Cardiopulmonary resuscitation: outcome and its predictors among hospitalized adult patients in Pakistan

Nadeem Ullah Khan · Junaid A. Razzak · Humaid Ahmed · Muhammad Furqan · Ali Faisal Saleem · Hammad Alam · Anwar ul Huda · Uzma Rahim Khan · Rifat Rehmani

Received: 19 January 2008 / Accepted: 18 February 2008 / Published online: 18 March 2008
© Springer-Verlag London Ltd 2008

Abstract

Introduction Our aim was to study the outcomes and predictors of in-hospital cardiopulmonary resuscitation (CPR) among adult patients at a tertiary care centre in Pakistan.

Methods We conducted a retrospective chart review of all adult patients (age ≥14 years), who underwent CPR following cardiac arrest, in a tertiary care hospital during a 5-year study period (June 1998 to June 2003). We excluded patients aged 14 years or less, those who were declared dead on arrival and patients with a “do not resuscitate” order. The 1- and 6-month follow-ups of discharged patients were also recorded.

Results We found 383 cases of adult in-hospital cardiac arrest that underwent CPR. Pulseless electrical activity was the most common initial rhythm (50%), followed by asystole (30%) and ventricular tachycardia/fibrillation (19%). Return of spontaneous circulation was achieved in 72% of patients with 42% surviving more than 24 h, and 19% survived to discharge from hospital. On follow-up, 14% and 12% were found to be alive at 1 and 6 months, respectively. Multivariable logistic regression identified three independent predictors of better outcome (survival >24 h): non-intubated status [adjusted odds ratio (aOR): 3.1, 95% confidence interval (CI): 1.6–6.0], location of cardiac arrest in emergency department (aOR: 18.9, 95% CI: 7.0–51.0) and shorter duration of CPR (aOR: 3.3, 95% CI: 1.9–5.5).

Conclusion Outcome of CPR following in-hospital cardiac arrest in our setting is better than described in other series. Non-intubated status before arrest, cardiac arrest in the emergency department and shorter duration of CPR were independent predictors of good outcome.

Keywords Cardiopulmonary resuscitation · Cardiac arrest · Emergency care · Karachi · Pakistan

Introduction

Cardiopulmonary resuscitation (CPR) for cardiac arrest is a frequently performed medical intervention. Studies of CPR among hospitalized patients revealed survival to discharge ranging from 6% in cancer patients in the USA [1] to as high as 43% in monitored bed patients in Sweden [2]. Multiple reasons have been described for this variation including differences in inclusion/exclusion criteria, differences in the setting in which the CPR was performed and problems with definitions of common variables [2, 3]. To overcome the problem of data comparability, the in-hospital Utstein style data collection recommendations were published in 1997 and revised in 2004 [4]. These recommendations defined “a set of data elements that are essential or desirable for documenting in-hospital cardiac arrest” and suggested guidelines for “reviewing, reporting, and conducting research” on this topic [3].

There are limited data on the outcomes of CPR from low and middle income countries [5–9]. The differences in resources and the disease pattern in low and middle income
countries are likely to have an impact on the eventual outcome of CPR [5–9]. A previous study done in Pakistan showed CPR outcomes similar to the outcomes seen in more developed settings [6]. However, this study did not use the Utstein style making comparisons difficult. We conducted this study to define the outcomes and predictors of cardiopulmonary resuscitation in an adult in-patient population at a tertiary care teaching hospital in Pakistan.

Methods

Study design: retrospective cohort

Study setting The study was conducted at the Aga Khan University Hospital, which is a 545-bed tertiary care teaching hospital, located in Karachi, Pakistan. The bed capacity of the emergency department (ED), intensive care unit (ICU), coronary care unit (CCU) and wards/floors at the time of the study was 23, 21, 16 and 422, respectively. In addition there are 60 beds with cardiac monitors. An average of 23,000 adult patients were admitted to the hospital annually during the study period. For patients in cardiac arrest, there is a dedicated round-the-clock “code team” with overhead and mobile paging system. The code team comprises a senior medical or cardiology resident, an anaesthesia resident and trained nursing staff. Most of the residents are certified to perform CPR and provide advanced cardiac life support. According to hospital policy nursing staff cannot give any medications to patients in cardiac arrest without physician orders. Only physicians are credentialed to perform cardiac defibrillation. Defibrillators at the study site are monophasic.

Study population The cases were selected through a computerized search of the hospital information management system for the diagnosis of cardiac arrest or the procedure of “endotracheal intubation” and “CPR”. A research assistant collected the data on patient and event characteristics and outcome as per the guidelines of the in-hospital Utstein style using a standard questionnaire. The research assistants were medical graduates with 1 year internship and were trained by the principal investigator in data retrieval from medical records. The completed questionnaires were rechecked by the principal investigator for missing information. Blinding of abstractors and inter-rater reliability assessment were not done. The study was approved by the Ethical Review Committee of the Aga Khan University.

