



MGM INSTITUTE OF HEALTH SCIENCES

(Deemed University u/s 3 of UGC Act, 1956)

Grade 'A' Accredited by NAAC

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Value Added Course

BLS PROVIDER COURSE

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1.Course Aspirants:

- 1) 1st, 2nd, 3rd/I year UG MBBS Students
- 2) Interns
- 3) PG Degree/Diploma Students

2. Objectives of Course: To Provide safe environment for repeated practice of various Basic skills and to increase patient safety. At the end of course the student should be able to :-

- Recognize cardiac arrest,
- Provide effective chest compressions
- Provide artificial ventilation
- Use AED
- Provide First aid for common medical emergencies like trauma, hemorrhage, Burns, poisoning, Snakebite & dog bite etc
- To teach communication skill and team dynamics

3. Duration of the Course:

- 16 hours

4. Course Content:

- **First Aid:** Airway obstruction management, first aid for trauma, poisoning, hemorrhage, burns, dog bite, snake bite & common medical emergencies like bleeding from nose, convulsions etc
- **BLS:** chain of survival, Recognition of cardiac arrest, How to call for help, Chest compressions, Artificial ventilation, AED use, Recognition and management of respiratory arrest, management of Obstructed airway, Infant and child CPR, Team dynamics

6. Teaching methods:

- a. Lectures
- b. Videos
- c. Practical skill demo on manikin
- d. Practice sessions on manikin
- e. Practice & skill on manikin
- f. Team dynamics role play

- **7.Student Capacity:** 30 students

8.Assessment:

- a. Pre Test
- b. Practical skill test (including team dynamic) using checklist (85% marks for passing)
- c. Theory examination (MCQ) (85% marks for passing)
- d. Remediation for poor performers
- e. Post Test after remediation

f. Feedback

Training schedule of Basic cardiac life support - Students (UG, PG)

Day 1 2pm to 5.30 pm

Sr No	ACTIVITY	Time
1	Introduction to BLS, Recognition of arrest	2.00—2.30
2	Core links chain of survival of BLS	2.30--- 3.00
3	Chest compression	3.00—3.30
4	Video	3.30—4.00
5	Practice on Manikin	4.00---5.30

Day 2 2pm to 5.30 pm

Sr No	Activity	time
1	Airway problem after cardiac arrest, Airway management	2.00—2.45
2	Breathing, use of pocket mask and bag mask, ventilation	2.45— 3.15
3	Foreign body obstruction adult and pediatric Respiratory arrest , treatment	3.15—4.15
4	Video of respiratory arrest management, practice	4.15—5.30

Day 3 2pm to 5.30 pm

Sr NO	Activity	time
1	AED lecture and video	2.00--- 2.45
2	Infant and child CPR	2.45--- 3.15
3	Practice of Infant and child CPR	3.15--- 4.00
4	Team dynamics	4.00—5.30

Day 4 2pm to 5pm

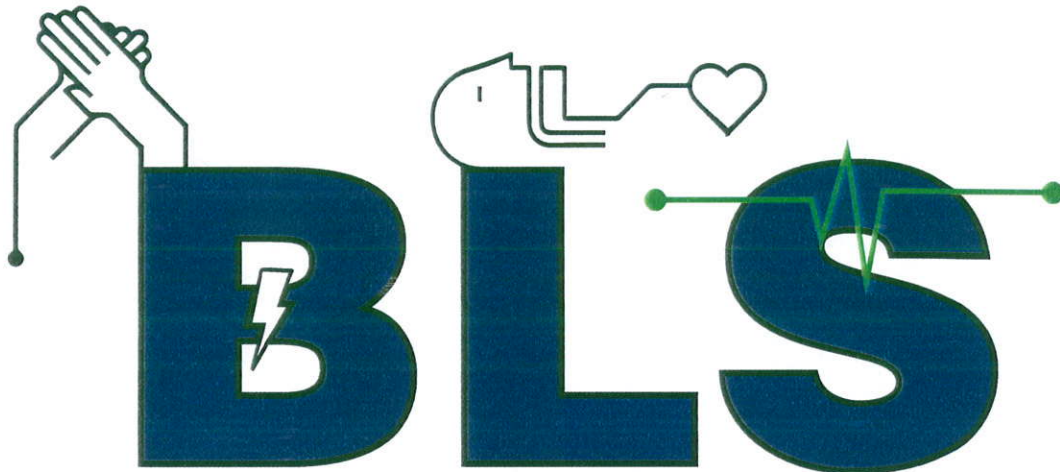
Sr No	Activity	time
1	First Aid Lecture cum demonstration and video	2.30--- 4.00
2	Practice of techniques	4.00—5.00
3	Practice of chest compression and ventilation	5.00—5.30

Day 5 2pm to 5pm.

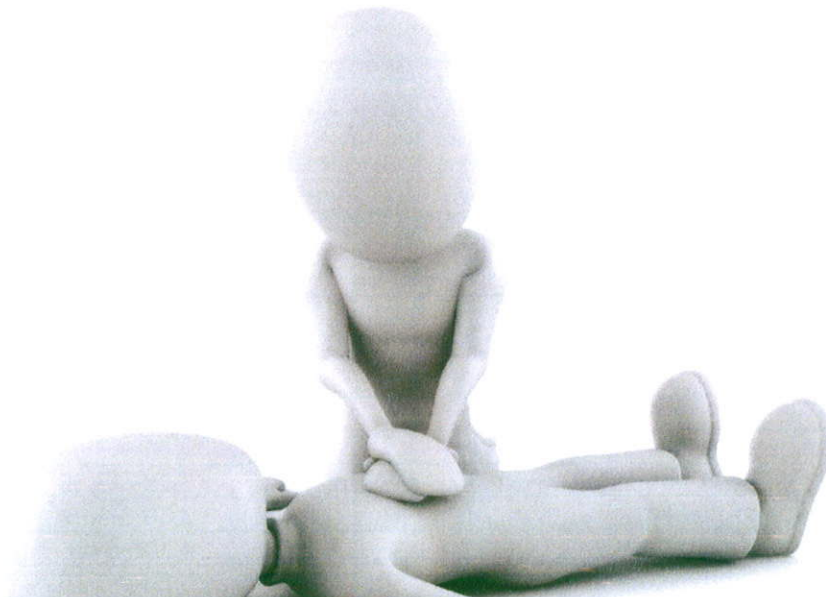
Sr No	Activity	time
1	Revision practice and team dynamics	2.00--- 3.00
2	CPR in special situations eg. pregnant patient, trauma.	3.00--- 3.30
2	Examination (theory)	3.30--- 4.00
3	Examination (practical)	4.00--5.00
4	Remediation and feedback	5.00--- 5.30

CADIO PULMONARY RESUSCITATION

BASIC LIFE SUPPORT



BOOKLET



MAHATMA GANDHI MISSION

MGM Medical College and Hospital

**Medical Education Technology &
Skill Development Unit**

INDEX

1. Introduction
2. Basic life support for Adults
3. Basic life Support for infants and children
4. Defibrillator
5. Respiratory arrest
6. Management of choking in adult, pediatric and infant
7. Team dynamics
8. Summary of adult, pediatric and infant CPR guidelines



1. Introduction

Every life is precious. Timely and proper treatment can revive a person of cardiac arrest and give him a normal life. To achieve this, every health care worker must know skills to resuscitate adult & pediatric victims. Seventy percent of cardiac arrests occur out of hospital and only 10% patients are discharged from hospital after revival. Our aim is to increase the number of people who can provide high quality CPR and thereby increase chances of survival of sudden cardiac arrest victims.

After completing this BLS course you will be able to recognize cardiac arrest, activate emergency medical services (**EMS**) and provide high quality CPR individually and as a team member.

As recommended by American Heart Association (AHA), chain of survival is important for revival of cardiac arrest victim either inside hospital or outside hospital. In hospital arrest can be predicted and prevented in adult patients by monitoring and timely treatment as per link as shown in Fig. 1. Further links in inside hospital cardiac arrest (IHCA) treatment are recognition of arrest, activation of emergency response team, early CPR, rapid defibrillation and post arrest care by multi disciplinary team.

For out of hospital cardiac arrest in an adult (OHCA) after recognition and call for help, immediate CPR, defibrillation with AED, transport to hospital for advanced life support and post cardiac arrest care are the links of chain (Fig 1)

System-specific Chains of Survival



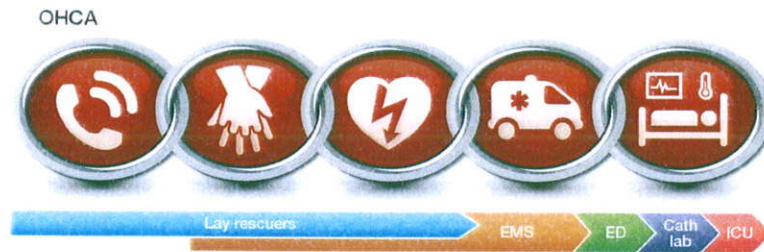


Fig 1 showing chain of survival for inside (IHCA) and outside hospital cardiac arrest (OHCA) adults.
(AHA 2015 guidelines)

IHCA –

1. Surveillance and prevention
2. Recognition and activation of Emergency response system
3. Immediate high quality CPR
4. Rapid defibrillation
5. Advanced life support and post arrest care

OHCA-

- 1 Recognition and activation of Emergency response system
2. Immediate high quality CPR
3. Rapid defibrillation

In children, if there is respiratory failure or shock cardiac arrest is likely. Timely treatment of these conditions is essential to prevent arrest. In children over 1 year of age, injury is the leading cause of death. Motor vehicle crashes are the most common cause of fatal childhood injuries. Targeted interventions, such as the use of child passenger safety seats, can reduce the risk. So prevention link is added in pediatric chain of survival (Fig. 2).

PEDIATRIC CHAIN OF SURVIVAL



Fig 2 showing pediatric chain of survival (AHA 2015 guidelines)

1. Prevention
2. Early CPR
3. Activate emergency medical service
4. Rapid Pediatric advanced life support

All links are interdependent and weakness in any link can reduce chances of successful survival. Every action before, during and after resuscitation is important. By learning high quality CPR you will have the ability to improve patient outcomes and save more lives.



