



HEALTHY COMMUNITIES AND  
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# **ADVANCED LIFE SUPPORT (ALS) EDUCATION PACKAGE**

Including:  
Basic Life Support  
Advanced Life Support  
Peri-arrest patient management

**April 2016**

This publication assists Medical Officers and Registered Nurses in the preparation for  
Advanced Life Support Competency Assessment.

**Edition 11**

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Including:  
Basic Life Support  
Advanced Life Support  
Peri-arrest patient management

*Edition 11*  
**(March 2016)**

*This document is written by Bendigo Health Nurse Educators and endorsed by the Bendigo Health Resuscitation Committee.*

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***Dedicated to the memory of:***

***Julie Macdonald (1961-2002)***



***RN, CCCert, Postgrad. Dip. CC,  
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For Bendigo Health staff, this document can be obtained from the Bendigo Health intranet.

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# 1. INTRODUCTION

## Preamble

This Advanced Life Support education package will assist the preparation of healthcare professionals for the practice of Advanced Life Support (ALS). It should be used in conjunction with skills tutorials to develop competency. The material contained herein is comprehensive but not exhaustive and is compiled to comply with Australia and New Zealand Committee on Resuscitation (ANZCOR) *Guidelines* and Bendigo Health clinical policies and procedures. The entire collection of ANZCOR *Guidelines* can be accessed at [www.resus.org.au](http://www.resus.org.au)

This educational material has been collated based on the available scientific literature, with the intention of accuracy and best practice at the time of publication. Therefore, the skills and knowledge gained from this will have a high degree of portability. The information is of general application but clinicians should take individual circumstances into account in practice.

## Rationale

Healthcare professionals respond to a variety of life threatening emergencies in diverse clinical settings. There is an expectation that Registered Nurses and Medical Officers who care for the critically ill will provide Advanced Life Support in addition to Basic Life Support (BLS). Although the Australian Resuscitation Council states <sup>(1)</sup> that “*any attempt at resuscitation is better than no attempt*” (ANZCOR Guidelines, Jan 2016), healthcare professionals are expected to provide evidence-based, high quality Basic and Advanced Life Support.

## Definition of Advanced Life Support <sup>(1)</sup>

Advanced Life Support can be defined as:

*The provision of effective airway management, ventilation of the lungs and production of a circulation by means of techniques additional to those of basic life support. These techniques may include, but not be limited to, advanced airway management, tracheal intubation, intravenous access/drug therapy and defibrillation.*

(ANZCOR Glossary, January 2016).

## Aim <sup>(2)</sup>

All healthcare professionals will demonstrate BLS competency for infants, children and adults, with the inclusion of training in the use of AEDs (Automated External Defibrillators). In addition, Medical Officers and Registered Nurses, who provide care for critically ill patients, will demonstrate ALS competency.

## Program Objectives <sup>(1, 2, 3)</sup>

After completing the Adult ALS program, the candidate will be able to:

- Prioritise steps in the management of a collapsed person using the **DRSABCD approach**, integrating BLS and ALS protocols
- Conduct a situational assessment and manage **Dangers**
- Assess patient **Responsiveness**

- **Send for help**, demonstrating an understanding of the roles of members of the resuscitation team
- **Assess and manage the victim's Airway**, including the use of airway adjuncts and assistance with endotracheal intubation or laryngeal mask insertion.
- **Assess and manage the victim's Breathing**, including resuscitator bag use
- **Assess and manage the victim's Circulation** including diagnosis of cardiac arrest arrhythmias and life threatening pulsatile cardiac arrhythmias (VT, VF, Asystole, PEA, SVT and bradycardia)
- Perform chest **C**ompressions
- Demonstrate use of an **AED**
- Demonstrate safe manual **D**efibrillation
- Demonstrate applied knowledge of first line drugs used in cardiac arrest and life threatening pulsatile cardiac arrhythmias
- Provide immediate post-event care
- Adhere to Occupational Health & Safety legislation
- Be aware of legal and ethical issues associated with resuscitation
- Provide a safe environment, e.g. Assembly and/or checks of equipment contained in the resuscitation trolley

Additions to Adult ALS competency, for relevant specific clinicians, include:

- Demonstration of competency of assistance with endotracheal intubation
- Demonstration of synchronous cardioversion competency
- Demonstration of transcutaneous pacing competency
- Demonstration of advanced paediatric life support competency
- Demonstration of intraosseous vascular access competency

### **Program Delivery**

The options available for undertaking this program include:

- Self-directed learning utilising this package, the '*Bendigo Health Advanced Life Support (ALS) Education Package*'
- Self-directed learning via online iLearn ALS modules
- Participation in Bendigo Health ALS education sessions and study days
- Workplace tutorials conducted by Bendigo Health ALS assessors

### **Program Information**

Specific information related to program booking, tutorial appointments and competency assessment appointments is available from clinical educators. Candidates should contact a clinical educator for more information.

### **ALS Competency Pathways**

Participants can attain ALS competency via a number of pathways.

To obtain ALS competency, participants must:

- Possess BLS competency
- Have knowledge of workplace/organisational resuscitation policies
- Complete an ALS competency assessment by a Bendigo Health ALS assessor
- Registered Nurses (RNs) must complete the Bendigo Health iLearn BLS e-learning module prior to competency assessment and bring a copy of the certificate of completion to the ALS competency assessment.

Optional:

- Utilisation of this '*Bendigo Health ALS Education Package*'
- Attendance at education sessions and tutorials
- Completion of iLearn ALS e-learning modules



**Every healthcare professional *must* refer to specific resuscitation policies for their organisation/ work area.**

### **Assessment** <sup>(2)</sup>

The candidate's competency to manage the patient with pulsatile life threatening cardiac arrhythmias and cardiac arrest will be assessed in a simulated life-threatening emergency scenario. Candidates will demonstrate BLS (Appendix A) including the use of adjunctive equipment e.g. Resuscitator bags (Appendix B) and AEDs. Candidates will also demonstrate adult ALS skills (Appendix C). The competent demonstration of

- intraosseous access device use,
- assistance with endotracheal intubation,
- synchronous cardioversion,
- transcutaneous pacing and
- paediatric advanced life support skills

are a requirement of relevant specific clinicians (e.g. Medical Registrars, Critical Care qualified RNs) and are optional for other adult ALS competency candidates.

Competency will be demonstrated under the supervision of a Bendigo Health ALS assessor. The performance will be recorded as "competent" or "not yet competent".

Approximately one hour should be set aside for the assessment.

### **Articulation** <sup>(2)</sup>

Successful Basic Life Support competency is a pre-requisite for entrance into the Advanced Life Support competency program.

## **References Section 1.**

1. Australian and New Zealand Committee on Resuscitation *Guidelines*. Melbourne: Australian Resuscitation Council, 2016.
2. Fuzzard, K., *Education Curriculum for Advanced Life Support (ALS)*. Internal document: Bendigo Health, 2016
3. Australian College of Critical Care Nurses *Advanced Life Support Curriculum Guide*. Leederville: Ink Press International, 2004.

## 2. BASIC LIFE SUPPORT

### Overview <sup>(1, 2)</sup>

Basic Life Support (BLS) is the preservation of life by the initial establishment of, and/or maintenance of, airway, breathing, circulation and related emergency care, including use of an AED. In this section, the indications for commencing Cardiopulmonary Resuscitation (CPR), the steps of assessment and the initiation and performance of CPR are presented. Additional information is presented that will assist Advanced Life Support healthcare professionals implement care.

### DRSABCD of Resuscitation <sup>(1)</sup>

The management of the collapsed person involves:

1. Checking for **D**anger to self and others
2. Checking for **R**esponse of the patient
3. **S**ending for help
4. Prioritising care:
  - A**irway
  - B**reathing
  - C**ompressions
  - D**efibrillation
5. Preventing further injury
6. Protecting the patient from the environment
7. Maintaining normal body temperature
8. Reassuring the patient
9. Continually observing the collapsed patient



**It is important to keep calm and adhere to DRSABCD**

### D. Danger <sup>(1)</sup>



**Quickly check for dangers to the patient and rescuers.**

In some instances it will be necessary to remove the source of danger before further care can commence.

- e.g.
- live electricity
  - firearms
  - needles
  - body fluids

Rescuers are required to adhere to standard precautions, e.g. Don protective gloves and other apparel <sup>(3)</sup>. Risk of disease transmission is very low and rescuers need not be

deterred from providing rescue breaths without a barrier device. However, rescuers should consider using a barrier device if this is available <sup>(1)</sup>. Additional precautions must be used for patients with specific diseases including respiratory and blood-borne infections <sup>(3)</sup>.

## R. Response <sup>(1)</sup>



To determine if the patient is conscious or unconscious, check the response to a verbal stimulus and if no response, **squeeze the shoulders firmly** ('talk and touch'). Tactile stimulation should not exacerbate or cause injury.

A patient is managed as **unconscious** if they fail to respond (or respond only with minor responses such as groaning) to a verbal or tactile stimulus.

## S. Send for help <sup>(1, 4)</sup>



The rescuer must **send for help**

It may be possible to summon help by shouting or pressing a code blue emergency buzzer, calling a Code Blue by telephone or summoning the ambulance service as appropriate to the specific work area.

If **conscious**, allow the patient to adopt a position in which they are comfortable, continue to observe and check DRSABCD.

## A. Airway <sup>(1)</sup>

When a victim is unconscious, all muscles are relaxed. The tongue, which is attached to the back of the jaw, falls against the back wall of the throat and blocks air from entering the lungs. The mouth falls open but this tends to block rather than open the airway.



It is essential to use positioning to achieve a clear airway.

A jaw thrust and a head-tilt/chin lift ('sniffing' position) are illustrated (Fig. 1). Gently tilting the head back and thrusting or lifting the lower jaw away from the chest achieves this.

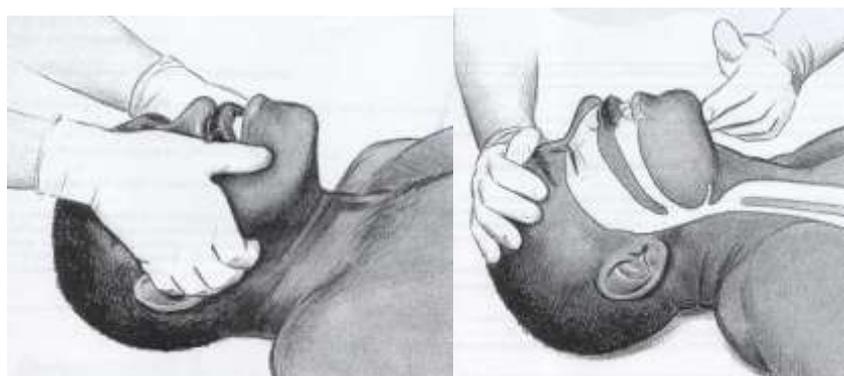


Fig.1. Ensure a clear airway



**Infants** (i.e. children less than one year of age) have narrow upper airways that are more easily occluded than adults. The trachea is soft and pliable and may become distorted with excessive backward head tilt or jaw thrust. Airway support is provided with jaw support and **neutral head alignment** (Fig. 2). The lower jaw should be supported at the point of the chin while keeping the mouth open. There must be no pressure on the soft tissues of the neck. Maximum backward head tilt must not be used in infants.



Fig.2. Infant head supported in neutral alignment

### **Absence of a Clear Airway** <sup>(1)</sup>

Recognised by: Absent or noisy breathing

Causes:

**Tongue:** The most common cause of a blocked airway in the unconscious patient is the tongue. Any condition that leads to unconsciousness or loss of tone in the muscles of the jaw can cause the tongue to fall back towards the back of the pharynx and obstruct the airway.

**Foreign material:** Semi-solid material (e.g. food, vomit) can block the airway.

**Other causes:** Laryngeal spasm, swelling or injury to the airway

In all age groups fluid can be cleared from the airway with the use of **suction**. If suction is not available or more particulate matter needs to be cleared, a finger sweep can be used. In the absence of suction, it may be necessary to quickly roll the patient onto their side, e.g. following a near drowning or where the airway is obstructed with vomit, blood or other material (Fig. 3). However, **it is not necessary to routinely roll all victims onto their side.**



Fig.3. Clearing the airway if obstructed by fluid and if no suction is available.

### **Oropharyngeal Airway (OPA), or Guedel Airway for Adults** <sup>(1, 5, 6)</sup>

An OPA may sometimes be required to achieve or maintain an open airway. However the device should only be used in moribund patients as laryngospasm or vomiting may result from OPA insertion in a patient with an intact gag reflex.

The OPA conforms to the shape of the palate. When inserted in the unconscious patient, it can assist in maintaining a clear airway by preventing obstruction by the tongue of the posterior pharynx. This enables the passage of gases through and around the tube, and facilitates suctioning.

### Inserting an adult oropharyngeal airway

Select an appropriately sized OPA. An oversized tube could obstruct the airway by depressing the epiglottis. The tongue could obstruct a tube that is too small.

Average adult: size 3-5

The correct size can be confirmed by placing the tube at the side of the cheek and ensuring it is level with the front of the teeth and reaches the angle of the jaw.



Fig.4. Insertion of the OPA in adults

The airway should be inserted 'upside down' and it is then rotated 180° as it nears the posterior wall of the pharynx, so that it points downward (Fig. 4).

### OPA for the infant or young child <sup>(7)</sup>

An OPA may be used for the unconscious child with an impaired gag reflex to relieve obstruction from the tongue. It may also be useful in maintaining an open airway during bag-mask ventilation.

Determine the size by placing the device next to the child's face with the flange at the level of the teeth. The tip of the airway should end at the angle of the jaw (Fig. 5). A size that is too small may push the tongue into the oropharynx and a size that is too large will obstruct the trachea. Insert the airway using a tongue depressor to displace the tongue forward. Insert the airway curve down ('**right way up**' or **forward**), over the tongue. Do **not** insert the airway in the inverted position and rotate, as in the adult, as it may traumatize the soft tissue structures of the oropharynx and damage the teeth. (For older children, insert the OPA as per adult method.)

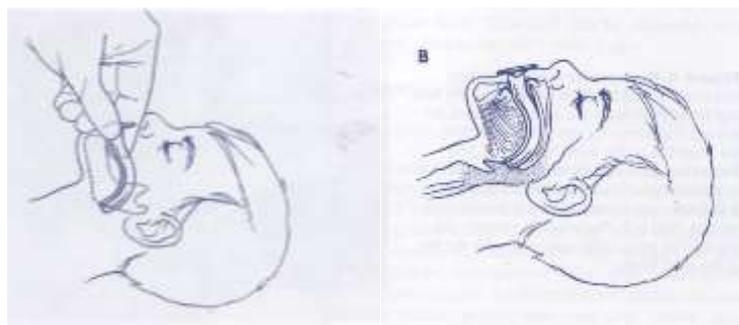


Fig.5. Measuring & placement of the young child's oropharyngeal airway

## Nasopharyngeal Airway (NPA) Insertion <sup>(1, 8)</sup>

Soft plastic NPAs are useful for patients with jaw clenching or oral trauma. They are as effective as OPAs for obtaining or maintaining a clear airway. Inadvertent insertion of an NPA into the cranial vault with fractured base of skull is possible but rare. In patients with known basal skull fractures or obvious nasal trauma, an oral airway is preferred. However, if this is not possible and the airway is obstructed, the insertion of an NPA may be life-saving. Select the correct size by ensuring the NPA extends from the tip of the nose to the earlobe. A size 6-7mm NPA will suit most adults. Lubricate the tip and insert gently into the nostril with the bevel facing the septum. Rotate the tube as it reaches the hypopharynx so it sits as shown (Fig. 6).



Fig 6. Position of nasopharyngeal airway

## Choking <sup>(1)</sup>

The symptoms and signs of obstruction will depend on the cause and severity of the condition. Airway obstruction may occur gradually or suddenly, and may lead to complete obstruction within a few seconds.

In the conscious person who has inhaled a foreign body, there may be extreme anxiety, agitation, gasping sounds, coughing or loss of voice. This may progress to the universal choking sign, namely clutching the neck with the thumb and fingers. Chest thrusts or back blows are effective in conscious adults and children. The use of abdominal thrusts is not recommended and, instead back blows and chest thrusts should be used. These techniques should be applied in rapid sequence until the obstruction is relieved.



**Perform up to five sharp, back blows** with the heel of one hand in the middle of the back between the shoulder blades (Fig.7).

Check to see if each back blow has relieved the airway obstruction. The aim is to relieve the obstruction with each blow rather than to give all five blows. An infant may be placed in a head downwards position prior to delivering back blows, i.e. across the rescuer's lap.

If back blows are unsuccessful the rescuer should **perform up to five chest thrusts**. To perform chest thrusts, identify the same compression point as for CPR and give up to five chest thrusts. These are similar to chest compressions but sharper and delivered at a slower rate. The infant should be placed in a head downwards and on their back across the rescuer's thigh, while children and adults may be treated in the sitting or standing position. With each chest thrust, check to see whether the airway obstruction has been relieved. The aim is to relieve the obstruction rather than deliver all five chest thrusts. If the obstruction is still not relieved and the person remains responsive, continue alternating five back blows with five chest thrusts.

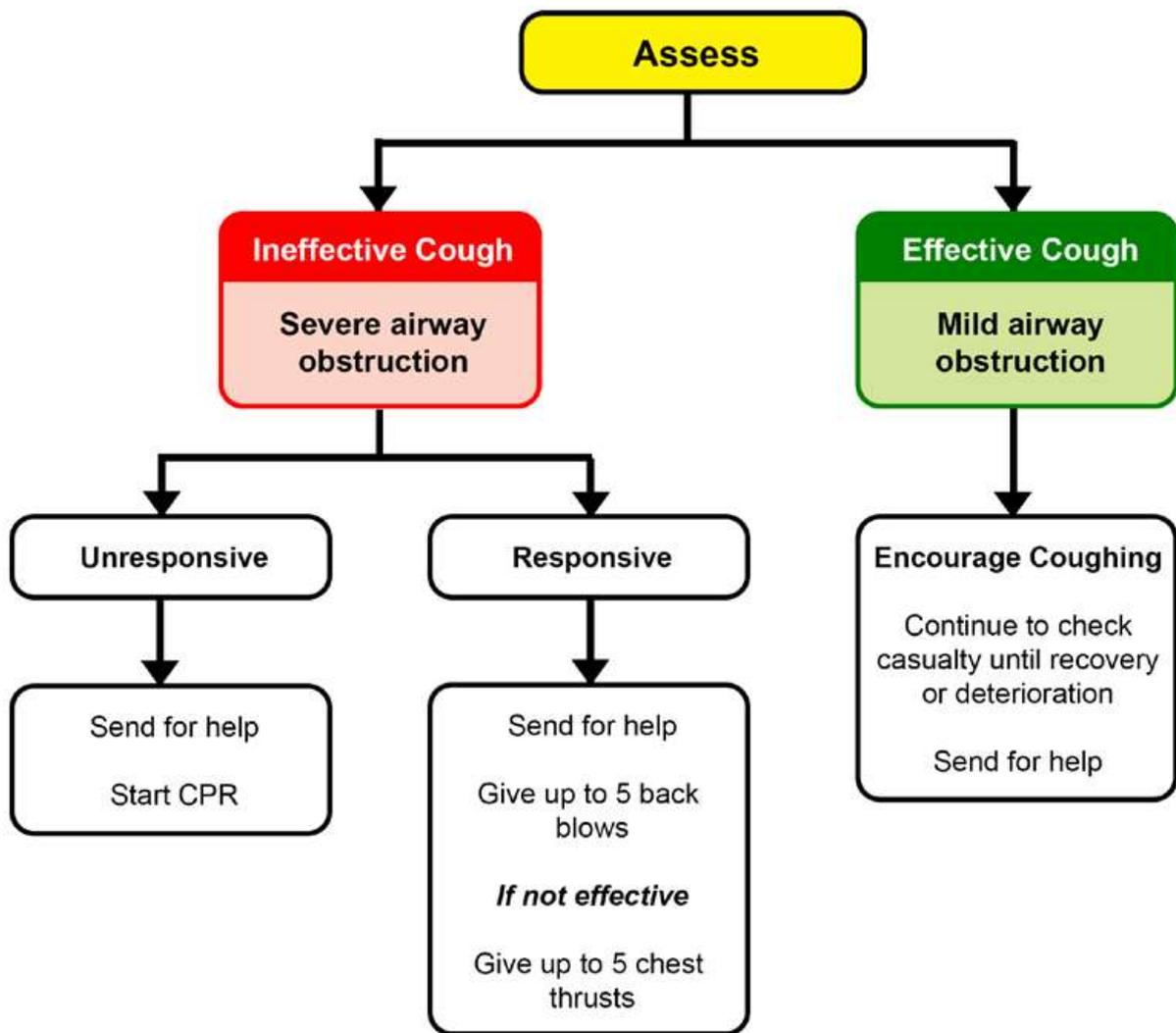


Fig. 7. Management of Foreign Body Airway Obstruction (Choking) Algorithm

## B. Breathing <sup>(1)</sup>

The next step is to assess whether or not the patient is breathing effectively.

**LOOK** for the movement of the upper abdomen or lower chest

**LISTEN** for escape of air from the nose and mouth

**FEEL** for movement of air at the mouth and nose

### If breathing:

Care for the patient in a lateral position, with the head in a backward tilt and the jaw supported to keep the airway open (Fig. 8). Remain with the patient and continuously check for breathing. A stable position is provided **without rotation of the neck**.



Fig.8. Positioning of the breathing, unconscious patient



**If not breathing, or only taking an occasional gasp, commence CPR!**

**Adults: Commence chest compressions and rescue breathing.** Give 30 compressions and then two breaths allowing about one second for each inspiration.

**Infants and children <9yrs: Deliver 2 rescue breaths.** Generally, application of breaths should precede external cardiac compressions because asphyxial causes predominate over cardiac causes in paediatric cardiopulmonary arrest.



**In infants and children <9 years, CPR by healthcare rescuers should commence with 2 ventilations.**

If delivery of rescue breaths is not feasible or the rescuer is unwilling to deliver mouth-to-mouth breaths, **commence chest compressions**, as described in the next section. It is reasonable in the institutional setting, if the usual equipment used to apply breaths is not immediately to hand, to commence CPR with chest compressions.

Rescue breaths may be delivered by the mouth-to-mask method, or by using a resuscitation bag, as follows.

#### **The Mouth-to-Mask Method <sup>(1)</sup>**

The mouth-to-mask method of rescue breathing avoids mouth-to-mouth contact by the use of a resuscitation mask, e.g. Concord mask. This is used in preference to mouth-to-mouth rescue breathing as the risk of infection transmission is reduced. This is further improved by the use of a bacterial/viral filter (Fig. 9).

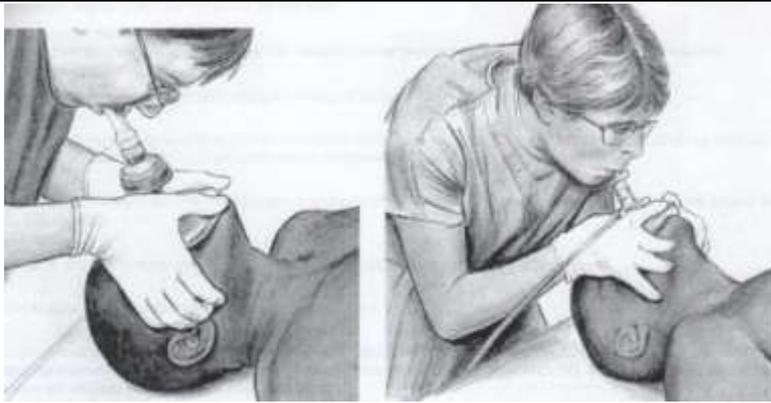


**Failure to maintain a backward head tilt and chin lift is the most common cause of airway obstruction during resuscitation.**

Position yourself at the patient's head, maintain a backward head tilt and chin lift. **Place the narrow end of the mask at the top of the bridge of the nose.** A lack of a seal around the mask will allow an air leak. Apply firm, even pressure around the rim of the mask. Hold the mask firmly against the face by gripping the fingers under the jaw and placing the thumbs over the mask.

When available it is important to add oxygen to the mask. This is achieved by quickly placing oxygen tubing under the rim of the mask and setting the oxygen flow at the maximum rate.

The mouth of the rescuer should be removed from the port of the mask to allow the patient to exhale. The rescuer should observe the rise and fall of the patient's chest.



*Fig.9. Mouth-to-mask Rescue Breathing*

### **Resuscitator Bag Method** <sup>(1, 5, 6)</sup>

Disposable resuscitator bags and reusable resuscitator bags are available. Healthcare professionals who use resuscitator bags must be able to check the correct function of the device (Appendix B).

