ISSN: 2545-2533 DOI:10.32114/CCI.2019.2.3.1.10

CCI JOURNAL CRITICAL CARE INNOVATIONS

Crit. Care Innov. 2019; 2(3):1-10

ORIGINAL ARTICLE

Survival in sudden cardiac arrest in emergency room: case-control study.

Oliwia Sosnowska-Mlak [1] ORCID https://orcid.org/0000-0002-4995-4783,

Nicolas Curt[2] ORCID https://orcid.org/0000-0001-8853-8195,

Luis M. Pinet Peralta [3] ORCID https://orcid.org/0000-0002-4864-3705.

[1]*Department of Nursing and Emergency Medicine, Siedlce University of Natural Sciences, and Humanities, Siedlce, Poland*

[2] *Collège des Cordeliers, Oloron-Sainte-Marie, France*

[3] *Maryland Institute for Emergency Medical Services Systems / University of Maryland School of Medicine, College Park, United States*

ADDRESS FOR CORRESPONDENCE:

Oliwia Sosnowska-Mlak, Department of Nursing and Emergency Medicine, Siedlce University of Natural Sciences, and Humanities,

Prusa 14, 08–110 Siedlce, Poland; e-mail: boetius@interia.pl

ABSTRACT

INTRODUCTION: A systematic analysis of risk factors, causes of sudden death and patient survivability allows implementation of increasingly effective methods and procedures for sudden cardiac arrest (SCA). The conditions of the emergency room (ER) allow for initial medical imaging and laboratory diagnostics, which facilitate the assessment of critical parameters that may be a predictor of SCA. The aim of the study is to determine survival of patients in the ER who experience SCA and to identify the factors that increase the likelihood of SCA.

MATERIAL AND METHODS: The study was conducted in 2018 using medical records of 73 patients who experienced SCA in the ER. Descriptive statistics and data analysis were performed using parametric tests (Pearson test). The level of significance was determined for $p < 0,05$.

RESULTS: The average patient age was 72 years (SD ± 16.29). In most cases, the patients were brought to the ER by the EMS. Sinus rhythm was the most prevalent ECG rhythm, before the onset of SCA, followed by asystole (50.7%), PEA (32.9%) and VF / pVT (16.4%), respectively. Approximately half of the patients (50.7%) achieved ROSC, while 49.3% of ER patients did not. The relationship between mortality and PO2, methanol, MPV, D-dimer, pH and HCO3 has been demonstrated.

CONCLUSIONS: In this sample of patients with SCA, non-defibrillatory rhythms (asystole, PEA) dominated. Half of the patients managed to achieve ROSC while in the ER. There are predictors of SCA in patients in ER.

KEY WORDS: sudden cardiac arrest, emergency room, acute coronary syndrome, heart failure

INTRODUCTION

Sudden cardiac arrest (SCA) occurring both in pre-hospital conditions and in the presence of hospital staff, has been an issue that has absorbed the medical community for many years. Data about the causes of SCA are limited, even among hospitalized patients. Resuscitation of patients with Out-of-Hospital Cardiac Arrest (OHCA) is associated with a high risk of failure and a lack of specialized diagnostic tools. In the emergency room (ER), early diagnosis and prompt treatment should be sought for every patient who experiences SCA in order to maximize the likelihood of ROSC (Return of Spontaneous Circulation).

Exacerbation or complication of SCA (including acute coronary syndrome), pulmonary embolism, intoxication (drugs, alcohol), disseminated neoplastic process or consequence of an accident are given as the main cause of SCA [1]. The most common incidents related to SCA occur at home (80% of events), while only 15% occur in public places. Only 2% to 15% of these cases reach the hospital and up to half of the patients brought to the emergency room survive[2, 3].

Arrhythmias significantly increase the risk of heart attack, and metabolic changes such as hypoxia and ischemia, calcium accumulation, loss of potassium and cell acidosis are factors favoring its occurrence [4, 5]. Ventricular Fibrillation (VF) and Pulseless Ventricular Tachycardia (pVT) are given as the most common electrophysiological mechanisms leading to SCA. Then there are successively: asystole (no mechanical heart activity) and Pulseless Electrical Activity (PEA) [6]. Hence, early recognition of the mechanism and causes of SCA as the foundation for out-of-hospital and hospital treatment becomes a priority. The aim of the study is to assess the survival rate of patients who experienced SCA in the ER. The authors also attempt to determine predictive factors related to the occurrence of SCA and death.

