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ORIGINAL ARTICLE

Outcome of Early Cardiopulmonary Resuscitation in Out-of-Hospital Cardiac Arrest Managed in Universiti Kebangsaan Malaysia Medical Centre

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ABSTRAK

Mangsa serangan jantung di luar hospital (OHCA) memerlukan bantuan bantu mula jantung (CPR) dan defibrilasi dengan segera sebelum ketibaan di Jabatan Kecemasan. Tindakan bantu mula CPR ini boleh meningkatkan peluang untuk terus hidup daripada serangan jantung secara tiba-tiba. Objektif utama kajian ini adalah untuk mengenal pasti faktor-faktor yang mempengaruhi hasil dari tindakan untuk melakukan CPR kepada mangsa OHCA di Jabatan Kecemasan, Pusat Perubatan Universiti Kebangsaan Malaysia (PPUKM). Objektif kedua adalah untuk menentukan jumlah CPR yang dimulakan oleh orang ramai sebelum ambulans tiba. Kajian rentas ini adalah selama satu tahun. Pesakit OHCA telah dikenal pasti dari buku log CPR. Rekod perubatan pesakit telah digunakan untuk mendapatkan butir-butir bantuan kecemasan yang dilakukan. Faktor-faktor yang dicatatkan termasuk: sebab pengsan, permulaan CPR di tempat kejadian, penggunaan defibrillator automatik (AED), jenis pengangkutan dan kejadian pulangan peredaran darah secara spontan (ROSC). Data dianalisis secara kategori menggunakan ujian chi-square dan Fisher. Sembilan pesakit daripada 98 menerima CPR dari tempat kejadian. Tiga pesakit mencapai ROSC. Faktor jantina mempunyai kaitan yang ketara dengan ROSC (p = 0.015). Lebih ramai pesakit yang menerima bantuan awal CPR mencapai ROSC berbanding dengan mereka yang lewat menerima CPR. Kadar bantuan awal CPR dan penggunaan AED oleh orang ramai masih rendah. Jantina perempuan mempunyai pengaruh yang positif ke atas ROSC. Usaha-usaha diperlukan untuk meningkatkan kesedaran dan penglibatan orang awam untuk memulakan bantuan awal CPR sebelum ketibaan perkhidmatan ambulans.

Kata kunci: CPR, kecemasan, OCHA, pra-hospital, ROSC

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ABSTRACT

Out-of-hospital cardiac arrest (OHCA) patients require immediate cardiopulmonary resuscitation (CPR). Early initiation of CPR and defibrillation before arrival at Emergency Department (ED) increases the chance of survival from sudden cardiac arrest. The main objective of this study was to identify the factors that influenced the outcome of early cardiopulmonary resuscitation (CPR) in out-of-hospital cardiac arrest (OHCA) patients managed at the ED of Universiti Kebangsaan Malaysia Medical Centre (UKMMC). The second objective was to determine the incidence of CPR initiated by the public prior to ambulance arrival. The present study was a one-year cross-sectional study. The OHCA patients were identified from the ED resuscitation logbook. Patients' medical records were used to obtain details of the resuscitation. Factors recorded included: aetiology of arrest, initiation of on-scene CPR, use of automated external defibrillators (AEDs), mode of transportation and the incidence of return of spontaneous circulation (ROSC) in the ED. Categorical data was analysed using chi-square and Fisher exact tests. Nine patients out of 98 had early CPR. Three patients achieved ROSC. Gender was significantly associated with ROSC (p-value=0.015). More patients who received early CPR achieved ROSC compared to those who received late CPR. The provision of early CPR and usage of AEDs by the public is still low. Female gender had a positive influence on ROSC. Efforts are required to increase the awareness and involvement of the public in initiating early CPR prior to the arrival of ambulance service.