2. Basic life support for Adults

When there is cardiac arrest, there is no blood supply to brain, heart, lungs and other organs. We must recognize the arrest at the earliest so that proper and timely treatment (high quality of CPR and effective ventilation) can save the life.

Identification of cardiac arrest – Signs of cardiac arrest are

- Unresponsiveness
- No breathing or agonal gasps
- No carotid pulse

Action plan

- Assess scene safety for you and the victim
- Assess responsiveness by tapping the shoulders and asking the victim to open the eyes or to show the tongue.
- If there is no response, shout for help. Activate EMS for AED / Defibrillator, if you are out of hospital. Activate specific code, if you are in hospital.
- Check for breathing and carotid pulse by the side of trachea (**Fig 3**), simultaneously.



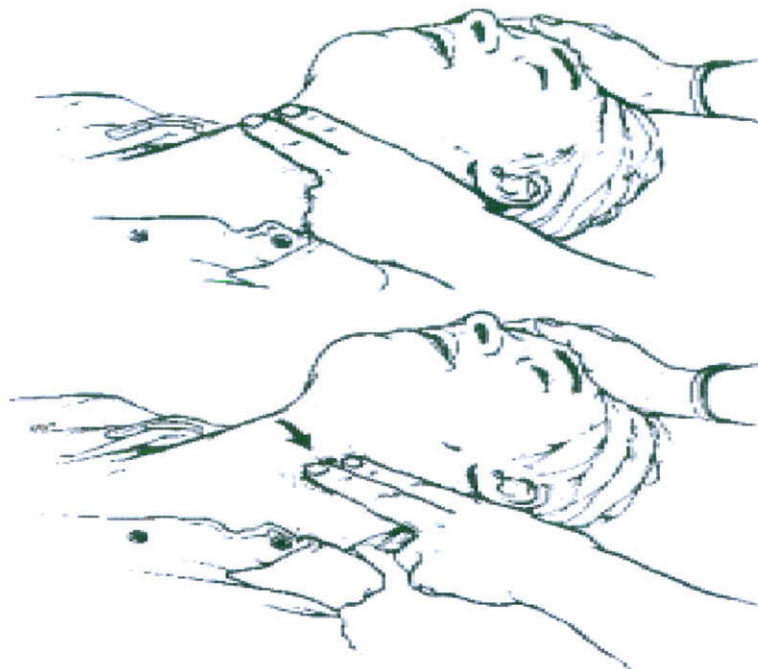


Fig 3- Check carotid pulse

- Check above signs within **10 seconds** as starting chest compressions after early recognition of arrest has a vital role in deciding the favorable outcome.

If victim is breathing and has pulse, observe till further help is available. If there is no breathing or victim is gasping and there is no pulse, Start chest compressions over lower half of sternum. The assessor may have doubt about absence of pulse at times. When in doubt start CPR.

Follow C – A – B – D sequence and provide high quality CPR

C – Chest compressions

A-airway

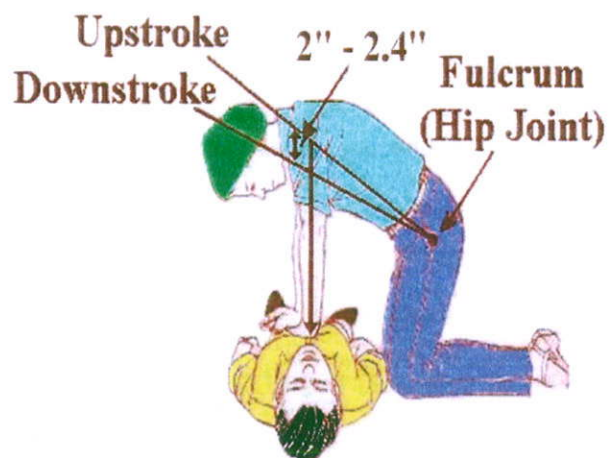
B-breathing

D - Defibrillation

C Chest Compressions

Victim should be on firm surface when CPR is started. If the victim is in face down position, carefully roll him/her to a supine (face up) position. Head, neck and torso should be turned simultaneously in line during this act to avoid neck movements. Remove chest clothing so that hands can be properly placed for chest compressions and AED pads can be attached to chest wall.





Chest Compression showing the proper position of the Rescuer (with shoulders over the victim's sternum & elbows locked)

Fig 4- showing position of rescuer

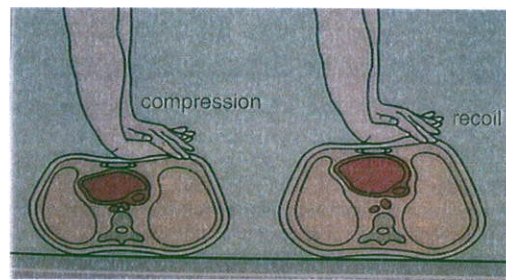
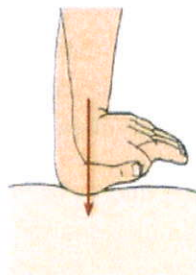
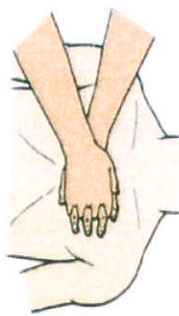


Fig.5 Showing position of hands and method of chest compression

Fig. 6 showing effect of midline chest compression. Heart is compressed between sternum and vertebral body.

During external chest compressions, heart is compressed between sternum & vertebrae so that blood is pushed into the arteries and to vital organs. During recoil phase as the heart is empty and the pressure is removed, blood returns to heart. This sequence of compression/recoil establishes some circulation in the arrested patient which in turn helps to maintain oxygenation of brain, preventing brain death.

Site of compression: Keep heel of hand on lower half of sternum in midline. Put heel of other hand on top of first hand as shown in **fig.5**

Criteria for high quality CPR –

- Compression rate – 100 – 120/min
- Compression depth – 5 -6 cm



- Allow complete chest recoil. Don't lean during recoil.
- Interruption in compressions must be ≤ 10 seconds. Interruption in compression stops blood flow to brain and heart. Change the rescuer roles every 2 min during this 10 seconds break to ensure effective chest compression.
- Compression: ventilation ratio should be 30:2. Five cycles of 30 Compressions: 2 Ventilations should be provided over 2 minutes.
- Avoid excessive ventilation.
- **Do not move the victim during resuscitation unless mandatory.**

Airway should be open for giving artificial breaths.

A-Open Airway

- When the victim is unconscious, tongue falls back leading to airway obstruction. Sit or stand by side of head of the victim. One can stand at the head end if another rescuer is available for giving compressions.
- Use **head tilt chin lift** method to open the airway. Place hand on victim's forehead and tilt the head back. (**Fig 7**) . Lift the chin with other hand. and avoid compression of the soft tissue below chin . Slightly open mouth of victim.
- In case of suspected cervical spine injury use only **jaw thrust** to open airway to reduce cervical spine movement. This can be done by putting fingers behind angles of mandible and moving the jaw forwards as shown in the **figure 8**. One may rest the elbows on the surface by the side of head if needed. If jaw thrust does not effectively open the airway, perform head tilt chin lift.

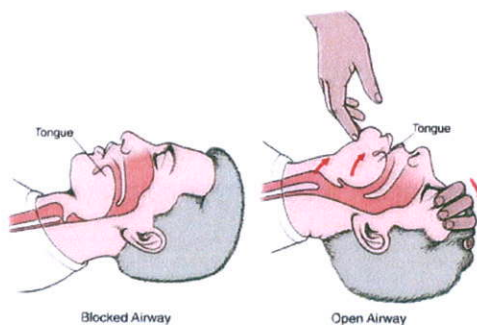


Fig.7 showing head tilt, chin lift method

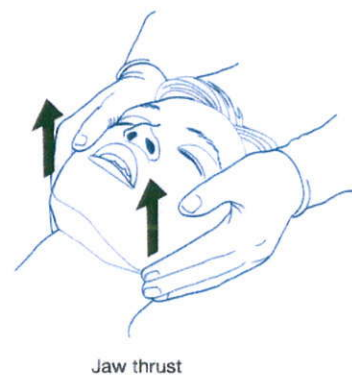


Fig. 8 showing x jaw thrust method



B - Give breaths

During CPR, maintaining adequate flow of oxygenated blood to heart and brain is essential. Respiratory rate of normal adult is 14 – 16 breaths/min. During CPR, 8- 10 breaths / min. (in 30:2 ratio of compression & ventilation) are adequate to maintain adequate oxygenation of blood.

Various methods of giving ventilation during BLS :-

1) Mouth to mouth ventilation –

Can be used for the victim outside hospital. Risk of infection is extremely low. Only isolated cases are reported. Use face shields or pocket mask for giving breaths as a standard safety precaution

Atmospheric air contains 21% oxygen. Expired air contains 17% oxygen. As our body uses a small percentage of oxygen, amount of oxygen in expired air is enough to prevent cerebral hypoxia.

Technique –

- Position yourself by the side of the victim
- Close the victim's nose with a pinch and take a normal breath. Seal your lips on the mouth of the victim and breathe into mouth. (Fig 9)
- Look at the rising and falling of the victim's chest to make sure that your breaths are passing to the victim effectively.
- Exhalation is passive, when you release the nose pinch.



Fig 9 Showing mouth to mouth ventilation

Limitations: -

- Not possible, if there is bleeding from oral cavity
- Risk of infection to the rescuer from resuscitation is extremely low. As standard safety precautions, barrier devices are recommended during resuscitation.

CPR provided by two rescuers:



One rescuer will provide chest compressions and another will ventilate the patient positioning himself at the head end of victim. (Fig 10).

When victim is ventilated, compressions should not be given. Rescuers switch their roles after 5 cycles of compression /ventilation(30:2) delivered over 2 minutes.

