A STUDY ON KNOWLEDGE AND PRACTICE ON POST CARDIAC ARREST CARE AMONG HEALTHCARE PROVIDERS WORKING IN EMERGENCY DEPARTMENT IN KELANTAN

by

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Diperakui bahawa disertasi yg bertajuk A STUDY ON KNOWLEDGE AND PRACTICE ON POST CARDIAC ARREST CARE AMONG HEALTHCARE PROVIDERS WORKING IN EMERGENCY DEPARTMENT IN KELANTAN

merupakan kerja dan penyelidikan yg asli dari, NORHAYATI ISMAIL nombor kad pengenalan:831222-11-5338, nombor matriks: **PUM 0086/12**, dari tempoh 2012 hingga 2016 adalah di bawah penyeliaan kami. Disertasi ini merupakan sebahagiaan daripada syarat untuk penganugerahan **Sarjana Perubatan Kecemasan**, segala hasil penyelidikan dan data yg diperolehi adalah hak milik terpelihara Universiti Sains Malaysia.

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LIST OF ABBREVIATIONS

ACLS	Advance cardiac life support
ACS	Acute coronary syndrome
AED	Automated external defibrillator
AHA	American heart association
AMI	Acute myocardial infarction
BLS	Basic life support
CME	Continuous medical education
CPC	Cerebral performance category
CPR	Cardiopulmonary resuscitation
ECC	Emergency cardiovascular care
ECG	Electrocardiogram
EMS	Emergency medical services
HKK	Hospital Kuala Krai
HRPZ	Hospital Raja Perempuan Zainab
HUSM	Hospital Universiti Sains Malaysia
ICU	Intensive care unit
IHCA	In hospital cardiac arrest
ILCOR	International Liason Committee of Resuscitation
MECC	Medical emergency coordinating centre
MOF	Multiorgan failure
NMRR	National Medical Research Registry
OHCA	Out of hospital cardiac arrest
PACT	Post cardiac arrest team

PCI	Percutaneous coronary intervention
PCAS	Post cardiac arrest syndrome
ROSC	Return of spontaneous circulation
SBP	Systemic blood pressure
SD	Standard deviation
TH	Therapeutic hypothermia
UK	United Kingdom
VF	Ventricular fibrillation
VT	Ventricular tachycardia

ABSTRAK

KAJIAN BERKENAAN PENGETAHUAN DAN AMALAN DALAM PENJAGAAN PESAKIT SELEPAS JANTUNG TERHENTI DI KALANGAN PENGAMAL KESIHATAN YANG BERTUGAS DI JABATAN KECEMASAN DI KELANTAN

PENGENALAN

'2010 (AHA) guidelines on CPR and ECC' telah membentuk rantaian ke lima di dalam rantaian kehidupan iaitu perawatan pesakit selepas jantung terhenti secara integrasi. Semenjak tahun 2002 dua kajian berkaitan 'therapeutic hypothermia' (HACA et al) dan (Bernard et al) telah terbukti resuscitasi pesakit dengan rentak permulaan 'ventricular fibrillation' akan meningkatkan kadar kehidupan dengan tahap neurologi yang baik. (Passali, Pantazopoulos et al. 2011) mendapati pengetahuan doktor dan jururawat dalam amalan resuscitasi ' BLS' dan 'ACLS' adalah kurang optimum dan amalan tidak seragam (Nick Truman et al. 2015). Amalan 'therapeutic hypothermia' juga masih kurang (Abella, Rhee et al. 2005).

OBJEKTIF

1. Untuk menentukan kadar pengetahuan dalam penjagaan pesakit selepas jantung terhenti di kalangan pengamal kesihatan yang bertugas di jabatan kecemasan di Kelantan.
2. Untuk menentukan kadar amalan dalam penjagaan pesakit selepas jantung terhenti di kalangan pengamal kesihatan yang bertugas di jabatan kecemasan di Kelantan
3. Untuk membandingkan kadar pengetahuan dan amalan dalam penjagaan pesakit selepas jantung terhenti di kalangan pengamal kesihatan yang bertugas di jabatan kecemasan di Hospital Umum, Hospital Daerah dan Hospital Universiti di Kelantan.
4. Untuk menentukan faktor yang berkaitan dengan kadar pengetahuan dan amalan dalam penjagaan pesakit selepas jantung terhenti di kalangan pengamal kesihatan yang bertugas di jabatan kecemasan di Kelantan.

METODOLOGI

Borang soal selidik yang mengandungi tiga bahagian iaitu demografi, pengetahuan dan amalan dalam penjagaan pesakit selepas jantung terhenti di hasilkan setelah merujuk '2010 AHA guideline on CPR and ECC'. Satu kajian telah dijalankan daripada bulan Jun sehingga November 2015 ke atas pengamal perubatan yang bertugas di Jabatan Kecemasan di Kelantan. Bilangan sampel saiz dikira adalah 156 dan respons di terima sebanyak 155 iaitu 99%. Maklumat kajian di masukkan dan dianalisa menggunakan perisian SPSS versi 22.

KEPUTUSAN

Seramai 156 subjek terlibat dengan kajian ini yang terdiri dari umur 24 hingga 57 tahun.Golongan lelaki (52.9%) lebih ramai dari golongan wanita (47.10%). Skor median pengetahuan antara institusi adalah berbeza iaitu hospital umum (6.0,IqR 3),hospital daerah(5.0,IqR 2) dan hospital universiti (7.0,IqR 3).Dalam kajian ini kami dapati lima faktor yang penting dalam menentukan skor pengetahuan iaitu pernah menghadiri kursus ACLS, posisi, institusi, tempat bekerja dan bilangan pesakit yang diresuscitasi mendapat ROSC dirawat. Kami juga mendapati faktor seperti pernah menghadiri kursus ACLS dan tempoh pekerjaan mempengaruhi skor median amalan.

