Lec. 14

CARDIOPULMONARY RESUSCITATION (CPR)

What does CPR stand for?

- C = Cardio (heart (
- P = Pulmonary (lungs (
- R= Resuscitation (recover (

DEFINITION

Cardiopulmonary resuscitation (CPR) is a technique of basic life support for the purpose of oxygenation to the heart, lungs and brain until and unless the appropriate medical treatment can come and restore the normal cardiopulmonary function.

Cardiopulmonary resuscitation is a series of steps used to establish artificial ventilation and circulation in the patient who is not breathing and has no pulse .

PURPOSE

- Restore cardiopulmonary functioning.
- Prevent irreversible brain damage from anoxia.

INDICATION

- Cardiac arrest
- Respiratory arrest
- Combination of both40

Definition of Cardiac arrest: It is loss of cardiac function, breathing and loss of consciousness.

Causes of cardiac arrest (6H & 4T)

1. Hypoxia
2. Hypotension.
3. Hypothermia
4. Hypoglycemia
5. Acidosis (H)

6. Hypokalemia (electrolyte disturbance)

1. Cardiac tamponed
2. Tension pneumothorax.
3. Thromboembolism
4. Toxicity (digoxin, local anesthetic, Insecticides)

OSCEstop

Reversible causes of cardiac arrest

Reversible cause	Assessing it	Treating it
Hypoxia	Ventilation adequacy, oxygen flow rate, ABG	15L/minute oxygen, good ventilation, i-gel airway
Hypovolaemia	History, drains, haemorrhage, fluid collections (expose patient)	Fluid resuscitation, treat cause (e.g. stop bleeding)
Hypo/hyperkalaemia	ABG and latest blood results	↑K^+: 10ml 10% calcium chloride; 10 units actrapid insulin in 50ml 50% dextrose rapidly; 50mmol sodium bicarbonate (50 mL 8.4% solution) rapidly ↓ K^+: 20mmol KCl over 10 minutes
Hypothermia/hyperthermia	Patient's temperature on recent observations, warmth to touch	Hypothermia: warm patient, extracorporeal CPR Hyperthermia: cool patient, IV fluids
Thrombosis (coronary or pulmonary) *Commonest cause*	History, risk factors, legs (DVT signs), post-surgery?	PE: thrombolysis, surgical embolectomy MI: PCI
Tension pneumothorax	Tracheal deviation, unilateral hyper-resonance and decreased breath sounds	Insert cannula into second intercostal space, mid-clavicular line; or open thoracostomy
Tamponade, cardiac	Recent chest trauma/surgery/pacemaker insertion/PCI Focussed cardiac ultrasound should be sought if high risk	Pericardiocentesis
Toxins	History, drug chart, gather info, capillary glucose	Treat toxaemia, e.g. naloxone for opioids

Diagnosis of cardiac arrest (TRIAD)

1. Loss of consciousness.
2. Loss of apical & central pulsations (carotid, femoral).
3. Apnea.

HOW CPR WORKS:

- Air we breathe in, travels to our lungs were oxygen is picked up by our blood and then pumped by the heart to our tissue and organs.
- When a person experiences cardiac arrest-whether due to heart failure in adults or the elderly or an injury such as near drowning, or severe trauma in a child-the heart goes from a normal arrhythmic Pattern called ventricular fibrillation, and eventually ceases to beat altogether.
- This prevents oxygen from circulating throughout the body, rapidly killing cells and tissue.
- In essence, cardio (heart) pulmonary (lung) resuscitation (revive, revitalize) serves as an artificial heartbeat and an artificial respirator.
- CPR may not save the victim even when performed properly, but if started within 4 minutes of cardiac arrest and defibrillation is provided within 10 minutes, a person has a 40% chance of survival.

EQUIPMENTS

✓ A hard flat surface

✓ No additional equipment is necessary but in hospital setting, an emergency

✓ crash cart with defibrillator and cardiac monitor should be brought to the bedside.

