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Return of spontaneous circulation and survival at hospital discharge in patients with out-of-hospital and emergency department cardiac arrests in a tertiary care centre

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Abstract

Objective: To examine clinical variables and outcomes in patients with out-of-hospital (unwitnessed) and emergency department (ED; witnessed) cardiac arrests at a tertiary care hospital in Karachi.

Methods: A prospective observational study was conducted to note that outcomes in patients with first attempted cardiopulmonary resuscitation in the Emergency Department of the Aga Khan University Hospital, Karachi, between Jan. 2000 and Dec. 2000. Cardiac arrest was defined as absence of a palpable central pulse and apnoea. Return of spontaneous circulation (ROSC) and survival at hospital discharge were primary outcomes. Logistic regression was applied to determine predictors for ROSC.

Results: Of 106 patients with cardiac arrest, 59% (n=62/106) patients had ROSC [52% (n=29/56) of unwitnessed group; 64% (n=32/50) of witnessed group]. Mean age was 48 years (range: 27-86); 68% (n=72/106) were males; and 41% (n=43/106) had ventricular fibrillation (VF) as initial rhythm. Male gender (OR 0.381; CI 0.156-0.928), PEA (OR 0.175; CI 0.063-0.489, reference VF) and asystole (OR 0.328; CI 0.114-0.944, reference VF) were negatively associated with ROSC. Less than ten minutes duration of CPR (OR 63.628; CI 8.221-429.457) and one co-morbidity status (OR 3.607; CI: 1.26-10.327, reference two or more co-morbidities) were positively associated with ROSC. Overall, 22% (n=23/106) of enrolled patients left the hospital alive: 34% (n=17/50) of the witnessed group and 12% (n=6/56) of the unwitnessed group.

Conclusion: Out of hospital arrest was associated with dismal survival at hospital discharge, emphasizing the need for development of pre-hospital care services for our country (JPMA 57:278;2007).

Introduction

Cardiopulmonary resuscitation (CPR) has shown a fascinating evolution with a goal to decrease the arrest to treatment interval.[1] In some part of the world, comprehensive networks of out-of-hospital medical providers and community-wide education programmes exist to achieve this goal. However in the developing parts of the world, like Karachi, the biggest city of Pakistan, a system of out-of-hospital care does not exist. Patient access to available ambulance service is poor, and a centralized control center for medical emergencies is not established. Many arrest victims are consequently transported to a hospital in private vehicles by non-medical personnel who are generally not trained in cardiopulmonary resuscitation (CPR).

Emergency Departments frequently manage patients with cardiac arrest. This is a definable condition that has definite outcomes- death or survival, and these outcomes are easily auditable and reported in literature. Many studies have looked at out-of-hospital cardiac arrests but the outcome in these cases depends largely on pre-hospital care, rather than the performance of the emergency department itself.[2-10] Outcomes from cardiac arrest have not been reported from Pakistan. This study examines the clinical variables and survival in patients arresting both out-of-hospital and in the Emergency Department at a tertiary care hospital in Karachi, Pakistan to identify the factors useful to increase the survival of cardiac arrest patients.

Methods

The study was conducted from January to December 2000 in the Emergency Department which has trained physicians working all 24 hours. The resuscitation documentation for the study was designed on Utstein style.[11] Data was collected prospectively on every patient who either presented with an out of hospital cardiac arrest (un-witnessed) to the ED or had cardiac arrest in the ED during the study time period. Cardiac arrest was reported to occur in ED if a patient had a documented pulse and blood pressure at presentation.

