PREVALENCE AND FACTORS ASSOCIATED WITH SURVIVAL OF CARDIAC ARREST AMONG IN-HOSPITAL ADULT PATIENTS – AN UTSTEIN STYLE REPORTING FROM A TERTIARY HOSPITAL IN EAST COAST OF MALAYSIA

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Study Protocol

LIST OF ABBREVIATIONS

ACLS	Advance Cardiac Life Support
AED	Automated External Defibrillator
AHA	American Heart Association
CPC	Cerebral Performance Category
CPR	Cardiopulmonary Resuscitation
HUSM	Hospital Universiti Sains Malaysia
IHCA	In-Hospital Cardiac Arrest
ILCOR	International Liaison Committee of Resuscitation
OHCA	Out of Hospital Cardiac Arrest
ROSC	Return of Spontanious Circulation

ABSTRAK

Pengenalan: Kejadian Gagal Jantung di dalam Hospital (*In-Hospital Cardiac Arrest*, IHCA) secara lumrahnya berlaku di setiap hospital di seluruh dunia. Secara amnya, jumlah kajian yang dilakukan berkaitan IHCA adalah lebih sedikit berbanding dengan kajian berkaitan Gagal Jantung di Luar Hospital (OHCA) terutamanya di Malaysia. Tujuan kajian ini dilakukan adalah untuk mengenal pasti kekerapan kejadian IHCA yang berlaku di sebuah hospital tertiari yang terletak di Pantai Timur Malaysia, dan untuk mencari faktor-faktor asosiasi yang berkaitan dengan IHCA di hospital ini.

Kaedah: Kajian ini melibatkan pengumpulan data secara retrospektif untuk semua IHCA bermula dari Januari 2012 hingga Disember 2017 yang menggunakan Garis Panduan Utstein sebagai templat untuk pengumpulan data. Data telah dianalisis dengan Regresi Logistik Sederhana dan Berganda.

Keputusan: Sebanyak 308 sampel telah direkrut dan 286 sampel telah dianalisis. Kajian kami menunjukkan bahawa kebanyakan pesakit yang terlibat IHCA adalah didalam lingkungan umur 60-69 tahun dengan usia purata 58 tahun. Kejadian IHCA berlaku kebanyakannya pada siang hari (56.7%). Punca kegagalan jantung dan ritma permulaan yang paling kerap adalah kegagalan jantung akibat *Non-Cardiac* (69.1 %) dan ritma *asystole* (65.2%). Analisis regresi logistik berganda menunjukkan terdapat perkaitan antara penggunaan mesin ventilasi dengan Pengembalian Peredaran Darah Spontan (ROSC).

Kesimpulan: Kajian ini menunjukkan bahawa kadar (ROSC) di Pantai Timur Malaysia sebanyak adalah lebih tinggi (55.8%) berbanding dengan negara membangun yang lain dan penggunaan mesin ventilasi dapat dikaitkan dengan kadar ROSC. Sebanyak 43 daripada 101 pesakit (42.5%) berjaya mengekalkan ROSC lebih daripada 24 jam.

Kata kunci: Gagal Jantung di Dalam Hospital, kembalian peredaran jantung spontan

ABSTRACT

Introduction: In-Hospital Cardiac Arrest (IHCA) commonly happens in every hospital throughout the world. Very few studies were done regarding this matter compared to out of hospital cardiac arrest (OHCA) especially in Malaysia. The purpose of the study is to determine the prevalence of IHCA in a tertiary hospital located in the East Coast of Malaysia, and to identify any associated factors.

Methods: This was a retrospective cross-sectional study involving all IHCA cases from 1st January 2012 until 31st December 2017 using the Utstein Style as its template for data collection. Data were analysed with simple and multiple logistic regression.

Result: A total of 308 patients have been recruited and 286 sample have been analysed. Our study showed that most of the patients who developed IHCA were in the age group of 60-69 years old with the mean age of 58. The events of IHCA happens mostly during the day (56.7%), mainly due to non-cardiac causes (69.1%) with the most common initial rhythm of asystole (65.2%). Multiple logistic regression analysis showed that the presence of mechanical ventilation was significantly associated with ROSC ($p < 0.001$).

Conclusion: The prevalence of ROSC in the East Coast region of Malaysia is higher (55.8%) compared to that of other developing countries and the use of mechanical ventilations are associated with ROSC in the study centre. Out of 101 resuscitated patients who received ROSC, forty three patients (42.5%) were able to maintain it for more than 24 hours.

