrest cases. Our study is a single-center, retrospective, observational study. It was conducted with 628 patients with in-hospital arrest who met the study criteria between January 1, 2018, and January 1, 2022. The cases were evaluated in two groups as pre-guideline period and post-guideline period interventions according to the cardiopulmonary resuscitation algorithm published on October 21. Study data were obtained from the hospital automation system, patient files, and clinical data. In the results of the study, the confidence interval was 95% and the statistical significance level was accepted as $p<0.05$. Mean age of 628 patients was 70.58±15.42 years, the range was between 18-97, and 292 (46.5%) of the patients were female. After the changes in the algorithm, there was no significant difference in terms of age, gender, and intervention time in the cases that were intervened pre/post-guideline period. Mortality was found to be significantly lower in patients who underwent cardiopulmonary resuscitation post-guideline period (p=0.001). It was determined that the survival rate after the guideline (OR:2.492. 95%Cl:1.473-4.217. p=0.001) was higher regardless of age, gender, and survival time of the survivors. There was no significant difference between the survival durations of the cases after post-resuscitation, in the pre-guideline and post-guideline period cases. Mortality rates after cardiopulmonary resuscitation were found to be significantly lower in cardiac arrest cases after Covid-19. However, these results need to be supported by more studies before they can be generalized.

Keywords: Cardiac arrest, resuscitation, Covid-19 pandemic

Introduction

Resuscitations applied to cardiac arrests are classified as in-hospital and out-of-hospital according to the area of application [1]. Despite the implementation of cardiopulmonary resuscitation, approximately 209.000 in-hospital cardiac arrests (IHCA) occur annually in the USA [2]. Despite all updates in resuscitation guidelines, survival rates are low after cardiopulmonary resuscitation [3].

The journey of CPR, which started with external chest compression and defibrillation applications in 1960 and 1962, was defined with a guide for the first time in 1966; the first guideline was published by the AHA in 1996 [4-6]. It has been updated over the years within the framework of studies on survival-increasing applications [7]. After the first international CPR guide was published in 2000, the CPR guide was updated in 2005, 2010, 2015, and 2020 during the COVID-19 disease,

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Corresponding Author: Adem Cakir, Çanakkale Mehmet Akif Ersoy State Hospital, Department of Emergency Medicine, Çanakkale, Türkiye
Email: dr.ademcakir@hotmail.com

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which affected the whole world as a global epidemic [8].

With the Covid -19 pandemic in 2020, disease transmission has become an important social problem. Accordingly, as in all medical applications, recommendations have been published for CPR to be applied to in-hospital cardiac arrests where suspected or possible covid-19 cases are encountered more frequently to reduce the transmission of Covid-19 [9,10].

Major changes highlighted along with CPR guideline published on October 21, 2020 [11];

1. "Recovery" has been added as the 6th link in the chain of survival,

2. Survival was expressed in a formula consisting of medical science, effective education, and local practices as the components of the influencing factors,

3. It is recommended to follow the recommendations of the AHA, emphasizing ongoing updates regarding Covid-19,

4. Early adrenaline administration (in the first 5 minutes) is emphasized in adult life support,

5. Endotracheal intubation, supraglottic airway, or bag-valve-mask applications are recommended for airway interventions,

6. Double sequential defibrillation has been recommended for refractory VF/VT,

7. Intravenous (IV) route was recommended as the vascular route, and it was stated that the intraosseous route could be accepted in cases where intravenous access was not possible,

8. Since the risk of harming the patient without cardiac arrest is low, it is recommended that non-healthcare workers could initiate CPR as well,

9. It was stated that parameters such as arterial blood pressure or ETCO2 could be used, if possible, to monitor and optimize the quality of CPR,

With these recommendations, an increase in the survival rate in cardiac arrest patients after CPR applications was aimed.

The adoption and implementation of changes made in an important practice such as resuscitation is an important point. However, with the increase in the level of knowledge, there are changes in these algorithms. In our study, we wanted to investigate the effect of the proposed guideline change regarding CPR practices published in 2020 on the success of resuscitation and survival and with the data we obtained, we aimed to contribute to the literature for CPR and post CPR care, where mortality is very high.

