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ARTYKUŁ ORYGINALNY / *ORIGINAL ARTICLE*

In-hospital sudden cardiac arrest protocol analysis

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Abstract

Background: In-hospital sudden cardiac arrest (SCA) is an event that is linked to high mortality. Data analysis of SCA and the course of in-hospital cardiopulmonary resuscitation (CPR) allows for its better understanding and improvement.

Aim: Analysis of cases of SCA and the procedures taken by the medical staff of University Hospital.

Methods: A retrospective analysis of 104 protocols of SCA, from May 2014 to December 2015. Actions taken by medical staff before the arrival of the resuscitation team (RT) and RT proceedings. Data are presented as median and mean ± standard deviation.

Results: 52.88% of cases were women, and their mean age was 70.82 ± 13.32 years. Resuscitation activities (basic life support: 48.08%, advance life support: 42.31%) were performed before the RT arrival, and no action was taken in 5.77% of cases. The cardiac arrest occurred most commonly in the afternoons hours, and the Emergency Room was the place of CPR in 41.35% of cases. The waiting time for RT was on average 4.47 ± 5.85 min. Non-defibrillation rhythms occurred in 79.80%, and the efficacy of resuscitation was 40%.

Conclusions: Resuscitation protocols should be registered not only as an important part of medical records, but also as a source of information during the CPR training of staff. The lack of rescue activities before the arrival of the RT indicates the urgent need to identify the cause of the problem and eliminate these negative behaviours.

Key words: cardiopulmonary resuscitation, sudden cardiac arrest, treatment

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INTRODUCTION

According to the Maastricht analysis, the annual estimated number of sudden cardiac deaths is 1 in 1000 people [1]. Survival rates for these individuals are in the range of 5–37%. One of the key factors affecting mortality is the location site of sudden cardiac arrest (SCA). In the case of in-hospital cardiac arrest, the recognition of patients at risk of cardiac arrest is of paramount importance. Also early diagnosis is essential. For this, it is desired that all patients at risk for SCA are treated in centres with continuous haemodynamic monitoring. In addition, the equipment for advanced life support should be available immediately [2]. The effect on the effectiveness of resuscitation activities is also the time from the SCA to the resuscitation team alert and the time for its arrival. The effectiveness of resuscitation in such cases varies between 20% and 60% [3–5].

The Hospital Accreditation Programme, launched in 2009, mandates the analysis of in-hospital deaths [6]. For this purpose, it is necessary for resuscitation teams to carry out the in-hospital SCA protocols. This documentation should be fulfilled in a reliable manner by qualified medical personnel. This is the basis for a relatively reliable analysis of factors that have a significant impact on the effectiveness of resuscitative efforts.

The aim of the study was to analyse in-hospital cases of SCA and resuscitation procedures performed by medical

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staff of one of the University Hospitals. Special attention was given to the impact of various factors on the survival of patients after SCA.

METHODS

The study was planned as a retrospective study based on the medical records created by the resuscitation teams of one of the University Hospitals. A total of 104 reports from May 2014 to December 2015 were analysed. The analysed documents contained detailed data on in-hospital cardiac arrest, with particular emphasis on the course of advanced life support. Due to the specific nature of the intensive care unit (ICU), we have excluded cases of SCA that occurred in the ICU.

Statistical analysis

Statistical analysis was performed using Statistica 12 (StatSoft, Tulsa, OK, USA). The data is presented as median or mean ± standard deviation. Shapiro-Wilk tests were used to evaluate the normality of the variable distribution. Kruskal-Wallis and Mann-Whitney U tests were used to verify the statistical hypotheses — for two tests without normal distribution. The Tau-Kendall test was used for the correlation analysis. Statistically significant results were obtained with p-values < 0.05.

RESULTS

Among the analysed cardiopulmonary resuscitation (CPR) protocols, SCA in 46.15% of cases occurred in men, and the average age of patients was 70.82 ± 13.32 years. In most cases of SCA the life support was started prior to the resuscitation team's arrival. Basic life support procedures were started in 48.09% of cases and advanced life support procedures in 42.31% of SCA cases. In as few as 5.77% of the cases no action was taken. In the analysis of these cases, a statistically significant correlation was found between the absence of resuscitation efforts before the arrival of the resuscitation team and the patient's death. Out of 104 resuscitations, death occurred in 63 (60.58%) cases. Table 1 summarises the effect of the resuscitation efforts undertaken.

