

Out-of-Hospital Cardiac Arrest (OHCA): A Critical Healthcare Problem

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Abstract

Out-of-Hospital Cardiac Arrest is one of the leading causes of death and disability worldwide. It contributes around 10% of the total mortality in developing countries. Cardiac arrest is an unexpected sudden event occur at any location, at any time, henceforth survival depends on rapid and proper intervention by trained personnel. Cardiac diseases are accounted for around 70% of cases of cardiac arrest; coronary artery diseases are the commonest cause.

The workup includes history and physical examination, laboratory tests, electrocardiography echocardiography, coronary angiography, and cardiac magnetic resonance imaging. Pre-hospital treatment (resuscitation) in Out-of-Hospital Cardiac Arrest is initiated with a sequence of critical events known as the "Chain of Survival". The "Chain of Survival" includes early recognition of symptoms, bystander cardiopulmonary resuscitation, early defibrillation and advanced cardiac life support.

Re-establishment of spontaneous circulation before hospital arrival is currently achieved in 40 - 60% of patients in whom advanced cardiac life support is attempted in developed countries where excellent chain of survival mechanism exists and implemented. Despite advances in post-resuscitation care management, about 50% of resuscitated patients from CA die or have a poor neurological prognosis.

Emergency medical services system is not only restricted to in-hospital care from arrival to hospital to stabilization of the patient but it also includes pre-hospital care and transportation of patient to hospital. The system is at an early stage of development in South Asian countries such as India, Pakistan and Nepal. There is no established pre-hospital emergency care mechanism in Nepal and no formal community-based cardio-pulmonary resuscitation education and training program is not developed in Nepal. No data is available about Out-Of-Hospital Cardiac Arrest in Nepal but as per anecdotal evidence it is likely to be a significant health care problem in Nepal.

Developing countries and underdeveloped countries including Nepal invest resources for establishment of emergency medical services system both for in hospital and prehospital care.

Keywords: Cardiac Arrest; Cardio-Pulmonary Resuscitation; Chain of Survival; Cardiac Arrest; Emergency Medical Services; Out-of-Hospital Cardiac Arrest; Pre-Hospital Emergency Care

Introduction

Introduction briefly focuses on burden of non-communicable diseases (NCDs) and cardiovascular diseases (CVDs), emergency medical services (EMS) and cardiac arrest (CA).

Burden of non-communicable diseases and cardiovascular diseases

Non-Communicable diseases (NCDs) burden is extremely high globally. NCDs are the leading cause of death worldwide; in 2016 NCDs were accounted for 41 million (71%) of the 57 million deaths. The burden is highest in low- and middle- income countries as 78% of all NCD deaths occurred in these countries [1].

Cardiovascular diseases (CVDs) are the most prevalent diseases worldwide [2,3]. Globally, it is the leading cause of death responsible for maximum deaths i.e. 17.9 million deaths, accounting for 44% of all NCD deaths and 31% of all global deaths [4]. The mortality from CVDs has increased in recent year as deaths due to CVDs was 15 million in 2015 [2,5,6]. The chest pain is among the most common complaints and top among the list with which patients present in emergency department [7,8]. Existing literatures have revealed that the cardiovascular diseases/conditions are the top most among the causes of mortalities in emergency departments [9-14].

Emergency medical services

Emergency medical services system (EMSs) is an integral and essential part of any effective and functional healthcare system as it saves lives by providing critical care instantly. Immediate access to care after a major cardiovascular incident reduces the morbidity and mortality [8,15].

EMSs are not restricted only to actual in-hospital care from arrival to hospital to stabilization of the patient but it also includes pre-hospital care and transportation of patient to hospital [8,16].

EMSs is at an early stage of development in South Asian countries such as India, Pakistan and Nepal [8,17-19].

Cardiac arrest (CA)

Cardiac arrest (CA) refer to the sudden collapse of cardiac activity with hemodynamic compromise, either due to sustained ventricular tachycardia (VT)/ventricular fibrillation (VF), asystole or pulseless electric activity (PEA) [20].

CA is an unexpected sudden event that may occur at any location, at any time, hence survival depends on prompt and proper intervention by trained personnel [21].

CA is the third leading cause of death worldwide [22]. CA is a common cause of death, accounted for more than 300000 patients' death per year in the United States of America (USA), with a case fatality rate of 95% [23].

Despite advancement in technology and improved diagnosis and care services, both in-hospital cardiac arrest (IHCA) or out-of-hospital cardiac arrest (OHCA) remains a significant and leading cause of mortality and morbidity globally [21,24,25]. OHCA is one of the most alarming conditions causing over 90% mortality rate in USA [2,23].