Keywords: CPR, emergency, OHCA, pre-hospital care, ROSC

INTRODUCTION

Cardiac arrest is a medical emergency. It is defined as the cessation of normal blood circulation due to failure of the heart to contract effectively to produce sufficient cardiac output. At least one third of the world population is at high risk of developing major cardiovascular events due to tobacco use, overweight, elevated blood pressure, blood cholesterol and diabetes (World Health Organization 2002). An estimated 17 million people die of cardiovascular disease annually (World Health Organization 2002). The majority of these deaths occur in out of the hospital setting. All out-of-hospital cardiac arrest (OHCA) patients require immediate cardiopulmonary resuscitation (CPR) and emergency medical intervention irrespective of the underlying cause. For every minute of delay in initiating CPR, the chance of survival decreases (American Heart Association in collaboration with International Liaison Committee on Resuscitation 2000; Travers et al. 2010; Berg et al. 2010). According to the American Heart Association 2010 guideline, CPR and defibrillation within 4 mins and the commencement of paramedic helpwithin 8 minutes of collapsed increases the chance of surviving sudden cardiac arrest to

43%. This emphasizes the importance of early initiation of CPR before the arrival of paramedics or before arriving at the emergency department (ED). To ensure each link in the survival chain works successfully, more initiatives are needed to increase public awareness about the importance of initiating early CPR. The guidelines also emphasize on the importance of chest compression without mouth-to-mouth ventilation (Travers et al. 2010; Berg et al. 2010). Chest compression without mouth-to-mouth ventilation is perhaps more acceptable to the public and easier to perform and teach. Studies on the prevalence of bystander CPR in Kota Bharu community in Kelantan, Malaysia, showed poor public response to initiate early CPR following OHCA and poor outcome (Hisamuddin et al. 2007; Chew et al. 2008a). More efforts are needed to increase the community awareness in Malaysia about the importance of initiating early CPR.

Kuala Lumpur is a Federal Territory and the capital of Malaysia. Both private and government ambulance organisations serve the community especially in urban areas like Kuala Lumpur. Government ambulance services are provided by Ministry of Health, Ministry of Education and Civil Defence. Private ambulance services are run by non-governmental organization such as Red Crescent and St. John's Ambulance. Literature search did not reveal any study related to the incidence of bystander CPR in OHCA in Kuala Lumpur.

The aim of the present study was to determine the prevalence of bystander OHCA CPR and to identify the baseline survival rate of OHCA patients managed in the ED of Universiti Kebangsaan Malaysia Medical Centre (UKMMC).

MATERIALS AND METHODS

This was a cross-sectional study of OHCA patients resuscitated in the ED of Universiti Kebangsaan Malaysia Medical Centre from January to December 2010. Data was collected following the approval of the institutional review board and ethics committee. The medical registration numbers of OHCA patients were obtained from the resuscitation logbook and respective patient's files were reviewed. All information was documented in a standardized data collection sheet. Only patients who arrested out of the hospital and managed in the ED were analysed. Early CPR is defined as CPR initiated following cardiac arrest prior to the arrival of paramedics or arrival to the ED. Data collected included: patients' age, gender, race, chief complaint and past medical history. The variables recorded were: aetiology of arrest, initiation of CPR at the scene, the application of automated external defibrillator (AED), mode of transportation and the incidence of ROSC. The time of collapse, CPR initiation, ED arrival, ROSC and CPR ended were documented. Descriptive data analysis was used to analyse the demographic characteristics of the patients. Categorical data was analysed using chi-square test and fisher exact test (p-value < 0.05). Data was analysed using Statistical Package for the Social Sciences version 19.0 (SPSS, Inc., Chicago, IL).

Table1: Factors that influence the outcome of CPR in OHCA patients

Characteristics	ROSC N (%)		*p*-Value
	YES	NO	
CPR			
Early	3 (33.3)	6 (66.7)	0.42
Late	19 (21.3)	70 (78.7)	
Gender			
Male	12 (16.4)	61 (83.6)	0.02
Female	10 (40)	15 (60)	
Witnessed arrest			
Yes	16 (25.4)	47 (74.6)	0.35
No	6 (17.1)	29 (82.9)	
Significant PMH			
Yes	16 (25)	48 (75)	0.61
No	1 (11.1)	8 (88.9)	
Unknown	5 (20)	20 (80)	
The initiator of CPR			
PHC	9 (25)	27 (75)	
Bystander	0 (0)	11(100)	0.17
No initiator	13 (25)	39 (75)	
Mode of transport			
PHC services	9 (21.4)	33 (78.6)	0.83
Others	13 (23.2)	43 (76.8)	
Etiology of arrest			
Trauma	3 (33.3)	6 (66.7)	0.65
Non-trauma	19 (21.1)	71 (78.9)	
Initial rhythm on AED			
Shockable	0 (0)	2 (100)	1.00
Non shockable	7 (27)	19 (73)	

Abbreviations: CPR, cardiopulmonary resuscitation; PHC, prehospital care; ED, emergency department; ROSC, return of spontaneous circulation; PMH, past medical history; AED, automated external defibrillator. All data are expressed as N (%) unless otherwise noted. P value <0.05 statistically significant using chi-square and #fisher exact test

RESULTS

A total of 117 OHCA patients were recruited at ED, UKMMC within the study period. Ninety-eight patients fulfilled the study criteria for final analysis. Nineteen patients had incomplete data. The mean age for OHCA patients was 48 years (range 1 month - 83 years) and 75% of the patients were males. The majority ethnic group was Chinese (45%) followed by Malays (34%), Indians (14%) and others (7%).

