Advanced Life Support Handbook

Prepared by: Russell Gooch

Reviewed by: Barry McCarthy, Paul Chant, Libby Bowell, Tim Jones

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Bledisloe Medical

Advanced Life Support

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2.0	Russell Gooch RN BA applied sci, Grad Cert Critical Care Grad Cert Emergency Nursing	01/01/2024	Director Bledisloe Medical	December 2024

Contents

Introduction

Most in-hospital cardiac arrests are not sudden or unpredictable events. The Australian and New Zealand Committee on resuscitation (ANZCOR) suggests that up to 80% of cases show slow and progressive deterioration during the hours prior to cardiac arrest (Australian Resuscitation Council [ARC}, 2019a). This program is aimed at those participating as team members in critical events, to train healthcare personnel in the recognition and immediate care of cardiopulmonary arrest, the ABCDE approach.

Specialist national and international bodies have formulated universal strategies to make treatment recommendations based on relevant research and opinion that guide clinical practice and treatment for sudden or emergency resuscitations. Advanced life support (ALS) is the combination of basic life support (BLS) techniques, and specialised clinical and chemical interventions. This program follows recommendations from the International Liaison Committee on Resuscitation (ILCOR) and the Australia New Zealand Committee on Resuscitation.

The course incorporates a standardised Airway, Breathing, Circulation, Disability, Exposure (ABCDE) approach, following ANZCOR Guidelines and algorithms for theoretical and practical treatment.

ACLS scenarios and simulations will be utilised to learn and practice the essential non-technical skills of leadership, teamwork, communication, and task management.

Pre-requisites

- Competent in Basic Life Support (Practiced and assessed during scenarios)
- Competent in recognition of shockable and non-shockable rhythms, including various tachycardias and bradycardias.

- ➢ Ventricular Tachycardia
- ➢ Torsade De Pointes
- ➢ Ventricular Fibrillation
- ➢ Asystole
- ➢ Pulseless electrical activity (PEA)
- ➢ Narrow complex tachycardia (SVT)
- ➢ Broad complex tachycardia (Conscious VT)
- ➢ Bradycardia

- Participants must complete a pre-course written theoretical assessment to be presented at the start of the program (but will not form part of overall theoretical pass mark)

Program Content and Aims

The program aims to develop theoretical knowledge and practical competence in the provision of evidence-based ALS for adult patients through:

- Recognition, assessment, and management of the critically ill or deteriorating patient using a structured ABCDE approach.
- Basic Life Support (BLS) with emphasis on cardiopulmonary resuscitation (CPR) quality and minimising time to early defibrillation (including modifications for pregnant patients)
- Airway management, including adjuncts, identification of foreign body airway obstruction, and risks and
- ANZCOR tachycardia, bradycardia algorithms, and cardiac arrest algorithms for management of shockable and non-shockable arrests
- ANZCOR recommendations for safe delivery of Defibrillation and External Cardiac pacing
- Teamwork and communication including principles of Crisis Resource Management (CRM)
- ANZCOR recommendations for post-resuscitation care
- Legal and ethical issues in resuscitation
- Involvement of and communication with family in resuscitation management

Assessment

To complete the program, the participant must successfully complete all clinical assessments and pass the final theoretical component.

Skills assessment

- Adult Basic Life Support
- Recognise and respond to clinical deterioration.
- Ability to apply the “ABCDE” patient assessment.
- Advanced airway management techniques
- Timely recognition of common dysrhythmias
- Manual defibrillation techniques with confident recognition of shockable rhythms
- Cardioversion
- External cardiac pacing
- ANZCOR ALS recommended algorithms and drug therapy.
- Post resuscitation care

Clinical assessments are outlined in appendix 1.

Theoretical assessment

- During simulations and scenarios, participants must demonstrate their ability to correctly identify and follow ANZCOR ALS algorithms.
- Participants will complete an end of course written theoretical assessment. The pass mark for the written assessment is 85%.

Remediation

Skills:

- Failure to successfully complete one of the clinical assessments during the program results in review and reassessment.
- Failure to successfully complete more than one of the clinical assessments during the course results in the recommendation for repeat of the program.

Theory:

- Failure to gain an 85% pass in the theoretical component, the participant will be invited to sit a supplementary paper on another day.
- Failure to gain an 85% pass in the supplementary paper results in the participant being invited to attend a full program.

Occupational Health and Safety

During a medical emergency or training session, practices and actions must be conducted with care to protect all individuals from harm.

Responding staff must adhere to basic safety principles that reduce risk to themselves while also being aware that staff in potential response areas may not be familiar with the dangers and safety precautions associated with ALS interventions and equipment (ARC 2019a).

Common sense should prevail during an emergency event. Rescuers should take time to survey the environment to ensure the safety of the rescuers other staff or bystanders even if this causes delay in the application of resuscitation measures.

Infection Control Prevention

Resuscitation events place victims and multiple rescuers in confined areas, putting rescuers at risk of cross infection and harm from sharps and defibrillation devices (ARC 2019a). The use of personal protective equipment (PPE) including gloves and eye protection should be maintained in all emergency situations. Universal precautions can seem of low importance in an emergency; however, resuscitation environments are frequently contaminated with various body fluids.

Rescuer safety while performing artificial ventilations, specifically regarding the appropriateness of ‘mouth to mouth’ ventilation has prompted discussion for health professionals regarding their actions. It is reasonable that chest compressions alone be performed until an appropriate device for ventilating the victim is available within the hospital or clinical setting (ARC 2019a).

First responder safety regarding infection control has been highlighted with the Covid-19 pandemic. All first responders must ensure currency in safety practices associated with known Covid and other infectious diseases.

Defibrillation Safety

To decrease the shock hazard to bystanders and rescuers, defibrillation should only be performed by trained staff.

Gloves should be used by all resuscitation personnel, including those performing chest compressions as part of the resuscitation attempt. Using gloves will reduce the shock risk to those performing cardiopulmonary resuscitation (CPR) if the victim has an implanted defibrillation device.

End of life Plan

Documentation that clearly articulate requests from patients regarding which resuscitation measures, if any, they will permit are becoming more prevalent. A current order is designed to assist staff, the patient, and their family in the event of a life-threatening emergency. In the absence of such an order all emergency protocols should be initiated and ceased only by the order of an authorised medical officer.

The ABCDE approach to patient assessment

The Airway, Breathing, Circulation, Disability, Exposure (ABCDE) approach is a systematic method for the immediate assessment and treatment of deteriorating and critically ill patients and is applicable in all clinical emergencies.

The initial step is to ensure one's own safety, then a general impression is gained by looking at the patient (are they awake, skin colour, diaphoresis, does the patient look unwell?).

Note that if the patient appears unresponsive, the Basic Life Support cascade of DRSABCD should be initiated immediately (ARC, 2019).

The underlying principles of the ABCDE approach:

1. Complete initial assessment and re-assess regularly.
2. Treat critical issues before moving to the next part of assessment.
3. Recognise when extra help is needed. Call for appropriate help early.
4. Assess the effects of treatment.
5. Use all members of the team. This enables interventions (e.g., assessment, attaching monitors, intravenous access), to be undertaken simultaneously.
6. The aim of the initial treatment is to keep the patient alive and achieve some clinical improvement. This will buy time for further treatment and making a diagnosis.

The critical clinical situation is frequently complex, and the systematic ABCDE approach helps break it down into logical, manageable parts.

Table 1

Assessment in Brief	
A – Airway	Voice Breath sounds
B – Breathing	Respiratory rate (12–20 min) Chest wall movements/ Chest percussion/Lung auscultation Pulse oximetry (95%–100%)
C – Circulation	Skin colour, warmth, and dryness Capillary refill time (<2 s) Palpate pulse rate (60–100 min) Regularity Heart auscultation/ Blood pressure Electrocardiography monitoring
D – Disability	Level of consciousness – AVPU (*Alert/Voice/Pain responsive/Unresponsive)* Limb movements/ Pupillary light reflexes Blood glucose level /Drugs
E – Exposure	Expose and examine skin Temperature

A - Airway

- Airway patency is the primary concern. If the patient responds in a normal voice, then the airway is patent.
- Airway obstruction can be partial or complete, with central cyanosis being a late sign of airway obstruction. Signs of a partially obstructed airway include a changed voice, noisy breathing (e.g., stridor), and an increased breathing effort.
- A completely obstructed airway causes paradoxical chest and abdominal movements (see-saw respirations). There is no air entry despite great effort. In the critically unwell patient, depressed consciousness may lead to positional airway obstruction.
- Airway obstruction is a medical emergency and must receive immediate treatment. Initially, one can attempt if an airway can be established with the use of airway opening manoeuvres, airway suction may be used if an obstruction is visualised, or insertion of an oropharyngeal or nasopharyngeal airway. More invasive tracheal intubation is required if these methods fail.
- Give supplemental oxygen. For conscious patients, deliver supplemental oxygen. ANZCOR recommend that in an emergency, if oxygen saturation drops below 92%, deliver supplementary oxygen (ARC, 2021a). To prevent oxygen toxicity in the conscious patient, it is important to titrate oxygen delivery to maintain oxygen saturations below 99%.
- In all cases of cardiopulmonary resuscitation, initially use 100% oxygen (ARC, 2016). Post return of spontaneous circulation, adjust the flow rate to maintain oxygen saturations between 94 to 99% (ARC, 2016a). For patients at risk of hypercapnic respiratory failure, adjust oxygen flow rate to maintain oxygen saturations of 88 – 92% or as per medical order.

B - Breathing

During the immediate assessment of breathing, it is vital to diagnose and treat life-threatening conditions immediately (e.g., acute severe asthma, pulmonary oedema, tension pneumothorax, or massive haemothorax).

- Look, listen and feel for general signs of respiratory distress including diaphoresis, central cyanosis, use of the accessory muscles of respiration, and abdominal breathing.
- Assess respiratory rate. The normal rate is 12–20 breaths min.
- Assess chest rise for depth, rhythm and symmetry of rise and fall.
- Note any chest deformity, look for a raised jugular venous pulse (JVP) (e.g., in acute severe asthma or a tension pneumothorax), note the presence and patency of any chest drains. Remember that abdominal distension may limit diaphragmatic movement, thereby worsening respiratory distress.
- Assess and listen for breath sounds. Stridor or wheeze suggests partial airway obstruction, while rattling suggests the presence of airway secretions with inability for the patient to clear.

- Consider percussing the chest. Hyper-resonance may suggest a pneumothorax; dullness usually indicates consolidation or pleural fluid.
- Auscultate the chest. Bronchial breathing indicates lung consolidation with patent airways. Absent or reduced sounds suggest a pneumothorax or pleural fluid, or lung consolidation caused by complete obstruction.
- Feel the chest wall to detect surgical emphysema or crepitus (which suggests traumatic pneumothorax until proven otherwise)
- Immediately call for expert help if the patient's depth or rate of breathing is judged to be inadequate or absent. Use bag valve-mask or pocket mask ventilation to improve oxygenation and ventilation.

C - Circulation

For most medical or surgical emergencies, consider hypovolaemia (ARC, 2016) to be the primary cause of shock, until proven otherwise. Unless there are obvious signs of a cardiac cause, give intravenous fluid c to any patient with cool peripheries and a fast heart rate. Remember that breathing problems, such as tension pneumothorax, can also compromise a patient's circulatory state. This should have been treated earlier on in the assessment under the breathing component.

- Assess limb temperature by feeling the patient's hands: Are they cool or warm? Look at the colour of the hands and digits: Are they blue, pink, pale, or mottled?
- Palpate peripheral and central pulses, assessing for presence, rate, quality, regularity, and equality. Barely palpable central pulses suggest a poor cardiac output.
- Measure the capillary refill time (CRT). Apply cutaneous pressure for 5 seconds. A fingertip is used to hold pressure on the patient's skin at heart level (or just above) with enough pressure to cause blanching. Time how long it takes for the skin to return to the colour of the surrounding skin after releasing the pressure. The normal value for central CRT is usually < 2 seconds. A prolonged CRT suggests poor perfusion.
- Measure the patient's blood pressure. Even in shock, the blood pressure may be normal, because compensatory mechanisms increase peripheral resistance in response to reduced cardiac output. A low diastolic blood pressure (BP) suggests arterial vasodilation (as in anaphylaxis or sepsis). A narrowed pulse pressure (difference between systolic and diastolic pressures; normally 35–45 mmHg) suggests arterial vasoconstriction (cardiogenic shock or hypovolaemia) and may occur with rapid tachyarrhythmia.
- Auscultate heart sounds. Muffled or distant heart sounds may indicate pericardial tamponade. Look for other signs of a poor cardiac output, such as reduced conscious level and (if the patient has a urinary catheter) oliguria (urine volume < 0.5 mL kg per hour).
- Insert cannula and take blood for urgent haematological, biochemical, coagulation and microbiological investigations and, if indicated, cross-matching, before infusing intravenous fluid.

- Give crystalloid solution if hypovolemia is suspected. At least 20mL/Kg is recommended for hypovolaemic shock (ARC, 2018).
- **Reassess the heart rate and BP frequently, aiming for the patient's normal BP or, if this is unknown, a target > 100 mmHg systolic.**
- If the patient has primary chest pain or a suspected acute coronary syndrome (ACS), record a 12-lead electrocardiograph (ECG) early. Immediate general treatment for ACS includes but is not limited to:
  - Strict rest in bed in semi recumbent position with head slightly elevated
  - Stay with the patient
  - Notify senior staff
  - Assess pain
  - Full set of vital signs
  - Oxygen as needed
  - Aspirin 300 mg orally, crushed or chewed, unless contraindicated, as per Medical Officer order.
  - Nitro-glycerine, as sublingual glyceryl trinitrate (tablet or spray)
  - Regular vital signs at 5-minute intervals
  - Repeat steps as per procedure/standing order if chest pain unrelieved
  - Medical officer review as soon as possible

D - Disability

Common causes of unconsciousness include profound hypoxia, hypercapnia, cerebral hypoperfusion, or the recent administration of sedatives or analgesic drugs.

- Rapidly assess patient's conscious level using the AVPU method: **A**lert, responds to **V**ocal stimuli, responds to **P**ainful stimuli or **U**nresponsive to all stimuli. Assessment may progress to Glasgow Coma Scale score.
- Exclude or treat hypoxaemia and hypovolaemia.
- Check the patient's drug chart for reversible drug-induced causes of depressed consciousness.
- Check pupils (size, equality, and reaction to light).
- Check glucose: Treat hypoglycaemia as per local protocols.

E - Exposure

Full exposure of the patient’s body is required. Remember to respect the patient’s dignity and minimise heat loss in the process.

- Take temperature.
- Observe for bites, swelling, oedema, and rashes etc.
- Look in mouth and nose and any other relevant orifice.
- Check any drains, dressings, catheters, or pumps, IV lines or medical patches.

Cardiopulmonary Resuscitation Introduction

Basic Life Support (BLS) is the foundation of ALS interventions (ARC, 2019). It is essential that all advanced life support providers are proficient in basic life support techniques and can ensure that basic life support is provided and maintained at a high standard without unnecessary pause during the resuscitation attempt.

Of the interventions used during a resuscitation attempt BLS is often the most poorly performed, in many arrest situations it is the team member with the least ALS training who performs chest compressions. ALS trained members have a responsibility to ensure BLS is optimised for as long as it is required. "The purpose of cardiopulmonary resuscitation is to temporarily maintain a circulation sufficient to preserve brain function until specialised treatment is available." (ARC, 2019a). It must be remembered that the efficiency of defibrillation and effect of the drugs given in ALS is dependent on the movement and oxygenation of blood.

Basic Life Support

Initial steps of basic life support resuscitation are DRSABCD (ARC, 2019)

D - Check for danger (environmental and infectious)

R - Check for response

S - Send for help

A - Assess and open the airway

B – Assess for abnormal breathing

C - Start CPR with 30 compressions: 2 breaths

D - Attach an Automated External Defibrillator (AED) if available and follow the prompts

D - Danger

Not all resuscitation attempts occur in an ideal environment, and rescuers must ensure they do not become the second victim. Change or remove any obvious environmental hazards within the immediate area or move the victim (as a last resort) to ensure rescuer safety during the resuscitation attempt.

