

Out-of-hospital cardiac arrest treated by emergency medical service teams during COVID-19 pandemic: A retrospective cohort study

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Abstract

Background: *Out-of-hospital cardiac arrest (OHCA) is a challenge for medical personnel, especially in the current COVID-19 pandemic, where medical personnel should perform resuscitation wearing full personal protective equipment. This study aims were to assess the characteristics and outcomes of adults who suffered an OHCA in the COVID-19 pandemic treated by emergency medical service (EMS) teams.*

Methods: *All EMS-attended OHCA adults over than 18 years in the Polish EMS registry were analyzed. The retrospective EMS database was conducted. EMS interventions performed between March 1, and April 30, 2020 were retrospectively screened.*

Results: *In the study period EMS operated 527 times for OHCA cases. The average age of patients with OHCA was 67.8 years. Statistically significantly more frequently men were involved (64.3%). 298 (56.6%) of all OHCA patients had resuscitation attempted by EMS providers. Among resuscitated patients, 73.8% were cardiac etiology. 9.4% of patients had return of spontaneous circulation, 27.2% of patients were admitted to hospital with ongoing chest compression. In the case of 63.4% cardiopulmonary resuscitation was ineffective and death was determined.*

Conclusions: *The present study found that OHCA incidence rate in the Masovian population (central region of Poland) in March–April 2020 period was 12.2/100,000 adult inhabitants. Return of spontaneous circulation in EMS was observed only in 9.4% of resuscitated patients. The presence of shockable rhythms was associated with better prognosis. The prehospital mortality, even though it was high, did not differ from those reported by other studies. (Cardiol J 2021; 28, 1: 15–22)*

Key words: *out-of-hospital cardiac arrest, cardiopulmonary resuscitation, return of spontaneous circulation, outcome, COVID-19*

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Introduction

Out-of-hospital cardiac arrest (OHCA) remains a major public health problem [1], especially in the emergency medical service (EMS) teams, where staff, due to limited personnel, are often forced to choose which procedure to follow first [2]. As Gräsner et al. [3] indicates, the prevalence of OHCA is 40 cases per 100,000 adults. For the United States and Canada, this is close to 400,000 OHCA cases per year, respectively [4]. The higher prevalence of OHCA of 170/100,000 is indicated by Gach et al. in their study [5]. Majority of OHCA occur in adults, with a small proportion occurring in pediatric and young adult populations [6].

The challenges faced by medical staff in terms of OHCA are further hampered by the current COVID-19 pandemic, as every pre-hospital patient should be treated as potentially infected with SARS-CoV-2 until this is ruled out [7, 8]. Therefore, following the recommendations of the World Health Organization (WHO), medical personnel providing medical assistance to patients with suspected/confirmed COVID-19 should be equipped with full personal protective equipment. This applies in particular to aerosol generating procedures, such as airway management or cardiopulmonary resuscitation (CPR) [9, 10]. In Polish settings, EMS personnel are usually equipped with a full protective suit, a mask with FFP2 or FFP3 class filter, protective glasses, visor and double gloves. This garment reduces the risk of infection but, as numerous studies have shown, makes it difficult to perform medical procedures, including those so important for CPR, such as chest compressions [10], airway management [11, 12], obtaining vascular access [13, 14], or the administration of drugs and fluids during resuscitation [15, 16].

This study aims were to assess the characteristics and outcomes of adults who suffered an OHCA in the COVID-19 pandemic treated by EMS teams.

Methods

The study was performed following the ethical standards of the Declaration of Helsinki and approved by the institutional review board of the Polish Society of Disaster Medicine (approval no. 01.06.20.IRB).

Study design

Emergency medical service teams' medical records were analyzed. The data were obtained concerning the largest voivodeship in Poland —

Masovia Voivodeship. Masovia Voivodeship is the largest voivodeship in Poland both in terms of area and population. It also includes the capital of Poland — Warsaw. The region covers an area of 35,558,47 km². As of 31 December 2019, there were about 5.4 million inhabitants, including 4.3 million adults (over than 18 years of age). There are 200 ground-based medical rescue teams located in 128 locations in the voivodeship.

The study population consisted of 527 adult OHCA patients for whom EMS teams intervened from March 1, 2020 to April 30, 2020. Data from adult patients aged 18 years or older with OHCA were analyzed (Fig. 1). Clinical diagnosis was based on the International Statistical Classification of Diseases and Related Health Problems classification in revision 10 [17]. All patients included an intention to treatment analysis. Patients were de-identified after data were collected from digital records.