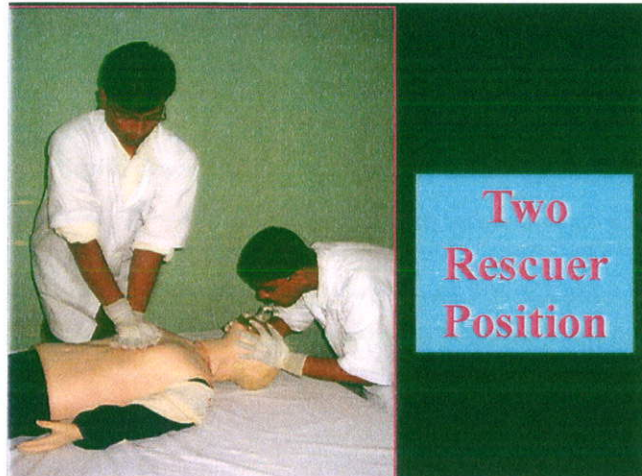


Fig 10 Showing two rescuer technique of CPR

2) Mouth to mask ventilation

Mouth to mask ventilation is provided by using pocket mask.(Fig 11) There is a one way valve in the pocket mask, which diverts victims exhaled air away from rescuer. This increases safety of the provider.

Provider should kneel down by the side of the patient. Place mask on victim's face, using both hands as shown in fig 11. Seal the mask against the face. Open airway by head tilt chin lift method and provide two rescue breaths. Each breath is delivered over 1 second. Different sizes of masks are available for adult and pediatric victims.



Fig 11 Showing mask to mouth ventilation



2) Bag mask ventilation –

Bag - mask ventilation is an essential emergency skill. This basic ventilation technique allows for oxygenation and ventilation of patients until a more definitive airway is established.

The resuscitation bag (silicon autoclavable bag) is a self inflating bag available in 3 sizes for Adult (capacity – 1.5L), child (500 ml) and infant (250 ml). The face masks for these bags are of different sizes for newborn (Zero size), infant, child (size 1, 2), and adult (size 3,4,5). Choosing the appropriate size helps to create a good seal and aids effective ventilation. Mask should cover the bridge of nose and chin. It should not cover eyes of victim.

The different parts of the resuscitation bag and mask assembly are shown in the following **figure 12**.

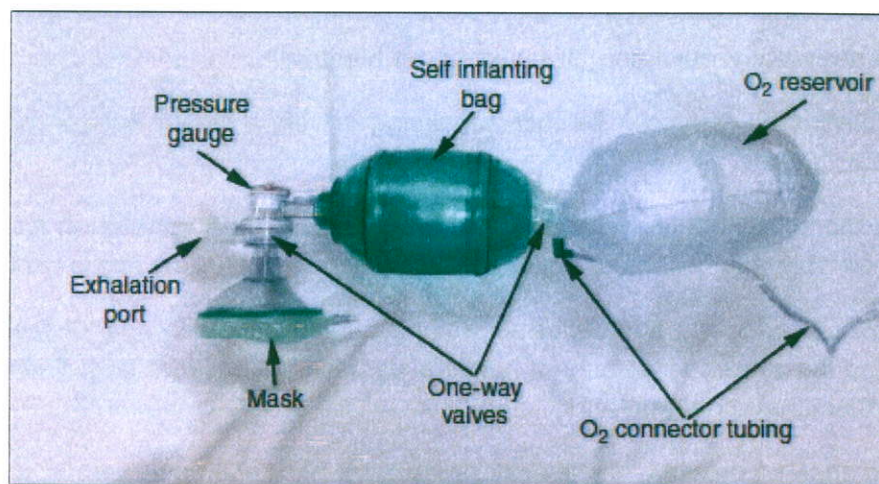


FIG. 12 showing parts of Resuscitator unit

Unidirectional or one way valves direct the gases from the bag to the patient during inspiration and exhaled gases from the patient to the atmosphere. Valve at other end allows air to enter in bag when compression is released. The oxygen concentration delivered by AMBU bag with reservoir bag is 21% when oxygen is not supplemented, about 40% when 2 L and > 90% when 15 L oxygen is supplemented and reservoir bag is attached.

Technique –

- Position yourself at head end of victim
- Cover the nose and the mouth with the mask giving airtight fit .
- Open airway with head tilt – chin lift method .
- The thumb and index finger of the left hand are placed on the mask body forming “C”. These fingers exert downward pressure to hold the mask to the face and prevent leaks. The remaining three fingers are kept on the mandible forming “E”. (Fig 13) This helps in lifting the jaw.



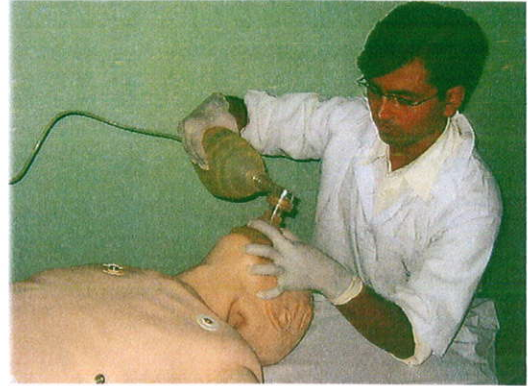
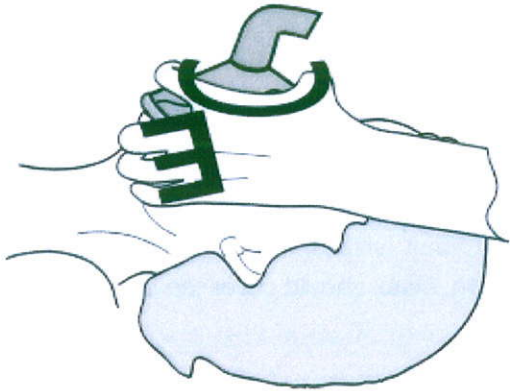


Fig 13 showing “E – C” technique of holding the face mask

- Give one breath over 1 sec. Give two rescue breaths.
- Sufficient chest rise should be observed during delivery of breath. Ratio of compression: ventilation is 30:2.
- If additional rescuer is available, a **two rescuer bag mask ventilation** technique can be used. (Fig 14) This is a better technique than single handed technique and is useful for obese victims.
- Create two opposing semicircles “C” with the thumb and index finger of each hand to form a ring around the mask connector, and hold the mask on the patient’s face. Then, lift up the mandible with the remaining digits.
- Avoid applying pressure on the soft tissues of the neck or on the eyes.
- Oropharyngeal airway helps for better ventilation with bag mask.

Avoid excessive ventilation as

- It may cause gastric distension leading to regurgitation and aspiration of stomach contents.
- It may increase intrathoracic pressure decreasing venous return to the heart & in turn decreasing cardiac output.



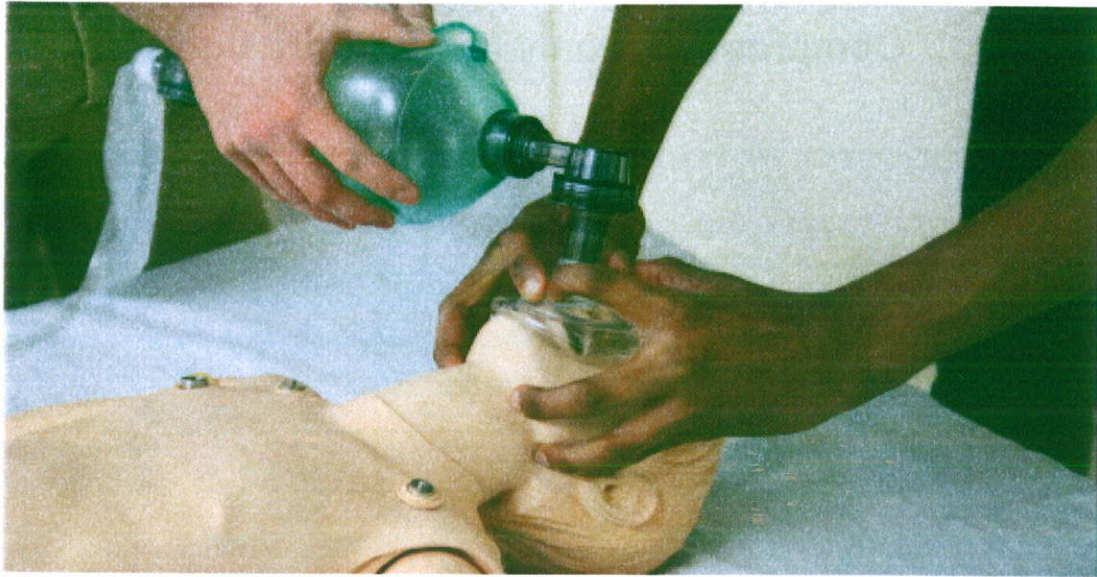


Fig 14 showing two rescuer bag mask ventilation technique of holding the face mask

Hands only CPR – If ventilation is not possible, continuous compressions at 100 to 120 per minute are given without ventilation. This has also proved to be helpful for resuscitation of adults.

Compressions only life support has also been recommended as per guidelines of Indian society of Anaesthesiologists in out of hospital scene for practice by lay person rescuer. The rate of compression must be 120/min. See (Compressions only life support Algorithm)

D- Defibrillation

In certain conditions, along with chest compression and ventilation, it is necessary to deliver electrical shock to the heart to start regular rhythm.

AED is a portable computerized device. (Fig 15) It can check heart rhythm through adhesive electrodes applied to the chest wall. It analyses cardiac rhythms which need a shock, it selects the energy essential to deliver shock. If rhythm is shockable, it gives audio visual instructions for the user to press the button for delivering shock. If one follows the instructions, even a lay person can use the machine easily.

Use Automated external defibrillator (AED) as soon as available during resuscitation.

Conventional Defibrillator can be used in hospital. Energy of 360 joules for monophasic or 200 joules for biphasic defibrillator is required. Details are given in chapter on defibrillation.

Follow the instructions given by AED machine and deliver the shock if machine instructs. Detail steps for use of AED are given in the chapter on defibrillation.