Rescuers performing chest compressions may be injured if the victim's bed is too high. The bed should be lowered, or a step supplied to raise the rescuer to a safe height. Climbing onto the bed as a last resort will allow for safer effective chest compressions but can also obstruct access to the patient and increase transition time for defibrillation and compression staff change.

Rescuers should take precautions to reduce the risk from infectious hazards with the use of appropriate personal protective equipment (PPE) (ARC, 2019). These considerations should proceed any other steps except for calling for assistance.

R - Response

Assess the collapsed patient's response to both verbal and tactile stimuli. Call out their name or ask for a verbal response. If this is absent, apply a painful stimulus such as squeezing the shoulder or trapezius muscle. It is important to remember that victims within a hospital setting may be affected by analgesics, anaesthetics or have an existing neurological injury (e.g., Cerebrovascular Accident CVA).

Anyone who fails to show response should be managed as unconscious and the remaining steps of life support should be followed.

A victim that shows a response at this stage should be managed according to their needs regarding position and airway support.

S - Send for help

The notification of an arrest event should be fast and accurate. As time from collapse to definitive treatment has a significant effect on the eventual outcome, it is important that the emergency call system is well known and those making a call state the exact nature of the emergency and the location of the patient.

A - Airway

"In an unconscious person, care of the airway takes precedence over any injury including the possibility of spinal injury" (ARC, 2021)

When a victim is unconscious, the airway can be compromised as the victim's muscles are relaxed and they lose the ability to cough or clear their own airway of obstructions to air flow. If the victim is lying on their back the tongue may fall against the back of the throat, blocking the passage of air.

Head tilt, chin lift

Visually check the oral cavity and remove any foreign matter (ARC, 2021). Clearing the mouth can be achieved with the use of suction equipment or positioning the victim to allow for drainage. Ensure you visualise the obstruction/oral cavity during attempt to remove the obstruction. A finger sweep can be used in the unconscious patient with an obstructed airway, if solid material is visible in the airway, however great care should be taken to prevent injury to the rescuer's fingers and victims' mouth.

Chin lift is commonly used in conjunction with Backward Head Tilt (ARC, 2021). The chin is held up by the rescuer's thumb and fingers to open the mouth and pull the tongue and soft tissues away from the back of the throat. A suggested technique is to place the thumb over the chin below the lip and supporting the tip of the jaw with the middle finger and the index finger lying along the jaw line. Be careful that the ring finger does not squash the soft tissues of the neck. The jaw is held open slightly and pulled away from the chest. (ARC, 2021).

Figure Head tilt chin lift Manoeuvre - Source: Bledisloe Medical 2023

Jaw Thrust

Any victim with a known or suspected upper spinal injury should be handled gently with no twisting. Aim to maintain spinal alignment of the head and neck with the torso. In victims needing airway opening, manoeuvres which are least likely to result in movement of the cervical spine should be used, jaw thrust should be tried before head tilt chin lift (ARC, 2016).

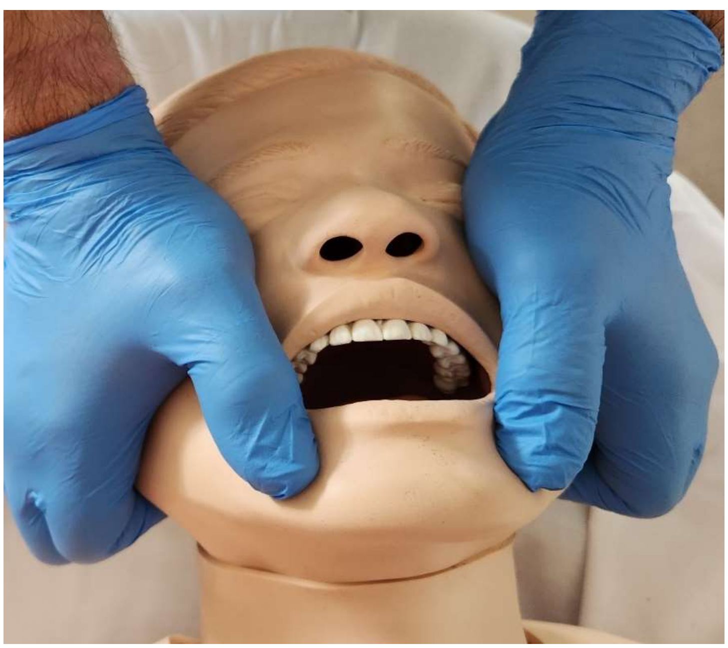


Figure Jaw Thrust Manoeuvre - Source: Bledisloe Medical 2023

B - Assess Breathing

Once the airway has been positioned, checked, and cleared, the rescuer should assess for breathing. "There is a high incidence of abnormal gasping (agonal gasps) after cardiac arrest. All rescuers "should use a combination of unresponsiveness and absent or abnormal breathing to identify the need for resuscitation" (ARC, 2021).

Rescuers should:

- LOOK for upper abdominal or lower chest movement,
- LISTEN for the escape of air from the nose or mouth, and
- FEEL the upper abdomen and chest for movement.

If there is absence of effective breathing the rescuer should commence chest compressions.

C - Compressions

"Rescuers should perform chest compressions for all patients who are unresponsive and not breathing normally" (ARC, 2021).

ANZCOR recommends that chest compressions be commenced on adults without checking for the presence of a palpable pulse (ARC, 2021).

Victims who require chest compressions should be placed in a supine position on a flat, firm surface to optimise the effectiveness.

- Hands should be placed over the lower half of the sternum.
- Pressure should be exerted through the heel of one palm. Hands should be placed one on top of the other or with fingers interlaced.
- Elbows should be straight, with head and shoulders in a vertical position over the victim's chest, rescuer bending from the waist.
- The lower half of the sternum should be compressed approximately one third of the depth of the individual's chest (**at least** 5cm in adults). Note that "inadequate compression depth is definitely associated with poor outcomes" (ARC, 2021)
- Rate of compressions should be maintained at 100-120 beats per minute.
- Compressions should be rhythmic with equal time for compression and relaxation.
- Rescuers should allow complete recoil of the chest after each compression.
- Quality compressions must be maintained. "When performing compressions if feasible change rescuers at least every two minutes to reduce rescuer fatigue. Changing rescuers performing chest compressions should be done with a minimum of interruption to compressions". (ARC, 2021). A board under the patient can assist in ensuring adequate depth.

Rib injury and fractures commonly result from chest compressions. This is an acceptable and expected complication of effective compressions. Care must be taken to ensure that rescuers performing compressions do not decrease the depth or rate of compressions if rib fractures are noted during the resuscitation attempt.

Chest Compressions with pregnant victims

Concern for the unborn child is always a factor, however, ANZCOR suggests that effective resuscitation of the mother is the best way to optimise foetal outcome (ARC, 2021)., The principles of resuscitation remain unchanged with a pregnant victim ANZCOR makes the following recommendations (ARC, 2021).

- Summon expert obstetrician and neonatologist help immediately.
- "Manually displace the uterus to the left to remove vena cava compression. Add left lateral tilt if this is feasible (the optimal angle of tilt is unknown). Aim for between 15 and 30 degrees." (ARC, 2011).
- Please note that the left lateral position can be utilised in any situation where a gravid female has vascular compromise.

Ventilations

Once 30 compressions have been performed, 2 ventilations should be given. Enough ventilation volume should be given to ensure rise of the chest. **Excessive volume and pressure should be avoided to reduce gastric inflation and high thoracic pressure.**

- When performing ventilations on a non-intubated patient, compressions must stop to allow for two effective ventilations to occur.
- Once the victim is successfully intubated, compressions do not need to pause to allow ventilation to occur. Note that a laryngeal airway device is not considered sufficient to treat the patient as intubated in this circumstance!
- Ventilation rate for an intubated patient is 6 to 10 ventilations per minute, or 1 ventilation every 15 compressions. (ARC, 2019b). The ventilator should attempt to time ventilations with the upward stroke of the compressor.

Compression ratio

The current recommended compression to ventilation ratio is 30:2 (30 compressions followed by 2 ventilations). This should not change regardless of the number of rescuers present, unless the patient has an advanced airway in place (endotracheal tube).

D - Automated External Defibrillator

The use of an AED (Automated External Defibrillator) has been shown to improve outcomes for those victims who have collapsed due to a shockable rhythm. For those trained in advanced life support methods, defibrillation is generally managed in manual mode to allow for individualised clinical intervention that is not always available with AED units.

Review points

The Australian and New Zealand Committee on Resuscitation (ANZCOR) make the following recommendations (ARC, 2021):

1. Rescuers must start CPR if the person is unresponsive and not breathing normally **as soon as possible.**
2. Bystander CPR should be actively encouraged.
3. Compression-to-ventilation ratio is 30:2.
4. All rescuers perform chest compressions for all patients who are not breathing normally. Rescuers who are trained and willing to give rescue breaths are encouraged to do so.
5. Chest compressions should be provided at a rate of approximately 100 – 120 /min.
6. Rescuers should aim to minimise interruptions to chest compressions**. Do not stop compressions for greater than 5 seconds.**
7. **A defibrillator should be applied and initiated as soon as it is available.**

Basic Life Support

- **D** — **Dangers?**
- **R** — **Responsive?**
- **S** — **Send** for help
- **A** — Open **Airway**
- **B** — Normal **Breathing?**
- **C** — Start **CPR**
  30 compressions : 2 breaths
- **D** — Attach **Defibrillator (AED)**
  as soon as available, follow prompts

Continue CPR until responsiveness or normal breathing return

Management of Foreign Body Airway Obstruction

A foreign body airway obstruction (FBAO) is a life-threatening emergency (ARC, 2021). If during the airway assessment, an obstruction is suspected in a conscious patient, the rescuer should attempt to clear the obstruction immediately.

Clinical methods to achieve this include the use of back blows or chest thrusts (ARC, 2021). Chest thrusts, back blows, or abdominal thrusts are effective for relieving FBAO in conscious adults and children, however, life-threatening complications associated with use of abdominal thrusts have been reported. Therefore, the use of abdominal thrusts in the management of FBAO is not recommended. Instead, back blows and chest thrusts should be used. These techniques should be applied in rapid sequence until the obstruction is relieved. If these measures do not remove the obstruction, direct visualisation and mechanical removal of the obstruction should be initiated.

Back blows are hard sharp blows delivered between the scapula with the heel of the palm, delivered up to five times, checking after each blow for effectiveness (ARC, 2021b). Chest thrusts are applied with the same hand position as chest compressions in CPR, but at a harder sharper rate, and as with back blows up to five thrusts should be given, checking for effectiveness between each thrust.

Airway obstruction may be partial or complete, and present in the conscious or unconscious person. Note that an obstructed airway is not always due to FBAO. Typical causes of airway obstruction may include, but are not limited to:

- Relaxation of the airway muscles due to unconsciousness
- Inhaled foreign body.
- Trauma to the airway
- Anaphylactic reaction

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. As such, the person should be observed continually.

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.

Figure 1 Universal choking sign - Source ANZCOR Guideline Universal choking sign (ARC, 2021)

Advanced Life Support

Advanced Life Support (ALS) is the provision of effective airway management, ventilation of the lungs and production of a circulation by means of techniques additional to those of BLS. These techniques may include, but not be limited to, advanced airway management, vascular access/drug therapy and manual defibrillation (ARC, 2019). “BLS is only a temporary measure to maintain ventilation and circulation. Effective external cardiac compression provides a cardiac output of only **20-30%** of the pre-arrest value, and expired air resuscitation provides ventilation with an inspired oxygen concentration of only 15-18% (ARC, 2019). The purpose of BLS is to help maintain myocardial and cerebral oxygenation until ALS personnel and equipment are available.

Electrical defibrillation is the mainstay of treatment for ventricular fibrillation and pulseless Ventricular Tachycardia (VT). The chance of successful defibrillation decreases with time. Therefore, performance of good CPR and decreasing the time to defibrillation are the first priorities in resuscitation from sudden cardiac arrest.

Time must be taken to ensure there is adequate and equal rise and fall of the chest, and that compressions are performed as well as possible. Initial careful assessment may also detect arrest causes such as airway obstruction and tension pneumothorax.

Airway assessment and management commences with the initial basic life support assessment. Advanced practitioners have a range of interventions available to them to correct or support an airway that is not initially clear. Historically, resuscitation management involved early intubation to manage a victim’s airway. Now emphasis is for early effective BLS and detection and treatment of shockable rhythms. Intubation can take valuable time to achieve and BLS may need to be paused. If the airway can be managed effectively with other methods, intubation can be delayed.

The general principles of cardiopulmonary resuscitation remain the same for ALS providers as for BLS providers: Provide good quality compressions, minimise interruptions to compressions, fill the lungs with oxygen, and provide ventilation but avoid excessive ventilation. (ARC, 2019). As soon as possible, Advanced Life Support treatments are used to **supplement** the care of any patient receiving Basic Life Support.

- Effective BLS may increase the likelihood of successful defibrillation.
- Effective BLS buys time until reversible causes can be diagnosed and treated.

Time must be taken to ensure there is adequate and equal rise and fall of the chest, and that compressions are performed correctly.

If effective CPR is paused to allow for endotracheal intubation, operators should limit the pause to 5 seconds. CPR should be re-initiated, and further attempts made after a period of effective CPR (ARC, 2018).

Oxygen

Patients who require ALS intervention should have oxygen administered if oxygen saturations fall below 94% with a targeted saturation of 94-99% (ARC, 2016). ANZCOR recommend patients not receiving CPR that are at risk of hypercapnic respiratory failure should have oxygen delivered to achieve a targeted oxygen saturation of 88-92%. A bag-valve-mask (BVM) device connected to supplemental oxygen is the best method for ventilation (ARC 2016).

“ANZCOR suggests that the highest possible inspired oxygen concentration is used on all patients during CPR to improve outcomes” “Oxygen should never be withheld because of the fear of adverse outcomes” (ARC,2016).

ANZCOR suggests that “the highest possible inspired oxygen concentration is used on all patients during CPR to improve outcomes” “Oxygen should never be withheld because of the fear of adverse outcomes” (ANZCOR 2016). Some experienced operators can manage a BVM device effectively by themselves; however, this device is designed to be used by two people (ARC, 2021). Unless CPR is being performed by a single operator, ALS responders must ensure that the device is being used effectively and ensure two operators are available, if necessary, one to hold the head and mask, and one to squeeze the bag.

There are several recognized methods to hold the BVM to the face. Studies suggest the optimal method is the thenar eminence method also known as the V-E or **Vice Grip.**

Vice Grip or VE grip. Source Promed Int

Airway adjuncts

Airway adjuncts may also increase the effectiveness of bag-valve-ventilation and negate the need for early intubation. The most frequently used is an oropharyngeal airway. The device should be used with great care in patients with oral trauma and should not be used in the semiconscious patient, because use with an intact gag reflex may induce vomiting. This device should be removed immediately if this is detected.

The nasopharyngeal airway also comes in a range of sizes and should be correctly sized to suit the individual patient (ARC, 2016). It is generally better tolerated than the oral device but has a greater risk of mucosal trauma than the oropharyngeal airway. This device should be used with great care on patients with a known or suspected basal skull fracture.

Airway adjuncts may also increase the effectiveness of bag-valve-ventilation and negate the need for early intubation (ARC, 2016).

Oropharyngeal

The oropharyngeal airway is designed to provide a patient airway channel between the tongue and the posterior pharyngeal wall.

The **oropharyngeal** airway comes in a range of sizes and should be correctly sized to suit the individual patient (ARC, 2016a). A correctly sized airway is measured from the corner of the mouth to the angle of the jaw. An oversized device may cause laryngospasm or trauma. A device too small will be ineffective.