Keywords: in-hospital cardiac arrest, return of spontaneous circulation, prevalence, associated factors

CHAPTER 1: INTRODUCTION

In-Hospital Cardiac Arrest (IHCA) is considerably common in hospitals all around the world.(1). Its causes range from a lot of factors. However it received less attention compared with other high-risk cardiovascular conditions such as stroke, myocardial infarction, and out-of-hospital cardiac arrest OHCA (1). In a systematic review of all randomized clinical cardiac arrest trials (n = 92) involving at least 50 patients from 1995 to 2014, only 4 (4%) exclusively involved patients with IHCA (1).

In Malaysia, especially in the East Coast of the country, a single prospective study was done in 2008 involving the population in an Emergency Department (ED) for a year. However this study does not represent the whole population of the hospital as it is small and only represents the population in the ED, while the most number of IHCA happens during admission to wards, intensive care units, and other units in the hospital (2).

Despite advancements in resuscitation technology and care, survival outcomes following IHCA remain low at 15%–25%, and vary drastically between 0% and 42% worldwide (3). Research shows that various patient and healthcare-related factors are associated with the survival outcomes of IHCA (4). Major patient-related factors are age, gender, initial cardiac rhythm, underlying medical condition, comorbidities and time of the IHCA event, whereas major healthcare-related factors are policies and protocols for IHCA care, duration and method of resuscitation, skills of healthcare professionals, response time of the emergency response team and location/hospital unit of the IHCA event(5).

The epidemiology of IHCA is very less known in Malaysia, specifically in the east coast region, signifying the need for research in this area. Therefore, this study was aimed to provide the first estimates of the incidence, characteristics and outcomes of IHCA at a tertiary-care hospital in the East Coast of Malaysia.

CHAPTER 2: STUDY PROTOCOL

2.1: INTRODUCTION

Cardiopulmonary resuscitation (CPR) has become a vital skill widely practised by all medical personnel as it is an essential life-saving skill for any cardiac arrest (CA) which could occur unexpectedly at anytime and anywhere. Indeed medical personnel have made CPR one of the most performed medical interventions in the world (Cummins et al, 1997).

CPR techniques and technology have improved considerably since the introduction of closed chest cardiac massage in 1960. This resulted from the work of Kowenhowen, together with the colleagues Knickerbocker and Jude (Kowenhowen et al, 1960). They have experimented with defibrillation and rediscovered the efficacy of external chest compression producing a passable circulation. However, it was Peter Safar (1924-2003), who was also also known as the " Father of Modern Resuscitation" who cleverly combined the techniques of airway positioning, ventilation and external chest compression producing the current Airway-Breathing-Circulation (ABC) technique of basic life support (Basket, 2001, 2003).

Cardiopulmonary resuscitation (CPR) refers to a series of emergency lifesaving actions which is performed in an effort to manually resuscitate a person in cardiac arrest. As CPR requires various emergency treatments in short time, the essential treatment procedures had been established as a standardized guideline. In 1962, the American Heart Association (AHA) had established "A Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care" for the first time and since then the efforts to medically improve CPR has been continued up to now, and it has been applied continually to CPR based on the research results known from many clinical studies. Thereafter, the International Liaison Committee on Resuscitation (ILCOR) which was constituted in 1993 had performed its tasks to apply new scientific grounds which were periodically accumulated at each 5 year from 2000 to the

Guidelines for Cardiopulmonary Resuscitation and came to present an Integrated Guidelines, providing each country scientific grounds for revising or establishing their own CPR guidelines (Kwangha Lee et al, 2012).

In the field of resuscitation, there has also been tremendous progress of the international community taking an interest in improvement and standardization of CP techniques in the last few years. This has led to the further intellectual exchange from many experts in major world resuscitation councils and as major milestone is the world's first international resuscitation conference held in 2000 specifically to produce international resuscitation guidelines. This has resulted in the publication of the International Guidelines 2000 Conference on Cardiopulmonary Resuscitation (CPR) and Emergency Cardiovascular Care (ECC).

These guidelines have since been reviewed by the expert task force and were also discussed and debated in the 2005 Consensus Conference to produce the International Liaison Committee on Resuscitation (ILCOR) 2005 CPR Consensus published on these publications that American Heart Association (AHA) Guidelines 2005 for CPR and ECC were produced.

These international guidelines have now made CPR a standard practice in both the in-hospital and out-of-hospital setting. Cardiac arrests can be divided into out-of-hospital cardiac arrests (OHCA) or in-hospital cardiac arrests (IHCA) the importance of this distinction is that for IHCA we would expect prompt resuscitation to be initiated by trained medical personnel whilst for any OHCA, survival would depend entirely on the initiatives of bystanders to activate the chain of survival and importantly start CPR. The survival rate of OHCA generally still remains low (Jacobs et al, 2004) and OHCA incidence and outcome varies greatly around the globe. A better understanding of the variability is fundamental to improving OHCA prevention and resuscitation.