MATERIAL AND METHODS

The study was conducted in 2018 in the archives of the ER of the Provincial Specialist Hospital named after Stefan Cardinal Wyszyński Independent Public Health Care Center in Lublin. The study was based on medical records of 686 patients who experienced sudden cardiac arrest. Seventy-three out of 686 people met the inclusion criteria for the study (occurrence of SCA in ER, complete documentation). The study received IRB approval (No. 2/2018).

Our dependent variable was SCA outcome and covariates of interest included age, sex, distance from the place of emergency at the SOR, way of getting to the ER (alone / EMS), primary SCA mechanism, blood test results, and initial diagnosis before SCA. Statistical analysis was performed using Statistica 13 computer software (version 13 PL). The results for which values were considered statistically significant were $p<0,05$. Parametric tests (Pearson's test) were used for statistical analysis of variables with normal distribution.

RESULTS

Study group

Demographic and clinical characteristics of the study group show that out of 73 patients, 47 of them (64.38%) were men, and 26 (35.62%) were women (Tables 1 and 2). The average age was 72 years (SD ± 16.29) with a range of 27 to 89 years. Sixty-two (89.86%) patients were brought to the ER by EMS, while seven (10.14%) patients arrived to the hospital in private vehicles (n = 7). The other four patients arrived in the ER through other means (e.g. sanitary transport).

In the ECG tests carried out in ER patients, sinus rhythm was the most prevalent at 68% followed by bradycardia at 10%, by changes characteristic of ACS STEMI at 9%, atrial fibrillation at 7% and tachycardia at 6% (Figure 1).

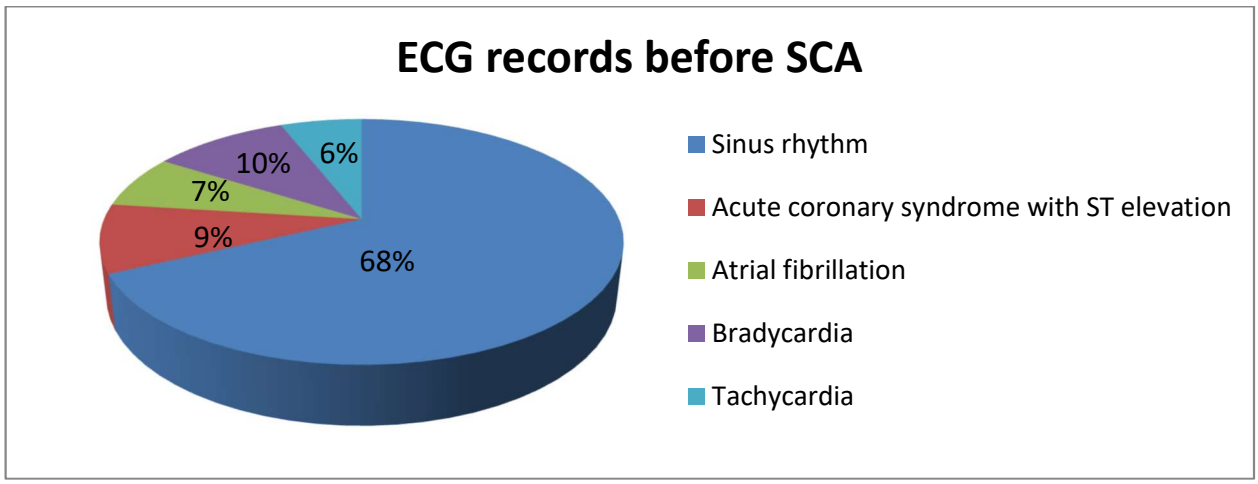

Figure 1.ECG records before SCA.

Table 1. Demographic and clinical characteristics of the study group.

