UNIT NO. 3

# RESUSCITATION UPDATE - 2013

Prof V. Anantharaman


## ABSTRACT

**The practice of resuscitation is guided by the principle of the Chain of Survival, which essentially has four links, viz. Early Access, Early CPR, Early Defibrillation and Early Advanced Life Support. Basic cardiac life support consists of the first two links in the Chain of Survival. Thirty chest compressions to 2 ventilations at the rate of 100 compressions a minute is the norm. Hands only CPR is only used when the rescuer is unable to perform mouth-to-mouth ventilation for some reason. Defibrillation, the third link in the chain of survival, is one of the key strategies in the management of cardiac arrest victims. The commonest initial rhythm 3 at the onset of cardiac arrest is coarse ventricular fibrillation (VF) and the most effective therapy to date for this malignant rhythm is electrical defibrillation of the heart. Advanced Cardiac Life Support (ACLS), the fourth link in the Chain of Survival, is very dependent on the optimal conduct of the earlier three links. Arrhythmia management continues to be the cornerstone of ACLS guidelines. The 2011 guidelines have introduced post-resuscitation interventions into ACLS (i.e. measures carried out after Return of Spontaneous Circulation or ROSC).**



**Keywords: cardio-pulmonary resuscitation, basic cardiac life support, defibrillation, advance cardiac life support.**

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## INTRODUCTION

Fifty three years ago, the basis for modern resuscitation practice was laid with the demonstration of modern-day Cardio-Pulmonary Resuscitation[1]. The advent of modern communication technology since then has resulted in the greater sharing of research evidence for determination of community practice of resuscitation. Over the last 15 years, at every five yearly intervals, the International Liaison Committee on Resuscitation (ILCOR), of which Singapore's National Resuscitation Council (NRC) is also a member (through its active role in the Resuscitation Council of Asia), produces a Consensus document on the Science of Resuscitation. The last release of this was in late 2010. Resuscitation Councils of various countries use this document and determine how the science is best applied to their own environment, resulting in the minor differences in the various national resuscitation guidelines. Singapore announced her current guidelines in March 2011 after the NRC reviewed the application of the science locally. These were published in the Singapore Medical Journal August 2011 issue (http://www.nrcsingapore.org/sg/index.php?option=com_content&view=article&id=72&Itemid=94 ).

The practice of resuscitation is guided by the principle of the Chain of Survival, which essentially has four links, viz. Early Access, Early CPR, Early Defibrillation and Early Advanced Life Support. These links will be referred to in the discussion of the many facets of resuscitation that range from basic to advanced life support.

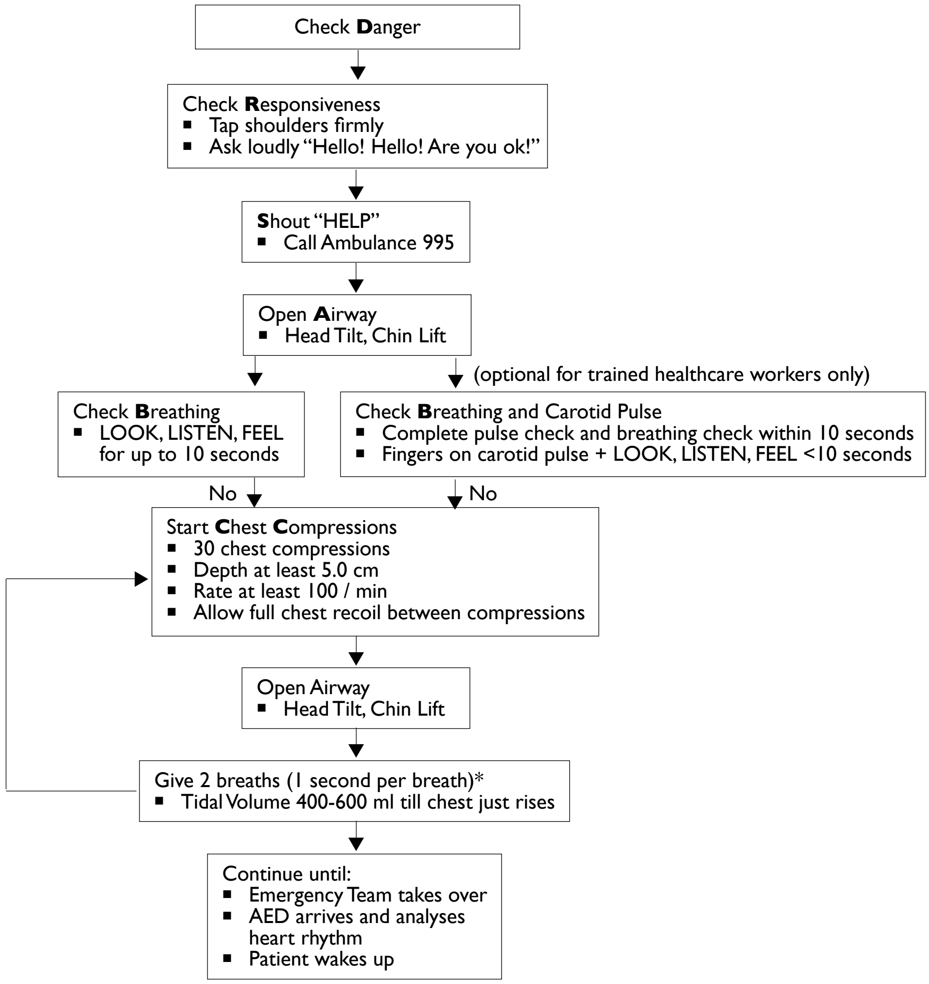
## BASIC CARDIAC LIFE SUPPORT

The key features of basic cardiac life support consist of the first two links in the Chain of Survival and include the following:

1. Need to train many community citizens in cardio-pulmonary resuscitation (CPR): the majority of cardiac arrests occurs out-of-hospital. In Singapore, on average, the time from collapse to arrival of the ambulance crew and starting of CPR is about 25 minutes[2]. Slow reaction time, low rate of bystander CPR (about 20%), the long time taken for ambulance crew to reach location because of road traffic and additional time to patients who live in high rise apartments all add to the delay. Survival drops by 7 to 10% for every minute of delay in initiating CPR.
2. The hand is positioned at the lower half of the sternum and the rescuer positioned vertically above the chest with the elbows extended and locked in position.
3. The rate of chest compressions is at least 100 per minute.
4. The depth of each chest compression should be at least 5.0 cm. Push hard. Allow full chest recoil after the end of each compression.
5. Two ventilations need to be given after every 30 chest compressions. This may be given by mouth-to-mouth breathing, mouth-to-mask or by bag-valve-mask.
6. Training of members of the public should include both chest compressions and mouth-to-mouth ventilation. The pulse check does not need to be taught to lay rescuers. The teaching and use of pulse check for healthcare workers is optional.
7. If a rescuer could not / did not perform mouth-to-mouth ventilation for any reason, then at least he must perform chest compressions well.
8. CPR done out-of-hospital should continue until:
   a. Emergency ambulance crew arrive and take over the resuscitation
   b. An AED is connected to the patient and advises stand clear for rhythm analysis
   c. The casualty regains a circulation and begins to move and breathe on his own

