In-hospital Cardiac Arrest: can we Change Something?

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In-hospital cardiac arrest: can we change something?

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Summary Cardiac arrest is classified as 'in-hospital' if it occurs in a hospitalised patient who had a pulse at the time of admission. A probability of patient's survival until hospital discharge is very low. The reasons for this are old age, multiple co-morbidity of patients, late recognition of cardiac arrest, poor knowledge about basic life support algorithm, insufficient equipment, absence of qualified resuscitation teams (RTs) and poor organization.

The aim of this study was to demonstrate characteristics of in-hospital cardiac arrests and resuscitation measures in University Hospital Osijek. We analysed retrospectively all resuscitation procedures data where anaesthesiology RTs provided cardiopulmonary resuscitation (CPR) during 5-year period.

We analysed 309 in-hospital resuscitation attempts with complete documentation. Victims of cardiac arrest were principally elderly patients, neurological (30.4 %), surgical (25.24 %) and neurosurgical patients (15.2 %) with many associated severe diseases. In 85.6 % of the cases, resuscitation was initiated by ward personnel and RTs arrived within 5 min in 67 % of the cases. However, in 14.6 % of the cases resuscitation measures had not been started before RT arrival. We found statistical correlation between lower initial survival rates and length of hospital stay ($p=0.001$), presence of cerebral ischemia ($p=0.026$) or cardiomyopathy ($p=0.004$) and duration of CPR ($p=0.041$). Initial survival was very low (14.6 %), and full recovery was accomplished in only eight patients out of 309 (2.59 %).

Identification of terminal chronic patients in which the CPR is not reasonable, a better organisation and ward personnel education can contribute to better overall success.

Keywords In-hospital cardiac arrest · Cardiopulmonary resuscitation · Resuscitation team · Survival

Herzstillstand im Spital: Können wir etwas ändern?

Zusammenfassung Herzstillstand wird als „in-hospital" definiert, wenn er bei einem hospitalisierten Patienten auftritt, der einen Puls zum Zeitpunkt der Aufnahme hatte. Die Wahrscheinlichkeit des Überlebens des Patienten bis zur Entlassung aus dem Spital ist sehr niedrig. Die Gründe dafür sind hohes Alter, multiple Komorbiditäten, spätes Erkennen des Herzstillstands, schlechte Reanimationskenntnisse, mangelhafte Ausrüstung, Abwesenheit von qualifizierten Wiederbelebungsteams und schlechte Organisation.

Ziel der Studie war es, die Charakteristika von „in-hospital" Herzstillständen und der entsprechenden Wiederbelebungsmaßnahmen im Universitätsspital Osijek aufzuzeigen. Wir analysierten retrospektiv alle Wiederbelebungsprozeduren eines 5-Jahreszeitraums, bei denen Anästhesisten-Reanimationsteams kardiopulmonale Wiederbelebung versuchten. Wir analysierten 309 komplett dokumentierte „in-hospital" Reanimationsversuche.

Opfer eines Herzstillstandes waren im Prinzip ältere Patienten, 30,4 % neurologische, 25,24 % chirurgische und 15,2 % neurochirurgische Patienten mit vielen schweren Begleiterkrankungen. Bei 85,6 % der Fälle wurde die Wiederbelebung durch das Stationspersonal begonnen. Die Reanimationsteams erschienen inner-

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halb von 5 Minuten in 67 % der Ereignisse. Allerdings wurde in 14,6 % der Fälle mit der Reanimation erst nach Eintreffen des Reanimationsteams begonnen. Wir fanden einen statistisch signifikanten Zusammenhang zwischen einer niedrigeren initialen Überlebensrate und der Dauer des stationären Aufenthaltes ($p = 0,001$), dem Vorliegen einer cerebralen Ischämie ($p = 0,026$) oder einer Kardiomyopathie ($p = 0,004$) und der Dauer der kardiopulmonalen Reanimation ($p = 0,0041$). Die initiale Überlebensrate war sehr niedrig (14,6 %). Eine komplette Erholung trat nur bei 8 von 309 Patienten (2,59 %) ein.