Inclusion criteria The study population consisted of adult patients (age >14 years) of Aga Khan University Hospital who underwent CPR between June 1998 and June 2003 anywhere in the hospital. Our definition of cardiac arrest was the same as described in the Utstein style, i.e. “the cessation of cardiac mechanical activity ... confirmed by the absence of detectable pulse, unresponsiveness, and/or apnea (or agonal respirations)”. For those patients who had more than one arrest during the admission, we included only the first episode.

Exclusion criteria Patients who were declared dead on arrival in the hospital and those who had an advance directive of no CPR or no endotracheal intubation were excluded. Patients less than 14 years of age were also excluded.

Statistical analysis Data were entered into SPSS version 14 for analysis. Outcome was analysed by calculating the percentage of patients with return of spontaneous circulation (ROSC), patients alive for more than 24 h, patients discharged alive and patients alive at 1 and 6 months. The patients’ and events’ characteristics were defined in percentages. Descriptive statistics were computed for categorical variables by computing their frequencies. The sample size required to study 18% survival (as reported in a previous study) with a power of 80% and \( \alpha = 0.05 \) was calculated to be 216. The sample size based on the review of 5-year patient records was 383. The primary outcome of successful CPR was dichotomized as survival \( \geq 24 \) h after CPR versus survival <24 h after CPR. Secondary outcome data of survival to hospital discharge versus death were also dichotomized. To assess univariate associations between the outcomes and potential predictors, odds ratios (ORs) and their 95% confidence intervals (CIs) were computed by logistic regression analysis. All significant factors on univariate analysis were considered for inclusion in the multivariable logistic model.

Results

A total of 383 patients met the inclusion criteria. The mean age was 54 years (SD±17) with 61% being males. Almost half of the patients were admitted with a non-cardiac medical diagnosis to the hospital (52%, \( n=198 \)). Hypertension (43%, \( n=163 \)) and ischaemic heart disease (37%, \( n=142 \)) were the most common pre-existing conditions, respectively. The intensive care unit (33%, \( n=128 \)) was the most common site of cardiac arrest followed by the emergency department (18%, \( n=70 \)), monitored beds (17%, \( n=65 \)), coronary care unit (13%, \( n=51 \)) and general beds (13%, \( n=48 \)) (Table 1).

The initial cardiac rhythm was pulseless electrical activity (PEA) in almost half of the patients (50%, \( n=191 \)), followed by asystole (30%, \( n=114 \)) and ventricular fibrillation (VF)/ventricular tachycardia (VT) (19%, \( n=71 \)). There was no initial rhythm recorded for seven patients (Table 1). Mortality rates for asystole, PEA and VT/VF
were 61% (n=70), 58% (n=110) and 49% (n=35), respectively (Table 2). The time of initiation of CPR did not differ between those with shockable rhythm (VT/VF) and those without (PEA/asystole) (p=0.261).

Evidence of return of spontaneous circulation (ROSC) was observed in 75% (n=287) of patients with 19% (n=74) sustaining ROSC for less than 20 min, 13% (n=51) for more than 20 min but less than 24 h and 42% (n=167) for more than 24 h. Nineteen percent (n=73) survived to hospital discharge (Fig. 1).

A third of cardiac arrests occurred between 8 a.m. and 4 p.m. (n=134). There was no difference between the 24-h survival between cardiac arrests during day shifts versus evening (4 p.m. to 11 p.m.)/night shifts (11 p.m. to 8 a.m.) (44 vs 41%, p=0.42).

Univariate logistic regression with 24-h survival and survival to discharge was done as shown in Tables 2 and 3. There was no difference in the determinants of survival for these two outcomes. Multivariable logistic regression identified the following three factors as independent predictors of survival in our patient population: non-intubated status [adjusted odds ratio (aOR):3.1, 95% CI:1.59–6.05 and aOR:4.38, 95% CI:1.87–10.3], location of cardiac arrest, i.e. emergency department (aOR: 18.94, 95% CI:7.03–51.04 and aOR: 12.9, 95% CI:4.3–38.7) and shorter duration of CPR (aOR:3.25, 95% CI:1.94–5.45 and aOR:1.80, 95% CI:0.99–3.2) in both primary (survival >24 h vs survival <24 h after CPR) and secondary (survival to hospital discharge versus death) outcomes, respectively.

