ORIGINAL ARTICLE

Outcomes of Cardiopulmonary Resuscitation Performed in Emergency Department, Hospital Universiti Sains Malaysia

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SUMMARY

Despite the progresses made in the science of cardiopulmonary resuscitation, there is lack of published works on this area in the Malaysian context. This survey was done to look at the outcomes of all cardiopulmonary resuscitation performed in Emergency Department (ED), Hospital Universiti Sains Malaysia (HUSM). This is a one year cross-sectional study from March 2005-March 2006. All adult cardiac arrest cases with CPR performed in ED, HUSM were included in the survey. The end points are return of spontaneous circulation (ROSC) and survival to ward admission. Out of the total 63 cases of cardiac arrest with CPR performed, only 19 cases (30.2%) had ROSC after CPR performed on them. Eventually only six patients (9.5%) had survival to ward admission. Patients with shockable intial arrest rhythm has a significantly higher chance to achieve ROSC (60.0%) compared to non-shockable rhythms (24.5%) (p = 0.025). However, there was no different in survival to ward admission between shockable and non shockable rhythms groups. The survival after cardiac arrest is still dismally poor. Perhaps we should be more selective in initiating CPR especially for out of hospital cardiac arrest.

KEY WORDS:
Cardiopulmonary resuscitation, return of spontaneous circulation, survival to admission, shockable rhythms, non-shockable rhythms, out-of-hospital cardiac arrest

INTRODUCTION

Cardiac arrest, defined by the cessation of cardiac mechanical activity[1], requires a series of sequentially linked prompt interventions known as the chain of survival[2]. The links in this chain are early recognition of signs of cardiac arrest, early activation of emergency medical services, early initiation of basic cardiopulmonary resuscitation (CPR), early defibrillation and early initiation of advanced cardiac life support. Every chain is important and weakness in any link would lessen the chance of survival of out-of-hospital cardiac arrests[2].

In essence, CPR is an attempt to restore spontaneous circulation by performing chest compressions with or without ventilations[1]. Ever since the introduction of modern CPR concept by Peter Safar way back in the 1960s[3], CPR technique has been refined from time to time, with the international resuscitation councils like the International Liaison Committee on Resuscitation (ILCOR), the American Heart Association (AHA) as well as the European Resuscitation Council (ERC) playing important roles in coming up with evidence based recommendations.

Nevertheless, despite the advances made in the knowledge and practice in CPR, there is a lack of research and review papers written about CPR in Malaysia. More than ten years ago, a study was conducted over a period of three months to look into the adequacy and outcomes of CPR performed among in-hospital cardiac arrest patients in six Malaysian district hospitals. In that study, it was found that as high as up to 59.5% of cases were inadequately resuscitated. It was also found out that in 24% of the cases, staff nurses failed to initiate resuscitation. Majority of the staff nurses were found to have just put up intravenous drips and oxygen through face mask to cardiac arrest patients but failed to start chest compression and positive pressure ventilation through bag-valve-mask devices. Besides that, many other reasons were also cited, including the inadequacy of the duration of resuscitation (less than 30 minutes in 42% of cases) as well as incomplete resuscitation trolleys (like missing essential items, expired drugs and leaking bag-valve-mask devices) in 44% of the cases[4].

In 2005, a self-administered anonymous questionnaire survey was done on 4989 healthcare staffs in Malaysia. This questionnaire survey was performed to look into the confidence and ability of Malaysian healthcare staffs with clinical background to perform first aid and CPR. The healthcare staffs range from all levels of occupational categories from the state health directors to community nurses, midwives and assistant nurses. It was found that only 52.7% of the healthcare staffs said that they were confident and able to perform first aid and CPR[5]. This being the case, when healthcare staffs, regardless of the position and the place where one works, are often looked upon and depended as the life-savers with the skills to do "something" during emergency situations.

