Distribution of certain pathophysiologic forms of cardiac arrest and survival in patients of Zenica-Doboj canton

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ABSTRACT

Aim To determine the presence of the pathophysiological forms of cardiac arrest at the beginning and at the end of the reanimation procedures and survival of the patients.

Methods This retrospective-descriptive-analytic research involved 41 patients admitted to the Department for urgent and regular admission at the Canton Hospital Zenica during the period 01 September 2008 to 31 May 2009. The data (number of patients before treatment, number of survivors and deaths, ECG forms of the cardiac arrest) were extracted from the Protocols. Chi-square test was used for the comparision of the data and calculation of statistical significance at the level of 0.005.

Results The most common pathophysiological form of cardiac arrest at the beginning of the reanimation procedures was asystole (AS), 27 patients (65.9%). Five patients survived cardiac arrest (12.2%). The most common pathophysiological form of the cardiac arrest, which was registered in the surviving patients immediately before the establishment of the normal cardiac rhythm was ventricular fibrillation (VF), four (80.0%) patients. One (3.7%) patient survived AS, four (66.7%) patients survived VF. Frequency of all forms of cardiac arrest was statistically significantly different (frequency of AS and EMD was higher and VT and VF was lower) in this study, than the expected frequency ($p > 0.005$).

Conclusion There is need for the improvement of the efficiency of pre-hospital treatment by improving the cooperation with institutions that provide first aid training (Red Cross).

Key words: cardiac arrest, basic life support, advanced life support, defibrillation, cardiopulmonary resuscitation.

INTRODUCTION

Cardiac arrest is the result of the cessation of all rhythmic impulses in the heart with the absence of spontaneous rhythm (1).

Ventricular tachycardia (VT) occurs in approximately 2% of all cases of cardiac arrest (2,3). Ventricular fibrillation (VF) is an epidemic problem, and it is represented by about 60% of all cases of the cardiac arrest (2,4). Cardiac arrest is caused by the asystole (AS) in about 30% of cases (2-5). While the results of treatment of VF are encouraging, even satisfying, survival after cardiac arrest caused by AS is only from 0 to 0.3%, according to numerous studies in the world (2-5). Electromechanical dissociation (EMD) is a form of the cardiac arrest represented by about 8% of all cases of the cardiac arrest (2-5).

The aim of the research was to determine the distribution of the pathophysiological forms of cardiac arrest before and after treatment, and the survival of the observed patients, as well as presence of statistically significant difference in the frequency of occurrence of certain forms of cardiac arrest in the patients from this study compared to the expected frequency.

PATIENTS AND METHODS

The retrospective-descriptive-analytical study was conducted at the department for urgent and regular admission of the Cantonal Hospital Zenica during the period between 1 September 2008 and 31 May 2009. The Protocols of the Department and the medical findings were used.

There were two inclusion criteria: patients with a diagnosis of the cardiac arrest, and recorded data on the pathophysiological form of the ECG curves in patients with this diagnosis. The study included 41 patients.

Descriptive statistic methods were used for processing the data related to the distribution of mortality from certain forms of the cardiac arrest. Frequency of all forms of cardiac arrest which would be expected for this sample was calculated based on data from studies of other authors (2-5). Chi-square test was used to compare the data and calculate statistical significance at the level of 0.005.

RESULTS

Of the total number of 41 patients, there were 27 (65.85%) males, and 14 (34.15%) females.

Three (7.3%) patients were in the age group 0-6 years, and none of the patients with cardiac arrest was in the age group 7-18 years. There were 23 (56.1%) patients in the age group 19-64 years, mostly presented with symptoms of cardiac arrest after professional injuries. There were 15 (36.6%) patients in the age group of 65 and over, with geriatric comorbidity.

Asystole was the most frequent form of cardiac arrest and it was found in 27 (65.9%) patients. Electromechanical dissociation was found in eight (19.5%) patients, VF in 6 patients (14.6), and VT was not recorded (Table 1).