The resuscitator bag has a face-mask, (but it can also be attached to an endotracheal tube or a tracheostomy tube if the mask is removed). It is preferred that oxygen is attached to the bag and set at maximum flow so that 100% oxygen is delivered. Even if no oxygen is available, the resuscitator bag can still be used.

While using a resuscitator bag and mask, the rescuer has the challenge of performing three tasks:

- Maintaining a patent airway
- Ensuring a tight face seal
- Ventilating the patient

If any of these tasks is inadequately performed, inadequate patient ventilation will occur. An oral or nasopharyngeal airway may assist in the maintenance of a clear airway.

The mask is applied to the patient's face. The index finger of the rescuer holds the portion that covers the chin. The **top of the mask is held firmly against the top of the bridge of the nose** by the thumb. Pushing down ensures a good seal. The other three fingers grip the base of the jaw, lifting it forward. In adults the head is held carefully in the tilt position. The other hand slowly squeezes the resuscitator bag. For adults, the rescuer's finger and thumb should meet when squeezing the bag (Fig. 10) in order to deliver a tidal volume of approximately 500mL.

**Self-inflating resuscitation bags should not be used to deliver oxygen to spontaneously breathing patients because minimal and unreliable amounts of oxygen are released passively from the patient exit valve despite introduction of high flow oxygen into the resuscitation bag.** If used to deliver oxygen to the spontaneously-breathing victim, an air-tight seal of the mask on the face is required, the one way delivery valve must be observed to open and ideally the reservoir bag observed to deflate periodically with each breath. A Hudson mask should be used for the spontaneously breathing victim.

If a tight seal cannot be obtained, the rescuer may use both hands to ensure a seal, while the bag is squeezed by another rescuer (Fig. 11). It is essential that a chin lift/head tilt be maintained.

When proper ventilation is being administered, the chest will be observed to gently rise and fall with each squeeze of the bag.



Fig. 10. One rescuer



Fig. 11. Two rescuers

### **Mouth-to-mouth rescue breathing** <sup>(1, 3)</sup>

Healthcare professionals must observe Standard Precautions in relation blood and body fluids. As such, it is not mandated that they provide mouth-to-mouth rescue breaths. It should be noted that the risk of disease transmission with mouth-to-mouth rescue breaths is very low, however, barrier devices must be used if the patient is known to have a serious infection. If the rescuer is unwilling or unable to deliver mouth-to-mouth breaths, compression only CPR should be employed until a Concord mask or resuscitator bag becomes available.

### **The Mouth-to-Mouth Method** <sup>(1)</sup>

If the rescuer elects to perform mouth-to mouth rescue breaths, kneel beside the patient's head. Take a breath, open your mouth as widely as possible and place it over the patient's slightly open mouth. Pinch the nostrils (or seal nostrils with rescuer's cheek) and blow to inflate the patient's lungs. Pull upwards with the hand on the chin to maintain head tilt. Give a 1 second breath to the patient to achieve chest rise. If the chest does not rise, possible causes are:

- obstruction in the airway (tongue or foreign material, or inadequate head tilt, chin lift)
- insufficient air being blown into the lungs
- inadequate air seal around mouth and or nose.

After inflating the lungs, lift your mouth from the patient's mouth, turn your head towards their chest and listen and feel for air being exhaled from the mouth and nose.

### **Stomach Distension** <sup>(1)</sup>

Distension of the stomach occurs when the rescuer blows too hard or when the airway is partially obstructed and air enters the stomach rather than the lungs. Do not apply pressure to the stomach.

If regurgitation of stomach contents occurs, suction should be used when available to clear the airway. Alternatively, turn the patient laterally and clear the airway. Reposition the patient and continue resuscitation as before.

## The Patient with a Tracheostomy <sup>(8)</sup>

### In the event of collapse of any patient with a tracheostomy:

Check for breathing by listening and feeling for the escape of air from the tracheostomy or stoma.

Watch for any movement of the lower chest and upper abdomen.

If laboured/paradoxical breathing, clear the tracheostomy by:

Turning patient onto their back and suctioning the tracheostomy

Turning patient onto their side to clear the stoma

Wiping away any mucus from the tube / stoma using a tissue

Removing any visible valve from an external tracheostomy tube (if indicated)

### If patient not breathing:

Connect resuscitation bag (without mask) to tracheostomy tube and ventilate patient. If tracheostomy tube seems blocked and patient cannot be ventilated, remove tracheostomy tube and replace. If patient has an intact upper airway, cover stoma and continue BLS via usual methods.

### Points of emphasis for a patient with a laryngectomy & permanent tracheostomy:

A patient who has undergone laryngectomy (removal of the larynx) breathes through a permanent stoma. **The upper airway is no longer used and has no anatomical connection to the trachea and lungs, therefore rescue breaths must occur via the stoma.**

## C. Compressions / CPR <sup>(1)</sup>

### Indications for Chest Compressions <sup>(1)</sup>



Rescuers should start chest compressions **for all victims who are unresponsive and not breathing normally.** (ALS rescuers may commence CPR with 2 breaths for paediatric patients.)



**Even if the victim takes occasional gasps, rescuers should suspect that cardiac arrest has occurred and start chest compressions.**

The routine check for a carotid pulse is no longer an essential step for providing Basic Life Support. This is because evidence suggests that rescuers are often unable to determine the presence of a pulse with accuracy.

Most victims requiring resuscitation have had a cardiac arrest. **Chest compressions are vital.** Giving compressions if the victim has a beating heart is highly unlikely to cause harm.

However, for healthcare professionals in certain clinical settings, the pulse check is still considered an essential part of patient assessment <sup>(5)</sup>. For example, the patient may have received a sedative or anaesthetic drug and is unresponsive and not breathing normally. This requires expert professional care, e.g. for the support of breathing. If the patient clearly has a strong pulse they do not require chest compressions.

Therefore, **healthcare professionals** in these special settings *may* briefly palpate for the presence of a carotid pulse (i.e. for no more than 10 seconds) <sup>(1)</sup>.



The important message regarding the pulse check is that **precious seconds must not be wasted searching for a pulse when a patient is unresponsive and not breathing normally and urgently needs chest compressions.**

### Pulse check in special settings <sup>(8)</sup>

To assess the carotid pulse, place 2 or 3 fingers gently on the 'Adam's Apple', then slide the fingers laterally. Feel with the flat portion or the pulps of the fingers (Fig. 12). Do not block the carotid artery by applying too much pressure. It may be necessary to palpate for a carotid pulse for a maximum of 10 seconds. It is important that only one carotid artery is palpated at a time. If no clear pulse is found, commence chest compressions.



Fig.12. Carotid pulse check in special settings

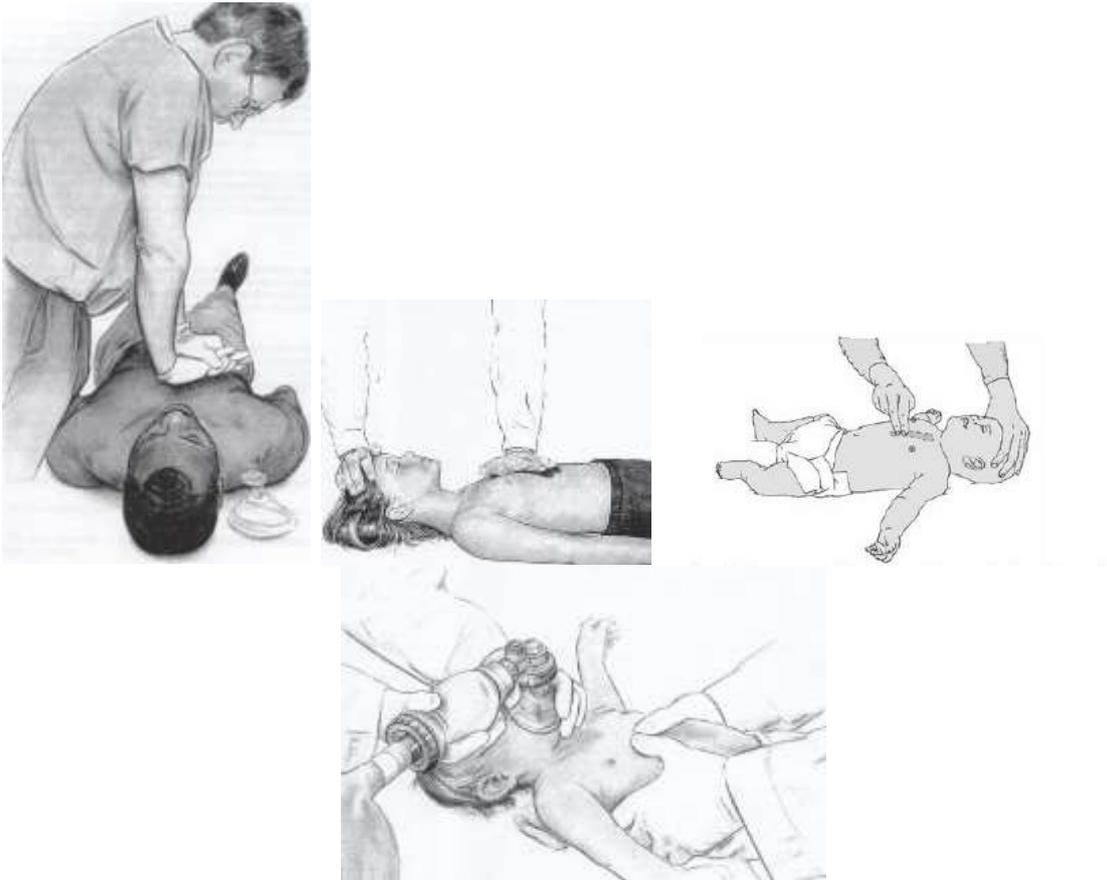


If the patient is unresponsive and not breathing normally (and/or has no carotid pulse) commence chest compressions.

### Technique for performing chest compressions <sup>(1)</sup>

- The patient must be positioned on their back on a firm surface.
- The rescuer is positioned comfortably alongside the patient's body, so that vertical pressure can be applied. If the patient is on a bed or trolley, the rescuer will usually need to kneel on the mattress or use a step to achieve the correct posture above the patient.
- Direct visualisation may be used to locate the compression point on the **lower half of the sternum**. Avoid compression beyond the lower limit of the sternum.
- All pressure is exerted **vertically** through the heels of the hands (Fig. 13). The rescuer's body weight is the compressing force. The shoulders should be vertical over the sternum and the compressing arms are kept **straight**. The heel of the hand remains in contact with the lower half of the sternum so that the correct position is maintained. Compressions should be rhythmic, with equal time for compression and relaxation. The rescuer must avoid rocking backwards and forwards or using thumps or quick jabs.

- Rescuers should allow **complete recoil** of the chest after each compression.



*Fig.13. Chest compressions (adults, children & infants)*

#### **Infants (less than one year old)**

- Direct visualisation is used to locate the lower half of the sternum.
- After locating the compression point, the rescuer places the pads of two fingers on that point and compresses the chest (Fig. 13). This 2-finger technique is recommended for lay rescuers and can also be used by healthcare professionals. A 2-thumb technique is preferred for healthcare professionals; the rescuers hands encircle the chest and the thumbs compress the sternum. Care must be taken to avoid restricting chest expansion.

#### **Children and Adults**

- Direct visualisation is used to locate the lower half of the sternum
- Either a one or two hand technique can be used for performing chest compressions in children (Fig. 13).

#### **Depth of Compression (all age groups) <sup>(1)</sup>**



The lower half of the sternum should be depressed by **one third of the depth** of the chest with each compression (Fig. 14). This equates to more than 5cm in adults, approximately 5cm in children and 4cm in infants. Inadequate compression depth is definitely associated with poor outcomes.

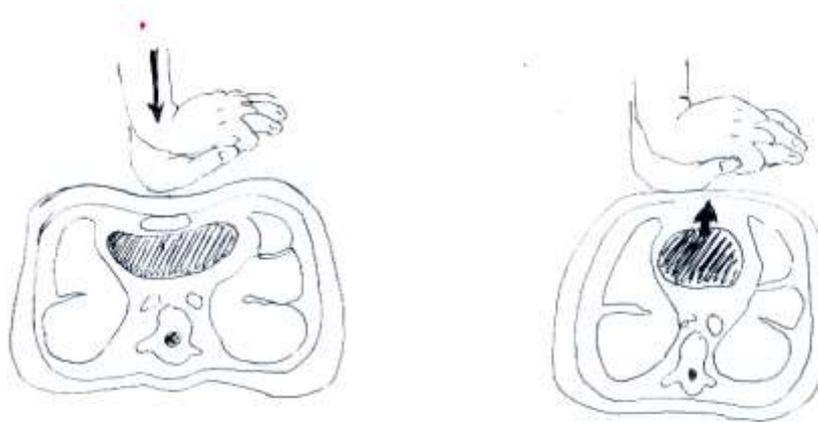


Fig.14. Depress by one third the depth of the chest

### **Chest compressions for the bariatric patient** <sup>(9, 10)</sup>

Morbid obesity can provide challenges during CPR. Airway management may be more difficult, and resuscitative efforts more demanding. No modifications to standard BLS or ALS care have been shown to be effective. However, techniques may need to be adjusted due to the physical attributes of individual patients. Chest compressions will be difficult to perform in many patients, simply because of sub-optimal rescuer positioning. A step or platform may be required to ensure that the rescuer's weight is compressing the chest from above the sternum. Frequent changes of rescuer performing chest compressions will be required (e.g. 1 minutely instead of the usual 2 minutely changes). The team leader and team members must consider the occupational health and safety issues related to prolonged efforts and devices such as the use of a step and mechanical lifters.

### **Rate of Chest Compressions (all age groups)** <sup>(1)</sup>



Rescuers should perform chest compressions for all ages at a rate of approximately **100-120 compressions per minute**.

### **Cardiopulmonary Resuscitation (CPR)** <sup>(1)</sup>

The combination of rescue breaths and chest compressions is known as CPR (cardio pulmonary resuscitation).

### **Compression-Ventilation Ratio** <sup>(1)</sup>



For basic life support rescuers, a **universal compression-ventilation ratio of 30:2** (30 compressions followed by 2 ventilations) is recommended for all ages.

Compressions are paused for a very short time for delivery of **2 breaths of 1 second each**. It is vital to minimise interruptions to chest compressions. If an endotracheal tube is in situ there is no need to pause compressions to deliver rescue breaths.

Evidence suggests that hyperventilation may increase intrathoracic pressure and decrease coronary and cerebral perfusion. Do not deliver large volumes or too many rescue breaths.



For infants and children, with two ALS rescuers present, the ventilation-compression ratio of 2:15 is performed.

### Compression only CPR <sup>(1)</sup>



When a rescuer is unable or unwilling to perform rescue breaths, they must perform chest compressions at a rate of approximately 100-120 per minute.

### Change over between rescuers during CPR <sup>(1)</sup>

- Frequent rotation of rescuers is undertaken (approximately every 2 minutes) to reduce fatigue and ensure ongoing quality compressions.
- One of the two rescuers indicates readiness or need to change.
- The rescuers must change over smoothly with minimal interference to the resuscitation procedure.
- The rescuer performing rescue breathing, having given a rescue breath, moves down to the victim's side ready to take over compressions. The sequence of 30 compressions to 2 inflations is maintained.
- The change-over can be done at the time of the rhythm checks.

### Minimise interruptions to CPR <sup>(1)</sup>

CPR should not be interrupted to check for response or breathing. Evidence has demonstrated that interruption of chest compressions is associated with poorer return of spontaneous circulation and lower survival rates.



**Minimise interruptions to chest compressions!**

## D. Defibrillation <sup>(1)</sup>

### The Automated External Defibrillator (AED) <sup>(1)</sup>

In the event of cardiac arrest, the use of AEDs to analyse the electrical rhythm of the heart is an essential element of BLS. AEDs accurately identify the cardiac rhythm as 'shockable' or 'non-shockable' and provide the operator with audible or visual prompts on actions required for the delivery of a shock, if required.



**The importance of early defibrillation to survival is clearly established.**

AEDs are now available in many public places where large crowds gather, and are often present in healthcare facilities. Clear signs indicate the presence of an AED (Fig. 15).



Fig. 15. AED sign

Many healthcare facilities possess large manual defibrillators (Fig.16) that have an AED mode that should be used by BLS rescuers.



Fig. 16. Manual / Automated External Defibrillator

Many brands of AED are available for use (Figs. 16, 17, 18).



Fig. 17. Powerheart AED



Fig. 18. Philips AED



**Promptly apply an AED to patients in cardiac arrest.** The patient must be unresponsive and not breathing normally.

### AED Instructions for Use <sup>(1, 6, 11)</sup>

#### 1. Turn AED ON

Follow machine instructions.

#### 2. Apply chest pads

Every effort should be made to minimize interruptions to cardiac compressions. Adhere pads firmly to the victim's exposed chest as indicated on the packaging in an anterior-lateral position (Fig. 19). Connect chest pads to the machine as indicated on the machine.



Fig. 19. Applying AED chest pads

Acceptable alternative positions are the anterior-posterior and apex-posterior positions. In large breasted individuals it is reasonable to place the left electrode pad lateral to or underneath the left breast, avoiding breast tissue.

Pad to skin contact is important for successful defibrillation. There may be a need to rapidly remove moisture or excessive chest hair prior to the application of pads. **Avoid placing pads over implantable devices (e.g. pacemaker) or medication patches. Do not place pads over ECG dots or leads.** This increases the risk of poor contact.

Healthcare professionals should check the suitability for younger children, where the AED is available in the workplace.



At Bendigo Health, the Code Blue Team Nurse Coordinator from Intensive & Coronary Care will provide pads suitable for infants and children when required. **If these are not available, adult AED pads must be used.**

### 3. Machine Use

- Turn AED on.
- Follow the prompts and apply chest pads.
- Plug the pads lead into the AED.
- The AED will instruct “*Analysing heart rhythm, stay clear of patient*” ...or similar. CPR must be paused while the machine analyses whether the patient requires a shock.
- Ensure self and **ALL OTHERS** are clear of the patient during analysis by the machine.
- The AED will prompt the rescuer to either check the patient and recommence CPR if no shock is advised, OR ‘*Shock advised, charging, stay clear of patient, deliver shock now, press the orange button now*’ ..... or similar.
- ALWAYS vocalise the intent to discharge a shock. State ‘**STAND CLEAR**’ in a loud voice and **visually and verbally check** that all present are clear of the patient and the bed, e.g. state ‘checking top, middle, bottom. Shocking now,’ before pushing the ‘Shock’ button. The rescuer must push the flashing button to deliver the shock.



**Recommence CPR immediately after delivery of a shock.**

### Safety <sup>(1)</sup>

**Care should be taken not to touch the victim during shock delivery.** There are no reports of harm to rescuers from attempting defibrillation in wet environments. In the presence of oxygen, there are no case reports of fires caused by sparking when shocks were delivered using adhesive pads. However, rescuers should avoid having the victim in contact with metal fixtures, avoid defibrillating in a flammable environment (e.g. petrol) and avoid allowing oxygen from a resuscitator bag to flow over the victim’s chest during shock delivery.



**If a shock is to be delivered, all rescuers must stand clear until this has occurred. The rescuer must advise all to “*stand clear*” and ensure safety.**



Some types of cardiac arrest do not require a shock. Follow the machine prompts, check the patient and recommence CPR if required.

### Precordial thump <sup>(1)</sup>

A precordial thump is a single sharp blow delivered by the rescuer's fist to the mid sternum of the victim's chest.

When a ***monitored, witnessed*** pulseless ventricular tachycardia (VT) arrest occurs (ie. the patient is connected to a cardiac ECG monitor), **if defibrillation is not immediately available**, a single precordial thump may be indicated.

**The precordial thump should not be used for unmonitored, unwitnessed arrest.**

### Cycles of CPR <sup>(1)</sup>

Each cycle (or loop) of CPR consists of approximately 2 minutes of CPR followed by brief analysis of whether a shock is required, before recommencing CPR. Interruptions to CPR must be minimised.



After every 2 minutes of CPR, AED analysis must occur.

### Recovery <sup>(1)</sup>

If the patient can breathe for themselves, is moving or responsive and has a pulse:

- turn them to the left lateral position,
- continually check airway, breathing and circulation,
- apply oxygen if available, to achieve SpO<sub>2</sub> of 94-98%.

BLS measures are recommended if there is loss of airway, breathing or circulation.

### Resuscitation in Late Pregnancy <sup>(1)</sup>

In noticeably pregnant women, standard CPR should be commenced immediately. Once CPR is in progress, if there are sufficient resources available, rescuers should place padding such as a towel, cushion or similar object under the right hip to tilt the woman's hips (approximately 15-30 degrees) to the left but leave her shoulders flat to enable good quality chest compressions (Fig. 20). The reason for this position in pregnant women is to move the weight of the pregnant uterus off of her major blood vessels in the abdomen. If a tilted position is not possible or tilting the hips compromises the quality of chest compressions, then chest compressions should be performed as described as above with the woman on her back.



*Fig.20. Left-sided pelvic tilt during late pregnancy*

In all other respects, the DRSABCD of Basic Life Support and the Advanced Life Support algorithms should be followed as for all adult patients.

## Duration of Cardiopulmonary Resuscitation <sup>(1, 12, 13)</sup>

Generally, the rescuer should continue resuscitation measures until:

- **The patient responds or begins breathing normally.**
- **There is evidence of a state clearly incompatible with life.**
- **It is impossible to continue** (e.g. due to rescuer exhaustion).
- **Evidence exists of refusal of CPR by a competent patient.** This *may* include a "Form of Refusal of Treatment Certificate" reproduced as Schedule 1, Section 5(2) of the Medical Treatment Act 1988 <sup>(12)</sup>.
- **CPR may be futile** <sup>(1)</sup>. The following factors can be taken into consideration:
  1. **Unresponsiveness** (i.e. no return of spontaneous circulation, ROSC) to resuscitative efforts of more than 20 -30 minutes and low end tidal waveform CO<sub>2</sub> values after 20 minutes of CPR. ANZCOR recommends against end tidal CO<sub>2</sub> cut-off values alone as a mortality predictor or for the decision to stop resuscitation.
  2. **Advanced terminal disease.**



**Full resuscitative efforts, according to protocol, should continue until a clear and final decision has been made to cease resuscitative efforts.**

It may be necessary to consult the patient's relatives to ascertain what the **patient's** wishes would be regarding resuscitation if they could speak for themselves <sup>(14)</sup>. After consideration of all factors, a consensus decision to withdraw active treatment should be reached amongst medical and other healthcare professionals. Relatives must be given explanations of this clinical decision, but **the burden of decision-making must not be placed upon relatives.**



It is of great importance that clinicians are mindful that **cessation of CPR is not withdrawal of care** for a patient and family.

