

A PILOT STUDY ON RETURN OF SPONTANEOUS
CIRCULATION AMONG PATIENTS WITH
CARDIOPULMONARY RESUSCITATION PERFORMED IN
EMERGENCY DEPARTMENT, HOSPITAL UNIVERSITI
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LIST OF ABBREVIATIONS

ACLS	Advanced Cardiac Life Support
AED	Automated External Defibrillator
AHA	American Heart Association
BLS	Basic Life Support
CPR	Cardiopulmonary Resuscitation
DNAR	Do Not Attempt Resuscitation
ECC	Emergency Cardiovascular Care
ECG	Electrocardiography
ED	Emergency Department
EMS	Emergency Medical Services
ERC	European Resuscitation Council
HUSM	Hospital Universiti Sains Malaysia
ILCOR	International Liaison Committee on Resuscitation
IHA	In Hospital Cardiac Arrest
NRCPR	National Registry of Cardiopulmonary Resuscitation
OHA	Out of Hospital Cardiac Arrest
OPALS	Ontario Prehospital Advanced Life Support
ROSC	Return of Spontaneous Circulation
PEA	Pulseless Electrical Activity
PHASE	Pre-Hospital Arrest Survival Evaluation Study
VF	Ventricular Fibrillation
VT	Ventricular Tachycardia

ABSTRAK

KAJIAN PERINTIS PENCAPAIAN PENGEMBALIAN SIRKULASI SPONTAN ATAU "RETURN OF SPONTANEOUS CIRCULATION" (ROSC) DALAM KALANGAN PESAKIT YANG DIBERI RAWATAN RESUSITASI KARDIOPULMONARI DI JABATAN KECEMASAN, HOSPITAL UNIVERSITI SAINS MALAYSIA

Pengenalan

Resuscitasi kardiopulmonari (CPR) merupakan sebahagian kerja asas rutin yang asas bagi seseorang doktor di Jabatan Perubatan Kecemasan. Semenjak tahun 1950an, teknik CPR sentiasa berkembang maju. Pengenalan "Utstein style" sebagai cara untuk melaporkan hasil usaha CPR telah mempertingkatkan keberkesanan penyelidikan yang piawai dalam bidang penting ini. Pemiawaian definisi dan pencontoh cara pelaporan juga menggalakkan perbandingan hasil-hasil penyelidikan. Namun, tidak banyak usaha penerbitan di Malaysia dalam bidang ini. Kajian perintis ini bertujuan untuk menilai keberkesanan hasil usaha CPR yang dilakukan di Jabatan Kecemasan (ED), Hospital Universiti Sains Malaysia (HUSM). Dua objektif dalam kajian ini adalah

1. sama ada ROSC dicapai atau tidak (tanpa mengira sama ada ROSC itu dapat dikekalkan sampai pesakit dimasukkan ke wad)
2. sama ada ROSC yang kekal sampai pesakit dimasukkan ke wad dicapai atau tidak

Metodologi

Kajian ini dilakukan sebagai satu kajian pemerhatian prospektif. Semua pesakit yang diberi rawatan CPR di ED, HUSM dimasukkan dalam kajian ini. Kajian ini dijalankan dalam tempoh setahun, iaitu dari Mac 2005 hingga Mac 2006. Kes-kes jantung terhenti yang mana CPR tidak dilakukan telah dikeenalikan daripada kajian ini.

Keputusan

Seramai 63 pesakit jantung terhenti dianalisa. Daripada jumlah 63 pesakit, 23 (36.5%) dikategorikan sebagai “jantung terhenti di luar hospital” atau “out-of-hospital arrests (OHA)”. Selebihnya 40 (63.5%) yang lain dikategorikan sebagai “jantung terhenti di dalam hospital” atau “in-hospital arrests (IHA)”.

Daripada jumlah 63 pesakit, 19 (30.2%) mencapai ROSC tanpa mengira sama ada ROSC itu dapat dikekalkan sampai pesakit dimasukkan ke wad. Yang selebih 44 pesakit (69.9%) tidak mencapai ROSC langsung. Hanya 6 pesakit (9.5%) mencapai ROSC yang kekal sampai pesakit dimasukkan ke wad, manakala yang selebih 57 pesakit (90.5%) tidak.

