Paediatric Advanced Life Support

1. Establish basic life support

2. Oxygenate, Ventilate
   - Provide positive pressure ventilation with a high inspired oxygen concentration

3. Attach a Defibrillator or Monitor
   - Monitor the cardiac rhythm:
     - Place the defibrillator pads or paddles on the chest wall; one just below the right clavicle, the other at the left anterior axillary line
     - For infants, when using this method of monitoring, it may be more appropriate to apply the pads or paddles to the front and back of the infant's chest
     - Place monitoring electrodes in the conventional chest positions and monitor with a cardiac monitor.

4. Assess Rhythm (+ check for pulse)
   - Check the pulse
     - **Child** - feel for the carotid pulse in the neck
     - **Infant** - feel for the brachial pulse on the inner aspect of the upper arm
   - Take **no more than 10 seconds**
   - Assess the rhythm on the monitor as being:
     - Non ventricular fibrillation (Non VF) or non pulseless ventricular tachycardia (non VT) (Asystole or Pulseless Electrical Activity)
     - Ventricular fibrillation (VF) or pulseless ventricular tachycardia (VT)

5A. Non VF/VT - Asystole, Pulseless Electrical Activity
This is more common in children
- Administer epinephrine
  - If direct venous or intraosseous access has been established, give 10 mcg/kg epinephrine (0.1 ml/kg of 1 in 10,000 solution)
  - If venous access has not been established consider giving 100 mcg/kg epinephrine via the tracheal tube (1 ml/kg of 1 in 10,000 or 0.1 ml/kg of 1 in 1000 solution) if one is already in place
  - Try the intraosseous route first if there is no circulatory access in place
- Perform 3 minutes of basic life support and ventilation with oxygen
- Repeat the administration of epinephrine
  - If direct venous or intraosseous access has been established, give a further dose of 10 mcg/kg epinephrine. In cases where intrarterial monitoring is already in place, higher doses such as 100mcg/kg epinephrine (1ml/kg of 1 in 10,000 or 0.1 ml/kg of 1 in 1000 solution) may be used if helpful as the effect can be measured. Higher doses may be considered in other circumstances, for example where extreme vasodilatation contributed to cardiac arrest i.e. septicaemia, anaphylaxis.
  - Repeat the cycle of 10mcg/kg epinephrine followed by 3 minutes of basic life support and ventilation
  - Consider the use of other medications such as alkalising agents, and treat reversible causes such as hypovolaemia.

5B. VF/Pulseless VT
- This is less common in paediatric life support but the rescuer must always be aware of the possibility of treating this arrhythmia rapidly and effectively
- Defibrillate the heart with three defibrillation shocks:
  - 2J/kg  2J/kg  4J/kg
  (Accuracy of dosage may be difficult using defibrillators with stepped energy levels.)
  - Place the defibrillator pads or paddles on the chest wall; one just below the right clavicle, the other at the left anterior axillary line
  - For infants, when using this method of monitoring, it may be more appropriate to apply the pads or paddles to the front and back of the infant's chest
- If VF/VT persists perform one minute of basic life support and give 10mcg/kg of epinephrine to support coronary perfusion
- Defibrillate the heart with three further shocks:
  - 4J/kg  4J/kg  4J/kg
- Repeat the cycle of defibrillation and one minute basic life support until defibrillation is achieved. Consider the use of other medications such as antiarrhythmics and treat reversible causes.

Advanced life support procedures
- Establish a definitive airway
  - attempt tracheal intubation
  - verify the position of the tracheal tube at regular intervals
- Establish ventilation
  - Ventilate with 100% oxygen using a self inflating resuscitation bag
- Establish vascular access
  - Gain access to the circulation by:
  - Direct venous access
  - Intraosseous access
- Give epinephrine every three minutes
6. Drugs in Paediatric Advanced Life Support

**Epinephrine (Adrenaline)**
Epinephrine is the first line drug for asystole. Its action is to increase aortic diastolic pressure during chest compressions and thus coronary perfusion pressure and the delivery of oxygenated blood to the heart. It also enhances the contractile state of the heart and stimulates spontaneous contractions. The initial intravenous or intraosseous dose is 10 micrograms/kg (0.1 ml of 1:10,000 solution). In the child with no existing intravenous access the intraosseous route is recommended as the route of choice as it is rapid and effective. In each case the epinephrine is followed by a normal saline flush (2-5 mls). If circulatory access cannot be gained, the tracheal tube can be used. Ten times the intravenous dose (100 micrograms/kg) should be given via this route. The drug should be injected quickly down a narrow bore suction catheter beyond the tracheal end of the tube and then flushed in with 1 or 2 mls of normal saline.

When it comes to the second and subsequent doses there is no convincing evidence that a tenfold increase in epinephrine is beneficial in children and in some adult studies a deleterious effect was observed. However, there are some anecdotal cases of return of spontaneous circulation with large doses of epinephrine and therefore it can still be used for second and subsequent doses in patients where cardiac arrest is thought to have been secondary to circulatory collapse. It is clear that patient response to epinephrine is very variable, therefore if the patient has continuous intra-arterial monitoring the epinephrine dose can be titrated to best effect.

**Alkalising Agents**
Children with cardiac arrest will be acidotic as the arrest has usually been preceded by respiratory arrest or shock. However, the routine use of alkalising agents has not been shown to be of benefit. Sodium bicarbonate therapy increases intra-cellular carbon dioxide levels so administration, if used at all, should follow assisted ventilation with oxygen, and effective BLS. Once ventilation is ensured and epinephrine plus chest compressions are provided to maximize circulation, use of sodium bicarbonate may be considered for the patient with prolonged cardiac arrest or cardiac arrest associated with documented severe metabolic acidosis (1 ml/kg of an 8.4% solution). These agents should be administered only in cases where profound acidosis is likely to adversely affect the action of epinephrine. An alkalising agent is usually considered if spontaneous circulation has not returned after the first or second dose of epinephrine/adrenaline.

**Intravenous Fluids**
In situations where the cardiac arrest has resulted from circulatory failure, a
standard (20 mls/kg) bolus of crystalloid fluid should be given if there is no response to the initial dose of epinephrine.

**Anti-arrhythmic drugs**

Amiodarone is now the treatment of choice in shock resistant ventricular fibrillation and pulseless ventricular tachycardia. This is based on evidence from adult cardiac arrest and experience with the use of amiodarone in children in the catheterisation laboratory setting. The dose of amiodarone for VF/pulseless VT is 5 mg/kg via rapid i.v. bolus followed by continued basic life support and a further defibrillation attempt within 60 seconds.

Further doses of epinephrine (usually at low dose unless specifically indicated by the clinical situation) should be given every 3-5 minutes.

Lidocaine (lignocaine) may still be used as an alternative to amiodarone but bretylium is no longer thought to be an appropriate agent in children.

After each drug CPR should continue for up to a minute to allow the drug to reach the heart before a further defibrillation attempt. It is DC shock that converts the heart back to a perfusing rhythm not the drug. The purpose of the anti-arrhythmic drug is to stabilise the converted rhythm and the purpose of epinephrine is to improve myocardial oxygenation by increasing coronary perfusion pressure. Epinephrine also increases the vigour and intensity of ventricular fibrillation which assists effective defibrillation. There should be about a minute of CPR between each set of shocks. Therefore, drugs should be given very promptly after an unsuccessful defibrillation attempt to allow time for the drug’s distribution each time before the next shock.

**PALS algorithm**

The *Paediatric Advanced Life Support algorithm* is available in Adobe PDF format.

**References**