KESIMPULAN

Petugas perubatan yang bertugas di Jabatan Kecemasan di Kelantan memiliki pengetahuan yang kurang dan amalan yang sederhana dalam perawatan pesakit selepas jantung terhenti di Kelantan. Tahap pengetahuan antara hospital daerah, hospital universiti dan hospital umum adalah berbeza tetapi tahap amalan tiada perbezaan. Pernah menghadiri kursus ACLS merupakan faktor penting yang menentukan tahap amalan dan pengetahuan yang lebih baik. institusi, tempat kerja, bilangan pesakit yang diresuscitasi berjaya mendapat ROSC, posisi petugas adalah faktor penting yang mempengaruhi tahap pengetahuan dalam penjagaan pesakit selepas jantung terhenti. Tempoh bekerja juga didapati merupakan faktor penting dalam menentukan tahap amalan perawatan pesakit.

ABSTRACT

A STUDY ON KNOWLEDGE AND PRACTICE ON POST CARDIAC ARREST CARE AMONG HEALTHCARE PROVIDERS WORKING IN EMERGENCY DEPARTMENT IN KELANTAN

INTRODUCTION

2010 American Heart Association (AHA) guidelines on CPR and ECC had created the fifth link of the chain of survival which is integrated post cardiac arrest care. Since 2002 two landmark study (HACA et al and Bernard et al) prove that therapeutic hypothermia in resuscitated patient with initial rhythm ventricular fibrillation improve their survival rate with good neurological outcome. (Passali, Pantazopoulos et al. 2011) found that nurses and doctors knowledge of basic and advanced life was suboptimal and practice is varied (Nick Truman et al. 2015). Therapeutic hypothermia implementation is low (Abella, Rhee et al. 2005).

OBJECTIVE

1 To determine the level of knowledge of post cardiac arrest care among healthcare personnel in Emergency Department in Kelantan

2. To determine the level of practice of post cardiac arrest care among healthcare personnel in Emergency Department in Kelantan

3. To compare the mean of knowledge and practice of post cardiac arrest care among general, district and university hospital

4. To determine factors associated with the level of knowledge and practice of post cardiac arrest care among healthcare personnel in Emergency Department in Kelantan.

METHADOLOGY

The questionnaire is created based on 2010 AHA guidelines on CPR and ECC which has 3 domains, demographic, knowledge and practice had been validated. The study was a cross sectional study conducted for six months period from Jun till November 2015 in whole tenth of Emergency Departments in Kelantan. Sample size calculated is 156 and the respond rate was 155, 99%.Data was entered and analyzed via SPSS version 22.

RESULT

We enrolled 155 people with age range from 24 to 57 years old. Male population (52.9%) are more than female (47.10%).The mean knowledge score is 5.25 , while the mean practice score is 7.5. The median score of knowledge among workplace are different general hospital (6.0,Iqr 3) district hospital (5.0,Iqr 2) and university hospital (7,0 ,Iqr 3).

In this study we found that five variables were statistically significant with knowledge score which were ACLS trained, position, workplace, place of practice, and number of patient with ROSC attended before. We also found that median practice score of respondent attended ACLS course and service duration is significantly different.

CONCLUSION

Healthcare personnel working in emergency department in Kelantan had low knowledge and average practice of post cardiac arrest care. The score of knowledge between districts, university and general hospital are different, however practice score are not. Previously attended ACLS course was found to be a significant factor for better knowledge and practice score. Workplace, place of practice, number of cardiac arrest patient with ROSC attended before and position of healthcare personnel was found to be a significant factor affecting knowledge of post cardiac arrest care. Service duration was found to be a significant factor for practice score.

1.0 INTRODUCTION

Post resuscitation care had been emphasized in the AHA 2005 guidelines,however it was put under fourth chain of survival together with early ACLS. A study was done to look for in hospital factors associated with improved outcome after out-of-hospital cardiac arrest in Norway found that no seizures, base excess >−3.5 mmol , body temperature ≤37.8 °C, and serum glucose ≤10.6 mmol are associated with survival (Langhelle, Tyvold et al. 2003).

Therapeutic hypothermia in cardiac arrest patient with ventricular fibrillation is associated with good neurological outcome and reduce the mortaliy (Holzer, Behringer et al. 1996) (Bernard, Gray et al. 2002). It is proposed that therapeutic hypothermia initiated in patient with initial rhytm ventricular fibrillation.Since 2005 two nonrandomized study show possible benefit of therapeutic hypothermia in nonshockable rhythm in OHCA and IHCA.

2010 AHA guidelines on CPR and ECC had created the fifth link of chain of survival which is integrated post cardiac arrest care. Post cardiac arrest care has potential to reduce early mortality by hemodynamic instability and later mortality by multiorgan failure and brain injury.

Post Cardiac Arrest Syndrome

Despite and advance in the resuscitation of cardiac arrest patient, the prognosis is still poor either cause by anoxic-ischemic neurological damage and post cardiac arrest syndrome (PCAS). It includes all clinical and biological manifestation related to global ischemia-reperfusion trigger by cardiac arrest and ROSC. The cardiocirculatory failure dominates the clinical picture and may lead to multiorgan failure (MOF).The decrease of cerebral perfusion further impair the neurological prognosis of these patients.