Variable	N(%)
Sex:	
Female	26(35,6%)
Male	47(64,4%)
Brought by the Emergency Medical Team:	
No	11(15,1%)
Yes	62(89,9%)
ECG (records before SCD):	
asystole rhythm	47(68,1%)
Acute Coronary Syndrome, uniesienie ST	6(8,7%)
Atrial fibrillation	5(7,3%)
Bradycardia	7(10,1%)
Tachycardia	4(5,8%)
No ECG acording	4(5,8%)
ECG (SCD mechanism):	
Asystole rhythm, including:	37 (50,7%)
- brady-asystole rhythm 7 (9,6%)	
PEA, including:	24 (32,9%)
- bradycardia 3(4,1%),	
- bradyarrhythmia 1 (1,4%),	
- 3rd degree block1 (1,4%)	
VF/pVT	12 (16,4%)
Diagnosis before SCD:	
Myocardial infarction / ACS	12 (16,5%)
Heart failure	12 (16,5%)
Alcohol intoxication	6 (8,2%)
Malignant tumor	6 (8,2%)
Pneumonia	4 (5,5%)
Pulmonary Embolism	3 (4,1%)
Stroke	3 (4,1%)
Others	27 (37%)
Survival on ER:	
ROSC	37 (50,7%)
Death	36 (49,3%)

Table 2. Characteristics of the study group, demographic and clinical components.

Variable	Average	Median	Minimum	Maksimum	Standard deviation
Age	68,88	72,00	27,00	89,00	16,29
Distance from the hospital [km]	12,63	4,80	0,03	55,00	14,60
Prehospital episodes of SCD [n]	0,17	0,00	0,00	1,00	0,38
SCA episodes in hospital [n]	0,64	0,00	0,00	5,00	1,16

The ECG mechanism in which the SCA occurred included sequentially: asystole (50.7%), PEA (32.9%), and ventricular fibrillation (16.4%). Patients admitted for cardiac arrest were predominantly diagnosed with myocardial infarction/ACS and heart failure (16.45%), followed by alcohol poisoning (ethyl, methyl and ethylene glycol) and malignancy (8.2% each), pneumonia (5.5%), pulmonary embolism (4.1%) and stroke (4.1%). Other less common diagnoses were reported in 37% of patients (e.g. acidosis, hyperglycemia, respiratory failure, shock, hypothermia, acute multiorgan failure, acute pancreatitis, alcoholic liver disease, pneumonia, ascites, renal failure, spinal fracture, anemia, abdominal haemorrhage, sepsis, toxic liver disease, rhabdomyolysis). Thirty-seven (51%) patients achieved ROSC while in the ER and the average distance from the scene to the hospital was 12.63 ± 14.60 km.

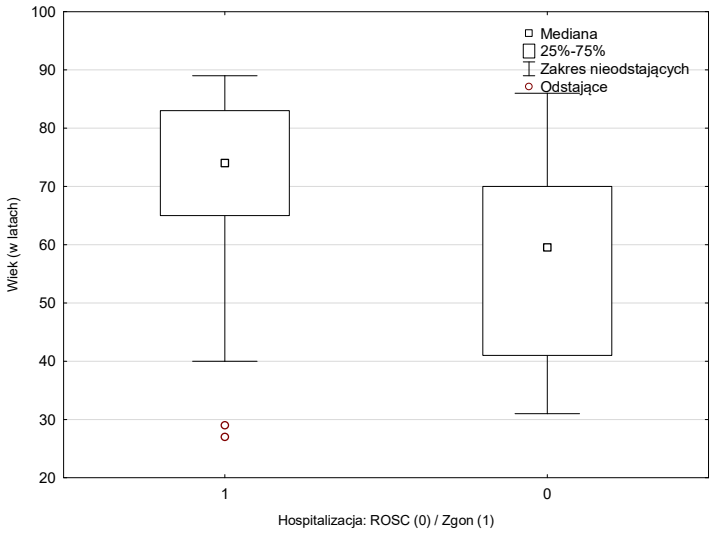

Figure 2. Patients' age and death from SCA in the (p=0,0074)

Correlation between sociodemographic factors and mortality

Results also show that that older people died more often as a result of SCA during their stay in ER compared to younger people (72,05 vs 57,08 year old; p=0,0074; Figure 2).

