

**A PROSPECTIVE STUDY ON THE OUTCOMES
OF IN-HOSPITAL CARDIAC ARREST CASES
RECEIVING CARDIOPULMONARY
RESUSCITATION IN TWO TERTIARY
HOSPITALS IN MALAYSIA**

By

DR. KWANHATHAI DARIN WONG

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LIST OF ABBREVIATIONS

ACLS	Advanced Cardiac Life Support
ADL	Activities of Daily Living
AED	Automated External Defibrillator
AHA	American Heart Association
BLS	Basic Life Support
BRESUS	British Resuscitation Study
CA	Cardiac Arrest
CAD	Coronary Artery Disease
CAT	Cardiac Arrest Team
CBT	Code Blue Team
CCU	Coronary Care Unit
CPC	Cerebral Performance Score
CPR	Cardiopulmonary Resuscitation
CRW	Coronary Rehabilitation Ward
DNAR	Do Not Attempt Resuscitation
ECC	Emergency Cardiovascular Care
ECG	Electrocardiography
ED	Emergency Department
EMS	Emergency Medical Services
ERC	European Resuscitation Council
HDW	High Dependency Ward
HKL	Hospital Kuala Lumpur

HUSM	Hospital Universiti Sains Malaysia
ICU	Intensive Care Unit
IHA	In-Hospital Cardiac Arrest
ILCOR	International Liaison Committee On Resuscitation
MLR	Multiple Logistic Regression
NAICU	National Audit Of Adult Intensive Care Units
NRCPR	National Registry Of Cardiopulmonary Resuscitation
OHA	Out-Of-Hospital Cardiac Arrest
OPALS	Ontario Prehospital Advanced Life Support
PEA	Pulseless Electrical Activity
PHASE	Pre-Hospital Arrest Survival Evaluation Study
ROSC	Return Of Spontaneous Circulation
SLR	Simple Logistic Regression
SPSS	Statistical Packages for Social Sciences
VT	Ventricular Tachycardia
VF	Ventricular Fibrillation

ABSTRAK

Kajian Prospektif Keputusan Kes-Kes Jantung Terhenti Di Dalam Hospital (IHA) Yang Menerima Rawatan Resusitasi Kardiopulmonari (CPR) Di Dua Buah Hospital Rujukan Tertiar Di Malaysia.

PENGENALAN

Perubatan resusitasi merupakan sebahagian daripada perawatan kecemasan. Kemajuan dalam bidang ini telah menghasilkan garis panduan antarabangsa yang berasaskan bukti untuk pengamalan resusitasi kardiopulmonari (CPR) yang lebih baik dan piawai. Bergandingan dengan penggunaan gaya Utstein sebagai cara untuk melaporkan keputusan CPR, telah mempertingkatkan keberkesanan penyelidikan yang piawai dalam bidang penting ini. Walau bagaimanapun, hasil penyelidikan daripada negara-negara lain masih belum dapat ditentukan bahawa ianya boleh diaplikasi kepada populasi tempatan. Penyelidikan dalam bidang CPR amat kurang di negara Malaysia. Kajian ini bertujuan untuk menyelidik kadar kehidupan (*survival outcomes*) untuk kes-kes jantung terhenti di dalam hospital (IHA) dalam populasi tempatan. Kajian ini diharapkan dapat memulakan satu bank maklumat (*database*) dimana pusat-pusat perubatan lain juga akan dapat menyumbang terhadapnya dan dapat dikongsi oleh seluruh negara.

OBJEKTIF

Tujuan penyelidikan ini adalah untuk mengetahui hasil keberkesanan CPR, iaitu kadar-kadar kehidupan untuk pesakit-pesakit yang mengalami IHA. Kajian dilakukan

untuk memperolehi kadar pesakit mendapat pengembalian sirkulasi spontan (*return of spontaneous circulation*, ROSC), kadar kehidupan segera (*immediate survival*) iaitu bersamaan ROSC melebihi jangka masa 20 minit, kadar pesakit hidup sehingga 24 jam dan kadar pesakit hidup sehingga discaj. Objektif seterusnya adalah untuk mengenal pasti sama ada terdapat faktor-faktor lain yang mempengaruhi kadar-kadar tersebut.

KAEDAH

Kajian ini dilakukan secara prospektif untuk semua pesakit yang mengalami IHA dan menerima rawatan CPR. Kajian dijalankan daripada Mac, 2007 sehingga Disember, 2007. Kajian ini menggunakan borang piawai Utstein mengenai CPR dalam hospital untuk merekodkan kes-kes jantung terhenti dalam hospital. Sebelum kajian dijalankan, semua kakitangan yang terlibat di dalam kawasan hospital diberi taklimat. Jika terdapat pesakit mengalami IHA, seorang daripada kakitangan yang terlibat dengan resusitasi pesakit tersebut akan mengisi borang Utstein pada masa kejadian. Borang-borang tersebut akan dikumpul dan susulan akan dibuat untuk pesakit-pesakit hidup sehingga discaj daripada hospital atau pun pesakit tersebut meninggal dunia.