Three patients received early CPR (Table 1). Patients who received

Table 2. Distribution of mean time of various core events following OHCA.

Core Events	OHCA (min)
From collapse to the initiation of CPR by Bystander	18 (39)
From collapse to the initiation of CPR by PHC Service	24 (26)
From collapse to ED arrival transported by others	29 (24)
From collapse to ED arrival transported by PHC	41 (27)
From collapse to gain ROSC	42 (41)
From CPR started to CPR stopped	35 (21)

Abbreviations: CPR, cardiopulmonary resuscitation; PHC, prehospital care; ED, emergency department; ROSC, return of spontaneous circulation. All data are expressed as mean (SD) unless otherwise noted

early CPR achieved higher rate of ROSC (33%) compared to those who received late CPR (20%). A higher rate of ROSC was found in female OHCA patients (39%) compared to the male counterparts (15%). The majority (64%) of OHCA were witnessed. PHC personnel witnessed 6% of OHCA and the rest was witnessed by family member or other bystanders. Eleven OHCA patients received bystander CPR. Forty-seven (48%) of OHCA patients had CPR initiated at the scene. PHC personnel initiated CPR in 36 OHCA patients and achieved higher percentage of ROSC (25%). Nine trauma related OHCA showed a higher rate of ROSC (33%) compared to 89 non-trauma related arrest with 21% ROSC. However, this association was not statistically significant. Automated external defibrillators were applied to 28 patients. Of these, two had shock able rhythm with shock delivered but neither achieved ROSC. Only PHC personnel used AED. Seventy-three patients had a significant past medical history (PMH) such as hypertension, diabetes mellitus and ischaemic heart disease. There was no significant difference in the presence of PMH between male and female patients. Forty percent of female patients achieved ROSC compared to 16% in male patients. Pre-hospital care ambulance services transported 43% of the patients to the ED. The remainder were brought to the ED using other modes of transportation. Higher percentages of ROSC (23%) were achieved in those that were brought by other modes compared to those brought in by PHC services. The mean (standard deviation) duration from collapse to ED arrival was 41 (27) mins in patients transported by PHC services and 29 (24) mins by other modes of transportation (Table 2). Twenty-two of the 98 OHCA patients achieved ROSC after receiving further resuscitation in ED. Of the 22 ROSC patients, nine (41%) survived to ward admission for definitive care. The mean (standard deviation) duration of survival was 49 (34) hours. The longest survival duration in the ward was 92.5 hrs.

DISCUSSION

The UKMMC serves the community of Cheras, in the southern region of the Federal Territory of Kuala Lumpur. This study represents a first look at the

outcome of bystander initiated CPR on OHCA patients from this area. The percentage of bystander CPR in the Cheras community (11%) was higher than in the Kota Bharu community (9%) (Hisamuddin et al. 2007). However, these figures are still poor compared to the worldwide average level of 33% (ECC Committee, Subcommittees and Task Forces of the American Heart Association 2005). These marked differences indirectly reflect the level of awareness and willingness of Cheras and Kota Bharu communities to perform CPR in OHCA. The public should be made aware that approximately 70% of OHCA occurs at home involving family members (Weaver et al. 1984). Early bystander initiated CPR can double the probability of survival of these patients (Finn et al. 2001). Early CPR improves survival by delaying the degradation of the ventricular fibrillation or ventricular tachycardia to a systole and enhances the possibility of successful defibrillation on arrival of AED-equipped paramedics (Finn et al. 2001). Bystander initiated CPR 'buys time' during this time-critical situation. Therefore, by increasing the incidence of bystander CPR in a community should also increase the overall survival of OHCA.