Material and Methods

Study setting and Study Population

This study is a retrospective, single-centered, observational study conducted with in-hospital cardiac arrest (IHCA) patients undergoing CPR at Çanakkale Mehmet Akif Ersoy State Hospital.

The study was initiated after the approval of the ethics committee, 628 patients who met the inclusion criteria of all adult patients who underwent CPR after IHCA (witnessed) between January 1, 2018, and January 1, 2022, at Çanakkale Mehmet Akif Ersoy State Hospital were included.

Study data were obtained from the hospital automation systems, patient files and epicrisis reports, Demographic data (age, gender, and etiologic causes of arrest) and clinical data (admission date, resuscitation duration, resuscitation success, post-resuscitation care and outcomes, and hospitalization duration) of the cases were recorded in the previously created study form.

Patients excluded according to exclusion criteria were:

• Patients under the age of 18 (n:17).

• Patients admitted to the emergency department after receiving CPR at another hospital (n:87).

• Patients whose patient files and/or epicrisis reports cannot be accessed (n:13).

Out of 745 patients who underwent CPR at Çanakkale Mehmet Akif Ersoy State Hospital on the specified dates, 628 patients who did not meet the exclusion criteria were included in the study.

Patients included in the study were grouped as before and after the publication of the AHA guideline published on October 21, 2020. After successful CPR, 1-month mortality follow-up of the patients admitted to the intensive care unit was enlisted. Survival duration was recorded as days.

Statistical Analysis

Statistical analysis was made by SPSS 20.0 for Windows® statistical program (IBM Inc. Chicago. IL. USA). Number, percentage, mean, standard deviation, median, minimum, and maximum values were used in the presentation of descriptive data. The conformity of the data to the normal distribution was evaluated with the Kolmogorov-Smirnov Test, Pearson chi-square test and Fisher's Exact test were used to compare categorical data. T-Test was used to compare two independent numerical data, and Mann-Whitney U-test was used when the data were not evenly distributed. Logistic regression analysis was performed to reveal the effect of demographic data on prognosis. Kaplan Meier survival analysis was performed for factors that may affect 30-day life expectancy.

For statistical significance $p<0.05$ and 95% confidence interval was used.

Ethical Considerations

The study protocol was approved by the Çanakkale Onsekiz Mart University, Faculty of Medicine Ethics Committee (18920478-050.01.04-E.1900164326. 2011-KAEK-27/2019-1900152520).

Since the study was conducted retrospectively, obtaining informed consent from patients to participate in the study

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was waived. The study was performed in accordance with the Declaration of Helsinki.

Results

The mean age of 628 patients included in the study was 70.58±15.42 years, the range was 18-97, and 292 (46.5%) were female. Gender distribution by age is shown in Figure 1.

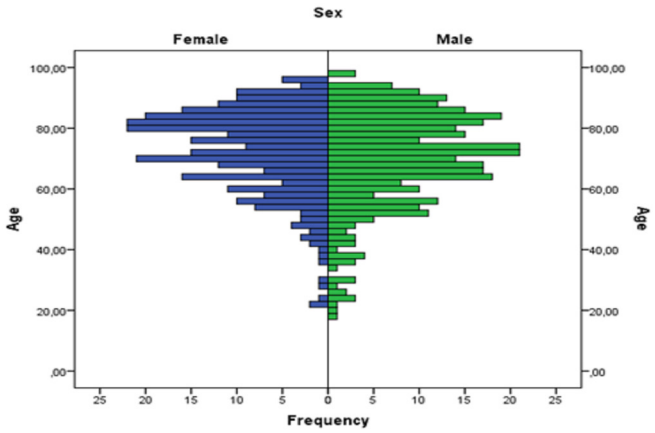

Figure 1. Age and gender distrubution

465 (74.0%) of the patients who underwent CPR resulted in mortality. 30-day survival follow-ups of 163 (26.0%) surviving patients were performed. According to the follow-ups, the mean value of days of life was found to be 2.65±6.94. When this period was compared with the period before and after the guideline, no statistically significant difference was observed (p>0.05).

When the factors affecting the success of CPR and which may be important in survival were compared in terms of pre- and post-guideline periods, no significant difference was found between the two groups in terms of age and gender distribution (p=0.775 and p= 0.387. respectively). While 48 (19.1%) patients who underwent CPR in the pre-guideline period survived, in the post-guideline period 115 (30.5%) patients who underwent CPR survived, and this difference was statistically significant (p=0.001) (Table 1).