A crash cart contains:

1. Airway equipment.
2. Suction equipment.
3. Intravenous equipment.
4. Laboratory tubes and syringes.
5. Prepacked medication for advanced tide support.

PHASES OF THE CARDIOPULMONARY RESUSCITATION:

Phases		Steps
Phase _ 1	Basic life support	C=circulation A= Airway B= Breathing
Phase _2	Advance cardiac life support	D= Drugs E= ECG F= fibrillation
Phase _3	Prolonged life support	Post resuscitation care

What is basic life support (BLS)?

It is life support without the use of special equipment.

What is Advanced Life Support (ACLS)?

It is life support with the use of special equipment (e.g., Airway, endotracheal tube, defibrillator)

CHAIN OF SURVIVAL



❖ EARLY RECOGNITION



Assessment is of crucial importance. It Includes:

1. Unresponsiveness
    a. Check the victim for a response.
    b. Shake shoulders gently.
    c. Ask "Are you all right "?
2. No breathing or no normal breathing (i.e., only gasping)
3. No pulse felt within 10 seconds.

❖ 2. CPR Sequence

- A Change From A-B-C to C-A-B
    a. Compressions
    b. Airway
    c. Breathing

Chest Compressions (cardiac massage)

The human brain cannot survive more than 3 minutes with lack of circulation. So, chest compressions must be started immediately for any patient with absent central Pulsations.

TECHNIQUE OF CHEST COMPRESSION

- Pt must be placed on a hard surface (wooden Board)
- The palm of one hand is placed in the Concavity of the lower half of the sternum 2 fingers above the xiphoid process. (AVOID Xiphisterna junction fracture & injury)
- The other hand is placed over the hand on the sternum.
- Shoulders should be positioned directly over the hands with the elbows locked straight and arms extended. Use your upper body weight to compress.
    - Sternum must be depressed at least 5 cm in adults, and 2-4 cm in children, 1-2 cm in infants.
- Must be performed at a rate of 100-120/min.
- During CPR the ratio of chest compressions to ventilation should be as follows:
    - Single rescuer = 30:2
    - In the presence of 2 rescuers chest Compressions must not be interrupted for ventilation.

- Chest compressions in infant (0-12 Months)



- Chest compressions must be continued for 2 minutes before reassessment of cardiac rhythm. (2minutes =equivalent to 5 cycles 30:2)

Golden Rules:

- ❖ Ensure high quality chest compressions: rate, depth recoil.
- ❖ Plan actions before interrupting CPR.
- ❖ MINIMIZE interruption of chest compressions.
- ❖ Early defibrillation of shockable rhythm.

Assessment of the adequacy of chest compressions:

Systolic BP: 60-80 mmHg. Diastolic BP: > 40 mmHg COP 30% of normal

PROBLEMS AND COMPLICATIONS OF CHEST COMPRESSIONS

1. RIB FRACTURES
2. FRACTURE STERNUM
3. RIB SEPARATION
4. PNEUMOTHORAX
5. HEMOTHORAX
6. LUNG CONTUSIONS.
7. LIVER LACERATIONS
8. FAT EMBOLI

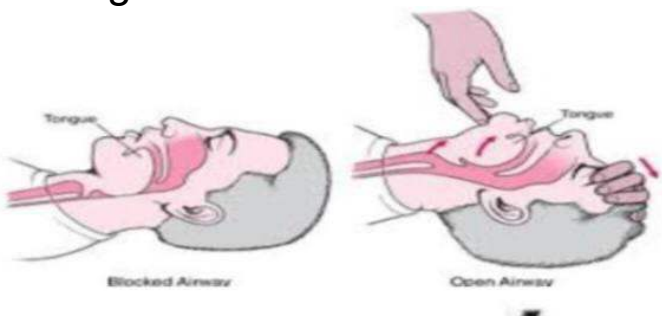
Airway

Loss of consciousness often results in airway obstruction due to loss of tone in the muscles of the airway and falling back of the tongue.