Out-of-hospital cardiac arrest (OHCA)

Out-of-Hospital Cardiac Arrest (OHCA), Epidemiology of OHCA, Causes of OHCA, Workup of the patient after OHCA in emergency department who survived SCA and Concept of Treatment of OHCA are concisely discussed under this heading.

OHCA is an important healthcare issue and global health care problem. OHCA is one of the leading causes of death and disability worldwide.

An OHCA is defined as cessation of cardiac mechanical activity, confirmed by the absence of signs of circulation (no central pulsation, unresponsiveness, and apnea or agonal, gasping respirations) and that occurs outside of a hospital setting [17].

Epidemiology of out-of-hospital cardiac arrest (OHCA)

Out-of-Hospital Cardiac Arrest (OHCA) is one of the leading causes of death and disability globally. It contributes around 10% of the total mortality in developing countries [18,27-30].

The incidence and outcome of OHCA varied critically worldwide. As per estimate, the mean incidence of adult OHCA globally was 55 per 100 000 person-years and the survival-to-discharge rate ranged from 2% to 11%. There is no uniform in reporting practices, hence it is believed to be one of the reasons for this variability [26,31].

The annual incidence is between 36 and 81 events per 100,000 population in developed countries [30,32]. National Health Service (NHS) Ambulance Services in United Kingdom (UK) treats approximately 30000 patients a year for OHCA [33].

OHCA is one of the leading cause of death in India [17]. The incidence OHCA in Hong Kong is 72 arrests per 100 000 persons and the survival rate of patients is low [26].

It is estimated that about 75-80% of all out-of-hospital cardiac arrests occur at home [34,35].

In USA overall rates of survival from OHCA has improved between 2005 and 2012, both in pre-hospital and in-hospital survival. The same trends were noted in both shockable and non-shockable cardiac arrest rhythms. The bystander CPR and use of automated external defibrillator (AEDs) has reasonably increased. The rate of neurological disability was also come down [36].

Causes of out-of-hospital cardiac arrest (OHCA)

Acute or chronic coronary artery disease (CAD) is the most common cause of OHCA besides heart failure and ischemic causes not directly related to CAD like coronary emboli, inflammatory disease, vasospasm. These are accounted for around 70% of cases. Other cardiac and non-cardiac diseases/disorders lead to OHCA. Other cardiac causes are structural heart disease for example cardiomyopathy, myocarditis, acute aortic dissection, congenital heart disease and electrical disorders such as long/short QT syndrome, Wolf-Parkinson-White syndrome (WPW). The non-cardiac causes are responsible for between 5 - 12% OHCA. These include electrolyte disorders such as hypo and hyperkalemia, acidosis, neurological disorders such as stroke, hypoxia, trauma, infectious diseases and sepsis, drugs and drug interaction such as digoxin, antiarrhythmic drugs, antidepressant drugs [20].

Workup of the patient after OHCA in emergency department who survived SCA

The workup includes history and physical examination, laboratory tests, electrocardiography (ECG), echocardiography (ECHO), coronary angiography, and cardiac magnetic resonance imaging (MRI) [20,37,38].

History and physical examination

One must enquire about prior diagnoses of heart diseases, concomitant diseases, family history of cardiac diseases, medications which could cause QT prolongation, electrolyte disorders, arrhythmia, drug abuse, angina equivalent symptoms, assess signs of heart failure.

Laboratory tests

These include electrolytes and renal function test, blood gas analysis including lactate and pH value, pO₂ and pCO₂, serial troponin measurements, if no coronary angiography available.

ECG

The findings depend upon cause; there could be ST-segment elevation or new left bundle branch block (LBBB) or 2nd or 3rd degree heart block, or long QT, WPW or signs of hypertrophic cardiomyopathy or polymorphic ventricular tachycardia due to epinephrine.

ECHO

ECHO findings may be of structural heart diseases, assessment of LV-function and wall motion abnormality.

Coronary angiography

It confirm/exclude ischemia as an underlying condition, anomalous origin of the coronary arteries.

Cardiac MRI

It helps in assessing LV-function, ischemia, structural heart diseases, myocarditis.

Concept of treatment of OHCA

Majority of patients suffering OHCA have no or nonspecific symptoms prior to the cardiac arrest. Contrary, individuals at low and moderate risk do not suffer from OHCA [39].

Cummins and colleges presented the “chain of survival” concept with the aim of improving survival from OHCA and this is still valid [40,41].

Chain of survival

Pre-hospital treatment (resuscitation) in OHCA is initiated with a sequence of critical events called as the “chain of survival” [30,41].

The Chain of Survival includes early recognition of symptoms, bystander cardiopulmonary resuscitation (CPR), early defibrillation and advanced cardiac life support (ACLS) [20,30,41].