Table 1. The final outcome of resuscitation

Return of spontaneous breathing	
Yes	20 (19.23%)
No	81 (77.88%)
Return of spontaneous circulation	
Yes	43 (41.35%)
No	58 (55.77%)
Return of consciousness	
Yes	8 (7.69%)
No	91 (87.50%)
Death	
Yes	63 (60.58%)
No	40 (38.46%)

Of all the SCA rhythms non-shockable rhythms occurred in 15.38%; nevertheless, defibrillation was carried out in a total of 28.85% of cases. In 14 cases defibrillation was performed in the case of conversion of non-shockable rhythm (usually pulseless electrical activity [PEA]) to a shockable rhythm. The median number of defibrillations was two, while the median energy used during defibrillation was 250 J. Adrenaline was used in all SCA cases and the median total dose of adrenaline given during cardiopulmonary resuscitation was 4 mg. In half of the cases, atropine was also used, with a median dose of 2 mg.

Based on the analysed protocols, it was found that in nearly half of the cases the location of the SCA was the emergency room (41.35% of the cases), followed by other hospital wards and clinics (Fig. 1).

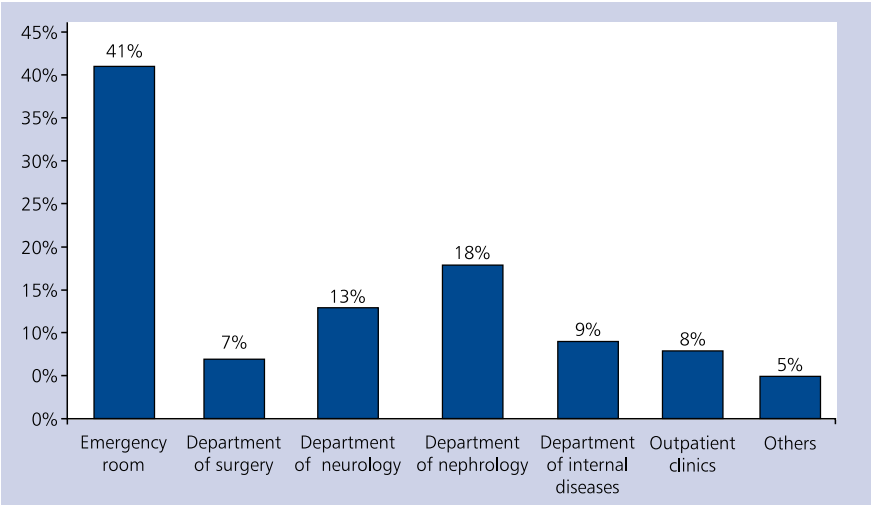

Figure 1. Percentage distribution of sudden cardiac arrest in hospital departments

Table 2. Summary of basic mean times during cardiopulmonary resuscitation

Parameter [min]	Mean	Median	Minimum	Maximum	Standard deviation
The time from cardiac arrest statement to call the resuscitation team	1.80	0.00	0.00	40.00	6.33
Waiting time for resuscitation team	4.47	2.00	0.00	31.00	5.85
The duration of cardiac arrest	24.19	25.00	0.00	60.00	14.66

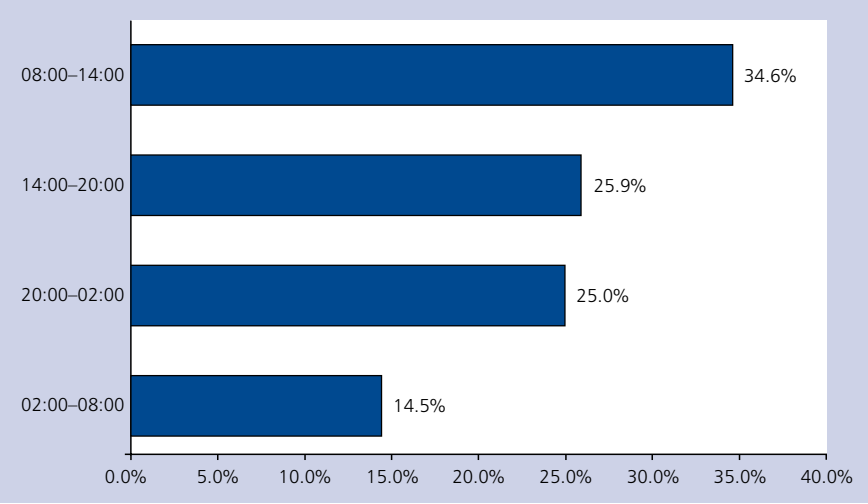

Figure 2. Frequency of sudden cardiac arrest depending on the time of day

The waiting time for the resuscitation team was on average 4.47 ± 5.85 min. There was no statistically significant difference between the waiting time depending on the place where the CPR was performed. The median time from onset of cardiac arrest to CPR was 1.80 ± 6.33 min, while the median duration of SCA was 24.19 ± 14.66 min (Table 2). There was a significantly shorter waiting time (162 s) for the resuscitation team in cases of successful resuscitation, while a significantly longer time (337 s) was reported in patients with fatal outcome ($p < 0.05$). The analysis of the incidence of SCA according to the time of day showed that the cardiac arrest occurred most commonly in the early morning hours (8:00–14:00) (Fig. 2). It has been shown that between 8:00 and 14:00 and 02:00 and 8:00 there is a statistical difference in the number of unsuccessful resuscitations ($p = 0.022$).

