

The outcomes of patients admitted to the Intensive Care Unit following cardiac arrest at a tertiary hospital in Saudi Arabia

Wyniki leczenia chorych po nagłym zatrzymaniu krążenia przyjętych na oddział intensywnej terapii szpitala referencyjnego w Arabii Saudyjskiej

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Abstract: Introduction. Cardiopulmonary arrests may occur unexpectedly and result in high mortality rates. Saudi Arabia currently relies on data on resuscitation outcomes and factors affecting the outcome which overwhelmingly come from the United States and Western Europe. **Objectives.** The objectives of this study were thus to evaluate the outcome of patients who had a cardiac arrest that in one tertiary care hospital in Saudi Arabia and to investigate factors that may have impacted those outcomes. **Patients and methods.** Included in this study were all adult patients who survived cardiac arrest admitted to Intensive Care Unit (ICU). We reviewed time period between January 2000 and March 2007. **Results.** In this retrospective cohort study we identified 1749 patients with cardiac arrest; 495 (28.3%) of them were admitted to the ICU. Of those admitted, 238 (13.6% of the original cohort) survived to ICU discharge, and 134 (7.7%) to discharge from the hospital. **Conclusions.** The prognosis of cardiac arrests victims remains poor. We reviewed recent changes to resuscitation protocols which, when implemented, may improve outcome of cardiac arrest patients. To improve this situation initiatives such as the creation of "medical emergency team" to provide early response to at-risk patients might potentially change the fate of some individuals.

Key words: cardiac arrest, outcome, Saudi Arabia

INTRODUCTION

Cardiopulmonary arrests may occur unexpectedly and result in high mortality rates [1,2]. Cardiopulmonary resuscitation (CPR) was developed in an attempt to prolong life of patients suffering such an event. Though modern CPR has been in existence for over 40 years, the overall survival rate of patients who experience cardiac arrest remains dismally poor. New research regarding advanced technologies and techniques has uncovered a number of promising areas for clinicians to consider [3]. Combined data from large studies in over 40,000 patients show a survival rate to discharge of only 16% for patients with in-hospital cardiac arrest [4,5]. Survival of the out-of-hospital cardiac arrest victims remains low worldwide although efforts to train first responders and bystanders con-

tinue to increase [3]. Generally, there is a belief that correctly performed CPR does exert a significant survival benefit [6]. Prognosis of patients who experience cardiopulmonary arrest may be thus considered separately in two groups: The first group are patients who experience the event outside hospital, while the second group includes hospitalized patients.

This study looks at the prognosis of cardiac arrest patients in whom this event occurred in hospital. Selecting the hospital environment offers the advantages of pre-arrest documentation as well as the knowledge that resuscitation was performed by a highly trained hospital personnel.

In hospitals, cardiac arrest is a relatively common event with an estimated incidence of 1:1000 patients, although this incidence depends on the population in a given institution. In literature the survival rate of those patients to discharge from the hospital is in the range 5–37% [7]. Factors affecting the prognosis of in-hospital cardiac arrest victims include the organization of the in-hospital response team, the delay between the call and the arrival of the resuscitation team, the availability of the equipment, and the level of staff training [7]. The main factor may be actually a type of patients in whom resuscitation is attempted. In general, factors associated with better survival rates include younger age, absence of

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Table 1. Outcome of 1749 CPR attempts performed in the study period between January 2000 and March 2007

Total in hospital cardiac arrest outside of CCU	1749 (0.72% of admissions)
Immediate survival probability	495/1749 (28.3%)
ICU discharged rate	238/1749 (13.6%)
Hospital discharged rate	134/1749 (7.7%)
CCU – Cardiac Care Unit, CPR – cardiopulmonary resuscitation, ICU – Intensive Care Unit	

Table 2. Probability of survival after ICU admission depending on the underlying diagnosis

Underlying disease	Number of patients	Probability of survival (95% CI)
Respiratory disease	111	0.34 (0.25–0.44)
Cardiac disease	120	0.28 (0.20–0.37)
Neurological disease	40	0.35 (0.21–0.52)
Renal failure	63	0.17 (0.1–0.3)
Gastrointestinal disease	36	0.28 (0.14–0.45)
Sepsis	33	0.21 (0.9–0.39)
Traffic accident	25	0.16 (0.04–0.36)
Other	67	0.24 (0.14–0.35)

Abbreviations – see Table 1

multiple co-morbidities, primary respiratory rather than primary cardiac arrest, ventricular arrhythmias rather than asystole or pulseless electrical activity (PEA), witnessed arrests, and shorter duration of the need for CPR [7].

Determining accurate local resuscitation rates is necessary in an era of increased debate regarding end-of-life directives and evidence-based treatment. Also, despite considerably different models of health care delivery, Saudi Arabia currently relies on data on resuscitation outcomes and factors affecting the outcome which overwhelmingly come from the United States and Western Europe [8].