Table 1. Comparison of demographic data of CPR cases before and after 2020

Parameter	Pre-Guideline Period (n:251)	Post-Guideline Period (n:377)	P value
Age	70.36±14.81	70.72±15.83	0.775
Sex			
Female (n:292)	122 (48.6%)	170 (45.1%)	0.387
Male (n:336)	129 (51.4%)	207 (54.9%)	
Mortality			
Live (n:163)	48 (19.1%)	115 (30.5%)	**0.001**
Exitus (n:465)	203 (80.9%)	262 (69.5%)	
Time	2.34±6.77	2.86±7.05	0.359

Regarding the logistic regression analysis, in which we compared the mortality before and after the guideline period with other factors, it was determined that the mortality after the guideline (OR:2.492. 95%Cl:1.473-4.217. p=0.001) was higher regardless of age, gender, and survival time of the survivors. No statistically significant difference was observed in other factors in the regression analysis. (Table 2).

Table 2. Logistic regression analysis comparing survival rates with other factors before and after the 2020 guideline

Parameter	Beta	Wald	Odds Ratio	95% C.I.		P value
				Lower	Upper	
Age	0.004	0.451	1.004	0.993	1.014	0.502
Sex	0.173	1.083	1.188	0.859	1.645	0.298
Mortality	0.913	11.572	2.492	1.473	4.217	**0.001**
Time	-0.026	2.523	0.975	0.944	1.006	0.112

According to Kaplan Meier analysis results of patients who survived after successful CPR at 30 days, the mean number of survival days in the pre-guideline period was 12.25±1.58 (9.150-15.350) days. while the mean post-guideline period survival was 9.41±0.95 (7.556-11.261) days. Although the mean number of days of survival before the guideline was higher, this difference was not statistically significant (p=0.114) (Table 3).

Table 3. Kaplan Meier analysis results at 30-day survival of patients who survived after successful CPR

Date	Mean	Std. Error	95% C.I.		Log Rank P Value
			Lower	Upper	
Pre-Guideline Period	12.250	1.582	9.150	15.350	0.114
Post-Guideline Period	9.408	0.945	7.556	11.261	

It could also be observed that survival times in the pre-guideline period are longer than in the post-guideline period in Kaplan Meier analysis graph as well (Figure 2).

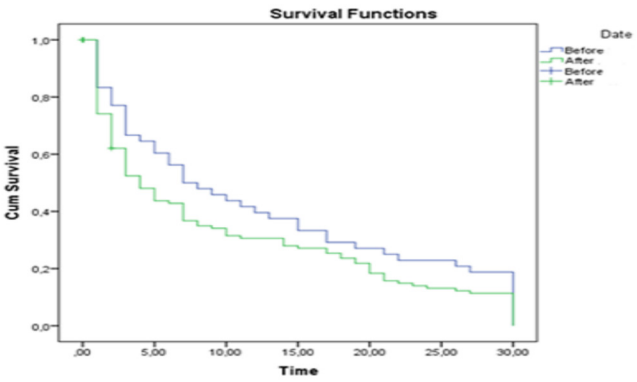

Figure 2. Kaplan Meier graph showing 30-day survival of patients who survived after successful CPR

Discussion

The survival rate in pre-pandemic IHCA cases varied between 10% and 20% [3,11]. It was observed that there were serious changes in these rates after the pandemic. In our IHCA cases, the return rates of the cases who underwent CPR before the guideline change and the patients who underwent CPR after the updated guideline were compared, and it was found that the rate of return after the updated guideline was statistically significantly higher. In a study by Shao et al conducted in Wuhan; they reported that the IHCA results were poor, and the return rate was 13.2% [12]. Thapa et al, in their study with 54 IHCA cases stated that

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while the pre-pandemic return rates were around 25%, this rate decreased to 13% after the pandemic [13]. In our study, the high return rate of 30.5% in patients who underwent CPR after the guideline was different from the literature. The use of personal protective equipment by the personnel working in all clinics after Covid-19 reduces the loss of time related to the intervention of patients. In addition, the decreasing number of patients due to the pandemic taught us how to use healthcare personnel and equipment efficiently. These are possible reasons for the higher rate of return on our results after the guideline. In this context, we believe that survival in resuscitation can be increased by both the effective use of hospitals and the availability of sufficient personnel.