KEPUTUSAN

Dalam kajian ini seramai 61.2% (60 kes) IHA telah mengalami ROSC selepas CPR. Kadar kehidupan segera (*immediate survival*) adalah 38.8% (38 kes), kadar pesakit hidup sehingga 24 jam adalah 14.3% (14 kes) manakala kadar pesakit hidup sehingga discaj adalah 8.16% (8 kes). Purata umur pesakit adalah 50 tahun dan 59% adalah berumur antara 40 hingga 70 tahun. Nisbah pesakit lelaki terhadap pesakit perempuan

adalah 2.1:1. Kebanyakan kes IHA adalah kes yang di bawah pemerhatian (91%) dan disaksikan (99%). Penyebab utama IHA adalah tekanan darah rendah (41.8%), serangan jantung (19.4%) dan respiratori depresi (17.3%). Kes turut dibahagikan kepada kes berkaitan kardiak iaitu sebanyak 29.6% dan bukan kardiak iaitu sebanyak 70.4%. Sebanyak 76.5% daripada pesakit mengalami jantung terhenti menerima CPR dalam jangka masa kurang daripada 1 minit. Rentak awal jantung adalah bradikardia (31 kes), asistole (28 kes) dan PEA (27 kes). Kadar kehidupan pada waktu siang berbanding dengan malam adalah 45.6% terhadap 29.3%. Faktor penting yang mempengaruhi kadar pesakit hidup sehingga 24 jam dan kadar pesakit hidup sehingga discaj adalah mendapat rentak awal jantung yang boleh diberi kejutan (*shockable rhythm*) ketika pesakit didapati mengalami IHA.

KESIMPULAN

Dalam kajian ini, seramai 61.2% telah mengalami ROSC selepas CPR. Kadar kehidupan segera (*immediate survival*) adalah sebanyak 38.8%, kadar pesakit hidup sehingga 24 jam adalah sebanyak 14.3% manakala kadar pesakit hidup sehingga discaj adalah sebanyak 8.16%. Hanya faktor mengalami rentak awal jantung yang boleh diberi kejutan (*shockable rhythm*) mempengaruhi kadar-kadar kehidupan (*survival outcomes*).

ABSTRACT

A Prospective Study On The Outcomes Of In-Hospital Cardiac Arrest (IHA) Cases Receiving Cardiopulmonary Resuscitation (CPR) in Two Tertiary Hospitals In Malaysia.

INTRODUCTION

Resuscitation medicine is an integral part of acute emergency care. The advancement in this field has led to evidence-based international guidelines on the practice of CPR which has improved and standardized its practice. Coupled with the usage of the Utstein style to report on outcomes of CPR, this has further enhanced increasing standardized research in this arena. However, it remains to be proven whether these results of research mainly from other countries is applicable to our local population. There is currently a severe lack of CPR research in Malaysia. This study aims to tackle this by investigating the rates of survival outcomes for in-hospital cardiac arrest (IHA) in our population. This study also serves as a starting point to hopefully create a database that other centers in the nation will be able to add on to.

STUDY OBJECTIVE

The objective of this study is to determine the outcomes of CPR in In-Hospital Cardiac Arrest (IHA) cases. The endpoints are looking at the success rate of achieving ROSC (return of spontaneous circulation), immediate survival (ROSC at least 20

minutes), 24-hour survival and survival-to-hospital discharge. Another objective is to identify any factors that could lead to the improvement in these endpoints.

METHODOLOGY

This is a prospective study using convenient sampling. It was conducted from March, 2007 until December, 2007. The standard Utstein in-hospital CPR reporting form was distributed to all locations involved in this study and a briefing was given to all the staff involved in these areas at the beginning of the study. Any case of IHA requiring CPR in these areas was then included into the study and a member of the primary resuscitating team would fill in the form. The forms were then collected and the follow up of the patients that survived were then conducted until the patients were discharged from hospital or passed away in hospital.

RESULTS

In this study, survival outcomes for IHA receiving CPR obtained were a rate of ROSC of 61.2% (n=60), immediate survival rate of 38.8% (n=38), 24-hour survival of 14.3% (n=14) and a survival-to-discharge rate of 8.16% (n=8). The mean age of the study population was 50 years and 59% were in the middle-age range of 40 to 70 years. The males outnumbered females by a ratio of 2.1: 1. Majority of IHA events were monitored (91%) and witnessed (99%). The main immediate causes of arrest were hypotension (41.8%), myocardial infarction (19.4%) and respiratory depression (17.3%). When divided into cardiac causes versus noncardiac, the percentages were 29.6% vs 70.4% respectively. The time from collapse to CPR was less than 1 minute in 76.5%. The initial

rhythms detected at IHA were bradycardia (n=31), asystole (n =28) and PEA (n=27). The immediate survival of day time versus night time IHA was 45.6% vs 29.3%. The other survival rates were not affected by time of IHA. The only significant factor associated with 24-hour survival and survival-to-discharge was having a shockable rhythm at time of arrest.