In the in-hospital settings, survival rates are expected to be higher than OHCA but the survival rates have varied considerably (Herlitz et al., 2000). Data collected from the Get with

the Guideline (GWTG) Resuscitation registry had shown that from 84,625 patients with IHCA, the initial cardiac-arrest rhythm was asystole or pulseless electrical activity (PEA) in 67,135 (79.3%) and ventricular fibrillation (VF) or pulseless ventricular tachycardia (VT) in 17,490 (20.7%). During the study period, the proportion of cardiac arrests due to asystole or PEA increased from 68.7% in 2000 to 82.4% in 2009. Both survival and neurologic outcomes after in-hospital cardiac arrest (IHCA) have improved during the past decade at hospitals participating in a large national quality-improvement registry. In the study of patients at hospitals participating in a national quality-improvement registry, it is found that survival after IHCA improved substantially between 2000 and 2009. (6)

The BRESUS study in 1992 reported a 19% survival-to-discharge rate in 12 British hospitals out of 3765 patients (Turnstall-Pedoe et al., 1992). A further meta-analysis of in-hospital CPR in 1998 found an overall rate of survival-to-discharge of 14.6% (Ebell et al., 1998). Survival after cardiac arrest improved regardless of whether or not the initial cardiac-arrest rhythm was treatable by defibrillation. In patients with VF or pulseless VT, improvement in survival over time was not accompanied by shorter defibrillation times. These observations suggest that factors other than rapid defibrillation may have accounted for the improvement in survival. These factors may include earlier recognition of cardiac arrest (i.e., shorter response times), quality of acute resuscitation (e.g., greater availability of trained personnel and provision of high-quality chest compressions with fewer interruptions), and post resuscitation care (e.g., therapeutic hypothermia and early cardiac catheterization). In fact, many of these processes have been emphasized in the American Heart Association (AHA) Guidelines for CPR during the past decade. Future studies are needed to better understand which specific factors are responsible for improvements in survival after cardiac arrest so that survival gains can be consolidated and expanded to all hospitals. (Girotra et al., 2012) all these disparity has been explained by the wide variations in inclusion criteria and outcome definitions.

Sudden cardiac arrest remains a leading cause of prehospital and in-hospital death. Efforts to resuscitate patients after cardiac arrest have preoccupied scientists and clinicians for decades. However, the majority of patients are never successfully resuscitated. Based on the published reports, the overall survival rates after cardiac arrest are grim, ranging from 1% to <20% for out-of-hospital non-traumatic cardiac arrest and <40% for in-hospital cardiac arrest. Of these, 10% to 50% have poor neurological function. Surprisingly, the physiologic principles that underlie the life-saving process of cardiopulmonary resuscitation (CPR) remain only partially understood and are often controversial. Some would argue that current approaches to cardiac arrest are fatally flawed, and that is why the overall survival rates have hovered around 7% for out-of-hospital cardiac arrest and <30% for in-hospital cardiac arrest nationwide for a half a century (Lurie et al., 2016)

To address this complex problem which had occur since the inception of CPR, the Utstein Conference emerged to address this problem of disparity in nomenclature and definitions. The Utstein conference was held at the historic Utstein Abbey, Norway in June 1990 and was attended by members of the American Heart Association (AHA), the European Resuscitation Council (ERC), The Heart and Stroke Foundation of Canada and the Australian Resuscitation Council (Cummins et al., 1991)

However, it was not until 1997 that the Utstein Task Force further developed a standardized guideline for in-hospital resuscitation and produced a standardized in-hospital resuscitation reporting form. This was deemed necessary due to the complexity and the unique challenges the in-hospital resuscitation presented (Cummins et al., 1997).

With the introduction of the Utstein Style report, review and research in-hospital and out-of-hospital resuscitation, the results of the resuscitation endeavours in different countries

can now be compared more meaningfully researchers can now use well-defined end-points to assess effectiveness of delivery of different system and interventions.

Currently, these internationally produced guidelines are backed by scientific evidence to help standardize our practice and harmonize the recommendations in the practice of CPR and ECC. This has indeed greatly benefited our in-hospital patients and in a wider context our community as a whole. All health care providers can now follow the same guidelines and eliminate confusion. Once the practice of good delivery of care on CPR and ECC is met within the health care facilities, further dissemination of knowledge to layperson especially regarding Basic Life Support (BLS) would further enhance the chances of survival in out-of-hospital cardiac arrest.

Since the production of these Utstein guidelines, we have witnessed a proliferation of studies around the world of researchers who have used these guidelines to look into the practice and outcomes of CPR and ECC resuscitation within their own hospitals and countries. This represents a truly vast improvement from the past as we can now appreciate how practises may defer around the word and by the set end-points, are able to look further into the multiple factors that may affect these end-points and ultimately contribute to the improvement of these outcomes.

