

Magdalena Joanna Borkowska

**Ocena wpływu pandemii COVID-19 na przeżywalność  
pacjentów z zatrzymaniem krążenia**

Assessment of the effect of the COVID-19 pandemic on outcomes  
of patients with cardiac arrest

**Streszczenie w języku angielskim**

Promotor: Dr hab. n. med. Łukasz Szarpak

Warszawa, 2022

## **Introduction**

Sudden cardiac arrest, despite the development of medicine, is still a challenge for medical personnel, especially in terms of the activities of emergency medical teams, because of the limited availability of medical personnel. The survival of patients with sudden cardiac arrest is influenced by many factors, including those related to the patient's comorbidities, the circumstances of the occurrence of SCA and its finding, as well as the ability to undertake and conduct resuscitation by casual witnesses of the event, time of arrival of medical personnel, time to implement electrotherapy and advanced resuscitation procedures or the quality of post-resuscitation care for patients who have returned to spontaneous circulation. Good organization of assistance in the event of sudden non-hospital cardiac arrest is based on training potential witnesses of the incident, preparing the local community for such an incident, the quality of actions taken by both witnesses, dispatchers and emergency medical teams, and reliance on intensive care units, which in many countries are centers of care for patients after cardiac arrest. Post-resuscitation care is an important element of the continuum of care and should be based on a wide range of diagnostic and therapeutic options, however, the quality of activities undertaken in the first minutes after the occurrence of a SCA event is of primary importance.

Since December 2019, the world has faced a huge medical, organizational, social and economic challenge, namely the SARS-CoV-2 coronavirus pandemic that causes the COVID-19 disease. The SARS-CoV-2 coronavirus causes acute respiratory failure in some patients, may also cause damage to the heart muscle or promote thromboembolic complications, which may lead to cardiac arrest. In addition, SARS-CoV-2 infection is transmitted mainly by droplets, which require medical personnel to use barrier agents that may impede the performance of specific medical procedures, and thus reduce the chances of their survival in patients with cardiac arrest. Conducting cardiopulmonary resuscitation is demanding both in terms of the correctness of the rescue procedures undertaken and the quality of their performance. The necessity to use protective measures may influence the quality and effectiveness of resuscitation activities in various ways, including, first of all, the time to reach the patient, parameters related to the quality and time of airway protection, and the quality of chest compressions. The impact of the pandemic on the survival of patients with SCA results from many aspects, including the possible deterioration of care for elderly patients, problems with social isolation, the reaction time of the witnesses of the incident, the fears of the witnesses of the incident for their own safety, the moments of the pandemic waves, work and the excess of reports, the impact of security measures on the quality of services provided and organizational issues related to the availability of places in intensive care units. All these factors might reduce the survival rate of patients.

## **Aim**

The common goal of the series of studies included in the monothematic series of publications that form the basis of the doctoral dissertation is to assess the impact of the COVID-19 pandemic on the survival outcomes of patients in cardiac arrest in both pre-hospital and in-hospital settings.

## **Material and methods**

The series of publications constituting the basis of the doctoral dissertation included three publications whose total score of the Ministry of Education and Science was 340 points, and the total Impact Factor score was 9.716 points. The first study was designed and conducted as a retrospective analysis of the mobility of emergency medical teams from the Masovia region to patients with cardiac arrest. The period of the onset of the COVID-19 pandemic from March 1 to April 30, 2020, was analyzed. During the period under study, 527 cases of emergency medical teams intervened in patients with out-of-hospital cardiac arrest.

The first study was designed and conducted as a retrospective analysis of the mobility of emergency medical teams from the Masovia region to patients with cardiac arrest. The period of the onset of the COVID-19 pandemic from March 1 to April 30, 2020 was analyzed. During the period under study, 527 cases of emergency medical teams intervened in patients with out-of-hospital cardiac arrest.

The second study was designed as a meta-analysis to assess the impact of the COVID-19 pandemic on the survival of patients in community cardiac arrest. In order to select studies qualified for meta-analysis, a review of electronic writing databases (MEDLINE, EMBASE, Web of Science, Scopus and COCHRANE) was performed. The last database search was carried out on February 19, 2021. Based on a keyword list, a database search identified 242 potentially relevant publications. Ultimately, however, five studies reporting data from 4,210 out-of-hospital CPR cases were included in the meta-analysis. Survival to hospital discharge was the primary endpoint. In addition, the following parameters were also analyzed: implementation of advanced resuscitation procedures, return of spontaneous circulation at the pre-hospital stage, survival on admission to hospital and discharge from hospital in good neurological condition (assessed on the basis of the CPC scale at 1-2).