**Discussion**

Our study found that only one of five patients with in-hospital cardiac arrest was discharged alive from the hospital. This survival rate is within the range of survival

---

**Table 1** Descriptive characteristics of patients and events (n=383; June 1998 and June 2003). **VF** ventricular fibrillation, **VT** ventricular tachycardia, **COPD** chronic obstructive pulmonary disease.

| Parameters | Values | Parameters | Values |
|------------|--------|------------|--------|
| Age (mean; 95% CIs) | 54 (52.2, 55.6) | Immediate precipitating cause | 108 (28; 0.24, 0.33) |
| Gender | | Metabolic | |
| Female | 149 (39; 0.34, 0.43) | Cardiac (arrhythmias/ischaemia) | 127 (33; 0.29, 0.38) |
| Male | 234 (61; 0.55,0.65) | Hypoxia/acute respiratory insufficiency | 60 (16; 0.12, 0.2) |
| | | Hypotension | 40 (10; 0.08, 0.14) |
| Reason for admission | | Others (sepsis/unknown) | 48 (13; 0.09, 0.16) |
| Cardio | 116 (30; 0.25,0.34) | Location where code ran | |
| Medical (non-cardiac) | 198 (52; 0.47, 0.57) | Intensive care unit | 128 (33; 0.28, 0.38) |
| Surgical (non-cardiac) | 54 (14; 0.10, 0.17) | Emergency room | 70 (18; 0.15, 0.22) |
| Trauma | 9 (2; 0.0117, 0.04) | Special care unit | 65 (17; 0.13, 0.21) |
| Day care procedure | 6 (1.6; 0.006, 0.03) | Coronary care unit | 51 (13; 0.10, 0.17) |
| Pre-existing conditions | | Floor | 48 (13; 0.09, 0.16) |
| Hypertension | 163 (43) | Diagnostic and therapeutic area | 11 (3; 0.09, 0.16) |
| Ischaemic heart disease | 142 (37) | Operation theatre | 5 (1.3; 0.005, 0.03) |
| Diabetes | 137 (36) | Recovery room | 2 (1; 0.0002, 0.02) |
| End-stage diseases | 62 (16) | Initial rhythm at time of CPR | |
| Hyperlipidaemia | 45 (12) | Pulseless electrical activity | 191 (50; 0.45, 0.54) |
| Chronic renal failure | 43 (11) | Asystole | 114 (30; 0.25, 0.34) |
| Malignancy | 39 (10) | VF or VT | 71 (19; 0.15, 0.23) |
| COPD | 22 (6) | Unknown | 7 (2; 0.008, 0.04) |
| Pulmonary tuberculosis | 14 (4) | Event monitored or witnessed or both | |
| CPR intervention in place at time of arrest | | Monitored | 323 (84; 0.80, 0.88) |
| Intra-arterial catheter | 85 (22) | Unmonitored | 60 (16; 0.12, 0.19) |
| Intravenous access | 358 (94) | Event time intervals (mean; 95% CIs) | |
| ECG monitoring | 291 (76) | Interval from collapse to CPR start time | 2 min (0.12, 4.34) |
| Invasive airway | 176 (46) | Interval from collapse to defibrillation | 8 min (4.17, 11.47) |
| Implantable defibrillator | 3 (1) | Interval from collapse to advanced airway achieved | 11 min (7.53, 13.83) |

| Duration of CPR | | Interval from collapse to 1st dose of epinephrine | 9 min (3.9, 14) |
| ≤10 min | 169 (44; 0.39, 0.49) | | |
| >10 min | 214 (56; 0.51, 0.61) | | |

*a Variable with multiple responses*
Table 2 Univariate analysis of the factors associated with successful CPR (June 1998 and June 2003). *PEA* pulseless electrical activity, *VF* ventricular fibrillation, *VT* ventricular tachycardia