The study cohort were comprised of adult OHCA patients treated by EMS teams during the above specified periods. Demographic data gathered from electronic medical records included gender, age, medical diagnosis and medical procedure.

Outcomes

Primary outcome of this study was the return of spontaneous circulation (ROSC) in the prehospital period, defined as the steady return of circulation and/or breathing. The etiology of OHCA was categorized as cardiac or noncardiac. Noncardiac causes were subdivided into respiratory disease, stroke, malignant tumor, external causes (e.g., trauma, drowning, burn, asphyxia, or intoxication), or other noncardiac causes. The etiology of OHCA was presumed to be cardiac unless evidence suggested a noncardiac cause [18]. Therefore, the cardiac etiology included confirmed and presumed cases.

Statistical analysis

Data were analyzed by means of the statistical package STATISTICA 13.3EN (Tibco Inc, Tulusa, OK, USA). Categorical variables were expressed as number and percent. Continuous variables were reported as mean and standard deviation (SD) or median and interquartile range (IQR), depending on the normal distribution of the data. Binary data were compared between the treatment groups using by the χ^2 test. Continuous data were compared between groups using the t test. Group differences were calculated, along with their 95% confidence intervals (CI). The authors focused on compar-

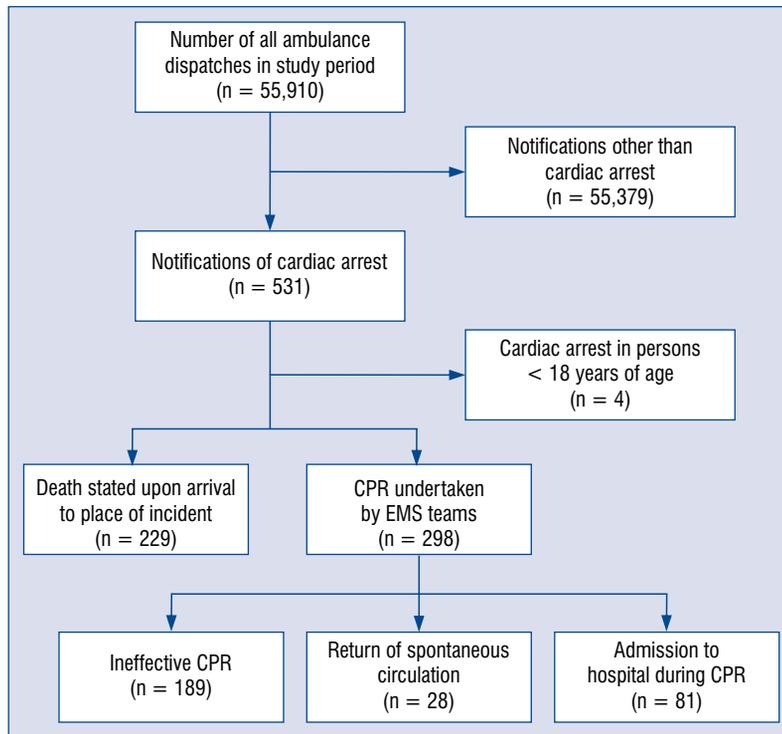


Figure 1. Patients' flow chart; CPR — cardiopulmonary resuscitation; EMS — emergency medical service.

ing means rather than medians, because it was intended to include extreme values in analysis. Thus, the t-test for group comparisons of means was used. A p -value ≤ 0.05 was considered to indicate statistical significance.

Results

In the period from March to April 2020, medical emergency teams from the Mazovian region performed 55,910 interventions, of which 527 interventions were carried out on patients with cardiac arrest, which constituted 0.9% of all intentions in the examined period. CPR was initiated in 298 cases, while in the remaining 229 cases, death before the EMS team had arrived was diagnosed and no resuscitation activities were undertaken (Table 1).

Patients without resuscitation activities where death was diagnosed were statistically significantly older than those in whom CPR activities were undertaken (70.8 vs. 65.4 years, respectively; $p = 0.001$).

The analysis showed that the time from the call to contact was on average 2 min longer in the case of patients who were found dead without resuscitation (12 vs. 10 min; $p = 0.026$, respectively).

On the other hand, there were no significant differences between the groups in terms of etiology of cardiac arrest, the reason reported during the call or rate of resuscitation provided by bystanders (Table 1).