This immense improvement we have seen worldwide into the research of CPR and resuscitation though has not yet filtered down into our Malaysian scene and unfortunately until 2017, though there are few publications on out-of-hospital cardiac arrest Utstein Style reporting, no IHCA Utstein Style reporting has been published. A study done by Chan et el (2016) which looked on factors that affected in the adequacy of in-hospital resuscitation but did not look at patient survival rates. He found that almost 56% of cases were inadequately resuscitated and the reasons cited included staff nurses who failed to initiate chest compression

and to provide positive pressure ventilation through bag-valve-mask, inadequate duration of resuscitation and inadequately equipped resuscitation trolleys.

Resuscitation medicine is an integral part of acute emergency medicine. At the Emergency Department of HUSM (Hospital Universiti Sains Malaysia), a pilot study was conducted in 2007 to look at all cases resuscitated in the department it showed within a one-year period, there were 40 cases of IHA and 22 cases of OHCA. Among the 40 cases of IHCA, there were five patients that achieve return of spontaneous circulation (ROSC) till admission to the ward while in the OHA group only one patient survived to hospital admission. However, follow-up was not concluded to see whether these patients survived to hospital discharge. The study adopted Utstein style definitions but did not incorporate the use of the Utstein data collection (Chew, 2007). These two publications are among the very few study done in Malaysia regarding in-hospital cardiac arrest resuscitation, and we are lacking in this area.

The Utstein Guidelines for IHCA events deals mainly with four major categories of variables for documentation which are patient variables, arrest variables, outcome variables and hospital variables. These variables become available at different times. Patient variables are available before the arrest but are recorded after the arrest. Arrest variables and hospital variables are recorded at the time of arrest. Outcome variables are recorded after the arrest and requires follow-up of the patient. It is not possible to collect all of these variables but most of the important variables are incorporated into the "standard reporting of in-hospital cardiopulmonary resuscitation" Form, reproduced in the Appendix. However, it is important to use the definitions for nomenclature as stated by Utstein Task Force in order for all documentation to be standardized.

Bearing in mind the current scenario of the lack of CPR research in Malaysia, it is deemed rather appropriate that further studies on IHCA be conducted as almost a decade has

passed since the last published Malaysia study. By using the Utstein Style as a tool to conduct the research, it is hoped that the current study undertaken would help to contribute in achieving meaningful results that could be used to later compare to other centres. The main aim of conducting this study is to discover what the outcomes of CPR performed for IHA are in our local setting to determine what is happening in an area of hospital not covered by routine statistics.

It is hoped that in time to come this research will serve as a meaningful starting point, to the initiation of the trend of cardiopulmonary resuscitation research within Malaysia. If other centres were to follow suit, it would lead to the creation of larger databases to evaluate the resuscitation outcomes within Malaysia in-hospital and out-of-hospital CPR. This accumulation of data would be indeed beneficial, leading to further evaluation and improvement of the level of care in this field in an evidence-based manner.

As Malaysia, a developing nation moves towards a vision of a developed nation, all aspects of healthcare should continue to evolve to higher level of standard. The management of IHCA, an important area of acute medicine that all healthcare personnel should be trained and familiar with must not be neglected as it forms a vital link in the chain of survival. We should expect a time when one day the success rate of CPR in a hospital would become an important key indicator of its performance.

2.2 : LITERATURE REVIEW

Pathophysiologic Basis of CPR

Cardiac arrest is defined as the cessation of cardiac mechanical activity and is confirmed by the absence of signs of circulation. In an attempt to restore the spontaneous circulation, performing chest compression is cardiopulmonary resuscitation (CPR) with or without ventilation (Da Silva et al., 2016)

There are two theories as to how CPR works. The cardiac pump mechanism postulates blood flow is generated when the heart is squeezed between the sternum and the vertebral bodies of the spine during the systolic phase. The cardiac valves prevent retrograde blood flow. According to thoracic pump mechanism, chest compression cause an increase in intrathoracic pressure forcing the forward flow of bloods through the heart while the heart acts as a passive conduit. Transmission of the intrathoracic pressure towards venous return system is prevented by the venous valves and the much greater capacitance of the venous system. During chest relaxation, the pressure gradient between the arterial and venous system causes the venous return to the thorax (Haukoos & Cairns, 2006)

