AUSTRALIAN RESUSCITATION COUNCIL

NEW ZEALAND Resuscitation Council
Whakahauora, Aotearoa

GUIDELINE 11.2

PROTOCOLS FOR ADULT ADVANCED LIFE SUPPORT

The flow diagram illustrates the sequence of actions to be undertaken once equipment and drugs are available. Several tasks in the diagram may be undertaken at the same time.

The algorithm is based on the following considerations:

1. The importance of good CPR and early defibrillation in achieving successful outcomes. Ventricular Fibrillation (VF) is in many situations the primary rhythm in sudden cardiac arrest. The vast majority of survivors come from this group.

   The chance of successful defibrillation decreases with time. Therefore the performance of good CPR and decreasing the time to defibrillation is the first priorities in resuscitation from sudden cardiac arrest.

   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.[1]

2. Automated External Defibrillators (AEDs) can accurately diagnose cardiac rhythms and separate them into two groups:

   a. "Shockable" = those responsive to defibrillation
   b. "Non-shockable" = those unresponsive to defibrillation

3. There are interventions that are indicated in all causes of cardiac arrest.

4. There is a group of potentially reversible conditions that, if unrecognised or left untreated during cardiac arrest, may prevent successful resuscitation.

NOTES ON THE ALGORITHM

Good quality CPR

The provision of good quality CPR is the cornerstone of advanced life support. As outlined in Guideline 11.1.1 this includes delivery of chest compressions over the lower half of the sternum at a depth of at least 5 cm, and at a rate of approximately 100 per minute, while minimising interruptions to compressions at all times.

Assess rhythm

As soon as the defibrillator is available, then after about 2 minutes of CPR, or earlier if responsiveness or normal breathing becomes apparent, the rhythm should be checked. If a rhythm compatible with spontaneous circulation is observed then the pulse should also be checked [Class A; Expert Consensus Opinion].

Shockable Rhythm

- Ventricular fibrillation is asynchronous chaotic ventricular activity that produces no cardiac output.
- Pulseless ventricular tachycardia is a wide complex regular tachycardia associated with no clinically detectable cardiac output.
- A defibrillator shock should be administered according to the algorithm.
- Administer a single shock and immediately resume CPR for 2 minutes after delivery of shock. Do not delay commencing CPR to assess the rhythm.

[Class A; LOE II to IV][2]

Energy levels

- **Monophasic:** the energy level for adults should be set at maximum (usually 360 Joules) for all shocks. [Class A; LOE 2][2]
- **Biphasic waveforms:** the default energy level for adults should be set at 200J for all shocks. Other energy levels may be used providing there is relevant clinical data for a specific defibrillator that suggests that an alternative energy level provides adequate shock success (eg. usually greater than 90%). [Class A; LOE 2][2]

Immediate CPR

Interruptions to CPR decrease the chance of survival from cardiac arrest. While defibrillation is of paramount importance for VF/VT, a period of well performed CPR immediately after each shock can help maintain myocardial and cerebral viability, and improves the likelihood of subsequent shock success.[1]

- During CPR advanced life support interventions are applied and potential causes of arrest sought.
- After each defibrillation continue a further 2 minutes of CPR, unless responsiveness or normal breathing become apparent.
- If using a defibrillator in manual mode, the defibrillator should be charged during CPR as the end of the 2 minute loop of CPR approaches, to minimise interruptions to CPR and increase the likelihood of shock success.[6]
- Rhythm is then reassessed and treatment is directed as necessary. If rhythm assessment results in a significant interruption to CPR then a further 2-minute period of CPR is recommended before further shocks are delivered. This is done to obtain the benefits of CPR on VF waveform and increase the likelihood of shock success.
- Consideration should be given to administration of a vasopressor in the period of CPR after the second failed defibrillation attempt. Consideration should be given to administration of an antiarrhythmic after the third failed defibrillation attempt. The sequence of escalating advanced life support would then be:
  - attempt defibrillation ensure good CPR;
  - attempt defibrillation add vasopressor (adrenaline 1 mg);
  - attempt defibrillation, add anti-arrhythmic (amiodarone 300 mg).