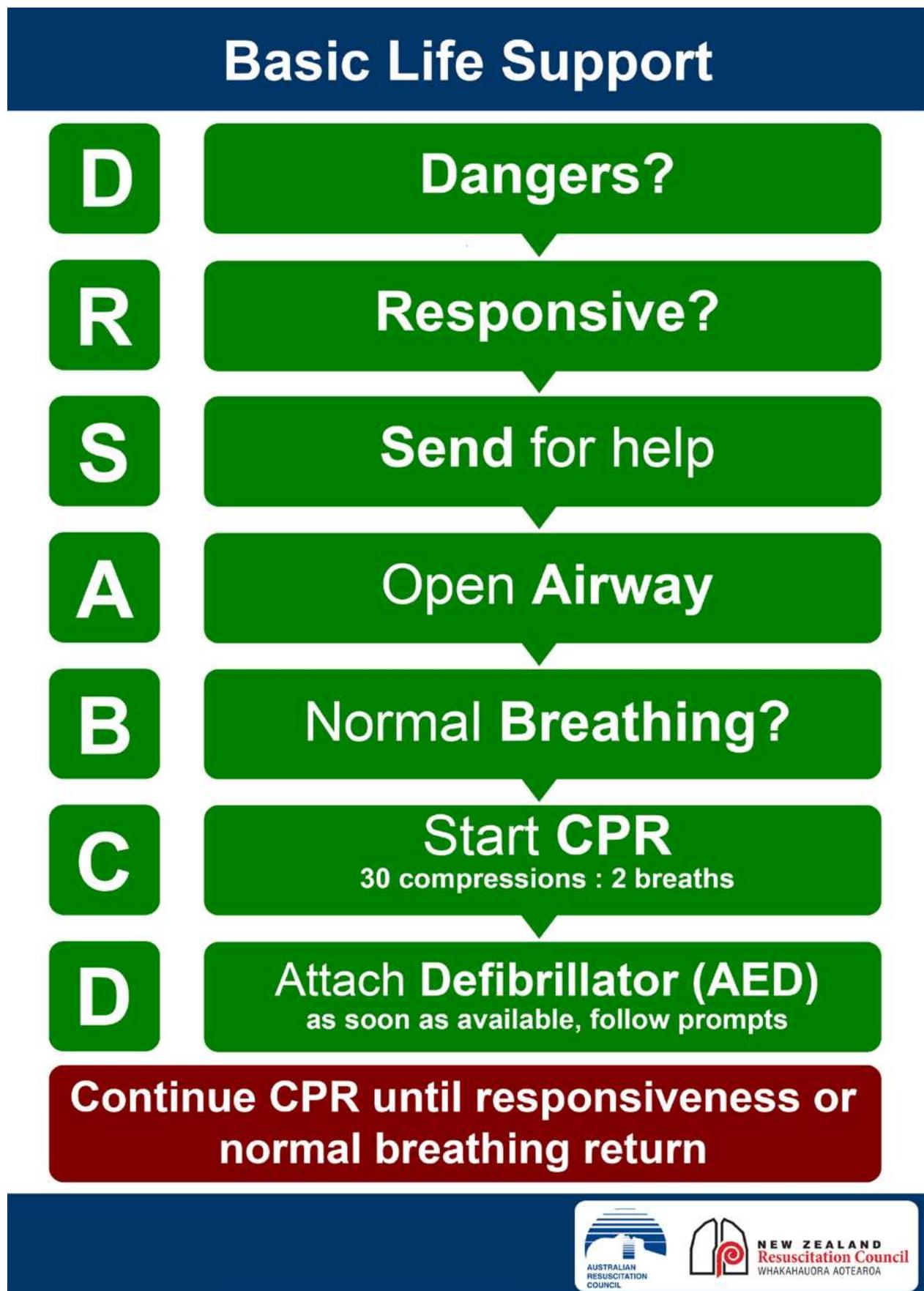


Fig. 21. Basic Life Support Flowchart

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Fig. 10. International Liaison Committee on Resuscitation 'Guidelines 2000 for Cardiopulmonary Resuscitation' *Circulation*. 102(8) Supplement.

Fig. 11. International Liaison Committee on Resuscitation 'Guidelines 2000 for Cardiopulmonary Resuscitation' *Circulation*. 102(8) Supplement.

Fig. 12. International Liaison Committee on Resuscitation 'Guidelines 2000 for Cardiopulmonary Resuscitation' *Circulation*. 102(8) Supplement.

Fig. 13. (Adult & child) International Liaison Committee on Resuscitation 'Guidelines 2000 for Cardiopulmonary Resuscitation' *Circulation*. 102(8) Supplement, 2000. (Infant) European Resuscitation Council, Reproduced in *ARC Guidelines*. Melbourne: Australian Resuscitation Council, 2010.

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### 3. ADVANCED LIFE SUPPORT (ADULT)

This section contains information related to the practice of Advanced Life Support (ALS) for adult patients. This includes ALS Flowcharts (Figs. 1, 2, 3 & 4), cardiac rhythm recognition, electrical therapies, ALS pharmacology, intraosseous (IO) vascular access, advanced airway management, transcutaneous pacing and teamwork.

All ALS candidates must demonstrate:

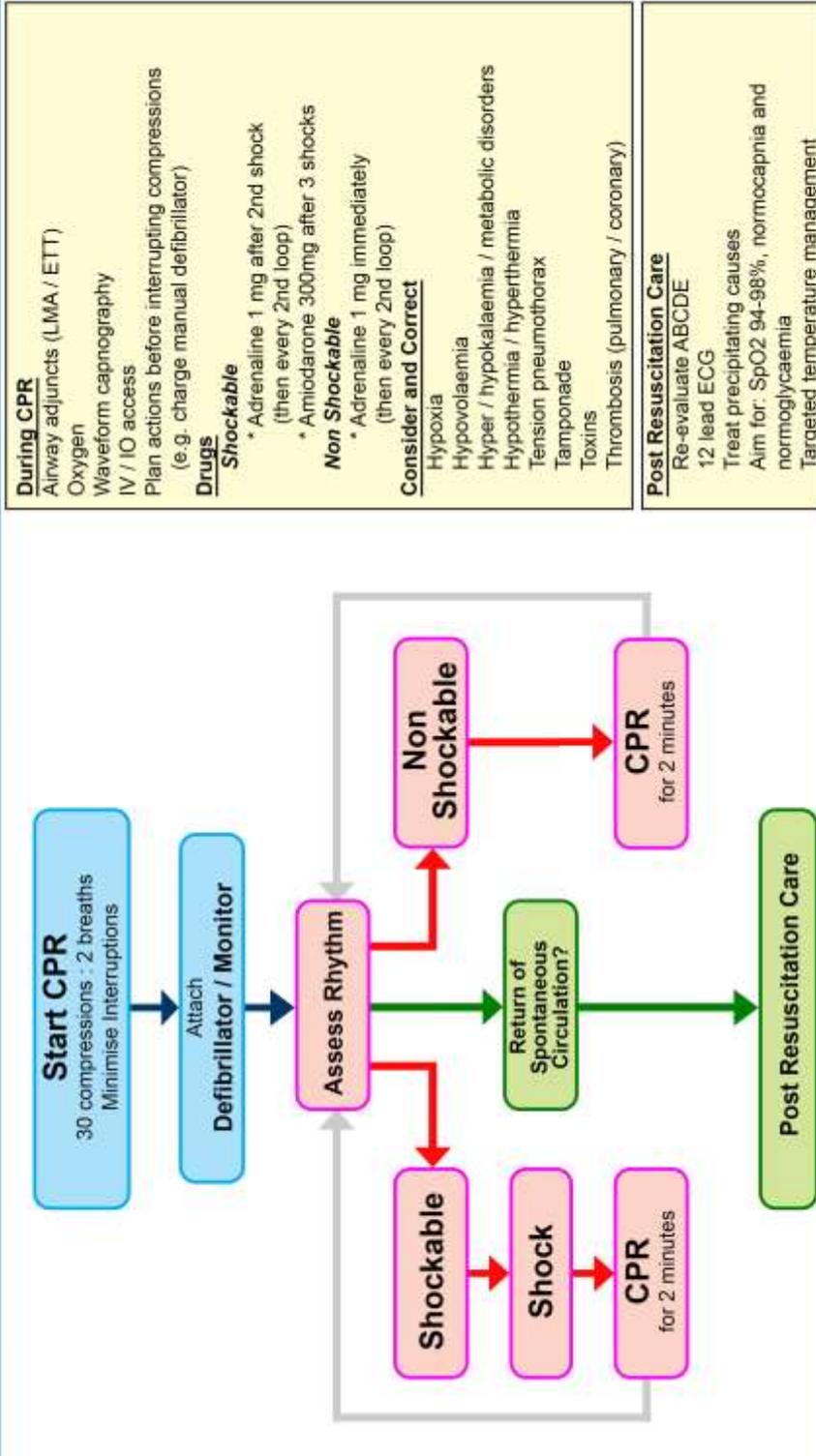
- BLS (Appendix A) including the use of adjunctive equipment e.g. Resuscitator bags (Appendix B).
- Adult ALS skills (Appendix C).

Relevant, specific ALS candidates, (e.g. Critical Care qualified Registered Nurses, Medical Registrars) must also demonstrate <sup>(3)</sup>.

- intraosseous vascular access competency (please complete iLearn IO module prior to the competency assessment)
- assistance with endotracheal intubation
- synchronous cardioversion competency
- transcutaneous pacing competency
- paediatric advanced life support competency

To assist candidates with preparation for ALS competency, the Advanced Life Support Assessment Sheet (Appendix C) and an example ALS scenario (Appendix D) are included.

# Advanced Life Support for Adults



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Fig. 1. Adult Advanced Life Support Flowchart <sup>(1)</sup>

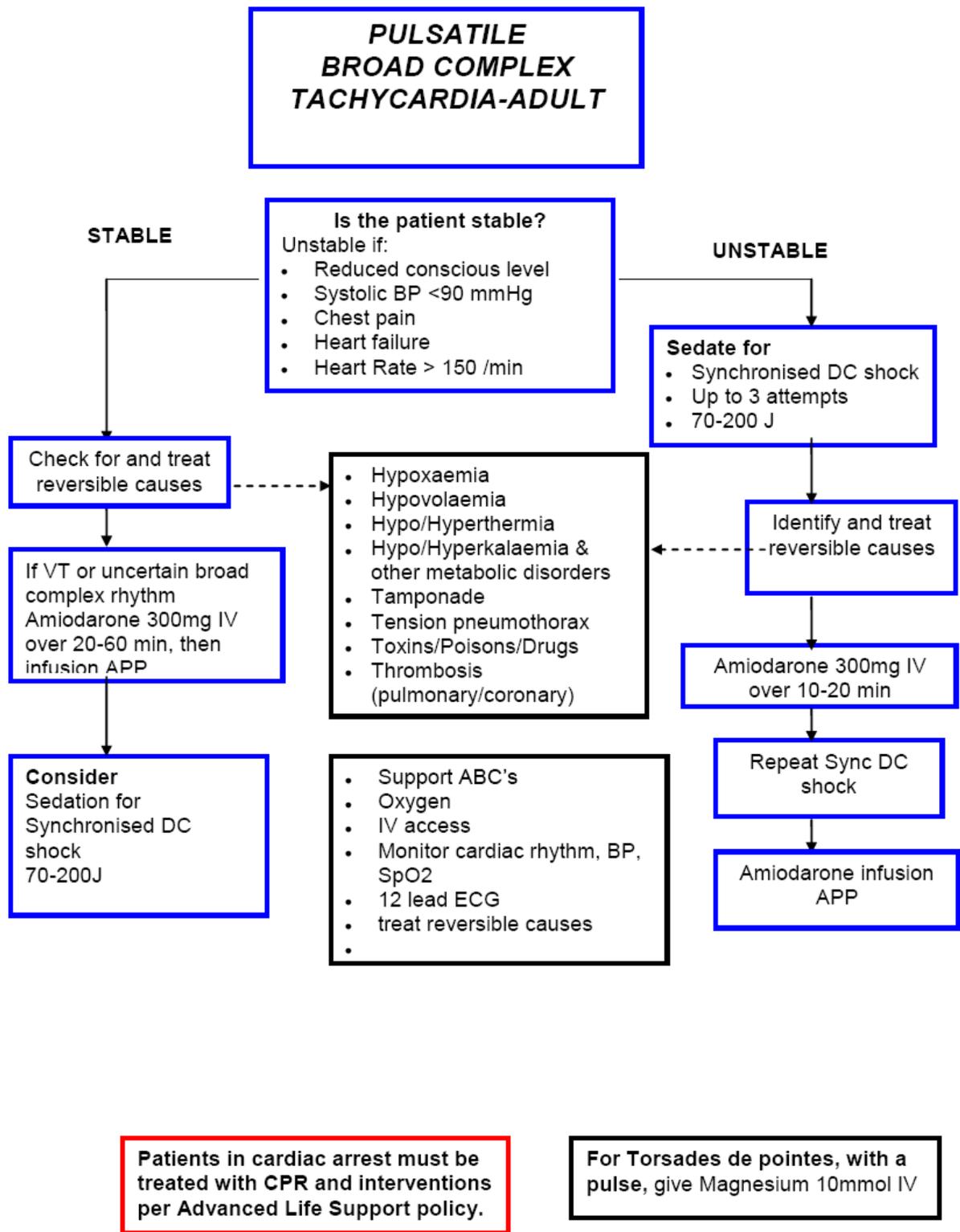


Fig.2. Pulsatile Broad Complex Tachycardia (Adult) Flowchart <sup>(1, 2)</sup>

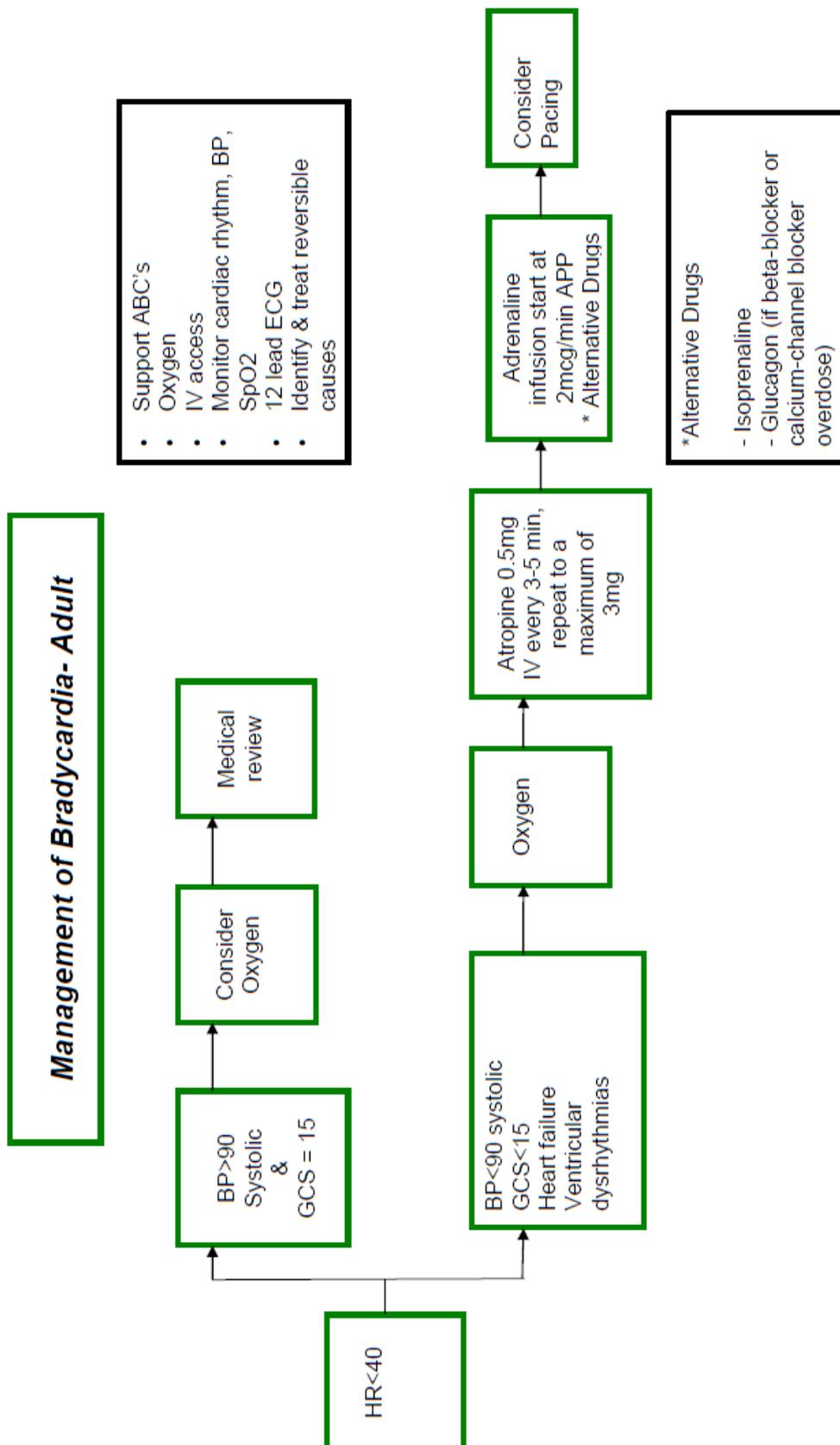


Fig.3. Bradycardia (Adult) Flowchart<sup>(1, 2)</sup>

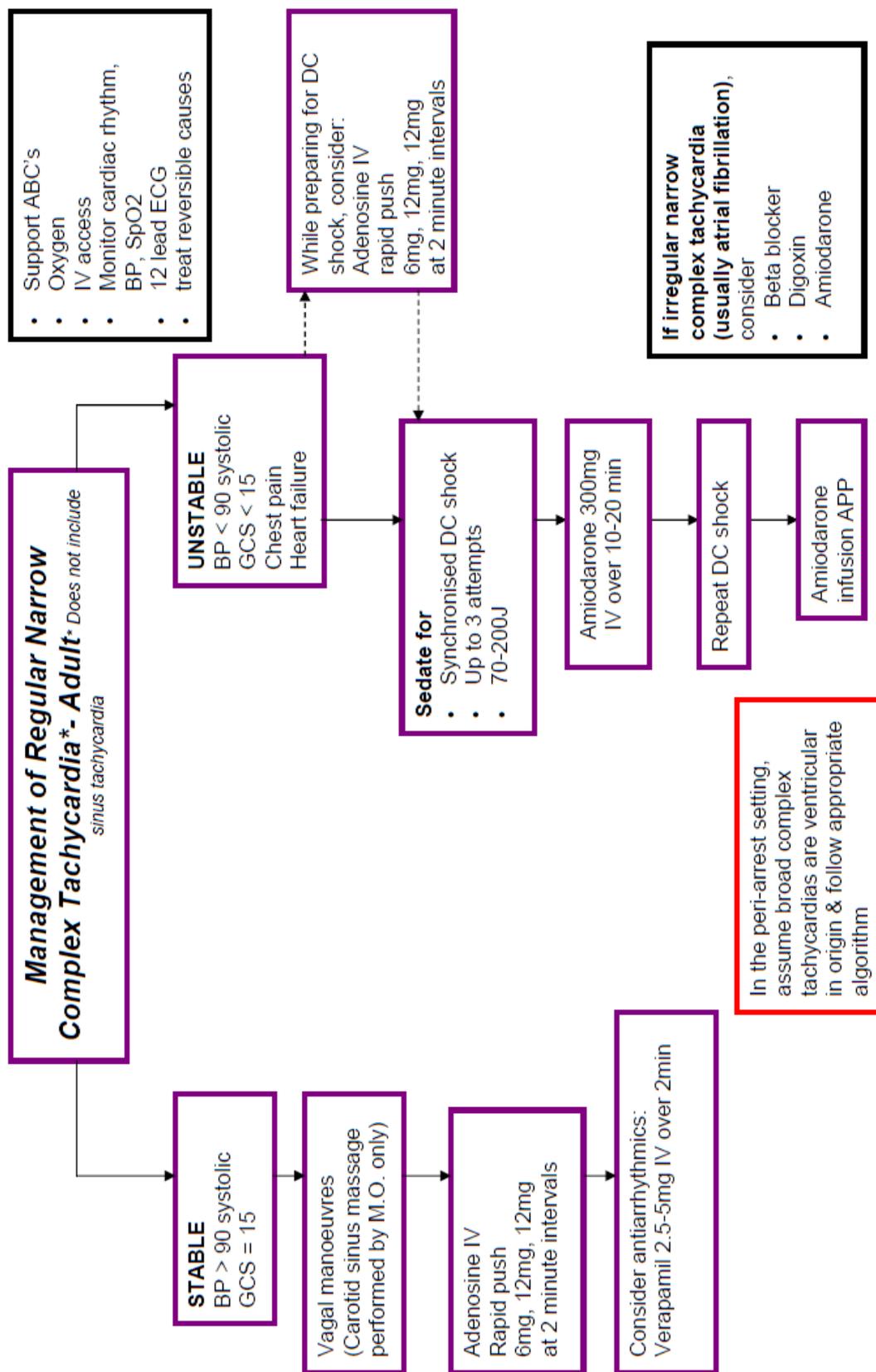


Fig.4. Regular Narrow Complex Tachycardia (Adult) Flowchart <sup>(1, 2)</sup>

# Rhythm Recognition

The cardiac rhythms of patients in cardiac arrest should be thought of as either “Shockable” or “Non-Shockable” (Fig. 1). The rhythms that require treatment with a direct current (DC) shock (defibrillation) are termed “Shockable” rhythms.

Note: All defibrillators now in use at Bendigo Health are biphasic waveform machines. The quoted energy levels in this package all refer to **biphasic defibrillators**.

## SHOCKABLE RHYTHMS:



The shockable rhythms are ventricular fibrillation (VF) and ventricular tachycardia (VT).

### Ventricular Fibrillation (VF) <sup>(1)</sup>

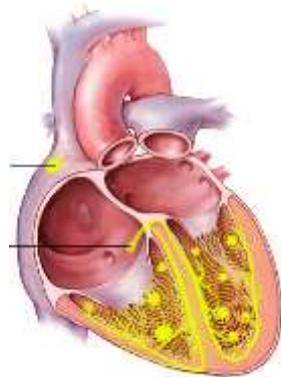


Fig.5. Ventricular Fibrillation (VF)

Ventricular Fibrillation, commonly called VF (or V-Fib), is an immediately life threatening condition. It produces no effective myocardial contraction. The uncoordinated ventricular muscle quivers, therefore there is no effective cardiac output. Left untreated VF invariably leads to ventricular standstill and death.

#### **What you see on the monitor:**

**Rhythm:** *indeterminate*

**Rate:** *indeterminate*

**Other:** *size of fibrillatory waves may be variable (fine → coarse)*

#### **Treatment:**

- Immediate defibrillation is performed in **witnessed, monitored** VT/VF, if a defibrillator is immediately available. If a defibrillator is not immediately available, CPR is performed until a shock is delivered. The rescuer delivers a shock, to the chest of the patient, to produce reversion of the VF, followed by 2 minutes of CPR.
- Rescuers will follow the *Advanced Life Support for Adults* flowchart (Fig. 1) on the ‘shockable’ loop of the chart.

### Ventricular Tachycardia (VT) <sup>(1, 2, 4)</sup>

Ventricular Tachycardia (VT) is defined as three or more premature ventricular contractions (PVC’s) in a row, with a rate above 100 bpm. VT is an unstable rhythm. It can occur in short bursts causing few or no symptoms. Alternatively it may be

sustained, becoming symptomatic and causing unconsciousness, loss of cardiac output and death.

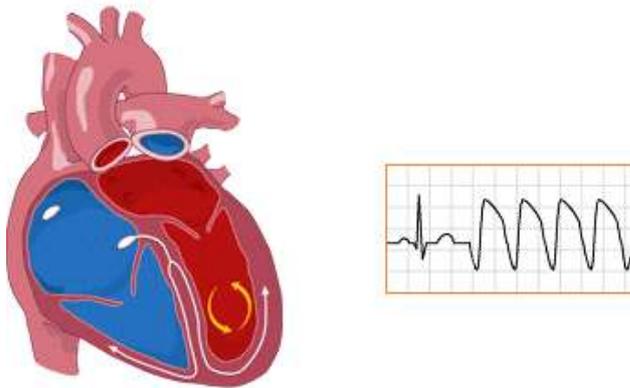


Fig.6. Ventricular Tachycardia

**What you see on the monitor:**

**Rhythm:** Regular or slightly irregular ventricular rhythm

**Rate:** Ventricular rate of 100 bpm or above.

**P wave:** absent or obscured by QRS complex

**QRS complex:** wide and bizarre, duration longer than 0.12 seconds.

**Treatment:**

- Treatment depends on whether the patient's pulse is detectable.

Therefore:

- A patient who is unresponsive and not breathing normally, with no palpable carotid pulse, is treated according to the *Advanced Life Support for Adults* flowchart (Fig. 1) on the 'shockable' loop of the chart.
- A patient with a palpable carotid pulse is treated according to the *Pulsatile Broad Complex Tachycardia – Adult* protocol (Fig. 2).



**In summary, for VT/VF cardiac arrest:**

CPR →



check rhythm is VT/VF & shock asap



CPR 2min



check rhythm is VT/VF & shock



Adrenaline + CPR 2min



check rhythm is VT/VF & shock



Amiodarone + CPR 2min



Check rhythm is VT/VF & shock



Adrenaline + CPR 2min .....

Rescuers must minimise interruptions to compressions, consider reversible causes, consider airway adjuncts (LMA/ETT) give oxygen, assess waveform capnography and plan actions before interrupting compressions.

### **NON SHOCKABLE RHYTHMS**

The cardiac rhythms that do **not** require treatment with a DC shock are termed “Non-Shockable” rhythms. These non-shockable rhythms are asystole and pulseless electrical activity (PEA).

#### **Asystole** <sup>(1)</sup>



*Fig.7. Asystole*

Asystole is the absence of myocardial electrical activity and therefore produces no cardiac output. The patient is pulseless and non-responsive. Rapid initiation of CPR and ALS measures is vital.