CLEAR THE AIRWAY

(A) Basic techniques for airway patency :

1. Head tilt, chin lift: one hand is placed on the forehead and the other on the chin the head is tilted upwards to cause anterior displacement of the tongue.





2. Jaw thrust:



3. Finger sweep: Sweep out foreign body in the mouth by index finger (in unconscious pt only. This is NOT advised in a conscious or convulsing patient).



4. Heimlich maneuvers: if the pt is conscious of the foreign body cannot be removed by a finger sweep. It is done while the pt is standing up or lying down. This is a subdiaphragmatic abdominal thrust that elevates the diaphragm expelling a blast of air from the lungs that displaces the foreign body. In infants his can be done by a series of blows on the back and chest thrusts.



Breathing

Rescue breathing can be mouth-to-mouth breathing or mouth-to-nose breathing if the mouth is seriously injured or can't be opened.

With the airway open (using the head-tilt, chin-lift maneuver), pinch the nostrils shut for mouth-to-mouth breathing and cover the person's mouth with yours, making a seal.

Basic techniques include:

1. Mouth to mouth breathing: with the airway held open, pinch the nostrils closed, take a deep breath and seal your lips over the patient's mouth. Blow steadily into the patient's mouth watching the chest rise as if the patient was taking a deep breath.



2. Mouth to nose breathing: seal the mouth shut and breathe steadily through the nose.
3. Mouth to mouth and nose: is used in infants and small children.

Assessment of restoration of breathing and circulation

- Contraction of pupil
- Improved color of the skin
- Free movement of the chest wall
- Swallowing attempts Struggling movements

Signs of restored ventilation and circulation Include:

- Struggling movements
- Improved color
- Return of or strong pulse51
- Return of systemic blood pressure