The triage of Covid-19 patients has made patient intervention and care difficult during the pandemic period due to the limited number of beds in the current intensive care unit and the unpredictability of the clinical course. Besides, healthcare workers needed more personal protective equipment (PPE). Due to the increase in this need and the complexity of the PPE wearing procedure, the preparation period in IHCA cases became longer and initiating chest compressions was delayed in terms of the time mentioned in the algorithms. For these reasons, it has been reported that mortality was high in IHCA cases during the pandemic period. Also, in cases with poor prognosis, unnecessary personnel exposure has led practitioners to shorter cardiac arrest times and fewer intubation attempts [14,15]. In a study by Shao et al conducted in Wuhan; post-CPR 30—day survival in IHCA cases has been reported to be 2.9% [12]. Lim et al. reported that pre-pandemic survival rate was 4% whereas this rate decreased to 2.9% after the pandemic [16]. Thapa et al. in their study with 54 cases with IHCA; found a return rate of 13% and reported that 100% mortality was observed in these cases [13]. Girotra et al. in their study with IHCA patients with Covid-19, reported a survival rate of 11.9% after CPR. Hayek et al. reported a survival rate of 11% and Mitchell et al. found a survival rate of 11.9% [17-19]. In our study, it was found that the survival rates in patients who underwent CPR after the guideline were significantly higher (30.5%) than in the patients who underwent CPR before the guideline. In our study, it was found that the survival rates of patients who underwent CPR after the guideline were significantly higher (30.5%) than the patients who underwent CPR before the guideline. In addition, thanks to the development level of the emergency services and intensive care clinics in our country and the high number of patient beds, it has enabled fast and effective intervention during the pandemic period. In our opinion, one of the other reasons for this situation may be the presence of emergency cases with a high recovery rate after cardiac arrest among the cases included in the study.

After the pandemic, there have been delays in the intervention of IHCA patients. In their study, Chan et al. reported the process of wearing personal protective equipment is causing delays and that prolongs the initiation of intervention resulting in higher durations than the suggestions in the algorithm [15]. In our study, we showed that the use of effective protective equipment by the staff in our hospital during the pandemic period prevented the loss of time in the interventions, and thus intervened quickly. In this context, we think that personal protective equipment management (training, algorithm, etc.) to be carried out by health centers will provide fast intervention and good results.

In the results of our study, no significant difference was found between the intervention times in cardiac arrest cases pre- and post-guideline periods.

In our study, it was observed that there was no statistically significant difference in terms of mean age and gender in cases with arrest pre- and post-guideline periods.

As a result, it is seen that the number of patients in the clinics that were busy before the pandemic period decreased worldwide; On the other hand, he learned lessons about the unbearable increase in the number of patients in clinics such as emergency services and intensive care units, the deficiencies in the use of primary health care centers all over the world, and the ineffective use of secondary and tertiary health institutions due to unnecessary patient burden. In this context, we think that the health knowledge level trainings to be given at the social level will produce a solution in this regard, and that the effectiveness of health centers can be increased not only in resuscitation but also in all subjects.

Limitations of Study

There are several limitations of our study. The first of these limitations is that our study was conducted retrospectively. Secondly, since our study was a single-center study. the results may not be generalizable to other health systems. Finally, the treatment and interventions before cardiac arrest in IHCA cases were unknown in this study. Therefore, higher number of patients and results from multicentered studies are needed to generalize our results.

Conclusion

According to the results of the study, it was seen that the survival rate after CPR was higher in the cases after the guideline compared to the survival rates before the guideline. We think that this will be possible with a fully-prepared resuscitation team. In order to generalize the data of our study, it is needed to be supported by multicenter studies with higher numbers of patients.

Conflict of interests
The authors declare that there is no conflict of interest in the study.

Financial Disclosure
The authors declare that they have received no financial support for the study.

Ethical approval
The study protocol was approved by the Canakkale Onsekiz Mart University, Faculty of Medicine Ethics Committee (18920478-050.01.04-E.1900164326, 2011-KAEK-27/2019-1900152520).

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