V. ANANTHARAMAN, Senior Consultant, Department of Emergency Medicine, Singapore General Hospital

### FIGURE 1. ALGORITHM FOR CARDIO-PULMONARY RESUSCITATION (CPR)




* If unable / unwilling to do mouth-to-mouth breathing for any reason, at least continue chest compressions at least 100 per minute

9. The BCLS algorithm for adults is as given in Figure 1. The steps of CPR can also be pictorially represented as in Figure 2.
10. Hands-only CPR has been used in some states around the world. This refers to provision of only chest compression without any mouth-to-mouth ventilation. The brain needs oxygen to survive. Deprivation of oxygen for more than 4 to 6 minutes results in the onset of brain damage which is usually irreversible after at least 10 minutes of oxygen deprivation. In communities with short emergency ambulance response times, hands-only CPR has appeared to show some benefit. However, where time from collapse to CPR is more than 15 minutes, 30:2 CPR results in better survival than hands-only CPR. Standard 30:2 CPR is, however, very difficult to instruct over the telephone. Hands-only CPR is recommended only in the following situations:
    a. For Dispatcher assisted CPR: This is telephone CPR advice provided by the SCDF Call Centre operator. This allows some form of CPR to be provided by an untrained rescuer before the arrival of the ambulance team.
    b. If the rescuer is unable to or unwilling to provide mouth-to-mouth ventilation.

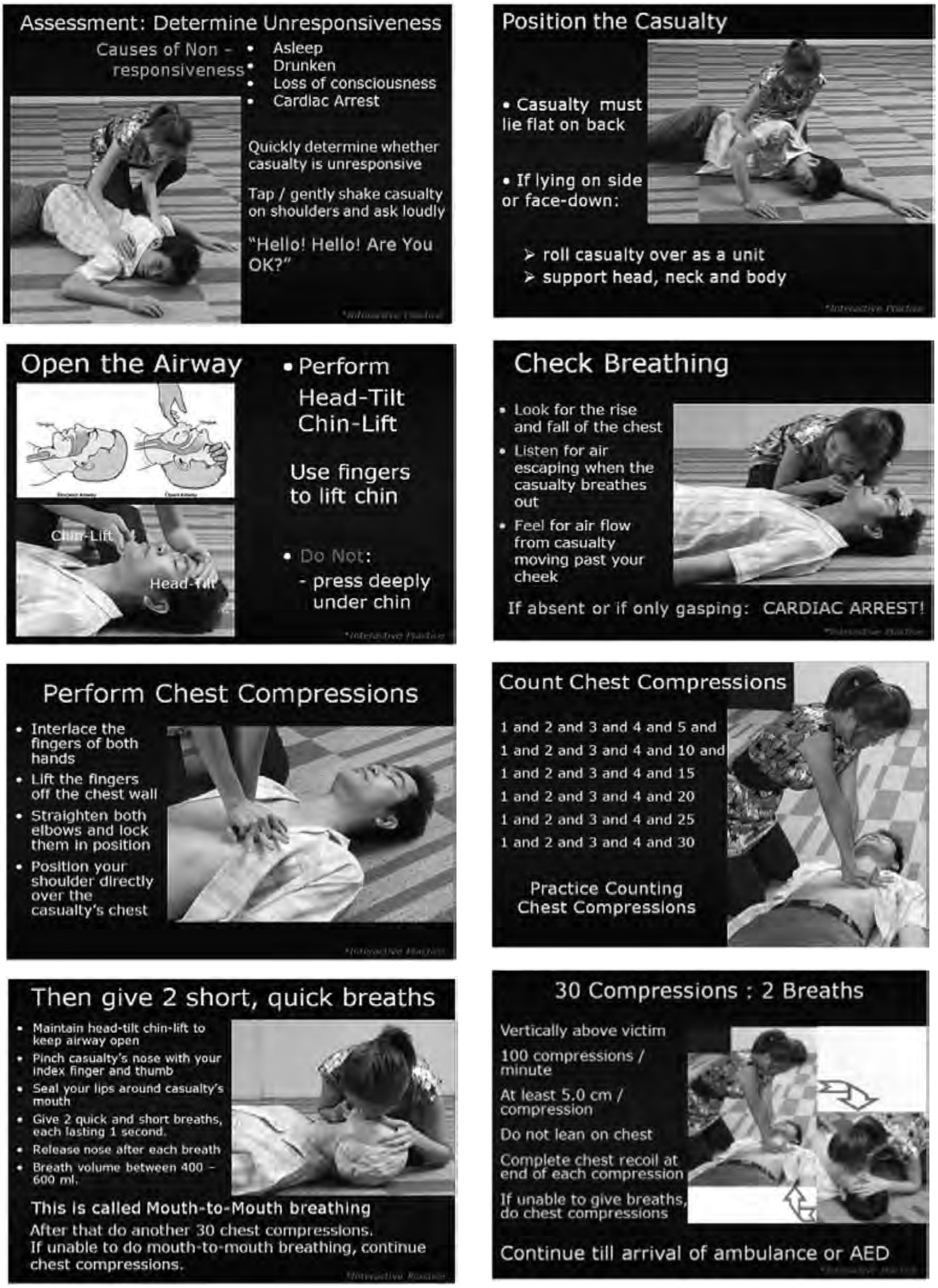
## DEFIBRILLATION

Defibrillation, the third link in the chain of survival, is one of the key strategies in the management of cardiac arrest victims. The commonest initial rhythm[3] at the onset of cardiac arrest is coarse ventricular fibrillation (VF) and the most effective therapy to date for this malignant rhythm is electrical defibrillation of the heart. If VF is not managed promptly, and the patient does not receive CPR or defibrillation within the first few minutes of collapse, coarse VF degenerates into a fine VF of low amplitude and subsequently, within 10 to 12 minutes into a straight line (asystole), which is more difficult to resuscitate back to life. The following statements concerning defibrillation reflect the local consensus on use of defibrillation in Singapore for both in-hospital and out-of-hospital cardiac arrests.

1. The CPR-Defibrillation Sequence
    a. If a life support provider with a defibrillator at hand witnesses a cardiac arrest, defibrillation may be applied immediately. In the immediate absence of a defibrillator, CPR should be initiated first and continued while awaiting the arrival of the defibrillator and while it is being applied. This is relevant in both witnessed and unwitnessed cardiac arrests.

**FIGURE 2. STEP-BY-STEP GUIDE TO CPR**

**(BY COURTESY OF NATIONAL RESUSCITATION COUNCIL, SINGAPORE)**



b. In patients with persistent or recurrent VF despite initial defibrillation, the CPR-defibrillation sequence is adopted. In this sequence, the emphasis is to provide good quality, uninterrupted CPR of 1-2 min duration in-between defibrillations. Good quality CPR promotes systemic and coronary perfusion and also helps improve intravascular medication delivery when resuscitation drugs are used in the context of advanced cardiac life support. At the end of a period of CPR, rhythm analysis should be carried out to determine the need for further cardiac compressions or defibrillation.
c. On delivery of a defibrillatory current to a patient in VF or pulseless VT, CPR should be initiated immediately and continued for at 1-2 minutes before rhythm analysis is performed.

