Society Consensus
Guidelines for Resuscitation in INDIA

August 2011

This document is prepared as foundation for the development of guidelines for resuscitation and treatment of the sick and injured patients in India. The said treatment is rendered with the available resources and at the available settings to give an optimally better outcome for the concerned patient and optimal satisfaction for the health care provider.

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Indian Society of Critical Care Medicine (ISCCM)

Society of Emergency Medicine India (SEMI)

International Trauma Care - Indian Chapter (formerly ITACCS)

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GVK Emergency Management Research Institute (GVK EMRI)

Indian Association of Cardiovascular Thoracic Anaesthesiologists (IACTA)

Academy of Regional Anaesthesia of India (AORA)

South Asian Society on Atherosclerosis and Thrombosis (SASAT)

CONTENTS

ABBREVIATIONS :

AED –Semi-Automated External Defibrillator
CPR – Cardiopulmonary Resuscitation
CPP – Coronary Perfusion Pressure
MAP – Mean Arterial Pressure
EMS – Emergency Management Services (Pre-hospital)
ERS – Emergency Response System (In-hospital)
BVM – Bag Mask Ventilation
BLS- Basic Life Support
ALS – Advanced Life Support
PETCO2 – Partial pressure of End Tidal CO2
ILCOR – International Liaison Committee on Resuscitation
AHA – American Heart Association
ERC – European Resuscitation Council

PREFACE

The need for an Indian version of resuscitation guidelines has been an important need that has eluded us in the past. Many efforts have been also been made to move towards addressing the bigger need of a Resuscitation Council for India. The former goal is met herein, while the latter is something that we must all work together to achieve… in the near future.

This guideline is built upon the efforts of many people and efforts over the years, many people who nudged us and have expressed a desire for some direction and standard. It proved difficult to immediately hoist this as a national effort due to complexities of society boundaries, communication and differing interests. Thus a decision was made, that took fruition, at the First National Convention on Resuscitation organized by Indian Society of Anaesthesiologists at Mangalore in 2007 when luminaries in the field, from different societies decided to work in together to set things right.

Building upon work started by ISCCM in 1998 and others before, the meeting of minds started with in 2008 with the Indian Society of Anesthesiologist (ISA), Indian Society of Critical Care Medicine (ISCCM), Society of Emergency Medicine India (SEMI), the International Trauma Care-Indian Chapter (formerly ITACCS), later joined by the Indian Association of Cardiovascular and Thoracic Anesthesiologists (IACTA) and GVK Emergency Management Research Institute (GVK EMRI); to develop a consensus amongst these societies for an Indian guideline in resuscitation.

So why an Indian standard? Why not just adopt one of the existing international standards? These are often asked questions… but who decides what standard to adopt? Who propagates it so that our people benefit? Furthermore, the current resuscitation standards and organisations out there are actually largely country specific, these evolved to take into account local issues and circumstances, to become a platform for advocacy and propagation of the standard, to become a forum for advancement, sharing of best practices, driving public participation and action. A platform for research and advancements in the systems they are couched in. For all these reasons, we too need to fit this to India. Also being a nation of over a billion people, with illnesses, infrastructure, cultural and other many other differences, we may have valuable contributions, ideas and unique solutions for our own people and circumstances. This may also benefit other nations and systems.

The intent is to also invite and have participation of other relevant societies and organisations in India, to develop a broader consensus covering the standards, practice and education of resuscitation. Gradually working from clinical practioners to a build national consensus involve nursing, paramedics and society at large, while moving towards the formation of a Resuscitation Council for India.

The purpose of these guidelines is to establish the best practices for India to adopt, out of the myriad of guidelines, standards and experiences on resuscitation being practiced today across the world. Many new changes and enhancements have evolved in particular over the last 10 years, which need to be communicated, disseminated and actively established into the Indian response to an emergency.

In resuscitation, the world is moving to consensus led by the International Liaison Committee on Resuscitation (ILCOR) and the American Heart Association (AHA), ILCOR itself is a coming together of several country and regional councils, but with appropriate region country specific modification to tailor the guidelines to local conditions, without loss of the key benefits or value. It is in the need for improved and standardized responses for both medical and non-medical responders in India, as well as

the education and possible certification that this document hopes to seed. In time we hope India will also have its own Council representation on ILCOR's board.

As you review, teach or practice… please keep in mind this truth…

…if the life of a loved-one depended on it, and you are not there… what are their chances of surviving… surviving neurologically intact?

What should the level of response be, given available India's responders, India's system, our processes, our resources and our equipment? What do we need to do to maximize chance of survival?

…As if it is your father or mother, wife, son or daughter who needed to be resuscitated and you were not there!!! What should everyone around the victim know, have and do?

Thus the ultimate scope is not limited to medical responders, or medical societies, and should in time bring other stakeholders, including laypersons, to participate. We also believe that this effort will build to become a platform for extending the practice beyond clinicians and healthcare providers and to drive the need for improved systems of education, research & practice.

To achieve this, we need to start on our journey, this is our baby-step forward…we offer this effort to the nation.

This document is prepared as foundation for the development of guidelines for resuscitation and treatment of the sick and injured patients in India.
The said treatment is rendered with the available resources and at the available settings to give an optimally better outcome for the concerned patient and optimal satisfaction for the health care provider.
This serves as guide, and clinical judgment must be exercised at all times.

ACKNOWLEDGEMENTS

We acknowledge the following societies for taking a bold step forward, we thank the various boards and office bearers, and expect continued support from…

Indian Society of Anesthesiologists (ISA)
Indian Society of Critical Care Medicine (ISCCM)
Society of Emergency Medicine India (SEMI)
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Indian Association of Cardiovascular and Thoracic Anesthesiologists (IACTA)
GVK EMRI (Emergency Management Research Institute)
Academy Of Regional Anesthesia (AORA)
South Asian Society on Atherosclerosis and Thrombosis (SASAT)

Many have helped and given their valuable insight and support and we thank them all. In particular the members of the working group who actively participated and discussed these guidelines over the years are (in alphabetic order):-

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We also specially thank KLE University, Belgaum, ShivaPrime Technovation Pvt Ltd, Laerdal India Pvt Ltd and SiliconLabs Pvt Ltd for sponsoring the production of these guidelines

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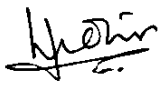
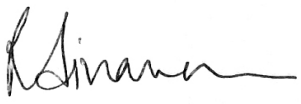
Yours truly,

Dr. S. Manimala Rao *(Chairperson)*

Dr. Ram Rajagopalan *(Vice Chairperson)*



Dr. P.F. Kotur *(Secretary)*



Mr. Sivaram Rajagopalan *(Coordinator)*

THE IDEA AND SCIENTIFIC BASIS FOR THIS DOCUMENT

International Liaison Committee on Resuscitation (ILCOR) with its member organizations namely American Heart Association, European Resuscitation Council, Australian/New Zealand Resuscitation Council, Asian Resuscitation Council and others have extensively reviewed the literature that is available regarding the questions that are raised during the guideline review process. Most of the literature that is available is from the west and some developed countries in the east.

With a varied geographical and climatic conditions, disparity in development, remote health care centers, lack of trained staff and limited resources compounded by over a billion population most of whom being far away from the equipped health care centers, the scenario in India might be a little different from the west. The difficulties faced may be in the form of equipment/ customs/ personnel and awareness. The guidelines are being adapted with an idea that managing emergencies is the same wherever we are until proved otherwise; in the absence of evidence suitable for a particular region it is good to follow the proved methods from other regions till it can done in the said region. Till the formation and establishment of groups and processes to review the literature and tailor the interventions to suit our scenario it is better we adapt the existing guidelines, suit them to our scenario depending on the feasibility and appropriateness of the intervention. *"2010 International Consensus on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care With Treatment Recommendations"* released by the ILCOR in October 2010 is taken as the core reference document for treatment options and the 2010 Guidelines from the AHA and the ERC as used to come to a conclusion on the best treatment option.

CHAIN OF SURVIVAL

ILCOR/AHA/ERC guidelines reiterate the importance of the continuity of care for any victim in emergency. The care begins with the detection of emergency. An integrated set of coordinated actions are required for successful outcomes while managing cardiac arrest [1]. These coordinated actions are linked together and should happen at the most appropriate time and at most appropriate pace. A delay or break in any of the links may lead to variable disability or loss of life.

An emergency needs to be detected at right time. A delay in detecting it may make it unmanageable. Early detection is the first step in effective management of cardiac arrest so is the case with any emergency. Ability to detect the emergency depends on the awareness. At least a few people around should be trained as first responders so that they can dispense the first aid till the health care provider's assistance is taken.

Chart 1: Chain of Survival

Early reporting and activation of Emergency Response System is of much importance. Society requires a well managed and funded Pre-Hospital Emergency

Medical Service System (PHEMSS). Out of hospital arrests depend on the care given by the First Aider and the services of trained Pre-hospital health care provider. USA have 911, European Union has 112; likewise India has 108 as the most common emergency response number, through GVK-EMRI and however there are also many other services more localized such as 1298 in Mumbai, as well as hospital based ambulances services, such as 1066 of Apollo Hospitals. In a study conducted by the National Health Systems Resource Center under the Ministry of Health & Family Welfare, Government of India, the need of "108" model of emergency medical services across the country is emphasized [2]

In-hospital arrests can occur in any area of the hospital and not just in the Emergency or Intensive Care Units. Not always are the advanced providers available. Every hospital should have an Emergency Response System (ERS) (often referred to as a code blue) with common emergency number to alert the emergency team. Crash carts should be placed at strategic locations. There should be an emergency response team constituted from available Physicians, Nursing staff and the other health care providers. The emergency response team along with the crash cart would be able to arrive at the scene as soon as a call is given. Every health care provider should be updated on the Basic Life Support measures.

For a cardiac arrest victim **the sooner we start Cardio-Pulmonary Resuscitation (CPR), the better the outcome**. Chest compressions are the foundation of CPR [1]. Regardless of his/her professional background and his/her skill level, each and every individual in the community needs to know the skill of giving chest compressions [1]. This is because of total arrests that occur, over 90% occur outside of a hospital/healthcare facility, and that too mostly in the home.

Early defibrillation is the next link in the chain of survival. The incidence of in-hospital cardiac arrest is 3-6/1000 admissions [4,5,6] and approximately 25% of them present with Pulseless ventricular arrhythmias [7]. The victim's survival chances decrease with increasing interval between arrest and defibrillation [9,10]. The next link in the chain of survival is **early advanced care**. The advanced care should be followed by a **good post cardiac arrest care.**

The cornerstone of the ERS must be to minimize the time from collapse to treatment. It is important to distinguish between "time from call" to "time from collapse".

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1 - PRE HOSPITAL/EMERGENCY RESPONSE

The individual who collapses suddenly is managed in five stages:

1. The initial response (First responders)
2. Basic Life Support and Public Access Defibrillation
3. Advanced life support
4. Post resuscitation care
5. Long-term management

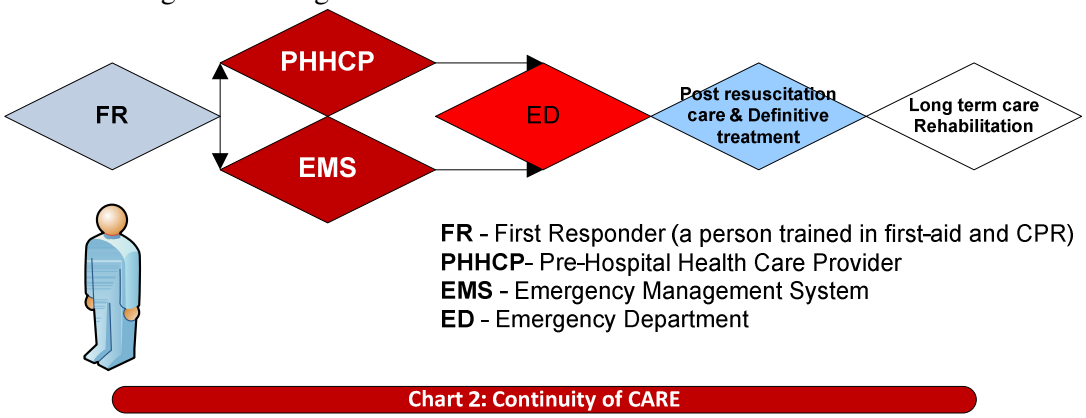

Chart 2: Continuity of CARE

The initial response, including basic life support and public access defibrillation, can be carried out by trained lay people, paramedical personnel, nurses and physicians. There is a requirement for increasingly specialized skills as the patient moves through the stages of advanced life support, post resuscitation care, and long term management. In recent times there has been vast improvement in survival rates due to bystander CPR.

The capabilities of system can be overwhelmed at any time. Such a situation where in the capabilities are overwhelmed or there is a potential of being overwhelmed is an emergency. Though emergencies may seem unpredictable the most susceptible cohort can easily be identified. Individuals with pre-existing medical conditions that have the potential to deteriorate health are one such group that has the potential to land in emergency or go into arrest.

In an effective health care system an individual with a health care Emergency will be handled by people with increasingly specialized skills as the patient moves from the scene to the hospital. Medical care in the immediate period following injury or onset of illness stabilizes the victim and decreases mortality and morbidity [1,2,3,4].

Having trained first responders in the community would help reduce time for initiation of care and if he is trained can help initiate CPR as early as possible. Even in patients who are not in arrest simple procedures such as opening the airway, applying direct pressure to control bleed or proper care for the spine preventing further injury can add a lot to the chances of decreasing morbidity mortality and quality of life post event for the patient.

The 2010 Guidelines have emphasized the important role to be played by emergency dispatch officers in call centers of the Pre-hospital Emergency Medical services. These officers are the first person to get the information and as well give instructions to the caller about detecting the arrest and initiating CPR. The availability of automated external defibrillators would reduce the time from arrest to shock.

Semi-Automated External Defibrillators which are referred to as an AED in this document, are easily used by nonconventional responders, such as firemen, police, ambulance drivers, trained security guards, and minimally trained or untrained lay

persons. This advance has inserted another level of response into the cardiac arrest paradigm. A number of studies have demonstrated that AED use by nonconventional and lay responders in strategic response systems can improve cardiac arrest survival rates. This strategy is based on shortening the time to first defibrillation attempt while awaiting arrival of advanced life support. Steps should be taken to make AED's available at a 2 min walking distance in any location. Today based on ILCOR/ AHA guidelines the BLS responders should be authorized to use AED and AED operation should as simple as anyone without training should be able to use it. Taking the scenario that is prevalent in our country, AED is not available at present; EMS services are not available in about half of our geographical area. Calling for AED or EMS services is no meaning in certain areas, in such a scenario it is prudent that rescuers should continue giving chest compressions after calling for help. As EMS services are not available at all places it is prudent that help may be sought from the available services.