| Variables                                      | Survived >24 h (n=162) | Died in <24 h (n=221) | p value | OR (95% CI)  |
|------------------------------------------------|------------------------|------------------------|---------|--------------|
| Age                                            |                        |                        |         |              |
| 60 years or less                               | 89 (55)                | 129 (58)               | 1.00    |              |
| More than 60 years                             | 72 (45)                | 92 (42)                | 0.55    | 1.13 (0.75–1.7) |
| Gender                                         |                        |                        |         |              |
| Female                                         | 60 (37)                | 89 (40)                | 0.52    | 1.0          |
| Male                                           | 102 (63)               | 132 (60)               | 0.00    | 2.48 (1.586–3.865) |
| Reason for admission                           |                        |                        |         |              |
| Non-cardiac                                    | 95 (59)                | 172 (78)               | 1.0     |              |
| Cardiac                                        | 67 (41)                | 49 (22)                | 0.00    | 2.48 (1.586–3.865) |
| Pre-existing conditions                        |                        |                        |         |              |
| Two or more comorbidities                      | 60 (37)                | 86 (39)                | 1.0     |              |
| No or one comorbidity                          | 102 (63)               | 135 (61)               | 0.71    | 1.08 (0.713–1.645) |
| ECG monitoring before cardiac arrest           |                        |                        |         |              |
| Yes                                            | 108 (67)               | 183 (83)               | 1.0     |              |
| No                                             | 54 (33)                | 38 (17)                | 0.001   | 2.40 (1.49–3.88) |
| Advanced airway before cardiac arrest          |                        |                        |         |              |
| Yes                                            | 38 (23)                | 138 (62)               | 1.0     |              |
| No                                             | 124 (77)               | 83 (38)                | 0.001   | 5.42 (3.445–8.544) |
| Intra-arterial catheter before cardiac arrest  |                        |                        |         |              |
| Yes                                            | 15 (9)                 | 70 (32)                | 1.0     |              |
| No                                             | 147 (91)               | 151 (68)               | 0.001   | 4.54 (2.488–8.296) |
| Immediate precipitating cause                  |                        |                        |         |              |
| Non-cardiac                                    | 93 (57)                | 163 (74)               | 1.0     |              |
| Cardiac                                        | 69 (43)                | 58 (26)                | 0.001   | 2.08 (1.353–3.212) |
| Location where code ran                        |                        |                        |         |              |
| ICU                                            | 22 (14)                | 106 (48)               | 0.001   | 1.0          |
| Emergency room                                 | 62 (38)                | 8 (4)                  | 0.04    | 37.3 (15.68–88.9) |
| CCU                                            | 16 (10)                | 35 (16)                | 0.04    | 2.203 (1.04–4.66) |
| Monitored bed                                  | 27 (17)                | 38 (17)                | 0.001   | 3.423 (1.74–6.72) |
| General bed                                    | 24 (15)                | 24 (11)                | 0.001   | 4.818 (2.32–9.98) |
| Other areas (OR, D & T, others)                | 11 (6)                 | 10 (4)                 | 0.001   | 5.300 (2.01–14.0) |
| Initial rhythm at time of CPR                  |                        |                        |         |              |
| Non-shockable (PEA/asystole)                   | 126 (78)               | 186 (84)               | 1.0     |              |
| Shockable (VF/pulseless VT)                    | 36 (22)                | 35 (16)                | 0.11    | 1.52 (0.90–2.547) |
| Event was monitored or not                     |                        |                        |         |              |
| Event was monitored                            | 123 (76)               | 200 (90)               | 1.0     |              |
| Event was not monitored                        | 39 (24)                | 21 (10)                | 0.001   | 3.02 (1.697–5.372) |
| Duration of CPR                                |                        |                        |         |              |
| >10 min                                        | 66 (42)                | 143 (66)               | 1.0     |              |
| ≤10 min                                        | 92 (58)                | 73 (34)                | 0.001   | 2.73 (1.788–4.171) |
| Time shift                                     |                        |                        |         |              |
| Evening and night                              | 109 (67)               | 140 (63)               | 1.0     |              |
| Morning                                        | 53 (33)                | 81 (37)                | 0.42    | 0.84 (0.548–1.288) |
| Interval between collapse and start of CPR (n=365) |            |                        |         |              |
| Start after 1 min                              | 14 (9)                 | 24 (11)                | 1.0     |              |
| Start within 1 min                             | 138 (91)               | 189 (89)               | 0.53    | 1.25 (0.62–2.5) |
| Interval between collapse and defibrillation (n=124) |            |                        |         |              |
| Attempted after 3 min                          | 18 (39)                | 42 (54)                | 1.0     |              |
| Attempted within 3 min                         | 28 (61)                | 36 (46)                | 0.11    | 1.81 (0.9–3.8) |
| Interval between collapse and advanced airway (n=90) |            |                        |         |              |
| Secured after 5 min                            | 24 (43)                | 16 (47)                | 1.0     |              |
| Secured within 5 min                           | 32 (57)                | 18 (53)                | 0.69    | 1.18 (0.50–2.79) |
| Interval between collapse and 1st dose of epinephrine (n=174) | | | | |
| Administered after 2 min                       | 34 (46)                | 38 (38)                | 1.0     |              |
| Administered within 2 min                      | 40 (54)                | 62 (62)                | 0.29    | 0.72 (0.39–1.32) |
reported in numerous other studies where figures varied from 5.3 to 22.5% [7–9, 10–13]. Multiple reasons are likely to explain this variability including the quality of care, availability of hospital support services, types and acuity of illnesses seen at a given facility and the selection of patients for the institution of CPR. Interestingly the survival from CPR has remained somewhat constant over the past two decades. According to a review of the literature published in 1987, the survival at that time was 15% (range: 3–27%). A meta-analysis published in 1992 revealed survival to discharge ranging from 6.6 to 24.3% [11]. Among high income countries, the highest survival of 43% was reported from Sweden [2] in monitored bed patients. In Pakistan, on the other hand, a previous study showed a survival rate of 18% [6]. However, the patient population is perhaps different in recent studies with an increasing age and severity of illness of the hospitalized patient. In addition, the previous studies differed in their design and methodology, rendering them incomparable to newer Utstein style-based studies. Thus, variations observed in the outcome of Utstein style-based studies are more likely to identify the impact of hospital and patient-based variables in determining the outcome.