Compressions only life support algorithm

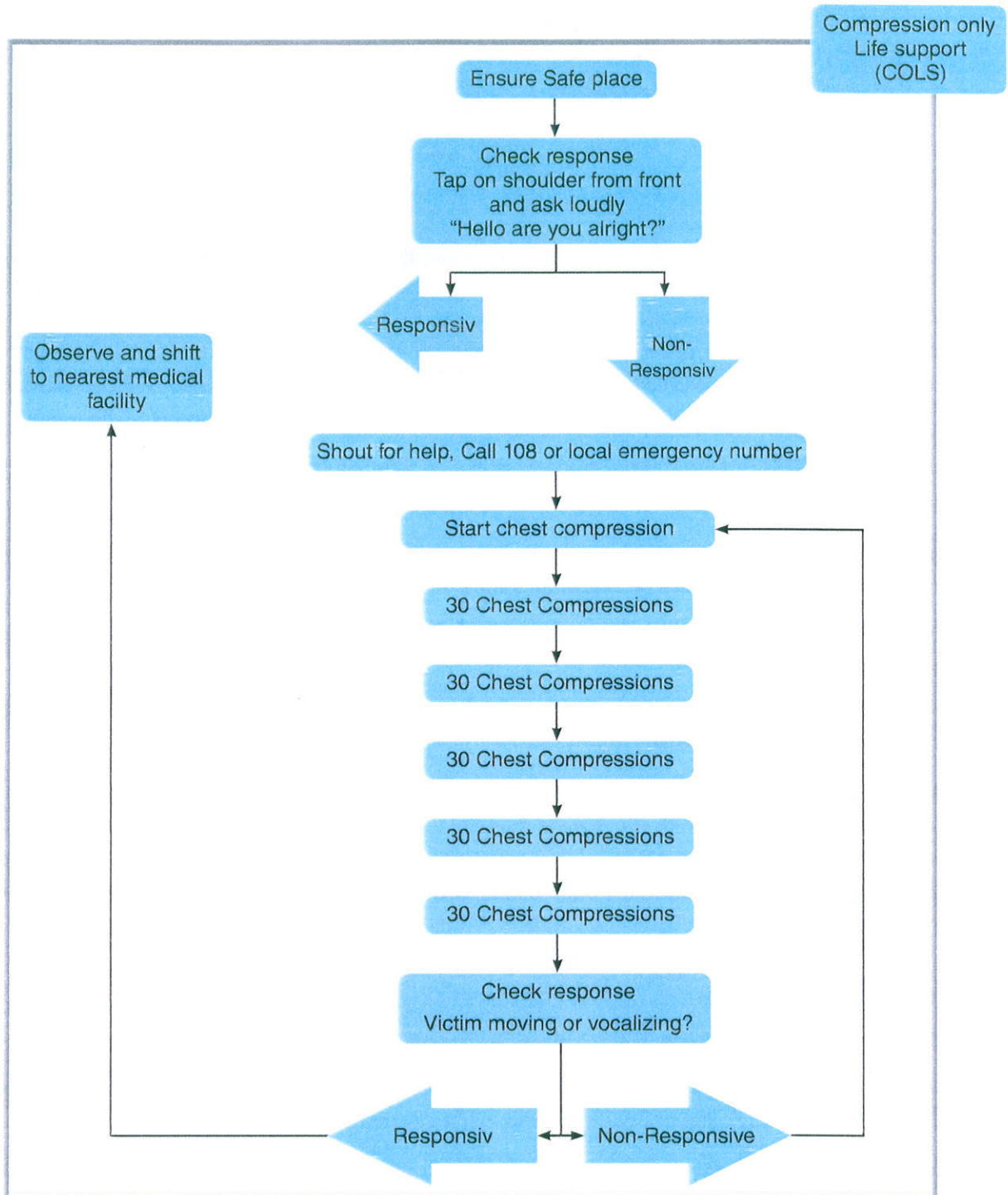




Fig 15 Automated external defibrillator

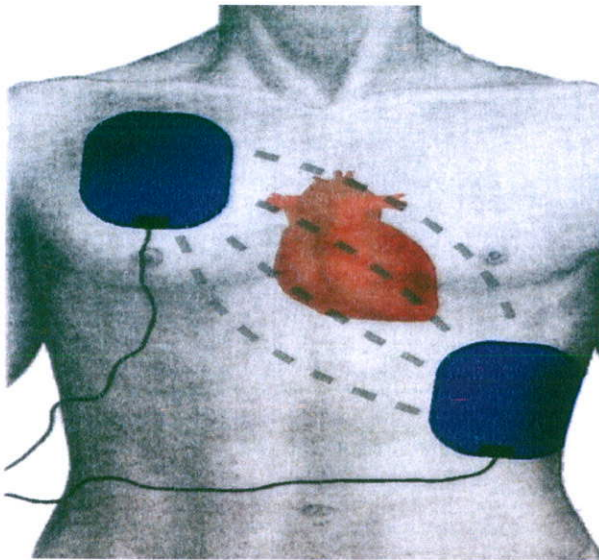


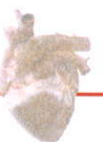
Fig 16 showing position of pads

Figure 16 shows where to apply defibrillator pads on the chest.

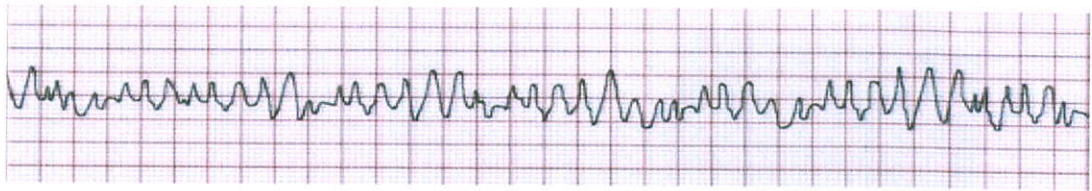
Shockable Rhythms of cardiac arrest

Cardiac rhythms requiring defibrillation are as shown in **Fig 17**

- Fine Ventricular fibrillation



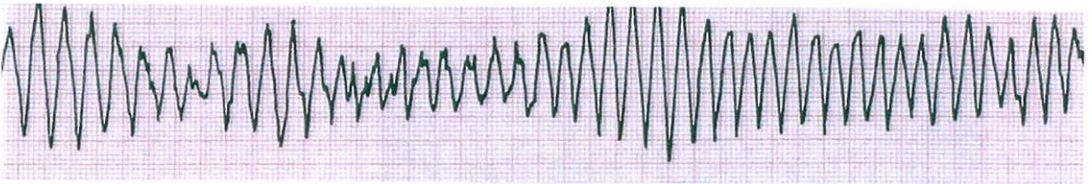
Coarse ventricular fibrillation



- Monomorphic ventricular tachycardia



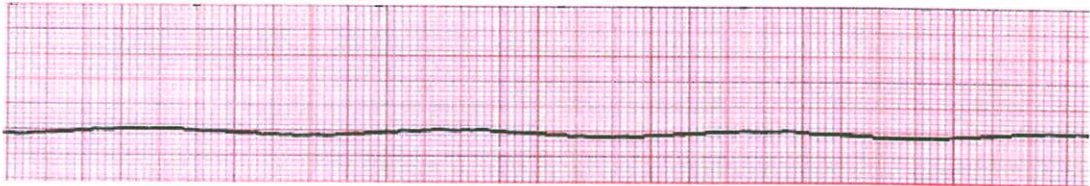
- Polymorphic ventricular tachycardia (Torsades de pointes)



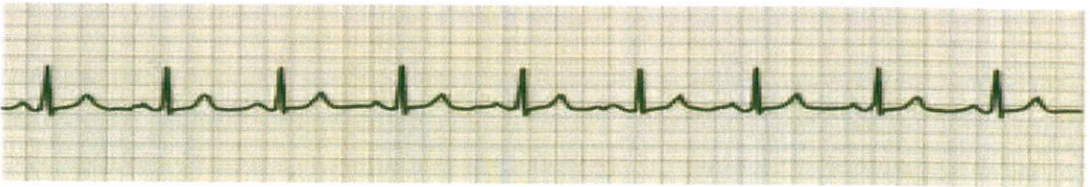
Non shockable rhythms of cardiac arrest

Asystole and pulseless electrical activity do not require shock (Fig. 18)

- Asystole



- Pulseless electrical activity (Any organized rhythm without pulse)

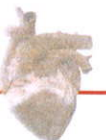
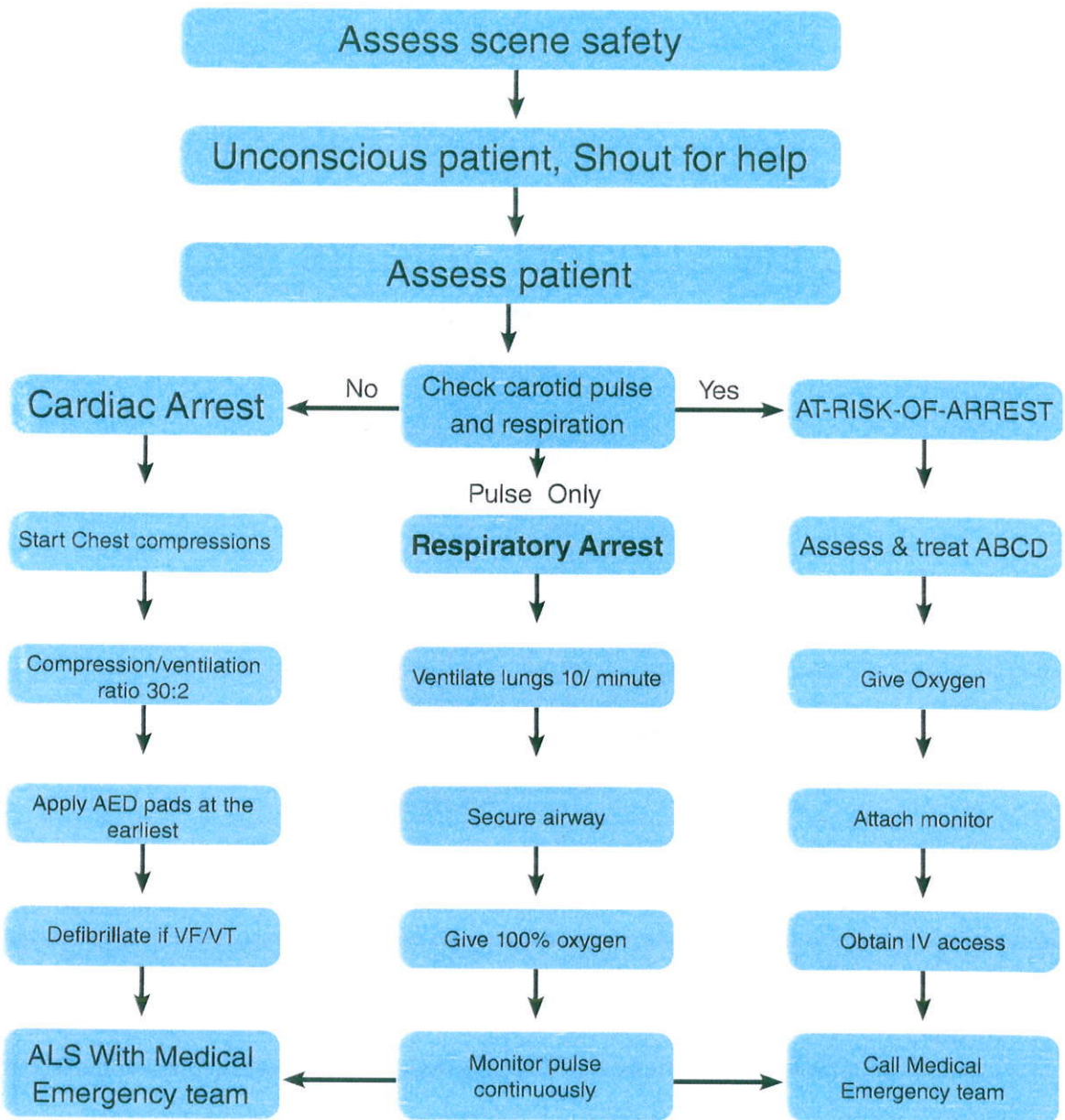


