

ANZCOR Guideline 12.5 – Management of Specific Dysrhythmias in Paediatric Advanced Life Support

Summary

Who does this guideline apply to?

This guideline applies to infants and children.

Who is the audience for this guideline?

This guideline is for health professionals and those who provide healthcare in environments where equipment and drugs are available.

Recommendations

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

1. This guideline provides detailed advice regarding the management of specific dysrhythmias in infants and children.
2. High quality CPR is fundamental to management in all cases without a perfusing rhythm.
3. ANZCOR recommends a single 4J/kg shock at 2 minute intervals for ventricular fibrillation and pulseless ventricular tachycardia.
4. 3 stacked shocks (4J/kg) should be considered under special circumstances.
5. Manual defibrillators are preferred in children. If a manual defibrillator is not available it is appropriate to use a standard AED for children over 8 yrs. For infants and children under 8 years, the order of preference is:
 - Manual Defibrillator
 - AED with paediatric attenuation
 - Standard AED.
6. For cardiac arrest, adrenaline (epinephrine) is given in a dose of 10 micrograms/kg IV at 3-5 minute intervals.
7. Persistent or refractory VF or VT may be treated with amiodarone 5 mg/kg IV. This may be repeated. If amiodarone is unavailable, lidocaine (lignocaine) is a reasonable alternative.

8. In shock resistant VF, pulseless VT and PEA, early consideration should be given to correctable underlying causes.

Guideline

1 Asystole or Severe Bradycardia

Asystole or pulseless severe bradycardia less than 60 bpm which is unresponsive to oxygen and ventilation or chest compressions should be treated with adrenaline (epinephrine) 10mcg/kg via intravenous (IV) or intraosseus (IO) routes [Class A; Expert Consensus Opinion]. If these routes are not available, adrenaline (epinephrine) 100 mcg/kg should be administered via the endotracheal tube (ETT) ¹ but this route is the least desirable [Class A; Expert Consensus Opinion]. Possible causes should be sought and treated.

If after adrenaline (epinephrine) a perfusing sinus rhythm cannot be restored, the priority of management is continuous high quality CPR with repeated adrenaline (epinephrine) every 3-5 minutes and a consideration of potentially reversible causes. Sodium bicarbonate 1mmol/kg IV or IO may be given in cases of prolonged arrest. [Class B; Expert Consensus Opinion]. If facilities are available, pacing (oesophageal, transcutaneous, transvenous, epicardial) may be effective. Pacing should not interfere with CPR.

2 Ventricular Fibrillation and Pulseless Ventricular Tachycardia

Asynchronous multifocal ventricular contraction i.e. ventricular fibrillation (VF) produces no cardiac output. Similarly, rapid wide-QRS complex ventricular tachycardia (VT) may produce no cardiac output. The only effective treatment is direct current (DC) shock, which simultaneously depolarizes all contractile tissue and may allow resumption of sinus rhythm. If the onset of VF or pulseless VT is witnessed on an ECG monitor, such as in the ICU environment (see below), defibrillation should be attempted before any other treatment. In this circumstance also, a precordial thump may be given as a safe action (Class B; Expert Consensus Opinion), although its efficacy in children has not been proven.

The ideal energy dose for safe and effective paediatric defibrillation is unknown but present evidence supports a dose of 2-4 J/kg. ¹ For the sake of simplicity ANZCOR continues to recommend 4 J/kg for the initial and subsequent doses using a biphasic (preferable) or monophasic shock for VF and pulseless VT, (CoSTR 2015, weak recommendation, very-low-quality evidence) followed immediately by 2 minutes of CPR without waiting to analyse the rhythm (see guideline 12.3, 12.6). ¹⁻³

Manual defibrillators are preferred in children. If a manual defibrillator is not available it is appropriate to use a standard AED for children over 8 yrs. For infants and children under 8 years, the order of preference is:

- Manual Defibrillator
- AED with paediatric attenuation
- Standard AED.

Failure to revert to a perfusing rhythm is treated with adrenaline (epinephrine) (10 mcg/kg IV or IO or 100 mcg/kg ETT) and a subsequent single DC shock (4J/kg monophasic or biphasic shock). Persistent or refractory VF or VT may be treated with antiarrhythmics such as amiodarone 5 mg/kg IV ¹ [Class A; LOE II] or IO as a bolus followed by additional DC shock.