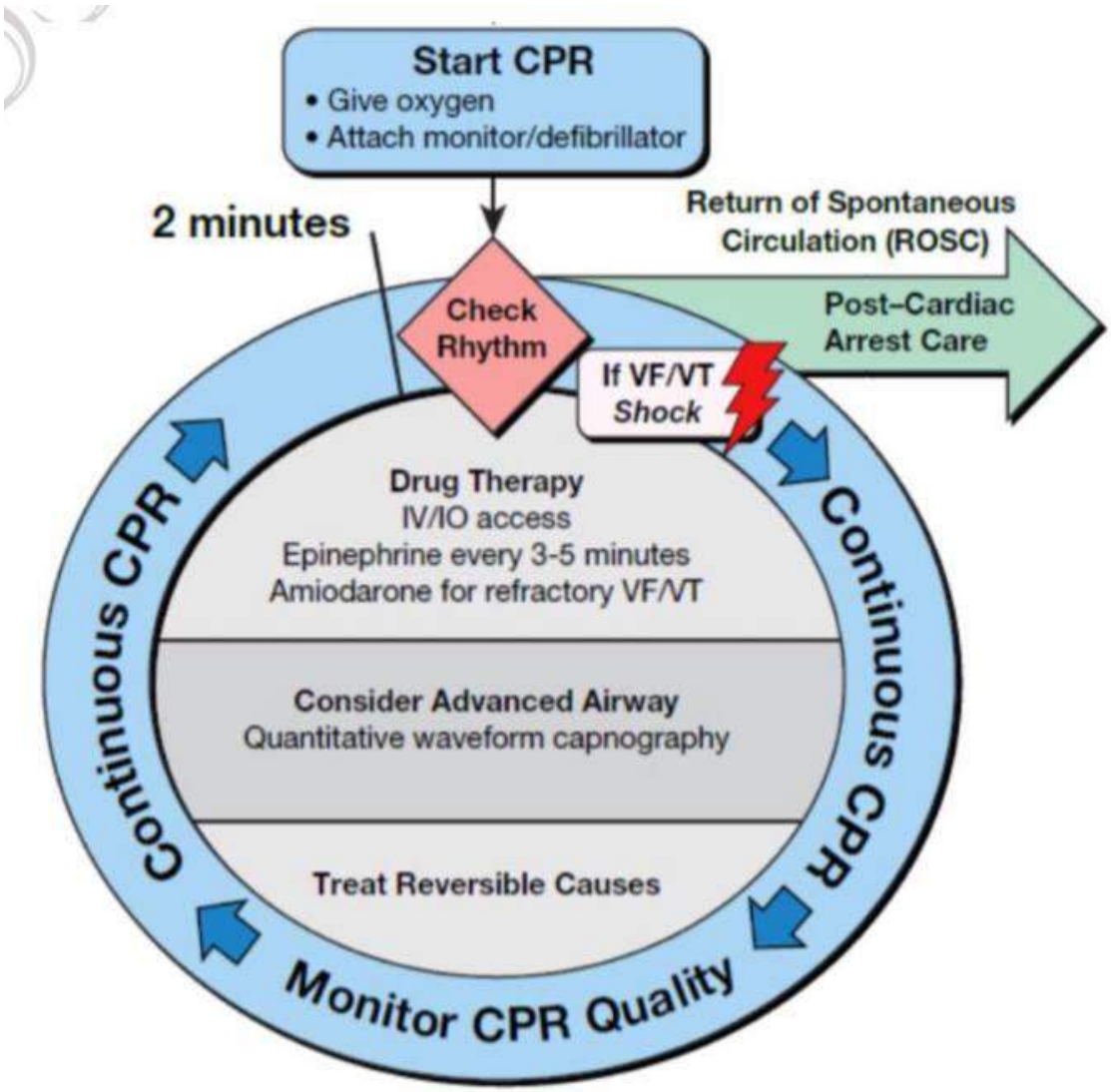
When to terminate BLS

- Pulse and respiration returns
- Emergency medical help arrives
- Physician declared patient is deceased
- In a non-health setting. another indication to stop BLS would be that the rescuer was Exhausted and physically unable to Continue to perform BLS.

ADVANCED LIFE SUPPORT

ALS includes:

- ❖ Circulation by cardiac massage
- ❖ Airway management by equipment's
- ❖ Breathing by advanced techniques
- ❖ Defibrillation by manual defibrillator
- ❖ Drugs.



Advanced techniques for airway patency,

- ❖ Face Mask
- ❖ Oropharyngeal airway
- ❖ Nasopharyngeal airway
- ❖ Laryngeal mask (LMA)
- ❖ Endotracheal tube
- ❖ Cricothyrotomy (Surgical Airway)
- ❖ Tracheostomy (Surgical Airway)