Other than these, there is a paucity of published works on CPR in the Malaysian context. This study is a one year survey conducted in the emergency department (ED), Hospital Universiti Sains Malaysia (HUSM), looking at the outcomes of CPR performed in this ED.

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MATERIALS AND METHODS

This is a cross-sectional survey performed from March 2005 to March 2006. The primary end point of the study is the achievement of return of spontaneous circulation (ROSC) and the secondary end point is survival to ward admission; that is, the achievement of sustained ROSC until admission to the respective wards. Signs of ROSC are breathing (more than an occasional gasp), coughing, movement, a palpable pulse or a measurable blood pressure[1].

This study did not take into consideration other more comprehensive end points such as survival to hospital discharge, survival at six months interval and neurological status on discharge as this study is primarily done to look into the outcomes of CPR done in ED, HUSM. These other end points are influenced by confounding factors such as the management of patients in the intensive care units and other respective wards, concurrent nosocomial medical complications (such as hospital acquired pneumonia) that the patients may develop as well as the patients' own deteriorating physiological status.

All adult patients with CPR performed in Emergency Department were included in the survey. Patients with 'Do Not Attempt Resuscitation' (DNAR) order and patients who, in the discretion of the attending doctors, showing signs of irreversible death like rigor mortis, decapitation, dependant lividity were excluded from the survey. Patients with CPR performed in the other wards such as medical, surgical and oncology wards were also excluded as this survey is primarily looking at outcomes of CPR performed in ED, HUSM.

The variables in this survey include the types of cardiac arrest (whether the cardiac arrest occurs prior to arrival to ED, HUSM or cardiac arrest that occurs while patient is being treated in the ED itself), aetiologic basis of the cardiac arrest (whether the cardiac arrest is due to traumatic or non-traumatic causes) and initial cardiac arrest rhythms recorded. Initial cardiac arrest rhythms referred to the first monitored cardiac rhythm when the cardiac monitor is attached to the patient after a cardiac arrest[1]. Initial cardiac arrest rhythms generally are divided into two main groups, namely, the shockable rhythms (ventricular fibrillation and pulseless ventricular tachycardia) and non-shockable rhythms (asystole and pulseless electrical activities). A shockable rhythm refers to the rhythm that is treatable by defibrillation.

The ED, HUSM has an attendance rate of between 40,000 to 50,000 patients per year. It has four interconnecting treatment zones (red, yellow, green zones and the observation ward). The red zone, where resuscitation takes place, is a four-bedded area, with every bed equipped with complete vital signs monitoring system. There are also two fully equipped, regularly updated resuscitation drugs trolleys and two biphasic defibrillators in the Red Zone.

The variables in this survey are categorical variables. Chi-squared test and Fischer-exact tests are used with confidence interval taken at 95% and p-value < 0.05 is considered as statistically significant value. Statistical Packages for Social Science (SPSS®) version 12.0.1 was used for analysis. This survey did not intervene in any way the process of resuscitation that was carried out in accordance to basic life support and advanced life support protocols. Data for this study were obtainable from the patient's case notes and the nursing record books in emergency department.

RESULTS

A total of 63 cardiac arrest patients with CPR performed in ED, HUSM were analyzed in that one year study period. Out of these 63 patients, 23 (36.5%) suffered a cardiac arrest before arrival to the emergency department whereas the other 40 (63.5%) patients had a cardiac arrest in the ED, HUSM while they were being treated in ED itself.

Nineteen out of the 63 patients (30.2%) had ROSC after CPR performed on them. Out of the 19 patients that had achieved ROSC, only four of them were from the category of patients who suffered cardiac arrest prior to arrival to the ED. The other 15 cases that achieved ROSC were from the category of patients developing cardiac arrest in the ED while they were being treated there.

Even though there were 19 patients achieved ROSC, eventually only six out of the total 63 patients (9.5%) survived until admission to their respective wards. The other 13 patients, though achieved ROSC, but it was not sustained enough until ward admission. These patients eventually died in the emergency department despite CPR being performed on them again.