Source Promed Int

Source Bledisloe Medical 2023

There are two common methods for insertion:

1.Enter the oral cavity from the side of the mouth, sliding down and over the tongue. (90-degree method)

Source Bledisloe Medical 2024

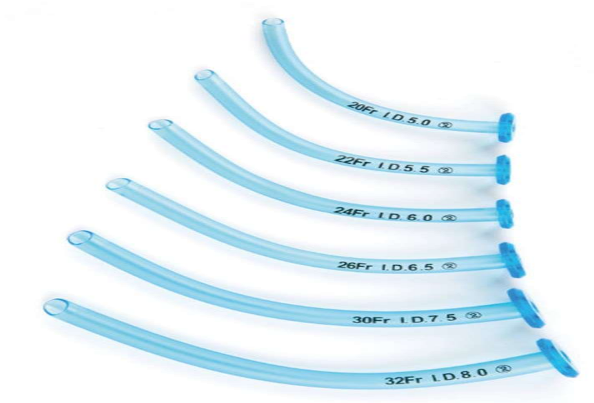
2.Insert from the centre of the oral cavity with the adjunct's angle reversed, when it reaches the back of the tongue rotate and insert it into its final position. (180-degree method)

Oropharyngeal insertion 180-degree method – Source Bledisloe Medical 2023

Both methods should be inserted under direct visual observation to reduce the risk of mucosal trauma. Be aware that injury to the soft palate is possible with the 180-degree insertion method, increasing swelling to the area. The airway should be opened with a head tilt/chin lift or jaw thrust manoeuvre (as appropriate) before attempting insertion of an oropharyngeal airway. The presence of oropharyngeal foreign body must also be excluded to avoid inadvertently causing or increasing any airway obstruction.

Nasopharyngeal

The **nasopharyngeal** airway also comes in a range of sizes and should be correctly sized to suite the individual patient. It is generally better tolerated than the oral device but has a greater risk of patient trauma than the oropharyngeal airway. This device is contraindicated for victims with base of skull fractures and even with careful well lubricated insertion is likely to cause trauma to the nasal mucosa with resulting haemorrhage.



A

Nasopharyngeal airway measuring for size.

Source Bledisloe Medical 2023

correctly sized airway is measured from the lateral edge of the nostrils to the tragus of the ear. An appropriate diameter is one that does not cause lasting blanching of the nostril.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Source Bledisloe Medical 2023

Ensure the NPD is well lubricated and observe for persistent blanching of the nares, if this occurs pressure injury could result if left insitue. Correct positioning can be observed by looking for the tube presence in the back of the oropharyns.

Advanced airway devices

In a prolonged arrest when adequately trained staff becomes available, or an adequate airway cannot be achieved by non- invasive measures Intubation may be desirable to achieve and maintain safe ventilation.

ANZCOR states that "To avoid substantial interruptions in chest compressions providers may defer an intubation attempt until return of spontaneous circulation (ROSC)" (ANZCOR 2016). And that if effective CPR is paused to allow for endotracheal intubation **"**operators should limit the pause to 5 seconds. CPR should be reinitiated, and further attempts made after a period of effective CPR" (ANZCOR 2016).

There is evidence that without adequate training and experience, the incidence of complications, such as unrecognised oesophageal intubation, is unacceptably high. Alternatives to the ETT that have been studied during CPR include the BVM device and advanced airway devices such as the laryngeal mask airway (LMA) (ARC, 2016).

“The choice of airway used should depend on the skills and training of the healthcare provider. Tracheal intubation may result in increased hands-off time in comparison with insertion of a supraglottic airway (e.g., LMA, laryngeal tube) or a bag-mask device. 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, but this has not been formally assessed” (ARC, 2016).

Cricoid pressure

Cricoid pressure is a manoeuvre where downward pressure is exerted over the cricoid cartilage to occlude the oesophagus. This is performed to help prevent passive regurgitation of stomach contents during intubation. Not all patients require cricoid pressure to be applied and it is at the discretion of the person performing the intubation if they wish it applied. Some patients are fasting thus pose little risk of regurgitation. ANZCOR suggest that cricoid pressure should be considered in all cases of emergency intubation.

Laryngeal mask airway

In comparison with BVM, use of laryngeal mask (LMA) may enable more effective ventilation and reduce the risk of gastric inflation. This device sits above the larynx and is easier to insert than an ETT, usually inserted without stopping chest compressions (ARC, 2016b). The LMA does not guarantee protection of the airway, but pulmonary aspiration is uncommon, and provided that tidal volumes do not generate high inflation pressures during intermittent positive pressure ventilation (> 20cmH2O), gastric inflation is unlikely.

Advancements in LMA technology has resulted in development of a variety of devices that vary from the classical LMA. Each type has its’ benefits. Selection and use on real patients should be preceded by several episodes of instruction and practice in a simulation environment.

LMA insertion does not require vigorous movements to align the head and neck so may be particularly useful when spinal injury is suspected.

Classic technique for the insertion of an LMA (Reichman, 2013):

- Try to insert without stopping chest compressions.
- Size: Most men - size 5. Women - size 4.
- Apply a thin layer of lubricant to the posterior surface.
- Hold LMA like a pen, insert into the mouth. Advance the tip with the upper, lubricated surface applied to the palate until it reaches the posterior pharyngeal wall. Press the mask backwards and downwards around the corner of the pharynx until resistance is felt. Inflate cuff with air (30-40 ml).

Do not hold the LMA during inflation, (the tube should lift slightly out of the mouth as the cuff finds it's correct position).

- Secure LMA with bandage or tape, and confirm position with visualisation of chest rise, or listening over the chest for air entry. A large audible air leak suggests malposition, a small leak is acceptable if associated with chest rise.

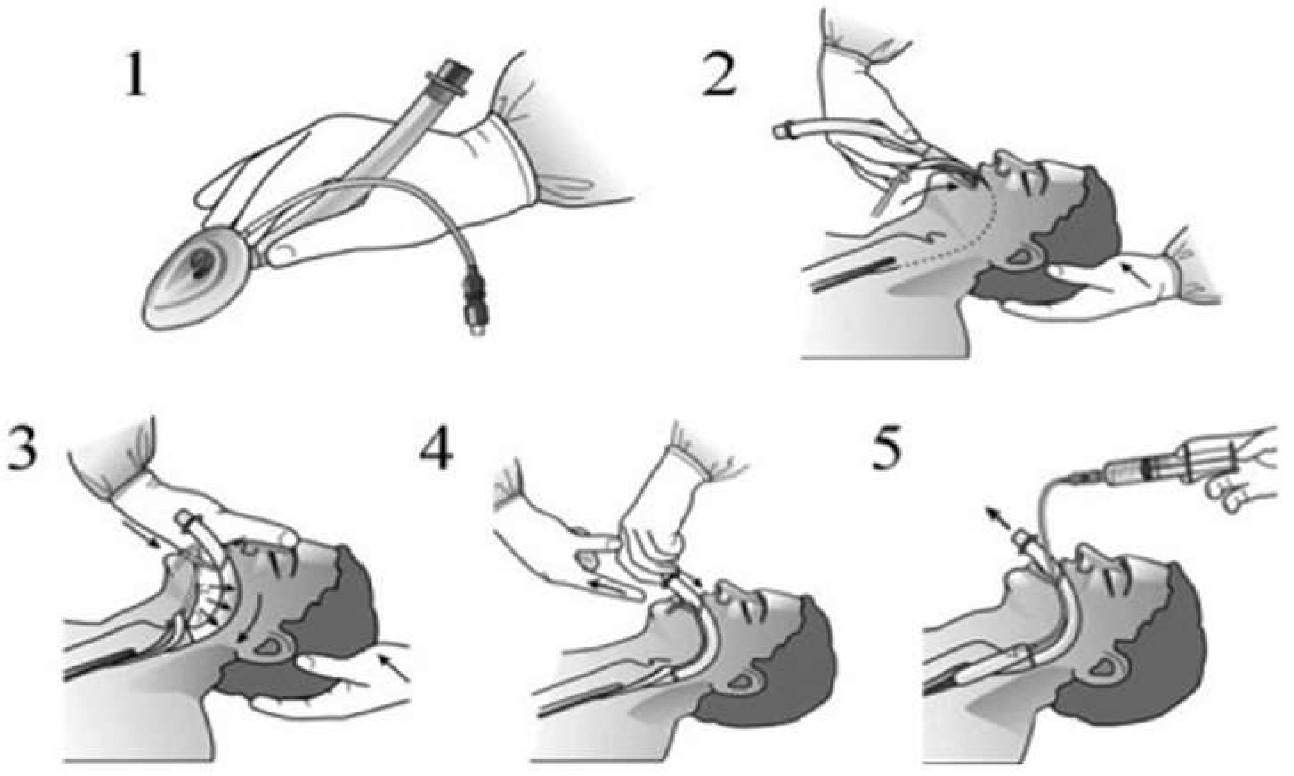


Figure 2 Manufacturer's recommended insertion technique (Courtesy of LMA North America, San Diego, CA) (Reichman, 2013)

Variations for the insertion of laryngeal mask airway are possible particularly from advanced practitioners. Proficiency in the establishment and use of an LMA should be gained under supervised practice.

In Emergency situations, LMA insertion and use should be attempted with care and abandoned if:

- Hypoventilation occurs due to excessive leak around the cuff due to high airway resistance from pulmonary disease, bronchospasm, pulmonary oedema.
- Airway foreign body cannot be excluded.

A popular variation to the LMA Classic is the i-gel (Intersurgical Australia, 2022). This more rigid device is popular for its simplicity of insertion compared to the classic LMA. There is no cuff to inflate with an i-gel. The device may leak for a minute or so as the material warms and moulds to fit the patient's anatomy.

LMA **Source Bledisloe Medical 2023**

Source Bledisloe Medical 2023

Intubation

Tracheal Intubation is more likely to be used in a prolonged arrest when adequately trained staff become available, or when effective ventilation cannot be achieved by correctly applying (ARC, 2016b):

- Airway positioning
- Suction
- Airway adjuncts
- Bag valve mask device with two operators
- LMA

This program does not teach or assess the skill of intubation; however, all ALS practitioners should be familiar with the equipment required to intubate and be able to assist a suitably trained practitioner to perform the procedure.

The application of end tidal carbon dioxide (CO2) monitoring is considered the most reliable indicator of successful placement following endotracheal intubation (ARC, 2016). Quantitative measurement of end tidal CO2 (EtCO2) may also be a safe and effective non-invasive indicator of cardiac output during CPR. An EtCO2 of at least 10mmHg is an indicator of effective CPR with adequate return of waste products to the lungs. An EtCO2 of less than 10 indicates that cardiac compressions are inadequate, or the patient is being hyperventilated, increasing intrathoracic pressure, and therefore decreasing circulation.

ANZCOR recommends using waveform capnography to confirm and continuously monitor the position of a ETT during CPR in addition to clinical assessment (ARC, 2016b). If waveform capnography is not available, a non-waveform CO2 detector can be used **in conjunction** with clinical assessment such as visualisation of chest rise, auscultation, or fogging of the ETT tube.

An abrupt rise in EtCO2 may also be an early indicator of return of spontaneous circulation in intubated patients.

Tracheostomy and Laryngectomy

Care should be taken in the initial airway and breathing assessment to identify the presence of a tracheostomy or tracheal stoma. Following a laryngectomy, a patient cannot be ventilated via the nasal or oral cavity. A patient with a tracheostomy is more likely to come to harm by not having oxygen applied to the face if confusion surrounds the nature of the stoma. The default emergency action is to apply oxygen to the face and stoma. Any oxygen applied to the upper airway can be removed in the case of laryngectomy once this has been confirmed to be the case. (ARC, 2019)

Ventilation of a laryngectomy patient or a patient with a tracheostomy should be achieved by:

- Connecting the bag valve mask device directly to the tracheostomy
- Ventilating with a bag value device using an infant face mask, or an adult mask turned sideways over the stoma.

Reversible Causes of Cardiac Arrest

The common causes of cardiac arrest may be divided into cardiac and non-cardiac causes (ARC, 2018). It is important that the ALS provider has a clear understanding of these causes, the pathophysiology behind them and suitable treatment regimens for them. The chance of patient survival will depend on the discovery and successful reversal of the cause of arrest. To determine the cause of a refractory arrest, the physical observations, patient history and precipitating events may give the rescuer an indication of the arrest cause (ARC, 2018). The rescuer should undertake interventions based on the presumed aetiology (cardiac or non-cardiac).

The 4Hs and 4Ts are a simple reminder of conditions that may precipitate cardiac arrest or decrease the chances of successful resuscitation (ARC, 2018). These conditions should be sought and, if possible corrected.

- Hypoxaemia
- Hypovolaemia
- Hyper/hypokalaemia & metabolic disorders
- Hypo/hyperthermia
- Tension pneumothorax
- Tamponade
- Toxins / poisons / drugs
- Thrombosis-pulmonary/coronary

In the setting of non-shockable lethal arrythmias, rapid consideration of reversible arrest causes becomes paramount (ARC, 2018). Of note, evidence suggests that most in-hospital PEA arrests have hypoxia as a primary reversible cause.

Types of Lethal Arrhythmias

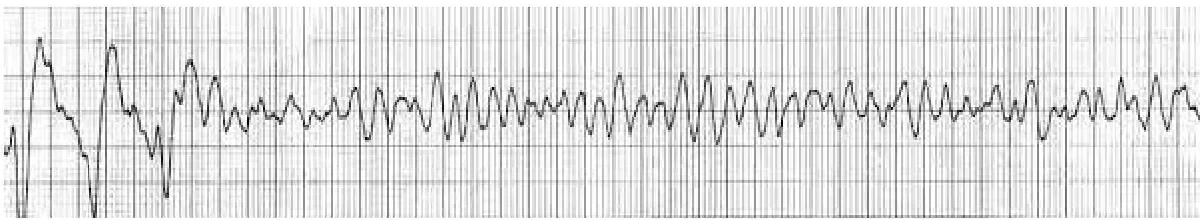
The recognition of conditions and their associated treatments should follow ANZCOR protocols in a coordinated fashion (ARC, 2018). Treatment types can be broadly classified into two categories: Those that can be treated with defibrillation, and those that do not respond to defibrillation.

There are three main shockable rhythms, Ventricular Fibrillation (VF) and pulseless Ventricular Tachycardia (VT), including pulseless Torsades de Pointes (ARC, 2018).

Ventricular Fibrillation (VF)

In this rhythm the ventricular fibres are all quivering independently, there is no coordinated contraction, and therefore there is no cardiac output.

Ventricular Fibrillation



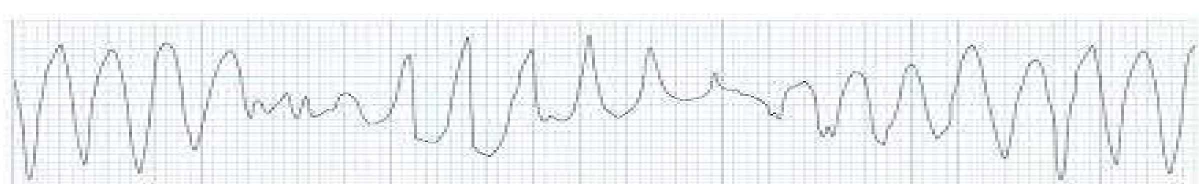
Ventricular Tachycardia (VT)

VT is a rapid irritable rhythm that arises in the ventricles. The person may be asymptomatic, compromised, or in full cardiac arrest. Pulseless Ventricular Tachycardia is treated as ventricular fibrillation. Conscious (pulsed) VT will be treated under the tachycardia algorithm, discussed later.

Ventricular Tachycardia

Torsades De Pointes

Torsades de Pointes is a variant form of ventricular tachycardia in patients with a prolonged QT, commonly caused by drugs, low potassium, calcium, or magnesium, and may cause cardiac arrest (ARC, 2009). If the patient is pulseless, they are treated the same way as VF and defibrillated immediately. The treatment variation between the shockable rhythms is the addition of Magnesium Sulphate 5 mmol bolus (this may be repeated once) if the rhythm is Torsades de Pointes.



