Pomeranian J Life Sci 2019;65(1):37-41 doi: 10.21164/pomjlifesci.531

Analysis of the reasons for ambulance being called for out of hospital sudden cardiac arrest. A retrospective multi-center study

Analiza powodów wezwań zespołów ratownictwa medycznego do przypadków pozaszpitalnego nagłego zatrzymania krążenia. Badanie retrospektywne wieloośrodkowe

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ABSTRACT

Introduction: The survival of sudden cardiac arrest (SCA) in addition to rapid diagnosis, implementation of high-quality cardiopulmonary resuscitation, immediate defibrillation also depends on the effective dispatching and cooperation of the emergency medical team members.

Materials and methods: The research was a retrospective analysis of medical documentation kept in 2015. The provisions regarding interventions were analyzed in patients who were diagnosed with sudden cardiac arrest during the first medical contact undertaken by the emergency medical team – a total of 1136 events.

Results: The mean age of SCA patients was 69.33 years. The main reason of calls was SCA (26.53%) and loss of consciousness (22.53%) although more than half of calls were connected other medical problems.

Conclusions: The results allow you to conclude, that calls such as syncope, chest pain or breathing disorders should be treated as high priority and dispatcher assistance until ambulance arrival should be performed to ensure rapid instructions in case of SCA.

Keywords: emergency medical service; sudden cardiac arrest; cardiopulmonary resuscitation; Multicenter study; dispatching.

ABSTRAKT

Wstęp: Przeżywalność nagłego zatrzymania krążenia (NZK) zależy nie tylko od szybkiego rozpoznania, wdrożenia wysokiej jakości resuscytacji krążeniowo-oddechowej i bezzwłocznego przeprowadzenia defibrylacji, ale także od skutecznej współpracy zespołu ratownictwa medycznego.

Materiały i metody: Badanie stanowiło retrospektywną analizę dokumentacji medycznej prowadzonej w 2015 r. Przeanalizowano zapisy dotyczące interwencji u pacjentów, u których w trakcie pierwszego kontaktu medycznego podjętego przez zespół ratownictwa stwierdzono nagłe zatrzymanie krążenia. Łącznie było to 1136 zdarzeń.

Wyniki: Średnia wieku pacjentów z NZK wynosiła 69,33 lat. Główne przyczyny wezwań stanowiły: NZK (26,53%), utrata przytomności (22,53%), jednak więcej niż połowa zgłoszeń była związana z innymi problemami medycznymi.

Wnioski: Wyniki badań pozwalają twierdzić, że wezwania do przypadków takich jak omdlenia, bóle w klatce piersiowej czy duszności powinny być traktowane jako zdarzenia o podwyższonym ryzyku wystąpienia NZK.

Słowa kluczowe: służby ratownictwa medycznego; nagły zgon sercowy; resuscytacja krążeniowo-oddechowa; badanie wieloośrodkowe; dysponowanie.

INTRODUCTION

Sudden Cardiac Arrest (SCA) represents 1% of all interventions by emergency medical service (EMS) teams [1]. The survival of victims with SCA is dependent on: early detection of cardiac arrest, cardiopulmonary resuscitation (CPR) intervention and using an automatic external defibrillator (AED). It has been shown that the time it takes for EMS to arrive to a victim with SCA has no correlation with return of spontaneous circulation (ROSC). Training EMS personnel to be prepared for such activities is an important element that can influence the quality of resuscitation. This is particularly observed in the initial stages, when the EMS team is called to the place of the incident. During this time, the team leader can clearly assign roles and discuss strategies for dealing with the victim. The communication within EMS teams is an important aspect, which significantly increases patient outcome [2]. Preparing equipment and even some medication during the journey, shortens the time of action at the place of the event. It has been shown that

a two-person medical response team is not able to perform CPR according to the algorithm in the guidelines. The largest problem is obtaining intravascular access and preparing medication according to antiseptic regulations [3]. The average time it takes for EMS teams to arrive to a patient with SCA in Poznan during 2015 was 5.42 minutes [1].

Cardiovascular diseases are one of the leading causes of death in Europe. According to the World Health Organization, cardiovascular diseases constitute the number one cause of death globally: more people die from cardiovascular diseases than from any other cause, and the number will continue to rise [4]. In Europe, between 55–113 incidents of SCA occur annually per 100,000 inhabitants. Over the last few decades, many SCA databases have been formed, while there are a limited number of European countries still excluded from this analysis. The absence of these pan-European databases means that there are still gaps in the epidemiology of sudden cardiac arrest [4, 5].