First responders should be supported by an efficient and prompt pre-hospital emergency medical service system (also called Emergency Management System). The trained personnel on the ambulance will be able to dispense efficient basic Life support if not the advanced life support.

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INITIAL RESPONSE AND BASIC LIFE SUPPORT

The documents which formed a base for the treatment options are from the ILCOR/ AHA/ERC guidelines. The treatment options are selected based on the best available evidence as quoted by ILCOR and the feasibility and applicability in Indian scenario as quoted in the preamble and the session after it. Though the options are not based on available evidence from India, they may be taken as options till we test them, tailor and select the best option from the results. Till then the selection of treatment options will depend on the feasibility, applicability of he said options in the settings that we have now.

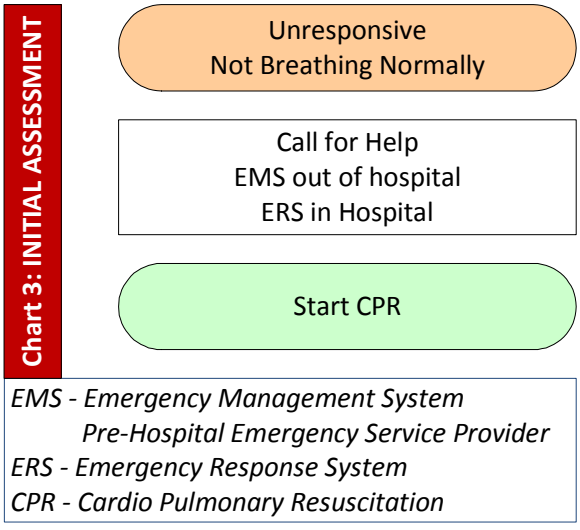
BASIC LIFE SUPPORT SEQUENCE

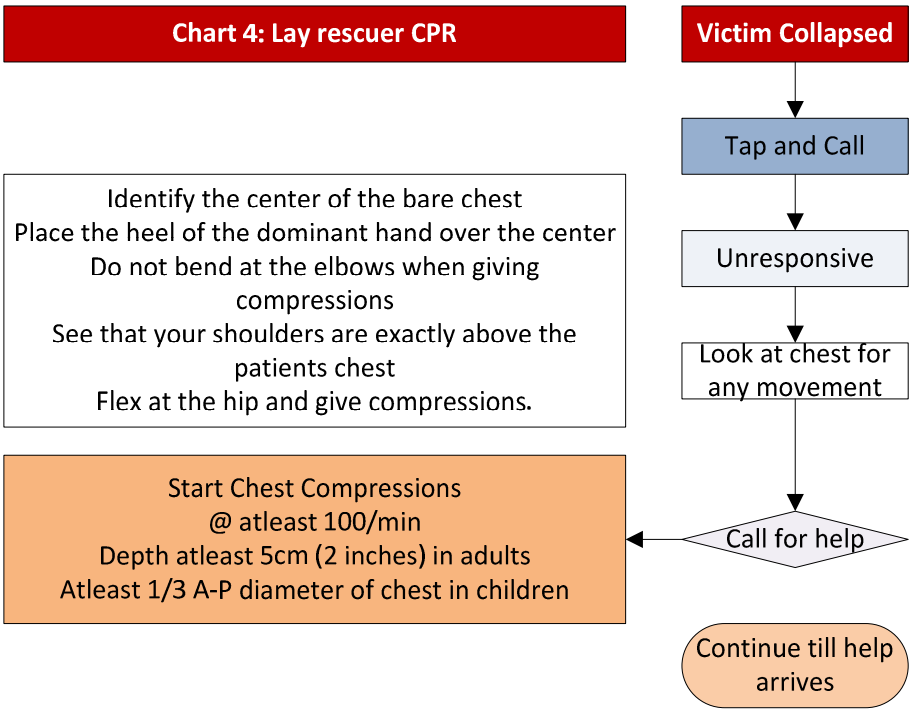
The initial evaluation will confirm whether a sudden collapse is indeed due to a cardiac arrest. Observations of the state of consciousness, respiratory movements, and the presence or absence of pulses in the carotid or femoral arteries can promptly determine whether a life threatening cardiac arrest has occurred. For lay responders, the pulse check is no longer recommended. As soon as a cardiac arrest is suspected, confirmed, or even considered to be impending, calling an emergency rescue system is the immediate priority. With the development of AEDs that are easily used by nonconventional emergency responders, an additional layer for response has evolved.

Collapsed victim

1. Make sure you the bystanders and the patient are safe
2. Assess for response and check breathing
    a. Tap and call
    b. Tap his/her shoulders and shout in to his/her ears
    c. look for chest movement

- *An unresponsive victim who is not breathing or gasping is considered to be in arrest.*





3. If the person is **not responding and not breathing (or gasping)** call for help
    a. In an out of hospital scenario you may ask someone to call a local emergency number and get the AED (if it is available at the scene). The services of nearest hospital ambulance services can also be availed. In about half of our geographical area EMS services are not available, in such a scenario it is prudent that the rescuer continue giving CPR after calling for help as soon he finds some one unresponsive and not breathing normally.
    b. If it's a hospital, activate the Emergency Response System/ Code blue
    c. Make the victim lie on his/her back and kneel beside him

➢ *Checking for response, movement of chest plus calling for help should be done within 10 seconds.*

4. Check for carotid pulse

a. Place the tip of your finger over the thyroid cartilage and slide it laterally into the groove between the trachea and sterno-cleidomastoid muscle, where we can feel the carotid pulse
b. 5-10 seconds is the maximum time that you can take to assess the pulse.

➢ *Checking response and breaths, calling for help and pulse check put together is the basic survey to rule out arrest.*

5. If pulse is not palpable:

a. If you cannot palpate pulse or if doubtful start chest compressions
b. Place the heel of one hand over the center of the bare chest and the other hand over it.
c. Give 30 compressions followed by 2 breaths.
d. Compressions should be at the rate of ***at least 100/min***
e. 30 compressions should be given in 18 seconds
f. Compressions depth should ***at least be 5cm (2 inches)***
g. Each breath should be delivered over 1 second. Adequate chest rise is an indication of adequate breath volume

h. 2 breaths should be delivered in 5-10 seconds
i. Lone rescuer should use Mouth-to-Mouth or Mouth-to-Mask breaths; Bag and mask device can be used only when there are two rescuers
j. When giving mouth to mouth breath the rescuer should pinch the nose, seal the mouth and blow air over 1 second; take a normal breath and give the second breath. If the rescuer likes to use a barrier to give breaths, any porous sheet or cloth can be used. But time should not be wasted to find such material to give breaths.
k. In children and infants when there are two rescuers compression ventilation ratio is 15:2
l. **Do not interrupt compressions for more than 10 seconds**
m. **Allow full chest recoil** (ensure you do not lean on the victim's chest between compressions)
n. When 2 or more rescuers are available the compressor should change his or her role after 2 minutes or after 5 cycles of CPR.

6. Attempt defibrillation as soon as the AED is available

a. Use AED as soon as it is available. Continue compressions until AED instructs to stop CPR to analyze the rhythm. As AED's may not be available in the present scenario, asking for it may not make any sense and it is prudent that we continue giving CPR .Pre-cordial thump can be tried in witnessed cardiac arrests.

1. Steps of operating AED
    1. Power on
    2. Attach pads to patients bare chest and then plug in the connector to the machine
    3. Clear
    4. Analyze
    5. Clear
    6. Shock (push button on AED to deliver Shock)
    7. Resume compressions immediately

7. Continue CPR till advanced help arrives

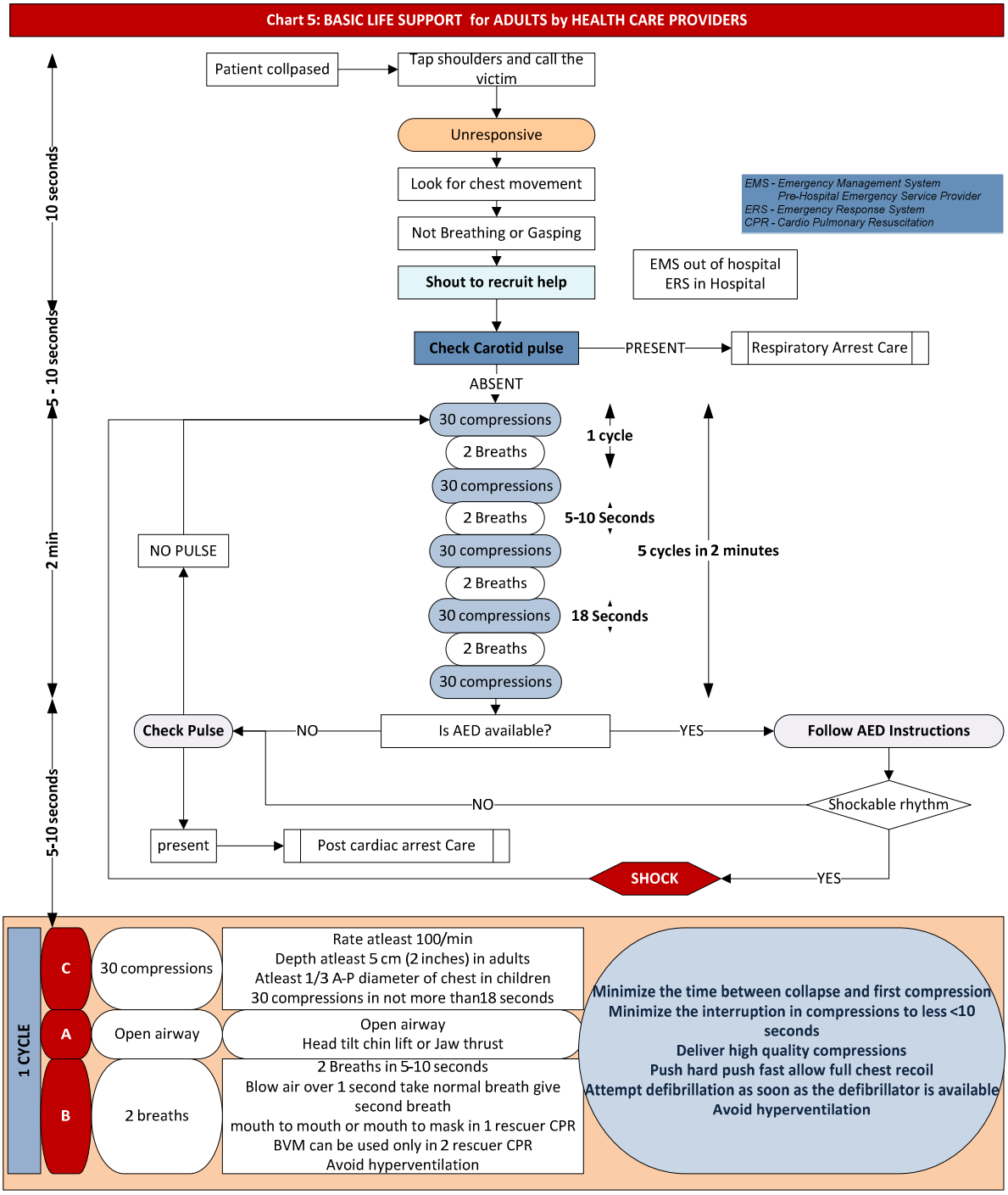


Chart 5: BASIC LIFE SUPPORT for ADULTS by HEALTH CARE PROVIDERS
10 seconds
5 - 10 seconds
2 min
5-10 seconds
Patient collpased
Tap shoulders and call the victim
Unresponsive
Look for chest movement
Not Breathing or Gasping
Shout to recruit help
EMS - Emergency Management System
Pre-Hospital Emergency Service Provider
ERS - Emergency Response System
CPR - Cardio Pulmonary Resuscitation
EMS out of hospital
ERS in Hospital
Check Carotid pulse
PRESENT
Respiratory Arrest Care
ABSENT
30 compressions
2 Breaths
30 compressions
2 Breaths
30 compressions
2 Breaths
30 compressions
2 Breaths
30 compressions
1 cycle
5-10 Seconds
18 Seconds
5 cycles in 2 minutes
NO PULSE
Check Pulse
NO
Is AED available?
YES
Follow AED Instructions
NO
Shockable rhythm
present
Post cardiac arrest Care
SHOCK
YES
1 CYCLE
C
30 compressions
Rate atleast 100/min
Depth atleast 5 cm (2 inches) in adults
Atleast 1/3 A-P diameter of chest in children
30 compressions in not more than18 seconds
A
Open airway
Open airway
Head tilt chin lift or Jaw thrust
B
2 breaths
2 Breaths in 5-10 seconds
Blow air over 1 second take normal breath give second breath
mouth to mouth or mouth to mask in 1 rescuer CPR
BVM can be used only in 2 rescuer CPR
Avoid hyperventilation
Minimize the time between collapse and first compression
Minimize the interruption in compressions to less <10 seconds
Deliver high quality compressions
Push hard push fast allow full chest recoil
Attempt defibrillation as soon as the defibrillator is available
Avoid hyperventilation

RECOGNITION OF ARREST BY LAY RESCUERS AND HEALTH CARE PROVIDERS

Early recognition is the key for early management of cardiac arrest. The conventional method of recognizing arrest has been to look for unresponsiveness, apnea and pulselessness. The present recommendation is**:**

1. *For **untrained rescuers** any victim who is unresponsive and not breathing or gasping is deemed to be in arrest. They should initiate CPR immediately after calling for help. Agonal breaths are considered to be sign of arrest.*
2. *For **health care providers** a victim who is unresponsive, not breathing or gasping and pulseless is deemed to be arrest. Health care providers should check response and breaths. Call for help if unresponsive and not breathing or gasping. Check pulse to initiate initiating CPR.*

When combination of Unresponsiveness and not breathing normally is taken as sign of arrest by lay people there is a chance that the victim who is considered to be in arrest might not actually be in arrest but has received chest compressions. Will that be of any risk to the victim? *Laymen performing compressions can drastically reduce the time from collapse to compressions and rarely lead to serious harm and hence can be encouraged*

CAB OR ABC:

Begin CPR with compressions rather than rescue breaths. Beginning CPR with compressions rather than breaths reduces the time to the first compression. In VF induced witnessed cardiac arrest the breaths are not as important as the compressions; the reason being that oxygen content in non circulating arterial blood remains unchanged till the circulation starts either spontaneously or with compressions. In witnessed VF induced cardiac arrests the critical aspect is not the lack of content of oxygen in the blood but flow of blood; the blood may contain enough oxygen to sustain initially but needs to be moved as early as possible. Hence the sooner we start compressions the better. Initiating with compressions rather than breaths reduces the time to first compression by 10 – 15 seconds

COMPRESSIONS :

"Place the heel of the hand on the center of the bare chest with the other hand on the top." Use of inter nipple line as a guide is unreliable. The *compression rate should be at least 100 compressions per minute. Do not interrupt compression for more than 10 seconds.* The coronary perfusion pressure scales up from zero gradually and plateaus off by the middle of the cycle. It abruptly falls to zero when compressions stop. Chest compression fraction is the total resuscitation time spent giving compressions and this increases survival at the time of discharge. *The chest should be allowed to recoil completely after each compression. The chest compression time and relaxation time should approximately be equal.* Complete chest recoil should be allowed during decompression. Incomplete chest recoil can result in significant reduction in mean arterial pressure, coronary perfusion pressure, cardiac output and myocardial blood flow**.**

When two or more rescuers are available, switch chest compressors every 2 minutes (or after about 5 cycles of CPR) to prevent decrease in the quality of compressions. Health care providers may switch roles when pulse check or rhythm assessment is done.