Our study highlighted that age, gender, pre-existing conditions and time of day at which the patient developed CPR before EMS arrival n= NA

| Location of arrest | n=NA |
|-------------------|------|
| Out-of-hospital   | n=NA |
| Home              | n=NA |
| Public place      | n=NA |
| Other             | n=NA |
| In-hospital       |      |
| Ward              | n=48 |
| Emergency Dept    | n=70 |
| Operating Room    | n=5 |
| CCU/ICU           | n=179|
| Other             | n=81 |

| Arrest witnessed/monitored | n=362 |
|-----------------------------|-------|
| By layperson/bystander      | n=Unknown |
| By healthcare personnel     | n=323  |
| Arrest not witnessed        | n=18  |
| Unknown                     | n=3   |

| Resuscitation attempted     | n=383 |
|-----------------------------|-------|
| All cases                   |       |
| Any defibrillation attempts | n=115 |
| Chest compressions          | n=370 |
| Assisted ventilation        | n=383 |

| First monitored rhythm      |       |
|-----------------------------|-------|
| Shockable                   | n=71  |
| VF                          | n=24  |
| VT                          | n=47  |
| Nonshockable                | n=305 |
| Asystole                    | n=114 |
| PEA                         | n=191 |
| Unknown                     | n=7   |

| Outcome (recorded for all categories) |       |
|---------------------------------------|-------|
| Any ROSC                               |       |
| Yes                                   | n=287 |
| No                                    | n=96  |
| Unknown                                | n=0   |
| Survived event                        | n=51  |
| Discharged alive                      | n=73  |
| Neurological outcome at discharge     |       |
| CPC 1 or 2                            | n=Unknown |
| CPC 3 or 4                            | n=Unknown |
| CPC 5                                 | n=Unknown |

| Absence of signs of circulation and/or considered for resuscitation n=Unknown |
|-----------------------------------------------------------------------------|
| Resuscitation not attempted                                                 |
| All cases n=Unknown                                                         |
| DNAR n=Unknown                                                              |
| Considered futile n=Unknown                                                |
| Resuscitation attempted                                                     |
| All cases n=383                                                             |
| Any defibrillation attempts n=115                                            |
| Chest compressions n=370                                                   |
| Assisted ventilation n=383                                                 |

| Absence of signs of circulation and/or considered for resuscitation n=Unknown |
|-----------------------------------------------------------------------------|
| Resuscitation not attempted                                                 |
| All cases n=Unknown                                                         |
| DNAR n=Unknown                                                              |
| Considered futile n=Unknown                                                |
| Resuscitation attempted                                                     |
| All cases n=383                                                             |
| Any defibrillation attempts n=115                                            |
| Chest compressions n=370                                                   |
| Assisted ventilation n=383                                                 |

| Location of arrest | n=NA |
|-------------------|------|
| Out-of-hospital   | n=NA |
| Home              | n=NA |
| Public place      | n=NA |
| Other             | n=NA |
| In-hospital       |      |
| Ward              | n=48 |
| Emergency Dept    | n=70 |
| Operating Room    | n=5 |
| CCU/ICU           | n=179|
| Other             | n=81 |

| Arrest witnessed/monitored | n=362 |
|-----------------------------|-------|
| By layperson/bystander      | n=Unknown |
| By healthcare personnel     | n=323  |
| Arrest not witnessed        | n=18  |
| Unknown                     | n=3   |

| CPR before EMS arrival n= NA |
|------------------------------|---|

| Etiology | n= |
|----------|---|
| Presumed cardiac | 127 |
| Trauma     | 11 |
| Respiratory | 60 |
| Other non-cardiac | 148 |
| Unknown    | 37 |
Table 3 Univariate analysis of the factors associated with survival to discharge (June 1998 and June 2003). *PEA* pulseless electrical activity, *VF* ventricular fibrillation, *VT* ventricular tachycardia

