Original Article

An audit of in-hospital cardiopulmonary resuscitation in a teaching hospital in Saudi Arabia: A retrospective study

ABSTRACT

Objectives: Data reflecting cardiopulmonary resuscitation (CPR) efforts in Saudi Arabia are limited. In this study, we analyzed the characteristics, and estimated the outcome, of in-hospital CPR in a teaching hospital in Saudi Arabia over 4 years.

Methods: A retrospective, observational study was conducted between January 2009 and December 2012 and included 4361 patients with sudden cardiopulmonary arrest. Resuscitation forms were reviewed. Demographic data, resuscitation characteristics, and survival outcomes were recorded.

Results: The mean ± standard deviation age of arrested patient was 40 ± 31 years. The immediate survival rate was 64%, 43% at 24 h, and 30% at discharge. The death rate was 70%. Respiratory type of arrest, time and place of arrest, short duration of arrest, witnessed arrest, the use of epinephrine and atropine boluses, and shockable arrhythmias were associated with higher 24-h survival rates. A low survival rate was found among patients with cardiac types of arrest, and those with a longer duration of arrest, pulseless electrical activity, and asystole. Comorbidities were present in 3786 patients with cardiac arrest and contributed to a poor survival rate ($P < 0.001$).

Conclusions: The study confirms the findings of previously published studies in highly developed countries and provides some reflection on the practice of resuscitation in Saudi Arabia.

Keywords: Cardiopulmonary resuscitation; in-hospital arrest; outcome; survival rate

Introduction

For any arrested patient, cardiopulmonary resuscitation (CPR) is indicated to restore his/her cardiac and pulmonary function in the shortest possible time and to achieve a high survival rate with a good outcome. Many studies have been conducted to determine the actual success rate and the average survival rate following in-hospital CPR.[1-8] Most of these studies were conducted in developed countries with advanced drugs and equipment and great health facilities. Data regarding the outcome of the in-hospital CPR survival rate and outcome in developing countries are limited. In our study, the objective was to determine the survival rate among in-hospital cardiopulmonary arrested patients and to predict any determinant factors for survival in a tertiary care teaching hospital in Saudi Arabia.

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Methods

Approval of the study was provided by the Research Ethics Committee of our medical center (reference no. 648-11). A retrospective epidemiological study was conducted to review all CPR sheets over the 4-year period from January 2009 to December 2012. The need for informed consent was waived by the Research Ethics Committee. The CPR sheet followed the Utstein format in documenting resuscitation activity.[9] Patients' characteristics and information related to resuscitation in various hospital departments were reported. Our medical center is an 800-bed tertiary care teaching hospital, with 26 adult intensive care beds, twenty neonatal intensive care beds, and ten pediatric intensive care beds. It is located in a major city with a population of 5 million. All types of patients are treated in this hospital.

Cardiopulmonary arrest was defined as no palpable pulse, unmeasurable blood pressure, or absence of breathing. Patients with more than one cardiopulmonary arrest during their hospitalization were included as one arrest. Once the patient had had a cardiopulmonary arrest, a hospital-wide code alarm was activated and the resuscitation team was called to initiate resuscitation. The team was led by an intensive care senior resident, with support from an anesthesia senior resident, medical or surgical junior resident, and an intensive care nurse. All the members of resuscitation team were trained in both basic and advanced cardiac life support on a regular basis, except for the junior residents for whom the training was limited to basic life support (BLS). The nursing role was limited to assisting with drugs and equipment preparation and documentation of the resuscitation effort. The American Heart Association Guidelines were followed during resuscitation.

The reported data were reviewed by two of the authors, stored in a computer database, and transferred to the IBM SPSS Statistics Version 20 (Armonk, New York, USA). The following data were included in the study: patients' characteristics such as age, sex, and previous medical history; location and time of arrest, the time from the arrest to the arrival of the resuscitation team, and start of resuscitation; type of arrest and whether witnessed or not; duration of resuscitation, resuscitation effort, initial arrest rhythm, and need for defibrillation; the need and type of airway management devices; administered medications, particularly adrenaline and atropine; and the outcome of the resuscitation and patient survival rate for the first 24 h, and upon discharge from the hospital. All survivors of cardiopulmonary arrest were transferred to critical care areas after the return of spontaneous circulation (ROSC) for continuous care.

Statistical analysis

The mean with standard deviation (SD) or the range was calculated to show the central tendency of continuous variables, while frequency distribution and corresponding percentage were reported for nominal and categorical variables. Chi-square test and two-tailed *P* value were calculated to establish the relationship between categorical variables. $P < 0.05$ was considered statistically significant. The statistical analysis was performed using IBM SPSS Statistics version 20 (Armonk, New York).

Results

A total of 4981 patient charts were reviewed for patients who had cardiopulmonary arrest during the study period. Of these, 620 charts were excluded from the study. In 234, resuscitation was not needed and another 386 patients were labeled as "Do not attempt resuscitation" cases. Finally, 4361 CPR forms were included in the study. Patients' demographic and resuscitation characteristics are shown in Table 1. The mean ± SD age of arrested patients was 40 ± 31 years.