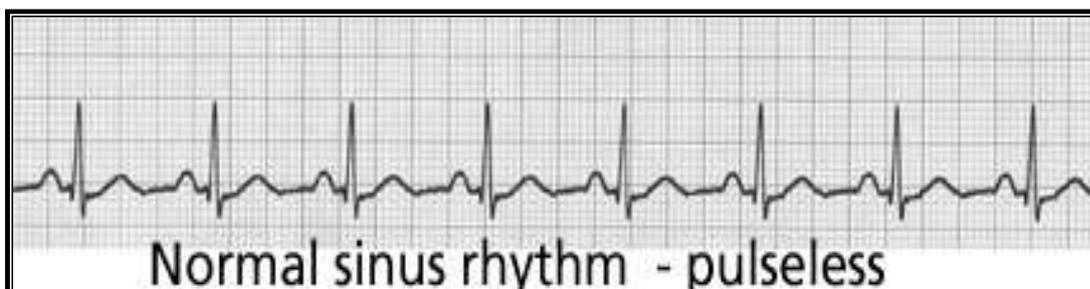
#### ***What you see on the monitor:***

*Asystole appears as a nearly flat line (except for those changes caused by chest compressions). No electrical activity is evident, although there may be P waves for a time. In a patient with a pacemaker, pacing spikes may be visible on the strip however no QRS complexes follow.*

#### **Treatment:**

- Assess the patient’s responsiveness, breathing (+/- carotid pulse check).
- Begin immediate CPR.
- Follow the *Advanced Life Support for Adults* flowchart (Fig. 1) on the ‘non-shockable’ loop of the chart.

#### **Pulseless Electrical Activity (PEA)** <sup>(1)</sup>



*Fig.8. PEA- Varying forms of coordinated electrical rhythm - no cardiac output*

Pulseless Electrical Activity (PEA) may also be termed Electromechanical Dissociation (EMD). It exists when there is a coordinated electrical rhythm (this includes a range of rhythms) without a detectable cardiac output. Potential causes must be sought and treated, including hypoxia, hyper/hypothermia, hypovolaemia, hyper/hypokalaemia, pulmonary/cardiac embolus, tension pneumothorax, cardiac tamponade, toxins, thrombus, acidosis and ventricular rupture.

**What you see on the monitor:**

*Organised electrical activity, often bradycardia, will be seen. Each case of PEA is unique and the rhythm seen on the monitor will therefore differ from case to case. However all patients with PEA will have no detectable cardiac output.*

**Treatment:**

- CPR
- Identify and treat underlying cause.
- Follow the *Advanced Life Support for Adults* flowchart (Fig. 1) on the 'non-shockable' loop of the chart.



**In summary, for non-shockable cardiac arrest:**

CPR 2min + Adrenaline



check rhythm, if non-shockable



CPR 2min



check rhythm, if non-shockable



Adrenaline + CPR 2min



check rhythm, if non-shockable

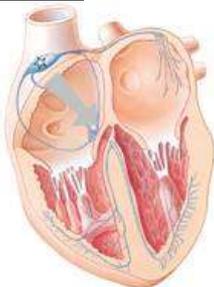


CPR 2min ....etc.

Rescuers must minimise interruptions to compressions, consider reversible causes, consider airway adjuncts (LMA/ETT) give oxygen, assess waveform capnography and plan actions before interrupting compressions.

**PULSATILE DYSRHYTHMIAS**

**Bradycardia** (1, 2, 3)



*Fig.9. Bradycardia*

Bradycardia is characterised by a ventricular rate below 60 beats per min.

**What you see on the monitor:** QRS complexes at a rate <60 bpm

**Treatment:**

- Assess for responsiveness, breathing +/-carotid pulse check. If absent, define as PEA and treat as above by commencing BLS measures.
- If the patient has a palpable carotid pulse, establish if bradycardia is associated with patient compromise (assess vital signs and initiate a Code Blue, MET or Clinical Review).
- Follow the *Bradycardia – Adult* protocol for heart rate <40 bpm (Fig. 3).

**Supraventricular Tachycardia (SVT)** (1, 2, 4)

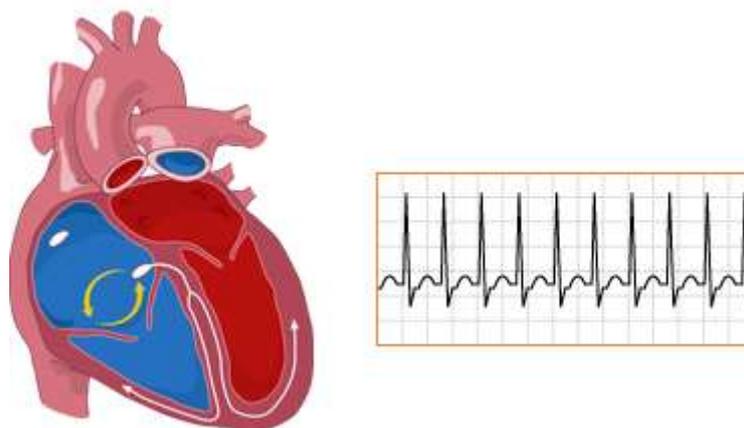


Fig.10. Supraventricular Tachycardia

Supraventricular tachycardia (SVT) is a general term that refers to those tachydysrhythmias where impulses originate at or above the AV node. This includes all sinus mechanisms, atrial rhythms and AV nodal rhythms. Narrow complex tachycardias, excluding sinus tachycardia, are treated as per the *Regular Narrow Complex Tachycardia – Adult* flowchart (Fig. 4). (Broad complex tachycardias are treated as VT until proven otherwise.)

**What you see on the monitor:**

**Rhythm:** Regular (irregular if rapid AF)

**Rate:** 160-250 bpm

**P wave:** Present, however may not be visible with higher rates

**PR interval:** May be normal, but is difficult to measure

**QRS complex:** If the QRS complex is truly narrow in all 12 leads then the rhythm must be SVT

**Treatment:**

- Per *Regular Narrow Complex Tachycardia – Adult* protocol (Fig. 4).

**Ventricular Tachycardia (VT)** (1, 2, 4)

As outlined in the section on shockable rhythms, Ventricular Tachycardia (VT) is defined as three or more premature ventricular contractions (PVC's) in a row, with a rate above 100 bpm. VT may be pulsatile but is an unstable rhythm. It can occur in short bursts causing few or no symptoms. Alternatively it may be sustained, becoming symptomatic and causing unconsciousness, loss of cardiac output and death.

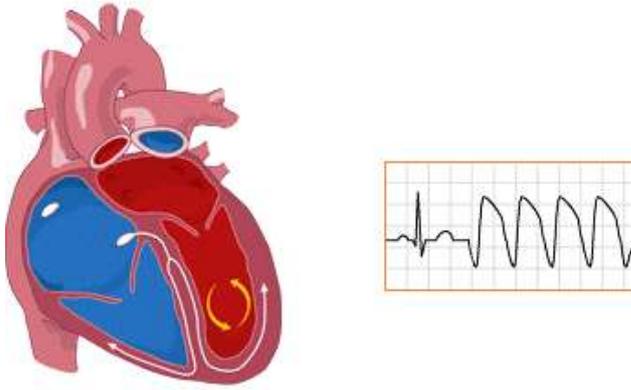


Fig.6. Ventricular Tachycardia

**What you see on the monitor:**

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**Rate:** Ventricular rate of 100 bpm or above.

**P wave:** absent or obscured by QRS complex

**QRS complex:** wide and bizarre, duration longer than 0.12 seconds.

**Treatment:**

- Treatment depends on whether the patient's pulse is detectable.

Therefore:

- A patient who is unresponsive and not breathing normally, with no palpable carotid pulse, is treated according to the *Advanced Life Support for Adults* flowchart (Fig. 1) on the 'shockable' loop of the chart.
- A patient with a palpable carotid pulse is treated according to the *Pulsatile Broad Complex Tachycardia – Adult* protocol (Fig. 2).

## Direct Current Reversion

Direct current reversion (DCR) refers to electrical therapies that utilize a direct current, i.e. **defibrillation** and **cardioversion**, to treat cardiac arrhythmias <sup>(4)</sup>. All ALS competent healthcare professionals <sup>(3)</sup> must be able to safely perform defibrillation for patients in VT/VF cardiac arrest using a manual defibrillator (Fig. 11). With a manual defibrillator, the rescuer must diagnose the patient's rhythm <sup>(1)</sup>. (Relevant, specific ALS clinicians must also be able to safely perform synchronised cardioversion for pulsatile VT and SVT when indicated <sup>(3)</sup>.)



Fig.11. Defibrillators that operate in manual or AED mode

### Factors affecting successful DCR <sup>(1, 5)</sup>

The aim of DCR is to deliver sufficient energy with the lowest possible electrical current that will pass through the chest wall to the myocardium and revert the presenting arrhythmia. Two factors affect current flow through the heart. Successful DCR requires selecting an appropriate energy to generate an adequate current flow. Too much current to the myocardial cells will cause damage to the cells and result in unsuccessful DCR, too little current and the cells will fail to depolarise. Therefore, the 'threshold' is the minimum amount of current required to achieve successful DC reversion. The second factor, which effects successful DCR, is thoracic impedance, or resistance to current flow through the body. It is influenced by:

- Energy level selected
- Pad size
- Pad position
- The number of shocks the patient has received
- The amount of skin, fat, bone and lungs

### Use of self-adhesive pads or paddles <sup>(1)</sup>

Self-adhesive defibrillation pads have advantages compared with hand held defibrillation paddles, ie. Pads can be charged during compressions and can be used for transcutaneous pacing.

### Pad placement <sup>(1)</sup>



One uncharged self-adhesive pad is placed on the left mid axillary line over the 6<sup>th</sup> intercostal space and the other on the right parasternal area over the 2<sup>nd</sup> intercostal space (Fig. 12).



Fig.12. Anterior placement of paddles or electrodes

Alternatively, self-adhesive pads may be placed in the anterior-posterior position (Fig. 13.) where the “sternum” pad is placed anteriorly over the precordium and the “apex” self-adhesive pad is placed posterior to the heart in the infrascapular area.

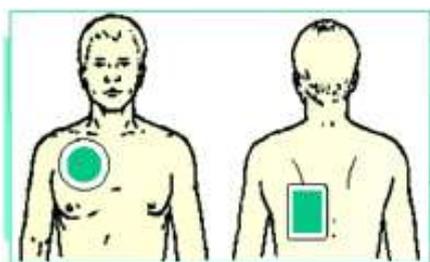


Fig.13. Anterior-posterior pad placement

- Ensure skin is clean and dry
- If paddles are being used, they require firm pressure applied during DCR to ensure good contact
- If performing DCR on a patient with a permanent pacemaker or implantable cardioverter defibrillator (ICD), *if feasible*, place the pads at least 8cm from the device generator, as DCR may cause damage to the device. Pacemaker and ICD functions should be checked following DC reversion.



#### Safety during DCR <sup>(1, 5)</sup>

- Ensure no flammable material, oxygen, fluids or metal objects are in contact with the patient.
- Do not charge pads unless they are placed on the victim’s chest.
- Do not place pads over ECG dots (risk of poor contact, burns or sparks), ECG leads (may melt), medication patches or implantable devices (pacemaker, ICD, port-a-cath, central line).
- Do not deliver shocks with a gap between the pad and the chest wall (spark hazard).
- Do not discharge or wave pads in the air whilst charged.
- Ensure self and all others are clear of danger before discharging.
- When self-adhesive pads are used, CPR can be performed during charging. Always vocalize intent to charge pads. State “**charging defibrillator**”, in a loud voice.
- If a shock is required, the operator states, “**stand clear, shocking**” in a loud voice and ensures that CPR has stopped, no one is in contact with the patient and **visually checks** that all present are clear of the patient and bed prior to shock delivery. More details are given below.

## DEFIBRILLATION



Defibrillation refers to the **emergency** application of a high energy electrical current through the chest to the myocardium in the arrested patient in VT/VF.

Information regarding defibrillation using an AED was discussed in Section 2 'Basic Life Support'. However, defibrillation can also be achieved manually by an ALS competent operator.

The aim of defibrillation is to produce a simultaneous depolarisation of all the rhythm generating and transmitting cells within the heart allowing one of the normal, "intrinsic" pacemakers to take over and re-establish a stable rhythm <sup>(1, 5)</sup>.

### Indications <sup>(1)</sup>

In accordance with the Advanced Life Support for Adults Flowchart (Fig. 1), defibrillate:

- Ventricular Fibrillation (VF)
- Pulseless Ventricular Tachycardia (VT)

### Background <sup>(1)</sup>

A key factor that influences the patient's chances of survival is the time to defibrillation.

### Energy levels <sup>(1)</sup>

Biphasic machines: **200J**

Other energy levels may be used where a manufacturer of a defibrillator can demonstrate >90% shock success, in line with ANZCOR requirements. **If the first shock is not successful and the defibrillator is capable of delivering shocks of higher energy, it is reasonable to increase the energy to the maximum available for subsequent shocks.**

### Sequence for defibrillation <sup>(1)</sup>

In VT/VF, CPR must be commenced immediately. As soon as a defibrillator becomes available, the rescuer delivers a single shock. CPR must be provided if there is a delay obtaining a defibrillator. The shock is followed by 2 minutes of CPR, regardless of the rhythm. If still in VT/VF, single shocks are delivered every 2 minutes. Effective BLS will increase the likelihood of successful defibrillation.



**Patients in VT/VF must receive cycles of 2 minutes of CPR followed by a single shock** (Fig. 14).

During CPR, ALS interventions such as adrenaline (a vasopressor) and antiarrhythmic drugs are given and causes of arrest are sought and treated.



**Minimise interruptions to chest compressions <sup>(1)</sup>.**

## MANUAL DEFIBRILLATION TECHNIQUE <sup>(1, 6)</sup>

Confirm the patient is unresponsive and not breathing normally → CPR

↓  
Chest compressions continue &  
apply chest pads

↓  
Turn defibrillator on

↓  
Announce

**“Prepare for rhythm check”**

**“Compressions continue”**

**“Oxygen away”**

**“All others away”**

↓  
Call – **“Charging to 200J”**,

Charge defibrillator to 200J

↓  
Call- **“Hands off” or “Stand clear”**

**“Evaluating rhythm”**,

With compressions off, evaluate rhythm

↓  
Defibrillate or disarm

↓  
If shockable call

**“Shockable rhythm, Stand clear”**

**“Shocking”**

Scan the bed area to ensure that all rescuers  
are clear of the bed and  
not in direct contact with the patient

↓  
Discharge the shock for VT/VF

↓  
Recommence CPR, regardless of rhythm

↓  
If non-shockable call

**“Non- shockable, disarming”**

Assess carotid pulse  
Continue CPR if required

As above, the mnemonic **“COACHED”** may assist rescuers to recall the order of events during defibrillation <sup>(6)</sup>:

**C**ontinue compressions

**O**xxygen away

**A**ll others away

**C**harging only

**H**ands off

**E**valuate rhythm

**D**efibrillate or disarm



**It is vital that 2 minutes of CPR commence after a shock, regardless of the rhythm.** The patient is then reassessed and treatment is directed as necessary <sup>(1)</sup>.

Performing compressions on a victim with a beating heart is unlikely to do harm <sup>(1)</sup>. Indeed, most victims will have a non-perfusing rhythm for the first minutes after successful defibrillation. Therefore, 2 minutes of CPR is required after defibrillation.

### Failure to defibrillate <sup>(1, 5, 7)</sup>

- Recommence CPR
- Check pad connections are firm
- Check pad position
- Check that there is adequate skin contact
- Consider changing the defibrillator gel pads
- Check for flat battery, plug into power source
- Check that the synchronise mode has not been activated for defibrillation
- Check for lead fracture
- Check pads expiration date and avoid using damaged pads.
- Check that excessive chest hair is removed prior to applying pads.

### Failure to revert <sup>(1, 5, 7)</sup>

Consider:

- Anterior/posterior pad placement
- Acidosis
- Electrolyte imbalance
- Hypothermia
- Hypoglycaemia
- Digoxin toxicity
- Prolonged arrest

## CARDIOVERSION

Cardioversion <sup>(2, 4, 5)</sup> refers to the application of an electrical shock to the myocardium. However, rather than the electrical current being applied at a random point in the cardiac cycle, it is **synchronised** with the patient's R-wave on the ECG waveform. There is a danger that if DC reversion is applied during the vulnerable repolarization period of the cardiac cycle (i.e. period that immediately precedes the apex of the T wave) it may trigger ventricular fibrillation! By synchronizing the shock with the R-wave of the patient's ECG, this vulnerable period may be avoided.

Synchronisation with the ECG can be achieved by applying the defibrillator monitor leads to the patient or by using a "slave cable" (auxiliary cable) between the cardiac monitor and the defibrillator. The patient's ECG must be visible on the defibrillator monitor in order to synchronise.



**The machine must be synchronous with the R-wave to safely revert pulsatile VT and SVT.**

### Indications <sup>(2, 4, 5)</sup>

- Pulsatile VT (Refer to Fig. 2)
- Atrial fibrillation (Refer to Fig. 4)
- Atrial Flutter (Refer to Fig. 4)
- Supraventricular tachycardia (Refer to Fig. 4)



**As the patient usually remains conscious with these arrhythmias, adequate sedation must be delivered prior to the procedure.**

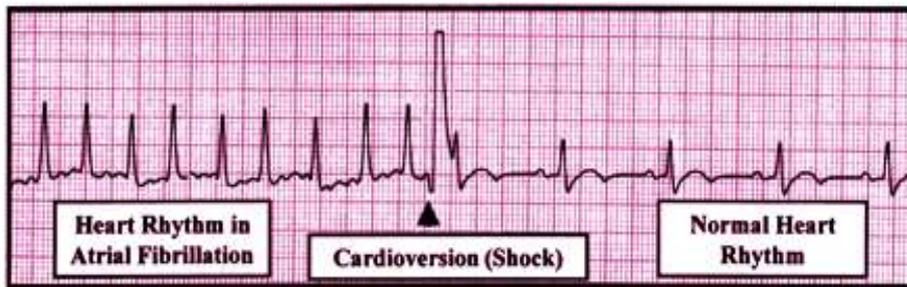
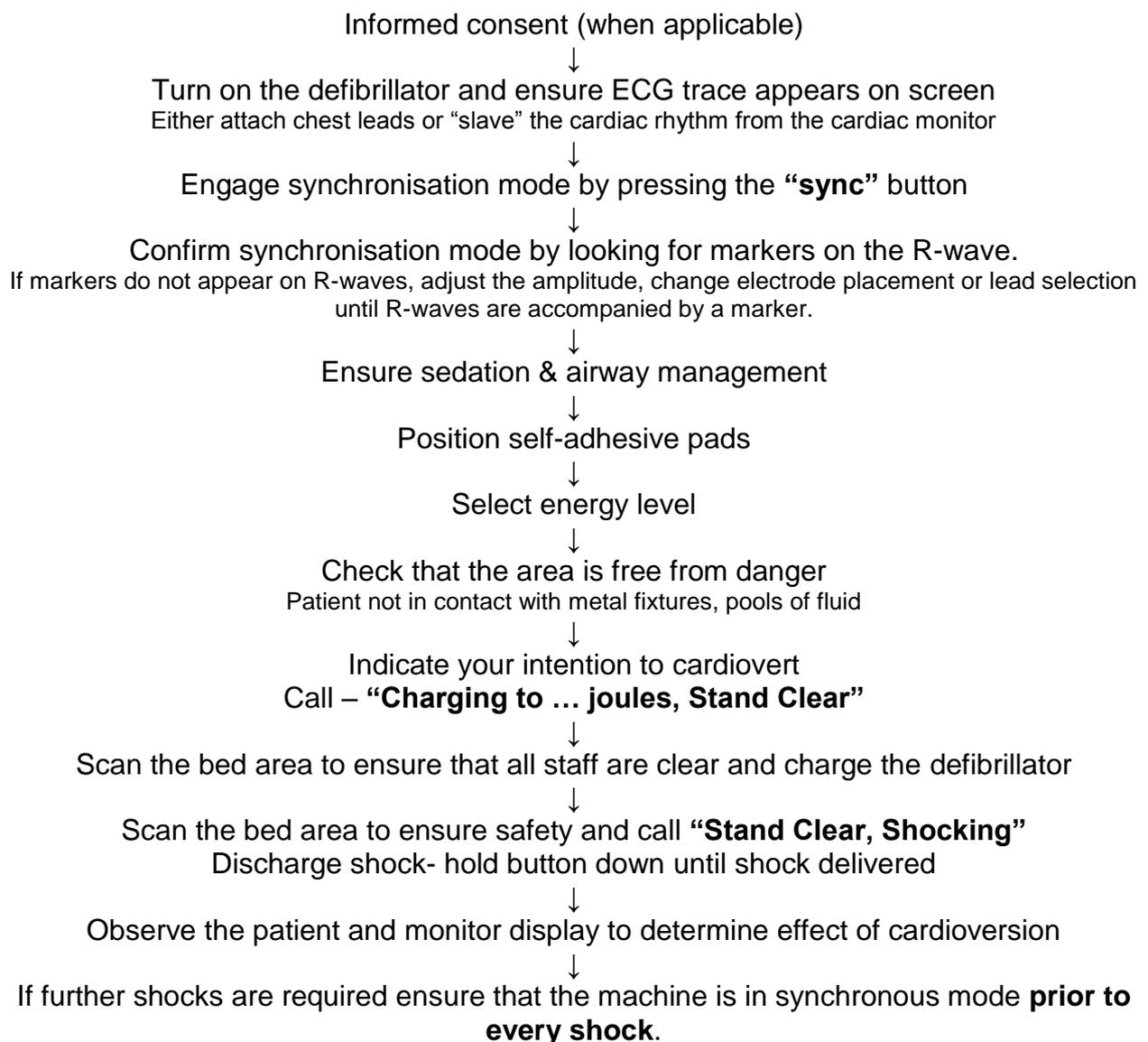


Fig.14. Successful cardioversion

**Contraindications** <sup>(5, 7)</sup>

- Hypo/hyperkalaemia
- Complete heart block
- Sick sinus syndrome
- Digoxin Toxicity
- Chronic AF (> than 6 months duration)

**SYNCHRONOUS CARIOVERSION TECHNIQUE** <sup>(5)</sup>



## **Energy levels** <sup>(2)</sup>

Energy levels are prescribed by the senior treating doctor and usually fall into the ranges below.

<i>Energy Levels</i>	:	VT with a pulse	70 – 200J up to 3 attempts
		SVT	70 – 200J up to 3 attempts

## **Successful discharge of shock** <sup>(1)</sup>

In synchronous cardioversion, during discharge of the shock the machine quickly 'searches' for the first R-wave to occur. It may be necessary for the operator to hold the discharge button down for a couple of seconds until an R-wave is detected and the shock discharged by the machine. This can seem like a short delay. Proof that the shock has been delivered to the patient is evidenced by muscle spasm.

## **Potential complications of DC reversion** <sup>(7)</sup>

- Myocardial ischaemia, cardiac enzyme elevations and arrhythmias due to myocardial damage associated with high energy shocks.
- Respiratory arrest
- Burns to the skin
- Pulmonary oedema
- Hypotension
- Emboli formation

# Pharmacology

The following is only a brief guide to the use of ALS drugs. Prior to use or for more information, comprehensive texts, product information and other sources must be consulted.



**In cardiac arrest, in the absence of a medical officer, ALS competent Registered Nurses (RNs) and Registered Midwives (RMs) employed at a health service in Victoria may administer the Schedule 4 poisons adrenaline and amiodarone consistent with ANZCOR Guidelines per Department of Health Secretary Approval and consistent with Regulation 5(3) of the Drugs, Poisons and Controlled Substances Regulations 2006, without an order from a medical officer.**<sup>(8)</sup>



**All IV drugs delivered via a peripheral cannula to the arrested or hypotensive adult patient must be followed by at least 20-30mL IV fluid flush**<sup>(1)</sup>.

## FIRST LINE DRUGS IN CARDIAC ARREST<sup>(1, 2, 9)</sup>

### ADRENALINE<sup>(1, 2, 9)</sup>

**Action:** Adrenaline is a powerful cardiac stimulant. Increased cardiac output is achieved by an increase in myocardial rate and contractility ( $\beta$  effects). Adrenaline is a potent alpha-receptor activator. The  $\alpha$  - adrenergic effect of vasoconstriction shunts peripheral blood supply to the central circulation, therefore improving coronary artery blood flow.

**Pharmacokinetics:** When administered IV, adrenaline has a rapid onset and short action duration. The drug is metabolised by the liver and other tissues, however the majority is taken up and metabolised by sympathetic nerve endings.

#### Presentation:

Pre-filled syringe	1mg in 10mL (1:10,000)	(clear colourless solution)
Ampoules	1mg in 1 mL (1:1000)	
	1mg in 10mL (1:10,000)	

**Dose:** 1 mg

**Route:** IV, IO or ETT

#### Frequency:

Shockable rhythms, deliver after the 2<sup>nd</sup> shock and then every 4 minutes during cardiac arrest.

Non-shockable rhythms, deliver immediately and then every 4 minutes during cardiac arrest.

#### Adverse effects:

Cardiovascular: Pallor, palpitations, hypertension, ventricular arrhythmias, myocardial infarction.