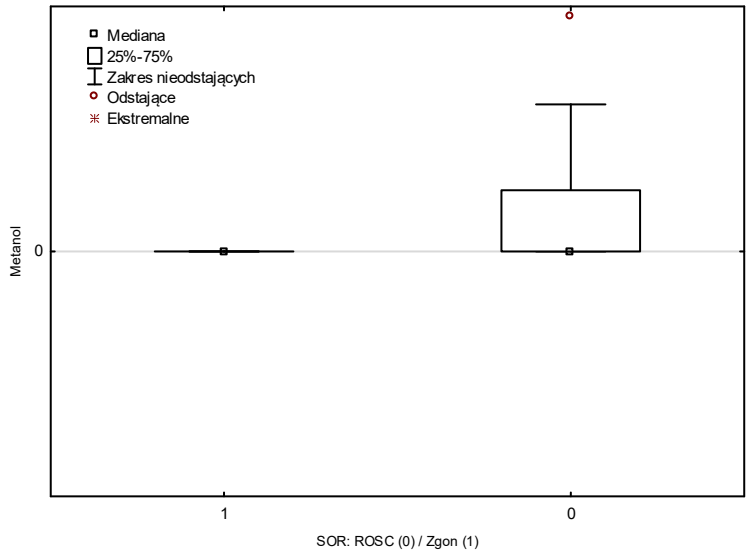

Figure 3. Methanol level and death from SCA in the ER (p=0,0253)

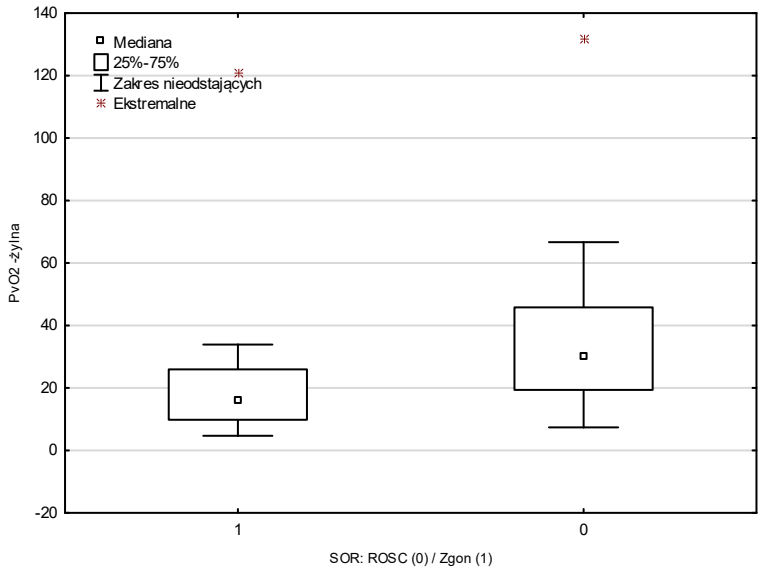

Figure 4. Oxygen partial pressure level and death from SCA in the ER (p=0.0317)

Correlation between laboratory tests and mortality

It was also found that death was more common in patients with higher methanol levels (1,73 vs 0,28 mg/dL; p=0,0253; Figure 3) compared with patients with lower levels of methanol. Patients with lower O2 partial pressure in venous blood were significantly more likely to die (25.01 vs. 37.45 mmHg; p=0.0317; Figure 4) compared with patients with higher PO2 values. Lastly, patients with a lower MPV (Mean Platelet Volume) rate were significantly more likely to die (8.69 vs 9.21; p=0.0410; Figure 5) compared with patients with higher MPV.

