AUSTRALIAN RESUSCITATION COUNCIL

NEW ZEALAND Resuscitation Council WHAKAHAUORA AOTEAROA

ANZCOR Guideline 12.2 – Advanced Life Support for Infants and Children: Diagnosis and Managment

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 Resuscitation Committee on Resuscitation (ANZCOR) make the following recommendations:

1. Cardiac arrest should be suspected in a child or infant if they are unresponsive and not breathing normally. Pulse check may be used but should not delay CPR for more than 10 seconds. If the rescuer is uncertain about the presence of a pulse then CPR should be started.
2. For a single rescuer and an unwitnessed collapse, commence CPR before seeking help.
3. For a witnessed collapse and/or multiple rescuers call for help immediately and then start CPR.
4. Rescuers should provide both ventilation and chest compressions for infant and child cardiac arrest.
5. For infants and children, CPR should commence with 2 ventilations.
6. Infant and child CPR should be delivered with a ratio of 2 breaths to 15 compressions.
7. Compressions should be delivered at a rate of 100-120/min
8. Compression depth should be approximately 1/3 the AP diameter of the chest (4cm in infants, 5cm in children).
9. A two thumb technique is preferred for delivering compressions to an infant.
10. Either one or two handed technique may be used for delivering compressions to children.

11. Vascular access should be attempted by peripheral intravenous cannula or by an intraosseous route if an IV cannot be placed within 60 seconds.
12. An ECG should be displayed (leads/pads/paddles) as soon as this can be achieved during management of the arrest.
13. Ventilation may be provided by mouth to mouth, bag/valve/mask, or more advanced airway techniques.
14. Endotracheal intubation should not be attempted or persisted with if it results in prolongation of hypoxia.
15. Following endotracheal intubation compressions should be given continously at 100-120/min with ventilations delivered at 10 breaths/minute.
16. Drugs should be given via the IV or IO route, with the ETT used only when vascular access cannot be achieved.
17. Infants and children who have a sudden cardiac arrest should be investigated for underlying causes such as membrane channelopathies.

Guideline

1 Diagnosis

Cardiorespiratory arrest should be suspected when the infant or child is unresponsive and not breathing normally. Additional signs are pallor, cyanosis and absence of pulse. Healthcare personnel may use pulse palpation in their assessment but valuable time should not be wasted. If a pulse cannot be confidently identified within 10 seconds, or there is uncertainty, cardiopulmonary resuscitation (CPR) should be commenced[1] (Class A). In two studies of paediatric cardiac arrest, healthcare personnel could not reliably determine the presence or absence of a pulse when other information about the presence or absence of a circulation was unknown to them [2,3] [LOE III-2].

Resuscitation should commence immediately with basic techniques in the healthcare setting and continued with the aid of drugs and equipment as soon as these become available. Advanced CPR implies the preservation of a patent airway by endotracheal intubation or other device, the provision of positive pressure ventilation via mechanical devices with oxygen, the treatment of cardiac dysrhythmias, the treatment of the cause of cardiorespiratory arrest and the treatment of complications arising from its management.

Many recommendations are based on expert consensus opinion. These guidelines cannot replace broader education and training for paediatric emergencies.

2 Initial Actions

A single rescuer encountering an unwitnessed collapse of an infant or child should start CPR immediately and then obtain assistance. A rescuer witnessing a sudden collapse should obtain help immediately and then start CPR[1] [Class B; Expert Consensus Opinion].

When several rescuers are in attendance, the initial actions e.g., bag-valve-mask ventilation/tracheal intubation and ventilation, display of the electrocardiograph and access to the circulation should be attempted simultaneously. Thereafter treatment should be guided by the cardiac rhythm. The choice and sequence of drug and fluid therapy or direct current shock is indicated in the flowchart (ANZCOR Guideline 12.3).

2.1 Electrocardiograph

The electrocardiograph may be displayed using chest leads, defibrillator paddles or pads. Drug therapy or immediate direct current shock is administered according to the existing arrhythmia while chest compressions and mechanical ventilation with oxygen are maintained.

2.2 Access to Circulation

Access to the circulation with a peripheral intravenous (IV) cannula should be attempted if not already present. However, valuable time should not be wasted (more than 60 seconds) with repeated unsuccessful attempts at cannulation because alternative safe and ready access to the circulation is possible via the intraosseous route (IO) [1] [Class A; LOE III-1] (ANZCOR Guideline 12.6) or less effectively via the respiratory tract (endotracheal tube, ETT) [1].

All resuscitative drugs and fluids may be given via the IV or IO route but only adrenaline, atropine and lignocaine are absorbed when given via ETT [1]. If a central venous line exists it should be used in preference to any other route but central venous cannulation via the subclavian or internal jugular veins should not be attempted initially as it wastes time and is hazardous in this circumstance [Class A; Expert Consensus Opinion]. However cannulation of an external jugular or femoral vein may be easily accomplished. Surgical cutdown onto a peripheral vein may be required.