AUTOMATED EXTERNAL DEFIBRILLATORS (AED) :

An AED is a computerized device, which can detect the shockable rhythms and guide the rescuer to deliver effective CPR and defibrillation. Fully-automatic external defibrillators (FAED) and semi-automatic external defibrillators (SAED) are on the market, however for purpose of this document, all references are to semi-automatic external defibrillators exclusively, which for convenience are referred to just as an AED. AED's require the shock button to be manually pressed to deliver a shock, thus are really semi-AED. Lay rescuer AED programs also called public access Defibrillation programs have been recommended by AHA for the first time in 1995. The aim of this program is to reduce the time from the onset of Sudden Cardiac Arrest (SCA) - VF/ Pulseless VT arrest - to the initiation of CPR and defibrillation. In the process, a network of first responders, integrated ambulance services along with strategically placed AED's have been tried. This intervention has shown to improve the survival chances. CPR and AED use by public safety first responders has shown to increase survival rates for SCA. Establishment of such programs in high incidence areas is highly recommended. For a successful AED program, trained first responders, deployment of AED's and coordination with the local EMS is needed. The goal should be to limit the time gap between collapse and first shock delivery. 3 minutes is recommended by AHA.

AIRWAY AND VENTILATIONS

OPENING THE AIRWAY

For unresponsive adults and children use head tilt chin lift maneuver to open the airway. Lay rescuers can use head tilt chin lift maneuver. In patients suspected to have spinal injury, health care providers should use manual inline stabilization of spine and jaw thrust. If jaw thrust does not adequately open the airway head tilt chin lift can be used.

VENTILATIONS :

Lone rescuer ventilations :

Mouth-to-mouth breathing or mouth-to-barrier device ventilation should be used when a lone rescuer is attempting CPR.

The most common cause of inadequate chest rise after breaths is improperly positioned airway. Rescuers are advised to reposition the airway before giving the second breath if there is no chest rise with the first breath. In victims with serious injury of mouth, mouth to nose ventilation may be tried if possible. In patients with tracheotomy, rescue breaths can be delivered through the stoma with the seal being achieved using a pediatric face mask.

Two rescuer ventilations :

Bag mask ventilation is not recommended for a lone rescuer CPR. Can be used only when there are two rescuers (one giving compressions and the other giving breaths). The breaths should be delivered over 1 second during the pauses in compressions

Bag and mask ventilation is a skill that can be mastered only with practice. One rescuer will form a seal on the mouth and the other rescuer will squeeze the bag. About 600 ml tidal volume can be delivered for adequate chest rise and that would be enough to oxygenate and maintain normocarbia in apneic patients. The routine application of cricoids pressure is not recommended.

When an advanced airway is in place, continuous compressions at a rate of at least 100/min accompanied by breaths at a rate of 8-10/min. The breaths are given every 6-8 seconds

During CPR the cardiac output is approximately 25 to 33% of normal cardiac output. Less than normal tidal volumes may be sufficient to meet the exchange capabilities at the alveoli. With excessive ventilation, the chance of gastric inflation and regurgitation increase. Excessive ventilation is harmful as it may increase the intra thoracic pressure and there by impede venous return.

CHOKING

Obstruction of airway by a foreign body often occurs while eating. Foreign bodies may cause mild or severe airway obstruction. If it's a mild airway obstruction the victim may speak and breathe. Severe airway obstruction makes the victim unable to speak and breathe, has wheezing, and will be in respiratory distress. Maneuvers which can increase pressure within the chest can help dislodge the foreign body. Chest compressions, abdominal thrusts, back blow can be used to dislodge the object. A single method or a combination of abdominal thrusts and back blow can be used. For ease of teaching and learning by first responders a single method of abdominal thrusts can be taught. In case this is not effective back blow too can be used.

ADULT CHOKING SEQUENCE

Victim with symptoms of mild airway obstruction

- Encourage the victim to cough
- Make arrangements to shift the victim to emergency room.

Victim with symptoms of severe airway obstruction and conscious

- Ask the victim "Are you choking?"
- A choking victim clutches his/her neck and would be unable to speak except for a nod
- Reassure the victim that you are going to help him
- Give abdominal thrusts
    - Stand behind the victim
    - Place the fist of one hand between the navel and xiphoid sternum and grasp it with the other hand.
    - Apply upward and backward thrusts.
- Continue abdominal thrusts till the foreign body is dislodged or the victim becomes unresponsive

UNRESPONSIVE VICTIM

Carefully lower the victim onto the floor and start chest compressions (without checking pulse). 30 compressions followed by 2 breaths. Look for foreign body in the mouth before giving breath. Use finger sweep to be to remove foreign body only if you can visualize it.

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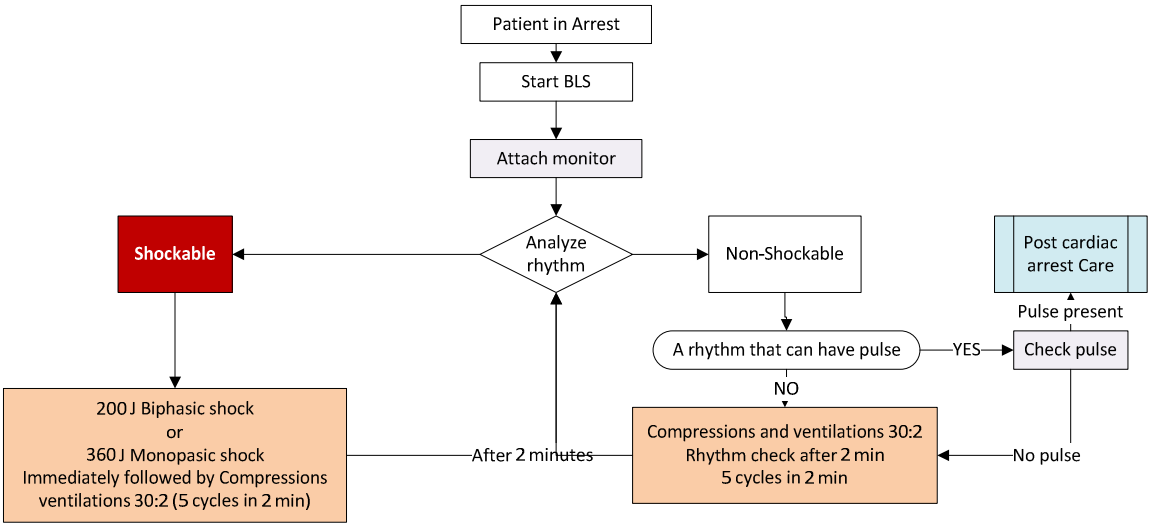
2 - ADVANCED LIFE SUPPORT

INTRODUCTION :

The Consensus statement on treatment recommendations from ILCOR is taken as a base document along with AHA and ERC guidelines to arrive at the consensus for advanced life support guidelines discussed below.

ADVANCED LIVE SUPPORT CHART

Chart 6: Advanced Life Support for adults by Health Care providers



SHOCKS	Manufacturer recommended energy level to be used. In the absene of which maximal energy is to be used. 200 j biphasic shock 360 J Monophasic shock In witnessed arrests and defibrillator unavailable try precordial thump	**Try to improve compression quality:** • If PETCO2 < 10 mm of Hg • If intra-arterial pressure during relaxation phase < 20 mm of Hg
DRUGS	Administer drugs as soon as IV line is available. Do not delay defibrillation to give drugs/ Do not interrupt compressions to give drugs Administer drugs when the compressions are being given **Vasopressors:** • Inj Adrenaline 1 mg IV/IO just before or after the shock during compressions • followed by 20cc NS bolus • Repeat every 3-5 min • Can be given in all four rhythms **Anti-arrhythmic:** • Inj Amiodarone 300 mg IV/IO Bolus followed by 20 cc NS bolus • Can repeat 150 mg additional dose after 3-5 min if there is no response to first dose • Amiodarone indicated only in shockable rhythms • Use Inj lignocaine 2% (1 -1.5 mg/Kg first dose; 0.5 – 0.75 mg/Kg second dose) when Amiodarone is not avilable.	Supplement oxygen Advanced airway insertion should not interfere with compressions. With advanced airway in place, give continuous compressions @ 100 com/min and breaths @ 8 -10 br/min (breath every 6-8 sec) **Always look for reversible causes** Hypoxia, Hypovolemis, Hypo/hyperkalemia, Hydrogen ions, Hypothermia Tension Pneumothorax, Tamponade, Thrombosis - Cardiac, Thrombosis - Pulmonary, Toxins

Minimize the time between collapse and first compression
Minimize the interruption in compressions to less <10 seconds
Deliver high quality compressions
Push hard push fast allow full chest recoil
Attempt defibrillation as soon as the defibrillator is available
Avoid hyperventilation

Survival from cardiac arrest requires a high quality basic life support supported by advanced life support interventions with integrated post-cardiac arrest care. Advanced life support interventions that may include advanced airway management and drugs have

shown to improve the chances of return of spontaneous circulation but have not proven to improve survival at the time of discharge. High quality CPR that is initiated early and early defibrillation have shown to improve the survival at the time of discharge. Lack of standardized post cardiac arrest care may be one of the reasons for the returned spontaneous circulation not being translated to survival at the time of discharge. Now that the standards for post cardiac arrest care have been emphasized and guidelines in place, we shall wait and see whether the accrued advantages of advanced interventions contribute to survival at the time of discharge with a better post cardiac arrest care.

Advanced interventions in the form of drugs or airway management should not interrupt compressions or cause delay in defibrillation. High quality CPR and early defibrillation are essential for any resuscitation attempt. It requires frequent monitoring while giving compressions to assess the effectiveness of compressions.

MONITORING DURING CPR

PARAMETERS THAT HELP MONITOR AND OPTIMIZE THE QUALITY OF CPR:

Mechanical parameters:

- Rate and depth of compressions
- Allowing full chest recoil
- Minimizing interruptions of compressions (maximum 10 seconds)

The above mentioned points have been dealt with in the basic life support session.

Physiological parameters:

- Partial pressure of end tidal CO_2 (PETCO2)
- Arterial pressure during relaxation phase of chest compressions
- Central Venous Oxygen saturation

End-tidal CO2: It is the CO2 content of exhaled air

The normal value range is from 35- 40 mm of Hg. As the blood does not move during arrest, the CO2 from tissues is not delivered to the lungs. The minimal amount of blood flow with compressions can move the CO2 to the lungs. In intubated patients this can be detected by an ETCO2 probe. Animal and human studies have shown that PETCO2 correlates with the coronary perfusion pressure and cerebral perfusion pressure during CPR. In intubated patients, continuous waveform capnography can be used to monitor CPR quality and optimize chest compressions.

A value less than 10 mm of Hg, is an indication to improve the CPR quality.

In intubated patients a sustained normal value can be considered as an indication of return of spontaneous circulation. Evidence for the same in non-intubated patients is uncertain.

Coronary perfusion pressure and arterial relaxation pressure:

Coronary perfusion pressure (CPP) = Aortic relaxation pressure - Right Atrial relaxation pressure.

Increased Coronary perfusion pressures during CPR have shown to improve the chance of return of spontaneous circulation. The measurement of CPP may not be feasible during CPR but a reasonable alternative in the form of arterial relaxation pressure can be used. The same study which showed a correlation between the CPP and ROSC has shown positive correlation between arterial relaxation pressures and the chance of ROSC.

Arterial relaxation pressure < 20 mm of Hg is an indicator to improve the CPR quality or giving Vasopressor or both.

Central Venous Oxygen Saturation (ScvO2):

Provided the arterial oxygen saturation, the oxygen consumption and the hemoglobin content are normal, the changes in central venous oxygen saturation may reflect changes in oxygen delivery to the tissues by means of changes in cardiac output. Normal ScvO2 ranges from 60-80%. During CPR they range from 25 -35%. **A value less than 30% is an indicator to improve CPR quality.** *When in place before cardiac arrest*, ScvO2 can be used as measure of CPR quality, can be used to detect return of spontaneous circulation during chest compressions or when the rhythm check reveals organized rhythm.

Other parameters that may be of use include ***pulse oxymetry*** (presence of plethysmography wave form is an indication of return of spontaneous circulation and may help in post cardiac arrest care); ***Arterial blood gases*** (routine measurement of arterial blood gases has uncertain value); ***Echocardiography*** (Treatable causes of arrest such as Tamponade, Pulmonary embolism, Ischemia and Aortic dissection can be detected using echocardiography and may help in treatment decisions)

RHYTHMS IN CARDIAC ARREST

Cardiac arrest can be caused by 4 rhythms;
Ventricular fibrillation (VF); Ventricular tachycardia without pulse (VT); Asystole; Pulseless Electrical Activity (PEA).

VT and PEA have an organized electrical activity but might not have resulted in mechanical ventricular activity or a mechanical activity that is insufficient to generate blood flow. Asystole is absence of electrical activity and VF is disorganized electrical activity. It is common that one rhythm might evolve in to the other during the course of arrest. The treatment strategy should shift from one rhythm specific strategy to the other smoothly.