This may be repeated. If amiodarone is unavailable as an anti-arrhythmic for DC-shock resistant VF or VT, lidocaine (lignocaine) is a reasonable alternative [weak recommendation, very low quality of evidence]¹ in a dose of 1 mg/kg IV or IO or 2-3 mg/kg via ETT.

Adrenaline (epinephrine) (10 mcg/kg IV, IO or 100 mcg/kg ETT) should be given every second cycle of shock-2 minutes of CPR [Class B; Expert Consensus Opinion]. (Refer to Guideline 12.3, 12.4). Subsequently, refractory VF or VT may be treated with sodium bicarbonate 1mmol/kg IV or IO, magnesium (magnesium sulfate heptahydrate) 0.05-0.1 mmol/kg IV or IO, potassium chloride 0.05 mmol/kg IV or IO).

2.1 Witnessed onset of monitored VF/pulseless VT

Three stacked shocks (4J/kg, 4J/kg, 4J/kg) may be given when the onset of a shockable rhythm is witnessed with monitoring in special circumstances such as:

- 1) In the cardiac catheter laboratory
- 2) In the intensive care unit or cardiac ward post cardiac surgery
- 3) In other circumstances when a defibrillator is already attached.

Automated external defibrillators are suboptimal for this purpose because of delay to shock.

3 Pulseless Electrical Activity (PEA)

Absent pulses despite relatively normal co-ordinated electrical activity on the electrocardiograph is pulseless electrical activity (PEA), sometimes called electromechanical dissociation (EMD). It may be due to poor intrinsic myocardial contractility or it may be secondary to a number of remediable causes including hypoxaemia, hypovolaemia, hypo/hyperthermia, hyperkalaemia, hypocalcaemia, severe acidosis, pericardial tamponade, tension pneumothorax, toxins or poisons or drugs including calcium channel blocker, or massive thrombotic or gaseous pulmonary embolism.

Treatment for PEA is the administration of adrenaline (epinephrine) in an initial and any subsequent dose of 10mcg/kg IV or IO or 100 mcg/kg ETT [Class A; Expert Consensus Opinion]. Since hypovolaemia or severe acidosis are possible treatable causes, persistent PEA may be treated with an intravenous or intraosseous bolus of colloid or crystalline fluid 20 mL/kg and/or sodium bicarbonate 1 mmol/kg [Class B; Expert Consensus Opinion]. Simultaneously, an underlying cause should be sought by clinical examination and by investigation and subsequently treated. A chest radiograph, 12 lead electrocardiograph and echocardiograph (if available) should be obtained as they may be used to detect causes such as pericardial tamponade, pneumothorax, ventricular rupture or pulmonary embolism.

4 Tachydysrhythmias

Any heart rate above normal-for-age should be considered a tachydysrhythmia, particularly if associated with poor circulation and hypotension and if the patient has a history of cardiac disease, has had cardiac surgery or could have been poisoned with cardio-active drug(s). Of course, such tachycardia may be sinus tachycardia (ST) as the result, rather than the cause of poor circulation. It is important to determine the type and aetiology of the tachycardia, otherwise drug or other treatment may exacerbate the situation. A history related to the tachycardia and a 12-lead ECG should be analysed carefully.

If the rhythm diagnosis is not clear, the rate and duration of the QRS complex are starting points to differentiate sinus tachycardia (ST), ventricular tachycardia (VT), supraventricular tachycardia (SVT) and wide QRS-complex SVT. Other tachycardias such as junctional ectopic tachycardia (JET) also occur.

5 Supraventricular Tachycardia

SVT is the most common spontaneous-onset dysrhythmia in childhood and infancy. It may cause life-threatening hypotension. It is usually re-entrant with a rate of 220-300/min in infants, usually less in children (approximately 180/min). The QRS complex is usually narrow (<0.08 secs) making it difficult sometimes to discern from sinus tachycardia. However, whereas ST is a feature of other illness, SVT is a singular entity. The heart rate in ST is variable with activity or stimulation whereas in SVT it is uniform and is often of sudden onset and offset. In both rhythms, a P wave may be discernible.