Data was collected on 4 sets of variables: Hospital variables included settings and resuscitation management. Patient variables were age, gender, site of occurrence, witness, and possible diagnosis after interviewing a family member for cardiac arrest (postmortem diagnosis was not included in the study due to lack of uniform availability). Arrest/event variables were initial cardiac rhythm, therapeutic interventions, interval between documented arrest and return to spontaneous circulation (ROSC), which is labeled as duration of resuscitation performed. ROSC was defined as presence of at least 60 mm Hg systolic blood pressure and a palpable pulse without CPR. Initial cardiac rhythms were

defined as ventricular fibrillation (VF), ventricular tachycardia (VT), asystole (AS) and pulseless electrical activity (PEA). Outcome variables were sustained ROSC for greater than twenty minutes, alive in the emergency room after cardiac arrest, admission to hospital from the emergency room or transfer to another facility, and hospital survival. Hospital survival was indicated as being alive when discharged from the hospital. The first arrest event was recorded for patients who had multiple cardiac arrests.

Inclusion criteria were all patients with documented cardiac arrest and the first attempted CPR in ED. Unstable patients requiring only cardio version or patients with respiratory distress without cardiac instability were excluded from the study. Informed consent was obtained from the patients' family members. Ethical approval was obtained from the Institutional review board.

The data was collected by two investigators (RR and MB). Chi-square test and logistic regression was performed to assess the predictors for ROSC for CPR. Various models were regressed with ROSC as the dependent variable. An odd ratio of more than 1 indicates an increased likelihood of the outcome (ROSC) at a p value of < 0.05. Data was analyzed using Microsoft Excel and SAS version 8.0.

Results:

Of the 106 patients with cardiac arrest during the study time period, 59% (n=62/ 106) had ROSC. Fifty-two percent (n=29/ 56) of un-witnessed group while 64% (n=32/ 50) of witnessed group had ROSC.

Table 1a describes patient variables and outcomes of the study sample. Majority of the patients were males (n=72; 67.92%) and were between 19 and 60 years of age (n=44/106; 41.51%). Unwitnessed or out-of-hospital arrests were fifty-six (52.83%). Ventricular fibrillation was the most common rhythm documented at the time of initiation of CPR (n=43/106; 40.57%). Majority of the patients had CPR performed for more than ten minutes (n=68/106; 64.15%). One patient died in the Emergency Room after ROSC (ER deaths of 45 compared to 44 at the end of CPR). During hospital stay, 35.85% of total patients died (38/106). Number of patients who were discharged alive from the hospital to home was 23 giving a 22% hospital survival.

On dichotomizing the study population between witnessed and un-witnessed cardiac arrest, the males were still predominant while the comorbidity status was nearly similar in both groups. Patients with age 61 years or above (n=23/56; 41.07%) were slightly more common in un-witnessed group while witnessed group had more patients between ages 19 and 60 (n=22/50; 44.00%). Interestingly PEA was the most common first documented rhythm in un-witnessed group (n=25/56; 44.64%) while ventricular fibrillation was common

Table 1a. Patients variables and outcomes with cardiac arrest during the study time period from Karachi, Pakistan (n=106).

Patient Variables and outcomes	n (%) (Total n=106)
Return of spontaneous circulation	61(57.55%)
Age(years)	
0-18	22(20.76%)
19-40	13(12.26%)
41-60	31(29.25%)
61-above	38(35.85%)
Female	34(32.08%)
Witnessed arrest	50(47.17%)
Rhythm	
VF	43(40.57%)
AS	25(23.58%)
PEA	30(28.3%)
VT	8(7.55%)
Duration of resuscitation	
Less than or equal to 10 minutes	38(35.85%)
Greater than 10 minutes	68(64.15%)
Co-morbidity	
One disease	59(55.66%)
More than one disease	47(44.34%)
Emergency Room Deaths	45(42.45%)
Hospital Deaths	38(35.85%)
Hospital Survival	23(21.70%)

Table 1b. Patients variables and outcomes with cardiac arrest dichotomized as witnessed and unwitnessed cardiac arrest during the study time period from Karachi, Pakistan (n=106).