The pathophysiology of the PCAS can be divided by 4 domains which are brain injury, myocardial dysfunction, a systemic ischemia/reperfusion response, and any underlying pathophysiology that precipitated the arrest.

Cerebral edema, ischemic degeneration, and impaired auto-regulation characterize the brain injury pattern in the PCAS. Brain injury itself is a leading cause of morbidity and mortality in a patient that resuscitated for cardiac arrest. Brain tissue is vulnerable to ischemia. Ischemia cause cerebral edema which worsens by impaired vascular autoregulation. Hemodynamic instability, further worsened the injury to brain tissue by persistent ischemia

or hyperemic reperfusion .Reperfusion injured the brain tissue by activated apoptotic cellular pathways and subjecting the tissue to free radical formation and mitochondrial injury. The brain is sensitive to high temperature, high glucose level and seizures in the post-arrest period. It manifests as a range of neurologic deficits includes neuro-cognitive dysfunction, seizures, myoclonus, coma, and brain death.

Myocardial dysfunction in the PCAS present with global hypokinesis which may be reversible. Underlying coronary artery disease or acute coronary syndrome can exacerbate myocardial dysfunction. Patient tend to be hemodynamically labile and combination with cathecolamine excess and myocardial stunning lead to tachycardia, hypotension and low cardiac output.

The global systemic ischemia/reperfusion response in the PCAS is the major representation of shock and is characterized by a systemic inflammatory immune response, impaired vasoregulation, increased coagulation, adrenal suppression, impaired oxygen delivery and utilization, and immunosuppression. CPR just partially sustained the coronary and cerebral perfusion pressure, it was unable to support the persistent aerobic metabolism

during cardiac arrest and result with the MODS. Inflammatory cascades leads to immunosuppression, endothelial dysfunction, and activation of coagulation pathways in the microcirculation. Systemic stress causes relative adrenal insufficiency, which present as hypotension. Same to the patient experience from septic shock, this ischemia/reperfusion response in the PCAS may be reversible and responsive to early goal-directed therapy

Persistent precipitating pathology in the PCAS is related to disease that cause the cardiac arrest such as acute coronary syndromes, pulmonary disease, haemorrhage, sepsis, toxic exposures, and environmental insults. The management is disease specific that should be tailored with management of neuronal, myocardial and systemic disease (Reynolds and Lawner 2012).

Integrated Post cardiac arrest care

Integrated post cardiac arrest care or PCAS management in emergency department (ED) is a comprehensive, structured , multidisciplinary system of care for treatment of post cardiac arrest patient(Class I ,LOE B) (Peberdy, Callaway et al. 2010) .The objectives of post cardiac arrest care are optimize cardiopulmonary function and vital organ perfusion, transport to an appropriate hospital with a comprehensive post–cardiac arrest treatment , identify and treat acute coronary syndrome (ACS) and other reversible causes, control temperature to optimize neurologic recovery and anticipate, treat, and prevent multiple organ dysfunctions including avoiding excessive ventilation and hyperoxia (Hazinski, Chameides et al. 2010).

The immediate post cardiac arrest algorithm outlines all the steps for immediate assessment and management of post cardiac arrest patient with ROSC (Figure 1.1) (2010 AHA guideline on CPR and ECC).

