Out of hospital cardiac arrest during COVID-19 pandemic: A retrospective study from north east of Italy

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Abstract

The novel coronavirus disease 2019 (COVID-19) outbreak affected the epidemiology and the outcomes of Out-Of Hospital Cardiac Arrest (OHCA). We performed a retrospective observational study in the Western district of Vicenza (Veneto, Italy) to evaluate patients affected by non-traumatic OHCA and we analyzed epidemiological and clinical characteristics associated with sustained Return Of Spontaneous Circulation (ROSC). We collected 114 cases from January 2019 to May 2021 and we compared data of the pre-pandemic period (2019) with the pandemic one (2020-2021). During the pandemic we found an increase of bystander CPR, of OHCA with a cardiac cause and of shockable presenting rhythms. All these observations weren't associated with an increase of sustained ROSC, which could be determined by both the reorganization of the health care system with the reduction of medical screenings and by the interruption of training courses reducing the efficacy of cardiopulmonary resuscitation. On the other hand, the higher percentage of presenting shockable rhythm reinforces the importance of bystander rule and of short time to start CPR.

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Introduction

Out-of Hospital Cardiac Arrest (OHCA) is one of the major causes of death worldwide. It represents an important challenge for medical operators and a lot of efforts have been done to improve resuscitation rate and long-term outcomes. The quality of Cardiopulmonary Resuscitation (CPR) maneuvers is the most important endpoint, starting from a rapid bystander activation of chest compressions, early defibrillation in case of shockable rhythm, good chest compressions rate and depth, adherence to pharmacological algorithm and use of some important devices such as ETCO2, external chest compression device (LUCAS®) and ultrasound. Adequate and constant training is also another essential piece of the puzzle for high quality CPR. The novel coronavirus disease 2019 (COVID-19) outbreak affected the epidemiology and the outcomes of OHCA. Some studies, both in Europe and in the United States performed during COVID-19 pandemic, have reported an increase of the incidence and mortality of OHCA.[1,2] A lot of direct and indirect factors may explain these observations: severe hypoxia caused COVID-19 pneumonia, myocardial and coronary inflammation, arrhythmias, pulmonary embolism, a delay in treating time-dependent conditions as acute coronary syndromes[3] and the fear for COVID-19 infection that might have impaired resuscitation maneuvers.

Moreover, the restriction determined by the pandemic lockdown reduced dramatically the possibility to enter and accomplish specific training programs, both for healthcare operators and for the general population.

In order to evaluate the impact of COVID-19 pandemic in OHCA outcomes, we planned a retrospective analysis in the rural west district of Vicenza (Italy), comparing the pre-pandemic period with pandemic years.

Materials and Methods

We performed a retrospective observational study in the rural western district of Vicenza (Veneto, Italy), which counts nearly 120.000 inhabitants, to evaluate patients affected by non-traumatic OHCA and we analyzed epidemiological and clinical characteristics associated with sustained Return Of Spontaneous Circulation (ROSC).

Inclusion criteria were subjects older than 18 years old who underwent CPR performed by the pre-hospital medical emergency service of the Western district of Vicenza, whereas all the subjects who did not undergo RCP by the emergency medical service team were excluded.

The emergency medical service team was made by one doctor, one nurse and one driver with a basic life support and defibrillation certificate.

CPR was performed according to the current Advanced Cardiac Life Support (ACLS) guidelines. The monitoring, rhythm diagnosis and defibrillation were performed using Zoll X Series®. When indicated by the team leader, LUCAS® chest compression device was applied for external mechanical chest compressions.

Point Of Care Ultrasound (POCUS) was performed using a Sonosite Nanomax® ultrasound, both during CPR to evaluate the quality of chest compressions and during the 10 seconds pauses for the rhythm check.

LMA® Supreme™ was used as sovraglottic device, whereas orotracheal intubation was performed according to the indications of the team leader.

No data regarding post-resuscitation care after hospital admission, or survival at the hospital discharge are included in the database.

All the patients with a sustained ROSC were transported to a tertiary care center. In our study a sustained ROSC was represented by survival to hospital admission.

A cardiac cause of the cardiac arrest was defined by the recording of a presenting shockable rhythm by the Advanced Life Support (ALS) team.

We excluded from the data-analysis traumatic-OHCA, people aged less 18 years, patients declared dead soon after the arrival of the ALS team and without any resuscitation maneuvers.

Data were represented as mean and Standard Deviation (SD) for quantitative date, whereas qualitative data was transformed into frequencies and percentages.

The comparison of means between groups was performed using student's T- test, Pearson chi-squared test with Yates continuity correction was used to compare categorical data within groups.

A P-value lower than 0.05 was considered significant.

Statistical analysis was performed using GNU PSPP 0.10.2 free software.

Results

We collected 114 cases from January 2019 to May 2021, and we compared data of the Pre-Pandemic Period (P-PP; January 2019 to January 2020, 64 cases) with the Pandemic Period (PP; March 2020- March 2021, 50 cases).

Baseline characteristics of the study population are shown in Table 1.

In particular, we did not find any significant differences between P-PP and PP for age, gender, CPR duration and mean time of ALS team arrival.