2. Automated external defibrillators (AEDs) are becoming increasingly available in public areas in Singapore. These devices have protocols to guide users through a process of performing safe defibrillation. The actions required are often delivered through voice prompts. The devices even prompt rescuers to "stand clear" during the stages of rhythm analysis and delivery of defibrillatrory shock. Training for healthcare workers and members of the public (bystanders) on the use of these devices integrated with good quality CPR is available at more than fifty NRC-accredited training centres in the country.

3. Defibrillation waveforms and energies
   a. All new defibrillators in Singapore use biphasic waveform to deliver shocks. There is good evidence to indicate that the lower energies used in biphasic defibrillators achieve higher first shock defibrillation success than previous traditional monophasic defibrillators[4,5,6,7,8]. Use of lower energies also allows the creation of smaller sized and lighter defibrillators which easier to maintain and with extended battery life.
   b. The energy range that may be used to deliver biphasic defibrillatory shocks to patients in VF or pulseless VT is 150 to 360 joules. When using monophasic defibrillators, only 360 joule shocks are recommended. Most centres begin biphasic defibrillation at the lower energy range (either 150 or 200 joules). The occurrence of persistent or recurrent VF usually results in the use of escalating doses of defibrillatory energy, usually to 300 joules and further to 360 joules, if required, unless low-energy devices are being used, in which case defibrillation continues at the lower energy levels without escalation.
   c. Though there has been some evidence that some patients require higher energy shocks for successful defibrillation of VF, there are no parameters currently available that allow prediction of optimal energy levels for successful defibrillation. There is also no evidence of increased myocardial damage / dysfunction in humans following use of escalating higher-energy shocks of up to 360 joules.

4. Training rescuers in defibrillation
   a. The NRC recommends that all healthcare workers know how to use an AED or defibrillate in a (semi-)automated mode with a standard manual defibrillator and that all emergency and non-emergency ambulances be equipped with an AED when transporting patients. In addition, the NRC recommends that increased focus be given to imparting AED skills to the following:
   i. School teachers and student groups, for secondary school levels and above
   ii. Grassroots organisations and community groups
   iii. Sports personnel, including coaches
   iv. Armed forces personnel
   v. Community citizens
   b. The NRC is also working with major organisations in Singapore to facilitate the training of the various groups in the combined skills and CPR+AED.

5. Defibrillation paddles / pads and their application and position:
   a. When delivering shocks both self-adhesive pads and paddles are acceptable. The larger the paddle/pad interface, the higher the shock success[9]. Commercially made paddles/pads usually come in sizes ranging from 8 cm to 12 cm.
   b. The paddle/pad must be applied in direct contact with the human skin
   c. Adequate exposure of the application area is essential during pad application.
      i. In a hairy-chested individual, the area of application should be shaved prior to applying the paddle/pad.
      ii. In a female patient in the out-of-hospital scenario, chest exposure should be limited just to be able to apply the defibrillation pads, after which the chest wall may be covered by the patient's own clothing.
   d. The anterior - lateral position for paddle/pad placement is preferred. The anterior paddle/pad is applied on the right anterior chest just below the right clavicle. The lateral paddle/pad is applied immediately below and lateral to the left breast. Alternative acceptable paddle/pad positions include anterior-posterior and apex-posterior positions.
   e. In a patient with a permanent pacemaker or an implantable cardioverter-defibrillator (ICD), defibrillation paddle/pads should be applied at least 4 finger breaths away from the device.

6. Use of monitoring leads during cardiac resuscitation
   a. To ensure no interference with CPR and defibrillation during a resuscitation, the recommended standard electrode positions of 4-lead cardiac monitoring systems are:

| Lead | Positioning |
|---|---|
| Right arm lead | Anterior aspect of right shoulder |
| Left arm lead | Anterior aspect of left shoulder |
| Right leg lead | Right anterior superior iliac spine of pelvis |
| Left leg lead | Left anterior superior iliac spine of pelvis |
| Ground lead (in 5-lead systems) | Lower end of sternum |

7. Use of Oxygen during Defibrillation
   a. Though oxygen is an essential drug used during a resuscitation, its use poses a small risk of fires. To prevent sparking during a defibrillation, the following are recommended:
      i. Turning off oxygen devices that are not in use
      ii. Remove any open sources of oxygen (nasal cannula, face mask) and ensuring that these are directed away from the chest wall
      iii. Form a tight seal with the bag-mouth-mask device when manually ventilating patient or connecting the tracheal tube to a ventilator

8. The use of an AED during a resuscitation may be summarised pictorially as in Figure 3.

9. Ensure that while using an AED or a manual defibrillator, one needs to minimise interruptions to chest compressions and ventilation.

## ADVANCED CARDIAC LIFE SUPPORT

Advanced Cardiac Life Support (ACLS), the fourth link in the Chain of Survival, is very dependent on the optimal conduct of the earlier three links. Arrhythmia management continues to be the cornerstone of ACLS guidelines. The 2011 guidelines have introduced post-resuscitation interventions into ACLS (i.e. measures carried out after Return of Spontaneous Circulation or ROSC). Currently there exists a large gap in the numbers who achieve ROSC and those who leave hospital alive. Post-ROSC measures are playing a larger role in the management of cardiac arrest victims. The 2011 ACLS guidelines address the following aspects of the vital fourth link of the chain of survival:

- Immediate actions following cardiac arrest.
- Airway.
- Breathing (ventilation).
- Supporting the Circulation during cardiac arrest.
- Peri-arrest arrhythmias.
- Identifying reversible causes.
- Post-resuscitation care.
- Organ donation.

### 1. Immediate Actions Following Cardiac Arrest – the Universal Algorithm for Cardiac Arrest

(Figure 5)

The principles outlined above for Basic Cardiac Life Support and Defibrillation apply in the immediate phase after cardiac arrest. Good basic life support is the cornerstone of advanced cardiac life support. There is also a need for a system of calling for help within ward areas, ambulatory clinics and public areas of the hospital

### 2. Airway Control and Management

An open airway is crucial for the delivery of oxygen to the lungs and then to the tissues. Access to the airway needs to be ensured within a few minutes of the start of the resuscitation. Basic airway opening techniques include the head-tilt, chin lift and the classical or modified jaw thrust. Once opened the airway needs to be cleared of secretions, usually with a blunt-tipped stiff suction catheter. The routine use of cricoid pressure is not recommended. While it may offer some protection from aspiration and gastric insufflation, it may also impede ventilation and interfere with intubation. If used, pressure should be adjusted, relaxed, or released if it impedes ventilation or placement of an advanced airway.

Oropharyngeal and nasopharyngeal airways can prevent the tongue from occluding the upper airway and may be used in unresponsive patients (those with no cough or gag reflex), or during bag-mask ventilation.

The use of endotracheal intubation or a supraglottic airway, such as the laryngeal-mask airway (LMA) or a combi-tube would help to allow reliable ventilation. SpO2 and ECG monitoring are crucial during placement of an advanced airway. Once in position and secured, the expected standard for confirming correct placement would be:

- Bilateral chest expansion
- Demisting of ETT during inspiration
- 5-point auscultation
- Continuous ETCO2 measurement
- Chest X ray

Endotracheal tube placement allows a definitive patent airway, suction of secretions, reliable oxygen delivery and protection from aspiration of gastric contents.