Identification of rhythm is important for doctors and nurses when conventional defibrillator is used. This is not needed when AED is used.



Coordinated efforts of trained members improve chances of successful resuscitation. Divide tasks among team members and provide high quality CPR for successful resuscitation. Continue CPR till Medical emergency team takes over.

Adult Basic life support algorithm



3. Basic life support -Infants and children



An infant is an individual below 12 months and a child is an individual after 12 months of age till onset of puberty. It is important to know the anatomical differences between infants, children and adults as they affect technique of CPR. These differences are:

1. Airway:

- Infants have relatively narrow nostrils and large tongue, thereby making breathing difficult.
- Infants have compressible floor of mouth and trachea which is short and soft. It can be easily compressed.
- Children have loose teeth which can fall off during different maneuvers and intubation, obstructing the airway.

2. Breathing:

- Ribs in adults are obliquely placed which become horizontal on chest expansion during breathing, whereas infants have horizontally placed ribs resulting in limited chest expansion.
- In spite of higher respiratory rate, infants have respiratory muscles which are easily fatigued.
- Lower airways are more in number and are smaller in size, therefore they can be easily blocked.

3. Circulation:

- Relatively small amount of blood loss can cause more deleterious effects on infants.

❖ The **SSS** approach for assessment of unconscious child:

When assessing an infant & child the SSS approach is important. It includes Safety, Stimulate and Shout.

First, take the child away from any danger to a **safe** location. Then **stimulate** the child for checking responsiveness and finally **Shout** for help if the child is unresponsive.

❖ How do we check for responsiveness in a child?

-It is simple, tap the shoulder.

❖ And how we check it in an infant?

-Its simpler, flick it's feet. (Fig. 19)



- If the child is unresponsive, activate emergency response system. Look for the chest and abdominal movements and check the pulse within 10 seconds.
- In a child, feel the carotid or femoral pulse and in an infant, feel the brachial pulse (Fig 20, 21) on the inner aspect of the arm, midway between the shoulder and elbow.(At least for 5 seconds)



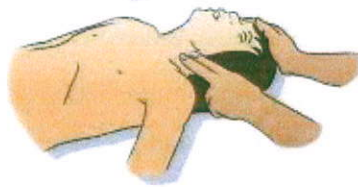


Fig. 20,



Fig. 21

- If there is pulse but no chest movements, start giving rescue breaths.
- If in doubt regarding presence of definitive pulse or that pulse rate is less than 60 beats per minute and there are signs of poor perfusion (low temperature, altered mentation, weak pulse, pale or cyanosed child) then CPR is needed.
- If the arrest is witnessed, call for EMS with automated external defibrillator (AED) and start chest compression if you are alone.
- If arrest is not witnessed, give CPR (30:2) or 15:2 if another rescuer is available (5 cycles) and then call for AED
- AED should be used as soon as available.

CAB in children and Infants

CPR provider should check for pulse and breathing simultaneously to minimize the delay in starting CPR. If the child is unresponsive, pulseless and not breathing or gasping; start CPR.

C - Chest compression

- Place the infant or child on firm surface.
 - Compression depth should be of at least one third of the anteroposterior diameter of chest, i.e. approximately 1.5 inches (**4 cm**) for **infants** and approximately 2 inches (**5 cm**) for **children**.
 - Rate of compression should be 100-120 /min. Chest compression and recoil time should be nearly equal.
 - Two different techniques of chest compressions are recommended for infants.
- A. **Two finger technique** –Infant's chest compressions are performed with 2 fingers. Compress in mid line, on lower half of sternum, just below the nipple line. **(Fig 22) It is used when single**



rescuer is available.



Fig 22 showing two finger chest compression technique

B. **Two thumb-encircling hands technique** for CPR in an infant (Fig. 23):

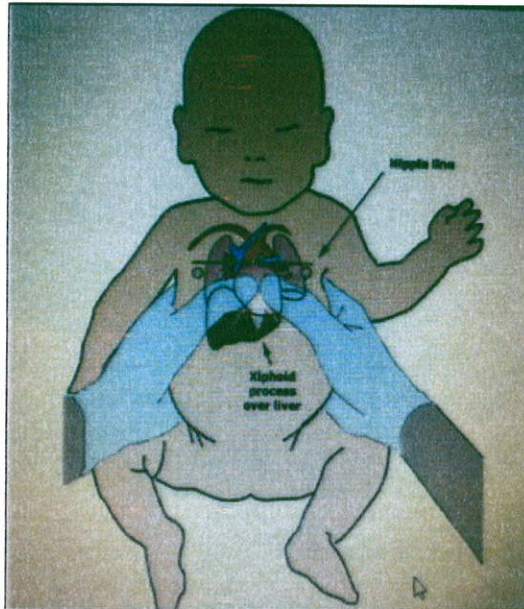


Fig 23 showing two thumb – encircling hands technique

The thorax is encircled with both hands and cardiac compressions are performed with thumbs which compress over the lower half of the sternum, avoiding the xiphoid process, while the fingers are spread around the thorax (Fig 23). This is a preferred technique when two rescuers are available and is a more effective technique.



A -Airway:

- Open the Airway.
- If no breathing is detected, gently tilt the victim's head backward by lifting the chin. Infant's neck should be in neutral position such that the external ear canal and top of infant's shoulder are at same level.
- Do not overextend the head because this could result in obstruction of the airway.

B - Breathing:

Can be given by i) mouth to mouth, mouth to mouth and nose (Fig 25) iii) with pediatric bag mask.

Fig 24 Showing mouth to mouth breathing



Fig 25

- Airway is opened by head tilt chin lift.
- Cover the infant's nose and mouth with your mouth. Make sure you create a seal.(Fig 25)
- Give the infant a quick gentle breath from your cheeks.
- Move your mouth away and allow passive exhalation.
- Repeat with another gentle breath.
- The chest rise should be visible. Give two such breaths. Every breath should be delivered over one second.
- The inflation pressure may be higher as the airway size is small.
- If the infant cannot be ventilated, readjust position of head.



- Failure of chest rise both after head tilt/chin lift and jaw thrust should lead to suspicion that a foreign body may be causing the obstruction and appropriate action should be taken. Both compressions and ventilations in 30:2 ratio for single rescuer and 15:2 ratio for two rescuers are essential in pediatric patients.

❖ **CPR in a child:**



Fig 26 showing chest compression with one hand

Hit hard and hit fast is the thumb rule.

- Compressions should be performed over the lower half of the sternum with either the heel of one hand or with two hands. (Fig.26)
- Once BLS has started, interruption in chest compressions should only be for ventilation.
- Obstructed airway is the most common problem in an unresponsive child hence airway opening maneuvers should be immediately performed.
 - Head tilt and chin lift maneuver should be used to open the airway.(Fig 27)
 - If cervical spine injury is suspected, then jaw thrust maneuver (Fig 28) should be performed.
- Both compressions and ventilations are essential in pediatric patients. 30:2 ratio for single rescuer and 15:2 ratio for two rescuers is recommended.
- As needed, change rescuer's role every 2 minutes to maintain high quality of CPR. Use AED as soon as it is available.



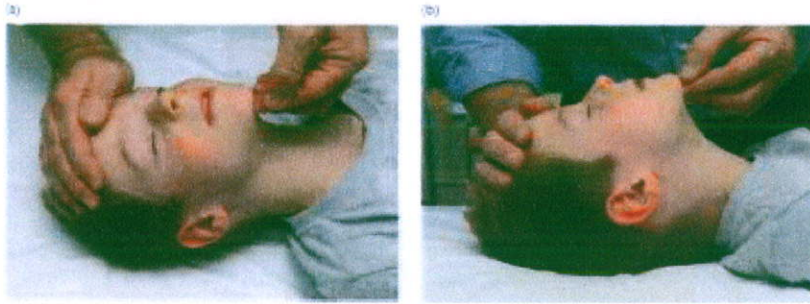


Fig 27 showing head tilt chin lift technique



Fig 28 showing jaw thrust technique

- ❖ Continue chest compressions till AED arrives and it prompts for analysis of rhythm.
- ❖ **AED in Pediatric CPR:** Switch on the machine. Apply pediatric pads.(Fig. 30)

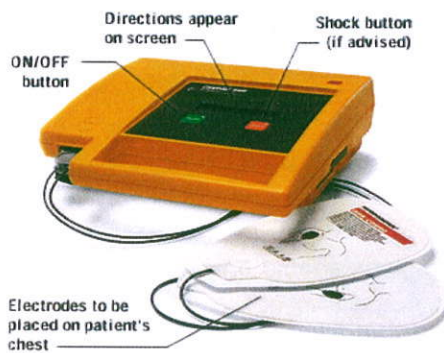


Fig 28 showing AED



Fig 28 showing placement of chest pads

- ❖ Actions are based on rhythm analysis by AED. Rhythm may be shockable or nonshockable.