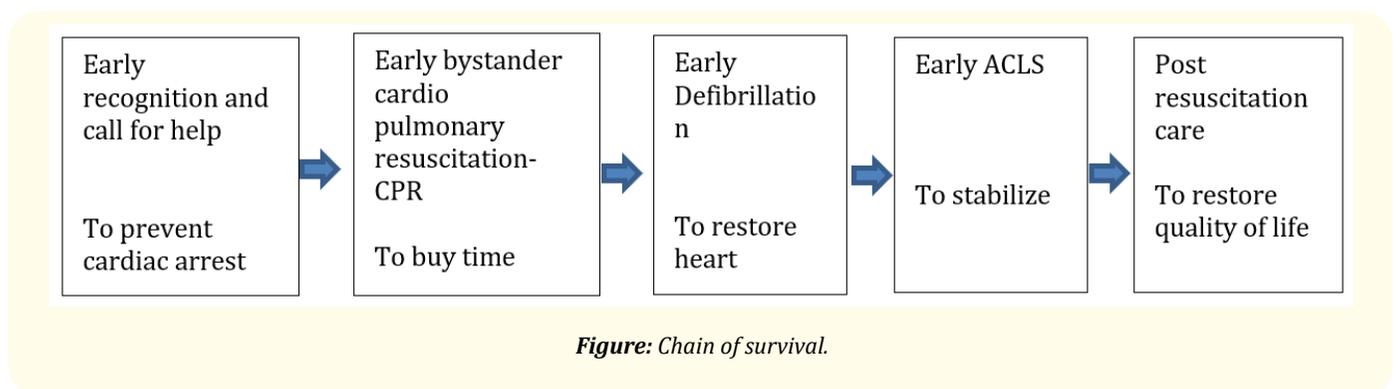


Figure: Chain of survival.

Re-establishment of spontaneous circulation (ROSC) before hospital arrival is currently achieved in 40-60% of patients in whom advanced cardiac life support (ACLS) is attempted in developed countries where excellent chain of survival mechanism exists and implemented [30].

Bystander CPR is CPR performed by a person (bystander) to a victim having cardiac arrest. Bystander is a person who is not a part of the emergency response system engaged in the victim’s resuscitation [17].

ROSC is defined as a brief restoration of spontaneous circulation (for more than 30 seconds) that specifies evidence of more than an occasional gasp, occasional fleeting palpable pulse, or arterial waveform [17].

Post cardiac arrest syndrome

There are four key components of Post-Cardiac Arrest Syndrome [42]:

1. Post-cardiac arrest brain injury.
2. Post-cardiac arrest myocardial dysfunction.
3. Systemic ischemic/reperfusion injury.
4. Persisting precipitating pathology.

Despite advances in post-resuscitation care management, about 50% of resuscitated patients from CA die or have a poor neurological prognosis. The neurological outcome can be assessed with simple validated neurological score like Cerebral Performance Category (CPC) [17,42].

Nepal perspective

Nepal is a land locked country situated in South Asia between two thickly populated countries China in north and India in south, east and west. The field of emergency medicine is being recently recognized sub-specialty in Nepal [43]. There exists no structured or sanctified model of emergency in country; the different models are practiced in different hospital [43].

The general public does not view emergency clinician as a specialist [43,44]. There is difficulty in recruiting or finding emergency care specialists for most of the hospitals due to various reasons such as limited perks, substantial workload, unfriendly working environment, lack of acknowledgment, legal and social issues [43].

There is no established pre-hospital emergency care mechanism in Nepal and lack of emergency care in primary care setting (sub-health post, health post and health center level) [19,43,45]. The existing healthcare system of Nepal (public and private) does not offer ambulance services [43,45].

Knowledge of healthcare professionals working in medical colleges about CPR is not adequate [35]. There is no formal community-based CPR education and training program in Nepal.

No data is available about OHCA in Nepal but as per anecdotal evidence OHCA is likely to be a significant health care problem in Nepal.

Conclusion

Globally, cardiovascular diseases are the leading cause of death responsible for maximum number of deaths. Low and middle-income countries bear more burden than the developed countries as emergency medical services system does not exist in majority of the low-income countries while it is at the primitive stage in most of the middle-income countries. Effective emergency medical services system is vital for any functional healthcare system as it saves lives by providing critical care to the people instantly. Pre-hospital emergency care is a part of emergency medical services system.

Cardiac diseases are almost responsible for sudden out-of-hospital cardiac arrest, a critical medical emergency. Successful resuscitation in out-of-hospital cardiac arrest patient relies on a strong chain of survival. Early cardiopulmonary resuscitation (CPR) is the cornerstone intervention to optimize the survival rates of out-of-hospital cardiac arrest patients.

Besides adequate training of healthcare professional, public educational programs are crucial, to improve the public's awareness of how to identify cardiac arrest and initiate successful CPR. Developing countries and underdeveloped countries invest resources in emergency medical services system.

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