VF/ PULSELESS VT:

The only rhythm specific therapy that has shown to improve the survival is defibrillation for VF and pulseless VT. The first provider should immediately initiate CPR, whereas the other provider should go and bring the AED or a manual defibrillator. The benefit of delaying defibrillation to perform CPR before defibrillation is unclear. Defibrillation should be done as soon as possible.

Drug therapy in the form of Vasopressor can be tried when VF/ Pulseless VT persists even after at least one shock and 2 minutes of CPR. The drug should be administered during compressions and the results are better if administered immediately following the shock and during compressions. **Anti-arrhythmic drug therapy may be tried when the VF/Pulseless VT is refractory to CPR, defibrillation and Vasopressor therapy**. Amiodarone is the first line agent in the management of VF/ Pulseless VT. Use Lidocaine 2% in the absence of Amiodarone, but the outcome is not as good as with Amiodarone.

The potential reversible causes for refractory VF/ Pulseless VT might be acute coronary ischemia or myocardial infarction. Efficient handling of hypoxia and hypotension along with detection and treatment of STEMI and therapeutic hypothermia play a major role in the post cardiac arrest care of patients with VF/ Pulseless VT.

ASYSTOLE/ PULSELESS ELECTRICAL ACTIVITY (PEA) :

If the rhythm is asystole or PEA, **CPR should be initiated immediately without defibrillation**. Next rhythm check should be done after 2 minutes of CPR. **Vasopressor can be given as soon as possible to improve myocardial and cerebral blood flow.** Routine use of atropine is unlikely to have benefit in the management of arrest even in Asystole or slow PEA. Shocks are not useful in asystole. Electrical pacing is not effective as routine treatment for the management of asystolic cardiac arrest. Fist pacing can be tried in patients with unstable bradycardia until an electrical pace maker is available.

Reversible causes have to be ruled out.

REVERSIBLE CAUSES :

Identifying the reversible causes of arrest is an important task while managing cardiac arrest. Point of care examination and testing can identify these causes, and interventions at the point of care, will reverse the situation resulting from the cause. Situations like hypovolemia can be corrected at the bedside just by giving fluids, pneumothorax under tension can be identified and treated at the bedside. The 5 H's and T's that are should be considered are given in the table.

Reversible causes	
Hypoxia	**Tamponade**
Hypovolemia	**Tension Pneumothorax**
Hyper/Hypokalemia	**Toxins**
Hydrogen Ions	**Thrombosis - Cardiac**
Hypothermia	**Thrombosis - Pulmonary**

DEFIBRILLATION

VF arrests, early CPR and rapid defibrillation can significantly increase the chance of survival to hospital discharge. Every minute delay in defibrillation after collapse in VF induced arrest, the chance of survival decreases by 7 to 10% if no CPR is provided; with effective CPR the decrease is more gradual and is between 3 to 4%. Over time, VF transforms to asystole and CPR delays this progression. *VF/ Pulseless VT arrests should be treated with defibrillation as early as possible*.

DEFIBRILLATOR AND DELIVERY OF SHOCK :

Whenever a victim is found to be in arrest, the first rescuer should start high quality CPR and the second rescuer should activate the emergency response system and get the AED or manual defibrillator depending on the availability. Rhythm assessment and shock delivery if required should be done as soon as possible. CPR should be performed while defibrillator is being readied; the benefit of delaying defibrillation to perform CPR is uncertain. Analysis of rhythm and shock delivery should be done within 10 seconds. Begin CPR with compressions immediately following shock delivery, and it should be continued for 5 cycles. The fifth cycle should ideally end with compressions when using manual mode of defibrillation; however if AED's are used they maintain the time; stop CPR when the AED asks to do so. The shorter the time period between the last compression and the shock, the better is the outcome. Giving the rescue breaths at the end of 5th cycle and then assessing the rhythm to deliver shock increases the time gap

between the last compression and defibrillation over and above allowed 10 seconds hence it is reasonable to proceed immediately to shock without rescue breathing.

Resume compressions immediately after delivery of shock. After VF is terminated, most victims demonstrate a non-perfusing rhythm (pulseless electrical activity or asystole) for several minutes; the appropriate treatment for such rhythms is immediate CPR.

AED's are designed in such a way that lay rescuers need not undergo any training to use the AED. Ability to follow the commands is what is needed for operating the AED. Trained health care professionals who can read ECG's may use the manual mode of defibrillation. In-hospital defibrillators should be bimodal- that is they can be used either in the AED mode or manual mode. Junior staff and staff who are not good at reading ECG's can start CPR with the defibrillator in the AED mode and turned to manual mode when the experienced health care provider arrives at the scene.

Manual mode of defibrillation may reduce the duration of interruption of compressions compared to automated mode but at the same time there is increased chance of inappropriate shock in manual mode. Present day defibrillators can use any of the available wave forms such as Monophasic or Biphasic or Multiphasic. Mono and Biphasic wave forms are available for clinical use. Biphasic defibrillators have a comparatively better shock success rate and are effective even at lower levels of energy compared to Monophasic defibrillators. In the absence of Biphasic defibrillators, Monophasic defibrillators may be used, however it is strongly recommended that Monophasics be discontinued and replaced with Biphasic defibrillators.

Among the biphasic wave forms we have "T*runcated exponential wave forms; Rectilinear wave forms; pulsed wave biphasic waveforms.* The advantage of one over the other is not defined. Any of the wave forms may be used. Manufacturer recommended energy level should be used for each of the above wave forms. A machine will have any one of the technology, hence it is important for defibrillators to be clearly marked as biphasic with the recommended energy clearly marked.

When biphasic defibrillators are being used the providers should use manufacturer recommended energy level to deliver shock (120 -200J); if the recommended dose is not known maximal dose (200J) may be used. When Monophasic defibrillators are being used, the first and subsequent shocks should be delivered with the maximum energy level that is available (360 J).

Single shock protocol is preferred over stacked shocks. The idea is to minimize the interruptions in chest compressions and moreover the first shock has shown to have more than 90% success rate compared to subsequent shocks in stacked shock protocol.

Self-adhesive defibrillation pads are an acceptable alternative to defibrillation paddles. Antero-lateral position is the reasonable position to apply paddles/pads. Note however that AED or AED modes will require use of self-adhesive defibrillation pads for automatic analysis to occur. This is considered default position depending on the ease of placement and education. Other positions that may be used are antero-posterior (pads/paddles), Anterior – Lt infra-scapular and Anterior- Rt. Infra-scapular. For adults a pad size of 8 -12 cm is reasonable though a specific size for optimal defibrillation is not defined. The composition of conducting material used for uniform conduction is not defined due to lack of evidence. The conducting material helps reduce the level of impedance.

IN-HOSPITAL USE OF AED'S:

The AED's can be placed in areas where the staff have limited rhythm recognition skills or in areas where defibrillation is done infrequently. Multimodal defibrillators are of use in resource limited settings like ours in the government and nongovernment sector. The personnel available may not have the skills to recognize rhythms. In such a scenario the availability of AED's is of much help in reducing the time between collapse and first shock. Presence of AED mode in hospital defibrillators may facilitate our junior staff use it in AED mode till the experienced staff come. Note that BLS standards today call for training and use of an AED

USE OF PRECORDIAL THUMP:

Precordial thump may be considered for termination of monitored unstable ventricular tachycardia when defibrillator is not readily available for use. But it should not delay CPR or use of defibrillator.

DRUGS AND IV ACCESS

The drug administration is of secondary importance compared to quality CPR and defibrillation. Some studies reported a lower CPP when Vasopressor is delayed; another study has reported that the interval between the first shock and administration of anti-arrhythmic is a predictor of survival. The drugs should be administered as soon as an intravenous access is available. The routes that can be used to deliver drugs during cardiac arrest are: peripheral Intravenous; Intra-osseous; Central IV drug Delivery; Intra-tracheal.

The drugs administered via peripheral intravenous should be administered by bolus injection and followed by a 20 cc of IV fluid bolus to push the drug to the central circulation. Peripheral intravenous access may not be readily available in case of arrest. In such a situation the providers may establish an intra-osseous access. Bones have a non-collapsible venous plexus. Access to this plexus can be established efficiently; can be used for drug administration; fluid resuscitation; sampling of venous blood for laboratory evaluation. Central venous access should be tried only by appropriately trained providers in the absence of contra-indications. The same line can be used to monitor ScvO2. *Placement of any of the lines should not interrupt chest compressions or delay defibrillation.* Endo-tracheal route for administration of drugs (Adrenaline, vasopressin and lidocaine) can be used when the intravenous access is not available.

VASOPRESSOR :

Adrenaline: Alpha-adrenergic effects of Adrenaline can increase the coronary perfusion pressure and cerebral perfusion pressure during CPR. Administer 1 mg of Adrenaline IV/ IO bolus every 3-5 minutes during CPR.

Vasopressin: A dose 40 IU can be given as IV/IO bolus as a replacement of either the first or the second dose of Adrenaline.

ANTI-ARRHYTHMICS :

Amiodarone: It has to be considered when the initial phases of CPR, shocks and Vasopressor have failed to revert VF/ Pulseless VT. The initial dose is 300 mg bolus IV/IO. This can be followed by a second dose of 150 mg IV/IO bolus given only when the first dose did not work.

Lidocaine: Use 2% lidocaine if Amiodarone is not available. The first dose is 1 to 1.5 mg/kg IV/IO bolus. A second dose of 0.5 to 0.75 mg/kg IV/IO bolus may be considered if the first dose has no effect.

Magnesium Sulphate: Routine administration of Magnesium Sulphate is not recommended in the management of cardiac arrest. When arrest is associated with Torsades de pointes, 1-2 gm of Magnesium Sulphate diluted in 10 ml D5W may be administered IV/IO.

INTERVENTIONS NOT RECOMMENDED FOR ROUTINE USE DURING CPR :

Available evidence shows that routine use of Atropine in PEA and Asystole is unlikely to have any benefit. Routine use of sodium bicarbonate, Calcium, fibrinolysis is not recommended for patients in cardiac arrest. However in special situations like pre-existing metabolic acidosis, hyperkalemia or tricyclic antidepressant overdose bicarbonate may be used. But the adverse effects have to be kept in mind.

AIRWAY & VENTILATION

OXYGEN :

Use of 100% oxygen is reasonable. *It is reasonable to use Oro-pharyngeal and Naso-pharyngeal airways when performing bag mask ventilation in cardiac arrest. In patients with known or suspected basal skull fracture an oral airway is to be used. Routine use of cricoids pressure is not recommended.*

ADVANCED AIRWAYS:

If placement of advanced airway is going to interrupt chest compressions, it is better to defer the advanced airway placement until the patient fails to respond to the initial rounds of CPR and defibrillation or return of spontaneous circulation.

There is inadequate evidence to define the optimal timing for the placement of an advanced airway. However if a supraglottic airway (laryngeal mask airway or an esophageal tracheal tube or a laryngeal tube) is available it can be used. Placement of a supraglottic airway will not interrupt compressions and can be placed when the compressions are going on.

ENDO-TRACHEAL INTUBATION :

The indication for intubation in case of arrest:

1. Inadequate Bag and Mask Ventilation
2. Absence of airway protective reflexes

The factors that go against intubation in case of arrest are; inexperienced providers might take a long time to intubate, which might result in prolonged interruption of compressions; might cause injury to the airway; might cause hypoxemia from prolonged intubation attempts; might fail to recognize tube misplacement or displacement.

The advantages that properly placed endotracheal tubes provide include: it keeps airway patent; permits suction; protects airway from aspiration; provides alternate route to administer drugs.

How to minimize time interruption of compressions while intubating the patient :

Preparation should be done while CPR is underway. The compressor should continue compressions till the end of the cycle. The intubator should take position and hold laryngoscope in place while the compressions are going on. It is presumed that the tube is kept ready with stylet in place. As soon as the 30^{th} compression is over the intubator should visualize the vocal cords and insert the tube taking no more than 10 seconds. The compressor should start compression at his/her usual pace and interval. Compressions can be started as soon as the tube passes the vocal cords.

Confirmation of tube placement

The risk of misplacement or displacement of the tube is very high (6% to 25%). Confirmation of airway placement can be done

- Watching the tube passing through the vocal cords;
- Chest expansion; absence of sounds over the epi-gastrium and their presence on the chest on auscultation.

For additional confirmation

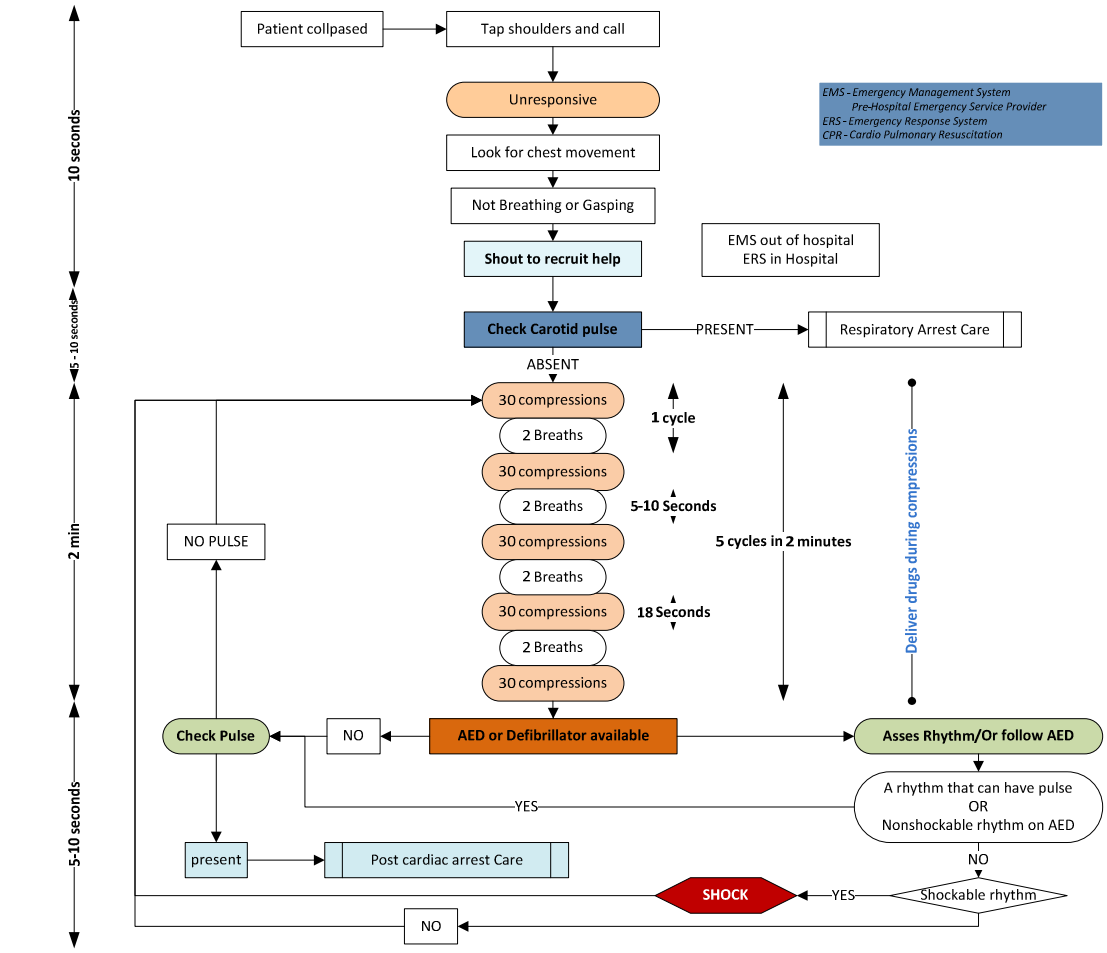
- Continuous wave form capnography can be used and is a most reliable method of confirming and monitoring correct placement of endotracheal tube.
- In the absence of capnography exhaled CO2 detectors can be used. When capnography is not available esophageal detector devices (EDD) can be used as an initial method of confirming the tube placement.