Of the 65-witnessed arrests documented in this study, only nine received out-of-hospital CPR. Three OHCA CPR were categorized as early and all were initiated by healthcare providers. Although not statistically significant, OHCA patients who received early CPR appear to have a better outcome compared to those receiving late CPR. It was identified from the documented history that CPR performed by bystanders had indeterminate periods of discontinuity. Several CPR were performed for a short duration prior to transportation without resuming CPR in their vehicle. These inadequacies may have influenced the outcome of OHCA. Early CPR is a vital link in the chain of survival (ECC Committee, Subcommittees and Task Forces of the American Heart Association 2005). To maximize success, bystander CPR should be applied within 4 mins of collapse. The quality and technique of CPR performed as well as the time interval between collapse and the start of bystander CPR are equally important determinants for OHCA outcome (Hisamuddin et al. 2007).

In our study, female OHCA patients appear to have a higher percentage of ROSC compare to male patients (p=0.015). This finding is comparable to the study in Sweden, which reported that female OHCA was a predictor of higher rate of survival (Herlitz et al. 2004). This is explained by the pre-morbid medical conditions in both sexes. Male patients in our study had a higher incidence of severe pre-morbid medical conditions such as ischemic heart disease and hypertension compared to female patients even though the incidence of PMH in both sexes was not statistically significant. Patient's gender may influence the outcome of OHCA (Herlitz et al. 2004; Andjelic & Djordjevic 2010). The more severe the pre-morbid conditions or medical history of a patient, the poorer is the outcome.

In our study, PHC personnel initiated most of the CPR performed

at the scene. The OHCA patients that received PHC CPR have achieved more ROSC in the ED compared to bystander CPR. However, there was no difference in the survival outcome in both groups. There were only two OHCA patients recognized by AED as having shockable rhythm. PHC personnel delivered shock to these two patients but they did not achieve ROSC. Most of the initial cardiac arrest rhythms identified in this study were non-shockable rhythms, which was asystole. These findings are comparable to the study of OHCA patients in Hong Kong (Lau et al. 2005). A study of the emergency medical services system in Chicago, which served more than 3 million inhabitants, showed approximately 10% of OHCA occurred after the arrival of emergency personnel (Becker et al. 1991). The trend of outcomes of OHCA witnessed by PHC personnel was not statistically significant compared to bystander-witnessed arrest. It is believed that besides providing good quality CPR, PHC personnel have the additional advantage of having an AED in the ambulance. Moreno Martin et al. (2009) demonstrated the effectiveness of having AEDs in all BLS ambulance units. Defibrillation for shockable rhythms can be delivered before patient's arrival to the ED. Survival with complete recovery was observed in 7% of OHCA patients. This figure is similar to the results for recovery in ED (12%), which included the arrests attended directly by ACLS equipped and trained services (Moreno Martin et al. 2009). This shows the advantage of being equipped with this device at all times. The AED was found to be safe even in the hands of untrained schoolchildren (Gundry et al. 1999). By placing AED in strategic public locations, the time from collapse to application of the first shock was significantly shortened (Valenzuela et al. 2000; Israel & Hohnloser 2006).

Higher percentages of ROSC were noted in OHCA patients transported to the ED by other modes of transport. These OHCA patients had collapsed at home and were witnessed by family members. The favourable outcomes were probably due to shorter time intervals from time of collapsed to the initiation of ACLS in the ED.

It appears that trauma related OHCA in our study have better outcome compared to non-trauma. Our result seems to differ from the study by Chew et al. (2008b) that suggested the percentage of non-trauma related cases have a better outcome in terms of achieving ROSC. Very low survival rates have been reported for victims of traumatic cardiac arrest (Stockinger & McSwain 2004). CPR might be useful in severe trauma patients only in systems with very short transportation times (Pepe & Eckstein 1998). Those patients with the best outcome from trauma arrest generally are young, have treatable penetrating injuries, have received out-of-hospital endotracheal intubation, and prompt transport (less than ten minutes) to a trauma care facility (Chew et al. 2008b; Pepe & Eckstein 1998).

There are several limitations in this study. The sample size was small. There were only 98 incidence included for analysis over a limited period of 12 months. This study did not analyse the quality, skills and knowledge of

bystanders performing CPR. Further study is needed to determine the association of ED management with the outcome of resuscitating OHCA patients.

CONCLUSION

The provision of early CPR for OHCA by the public in the Cheras area is low and AED was not widely available for public use. Females have a better rate of ROSC than males. To improve outcomes, more effort is required to increase the awareness and involvement of the public in managing OHCA.

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