Eine Identifizierung von terminal chronisch kranken Patienten, bei denen eine kardiopulmonale Reanimation nicht sinnvoll ist, scheint nicht vernünftig. Eine bessere Organisation und eine Schulung des Stationspersonals kann zu einem besseren Gesamterfolg beitragen.

Schlüsselwörter Herzstillstand („in hospital") · Kardiopulmonale Reanimation · Reanimationsteam · Überleben

Introduction

Cardiopulmonary resuscitation (CPR) was developed to treat individuals who have a sudden unexpected cardiac arrest due to some reversible conditions [1]. Cardiac arrest is the main reason for a sudden death. There are few definitions of cardiac arrest, but mostly used definition is: a cardiac arrest is the cessation of cardiac mechanical activity which is confirmed by the absence of a detectable pulse, unresponsiveness and apnoea. It is classified as 'in-hospital' if it occurs in a hospitalised patient who had a pulse at the time of admission [2].

In developed countries the incidence of cardiac arrest is 1–2 cases on 1,000 people, so in Croatia about 6,000 people develop cardiac arrest per year [3]. The incidence of in-hospital cardiac arrest is 3–4/1,000 in hospitalised adult patients [4], or 0.175 cardiac arrests per hospital bed per year [5].

In-hospital cardiac arrest is a significant public health problem with a low probability of patient's survival until hospital discharge. Techniques of CPR were introduced more than 50 years ago for treatment of sudden cardiorespiratory arrest with chance for recovery. However, the CPR is now widely used to treat arrests in people with severe underlying diseases and poor overall likelihood of survival [6, 7]. The rate of survival from cardiac arrest, particularly in the hospital setting, remains very low. Reasons for this are old age, multiple co-morbidity of patients, late recognition of cardiac arrest, poor knowledge about basic life support (BLS) algorithm, insufficient equipment (monitors, defibrillators and resuscitation carts), absence of qualified resuscitation teams (RTs) and poor organization. Also, the resuscitation measures are often applied in terminal chronic patients whose death is unavoidable despite resuscitation measures and intensive care treatment [8]. Better education, ward personnel training and organisation of RTs in hospitals could contribute to better overall success [9, 10].

The purpose of this study was to demonstrate epidemiological characteristics of in-hospital cardiac arrests and resuscitation measures in our hospital.

Patients, materials and methods

This study was approved by University Hospital Osijek research ethical committee. We analysed retrospectively all resuscitation procedure data where Resuscitation teams (RTs) from Department of Anaesthesiology, Resuscitation and Intensive Care Unit (ICU) provided CPR during 5-year period, from 1st of January of 2007 till 31st of December of 2011 in University Hospital Osijek.

At a minimum, CPR is defined as the use of chest compressions and rescue breathing. BLS measures were defined as manual ventilation free of invasive airway management and chest compression. Advanced life support (ALS) measures include invasive airway management (endotracheal intubation, laryngeal mask airway or ventilation over tracheostomae), chest compression, drugs application or defibrillation if it is necessary. Initially successful CPR was defined as return of spontaneous circulation for at least 15 min after CPR procedure.

University Hospital Osijek is a teaching hospital that cares for more than 1 million people in Eastern Croatia. The hospital has 1,160 acute care beds divided in 18 major wards. Our hospital has had RTs over 20 years, which are qualified and equipped for providing ALS measures. They constitute of an anaesthesiologist and a nurse—anaesthetist, and they are available 24 h a day on mobile phone.

In this study, we included resuscitation attempts that were initiated outside the Department of Anaesthesiology, Resuscitation and ICU. Exclusion criteria were cardiac arrests in operation rooms and ICU and respiratory arrest without cardiac arrest. Also, exclusion criteria include all cardiac arrests in which resuscitation was initiated outside of the hospital prior to arrival in the Emergency department. Data on every cardiac arrest and CPR were noted from patient's medical history and were entered in a special form. In order to determine the characteristics of all in-hospital cardiac arrests, we noted patient's age and gender, date, time and shift when the arrest happened, patient's location and all resuscitation measures undertaken by ward staff and RTs. Also, we noted pre-arrest patient characteristics and clinically assessed cardiac arrest cause, duration of CPR, initial outcome and signs of recovery after initially successful CPR.