Dalam sub-kajian OHA, ROSC yang dicapai tanpa mengira sama ada ROSC itu dikekalkan sampai kemasukan wad adalah hanya 17.4% (n=4) and ROSC kekal sehingga kemasukan wad adalah hanya 4.3% (n=1). Dalam sub-kajian IHA pula, ROSC yang dicapai tanpa mengira sama ada ROSC dikekalkan sampai kemasukan wad adalah sedikit lebih baik, iaitu pada 37.5% (n=15), manakala ROSC yang dicapai sehingga kemasukan wad adalah sedikit lebih baik pada 12.5% (n=5). Peluang seseorang pesakit dengan IHA untuk mencapai ROSC tanpa mengira sama ada ROSC itu kekal sehingga kemasukan adalah lebih kurang dua kali ganda (37.5%) berbanding dengan seseorang pesakit dengan OHA (17.4%).

Faktor lain yang dikaitkan dengan peluang hidup yang lebih tinggi adalah pemulaan CPR yang awal dalam tempoh 5 minit, kehadiran pakar perubatan kecemasan semasa CPR, kehadiran residen perubatan kecemasan semasa CPR dan ritma pemulaan yang boleh diberi renjatan elektrik.

Kesimpulan

Secara keseluruhan, ROSC yang dicapai tanpa mengira sama ada ia kekal sehingga kemasukan wad adalah 30.2% dan ROSC yang dicapai sehingga kemasukan wad (hidup sampai kemasukan wad) adalah hanya 9.5%.

Faktor yang kemungkinan mempengaruhi hasil CPR dengan positif (yakni meninggikan peluang pencapaian ROSC tanpa mengira sama ada ROSC kekal sehingga kemasukan wad dan ROSC sehingga kemasukan wad) adalah IIIA sebagai jenis jantung terhenti, usaha CPR yang awal dalam tempoh 5 minit selepas jantung terhenti, kehadiran pakar perubatan kecemasan, kehadiran residen perubatan kecemasan dan ritma jantung yang boleh diberi renjatan elektrik.

Kesimpulan

Secara keseluruhan, peluang hidup pesakit dengan jantung terhenti adalah rendah. Penyelidikan yang lebih lanjut untuk mengkaji faktor-faktor yang mempengaruhi hasil CPR adalah diperlukan.

ABSTRACT

A PILOT STUDY ON RETURN OF SPONTANEOUS CIRCULATION (ROSC) AMONG PATIENTS WITH CARDIOPULMONARY RESUSCITATION (CPR) PERFORMED IN EMERGENCY DEPARTMENT, HOSPITAL UNIVERSITI SAINS MALAYSIA

Introduction

Cardiopulmonary resuscitation (CPR) is an integral part of routine job prescription for emergency medicine doctors. Since the 1950s, the technique of CPR is ever improving. The introduction of the Utstein's style of reporting of outcomes of CPR has further enhanced standardized research works in this vital area. The standardization of definitions and reporting template has also allowed more meaningful comparison of one study with another. Despite that, there has not been many published works in this area in Malaysia. This pilot study serves to look into the effectiveness of CPR performed in Emergency Department (ED), Hospital Universiti Sains Malaysia (HUSM). Two end points of this study are

1. whether return of spontaneous circulation (ROSC) achieved regardless of whether the ROSC was sustained until admission to ward
2. whether ROSC achieved and sustained until admission to ward. This is also known as survival to admission

Methodology

This study was conducted as a prospective, observational study. All patients with CPR done in ED, HUSM were included in this study. The study was undertaken for a period of one year, from March 2005 to March 2006. Cardiac arrest cases where CPR was not performed were excluded from the study.

Results

A total of 63 cardiac arrest patients were analyzed. Out of these 63 patients, 23 (36.5%) of the 63 patients were categorized as out-of-hospital Arrests (OHA) whereas the other 40 (63.5%) patients had an in-hospital Arrest (IHA).

In total, out of these 63 patients, 19 (30.2%) of them had ROSC regardless of whether the ROSC was sustained until admission to ward. The other 44 (69.8%) did not achieve ROSC at all. Only 6 patients (9.5%) achieved ROSC until admission to ward (survival to admission) whereas the other 57 patients (90.5%) did not.

In the OHA subgroup analysis, ROSC achieved regardless of whether it was sustained until admission to ward is only 17.4% (n=4) and ROSC achieved until admission to ward is only 4.3% (n=1). In the IHA subgroup analysis, ROSC achieved regardless of whether it was sustained until admission to ward is slightly better at 37.5% (n=15) and ROSC achieved until admission to ward is slightly better at 12.5% (n=5). The chance of a patient with IHA to achieve ROSC regardless of whether the ROSC was sustained until admission to ward was about two times (37.5%) higher compared to a patient with OHA (17.4%) ($p=0.094$).

