AUSTRALIAN RESUSCITATION COUNCIL

NEW ZEALAND Resuscitation Council WHAKAHAUORA AOTEAROA

ANZCOR Guideline 12.4 – Paediatric resuscitation in special circumstances

Summary

ANZCOR Guidelines 12.1 to 12.5 are provided to assist health professionals in the resuscitation of children. Differences from the adult and newborn guidelines reflect differences in the causes of cardiorespiratory arrest in, and anatomy and physiology of newborns, older infants, children and adults. These guidelines draw from Paediatric Life Support 2020 International Consensus on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science with Treatment Recommendations[1] the development of which included representation from ANZCOR. The 2020 European Resuscitation Council Paediatric Life Support guidelines[2], 2020 American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Care[3], previous Paediatric Life Support International Consensus on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science with Treatment Recommendations[4-6] statements and local practices have also been taken into account.

ANZCOR Guideline 12.4 focuses on the management of the infant or child after cardiorespiratory arrest in cases where the special circumstances leading to the arrest may be known or suspected. It should be read in conjunction with the other paediatric guidelines (ANZCOR Guidelines 12.1, 12.2, 12.3 and 12.5).

To whom does this guideline apply?

This guideline applies to infants and children (refer to ANZCOR Guideline 12.1 for definitions) requiring paediatric advanced life support (PALS) in a healthcare environment (prehospital or hospital).

Who is the audience for this guideline?

This guideline is intended for health professionals who care for infants and children in healthcare environments where resuscitation equipment and medications are available.

Summary of Recommendations

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

1. ANZCOR suggests that staff in hospitals performing cardiothoracic surgery in children should establish institution-specific algorithms for cardiac arrest after cardiothoracic surgery [Good Practice Statement].
2. ANZCOR suggests the following in relation to traumatic cardiac arrest (TCA) [Good Practice Statement]:
   - Rescuers should commence CPR while prioritising the search for and correction of any of the reversible causes of TCA.
   - External exsanguinating haemorrhage should be controlled using direct pressure +/- tourniquets (depending on the site).
   - Bilateral finger or tube thoracostomy (or needle thoracocentesis) should be considered.
   - Fluid resuscitation should occur with blood products as soon as available.
   - Emergency thoracotomy should be considered in patients with penetrating trauma.
3. ANZCOR suggests that extracorporeal life support (ECLS) be considered as an intervention for selected infants and children with in-hospital cardiac arrest (IHCA) refractory to conventional CPR (and a presumed reversible cause) in hospitals with appropriate expertise and resources and where resuscitation systems allow ECLS to be performed well with active quality improvement systems [CoSTR 2019, weak recommendation, very low quality of evidence].

Abbreviations

Abbreviation	Meaning/Phrase
ANZCOR	Australian and New Zealand Committee on Resuscitation
ARC	Australian Resuscitation Council
CoSTR	Consensus on Science with Treatment Recommendations
CPR	cardiopulmonary resuscitation
ECLS	extracorporeal life support
ECMO	extracorporeal membrane oxygenation
ED	emergency department
IHCA	in-hospital cardiac arrest
ILCOR	International Liaison Committee on Resuscitation
IV	intravenous
NZRC	New Zealand Resuscitation Council
OHCA	out-of-hospital cardiac arrest
PALS	paediatric advanced life support
ROSC	return of spontaneous circulation
TCA	traumatic cardiac arrest

Guideline

1 Reversible causes of cardiorespiratory arrest

During CPR, the early identification and treatment of any reversible cause of cardiac arrest is a high priority for advanced life support providers. The mnemonic "4H4T" may be useful to remind rescuers of what to actively consider and correct:

- Hypoxia
- Hypovolemia
- Hypothermia or hyperthermia
- Hyper/hypokalaemia or other metabolic disorder
- Tension pneumothorax
- Tamponade (cardiac)
- Toxins
- Thrombosis (pulmonary or coronary)

The management of each of these causes is generally the same in cardiac arrest as in acute life-threatening disease.

Specific conditions such as cardiac surgery, neurosurgery, trauma, drowning, sepsis, and pulmonary hypertension also require a specific approach. The more widespread use of ECMO in life support has significantly changed the concept of 'reversibility' following cardiac arrest. Staff in hospitals performing cardiothoracic surgery in children should establish institution-specific algorithms for cardiac arrest after cardiothoracic surgery [Good Practice Statement].

2 Life support for blunt or penetrating trauma

Paediatric traumatic cardiac arrest (TCA) is rare but has a poor prognosis. The response to TCA is time-critical and success depends on a well-established chain of survival, including advanced prehospital and specialised trauma centre care.

The ILCOR 2020 PLS Task Force performed an evidence update on the topic of resuscitation after TCA[1] to identify any evidence on the topic published since the last review in 2010.[5] There was insufficient evidence to make a recommendation for modification of standard resuscitation for infants and children experiencing cardiac arrest due to major trauma.

Given the poor prognosis of paediatric TCA with standard care, greater prioritisation of management of some of the reversible causes is suggested in traumatic arrest e.g., treatment of assumed reversible causes should be given a higher priority to administration of adrenaline. CPR should be performed simultaneously with other interventions where possible, depending on available personnel. Rescuers should minimise spinal movement as far as possible without hampering the process of resuscitation [Good Practice Statement].

Shockable rhythms are rare in paediatric TCA. Massive haemorrhage is a common cause of TCA. The initial treatment for external massive bleeding is direct pressure (if possible, using haemostatic dressings). Depending on the site, external bleeding may be appropriately managed with application of a tourniquet.