All data were entered into database and analysed by SPSS statistical programme (version 17.0 for Windows, SPSS Inc., IL, USA). Frequency or arithmetic mean and standard deviation were calculated for all data. Also, we tested possible associations between initial outcome and certain variables using Chi-square test. Differences were considered significant at p value < 0.05.

Table 1 Distribution of cardiopulmonary resuscitation attempts by time and location

	n = 309 (%)
Hospital ward	
Neurology	94 (30.4)
Neurosurgery	47 (15.2)
General surgery	78 (25.24)
Internal medicine	34 (11)
Infectology	10 (3.2)
Dialysis	27 (8.7)
Urology	11 (3.6)
Gynaecology	1 (0.3)
Otorhinolaryngology	3 (1)
Paediatrics	1 (0.3)
Psychiatry	1 (0.3)
Radiology	2 (0.6)
Location	
Ward	129 (41.7)
Intermediate care unit	170 (55)
Emergency	4 (1.2)
Other	6 (1.9)
Shift	
06.00–14.00 h	135 (43.7)
14.00–22.00 h	99 (32)
22.00–06.00 h	75 (24.3)
Working day	
Working day	214 (69.3)
Weekend day	95 (30.7)

Table 2 Applied cardiopulmonary resuscitation measures

	By ward personnel	By RT
	n (%)	n (%)
Ventilation		
Nothing	47 (15.2)	4 (1.3)
Face mask + ventilation bag	130 (42.1)	
Face mask + airway + ventilation bag	96 (31.1)	6 (1.9)
ET tube + ventilation bag	25 (8.1)	289 (93.5)
ET canulla + ventilation bag	11 (3.6)	10 (3.2)
Chest compression		
Yes	263 (85.1)	309 (100)
No	46 (14.9)	
Defibrillation		
Yes	24 (7.8)	24 (7.8)
No	285 (92.2)	285 (92.2)
Drugs		
Nothing	120 (38.8)	11 (3.5)
Epinephrine	178 (57.6)	292 (94.5)
Atropine	53 (17.15)	110 (35.6)
Amiodarone	7 (2.26)	10 (3.2)
Dopamine	3 (0.97)	2 (0.6)
Norepinephrine		2 (0.6)
Dobutamine		3 (1)

RT resuscitation team, *ET* Endotracheal

Results

This analysis identified clinical and epidemiological characteristics of all resuscitation efforts in University Hospital Osijek in 5-year period. There were 541 documented calls to RTs in this period, and 376 CPRs were performed. In 165 cases RT was called for other reasons such as consciousness disturbances, respiratory insufficiency, epileptic seizures, collapses, hypotensions or hypertensions. Sixty-seven CPR attempts were excluded due to incomplete documentation, when CPR was terminated before RT arrival or in emergency room when the patient was dead before arrival to the hospital. Finally, 309 CPRs with complete documentation were included in the study.

During investigated period, RTs performed CPR on 58.3% (180/309) male and 41.7% (129/309) female patients. Average age was 68.9 ± 12.56 years. The youngest patient was 11 years old and the oldest patient was 93 years old, and most of resuscitated patients were older than 60 years (75.7%). The data concerning hospital location and time of CPR are described in Table 1. CPR measures had been started by ward personnel in over 85% of the cases, but in 44 patients (14.2%) CPR measures had not been started before RT arrival. Average time until BLS