Other factors found to be associated with higher chance of survival rate are early commencement of CPR within 5 minutes, presence of emergency physicians during CPR, the presence of emergency medicine residents during CPR and shockable rhythm as the initial cardiac arrest rhythm.

Conclusion

Overall, ROSC achieved regardless of whether it was sustained until admission to ward is only 30.2% and ROSC achieved until admission to ward (survival to admission) is only 9.5%.

Factors that possibly influence the outcomes positively (which means increasing the chance of achieving ROSC and ROSC until admission to ward) are in-hospital Cardiac Arrests as the type of arrest, early commencement of CPR within 5 minutes, presence of emergency physicians, presence of emergency medicine residents and shockable rhythm as the initial cardiac arrest rhythm. Out of these five factors, only shockable rhythm as the initial cardiac arrest rhythm is statistically significant.

1. INTRODUCTION

Modern cardiopulmonary resuscitation (CPR) is, without a shadow of doubt, closely linked with the name of Peter Safar (1924-2003). The enormity of his contributions since the 1950s, including his landmark paper of mouth-to-mouth ventilation (Baskett, 2001), earned him titles such as “Father of Modern Resuscitation” (Baskett, 2003) and “Father of CPR” (Oransky, 2003). Among his other insurmountable list of works include the development of the technique of head-tilt, chin-lift and jaw thrust to open obstructed airway in unconscious victims (Baskett, 2001), the importance of the concept of bystander-initiated resuscitation (Mosesso and Paris, 2003) and the design of the well-known and widely utilized resuscitation dummy called “Resusci-Anne” together with Asmund Laerdal, a toymaker from Norway. (Baskett, 2001, Baskett, 2003, Oransky, 2003).

About the same time (around 1960s), Kouwenhoven, together with his colleagues Knickerbocker and Jude, were experimenting with defibrillation and rediscovered the efficacy of external chest compression to produce a passable circulation, first in canine models, then in humans (Baskett, 2001, Baskett, 2003). With his ingenuity, Safar combined the techniques of airway positioning, ventilation, and external chest compression to produce the current technique of basic life support (Baskett, 2001) that has stood the test of time.

Ever since then, the technique of resuscitation is ever improving, with the American Heart Association (AHA), beginning in 1966, held various conferences on CPR (AHA, 2000). Experts from other major world resuscitation councils were invited during these conferences to encourage international intellectual exchange. Besides AHA making various recommendations on CPR and emergency cardiovascular care

(ECC), the European Resuscitation Council (ERC) has also produced various guidelines in this area.

Nevertheless, due to lack of uniformity in terms of definitions and research criteria and the disparity in terms of methodologies and results from one study to another, efforts to make useful comparisons between these studies were hampered. To address this major concern, representatives of the AHA, the European Resuscitation Council, the Heart and Stroke Foundation of Canada, and the Australian Resuscitation Council held two conferences in 1990 and 1991 at the ancient abbey of Utstein on an island near Stavanger, Norway.

As a result of these conferences, the standardized Utstein style template for reporting out-of-hospital cardiac arrest was produced. In 1997, a similar Utstein style for reporting in-hospital cardiac arrests was produced (Cummins *et al.*, 1997).

Since then, the Utstein-style definitions and reporting templates have been used extensively in published outcome studies of cardiac arrest. The use of these standardized definitions and templates have certainly proven to be beneficial; as it has contributed to a greater understanding of the elements of resuscitation practice and has facilitated progress toward an international consensus on science and resuscitation guidelines (Jacobs *et al.*, 2004). The first consensus was the International Guidelines 2000 Conference on Cardiopulmonary Resuscitation (CPR) and Emergency Cardiovascular Care (ECC).

In other words, with such an international concerted effort, backed with scientific evidences, a harmonious recommendation and guideline in the practice of CPR and ECC was able to be developed to benefit, not only in-hospital cardiac arrest patients, but also the community as a whole, especially in relation to out-of-hospital arrests.

Nevertheless, although the Utstein-style reporting template has many benefits, it also has several limitations. These templates, for instance, were found to be too complex and both their recommended core and supplementary data have elements that are logistically difficult to collect. For example, it is difficult for rescuers to estimate and record specific intervals accurately during the resuscitation event (Fredriksson *et al.*, 2003).

In addition, because there are two different templates for in-hospital and out-of-hospital cardiac arrests, this has resulted in inconsistencies in terminology between these two templates. As a result, efforts to adequately integrate and compare individual research studies were hindered (Fredriksson *et al.*, 2003).