Out of the six cases that achieved survival to ward admission, only one of them was from the category of patients who suffered cardiac arrests prior to arrival to ED; the other five patients that achieved survival to ward admission were from the category of patients who suffered cardiac arrests in the ED itself (Table I).

In terms of the types of initial cardiac arrest rhythms, out of the total of 63 cases, 10 cases were associated with shockable initial cardiac arrest rhythms; six cases (60.0%) achieved ROSC. All these 10 cases were given immediate defibrillation despite the fact that there were two cases where the cardiac arrest occurred in out of hospital setting and in both cases; there was a delay of more than 5 minutes between collapse and initiation of CPR in ED. Ironically, both patients achieved ROSC although both patients eventually died in ED (with no survival to hospital admission for both cases). Among the 53 cases that were associated with non-shockable rhythms, only 13 cases (24.5%) achieved ROSC ($p=0.025$).

However, in terms of survival to ward admission, out of the 10 cases associated with shockable rhythms as their initial cardiac rhythms, only one case (10.0%) achieved survival to ward admission. On the other hand, among the 53 cases that were associated with non shockable rhythms, 5 cases (9.4%) achieved survival to ward admission ($p=0.955$) (Table II).

In terms of aetiologies, 19 cases (30.2%) were trauma related whereas 44 cases (69.8%) were non trauma-related. Among the 19 trauma-related cases, 3 cases (15.8%) achieved ROSC. On the other hand, out of the other 44 non trauma-related cases, 16 cases (36.4%) achieved ROSC. However, only two

Table I: Category of Cardiac Arrest and Outcomes

	Cardiac Arrest Prior To Arrival to ED, HUSM	Cardiac Arrest in ED HUSM	P value
N	23	40	
ROSC	4 (17.4%)	15 (37.5%)	P=0.09
Survival to Ward Admission	1 (4.3%)	5 (12.5%)	P=0.40

Table II: Initial Cardiac Arrest Rhythms and Outcomes

	Shockable Rhythms	Non-Shockable Rhythms	P value
N	10	53	
ROSC	6 (60%)	13 (24.5%)	P=0.02
Survival to Ward Admission	1 (10%)	5 (9.4%)	P=0.96

Table III: Aetiologies of Cardiac Arrest and Outcomes

	Trauma Related	Non Trauma Related	P value
N	19	44	
ROSC	3 (15.8%)	16 (36.4%)	P=0.10
Survival to Ward Admission	2 (10.5%)	4 (9.1%)	P=0.86

out of the 19 trauma related cases (10.5%) achieved survival to ward admission. For the 44 non trauma-related cases, four cases (9.1%) achieved survival to ward admission (Table III).

DISCUSSION

Overall, from this one year survey, only 30.2% of cardiac arrest cases with CPR performed in ED, HUSM achieved ROSC; and only 9.5% of cases achieved survival to ward admission.

Patients who suffered cardiac arrests prior to arrival to ED, HUSM had a lower chance to achieve ROSC and survival to ward admission compared to patients who suffered a cardiac arrest while being treated in ED[6]. In this study, the chance to achieve ROSC is 17.4% (for those suffered cardiac arrests prior to arrival to ED) compared to 37.5% for those who suffered cardiac arrests while being treated in ED.

The chance of survival to ward admission is only 4.3% for those who suffered cardiac arrests outside the ED as compared to 12.5% for the group who suffered cardiac arrests in the ED. Predictably, if the survival rate to ward admission is only 4.3% for this group, the survival rate to hospital discharge would likely be even lower than 4.3% due to various factors while the patients were being treated in the wards such as concomitant infections, deteriorating physiological functions, ventilation related complications, etc. This figure is slightly lower than the 5% reported in some studies done in other countries[7].

Therefore in this survey, although statistically it was not significant, the rate of achieving ROSC is double for the group that suffered cardiac arrests while being treated in ED as compared to those suffered an arrest outside the ED. The rate of survival to ward admission for those who suffered cardiac arrests while being treated in ED is also higher (12.5%) compared to those that suffer cardiac arrests prior to arrival to ED.