Return of spontaneous circulation analysis

A detailed distribution of patients in whom CPR was implemented is presented in Table 2. Due to the resuscitation status, patients were divided into three groups. In 189 cases CPR was ineffective, was discontinued, and the patient was found dead. In 28 cases there were 28 cases of pre-hospital ROSC, while 81 patients were transferred to hospital during CPR. The group of patients with unsuccessful CPR or were found dead had the highest age — 67.9 years, compared to those with ROSC — 58.3 years, and those transported to hospital with ongoing CPR — 62.0 years (Fig. 2).

Resuscitation was usually provided in the morning and the time of day did not significantly affect the effectiveness of resuscitation; similarly, there was no significant correlation between the effectiveness of resuscitation and the institution of resuscitation by witnesses or the presence of medical personnel during cardiac arrest.

Table 1. Number and Incidence rate of out-of-hospital cardiac arrests in study period.

Parameter	Total (n = 527)	Resuscitation has been initiated (n = 298)	No resuscitation was undertaken (n = 229)	P
Age, mean (SD)	67.8 (16.2)	65.4 (170.2)	70.8 (14.4)	0.001
Age of men	65.0 (15.9)	62.4 (17.4)	68.3 (13.2)	< 0.001
Age of women	72.7 (15.5)	70.7 (15.5)	75.3 (15.3)	< 0.001
Sex:				
Male (%)	339 (64.3)	192 (64.4)	147 (64.2)	1.0
Female (%)	188 (25.7)	106 (35.6)	82 (35.8)	
Weekday (Monday to Friday)	381 (72.3)	217 (72.8)	164 (71.6)	1.0
Weekend (Saturday and Sunday)	146 (27.7)	81 (27.2)	65 (28.4)	
Morning (8 am to 4 pm)	206 (39.1)	120 (40.3)	86 (37.5)	0.768
Evening (4 pm to 11 pm)	176 (33.4)	95 (31.9)	81 (35.4)	
Night (11 pm to 8 am)	145 (27.5)	83 (27.8)	62 (27.1)	
Time from call to contact with patient, min	11.1 (7.0)	10.0 (5.9)	12.0 (8.2)	0.026
Time from call to hospital arrival, min	46.0 (27.3)	45.4 (27.8)		
Time from contact with patient to hospital arrival	57.5 (28.6)	57.3 (29.2)		
Cardiac arrest etiology:				
Cardiac	379 (71.9)	220 (73.8)	159 (69.4)	0.387
Non-cardiac	148 (28.1)	78 (26.2)	70 (30.6)	
Bystander CPR	53 (10.1)	37 (12.4)	16 (10.0)	1.0
SCA in the presence of EMS	25 (4.7)	20 (6.7)	5 (2.2)	1.0
The reason for the call EMS				
Sudden cardiac arrest	134 (25.4)	81 (27.2)	53 (23.1)	0.091
Unconscious	154 (29.2)	89 (29.9)	65 (28.4)	
Syncope	68 (12.9)	37 (12.4)	31 (13.5)	
Chest pain	9 (1.7)	9 (3.0)	0 (0.0)	
Dyspnoea	67 (12.7)	33 (11.1)	34 (14.8)	
Convulsions	13 (2.5)	9 (3.0)	4 (1.7)	
Choking	5 (0.9)	2 (0.7)	3 (1.3)	
Hemorrhage, bleeding	3 (0.6)	2 (0.7)	7 (0.4)	
Injury	3 (0.6)	3 (1.0)	0 (0.0)	
Others	71 (13.7)	33 (11.1)	38 (16.6)	
Initial heart rhythm				
Asystole	400 (75.9)	171 (57.4)	229 (100.0)	< 0.001
PEA	62 (11.8)	62 (20.8)	0 (0.0)	
VF/pVT	65 (12.3)	65 (21.8)	0 (0.0)	

CPR — cardiopulmonary resuscitation; EMS — emergency medical service; NS — not statistically significant; PEA — pulseless electrical activity; pVT — pulseless ventricular tachycardia; SCA — sudden cardiac arrest; SD — standard deviation; VF — ventricular fibrillation

Statistical analysis showed that the first electrocardiogram rhythm observed by medical personnel was significant in terms of CPR effectiveness and follow-up (p = 0.026; Table 2).

Discussion

The aim of this study was perform an epidemiological analysis of OHCA during the imple-

Table 2. Demographic findings according to the relationship between the effectiveness of resuscitation.