The objectives of this study were thus to evaluate the outcome of patients who had a cardiac arrest that in one tertiary care hospital in Saudi Arabia and to investigate the factors that may have impacted those outcomes.

PATIENTS AND METHODS

Setting

The study was approved by the Institutional Review Board and conducted in a 21-bed medical and surgical Intensive Care

Unit (ICU) in an 800-bed tertiary care teaching hospital in Riyadh, Saudi Arabia. This ICU is a closed unit, run by in-house, full-time, board-certified intensivists. This ICU has more than 1000 admissions per year.

Patients

Included in this study were all adult patients who suffered cardiac arrest followed by successful CPR (defined as the return of spontaneous cardiac output). In the prognostic considerations we included patients who were subsequently admitted to ICU. We reviewed time period between January 2000 and March 2007. The patients in the Coronary Cardiac Care Unit (CCU) were excluded.

CPR Team

The CPR Team consisted of a consultant emergency physician acting as team leader, along with a senior medical resident, 2 junior residents, a respiratory therapist, and registered nurses. During the first 2 years of the study the team leader was an intensivist. All team participants were certified in Advanced Cardiac Life Support.

Measurement

The data included in this study was collected from the ICU database and included information about patients who were admitted to the ICU after successful administration of CPR prior to that admission. The data collected included: baseline demographics (gender, age, body mass index); type of admission using pre-specified admission diagnoses; lactic acid level upon admission to the ICU; and Acute Physiology and Chronic Health Evaluation II (APACHE II) scores [9]. Patients were followed until discharge from the hospital or death whichever occurred first.

Statistical analysis

Continuous data were expressed as means \pm standard deviations and compared using the Student t-test. Categorical data was expressed as a percentage and compared using the χ^2 test. Statistical significance was defined as $\alpha < 0.05$. Statistical analysis was performed using Minitab for Windows (version 13.1).

RESULTS

There were total 224,644 patients admitted to the hospital during the study period. This study documents 1749 patients who underwent CPR during the study period. Overall survival to hospital discharge among those patients who suffered an arrest was 7.7% (134/1749) (Tab. 1). Following CPR, the immediate survival rate for patients to the ICU admission was

28.3% (495/1749). Of those admitted to ICU, 238 (13.6% out of original 1749, and 48.1% of those admitted) survived to ICU discharge. Of those who were discharged from ICU alive, 134 survived to hospital discharge (7.7% of all who suffered cardiac arrest, 27.1% of those admitted to ICU and 56.3% of those discharged from ICU).

The following data pertain to 495 patients who survived cardiac arrest and were admitted to ICU. From the records, the most common reason for cardiac arrest among those patients was primary cardiac disease (24.2%), followed by respiratory disease (22.4%). We have found that survival to discharge among those patients was most likely among patients with primary respiratory disease (34%), and lowest among those in whom initially successful cardiac arrest procedures occurred in a setting of motor vehicle accident (16%) or presence of renal disease (17%) (Tab. 2). The difference in probability of survival between patients with primary respiratory diagnosis and primary renal diagnosis was significant (34.2% vs. 17.5%, relative risk [RR] 1.96, 95% CI 1.08–3.56).

Fifty-six percent of patients who survived cardiac arrest admitted to the ICU were older than 65 with the majority (56.5%) of males. The probability of survival to hospital discharge was higher among those who were young (29.9% among those who were <65 years of age vs. 23.5% among those who were older; RR 1.27, 95% CI 0.94–1.72) and who had shorter duration of arrest before return of spontaneous circulation (30.1% among those with CPR <15 min vs. 23.1% among those with longer CPR duration; RR 1.30, 95% CI 0.96–1.76) (Tab. 3). The level of lactic acid and APACHE II score on admission were lower among those who survived, although only APACHE II score remind as independent risk factor in multivariate analysis (Tab. 4).

Initial heart rhythms were also studied. The most common initial rhythm for those patients that survived a cardiac arrest and were admitted to the ICU was PEA, and presence of this rhythm during cardiac arrest was still associated with lowest probability of survival even among those patients who were admitted to ICU (Tab. 3).