3 Airway

An airway should be established initially by head tilt-chin lift (Guideline 4) or jaw thrust (Guideline 4). The patency of the airway should be assessed by observation of movement of the chest and abdomen during breathing. An indrawing of the chest wall and/or distension of the abdomen with each inspiratory effort without expiration of air implies an obstructed airway. If airway obstruction is not relieved by backward head tilt-chin lift or by jaw thrust, the pharynx should be immediately inspected with the aid of a laryngoscope and cleared of any secretions, vomitus or blood with a pharyngeal sucker (e.g., Yankauer's). Magill's forceps may be used to extract a foreign body. Establishment and maintenance of an airway may be achieved by an oropharyngeal or nasopharyngeal airway, endotracheal tube, laryngeal mask airway or other device. An oropharyngeal airway of approximate length is the equivalent distance from the centre of the lips to the angle of the mandible. A nasophayryngeal airway of appropriate length is the equivalent distance from the tip of the nose to the tragus of the ear.

4 Breathing

If spontaneous ventilation is not immediately resumed on establishment of an airway, rescue breathing should be commenced with mouth-to-mouth ventilation, mouth-to-nose ventilation or by ventilation given by an oxygen inflated bagging circuit (bag-valve-mask), self-inflating bag (bag-valve-mask) or an operator powered resuscitator dependent on an oxygen supply. The inspiratory time should be approximately one second.

When combined with cardiac compressions, rates of ventilation are given in the table. Generally, application of breaths should precede external cardiac compression because asphyxial causes predominate over cardiac causes in paediatric cardiopulmonary arrest. However, since it is not certain if compressions or ventilations should be given first [4], it is reasonable in the institutional setting, if the usual equipment used to apply breaths is not immediately to hand, to commence CPR with chest compressions.

ANZCOR recommends that rescuers provide rescue breaths and chest compressions for pediatric IHCA and OHCA. If rescuers cannot provide rescue breaths, they should at least perform chest compressions [4] (CoSTR 2015, strong recommendation, low-quality evidence). Supplemental oxygen should be administered in the mouth-to-mask and bag-valve-mask techniques.

4.1 Bag-Valve-Mask Ventilation and Endotracheal Intubation

Adequate inflation of the lungs is often possible with bag-valve-mask ventilation but this is a difficult technique for the non-expert. Bag-valve-mask ventilation is an acceptable technique if the lungs can be inflated adequately (Class B).

Bag-valve-mask ventilation was associated with fewer complications than endotracheal intubation in out-of-hospital prospective controlled studies when transport times to hospital were short [1] (LOE II). Bag-valve-mask ventilation was no less appropriate than endotracheal intubation during cardiac arrest or trauma in retrospective studies [1] [LOE III-2].

Intubation of the trachea has several advantages but should not be attempted at the disadvantage of prolonging hypoxaemia [Class A; Expert Consensus Opinion]. If intubation cannot be accomplished easily, oxygenation should be re-established by assisted or controlled positive pressure ventilation with a mask technique before a re-attempt at intubation. Intubation establishes and maintains a patent airway, facilitates initial mechanical ventilation with 100% oxygen and later accurate administration of lesser amounts, minimizes pulmonary aspiration and pulmonary oedema, enables suctioning of the trachea and provides a route for the administration of selected drug therapy. Intubation is more practicable for airway maintenance and ventilation than bag-valve-mask during prolonged management or transport [Class B; Expert Consensus Opinion]. After intubation, an oro- or nasogastric tube should be inserted to decompress the stomach which is often inflated by mask-delivered positive pressure ventilation.

5 Circulation

If the victim is unresponsive and not breathing normally chest compression should be commenced immediately [Class A; Expert Consensus Opinion]. The circulation may also be assessed by palpation of a carotid, brachial or femoral pulse [Class B; Expert Consensus Opinion]. Chest compression should be commenced if a pulse is not palpable or cannot be identified within 10 seconds, or is less than 60 beats per minute (bpm).

To give chest compression, the victim should be placed on a firm surface and compression directed to the lower sternum. The aim is to generate blood flow by sufficient compression. This may be judged by palpation of a pulse but it may be difficult to discern a pulse even during apparently effective chest compression.

5.1 Depth of Compression

At least one third the anterior-posterior dimension of the chest or approximately 5 cm in children and approximately 4 cm in infants {CoSTR 2015, weak recommendation, very low quality of evidence).

5.2 Method of Compression

- **Infant:** Chest compression for an infant can be performed with the two-thumb technique or two-finger technique [Class A; LOE IV]. The two-thumb technique is the strongly preferred technique for healthcare rescuers [1] [Class A; Expert Consensus Opinion]. With this technique, the rescuer's hands encircle the chest and the thumbs compress the sternum. Care should be taken to avoid restricting chest expansion during inspiration.