### 3. Breathing (Ventilation)

The basic objective of ventilation in advanced life support is to ensure oxygenation of tissues. In cardiac arrest management the recommended rate of ventilation is 10 breaths per minute and tidal volume 400 – 600 ml. If bag-mask ventilation (BMV) is being used, the user should compress the bag by about one-third which would be just about sufficient to produce a chest rise over 1 second. Following insertion of an advanced airway device, it is recommended that continuous chest compressions be given with interposed ventilations once every 6 – 8 seconds (or about 8 – 10 breaths per minute).

### 4. Supporting the Circulation during cardiac arrest

This includes the following:

a. <u>Continuing cardio-pulmonary resuscitation with minimal interruption</u>
   This has already been clearly described earlier under Basic Cardiac Life Support.

b. <u>Establishing vascular access</u>
   This is achieved through either intravenous or intra-osseous access. Use one of the larger veins, commonly

**FIGURE 3. STEP-BY-STEP GUIDE TO USE OF AN AED**

**(BY COURTESY OF NATIONAL RESUSCITATION COUNCIL, SINGAPORE)**


at either the right or left ante-cubital fossa, or the external jugular vein. Central lines may be used for administration of intravenous drugs. However, because of their length, every bolus dose of drugs given via a central line requires flushing with at least 20 ml of normal saline. Central lines are also not recommended for rapid fluid resuscitation owing to their length. They would, however, be useful for central venous pressure monitoring as a guide to fluid resuscitation and circulatory management. Using a large peripheral vein allows a faster rate of fluid administration, if needed. If intravenous access cannot be obtained, intra-osseus access at either the proximal tibia or distal femur.

c. Providing infusion fluids
Normal saline is the optimal infusion fluid used in cardiac resuscitation. Rapid fluid resuscitation via central lines may not be a viable option.

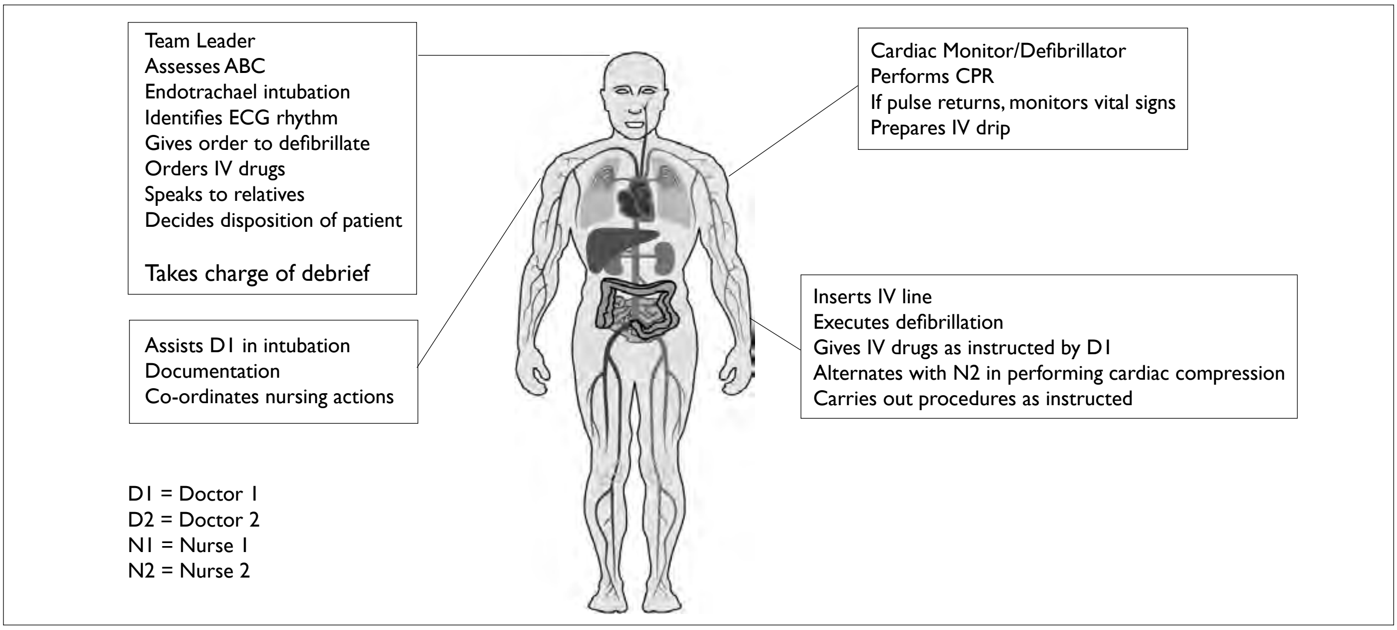
d. Continuous ECG monitoring for cardiac rhythm
The further management of the patient would be based on the cardiac rhythm diagnosis, and the resuscitation team would administer the appropriate cardiovascular drugs. The algorithms for the management of the various rhythm disorders are as presented in Figures 4 to 8.

e. Use of intravascular drugs to manage the circulation
Administration of drugs via an endotracheal tube is no more recommended owing to unreliable absorption via airways that may be filled with pulmonary edema fluid. Drugs may be given via the intra-osseus or central line route in the same dosages as via the intravenous route.