Attention should be given to secure the tube after proper placement. It should be secured with tape or a commercial device. The devices may be considered during patient transport. Chest radiograph can be taken after tube placement confirmation and fixation. This can be done during post cardiac arrest care.

Ventilations with ET tube in place :

Once ET tube is in place we need not go for 30:2 compression ventilations. Continuous compressions have to be given at a rate of at least 100 compressions per minute and breaths should be given at a rate of 8-10 breaths per minute. Breath should be given every 6-8 seconds. Automatic transport ventilators can be useful for ventilation during prolonged resuscitative efforts especially in pre-hospital settings. Bag Mask device has to be kept as a backup.

CHART 7: BASIC LIFE SUPPORT & ADVANCED LIFE SUPPORT for ADULTS by HEALTH CARE PROVIDERS



Compressions
@ atleast 100/min
Depth atleast 5cm (2 inches) in adults
Atleast 1/3 A-P diameter of chest in children
30 compressions in not more than18 seconds

C — 30 compressions
A — Open airway
B — 2 breaths
1 CYCLE

Open airway
Head tilt chin lift or Jaw thrust

2 Breaths in 5-10 seconds
Blow air over 1 second take normal breath give second breath
mouth to mouth or mouth to mask in 1 rescuer CPR
BVM can be used only in 2 rescuer CPR
Avoid hyperventilation

Try to improve compression quality:
- If PETCO2 < 10 mm of Hg
- If intra-arterial pressure during relaxation phase < 20 mm of Hg

SHOCKS
Manufacturer recommended energy level to be used. In the absence of which maximal energy is to be used.
200 j biphasic shock. 360 J Monophasic shock.
In witnessed arrests and defib unavailable precordial thump can be used.

Supplement oxygen
Advanced airway insertion should not interfere with compressions.
With advanced airway in place, give continuous compressions @ 100 com/ min and breaths @ 8-10 br/min (breath every 6-8 sec)

DRUGS
Administer drugs as soon as IV line is available.
Do not delay defibrillation to give drugs/ Do not interrupt compressions to give drugs
Administer drugs when the compressions are being given

Vasopressors:
- Inj Adrenaline 1 mg IV/IO just before or after the shock during compressions
- followed by 20cc NS bolus
- Repeat every 3-5 min
- Can be given in all four rhythms

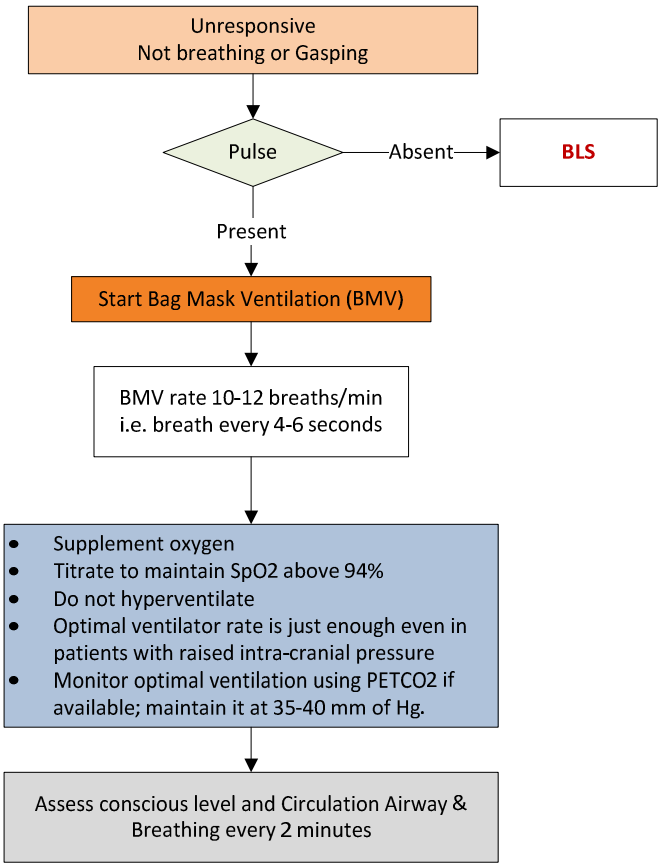
Anti-arrhythmic:
- Inj Amiodarone 300 mg IV/IO Bolus followed by 20 cc NS bolus
- Can repeat 150 mg additional dose after 3-5 min if there is no response to first dose
- Amiodarone indicated only in shockable rhythms
- Use Inj lignocaine 2% (1 -1.5 mg/Kg first dose; 0.5 – 0.75 mg/Kg second dose) when Amiodarone is not avilable.

Always look for reversible causes

Hypoxia	Tension Pneumothorax
Hypovolemis	Tamponade
Hypo/hyperkalemia	Thrombosis - Cardiac
Hydrogen ions	Thrombosis - Pulmonary
Hypothermia	Toxins

Minimize the time between collapse and first compression
Minimize the interruption in compressions to less <10 seconds
Deliver high quality compressions
Push hard push fast allow full chest recoil
Attempt defibrillation as soon as the defibrillator is available
Avoid hyperventilation

Chart 8:Management of Respiratory Arrest



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3 - POST RESUSCITATION STRATEGIES

While it is appreciated that good post-resuscitation care plays a major role in the recovery of survivors of sudden cardiac arrest, very little evidentiary support is available in current literature. Support of the cardio respiratory system is essential after return of spontaneous circulation (ROSC).

Respiratory support:

1. In the patient with ROSC who has had a return of consciousness, respiratory support mainly aimed at maintaining oxygenation is essential. Consider the following:-
    a. As peri-arrest stunning of the myocardium leads to pulmonary edema, treatment with diuretics and venodilators (nitroglycerine) will help improve oxygenation.
    b. As bag-mask ventilation during CPR may result in gastric distension, decompression using a nasogastric tube will aid respiration.
    c. If oxygenation remains unresponsive to administration of face mask oxygen and the measures mentioned above, support with noninvasive ventilation or endotracheal intubation may need to be considered.
2. Patients intubated during CPR, or those who remain unconscious and unable to protect their airway after ROSC, will require invasive ventilatory support. Here too the initial focus is on correcting recalcitrant hypoxia by the administration of oxygen and the judicious use of positive end-expiratory pressure (PEEP).
3. Hypocapnia could result in cerebral ischemia. Hyperventilation should be avoided and ventilatory rate to maintain normocapnia (PaCO2 of 40 -45 mm of Hg or PETCO2 of 35 – 40 mm of Hg) would be appropriate.
4. Oxygen supplementation should be titrated to maintain oxygen saturation above 94%.

CARDIOVASCULAR SUPPORT :

Haemodynamic instability after recovery from a cardiac arrest may be due to the coronary disease which will require revascularization therapy. More typically, low blood pressure is a consequence of peri-arrest myocardial dysfunction (transient; lasting for 24 to 48 hours) or vasodilation that appears to be related to the release of inflammatory cytokines in the post arrest period. Therapy in this situation is also based on logical correction of physiological parameters rather than on outcome data from clinical trials.

1. Obtain a 12 lead ECG and cardiac markers after return of spontaneous circulation.
2. Invasive monitoring of arterial pressure will be essential in the initial days after resuscitation.
3. A stable vascular access (central or peripheral) to allow administration of fluids, vasoactive and inotropic medicines is necessary.
4. While evaluating the hypotensive patient, 2-D Echocardiography will rapidly identify the existence of myocardial dysfunction and allow appropriate choice of therapy.
5. The hypotensive patient with myocardial dysfunction (clinical pulmonary edema or echocardiographic evidence of global myocardial dysfunction) should not be challenged with fluids. Vasoactive drugs such as adrenaline or noradrenaline should be considered to stabilize blood pressure prior to initiation of inotropes (dobutamine).
6. In hypotensive patients without myocardial dysfunction, fluid resuscitation may need to be followed by pressor agents to counter the vasodilation.

7. Targeted mean arterial pressures >100 mm Hg have been demonstrated to be no more effective than lower pressures in influencing neurological outcomes. Likewise, though there is no evidence of benefit from setting specific cardiac output goals, maintaining a Mean arterial pressure over 65 mm of Hg is found to be reasonable.
8. It is logical to continue the last anti-arrhythmic drug used prior to ROSC as it may have contributed to resuscitability. There is insufficient evidence to recommend prophylactic anti-arrhythmics in all survivors of sudden cardiac arrest

NEUROLOGICAL SUPPORT AFTER CPR :

While much attention is directed at good intensive care support of the haemodynamics and ventilation, processes aimed at maximizing neurological recovery are probably equally important. Though there is no proven effect of specific medications in enhancing neurological recovery, the following aspects of neurological support should be considered:

1. Control of seizures: Seizures are common in the post-resuscitation period (over 10% after ROSC and nearly 40% in patients, in coma after an arrest) and may exacerbate cerebral injury. Control of seizures with benzodiazepines, phenytoin, or propofol, is appropriate. Myoclonus and myoclonic status may respond better to a combination of valproate and benzodiazepine. While seizures and myoclonus are by themselves not predictors of adverse outcome, myoclonic status is associated with bad outcome especially when it occurs early (<24 hours) after ROSC. In the absence of definitive studies, prophylactic administration of anti-seizure medications to all comatose survivors of CPR is not recommended.
2. Blood glucose control: Though there is a strong association between high blood glucose levels after CPR and poor neurological outcome there are no studies demonstrating improved neurological outcome or survival with strict glycaemic control. Comatose patients are at a risk for unrecognized hypoglycaemia, and this risk increases as the blood glucose target is lowered. A recent RCT of 90 patients in coma after a witnessed VF arrest demonstrated no effect on survival or recovery of neurological status with tight control (70-108 mg/dl) when compared to a regimen of moderate control (108-145 mg/dl). However, hypoglycemia (<55mg/dl) was nine times as frequent in the tight control group (18% vs. 2%; p=0.019). Higher serum neuron specific enolase levels at 48-hours post-resuscitation implied greater neuronal injury with tight control. Considering the potential for hypoglycaemia-induced brain-injury, care must be taken to avoid low blood sugar targets after CPR.
3. Control of hyperthermia: The risk of a poor neurological outcome increases with increasing body temperature above 37°C, and hyperthermia is common in the first 48 h after cardiac arrest. Treatment of hyperthermia with antipyretics or active cooling methods appears logical.
4. Therapy directed at limiting brain injury: Unfortunately there is no proven value of medications to enhance neurological recovery. The multi-centre BRCT trials demonstrated no improvement of survival or neurological function with the administration of barbiturates, steroids or calcium channel blockers (lidoflazine) in the peri-resuscitation period. Only mild therapeutic hypothermia (see below) is of value in enhancing neurological recovery after CPR.

MILD THERAPEUTIC HYPOTHERMIA

Cooling the brain after anoxic injury may suppress many of the chemical reactions that promote reperfusion injury. Despite its lack of efficacy in head trauma, two recent randomised clinical trials of mild hypothermia (core temperature of 33± 1C) in unconscious patients after CPR showed improvement in short-term and 6-month outcomes. Though these trials were restricted to VF/VT arrest in a pre-hospital setting, it appears reasonable to extrapolate this benefit to non-shockable rhythms and to in-hospital arrest as well. As the benefits demonstrated in these trials are very dramatic and considering its very acceptable risk profile (mainly the development of mild coagulopathy and infections) therapeutic hypothermia, which is often achievable at a low cost, must be the standard of care in these patients.

The following approach to mild therapeutic hypothermia (MTH) is generally used:

1. MTH must be administered to all unconscious adult patients with restored spontaneous circulation (ROSC) after out-of-hospital VF/VT arrest. MTH should also be considered in in-hospital arrest and non-shockable pre-hospital events with short resuscitation times. MTH is best avoided in patients with significant haemodynamic instability after ROSC.
2. The cooling should be started as soon as possible; usually in the emergency department, prior to ICU transfer. It is initiated by full exposure of the victim's body and surface cooling with ice and iced water sprays. Cold saline (4C) infusion administered during resuscitation or after ROSC will accelerate cooling. Specialized cooling devices using refrigerants for surface or intravascular cooling are effective, but the cost of such treatment is prohibitive in most Indian patients.
3. Continuous monitoring of core temperatures (with a rectal or esophageal probe or bladder thermistor) will allow maintenance of the temperature in the 33± 1o C range for 12 to 24 hours and will minimize the arrhythmia risk associated with deeper cooling.
4. Shivering may occur and will occasionally need the administration of sedative and neuromuscular blocking drugs.
5. The optimal rate of re-warming after the therapeutic period is unknown and passive methods are currently considered to be acceptable.
6. MTH increases the risk of coagulopathies and infection. Routine monitoring of platelet counts and PT, APTT is justifiable.