Chi-square test was used to compare the obtained frequency of forms of cardiac arrest with the expected frequency. The obtained chi-square (39.2) was higher than the limit value (12.837), so it can be concluded that frequency of all forms of cardiac arrest in this study was statistically significantly different thann the expected frequency (p>0.005) (1-5). Frequency of AS and EMD was higher, and VT and VF was lower in this study (Table 1).

Five (12.2%) patients survived cardiac arrest. Of the total number of survivors, four (80%) patients had VF and one (20%) patient had AS, as the rhythms which were registered shortly before the establishment of a normal heart rhythm. Of the total number of patients with VF, four (66.7%) patients survived. Of the total number of patients with AS, one (3.7%) patient survived (Table 1).

Table 1. Distribution of certain pathophysiological forms of cardiac arrest before treatment, and survival/mortality of the observed patients from certain forms of cardiac arrest

Cardiac rhythm	Number (%) of patients before treatment	Number (%) of survivors after treatment	Number (%) of deaths
VT	0	0	0
VF	6 (14.6)	4 (66.7)	2 (33.3)
AS	27 (65.9)	1 (3.7)	26 (96.3)
EMD	8 (19.5)	0	8 (100)
Σ	41 (100)	5 (12.2)	36 (87.8)

VT, ventricular tachycardia; VF, ventricular fibrillation; AS, asystole; EMD, electromechanical dissociation
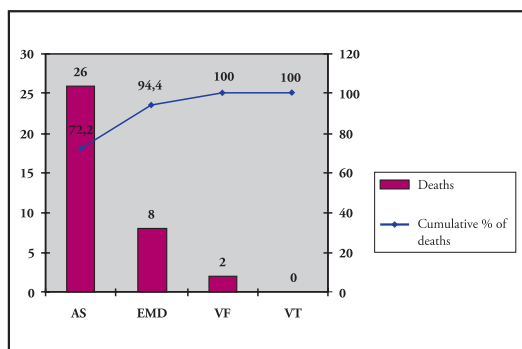
Figure 1. Cumulative distribution function of mortality from certain forms of cardiac arrest

Thirty-six (87.8%) patients died. Of the total number of deaths, 26 (72.2%) patients had AS, eight (22.2%) patients had EMD, two (5.6%) had VF, as the rhythms registered shortly before their death. Of the total number of patients with AS, 26 (96.3%) patients died. All patients with EMD died. Of the total number of patients with VF, two (33.3%) patients died (Table 1, Figure 1).

The cumulative distribution of mortality function from the forms of the cardiac arrest has shown that even 94.4% of cases of cardiac arrest would be resolved by reducing mortality from AS and EMD (Figure 1).

During the reanimation procedures, an indication for defibrillation was set in nine patients, and defibrillation was carried out in all. But, of these nine patients, defibrillation was carried out in the ambulance in one (11.1%) case, and in 8 (88.9%) patients only after the hospitalization.

DISCUSSION

According to published data between 67% and 77% of all cases, cardiac arrest affects males (2-5). Similar results have been obtained in this study.

Most cases of the cardiac arrest occur between the age of 45 and 75, which is consistent with our results (2-5). This is explained by an exposure to injuries as well as diseases of this active working population (1).

The most frequently reported pathophysiological forms of the cardiac arrest according to the data from the literature is ventricular fibrillation (VF) (60%), asystole (AS) (30%), electromechanical dissociation (EMD) (8%) and finally ventricular tachycardia (VT) (about 2 %) (2-5). According to the data that have been reached in this study,

the most common rhythm that could be registered during the monitoring of the patient, was AS, then EMD, and VF. The VT has not been found in our patients.

This is in the contrast with published data (2-5). So, a statistically significant difference was noted between the obtained frequency of forms of the cardiac arrest in the sample compared to the expected frequency (2-5). This discrepancy could be explained by the fact that in developed western countries patients are monitored during a short period of time after suspicion of cardiac arrest (automatic defibrillators with monitors are located at every major intersection, etc.) (6-9). For this reason the VF was the most frequently recorded finding in developed countries (6-9). During that short period of time the heart muscle has still not exhausted its reserves of energy (adenosine triphosphate), which results in the appearance of VT or VF (1). But, after a long time period without reanimation procedures, the heart muscle drops into acidosis, which results in the appearance of AS or EMD (1).