Shockable rhythm – Machine will instruct to give shock and resume CPR immediately for 2 minutes or until instructed by the AED to allow for rhythm check. If needed, shock can be repeated. Continue until advanced life support providers take over or movements are seen.

Nonshockable rhythm – Resume CPR immediately for 2 minutes or until instructed by the AED. Continue CPR until advanced life support providers take over or the movements are seen.



- **Continued Care:**

-If the victim is still unresponsive and not breathing, continue the 5 cycles of CPR until help arrives.

-If the victim regains a pulse, but is not breathing, administer rescue breaths.



4. Defibrillator

Cardiac arrest may be due to sinus arrest, pulseless electrical activity, ventricular fibrillation (irregular and asynchronous cardiac rhythm) and pulseless ventricular tachycardia (regular rapid broad complex rhythm). **In more than 70% adult victims, ventricular fibrillation (VF) is the cause of arrest.**

Normally all the muscle fibers of heart contract simultaneously and effective forceful contraction of left ventricle pumps out the blood to all organs. When VF is there, due to irregular activity of heart muscle fibres, heart cannot pump out the blood. So there is no blood supply to brain, lungs and other organs.

For VF or Pulseless ventricular tachycardia (PVT), CPR alone is not sufficient to restore regular rhythm. Defibrillation is required along with CPR. For defibrillation, external shock is delivered through chest to the heart by using automated external defibrillator (AED) or conventional defibrillator. When shock is delivered to heart, the irregular contraction of cardiac muscles stop due to termination of chaotic electrical activity and if the myocardium is viable, Sinus node is reset to begin synchronous contractions resulting in an organized rhythm.

AED is a portable computerized device. It can check heart rhythm through adhesive electrodes applied to the chest wall. It analyses cardiac rhythms which need a shock and selects the energy essential to deliver shock.. If rhythm is shockable , it gives audio visual instructions to the user to press the button for delivering shock. If one follows the instructions, even a lay person can use the machine easily.

Shock must be delivered at the earliest as chances of survival decrease by 10% every minute. So as soon as one finds the unresponsive victim, call for the help with defibrillator. If not treated within minutes, VF turns to asystole. Only CPR cannot restore synchronized rhythm. Defibrillation is essential to terminate VF.



Fig. 31 Automated external Defibrillator

Parts of AED: - It has three buttons (Fig 31)

1. On button – To switch on the machine (green)
2. Analyze button – When activated, the machine will analyze the rhythm
3. Shock button (orange) - When activated, will deliver shock to the heart through chest.

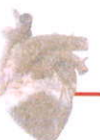
It has two self adhesive pads. Separate adult and pediatric pads are available.

How to use the machine? :-

1. One might have to press the button or device will be automatically switched on when the box of AED is opened.
2. The machine will instruct to **attach pads** to victim's chest. Choose proper size of pads. Adult size (13 cm) pad is used for all above 8 years. For children below 8 years pediatric pads (8cm) are available. If there is pediatric attenuator, adult pads can be used for pediatric patients.
3. Open package and remove the self -adhesive pads. Insert the electrode connector into the defibrillator.
4. Peel the backing away from the AED pads and attach self adhesive pads to victim's chest after removal of all clothing on the chest. Skin should be dry.

AED Pads can be put in **various positions** –

- Antero lateral (Fig 32) - most commonly used position
- Antero posterior (Fig 33)



- Antero – left infra scapular
- Antero and right infra scapular

5. For **analysis of rhythm**, everybody should be cleared from the patient. Be sure that no one is touching the patient, including the one who is providing the artificial ventilation. After pressing analyze button, AED will analyze rhythm within 5 to 15 seconds. After rhythm analysis, AED will determine if the shock is essential and instruct to press the shock button if rhythm is shockable.

6. **Deliver shock.** Nobody should touch the patient when the shock is delivered. The person delivering shock should loudly state that I am going to shock at 3 and should visually confirm that nobody is in contact with the patient and count 1, 2, 3. Pressing the shock button will produce contraction of muscles as soon as the shock is delivered.

7. CPR should be resumed (Fig 34) for two minutes immediately after shock as spontaneous rhythm and heart activity may not be adequate for perfusion immediately after delivery of shock. Rhythm and pulse check should be done after 2 minutes of CPR.

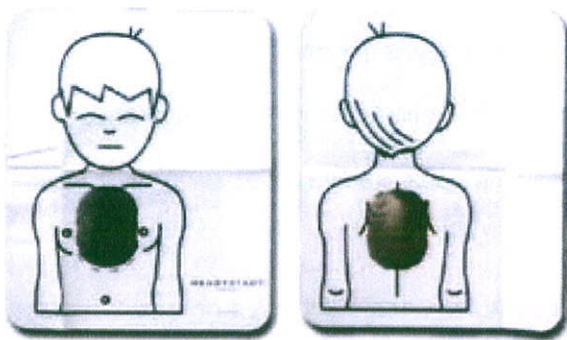


Fig 33 anteroposterior position of pads

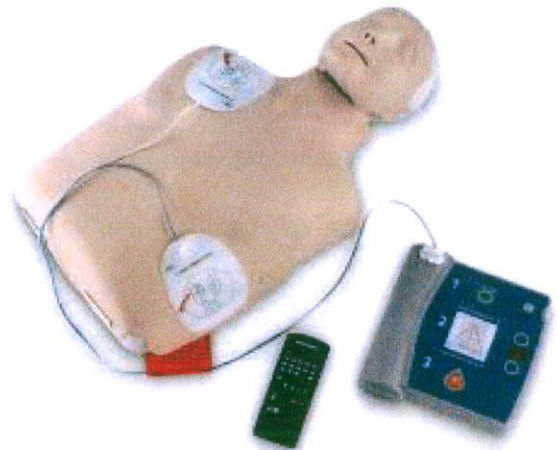


Fig 33 anteroposterior position of pads



Fig 34 Resume CPR immediately after shock



Special care while using AED:

- If AED does not instruct for rhythm analysis, high quality chest compressions and ventilations should be resumed. Check all the connections and make sure that they are intact. When defibrillator or AED is ready for use, it should be used immediately.
- When **hairs** are present on the chest, AED pads may stick to the hairs instead of chest wall. There will be problem in analyzing the rhythm and machine will instruct for checking the electrodes. One should press down firmly on pad. If still the problem persists, pull off the pads. Most of the hairs will be removed. Use another pads for delivering shock. One can shave the area with razor available with AED and apply pads.
- **Medication patch** (Nitroglycerin, fentanyl, nicotine etc) may block transfer of energy from adhesive pads to heart or cause skin burns. Medication patch must be removed and area should be cleaned before attaching electrode pads.
- AED should not be used on the wet **chest wall**. Wipe the chest before attaching electrodes. If the patient is lying on the snow or ice AED can be used.
- If the patient is having **implanted cardioverter/ defibrillator or pace maker**, AED electrode pads should not be directly placed over the device as device may interfere with shock delivery. Anteroposterior position is preferred instead of anterolateral, to avoid this problem. If the implanted defibrillator is delivering shock to the patient, allow 30 to 60 seconds for implanted defibrillator to complete the cycle and then AED shock should be delivered. Function of implanted device should be checked as AED may interfere with that.

Manual Defibrillator

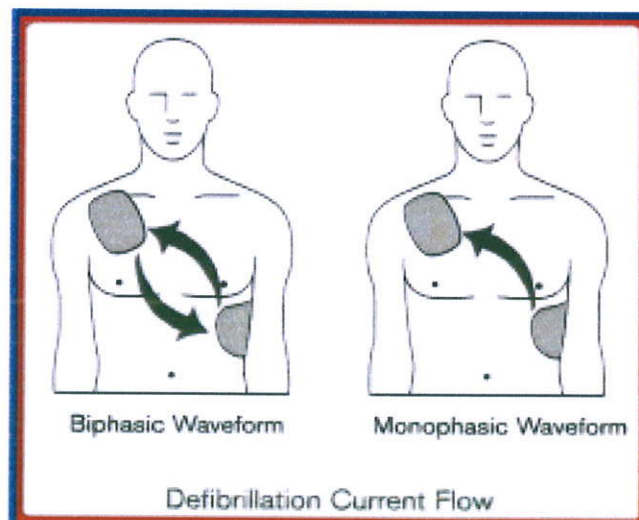


Fig 35 Direction current in biphasic and monophasic defibrillator





Fig. 36 monophasic Defibrillator

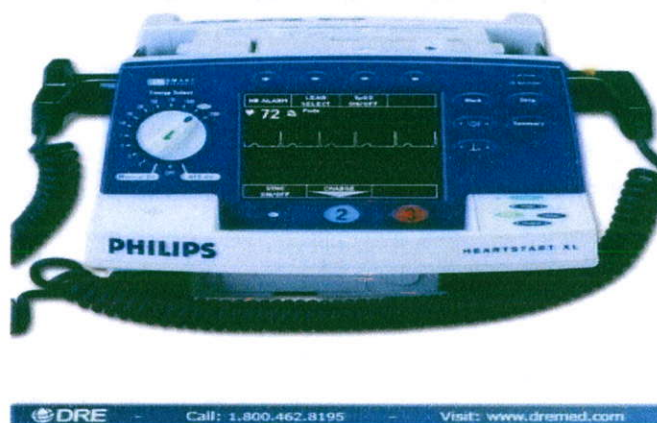


Fig. 37 Biphasic Defibrillator

Parts:

It has cardiac monitor, ECG cable and two paddles for adults and pediatric patients, lead selection button. When the machine is switched on, ECG can be recorded either via ECG leads & cables or paddles placed on chest.

One has to confirm that rhythm is shockable and select energy and take decision to deliver shock.

Defibrillator may be monophasic (Fig 36) or biphasic (Fig 37). In monophasic defibrillator, current flows in one direction during shock delivery over 10 millisecond. In biphasic defibrillator, heart receives shock when the current is flowing in both the directions (Fig. 35). So biphasic defibrillator requires nearly half the energy as compared to monophasic defibrillator and produces less injury to heart and skin burns.