There are a few marked differences in patient characteristics of those who suffer a cardiac arrest while in ED and those that suffer a cardiac arrest outside the hospital. Firstly, most patients who suffer cardiac arrests in the ED would already have intravenous drips in situ and therefore, this would facilitate drug administration promptly should the patients collapse. More importantly, patients who suffer a cardiac arrest while being treated in ED would very likely have their vitals signs (blood pressure, pulse rate and oxygen saturation) monitored as well as emergency procedures such as endotracheal intubation and mechanical ventilation been carried out before they deteriorate to cardiac arrest. In fact, one study even quoted as high as approximately one third of in hospital patients had already had an invasive airway in place at the time of the onset of cardiac arrest[8]. These features are rarely present in the out-of-hospital cardiac arrest victim. In short, unlike out-of hospital cardiac arrest, an overwhelming majority (86%) of events are witnessed, monitored, or both[8]. A witnessed arrest means that, should the patient develop ventricular fibrillation or pulseless ventricular tachycardia, defibrillation can be delivered at the earliest instance.

Another confounding factor in our setting that adversely affects the outcome of out of hospital cardiac arrest is the ambulance response time. Though the ambulance response time in Kota Bharu community was found to be slightly better than, for instance, the time in Kuala Lumpur (15.2 minutes in Kota Bharu as compared to 21.1 minutes in Kuala Lumpur)[9], this is still longer than the recommended time of less than 7 – 8 minutes as achieved in some communities worldwide[10]. Hence, a lot of critical time especially the first few critical minutes is wasted in waiting for the ambulance to arrive. In these circumstances, the public must be taught to perform bystander CPR while waiting for the arrival of ambulance. Understandably, if the ambulance response time is not good enough, the time taken to bring cardiac arrest patients by relatives and friends' own vehicles would be even longer than those brought in by ambulance due to traffic rules, traffic congestion, etc.

The American Heart Association guidelines on CPR and Emergency Cardiovascular Care stated that there are two interventions that have demonstrated survival benefit for cardiac arrest patients – namely prompt, effective chest compression, and prompt defibrillation in cases of shockable rhythms[11]. And in cases of cardiac arrest with initial shockable arrest rhythms, every one minute delay in defibrillation would decrease survival rate by 7 to 10%. By a mere delay of more than 12 minutes of ventricular fibrillation, the survival rate of adults would decrease to merely less than 5%[12].

In terms of the types of initial cardiac arrest rhythms, shockable rhythms was shown to result in a higher rate of achieving ROSC (60% as compared to 24.5% in non-shockable rhythm (p= 0.025). Inevitably, many studies have demonstrated that patients presented with shockable initial cardiac arrest rhythms (namely, ventricular fibrillation and pulseless ventricular tachycardia) have a higher survival rate as compared to non-shockable rhythms (namely asystole and pulseless electrical activity). For example, in a study involving 105 in-hospital cardiac arrest patients, patients with pulseless ventricular tachycardia or ventricular fibrillation were found to be more likely to survive to hospital discharge than those with asystole or pulseless electrical activity[13]. Similarly, among patients who had cardiac arrests in an out-of-hospital setting, survival rate is higher in the setting of ventricular fibrillation or pulseless VT as compared to non-shakeable rhythms[14].

In this survey, however, although in terms of achieving ROSC is significantly higher in those presented with shockable rhythms, the rate survival to ward admission are almost similar in both shockable (10%) and non-shockable (9.5%) rhythms groups. In other words, although there was a greater rate of ROSC achieved when defibrillation was given immediately to cardiac arrest patients with shockable rhythm, majority of these patients suffered a second cardiac arrest and eventually pronounced dead in the ED before they had a chance to be admitted to the respective wards. The reason behind why these patients eventually died in ED before ward admission could not be ascertained in this survey; but it could possibly be due to patient's physiological deterioration during the post-resuscitation period. This serves to illustrate the importance of post-resuscitation care in ED that demands equally intensive vigilance as the actual resuscitation process itself.