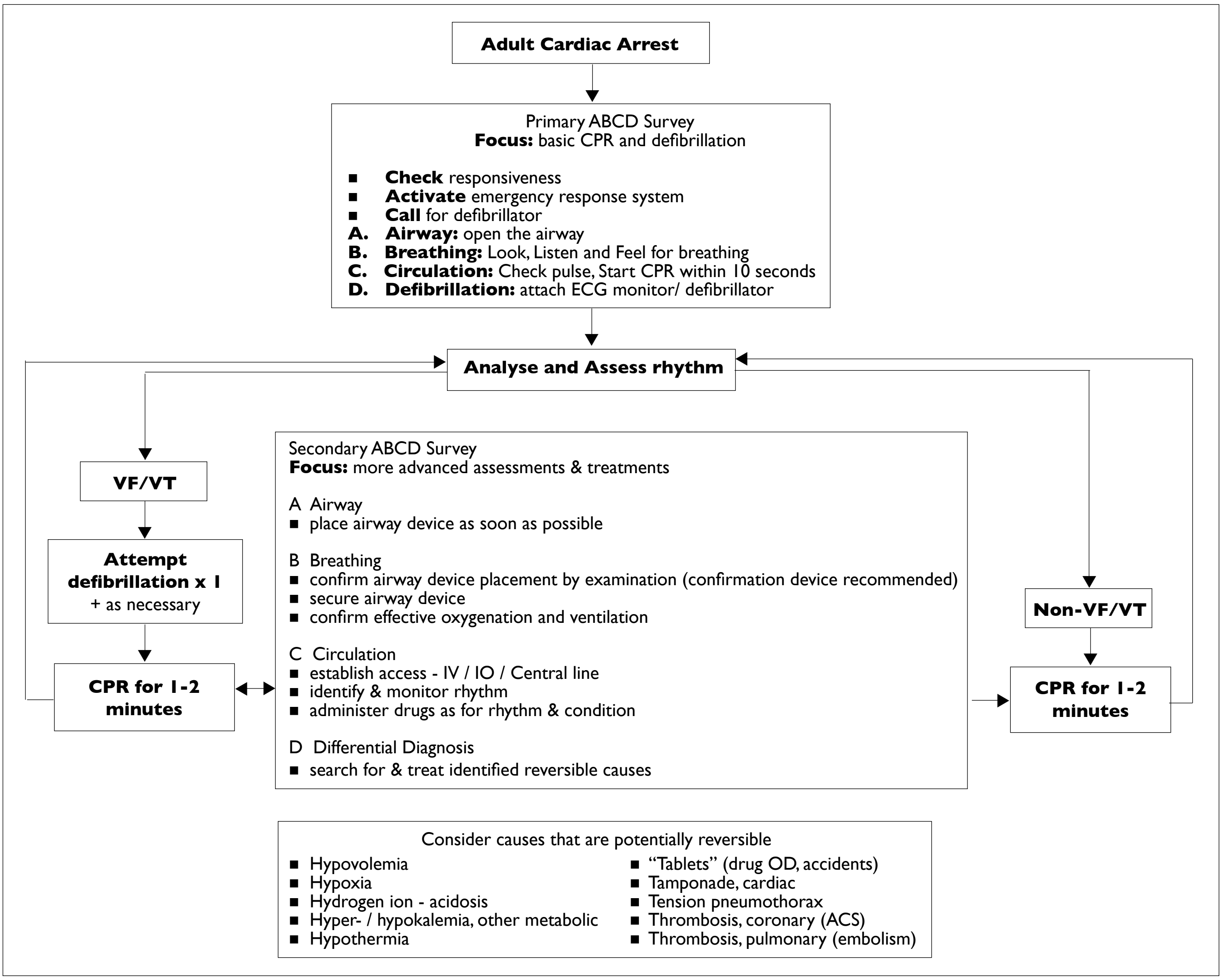
**5. Peri—arrest arrhythmias**

In a patient with cardiac arrest and during the immediate period following return of spontaneous circulation, the patient may have one or more of many cardiac arrhythmias.