As the VF rhythm is not organized, the shock is delivered in **asynchronous** mode of machine.



How to use a manual defibrillator?

1. Place the manual defibrillator on a dry surface.
2. Turn on the defibrillator.
3. Defibrillator has batteries and should be fully charged. If the defibrillator monitor shows low battery output, obtain another defibrillator.
4. Take out the paddles, apply jelly to paddles
5. Confirm that rhythm is shockable
6. Charge the paddles by selecting energy of **360 joules** for monophasic defibrillator or **120- 200 joules** for biphasic defibrillator. If one does not know the type of defibrillator, choose maximum energy available on defibrillator. For pediatric patients, use 2 Joules/kg energy for first shock and 4 joules for subsequent shocks for either mono or biphasic defibrillators.
5. Place paddles on chest as shown in figure 8. Apply pressure of about 12 kg
7. Press shock button on both the paddles simultaneously after confirming that nobody is touching the patient
8. Continue CPR for two minutes (5 cycles) and then check rhythm. If still VF is persistent shocks may be repeated as per VF algorithm

Maintenance of defibrillator:

Always keep the batteries fully charged. Keep a log book to confirm that machine is always in working condition. Make sure that you know all about your machine before actual use.



5. Respiratory arrest

When breathing stops, there is no supply of oxygen and exhalation of carbon di oxide. Victim becomes unconscious when oxygen is not provided to brain. If treated at the earliest, respiratory arrest may be reversible. If not detected and treated in time, it can lead to cardiac arrest and brain damage.

Diagnosis of respiratory arrest:

- Victim is unresponsive.
- There is no breathing or agonal gasps may be there.
- Pulse is palpable.

Action plan:

Start immediate treatment to prevent cardiac arrest.

- Activate emergency service, as victim with respiratory arrest may have cardiac arrest at any time. Start giving rescue breaths. If you are out of hospital and not having any device to ventilate, mouth to mouth respiration can be given to the victim.
- Obstructed airway is the most common problem in an unresponsive victim. Hence airway opening maneuvers should be performed immediately.
 - Head tilt and chin lift maneuver should be used to open the airway. (Fig 7)
 - If cervical spine injury is suspected, then jaw thrust maneuver (Fig 8) should be performed.
- Infant's neck should be in neutral position such that the external ear canal and top of infant's shoulder are at same level. Do not overextend the head because this could result in obstruction of the airway.

Breathing:

Can be given by i) mouth to mouth (Fig 9) ii) mouth to mouth and nose in infant (Fig 25) iii) mouth to mask or iv) AMBU bag & mask.

These techniques are described in detail in Adult and Pediatric basic life support chapters.

Risk of infection to the rescuer from resuscitation is extremely low. As standard safety precautions, barrier devices are recommended during resuscitation.



Fig 9 showing mouth to mouth ventilation



Fig 25 showing mouth to mouth and nose ventilation in infant

- Airway is opened by head tilt chin lift and artificial breaths are delivered.
- Rate of ventilation in **adults** should be about **10-12 breaths/min** (one breath after every 5-6 seconds) and **12-20 breaths/min** in **child and infant** (one breath every 3-5 sec)
- The chest rise should be visible. Every breath should be delivered over one second.
- If the victim cannot be ventilated, readjust position of head.
- If still ventilation is not possible after two attempts, or signs of poor perfusion are seen (pulse rate less than 60/min in child/infant), start chest compressions.
- Do not try to give breaths very forcefully, rapidly or with high volumes. This can lead to gastric inflation which can result in vomiting and difficulty during ventilation.
- Ventilation technique using Bag and mask is already described in chapters of basic life support



for adults and pediatric patients. This technique can be adopted during transport or in hospital patients.

Life threatening emergencies due to narcotics (opioids)

Opioid addiction is increasing in India. These are narcotics used for treatment of pain. Heroin is a crude extract of narcotic.

Opioid when consumed in high doses, can lead to respiratory and central nervous system depression. This in turn can lead to cardiac arrest. Consumption of opioids along with alcohol and sleeping pills, increase the chance of respiratory depression.

If a person is found unconscious, assessment of surrounding should be done along with resuscitation efforts. Look for injection marks on the skin, wrappers of tablets or injection ampoules. Ask family members or friends about drug consumption.

In case of Opioid overdose, patient may be unconscious with respiratory depression but may have pulse. Give rescue breathing (1 breath every 5 – 6 seconds) with bag & mask.

Victim may develop cardiac arrest in such situation. If victim is unresponsive, call EMS to bring naloxone and AED. If no help is available give CPR for 2 minutes before EMS is activated.

Naloxone is administered as soon as available. As per AHA 2015 recommendations, 2 mg intranasal or 0.4 mg intramuscular dose is administered. **Naloxone may be repeated after 4 min.** Continue ventilation. If victim stops responding give CPR and repeat naloxone. Naloxone should be administered along with routine resuscitation measures. Prefilled auto injectors of naloxone are also available.



6. Management of choking in adult, pediatric and infant

FOREIGN BODY AIRWAY OBSTRUCTION (Chocking)

Foreign body airway obstruction (FBAO) causes asphyxia. If severe, it can result in rapid loss of consciousness and death if first aid is not undertaken quickly and successfully. Immediate recognition and response are most important.

Recognition and Assessment of severity: -

Mild obstruction

- The patient is able to breathe, cough effectively and speak, may wheeze between the coughs
- Children are fully responsive, crying or verbally respond to questions; may have a loud cough

Severe obstruction:

Ask the victim if he/she is choking. If the victim nods but can't talk, one should assume that severe obstruction is present.

Patient may show following signs & symptoms.

- Inability to breathe or speak.
- Wheezy breath sounds particularly during inspiration
- Difficulty in breathing
- Clutching the neck with thumb and fingers, making universal choking sign.(Fig -39)
- Cyanosis.
- Unconsciousness if obstruction is not relieved



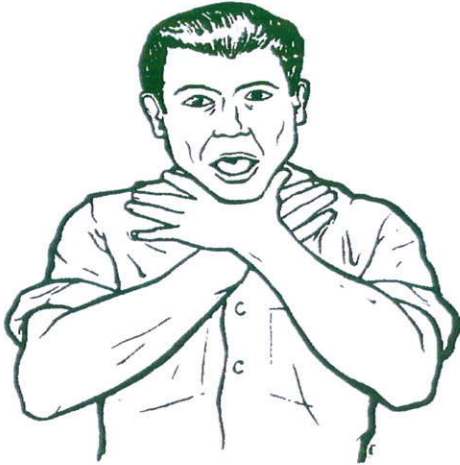


Figure 39 showing universal choking sign

Management

Adults and children (age > 1 year)

- **In mild obstruction**, encourage the patient to continue coughing; however, do nothing else except monitoring for deterioration.
- **In severe obstruction in a conscious patient:**
 - Stand behind the victim (who is leaning forward), put both arms around the upper abdomen, clench one fist and place thumb side of the fist against victim's abdomen, grasp it with the other hand and pull sharply inwards and upwards. (abdominal thrusts /Heimlich manoeuvre – Fig 40)
 - Continue abdominal thrusts until successful or the patient becomes unconscious.
- **In an unconscious patient:**
 - Lower the patient to the floor.
 - Call an EMS immediately if second rescuer is present.
 - Begin CPR (Do not check for pulse)
 - If you are alone, give CPR for 2 minutes and then call EMS.
 - Every time during CPR when ventilation is given, open the mouth & look for presence of foreign body.
 - Don't try to remove the foreign body unless it is visible. Do not perform blind finger sweep inside the mouth as that may push the foreign body further down.



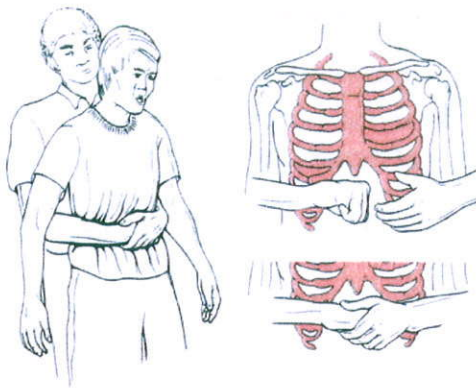


Figure 40 showing Heimlich manoeuvre

For infants (<1 year old) –

If a foreign body is easily visible and accessible in the mouth then remove it.

The physical methods of clearing the airway, should be done only if

1. Diagnosis of FBAO is witnessed.
2. Head tilt/chin lift, jaw thrust have failed to open airway of apneic infant.

Relief of choking in Infant:

- Use backslaps and chest thrusts for removing the foreign body.
- For giving back slaps, remove chest clothing of infant. Kneel with infant in your lap.
- With the head lower than chest and face downwards, support the infant on your fore arm. Head is supported with fingers, taking care not to compress soft tissue under jaw.(Fig 41)

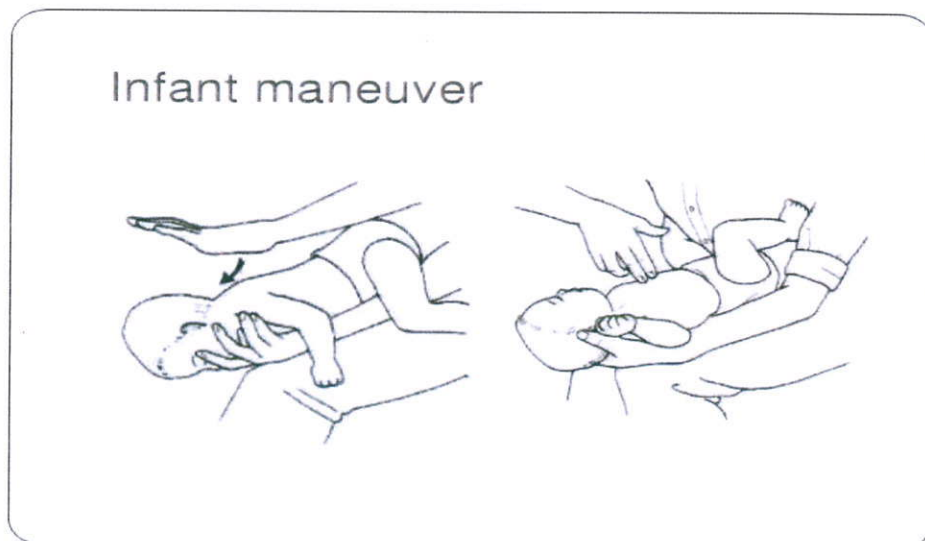


Figure 41 showing back slaps and chest thrust maneuvers



Give 5 slaps between shoulder blades with heel of hands.