Nonetheless, an important aspect is the potential to reverse the causes of cardiac arrest, where the identification and treatment determines the return of spontaneous circulation. In order to make them easier to remember, they were separated into two groups based on their first letter. Four H's (hypoxia, hypovolemia, hypo/hyperthermia, hypo/hyperkalemia, and other metabolic disorders) as well as four T's – tamponade (cardiac), tension pneumothorax, thrombosis (coronary and pulmonary) and toxins.

Once a bystander notices a victim in distress, the bystander dials 999 and the call gets intercepted by a dispatcher. He is obliged to obtain information necessary in order to carry out the order, including all questions relevant to the medical history, which is made available in an electronic and hardcopy form to the EMS team, constituting a written set of questions and recommendations supporting the decision making. After receiving the call, and based on the interview, priority is assigned based on the urgency of the trip. The medical dispatcher gives one of two codes: the first "alarm" code – given in suspicion of a direct life-threatening condition and thus signifies a departure of the team within one minute, with obligatory use of sirens. The second "urgent" code – given when the dispatcher suspects a health condition, meaning a timely departure within two minutes, without the use of sirens. Upon arriving to the victim and preliminary examination, the leader of the EMS team decides to begin or withdraw from resuscitation. In the event that there is a possibility to reverse the potential causes of SCA in a hospital setting (eg. hypothermia, intoxication, pulmonary embolism, acute coronary syndrome), CPR should be extended, and the patient should be transported to the hospital. The transport poses a threat to members of the EMS. Performing any maneuvers in an ambulance traveling at high speeds poses an increased risk to the rescuers, and in the event of an accident, reduced the chances of survival, as the personnel performing CPR does not use seat belts. In such cases, the European Resuscitation Council (ERC) recommends using devices for mechanical chest compressions [6].

In accordance with the provisions of the Emergency Medical Services Act, the median time of arrival to the scene is used as a control tool that is reviewed monthly. The median of arrival time should be no longer than 8 minutes in a city with more than 10,000 inhabitants and 15 minutes outside the city. Maximum time for EMS arrival shall not exceed 15 minutes (in a city with over 10,000 inhabitants) and 20 minutes (outside the city).

The aim of this study was to analyze the reasons of the call of ambulances responding to out of hospital cardiac arrest.

MATERIALS AND METHODS

The materials for analysis were collected from the Provincial Rescue Service Station in Poznan and the Provincial Emergency Service Station in Bydgoszcz. Both units, at the time of the survey, provided emergency medical services for Poznan and Bydgoszcz counties and were included in the study. The analysis was performed on all calls to emergency medical services that revealed sudden cardiac arrest during first professional rescue contact between January 1 and December 31, 2015. The research was based on medical documentation from the rescue team and the operation cards which constitute mandatory documentation provided by the EMS after a dispatch. Detailed analysis was performed on part I – acceptance of the call, part III – execution of the order, part V – cessation of medical rescue or declaration of death. Cases, where CPR was not performed, were marked as no-CPR. Cases in which CPR was performed with a return of spontaneous circulation were marked as CPR-ROSC and CPR-no-ROSC when CPR was terminated due to patient death. During this study period, EMS teams were not equipped with mechanical chest compression devices and the transport to the hospital could be undertaken only, when ROSC was achieved. To analyze the results, we used Statistic Version 12.5 PL (statistical significance analysis was performed using the χ^2 test at alpha = 0.05).

RESULTS

1136 calls for sudden cardiac arrest, which occurred outside the hospital, were qualified to the study. In 186 cases, a second ambulance was requested, yielding double the documentation for these incidents. After deducting the duplicated documentation from all applications, 950 events were obtained and analyzed. Among the 950 victims of SCA, 309 were females and 589 males. In 52 cases, the medical documentation failed to include the victims gender. The average age of the victims was 69.33 years. 75% of the victims were over 61 years old. In 88.9% of calls, the ambulances were dispatched using the first code, while 11.6% were dispatched in using the second. Among all analyzed documents, no information was found regarding continued CPR during transport to a definitive care site by EMS.