In addition, it was found that there is a significant difference in time to arrival of the resuscitation team, depending on the time of day between 8:00 AM and 2:00 PM ($p = 0.043$). Time to arrival of the resuscitation team was shorter at night and amounted to 3.96 ± 3.63 min, while in the afternoon it was 6.26 ± 6.79 min.

DISCUSSION

There are few data on in-hospital cases of SCA, while many studies have been carried out on out-of-hospital cardiac arrest. The results of these studies are only partially applicable to in-hospital patients due to different cardiac arrest mechanisms and other characteristics of the population [7]. Assessing the occurrence of this event allows us to identify the frequency and the hospital wards where cardiac arrest occurs most commonly. It is also one of the key components of the care quality assessment [7].

Key importance in resuscitation is the speed of undertaken medical action [8]. The "speed of action" involves the time from the SCA to the resuscitation team alert and the team arrival time [9]. According to the European Resuscitation Council guidelines, the defibrillation should be started within 3 to 5 min after cardiac arrest and can result in a survival rate of up to 50–70% [10]. In the three-phase model published in 2002 by Wiesfeldt and Becker [11], which depends on the time since SCA, early defibrillation is most effective in the first phase, i.e. the electrical phase (< 4 min). With regards to the above data, in order to achieve continuous quality improvement, it is recommended that the work of the resuscitation team is monitored.

Internal audit data should be the basis for verifying the effectiveness. In our study, the waiting time for the resuscitation team was on average 4.47 ± 5.85 min and the call alert time was 1.80 ± 6.33 min.

The above data indicate the necessity of earlier diagnosis of SCA and shortening waiting time for the resuscitation team.

It seems that this improvement may result in better survival rate [11], which in our study only amounted to 38.4%. The study showed that the median resuscitation time was about 25 min, and the shorter resuscitation time correlated with the return of spontaneous circulation. There is not much empirical evidence regarding the optimal duration of advanced life support. However, researchers point out that systematic efforts to prolong their duration may lead to increased survival. In addition, resuscitation for more than 30 min, in patients with co-morbid conditions, may lead to improved efficacy [12].

The incidence of SCA was analysed in relation to the time of day. Most frequently SCA occurred in the morning. In addition, the mortality during these hours was the highest, and the time to resuscitation team arrival was the longest. Increasing the number of episodes of SCA after waking suggests a risk factor for heart attack in the morning. Determining the time frame of its occurrence will facilitate the studies to detect the possible pathomechanism of these incidents and develop better methods to protect patients from life-threatening cardiac arrest [13–15]. The time to start the basic life support is emphasised in the literature [16–18]. Occasional cases where resuscitation efforts were not started prior to the arrival of CPR may indicate insufficient medical staff training. Einav et al. [19] in their study suggest that many primary care clinics are under-equipped and their physicians are under-prepared to initiate life-saving services. Numerous studies indicate that staff training in advanced life support improves resuscitation outcome [20–22].

In the literature, shockable rhythms occur in 25% or less frequently [12, 23], but in the presented study this percentage is significantly lower. Note that non-shockable rhythms occurred in about 80% of patients, while defibrillation was performed in 28.85% of cases. This situation was probably due to a change in the baseline rhythm — most often PEA — to a shockable rhythm [24]. In addition to adrenaline, atropine was frequently used in the SCA treatment, although according to the latest European Resuscitation Council guidelines, atropine is not recommended for routine use during CPR [25]. Asystole usually results from primary myocardial pathology rather than excessive vagal nerve stimulation, and there is no evidence that routine use of atropine is beneficial in the treatment of asystole or PEA. The advantages of atropine in out-of-hospital and in-hospital cardiac arrest have not been demonstrated [25]. Atropine was the recommended drug in the 2005 European Resuscitation Council guidelines, so its contemporary use may result from habit, ignorance, or dislike of using the current CPR algorithms.

The study assessed the immediate survival with the return of spontaneous circulation, but the survival rate until discharge from hospital and further was not assessed. It was shown that return of spontaneous circulation was obtained in less than 2/5 of resuscitated patients. This percentage is slightly lower compared to the data available in the literature [12]. Lower survival may be due to the fact that patients initially were in severe or terminal condition, which could have led to CPR with a deviation from the current resuscitation guidelines. That is why it is so important to have an adequate training policy that will increase the knowledge of the official guidelines.

CONCLUSIONS

Resuscitation protocols should be considered not only as an important part of medical records, but also because they provide the basis for analysing factors affecting the effectiveness of resuscitative efforts. They may also be an important source of information presented during annual CPR training for hospital staff. The lack of rescue efforts by some hospital staff before the arrival of the resuscitation team indicates the urgent need to identify the cause of the problem and take action to eliminate these negative behaviours.

Conflict of interest: *none declared*

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