Emergency thoracotomy in paediatric TCA patients with penetrating trauma should be considered as this may improve survival. Current evidence shows no benefit (or even worse

outcome) of thoracotomy in children after blunt trauma and this intervention is not generally recommended.[2]

Children with TCA should preferably be transported directly to a major trauma centre designated for children based on the local trauma system [Good Practice Statement].

ANZCOR suggests the following in relation to paediatric traumatic cardiac arrest [Good Practice Statement]:

- Rescuers should commence CPR while prioritising the search for and correction of any of the reversible causes of paediatric TCA.
- External exsanguinating haemorrhage should be controlled using direct pressure +/- tourniquets.
- Bilateral finger or tube thoracostomy (or needle thoracocentesis) should be considered.
- Fluid resuscitation should occur with blood products as soon as available.
- Emergency thoracotomy should be considered in paediatric TCA patients with penetrating trauma with or without signs of life on arrival to ED.

3 Cardiac arrest in children with sepsis

Severe sepsis and septic shock are known risk factors for paediatric cardiac arrest. Early management of suspected sepsis in children is vital as IHCA associated with sepsis has a poor outcome. The management of cardiac arrest in children with sepsis should follow the standard PALS algorithm. Early consideration and correction of possible reversible causes is a priority. Children with refractory septic shock may benefit from extracorporeal life support (ECLS) using ECMO.[2]

4 Children with congenital cardiac disease

Infants and children with repaired or unrepaired congenital heart disease may require special considerations during resuscitation. However, standard CPR techniques should be used initially pending advice from a specialist centre [Good Practice Statement].

Standard PALS techniques may be ineffective in cardiac arrest in children with pulmonary hypertension. In this setting, reversible causes of increased pulmonary vascular resistance (cessation of usual medication, hypoxia, hypercarbia, cardiac arrythmias, cardiac tamponade, drug toxicity) should be sought and treated. Treatment with pulmonary vasodilators should be considered in combination with CPR. If these are ineffective, ECLS may be lifesaving.[2]

5 Children with hypothermic cardiac arrest

Cardiac arrest caused by hypothermia is rare in Australia and New Zealand. The chance of survival with good neurological outcome in children after hypothermic arrest is difficult to estimate. The adage 'no child can be declared dead unless warm and dead' may not apply for children with prolonged submersion times, a lethal injury, a fully frozen body, or an unmanageable airway. However, there are cases of children with prolonged submersion times in ice cold water that have been associated with survival. Evidence suggests a worse prognosis for children with preceding or associated asphyxia. The mechanism and circumstances of the

hypothermia and the first measured core body temperature (<24 ^{0}C is more likely primary hypothermia) should be considered.

The standard paediatric ALS actions should be adapted to adjust for the hypothermic state of the victim. Hypothermic cardiac arrest patients should receive continuous CPR during transfer. Chest compression and ventilation rate should follow the standard PALS algorithm. Adrenaline (epinephrine) may be withheld until core temperature is >30 ^{0}C. If initial defibrillation attempts are unsuccessful, further shocks may be withheld until core temperature is >30 ^{0}C.

6 Children with toxic ingestions

Poisoning very rarely causes cardiac arrest in children.

Expert toxicological help should be sought for specific management of intoxications with high-risk medications (beta-blockers, tricyclic antidepressants, calcium channel blockers, digoxin or insulin).

The National Poisons Centre may be contacted for specific advice (available 24 hours):

- Australian Poisons Information Centre call 13 11 26
- New Zealand Poisons Centre call 0800 764 766 (0800 POISON)

Drug-induced hypotension usually responds to IV fluids. Specific therapies (e.g., antidotes) may be used, where available, in addition to standard PALS algorithms.

7 Extracorporeal Life-Support (ECLS)

Institution of extracorporeal life support (extracorporeal membrane oxygenation or ECMO) during cardiopulmonary resuscitation, may be considered for infants and children in hospitals that have the expertise, resources and systems to optimise the use of ECMO during and after resuscitation.[4]

A systematic review on ECLS for paediatric IHCA was performed in 2018[7] and an ILCOR Pediatric CoSTR was published as part of the 2019 CoSTR summary.[8]

For the critical outcomes of favorable neurological outcome at hospital discharge and survival to hospital discharge, the limited number of studies with paediatric populations showed improved outcomes with ECLS compared to conventional CPR [CoSTR 2019, weak recommendation, very low quality of evidence].[8] No studies were identified that addressed ECLS for children with OHCA.

ANZCOR suggests that ECLS be considered as an intervention for selected infants and children with IHCA refractory to conventional CPR (and a presumed reversible cause) in hospitals with appropriate expertise and resources and where resuscitation systems allow ECLS to be performed well with active quality improvement systems [CoSTR 2019, weak recommendation, very low quality of evidence].

References

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About this Guideline

Search date/s	ILCOR literature search details and dates are available on the CoSTR page of the ILCOR website (https://costr.ilcor.org) and the relevant CoSTR documents.
Questions/PICOs:	Are described in the CoSTR documents (https://costr.ilcor.org)
Method:	Mixed methods including ARC NHMRC methodology before 2017 and ILCOR GRADE methodology described in ILCOR publications since 2017. The guideline process includes involvement of stakeholders from member organisations of the ARC & NZRC, and peer review by members of the Australian and New Zealand Committee on Resuscitation (ANZCOR). Details of the guideline development process can be found on the ARC website at https://resus.org.au.
Principal reviewers:	Jason Acworth, Gabrielle Nuthall, Richard Aickin
Main changes:	This guideline includes new content in addition to content from previous Guidelines 12.6.
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