Then turn the infant as a unit on another forearm, encircling occiput with hand. Give five chest thrusts on lower half of sternum with fingers of other hand (Fig 41). This site is same where chest is compressed during CPR but rate is slower. **Abdominal thrusts are not used in infants.**

- Repeat the chest thrusts and backslaps till foreign body is removed or infant becomes unconscious.
- Give CPR if infant is unconscious. **After every 5 cycles, open the airway and look for foreign body.** If visible, take it out.
- EMS should be activated for AED after two minutes of CPR if single rescuer is there.



7. Team dynamics

A single rescuer alone can resuscitate a person having cardiac arrest but if a team of workers is available, chances of successful outcome increase. There are many activities involved during and after resuscitation which require skill and speed. A team leader is essential to train and guide the team. Good communication and co-ordination of team is essential.

One should be able to work as a member as well as a team leader. We should know the roles of team member and as well as team leader.

Role of team leader

1. To organize the group
2. To allot specific work as per their expertise, and if the role is not up to the mark, he should not hesitate to allot the work to another member.
3. To monitor the performance of individual team member
4. To support the team member as needed
5. To take comprehensive patient care
6. Should have exemplary behavior.
7. At the end of event he should analyze the event and activities. Explain in detail about activities. Should tell the drawbacks of any member or system. He should explain the team members why the particular task is to be done in specific way for example why push hard and push fast as well as complete chest recoil is essential.
8. Should train and coach the members to optimize all the necessary skill and leadership qualities



9. He should try to improve the team effectiveness

Role of team members – Team member must be proficient in resuscitation skills and algorithms. It is essential that the member.

1. Should be aware about role assignment. He/ She should know his role and role of other members.
2. Be prepared to fulfill the responsibility
3. If he/she is not confident about performing the task up to the mark, should tell the leader about the limitation and get adequately trained after the event.
4. He should be committed to success.

Communication skill of the team –

Closed loop communication is essential. Team leader gives order, after receiving a clear response. Team leader confirms that the member has understood the message. Leader listens for confirmation of task performance before assigning next order. Leader should not give more tasks to a member without receiving confirmation of completed assignment. Team member should not give drugs without verbally confirming the order with the leader and should not forget to inform leader after giving the drug or performing a particular procedure.

Clarity of message –

The message should be delivered in a controlled tone of voice by all the team members. The leader should not shout at members. There can be delay in treatment and errors due to unclear communication by leader. Team leader should encourage member to speak clearly and member should ask the leader if there is any doubt.

Allotment of roles –

At least five members are essential for different roles during resuscitation.

1. Team leader
2. Member giving ventilation
3. Member giving chest compressions
4. Member for providing defibrillation
5. Member to record time.

Their position can be adjusted as shown in fig.42

- Every member should know what his / her role is. When more than six members are present the tasks should be assigned to all. If not done, there are chances that the same task may be performed more than once or essential task may be missed.
- Team members should communicate if they can handle additional responsibilities. Team leader should also encourage members to participate in leadership and also tell them to prompt any



suggestions if any. He should see that the member is doing his work up to the mark. Team leader should not assign task to a member who is not confident of his responsibility and also should not assign tasks unevenly to the members. Team member should not accept task beyond level of their competence. Evaluation of limitations of member allows leader to call for backup team members as needed. Members should anticipate the situations in which they might require help and should inform the leader. Member should not practice a new skill during emergency. Asking for help is not indication of weakness. It's better to seek for early advice when the patient doesn't respond to primary treatment. Team member should not reject offer from others if task completion is essential to treatment and member is unable to complete the task. Member should not take many assignments when assistance is available.

Knowledge sharing –

Sharing helps for effective team performance. When patient is not responding leader should assess and ask the team members "Are we missing something?" Team members should give suggestions if they think that it will be useful for patient. Discussion will help for differential diagnosis. Team leader should not ignore suggestions from the team members. If the leader suggests improvement in the role of team member it should be well accepted by the member.

Constructive intervention –

As time is crucial during resuscitation team leader or a member may feel need for intervention if the particular action or task has to be performed at that particular time. Leader should perform it with tact. Debriefing should be done after works if a constructive criticism is needed.

Re-evaluation –

While the patient's treatment is going on, leader should monitor and re-evaluate patient's status, drugs and treatments administered and patient's response. Periodic updates should be given to team members and further plan should be communicated. Leader should remain flexible for changing treatment plans according to change in the patient's condition. Additional monitoring measures should be added when patient's condition is not improving. If another expert is called for help, the leader should brief about the current status and the treatment given to the patient.

Mutual respect –

All the members should have mutual respect for each other during resuscitation process. Leader should speak in a friendly manner and a controlled tone. He should acknowledge and thank the members for their valuable contribution. Behavior of any member should not be aggressive. Members and leader should work cohesively.



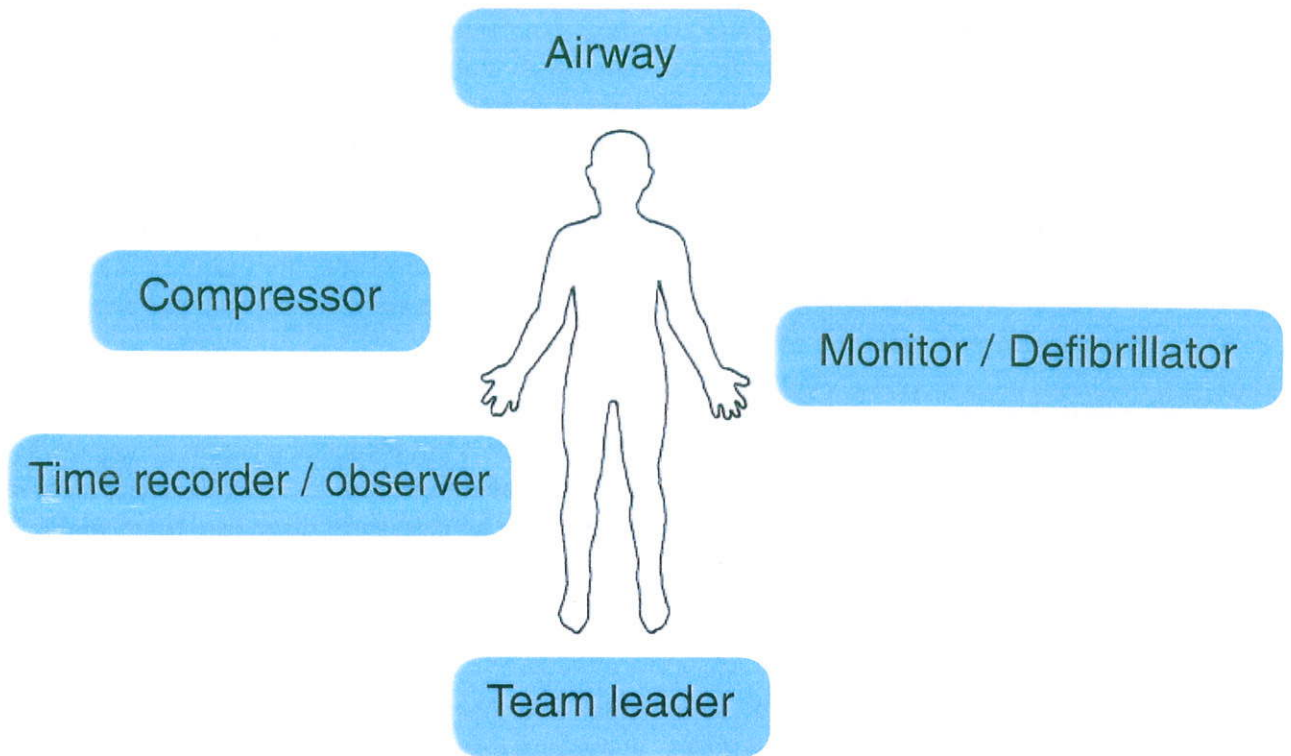


Fig 42 showing position of team members



8 Summary of adult, pediatric and infant CPR guidelines

Summary of high quality CPR components for BLS providers. (AHA 2015)

Component	Adult and Adolescents	Children (Age 1 year to Puberty)	Infants (Age less than 1 year, Excluding Newborns)
Scene safety	Make sure the environment is safe for rescuers and victim		
Recognition of cardiac arrest	Check the responsiveness No breathing or only gasping (i.e. no normal breathing) No definite pulse felt within 10 seconds (Breathing and pulse check can be performed simultaneously in less than 10 seconds)		
Activation of emergency response system	If you are alone with no mobile phone, leave the victim to activate the emergency response system and get the AED before beginning CPR	Witnessed collapse Follow steps for adults and adolescents Unwitnessed collapse Give 2 minutes of CPR Leave the victim to activate the emergency response system and get the AED Return to the child or infant and resume CPR Use the AED as soon as it is available.	
Compression ventilation ratio without advance airway	1 or 2 rescuers 30:2	1 rescuer 30:2 2 or more rescuer 15:2	
Compressions rate	100-120/min		
Compression depth	At least 2 inches (5 cm)	At least one third AP diameter of chest	At least one third AP diameter of chest about 1½ inches (4cm)
Hand placement	2 hands on the lower half of the breastbone (sternum)	2 hands or 1 hand (optional for very small child on the lower half of the breastbone (sternum)	1 rescuer 2 fingers in the center of the chest, Just below the nipple line 2 or more rescuers 2 thumb – encircling hands in the center of the chest, just below the nipple line
Chest recoil	Allow full recoil of chest after each compression, do not lean on the chest after each compression		
Minimizing interruptions	Limit interruptions in chest compressions to less than 10 seconds		