Respiratory: Respiratory difficulty, pulmonary oedema,

CNS: Fear, anxiety, tenseness, restlessness, headache, tremor, weakness, dizziness, cerebrovascular haemorrhage, convulsions, rigidity and tremor may be exacerbated in parkinsonian patients.

<u>Integumentary:</u>	Tissue necrosis at injection site.
<u>Renal:</u>	Renal failure with anuria
<u>Metabolic:</u>	Metabolic acidosis, elevated serum glucose,
<u>Other:</u>	Psychiatric disorders may be exacerbated.

**Contraindications:**

- Arterial or intracardiac administration.

**AMIODARONE** (1, 2, 9)

**Action:** Amiodarone is a class III antiarrhythmic that prolongs the action potential duration and hence the refractory period of atrial, nodal and ventricular tissues. Amiodarone also increases coronary blood flow, decreases cardiac oxygen requirements without producing negative inotropic effects, and suppresses ectopic pacemakers.

**Pharmacokinetics:** The half-life of amiodarone is long, usually in the range of 14 to 59 days. Amiodarone appears to accumulate in adipose tissue and in highly perfused organs (lung, bone marrow, adrenals, liver, pancreas, heart, spleen and kidney).

**Delivery:** In VT/VF after the 3<sup>rd</sup> shock.

**Dose in cardiac arrest:** 300mg in 10-20mL of 5% glucose bolus over 1-2 minutes in VT/VF. This may be followed by an additional dose of 150mg.

**Dose in pulsatile VT or SVT:** infuse dose, usually 300mg, over 10-20 min if unstable or 20-60 min if stable (per Fig. 2 *Pulsatile Broad Complex Tachycardia Flowchart* and per Fig. 4 *Regular Narrow Complex Tachycardia Flowchart*).

**Route:** IV or IO in emergency then oral maintenance

**Presentation:** 150mg/3mL ampoules (clear pale yellow solution)

**Adverse effects:**

Cardiovascular: Moderate and transient reduction in BP. Circulatory collapse may be precipitated by rapid administration or over dosage. Torsades de pointes, bradycardia, exacerbation of cardiac failure, sinus arrest.

CNS: Tremor, insomnia, headaches, dizziness, vertigo, fatigue, vivid dreams, paraesthesia, gait abnormalities and abnormal nerve conduction.

Respiratory: Cases of pulmonary toxicity have been reported. Bronchospasm.

GIT: Temporary nausea, vomiting, constipation, salty or metallic taste in the mouth.

Metabolic: Abnormal liver function tests, abnormal thyroid function tests.

Integumentary: Photosensitivity, bluish skin discoloration, erythema, hair loss.

Other: Hot flushes and sweating, weight gain.

**Contraindications:** Bradycardia and AV block with syncope, sick sinus syndrome, severe conduction disorder (unless pacemaker insitu), sinus bradycardia, sinoatrial heart block, hypersensitivity to iodine, thyroid dysfunction, hypotension, severe respiratory failure, myocardopathy, heart failure, circulatory collapse, severe arterial hypertension, pregnancy, lactation.

## PERI-ARREST & SECOND LINE CARDIAC ARREST DRUGS

### ADENOSINE <sup>(1, 2, 9)</sup>

**Action:** Adenosine inhibits conduction through the AV node. The action interrupts the re-entry circuits of aberrant tachycardic electrical activity through the AV node therefore re-establishing sinus rhythm. It is indicated in the treatment of SVT.

**Pharmacokinetics:** IV adenosine is removed from the circulation very rapidly with the half-life estimated to be less than 10 seconds. Therefore, adenosine and a subsequent IV flush, need to be administered rapidly.

**Presentation:** Ampoule, 6mg/2mL

**Dose:** 6mg, then 12mg, then 12mg (per Fig. 4 *Regular Narrow Complex Tachycardia – Adult Flowchart*)

**Route:** IV adenosine administered via rapid IV injection into a large vein, immediately followed by a 20-30mL flush. Can also be administered IO.

**Frequency:** Deliver at increased dose after 2 min if cardioversion does not occur.

#### **Adverse effects (usually transient):**

Cardiovascular: Bradycardia, hypotension, facial flushing, headache, sweating, palpitations & chest pain.

Respiratory: Bronchoconstriction, dyspnoea, chest pressure, hyperventilation.

Central Nervous System: Light-headedness, dizziness, tingling in arms, numbness, apprehension, blurred vision, burning sensation, heaviness in arms, neck and back.

Gastrointestinal: Nausea, metallic taste, tightness in throat, pressure in groin.

**Warning:** ***Cases of prolonged asystole, ventricular tachycardia, ventricular fibrillation, transient increase in BP and bronchospasm have been reported in conjunction with adenosine use.***  
***Used with caution in asthmatics as it may cause bronchospasm.***

#### **Contraindications:**

- Known hypersensitivity to adenosine
- Second or third degree atrioventricular block (except in patients with a functioning artificial pacemaker).
- Sick Sinus Syndrome

### ATROPINE <sup>(1, 2, 9)</sup>

**Action:** An anticholinergic agent that competitively inhibits the muscarinic actions of acetylcholine. It induces a parasympathetic blockade, allowing the sympathetic nervous system effects to dominate; thus increasing heart rate, reducing secretions and gastrointestinal tone, also pupil dilation. Indicated in bradyarrhythmias.

**Pharmacokinetics:** With intravenous administration, increased heart rate effect peaks within 2-4 minutes. Serum levels of atropine drop rapidly within the first 10 minutes and then decrease more gradually. Atropine is metabolised by the liver. Approximately 30-50% of the dose is excreted in the urine unchanged.

**Dose:** 0.5mg increments to a total of 3mg (per Fig.3 *Bradycardia Flowchart*).  
Doses 500-600 microg are consistent with ANZCOR Guidelines.

**Route:** IV, IO or ETT

**Presentation:** Ampoules 600 micrograms in 1mL

**Frequency:** each 3-5 minutes

**Adverse effects:**

Cardiovascular: Tachycardia and palpitations, possible atrial arrhythmias, atrioventricular dissociation, multiple ventricular ectopic beats and angina

CNS: Thirst, dryness of mouth, dilatation of pupils, blurred vision, photophobia, tremor, headache, nervousness, drowsiness, weakness, insomnia and fatigue, hallucinations, delirium.

Renal: Urinary difficulty and retention

GIT: Constipation.

Integumentary: Flushing, dryness of skin.

**Contraindications:** Severe ulcerative colitis, toxic megacolon, GI obstruction, closed angle glaucoma, obstructive uropathy, myasthenia gravis, tachycardia due to cardiac insufficiency or thyrotoxicosis, acute haemorrhage with unstable cardiovascular status, fever, high ambient temperature, prostate enlargement, pregnancy induced hypertension.

## LIGNOCAINE

**Action:** Lignocaine is a class 1B antiarrhythmic. Lignocaine stabilises the neuronal membrane and prevents the initiation and transmission of nerve impulses. Lignocaine is a sodium channel blocker. Lignocaine is indicated when amiodarone cannot be used in pulsatile VT, and in VT/VF arrest, not responsive to defibrillation.

**Pharmacokinetics:** In the heart, lignocaine reduces automaticity by decreasing the rate of diastolic depolarisation. The duration of the action potential is decreased to the blockade of the sodium channel and the refractory period is shortened. Lignocaine is distributed rapidly to all body tissues, with a half-life of 1.6 hours. About 80% of the dose is metabolised by the liver, less than 10% is excreted via the kidneys. ***If a successful bolus dose is administered, ongoing lignocaine infusion must be considered.***

**Dose:** 1mg/kg, usually 50-100 mg

**Route:** IV, IO or ETT

**Presentation:**

Ampoules 100mg/5mL

**Frequency:** If arrhythmia persists after 15-30 minutes, a second dose of 0.5mg/kg may be given.

**Adverse effects:**

CNS: light-headedness, drowsiness, dizziness, apprehension, euphoria, tinnitus, blurred vision, sensations of cold or numbness, difficulty swallowing, slurred speech, convulsions, unconsciousness,

Cardiovascular: hypotension, arrhythmias and heart block, bradycardia,

Respiratory: dyspnoea, respiratory depression

GIT: vomiting;

Other: increased energy levels may be required for defibrillation, anaphylaxis.

**Contraindications:** Stokes-Adams syndrome, myasthenia gravis, severe shock, impaired cardiac conduction, serious CNS diseases.

## MAGNESIUM SUPHATE (MgSO<sub>4</sub>)

**Action:** Essential electrolyte for cell membrane stability. Considered 2<sup>nd</sup> line in VT/VF.

**Dose:** 5mmol

**Route:** IV or IO slow bolus over 2 minutes during cardiac arrest

**Presentation:** 10mmol in 5 mL

**Adverse effects:** Hypermagnesaemia – nausea, vomiting, flushing, hypotension, muscle weakness, muscle paralysis, blurred or double vision, CNS depression, and loss of reflexes. More severe hypermagnesaemia may result in respiratory depression, respiratory paralysis, renal failure, coma, cardiac arrhythmias and cardiac arrest. Use with caution in patients receiving digitalis.

### **POTASSIUM CHLORIDE (KCl)**

**Action:** Potassium is an essential electrolyte in intra and extracellular physiological function. Hypokalaemia can disrupt electrical and mechanical cardiac function. Indicated in arrhythmias with  $Se K^+ < 4.0$  and considered 2<sup>nd</sup> line in VT/VF.

**Dose:** 5mmol

**Route:** IV or IO

**Presentation:** 10mmol in 10mL

**Delivery:** bolus of 5mmol

**Adverse effects:** Flaccid paralysis, listlessness, mental confusion, weakness and heaviness of legs, fall in BP, cardiac arrhythmias and heart block, nausea, vomiting, diarrhoea and abdominal discomfort, hyperkalaemia with ECG changes e.g. peaked T-waves, VF, ventricular standstill.

### **SODIUM BICARBONATE (NaHCO<sub>3</sub>)**

**Action:** Sodium Bicarbonate buffers excess hydrogen ions and therefore raises blood pH. Considered 2<sup>nd</sup> line in cardiac arrest, but early efficient CPR with adequate ventilation negates its need. Routine administration in cardiac arrest is not recommended.

**Dose:** 1 mmol/kg

**Route:** Slow IV or IO injection over 2-3 minutes.

**Presentation:** 100mmol in 100mL glass infusion vial

**Adverse effects:** Alkalosis, hypokalaemia, hyperirritability or tetany, vascular irritation, acidosis with inadequate ventilation, extravasation of hypertonic sodium bicarbonate solution has been reported to cause chemical cellulitis and ulceration.

### **VERAPAMIL**

**Action:** Anti-arrhythmic action by prolonging impulse conduction in the AV node. Inhibits calcium ion influx and the decrease of the vascular smooth muscle tone prevents coronary spasms and lowers raised blood pressure. It is indicated 2<sup>nd</sup> line in SVT.

**Dose:** 1mg/min to a maximum of 10mg

**Route:** IV or IO

**Presentation:** 5mg/2mL ampoules

**Adverse effects:** Hypotension, AV block, bradycardia, asystole, myocardial insufficiency, elevation of the pacing and sensing threshold in pacemaker wearers, frequently causes nausea, bloating, constipation. May cause headache, nervousness, dizziness, fatigue, sensory disturbances.

## VASCULAR ACCESS

### PERIPHERAL IV

Access the circulation via a large bore IV cannula in a large vein situated above the diaphragm <sup>(1)</sup>.

### CENTRAL VENOUS CATHETER (CVC) <sup>(1)</sup>

If a central venous catheter (CVC) or Peripherally Inserted Central Catheter (PICC line) is available and functioning, then this should be used for as it provides more rapid drug delivery. Insertion of a new CVC or PICC should not be attempted whilst CPR is in progress.

### INTRASOSEOUS (IO) DRUG ADMINISTRATION <sup>(1, 10)</sup>

If IV access cannot be achieved within 1 minute in the arrested patient, intraosseous (IO) vascular access should be obtained. Intraosseous access can be obtained with the use of an intraosseous drill or other intraosseous access device. With infants, due to softer bones, IO access can be obtained manually with an intraosseous needle (or with a powered intraosseous access device). All IV medications, IV fluids and blood products can be delivered via the IO route. Tibial and humeral sites are usually readily accessible.

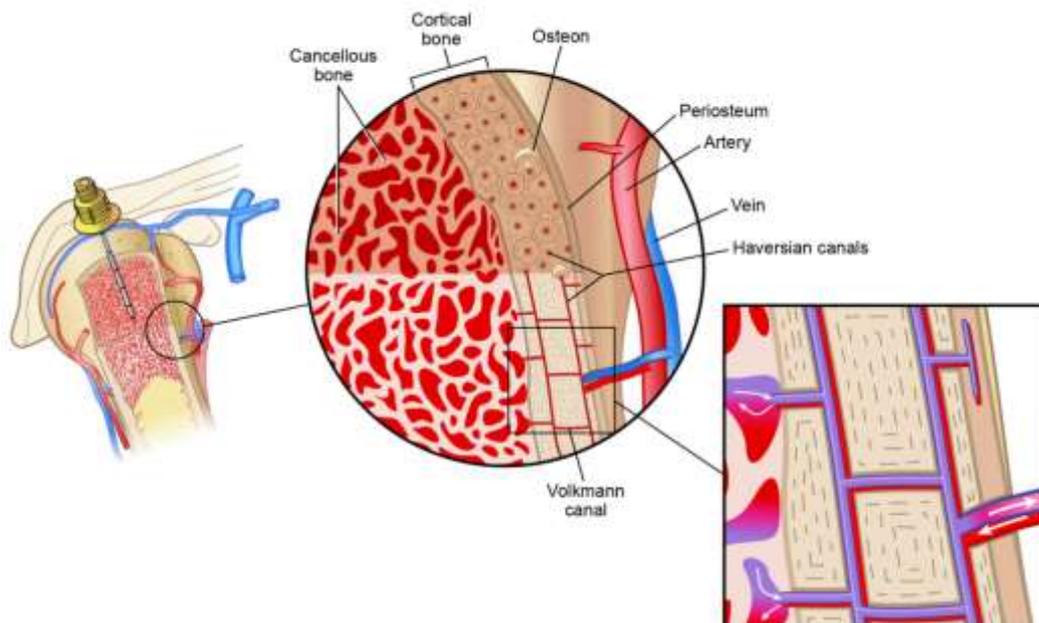


**Intraosseous access is quickly obtained with the use of an IO drill.**

### Intraosseous vascular access <sup>(10)</sup>

The following is only a brief guide to the use of intraosseous vascular access. Prior to use or for more information, comprehensive texts, product information and other sources (such as the iLearn module when available) must be consulted.

Intraosseous access (IO) is the process of injecting directly into the marrow of a bone to provide a non-collapsible entry point into the systemic venous system (Fig. 15). This technique is used in emergency situations to provide fluids and medication when intravenous access is not available or not feasible. Bone marrow has a rich blood supply and forms part of the peripheral circulation. Insertion of an intraosseous cannula into the bone marrow provides valuable access through which all IV drugs and fluids may be given.



*Fig. 15. The IO needle is inserted into bone marrow*

The needle is inserted perpendicular to the bone surface using an IO access device to traverse through the cortex. A loss of resistance signals entry into the bone marrow and the position is confirmed either by aspiration of bone marrow or injection of saline without extravasation. Various brands of intraosseous drills and needles are available. The example illustrated is a drill available at Bendigo Health (Fig 16).

Select the needle size by estimating the soft tissue depth using your finger.

Pink Needles – Small (15mm)

Blue Needles – Medium (25mm)

Yellow Needles – Large (45mm)

The 45mm needle should be considered in all proximal humerus insertions in patients >40kg.



Fig. 16. Intraosseous drill and needles

### Insertion sites

Suitable sites are outlined below (Fig. 17).

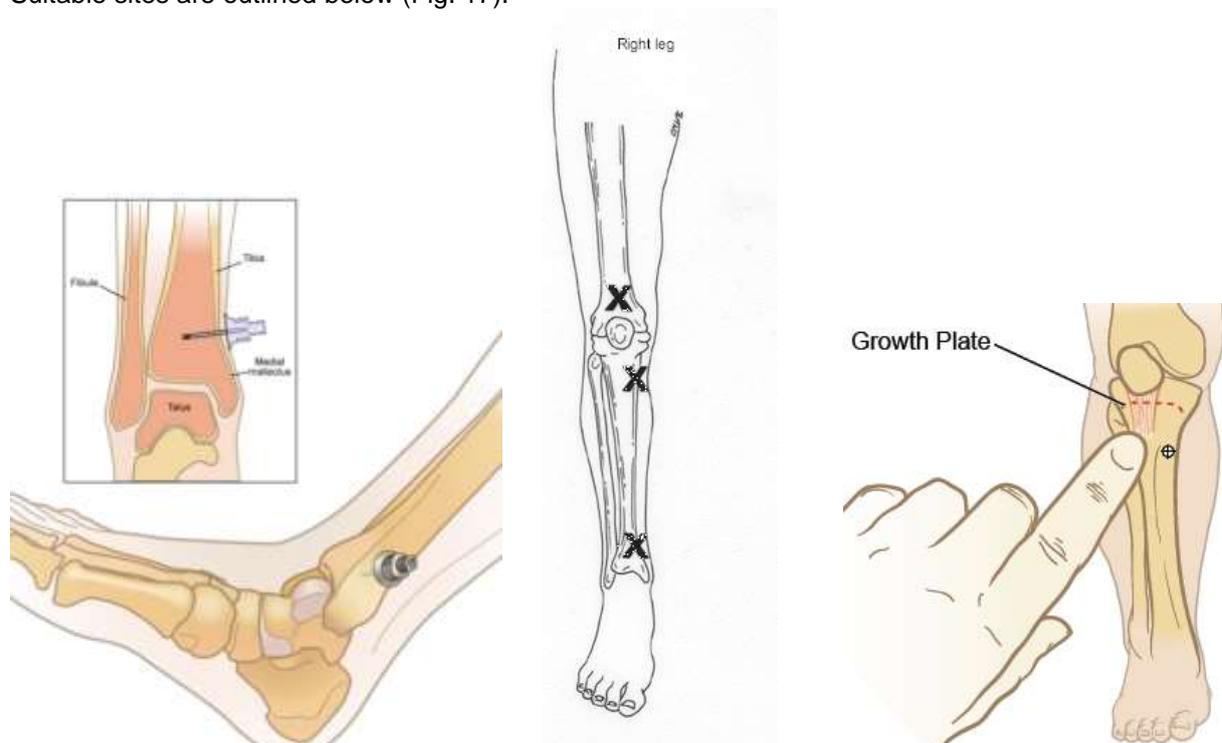


Fig. 17. Lower limb insertion sites for IO access

### Proximal Tibia:

Adults- 3cm below the patella, 2cm medial to the tibial tuberosity, on the flat aspect.

Infants and small children- 1cm below the patella, 1cm medial to the tibial tuberosity, on the flat aspect.

Distal Tibia:

Adults- 3cm above the medial malleolus, avoiding the saphenous vein.

Infants and small children- 1-2cm above the medial malleolus, avoiding the saphenous vein.

Distal femur:

Infants and small children- 2-3cm above patella, midline, use this site for infants and children only.

Proximal humerus:

In adults it is prudent to use a site above the diaphragm in the arrested patient, i.e. the proximal humerus as follows:

**Insertion**

Obtain drill and attach needle

Place the patient's hand over the abdomen

Locate the head of the humerus, which feels like a ball

Place one hand vertically over the axilla (Fig. 18)



*Fig. 18. Place one hand vertically over the axilla*

Place the opposite hand along the midline of the upper arm laterally (Fig. 19)



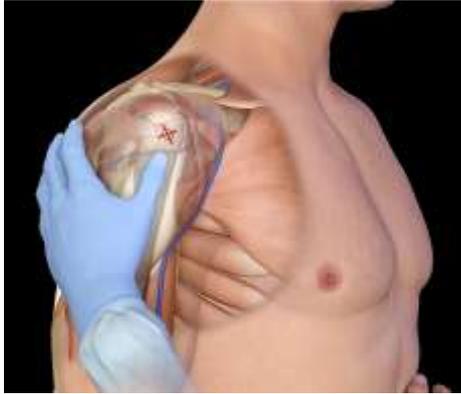
*Fig. 19. Locate the midline of the upper arm*

Place your thumbs together over the arm -this identifies the vertical line of insertion on the proximal humerus (Fig. 20)



*Fig. 20. Identify the line of insertion*

Palpate deeply as you climb up the humerus to the surgical neck- it will feel like a golf ball on a tee  
The insertion site is the most prominent aspect of the greater tubercle, 1 to 2 cm above the surgical neck (Fig. 21)



*Fig. 21. Identify the insertion site*

Swab site with chlorohexidine  
Remove needle cap

Aim the needle tip downward at a 45-degree angle to the horizontal plane (Fig. 22) - the correct angle will result in the needle hub lying perpendicular to the skin

Push the needle tip through the skin until the tip rests against the bone -the 5 mm mark from the hub must be visible above the skin for confirmation of adequate needle length

Gently drill into the humerus 2 cm or until the hub reaches the skin in an adult  
Stop when you feel the “pop” or “give” in infants and children



*Fig. 22. Insert the needle*

Hold hub and remove drill (Fig. 23)



*Fig. 23. Remove drill*

Hold hub while twisting the stylet off the hub with counter clockwise rotations (Fig. 24)- the needle should feel firmly seated in the bone (1st confirmation of placement)  
Place the stylet in a sharps container.



*Fig. 24. Remove stylet*

Apply dressing (Fig. 25)



*Fig. 25. Apply dressing*

Attach a primed extension set to the hub, firmly secure by twisting clockwise (Fig. 26)



*Fig. 26. Attach primed extension set*

**Before flushing**, aspirate blood to confirm position (Fig. 27)

- discard first part of sample containing saline if samples are to be obtained for testing
- label sample as a blood/marrow intraosseous sample
- never place sample in ABG machine



Fig. 27. Aspirate blood

Flush with 0.9% sodium chloride, 5-10mL (adults), 2-5 mL (infants and children)



**In arrest, deliver adrenaline and flush with 20-30mL (adults).**

**Do not insert an IO needle into bones with:**

- Fractures
- Previous orthopaedic procedures near insertion point (prosthetic limb or joint)
- IO within past 24 hours (in the targeted bone)
- Infection at the insertion site
- Osteoporosis, osteogenesis imperfecta
- Inability to locate landmarks or excessive tissue

**Complications**

- Pain
- Extravasation
- Fat emboli
- Infection (localised or systemic)
- Dislodgment of needle
- Compartment syndrome (from extravasation)
- Osteomyelitis
- Epiphyseal injury in children

Do not leave IO insitu for greater than 24 hours.

**ETT DRUG ADMINISTRATION** <sup>(1, 2)</sup>

If IV or IO access cannot be achieved and an endotracheal tube (ETT) is present, endotracheal administration of some medications is possible, although the absorption is variable and plasma concentrations are substantially lower than those achieved when the same drug is given by the intravenous route. Dilution with water instead of 0.9% saline may achieve better drug absorption.

This route cannot be used if a Laryngeal Mask Airway is present.



**Administration of drugs via the tracheal route should only occur when the IV or intra-osseous route is unobtainable.**

**Procedure**

- Suction airway if secretions are copious
- Pre-oxygenate with 2 insufflations of the resuscitator bag

-  **Administer 3-10 times the IV dose**, ensuring the total volume exceeds 10ml (i.e. either administer neat from a pre-filled syringe or draw up from an ampoule and dilute in Water for injection.)
- Syringe medication directly down ETT or tracheostomy tube. Do not use a mixing cannula or needle that could dislodge from a syringe.
- Re-connect resuscitator bag and administer 2 insufflations to disperse the drug.

 **Adrenaline, Lignocaine and Atropine are the only ALS drugs that can be given via the endotracheal tube (ETT) or tracheostomy tube in cardiac arrest.**

# Advanced Airway Management

## ENDOTRACHEAL INTUBATION

### Introduction <sup>(1)</sup>

There is insufficient data to support the routine use of any specific approach to airway management during cardiac arrest. The choice of airway used should depend on the skills and training of the healthcare provider. ANZCOR suggests using either an advanced airway or a bag-mask device for airway management during CPR for cardiac arrest. Both a bag-mask device and an advanced airway are frequently used in the same patient as part of a stepwise approach to airway management.

Tracheal intubation may result in increased hands-off time in comparison with insertion of a supraglottic airway (e.g. LMA) or a bag-mask device. There is inadequate evidence to define the optimal timing of advanced airway placement during cardiac arrest. To avoid substantial interruptions in chest compressions providers may defer attempts to insert devices/adjuncts until return of spontaneous circulation (ROSC).