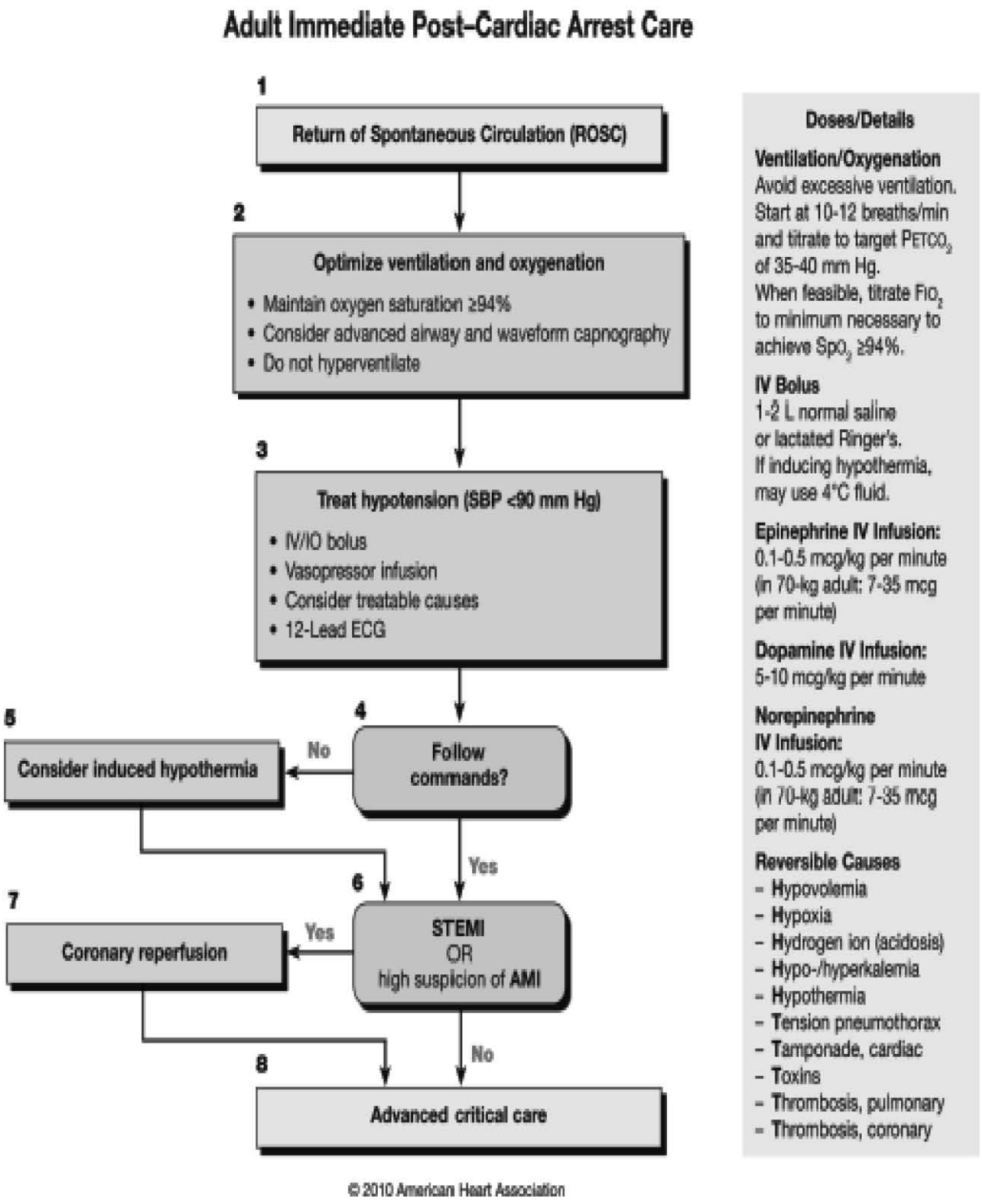

Figure 1.1: Post Cardiac Arrest Care Algorithm

Table 1.1:Multiple system approach to post cardiac arrest care

Ventilation	Hemodynamics	Cardiovascular	Neurological	Metabolic
Capnography -confirm secure airway and titrate ventilation -ETT when possible for comatose patient -PETCO2 35-40mmHg -Paco2 40-45mmHg	Frequent blood Pressure monitoring/Arterial line -maintain perfusion and prevent recurrence hypotension -MAP ≥ 65mmHg or SBP ≥ 90mmHg	Continuous cardiac monitoring -detect recurrence arrhythmia -no prophylactic antiarrythmic -treat arrhythmias as required -remove reversible cause	Serial neurological exam -serial examination define coma,brain injury and prognosis -response to verbal commands or physical stimulation -pupillary light and corneal reflex, spontaneous eye movement -gag, cough, spontaneous breath	Serial lactate -confirm adequate perfusion
CXR -confirm secure airway and detect causes or complication of arrest:pneumonitis,pneumonia,pulmonary oedema	Treat Hypotension -maintain perfusion -fluid bolus if tolerated -dopamine 5-10mcg/kg/min -norepinephrine 0.1-0.5mcg/kg/min -epinephrine 0.1-0.5mcg/kg/min	12 lead ECG/troponin -detect ACS/STEMI,assess QT interval	EEG monitoring -exclude seizures -anticonvulsants if seizing	Serum potassium -avoid hypokalemia which promotes arrhythmias -replace to maintain K > 3.5 mEq/L
Pulse oximetry/ABG -maintain adequate oxygenation and minimize Fio2 -Spo2≥ 94% -PaO2 100mmHg -reduce Fio2 as tolerated Pao2/Fio2 ratio to follow acute lung injury		Treat ACS -aspirin/heparin -transfer to acute coronory treatment centre -consider emergent PCI or fibrinolysis	Core temp measurement if comatose -Minimize brain injury and improve outcome -prevent hyperpyrexia > 37.7 -induce TH if no contraindications -cold IV fluid bolus 30ml/kg if no contraindication -surface or endovascular cooling for 32-34°C for 24hr -After 24hr,slow rewarming 0.25°C/hr	Urine output,serum creatinine -detect acute kidney injury Maintain euvolemia -RRT if indicated
Mechanical ventilation -minimize ALI, potential oxygen		Echocardiogram -detect global stunning,wall motion abnormalities,structural	Consider non-enhanced CT scan -exclude primary intracranial process	Serum glucose -detect hyperglycemia & hypoglycaemia

toxicity -Tidal volume 6-8ml/kg -titrate minute ventilation to PETCO2 35-40mmHg Paco2 40-45mmHg -reduce Fio2 to keep Sao2 ≥94%		problems or cardiomyopathy		-treat hypoglycaemia (< 80mg/dL) with dextrose Treat hypergylcemia to target glucose 144-180mg/dL -local insulin protocols
		Treat myocardial stunning -fluid to optimize volume status (requires clinical judgement) -dobutamine 5-10mcg/kg per min -Mechanical augmentation (IABP)	Sedation/muscle relaxation -to control shivering,agitation or ventilator desynchrony as needed	Avoid hypotonic fluids -may increase oedema including cerebral oedema

Table 1.1 above show the Multiple system approach to post cardiac arrest care (Peberdy, Callaway et al. 2010) . It divides into five components which are ventilation, hemodynamic, cardiovascular, neurological and metabolic. Regarding ventilation,

capnography are advisable to be used to confirm airway is secure, maintain end tidal CO2 of 35-40mmHg and partial pressure of CO2 of 40-45mmHg by arterial blood gases, consider intubation in comatose patient , perform chest radiograph to secure airway and look for causes and complication of arrest, monitor oxygen saturation via pulse oximetry to keep SpO2 ≥ 94%.

Regarding hemodynamic, regular blood pressure monitoring is important to keep MAP of ≥ 65mmHg and SBP ≥ 90mmHg. Hypotension should be treated with intravenous fluid and inotrophic support to maintain perfusion.