It was found that patients with higher D-dimer levels were more likely to die than patients with lower D-dimer levels (24.89 vs. 5.95 µg/l; p=0.0075; Figure 6). Moreover, patients with lower venous (“V”) and arterial blood deaths (“A”) were more likely to die as a result of SCA during a hospitalization in ER than patients with higher pH. Also, patients with lower HCO_3 levels in both venous (“V”) and arterial blood died (“A”) more often during hospitalization as a result of SCA than in patients with higher levels (V: 12,33 vs 22,87 mmHg; $p_Ż$=0,0121 and A: 13,98 vs 19,18 mmHg; p_T=0,0526).

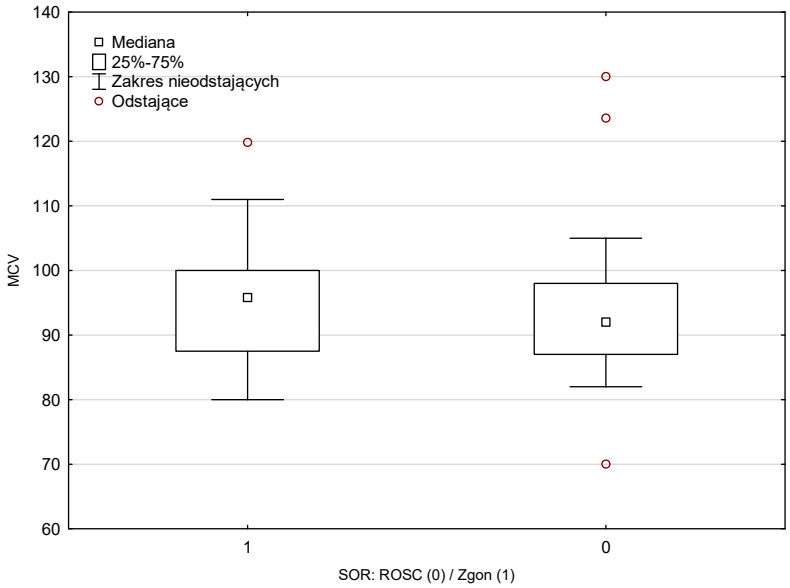

Figure 5. Mean Platelet Volume and death from SCA in the ER (p=0.0410)

.

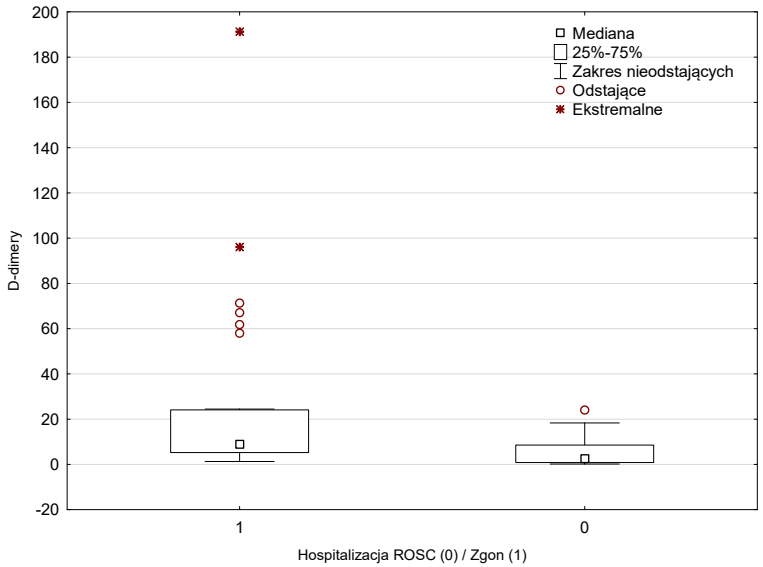

Figure 6. D-dimers levels and death from SCA in the ER (p=0.0075)

DISCUSSION

Analysis of the causes of SCA among patients hospitalized in ER is difficult due to the short time from admission to implementation of resuscitation activities. This precludes more extensive medical imaging and laboratory diagnostics from being performed before SCA. The study group was limited to cases in which tests were performed before SCA.