BREATHING

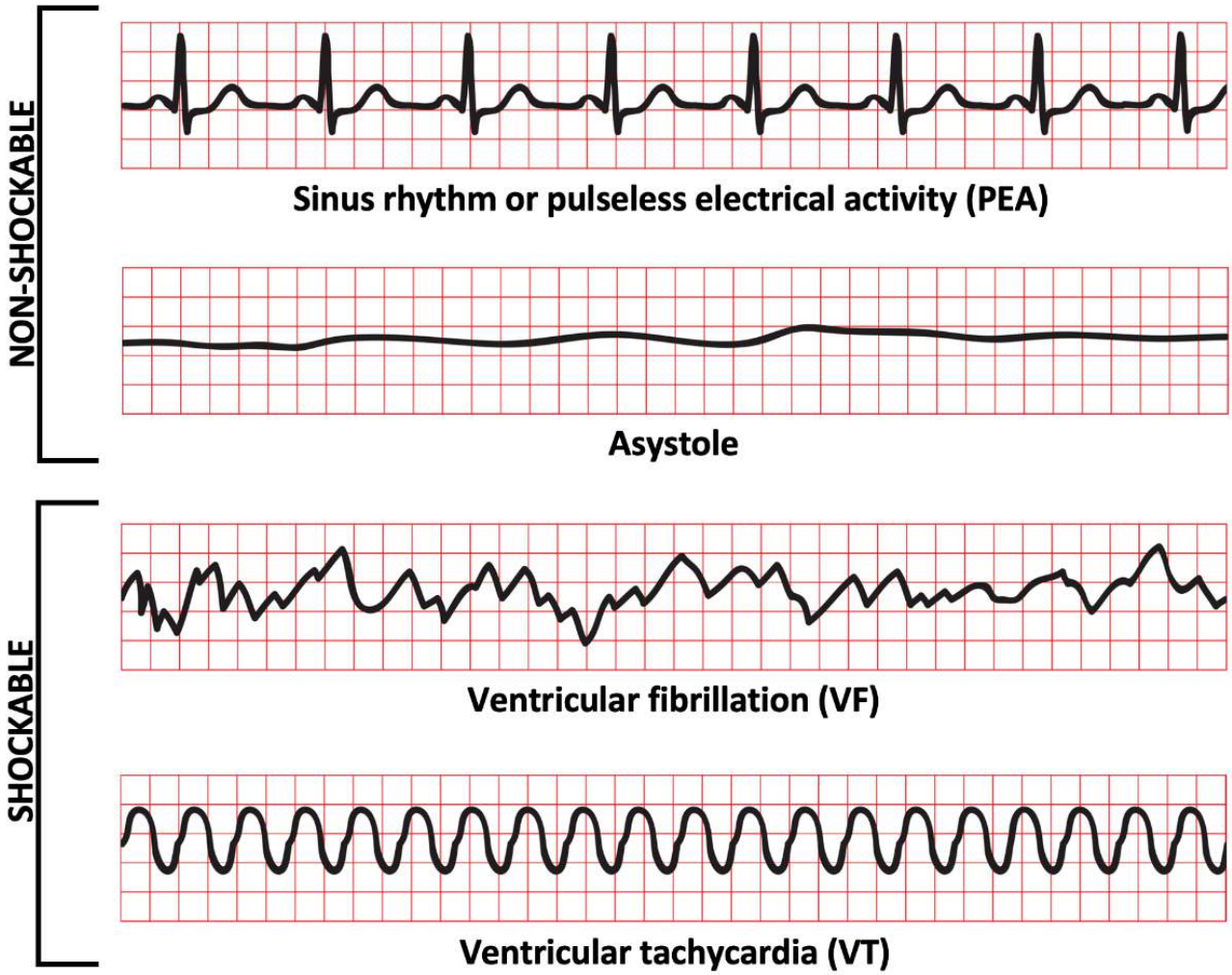




- Expired air contains 16% O, so supplemental 100% O2 should be used as soon as possible.
- Successful breathing is achieved by delivery of a tidal volume of 800-1200 ml in adults at a rate of 10-12 Breaths/min in adults

Advanced techniques include :

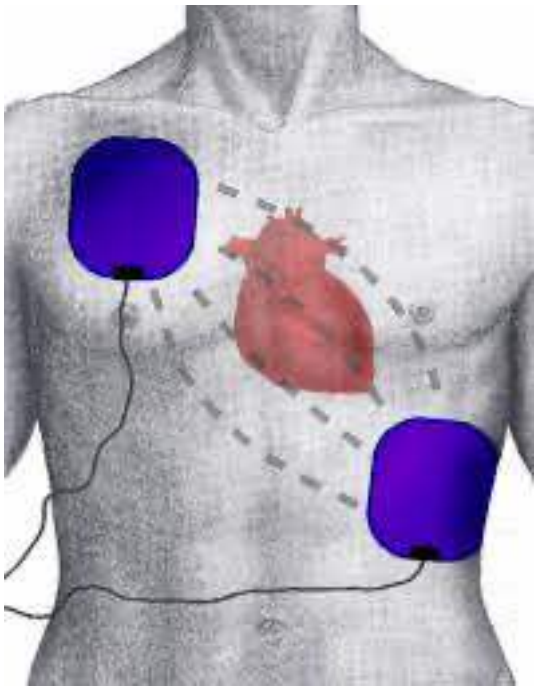
01. Self-inflating resuscitation bag (Ambu Bag)
02. Mechanical ventilator in OR or in ICU
    - Expired air =16% O2 .
    - Ambu Bag (room air) = 21% O2.
    - Ambu bag + O2 (10-15L) = 45% O2
    - Ambu Bag + O2 + Reservoir bag = 85% O2
03. DEFIBRILLATION
    - Defibrillation consists of delivering a therapeutic dose of electrical energy to the affected heart with a device called a defibrillator .
    - In cardiac arrest, the associated heart rhythms can be categorized into two Groups :
        - Shockable rhythm: VT/VF
        - Non shockable rhythm: asystole and PEA
    - The basic difference in the treatment of these two groups of arrythmia is the need for defibrillation in patients with VT/VF