| Variables                                      | Death (n=299) | Hospital discharge (n=84) | p value | Univariate logistic regression OR (95% CI) |
|------------------------------------------------|--------------|---------------------------|---------|-----------------------------------------|
| **Variables**                                  | n (%)        | n (%)                     |         |                                         |
| Age                                            |              |                           |         |                                         |
| 60 years or less                               | 173 (58)     | 45 (54)                   | 1.00    |                                         |
| More than 60 years                             | 126 (42)     | 38 (46)                   | 0.55    | 1.16 (0.71–1.9)                         |
| Gender                                         |              |                           |         |                                         |
| Female                                         | 121 (40.5)   | 28 (33)                   | 1.0     |                                         |
| Male                                           | 178 (59.5)   | 56 (67)                   | 0.23    | 1.36 (0.81–2.3)                         |
| Reason for admission                           |              |                           |         |                                         |
| Non-cardiac                                    | 231 (77)     | 36 (43)                   | 1.0     |                                         |
| Cardiac                                        | 68 (23)      | 48 (57)                   | 0.001   | 4.53 (2.72–7.54)                        |
| Pre-existing conditions                        |              |                           |         |                                         |
| No or one comorbidity                          | 178 (59.5)   | 59 (70)                   | 1.0     |                                         |
| Two or more comorbidities                     | 121 (40.5)   | 25 (30)                   | 0.76    | 1.60 (0.95–2.7)                         |
| ECG monitoring before cardiac arrest           |              |                           |         |                                         |
| Yes                                            | 238 (80)     | 53 (63)                   | 1.0     |                                         |
| No                                             | 61 (20)      | 31 (37)                   | 0.002   | 2.3 (1.35–3.85)                         |
| Advanced airway before cardiac arrest          |              |                           |         |                                         |
| Yes                                            | 163 (54.5)   | 13 (15.5)                 | 1.0     |                                         |
| No                                             | 136 (45.5)   | 71 (84.5)                 | 0.001   | 6.54 (3.5-12.33)                        |
| Intra-arterial catheter before cardiac arrest  |              |                           |         |                                         |
| Yes                                            | 82 (27)      | 3 (4)                     | 1.0     |                                         |
| No                                             | 217 (73)     | 81 (96)                   | 0.001   | 10.2 (3.13-33.20)                       |
| Immediate precipitating cause                  |              |                           |         |                                         |
| Non-cardiac                                    | 217 (73)     | 39 (46)                   | 1.0     |                                         |
| Cardiac                                        | 82 (27)      | 45 (54)                   | 0.001   | 3.05 (1.85–5.03)                        |
| Location where code ran                        |              |                           |         |                                         |
| ICU                                            | 122 (41)     | 6 (7)                     | 0.001   | 1.0                                     |
| Emergency room                                 | 26 (9)       | 44 (52)                   | 0.001   | 34.4 (13.3–89.2)                        |
| CCU                                            | 42 (14)      | 9 (11)                    | 0.008   | 4.35 (1.5–13)                           |
| Monitored bed                                  | 56 (19)      | 9 (11)                    | 0.032   | 3.3 (1.1–9.6)                           |
| General bed                                    | 38 (13)      | 10 (12)                   | 0.002   | 5.35 (1.8–15.7)                         |
| Other areas (OR, D & T, others)                | 15 (5)       | 6 (7)                     | 0.001   | 8.1 (2.32–28.50)                        |
| Initial rhythm at time of CPR                  |              |                           |         |                                         |
| Non-shockable (PEA/asystole)                   | 249 (83)     | 63 (75)                   | 1.0     |                                         |
| Shockable (VF/pulseless VT)                    | 50 (17)      | 21 (25)                   | 0.08    | 1.7 (0.93–2.96)                         |
| Event was monitored or not                     |              |                           |         |                                         |
| Event was monitored                            | 262 (88)     | 61 (73)                   | 1.0     |                                         |
| Event was not monitored                        | 37 (12)      | 23 (27)                   | 0.001   | 2.7 (1.48–4.8)                         |
| Duration of CPR                                |              |                           |         |                                         |
| 10 min or more                                 | 174 (60)     | 35 (43)                   | 1.0     |                                         |
| 10 min or less                                 | 118 (40)     | 47 (57)                   | 0.007   | 1.9 (1.21–3.25)                        |
| Time shift                                     |              |                           |         |                                         |
| Morning                                        | 106 (35.5)   | 28 (33)                   | 1.0     |                                         |
| Evening and night                              | 193 (64.5)   | 56 (67)                   | 0.71    | 1.09 (0.65–1.83)                        |
| Interval between collapse and start of CPR (n=365) |         |                           |         |                                         |
| Start after 1 min                              | 30 (10)      | 8 (10)                    | 1.0     |                                         |
| Start within 1 min                             | 255 (90)     | 72 (90)                   | 0.89    | 0.94 (0.41–2.15)                        |
| Interval between collapse and defibrillation (n=124) |       |                           |         |                                         |
| Attempted after 3 min                          | 51 (50.5)    | 9 (39)                    | 1.0     |                                         |
| Attempted within 3 min                         | 50 (49.5)    | 14 (61)                   | 0.32    | 1.6 (0.63–3.99)                         |
| Interval between collapse and advanced airway (n=90) |        |                           |         |                                         |
| Secured after 5 min                            | 22 (43)      | 18 (46)                   | 1.0     |                                         |
| Secured within 5 min                           | 29 (57)      | 21 (54)                   | 0.77    | 1.13 (0.48–2.61)                        |
| Interval between collapse and 1st dose of epinephrine (n=174) |  |                           |         |                                         |
| Administered after 2 min                       | 53 (39)      | 19 (51)                   | 1.0     |                                         |
| Administered within 2 min                      | 84 (61)      | 18 (49)                   | 0.17    | 1.67 (0.8–3.47)                         |
cardiac arrest do not significantly affect the outcome of CPR. In the literature age remains a controversial variable in predicting outcome. Many studies [10–12, 15, 16] support the idea that it can predict outcome while others [17–21] argue that age per se does not exert any significant effect on the outcome of cardiac arrest and should not be used as a criterion to make the decision about the potential benefits of CPR. Our study complemented other studies which did not observe any difference in outcome with respect to gender of the victim [5, 8, 14–16].