Defibrillation

Defibrillation is delivery of energy to the myocardium to depolarise all myocardial cells simultaneously, with the aim of enabling the natural pacemaker tissue (sinus node) to resume control (ARC, 2016).

When cardiac output ceases, cerebral injury begins to occur within 3min. The chance of successful defibrillation decreases with time (ARC, 2016). **Therefore, the performance of good CPR and decreasing the time to defibrillation are the highest priorities in resuscitation from sudden cardiac arrest.**

As stated, good quality CPR may achieve up to 30% of normal cardiac output, however this equates to less than 10% of normal coronary artery flow (ARC, 2019). It is therefore essential that defibrillation is applied as soon as possible, in conjunction with high quality CPR to increase the likelihood of successfully converting the rhythm. As the myocardium becomes successively more hypoxic with time, chance of defibrillation success drops drastically, even with high quality CPR. Data indicates that most patients who survive a shockable rhythm are successfully defibrillated within five minutes of entering the arrest state.

“The amplitude and waveform of VF deteriorate as high energy phosphate stores in the myocardium decrease. This rate of decrease can be slowed, or even reversed by effective BLS” (ARC 2018).

Basic defibrillation treatment principles:

- Start efficient CPR as soon as possible.
- Do NOT pause chest compressions for greater than 5 seconds.
- Apply a defibrillator as soon as it is available.

Recommended Energy Levels

There are a variety of defibrillators available, each supplied with manufacturer recommendations for energy levels. ANZCOR recommend following the manufacturer’s recommendations or the following:

- Monophasic: the energy level for adults should be set at maximum (usually 360 Joules) for all shocks
- Biphasic waveforms: the default energy level for adults should be set at 200 Joules.

ANZCOR also suggests a strong correlation between survival and early successful defibrillation. ANZCOR recommends that “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” (ARC, 2016).

Shock protocol

There are two distinct defibrillation processes for manual defibrillation:

1. **For the unconscious patient found not breathing and with no monitoring in place.**

In this instance, the recommendation is that CPR be initiated first and then a defibrillator applied while continuing compressions during application of pads. Compressions should continue while the defibrillator is charging and then paused for rhythm interpretation and shock delivery if a shockable rhythm is detected (ARC, 2016).

2. **For a monitored and witnessed arrest.**

ANZCOR recommend a sequence of 3 stacked shocks be considered in some cases of monitored witnessed arrests (ANZCOR, 2011; ARC, 2019), but clearly indicate **"the patients need to be in a well oxygenated, well perfused state immediately before the arrest."** (ARC, 2011, p.8).

Defibrillation recommendations are based on the knowledge that myocardial oxygen levels directly affect the likelihood of defibrillation success. The single shock protocol was adopted to reduce the time CPR is paused, however, ANZCOR acknowledges that there are times when the single shock protocol may be modified (ARC, 2019).

- **In a witnessed, and monitored setting** - when the defibrillator is immediately available (e.g., first shock able to be delivered within 20 seconds)
- **Immediate post cardiac surgery** cases, as the adverse effects of external cardiac compressions may be more significant after cardiac surgery (Disruption of grafts, valves etc.).

Note: When delivering 3 stacked shocks, the time required for rhythm recognition and for re-charging the defibrillator is short (i.e., < 10 seconds) (ARC, 2011).

Stacked shocks should be given as fast as possible; therefore, it is reasonable to use 200 joules for each shock with consideration given to increasing the defibrillation energy for the next single shock event in 2 minutes. CPR should not be performed between the three stacked shocks, as this makes it more difficult for rhythm recognition to occur.

How to perform a 3 stacked shock sequence in a monitored witnessed cardiac arrest:

In critical care areas (e.g., emergency department, coronary care, intensive care, cardiac catheter laboratory, operating theatres), when a monitored and witnessed sudden cardiac arrest occurs in **a previously well oxygenated and perfused patient, and a defibrillator is rapidly available (< 20 sec) or** may already be attached to the patient (ARC, 2019 11.1; ARC, 2016).

3. Confirm cardiac arrest and shout for help.
4. If the initial rhythm is VF/pulseless VT, administer up to three quick successive (stacked) shocks (without commencing chest compressions)

5. Rapidly check for a rhythm change between each shock, and if appropriate (i.e., the rhythm becomes organised), check for a pulse and other signs of return of spontaneous circulation (ROSC) after each defibrillation attempt
6. If the third shock is unsuccessful (i.e., patient “does not have ROSC within 10 seconds”, or the rhythm is asystole or PEA, start chest compressions and continue CPR following the ALS algorithm. Consider any special circumstances of the arrest (see ANZCOR Special Circumstances Guideline 11.10, (ARC, 2011).
7. A precordial thump may be used immediately whilst awaiting the arrival of a defibrillator in a monitored VT arrest. This is not recommended for VF, as it is ineffective (ARC, 2019a).

Use of oxygen therapy during defibrillation

The removal of high flow oxygen from the patient during defibrillation when using **paddles (as opposed to pads) is recommended,** as there have been fires reported due to sparking in oxygen rich environments (ARC, 2016). Current recommendations following the wide ranged use of stick-on pads is to avoid the flow of concentrated oxygen across the chest during defibrillation, however ANZCOR also states “There are no case reports of fires caused by sparking when shocks were delivered using adhesive pads” (ARC, 2016).

Whatever, it is current practice to remove the oxygen source from the patient when the defibrillator is being charged.

Single shock defibrillation protocol

↓

Patient is found unconscious and not breathing, commence BLS and apply defibrillation pads as soon as possible.

↓

Continue chest compressions and remove oxygen while charging defibrillator to 200 joules.

↓

When fully charged stop chest compressions and evaluate cardiac rhythm?

↓

If shockable rhythm exists defibrillate and immediately recommence BLS

(Increase defibrillation joules to maximum for next and any subsequent shocks)

Stacked shock protocol.

Patient is conscious is on a cardiac monitor and has a witnessed arrest,

- **Call for help.**

↓

- **If a defibrillator is immediately available (within 20 seconds)**
- **The cause is NOT central hypoxaemia.**
- **apply defibrillation pads.**

↓

- **Do not start BLS.**
- **Charge to 200j**

↓

- **Defibrillate the patient and immediately recharge the defibrillator to 200j.**
- **Check rhythm and if unchanged defibrillate again.**
- **Check rhythm and if unchanged defibrillate a 3rd time.**

↓

- **Commence BLS and prepare to defibrillate at 360j in 2 minutes if rhythm is still unchanged.**

(check rhythm between shocks and stop if shock 1 or 2 is successful)

“Coached” mnemonic for Defibrillation.

The C.O.A.C.H.E.D. Approach:

C: Continue compressions

O: Oxygen away (1 metre away)

A: All others away (visual check)

C: Charging (top clear, middle clear, bottom clear)

H: Hands off (state - "*I am safe*")
(if Mechanical CPR state - "*pause compressions*")

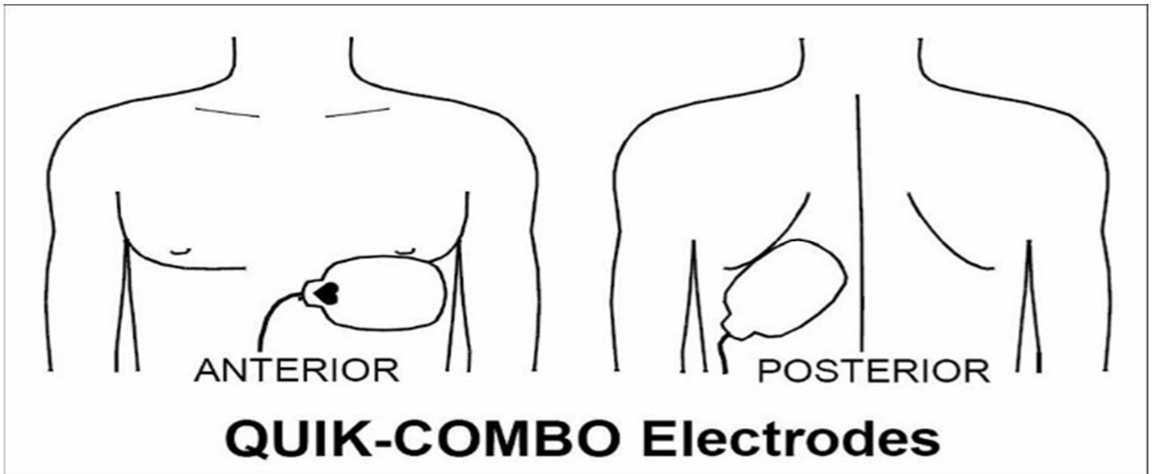
E: Evaluate rhythm

D: Defibrillate or disarm charge

Defibrillation Pad Placement

It is reasonable to place paddles or pads on the exposed chest in an anterior-lateral position. One paddle or pad is placed on the mid axillary line over the 6th left intercostal space and the other on the right parasternal area over the 2nd intercostal space. Alternative positions are the anterior-posterior (for paddles and pads) and apex-posterior (for pads). In large-breasted individuals it is reasonable to place the left electrode pad (or paddle) lateral to or underneath the left breast, avoiding breast tissue. Consideration should be given to the rapid removal of excessive chest hair prior to the application of pads/paddles but emphasis must be on minimizing delays in shock delivery. (ANZCOR 2016.) ANZCOR has noted that some studies have shown that defibrillating close to a pacemaker or implanted defibrillation device (ICD) can cause damage to the device; thus, where possible steps should be taken to reduce damage risk (ARC 2016).

In the presence of an implanted pacemaker, the placement of pad/paddles should not delay defibrillation. When treating an adult with a permanent pacemaker or an ICD, the defibrillator pad should be placed on the chest wall ideally at least 8 cm from the device position. The anterior-posterior and anterior-lateral pad placements on the chest are acceptable in patients with a permanent pacemaker or ICD (ARC 2016).



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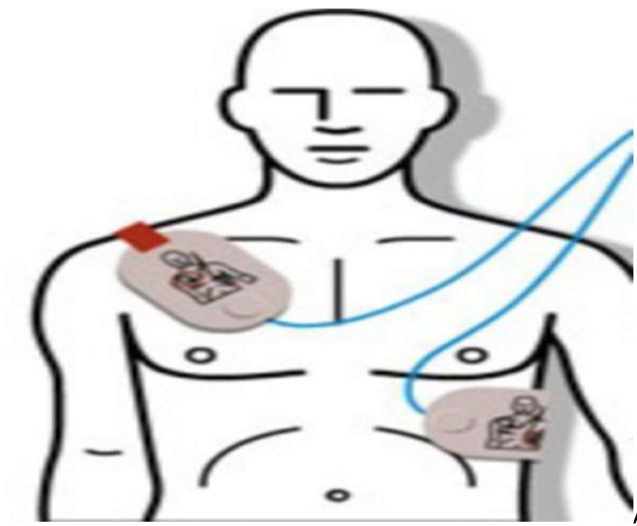


Anterior Lateral Pad position

Impedance

Impedance is the resistance to energy flow (ARC, 2016). Therefore, the greater the impedance the less energy from the pads reaches the target organ. It is important to have the correct position and ensure optimal contact with the skin. All items that may interfere with this contact should be removed, i.e., any moisture, ECG dots, drug patches, or jewellery. The amount of impedance is difficult to determine, as it relates to body mass, temperature, diaphoresis, and quality of the contact with the pads.

Precordial Thump

A precordial thump is a single blow to the mid sternum when a monitored patient develops Pulseless Ventricular Tachycardia. This technique can be attempted when a defibrillator is not immediately available i.e., within 20 seconds (ARC, 2011)

The rescuer gives a single blow to the centre of the victim's chest from the height of 25-30 centimetres (about the height of the shoulder) with the underside of a closed fist (ARC, 2011).

Points to remember about the Precordial thump:

- It is to be used as a once-only sharp hard blow to the mid sternum.
- Patient arrest must be monitored and witnessed.
- **Rhythm must be pulseless ventricular tachycardia.**
- **Performed within the first 20 seconds of arrest.**

Review points:

- Defibrillation is not to be delayed by performing a precordial thump.
- Precordial thump should not be used for an un-monitored arrest.
- Precordial thump is only recommended for a monitored witnessed arrest when a defibrillator is not available, and the arrest rhythm is Ventricular Tachycardia

Lethal Rhythms that do not require defibrillation.

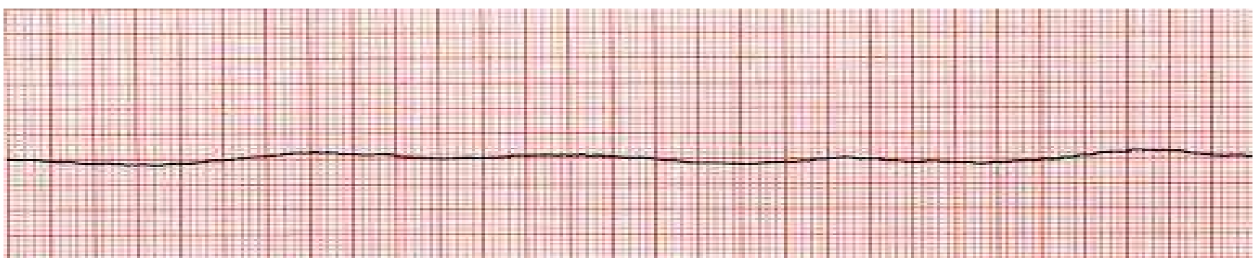
(Non-Shockable Rhythms)

There are two distinct rhythm types that present as lethal and do not respond to defibrillation.

- Asystole
- Pulseless Electrical Activity (PEA)

Asystole

Asystole is a cardiac state of no electrical activity (ARC, 2018). Treatment for this is CPR and drug therapy. The cardiac tissue is depolarized, therefore there is no benefit from defibrillation. There is a risk that fine Ventricular Fibrillation could be mistaken for Asystole. To clarify the asystole diagnosis, the size or gain may be increased on the monitor to amplify the input. The patient and monitor lead connections should also be checked to ensure accuracy in rhythm diagnosis.



Asystole is a rhythm used to confirm death, as it is cardiac standstill. A small number of people are resuscitated from asystole when early CPR is established, and reversible causes are rectified, however prolonged efforts at resuscitation are usually futile.

Pulseless Electrical Activity (PEA)

PEA is not a specific rhythm; the name is given to any organised rhythm that should normally provide a cardiac output (ARC, 2018). In PEA, the patient is unconscious and without a pulse. Defibrillation is ineffective for PEA, as the patient already has an organised rhythm, just lacks pulsatile activity.

Pharmacological Management

The administration of medication in ALS occurs only after the priorities of early recognition and initiation of emergency response system, early CPR and early defibrillation have been addressed.

Intravenous drug administration is the preferred route but must be followed by a minimum of 20 to 30mls IV fluid flush and effective CPR to ensure circulation of the drug to its target sites (ARC, 2016). If a central line is present, it should be used as it provides more rapid drug delivery.

Intraosseous (IO) route is the preferred route if intravenous access cannot be established (ARC, 2016). IO access has been found to be safe and effective for fluid resuscitation, drug delivery and laboratory studies.

Drugs commonly used in the shockable lethal arrest algorithm:

Vasopressors

Vasopressors influence the diameter of blood vessels by contracting vascular smooth muscle in the vessel walls. The goal of using vasopressors in cardiac arrest is to constrict peripheral blood vessels to improve central perfusion, and to increase myocardial contractility. The desired effect is improved perfusion of the heart and brain. Profound vasoconstriction can be a consequence of very high doses of vasopressors, which can ultimately lead to peripheral necrosis because of reduced blood flow to the peripheries.

The use of vasopressors in cardiac arrest remains the current practice, however research is ongoing.

“Although there is evidence that vasopressors (adrenaline (epinephrine) or vasopressin) may improve return of spontaneous circulation and short-term survival, there is insufficient evidence to suggest that vasopressors improve survival to discharge and neurologic outcome” (ARC, 2016).