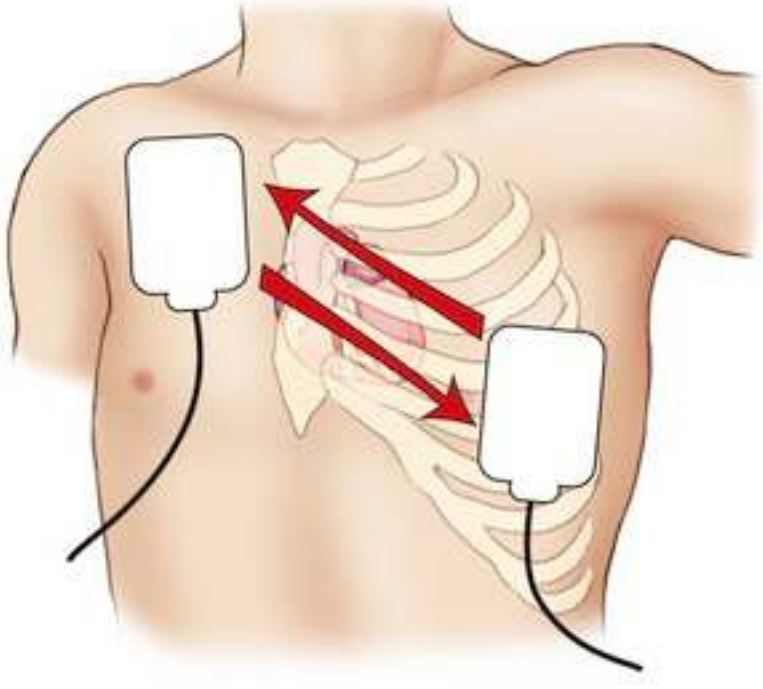


Defibrillation

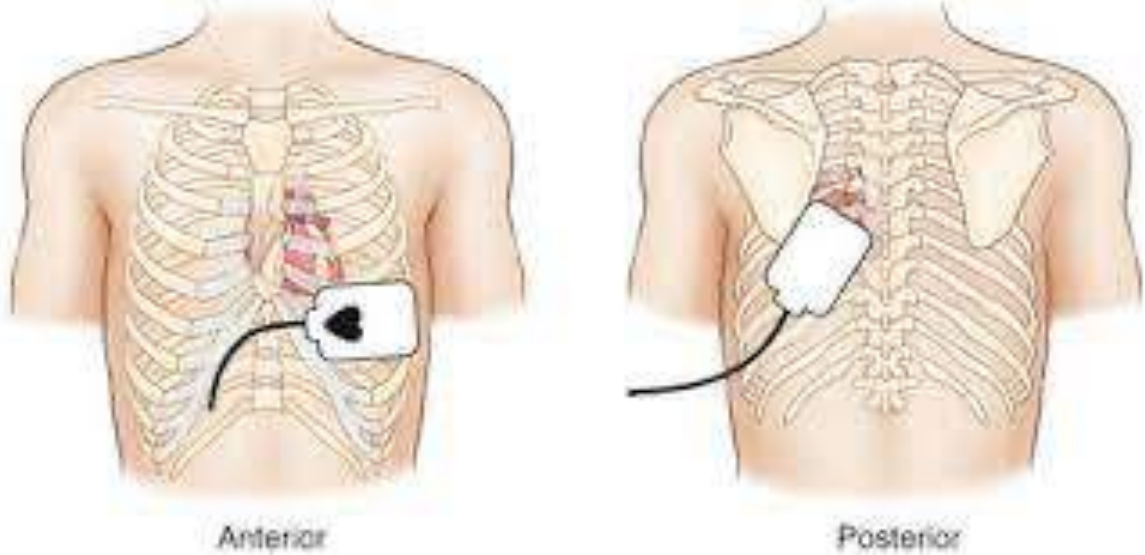
Position of Paddles:

- One paddle is placed in the right infraclavicular region, while the other is placed in the left 5th -6th intercostal space anterior axillary line.





- Alternatively, antero-posterior position may be used: one paddle is placed in the left intrascapular region while the other is placed in the left 5th-6th intercostal space anterior Axillary line.



- Action Completely depolarize all myocardial cells so SA node can re- Establish as pacemaker
- Voltage of electricity discharge High from. 150 J to 360J(biphasic) 360 J (monophasic)

Drugs used in CPR.

Adrenaline:

Given as a vasopressor a_1 effect (not as an Inotrope)
Dose: 1 mg (0.01 mg/kg) IV every 4 minutes (alternating cycles) while continuing CPR.

- Adrenaline 1mg IV (10ml of 1:10,000)
- When to give
    - Shockable rhythm: give after 3rd shock (during CPR). Flush with 20ml saline.
    - Non-shockable rhythm: give as soon as IV access is established. Flush with 20ml saline.
- Repeat adrenaline dose during every other CPR cycle thereafter (i.e., repeat every 3-5 minutes once given, regardless of rhythm)

Amiodarone:

- Dose: 300 mg IV bolus (5 mg/kg)
- Given: in shockable rhythm After the 3rd shock.
- If unavailable give lidocaine 100 mg IV (1-1.5 mg/kg)

Vasopressin (ADH): 40 IU single dose once.

Magnesium:

- Dose: 2 g IV.
- Given:
    - VF/VT with hypomagnesemia.
    - Torsade de pointes.
    - Digoxin toxicity.

Calcium:

- Dose: 10 ml of 10% Calcium chloride IV.
- Indications: PEA caused by: hyperkalemia, Hypocalcemia, hypermagnesemia, and overdose of calcium channel blockers.
- Do NOT give calcium solutions and NaHCO3 simultaneously by the same route.

IV Fluids:

- Infuse fluids rapidly if hypovolemia is suspected.
- Use normal saline (0.9% NaCl) or Ringer's solution.
- Avoid dextrose which is redistributed away from the intravascular space rapidly and causes hyperglycemia which may worsen neurological Outcome after cardiac arrest.
- Dextrose is indicated only if there is documented Hypoglycemia.

Thrombolytics:

- Fibrinolytic therapy is considered when cardiac Arrest is caused by proven or suspected acute pulmonary embolism.
- If a fibrinolytic drug is used in these circumstances Consider performing CPR for at least 60-90 Minutes before termination of resuscitation Attempts.
- E.g.: Alteplase, tenecteplase (old generation: Streptokinase)

Sodium bicarbonate:

- Used in :
  1. Severe metabolic acidosis (pH < 7.1)
  2. Life-threatening hyperkalemia .
  3. Tricyclic antidepressant overdose .
- Dose: (half correction) 1/2 Base Deficit x 1/3 Body weight.

Avoid its routine use due to Its complications:

1. Increases CO2 load.
2. Inhibits release of O2 to tissues.
3. Impairs myocardial contractility.
4. Causes hypernatremia.
5. Adrenaline works better in acidic medium.