The third study was also designed as a meta-analysis, however, it looked at the impact of the COVID-19 pandemic on the survival of patients with in-hospital cardiac arrest (IHCA). The study, like the second study, was conducted based on the PRISMA methodology. Based on the defined keywords, electronic databases were searched, including Medline, Embase, CENTRAL, Web of Science or Scopus databases. The last search of the above databases was made on February 2, 2021. Based on the search, four studies were included in the meta-analysis. The primary endpoint of the study was 30-day hospital survival. Additionally, the frequency of spontaneous circulation return, total mortality as well as survival to hospital discharge in good neurological condition were assessed.

## **Results**

The first study analyzed the departure of emergency medical teams to patients in cardiac arrest during the first months of the COVID-19 pandemic. In the analyzed period, the frequency of OHCA was 12.2 per 100,000 inhabitants of the Masovia voivodeship. Out of 527 interventions until cardiac arrest, only 56.5% underwent CPR. The analysis showed that the median arrival of the EMS team was on average 2 minutes longer in the non-resuscitation group compared to the resuscitation group (12 and 10 minutes, respectively;  $p = 0.026$ ). The groups of patients who underwent CPR versus those who did not initiate CPR differed in age ( $65.4 \pm 17.2$ , respectively) and  $70.8 \pm 14.4$  years;  $p = 0.001$ ). The return of spontaneous circulation in pre-hospital conditions was observed in only 9.4% of patients, with 27.2% of patients admitted to the hospital emergency department during the ongoing resuscitation operation. On the other hand, in the remaining 63.4% of cases, resuscitation was ineffective, and the patient died.

In the second study to assess the impact of COVID-19 on the survival of patients with cardiac arrest outside the hospital, the survival to hospital discharge was 0.5% in patients with suspected or confirmed COVID-19 and was statistically significantly lower than in the group of patients, who were not diagnosed with COVID-19 (2.6%;  $p < 0.001$ ). In turn, the survival to discharge from hospital with good neurological status was 0.0% vs. 3.1% ( $p = 0.07$ ). The return of spontaneous circulation was observed in 13.3% of COVID-19 patients and 26.5% of patients without COVID-19 ( $p < 0.001$ ). In addition, the groups of patients with and without COVID-19 showed slight differences in terms of the following parameters: resuscitation undertaken by an incident witness (51.4% and 49.1%;  $p = 0.43$ ), implementation of advanced life support procedures (49.7% and 55.8%;  $p = 0.29$ ), presence of shockable rhythm during patient assessment 5.7% and 37.4% ( $p = 0.04$ ), or use of mechanical chest compression systems (6.7% respectively) and 25.5%;  $p = 0.54$ ).

The third study looked at the impact of the COVID-19 pandemic on the survival of in-hospital cardiac arrest. In the present period, the recovery of spontaneous circulation in the pre-pandemic period compared to the pandemic period was 51.9% and 48.7%, respectively ( $p = 0.33$ ). In turn, the survival to hospital discharge was 35.6% and 32.1% ( $p = 0.16$ ), while the survival in good neurological condition was statistically significantly higher in the period preceding the COVID-19 pandemic (27.3%) than in during the COVID-19 pandemic (9.1%;  $p = 0.02$ ). Additionally, the patient survival rate during the pandemic was analyzed. Comparing the groups of patients diagnosed with COVID-19 compared with patients without COVID-19, significant differences were shown in terms of return to spontaneous circulation (30.5% and 52.6%;  $p = 0.001$ ) and survival to hospital discharge (25.0% and 41.8%;  $p = 0.01$ ).

## **Conclusions**

The conducted research allows for the formulation of the following conclusions:

- Extending the travel time of an emergency medical team during a pandemic reduces the patient's chances of survival;
- In the initial period of the COVID-19 pandemic, mortality as a result of cardiac arrest outside the hospital in the population of Mazovia residents, although it is high, does not differ from the results obtained in other studies;
- The COVID-19 pandemic, compared to the pre-pandemic period, did not reduce the frequency of cardiopulmonary resuscitation by the witnesses of the event;
- Co-occurrence of COVID-19 in patients with cardiac arrest in both pre-hospital and in-hospital settings reduces the frequency of shockable rhythms and reduces the chances of survival until hospital discharge.