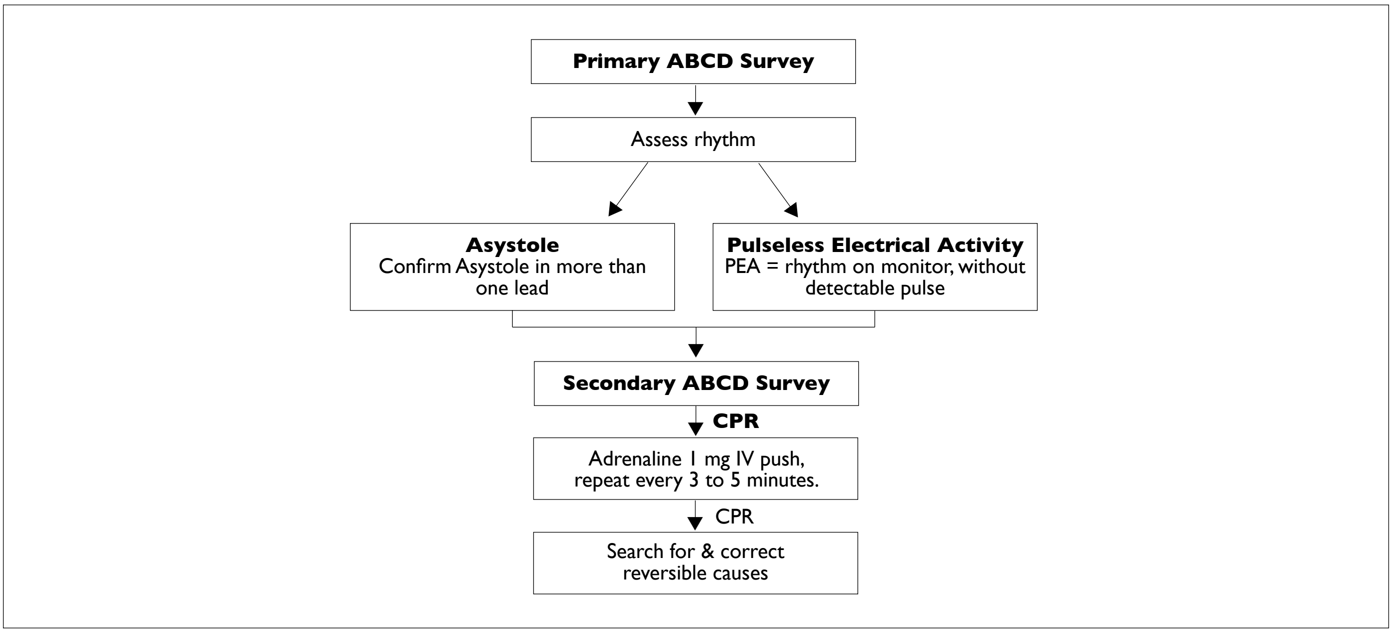
## FIGURE 4. ACLS TEAM ORGANISATION DURING A RESUSCITATION




## FIGURE 5. UNIVERSAL ALGORITHM FOR CARDIAC ARREST



## FIGURE 6. ASYSTOLE / PEA MANAGEMENT ALGORITHM




## FIGURE 7. BRADYCARDIA MANAGEMENT ALGORITHM

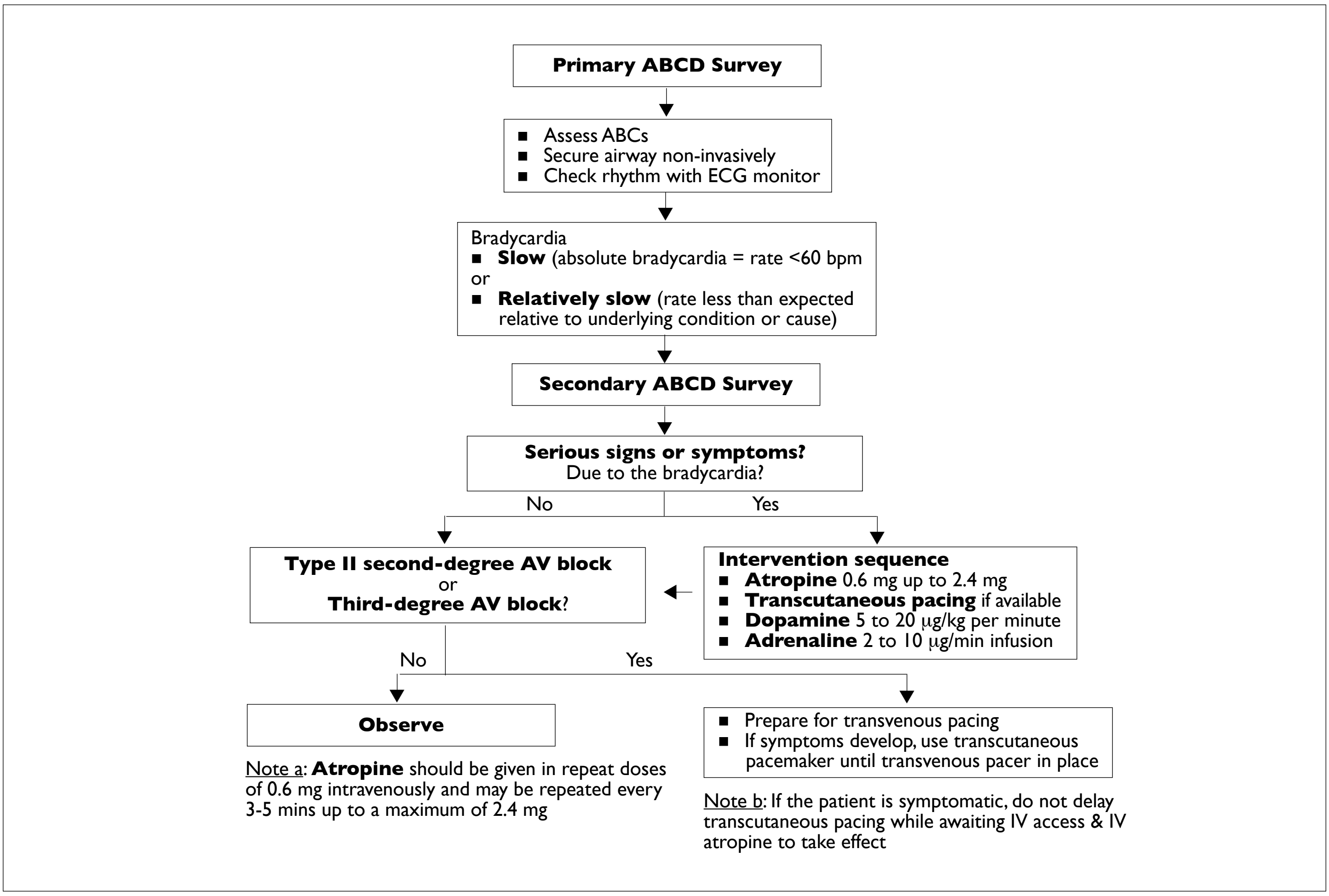
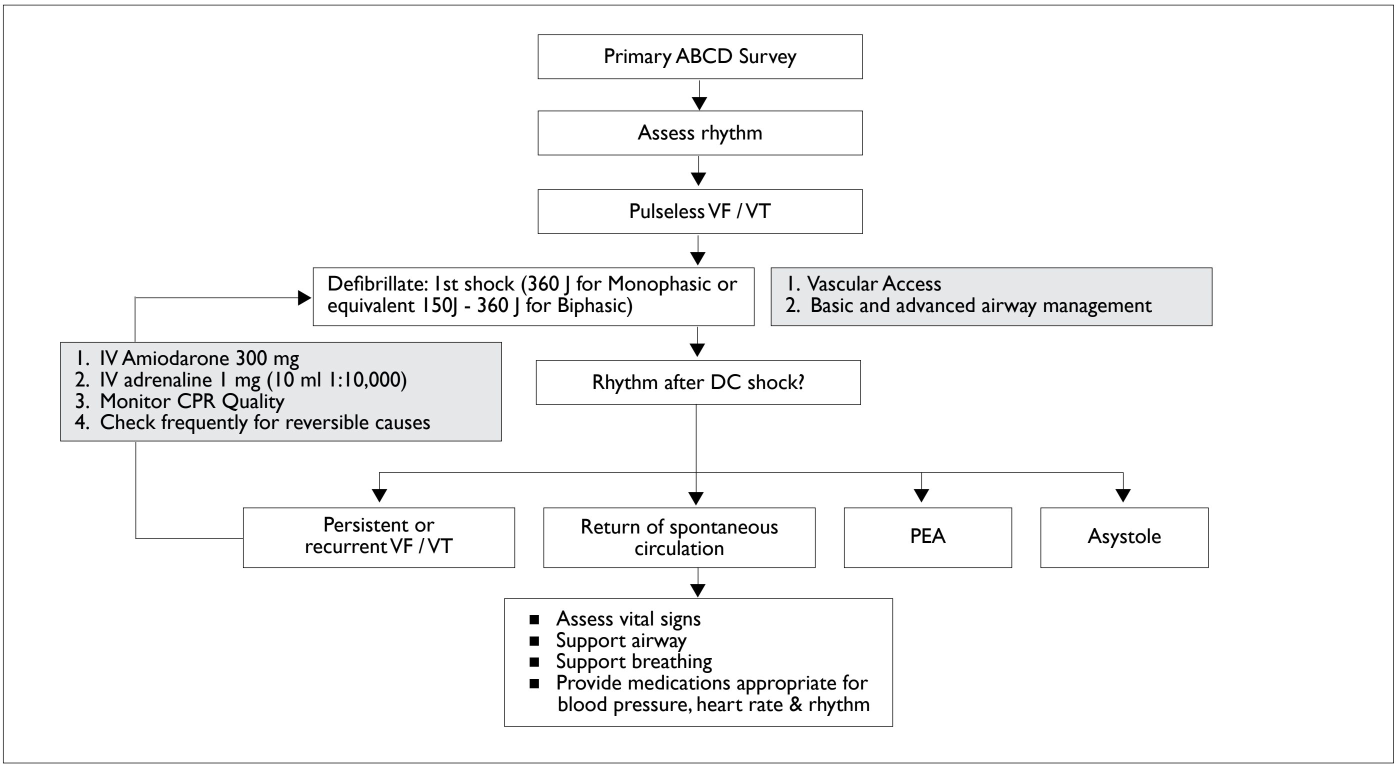


**FIGURE 8. MANAGEMENT OF WITNESSED VF / PULSELESS VT**




Each of these arrhythmias require organised treatment modalities, pari-passu with the above interventions. The range of rhythms that one should be prepared to deal with are listed below. Their management is summarised in the attached Figures 5 to 10 as follows:
Figure 6: Asystole and Pulseless Electrical Activity
Figure 7: Bradycardias
Figure 8: Witnessed VF / Pulseless VT
Figure 9: Narrow Complex Tachycardias
Figure 10: Wide Complex Tachycardias