was 1.92 ± 2.40 min, and 6.77 ± 6.02 min elapsed before ALS measures. About a half (49.5%) of the patients were monitored at a moment of collapse, and the most registered initial rhythm was asystole (45%) and pulseless electrical activity (13.9%). Ventricular fibrillation (VF) or ventricular tachycardia (VT) without pulse was registered in 6.8% of the patients (21/309). In the remaining cases (34.3%), the first rhythm was not documented or signs of recovery appeared before RT arrival. All measures applied during CPR were described in Table 2. Average duration of CPR was 29.92 ± 16.09 min. At the end of CPR, 85.4% (264/309) of the patients were dead, and 14.6% (45/309) were initially alive. Signs of recovery with the return of spontaneous circulation were noted in 77.7% (35/45) of initially alive patients. Return of circulation and spontaneous respiration were noted in 22.3% of the patients (10/45). After initially successful CPR, three patients were cardiorespiratory stable and stayed at the ward. Remaining 42 patients were transferred to ICU, but six patients died just after arrival at ICU, and most of initially alive patients died in first few days of ICU treatment (85%). Final outcome was 2.5% (8/309) of alive patients, which were discharged from hospital. Pre-arrest characteristics of resuscitated patients were described in Table 3. Clinically assessed possible causes of arrest were hypoxia in 65.7%, cardiac dysfunction due to ischemia or arrhythmia in 22.7% (70/309) and metabolic causes in 8.4% (26/309) of the patients. RT had not decided on possible cause of arrest in ten cases (3.2%). Correlation

Table 3 Patients' pre-arrest characteristics

	n (%)
Length of hospital treatment	
<1day	54 (17.5)
1–5 days	105 (34)
5–10 days	92 (29.8)
>10 days	58 (18.8)
Cardiovascular diseases	
CAD	61 (19.7)
Cardiomyopathy	121 (39.1)
Atrial fibrillation	38 (12.3)
Arterial hypertension	150 (48.5)
Valve disorders	3 (1)
Pacemaker	4 (1.3)
Others	7 (2.3)
Neurological diseases	
Cerebral ischemia	79 (25.6)
Cerebral haemorrhage	56 (18.1)
Polyneuropathy	4 (1.3)
Tumour	11 (3.6)
Respiratory diseases	
Asthma/COPD	19 (6.1)
Pneumonia	21 (6.8)
Tumour	5 (1.6)
Others	3 (1)
Endocrinology disorders	
Diabetes mellitus type I	8 (2.6)
Diabetes mellitus type II	42 (13.6)
Hyperthyreosis	3 (1)
Infections	
Pneumonia	21 (6.8)
Peritonitis	7 (2.3)
Uroinfection	3 (1)
Sepsis	20 (6.5)
Others	2 (0.6)
Another diseases/states	
Pancreatitis	9 (2.9)
Gastrointestinal bleeding	8 (2.6)
Severe trauma	14 (4.5)
Chronic renal failure	42 (14.2)
Malignant diseases	37 (11.9)
Major abdominal surgery	30 (9.7)
CAD coronary artery disease, *COPD* chronic obstructive pulmonary disease	

between success of initial recovery and some peri-arrest factors were described in Table 4.

Discussion

Modern CPR is based on two major principles, namely closed-chest cardiac massage to restore threshold blood flows, especially to the heart and the brain, and artificial ventilation through an unobstructed airway to maintain vital gas exchange. There is a very short therapeutic time window between onset of cardiac arrest and irreversibility of cellular injury, and especially so in the heart and brain [11]. Health care providers must be aware of this fact and be familiar with CPR measures. The CPR must be standardised, team based and highly organized medical intervention both in and out of hospital.