Adrenaline (Epinephrine)

Indications	Dose
Cardiac arrest with a shockable rhythm	1mg IV/IO every 4 minutes (i.e., every second “loop” or “cycle” of the ALS algorithm)

Adrenaline is available in two dilutions:

10mL ampoule or Minijet®: 1 in 10 000 (10mls of this solution contains 1mg of adrenaline) 1mL ampoule: 1 in 1000 (1ml of this solution contains 1mg of adrenaline)

Action

- Adrenaline 1mg IV / IO given immediately after the second shock for treatment of shockable rhythms, then every second 2-minute loop (i.e., every 4 minutes thereafter) (DynaMed, 2023).

Anti-arrhythmics

The role of an anti-arrhythmic is essentially to block and stop arrhythmias. As is the case with vasopressors, the evidence that anti-arrhythmic drugs are of longer-term benefit in cardiac arrest is limited. No anti-arrhythmic drug (amiodarone, lignocaine, magnesium) has been proven to increase survival to discharge. Additionally, it is possible for anti-arrhythmic drugs to be pro-arrhythmic.

Amiodarone

"Amiodarone is an antiarrhythmic drug with complex pharmacokinetics and pharmacodynamics. It has effects on sodium, potassium, and calcium channels as well as alpha and beta-adrenergic blocking properties"(ARC, 2016).

Indications	Dose
Pulseless Ventricular Tachycardia Ventricular Fibrillation Or Conscious Tachycardia	Initial bolus dose of 5mg/kg or 300mg IV/IO (additional 150mg can be considered) 300mg diluted in Dextrose given as infusion over 20-60 minutes

Note: Amiodarone is contraindicated for Torsades de Pointes.

- Administer after third shock, if VT/VF has proven refractory to defibrillation and adrenaline. Consider additional 150mg if VT/VF persists'.

The main role of amiodarone is to slow down the action potential, limiting the speed at which electrolytes can cross the cell membrane. Amiodarone increases the time taken to depolarise and repolarise, thus terminating the cycle. It should be noted that the QT interval is also lengthened, which is why Amiodarone is an agent that should **not be used in cases of Torsades de Pointes.**

Lidocaine (lignocaine)

Indications	Dose
Pulseless VT / VF (When amiodarone is not available)	Initial bolus dose of 100mg IV/IO (1 - 1.5mg /kg). An additional 50mg can be considered. Maximum dose is 300mg in a one-hour period.

Lidocaine (lignocaine) is given initially as a 1mg/kg bolus (ARC, 2016e). During resuscitation, an additional bolus of 0.5 mg/kg may be considered. It is not recommended to commence a lidocaine (lignocaine) infusion until return of spontaneous circulation.

Lidocaine is recommended for use during ALS when amiodarone is unavailable. Lidocaine is a membrane-stabilising anti-arrhythmic drug. It decreases ventricular automaticity, and its local anesthetic action suppresses ventricular ectopic activity. Lidocaine suppresses activity of depolarized, arrhythmogenic tissues. Therefore, it is effective in suppressing arrhythmias associated with depolarisation (e.g., ischemia, digitalis toxicity), but is relatively ineffective against arrhythmias occurring in normally polarised cells (e.g., atrial fibrillation/flutter).

Magnesium Sulphate

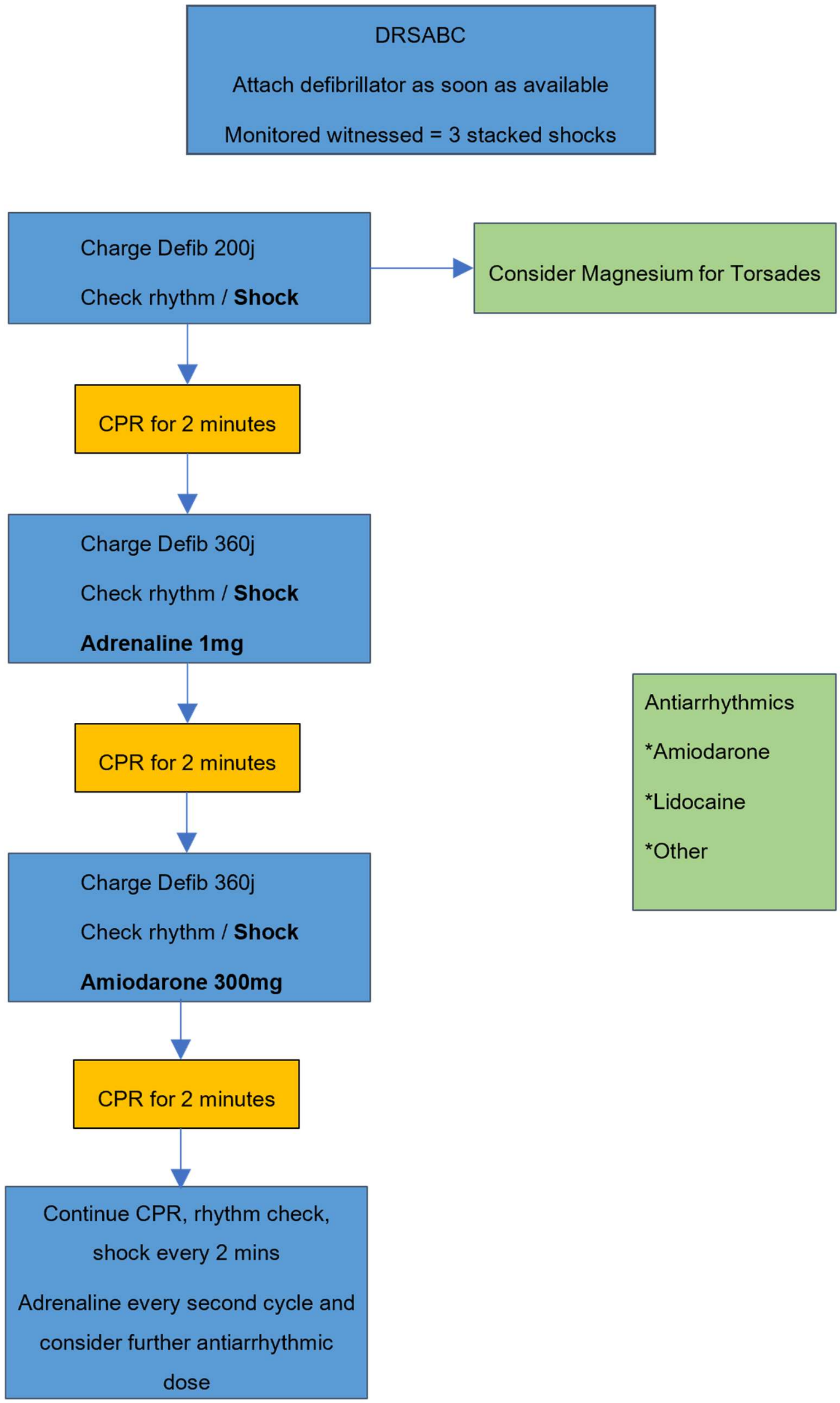
Indications	Dose
Torsades de Pointes, Ventricular or supraventricular tachycardia associated with hypomagnesaemia, Digoxin toxicity	5mmol bolus (ARC) May repeat dose once after 10–15 min

Magnesium is the second most prevalent intracellular cation in the body and has an important role in supporting membrane stability. Low magnesium levels cause myocardial hyperexcitability, particularly when hypokalaemia is present. There is insufficient evidence for or against its use in cardiac arrest (ARC, 2016e)

Consider Magnesium administration for:

- Hypomagnesemia
- Torsades de Pointes
- Documented hypokalaemia

Shockable Algorithm

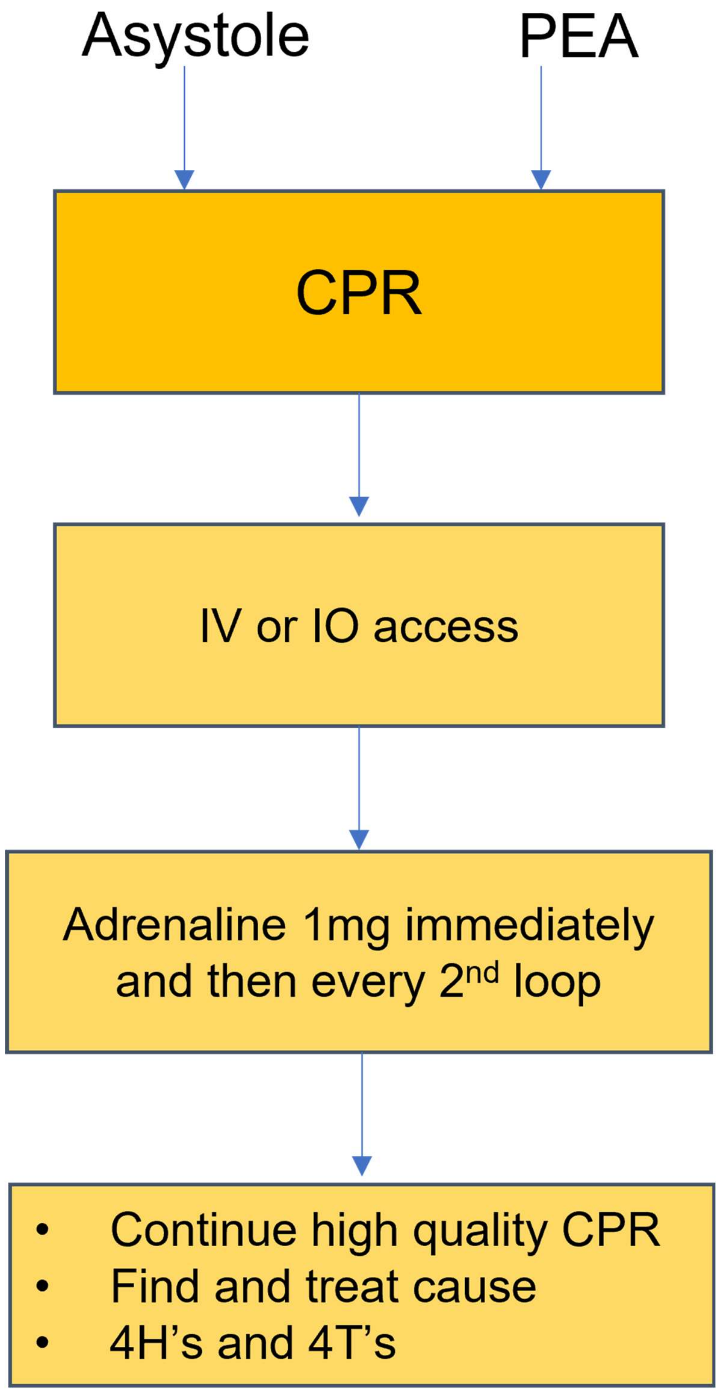


Review points

8. A defibrillation shock is delivered as soon as a defibrillator is available.
9. Pads are placed on the exposed chest in an anterior-lateral position or an anterior-posterior position.
10. In patients with an implanted cardioverter/defibrillator (ICD) or a permanent pacemaker, the defibrillator pad/paddle is placed on the chest wall ideally at least 8 centimetres from the generator position.
11. For Monophasic waveforms: the initial energy level for adults is set at maximum (usually 360 Joules) for all shocks.
12. For Biphasic waveforms: The default energy level for adults is set at 200 Joules for shocks.
13. If the first shock is not successful and the defibrillator can deliver shocks of higher energy, it is reasonable to increase the energy to the maximum available for subsequent shocks.
14. A single shock strategy is used in patients in cardiac arrest requiring defibrillation for VF or pulseless VT.
15. Up to 3 stacked shocks may be given as the first shock event in the treatment of a monitored and witnessed arrest where a defibrillator is immediately available promptly **(within 20 seconds) if the patient was not hypoxic prearrest.**
16. Intravenous (IV) administration is the preferred means of administering medications to patients during or after cardiac arrest, followed by IO access.
17. Given the observed benefit on short-term outcomes, standard dose adrenaline (epinephrine) is administered to adult patients in cardiac arrest.
18. Vasopressin is not to be added to standard dose adrenaline (epinephrine) during cardiac arrest.
19. Given the observed benefit on short-term outcomes, amiodarone is used in adult patients with refractory VF/VT.
20. Other drugs, including calcium, lidocaine (lignocaine), magnesium (magnesium sulphate heptahydrate), potassium, sodium bicarbonate (and other buffers) may be considered to help manage conditions that are associated with patients who have arrested.
21. Fibrinolytics should not be used routinely in cardiac arrest but may be used when pulmonary embolus is the suspected cause of cardiac arrest.

Treatment protocol for non-shockable lethal rhythms

Non-Shockable Arrest Rhythms



Drugs commonly used when considering the reversible causes of arrest:

Sodium Bicarbonate

Cardiac arrest can result in combined respiratory and metabolic acidosis (ARC, 2016e). The routine use of sodium bicarbonate for the treatment of presumed intra-arrest acidosis is no longer recommended, but it may be considered for severe metabolic acidosis and prolonged (>15 minutes) arrests. High quality CPR, including adequate ventilation, should negate the need in many cases for buffers such as bicarbonate.

Consider administration of **1mmol/kg over 2-3** minutes for (DynaMed, 2023):

- Hyperkalaemia
- Treatment of documented metabolic acidosis
- Protracted arrest (>15min)
- Tricyclic antidepressant overdose

Calcium

Routine administration of calcium in cardiac arrest is not recommended, as there is no demonstrated benefit to discharge (ARC, 2016e). There is potential for deleterious effects such as an increase in myocardial and cerebral injury by mediating cell death and tissue death at the injection site if extravasation occurs (ARC, 2016).

Calcium is available in two forms:

Calcium chloride 10% 10 mL amp (10mls contains 6.8mmols of Ca2+ ions), and Calcium gluconate 10mL amp (10mL contains 2.2mmols of Ca2+ ions), for either formulation, the dose is 10 mL (DynaMed 2023).

It can be given for:

- Hyperkalaemia. Calcium improves cardiac contractility, whereas hyperkalaemia reduces that contractility, but does not influence serum K+ levels.
- Hypocalcaemia
- Overdose of calcium-channel blocking drugs

Fibrinolytics

ANZCOR states the routine use of fibrinolytics in cardiac arrest is not recommended (ARC, 2016e). An increased risk of intracellular bleeding has been identified. Fibrinolytics should be considered for patients with strongly suspected or known pulmonary embolism (ARC, 2011). If fibrinolytics are used in these circumstances, consider continuing CPR for at least 60-90 minutes before termination of resuscitation.

Fluids

“Whether fluids should be infused routinely during cardiac arrest is controversial” Fluid administration during cardiac arrest may be considered to ensure normovolaemia, with the recommendation of at least 20mL/kg of isotonic fluids if hypovolaemia is suspected (ARC, 2016e), but in the absence of hypovolaemia to begin with, infusion of an excessive volume of fluid is likely to be harmful (Soar et al., 2015, p.125) A manual blood pump giving set should be used to administer fluid (particularly via IO route). The 2015 European Resuscitation Council guidelines suggest that in the initial stages of resuscitation normal saline (0.9% NaCl) or Hartmann’s Solution may be used and that glucose solutions should be avoided, due to redistribution of the fluid away from the intravascular space, hyperglycaemia, and possibly worsened neurological outcome (Soar et al., 2015, p.125). Infusions of 5% dextrose may cause fluid overload and a resultant dilution of serum electrolytes and possible peripheral and pulmonary oedema.

Assessment of fluid status during cardiac arrest is difficult and may be largely based upon the patient’s presenting history and symptoms.