[Class A; LOE II to IV][2]

Non-shockable rhythm (Non VF/VT)

- Asystole is characterised by the absence of any cardiac electrical activity.
- Pulseless Electrical Activity (PEA) (sometimes referred to Electromechanical Dissociation [EMD]) is the presence of a coordinated electrical rhythm without a detectable cardiac output.
- The prognosis in this group of cardiac rhythms or asystole is much less favourable than with VF/VT.
- During CPR advanced life support interventions are applied and potential causes of arrest sought.
- Defibrillation is not indicated and the emphasis is on CPR and other ALS interventions (ie. intravenous access, consideration of advanced airway, drugs and pacing).

[Class A; Expert consensus opinion]

During CPR

The following interventions apply to all rhythms and are carried out continuously or during each loop of the algorithm. Each loop comprises 5 sets of 30 compressions (at approximately 100/minute) : 2 breaths, which equates to approximately 2 minutes.

Other management priorities during CPR:

- Minimise interruptions to CPR during ALS interventions. [Class A; LOE III-2]
- Administer 100% oxygen when available [Class A; Expert consensus opinion]
- Obtain intravenous or intra-osseous access [Class A; LOE 2]
- Consider airway adjuncts, but attempts to secure the airway should not interrupt CPR for more than 20 seconds. [Class A; Expert consensus opinion]
- Waveform capnography should be used to confirm airway placement and monitor the adequacy of CPR [Class A; Expert consensus opinion]
- Adrenaline should be administered every second loop (approximately every 4 minutes). [Class A; Expert consensus opinion]
- Other drugs/electrolytes should be considered depending on the individual circumstances.

[Class A; Expert consensus opinion]

Medications during CPR

Vasopressors:

There are no placebo-controlled studies that show that the routine use of any vasopressor at any stage during human cardiac arrest increases survival to hospital discharge, though they have been demonstrated to increase Return of Spontaneous Circulation. Current evidence is insufficient to support or refute the routine use of any particular drug or sequence of drugs. Despite the lack of human data it is reasonable to continue to use vasopressors on a routine basis.[3] Adrenaline (1 mg), when indicated, should be administered after rhythm analysis (± shock), at the time of recommencement of CPR. [Class A; Expert consensus opinion]

Antiarrhythmics:

There is no evidence that giving any antiarrhythmic drug routinely during human cardiac arrest increases rate of survival to hospital discharge. In comparison with placebo and lignocaine the use of amiodarone in shock-refractory VF improves the short-term outcome of survival to hospital admission. Despite the lack of human long-term outcome data it is reasonable to continue to use antiarrhythmic drugs on a routine basis.[3]

Amiodarone (300 mg) should be administered after the third failed attempt at defibrillation, at the time of recommencement of CPR. [Class A; LOE II]

Other drugs:
There is no evidence that routinely giving other drugs (e.g. buffers, aminophylline, atropine, calcium, magnesium) during human cardiac arrest increases survival to hospital discharge.[3]

Correct Reversible Causes
Very few data address the aetiology of cardiac arrest directly. One prospective study and one retrospective study suggested that rescuers can identify some noncardiac causes of some arrests.[4 5] The physical circumstances, history, precipitating events, clinical examination, or the use of adjunct techniques (such as ultrasound) may enable the rescuer to determine a cardiac or noncardiac cause of the cardiorespiratory arrest. The rescuer should undertake interventions based on the presumed aetiology (cardiac or noncardiac).