Patient Variables and outcomes	Witnessed Cardiac Arrest (Group A) 50 (47.17%)	Unwitnessed Cardiac Arrest (Group B) 56 (52.83%)
Return of spontaneous circulation	32(64.00%)	29(51.78%)
Age (years)		
0-18	13(26.00%)	11(19.64%)
19-40	4(8.00%)	9(16.07%)
41-60	18(36.00%)	13(23.21%)
61-above	15(30.00%)	23(41.07%)
Female	16 (32.00%)	18(32.14%)
Rhythm		
VF	31(62.00%)	12(21.43%)
AS	8(16.00%)	17(30.36%)
PEA	5(10.00%)	25(44.64%)
VT	6(12.00%)	2(3.57%)
Duration of resuscitation		
Less than or equal to 10 minutes	27(54.00%)	11(19.64%)
Greater than 10 minutes	23(46.00%)	45(80.36%)
Co-morbidity		
One disease	27(54.00%)	32(57.14%)
More than one disease	23(46.00%)	24(42.86%)
Emergency Room Deaths.	18(36.00%)	27(48.21%)
Hospital Deaths	15(30.00%)	23(41.0%)
Hospital Survival	17(34.00%)	6(11. 7%)

VF = Ventricular Fibrilation
AS = Asystole
PEA = Pulseless Electrical Activity
VT = Ventricular Tachycardia

Table 2. Odds ratio estimates for ROSC using patient variables and outcomes in logistic regression.

Variables	Odds Ratio (95% CI)	P value
Age (categorized, less than 19 years age group as reference)		
19-40 years	1.904(0.458-7.918)	0.3761
41-60 years	0.903(0.310-2.626)	0.8508
Greater than 60 years	1.451(0.513-4.099)	0.4828
Gender (Female as reference)	0.381(0.156-0.928)	0.0336
Witnessed cardiac arrest (unwitnessed cardiac arrest as reference)	1.541(0.706-3.363)	0.2777
ECG rhythm at initiation of CPR (ventricular fibrillation as reference)		
Asystole	0.328(0.114-0.944)	0.0388
PEA	0.175(0.063-0.489)	0.0009
Ventricular Tachycardia	0.505(0.102-2.493)	0.4017
Duration of Resuscitation(greater than 10 minutes as reference)	63.628(8.221-429.457)	<0.0001
Co-morbidity (2 or more as reference)		
One co-morbidity	3.961(1.748-8.973)	0.001

Table 3. Logistic regression model to assess significant predictors for ROSC keeping duration of CPR in the model.

Variables	Odds Ratio (95% CI)	P value
Gender (Female as reference)	0.313 (0.104-0.944)	0.0392
Co-morbidity (2 or more as reference)		
One co-morbidity	3.607 (1.26-10.327)	0.0168
Duration of CPR (greater than 10 minutes as reference)	68.483 (8.471-553.625)	<0.0001

in witnessed group (n=31/50; 62.00%). Majority of patients in un-witnessed group had resuscitation performed for more than 10 minutes (n=45/56; 80.36%) when compared to witnessed group where 54% of patients (n=27/50) had resuscitation duration less than 10 minutes. The overall ROSC in the witnessed group was 64% (n=32/50) compared to 51.78% (n=29/56) in un-witnessed group. One patient died in the Emergency Room after ROSC in the un-witnessed group. More patients died during the hospital stay in un-witnessed group (n=23/56; 41%) when compared to witness group (n=15/50; 30%). More patients were discharged alive from the hospital in witnessed group (n=17/50; 34.00% hospital survival) compared to un-witnessed group (n=6/56; 11.70% hospital survival).

When assessing for the predictors of ROSC, Male gender (OR 0.381; CI 0.156-0.928), PEA (OR 0.175; CI 0.063-0.489, reference VF) and asystole (OR 0.328; CI 0.114-0.944, reference VF) were found to be negatively associated while less than ten minutes duration of CPR (OR 63.628; CI 8.221-429.457) and one co-morbidity status (OR 3.607; CI: 1.26-10.327, reference two or more co-morbidities) were

positively associated with ROSC. Table 2 summarizes the odds ratio estimates after univariate logistic regression was performed, while table 3 identifies the selected model for multiple logistic regression. Most interestingly, witnessed cardiac arrest (OR 1.541; CI 0.706- 3.363, reference un-witnessed arrest) was not found to be statistically significant predictor for ROSC.