Table 1 describes a protocol for mild therapeutic hypothermia that may be easily applied in the Indian intensive care unit, without the need for specialized technology

Table 1 : A Protocol for Mild Therapeutic Hypothermia after Cardiac Arrest

a. **Unconscious patient after** **VF/VT arrest. Administer: MTH**
Any non-VF/VT arrest with short resuscitation time: Consider MTH
Any in-hospital arrest with short resuscitation time: Consider MTH
Low BP after ROSC: Avoid MTH if large doses of pressors needed

b. **Use refrigerated resuscitation fluids (4°C) during CPR**

c. **Place an electronic rectal/esophageal probe or bladder thermistor for continuous display of core body temperatures. Draw blood to check baseline platelet count, PT and APTT**

d. **Initiate cooling after ROSC by full exposure of the victim's skin. Apply ice packs placed over the major vessels in the neck, axilla and groin. Spray the skin surface with iced water (using an atomiser) and expose to circulating fans.**

e. **If patient does not have pulmonary oedema or cardiac dysfunction, administer boluses of cold saline (4°C) to accelerate core cooling. Monitor clinically for volume overload, especially if large volumes of cold saline (>30ml/kg) are used.**

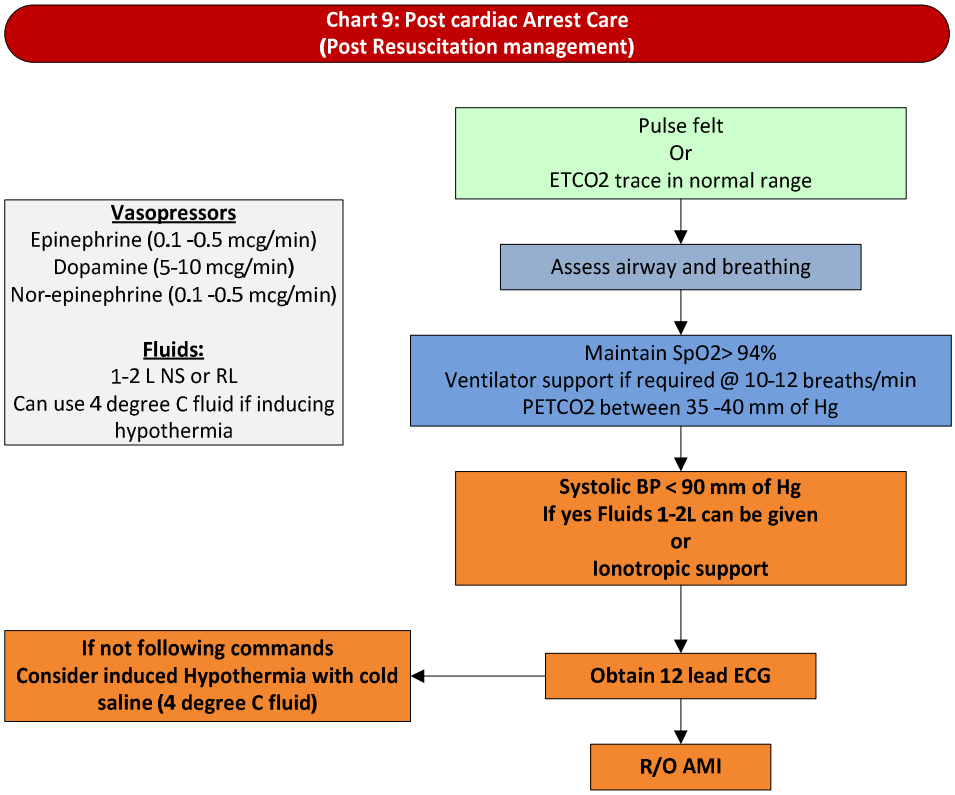
f. **Maintain a temperature target of 33 ± 1°C. If temperature < 33°C remove ice packs but continue exposure of skin and circulating fans. Avoid temperatures < 32°C.**

g. **If shivering occurs, consider "counter-warming" (warm packs) of the extremities. If conservative methods do not abort the shivering consider titrable doses of IV pethidine (25 to 50 mg). Magnesium sulphate infusion (1-3gm/hr) is also effective. Consider neuromuscular blocking drugs only as a last resort in recalcitrant rigors. A single paralysing dose of neuromuscular blocker (0.1mg/kg of vecuronium) is usually sufficient.**

h. **Maintain at 33 ± 1°C for 12-24 hrs. There is no proven benefit to extending the duration of MTH.**

i. **After 24 hrs (maximum), passively re-warm the patient by stopping skin exposure, surface cooling and circulating fans. Woolen blankets, or rarely, circulating air-warming devices may be considered. Avoid hyperthermia**

j. **Continue to monitor the coagulation profile daily, until normalisation of parameters.**



PROGNOSTICATION

While ALS can result in the restoration of circulation in over 40% of victims, less than 5% of pre-hospital arrests and about 15% of in-hospital SCA survive to be discharged alive from the hospital. Survival to discharge is strongly correlated with recovery of neurological function and prognostication of such recovery is a major concern after CPR. Such prognostication can guide the patient's family in making decisions regarding ongoing life-support measures and can go a long way in limiting the costs of care in individuals who are unlikely to show meaningful neurological recovery. Though prognostication is predominantly a clinical exercise, it is common for clinicians to include diagnostic tests which have very limited impact on predicting good outcomes. Despite the uncertainty that persists, certain caveats can be identified:

1. In general, it is difficult to predict good neurological outcome after CPR, but poor outcome can be identified by clinical / investigational features.
2. Though arrest to CPR interval, duration of CPR and etiology may correlate with poor outcome, none of these factors can sufficiently discriminate between good and poor outcome
3. Early neurological signs (e.g. pupillary light response within hours after the arrest) have no prognostic value. The earliest predictions of poor outcome can only be made only after 24 hours from the time of ROSC.
4. Myoclonic status epilepticus is the only feature in the first 24 hours that predicts a bad outcome with certainty.
5. Nearly 50% of the patients who die, will do so by 72 hours; amongst survivors, absence of light and corneal reflexes, and motor function not better than flexor (i.e. extensor or absent) at this time is unequivocally associated with poor outcome.

6. Though somatosensory evoked potential studies (an absent N20 component with median nerve stimulation) and serum neuron-specific enolase levels (> 33ug/L) on days 1-3 after the arrest have the ability to predict poor outcomes with certainty, their unavailability in most Indian hospitals limits their value as prognostic tools.
7. Routine EEG evaluation, ICP monitoring, jugular venous saturation monitoring and CT or MRI imaging have not been shown to have sufficient discriminatory power in prognostication at present and should not be used for this purpose.
8. When any of the above tests identify a patient with virtual certainty of non-recovery, it is important to indicate this to the patient's family so that decisions about ongoing support can be made.
9. Even when all the above tests identify that the patient has a chance of recovery, the duration time and the extent of recovery are difficult to predict (indeterminate outcome). Once again it is important to counsel the family on the prognosis, plans related to ongoing support and the costs of such care.

Table 2 : Prognostication Of Neurological Function After Cardiac Arrest

Post-CPR; patient is Neurologically unresponsive

Assessment at less than 24 hours

1. **Do NOT prognosticate on the basis of location of arrest, duration of circulatory arrest or cardiac rhythm at presentation**
2. **Do NOT prognosticate on the basis of an absent pupillary light response, absent corneal reflex or absent motor activity.**
3. **Recovery unlikely if myoclonic status epilepticus seen in this period**

Assessment at 24-72 hours

4. **Recovery unlikely if pupillary, corneal reflexes are absent.**
5. **If SSEP is available; evaluate median nerve stimulation on both sides; recovery unlikely if SSEP shows bilateral absence of N20 component.**
6. **if serum neuron specific enolase can be measured; recovery unlikely if NSE >33ug/L.**

Assessment after 72 hours

7. **Recovery unlikely if corneal or papillary reflexes are absent of if GCS motor response is extensor or poorer.**
8. **Patients not classified as "unlikely to recover" by the above tests fall into the category of "indeterminate outcome"; require long observational periods to assess improvements.**

The following tests have NO value in assessing neurological prognosis

9. **Standard EEG**
10. **Measurement of Intracranial pressure and jugular venous saturation.**
11. **Brain CT scan**
12. **Brain MRI**

Consider confounders; Sedative medications
In patients administered mild therapeutic hypothermia, consider neurological assessment after achieving normothermia

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4 – INTRA OPERATIVE CONSIDERATIONS

Intra operative cardiac arrest (CA) occurs due to varied etiology and frequency. The exact percentage may not be totally evident. In India, we also do not have such readily available data.

The etiological factors for CA are varied. They could be due to:-

1. Surgical, anaesthesia or drug related.
2. Inadequate or uncontrolled pre operative preparation assessment
3. Severe co-morbidities.
4. Severe bleeding
5. Cardiac complications.

Anaesthesia is commonly regarded as high risk activity. Many experts acknowledged that very impressive safety improvements have been made in this field [2,3] and that Anesthesia related deaths have reduced over the years (4). Anesthetic mortality in the past few years is estimated to range from 0.5 to 10 per 10,000 anaesthetics [5,6].

Monitoring is critical during, and after any arrest, even though the decreases in mortality and brain damage did not show much relationship to use of mandatory monitoring by end tidal CO_2 or the pulse oxymetry. The deaths due to respiratory events decreased but those due to cardiac are on the rise [7]. In particular, End tidal monitoring has two key values:-

1. It confirms that the tube is in the trachea and not the esophagus.
2. It tells us the adequacy of resuscitation and the prognosis after an arrest.

Intensive cardiac monitoring could help reduce cardiac events too as end tidal monitoring has reduced respiratory events.

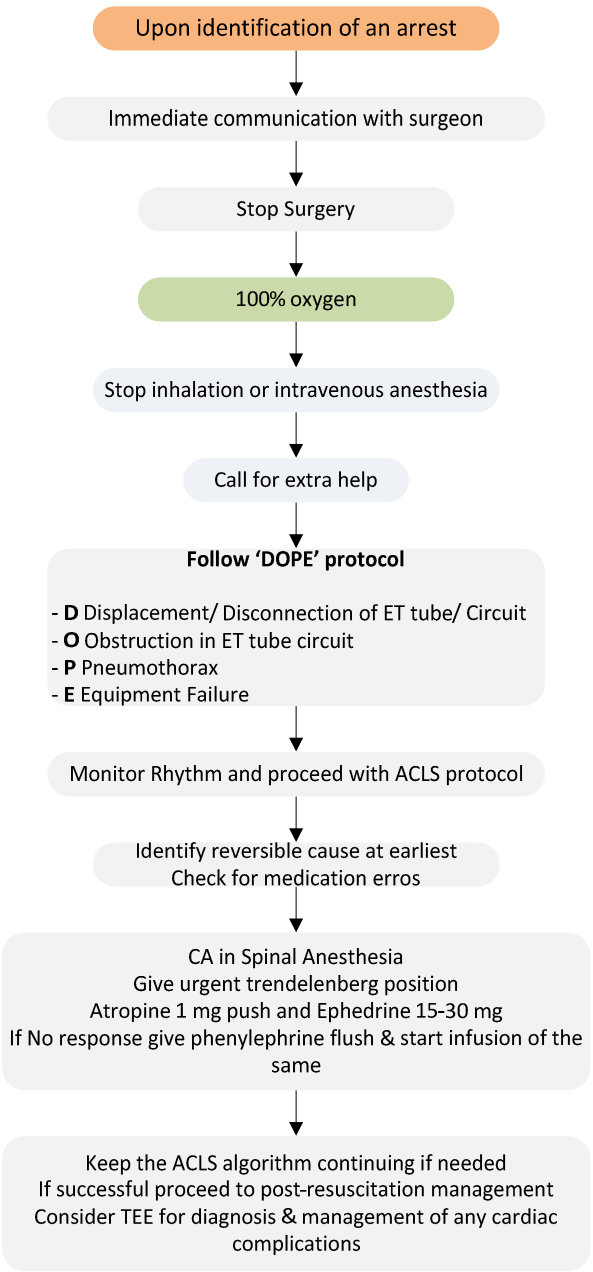
A rate of 0.136 CA has been reported by Japanese anaesthesiologists in a 13 year period. The majority were due to surgical causes and uncontrolled haemorrhage. While Anaesthesia related were mainly due to cardiac complications [8]. Patients undergoing spinal anaesthesia are known to have sudden cardiac arrests. They were analyzed for recurring patterns, which revealed high dose of sedative medication leading to loss of verbal contact with patient and leading to respiratory inadequacy and hypoxia. The second factor was inadequate appreciation of interaction between high spinal and the mechanism of CPR. Prompt reversal with Trendelenberg position, atropine and good powerful alpha agonist will restore perfusion [9].

Improvements in operative and perioperative critical care are resulting in an improved outcome after intra operative cardiac arrest. A retrospective analysis of patients who experienced CA in non cardiac surgeries with main outcome measure of survival out of OR and survival for discharge out of hospital. In 16,661 patients 24 had CA. 62% were resuscitated and shifted to ICU, 38% were discharged from hospital. 50% 0f CA's were related primarily to be cardiac in origin. Predictors of mortality was high, when higher dosages of pressor or inotropes were used and the CA lasted for more than 15 minutes [10].

Use of trans-esophageal echocardiogram (TEE) during CA in patients undergoing non cardiac surgery seems to be a useful tool in diagnosing and management, post resuscitative efforts. According to guidelines given by the American Society of Anesthesiologist and American Society of Cardiovascular Anaesthesiologist's, life-threatening haemodynamic disturbances is rated as category 1 for use of TEE. Suspected primary diagnosis could be established in 19 out of 22 patients who had CA in non cardiac surgery. TEE has few disadvantages and could be learnt with training [11].

GUIDELINES FOR INTRA OPERATIVE CARDIAC ARREST

Chart 10: Intra-operative Considerations



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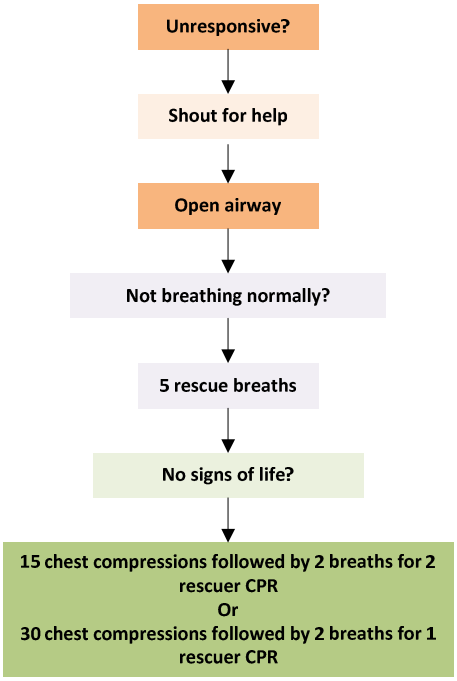
5 - PEDIATRIC CONSIDERATIONS

INTRODUCTION

Major differences in adult and pediatric resuscitation are based on the different etiologies of arrest as well as the differences in anatomy and physiology in children as compared to the adults. The majority of arrests in children are due to hypoxaemia or hypotension or both. Respiratory arrest may occur alone and if treated promptly, may not be associated with cardiac arrest. Hence a lot of emphasis is placed on airway and ventilation in children.