Atropine:

- Its routine use in PEA and asystole is not beneficial and has become obsolete.
- Indicated in: sinus bradycardia or AV block Causing hemodynamic instability.
- Dose: 0.5 mg IV. Repeated up to a maximum of 3 mg (full atropinization)

Return of circulation

- Full ABCDE assessment
- Controlled oxygenation (aim 92-96%)
- Consider therapeutic hypothermia 32-36˚ for 24 hours (avoid hyperthermia)
- Post-arrest investigations
- Treat cause
- Consider transfer to intensive care if still requiring ventilation or high- dependency care if not No return of circulation
- In general, CPR should be continued as long as there is a shockable rhythm (mechanical compression device may be used)
- Only stop if a registrar or above makes the decision with the team
- Extracorporeal CPR using extracorporeal membrane oxygenation (ECMO) device may be considered where available for select patients to facilitate other definitive treatments, e.g., PCI, pulmonary thrombectomy for massive PE, rewarming for hypothermia.
- Afterwards → Retrospectively document everything that happened.

Algorithm differences in children

- **Pulse check.**
  1) Infant (<1 year): feel brachial pulse.
  2) Children (>1 year): feel carotid pulse.

- **Compression: ventilation ratio**
  1) At birth: 3:1 ratio
  2) Infants/children: start with 5 rescue breaths, then 15:2 ratio

- **Compressions**
  1) Compress to at least one-third of the AP chest diameter.
  2) Infant (<1 year):
     - Encircling technique (preferred): performed by placing both thumbs flat on the lower sternum pointing towards the infant's head and the fingers around the rib cage
     - Two-finger technique (may be easier if only one rescuer): compress the sternum with the tips of two fingers
  3) Children (>1 year): as for an adult but only use one hand (unless need 2nd to achieve target depth)

- **Defibrillation**
  1) Energy:
     - Manual defibrillator: 4J/kg
     - If using automated defibrillator for child <8 years: use pediatric- attenuated adult shock energy
     - If using automated defibrillator for child >8 years: use adult shock energy
  2) Infants: 4.5cm pads
  3) Children: 8-12cm pads
  4) If pediatric electrodes are unavailable, it is acceptable to use the adult defibrillator and settings – ensure the pads are not touching each other.

- **Drug doses.**
  1) Adrenaline 10mcg/kg (0.1ml/kg of 1:10,000 solution)
  2) Amiodarone 5mg/kg – repeat same dose after 5th shock if still in shockable rhythm.

MCQ test

1- Reversible causes of cardiac arrest (all true except one)
   a) Hypoxia
   b) Hypotension.
   c) Hypothermia
   d) Hypoglycemia
   e) Alkalosis

2- CPR in pediatric (all true except one)
   a) At birth Compression: ventilation ratio 3:1 ratio
   b) Compress to at least one-third of the AP chest diameter
   c) Children (>1 year): as for an adult but only use one hand
   d) Defibrillation Manual defibrillator: 4J/kg
   e) Endotracheal tube not indicated

3- Avoid routine use of sodium bicarbonate due to
   a) Increases CO2 load:
   b) Inhibits release of O2 to tissues.
   c) Impairs myocardial contractility.
   d) Causes hyponatremia.
   e) Adrenaline works better in acidic medium.

4- Use of adrenaline in cardiac arrest (all true except one)
   a) Adrenaline 1mg IV (10ml of 1:10,000)
   b) Shockable rhythm: give after fifth shock (during CPR).
   c) Flush with 20ml saline.
   d) Non-shockable rhythm: give as soon as IV access is established.
   e) Repeat adrenaline dose during every other CPR cycle thereafter (i.e., repeat every 3-5 minutes once given, regardless of rhythm

5- One of the following is shockable rhythm64
   a) AF
   b) VF
   c) SVT
   d) Ectopic beat
   e) PEA

6- Golden rules:
   a) Ensure high quality chest compressions: rate, depth recoil
   b) Plan actions before interrupting CPR.
   c) MINIMIZE interruption of chest compressions.
   d) Early defibrillation of shockable rhythm.
   e) Delay DC shock for shockable rhythm