## 6. Identifying reversible causes

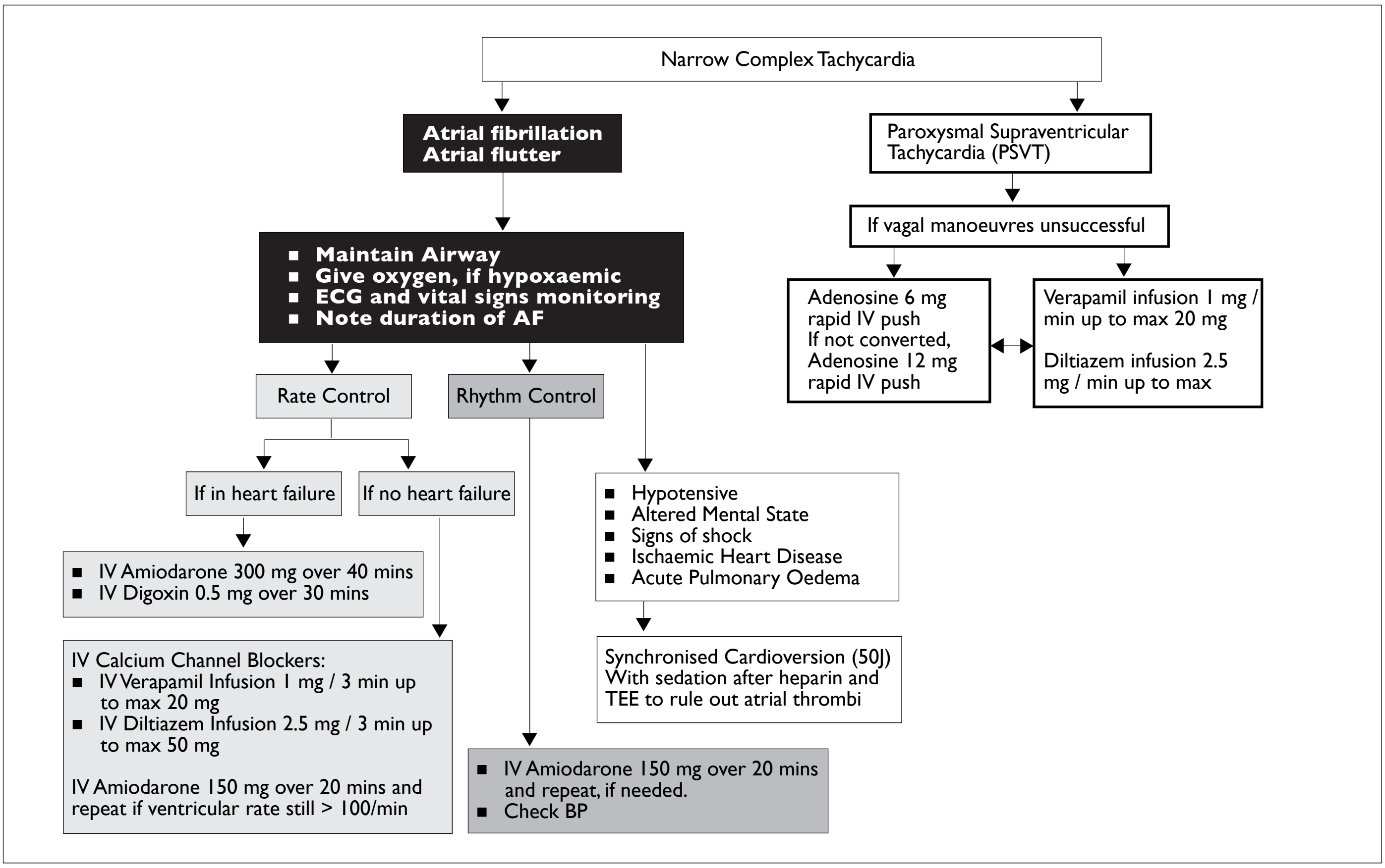
For every cardiac resuscitation, if the patient does not readily respond to the initial resuscitation measures, one needs to determine likely factors contributing to the non-response. Reversible causes are usually grouped under the 5 H's and 5 T's and these are as follows:

- Hypovolaemia
- Hypoxia
- Hydrogen ion acidosis
- Hypo / hyperkalaemia
- Hypothermia
- Toxins
- Trauma
- Tension Pneumothorax
- Tamponade – cardiac
- Thrombosis – cardiac / pulmonary

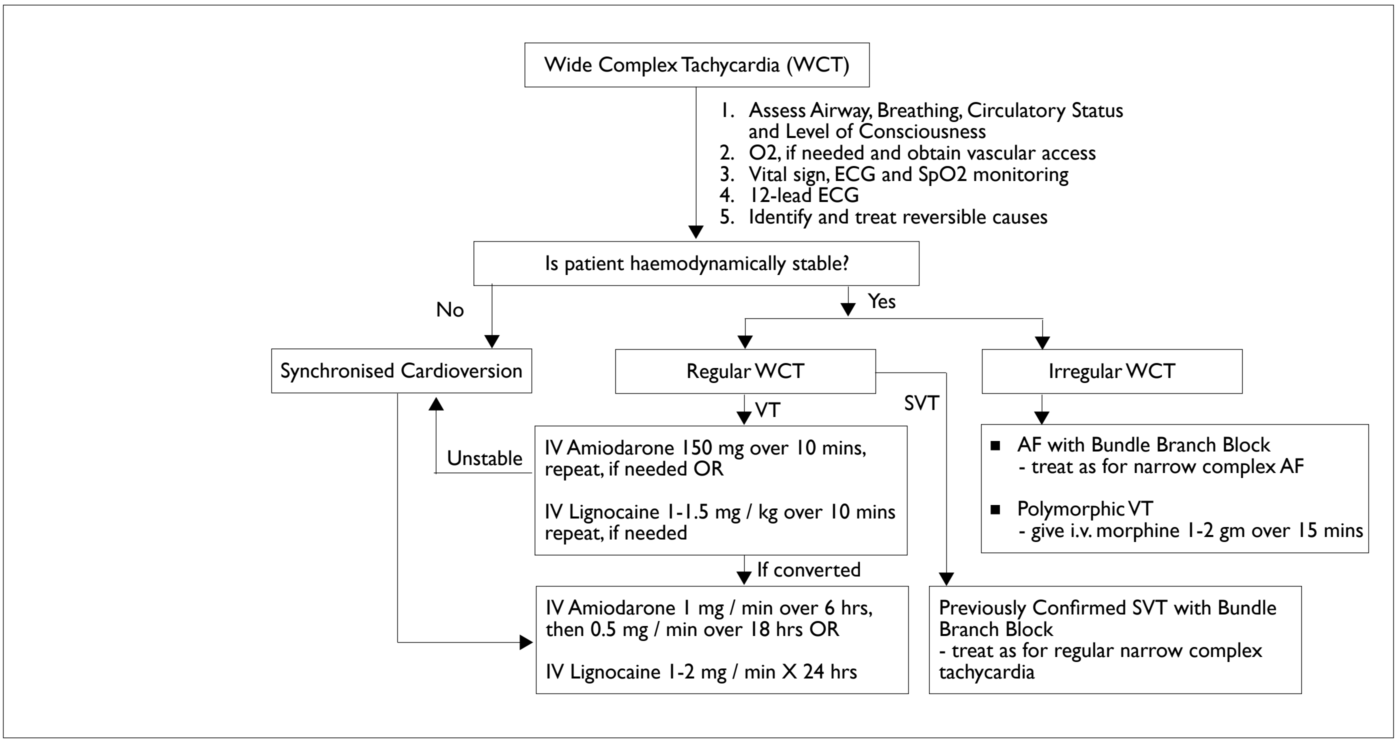
Careful evaluation to look for any of these reversible causes usually pays dividends and increases chances of a good outcome. The approach to evaluation of these reversible causes is as follows:

a. Hypovolemia is difficult to diagnose in the cardiac arrested individual. Usually, history of fluid loss, if available, will initiate the need for rapid fluid replacement. Empirical fluid therapy is usually employed in cardiac resuscitations at a rate of 500 to 1000 ml over 1 hour. The optimal resuscitation fluid is Normal Saline.
b. Hypoxia occurs with lack of oxygen and alveolar ventilation. One needs to ensure that a definitive airway is placed correctly, and to check breath sounds at frequent intervals to ensure that the endotracheal tube has not slipped out of the trachea or into the right main bronchus. Oxygen supply must be ensured whether from an oxygen cylinder (ensure it is not depleted) or piped. Therefore all connections of the oxygen delivery system will need to be checked to ensure that hypoxia is not the cause of a poor outcome.
c. Hydrogen ion – acidosis: The acidosis of cardiac arrest is a combination of respiratory and metabolic acidosis. Respiratory acidosis is caused by lack of alveolar ventilation with oxygen. The metabolic acidosis is caused by lack of blood circulation to the tissues and lack of oxygen in the tissues. Respiratory acidosis is addressed by early endotracheal intubation and delivery of 100%