Conscious Arrythmias

As the name suggests, conscious rhythms are those where the patient can sustain a cardiac output sufficient to maintain cerebral perfusion (ARC 2009). These rhythms require prompt treatment, as the patient's ability to deliver adequate cardiac output through other compensatory measures is often limited (DynaMed, 2023; DynaMed, 2023). These rhythms include:

- Bradycardia
- Broad complex tachycardia
- Narrow complex tachycardia

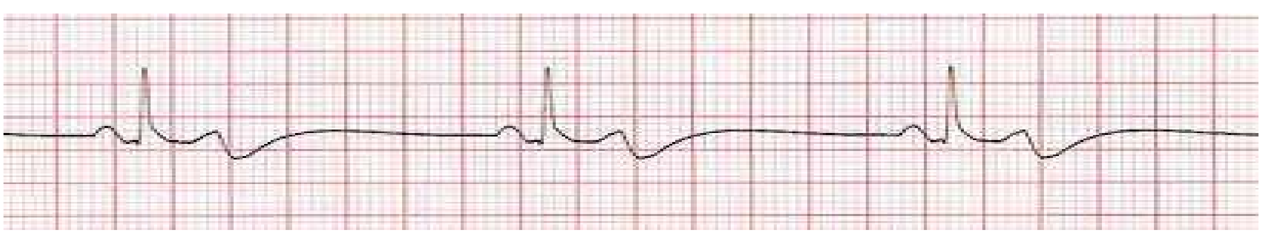
Determining how aggressively to act in these instances revolves around a key point- is the patient compromised (unstable)? Signs of a compromised, unstable patient include:

- Unstable hypotension
- The arrythmia is causing acute, coronary type chest discomfort.t
- Acute altered mental status, indicating poor perfusion.
- Acute pulmonary oedema or fulminant congestive cardiac failure

Bradycardia

This term bradycardia is given to any organised rhythm where the pulse is less than 60 beats per minute (ARC 2009; ARC 2016c; DynaMed, 2023b). Types of rhythms that fall into this category can include:

- Sinus Bradycardia
- Junctional rhythm
- Heart blocks



The determining factor for treatment for all bradycardias, irrespective of type, is whether the patient is compromised. Patients with bradycardia do not require emergency treatment when they have no adverse symptoms. Adverse symptoms include, but are not limited to:

- Dizziness, light-headedness,
- loss of consciousness,
- Fatigue, weakness, nausea, shortness of breath.

Causes

- Cardiac Ischemia / Infarction
- Heart Block (conduction abnormalities)
- Cardiac Trauma
- Endocarditis
- Electrolyte imbalance
- Drugs

Drugs Commonly Used in the Bradycardia Algorithm

In treating bradycardia, it is important to consider the cause; however, this should not delay implementation of the symptomatic bradycardia algorithm in a compromised patient (ARC, 2009; DynaMed, 2023). ANZCOR recommends the following drugs for treatment of symptomatic bradycardia:

1. Atropine is an anticholinergic agent that is used to block the parasympathetic branch of the vagus nerve; this allows sympathetic stimulation to increase heart rate (ARC, 2009; DynaMed, 2023). Dose is 500-600 mcg repeated every 3-5 minutes with a maximum dose of 3mg.

Atropine Sulphate

Indications	Dose
Symptomatic, compromised bradycardia	500-600mcg May repeat dose every 3-5 min, MAX 3mg

1. If Atropine fails, low dose Adrenaline or another vasopressor agent is the second line, either by bolus or infusion (ARC, 2009). Adrenaline is usually administered at a rate of 2-10 mcg/min. In some instances, micro bolus doses of Adrenaline 10 – 100mcg may be necessary but should only be administered by experienced practitioners.

Adrenaline (epinephrine)

Indications	Dose
Symptomatic, compromised bradycardia resistant to atropine therapy	Drip: 2-10 mcg/min May consider 10-20 mcg bolus dosing PRN

Other drugs that may be utilised could include:

- Isoprenaline, Dopamine, Theophylline, Glycopyrrolate.
- Also consider IV Glucagon, or insulin / glucose / K+ therapy for beta-blocker or calcium channel blocker overdose.

An alternative to second line vasopressor agents is electrical pacing, via either an external or internal route (ARC, 2009)

Transcutaneous pacing

Transcutaneous pacing is primarily used for the treatment of symptomatic bradycardia (ARC, 2009). Large adhesive pads (same as for defibrillation - multifunction pads) are used to pass an electrical current through the chest wall and heart. External cardiac pacing is used as a therapeutic bridge until a more permanent option can be initiated. i.e., internal pacing or drug therapies. Cardiac pacing in contraindicated in patients with severe hypothermia.

External pacing requires very little set up time or equipment and does not include any of the complications associated with invasive pacing techniques (ARC, 2009; DynaMed, 2023b). It is the least expensive mode of pacing and is especially useful for patients at high risk of bleeding or infection. The major disadvantage of non-invasive pacing is discomfort. Current applied across the chest results in both cutaneous nerve stimulation at the site of the pads and skeletal muscle stimulation and may cause some discomfort to the patient.

There are two distinct modes of external cardiac pacing, Demand and Non-Demand pacing. Non- Demand mode may also be referred to as fixed, or asynchronous.

Demand Pacing

In demand mode, the pacemaker delivers an impulse only when it is required. In this mode, the pacemaker will search for the intrinsic beat and, if it is not detected within a designated interval, it will deliver an impulse. The pacemaker operating in demand mode will sense patient’s intrinsic beat. It will measure the distance between the patient’s R waves, the greater the distance between R waves the slower the rate. In demand mode, the impulse will only be delivered when the intrinsic rate falls below the minimum heart rate set by the operator and will stop pacing when the intrinsic rate is above that set as a minimum by the operator.

Demand pacing is the preferred and safest mode of pacing, as it reduces the chance of the patient receiving a pacing impulse in addition to an intrinsic beat. Such an occurrence could result in an R on T phenomenon and lead to ventricular dysrhythmias. Note that to pace in demand mode, the pacemaker must also have continuous ECG monitoring of the patient. This is required to allow the pacemaker to detect the intrinsic rhythm.

Non-Demand Pacing

This mode of pacing delivers an electrical stimulus at the selected rate regardless of the patient's intrinsic rhythm. In other words, the pacemaker delivers current at selected rate and ignores intrinsic beats. During non-demand pacing, competition between the pace stimulus and the patient's intrinsic beat can occur, increasing theoretical risk of an R on T event.

Most pacemaker devices default to the preferred demand pacing mode, provided the diagnostic limb leads are in place. The option of non-demand mode may need to be selected on those occasions when the intrinsic rhythm R waves cannot be clearly identified. This can occur due to artefact, low impulse voltage, irregular rhythms or those rhythms affected by ectopic beats.

Pad Placement

As with defibrillation, pad placement can be anterior / lateral or anterior / posterior; however, the anterior / posterior placement is the most utilised and preferred placement, as capture can usually be achieved with lower energy levels, which should be more comfortable for the patient. (Striker, 2019)

As the pacing impulse originates from only one of the adhesive pads, the manufacturers recommend that the pad from which the impulse originates be placed closest to the myocardium, as a lower current is usually required to achieve capture (Striker, 2019). This pad can be identified by a small red heart-shaped symbol on the non-adhesive side of the pad. In a severely unstable patient, consider commencing pacing prior to analgesia.

Capture

Electrical capture occurs when a pacing stimulus results in cardiac cell depolarisation and ventricular contraction is seen on the ECG monitor (Striker, 2019; Doukky et al., 2019). Note that this complex is usually seen as a broad ventricular complex. Mechanical capture is the contraction of the myocardium and is evidenced by the presence of a palpable pulse and signs of improved perfusion and increased blood pressure (REF).

Note*: Skeletal muscle contraction is evident with pacing energy levels as low as 10mA and should not be viewed as evidence of mechanical capture.*

Selecting Mode, Rate and Current

Most pacemakers default to demand mode, as this is considered the safest mode of pacing and should be selected if patient intrinsic rhythm allows (Striker, 2019). The pacing rate should be selected with a rate high enough for adequate perfusion (usual rate range is 60-90bpm for adult external pacing). Once capture is achieved, the energy is set 5-10mA above the pacing threshold to ensure that capture is maintained.

Patient Discomfort

External cardiac pacing can be distressing to both the patient and patient family members. The physical effects of skeletal muscle stimulation are confronting to relatives and painful to the patient. Care should include explanation and reassurance of the process and consideration of analgesia and sedation for all conscious patients. Analgesia and sedation at very low levels should be given as the patient requires.

Safety Precautions and Care

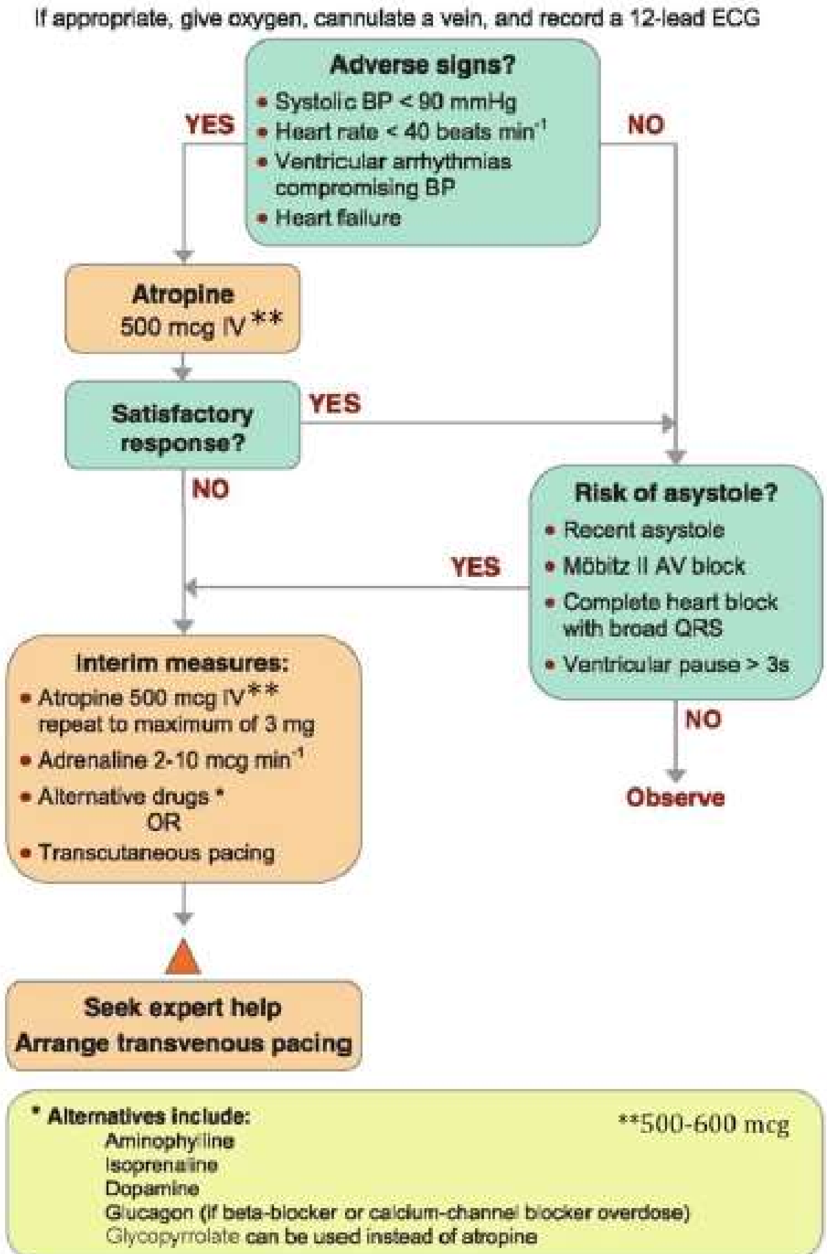
- In most cases it is quite safe to touch and care for the patient while they are being paced. Occasionally, the operator may experience a slight tingling or muscle twitching in the hands- thus gloves should be worn.
- Pacing thresholds can change, and loss of capture can occur. For the patient to remain compliant, frequent re-assurance and assessment for pain relief is needed. To ensure safety, patients should never be left unattended.
- Care should be 1:1 and include frequent observations of vital signs, the underlying rhythm and pacing threshold.
- The treatment with IV fluid should only occur following assessment by a medical practitioner, as unlike other forms of shock, bradycardic hypotensive patients generally do not have a circulating fluid deficit. Fluid boluses for these patients may lead to issues of overload.

Emergency Transcutaneous Pacing Procedure:

- Seek expert help.
- Ensure monitor cable connected to defibrillator. Identify the pacing controls and how to adjust them.
- Position pacing pads on patient. Anterior / Posterior (preferable) or Anterior / Lateral
- Ensure required mode is selected (demand or non-demand) demand preferred.
- Set rate between 60 and 90 BPM as per medical officer order, consider baseline pulse if known.
- Increase output until capture is noted. Set current 5-10 Ma above capture.
- Check patient response. Frequent observations and evaluation of treatment
- Ensure one-on-one care of patient.

Bradycardia Algorithm

(includes rates inappropriately slow for haemodynamic state)



ARC Guideline 11.9 (ARC, 2009)

Tachycardia

Tachycardias can be characterised as narrow or broad complex, depending on the width of the QRS complex (ARC, 2009). A QRS complex of < 0.12 second is considered narrow complex, as no matter the reason for the arrhythmia, conduction through the ventricular aspect of the heart is normal Therefore, the abnormality MUST arise above the ventricular level. This is important for treatment considerations with medication, which will be discussed in detail in a later section.

Determining how aggressively to act in these instances revolves around a key point- is the patient compromised/unstable (ARC, 2009). Signs of a compromised, unstable patient include:

- Hypotensive and symptomatic
- The arrythmia is causing acute, coronary type chest discomfort.
- Acute altered mental status, indicating poor perfusion.
- Acute pulmonary oedema or fulminant congestive cardiac failure

Unstable, compromised patients generally require urgent electrical therapy (synchronised cardioversion.)

Narrow Complex Tachycardia (Supra Ventricular Tachycardia) (SVT)

Narrow-complex tachycardias can be subdivided into regular and irregular types.

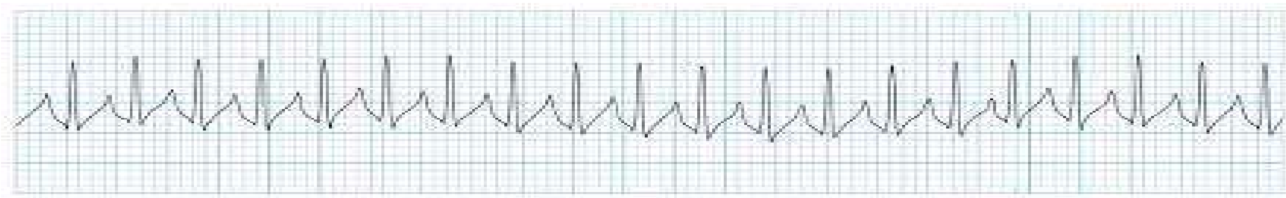
Regular narrow-complex tachycardia includes:

- Sinus tachycardia
- AV nodal re-entry tachycardia-(AVNRT) (most common type of SVT)
- AV re-entry tachycardia- (AVRT) (often caused by WPW syndrome)
- Atrial flutter with regular AV conduction (usually 2:1)

If the patient is unstable with signs of cardiovascular compromise, attempt synchronised cardioversion (ARC, 2009), with sedation as required. ANZCOR also states that it is reasonable to give adenosine to the unstable patient while preparations for cardioversion are made (ARC, 2009).

Irregular narrow complex tachycardia (e.g., atrial fibrillation (AF)) is usually **not** treated with Adenosine, but the medical officer may order Adenosine to assist with diagnosis of AF. Irregular narrow complex tachycardia when diagnosed is treated by rate control medications (ARC, 2009).