However, if endotracheal intubation is attempted, ongoing CPR must be maintained and laryngoscopy should be performed during chest compressions.



**Attempts at intubation should not interrupt cardiac compressions for more than 5 seconds.**

An ALS accredited healthcare professional is expected to <sup>(3)</sup>:

- prepare equipment and drugs for an endotracheal intubation,
- prepare the patient for endotracheal intubation,
- assist during endotracheal intubation,
- understand expected outcomes and alternative equipment when standard intubation is not achievable.

### Indications for Endotracheal Intubation <sup>(1, 11)</sup>

- To maintain a patent airway, where airway compromise is either real or potential
- To protect an airway, e.g. loss of gag reflex, patients at risk of aspiration
- To enable suctioning for clearance of secretions
- To institute mechanical ventilation
- To deliver high concentrations of oxygen

In the arrested patient, endotracheal intubation also:

- Decreases the risk of gastric insufflation
- Provides access for drug administration

### Techniques <sup>(1, 11)</sup>

In the arrested patient, orotracheal intubation is the standard method of intubation through direct visualisation. General anaesthesia is not usually required. However, in patients with some cardiac output and level of awareness, medical staff will institute sedative and paralysing agents. Refer to 'Pharmacology for Intubation' that follows this section.

### Personnel <sup>(1, 11)</sup>

Endotracheal intubation requires skilled assistance.

The intubator coordinates the intubation procedure.

Assistants must be available to:

- hand up equipment
- administer drugs
- monitor the patient
- apply cricoid pressure (if requested)
- complete documentation

## Equipment <sup>(1, 11)</sup>

Emergency drugs, e.g. Adrenaline

Monitoring- cardiac rhythm, BP, SpO2

Stethoscope

Resuscitation trolleys contain equipment for endotracheal intubation:

- Gloves and protective eye wear
- Oropharyngeal (Guedel) airways
- Resuscitation bag- connected with maximum flow oxygen
- Yanker suction- connected and tested
- IV access
- End-tidal CO2 detector
- Endotracheal tubes: females 7-8mm, males 8-9mm
- Laryngoscopes
- Introducer stylet
- Bougie
- Magill's forceps
- 10mL syringe
- Lubricant
- Tapes

## Procedure <sup>(1, 11)</sup>

- Informed consent where applicable (N/A with arrested patient)
- Pre-oxygenation with full flow oxygen for 5 minutes, when possible
- Consider the **concurrent** use of intranasal oxygen 2Lpm pre procedure
- Place functioning suction & resuscitator bag near head of patient
- Check laryngoscope has an adequate, secure light source
- Lubricate ETT prn
- Position patient supine in the 'sniffing position' with a small pillow under the head
- Anaesthetic agents if required (N/A with arrested patient)
- Remove oxygen mask and increase intranasal oxygen flow to 15 Lpm
- Cricoid pressure by assistant (PRN)



### Cricoid pressure <sup>(11)</sup>

Cricoid pressure is applied, on the instruction of the intubator (Fig. 28).

Cricoid pressure may reduce the risk of regurgitation of gastric contents (and therefore pulmonary aspiration) and can facilitate visualization of the glottis.

The cricoid is a full cartilaginous ring. Pressure upon it will occlude the oesophagus behind it, while maintaining a patent airway. Firm downward pressure with the thumb and index finger is applied below the thyroid cartilage (Adam's apple). Cricoid pressure should not be performed during vomiting due to the risk of oesophageal rupture. Pressure must not be released until the intubator is satisfied that tube position is clinically confirmed as being in the airway and the cuff is inflated.

In the arrested patient, the application of cricoid pressure may prevent the regurgitation of gastric contents into the pharynx until the airway can be protected with a cuffed ETT.

Fig.28. Cricoid pressure



- Intubation of trachea
- Cuff inflation with 5-10mls of air to achieve a seal
- Confirm ETT position



#### Confirmation of ETT position <sup>(11)</sup>

It is **essential** that the position of the ETT in the trachea is assessed by:

- Visualisation by intubator of tube passing between vocal chords
- Symmetric bilateral chest expansion on bagging with resuscitation bag
- Bilateral air entry on chest auscultation at axilla
- Absence of gurgling over epigastrium
- Capnograph/exhaled CO<sub>2</sub> detection device- confirms CO<sub>2</sub> present. CO<sub>2</sub> is exhaled only from functioning alveolar/capillary interface in the lungs. (So will not be sustained when circulation is absent.)
  - On monitor, capnograph waveform must be sustained.
  - 'Easy Cap CO<sub>2</sub> Detector' Exhaled CO<sub>2</sub> turns indicator from purple to yellow
- Improvement in skin color
- SpO<sub>2</sub> sustained or improving
- Condensation on ETT with exhalation
- Confirm ETT position on X-ray when available, tube tip should be in the trachea level with the aortic knuckle.

- Secure ETT with tape
- Length at lip approx: males, 21-23cm, females 19-21cm
- Ongoing ventilation with resuscitator bag or mechanical ventilator

#### Complications of Endotracheal Intubation <sup>(5)</sup>

During intubation: incorrect tube placement, laryngeal trauma, cardiovascular response to laryngoscopy and intubation, increased intracranial pressure, hypoxaemia and aspiration.

While tube is in place: blockages, dislodgment, tube deformation, damage to larynx, and complications of mechanical ventilation.

Following extubation: aspiration, post-extubation airway obstruction, laryngeal and tracheal stenosis.

#### Specific documentation

ETT size

ETT length at lip

Volume or pressure of air in cuff

Adverse events/findings/complications  
Full respiratory, cardiovascular and neurological assessment  
Medication used for intubation

### **Waveform Capnography** <sup>(1)</sup>

End-tidal CO<sub>2</sub> (ETCO<sub>2</sub>) is exhaled when cellular metabolism is occurring. When end-tidal CO<sub>2</sub> is present and sustained, evidence exists of perfusion and cellular metabolism. Therefore, in addition to waveform capnography being used to confirm airway position, waveform capnography can also be used as a measure of the adequacy of cardiac output during CPR. Waveform capnography during CPR has potential roles in:

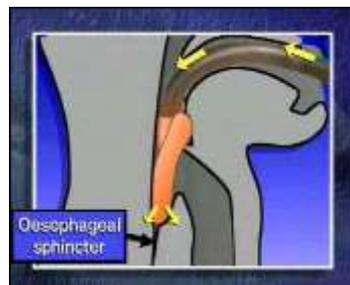
- Confirming tracheal tube placement
- Monitoring the ventilation rate to assist in avoiding hyperventilation
- Assessing the quality of chest compressions during CPR (CO<sub>2</sub> values are associated with compression depth and ventilation rate)
- Identifying ROSC during CPR (by an increased CO<sub>2</sub> value)
- Assessing prognosis during CPR (low CO<sub>2</sub> values may indicate a poor prognosis and less chance of ROSC).



**Waveform capnography should be monitored during cardiac arrest.**

### **LARYNGEAL MASK AIRWAY** <sup>(1, 5, 11)</sup>

The Laryngeal Mask Airway (LMA) is designed to act as an intermediate airway management device, providing improved airway and ventilation to that of a resuscitator bag and mask and oropharyngeal airway, but not providing the security of endotracheal intubation (Fig. 29).



*Fig.29. Laryngeal mask airway insitu*

The LMA can be used in an emergency instead of an ETT, where an ETT is either not available or when the attempts to secure an ETT are prolonged <sup>(1)</sup>. Once in position some types of LMA can serve as a guide to pass stylets, bougies, the bronchoscope or even an ETT into the trachea <sup>(13)</sup>.

The LMA has been studied specifically during CPR, looking at insertion and ventilation success rates. The studies suggest that relatively inexperienced personnel can insert the device, however, training is required. Although, the airway is not completely secure, the LMA has the advantage of being comparatively easier to insert.

The LMA has a distal elliptical spoon-shaped mask with an inflatable rim (Fig. 30), which is positioned blindly into the pharynx to form a low-pressure seal (capable of withstanding 20cmH<sub>2</sub>O pressure) against the laryngeal inlet (Fig. 29).

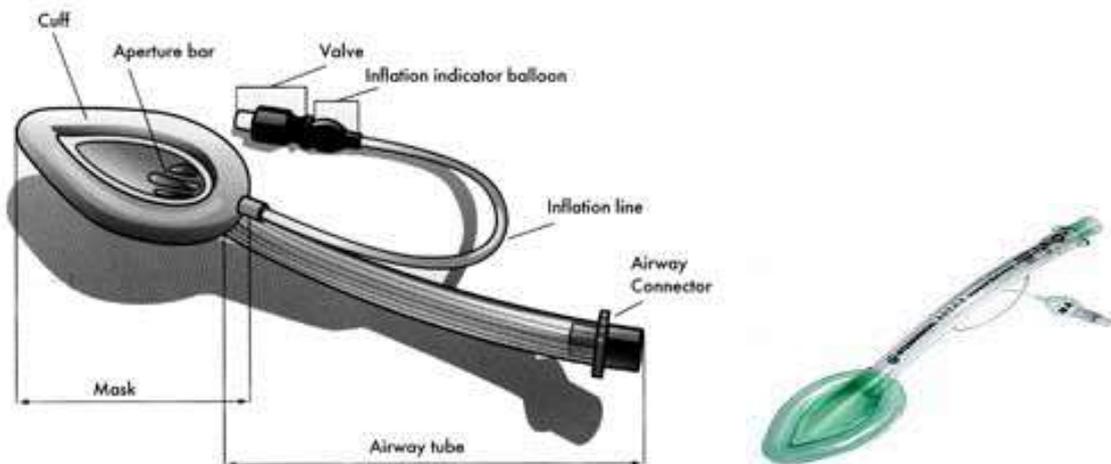


Fig.30. Laryngeal mask airways

### Indications

- Airway management when endotracheal intubation fails or is not available.
- Airway management of the unconscious patient without a gag reflex who requires assisted ventilation.
- Inability to adequately oxygenate and ventilate using a resuscitator bag and mask.

### Contraindications

- Patient not sufficiently unconscious
- Unconscious patient unable to open mouth sufficiently (e.g. trismus)
- Suspected epiglottitis or upper airway obstruction due to other causes
- Gross or morbid obesity
- >14 weeks pregnant
- Patients who require high pressure ventilation (e.g. increased airway resistance, decreased pulmonary compliance, advanced pregnancy and morbid obesity)
- Significant volume of vomit in the airway

The LMA does not prevent passive regurgitation or gastric distention.

### Procedure

- Pre-oxygenation with full flow oxygen for 5 minutes, when feasible
- Place functioning suction and resuscitator bag near head of patient
- Check LMA cuff by inflating/deflating (Fig. 31)
- Lubricate top part of cuff (Fig. 31)

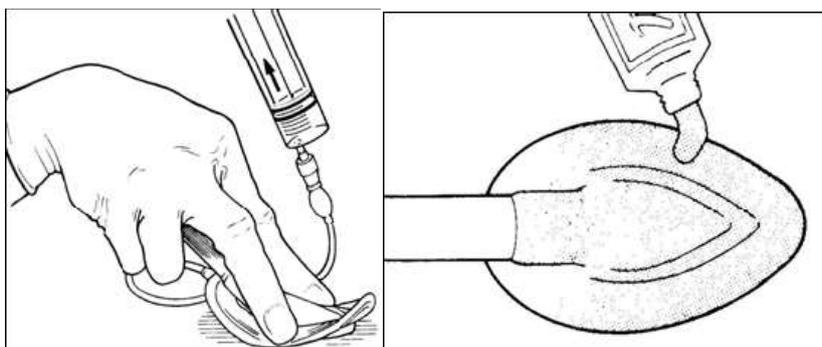
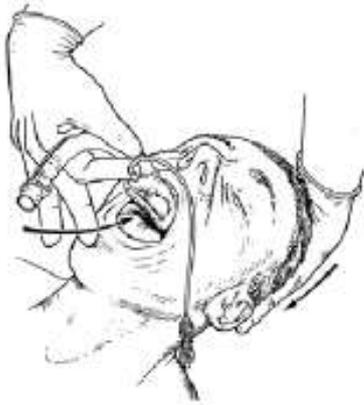


Fig.31. Checking LMA cuff and lubricating cuff

- Position patient supine in the 'sniffing position'
- Anaesthetic agents if required (N/A with arrested patient)
- The operator stands behind the head of the patient
- Holding the LMA like a pen, the index finger is placed anteriorly at the junction of the tube and cuff. The opening should be facing the patient's chin (Fig. 32).
- The tip of the cuff should be pressed up against the hard palate, avoiding folding of the cuff



*Fig.32. LMA opening is facing patient's chin.*



*Fig.33. Inserting LMA*

- Advance the airway in one fluid movement, through the oropharynx while maintaining pressure upwards as the LMA is advanced to ensure the tip remains flattened and avoids the tongue. Advance until resistance is felt (Fig. 33).
- Withdraw finger while holding the tube in place with the other hand, ensuring an anchor finger is on the chin as well.
- Inflate the cuff with the recommended volume of air (Fig. 34).



*Fig.34. Inflating the cuff*



*Fig. 35. Ventilating with LMA*

- The tube will rise during inflation of cuff and as the mask finds its correct position.
- Assess for correct position by connecting to resuscitator bag and gently ventilating to observe chest rise and fall and minimal air leak.
- Auscultate to ensure equal and adequate ventilation.
- Secure the tube as per endotracheal tube.
- Ventilate with resuscitation bag (Fig. 35) or mechanical ventilator. (Avoid high pressures as the LMA has a low pressure seal with the glottis. Pressures should not exceed 20cm H<sub>2</sub>O.)

Patient Weight (kg)	LMA size	Cuff Volume (mL)
<6.5	1	2-5
5-10	1.5	2-8
10-20	2	2-10
20-30	2.5	2-15
>30	3	10-25
>70	4	20-30
>80	5	20-40

Table 1. LMA size selection

### LMA Tips

Some operators prefer to inflate the cuff partially before insertion, although the device was initially designed to be inserted with the cuff deflated.

Successful use of the LMA depends in part on appropriate size selection (Table 1). Generally sizes are determined by weight. However judgment should be used as patient anatomy and physiology are more important than weight in size selection.

It is also important not to exceed the maximum cuff inflation amounts as indicated in Table 1.

If the maximum inflation volume is necessary to maintain a seal, the use of a larger size mask should be considered.

The following information can be used as a guide when choosing an adult LMA (Table 2):

<b>Size 3</b>	Small adult female <50 kg
<b>Size 4</b>	Ordinary sized female
<b>Size 5</b>	Ordinary sized male
<b>Size 6</b>	Large male >100 kg

Table 2. Adult LMA sizes

- Choose the largest size you think will fit and inflate with the smallest volume required to obtain an adequate seal. The larger the size used, the lower the intracuff pressure needed to obtain an adequate seal.
- Consider changing to a larger sized mask if leaks occur when the lungs are inflated to peak airway pressure <20 cmH<sub>2</sub>O.
- It is better to use a large size with small inflation volumes than a small size with large volumes.
- Always have a larger and smaller sized LMA immediately available.

### PHARMACOLOGY FOR INTUBATION <sup>(9, 11)</sup>

The following brief summary reminds the reader of a few key points in relation to the use of drugs during intubation. Further information must be sought from the product information and evidence based reliable sources before the use of such drugs.

## **Sedative Drugs**

*Midazolam*: Short acting benzodiazepine sedative. Effects include amnesia.

Dose: 1-2.5mg increments slowly IV.

Onset: 30 seconds-5min

Duration: 10-90min

Adverse effects: respiratory depression, cardiac arrhythmias, hypotension.

*Propofol (Diprivan)*: Short acting anaesthetic agent without analgesic properties.

Dose: 1-2mg/kg slowly IV

Onset: Rapid

Duration: 5-10min

Adverse effects: hypotension, respiratory depression, bradycardia, pain at injection site.

*Fentanyl*: Short acting opiate with analgesic effects, blunts intracranial pressure response to intubation. Used in conjunction with other sedatives.

Dose: 50-100mcg IV.

Onset: 1min

Duration: 30-60min

Adverse effects: respiratory and cardiovascular depression, muscle rigidity, nausea and vomiting.

*Ketamine*: A dissociative anaesthetic agent. May cause bronchodilation. Analgesic effects. Myocardial depression is uncommon.

Dose: 1-2mg/kg

Onset: 60 seconds

Duration: 5-10min

Adverse effects: Hypertension, tachycardia, increased ICP, hallucinations.

## **Neuromuscular Blockers**

*Suxamethonium*: Depolarising muscle relaxant. Combines with the cholinergic receptors of the motor end plate to produce depolarisation.

Dose: 0.3-1mg/kg

Onset: 30seconds

Duration: 2-6min

Adverse effects: Muscular fasciculations, malignant hyperthermia, apnoea, salivation, cardiac arrhythmias, hypo/hypertension, increased intraocular pressure.

*Rocuronium*: Rapid onset, non-depolarising neuromuscular blocking agent that prevents acetylcholine binding to receptors on the muscle end plate. Dose: 0.6mg/kg IV bolus

Onset: 1-2min

Duration: 30-50 min

Adverse effects: tachycardia, hypotension, bronchospasm, skin reactions, hiccups.

*Atracurium*: Non-depolarising skeletal muscle relaxant. It prevents acetylcholine binding to the receptors on the muscle end plate. Drug of choice in kidney and liver failure.

Dose: 0.4-0.5mg/kg

Onset: 2min

Duration: 15-35min

Adverse effects: Anaphylactoid reaction, hypertension, tachycardia, bradycardia, bronchospasm, skin reactions.

# Transcutaneous Pacing (1, 12, 13)

## Introduction

Transcutaneous (external) pacing is initiated in an emergency setting for haemodynamically compromised bradycardia not controlled with drug therapy as per the Bradycardia – Adult protocol (Fig. 3). It is a temporary therapy used as a bridge to the insertion of a temporary transvenous pacing wire or permanent pacemaker insertion.

The aim of transcutaneous pacing is to deliver a current across the patient's chest to induce contraction of the myocardium and induce contractions at an adequate heart rate to optimise cardiac output. Cutaneous nerves and skeletal muscle may also be stimulated, causing pain and discomfort.



Fig.36. Defibrillator with pacing capability

## Equipment

Defibrillator with capacity to perform transcutaneous pacing (Fig. 36) buttons front right.

ECG leads

Pacing self-adhesive pads (Fig. 37)

Pad connection lead (Fig. 38)

Full resuscitation and monitoring capability



Fig.37. Self adhesive pads



Fig. 38. Pad connection lead

## Preparation of Patient

Explanation to patient  
Informed consent PRN  
Supine position  
Oxygen  
Primary survey assessment  
IV access x 2  
Baseline vital signs & ECG  
Analgesia/sedation

## Procedure

Establish ECG trace on defibrillator **via defibrillator's ECG leads or slave from monitor**

Don gloves & apply self-adhesive pacing pads to patient's chest, eg:

- +ve pad posterior below L scapula and -ve pad anteriorly at V4, or,
- +ve pad R parasternal border and -ve pad anteriorly at V4

Connect pads to connection lead

Attach connection lead to defibrillator

Turn pacer function 'on'

Ensure pacing mode is 'demand'

Select pacing rate as ordered (usually 60-80bpm)

Select pacing output of approx. 30mA

Press 'start'

Pacing spikes should be visible on the ECG display (Fig. 39)



Fig.39. Pacing spikes

Increase the output until 'capture' is achieved (this energy level is the 'threshold')

**Every** pacing spike must be followed by a paced beat (Fig. 40)

Increase the output by a further 5-10mA as a safety margin

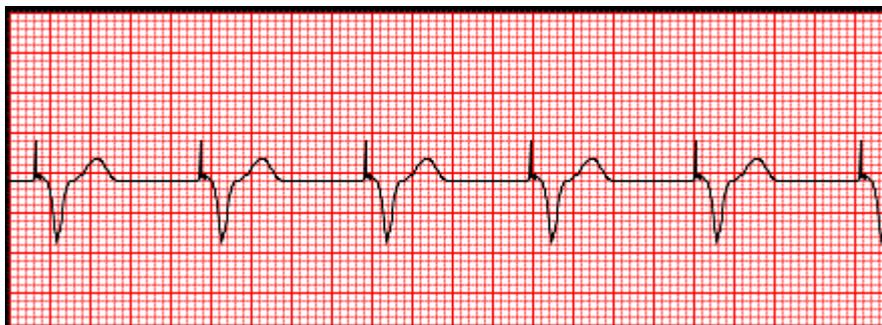


Fig.40. Paced rhythm

## Patient management

Continuous O2 and airway management

Continuous observation and monitoring

15 min documentation of patient status & pacer settings (mode, rate, output)

Patient education and support

Sedation/analgesia as required  
Maintain integrity of pacing equipment/leads/connections  
Caregivers to wear protective gloves if touching pacing pads  
Keep patient skin and linen dry

### **Transcutaneous pacing and the arrested patient**

If defibrillation is required for VT/VF, the self-adhesive pads also function as defibrillation pads.

Immediately prepare to defibrillate the patient according to section 3.

Performing CPR whilst pacing should be safe, but rescuers may occasionally experience slight tingling or muscle twitching of the hands. Wear protective gloves to prevent this. If strong or painful sensation is felt, then pacing will need to be turned off.

### **Troubleshooting**

Noisy ECG signal

- Shave excessive chest hair
- Place ECG dots on clean, dry skin
- Select another ECG lead to view
- Move dots away from pacing pads

Patient discomfort (ranging from tingle/twitch to intolerable pain)

- Analgesia
- Sedation (consider protection of airway with cuffed ETT)

Failure to capture

- Insufficient output
- Correct acidosis, hypoxia
- Change pad position

Undersensing

(Does not detect intrinsic QRS & delivers a pacing spike- danger of 'R on T' → VF)

- Increase ECG amplitude
- Reposition and refresh ECG dots
- Select another lead to view

Oversensing

(Pacing inhibited due to signals like artefact or P waves being incorrectly interpreted as R waves)

- Decrease ECG amplitude
- Select another lead to view
- Reduce causes of artefact
- Reposition/refresh ECG dots

## Teamwork <sup>(14)</sup>

Human factors are the non- technical cognitive, social and personal resource skills that along with technical skills, influence rescuer performance. These crucial human factors are common causes of adverse incidents and are highlighted below:

### **Situational awareness**

During a cardiac arrest when many activities are occurring simultaneously, it is important that only the relevant information is shared by the team as distraction may reduce team performance. Teams function best when members have shared understanding of the situation. It is therefore vital that the team leader is able to ascertain the 'big picture', allowing others to be task focussed.

### **Decision making**

Knowledge and skills are required to make informed decisions. All team members will make decisions, e.g. site selection for IV access or when to notify of fatigue performing CPR. Treatment decisions should be made according to ANZCOR guidelines. The team leader will provide overall guidance such as the diagnosis of cardiac rhythm, the treatment of possible causes of arrest and the duration of resuscitation.

### **Team working**

Team members should work together toward a common goal. This is enhanced by the knowledge of BLS and ALS best practice possessed by individuals and the ability of members to work cohesively. This is achieved by clear communication and coordination that utilises the specific skills of members. In fact teams function optimally when participants know each other's names.

#### Good team members are:

- Skills competent
- Committed
- Communicate openly, raise concerns, listen attentively
- Supportive- allow others to achieve their best
- Accountable
- Willing to seek help when needed
- Creative- they make suggestions
- Participate in providing feedback

#### Good team leaders:

- Accept leadership
- Know team member's name and capability
- Appropriately delegate
- Are knowledgeable, credible, professional
- Stay calm and control distractions
- Communicate effectively by giving instructions, listening and showing empathy
- Show assertiveness when appropriate
- Demonstrate tolerance
- Have good situational awareness

#### Specifically in cardiac arrests, leaders should:

- Follow ANZCOR Guidelines and explain any necessary deviations
- Consult and seek assistance if unsure
- Allow team members autonomy in their skill set

Allocate specific roles and tasks to avoid doubling up or omission of tasks

Plan tasks during 2 min CPR cycles

Team leaders should conclude the event by:

Thanking the team

Ensuring support for relatives and staff occurs as needed

Completing all documentation

Handing over

Reporting incidents



**Team leaders must lead and team members must collaborate.**

### **Task Management**

Numerous tasks must be carried out sequentially or simultaneously without disturbing the prioritised approach. Brief planning for arrivals (where possible) is advantageous, however, teams are often responding at unanticipated time and locations to cardiac arrest so must always be prepared to act.



**Team members must be familiar with equipment on resuscitation trolleys and in bags taken to code blue events.**

## **Post Resuscitation Care <sup>(1)</sup>**

During CPR, if responsiveness or normal breathing occurs, check the cardiac rhythm. If the rhythm appears consistent with life, then check the carotid pulse.

