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. 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 the 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). 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 1: Patients’ demographic data and cardiopulmonary resuscitation characteristics

| Characteristics | n (%) |
|-----------------|-------|
| 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) |

The total number is not the same for all variables because of missing data.
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

| Place of arrest | Count | Survived Yes | Survived No | Total | $\chi^2$ | $P$ |
|-----------------|-------|--------------|-------------|-------|----------|------|
| Emergency room  | 777   | 391          | 1168        | 1565  | 34       | <0.001|
| Medical wards   | 667   | 320          | 987         | 1007  |          |      |
| Surgical wards  | 136   | 62           | 198         | 298   |          |      |
| Intensive Care Units | 1009 | 693         | 1702        | 2602  |          |      |
| Others          | 213   | 96           | 309         | 522   |          |      |
| Total           | 2802  | 1552         | 4354        | 6856  |          |      |

| Type of arrest | Count/ Percentage | Survived Yes | Survived No | Total | $\chi^2$ | $P$ |
|----------------|-------------------|--------------|-------------|-------|----------|------|
| Respiratory    | 771/85            | 904/15       | 238         | <0.001|          |      |
| Cardiac        | 1013/56           | 1804/44      | 100         | 0.022 |          |      |
| Both           | 764/59            | 1292/41      | 100         | 0.82  | O.844   |      |
| Time of arrest (h) | Count/ Percentage | Survived Yes | Survived No | Total | $\chi^2$ | $P$ |
| 0001-0700      | 478/61            | 777/39       | 8           | 0.022 |          |      |
| 0701-1500      | 695/67            | 1033/33      | 100         | 0.82  | O.844   |      |
| 1501-2400      | 686/67            | 1028/33      | 100         |        |          |      |
| Total          | 1859/65           | 2838/35      | 100         | 0.82  | O.844   |      |

| Duration of arrest (min) | Count/ Percentage | Survived Yes | Survived No | Total | $\chi^2$ | $P$ |
|--------------------------|-------------------|--------------|-------------|-------|----------|------|
| <15                      | 1039/77           | 1346/23      | 155         | <0.001|          |      |
| >15                      | 806/65            | 1469/44      | 100         |        |          |      |
| Total                    | 1845/65           | 2815/35      | 100         | 0.82  | O.844   |      |

| Witness of arrest | Count/ Percentage | Survived Yes | Survived No | Total | $\chi^2$ | $P$ |
|-------------------|-------------------|--------------|-------------|-------|----------|------|
| Yes                | 2558/65           | 3944/35      | 33          | <0.001|          |      |
| No                 | 123/47            | 261/53       | 100         |        |          |      |
| Total              | 1845/65           | 2815/35      | 100         | 0.82  | O.844   |      |

| Use of airway tools | Count/ Percentage | Survived Yes | Survived No | Total | $\chi^2$ | $P$ |
|---------------------|-------------------|--------------|-------------|-------|----------|------|
| Endotracheal tube   | 2037/64           | 3181/36      | 5           | 0.318 |          |      |
| Laryngeal mask      | 83/70             | 119/47       | 100         |        |          |      |
| Oropharyngeal airway| 42/70             | 74/30        | 100         |        |          |      |

| Type of arrest | Count/ Percentage | Survived Yes | Survived No | Total | $\chi^2$ | $P$ |
|----------------|-------------------|--------------|-------------|-------|----------|------|
| Nasopharyngeal airway | 10/5 | 18 |          |        |          |      |
| Others          | 14/5              | 19           |            |        |          |      |
| Total           | 2186/64           | 3411/36      | 100         |        |          |      |
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.\cite{14,16,18,21} 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.\cite{22} in the BRESUS study, Brindley et al.\cite{17} in their Canadian study, and Cooper et al.\cite{21} 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.\cite{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.\cite{27,31} while Curry and Gass\cite{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.\cite{33,34} Similar to previously published studies, a higher risk of death was reported if the arrest occurred at night.\cite{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.\cite{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,\cite{17,24-26,37-40} witnessed arrests and shorter time of CPR were associated with higher survival rates when compared to un witnessed 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.\cite{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.\cite{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,\cite{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.

### Table 4: Survival rate among various cardiac rhythm

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

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