Discussion

To our knowledge no study of cardiac arrests occurring in an emergency department in Pakistan has been permitted. We chose to study the outcome of arrests occurring within our emergency department to assess the predictors of ROSC, especially in a country where there is no formal prehospital care.

Cardiac arrest in adults is associated with an initial rhythm of VF or VT in most cases, and degenerates to asystole with time.[2,3] Survival is better in patients found to be in VF/VT[4,5] as also seen in our study. In advanced response systems, defibrillation by trained "first responders", improves outcome for adult arrest victims in VF/VT.[5,6,12-13] In Pakistan there is no formal training given to ambulance personnel in basic life support and defibrillation, and automatic external defibrillators are not stocked in the ambulances. With the lack of available monetary resources for the health care, this aspect of management of cardiac arrest is the most difficult aspect to be addressed in our country.

Early, effective CPR by bystanders or medical providers can also improve outcome from adult arrest.[5,7,13] Using the "golden standard" of Utstein, the survival rate reported for patients suffering a by-stander-witnessed cardiac arrest ranged from 5.3% to 37.7%.[8] Research has consistently shown that patients who arrive pulseless to an ED, even with out-of-hospital intervention, rarely survive[10,14,15] those who do, are the patients who arrest shortly before ED arrival.[8,14-16] Considerable concerns have been voiced about both medical value and cost effectiveness of continuing efforts in victims of out-of-hospital cardiac arrest transported to the emergency department after unsuccessful CPR in field.[17,18] The rates of survival among these patients have been reported to be 0- 13% in various studies.[16] This further emphasizes a need for establishing a formal pre-hospital care and a national effort to teach CPR to non-medical personnel for improving the health care in our country.

In our study the overall rate of ROSC was 57.5% while overall discharge rate from the hospital was 22%. This is interestingly comparable to the studies from countries with an organized pre-hospital care. A summary of such studies is as follows. A study from UK[19] on 100 cardiac arrests treated in the emergency department showed that 49 suffered their arrest in the department of whom 20% survived to leave hospital. In another[20] prospective study of 325 cardiac arrests, only 28

occurred in the emergency department; of these ten survived. A prospective study[21] of 33 arrests in emergency department observed that 52% survived to be admitted, and 30% of the patients were discharged from the hospital alive. In another[22] study of 98 cardiac arrests treated in the emergency department, 28 suffered their arrest in the department of whom 40% survived to leave hospital. In a study[23] on 77 cardiac arrests in the emergency department, 42 (55%) survived to be admitted to the hospital. Overall 33 patients (43%) survived to be discharged from the hospital. In a multicenter study[24] of 3765 cardiac arrests, 580 cases occurred in emergency departments. Of these, 49% survived the arrest to leave the department and 24% left the hospital alive. Our figures of 57.5% and 22% are comparable to this.

It has previously been shown that patients with a witnessed cardiac arrest had higher survival rates than those who had an unwitnessed arrest.[9,10] In analogy of this, higher rates of witnessed arrest should result in higher ROSC and in turn higher survival rates. However, we found no statistically significant association between the proportion of witnessed cases and ROSC in our study population. Similar observations have been reported in systemic review of studies of out-of-hospital cardiac arrest published recently according to Utstein guidelines.[25]

Although direct comparison with the previous studies is difficult, a helpful comparison may be achieved by studying the survival by rhythm. In the study of 28 arrests,[18] the survival rate for VF/VT arrests was 64%, but only 7% for asystolic and PEA arrests. These results are consistent with the findings of our study.

In conclusion, survival from out-of-hospital arrest at our emergency section is poor despite the presence of experienced and well-trained staff and modern resuscitation equipment. The outcomes reflect the level of out-of-hospital care available in the city. Survival from ED arrests is on a par with that reported in literature. The number of ED arrests may be influenced by the tertiary care nature of the patients, the lack of prehospital care, and long wait times for admission in the institution. Community education in CPR and provision of emergency medical services able to provide early defibrillation and prehospital stabilization are long-term public health goals for Karachi, Pakistan.

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