Furthermore, we did not find any significant difference in ROSC rate.

Anyway, in PP we found a significant increase of shockable rhythm (28% *vs* 11% p=0.026) and bystander CPR (73% *vs* 44% p=0.004).

In PP we observed a significant increase of endotracheal

Table 1. Demographic and clinical characteristics of patients; comparison between pre-pandemic period (P-PP) and pandemic period (PP).

	2019-2021 (%)	PP-P (%)	PP (%)	p (PP-P vs PP)
N cases	114	64	50	/
Age (years)	71.2 ± 15.9	71.3 ± 17.3	71.1 ± 14.3	0.926
Male sex	70	72	69	0.808
Shockable rhythm	18	11	28	0.026
CPR time (minutes)	33.5 ± 14.8	31.1 ± 13.3	35.7 ± 15.9	0.122
Bystander CPR	56	44	73	0.004
ALS team arrival (minutes)	13.3 ± 7.1	14.0 ± 7.6	12.4 ± 6.5	0.250
Endotracheal intubation	54	42	68	0.011
Epinephrine (mg)	4.2 ± 2.8	3.5 ± 2.4	5.1 ± 3.1	0.002
ROSC	14	14	14	1
POCUS	6	3	10	0.261
LUCAS	56	42	74	0.001
CAUSES				
• UNKNOWN	67	81	50	
• CARDIAC	22	8	40	
• HYPOXIC	7	8	6	0.001
• HYPOVOLEMIC	3	3	2	
• OBSTRUCTIVE	1	0	2	

Data are shown as percentages or mean±standard deviation. CPR: cardiopulmonary resuscitation; ALS: advanced life support, POCUS: point-of care ultrasound.

intubation (68% *vs* 42% p=0.011), LUCAS® application (74% *vs* 42% p=0.001) and mean dosage of epinephrine (5.1±3.1 mg *vs* 3.5±2.4 p=0.002).

Moreover, in the PP we observed an increase of cardiac causes of cardiac arrest and a reduction of unknown cause of OHCA (40% *vs* 8% and 50% *vs* 81% respectively; p=0.001).

Interestingly, as shown in Table 2, in P-PP 67% of shockable rhythms reached ROSC, whereas the percentage decreased significantly in the PP (9%; p=0.000). Consequently, in PP presentation rhythm wasn't strictly associated with ROSC.

Similarly, the percentage of bystander CPR was higher in those patients who reach the ROSC in the P-PP (25% *vs* 6% p=0.063), even if the result was not completely significant; this result was not observed during the PP (14% *vs* 8% p=0.902). Furthermore, in P-PP we observed that 80% of cardiac arrest by cardiac cause reached ROSC (p=0.000), contrary to PP where there was not a significant difference, in term of ROSC, among the causes of cardiac arrest (p=0.852).

Finally, endotracheal intubation was associated with ROSC in P-PP (26% *vs* 5% p=0.049), whereas the same data was not confirmed during the PP (18% *vs* 6% p=0.518).

Discussion

COVID-19 outbreak affected epidemiological and clinical data of OHCA in the last two years. In particular lockdown periods, infection fear, COVID-19 related diseases influenced the approach to OHCA's CPR.

In the study of Baldi *et al*. in Lombardia, the biggest northern region of Italy, OHCA increased by 58% in February-March 2020 compared to the same period in 2019. They also reported an increase of the number of cardiac arrests determined by medical causes, a higher incidence of cases occurred at home, a longer mean time of ALS team arrival and a higher mortality (14.9%; death in the field 2020 *vs* 2019, 82.2% *vs* 67,3%).[4] Similarly, Uy-Evanado A and coworkers found a reduction of bystander CPR and AED use, an increase of the time to reach the setting of the cardiac arrest and finally a higher mortality.[5] In our study we didn't find any significant difference in ROSC rate during the pandemic (14% both in P-PP and in PP), even if the overall mortality rate of our region was increased by 27%, with a peak of 57% in November 2020, according with the epidemiologic data of Veneto region.[6]

It is well known that the time to start CPR, the quality of CPR and bystander CPR are important determinants for a successful resuscitation.[7]

Our data did not find any significant difference regarding the mean time of ALS team arrival to the scene and this is in contrast with the need to put on all the required DPI in case of patients with a suspected COVID-19 infection. We supposed that it can be explained by the important traffic limitations enforced during the lockdown.

Furthermore, we found a significant increase of bystander CPR in pandemic period. This may be explained both by a higher number of OHCA that occurred at home or in private residences and by an early CPR performed by members of the family. This data, in association with unchanged time to scene arrival, may explain also the increase of shockable rhythm at presentation. Shockable rhythms are usually associated to cardiac causes of cardiac arrest and an early defibrillation is often necessary to achieve the ROSC. Furthermore, post-resuscitation treatment is specific, standardized and potentially definitive.[8] But in our study both increased rate of bystander CPR and shockable rhythm at presentation weren't associated with increased ROSC rate.