PEDIATRIC BASIC LIFE SUPPORT

Chart 11: Pediatric Basic Life Support



Rescuers who have been taught adult BLS, and have no specific knowledge of paediatric resuscitation, should use the adult sequence. The following modifications to the adult sequence will, however, make it more suitable for use in children :

a. Give five initial rescue breaths before starting chest compression.
b. If you are on your own, perform CPR for 1 min before going for help.
c. Compress the chest (details provided below).

Resuscitation should follow the usual standard ABC – Airway, Breathing and Circulation

A- Airway:

Relaxation of the jaw with passive posterior displacement of the tongue or the presence of vomitus or a foreign body can lead to airway obstruction. So the rescuer must first open the airway, clear the airway of secretions or foreign objects and then maintain

the open airway with a head tilt, chin lift and/or jaw thrust maneuver. In case of a head or neck injury, avoid the head tilt and chin lift.

B- Breathing

- Look- for rise and fall of the chest or abdomen
- Listen for exhaled air and
- Feel for the flow of exhaled air at the nose and mouth

If the child is breathing well place the child in the lateral or recovery position. If not proceed with ventilation – either mouth to mouth or with bag/mask ventilation while maintaining the open airway. Check efficacy of ventilation by assessing the rise and fall of chest or abdomen (note that the fall of the abdominal wall is important- continuous distension of the abdomen signifies an obstructed airway with gastric distension). Use oxygen supplementation wherever possible.

C- Circulation:

While assessing the signs of circulation, do not spend more than 10 seconds in identifying the pulse. In infants, check a pulse over the brachial or femoral artery instead of the carotid due to technical difficulty (large head, small neck and difficulty in finding the carotids). In a child the carotid pulse may be felt as in adults.

If there are no signs of circulation, or no pulse, or a slow pulse (less than 60/min with poor perfusion), or if one is not sure, it is advised to start chest compression combined with rescue breathing in the ratio 30:2 (similar to adults) for lone rescuer and 15:2 in case of 2 rescuers. The best method for compression varies slightly between infants and children.

In general

- 'Push Hard': with sufficient force to depress the chest approximately 1/3 to ½ the antero-posterior diameter of the chest
- 'Push fast': at a rate of approximately 100 compressions per minute
- Release completely to allow the chest to recoil fully so as to allow complete re-expansion and thus blood flow to the heart
- Minimize interruptions in chest compressions which would interrupt coronary filling.

CHEST COMPRESSION IN INFANTS:

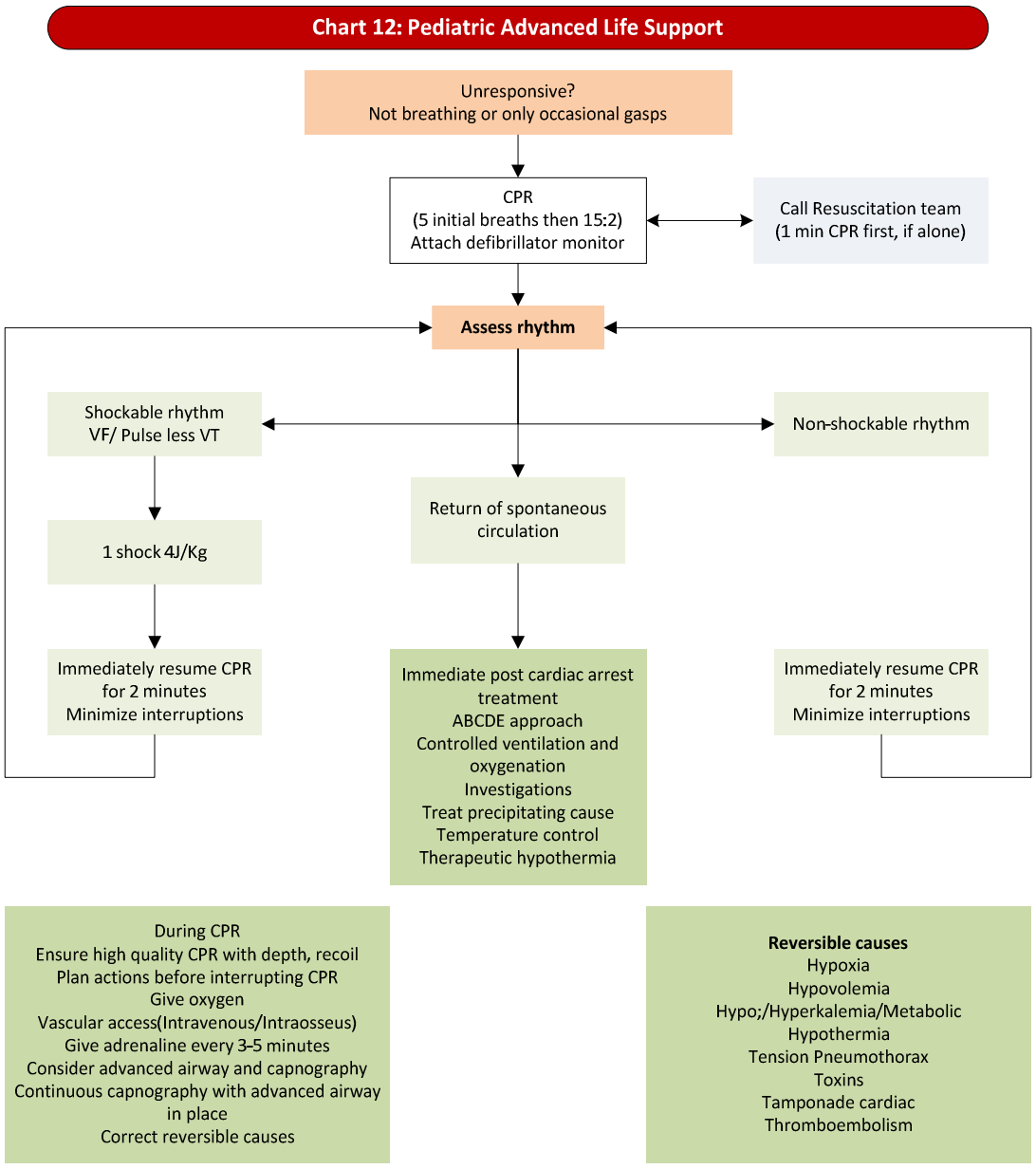
- The lone rescuer should compress the sternum with the tips of two fingers.
- If there are two or more rescuers, use the encircling technique:

1. Place both thumbs flat, side by side, on the lower half of the sternum (as above), with the tips pointing towards the infant's head.
2. Spread the rest of both hands, with the fingers together, to encircle the lower part of the infant's rib cage with the tips of the fingers supporting the infant's back.
3. Press down on the lower sternum with your two thumbs to depress it approximately one-third to one half of the depth of the infant's chest.

CHEST COMPRESSION IN CHILDREN OVER 1 YEAR:

1. Place the heel of one hand over the lower third of the sternum (as above).
2. Lift the fingers to ensure that pressure is not applied over the child's ribs.
3. Position yourself vertically above the victim's chest and, with your arm straight, compress the sternum to depress it by at least one third of the depth of the chest.
4. In larger children, or for small rescuers, this may be achieved most easily by using both hands with the fingers interlocked.

PEDIATRIC ADVANCED LIFE SUPPORT



In the above PALS chart, the following are the dose recommendations for pediatric age group :

a. Adrenaline 10 microgram/kg every 3-5 minutes in algorithms for both shockable and non-shockable rhythms.
b. Amiodarone 5mg/kg if VF or pulseless VT persists after third shock.
c. Magnesium in children with documented hypomagnesemia or torsade de pointes. It should be given in the dose of 25-50mg/kg (up to max. of 2gm) as infusion over few minutes.

One of the controversial topics in pediatric resuscitation is defining bradycardia which may be difficult for different age groups. It is important to be abreast with the normal heart rates for all age groups.

Clinically significant bradycardia: is defined as a heart rate of less than the normal range of heart rate for that particular age and is associated with poor systemic perfusion, hypotension or altered consciousness. Or as an arbitrary rule, a heart rate of less than 60/min with poor perfusion is an indication to start chest compressions in children.

Defibrillators may be used for pediatric resuscitation depending on the ECG rhythm. Following particulars need to be kept in mind -

Paddle size- to use the largest paddles or self adhering electrodes that will fit on the chest wall without touching and to leave at least 3 cm between paddles. One may use adult paddles for children >10kg (1year of age) and have to use infant paddles for infants < 10 kg.

Energy Dose- The lowest energy dose for effective defibrillation and the highest safe dose in infants and children is not known. A single shock of 4J/kg is advocated followed by resumption of CPR. Earlier it was advisable to start with 2J/kg and then increment to 4J/kg in the subsequent shocks, but this has been discouraged recently in view of existing literature.

AED's – Should not be used in <1year of age. For 1-8 years AED's may be used with a paediatric attenuating system and pediatric paddles preferred, though not compulsory – can use adult paddles if pediatric paddles are not available.

After defibrillation do not stop to check rhythm but continue CPR for 5 cycles before doing so

- Intravenous or intraosseous routes are preferred for drug administration over intratracheal route.
- Either cuffed or uncuffed tracheal tubes may be used in infants and children.
- Reversible causes that can be detected and handled at the point of care should be checked for and handled. Drugs such as sodium bicarbonate or calcium are not indicated for routine administration but can be tried only in special situations.
- There is no role of dextrose containing solutions for resuscitation unless hypoglycemia is documented.
- Calcium does not have any role in resuscitation except when specifically indicated as in hyperkalemia, hypocalcemia or calcium channel blocker overdose.
- Sodium bicarbonate does not have any role in resuscitation except when specifically indicated as in hyperkalemia or Tricyclic antidepressant overdose.

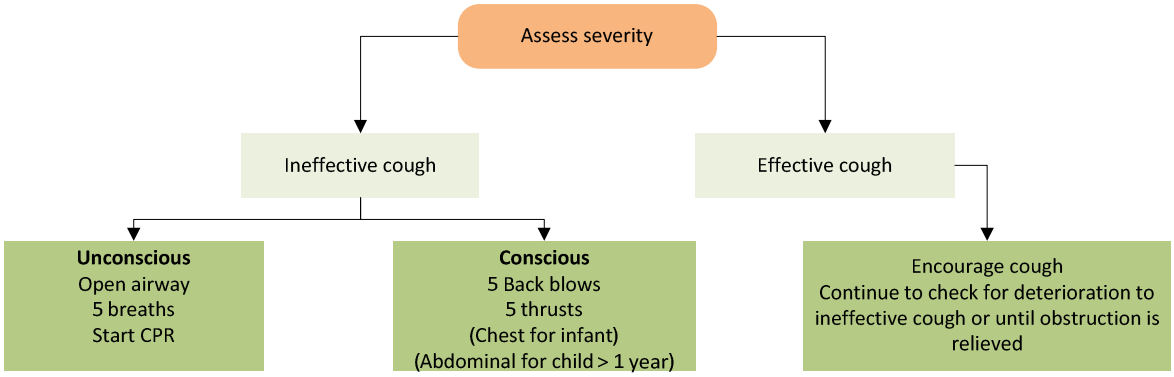
FOREIGN BODY AIRWAY OBSTRUCTION (FBAO)

FBAO is characterized by sudden onset respiratory distress associated with coughing, gagging or stridor and should be suspected if:-

- the onset was very sudden;
- there are no other signs of illness;
- there are clues to alert the rescuer, for example a history of eating or playing with small items immediately prior to the onset of symptoms.

A spontaneous cough is much more effective than maneuvers, but if coughing becomes ineffective, active interventions need to be commenced rapidly and confidently.

Chart 13: Foreign Body Airway Obstruction



Technique of Back blows:

In infants, after placing the infant in prone position on the lap with head down and supporting the infant jaw with fingers, deliver 5 sharp blows between the shoulder blades. In a child who is big enough not to fit on the lap, a forward leaning position can be assumed. If back blows are ineffective and the child is still conscious, use chest thrusts for infants and abdominal thrusts for the child.

Technique of Chest thrusts :

Chest thrusts are delivered in infants similar to chest compressions but sharper in nature and delivered at a slower rate. The landmark for chest compression is about a fingers breadth above xiphisternum.

Technique for Abdominal thrusts :

This maneuver also called as Heimlich maneuver is performed similar to adults. (see section on Choking)

POST RESUSCITATION CARE

Post resuscitation supportive therapy needs to be continued as in adults but infants and children may take longer to recover because cardio-respiratory arrest in children is often secondary to global hypoxemia leading to multi-organ damage.