Table 2 shows the 24-h survival rate in relation to type of arrest, time and place of arrest, duration of arrest, witnessed arrests, and the airway tools used. The administered medications and their relationship to 24-h survival rate are shown in Table 3, both during the resuscitation period and as infusions during the

Table 1: Patients demographic data and cardiopulmonary resuscitation characteristics

Characteristics	*n*[a] (%)
Sex	
Male	2414 (55)
Female	1937 (44)
Age (years)	
≤10	1359 (31)
11-40	632 (15)
41-60	918 (21)
61-80	1177 (27)
≥80	269 (6)
Type of arrest	
Cardiac	1806 (41)
Respiratory	906 (21)
Both	1292 (30)
Witnessed	
Yes	3948 (91)
No	263 (6)
Survival rate	
Immediate survival rate	2802 (64)
Survival for >24 h	1858 (43)
Discharge from hospital	1330 (30)
Total death	3024 (70)

[a]The total number is not the same for all variables because of missing data

Table 2: Survival rate in relation to various variables

Survival rate versus various variables	Count/ Percentage	Survived		Total	χ^2	*P*
		Yes	No			
Place of arrest						
Emergency room	Count	777	391	1168	34	<0.001
	Percentage	67	33	100		
Medical wards	Count	667	320	987		
	Percentage	68	32	100		
Surgical wards	Count	136	62	198		
	Percentage	69	31	100		
Intensive Care Units	Count	1009	693	1702		
	Percentage	59	41	100		
Others	Count	213	86	299		
	Percentage	71	29	100		
Total	Count	2802	1552	4354		
	Percentage	64	36	100		
Type of arrest						
Respiratory	Count	771	133	904	238	<0.001
	Percentage	85	15	100		
Cardiac	Count	1013	791	1804		
	Percentage	56	44	100		
Both	Count	764	528	1292		
	Percentage	59	41	100		
Time of arrest (h)						
0001-0700	Count	478	299	777	8	0.022
	Percentage	61	39	100		
0701-1500	Count	695	338	1033		
	Percentage	67	33	100		
1501-2400	Count	686	342	1028		
	Percentage	67	33	100		
Total	Count	1859	979	2838		
	Percentage	65	35	100		
Duration of arrest (min)						
<15	Count	1039	307	1346	155	<0.001
	Percentage	77	23	100		
>15	Count	806	663	1469		
	Percentage	55	45	100		
Total	Count	1845	970	2815		
	Percentage	65	35	100		
Witness of arrest						
Yes	Count	2558	1356	3944	33	<0.001
	Percentage	65	35	100		
No	Count	123	138	261		
	Percentage	47	53	100		
Total	Count	1845	970	2815		
	Percentage	66	34	100		
Use of airway tools						
Endotracheal tube	Count	2037	1144	3181	5	0.318
	Percentage	64	36	100		
Laryngeal mask	Count	83	36	119		
	Percentage	70	30	100		
Oropharyngeal airway	Count	42	32	74		
	Percentage	57	43	100		
Nasopharyngeal airway	Count	10	8	18		
	Percentage	56	44	100		
Others	Count	14	5	19		
	Percentage	74	26	100		
Total	Count	2186	1225	3411		
	Percentage	64	36	100		

Table 3: Survival rate in relation to administered medication throughout the cardiopulmonary resuscitation

Variables	Count/ Percentage	Survived		Total	χ^2	*P*
		Yes	No			
Vasopressor and Inotropes infusion after ROSC						
Dopamine	Count	765	508	1273	0.8	0.844
	Percentage	60	40	100		
Dobutamine	Count	70	43	113		
	Percentage	62	38	100		
Adrenaline	Count	43	24	67		
	Percentage	64	36	100		
Noradrenaline	Count	194	119	313		
	Percentage	62	38	100		
Total	Count	1072	694	1766		
	Percentage	61	39	100		
Drug boluses						
Adrenaline	Count	1931	1433	3364	226	<0.001
	Percentage	57	43	100		
Atropine	Count	352	7	359		
	Percentage	98	2	100		
Total	Count	2283	1440	3723		
	Percentage	61	39	100		

ROSC: Return of spontaneous circulation

postresuscitation period after ROSC. The correlation between the type of arrhythmia and survival rate is presented in Table 4.

Comorbidities were reported in 3786 cardiac arrest victims. End-organ failure (lungs, liver, kidneys, and hematological) was diagnosed in 30% of patients, cardiovascular diseases (ischemic heart diseases and hypertension) in 24%, and infectious diseases in 19%, while prematurity and congenital anomalies were recorded in 15% ($P < 0.001$). Adequate air entry was reported in 3573 of 4204 and had a strong correlation with survival ($P < 0.001$). Return of spontaneous breathing was recorded in 1094 sheets (26%) from 4192 total cases and had a positive relationship with survival rate ($P < 0.001$).