DISCUSSION

The underlying low incidence of cardiac arrest in our hospital can be explained by high proportion of newborns (around 20% of all admissions). On the other hand, the immediate survival and discharge rate of patients with an attempted CPR in our center is at the lower end of numbers observed in most studies. In studies published in the United States, immediate CPR survival and discharge rates were reported to be between 44% and 60% and 9% and 17%, respectively [5,10]. In Canadian studies, reported discharge rates were between 5% and 25% [8,11,12]. In a one-year study by Pembeci et al. [13] in Turkey, the immediate survival rate was 49% and the discharge survival rate was 13.4%. Another study conducted in Iran showed only a 5.3% survival to discharge rate [1]. Results

Table 3. The effects of selected patients' characteristics on survival

Variable	Probability of survival	RR (95% CI)
Age		
<65	83/278 (29.9)	1.27 (0.94–1.72)
>65	51/217 (23.5)	
Sex		
Male	79/280 (28.2)	1.12 (0.83–1.50)
Female	55/218 (25.2)	
CPR duration		
<15 min	84/279 (30.1)	1.30 (0.96–1.76)
>15 min	50/229 (23.1)	
Time of admission to ICU		
7:45–16:00	43/163 (26.4)	0.96 (0.70–1.31)
16:00–7:45	91/332 (27.4)	
Initial Rhythm		
PEA	22/103 (21.4)	32.7% vs. 21.4%, RR 1.53, 95% CI 0.88–2.64
Bradycardia	4/20 (25)	
Asystole	46/198 (23.2)	
VT/VF	16/49 (32.7)	
Unknown	46/125 (36.8)	

The data are shown as numbers (percentage).

Abbreviations: PEA – pulseless electrical activity, RR – relative risk, VF – ventricular fibrillations, VT – ventricular tachycardia, others – see Table 1

Table 4. Selected variables in survivors as compared to patients who did not survive

	Results among those who survived	Results among those who did not survive	p
Lactic acid on admission	4.7 ± 4.7	6.6 ± 5.57	0.002
APACHE II	29 ± 8.5	32 ± 7.85	0.001
BMI	27.2 ± 8.71	26.74 ± 7.46	0.65

The data are shown as mean ± standard deviation.

Abbreviations: APACHE II – Acute Physiology and Chronic Health Evaluation II, BMI – body mass index

from miscellaneous studies varied from country to country as well as from regions within the same country [14]. One of the explanations of this finding might be different pattern of practice around “do not resuscitate” orders in our hospital in comparison with other centers [15].

The clinical predictors of successful outcomes following in-hospital cardiac arrest which we have identified generally confirm previous findings in other centers including the fact

that age alone may not be the most important factor and that it is the presence of multiple comorbidities which has most important role [16,17]. Our opinion is that there is insufficient data to recommend "no resuscitation" on the basis of age alone.

Other potential reasons for different survival rates in different centers may include competence of the CPR team or presence of a CPR team led by an anesthesiologist – this has been found to be a strong independent predictor of discharge survival [13,18]. The hours during which CPR administration occurs have also been found in some, but not in all studies to be a predictor of outcome success, with CPR attempts during office hours associated with improved discharge survival rates [8,19]. Generally, among patients who survived initial CPR we have observed trends consistent with previous observations – better survival outcomes if the arrest period was short, and better if the mechanism of arrest was that of ventricular fibrillation or ventricular tachycardia [13,14,20].

The latest guidelines published by the American Heart Association include substantial changes to the algorithms for basic life support and advance cardiovascular life support [21]. Early initiation of CPR and defibrillation are the most effective measures with the highest impact on survival in patients with cardiac arrest. Cardiopulmonary resuscitation should be performed with a compression-ventilation ratio of 30:2 with minimal interruptions and delivery of rescue breaths taking no more than 1 second. Cardiopulmonary resuscitation must be resumed immediately after each shock for 5 cycles. Amiodarone is an anti-arrhythmic drug of increased use. The expectation is that implementation of these changes to our practice we will improve the outcome.

The main strength of this study is that it included a large cohort of patients over long period of time. Further, the ICU operated under a closed-system staffed mainly by Critical Care Board-certified intensivists, thus increasing the homogeneity of clinical management and controlling for unknown variables.

This study also has limitations: it was conducted at a single institution and our observations were restricted to cardiac arrests outside of CCU. The analysis focused on patients who survived CPR and were admitted to the ICU, without analyzing the data on patients in whom cardiac arrest procedures were unsuccessful.

Conclusions:

- 1) administration of CPR and outcomes of patients who experience a cardiac arrest require continued research. This present study illustrates the disappointing rate of survival of patients with cardiac arrests. To improve this situation initiatives such as the creation of "medical emergency team" to provide early response to at-risk patients might potentially change the fate of some individuals [22]. I also suggest that a multi-center registry be considered to enhance further investigations
- 2) in contemporary Saudi practice, a multi-center cardiac arrest registry would allow critical appraisal of multiple resuscitative strategies along with the ability to study more

variables across a longer span of time. Further, such a registry could be used for quality assurance purposes and ongoing appraisal of the outcomes of in-hospital cardiac arrests. A registry would drive evidence-based care resulting in a potential to improve clinical outcomes for in-hospital patients with cardiac arrests followed by CPR efforts.

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