A. Medications for Pediatric Resuscitation and Arrhythmias

Medication	Dose	Remarks
Adenosine	0.1 mg/kg (maximum 6 mg)	Monitor ECG
	Repeat: 0.2 mg/kg (maximum 12 mg)	Rapid IV/IO bolus
Amiodarone	5 mg/kg IV/IO; repeat up to 15 mg/kg	Monitor ECG and blood pressure
	Maximum: 300 mg	Adjust administration rate to urgency (give more slowly when perfusing rhythm present)
		Use caution when administering with other drugs that prolong QT (consider expert consultation)
Atropine	0.02 mg/kg IV/IO	Higher doses may be used with organophosphate poisoning
	0.03 mg/kg ET*	
	Repeat once if needed	
	Minimum dose: 0.1 mg	
	Maximum single dose:	
	Child 0.6 mg	
	Adolescent 1 mg	
Calcium chloride (10%)	20 mg/kg IV/IO (0.2 mL/kg)	Slowly
		Adult dose: 5–10 mL
Epinephrine	0.01 mg/kg (0.1 mL/kg 1:10 000) IV/IO	May repeat q 3–5 min
	0.1 mg/kg (0.1 mL/kg 1:1000) ET*	
	Maximum dose: 1 mg IV/IO; 10 mg ET	
Glucose	0.5–1 g/kg IV/IO	$D_{10}W$: 5–10 mL/kg
		$D_{25}W$: 2–4 mL/kg
		$D_{50}W$: 1–2 mL/kg
Lidocaine	Bolus: 1 mg/kg IV/IO	
	Maximum dose: 100 mg	
	Infusion: 20–50 µg/kg per minute	
	ET*: 2–3 mg	
Magnesium Sulfate	25–50 mg/kg IV/IO over 10–20 min; faster in torsades	
	Maximum dose: 2g	
Naloxone	<5 y or ≤20 kg: 0.1 mg/kg IV/IO/ET*	Use lower doses to reverse respiratory depression associated with therapeutic

	≥5 y or >20 kg: 2 mg IV/IO/ET*	opioid use (1–15 µg/kg)
Procainamide	15 mg/kg IV/IO over 30–60 min	Monitor ECG and blood pressure
	Adult dose: 20 mg/min IV infusion up to total maximum dose 17 mg/kg	Use caution when administering with other drugs that prolong QT (consider expert consultation)
Sodium Bicarbonate	1 mEq/kg per dose IV/IO slowly	After adequate ventilation
IV indicates intravenous; IO, intraosseous; and ET, via endotracheal tube.		
***Flush with 5 mL of normal saline and follow with 5 ventilations.**		

B. Medications to Maintain Cardiac Output and for Post-Resuscitation Stabilization

Medication	Dose Range	Comment
Amrinone	0.75–1 mg/kg IV/IO over 5 minutes; may repeat x 2; then: 2–20 µg/kg per minute	Inodilator
Dobutamine	2–20 µg/kg per minute IV/IO	Inotrope; vasodilator
Dopamine	2–20 µg/kg per minute IV/IO	Inotrope; chronotrope; renal and splanchnic vasodilator in low doses; pressor in high doses
Epinephrine	0.1–1 µg/kg per minute IV/IO	Inotrope; chronotrope; vasodilator in low doses; pressor in higher doses
Milrinone	50–75 µg/kg IV/IO over 10–60 min then 0.5–0.75 µg/kg per minute	Inodilator
Norepinephrine	0.1–2 µg/kg per minute	Inotrope; Vasopressor
Sodium Nitroprusside	1–8 µg/kg per minute	Vasodilator; prepare only in D_5W
IV indicates intravenous; and IO, intraosseous.		
Alternative formula for calculating an infusion:		
Infusion rate (mL/h) = [weight (kg) x dose (µg/kg/min) x 60 (min/h)]/concentration µg/mL).		

References :

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6 - TRAUMA CONSIDERATIONS

Deaths due to trauma take a tri-modal distribution of peak incidence from the time of injury. The first peak occurs in the first seconds to minutes after the injury. These types of injuries include massive head trauma, disruption of the great vessels, or uncontrolled hemorrhage. The second peak occurs in the first few hours after the patient's arrival to the hospital. These injuries are again significant but not enough that they were immediately lethal. They include problems such as aortic ruptures with hematoma formation, pneumothorax, liver and spleen lacerations, or slower uncontrolled hemorrhage. The third peak occurs days to weeks after the injury when treatment in the hospital leads to post-surgical complications, sepsis, or pulmonary emboli.

ATLS focuses on the second peak; Deaths from:

- TBI, Epidurals, Subdurals, IPH…
- Basilar skull fractures, orbital fractures, Naso-ethmoid-orbital fractures (NEO)
- Penetrating neck injuries…
- Spinal cord syndromes…
- Cardiac tamponade, tension pneumothorax, massive hemothorax, esophageal injury, diaphragmatic herniation, flail chest, sucking chest wounds, pulmonary contusion, tracheobronchial injuries, penetrating heart injury, aortic arch injuries
- Liver laceration, splenic ruptures, pancreatico-duodenal injuries, retroperitoneal injuries
- Bladder rupture, renal contusion, renal laceration, urethral injury…
- Pelvic fractures, femur fractures, humerus fractures…

PRIMARY SURVEY

The treatment of the trauma patient in the ED is directed to identifying immediately life-threatening injuries. These injuries may not be readily apparent. The primary survey is a way of prioritizing the initial assessment. Once an accurate primary survey is complete, a more methodical and comprehensive secondary survey can be done. The primary survey should take approximately 30 – 60 seconds and should only be interrupted to deal with the problems it identifies. If a trauma patient becomes unstable during any part of the assessment, one should go back and quickly reassess the primary survey (That hematoma on the neck that looked benign initially may be expanding and causing airway compromise). It is as easy as ABC:

A – **A**irway maintenance with C-spine control
B – **B**reathing/ventilation
C – **C**irculation with hemorrhage control
D – Neurologic **D**isability
E – **E**xposure (the patient should be entirely undressed)

While the primary survey is occurring, other members of the team should be "throwing the safety net under the patient." This means that trauma patients, like all other critically ill patients, should have some level of intervention being performed even before the data is collected. Placing the patient on the monitor, obtaining IV access, and getting high flow oxygen started can easily occur without interrupting the primary survey. The team leader should ensure that all members of the team are working simultaneously without interfering with each other during the resuscitation.

AIRWAY MAINTENANCE WITH C-SPINE CONTROL

Rapid assessment for airway patency includes inspecting for foreign bodies or maxillofacial fractures that may result in airway obstruction. The chin lift or jaw thrust maneuver, or the insertion of an oral or nasal airway, is a first response to a patient making an inadequate respiratory effort. With enough personnel available, one person should be designated to hold in-line stabilization of the cervical spine. Patients who are vomiting should be rolled with maintenance of C-spine immobilization and suctioned. Patients who are talking and able to give even a confused history are unlikely to have an immediate airway problem and you can move on to breathing.

BREATHING/VENTILATION

The patient's neck and thorax should be inspected, auscultated, and palpated to detect abnormalities such as a deviated trachea, crepitus, flail chest, sucking chest wound, fractured sternum, and absence of breath sounds on either side of the chest. Possible interventions here include application of an occlusive dressing to a sucking chest wound, withdrawal of the endotracheal tube from the right main stem bronchus, reintubation of the trachea if no breath sounds are heard, and insertion of a large chest tube to relieve a hemopneumothorax.

CIRCULATION WITH HEMORRHAGE CONTROL

Hemorrhagic shock, a common cause of post-injury death, should be assumed to be present in any hypotensive trauma patient until proven otherwise. Direct pressure should be used to control obvious external bleeding, and a rapid assessment of hemodynamic status is essential during the primary survey.

This includes evaluation of level of consciousness, skin color, and presence and magnitude of peripheral pulses. Attention should be paid to the specifics of heart rate and blood pulse pressure (systolic minus diastolic blood pressure), particularly in young, previously healthy patients.

Not all hemorrhage results in hemorrhagic shock, and an unsuspecting clinician may fail to appreciate ongoing hemorrhage with blood loss of up to 30 percent of the circulating blood volume. While Class I hemorrhage (loss of up to 15 percent of circulating blood volume) is associated with minimal symptoms and is clearly no shock, Class III hemorrhage associated with gross hypotension is readily appreciated as a state of hypoperfusion. Yet, consider a young, healthy trauma victim who has lost 25 percent of his/her circulating blood volume (Class II hemorrhage) and had a preinjury blood pressure of 130/70 mmHg and a pulse rate of 60. If this patient experiences a 50 percent increase in his/her pulse rate (to a rate of 90) and a greater than 50 percent decrement of his/her pulse pressure (from 130/70 mmHg pulse pressure of 60 to 116/90 mmHg pulse pressure of 26), the unsuspecting clinician may assume that the patient is "hemodynamically stable." A false sense of security may lead to delays in aggressively pursuing the source of bleeding via ultrasound, peritoneal lavage, and operative exploration. From this example it should be clear that the practice of omitting diastolic blood pressure (and reporting "116/palpable," thus omitting the pulse pressure) is potentially hazardous. The alert, suspicious clinician identifies hemorrhage before it reaches the class III category of obvious shock.

	Class I	Class II	Class II	Class IV
Blood Loss (mL)	Up to 750	750-1500	1500-2000	>2000
Blood Loss (% blood volume)	Up to 15%	15-30%	30-40%	>40%
Pulse Rate	<100	>100	>120	>140
Blood Pressure	Normal	Normal	Decreased	Decreased
Pulse Pressure (mmHg)	Normal or increased	Decreased	Decreased	Decreased
Respiratory Rate	14-20	20-30	30-40	>35
Urine Output (mL/h)	>30	20-30	5-15	Negligible
CNS/Mental Status	Slightly anxious	Mildly anxious	Anxious, confused	Confused, lethargic
Fluid replacement (3:1 rule)	Crystalloid	Crystalloid	Crystalloid and blood	Crystalloid and blood

Two large intravenous lines should be established and blood obtained for laboratory studies. While there are varying preferences, there are significant advantages to a percutaneous large line in the groin for unstable patients in whom upper extremity peripheral veins are not available. Subclavian lines are potentially dangerous in the hypovolemic patient, saphenous vein cutdown at the ankle may not be appropriate for the patient with an injured lower extremity, and complications encountered from the femoral venous line may be minimized if the line is removed early, on completion of resuscitation in the early postoperative period. Unstable patients without an obvious indication for surgery should be assessed for their response to 2 L of rapid infusion of crystalloids. If there is not marked improvement, type O blood should be transfused (O-negative for females of childbearing age). Auscultation for breath sounds and heart sounds and inspection of neck veins are included in the assessment of circulation because two major causes of hypotension may be present in trauma patients with minimal blood loss: cardiac tamponade (hypotension, agitation, distended neck veins, muffled heart sounds) and tension Pneumothorax (hypotension, distended neck veins, absent breath sounds).

NEUROLOGIC DISABILITY

An abbreviated neurologic evaluation should be performed. This includes an assessment of the level of consciousness, pupil size and reactivity, and motor function. The Glasgow Coma Scale(GCS) should be used to quantify the patient's level of consciousness. Despite the common presence of alcohol and drugs in trauma patients, it should be assumed that alterations in level of consciousness are due to head injury. A GCS between 13 and 15 is considered mild, between 9 and 12, moderate. Patients with a GCS of 8 or less have a severe head injury and should be intubated regardless of their airway and breathing status. Further investigation of the head injury with a CT should occur as soon as possible after the patient's other injuries have been stabilized.

Peripheral neurologic disability must also be rapidly assessed and spinal immobilization maintained until instability has been ruled out. A complete cervical spine series must include AP, lateral, and odontoid views. Obtaining only a lateral film can result in missed fractures in as many as 15% of C-spine injuries.

An intoxicated patient cannot be cleared with radiographs as ligamentous instability can still be present despite normal x-rays. A recent study with over 34,000

patients enrolled has suggested criteria which can safely be used to clear the cervical spine without x-rays. Patients who are not intoxicated, with no alterations in mental status, have no peripheral neurologic deficits, no distracting injuries, and no cervical spine tenderness can be cleared from immobilization without radiographs.

Of course, x-rays of the neck, chest, and pelvis, which are considered standard on all major multi-system Trauma patients should wait for the secondary survey.

EXPOSURE

No primary survey is complete without thoroughly disrobing the patient and examining the total body surface area carefully for bruises, lacerations, impaled foreign bodies, and open fractures. If hemodynamically stable and with a stable airway, the patient should be log-rolled with one attendant assigned to maintain cervical stabilization. Check the back and thoracic and lumbar spine for tenderness. Check the gluteal cleft and perineum for injury. When the exam is completed, the patient should be covered with warm blankets to prevent hypothermia.

SECONDARY SURVEY

An **AMPLE** history should be obtained from the patient once a primary survey is completed. It is certainly possible to obtain the history during the primary survey; however, the initial priority should be on securing the airway, breathing, and circulation of the patient. The **AMPLE** history consists of:

A- allergies. It is important to know the medication (and other) allergies of a patient as the patient may

soon be receiving antibiotics, tetanus, and anesthetics.

M– medications. Knowing the patient's medications will not only give you an idea of expected drug-drug interactions, but it gives you an idea of the physiologic status of the patient. For instance, the patient on beta-blockers may not have an appropriate tachycardia.

P – past medical history. Again, it is important to know the patient's underlying diseases. A patient with chest pain may be having an MI or the patient may have had a significant syncopal event leading to the accident. Check **P**regnancy status if a female victim

L – last meal. A patient may have gastric distension or be at risk for aspiration if taken to the operating room. Last menstrual period can be considered here if the victim is a female

E- events. This is the history of the mechanism of the trauma. It will tell you what to look for in terms of injury pattern and will heighten your awareness to certain types of injuries. Don't forget that the medics who were at the scene are a valuable source of information in estimating the speeds involved and the extent of the injuries and blood loss.

The secondary survey is a more thorough assessment of the trauma patient which includes a detailed exam of the head and neck, exploration of wounds, and a more careful neurologic exam. A rectal and bimanual pelvic exam should be performed. This is done simultaneously with the performance of indicated x-rays.

As already stated, x-rays of the chest, cervical spine, and pelvis are standard on the multi-system trauma patient. If the patient, however, is acting appropriately, gives a good history, and can be adequately assessed, not all of these films are indicated. The chest x-ray is the single most valuable film in the unstable trauma patient. A significantly injured trauma patient should also receive "tubes and lines in every orifice." An NG tube may help prevent aspiration and the stomach must be decompressed prior to a diagnostic

peritoneal lavage (DPL). A Foley catheter will help monitor urine output. A Foley also must be placed prior to a DPL.

Remember, the rectal exam should be performed prior to the placement of the Foley to prevent pushing the Foley through a disrupted urethra. Other invasive monitoring may be required such as arterial lines, CVP monitoring, or a Swan-Ganz catheter.

Focused **A**ssessment with **S**onogram in case of **T**rauma (FAST) is a proven technique to identify intra-abdominal injuries in case of trauma victims. It is reasonable to recommend physicians posted in emergencies to learn the technique. FAST is a good alternative to DPL.

SUMMARY

The care of the trauma patient should be a coordinated effort. This effort certainly must come from the treating team in the hospital with pre-determined tasks for each member of the team. The effort must also come from the system in which the triage mechanism and pre-hospital protocols mesh with the treating trauma service.

Using a systematic approach to the critically injured patient is mandatory. A high index of suspicion should exist for occult life-threatening injuries and a reassessment made on a nearly continuous basis.