Discussion

In this 4-year retrospective study, CPR analysis of 4631 hospitalized patients revealed a higher occurrence of

Table 4: Survival rate among various cardiac rhythm

Types of arrhythmia	Survived		Total
	Yes	No	
Asystole and PEA			
Count	3	413	416
Percentage	1	99	100
Sinus rhythm			
Count	1578	16	1594
Percentage	99	1	100
Pulseless VT/VF			
Count	493	4	497
Percentage	99	1	100
Other			
Count	117	21	138
Percentage	85	15	100
Total			
Count	2191	454	2645
Percentage	83	17	100

$\chi^2=2359.52$, $P<0.001$. PEA: Pulseless electrical activity; VF: Ventricular fibrillation; VT: Ventricular tachycardia

arrest among males (55%) than females (44%), with greater distributions in the two age extremes: those aged younger than 10 years and those aged older than 61 years. Cardiac diseases were the most frequent comorbidity of patients with arrest followed by respiratory ones. Fortunately, the majority of the arrests were witnessed arrests (90%). The 24-h survival rate was 43%, and survival upon discharge from the hospital was 30%. Survival rates were higher in our study when compared to previous ones.[1-8,10-21] Differences in the study designs, sample sizes, and assessment techniques may contribute significantly to the variability in the survival rates. In addition, the inclusion of respiratory arrest in addition to the cardiac ones might contribute to the increase in survival rates. Respiratory arrest was associated with a better survival rate when compared to cardiac arrest or when both types of arrest occurred. This was reported by Tunstall-Pedoe *et al*.[22] in the BRESUS study, Brindley *et al*.[17] in their Canadian study, and Cooper *et al*.[23] in their study in the UK where they reported that patients whose primary mode of arrest was respiratory were more likely to survive in comparison to those with a primary cardiac arrest.

The witnessing of arrest is another factor that might lead to higher survival rate, and this was documented in previously published studies.[17,24-26] A third factor that might result in higher survival rates is the level of training of the resuscitation team members and their adherence to resuscitation guidelines. Many previously published studies reported better survival rates after formal resuscitation training,[27-31] while Curry and Gass[32] found that the death rate was not lower when resuscitation was performed by BLS-trained staff in comparison to untrained staff.

When we correlated the survival rate to both the time and place of arrest, we found that most of the arrests occurred in the period between 07:00 and 24:00 h and the lowest survival rate was found in the early morning time (00:01–07:00 h). Previous studies verified that there is a greater risk of cardiac arrest up to 3 h after patients wake up than during other hours of the day. This might be the result of an increase in blood pressure and cardiac frequency, which raises the muscle tone, blood viscosity, and promotes platelet aggregation.[33,34] Similar to previously published studies, a higher risk of death was reported if the arrest occurred at night.[23,35] Further studies are needed to better understand the lower survival rate among arrests occurring at night, to exclude contributions related to a slower response time of the resuscitation team or poor performance in resuscitation secondary to lack of sleep and less concentration.

Regarding the location of arrest and survival rate, the critical care area is associated with poor resuscitation outcomes when compared to various other hospital wards. The critical condition of such patients might be the main contributor to the higher mortality rate. However, in a sample of 200 patients, Khalafi *et al*.[36] reported that there was no difference in the outcomes of arrest between patients on the regular floor and Intensive Care Unit patients and further studies are needed to reach a conclusion on this subject.

Consistent with findings from other studies,[17,24-26,37-40] witnessed arrests and shorter time of CPR were associated with higher survival rates when compared to unwitnessed arrests or a longer duration of resuscitation. The administration of adrenaline boluses during the resuscitation was associated with a higher survival rate than continuous infusion. In a randomized study, Jacobs *et al*.[41] compared the provision of adrenaline to placebo on the ROSC in out-of-hospital cardiac arrests. They found that adrenaline markedly increased rates of ROSC. In a retrospective study conducted in Japan, the authors suggested that there was an increase in the ROSC, but worse long-term outcomes.[42] Future investigations should consider the timing of adrenaline administration in the design and interpretation of the results. Although atropine is no longer recommended for the treatment of pulseless electrical activity (PEA) and asystole (AS), and the use of adrenaline is more favorable than atropine for the treatment of bradycardia,[43,44] atropine was the treatment of choice for PEA and AS at the time of resuscitation. Similar to adrenaline, atropine use was associated with a higher survival rate.

The use of intravenous infusion of inotropic or vasopressor agents following the ROSC, as well as the use of various airway tools during the resuscitation, had no positive effect on the survival rate.

Consistent with the findings of other studies, the survival rate was low when nonshockable rhythm (PEA and AS) was the cause of cardiac arrest, and high among victims of defibrillation amenable rhythm (pulseless ventricular tachycardia/ventricular fibrillation).[7,8,10,12,15,17,23,45]

Although the findings of this study provide a better understanding of resuscitation, it has some limitations. One limitation is the retrospective nature of the study where the data were collected after the occurrence of the events, and access to the documented data in the CPR forms was limited, which might contribute to the absence of accurate information about important variables. Second, data regarding the neurological outcome of the surviving patients was unavailable, and third, the results represent the experience of only one hospital and the results might not be generalizable to all other health institutions.

Conclusions

This study provides reflections on the practice of CPR in Saudi Arabia and confirms the findings of previously published studies.

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Conflicts of interest
There are no conflicts of interest.

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