SVT

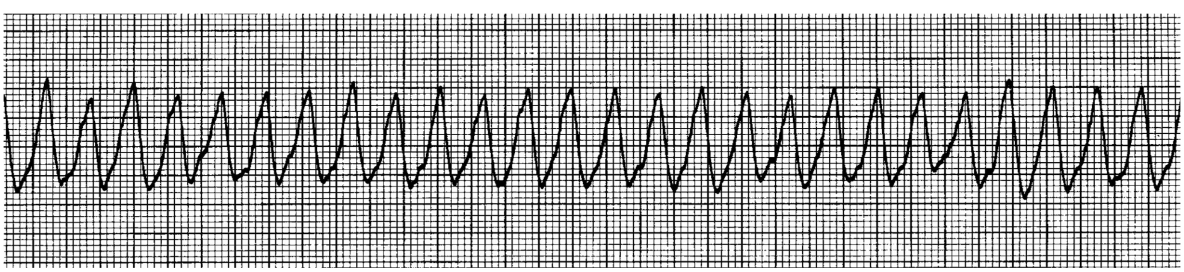


Vagal Manoeuvres

As one of the goals for narrow complex tachycardias is to slow conduction through the AV node (and, therefore, slow the ventricular response), the best drug is often no drug at all (ARC, 2009; DynaMed, 2023). Stimulation of the vagal nerve can slow conduction and can be used as a diagnostic manoeuvre to temporarily decrease the rate of arrythmia to better visualise it, or (as in the case of SVT), can often convert the rhythm itself. Vagal manoeuvres consist of a variety of techniques, from prolonged blowing out, to bearing down and tightening abdominal muscles, to leg raises. To get a vagal response that slows conduction in the heart, the stimulation generally needs to be greater than 10 seconds.

Broad Complex Tachycardia (Ventricular Tachycardia) (VT)

Broad Complex Tachycardia is characterized by a rapid, ventricular rhythm which has a broad complex (ARC, 2009) as described under shockable rhythms. The difference in this case is that the patient is still able to provide enough cardiac output to maintain cerebral perfusion and remain conscious. Other forms of broad complex tachycardia are tachycardias that arise above the AV node. For example, in a patient with a pre-existing conduction defect like a Bundle Branch Block, the QRS complex will be wide regardless of area of origin of the tachycardia within the heart. Until proven otherwise, all Broad Complex regular tachycardias should be presumed to be ventricular in origin. (ARC, 2009).



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Drugs commonly used in the conscious tachycardia algorithm.

Adenosine

Adenosine depresses sinus node activity and slows conduction through the atrioventricular node; it also produces peripheral and coronary vasodilation (ARC, 2009; DynaMed, 2023).

Adenosine is indicated for:

- Treatment of acute SVT
- Diagnostic aid for regular broad or narrow complex tachycardia

Contraindicated for:

- Second- or third-degree heart block (without pacemaker) or sick sinus syndrome (without pacemaker).
- Reactive airway disease, i.e., asthma (may cause bronchoconstriction lasting up to 30 minutes); use with caution in obstructive lung disease.

Adenosine may (rarely) accelerate ventricular rate in AF or atrial flutter, especially with an accessory conduction pathway, e.g., Wolff-Parkinson-White syndrome. However, due to the very short half-life of this drug, this is considered a relatively safe diagnostic measure.

People with a heart transplant are more sensitive to adenosine; a reduced initial dose is recommended.

Due to its very short half-life, adenosine must be given extremely quickly, followed by an immediate 20-30mL flush of IV fluid, preferably through a large bore IV in the Antecubital Fossa or a central line.

Duration of action - Less than 10 seconds (DynaMed, 2023)

Adenosine

Indications	Dose
Regular narrow complex tachycardia	6mg rapid IV bolus May repeated at 12mg

Metoprolol

Metoprolol is a Beta-blocking medication that slows conduction through the AV node, reducing ventricular response rates in arrythmias arising above the ventricles (DynaMed, 2023). This drug is commonly used for rate control of atrial fibrillation and flutter. It may have additive hypotensive effects as well, so caution is needed with this medication. Contraindications include history of bronchospasm or evidence of decompensated heart failure. (ARC, 2009)

Metoprolol

Indications	Dose
Irregular narrow complex Tachycardia	5mg IV, may be repeated for a total dose of 15mg. Consider oral dosing

Amiodarone

“Amiodarone is an antiarrhythmic drug with complex pharmacokinetics and pharmacodynamics. It has effects on sodium, potassium, and calcium channels as well as alpha- and beta-adrenergic blocking properties"(ARC 2016e, p.5; DynaMed, 2023).

Amiodarone

Indications	Dose
Conscious Tachycardia, usually broad complex	300mg diluted in Dextrose given as infusion over 20-60 minutes. Can be followed by an infusion of 900mg over 24 Hrs

Note: Amiodarone is contraindicated for Torsades de Pointes

Other drugs that can be considered in the algorithm for narrow complex tachycardias include:

Digoxin- used primarily for rate control, although this drug has antiarrhythmic properties (ARC, 2009).

Diltiazem- a calcium channel blocking drug with mechanism of action resulting in slowing conduction through the AV node, thus reducing ventricular response (ARC, 2009).

Cardioversion

Cardioversion is synchronised defibrillation, which means the shock is timed to avoid the vulnerable ventricular repolarisation period during the cardiac cycle to avoid an R-on-T phenomenon (DynaMed, 2023). It is used to terminate rhythms such as conscious ventricular tachycardia, atrial fibrillation, and atrial flutter. It is usually an elective procedure, but can be urgent, and requires light anaesthesia or analgesia for the patient. For the synchronised shock to work, the monitoring leads from the defibrillator must be attached to the patient (even if using the hands-free pads), and the synchroniser button must be activated.

Generally, application of synchronised cardioversion will either be at a high level (200 joules) (DynaMed, 2023a) for the first and all shocks or will be applied commencing with lower energy and increasing with each shock until cardioversion is achieved. The application of either method will depend on the treating clinician and the individual case being treated.

Energy Levels - Adults

- Monophasic defibrillators: 100-200j and increasing if no reversion,
- Biphasic defibrillators: may start as low as 50j and increasing if no reversion.

Note: ANZCOR has no guideline in relation to power levels for adult cardioversion. Each patient should be assessed by a medical officer and energy selection be chosen on an individual basis.

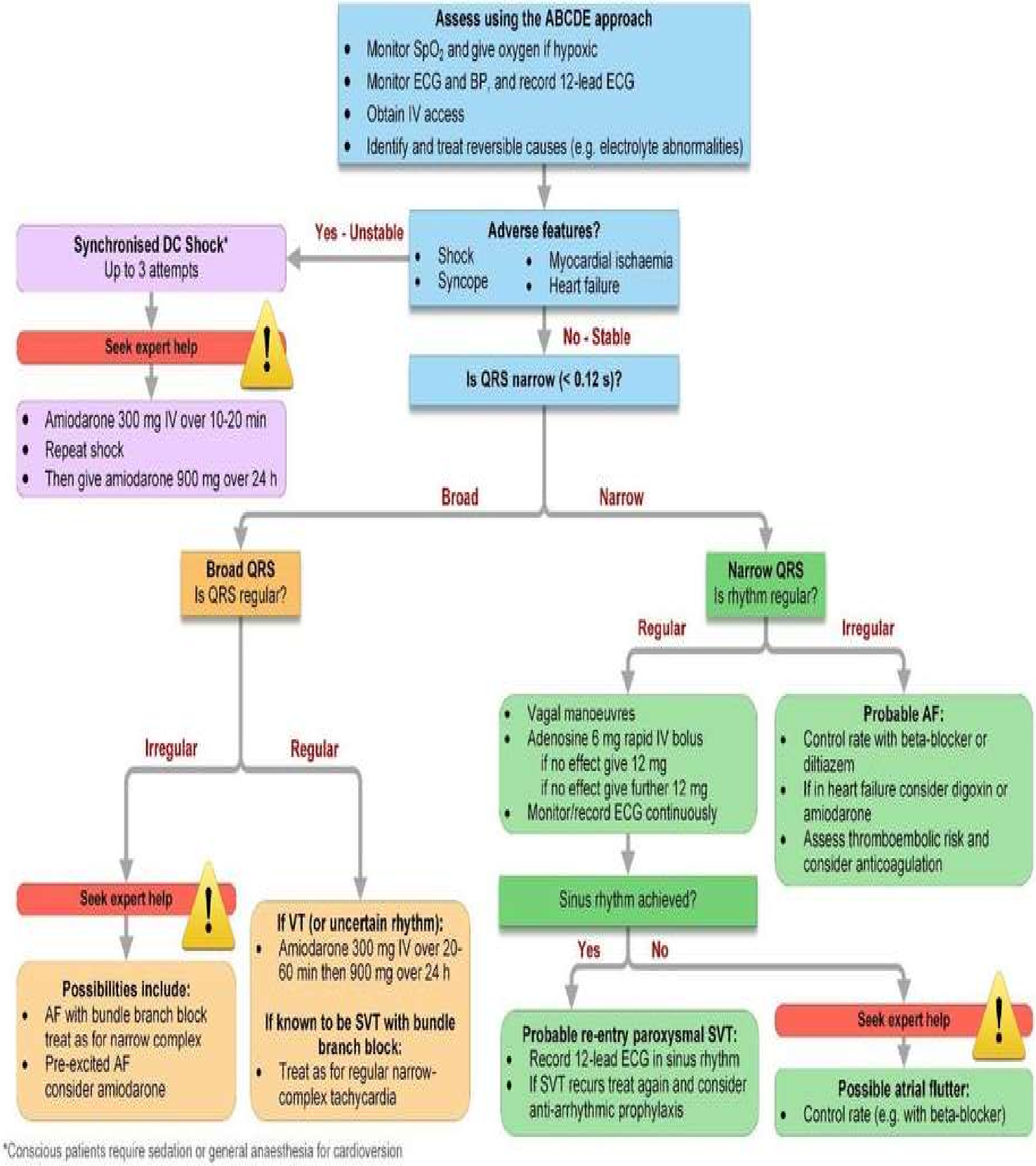
Procedure

When performing cardioversion, it is essential that expert assistance is called, and appropriate precautions and steps be taken to increase the likelihood of a positive outcome.

- Take time to obtain a 12-lead ECG if the patient is stable and there is any doubt about the patient's rhythm.
- Emergency equipment should be made ready, such as suction and bag-mask device in case manual ventilation is needed. Additional airway management equipment should be easily accessible, such as an oral airway and intubation equipment.
- Ensure patient consent.
- Ensure safe environment and adequate staff in case of emergency.
- Optimise patient oxygenation prior to the procedure.
- Ensure defibrillation pads are placed on clean clear skin.
- Administration of appropriate sedation medications should be considered before the synchronized cardioversion takes place.
- The "SYNC" button on the defibrillator machine should be pressed. Review the rhythm strip to ensure the R wave is being marked and sensed by the machine.
- Select the appropriate level of energy and follow standard precautions to "clear" the patient before delivering a shock. Expect a slight delay in the delivery of the shock as the machine times its delivery to the QRS complex. This delay means that the shock button may have to be held for up to one second before the shock is delivered.
- CAUTION: After the shock, reassess the patient's rhythm. If the patient has not converted and a second shock is indicated, depending on the machine brand you may need to push the SYNC button, as the machine will disengage SYNC after each defibrillation.

Although synchronized cardioversions are often performed without complications, they can occur. Cardiac complications can include hypotension and dysrhythmia, including ventricular fibrillation or asystole. In some cases, a patient may not be adequately breathing on their own and may need to be manually ventilated.

Tachyarrhythmia algorithm (with pulse)



Teamwork and Communication

Teamwork is one of the most important aspects of healthcare today, not just in a medical emergency, but in any healthcare environment. Resuscitation councils worldwide have been advocates for the promotion of Crisis Resource Management (CRM) and communication skills within ALS team training. In one review of literature related to poor cardiac operating theatre outcomes, it was found that 87% of the systems failures that led to litigation payout were communication errors amongst staff (Wahr, J. A, et al, 2013).

Minor events over the course of a procedure- those not expected to alter the outcome- decrease the team's ability to adapt to major issues that may occur, potentially leading to greater morbidity and mortality. Unfortunately, many team members have an unrealistic view of how they function within the team, and a misconception of how their teamwork is perceived by others. Of particular concern remains the core issue of communication. A leading healthcare accreditor in the United States showed that 65% of hospital reported sentinel events have in their root cause communication errors (The Joint Commission, 2011). Mortality can be reduced with teamwork training. Teamwork, effective team dynamics, and closed loop communication are cornerstones of life support courses. Practicing these concepts in a classroom environment builds the requisite skills for success.

Essentially, the team concept can be broken down into 8 key points, based loosely on airline industry research and other areas of investigation into functional teams in stressful situations. These concepts are applicable to any highly functioning team.

- **Mutual respect.** Team members with mutual respect, function smoothly and are capable of necessary communication. In an anxiety producing situation, speaking with clear, even tones are particularly important.
- **Know your limits.** The team functions smoothly when members know their boundaries and ask for help BEFORE things worsen. This can happen in instances where a team member has limited clinical expertise or is a novice practitioner.
- **Closed loop communication.** This is the practice of repeating back information and orders with a team member. In other words, if the team leader gives an order, the individual carrying out the order confirms hearing it and understands by repeating back: "Okay, adrenaline 1 mg I.V. bolus now."
- **Clear messages.** This involves delivering information in a clear way without shouting. Only one individual should speak at a time to avoid communication errors. Team members should question any order when there is ambiguity.
- **Knowledge sharing** is important in a team, where members may have different levels of competence and experience. To maximise this talent pool, open communication of individual expertise is key to success.

- **Clear roles and responsibilities.** The team functions smoothly when all members know their roles and tasks. These are normally assigned by the team leader, ideally before the patient arrives. Team members unable to perform these roles need to communicate this back to the leader. Team members able to take on additional tasks likewise should discuss this with the leader.
- **Constructive intervention**- A high functioning team can intervene BEFORE mistakes are made. If a team member sees an error about to be made, that person is empowered to speak up to keep the mistake from reaching the patient.
- **Summarizing and re-evaluating** is also an important function of high functioning teams. This is greatly helped if a team member is designated the role of scribe and can assist the team to get status updates such as “the last adrenaline was 4 minutes ago.” As the patient’s condition changes, the plan and previous interventions may need to be reviewed to focus on probable causes.

ISBAR (Introduction, Situation, Background, Assessment, Recommendation)

The ISBAR framework allows clinicians to communicate information or escalate a concern regarding a clinical or non-clinical event identified as a risk for patient safety. It assists in focussing the data and eliminating the irrelevant information. Communication failures frequently are central to reported causes of adverse patient outcomes. The ISBAR communication framework presents clinicians with a shared mental model for effective communication by providing a structure for concise and precise information transfer between clinicians or services. Using the ISBAR tool, a patient's clinical condition or issue can be presented in a professional manner so that the clinician is satisfied that their concerns have been heard or key information has been imparted. The ISBAR framework can be implemented by any staff member.

Table 1. ISBAR – structured communication

I identify	**Specify** • Who are you? • Where are you? • Patient's name, age, gender and department
S situation	**What is the problem/reason for contact?** • I'm calling because... (describe) • I have observed major changes... (ABCDE) • I have measured the following values... (RR*, SpO2¤, pulse/heart rhythm, BP^, capillary refill time, tp.#) • I have received test results...
B background	**If it's urgent and/or you are concerned – speak up.** **Brief and relevant case history** • Admission diagnosis and date • Previous illnesses of significance • Relevant problems and treatment/interventions to date • Allergies
A assessment	**Assessment (of the situation and background)** • I think the problem/reason for the patient's condition is related to (respiration, circulation, neurology). • I don't know what the problem is but the patient's condition has deteriorated. • The patient is unstable, we need to do something. • I am concerned.
R recommendation	**Request specific advice and interventions, and clarify expectations** • I suggest.../What interventions do you recommend? o Immediate intervention o Investigation/treatment o How often should I... • When should I next make contact? When will you be here? • Confirm messages and interventions with a closed loop.

The table is an adapted version of ISBAR, based on various national and international models.
It is used in the master's degree programme in specialist nursing.
*RR = respiratory rate
¤SpO_2 = peripheral capillary oxygen saturation
^BT = blood pressure
#tp. = temperature

Post Resuscitation Care in Advanced Life Support

Acute management does not stop when the patient has return of spontaneous circulation (ROSC) (ARC, 2016c). Maintenance of airway, oxygen therapy, and blood pressure are essential to preserve adequate perfusion and oxygenation to the vital organs. Interventions in the post-resuscitation period are likely to significantly influence the outcome.