The reason for this discrepancy could be also a small sample size in this study, which is the major limitation of this study. The resulting frequencies of the occurrence of cardiac arrest forms would be probably closer to the expected frequencies with an increased sample size, which should be a topic of the next research.

Literature data suggest that the survival of cardiac arrest ranges between 16 and 24% of all cases (2-12), which is higher than this study has shown (12.2%). The reason for the large survival rate of the AS (3.7%) in this study is probably a small sample size. This study has shown that most cases of cardiac arrest would be solved by reducing mortality of AS and EMD. But, it is the fact that AS and EMD have a poor prognosis (survival of AS is only 0-0.3%) (1-12). Therefore, it is necessary to prevent the occurrence of AS and EMD at first place. This would be achieved if the monitor was connected to the patient as soon as possible after the suspicion of cardiac arrest. The VF (which occurs most frequently before the AS) could be seen during the monitoring more frequently as a natural course of events, while the cardiac muscle has still not spent the energy stores (1). A potential solution is the procurement of the cardiomobiles (vehicles that are designed

for resuscitation) (13,14), as well as education of health professionals and citizens (13,14). In some countries automatic defibrillators are placed in each square in the city, and itizens have been trained to use them as the first aid measures (13,14).

According to the literature, the defibrillation is generally performed in 10-72% cases (6-9). Among our patients, the defibrillation was done in all patients who had the indications for the defibrillation (100% of the cases). However, defibrillation was carried out in one ambulatory patient, and in eight patients after the hospitalization.

In conclusion, it is necessary to recruit more staff from the emergency services to prepare for high-quality patient care by hospitalization, i.e., increase the efficiency of pre-hospital treatment of patients to achieve faster monitoring (2-14). This would have an impact on the reduction of the incidence of potentially "incurable" forms of cardiac arrest (AS and EMD), compared to the potentially "curable" forms (VT and V1in the driving schools (6-9) should be conducted, whereas municipality authorities should purchase and equip public spaces with the automatic defibrillators (bus and railway stations, cinema halls, etc.) (6-9). The improvement of cooperation between the health institutions with the institutions that provide first aid training (the Red Cross) will raise the awareness and knowledge of the first aid among the citizens (13,14). Finally, the risk of the injuries from the hazards at work, traffic, etc (13,14) needs to be reduced.

TRANSPARENCY DECLARATION

Competing interests: None to declare.

REFERENCES

1. Vnuk V. Emergency Medicine. Prehospital Procedures. Zagreb: Alfa, 2001.

2. Stiell IG, Wells GA, Field B, Spaite DW, Nesbitt LP, De Maio VJ, Nichol G, Cousineau D, Blackburn J, Munkley D, Luinstra-Toohey L, Campeau T, Dagnone E, Lyver M. Advanced cardiac life support in out-of-hospital cardiac arrest. NEJM 2004; 351:647-56.

3. Stiell IG, Nichol G, Leroux BG, Rea TD, Ornato JP, Powell J, Christenson J, Callaway CW, Kudenchuk PJ, Aufderheide TP, Idris AH, Daya MR, Wang HE, Morrison LJ, Davis D, Andrusiek D, Stephens S, Cheskes S, Schmicker RH, Fowler R, Vaillancourt C, Hostler D, Zive D, Pirrallo RG, Vilke GM, Sopko G, Weisfeldt M. Early versus later rhythm analysis in patients with out-of-hospital cardiac arrest. NEJM 2011; 365:787-97.

4. Rea TD, Fahrenbruch C, Culley L, Donohoe RT, Hambly C, Innes J, Bloomingdale M, Subido C, Romines S, Eisenberg MS. CPR with chest compression alone or with rescue breathing. NEJM 2010; 363:423-33.

5. Atwood C, Eisenberg MS, Herlitz J, Rea TD. Incidence of EMS-treated out-of-hospital cardiac arrest in Europe. Resuscitation 2005; 67:75-80.