  The two-finger technique may be used by a single rescuer in order to minimize the transition time between chest compression and ventilation [Class B; Expert Consensus Opinion].

- **Young child:** Chest compression can be performed with the 'heel' of one hand or the two-handed technique [1] [Class A].

- **Older child:** As for adults, using the two-handed technique [Class A; Expert Consensus Opinion].

Whatever technique is employed, pressure over the ribs and abdominal viscera should be avoided.

Approximately 50% of a compression cycle should be devoted to compression of the chest and 50% to relaxation to enable recoil of the chest wall.

5.3 Ratios and Sequences of Compressions And Inflations[1]

- **Basic life support rescue** by one or two rescuer(s): 30 compressions, then 2 lung inflations [Class A; Expert Consensus Opinion].

- **Advanced life support rescue** by healthcare rescuers: 2 breaths then 15 compressions. [Class A; Expert Consensus Opinion]. Compressions may be commenced first if equipment such as bag-valve-mask is not immediately to hand.

Rescuers trained in advanced life support may use the BLS approach (30:2) in circumstances where this is more achievable. Examples might include rescuers working with others trained in the 30:2 approach, being a solo rescuer, or adverse physical environments.

If rescue breathing is given by any type of mouth technique or mask technique, breaths should be delivered during a planned pause in chest compressions to allow adequate expansion of the lungs. However, to minimize the pause for lung inflation, chest compression should be recommenced during expiratory phase of the second inflation.

Chest compressions should not be interrupted if ventilation is given via endotracheal tube. Ventilation should be given just after a compression. This will minimise but not eliminate simultaneous ventilation and chest compression [Class A, Expert Consensus Opinion]. There is no data on whether ventilation via a laryngeal mask airway (LMA) during CPR is effective if the chest is simultaneously compressed. Therefore, if using an LMA, breaths should be delivered during a pause in chest compressions as for a mouth-to-mouth (rescue breathing) or a bag-valve-mask technique [Class A, Expert Consensus Opinion].

5.4 Rates and Ratios of Compressions

The ideal rate of ventilation during continuous cardiac compression is not known but a rate of approximately 10 breaths per minute is recommended [Class A, Expert Consensus Opinion].

Infant, Young and Older child

- **Basic life support rescue:** Single or two basic life support rescuers should use a compression-ventilation ratio of ratio of 30:2 with pauses for ventilation.

  The rate of chest compression is 100-120 per minute. With pauses for ventilation, the number of compressions given each minute will be less than 100. If 5 cycles are achieved in two minutes, approximately 75-90 compressions and 5 breaths per minute would be achieved.

- **Advanced life support rescue:** For advanced rescuers, a ventilation-compression ratio of 15:2 should be used.

There should be pauses for ventilation when using bag-valve-mask ventilation or a laryngeal mask airway. Delivering 5 cycles per minute in this way will yield approximately 75-90 compressions and 10 breaths per minute.

When the airway is secured with an endotracheal tube (or tracheostomy) chest compressions should be continuous, at a rate of 100-120 compressions per minute. Ventilation should be given at 10 breaths per minute. Care should be taken to avoid hyperventilation since this compromises the effectiveness of external cardiac compression while the resultant hypocapnia may cause cerebral vasoconstriction. During uninterrupted chest compressions, ventilation should be delivered during the release phase of a compression.

6 Importance of Detection of Expired Carbon Dioxide (CO_2)

The amount of CO_2 excreted by the lungs is determined by the amount of pulmonary blood flow and ventilation. Inability to detect CO_2 in expired breath from a victim receiving adequate chest compression may be due to lack of ventilation and should prompt an immediate laryngoscopic check of the correct location of an endotracheal tube. Adjustment of ventilation and chest compression is facilitated with continuous measurement ($P_{ET}CO_2$) or intermittent detection of end-tidal CO_2 (when the victim has been intubated or has an LMA in place). [Class B, Expert Consensus Opinion] However, it is not presently possible to specify a $P_{ET}CO_2$ which predicts survival or quality of survival [4]. (CoSTR 2015, No recommendation could be made).

Low CO_2 in expired breath from a victim receiving CPR may imply a treatable condition (eg: pneumothorax, hypovolaemia, cardiac tamponade) or inadequate cardiac compression or excessive ventilation or both. A high CO_2 in expired breath implies inadequate ventilation.

7 Investigation of Cause of Sudden Cardiac Arrest

In paediatrics, the cause of cardiac arrest is usually the result of established hypoxaemia or hypotension or both occurring in numerous diseases and traumatic events. However, occasionally cardiac arrest occurs unexpectedly in an apparently healthy child. In such cases, in addition to usual clinical investigations and coronial investigation when death is the outcome, the presence of an underlying cardiac dysrhythmia due to a disorder of membrane ion channelopathy should be considered [1] [Class A].

References

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