The main reasons why dispatchers were contacted included: sudden cardiac arrest (26.53%), syncope (22.53%), and dyspnea/problems breathing (14.74%). Detailed results have been presented in Figure 1. In females, the most common reason was a loss of consciousness (25.24%), while in males it was

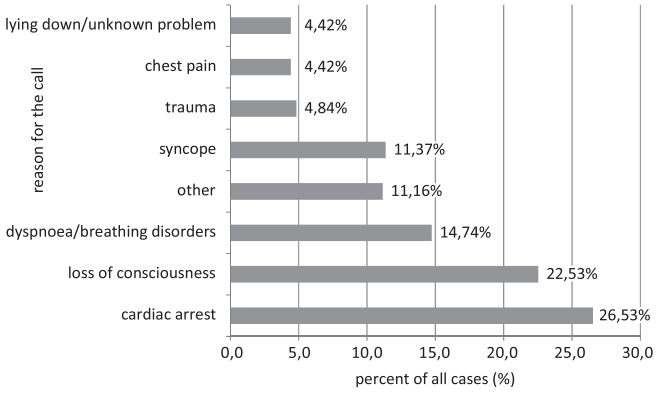

FIGURE 1. The main reasons for ambulance calls to sudden cardiac arrest cases

SCA (28.35%). SCA was more common in males when EMS was dispatched for a bodily injury (5.60% vs 0.97%), the difference was statistically significant.

Nearly ⅓ of the analyzes calls (31.89%) were registered between 10:00 and 16:00, next between 16:00–22:00 (30–42%) and lastly between 04:00–10:00 (22.74%). The least amount of SCA cases were reported to occur at night between 22:00–04:00 (14.95%). Majority of the calls that qualified to be SCA took place in March (10.32%), then in January and July (9.92% each) and the least in August (5.56%). There was no statistical significance between the intention if the call and month ($p = 0.9051$) or day ($p = 0.1483$). Also, there was no statistical relationship between gender and the month ($p = 0.5621$) or season ($p = 0.1536$) that the SCA event occurred.

TABLE 1. Analysis of the results of paramedics' action depending on the reason for the call

Reason of the call	CPR-ROSC	CPR-noROSC	no CPR
Sudden cardiac arrest	51.59%	27.38%	21.03%
Syncope	80.19%	8.49%	11.32%
Breathing disorders/dyspnea	65.00%	21.43%	13.57%
Injury	67.39%	2.17%	30.43%
Loss of conciousness	58.41%	21.03%	20.56%
Chest pain	51.90%	23.19%	11.90%
Unknown problem	59.52%	14.29%	26.19%
other	50.19%	15.74%	24.07%

In most cases, CPR was not performed if the call was for a bodily injury (30.43%), if the case was classified as an unknown problem (26.19%) or other (24.07%). However, if CPR was performed, ROSC was the most common when the primary cause of the call was fainting (80.19%), injury (67.39%), and dyspnea (65.00%). Detailed analysis of the results is presented in Table 1.

DISCUSSION

The study presents an analysis of the reasons for which EMS was dispatched to patients diagnosed with SCA during the initial examination by a first responder. We have observed a large number of reports that suggested respiratory problems that have also been shown by Brzezińska-Pawłowska et al. who analyzed EMS trips to patients with asthma or chronic obstructive pulmonary disease exacerbation. These researchers found that there was an increase in the number of trips that took place during the winter months and correlated the incidents with influenza [7]. According to Lin et al., the temperature of the air during the winter is associated with an increased risk of myocardial infarction. This correlation was particularly visible in males, elderly and people living in areas where a high concentration of particulate matter were noted [8]. On the basis of this study, the reason for SCA cannot be directly confirmed. Still, symptoms of pain located in the chest may suggest acute coronary syndrome or arrhythmia.

A study by Cebula et al. showed that CPR was performed by bystanders in 45.1% of cases. In addition, the authors noticed that dispatchers were instructing bystanders on how to correctly perform CPR in 20.25% of cases [9]. Untrained lay responders often misinterpret muscle reflexes as the return of circulation. The most common muscle reflex is agonal breathing (or gasp), which occurs in some patients during the first few minutes after a sudden cardiac arrest and is a result of respiratory centers in the brainstem. The patient looks as if he/she is gasping for air, which is perceived by the rescuer as dyspnea, wheezing or difficulty breathing. Out of 100 analyzed recordings between the dispatcher and the bystanders, it was indicated that abnormal breathing occurred in 38 victims [10]. Presently, there is no method that would help the dispatcher identify agonal breathing based on the description provided by the bystander. For this purpose, the dispatcher should stay on the phone with the bystander and ask for a reassessment of the breath. In all cases, where the dispatcher obtains information that the victim is unconscious, he/she must direct the interview towards the presence or absence of appropriate breathing patterns. The ERC guidelines recommend performing chest compressions if in doubt. ROSC rate is associated with ambulance arrival time. The time longer than 10 minutes was correlated with a decreased number of ROSC [11, 12, 13]. We think, that a higher number of ROSC in cases like chest pain or syncope might be caused by cardiac arrest, that occurred while an ambulance was on the way. The effect of resuscitation is highly depended on the time resuscitation has been started since symptoms onset and how long it had been performed [11, 14].