Regarding cardiovascular, continuous cardiac monitoring is important in detecting recurrent arrhythmia and needed to be treated accordingly, 12 lead ECG performed to detect acute coronary syndrome (ACS) or ST-elevation myocardial infarction and asses QT interval. Once ACS is detected it should be treated accordingly and patient should be transfer to acute coronary centre and consider emergent PCI or fibrinolysis in STEMI. ECHO can be performed to detect global stunning and wall motion abnormalities. Treat myocardial stunning with IV fluid or dobutamine.

Regarding neurological, serial exam should be done for neuro-prognostication, anticonvulsant started if patient seizing and monitor body temperature to prevent pyrexia, initiated therapeutic hypothermia if no contraindication and consider plain CT brain.

Regarding metabolic, took serial lactate to confirm adequate perfusion, check for serum potassium, check urine output and serum creatinine to detect acute kidney injury, check serum glucose and avoid hypotonic fluid.

Post Cardiac Arrest Care and Emergency Department

Healthcare personnel are the person that directly involved in the management of patient. Healthcare personnel working in emergency department can generally divided into 2 groups either from medical base or from paramedic base. As a front liner healthcare personnel working in emergency department are at risk of facing a lot of number of patient with cardiac arrest in their daily practice. Their patient are anticipated to be arrested due to variety of causes listed as 5Hs (hypoxia, hypotension, hypothermia, hydrogen ion (acidosis), hypokalemia and hyperkalemia) and 5Ts (tension pneumothorax, cardiac tamponade, toxins, pulmonary and coronary thrombosis) and not to forget from variety of age group.

Knowledge of resuscitation among emergency department personnel including basic life support (BLS), advance life support (ACLS), advance paediatric life support (APLS), and advance trauma life support ATLS are crucial to guide them in managing challenging event in saving cardiorespiratory arrest patient.

Good and effective resuscitation will increase the number of patient reaching ROSC, which subsequently will undergone a series of event that we call post cardiac arrest syndrome manifested with severe cardiovascular collapse and if not manage properly will end with MOD or worst patient dying. Integrated post cardiac arrest care is best treatment for post cardiac arrest syndrome which one of the component therapeutic hypothermia in OHCA with initial rhytm ventricular fibrillation improve the survival rate with good neurological outcome (Holzer, Behringer et al. 1996).

A study regarding nurses and doctors knowledge of basic and advanced life support was done in 5 hospitals in Athens, Greece found that their knowledge is suboptimal (Passali, Pantazopoulos et al. 2011). A pilot study, post cardiac arrest syndrome, knowledge and attitude of emergency, cardiology and intensive care unit (ICU) staff in two tertiary centre in

Ireland generally conformed to international guidelines, international liaison committee of resuscitation ILCOR (Nic Ionmhain et al.2013) .

A recent survey of current United Kingdom (UK) practice of post cardiac arrest management among intensive care practice was done in 2014 found that practice is varied (Nick Truman et al. 2015). Therapeutic hypothermia implementation is low (Abella, Rhee et al. 2005).

This study would like to explore the knowledge and practice of post cardiac arrest care among healthcare provider working in Emergency Department in Kelantan. Previous study related to the knowledge and practice of post arrest care among emergency department staff is limited and if present the study population number is small. There was no such study being done before in our country. We conduct the study in all emergency departments in Kelantan. Hopefully it can give us general idea where we are now in relation to post arrest management and what we could do next example creating our own protocol to improve our health services in reaching our mission of 2020 as a developed country.

LITERATURE REVIEW

Cardiac arrest defined as cessation of mechanical activity and is confirmed by absence of sign of circulation. The cause can be cardiac in origin or non-cardiac causes such as trauma, submersion, drug overdose, asphyxia or exsanguination (Jacobs, Nadkarni et al. 2004).

Sudden cardiac arrest (SCA) is a leading cause of death among adults over the age of 40 in the United States and other countries. Each year, approximately 300,000 persons in the United States experience an out-of-hospital cardiac arrest (OHCA), approximately 92% of persons who experience an OHCA event die. The median survival rate to hospital discharge after emergency medical service EMS treated cardiac arrest is 7.9%. The rate of survival to discharge after in hospital cardiac arrest (IHCA) is better which was 21% (Roger, Go et al. 2011).

In Malaysia a 1 year study from March 2005 till March 2006 was done in Emergency Department of Hospital Universiti Sains Malaysia (HUSM) to look for the outcomes of CPR performed in all adult cardiac arrest patients. The study show that out of 63 cases of cardiac arrest performed, only 19 cases (30.2%) had ROSC and only six patients (9.5%) had survival to ward admission (Chew, Idzwan et al. 2008).

Another study a mix method study was done in Kuala Lumpur to look for the incidence of OHCA in year 2011. In the study 285 pre-hospital care data sheet from Kuala Lumpur MECC was reviewed found overall incidence of OHCA cases was 285 and the survival rate was 16.8% (Karim and Abdul).

Coronary heart disease was listed as a first top killer in 2010 which constitute of 22,701 deaths it that year which is about 22.18% of the total fatalities. National Heart Institute (IJN) Consultant Cardiologist Dr Razali Omar states Malaysian should pay more attention to sudden cardiac arrest (SCA) as it causes more deaths than cancer or AIDS and encourages them to learn CPR (cardiopulmonary resuscitation) technique because it could help in saving people who have SCA.As a coronary heart disease is the first top killer it is expected that a great number of cardiac arrest patient will be encountered and resuscitated by emergency medical services (EMS) to save their lives (San Borneo post).