4 Hs and 4 Ts are a simple reminder of conditions that may precipitate cardiac arrest or decrease the chances of successful resuscitation. These conditions should be sought and, if present, corrected in every case. [Class A; Expert consensus opinion]

- **H**ypoxaemia
- **H**ypovolaemia
- **H**yper/hypokalaemia & metabolic disorders
- **H**ypo/hyperthermia
- **T**ension pneumothorax
- **T**amponade
- **T**oxins / poisons / drugs
- **T**hrombosis-pulmonary / coronary

Fluid administration:
There is insufficient evidence to recommend for or against the routine infusion of intravenous fluids during cardiac arrest resuscitation.[3]

Fluids should be infused if hypovolemia is suspected (hypovolaemic shock would normally require the administration of at least 20 mL/kg). [Class A; Expert consensus opinion]

Thrombolytics:
Routine administration of fibrinolytics for the treatment of in-hospital and out-of hospital cardiac arrest is not recommended.[3]

Fibrinolysis should be considered in adult patients with cardiac arrest with proven or suspected pulmonary embolism. [Class A; Expert consensus opinion]

Post Resuscitation Care
After the return of spontaneous circulation (ROSC), post-resuscitation care commences (see Guideline 11.8).

Re-evaluate the patient using the standard ABCDE approach: Airway Breathing Circulation Disability and Exposure. Other considerations include obtaining a 12 lead ECG and a chest radiograph. The adequacy of perfusion should be assessed, and the need for reperfusion therapy should be considered (eg. thrombolytics or percutaneous coronary intervention). The

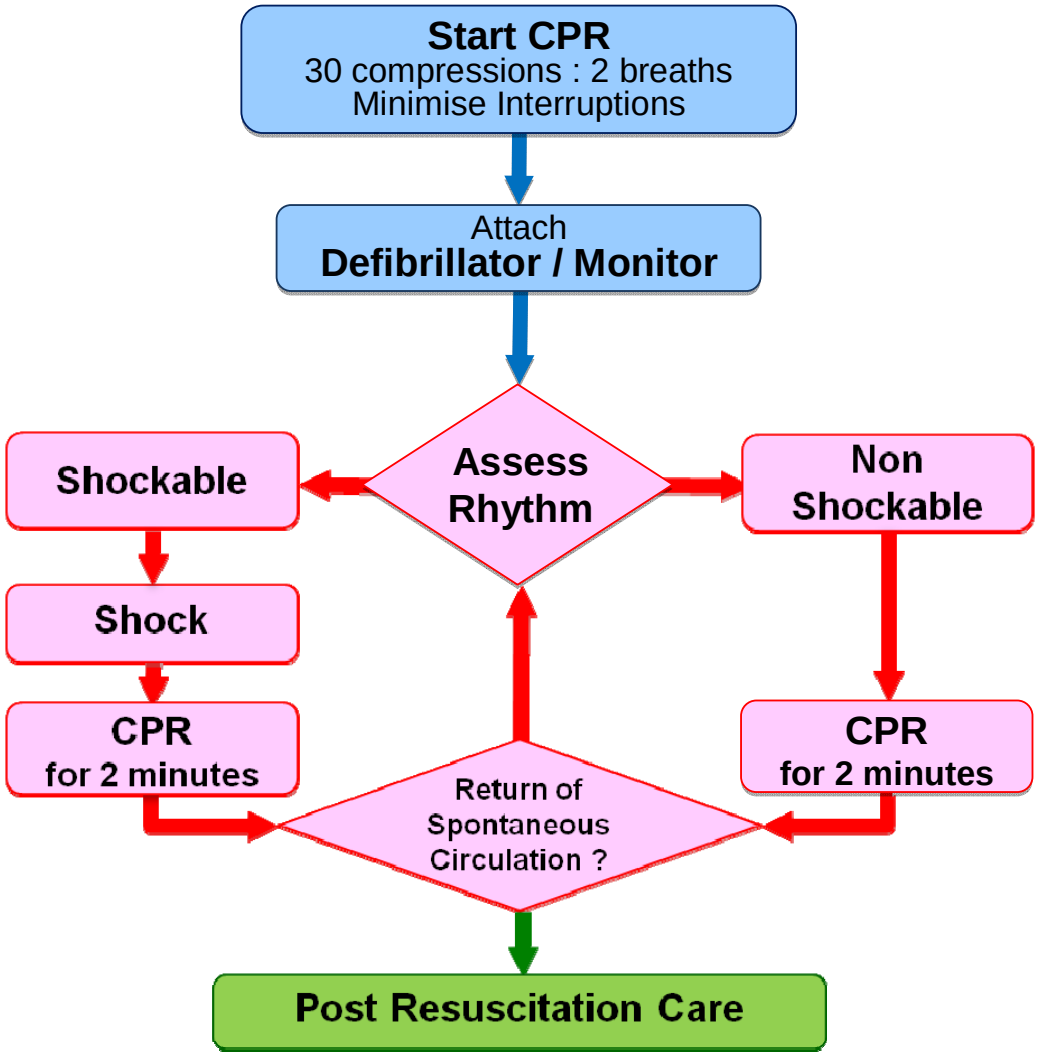
adequacy of oxygenation and ventilation should be confirmed and maintained (and advanced airway may be required).