If SCA occurs as a result of injury, the chances of survival are reduced. Authors of various papers indicate that only 2.4–8% of patients survive out-of-hospital cardiac arrest caused by trauma [15, 16]. CPR in case of an injury is frequently not performed, leading to a low survival rate. However, an interesting fact is that if CPR was performed on the victim, ROSC would likely be obtained, in comparison to other cases. The authors did not confirm the results in the literature, which warrants further evaluation. It should be made relevant that the study concerns the analysis of calls that require EMS intervention, therefore we cannot conclude that the cause of SCA was bodily injury.

In our study, the majority of reasons for calling EMS were not directly related to SCA but were associated with other symptoms. This is confirmed in many other reports. In one of the studies conducted by Muller, a large proportion of patients with pre-existing cardiac arrest experience symptoms of angina pectoris. These symptoms include chest pain, dyspnea, fainting, and nausea/vomiting. Acute coronary syndromes were one of the dominant causes. Only 25% of sudden cardiac deaths were not associated with coexisting symptoms. It was also observed that the initial rhythm present during SCA was dependent on the onset of symptoms. In the event of asystole, this time was 50 minutes, ventricular fibrillation 30 minutes and electrical activity without a heart rate 20 minutes. Although these differences were not statistically significant, they may indirectly indicate the efficacy of treatment [17]. Hollenberg et al., however, indicated that early symptoms were observed in 80% of patients, of which 22% were angina, 15% dyspnea, 7% nausea/vomiting, and 5% fainting. These conditions were of various intensity and lasted from 10 to 20 minutes [18]. On the other hand, Drezner et al., in 2012, remarked that 24% of SCA victims experienced fainting one or more (on average 2.6 times) times or had a seizure without a known cause [19].

Patients who had a cardiac arrest due to ventricular fibrillation or ventricular tachycardia are more likely to survive. Heart rhythm can be effectively restored before the arrival of the EMS if the bystander uses an automatic defibrillator. Although the idea of an AED has been around since the 1980's, there are no legal obligations in Poland to install these devices in public places. Public knowledge about AED's is still unsatisfactory [20]. Most SCA's occur in public places [1], which allows for an increased probability of survival, with the use of an AED. Although NGO's declare that the number of devices is consistently growing, one study in Poznan that was published in 2017 showed that these devices are not always properly marked, and access to them may be difficult [21].

The presented research has several limitations according to the authors. We analyzed the cases of ROSC in pre-hospital conditions, which should not be directly translated to the survival of patients. The study was not based on the Utstein protocol, which would additionally allow us to obtain further information about the course of resuscitation, specifically in SCA, use of AED, or CPR conducted by the bystander. The subject of the research was the documentation kept by EMS and not the telephone calls of the dispatchers, hence we did not receive information on how often dispatchers provided instructions for performing CPR to bystanders. Taking into account the methodology of the study, we could not exclude that some of the cases qualified to the study group was expected to lead to cardiac arrest, caused by chronic diseases, that did not meet the definition for SCA.

CONCLUSION

There is a clear need for the improvement of unsatisfactory CPR. This is one of the biggest challenges in modern medicine. There are a lot of variables that affect the survival of patients who are diagnosed with SCA. Appropriate organization of professional emergency medical systems, universal education in first aid based on current scientific reports, guidelines, and extensive interdisciplinary research are only a few activities that can drastically improve the survival of victims with sudden cardiac arrest. The aim of the study was to analyze the reasons for EMS calls to cases of sudden cardiac arrest. It was observed that the ambulance was most often dispatched to already diagnosed cardiac arrest by the bystander. the results let us conclude, that calls such as syncope, chest pain or breathing disorders should be treated as high priority and dispatcher assistance until the abmulance arrival should be performed to ensure rapid instructions in case of SCA. EMS should be prepared for all interventions in the event of SCA. Other above mentioned should also be treated as they pose an increased risk for SCA. This is information that can be used to improve the organization and functioning of the emergency medical system.

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