CPR is a lifesaving intervention and the cornerstone of resuscitation from cardiac arrest. Survival from cardiac arrest depends on early recognition of the event and immediate activation of the emergency response system, but equally critical is the quality of CPR delivered. Both animal and clinical studies demonstrate that the quality of CPR during resuscitation has a significant impact on survival and contributes to the wide variability of survival noted between and within systems of care. CPR is inherently inefficient; it provides only 10% to 30% of normal blood flow to the heart and 30% to 40% of normal blood flow to the brain even when delivered according to guidelines. This inefficiency highlights the need for trained rescuers to deliver the highest-quality CPR possible. Poor-quality CPR should be considered a preventable harm. In healthcare environments, variability in clinician performance has affected the ability

to reduce healthcare associated complications and a standardized approach has been advocated to improve outcomes and reduce preventable harms. The use of a systematic continuous quality improvement (CQI) approach has been shown to optimize outcomes in a number of urgent healthcare conditions. Despite this evidence, few healthcare organizations apply these techniques to cardiac arrest by consistently monitoring CPR quality and outcomes. As a result, there remains an unacceptable disparity in the quality of resuscitation care delivered, as well as the presence of significant opportunities to save more lives (AHA 2013).

Chest compressions have saved the lives of countless patients in cardiac arrest as they generate a small but critical amount of blood flow to the heart and brain. This is achieved by direct cardiac massage as well as a thoracic pump mechanism. In order to optimize blood flow excellent chest compression technique is critical. Thus, the quality of the delivered chest compressions is a pivotal determinant of successful resuscitation. If a patient is found unresponsive without a definite pulse or normal breathing then the responder should assume that this patient is in cardiac arrest, activate the emergency response system and immediately start chest compressions. Contra-indications to starting chest compressions include a valid Do Not Attempt Resuscitation (DNAR) order. Optimal technique for adult chest compressions includes positioning the patient supine, and pushing hard and fast over the centre of the chest with the outstretched arms perpendicular to the patient's chest. The rate should be at least 100 compressions per minute and any interruptions should be minimized to achieve a minimum of 60 actually delivered compressions per minute. Aggressive rotation of compressors prevents decline of chest compression quality due to fatigue. Chest compressions are terminated following return of spontaneous circulation (Rajab et al., 2011)

In 2002, Weisfeldt and Becker suggested a 3-phase model for VF that included an electrical, a circulatory, and a metabolic phase, with immediate defibrillation being the optimal treatment for only the first phase in which the interval from the onset of VF to the time of

defibrillation is of short duration. At about the same time, initial studies were published that described the use of delayed defibrillation or a period of cardiopulmonary resuscitation (CPR) before the initial defibrillating shock as a means to improve survival for VF of longer duration (John et al., 2013)

In-Hospital Cardiac Arrest (IHCA)

In a study done by Girotra et al (2012) of patients at hospitals participating in a national quality-improvement registry in the United States, it was found that survival after IHCA improved substantially between 2000 and 2009. These gains have been accompanied by a decrease in the rate of clinically significant neurologic disability among survivors. Using a conservative estimate of 200,000 IHCA annually in the United States, it is estimated that an additional 17,200 patients survived to hospital discharge in 2009 as compared with 2000 (on the basis of an 8.6% absolute improvement in risk-adjusted survival during this period). It is also estimate that more than 13,000 cases of clinically significant neurologic disability were avoided.

Since the year 2000, the survival after cardiac arrest had also improved regardless of whether or not the initial cardiac-arrest rhythm was treatable by defibrillation. In patients with ventricular fibrillation (VF) or pulseless ventricular tachycardia (VT), improvement in survival over time was not accompanied by shorter defibrillation times. These observations suggest that factors other than rapid defibrillation may have accounted for the improvement in survival. These factors may include earlier recognition of cardiac arrest (i.e., shorter response times), quality of acute resuscitation (e.g., greater availability of trained personnel and provision of high-quality chest compressions with fewer interruptions), and post-resuscitation care (e.g., therapeutic hypothermia and early cardiac catheterization). In fact, many of these processes have been emphasized in the American Heart Association Guidelines for CPR during the past decade. (Girotra et al., 2012).

Pulseless Electrical Activity (PEA) or asystole was the first documented rhythm in 71% of episodes in the present study. This is not very different from 67% non-VF/VT arrests in a study by Gwinnutt et al. or 79% in the Get With the Guidelines Resuscitation registry study by Girotra et al. with 84,625 hospitalized patients.