6. Bunch TJ, White RD, Gersh BJ, Meverden RA, Hodge DO, Ballman KV. Long-term outcomes of out-of-hospital cardiac arrest after successful early defibrillation. NEJM 2003; 196 :587.

7. Terranova P, Valli P, Severgnini B, Dell'Orto S, Greco EM. Early outcomes of out-of-hospital cardiac arrest after early defibrillation. IPEJ 2006; 6:194-201.

8. Parkash R, Tang A, Wells G, Blackburn J, Stiell I, Simpson C, Dorian P, Yee R, Cameron D, Connolly S, Birnie D, Nichol G. Use of implantable cardioverter defibrillators after out-of-hospital cardiac arrest. CMAJ 2004; 171:1053-6.

9. Kitamura T, Iwami T, Kawamura T, Nagao K, Tanaka H, Hiraide A. Nationwide public-access defibrillation in Japan. NEJM 2010; 362:994-1004.

10. Nichol G, Thomas E, Callaway CW. Regional variation in out-of-hospital cardiac arrest incidence and outcome. JAMA 2008; 300:1423-31.

11. Morrison LJ, Visentin LM, Kiss A, Theriault R, Eby D, Vermeulen M, Sherbino J, Verbeek PR. Validation of a rule for termination of resuscitation in out-of-hospital cardiac arrest. NEJM 2006; 355:478-87.

12. Rea TD, Cook AJ, Stiell IG. Predicting survival after out-of-hospital cardiac arrest: role of the Utstein data elements. Ann Emerg Med 2010; 55:249-57.

13. Rea TD, Page RL. Community approaches to improve resuscitation after out-of-hospital sudden cardiac arrest. Circulation 2010; 121:1134-40.

14. Iwami T, Nichol G, Hiraide A. Continuous improvements in „chain of survival" increased survival after out-of-hospital cardiac arrests: a large-scale population-based study. Circulation 2009; 119:728-34.

Distribucija pojedinih patofizioloških oblika srčanog zastoja i preživljavanje kod pacijenata s područja Zeničko-dobojskog kantona

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SAŽETAK

Cilj Utvrditi distribuciju patofizioloških oblika srčanog zastoja, prije i nakon tretmana, te preživljavanje pacijenata.

Metode Ovo retrospektivno, deskriptivno i analitičko istraživanje uključivalo je 41 pacijenta Službe za urgentni i redovni prijem Kantonalne bolnice Zenica, u periodu od 01. septembra 2008. do 31. maj 2009. godine. Podaci (broj pacijenata prije tretmana, broj preživjelih i umrlih) uzeti su iz protokola. Za uporedbu rezultata, kao i za izračunavanje statističke signifikantnosti na nivou 0,005 korišten je Hi-kvadrat test.

Rezultati Najzastupljeniji patofiziološki oblik srčanog zastoja na početku reanimacionih procedura bila je asistolija (AS), u 27 pacijenata (65,9%). Srčani zastoj je preživjelo pet (12,2%) pacijenata. Najzastupljeniji patofiziološki oblik srčanog zastoja, registrovan kod preživjelih pacijenata neposredno prije uspostave normalnog srčanog ritma, bila je ventrikularna fibrilacija (VF), u četiri (80,0%) pacijenta. Jedan (3,7%) pacijent je preživio AS, a četiri (66,7%) pacijenta preživjela su VF. Frekvencija svih oblika srčanog zastoja u ovom istraživanju bila je statistički signifikantno različita (frekvencija AS-a i EMD-a bila je viša, a VT-a i VF-a niža) od očekivane frekvencije (p>0.005).

Zaključak Istraživanje pokazuje kako postoji potreba za povećanjem efikasnosti prehospitalnog tretmana unapređenjem saradnje s institucijama koje pružaju obuku iz prve pomoći (Crveni križ).

Ključne riječi: srčani zastoj, basic life support, advanced life support, defibrilacija, kardiopulmonalna reanimacija.