ECG was dominated by sinus rhythm. On the other hand, the mechanism in which SCA occurred primarily involved non-shockable rhythms (asystole, PEA), although defibrillation rhythms were rare. Among patients in cardiac arrest treated by EMS teams, diagnoses of myocardial infarction/ACS and heart failure predominated, followed by alcohol poisoning (ethyl, methyl and ethylene glycol) and malignant neoplasm. While the first two diagnoses coincide with findings in other studies [7], the new factor is intoxication with ethyl alcohol, methyl alcohol and ethylene glycol. The results showed that the higher level of methanol in patients' blood was significantly associated with mortality, but lower ethylene glycol levels were more likely to cause death compared with higher levels.

Over the years, the functions of the internal organs deteriorate, and then even a slight disturbance of the water and electrolyte balance may exacerbate co-existing diseases. It can also facilitate the development of complications from infectious diseases or thromboembolic complications, and as a

consequence may increase the risk of death. In recent years, researchers have focused on electrolyte disorders in the elderly and many centers that provide courses or consultations with specialists in order to restore proper eating habits have been established [8]. In this study, 49.3% of patients with SCA did not achieve ROSC, while 50.7% of patients did. Of those who experienced ROSC, most of them were transferred to Cardiology and Toxicology Units, and others to the Intensive Care Unit. Older people died more often as a result of SCA.

The authors clearly point out specific laboratory parameters associated with the failure of resuscitation in the ER. These include: PaO2, methanol, MPV, D-dimers, pH and HCO3. Consideration should be given to other SCA predictors, including imaging (CT, X-ray, ultrasound).

CONCLUSIONS

Selected demographic and clinical factors have an impact on mortality among SCA patients. Death in the ER occurs more often with a non-defibrillatory rhythm. The higher mortality rate applies to the elderly. SCA occurs in people with ACS initially diagnosed, heart failure, alcohol intoxication and cancer. Studies have shown a significantly higher incidence of death in people with lower PaO2, MPV, pH, HCO3, and in people with higher levels of D-dimers and methanol.

Disclosure statement

The authors did not report any potential conflict of interest.

REFERENCES

[1] Rzońca P, Chrzanowska-Wąsik M, Goniewicz M, Bednarz K, Nowicki G. History of life suport. J Edu Health Sport, 2017; 7(3): 300-308.
doi:https://dx.doi.org/10.5281/zenodo.321710

[2] Karatas M, Selçuk EB. History of the cardiopulmonary resuscitation. Kafkas J Med Sci, 2012; 2(2): 84-87.

[3] Irzmański R, Piechota M, Cegliński T. Niedokrwienie mięśnia sercowego w aspekcie jego zaburzeń metabolicznych. Cardiol J. 2004; 11(11): 775-780.

[4] Kiliszek M, Małek ŁA, Koźluk E, Lodziński P, Opolski G. Genetyczne uwarunkowania najczęstszych arytmii. Kardiol Pol, 2006; 64(10 supl 6): 601-605.

[5] Weisfeldt ML, Sitlani CM, Ornato JP, et al., Survival after application of automatic externaldefibrillators before arrival of the emergency medical system: evaluation in the resuscitationoutcomes consortium population of 21 million. J Am Coll Cardiol. 2010;55(16):1713-20.
doi:https://dx.doi.org/10.1016/j.jacc.2009.11.077

[6] Flato UA, Paiva EF, Carballo MT, Buehler AM, Marco R, Timerman A. Echocardiography for prognostication during the resuscitation of intensive care unit patients with non-shockable rhythmcardiac agrest. Resuscitation. 2015;92:1-6.
doi:https://dx.doi.org/10.1016/j.resuscitation.2015.03.024

[7] Van de Werf F, Bax J, Betriu A, Blomstrom-Lundqvist C, Crea F, Falk V, et al.Management of acute myocardial infarction in patients presenting with persistent ST-segment elevation: the Task Force on the Management of ST-Segment Elevation Acute Myocardial Infarction of the European Society of Cardiology. Eur Heart J. 2008;29(23):2909-45
doi:https://dx.doi.org/10.1093/eurheartj/ehn416

[8] Jośko-Ochojska J, Spandel L, Brus R. Odwodnienie osób w podeszłym wieku jako problem zdrowia publicznego. Hygeia Public Health, 2014; 49(4): 712-717.