Our study identified several peri-arrest factors associated with low survival rates in patients whose cardiopulmonary arrest occurred during hospitalization. Cardiac arrest victims were elderly people with male predominance, which is in accordance with previous studies. Major proportion of resuscitation patients in our hospital are neurological, surgical and neurosurgical, which are under high risk for cardiac arrest. Among the surgical patients, most of them were abdominal surgery and traumatology patients due to heaviness of their primary state (conditions after major surgery, malignant diseases or multiple injuries). Relatively, little proportion of cardiology ward patients can be explained by two things. Firstly, the monitoring is much better in this population, so prevention of arrest is satisfactory and treatment of cardiac arrest by ward personnel is prompt. Secondly, the cardiologists often perform CPR measures including ALS themselves, without calling RT. Therefore a number of arrests that need an RT support is reduced. This is probably one of the reasons for low percentage of patients with VF/VT in our study. Our results show that 55 % of CPRs were in intermediate care units. This is expected because of severity of underlying diseases and conditions in this population. About 44 % of resuscitations were in daytime shifts (06.00–14.00 h), which we can explain with more ward personnel who recognize a cardiac arrest on time and call for help. Recent studies showed better survival rates after CPR in critical care areas and during the day shift [12–15]. Our results do not confirm these findings ($p = 0.154$). In a major proportion of cardiac arrests, CPR measures were started by ward personnel in a first few minutes after the incident and they immediately called RT. An appropriate location of Anaesthesiology Department in the University Hospital Osijek is a reason for quick arrival of RT to critical patients, mostly in the first 5 min. Although the ward staff starts early with BLS measures, they are often insufficient. ALS measures usually begin with RT arrival, but in small percentage of patients they were started by ward physicians and nurses (1.5 %). This is noted especially for resuscitation attempts at Department for Dialysis. Although ALS measures on Dialysis department started very early after arrest, survival rate was very low (11.1 % or 3/27), but we did not find statistical significance in survival rates in patients on dialysis and non-dialysis controls ($p = 0.648$). There are few studies about CPR in renal dialysis patients and all of them showed low survival rates. Hijazi and Holley showed, in a group of 74 patients, that a long-term survival was 3 % in dialysis patients vs. 9 % in non-dialysis controls [16]. More than half of resuscitated patients were monitored at

Table 4 Correlation between initial return of spontaneous circulation and some peri-arrest factors[a]

Peri-arrest factor	Initially alive patients, N=45	Initially dead patients, N=264	p value
	n (%)	n (%)	
Gender			
Male	26 (8.4)	154 (49.8)	0.944
Female	19 (6.1)	110 (35.6)	
Age			
<70 years	22 (7.1)	117 (37.9)	0.569
≥70 years	23 (7.4)	157 (47.6)	
Work shift time			
06.01–14.00	14 (4.5)	121 (39.2)	0.154
14.01–22.00	19 (6.1)	80 (25.9)	
22.01–06.00	12 (3.9)	63 (20.4)	
Day in week			
Working day	32 (10.4)	182 (58.9)	0.770
Weekend	13 (4.2)	82 (26.5)	
Location			
Hospital ward	16 (5.2)	113 (36.6)	0.333
Intermediate care unit	28 (9.1)	142 (46)	
Other	1 (0.3)	9 (2.8)	
CPR started before RT arrival			
Yes	37 (12)	228 (73.8)	0.462
No	8 (2.6)	36 (11.7)	
Length of hospital treatment			
≤5 days	33 (10.7)	126 (40.8)	0.001
>5 days	12 (3.9)	138 (44.7)	
Time to RT arrival			
≤5 min	32 (10.4)	177 (57.3)	0.590
>5 min	13 (4.2)	87 (28.2)	
Time to BLS			
≤2 min	36 (11.7)	219 (70.9)	0.629
>2 min	9 (2.9)	45 (14.6)	
Time to ALS			
≤5 min	34 (11)	180 (58.3)	0.321
>5 min	11 (3.6)	84 (27.2)	
Rhythm			
Shockable	3 (1)	17 (5.5)	0.954
Non-shockable	42 (13.6)	247 (79.9)	
Drugs			
Yes	22 (7.1)	101 (32.7)	0.178
No	23 (7.4)	163 (52.8)	
Chronic renal failure			
Yes	5 (1.6)	40 (12.9)	0.648
No	40 (12.9)	224 (72.5)	
Malignant disease			
Yes	9 (2.9)	45 (14.6)	0.630
No	36 (11.7)	219 (70.9)	

Table 4 (continued)