Post resuscitation care commences upon the return of spontaneous circulation (ROSC).



**After ROSC, resuscitation must continue.**

Comprehensive discussion of post resuscitation care is beyond the scope of the package, however, the following should be considered:

1. Perform a primary survey ABCDE Airway/Breathing/Circulation/Disability/Exposure
2. Consider:
  - a. Provide oxygen to achieve SpO<sub>2</sub> 94-98%
  - b. Monitor vital signs
  - c. Avoid hypoglycaemia and aim Se glucose <10mmol/L
  - d. 12-lead ECG
  - e. Chest x-ray
  - f. Thrombolytics or percutaneous coronary intervention
  - g. Advanced airway
  - h. Antiarrhythmic infusion
  - i. Treat causes of cardiac arrest
3. Use targeted temperature management (TTM) for adult victims of cardiac arrest who remain unresponsive after ROSC, to achieve 32-36°C; hyperthermia must be avoided

4. Assess for resuscitation related injuries
5. Clinicians should refer to ANZCOR Guideline 11.7 regarding prognostication
6. ANZCOR recommends that all patients who have restoration of circulation after CPR and who subsequently progress to death be evaluated for organ donation.

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## 4. ADVANCED LIFE SUPPORT (PAEDIATRIC)

This section contains information related to the practice of Advanced Life Support for paediatric patients <sup>(1)</sup>. This includes flowcharts (Figs. 1 & 2) and techniques utilised in the care of paediatric patients requiring resuscitation.

This learning package does not contain extensive information specific to resuscitation of the newborn. The ANZCOR flowchart 'Newborn Life Support' is included (Fig. 15), however the relevant ANZCOR *Guidelines*, the Victorian Newborn Resuscitation Project neoResus learning modules available at <http://www.neoresus.org.au/> and other comprehensive evidence based material should be consulted for further information. It is important to note that Basic Life Support for paediatric patients is contained in Section 2 of this manual. The material in Section 2 'Basic Life Support' and Section 3 'Advanced Life Support- Adult' is prerequisite for commencing this section.



**Senior clinicians who undertake competency assessment <sup>(2)</sup> in paediatric advanced life support skills will have access to relevant flow charts and tables during the competency assessment.**

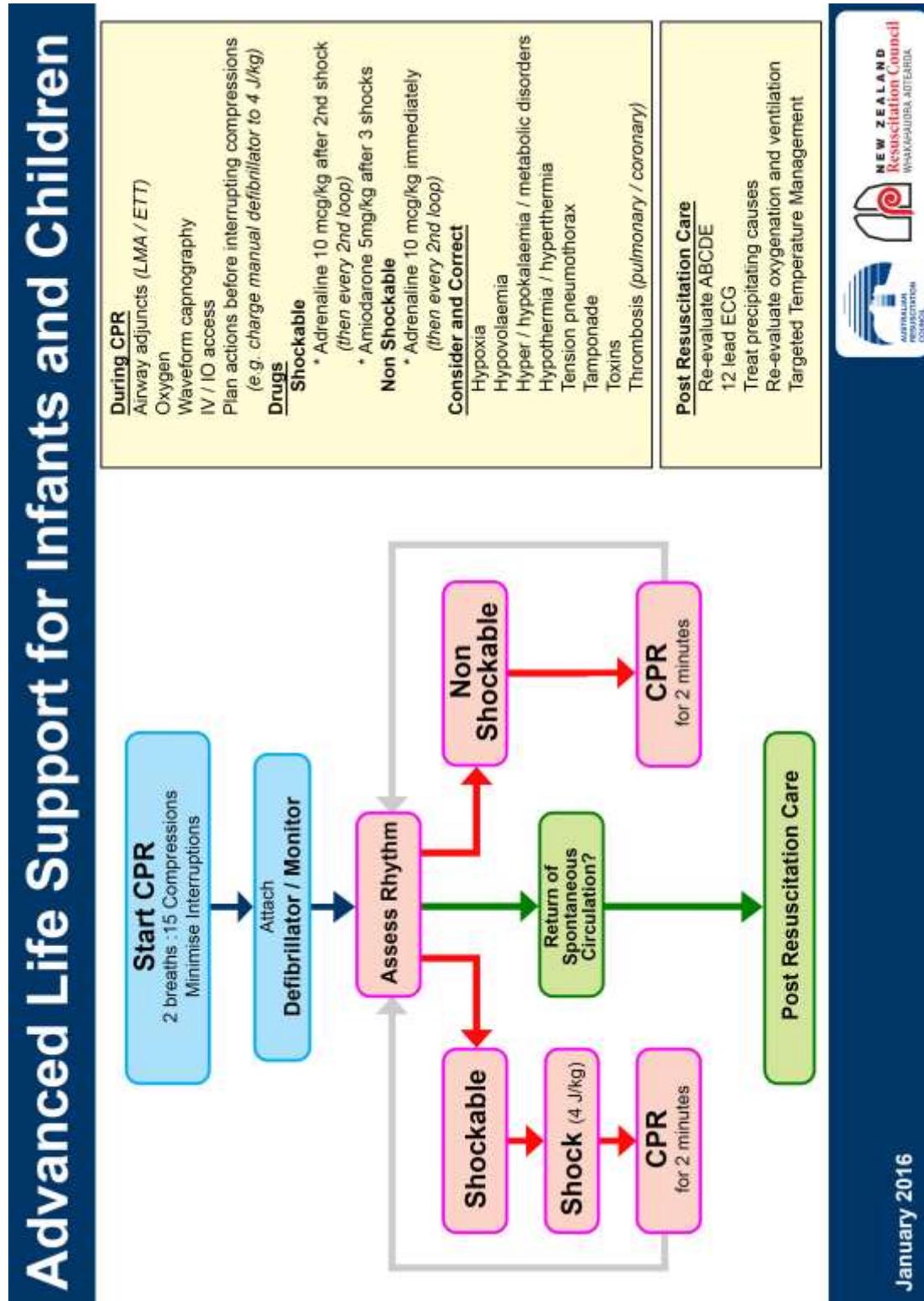


Fig.1. Advanced Life Support for Infants and Children Flowchart <sup>(1)</sup>

# PAEDIATRIC- Management of Tachydysrhythmias <sup>(1)</sup>

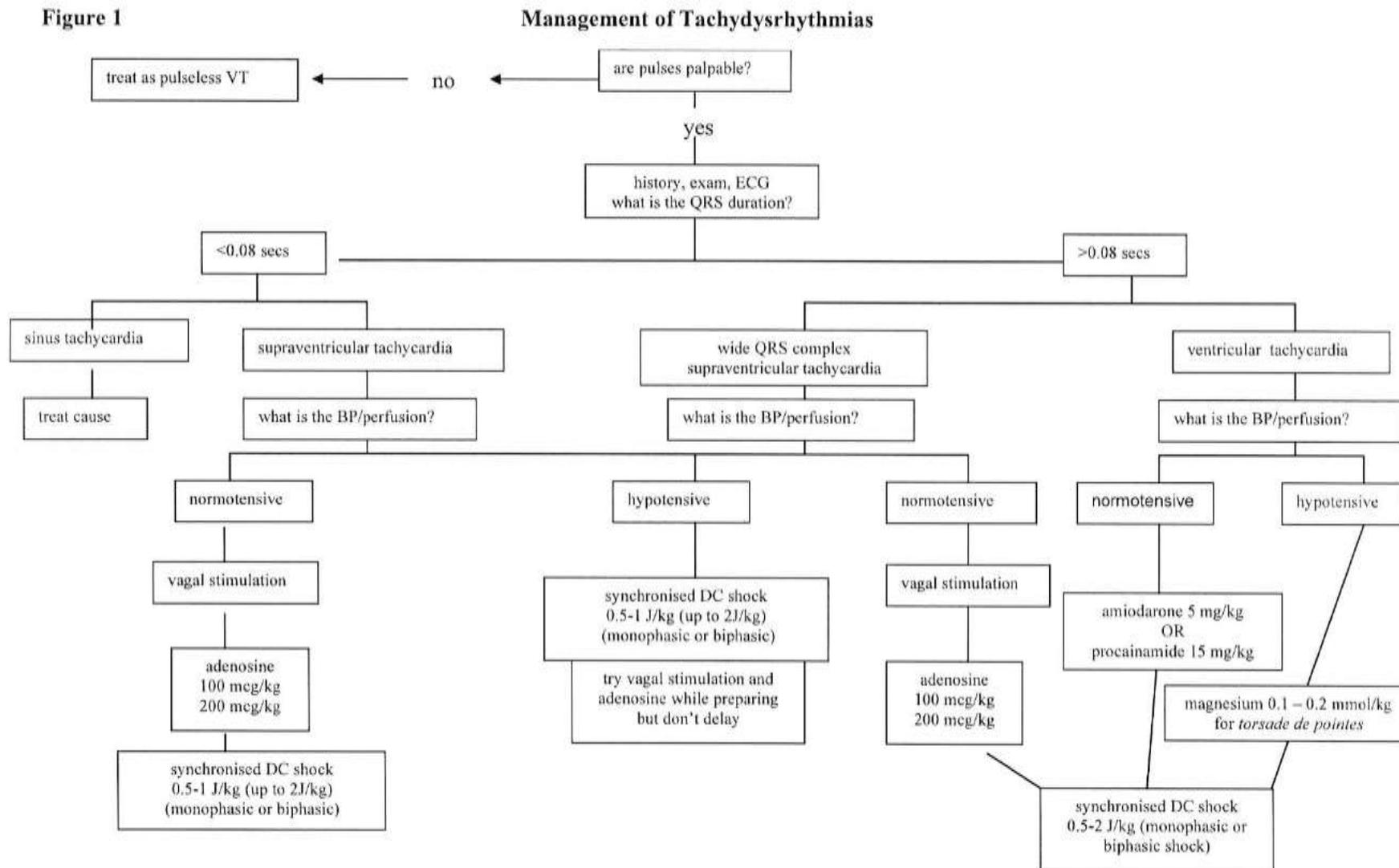


Fig. 2. Management of Paediatric Tachydysrhythmias Flowchart <sup>(1)</sup>

## INTRODUCTION <sup>(1)</sup>

During the management of paediatric cardiorespiratory arrest, clinicians can be assisted by using paediatric flowcharts and drug delivery tables, *after* the initial BLS measures have been commenced. Clinicians must be able to rapidly commence BLS measures and then when those measures are proceeding, rapidly locate relevant information on the charts if necessary. The use of tables and flowcharts is particularly relevant for clinicians who rarely care for the collapsed child. In paediatric resuscitation all drug doses, fluid volumes and electrical therapies are determined by the patient's weight or length. If an accurate weight and length is unavailable an estimate by age should be used. A colour-coded Broselow tape/scale is also very useful.

### Approximate weight:

A newborn	3.5kg
One Year	10kg
9 years and less	(age $\times$ 2) + 8kg
10 years and over	age $\times$ 3.3kg

Read in conjunction with previous sections of this manual, the following is a brief outline of the care an infant or young child in cardiorespiratory arrest will require. For broader and deeper education regarding this specialist area of practice, further sources must be used.

## DEFINITIONS

**Newborn:** At birth to several hours following birth **use Newborn Guidelines**

**Infant:** Less than 1 year **use Paediatric Guidelines**

**Child:** 1-8 years **use Paediatric Guidelines**

**Children 9yrs and above use Adult Guidelines**  
(Although with less susceptibility to ventricular fibrillation)

### Causes of Arrest in Childhood <sup>(1)</sup>

Cardiac arrest in infants and children usually occurs as a result of, **hypoxaemia or hypotension or both**. Early recognition of seriously ill children and early intervention to prevent deterioration are crucial. The initial cardiac rhythm discovered is usually severe bradycardia or asystole, which influences the order of resuscitative actions. Respiratory arrest may occur alone and if treated promptly may not progress to cardiorespiratory arrest.

### Diagnosis and Initial Management <sup>(1)</sup>

The diagnosis and immediate care of the paediatric patient in cardiorespiratory arrest must occur as described in Section 2. The implementation of Basic Life Support is essential. The establishment of resuscitator bag ventilation, the display of cardiac rhythm and access to circulation should occur simultaneously as skilled rescuers arrive. From that point, specific care will be guided by the cardiac rhythm (Figs. 1 & 2).



**In all emergency situations the rescuer should follow DRSABCD**

The following interventions are performed *in addition* to the BLS measures already outlined (Section 2).

## AIRWAY- PAEDIATRICS <sup>(1)</sup>

In-drawing of the chest wall and/or distension of the abdomen with each inspiratory effort without expiration of air implies an obstructed airway. If airway obstruction is not relieved by backward head tilt-chin lift or by jaw thrust, use suction to clear. A laryngoscope can be used by a skilled operator, to visualise any obstructions and to aid their removal with suction or Magill's forceps. Establishment and maintenance of an airway may be achieved by an oropharyngeal or nasopharyngeal airway, endotracheal tube, laryngeal mask airway or other device.

### Endotracheal Intubation <sup>(1)</sup>

If endotracheal intubation can be performed "expediently and expertly" <sup>(1)</sup>, it should proceed.

Intubation achieves a number of objectives:

- It establishes and maintains a patent airway
- Facilitates mechanical ventilation
- Reduces the risk of pulmonary aspiration
- Facilitates suctioning
- Provides a route for the administration of drugs (adrenaline, atropine, lignocaine and naloxone)

An overview of the assistance this operator requires from other team members is described in Section 3 'Advanced Airway Management'.

Un-cuffed, or cuffed (as a short term measure) endotracheal tubes may be used in paediatric patients. To determine the appropriate size of endotracheal tube and the insertion depth at the lip level (Fig. 4).

Confirmation that the tube is correctly placed relies on assessment of many factors as described in Section 3. Small sized disposable end tidal CO<sub>2</sub> detectors are available for use in infants (Fig. 3), in order to assess endotracheal tube placement.



Fig.3. Paediatric end-tidal CO<sub>2</sub> detector

**TABLE of DRUGS, FLUIDS, ENDOTRACHEAL TUBES and  
DIRECT CURRENT SHOCK FOR PAEDIATRIC RESUSCITATION**

Age	0	2m	5m	1y	2y	3y	4y	5y	6y	7y	8y	9y	10y	11y	12y	13y	14y
Body weight kg *	3.5	5	7	10	12	14	16	18	20	22	25	28	32	36	40	46	50
Height cm *	50	58	65	75	85	94	102	109	115	121	127	132	138	144	151	157	162
Adrenaline 1in 1000: mL (10 mcg/kg)	0.035	0.05	0.07	0.10	0.12	0.14	0.16	0.18	0.2	0.22	0.25	0.28	0.32	0.36	0.4	0.46	0.5 mL
Adrenaline 1in 10,000: mL (10 mcg/kg)	0.35	0.5	0.7	1	1.2	1.4	1.6	1.8	2	2.2	2.5	2.8	3.2	3.6	4	4.6	5 mL
Amiodarone: mg (5 mg/kg)	17.5	25	35	50	60	70	80	90	100	110	125	140	160	180	200	230	250 mg
Lignocaine 1%: mL (1mg/kg)	0.3	0.5	0.7	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.5	2.8	3.2	3.6	4.0	4.6	5.0 mL
Sodium bicarbonate 8.4%: mL (1 mmol/kg)	3.5	5	7	10	12	14	16	18	20	22	25	28	32	36	40	46	50 mL
Fluid volume: mL (20 mL/kg)	70	100	140	200	240	280	320	360	400	440	500	560	640	720	800	920	1000 mL
Endotracheal tube Uncuffed size: Age/4 + 4 mm (2 years and above)	3.5	3.5	3.5	4	4.5	4.5	5	5	5.5	5.5	6	6	6.5	6.5	7	7	7.5 mm
Cuffed size: Age/4 + 3 mm	3	3	3	3	3.5	3.5	4	4	4.5	4.5	5	5	5.5	5.5	6	6	6.5 mm
Oral length: Age/2 + 12 cm (2 years and above)	9.0	11	11.5	12	13	13.5	14	14.5	15	15.5	16	16.5	17	17.5	18	18.5	19 cm
Nasal length: Age/2 + 14 cm (2 years and above)	11	12	13	14	15	16	17	18	19	19	20	20	21	21	22	22	23 cm
Direct Current shock (biphasic or monophasic) VF, pulseless VT, First Shock (4J/kg) and all subsequent shocks, unsynchronized: Joules	10	20	30	50	50	50	70	70	70	100	100	100	150	150	150	200	200 J
Pulsatile VT, synchronized (approx 2J/kg): Joules	5	10	15	20	20	30	30	40	40	40	50	50	70	70	80	90	100 J
SVT, synchronized (approx 1J/kg): Joules	3	5	7	10	10	15	15	20	20	20	30	30	30	30	50	50	50 J

\* 50th percentiles

**REFERENCE:** Oakley P, Phillips B, Molyneux E, Mackway-Jones K. Updated standard reference chart. BMJ 1993; 306: 1613.

*Fig. 4. Paediatric Quick Reference Chart*

## BREATHING- PAEDIATRICS <sup>(1)</sup>

### Resuscitator bag ventilation <sup>(1)</sup>

If there is not an ETT insitu, standing at the child's head, the rescuer places an appropriately sized resuscitator mask with resuscitator bag over the child's mouth and nose to ventilate the patient (Fig. 5). The inspiratory time should be approximately one second. If an endotracheal tube has been inserted, the mask must be removed from the device and the bag connected directly to the endotracheal tube. High flow oxygen should be connected to the resuscitator bag.



Fig.5. Bag/mask ventilation



**Gentle chest rise and fall must be seen with each ventilation.**

It is important that resuscitator bags designed for use with newborns are *not* used with older patients, as insufficient ventilation may occur (Fig. 6).



Fig.6. Resuscitator bags

- 1500ml resuscitator bag-older children and adults
- 500ml resuscitator bag-infants and young children
- 250ml resuscitator bag-newborn or small neonates **ONLY**



**Inflation of the stomach may occur with mask ventilation. A nasogastric tube should be inserted after endotracheal intubation, to decompress the stomach.**

Healthcare professionals who use resuscitator bags for paediatric patients must be able to check the correct function of the device (Appendix B).

## CIRCULATION- PAEDIATRICS <sup>(1)</sup>

Having implemented Basic Life Support, the cardiac rhythm must be displayed to guide specific care (Figs 1 & 2).



**Chest compressions must occur when a pulse is not palpable, regardless of the electrical cardiac rhythm displayed.**

Pulses can be assessed at the brachial, femoral or carotid pulse sites (Figs. 7 & 8).

Cardiac compressions should be started in paediatric patients with an absence of a pulse for > 10 seconds or a **heart rate less than 60 bpm**. A brachial or femoral pulse is preferred to the carotid site as infants have a short, fat neck, which makes identification of the carotid pulse difficult.



*Fig. 7. Infant brachial pulse*



*Fig. 8. Child carotid pulse*

The universal BLS rescuer compression to ventilation ratio of 30:2 is recommended for all ages, however for infants and children, with ALS rescuers present, the ventilation to compression ratio of 2:15 is performed.



**ALS rescuers should use a ventilation to compression ratio of 2:15 in paediatric patients.**

For infants, the two-thumb technique with the hands encircling the chest and the thumbs compressing the sternum is preferred to deliver chest compressions (Fig. 9). It is important not to restrict chest expansion during rescue breaths. Alternatively, the two-finger technique may be employed, as described in Section 2.



*Fig.9. Hand encircling technique*

After the airway is secured with an ETT, there is no longer a need to pause compressions to deliver breaths, however care should be taken to avoid hyperventilation.



**If ETT insitu, compressions 100-120 /min and ventilations at 10/min**

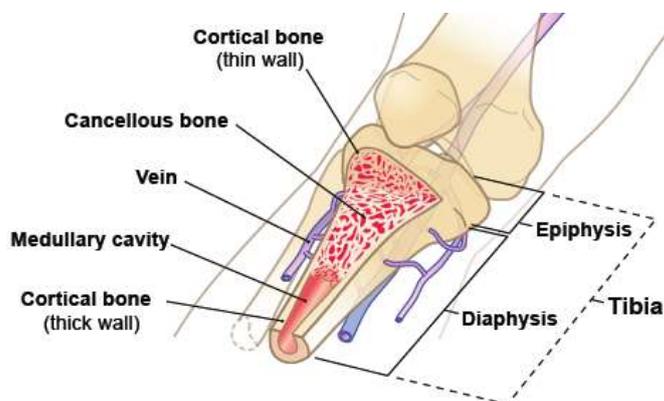
### **Access to circulation <sup>(1)</sup>**

Access to circulation should occur simultaneously as skilled rescuers arrive. Access to the peripheral circulation is important to provide a secure route for drug administration. Peripheral access points include the dorsum of the hand, wrist, forearm, cubital fossa, foot and ankle (long saphenous vein). In newborns and infants scalp veins may be used or the umbilical vein may be accessed up to one week after birth. Cannulation of the femoral vein may also provide good access to circulation.



**If peripheral access to circulation cannot be achieved within 60 seconds, access must be gained with an intra-osseous (IO) needle.**

Bone marrow has a rich blood supply and forms part of the peripheral circulation (Fig. 10). Insertion of an intra-osseous needle into the bone marrow provides valuable access through which all drugs and fluids may be given (Fig 11). The needle is inserted perpendicular to the bone surface and a rotary action used to traverse through the cortex. A loss of resistance signals entry into the bone marrow and the position is confirmed either by aspiration of bone marrow or injection of saline without extravasation. Refer to section 3.



*Fig.10. Bone marrow blood supply*



*Fig.11. Distal tibial site for IO insertion*

### **Endotracheal drug administration <sup>(1)</sup>**

Some ALS drugs can be delivered via the ETT.

ETT drug doses are as follows:

- Adrenaline 100mcg/kg (IV/IO dose is 10mcg/kg)
- Lignocaine 2-3mg/kg (IV/IO dose is 1mg/kg)

If necessary, the diluent used should be sterile water, to achieve a volume to be delivered of:

- 1-2ml for infants

- 2-5ml for young child
- 5-10ml for older child

### Glucose administration <sup>(1)</sup>

Critically ill paediatric patients may be hypoglycaemic. The blood glucose level must be checked during and after cardiac arrest (n= 3-8mmol/L). If the blood glucose level is low, it is treated with 0.25g/kg glucose IV or IO.



**Check BSL, if low give Glucose 0.25g/kg IV/IO**, e.g. 0.5mL/kg of 50% (only via a central venous line) or 2.5mL/kg of 10% glucose.

### Fluid therapy

Crystalloid is given IV or IO where hypovolaemia is suspected (Fig. 3). Repeated doses of crystalloid or colloid may be required.



**Give crystalloid 20ml/kg IV/IO for suspected hypovolaemia.**

## DIRECT CURRENT REVERSION <sup>(1)</sup>

The safe application of DCR must be adhered to as described in Section 3. However, the dose of joules delivered is smaller in infants and children.



**When performing DCR, the safety of the patient, rescuers and others is paramount.**

Defibrillation is the most effective treatment of pulseless ventricular tachycardia or ventricular fibrillation (VT/VF). The use of this therapy is according to protocol (Fig. 1). The dosage table (Fig. 3) assists rescuers to calculate the shock to be delivered, dependent upon the age/size of the child.



**In VT/VF, shocks of 4J/kg are delivered every 2 minutes.**



**Older children 9 years and above are treated per adult protocols.**

Small sized pads are available for infants < 1year of age (Fig. 12).



**For infants <1 year, use the small sized 'pink' pads with manual operation of the Philips manual defibrillators, as they are small enough to fit onto an infant's chest.**

## HeartStart Pediatric Radiotransparent/Reduced Skin Irritation Pads



Fig. 12. 'Pink' pads for infants <1yr with manual defibrillation



**Defibrillation should always be followed by 2 minutes of CPR.**

Pads with a larger surface area are suitable for all other age groups. The larger surface area reduces the risk of burns (Fig. 13).



**For all patients >1 year of age, 'red' pads are suitable for operation of the manual Philips defibrillators.**

## HeartStart Adult Plus Pads



Fig. 13. 'Red' pads for all ages over 1yr with manual defibrillators

Paediatric chest pads are available for Automated External Defibrillators (AEDs). Where available, the automatic energy dose is attenuated to a universal paediatric dose of 50J and is suitable for all patients <8 years (Fig. 14).



**For children <8yrs, 'light blue' pads are used with Philips AEDs.**



Fig. 14. 'Light blue' pads for <8yrs with Philips AED



**Important! Use adult pads for children if no other pads are available.**

## FURTHER CONSIDERATIONS

### Post cardiac arrest <sup>(1)</sup>

ANZCOR recommends avoiding hyperthermia post return of spontaneous circulation (ROSC). It is acceptable to target normothermia (36-37.5°C) or hypothermia (32-34°C) in the post ROSC period.