To address these issues, in April 2002, an ILCOR task force meeting was held in Melbourne, Australia to review and revise the Utstein definitions and reporting templates. The objective of this task force was to develop a single, simple, and practical template for uniform collection and reporting of data on cardiac arrest. Out of this meeting, a practical revised Utstein template was developed to enable uniform collection and tracking of data to facilitate better continuous quality improvement within hospitals, emergency medical services (EMS) systems, and communities. It also enables comparisons across systems for clinical benchmarking to identify opportunities for improvement (Fredriksson *et al.*, 2003).

Cardiac arrest is the cessation of cardiac mechanical activity as confirmed by the absence of signs of circulation. Cardiopulmonary resuscitation is an attempt to restore spontaneous circulation by performing chest compressions with or without ventilations (Jacobs *et al.*, 2004).

Technically, cardiac arrests can be divided into out-of-hospital cardiac arrests (OHCA) or in-hospital cardiac arrests (IHCA). This distinction is important

because any cardiac arrest that occurs in an out-of-hospital setting would most probably depend entirely on the initiatives of bystanders to start CPR. Nevertheless, the survival rate of OHA generally still remains low (Jacobs *et al.*, 2004).

The chance of survival of cardiac arrest is depended 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 chain is important and weakness in any link would lessens the chance of survival of out-of-hospital cardiac arrests (Cummins *et al.*, 1991). The concept of the chain of survival is illustrated in Figure 1 below.

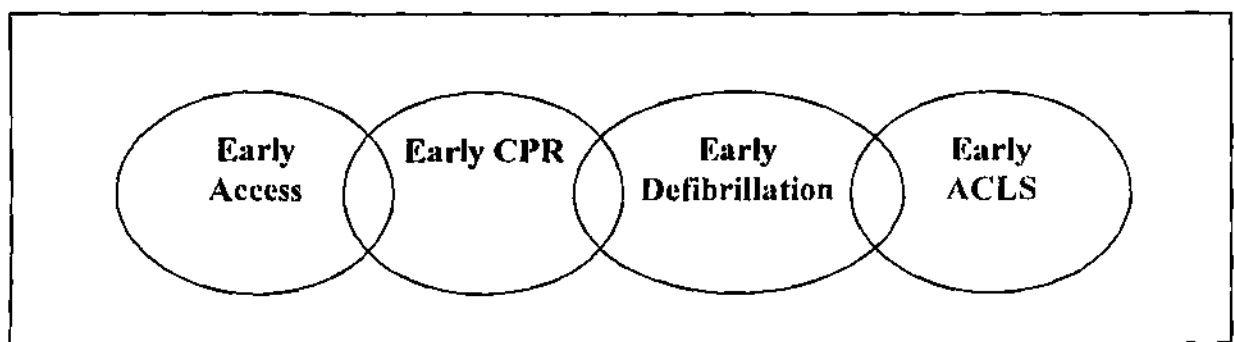


Figure 1: The Concept of the Chain of Survival

Out of the four chains, the first three involved the participation of the public including family members and friends to improve the chance of out-of-hospital cardiac arrests (Cummins *et al.*, 1991). This explains the importance of bystander CPR as a means of “buying time” by temporarily preserving the vital organs like the heart and brain (Cummins *et al.*, 1991). For example, the public could be trained not only for early recognition of cardiac arrest, but also recognition of common symptoms that may herald a cardiac arrest such as chest pain. They should also be taught to make early decision to activate the emergency medical services as well as be trained to provide accurate and essential details of the emergency via telephone (Cummins *et al.*, 1991).

The public can also be trained to perform bystander CPR. Bystander CPR is defined as CPR performed by a person who is not responding as part of an organized emergency response system to a cardiac arrest (Jacobs *et al.*, 2004).

For example, Herlitz *et al.* found that CPR initiated by a bystander helps maintain ventricular fibrillation and triples the chance of surviving a cardiac arrest outside hospital. Furthermore, it seems to protect against death in association with brain damage as well as with myocardial damage (Herlitz *et al.*, 1994).

Bystander CPR

In general, the overall survival rates of out-of-hospital cardiac arrests are less than 5% in most communities and there is no evidence that these rates are increasing, despite extensive use of advanced treatments and technology (Vaillancourt and Stiell, 2004).

The Ontario Prehospital Advanced Life Support (OPALS) Study was a multicenter, controlled clinical trial conducted in 17 locations to assess the incremental effect on the rate of survival after out-of-hospital cardiac arrest by adding the advanced cardiac life support program to the existing program of rapid defibrillation (Vaillancourt and Stiell, 2004).