Peri-arrest factor	Initially alive patients, N=45	Initially dead patients, N=264	p value
	n (%)	n (%)	
Severe infections			
Yes	8 (2.6)	46 (14.9)	0.954
No	37 (12)	218 (70.6)	
Cerebral ischemia			
Yes	5 (1.6)	70 (22.7)	0.026[a]
No	40 (12.9)	194 (62.8)	
CAD			
Yes	8 (2.6)	53 (17.2)	0.720
No	37 (12)	211 (68.3)	
Cardiomyopathy			
Yes	9 (2.9)	152 (49.2)	0.004
No	36 (11.7)	112 (36.2)	
CPR duration			
≤30 min	25 (8)	187 (60.6)	0.041
>30 min	20 (6.5)	77 (24.9)	

CPR cardiopulmonary resuscitation, *RT* resuscitation team, *BLS* basic life support, *ALS* advanced life support, *CAD* coronary artery disease
[a]Comparision was made between group of initially alive and initially dead patients

a beginning of CPR and most of them were at intermediate care unit. In the majority of studies, VF/VT is the first monitored rhythm in just 20–35 % of in-hospital cardiac arrests, unlike in out-of-hospital cardiac arrest, where the majority of cases have VF/VT at first few minutes after critical incident [17–20]. The lower prevalence of VF/VT rhythms in in-hospital cardiac arrest than in out-of-hospital arrest may be explained partially by differences in pathophysiology: cardiac arrest in hospital is frequently precipitated by hypoxia or hypotension, which are more likely to cause pulseless electrical activity (PEA) or asystole than VF/VT. Conversely, VF/VT rhythms are more common when ischemia is the precipitating cause of cardiac arrest, which often occurs in out-of hospital cardiac arrests [21, 22]. Our results show that small percentage (6.8 %) of patients had ventricular fibrillation or ventricular tachycardia at the beginning of CPR, what is lower than in previous studies. Very low percentage of VF/VT is probably associated with patient's characteristics, which are often susceptible to asystole due to nature of primary disease. Above mentioned reduced number of patients from Cardiology contribute to lower percentage of VF/VT rhythm. Also, in some cases ward staff recognize patients in cardiac arrest too late or switch patients on the haemodynamic monitor too late, when the initial rhythm has been already converted to asystole or PEA. In this investigation, we found no statistical correlation between survival rates and initial rhythm ($p=0.954$). Numerous studies undoubtedly showed that outcome from in-hospital cardiac arrest was consistently better

when the first monitored rhythm was VF/VT rather than asystole or PEA, firstly because VF/VT rhythms can be treated promptly and successfully with defibrillation, and secondly, the presence of a VF/VT implies a recent onset of cardiac arrest [23–26].

Clinically estimated main reasons of arrest in our study were hypoxia, heart disorders or metabolic causes. However, cardiac arrest is mostly secondary in hospitalised patients and occurs most frequently after severe impairment of respiratory function due to nature of their primary diseases. So, neurological, neurosurgical and surgical patients are especially susceptible to this form of cardiac arrest. Deterioration of primary condition precede almost all cardiac arrests, so recognition of this states and prevention of cardiac arrest is as important as prompt and appropriate treatment. Disturbances of consciousness, respiratory function aggravation and hypotension are most frequently reasons for primary condition deterioration. Tachydyspnoea and low blood pressure are the commonest warning signs before an imminent cardiac arrest and can be used as activation criteria for attendance of an RT. Experience with such teams have shown a reduction of the incidence and mortality of in-hospital cardiac arrest [27–29]. The role of RTs in our hospital is performing the ALS resuscitation measures and treatment of critically ill patients. In the future, extension of the role of the RTs to an early evaluation and stabilisation of the deteriorating patient must be one of priorities in our hospital.