### Prediction of Outcome <sup>(1)</sup>

Resuscitative efforts should be continued longer in the following:

- Witnessed VF arrest
- Near drowning in cold water

### Cessation of Cardiopulmonary Resuscitation

The decision to cease CPR should be based on factors including pre-arrest status, duration of arrest, response to resuscitation, remediable factors, duration and quality of resuscitation, likely outcome, opinions of experienced personnel, desires of parents and ready availability of extracorporeal life support for in-hospital arrest <sup>(1)</sup>. Available evidence shows that in the absence of reversible causes (e.g. poisoning, hypothermia as in iced-water drowning) prolonged resuscitation of children is unlikely to be successful. Severe hypothermia may confound a diagnosis of cardiac arrest. If feasible, a child in cardiac arrest out-of-hospital should be transported to hospital if there has been any ROSC during resuscitation.

If a situation is deemed futile (such as the realisation that resuscitation is prolonging death rather than saving life) or not in the child's best interests, physicians can legally and ethically withdraw or withhold treatment, preferably with the agreement of a parent or legal guardian. Healthcare professionals are under no legal obligation to persist indefinitely to try to save life in this circumstance <sup>(1)</sup>.

### **Care of Parents** <sup>(1)</sup>

Parents must be kept informed of the progress of resuscitative efforts. They should be invited, but not coerced to be present during resuscitation. Although parents and relatives may take solace in having witnessed the efforts of those involved they may also experience emotional trauma. Parents usually wish to be present, but require information and support by a healthcare professional.

If family presence is negatively affecting team performance, the family should sensitively be requested to leave. If resuscitation is unsuccessful or treatment is withdrawn or withheld, parents should be given the opportunity to be with their deceased child after equipment has been removed.

### **Care of Rescuers** <sup>(1)</sup>

When the cardiac arrest of paediatric patients occurs, the skills of individuals and the preparedness of organisations like hospitals come to the fore. It is important to remember the psychological impact such events may have on health professionals and the need for sensitive debriefing that may arise.

## **RESUSCITATION OF THE NEWBORN** <sup>(1)</sup>

“Newborn” refers to babes in the immediate minutes to hours following birth.



**Newborns should be managed using newborn guidelines** (Fig. 15).

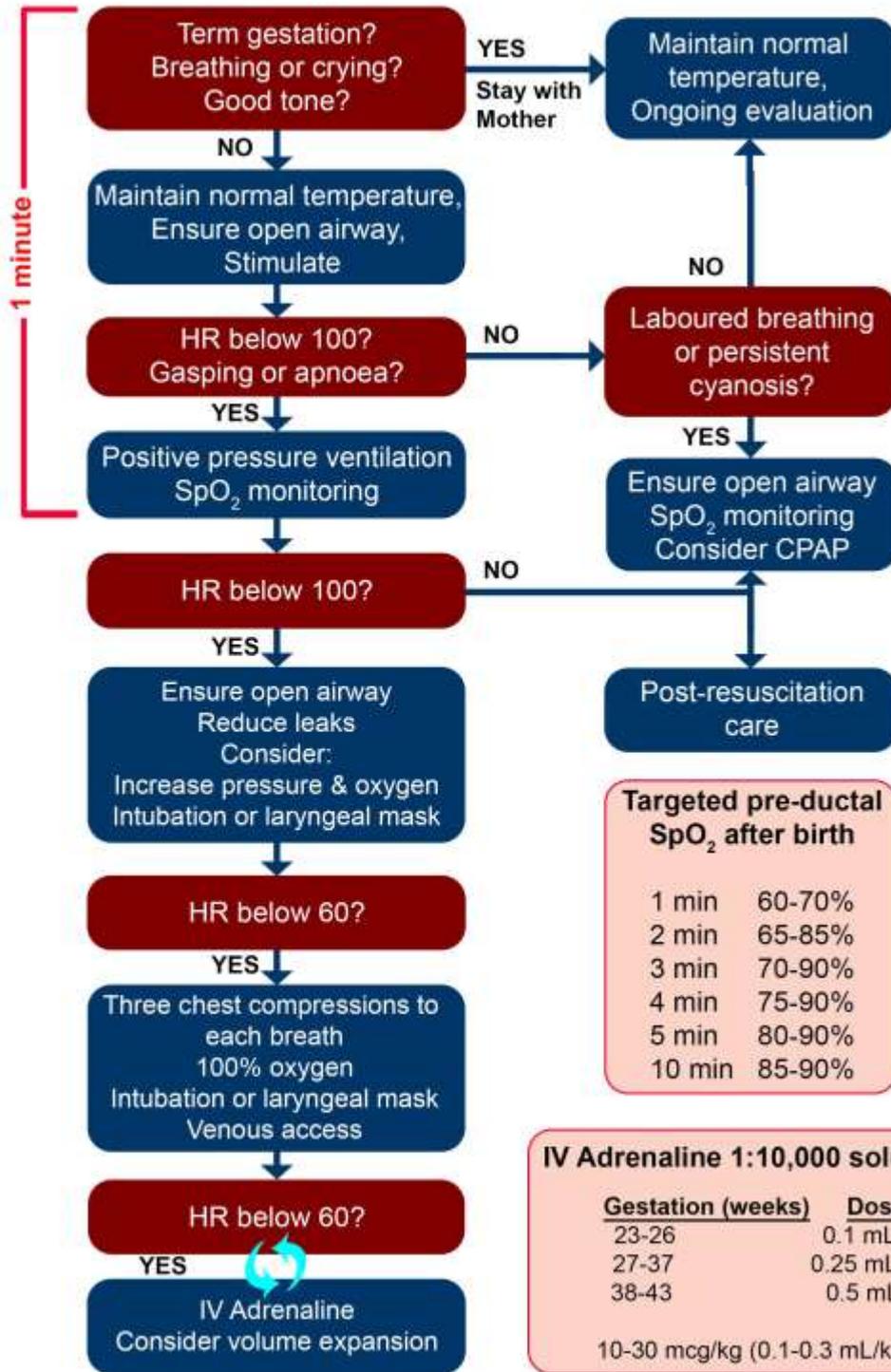


**Infants aged more than a few hours should be managed using paediatric guidelines** (Fig 1).

This learning package does not contain information specific to resuscitation of the newborn. The ANZCOR flowchart ‘Newborn Life Support’ is included (Fig. 15), however the relevant ANZCOR *Guidelines*, the Victorian Newborn Resuscitation Project neoResus learning modules available at <http://www.neoresus.org.au/> and other comprehensive evidence based material should be consulted for further information.

# Newborn Life Support

**At all stages ask: do you need help?**



January 2016



**NEW ZEALAND Resuscitation Council**  
WHAKAHAUORA ADTEAROA

Fig. 15. Newborn Life Support Flowchart

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Fig. 14. Philips Medical Systems [online]. Available: <http://www.medical.philips.com/au/>

Fig. 15. Australian Resuscitation Council *Guidelines*. Melbourne ANZCOR, Jan 2016.

# APPENDIX A.



HEALTHY COMMUNITIES AND  
WORLD CLASS HEALTHCARE

CARING | PASSIONATE | TRUSTWORTHY

## PRACTICAL ASSESSMENT OF BASIC LIFE SUPPORT SKILLS FOR HEALTHCARE PROFESSIONALS

Participant's Name:..... Dept.....

**Scenario:** While in a patient care area, a person slumps, apparently unconscious. What do you do?

ELEMENT	PERFORMANCE CRITERIA  <i>Age ranges: Infant &lt;1yr Child &lt;8yr Adult &gt;8yr</i>	EVIDENT			NOT YET EVIDENT		
		Adult	Child	Infant	Adult	Child	Infant
Checks <b>Danger</b>	Assesses & manages dangers to ensure safety for rescuers & victim						
Checks <b>Response</b>	Elicits response to verbal & tactile stimulus; talk & touch						
<b>Sends</b> for help	Activates emergency procedure						
Clears <b>Airway</b>	Removes foreign material. Uses suction if available. Gloved finger sweep of mouth. If airway obstructed with copious fluids, rolls victim onto side.						
	<b>Adults &amp; children-</b> backward head tilt /chin lift/jaw thrust. <b>Infants-</b> neutral alignment.						
Checks <b>Breathing</b>	Looks, listens & feels. If breathing, places in lateral position & observes until help arrives. Healthcare rescuer: for infants and children, delivers 2 breaths to the non- breathing.						
Checks need for <b>CPR</b>	If unresponsive & no adequate breathing, CPR is indicated. Healthcare rescuers may check for other signs of circulation including a brief pulse check.						
Performs <b>Chest Compressions</b>	Locates compression point on lower ½ of sternum & compresses ⅓ depth of chest. Rate 100-120 compressions/min.						
Performs <b>CPR</b>	Demonstrates 30 compressions: 2 breaths For healthcare professionals- children & infants 2 breaths to 15 compressions						
	Lies victim on back, delivers 2 rescue breaths by mouth-to-mask method or resuscitator bag. Observes chest rise & fall.						
	<i>*Uses airway adjuncts, e.g. oropharyngeal airway, oxygen.</i>						
Applies <b>Defibrillator</b>	Applies AED if CPR is indicated						
Uses <b>Defibrillator</b>	Follows .AED instructions in a safe manner for adults, children and infants						
Recovery	Places the responsive, breathing patient in lateral position, gives oxygen if available & observes until help arrives.						
Provides a safe care environment	Adheres to standard precautions & OHS, locates & checks adjunct equipment if applicable, e.g. resuscitator bag.						
Knowledge of BLS protocols	<b>Provides evidence of satisfactory completion of BLS on-line test</b>						

COMPETENT/ NOT YET COMPETENT (circle)

**\*Requirement to be competent in shaded elements is dependent upon workplace availability and candidate's workplace responsibilities.**

Competency must be evident in all **other** elements to obtain a 'competent' grade. Competency is current for one year. Only those elements where performance is 'not yet competent' need to be repeated satisfactorily to pass.

**Candidate/Assessor comments:**

**Candidate's signature & print name:**.....**Date:**.....

**Assessor/s signature/s & print name:**.....**Date:**.....

**BLS ASSESSOR MUST SEND THIS COMPLETED FORM TO CHERC FOR DATA ENTRY**

## APPENDIX B.

### CHECKING OF ADULT AND PAEDIATRIC RESUSCITATION BAG <sup>(1, 2)</sup>

#### Introduction

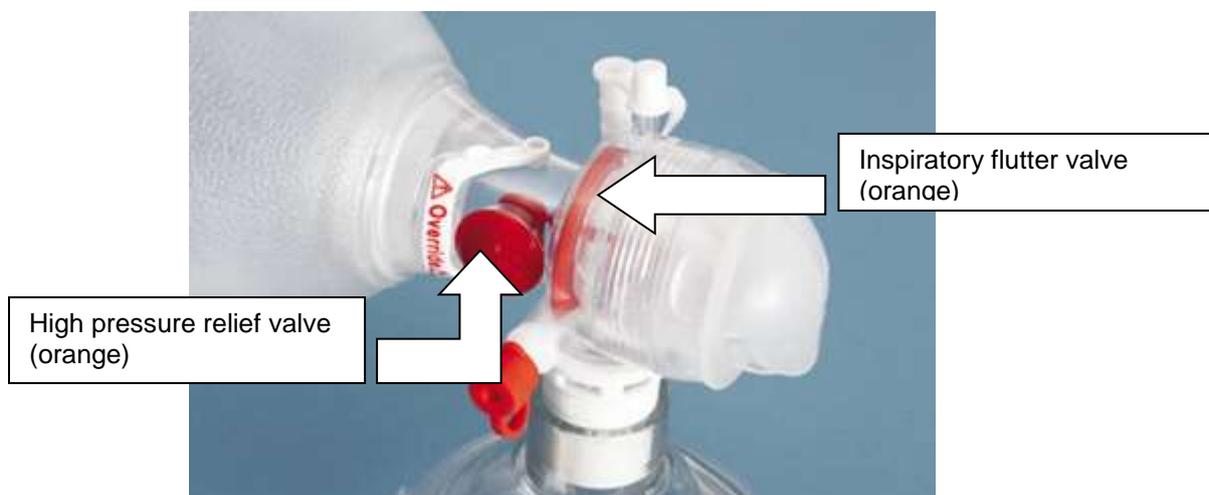
All resuscitator bags require rigorous, systematic checking to ensure correct function in the event of an emergency. The manufacturer's instructions must be followed regarding the checking of resuscitator bags.

#### Single Use Resuscitator Bags

Many clinical areas have access to single-use-only resuscitator bags. Clinicians must routinely check that the bag is in date. The bag should be squeezed to ensure the inspiratory valve opens (this can be done with the resuscitator inside its protective plastic bag). An example of one brand of disposable resuscitator bag is given below (Fig. 1):

#### Checking the Ambu Spur Resuscitator Bag Prior to Patient Use

- Squeeze bag and observe the inspiratory valve 'flutter' (orange)
- Attach to oxygen 15Lpm
- Ensure the reservoir bag fills
- Remove mask and occlude patient outlet
- Squeeze bag and listen for escape of gas from high pressure relief valve
- Reattach mask



*Fig. 1. Ambu Spur resuscitator bag*

A senior clinician needs to make a clinical judgement as to whether the patient requires ventilation pressures  $>40\text{cmH}_2\text{O}$  and if so would lift the white override clip to lock off the pressure relief valve.

#### Laerdal Resuscitator Bags

Laerdal resuscitator bags are supplied to some departments. Where supplied, they must be carefully checked by a competent person.

#### Basic Components: (Fig.2)

Check correct placement and presence of:

- Face mask (including mask-cover for soft masks)
- Non-rebreathing patient valve ('Duckbill' valve)
- Exhalation valve
- Ventilation Bag (Fig. 3)
  - 1500mL resuscitator bag    older children and adults
  - 500mL resuscitator bag    infants and young children
  - 250mL resuscitator bag    newborn or small neonates **ONLY**
- Intake valve
- O<sub>2</sub> nipple
- O<sub>2</sub> reservoir valve
- O<sub>2</sub> reservoir bag
- O<sub>2</sub> tubing

### Checking Procedure

1. Ensure all attachments are tight.  
Remove face-mask and occlude patient outlet (and occlude the pressure relief valve in paediatric device)
2. Squeeze ventilation bag - there should be no air leaks.  
Ensure there is passive re-inflation of ventilation bag after releasing.
3. Remove occlusion from patient outlet and squeeze ventilation bag. Observe opening and closing of non-rebreathing valve ('Duckbill').
4. (Paediatric device) Remove occlusion from pressure regulator and occlude patient outlet. Air should escape through the pressure regulator.
5. Ensure yellow exhalation valve is in place, and outer "lip" can move freely.
6. Attach O<sub>2</sub> tubing to nipple and O<sub>2</sub> supply.  
Turn on O<sub>2</sub> - observe filling of O<sub>2</sub> reservoir bag.
7. Squeeze ventilation bag and observe emptying of O<sub>2</sub> reservoir bag.
8. Replace face-mask. Re-seal Laerdal bag in clear plastic bag.
9. Date and sign tag to indicate correct functioning of bag.

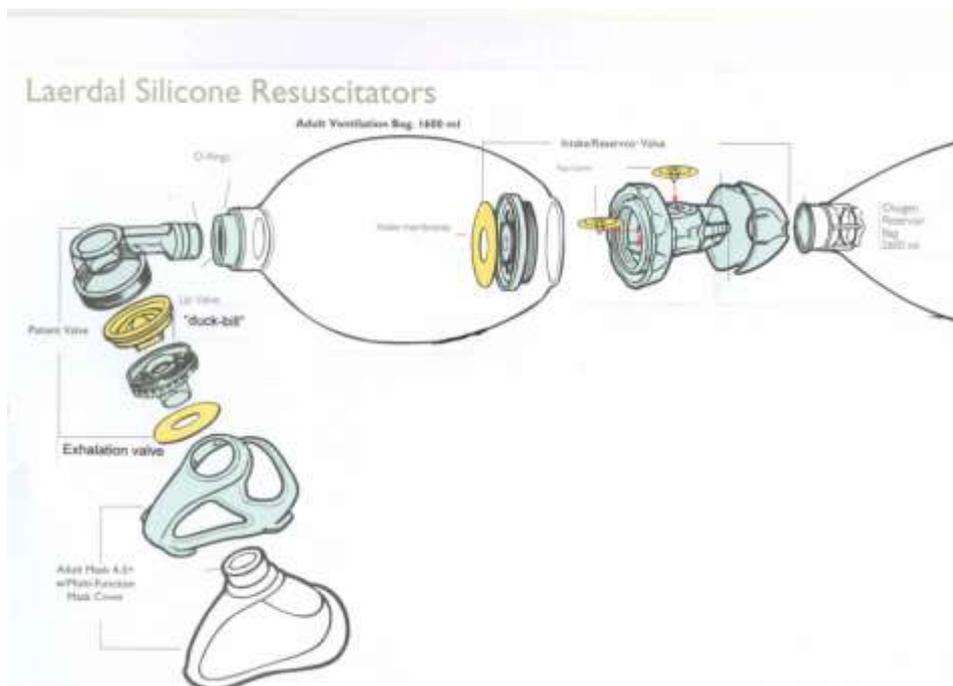


Fig.2. Laerdal bag components



*Fig.3. Laerdal bags*

### **References Appendix B.**

1. Ambu Corp *Instructions for Use Ambu Spur II* 2014
2. Bendigo Health *Resuscitation Bag (Adult & Paediatric) – Checking Protocol*  
Available Bendigo Health intranet. [Accessed 2 February 2016]

# APPENDIX C.



HEALTHY COMMUNITIES AND  
WORLD CLASS HEALTHCARE

CARING | PASSIONATE | TRUSTWORTHY

## PRACTICAL ASSESSMENT OF ADVANCED LIFE SUPPORT SKILLS

Participant's Name:..... Dept.....

Scenario No:

ELEMENT	PERFORMANCE CRITERIA	EVIDENT	NOT YET EVIDENT
<b>Adult Advanced Life Support Competency</b>			
<b>Provides a safe environment</b>	Adheres to standard precautions & OHS legislation, assembles &/or checks equipment used, e.g. resuscitator bag, defibrillator		
<b>Prioritised approach</b>	Integrates advanced skills into BLS using applied knowledge of ANZCOR ALS Protocols		
<b>Recognition of cardiac arrhythmias</b>	Diagnoses VT, VF, PEA, Asystole, bradycardia, SVT		
<b>Defibrillation</b>	Demonstrates safe use of manual defibrillation in Pulseless VT/VF		
<b>Applied knowledge ALS drugs</b>	Discusses indication, actions, dose, route, frequency & adverse effects of first line drugs appropriate to scenario		
<b>Applied knowledge of RN/RM administration of adrenaline &amp; amiodarone in cardiac arrest</b>	Describes timing and delivery of adrenaline and amiodarone consistent with ANZCOR Guidelines and <i>Secretary Approval Cardiac Arrest</i> , that permit registered nurses or registered midwives to possess and administer, adrenaline and amiodarone in the absence of a medical officer in the event of cardiac arrest.	<i>This element applies to RN/RM only</i>	
<b>Intraosseous Vascular Access Competency</b>			
<b>*Intraosseous vascular access</b>	Demonstrates safe insertion and use of intraosseous vascular access when indicated		
<b>Assistance with Endotracheal Intubation Competency</b>			
<b>*Endotracheal intubation</b>	Demonstrates applied knowledge of the intubation procedure & performs a clinical support role		
<b>Synchronous Cardioversion Competency</b>			
<b>*Synchronous cardioversion</b>	Demonstrates safe use of synchronous cardioversion when indicated		
<b>Transcutaneous Pacing Competency</b>			
<b>*Transcutaneous pacing</b>	Demonstrates safe use of transcutaneous pacing when indicated		
<b>Paediatric Advanced Life Support Competency</b>			
<b>*Paediatric advanced life support</b>	Demonstrates advanced life support knowledge and skills for paediatric patients		

COMPETENT / NOT YET COMPETENT (circle)

\*Requirement to be competent in shaded elements is dependent upon the candidate's workplace responsibilities. Competency must be evident in all other elements to obtain a 'competent' grade. Only those elements where performance is 'not yet competent' need to be repeated satisfactorily to pass. Competency is current for one year.

Candidate/Assessor comments:

Candidate's signature & print name:.....Date:.....

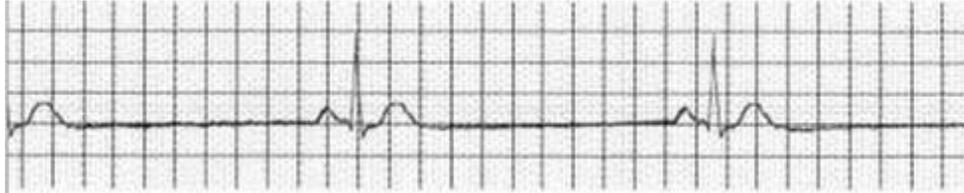
Assessor/s signature/s & print name:.....Date:.....

## APPENDIX D.

### EXAMPLE ALS SCENARIO

The following ALS scenario is representative of the type of scenario you may encounter as part of your competency assessment, so may assist you in your preparation.

Mrs. D is a 50 year old who has arrived in your department following an inferior AMI. She complains of chest pain despite morphine. This rhythm is seen on the cardiac monitor:



Q- What is this arrhythmia?

**Answer- Bradycardia**

She states she feels faint. Her SBP is 80mmHg, her GCS is 14 and her skin is pale and moist. The patient has oxygen 6Lpm via face mask and IV access insitu.

Q- What intervention is required?

**Deliver Atropine**

Action? *Parasympathetic blockade, sympathetic effects eg. increased HR*

Dose? *0.5mg boluses to max 2.5mg*

Route? *IV*

Adverse effects? *Tachyarrhythmias, angina, dry mouth .....*

After 2 doses of atropine, the heart rate is unchanged and the patient's GCS=12.

Q- What is the next drug given?

**Adrenaline infusion**

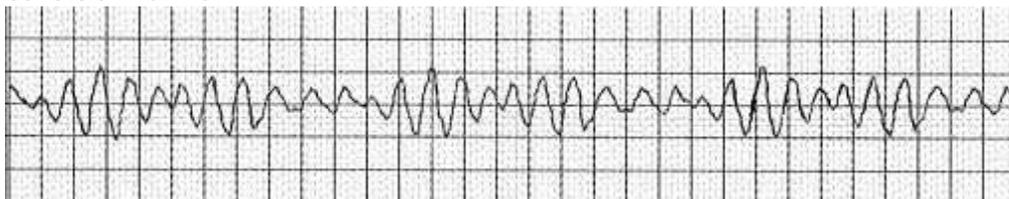
Action? *Alpha (peripheral vasoconstriction) and beta adrenergic ( $\uparrow$ contractility & heart rate)*

Dose? *Infusion prepared as per protocol and commenced at 2mcg/min*

Route? *IV*

Adverse effects? *HT, tissue necrosis, metabolic acidosis.....*

As a colleague is preparing for delivery of the infusion, you observe this on the cardiac monitor:



Q- What is this arrhythmia?

**VF**

Q- What do you do?

**D check for dangers**

**R check response** (unresponsive)

**S call code blue**

**A head tilt/chin lift**

**B check breathing** (not breathing)

**C commence chest compressions,**

**D defibrillate if immediately available-** per below

Q- Describe & demonstrate the intervention required:

**Apply defibrillation pads**

**Call- We are going to do a rhythm check**

Candidate to safely charge defibrillator while compressions continue, e.g. the 'COACHED' mnemonic:

**Continue compressions**

**Oxygen away**

**All others away**

**Charging only**

**Hands off**

**Evaluate rhythm**

**Defibrillate or disarm**

**Checks rhythm (VF), delivers shock 200J  
then CPR 2 minutes**

Mrs. S remains in the arrhythmia.

Q- What else do you do?

**Continue 2 minute cycles of CPR followed by a shock**

Q- What else?

**Adrenaline after 2<sup>nd</sup> shock and then every 2<sup>nd</sup> cycle (ie- 4 minutely)**

**Dose? 1mg**

**Routes? IV or IO**

Q- What volume of IV Normal Saline flush is required?

**20-30mL**

Q- Can any other drug be considered as well?

**Amiodarone between 3<sup>rd</sup> and 4<sup>th</sup> shock**

Action? *Antiarrhythmic that prolongs the refractory period of atrial, nodal & ventricular cells.*

Dose? 300mg over 2min

Routes? IV or IO

Adverse effects? *Bradycardia, hypotension.....*

Q- What else can be considered?

**Correct reversible causes**

**Airway adjuncts (LMA/ETT), oxygen, waveform capnography, IV/IO access**

**Plan actions before interrupting compressions**

Mrs. S. reverts to a sinus rhythm and has a strong carotid pulse.