Parameter	(A) Died on scene (n = 189)	(B) ROSC (n = 28)	(C) Admission under CPR (n = 81)	P-value	P
Age, mena (SD)	67.9 (16.7)	58.3 (20.7)	62.0 (15.9)	A vs. B = 0.028 A vs. C = 0.007 Other = NS	0.002
Age of men	65.5 (16.7)	54.6 (20.2)	56.3 (18.5)	A vs. B = 0.007 A vs. C = 0.016 Other = NS	< 0.001
Age of women	72.1 (72.3)	66.1 (20.4)	70.2 (17.4)	A vs. B = 0.001 A vs. C = 0.023 Other = NS	< 0.001
Sex:					
Male (%)	120 (63.5)	19 (67.9)	53 (65.4)	NS	1.0
Female (%)	69 (36.5)	9 (32.1)	28 (24.6)		
Weekday (Monday to Friday)	138 (73.0)	18 (64.3)	61 (75.3)	NS	1.0
Weekend (Saturday and Sunday)	51 (27.0)	10 (35.7)	20 (24.7)	NS	
Morning (8 am to 4 pm)	77 (40.7)	9 (32.1)	34 (42.0)	NS	0.460
Evening (4 am to 11 pm)	57 (30.2)	14 (50.0)	24 (29.6)	NS	
Night (11 pm to 8 am)	55 (29.1)	5 (17.9)	23 (28.4)	NS	
Time from call to contact with patient, min	10.8 (5.9)	10.0 (5.9)	9.4 (5.8)	NS	0.427
Time from call to hospital arrival, min		43.6 (18.9)	42.5 (24.0)	NS	0.347
Time from contact with patient to hospital arrival		54.6 (21.4)	53.4 (24.1)	NS	0.249
Cardiac arrest etiology					
Cardiac	142 (75.1)	18 (64.3)	60 (74.1)	NS	1.0
Non-cardiac	47 (24.9)	10 (35.7)	21 (25.9)		
Bystander CPR	23 (12.2)	7 (25.0)	7 (8.6)	NS	1.0
SCA in the presence of EMS	12 (6.3)	2 (7.1)	6 (7.4)	NS	1.0
The reason for the call EMS					
Sudden cardiac arrest	57 (30.2)	6 (21.4)	18 (22.2)	NS	0.650
Unconscious	54 (28.6)	8 (28.6)	27 (33.3)		
Syncope	23 (12.2)	3 (10.7)	11 (13.6)		
Chest pain	6 (3.2)	0 (0.0)	3 (3.7)		
Dyspnoea	21 (11.1)	4 (14.3)	8 (10.0)		
Convulsions	4 (2.1)	3 (10.7)	2 (2.5)		
Choking	2 (1.1)	0 (0.0)	1 (1.2)		
Hemorrhage, bleeding	1 (0.5)	0 (0.0)	0 (0.0)		
Injury	3 (1.6)	0 (0.0)	0 (0.0)		
Others	18 (9.5)	4 (14.3)	11 (13.6)		
Initial heart rhythm					
Asystole	119 (63.0)	15 (53.6)	37 (45.7)	A vs. C = 0.031 Other = NS	0.026
PEA	39 (20.6)	4 (14.3)	19 (23.4)	A vs. B = 0.034 B vs. C = 0.019 Other = NS	
VF/pVT	31 (16.4)	9 (32.1)	25 (30.9)	A vs. B = 0.003 A vs. C = 0.005 Other = NS	

CPR — cardiopulmonary resuscitation; EMS — emergency medical service; NS — not statistically significant; PEA — pulseless electrical activity; pVT — pulseless ventricular tachycardia; SCA — sudden cardiac arrest; VF — ventricular fibrillation

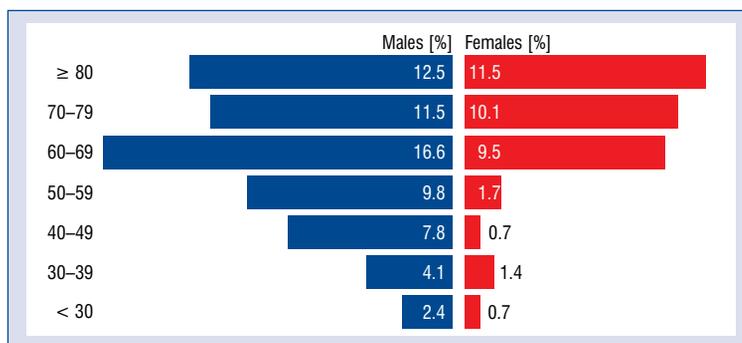


Figure 2. Patient status according to the age.

mentation of restrictions related to the COVID-19 pandemic. According to available research, this is one of the first studies of this type showing the effectiveness of pre-hospital resuscitation during a pandemic, where medical personnel should be dressed in full personal protective equipment and perform all resuscitation activities.