In our study we did not find any significant change in survival relative to the time of day at which CPR was performed. In other studies the time of the day of cardiac arrest has been shown to affect the outcome of cardiac arrest with better survival among patients who underwent cardiac arrest and CPR during morning or evening shifts [7, 8, 10, 12, 22, 23]. Brindley et al. [20] and Rakic et al. [12] suggested that it could be because of the increase in the number of unwitnessed arrests in the night, but Matot et al. [22] found that prognosis remains poor independent of the witnessed status of the event.

Univariate analysis showed that cardiac aetiology either for admission to the hospital or as a precipitating cause for cardiac arrest was associated with better outcome similar to studies from Turkey and the UK [11, 24]. We also observed that VF/VT as the initial rhythm has a better outcome than other rhythms, but the association is not significant, whereas Cooper et al. [10] and Grubb et al. [24] reported this observation as significant. As expected patients who had evidence of advanced medical interventions in place such as endotracheal intubation and intra-arterial catheter had a poor outcome. This is contrary to findings in other studies where patients intubated prior to cardiac arrest were more likely to survive [8, 25, 26]. Bedel et al. [19] and Huang et al. [27] also found that previously intubated patients had reduced survival and related this fact to co-existing illnesses.

In the final multivariate model we found that patients undergoing CPR in the ED, on the regular floor/ward, operating room and in the recovery room had a better survival than those in whom CPR was performed in the ICU, CCU or in a monitored bed. This is presumably because patients in these settings had a greater severity of illness and are likely to have more multiple co-existing conditions than patients in other parts of the hospital. Our final model also showed that CPR of “less than 10 min duration” is an independent predictor of survival to more than 24 h, which complements the finding of others [7, 8, 10, 11, 13, 28].

There are several limitations to our study. First, it was a single-centre study done in a private hospital in Pakistan. The findings are likely to be different in non-teaching private hospitals and in state-run hospitals with a much larger load of patients and limited resources. Second, this was a retrospective review of data and sometimes the exact timing of individual interventions was not recorded, thus making it difficult to correlate outcomes with individual interventions. Finally, we could not access information about the functional outcome in patients who were discharged alive from the hospital.

**Conclusion**

The outcome of CPR in this single-hospital study from a low income country showed a survival rate comparable to the more developed countries. Successful CPR was most likely to occur in certain settings (e.g. ED) and in patients with a CPR of less than 10 min duration.