Temperature control (e.g. induced hypothermia) may be instituted if indicated, and further investigation for reversible causes should be continued, and treatment instituted where necessary. See also guideline 11.7. [Class A; Expert consensus opinion]

REFERENCES

1. Eftestol T, Wik L, Sunde K, Steen PA. Effects of Cardiopulmonary Resuscitation on Predictors of Ventricular Fibrillation Defibrillation Success During Out-of-Hospital Cardiac Arrest. Circulation. 2004 June 21;110:10-5.
2. Sunde K, Jacobs I, Deakin CD, Hazinski MF, Kerber RE, Koster RW, et al. Part 6: Defibrillation: 2010 International Consensus on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science with Treatment Recommendations. Resuscitation. [doi: DOI: 10.1016/j.resuscitation.2010.08.025]. 2010;81(1, Supplement 1):e71-e85
3. Deakin CD, Morrison LJ, Morley PT, Callaway CW, Kerber RE, Kronick SL, et al. Part 8: Advanced life support: 2010 International Consensus on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science with Treatment Recommendations. Resuscitation. [doi: DOI: 10.1016/j.resuscitation.2010.08.027]. 2010;81(1, Supplement 1):e93-e174.
4. Pell JP, Sirel JM, Marsden AK, Ford I, Walker NL, Cobbe SM. Presentation, management, and outcome of out of hospital cardiopulmonary arrest: comparison by underlying aetiology. Heart (British Cardiac Society) 2003;89(8):839-42
5. Kuisma M, Alaspaa A. Out-of-hospital cardiac arrests of non-cardiac origin: epidemiology and outcome. Eur Heart J 1997;18(7):1122-1128.
6. Edelson DP, Robertson-Dick BJ, Yuen TC, Eilevstjonn J, Walsh D, Bareis CJ, et al. Safety and efficacy of defibrillator charging during ongoing chest compressions: a multi-center study. Resuscitation. 2010 Nov;81(11):1521-6.

Advanced Life Support for Adults



During CPR

Airway adjuncts (LMA / ETT)
Oxygen
Waveform capnography
IV / IO access
Plan actions before interrupting compressions
(e.g. charge manual defibrillator)
Drugs
Shockable
* Adrenaline 1 mg after 2nd shock
(then every 2nd loop)
* Amiodarone 300 mg after 3rd shock
Non Shockable
* Adrenaline 1 mg immediately
(then every 2nd loop)

Consider and Correct

Hypoxia
Hypovolaemia
Hyper / hypokalaemia / metabolic disorders
Hypothermia / hyperthermia
Tension pneumothorax
Tamponade
Toxins
Thrombosis (pulmonary / coronary)

Post Resuscitation Care

Re-evaluate ABCDE
12 lead ECG
Treat precipitating causes
Re-evaluate oxygenation and ventilation
Temperature control (cool)

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