We found similar results in a meta-analysis by Al-Jabory and coworkers. They showed a slightly higher number of bystander CPR in pandemic period, compared with non-pandemic period, and, surprisingly, a lower percentage of effective resuscitations.[9]

In pandemic period endotracheal intubation increased. Even though ACLS guidelines indicates that ETI and noninvasive airways management have the same class of recommendation and level of evidence,[10] invasive airway management can solve hypoxia-induced cardiac arrest, which could have been more common during the pandemic.

During Sars-CoV-2 pandemic advanced oxygenation and ventilation strategies should be considered and prioritized in order

Table 2. Relationship of qualitative data of ROSC; comparison between Pre-Pandemic Period (P-PP) and Pandemic Period (PP).

		2019-2021		P-PP		PP	
		ROSC (%)	p	ROSC (%)	p	ROSC (%)	p
SEX	MALE	15	0.973	13	1	18	0.518
	FEMALE	12		17		6	
RHYTHM	SHOCKABLE	30	0.074	67	0.000	14	1
	PEA/ASYSTOLE	11		9		14	
BYSTANDER CPR	YES	19	0.087	25	0.063	14	0.902
	NOT	6		6		8	
AIRWAYS MANAGE-MENT	ETI	21	0.033	26	0.049	18	0.518
	BMV/LMA	6		5		6	
POCUS	YES	14	1	0	1	20	1
	NOT	14		14		13	
LUCAS	YES	11	0.421	15	1	8	0.119
	NOT	18		14		31	
CAUSES	UNKNOWN	9	0.133	8	0.000	12	0.852
	CARDIAC	28		80		15	
	HYPOXIC	25		20		33	
	HYPOVO-LEMIC	0		0		0	
	OBSTRUC-TIVE	0		0		0	

Data are shown as percentages. CPR: cardiopulmonary resuscitation; POCUS: point-of care ultrasound.

to lower aerosolization risk. In fact, an early invasive airway management with HEPA filters was suggested by 2020 Interim Guidance for Basic and Advanced Life Support in Adults, Children, and Neonates with Suspected or Confirmed COVID-19.[11]

At the same time LUCAS® chest mechanical device was applied more frequently during the pandemic, helping the operators to maintain appropriate distances from patients' chest and airway. Anyway, there are conflicting data about the relationship between LUCAS® and OHCA outcome.[12] A recent meta-analysis by Zu *et al.* failed to show significant differences in the resuscitative effects of mechanical and manual chest compression in terms of ROSC rate, the rate of survival to hospital admission, survival to hospital discharge and neurological function in OHCA patients.[13]

Even though our results did not show any improvement of ROSC, we support the use of external chest compression devices in OHCA both to improve CPR quality, when a low number of rescuers is available, and operators' safety.

Furthermore, in pandemic period we found an increase of bystander CPR and of shockable presenting rhythms, even though these data did not determine a higher rate of ROSC. We can speculate that the quality of bystander CPR was poor, because bystanders might have started resuscitation maneuvers with reluctance and omitting rescue breaths for the fear of COVID infection. In addition, educational programs were interrupted during the last two years, both for healthcare workers and laypeople.

Finally, the increased of the number of OHCA with a cardiac cause in the pandemic period was not associated with ROSC. We think this finding could be strictly connected with the reorganization of national health care system during pandemic period that led to the interruption of a lot of screening programs for patients affected by cardiovascular disease.[14,15] At the same time COVID-19 infection might have worsened cardiovascular disease leading to myocardial injury, myocarditis, acute myocardial infarction, heart failure, dysrhythmias and venous thromboembolic events.[16]

Conclusions

In conclusion our study did not show a significant difference in the number of OHCA and in the time of ALS arrival to the scene during the pandemic in comparison with the pre-pandemic period.

On the contrary we observed a higher percentage of bystander CPR during pandemic, which could be associated with more shockable presenting rhythms.

Interestingly, all these observations were not associated with an increase of sustained ROSC, which could be determined by both the reorganization of the health care system with the reduction of medical screenings and by the interruption of training courses reducing the efficacy of cardiopulmonary resuscitation. On the other hand, the higher percentage of presenting shockable rhythm reinforces the importance of bystander rule and of short time to start CPR.

The management of OHCA performed by ALS teams was characterized by a more frequent application of a chest compressions mechanical device and a higher percentage of invasive airway management. These findings were strictly connected with the attempt to reduce infection risk and improve airway management during the pandemic in accordance with international guidelines.

Our study has several limitations. First of all, it is a retrospective analysis and we do not have any standardized OHCA registry yet.

Consequently, we could not estimate the real incidence of OHCA of our region for several reasons: our data were collected only from small area of the Western district of Vicenza that are mainly characterized by rural areas, especially during the pandemic period; many people died in their own home without calling the emergency medical service; we did not include in the study subjects who were declared dead by the ALS team without resuscitation maneuvers; some cases have been missed. So, the overall number of OHCA has been underestimated.

Then, we do not have any information regarding post resuscitation outcomes and care in patients with ROSC and a specific diagnosis is missing in many cases, especially for those without ROSC.

Finally, we cannot estimate precisely the number of OHCA victims affected by COVID-19 infection.

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