SCA is different from a heart attack. A heart attack occurs when blood supply of the heart is reduced or blocked, causing the heart muscle to become injured or die. Before arrested the heart attack victim is awake and present with signs and symptoms of heart attack. SCA victim is not awake.

One of the causes of SCA is heart attack. Other causes includes thickening of the heart muscle (hypertrophic cardiomyopathy, arrhythmogenic right ventricular dysplasia), heart rhythm disorders (Brugada syndrome, long QT syndrome, Wolff Parkinson White syndrome) and heart valve disorders (mitral valve prolapse).

SCA also can be cause by non-cardiac origin includes recreational drug use, electrical shock, and commotio cordis which is a disruption in the heart rhythm due to a sudden blow to the chest. When SCA occurs, the heart stops beating in an effective, organized manner. As a result, blood is no longer pumped throughout the body. Immediate CPR and defibrillation by bystander are proven to improve the survival rate if it was done quickly within three to five minutes after collapse.

Sudden cardiac arrest foundation report that the number of people who die each year from SCA is equal to the number who die from Alzheimers disease, assault with firearms, breast cancer, cervical cancer, colorectal cancer, diabetes, HIV, house fires, motor vehicle accidents, prostate cancer and suicides combined. SCA is a life-threatening condition--but it can be treated successfully through early intervention with cardiopulmonary resuscitation (CPR), defibrillation, advanced cardiac life support, and mild therapeutic hypothermia. When bystanders intervene by giving CPR and using automated external defibrillators (AEDs) before EMS arrives, four out of 10 victims survive.

The history of resuscitation itself started in 1960s which is about 5 decades ago. In 1950s Safar et al and (Elam, Greene et al. 1958) ‘rediscovered’ mouth-to mouth ventilation by reading how midwives used the technique to resuscitate newly born infants. In 1958 (Safar, Escarraga et al. 1958) confirmed the effectiveness of the mouth-to-mouth ventilation technique of (Elam, Greene et al. 1958). In 1960 they found that (Kouwenhoven, Jude et al. 1960) forceful chest compression produced respectable arterial pulses. The critical step of modern CPR ‘closed chest’ compression and ‘mouth to mouth’ ventilation had started (Kouwenhoven, Jude et al. 1960).

Chain of Survival

Since 1992 ECC guidelines describe a series of action design to reduce the mortality from cardiac arrests named as chain of survival by American Heart Association (AHA) which are early access, early CPR, early defibrillation and early advanced care (Council 2000). It has described as a link and if any of the link is missing the chance of survival will be reduced.

Early access is the first link comprise of early recognition of cardiac arrest, emergency medical services(EMS) is accessed and activated,dispatcher dispatch EMS team to the site,and arrival of team to the victim site.

The second link is early CPR means that early initiation of chest compression and ventilation once arrest are recognized and are stress to CPR by a lay person because waiting for EMS personnel to CPR is already late.CPR perform to simulate normal cardiac function to provide sufficient blood flow to the central nervous system and the myocardium to maintain temporary viability. The cerebral cortex,the tissue most susceptible to hypoxia is irreversibly damage resulting in death or severe neurological damage. Every minutes of CPR delay will reduce the chance of survival by 10%.The initial hope for closed CPR was that circulation and oxygenation could maintain viability long enough to bring defibrillator to victim's aid. BLS is often succesfull if defibrillation occur sooner than 8-10 minutes after collapse.If return of spotaneous circulation ROSC occur late beyond 8-10 minutes the frequency of permanent neurological damage is high(Association and Resuscitation 2000).

The third link is early defibrillation mean defibrillation of shockable rhytm ,ventricular fibrillation or pulseless ventricular tacycardia immediately upon recognition either with AED by lay person or EMS rescuer or defibrillator machine by EMS rescuer. Almost 85% of a person with ambulatory,out of hospital,primary cardiac arrest experience ventricular tacyarryhtmias during the early minutes of collapse (de Luna, Coumel et al.

1989). The percentage of ventricular tacycardia is lower.Most of the survival come from a group with ventricular fibrillation when EMS personel is arrive. A prehospital care study done in king country Washington found that over 92% of cardiac arrest survival come from group with ventricular fibrillation (Eisenberg 1984).

The fourth link is early advance cardiac life support which comprise of endotracheal intubation and intravenous medication to further improve the chance of survival. A study done in lowa that provide defibrillation alone,the ventricular fibrillation survival rate is 19% (Stults, Brown et al. 1984).While in King Country,Washington they provided defibrillation and ACLS had higher survival rate of 29% of witness ventricular fibrillation (Eisenberg, Hallstrom et al. 1984). Its proven that ACLS has added value to improve the survival.

The 5th link which is integrated post cardiac arrest care was discuss earlier. A figure of chain of survival is showed below(Figure 2.1) (Field, Hazinski et al. 2010).

Figure 2.1: Chain of Survival

Who cares the cardiac arrest patient

Emergency medical services (EMS) system is a system that provides emergency medical care in response to serious illness like cardiac arrest at pre-hospital level. EMS responder can be an emergency medical technician (EMT) only in rural area or EMT with paramedics in urban and semi urban region. EMT can provide CPR and defibrillation while paramedics can perform advance live support. Once a caller call EMS number, example 999, call taker will took the information and dispatches EMS team such as paramedic that will resuscitate the arrested victim with basic and advances life support till return of spontaneous circulation (ROSC) followed with post cardiac arrest care. Some experts have argued that OHCA survival rates are a reliable and valid measure of an EMS system's overall effectiveness and may be the most appropriate measure for comparing performance among EMS systems (AHA 2000). EMS team then will brought the patient to the hospital that can provide good post resuscitation care with percutaneous coronory intervention (PCI) centre (Graham, McCoy et al. 2015).