If haemodynamically stable (adequate perfusion and blood pressure), initial treatment of SVT should be vagal stimulation in the supine position. For infants and young children, application to the face of a plastic bag filled with iced-water or unilateral carotid sinus massage¹ [Class A; LOE IV]. Older children may be treated with unilateral carotid sinus massage or if conscious, asked to perform a Valsalva – such as blowing through a narrow straw [Class A; LOE III-1]. If mechanically ventilated, vagal stimulation may be effected by pharyngeal or tracheal suction. Eye-ball pressure should not be employed as vagal stimulation.

Drug therapy may be required. Adenosine is the drug of choice. It has a very short half-life and must be given as a rapid IV or IO bolus and flushed with 0.9% sodium chloride into the circulation. A dose in the range of 0.1 to 0.3 mg/kg converts most cases to sinus rhythm² [Class A; LOE IV]. The initial recommended dose is 0.1 mg/kg but if this is ineffective, the dose should be increased to 0.2 mg/kg. The first dose should not exceed 6 mg and the second dose 12 mg. Few cases of adenosine-induced pro-tachyarrhythmia, eg., *Torsade de pointes*, have occurred.

Amiodarone may be used to treat haemodynamically stable or unstable SVT² [Class A; LOE IV] in intravenous dosing schedules of 5 mg/kg over one hour followed by 5 mcg/kg/min or in a schedule of 25 mcg/kg/min for 4 hours followed by 5-15 mcg/kg/min. Amiodarone may cause hypotension, hypothyroidism and pulmonary toxicity.

Alternative drugs are procainamide⁴, [Class B; LOE IV] digoxin, a *beta* blocker or a calcium channel blocker. A suitable dose for procainamide is 15 mg/kg intravenously over 30-60 minutes. Procainamide may cause hypotension by vasodilation. Calcium channel blockers should not be used to treat SVT in infants and should be avoided or used cautiously in children because they may induce hypotension and cardiac depression.

SVT may cause severe hypotension or pulselessness in which case synchronized DC shock should be given immediately in a dose of 0.5-1.0 J/kg (monophasic shock or biphasic shock) but increased to 2J/kg if necessary⁵ [Class A; LOE IV].

If facilities are available, overdrive pacing (oesophageal, transcutaneous, transvenous, epicardial) may be effective.

6 Pulsatile Ventricular Tachycardia

Haemodynamically stable VT may be treated with antidysrhythmic agent such as amiodarone (5 mg/kg IV over 20-60 minutes) or procainamide (15 mg/kg IV over 30-60 minutes). Note that both amiodarone and procainamide prolong the QT interval and should not be given together. If pulses are present but accompanied by hypotension and poor circulation, cardioversion is needed in which case it should be synchronised with a monophasic or biphasic DC shock dose of 0.5-2 J/kg [Class A; Expert Consensus Opinion].

6.1 Polymorphic ventricular tachycardia

If polymorphic ventricular tachycardia (*Torsade de pointes*, 'twisting of peaks') is present, magnesium (magnesium sulfate heptahydrate) (0.1 –0.2 mmol/kg, 25-50 mg/kg IV) may be used ^{2,3} [Class A; LOE IV]. Note that this is primarily a descriptive term because of a changing axis and baseline. It may or may not be associated with a pulse. If pulseless, treat with DC shock, as for pulseless VT.

6.2 Wide QRS complex Supraventricular Tachycardia

SVT with aberrant conduction may cause a tachycardia with wide QRS complexes (>0.08 secs) and thus may be indistinguishable from VT. If pulses and blood pressure are normal the rhythm may be treated as for SVT with vagal stimulation and adenosine. If pulses are present but the blood pressure is low or circulation deemed inadequate, the rhythm should be regarded as pulsatile VT and treated with synchronised DC shock at monophasic or biphasic doses of 0.5 to 2 J/kg [Class A; Expert Consensus Opinion].

If pulses are absent, the rhythm should be regarded as pulseless VT and treated accordingly with unsynchronised DC shock at monophasic or biphasic doses of 4 J/kg ^{2,4}. [Class A; LOE IV].

References

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