It is not uncommon for a victim to survive the initial arrest only to die a short time later. The predominant causes are irreversible cardiac injury, brain injury because of cerebral hypoxemia and post-arrest inflammation, or organ failure as result of decreased cardiac or brain function.

Among patients surviving to ICU admission but subsequently dying in hospital, brain injury is the cause of death in approximately two thirds of r out-of-hospital cardiac arrests and approximately 25% after in-hospital cardiac arrests.

ANZCOR Guideline 11.7 (Arc, 2016c) suggests the treatment aims in the immediate post arrest period must concentrate on the prevention of further injury and the preservation of brain and cardiac function.

Treatment aims should be to:

- Continue respiratory support and optimise respiratory status.
- Maintain cerebral and organ perfusion by optimising haemodynamic status.
- Treat acute coronary syndrome and any other precipitating factors and prevent cardiac arrhythmias.
- Targeted Temperature Management (TTM) to help reduce inflammation and preserve brain function.

Investigations and drug therapy options will be influenced by the patient's present and pre-arrest condition and the possible causes for the arrest (H's and T's). Essentially, the post-care is guided by history and a full examination, which should typically include serum electrolytes, arterial blood gas, serum glucose, ECG, and chest x-ray.

Specific complications should be treated as they occur. These may include hypotension, arrhythmias, hypothermia, CNS injury (seizures), resuscitation injuries, cardiac failure, Sure, please provide the text selection that you'd like me to fix for grammar and spelling.and respiratory issues.

For optimal management, the patient should be placed in a unit appropriate for the required level of care and monitoring.

Oxygenation

Intubation and ventilation may be initiated or continued in the post-arrest period and titrated through continued appropriate monitoring (ARC, 2016c). ANZCOR encourages keeping the patient's SaO^2 and PaO^2 within normal range, as hypoxemia and hypocapnia can both be detrimental. ANZCOR suggests avoiding hyperoxia in adults with ROSC after cardiac arrest, as high fraction of inspired oxygen (FIO2) is a powerful vasoconstrictor, in addition to other toxic effects. FIO2 should be reduced as soon as possible and as low as possible to maintain the saturations in the 94-98% range.

Once ROSC has been established and the oxygen saturation of arterial blood (SaO^2) can be monitored reliably (by pulse oximetry [SpO^2] and/or arterial blood gas analysis [SaO^2]), it is reasonable to titrate the inspired oxygen to achieve a target saturation between 94 – 98% (ARC, 2016b, p.4).

Control of Arterial Carbon Dioxide

Arterial blood gas measurements should be used to titrate ventilation in the immediate post-resuscitation period, rather than End Tidal CO2 levels. ANZCOR suggests hypocapnia after a cardiac arrest can be harmful, causing brain ischemia. "Routine hyperventilation may be detrimental (e.g., result in cerebral vasoconstriction) and should be avoided." *(ARC, 2016c)*. Although there is no documented target for specific PaCO2 after resuscitation from cardiac arrest, ANZCOR suggests a normal range target of PaCO2 (35 to 40 mmHg) is appropriate (ARC, 2016c).

Blood Pressure

Organ perfusion needs to be optimised in the immediate post arrest period. It is important to ensure an adequate blood pressure as soon as possible following ROSC. "*Based on the pathophysiology of postcardiac arrest syndrome, it is reasonable to use intravenous fluids as part of a package of post-cardiac arrest care. If the blood pressure falls, a vasopressor may be given by small intravenous increments (e.g., adrenaline 50 to 100 mcg) or infusion until fluid status and the need for intravascular volume expansion can be assessed*." (ARC, 2016c, p.7)

There is insufficient evidence to recommend specific hemodynamic goals; such goals should be considered on an individual patient basis and are likely to be influenced by post-cardiac arrest status and pre-existing.

Prophylactic Anti-Arrhythmic

The benefits to long term recovery by using drugs to prevent arrhythmia post arrest is not clear. ANZCOR suggests that there is little evidence for routine anti-arrhythmic use, however these drugs may have some benefit for those people who develop arrhythmias, or for those that required an anti- arrhythmic agent during the arrest (ARC, 2016c).

Targeted Temperature Management (TTM)

Targeted temperature Management (TTM) has replaced the term “therapeutic hypothermia”. ANZCOR guidelines support TTM as part of a treatment regime for unconscious post-cardiac arrest patients to preserve or reduce inflammatory injury from global cerebral ischemia (ARC, 2016c).

Recommendations include:

- TTM (as opposed to no TTM) for patients who remain unresponsive following ROSC from shockable and non-shockable causes from both in and out of hospital arrests.
- Treat any hyperthermia occurring after cardiac arrest with antipyretics and / or active cooling.
- Cooling should be for a period of at least 24 hours and commonly up to 48 hours post arrest.
- Post cooling, fever should be avoided with a target temperature of 36 degrees Celsius.

Blood Glucose Control

Methods and levels of control of the post-arrest patient regarding blood glucose levels vary greatly. What is known is that levels may vary greatly in the post-arrest period and that both hypo and hyperglycaemia should be avoided. The ARC recommendation is “Providers should monitor blood glucose frequently after cardiac arrest and should treat hyperglycaemia (>10 mmol/l) with insulin but avoid hypoglycaemia” (ARC, 2016c).

Seizure control

The incidence of seizures following sustained ROSC is as high as 44% (ARC, 2016c). Seizures should be treated immediately, as they increase cerebral oxygen demand and can cause life threatening arrhythmias and respiratory arrest. It is suggested that the cause may be due to brain hypoxemia or may be because of multiple medication usage.

Recommendations regarding seizure control:

- ANZCOR suggests against routine seizure control in post-arrest patients.
- Recommends treatment of seizures if they occur.

Resuscitation Related Injuries

Post-resuscitation injuries are very common (ARC, 2016c). These are a natural consequence of the emergency procedures applied in arrest situations, and they may include:

- Rib fractures
- Lung contusion
- Vascular and soft tissue injury from access attempts and devices
- Airway injuries

After the arrest, all patients should be examined closely for injuries.

Legal and Ethical Issues Related to Resuscitation

Ethical issues surrounding resuscitation are at times unclear and are dependent upon law, local cultural and moral issues (ARC, 2015). Within the healthcare environment, careful consideration and discussion should clearly indicate whether healthcare personnel are to initiate or continue life-sustaining interventions for patients in cardiac arrest and those in peri-arrest.

It should be acknowledged that it is not possible to provide specific recommendations about ethical matters but, rather employ broad principles before and during resuscitation efforts.

The four key principles of beneficence, non-malfeasance, justice, and autonomy:

- Beneficence - implies that healthcare providers must provide benefit while balancing risks. This may involve attempting fluid resuscitation and antibiotic treatment but withholding CPR and defibrillation.
- Non-malfeasance - means doing no harm. Resuscitation should not be attempted in futile cases or when it is against the patient’s wishes.
- Justice - implies a duty to ensure equal benefit and risk to all within society. Therefore, resuscitation should be provided to all those who could have potential benefit.
- Autonomy - relates to capacity. Patients must be able to make informed decisions regarding their own healthcare.

Legal issues regarding resuscitation are governed by a variety of laws within Australia and often vary from state to state (ARC, 2015). For ALS providers, legal issues can generally be restricted to “act or not to act”, limiting care, and when to stop resuscitation. The use of care limiting orders has greatly increased and specifies a great range of care limitations depending upon the individual case. Limiting orders are only useful if completed and available to resuscitation staff prior to the incident. Without limiting orders, the decision regarding resuscitative care usually falls to the senior medical officer within the resuscitation team or the patient’s admitting consultant.

ANZCOR summarises legal and ethical issues into the following sections (ARC, 2015).

Duty to Rescue

While there is no legal duty of care for lay persons or by-standers to assist (or “rescue”) a person in need of emergency care, medical professionals and practitioners are subject to legal, ethical, and professional principles (ARC, 2015).

A ‘Good Samaritan’ or ‘Volunteer’ is defined in legislation as “persons who act without expecting financial or other reward” (ARC, 2015) and while under no duty of care to assist, these individuals are protected by a variety of legislation that defends them if they do render assistance. Protection is given when the Good Samaritan or Volunteer gives a standard of care appropriate to their training (or lack of training).

ANZCOR states doctors, and probably other trained healthcare workers, who have been requested to aid outside their usual place of work when ready for duty have a legal obligation to do so in New South Wales and in Western Australia, however the *Health Practitioner Regulation National Law Act* also applies to other Australian jurisdictions (as a national law). As stated in ANZCOR guideline 10.5 (ARC, 2015, p.3), a “doctor in any jurisdiction who fails to render emergency assistance to a victim may be subject to legal or disciplinary action since section 2.5 of the code of medical practice (Good Medical Practice: A Code of Conduct for Doctors in Australia) states: “Good medical practice involves offering emergency assistance in an emergency that takes account of your safety, your skills, the availability of other options and the impact on any other patients under your care; and continuing to provide that assistance until your services are no longer required” (AHPRA, 2020).

ANZCOR recommendations regarding duty to recue states “ANZCOR encourages healthcare professionals off-duty to render assistance if requested to do so even when they may have no duty to rescue, provided their own safety is not threatened” (ARC, 2015, p.2)

Consent for Treatment

Before treating a competent patient, it is standard procedure to obtain consent. If a victim has impaired capacity to give consent, wherever possible the consent of a substitute decision maker should be sought.

Family Presence

ANZCOR recommends healthcare providers consider involving family at the bedside during resuscitation efforts. The recommendation is given for both adult and paediatric resuscitation events as the majority of noted studies found that the performance of the resuscitation team was not slowed or adversely affected by the presence of family at the event, nor was the family negatively affected. Studies in fact indicated “that being present at the resuscitation was associated with improved measures of coping and positive emotional outcomes.” (ARC, 2016f, p.2). The ANZCOR recommendation is given with the proviso that the family member is given the option of being present, and ideally with an assigned support person.

Staff Debriefing

Facilitated debriefing post resuscitation can benefit participants clinical practice and psychological well-being (Gilmartin et al., 2020). ANZCOR state that a traumatic event can be distressing to responders, and suggest that sensitive, professional debriefing is likely to have value (2016g).

References, Standards, Supporting Documents

Primary policy, standards, or other authority

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Consultation

Key stakeholders who contributed to and/ or reviewed this version include:

- Russell Gooch
- Barry McCarthy
- Paul Chant

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Observed performance. **Demonstrated ABCDE patient assessment**	**Observed**	**Not Observed**
Assesses the following using an organised approach:		
A – Airway • Voice • Breath sounds		
B – Breathing • Respiratory rate • Chest wall movements • Chest percussion • Lung auscultation • Pulse oximetry		
C – Circulation • Skin colour, warmth, and dryness • Capillary refill time • Pulse rate • Heart auscultation • Blood pressure • Electrocardiography monitoring		
D – Disability • Level of consciousness – AVPU (may use GCS) – Alert – Voice responsive – Pain responsive – Unresponsive • Limb movements • Pupillary light reflexes • Blood glucose		
E – Exposure • Skin observation for; bites, swelling, oedema, rashes • Temperature • Check drains, dressings, catheters, or pumps, IV lines. • Look in mouth and nose and any other relevant orifice. • Medications including medical patches		

Observed performance. **Demonstrated patient assessment - Airway**	**Observed**	**Not observed**
Demonstrates effective airway position management using: • Head tilt / chin lift • Jaw Thrust (suspected neck injury)		
Demonstrates correct measurement and placement of: • Oropharyngeal airway • Nasopharyngeal airway		
Demonstrates correct and effective use of Bag-Valve mask device. • 2-person bag valve mask • Demonstrated V – E grip (vice grip)		
Discusses methods for clearing an obstructed airway. • Chest thrusts • Back blows		
Discusses use and insertion and management of LMA and or I-gel.		
Assesses ETT placement; (must know at least 3): • Equal rise and fall of chest. • Air entry via auscultation • End Tidal CO2 • Misting of tube • Direct visualisation during insertion		
Applies correct rate and volume for ventilation of intubated patient receiving chest compressions: • Rate 6-10 bpm. • Volume for visual chest rise only, avoids hyperventilation		
Demonstrates ability to apply supplemental oxygen: • BVM at 15 lpm oxygen for all patients receiving CPR. • Conscious patients who require resuscitation have oxygen applied to maintain sats between 94% - 98% • Conscious COPD patients who are CO2 retainers (Hypercapnic) have oxygen applied to maintain sats between 88% - 92%		

Observed performance		Not
Manual defibrillation	**Observed**	**Observed**
Correctly identifies *lethal rhythms (VT, VF)*		
Demonstrates pad placement Anterior / Lateral		
Correctly applies pads and demonstrates understanding of: • Clean dry skin • No jewellery • Not over Medication patches • 8 – 10 cm away from implanted defib / pacemaker • Ensures high quality BLS continues during pad placement		
Demonstrates knowledge and ability to set energy level, • Default 200j • Increase to 360j for 2nd and every subsequent shock		
Correctly applies defibrillation: • Utilises one-stop shock protocol, ensuring compressions continues while charging. • Selects correct energy. • Calls to remove oxygen. • Clears all rescuers except person doing chest compressions. • Charges defibrillator • When fully charged- pauses chest compressions to check rhythm. • Correctly identifies rhythm. • Confidently calls all clear • Performs safe visual sweep. • Safely applies defibrillation *while* watching environment for safety. • Adequately assesses accomplishment of defibrillation attempt (muscle twitch) • Immediately ensures CPR recommences without checking for rhythm. • Demonstrates process for organised rhythm (i.e., dumps charge and checks for a central pulse		

Observed performance. Monitored and witnessed arrest	Observed	Not Observed
Identifies need for 3 stacked shocks: Monitored witnessed arrest with a defibrillator immediately available. (Within 20 seconds, patient not centrally hypoxic as arrest cause) • Correctly applies pads. • Selects correct energy (200j throughout) • Calls to remove oxygen. • Clears all rescuers. • Charges defibrillator • Confidently calls all clear • Performs safe visual sweep. • Safely applies defibrillation while watching environment for safety. • Adequately assesses accomplishment of defibrillation attempt (muscle twitch) • Re-charges immediately and repeats up to 3 times in total if no change of rhythm. • Adequately assesses success of each defibrillation attempt (muscle twitch) • Safely dumps charge with a change to an organised rhythm. Commences CPR 10 seconds after the 3rd unsuccessful shock if nil change in rhythm		

Observed performance. **Demonstrated patient assessment. Cardioversion**	**Observed**	**Not Observed**
Correctly identifies narrow and broad complex tachycardias		
Correctly identifies patient instability, necessitating need for cardioversion per algorithm		
Demonstrate ability to plan for safe procedure: • Patient consent • Safe environment • Adequate staff		
Identifies need for sedation		
Identifies need for: • Expert help and medical order • Oxygenation • Pre procedure observations • Pathology		
• Correctly applies pads. • Discusses pad placement options		
• Selects appropriate energy. – Activates sync prior to cardioversion		
• Correctly charges defibrillator. • Confidently calls all clear • Performs safe visual sweep. • *Safely applies cardioversion.* • Adequately assess success of defibrillation (muscle twitch) – Checks for rhythm change following shock		
Re-engages sync between successive shock attempts		
Correctly identifies narrow and broad complex tachycardias and seeks expert help		

Observed performance External Cardiac Pacing	Observed	Not Observed
Correctly Identifies brady-arrythmias. Seeks expert help		
Gives examples and doses of recommended drug treatment. • Atropine sulphate • Adrenaline (epinephrine) IV infusion or micro bolus • Other alternative relevant drugs		
Identifies need for external cardiac pacing for patient. If drug therapy ineffective • Correctly applies pads. • Selects appropriate rate. • Identifies successful capture. • Sets threshold above capture. • Checks for both electrical and mechanical capture		
Demonstrates knowledge of pacing modes: • Demand • Non – demand		
Demonstrates understanding of ongoing patient care: • Close continual observations • Frequent vital signs • Use of analgesia / sedation		

Sure, please provide the text selection that you'd like me to fix for grammar and spelling.