Interestingly, the one-way association between VF/VT as the first documented rhythm and the cause being cardiac, predominantly myocardial infarction, was pronounced. This appears to be an important aspect when considering the underlying etiology and may raise the question of the need for urgent revascularization, anti-arrhythmic drugs or beta-blockers if tolerated. When the initial rhythm was PEA or asystole, the causes were not strictly non-cardiac, and approximately half of all cardiac episodes presented with PEA or asystole as well. Patients in VF or VT demonstrated a high probability of survival to discharge (54%) (Bergum et al., 2015) ROSC occurred in 58% of VF cases, yielding a survival-to-hospital discharge rate of 34% in this subset of patients. An automated external defibrillator (AED) was used to provide initial defibrillation in only 1.4% of patients whose initial cardiac arrest rhythm was VF. Neurological outcome in discharged survivors was generally good. Eighty-six percent of patients with Cerebral Performance Category-1 (CPC-1) at the time of hospital admission had a post arrest CPC-1 at the time of hospital discharge (Peberdy et al., 2003)

Since the introduction of the Utstein Style guidelines for the reviewing, reporting and research on in-hospital resuscitation in 1997, many studies have since been conducted and published from around the world. A summary of the main outcomes available from a handful of IHCA studies which have used the Utstein format from around the world are shown in Table 2.1

Table 2.1: Summary of main outcomes from IHCA studies using the Utstein format

Authors	Location	No. of IHCA	Immediate Survival	24-Hour Survival	Survival To Hospital Discharge
Petrick & Rankin, Resuscitation 36 (1998) 91-94	Sweden	133	-	35%	26%
Huang et al., Resuscitation 66 (2002) 265-270	Taiwan	103	67%	-	17%
Hajbaghery et al., Resuscitation 66 (2005) 317-321	Iran	206	19.9%	-	5.3%
Pembeci et al., Resuscitation 68 (2006) 221-229	Turkey	134	49.3%	28.5%	13.4%
Cooper et al., Resuscitation 68 (2006) 231-237	UK	2121	38.6%	24.7%	15.9%
Frederiksson et al., Resuscitation 68 (2006)	Sweden	833	-	47.8%	34%
Suraseranivongse et al., Resuscitation 71 (2006) 188-193	Thailand	639	61.7%	42.4%	6.9%
Shin TG et al., JKMS 27 (2012) 145-152	Korea	958			
HS Taha et al., Egyptian Heart Journal	Egypt	126	50.4%		7.6%
Girotra et al., NEJM 367(2012) 1912-1920	United States	84,625			22.3%

A decade of accumulation of in-hospital resuscitation data from April 1993 to March 2003 from Derriford Hospital, Plymouth, UK which included 2121 IHA, showed a 24.7% to 24-hour survival rate and 15.9% survival rate to discharge. Very low survival rates were found in PEA and asystole compared to VT/VF arrests. Very low survival rates decreased with increasing age and were on those led that 60 years of age. It was also found survival rates decreased the longer duration of resuscitation and those who arrested at night were less likely to survive (Cooper et al., 2006)

Another study from Sweden recorded IHA over 7 years came up with very high survival rates. .out of 883 patients, 37% survived to discharge with 96% of this group alive at 1 year

later. Among the reasons that may explain the high survival rate s the patient population of which almost a third were admitted due to myocardial infarction and about two thirds of the patients were admitted due to cardiac related diagnoses so their rate of VT/VT recorded as the initial rhythm was almost half of the recorded arrests. Patients with this initial rhythm have better outcomes compared to other rhythms especially if defibrillated early. Another reason is possibly the hospital's functional Don Not Attempt Resuscitation (DNAR) policy being in place which would effectively exclude many unlikely survivors and therefore increase the survival rates. The authors also acknowledged human resources and accessible defibrillators on all wards as the other factors which contributed to their higher survival rates (Frederiksson et al., 2006)

This Swedish study also showed another interesting point in that 70% of the population in their study consisted of patients over the age of 65 years old. Hence, resuscitation should not be considered futile just on the basis of old age as the Cerebral Performance Category (CPC) scores too, majority of their IHA patients came out very well (Frederiksson et al., 2006).
The CPC is a means to measure the neurological outcome. A CPC score of 1 denotes god cerebral performance (No neurological deficit), CPC score 2 represents moderate cerebral disability, with sufficient cerebral function for part-time work in a sheltered environment or independent activities of daily living (ADL). CC score of 3 represents severe cerebral disability or poor neurological outcome, dependent on others for ADL, CPC score 4 for comatose patients and CPC score 5 represents brain death (Cummins et al., 1997, Herlitz et al., 2000).

A much earlier study from Middlemore Hospital, Auckland, New Zealand looked at their data of IHA resuscitation over a one-year period and found out 33 attempted resuscitations their 24-hour survival rate was 35% and survival-to-discharge rate was 26%. There were 30 survivors at one year and 27 of them had a CPC score of 1 (Pattrick C& Rankin, 1998). This

would augur well for all CPR attempts as not only it is primary goal to restore the patient's life but also for them to have good neurological outcome to enjoy a good quality of life.