The analysis of the study material showed that 527 patients had OHCA, with only 298 (56.5%) cases of CPR. The remaining patients showed obvious signs of death and died without CPR. Baldi et al. [19] indicates that in the case of Italy, resuscitation was undertaken in 63.5% of patients, while in the same period of 2019 — the percentage of resuscitation undertaken was less than 6% higher.

The mean age of patients with OHCA in the study material was 67.8 years (and 65.4 years for patients on whom CPR was initiated). The age of patients with OHCA in other studies referring to OHCA in COVID-19 outbreak was higher, ranging from 69.7 (17) to 76.3 (2.8) years [19–21]. In the present study, it was also found that men with OHCA were significantly younger than women.

As shown by Baldi et al. [19] the cumulative incidence of OHCA in 2020 was strongly associated with the cumulative incidence of COVID-19 [19, 21]. Baldi et al. [19] compared OHCA that occurred in the provinces of Lodi, Cremona, Pavia, and Mantua during the first 40 days of the COVID-19 outbreak (February 21 through March 31, 2020) with those that occurred during the same period in 2019 and indicate a 58% increase in the rate of OHCA in 2020.

In the current study, cardiac arrest was much more common in men, who accounted for 64.4% of all OHCA, and 64.4% of cases where resuscitation was undertaken. The higher incidence of OHCA in men is also confirmed by other studies [19].

Besides, a study by Baldi et al. [19] which showed an over 5% increase in OHCA prevalence in 2020 compared to 2019 (respectively: 65.5% vs. 60.3%). Baldi et al. [19] also indicates that only 7.8% of patients were transported with ROSC and 10% with ongoing CPR. In the present study, ROSC was obtained in 9.4% of cases where resuscitation was undertaken and in 27.2% of patients who were transported to hospital with ongoing CPR. In the corresponding period of 2019, it was 19.5% for ROSC and 13.2% for transport with ongoing CPR respectively. Pranata et al. [22] suggest that the COVID-19 pandemic was associated with higher OHCA-related mortality. The numbers might be even higher in developing countries due to poor healthcare and emergency medical service systems [22]. In turn Bhatla et al. [23] indicated that cardiac arrests and arrhythmias are likely the consequence of systemic illness and not solely the direct effects of COVID-19 infection.

An important parameter affecting the effectiveness of CPR is the type of the initially observed rhythm. The study showed that the greatest influence on the ROSC concerning ineffective resuscitation was observed when ventricular fibrillation or pulseless ventricular tachycardia was observed as the first monitored cardiac arrest rhythm (odds ratio = 0.43; 95% CI 0.18–1.04). This is also confirmed by numerous studies [24, 25].

The CPR literature lacks consensus among the authors on the impact of witnessed CPR on the outcomes of OHCA. Shimamoto et al. [26] indicated that in nursing homes, bystander CPR was not associated with improved outcomes of OHCA. This is also confirmed by Lukić et al. [27]. In turn Goto et al. [28] show that dispatcher-assisted bystander child CPR was associated with improved 1-month favorable neurological outcomes. Analysis herein, shows that the bystander CPR

was implemented in 10.1% of all OHCA, and in 12.4% of OHCA cases where the EMS team undertook resuscitation, but in none of these cases did it show a significant correlation with ROSC. However, having said this, it should be noted that this data was derived from medical records and a description of the dispatcher's call and does not always take this aspect of previous CPR into account, hence it should be assumed that this result is underestimated.

Limitations of the study

This recent study has potential limitations. The first limitation is the fact that the study concerned only patients with OHCA from the Masovia Voivodeship in March and April 2020. This period was chosen deliberately, because then restrictions related to COVID-19 started to be introduced and according to WHO medical personnel should use full personal protective equipment during CPR. Another limitation is the outcome was monitored only at the pre-hospital stage; however, such knowledge also allows a determination the effectiveness of CPR and to indicate the problem of emergency calls coming too late for medical rescue teams.

Conclusions

The present study found that OHCA incidence rate in the Masovian population (central region of Poland) during the March–April 2020 period was 12.2/100,000 adult inhabitants. ROSC in EMS was observed only in 9.4% of resuscitated patients. The presence of shockable rhythms was associated with better prognosis. The prehospital mortality, even though it was high, did not differ from those reported by other studies.

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Conflict of interest: None declared

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