## FIGURE 9. NARROW COMPLEX TACHYCARDIA ALGORITHM




## FIGURE 10. WIDE COMPLEX TACHYARRHYTHMIA ALGORITHM



oxygen at the rate of 10-12 ventilations per minute. The excessive production of hydrogen ions as a result of tissue hypoxia can be addressed by delivering the O2 via good circulation through quality CPR and good oxygenation through alveolar ventilation with 100% oxygen at the rate suggested earlier. The circulation resulting from CPR and alveolar ventilation also ensures that carbon dioxide generated by the hydrogen ions interacting with the body's own bicarbonate buffering mechanism is brought to the lungs where it can be blown away. Therefore, good CPR and good alveolar ventilation with 100% oxygen should form the cornerstone of the prevention and treatment of the metabolic and respiratory acidosis of cardiac arrest. Administration of Sodium Bicarbonate solution intravenously, while it may attempt to reverse the changes in pH, can have other adverse consequences, viz. severe alkalosis, poor cardiac contractility and inactivation of resuscitation drugs in alkaline medium. Therefore, sodium bicarbonate is only administered in the presence of significant acidosis that can occur with prolonged resuscitations or poor initial resuscitation, and even then only in judicious amounts at the initial rate of 1 – 1.5 ml 8.4% NaHCO3 per kg body weight, and if re-administered only after at least 10-15 minutes at half the initial dose.

d. Hyperkalemia may be suspected especially in patients on hemodialysis or peritoneal dialysis (look for presence of a-v fistula or Tenckhoff catheter). Other metabolic disorders are extremely difficult to confidently identify in a collapsed patient. If hyperkalemia is suspected administering 10 ml of Calcium chloride followed by 20 ml 50% dextrose and insulin injection 8 units offers hope for some reduction in serum potassium levels within a few minutes.
e. Hypothermia is a rare occurrence in the tropics. However, in the event it does occur, gradual re-warming with blankets and warm intravenous fluids may help the gradual process of re-establishing a near normal temperature environment for the patient.
f. "Tablets" (drug OD, accidents) may not be picked up during a resuscitation. In cases of antidepressant overdose some administration of intravenous sodium bicarbonate may help in rapid elimination of the drug from the circulation and a slight lowering of drug levels just sufficient to allow return of a pulse.
g. Cardiac tamponade is best identified, during a resuscitation, by rapid transthoracic ultrasound. This would require brief interruption of chest compressions. Once identified, it is best treated by introduction of an intrapericardial catheter through the sub-xiphisternal approach and under continuous ECG guidance.
h. Tension pneumothorax is suspected during a cardiac resuscitation if breath sounds are significantly unequal on chest auscultation. Treatment has to based on the clinical diagnosis and should involve introduction of a large-bore intravenous cannula into the 2nd intercostal space over the anterior mid-clavicular line on the side affected. Once this is carried out, the tension in the pneumothorax will be relieved and the mediastinum gradually swings back to its usual near-central position. Then measures may be taken to place a chest tube electively into the chest on the affected side. One should not wait for Chest X-ray confirmation of a tension pneumothorax before performing needle thoracocentesis.
i. Thromboses of the coronary arteries (ACS) or the pulmonary vessels (pulmonary embolism) are well known causes of cardiopulmonary arrest. Recognising the cause suggests that if one could obtain initial return of spontaneous circulation after a short burst of active resuscitation, procedures to re-vascularise the thrombosed vessels become relevant soon after the pulse returns. It would be important to obtain a history of the patient before collapse to surmise that an acute thrombotic event was the cause of the collapse, in which case revascularisation procedures may be contemplated.

## 7. Post-Resuscitation Care

In the event of return of spontaneous circulation (ROSC), one needs to consider institution of measures 10 that will minimise likelihood of rearrest and increase chances of survival and good neurological outcome. The components of post-resuscitation care that are gradually being incorporated into in-hospital care protocols are as follows:

a. Therapeutic hypothermia at 33 degrees Celsius for at least 24 hours with gradual rewarming subsequently
b. Maintaining euglycaemic with blood sugar levels maintained between 6 to 10 mmol/L
c. Prevention of hyperoxemia and optimal ventilation. The recommended ventilator parameters are as follows:
   1. PaCO2 between 35 and 45 mm Hg (5 – 6 kPa)
   2. SaO2 between 94% and 98%
   3. Tidal volumes between 6 – 8 ml / kg body weight
   4. PETCO2 between 35 – 40 mm Hg.
   5. Normocapnic ventilations between 10 to 12 ventilations per minute.
d. Early PCI after ROSC so as to maximise myocardial viability.
e. Intravenous fluids and drugs titrated to optimise blood pressure, cardiac output and urine output. The target for blood pressure would be a mean arterial pressure (MAP) of 65 - 100 mm Hg and for blood oxygenation an SCVO2 ≥ 70%.
f. Neurological enhancement measures to minimise the impact of reperfusion injury on the brain.

## CONCLUSIONS

The way forward to maximise survivals from cardiac arrest is to make use of all of the principles described above when managing the collapsed patient. Confident performance of resuscitation requires training and retraining. Certification courses in basic and advanced resuscitation are available in various healthcare institutions and accredited training course. The challenge for the physician is to stay current in these basic resuscitation skills.

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### LEARNING POINTS

- **The practice of resuscitation is guided by the principle of the Chain of Survival, which essentially has four links, viz. Early Access, Early CPR, Early Defibrillation and Early Advanced Life Support.**
- **Basic cardiac life support consists of the first two links in the Chain of Survival. Thirty chest compressions to 2 ventilations at the rate of 100 compressions a minute is the norm. Hands only CPR is only used when the rescuer is unable to perform mouth-to-mouth ventilation for some reason.**
- **Defibrillation, the third link in the chain of survival, is one of the key strategies in the management of cardiac arrest victims. The commonest initial rhythm[3] at the onset of cardiac arrest is coarse ventricular fibrillation (VF) and the most effective therapy to date for this malignant rhythm is electrical defibrillation of the heart.**
- **Advanced Cardiac Life Support (ACLS), the fourth link in the Chain of Survival, is very dependent on the optimal conduct of the earlier three links. Arrhythmia management continues to be the cornerstone of ACLS guidelines. The 2011 guidelines have introduced post-resuscitation interventions into ACLS (i.e. measures carried out after Return of Spontaneous Circulation or ROSC).**