Out of the 63 cases, 19 cases were trauma-related whereas the other 44 cases where non trauma-related. Among these 19 trauma-related cases, 3 (15.8%) cases achieved ROSC. Out of the other 44 non trauma-related cases, 16 (36.4%) cases achieved ROSC. Although no statistical significance, this seems to suggest that the percentage of non-trauma related cases have a better outcome in terms of achieving ROSC.

However, among these 19 trauma-related cases, only two cases (10.5%) achieved survival to ward admission whereas out of the other 44 non trauma-related cases, only four cases (9.1%) achieved survival to ward admission.

Very low survival rates have been reported for victims of traumatic cardiac arrest. For example, a study by Stockinger and McSwain found that survival rate of traumatic cardiac arrest victims was only 3.7%[15]. In another study, it was found that, if hypovolemia is the primary cause of the arrest, the victim rarely survives[16]. Unless aggressively resuscitated with fluid and blood products, hypovolemia would rapidly deteriorate into decompensatory shock and to complicate matters, disseminated intravascular coagulopathy often develops.

There are several limitations in this survey. The sample size collected was small. There were only 63 samples, limited for a period of one year from March 2005 to March 2006. The survey was a single centre study limited to one location, the ED HUSM. There is another referral hospital in Kota Bharu with cardiac arrest cases where this survey did not take into consideration. The end points of this study are confined to only ROSC achievement and ROSC sustained until admission to ward rather than more elaborative end points like survival to hospital discharge and six months survival rate. Nevertheless, while it cannot be denied that certainly not all ROSC achieved would translate into success rate of survival until hospital discharge, achieving ROSC represents the very first step to, at least, give a hope to cardiac arrest patients. No ROSC achieved after a certain period of CPR means no hope at all for the cardiac arrest patients. Finally, post-resuscitation care aspect was not included in the analysis of this survey.

Despite the limitations, we hope that this survey would spur further comprehensive works on cardiac arrest in Malaysia. Future works including multi-centre Malaysian surveys, surveys involving a larger sample size to improve the power of the study as well as studies with more variables and more comprehensive end points like survival to hospital discharges could be carried out.

CONCLUSION

The chance of survival of a cardiac arrest in our community is still dismally low. The especially low ROSC achieved in patients suffered a cardiac arrest prior to arrival to ED, HUSM showed to us that perhaps we need to define a more selective criteria as to which of these patients should actually be attempted resuscitation. Many of these patients arrived 'late', taken more than the critical first few minutes[12] to arrive to ED and thus the chance of survival is extremely low. In this group of patients, probably resuscitation should never be attempted at all. The fact that in this survey, the number of cases where CPR performed for patients with cardiac arrest occurred out of hospital was only half as compared to the number of cases of cardiac arrest that occurred while in ED probably attest to the fact that patients suffered cardiac arrest outside the hospital are often brought in to ED in the state of irreversible death.

Finally, as mentioned by Garretson *et al.*, CPR success rates have not changed much in the last 30 years or so[17]. In this regards, nothing is as important as anticipating and detecting early subtle deteriorating changes. Patient outcomes may improve if changes of a patient's condition are addressed at the very onset of subtle deteriorations, rather than at the point of cardiac arrest, and this certainly require the rapid response from the resuscitation team in ED, including early interventional measures to counter the physiological

deterioration. This is especially true in the setting of traumatic cardiac arrest. The low rate of achieving ROSC in traumatic cardiac arrest shows that, for trauma cases, aggressive early resuscitation to counter hypovolemic shock, including early and judicial use of blood products as well aggressive initiation of damage control surgical measures are of paramount importance. Attending doctors for trauma cases need to anticipate and look hard for hidden sources of bleeding because once cardiac arrest occurred in the setting of hypovolemic shock, the chance of survival is poor.

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