From Turkey, a prospective study of their IHCA resuscitation produced rates for immediate survival of 49.3%, survival at 24 hours of 28.5% and survival-to-discharge of 13.4%. The multiple factors associated with increased discharge survival they found were monitoring prior to arrest, more experienced anaesthesiologists on the CPR team, CPR during office hours, well equipped hospital sites of resuscitation, early initiation of CPR and tracheal intubations prior to arrest (Pembeci et al., 2006)

In Taiwan, a study included 103 IHCA established their ROSC ate at 67%, survival-to-discharge rate at 17% and 3.9% at one year. Their patient population differed in that only 17% had coronary artery disease (CAD) which may indicate a low prevalence of CAD in their country. However, causes of arrest were primary cardiac (29%), respiratory (11%) and other illnesses the rest another finding was that almost half (49%) of those resuscitated were from their Emergency Department (ED) which could reflect ED overcrowding. In this study they too concluded that the survival-to-discharge rate was improved by shorter duration from colleague to resuscitation but in patients already intubated and ventilated at the time of arrest, it implied underlying critical illness and power prognosis for ROSC (Huang et al., 2002).

Data from a developing nation, Iran of which the first 6-month period in 2002 showed they had 206 IHA resuscitations from 4 educational hospitals with an immediate survival rate of 99% and survival-to-discharge rate of 5.3%. These rates are significantly lower compared to other studies. The authors suggest this could be due to the different types of patients involved. They found that most patients who survived to hospital discharge had cardiac arrest of non-cardiac etiology and survival rates was not significantly associated with age. It is also possible that the low survival rate could be attributed to a multitude of other inadequacies especially as defibrillators were not present on all wards and there was a delay to defibrillations

only 28% of cases had the first shock between -6minutes. In this study, they also found correlation of higher survival rate of their IHCA resuscitated in the morning shift (8.3%) compared to afternoon (4.8) and night shifts (3.6%). They concluded they needed to shorten response times, increase facilities for defibrillation and improve CPR management strategies with BLS and ACLS training programs to be initiated (Hajbaghery et al., 2005).

In Rome, the scenario of IHCA response was investigated in a study from September 2000 to March 2001 in which 32 hospitals were investigated and it was the first investigation carried out on the organization of the in-hospital response to cardiac arrest in Italy. However, they did not report on their outcomes of IHCA. Interviews were conducted with the physician in-charge of the cardiac arrest teams (CAT) in each hospital at the interviewer also examined the CAT equipment and made overviews of the hospital structure. Their findings seem to show many inadequacies in response time instead of increases and inadequate defibrillators available similar to study from Iran. They concluded that instead of increasing their team members or equipment capabilities of CAT, systemic BLS/ACLS training of the ward doctors and nurses with an early defibrillation policy would be a better approach to improve efficiency of first responder resuscitation. Also, applying homogenous standards for personnel training and audit of resuscitation would help improve the response (Sandroni et al., 2003)

Currently, without any published data available on the outcomes if IHCA in Malaysia, we look to or neighbour, Thailand. Suraseranivongse et al. (2006) did a one year prospective audit and their data showed 639 IHCA of patients aged from one-day old up to 96 years old. Their immediate survival rate was 61.7% and their survival-to-discharge rate was 6.9%. There were 67.8% IHCA occurring in non-monitored areas and the remaining only 31.3% in monitored areas. It was found that 84% was witnessed and 68.4% occurred in medical patients and 21.4% occurred in surgical patients. The most common underlying causes of IHCA were

found to be respiratory failure (24.7%) and septic shock 23.3%. The initial rhythms were found to be VF 12.4%, PEA 35.2% and asystole 42.6%

All the above studies shows considerable variation in the outcomes of IHCA resuscitation and there appears a variety of multiple factors which may cause the success rate of CPR to differ from institution to institution and probably even within different sites within the same institution. Research in the field of CPR is still severely lacking in our country and much still has to be done to reach any conclusion on the state of IHCA CPR within Malaysia.

Age Groups

An observational study was to investigate the survival and neurological outcome in the elderly after IHCA, and to identify which factors were associated with survival. 11,396 patients were included in the study. Thirty-day survival was 28% for patients aged 70-79 years, 20% for patients aged 80-89 years, and 14% for patients aged ≥90years. Factors associated with higher survival were: patients with an initially shockable rhythm, IHCA at an ECG-monitored location, IHCA was witnessed, IHCA during daytime (8 a.m.-8 p.m.), and an aetiology of arrhythmia. A lower survival was associated with a history of heart failure, respiratory insufficiency, renal dysfunction and with an aetiology of acute pulmonary oedema. Patients over 90 years of age with VF/VT as initial rhythm had a 41% survival rate. A trend indicating a less aggressive care with increasing age during cardiac arrest (fewer intubations, and less use of adrenalin and anti-arrhythmic drugs) was found, but there was no association between age and delay in starting cardiopulmonary resuscitation (CPR). In survivors, there was no significant association between age and a favourable neurological outcome (CPC score: 1-2) (92%, 93%, and 88% in the three age groups, respectively) (Hirlekar G et al., 2017)