Documented survival rates for in-hospital cardiac arrest range from 0 to 42 %, although major studies report a survival until discharge of about 20 %. Older age, sepsis, cancer, dementia, azotaemia, stroke and congestive heart failure are factors which influence CPR survival rates. Briendly et al. in Canada found that only 22.4 % of those with witnessed arrest survived until hospital discharge, and only 1 % of those with unwitnessed cardiac arrest [30]. Taffet et al. found immediate survival after CPR in 31 % of patients older than 70 years, but none of these patients survived until hospital discharge [31]. Our results show low immediate survival rate and very low survival rate till hospital discharge. Positive correlation between length of hospital stay, presence of cardiac or cerebrovascular diseases and CPR duration with initial survival rate indicate patient's characteristics, i.e. type and severity of main disease and co-morbidity as the most important predictors of unsuccessful CPR. Unnecessary administering of CPR measures in dying and incurable patients also contribute to high mortality rate. Too late recognition of patient in cardiac arrest and evidently poor quality of BLS measures contribute to low survival rate. Today, CPR has become default response to cardiac arrest for medical personnel. The CPR should not prolong dying process in terminal and incurable illness. The states in which cardiac arrest develops as normal consequence of primary state and without chance for recovery (e.g. terminal metastatic carcinoma, severe brain and cervical spine injury, terminal heart disease and terminal lung disease) should be recognized

before CPR initiation. We determined that in 20 % of our patients CPR measures should not have been started at all. Rational approach to all patients with cardiac arrest demands team work which includes ward staff and RT personnel. Ward physician must identify patients who are more likely to benefit from CPR, decide about CPR initiation, invite RT if it is necessary and start with BLS measures. However, our results do not confirm this thesis. A ward staff had never decided independently on 'do not resuscitate' for some patient, regardless of the cause of the arrest. Also, the decision about proceeding with or extending resuscitation efforts must be made with anaesthesiologist in RT after the CPR is in progress. This perhaps could minimize futile expenditure of intensive care resources and possible patient agony [32].

In our study we tested influence of some variables on initial survival rates, and we found statistical correlation between initial survival rates and length of hospital stay ($p=0.001$), presence of cerebral ischemia ($p=0.026$) or cardiomyopathy ($p=0.004$) and initial survival rate with the duration of CPR ($p=0.041$). Patients who stayed longer in hospital or had cerebral ischemia or cardiomyopathy had significant lower survival rates by comparison with controls. Longer hospital stay is probably associated with heavier disorders or complications of primary state, and cerebral ischemia and cardiomyopathy are markers of advancing cardiovascular diseases. These patients are disposed to cardiac arrest and lower survival rates due to these facts. Also, we found statistically lower survival rates in CPRs which were longer than 30 min. We found no significant association between either age or gender and initial outcome (Table 4). Likewise, no association was seen between location, working shift, day in a week, times of starting all CPR measures and the patient's initial survival. There was also no clear association between some severe diseases (coronary artery diseases, severe infections, malignant diseases and chronic renal failure) and initial successful CPR. There are many published data about influence of pre-arrest factors on survival rates. Advanced age, some severe diseases and longer period before the start of CPR measures were described as factors associated with worse outcome in most former studies [33–36]. Our study unexpectedly did not show same correlations, probably due to inappropriate and non-objective documentation what is the major and real problem with all retrospective studies. Also, it is very difficult to determine co-morbidity with predefined standardized criteria in retrospective studies.

Some previous studies showed poor and insufficient documentation for in-hospital cardiac arrests [37]. Our analysis also showed incomplete notation for very large number (about 15 %) of cardiac arrests which were excluded. Systematic data collection with standardized data sheet, e.g. Utstein template, is crucial to ensure the evaluation of the quality of the resuscitation services provided by hospitals. There is no systematic data collection about in-hospital cardiac arrests in Croatia. In the future, the prospective multicentre study must be done in co-operation with Croatian Society for Resuscitation

in order to determine the most important facts about cardiac arrest and resuscitation in our hospitals.

Conclusion

Although our study had few limitations, our results showed some critical points in management of critically ill patients and application of CPR measures. We can conclude that more attention must be paid to CPR management at all levels in hospital setting. Our results showed low initial survival rate and very poor final outcome. In our hospital, patient's characteristics, i.e. type of main disease and co-morbidity are the most important predictors of unsuccessful CPR. Unnecessary administering of CPR measures in dying and incurable patients also contribute to high mortality rate. Identification of terminal chronic patients in which the CPR is not reasonable, a better organisation and ward personnel education can contribute to better overall success.

Conflict of interest

The authors declare that there are no actual or potential conflicts of interest in relation to this article.

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