This study shows that though adding advanced life support to rapid-defibrillation phase has increased the rate of admission to a hospital significantly ($P < 0.001$), the rate of survival to hospital discharge did not ($P = 0.83$). In other words, the addition of advanced-life-support interventions did not improve the rate of survival after out-of-hospital cardiac arrest in a previously optimized emergency-medical-services system of rapid defibrillation. But rather, this study shows to us that health care planners should make bystander cardiopulmonary resuscitation and rapid-

defibrillation responses a priority for the resources of emergency-medical-services systems (Vaillancourt and Stiell, 2004).

Ironically, even though about three-quarters of out-of-hospital cardiac arrests occur at home or private residences rather than in public places (Iwami *et al.*, 2006), bystander-initiated CPR most frequently takes place in public places such as the street (Herlitz *et al.*, 1994) and this is usually performed by health care workers (Bossaert and Van Hoeyweghen, 1989). Not surprisingly, arrest patients in public or in the work place had a higher chance of being found in ventricular fibrillation and survival than those at a private residence (Herlitz *et al.*, 1994).

Back to our own local scenario, despite such an intensive international effort to improve the standard of CPR and ECC, not only there is not a parallel increased of local published research works in this critical area of CPR, but rather, the number of such publications in Malaysia is dismally low. Chan in 1997, who studied the outcomes of CPR performed in six Malaysian district hospitals, found that as high as up to almost 60% of cases were inadequately resuscitated. Many reasons were cited, including staff nurses who failed to initiate chest compression and to provide positive pressure ventilation through bag-valve-mask, inadequate duration of resuscitation and incomplete resuscitation trolleys (Chan, 1997).

With that in mind, this pilot study to look into the outcomes of cardiopulmonary resuscitation done in emergency department is undertaken. It is also seen as an attempt to gauge the degree of improvement (since the study by Chan seven years ago) in the outcomes of CPR performed in one of the university teaching hospitals with a postgraduate program in Emergency Medicine.

This study is designed as a pilot study due to lack of previous local data. Moreover, data from previous worldwide studies unfortunately vary greatly from one

study with another. For example, the outcome of survival to hospital discharge was cited to vary from 15% to 40% from one study to another. Reasons for such disparity include different sample population selection criteria (Herlitz *et al.*, 2000).

Furthermore, almost all published studies from other countries have their endpoints more than just the question of achieving ROSC. Rather, it includes endpoints like survival until hospital discharge and survival at six months.

The other problem with studies done previously is that most of these studies include CPR done in other wards rather than just confined to Emergency Department, which is the design of this study as one of its main objectives is to identify factors in the Emergency Department that would possibly determine the success in achieving ROSC.

The closest to our local setting was a study done in Tan Tock Seng Hospital, Singapore (Lim and Tham, 2001) where ROSC achieved in 17.4% of patients. Even that, the design of that study was exclusively limited to only out-of-hospital arrests, rather than include both in-hospital and out-of-hospital arrests, as seen in Emergency Department.

Another study was done in a 2300-bed university hospital in Thailand to, similarly, look into the outcomes and quality of IHA CPR done on 639 victims for a period of one year as well as factors affecting the outcomes of CPR. It was found that 394 (61.7%) achieved restoration of spontaneous circulation and 44 patients (6.9%) survived to discharge (Suraseranivongse *et al.*, 2006).

This pilot study looked into two of the most basic end-points rather than more sophisticated end-points. The end-points are firstly, achievement of Return Of Spontaneous Circulation (ROSC) regardless of whether the ROSC was sustained until

admission to respective wards and secondly, achievement of ROSC that was sustained until admission to respective wards or also known as survival to admission.

While it cannot be denied that certainly not all ROSC achieved would translate into success rate of survival until discharge from the hospital, nevertheless, achieving ROSC represents the very first step in at least giving hope for survival to the cardiac arrest victims. No ROSC achieved after a certain period of CPR means no hope at all for the cardiac arrest victims.

Furthermore, in the Utstein's style definition, a survived event for OHA cases is now defined as achieving sustained ROSC with spontaneous circulation sufficient enough until admission and transfer of care to medical staff at the receiving hospital rather than more elaborative definitions. And for the in-hospital setting, a survived event is defined as achieving sustained ROSC for >20 min (Jacobs *et al.*, 2004). With that in mind, taking the achievement of ROSC per se as end-points in this study can be seen as complying to what is prescribed as survived events of resuscitation by the Utstein's style definitions. The detailed description of other terms derived from the Utstein's style definitions would be elaborated further in the literature review section. It is, therefore, with this hope of producing a local data as a foundation that this pilot study is embarked upon.