CONCLUSION

In conclusion, the survival outcomes for IHA with CPR obtained were a rate of return of spontaneous circulation (ROSC) of 61.2% (n=60), immediate survival rate of 38.8% (n=38), 24-hour survival of 14.3% (n=14) and a survival-to-discharge rate of 8.16% (n=8). A shockable rhythm at the time of IHA was the only significant factor to affect outcomes.

1. INTRODUCTION

Cardiopulmonary resuscitation (CPR) has become a vital skill widely practiced 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 frequently 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 colleagues Knickerbocker and Jude (Kowenhoven et al., 1960). They experimented with defibrillation and rediscovered the efficacy of external chest compression producing a passable circulation. However, it was Peter Safar (1924-2003), 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 (Baskett, 2001, 2003).

When cardiac arrest (CA) is recognized, CPR is usually performed. This incorporates basic life support (BLS) initiated promptly and assessment made for necessity for defibrillation followed by advanced cardiac life support (ACLS). This leads us to another very important concept, “the chain of survival”. The chance of survival of CA is dependant on the prompt initiation of sequentially linked actions known as the

chain of survival. 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, early defibrillation and early initiation of advanced cardiac life support. Every link in the chain is important and a weakness in any link would decrease the chance of survival (Cummins et al., 1991). Figure 1.1 below illustrates this concept:



Figure 1.1: The concept of the chain of survival

Time is of utmost importance in determining the chance of successful resuscitation following CA as we are aware that with every passing minute without intervention, the chance for survival decreases approximately 7%-10%. It is also important to realize that the coronary perfusion pressure rises gradually with the performance of sequential compression. Hence, it is equally important to minimize delay and interruptions when performing chest compression (AHA, 2000). Recent guidelines published by the International Liaison Committee on Resuscitation (ILCOR) in 2005 states that CPR is important both before and after a defibrillation attempt (AHA, 2005). Needless to say, not only is time of the essence but providing good quality CPR plays a major role in any resuscitation of CA.

In the field of resuscitation, there has also been tremendous progress in terms of the international community taking an increased interest in the improvement and standardization of CPR techniques in the last few years. This has led to the further intellectual exchange from many experts in major world resuscitation councils and a major milestone is the world's first international conference assembled 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 in *Circulation and Resuscitation* simultaneously in November, 2005. It is based 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 (OHA) or in-hospital cardiac arrests (IHA). The importance of this distinction is that for IHA we would expect prompt resuscitation to be initiated by trained medical personnel whilst for any OHA, survival would depend entirely on the initiatives of bystanders to activate the chain of survival and importantly start CPR. The survival rate of OHA generally still remains low (Jacobs et al., 2004).

In the in-hospital setting, survival rates are expected to be higher than OHA but the survival rates have varied considerably (Herlitz et al., 2000). A review of 42 studies calculated survival rates to hospital discharge ranged from 3% to 27% (Cummins et al., 1989). 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). This disparity has been explained by the wide variation in inclusion criteria and outcome definitions.

It has therefore been found that despite many published research works by various researchers from various countries in the field of resuscitation in the past, it had failed to produce a translation into meaningful data comparison between one study with another. This has been attributed to the lack of standardization of definitions and a lack of uniformity of the various end-points employed by the different researchers (Cummins et al., 1991).

To address this complex problem, 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 that in-hospital resuscitation presented (Cummins et al., 1997).

With the introduction of the Utstein style to report, review and research in-hospital and out-of-hospital resuscitation, the results of the resuscitation endeavors in different countries as well as within countries can now be compared more meaningfully. Researchers can now use well-defined end-points to assess effectiveness of delivery of different systems and interventions.

Currently, these internationally produced guidelines are backed by scientific evidence to help standardize our practice and to 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 laypersons especially regarding Basic Life Support (BLS) would further enhance the chances of survival in out-of-hospital cardiac arrests.

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 practices may differ around the world and by comparing 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 2006, in Malaysia no studies on resuscitation using the Utstein style has been documented at all. The only study to be published in Malaysia regarding in-hospital resuscitation was by Chan in 1993. He did a three-month prospective study on factors that affected the inadequacy of in-hospital resuscitation but did not look at patient survival rates (Chan, 1997). He found that almost 60% 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. It is the only study published in Malaysia regarding in-hospital resuscitation so we are severely lacking in this area.

Resuscitation medicine is an integral part of acute emergency medicine. At the Emergency Department of HUSM (Hospital University 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 OHA. Among the 40 cases of IHA, there were five patients that achieved 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 conducted 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 form (Chew, 2007).

The Utstein guidelines for IHA 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. It is also important to use the standard definitions for nomenclature as stated by the 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 in-hospital resuscitation be conducted as more than a decade has passed since the last published Malaysian study. By using the Utstein style as a tool to conduct the research, it is hoped that the current study undertaken would help contribute to achieving meaningful results that could be used to later compare to other centers. 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 practice not covered by routine statistics.

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

As Malaysia, a developing nation races ahead towards a vision of a developed nation status by the year 2020, so too should all aspects of healthcare continue to evolve to an improved standard. Management of in-hospital cardiac arrests (IHA), 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.