In hospital doctor and paramedics working in emergency department will continue the patient care by placement of endotracheal tube (ETT) for definitive airway,supplemental oxygen and maintain patient hemodynamics, searching and treating the precipitating cause and its complication. It patient successfully manage till admission,patient should be placed in intensive care unit and if patient was comatose post ROSC therapeutic hypothermia should be implemented as it proven to improve survival and good neurological outcome.In intensive care unit (ICU) intensives will continue the care of patient with other team like cardiologist in myocardial infarction patient.

Implementation of the Post Cardiac Arrest Care

A retrospective study of 26 years perspective among community who had OHCA in the Municipality of Goteborg, Sweden in whom CPR was attempted between 1980 till 2006 are comparing the outcome of survival and cerebral performance between 2 period observed, the 1st one from 1980 till 2002 and the 2nd one from2003 till 2006.Among all groups no significant change in survival except in subgroup of patient with shockable rhythm,VF showed significant increase in survival (37% vs 57% ; $P < 0.0001$). The cerebral performance at hospital discharge has change significantly. The percentage with CPC score of 3 or more was reduced from 28% in period 1 to 6% in period 2 ($P < 0.0006$). In the latter period the practice of therapeutic hypothermia and early use of angiography in STEMI patient had increased reflecting use of advanced postresuscitation care. In other words implementation of advanced resuscitation care are proven to improved survival in initial rhythm was VF and improved cerebral performance to hospital discharge (Martinell, Larsson et al. 2010).

A multicentre prospective cohort study involved OHCA patient in the Aizu region, Fukushima Japan looking at favourable neurological outcome before (January 2006-April 2008) and after (January 2009-December 2010) implementation of the fifth link. After implementation the OHCA patient was transported from field to tertiary level hospital or from outlying hospital to tertiary hospital that provide post-resuscitation care. The study found one month survival with favourable neurological outcome improved significantly after the implementation (0.5% Vs 3%) (Tagami, Tosa et al. 2012).

A retrospective analysis using national sample of US hospital identifying patient resuscitated after cardiac arrest from 2000 till 2004 to look for association between hospital factors and mortality. The study found that mortality after in hospital cardiac arrest over 5 years is decreased and mortality was lower in urban, teaching and large hospital. It is proposed that better outcome is due to best practice of post cardiac arrest care (Carr, Goyal et al. 2009).

Therapeutic Hypothermia

Important recent work has demonstrated that the use of induced hypothermia can improve survival and neurologic recovery after cardiac arrest. Two landmark studies published in the New England Journal of Medicine in 2002 prompted the International Liason Committee on Resuscitation (ILCOR) to recommend therapeutic hypothermia for out of hospital cardiac arrest due to VF and pulseless VT in 2003 (Marshall and Siegel) . A multicentre trial involving post arrest patient with initial rhythm VF was selected to undergo TH with target temperature 32-34°C over 24hr period and other group received standard treatment with normothermia. The primary end point was a favourable neurologic outcome within 6 months after cardiac arrest and mortality within 6 months.55% of hypothermic group had a favourable neurologic outcome with cerebral performance category 1 (good recovery) and 2 (moderate disability) as compared to 39% in normothermic group. Mortality at 6months was 41% in hypothermic group as compared with 55% in normothermic group. This study conclude that patient that successfully resuscitated from ventricular fibrillation, therapeutic hypothermia increase the rate of favourable neurological outcome and reduce mortality (N Engl J Med 2002;346:549-56). In 2010, the AHA updates its recommendation and identified therapeutic hypothermia as a class I recommendation for VF cardiac arrest and a class IIb recommendation for cardiac arrest with asystole / PEA as initial presenting rhythm.

In cardiac arrest patient oxygen deprivation lead to neurological injury that responsible for two-third death in patient that initially achieve ROSC and leading to poor neurological outcome to the others (Laver, Farrow et al. 2004). When person sustained cardiac arrest there would no blood flow to the heart and the brain. Following ROSC large influx of blood and oxygen is delivered to both areas. Abrupt restoration of oxygen in an ischemic tissue will lead

to oxygen free radical formation and cell death. The goal of therapeutic hypothermia is to halt the physiologic event occurring during post cardiac arrest syndrome and minimize damage to body organs. Therapeutic hypothermia is well known practice that could reduce the effect of reperfusion injury (Holzer, Behringer et al. 1996).

AHA guidelines 2010 stated administration of normal saline cooled to 4°C with a bolus of 30ml/kg can be used to cool to 32-34° C over 24hr. Other method like surface cooling such as cooling blanket and ice packs to the axilla, groin and neck can be used.

A prospective clinical trial was done in a university teaching hospital to look for the effects of therapeutic hypothermia on intracranial pressure and outcome in patients with severe head injury involving of 136 patients admitted with (Glasgow Coma Scale (GCS) ≤8). Actual mortality rates were significantly lower, hypothermic patient 62% versus controls 72%. The number of patients with good neurological outcome was also higher in the hypothermia group, 15.7% versus controls 9.7%. Artificial cooling can significantly improve survival and neurological outcome in patients with severe head injury when used in a protocol with great attention to the prevention of side effects (Polderman, Joe et al. 2002).