**Funding/conflict of interest** The authors confirm that they have no conflicts of interest to disclose.

**References**

1. Reisfield GM, Wallace SK, Munsell MF et al (2006) Survival in cancer patients undergoing in-hospital cardiopulmonary resuscitation: a meta-analysis. Resuscitation 71(2):152–160
2. Herlitz J, Bang A, Aune S et al (2001) Characteristics and outcome among patients suffering in-hospital cardiac arrest in monitored and non-monitored areas. Resuscitation 48(2):125–135
3. Cummins RO, Chamberlain D, Hazinski MF et al (1997) Recommended guidelines for reviewing, reporting, and conducting research on in-hospital resuscitation: the in-hospital ‘Utstein Style’. Circulation 95:2213–2239
4. Jacobs I, Nadkarni V, Bahr J et al (2004) Cardiac arrest and cardiopulmonary resuscitation outcome reports: update and simplification of the Utstein templates for resuscitation registries. Resuscitation 63(3):233–249
5. Rajaram R, Rajagopalan RE, Pai M et al (1999) Survival after cardiopulmonary resuscitation in an urban Indian hospital. NAtl Med J India 12(2):51–55
6. Iqbal F (1994) In hospital cardiopulmonary resuscitation—analysis of 188 CPRs. J Pak Med Assoc 44(8):190–193
7. Hjajbaghery MA, Mousavi G, Akbari H (2005) Factors influencing survival after in-hospital cardiopulmonary resuscitation. Resuscitation 66(3):317–321
8. Pembeci K, Yildrim A, Turan E et al (2006) Assessment of the success of cardiopulmonary resuscitation attempts performed in a Turkish university hospital. Resuscitation 68(2):221–229
9. Suraseranivongse S, Chawaruechai T, Saengsung P et al (2006) Outcome of cardiopulmonary resuscitation in a 2300-bed hospital in a developing country. Resuscitation 71(2):188–193
10. Cooper S, Janghorbani M, Cooper G (2006) A decade of in-hospital resuscitation: outcomes and prediction of survival? Resuscitation 68(2):231–237
11. Ehell M (1992) Prearrest predictors of survival following in-hospital cardiopulmonary resuscitation: a meta-analysis. J Fam Pract 34(5):551–558
12. Rakic D, Rumboldt Z, Carevic V et al (2005) In-hospital cardiac arrest and resuscitation outcomes: rationale for sudden cardiac death approach. Croat Med J 46(6):907–912
13. Elshove-Bolka J, Guttormsen AB, Austlid I (2007) In-hospital resuscitation of the elderly: characteristics and outcome. Resuscitation 74(2):372–376
14. McGrath RB (1987) In-house cardiopulmonary resuscitation—after a quarter of a century. Ann Emerg Med 16:1365–1368
15. George AL Jr, Folk BP 3rd, Crecelius PL et al (1989) Pre-arrest morbidity and other correlates of survival after in-hospital cardiopulmonary arrest. Am J Med 87(1):28–34
16. Fairbanks RJ, Shah MN, Lerner EB et al (2007) Epidemiology and outcomes of out-of-hospital cardiac arrest in Rochester, New York. Resuscitation 72(3):415–24
17. Berger R, Kelley M (1994) Survival after in-hospital cardiopulmonary arrest of noncritically ill patients. A prospective study. Chest 106(3):872–879
18. Iacovelli W, Alaimo M, Salvadori A et al (1991) Survival of 213 patients who recovered in resuscitation from cardiac arrest (in Italian). Minerva Anestesiol 57(6):341–348
19. Bedel SE, Delbanco TL, Cook EF et al (1983) Survival after cardiopulmonary resuscitation in the hospital. N Engl J Med 309:569–576
20. Brindley PG, Markland DM, Mayers I et al (2002) Predictors of survival following in-hospital adult cardiopulmonary resuscitation. CMAJ 167(4):343–348
21. Tok D, Keles GT, Toprak V et al (2004) Assessment of in-hospital cardiopulmonary resuscitation using Utstein template in a university hospital. Tohoku J Exp Med 202(4):265–273
22. Matot I, Shleifer A, Hersch M et al (2006) In-hospital cardiac arrest: is outcome related to the time of arrest? Resuscitation 71:56–64
23. Marcu CB, Juhasz D, Donohue TJ (2005) Circadian variation and outcome of in-hospital cardiopulmonary resuscitation. Conn Med 59(7):389–393
24. Grubb NR, Elton RA (1995) In-hospital mortality after out-of-hospital cardiac arrest. Lancet 346:417–422
25. Herlitz J, Bang A, Ekstrom L et al (2000) Improved survival after in-hospital cardiac arrest (in Swedish). Lakartidningen 97(30–31):3363–3368
26. Hayes MM, Berg RA, Otto CW (2003) Monitoring during cardiac arrest: are we there yet? Curr Opin Crit Care 9(3):211–217
27. Huang CH, Chen WJ, Ma MH et al (2002) Factors influencing the outcomes after in-hospital resuscitation in Taiwan. Resuscitation 53(3):265–270
28. Enohumah KO, Moerer O, Kirmse C et al (2006) Outcome of cardiopulmonary resuscitation in intensive care units in a university hospital. Resuscitation 71:161–170