Gender Differences

Gender reportedly affects cardiac arrest, and survival rates are higher in men than in women according to a multivariate analysis. However, neurological progression was better in

surviving women than in men. In our study done by Silva et al, survival did not differ by gender, although the duration of CPR was longer in women than in men, which favoured neurological progression in women. Moreover, a recent study of 14,690 patients (36.4% women) with a mean age of 68.3 years showed no differences in survival between genders after adjusting for the Utstein-style variables. However, this study included patients with out-of-hospital cardiac arrest. Conversely, another study showed an increased propensity for CPR among men with out-of-hospital CA. These contradictory records in the literature demonstrate the lack of epidemiological data on the subject (Silva et al., 2016)

Working Shifts

A study of 174 IHA by Matot et al. (2006) found survival-to-discharge was poorer following night shift CPR than following morning and evening shifts. Excluding asystole s the arrest rhythm, the odds of survival-to-discharge was 4.9 times higher if the cardiac arrest did not occur during night shift ($p = 0.05$) and the relative risk of eventual in-hospital death for patients who had achieved return of spontaneous circulation (ROSC) following night shift resuscitation was 1.9 times higher that of those with ROSC following morning or evening resuscitation.

Another study done by Yuan-Jhen Syue et al (2016) in which they attempted to compare the prognoses of patients developing IHCA during night, morning, and evening shifts with cardiac origin cause and non-cardiac origin cause. They found that, for cardiac origin IHCA, both ROSC and survival to discharge were significantly lower for patients who were resuscitated during the night shift when compared to morning and evening shifts combined. In non-cardiac origin IHCA, ROSC was significantly lower for patients developing cardiac arrest in the night shift, but chances of survival to discharge were similar in the two study groups.

Trauma-related Causes

Reported survival rates for traumatic cardiac arrest are very low. A study by Stockinger and McSwain (2004) found their survival rate of traumatic cardiac arrest victims was only 3.7%. Another study by Lockey et al. (2006) found tht, if hypovolemia was the primary cause of the arrest, the victim rarely survived.

Initial Cardiac Arrest Rhythms

The initial rhythm at CA guides its management and affects patient survival. In hospital settings, the most commonly found rhythm is asystole, with rates ranging from 36% to 57%, followed by pulseless electrical activity, whose rates range from 16.5% to 39.3%. Although the incidences of these rhythms in this study are within these ranges, their limits widely vary. The populations in other studies derived from various in-hospital settings, including emergency rooms and wards in addition to coronary units and ICUs, and the monitoring of patients with CA may be delayed outside intensive care settings. In a population that exclusively experienced CA in the ICU, the main rhythm was ventricular tachycardia/ ventricular fibrillation (38.5%), followed by asystole and pulseless electrical activity. Another contributing factor to CPR quality is team training; a survey conducted in a Brazilian tertiary hospital observed error rates of 66% and 79.5% in the identification of shockable rhythms pulseless electrical activity, respectively (Silva et al., 2016).

2.3 OBJECTIVES

General Objectives

a) To determine the prevalence of adult in-hospital cardiac arrest (IHCA) events with CPR performed.

Specific Objectives

a) To determine the prevalence of ROSC among IHCA patients with CPR performed.

b) To determine the proportion of 24-hour survival of IHCA patients with CPR performed.

c) To identify associated variables affecting the ROSC, in 24-hour survival of IHCA patients after CPR.

2.4 RESEARCH METHODOLOGY

Study Design

This is a retrospective cross sectional study. The primary end-point of the study was whether immediate survival is achieved, defined as ROSC for at least 20 minutes. Secondary end-point was whether patients achieved ROSC sustained for 24 hours. Tertiary end-point was whether they survive to hospital discharge.

Study Approval

In Hospital Universiti Sains Malaysia (HUSM), consent was obtained from the Hospital Director for the purpose of the study, and consent and approval from the University's ethical and research committee was received prior to it.

Study Duration

This study was estimated to take a period of 6 months for data entry and analysis. However, due to the prolonged data collection time, it was further extended. The total duration of study was 24 months, starting from June 2018 to June 2020.

Venue

This study was conducted in Hospital Universiti Sains Malaysia (HUSM). HUSM is a tertiary centre and is among the main referral hospitals in the East Coast of Malaysian Peninsular. The data obtained from HUSM can be considered as a representative of the Malaysian population generally, and for the state of Kelantan specifically. This hospital is also chosen as the main researchers are based here.