A retrospective study of patients who presented after implementation of a TH-protocol compared to those who presented before the protocol was implemented at Harborview Medical Center, Seattle, Washington. The study was conducted to see whether implementation of a therapeutic hypothermia (TH) protocol upon arrival in a community hospital improved survival and neurologic outcomes in patients initially found to have ventricular fibrillation (VF), pulseless electrical activity (PEA), or asystole and then successfully resuscitated from out-of-hospital cardiac arrest. The therapeutic hypothermia period was associated with a significant improvement in neurologic outcomes in patients whose initial rhythm was VF, but not in patients with other rhythms(Don, Longstreth Jr et al. 2009).

A study of 4 years period from 2007 till 2010 in metro-Taipei tertiary medical centre ICU of post resuscitated OHCA patient admitted and fulfilled study criteria, comparing therapeutic hypothermia application (n=51) verses standard supportive care (n=124). The hospital survival rate was 14 out of 51 in TH group (27.5%),compared to 15 out of 124 (12.1%) in the non-TH group. In this study the survival rate of TH group is higher than no TH group.The TH group also had better neurological outcome compared to the non TH group (Wang, Yang et al. 2013).A pre-test, intervention and post-test study regarding TH was done in Newport Hospital among ED and ICU nurse found that pretest knowledge score was low which is 50 and 51 respectively from total of 10 question (Goldstein 2013).

An internet base survey among paediatric critical care community of knowledge and attitudes toward therapeutic hypothermia in comatose children after cardiac arrest was done. About 159 responders completed the survey. The result of the survey found that most (65%) were aware of the adult randomized trials of therapeutic hypothermia, but only 9% (always) or 38% (sometimes) utilize this therapy. It can be conclude that usage of TH among paediatric critical care is still low despite awareness is better (Haque, LaTour et al. 2006).

A nationwide survey on the implementation of the ILCOR guidelines mild therapeutic hypothermia after cardiac arrest in German intensive care units found that only 24% reported to use MTH. Of those, 93% started MTH in patients after out-of-hospital resuscitation with observed ventricular fibrillation and 72% when other initial rhythms were observed. MTH is underused in German ICUs (Wolfrum, Radke et al. 2007).

A survey of Canadian emergency and critical care physician found that 99% of respondent aware of TH and 91% agreed that it is beneficial, however only two-third (68%) had used it in clinical practice (Bigham, Dainty et al. 2010). An internet-based survey of use of therapeutic hypothermia among physicians was conducted. The majority (94%) were at post-training level includes emergency medicine. critical care, and cardiology. About 87% do not use TH.Despite proven benefit the practice of therapeutic hypothermia is still low (Abella et al.2005).

A Web-based survey was distributed to physicians among United States–based critical care, cardiology, and emergency medicine directories and critical care networks in the UK and Finland to assess the therapeutic hypothermia utilization among them after resuscitation from cardiac arrest. Of all replies, 74% of United States respondents and 64% of non–United States respondents had never used therapeutic hypothermia. United States emergency medicine physician adoption of cooling was significantly less than that of United States intensivists (16% vs. 34%, $p < .05$)(Merchant, Soar et al. 2006).

Early Percutaneous Coronory Intervention in Post Arrest

Sudden cardiac arrest usually was cause by acute coronory thrombosis (Davies and Thomas 1984).12 lead ECG should be done in pre-hospital and emergency department to detect STEMI in post arrest patient. Once STEMI is diagnosed patient should be arranged for early PCI to minimize myocardial death, dysrhythmia and increase cerebral blood flow when cardiac output is increased. Study done before, proven increased survival rate with early PCI in post arrest patient. Early angiography with therapeutic hypothermia does not increase cardiac and neurologic complication.

Healthcare providers working in the emergency department including doctors and paramedics encounter numerous critically ill patients that had potential to be arrested anytime either in the scene or in the department. Once arrested the resuscitation attempt including CPR, defibrillation and advance cardiac life support initiated and some of patient manage to return of spontaneous circulation (ROSC). The concept of 5H and 5T as a cause of arrested should be sought and treat accordingly. Getting patient to ROSC is not the sole goal of resuscitation but the aim is their survival to hospital discharge with good neurological outcome.

Post Arrest Consult Team (PACT)

A prospective cohort study with implementation of post arrest consult team (PACT) with concurrent controls from February 2011 to February 2013 in a 29 Toronto-area hospitals was done to improve the quality of care for admitted OHCA patients. Lack of standardized care is thought to be the cause of low survival rate in admitted out-of-hospital cardiac arrest (OHCA) patient. There were two hospitals that implemented the PACT which function as a consult service with a nurse and physician on- call 24hours per week. While patients from other hospitals acted as concurrent controls. The PACT focused on four key processes of care: targeted temperature management (TTM); coronary angiography; avoidance of premature withdrawal of life-sustaining therapy (WLST <72 hours) on the basis of neuroprognostication; and electrophysiology assessment. The study included nontraumatic OHCA patients who were >18 years old, survived at least 6 hours, and were comatose and patients with do-not-resuscitate orders, intracranial or other severe bleeding are excluded.

A generalized linear mixed model was used to assess whether PACT implementation was associated with higher odds of achieving each of the four targeted processes of care. There were about 162 patients from two intervention hospitals and 892 from 27 control hospitals that involved in the analysis. PACT did not improve use of TTM (ratio of ORs = 1.03, 95% CI = 0.89 to 1.20), angiography for patients without ST-elevation myocardial infarction (ratio of ORs = 1.10, 95% CI = 0.87 to 1.40), or electrophysiology assessment (ratio of ORs = 1.06, 95% CI = 0.81 to 1.38) as compared with concurrent control hospitals. However PACT was associated with reduced WLST <72 on the basis of neuroprognostication (ratio of ORs = 0.62, 95% CI = 0.39 to 0.98 (Brooks, Scales et al. 2014).