Guideline 12.3 – Management of other (non-arrest) arrhythmias in infants and children

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 12.3 focuses on the management of the infant or child with a cardiac arrhythmia (but not in cardiorespiratory arrest). It should be read in conjunction with the other paediatric guidelines (ANZCOR Guidelines 12.1, 12.2, 12.4 and 12.5).

To whom does this guideline apply?

This guideline applies to infants and children (Refer to ANZCOR Guideline 12.1 for definitions).

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) make the following recommendations:

1. ANZCOR suggests that vagal stimulation should be attempted as initial treatment of SVT (supraventricular tachycardia) in the haemodynamically stable child. Suggested methods include [Good Practice Statement]:

    - Iced water application to the face to elicit the diving reflex (in infants and young children).
    - Valsalva manoeuvre (in older children).
2. ANZCOR suggests that, for the treatment of children with SVT [Good Practice Statement]:
    - Adenosine IV/IO (initial dose 100 micrograms/kg) should be considered the preferred medication.
    - Synchronised cardioversion (1 J/kg) with the administration of suitable analgesia/sedation in conscious children may be considered in SVT with cardiovascular compromise when IV Adenosine is not able to be administered (e.g., no IV access) or is not effective.
    - Amiodarone or other antiarrythmic medications (e.g., calcium channel blockers, beta-blockers) given by a slow IV infusion with careful haemodynamic monitoring may be considered for refractory SVT after expert consultation.
3. ANZCOR suggests that synchronised cardioversion (1 J/kg followed by 2 J/kg if required) be used as the preferred first therapy for paediatric VT with cardiovascular compromise [Good Practice Statement].
4. ANZCOR suggests that, for the treatment of children with bradycardia:
    - IV/IO Adrenaline (epinephrine) 10 micrograms/kg (maximum 1mg per dose) may be administered to infants and children with bradycardia and poor perfusion that is unresponsive to treating the underlying cause, for example hypoxia [CoSTR 2010].
    - IV/IO Atropine 20 micrograms/kg (maximum 600 micrograms) may be administered for bradycardia caused by increased vagal tone [CoSTR 2010].
    - Emergency transthoracic pacing may be lifesaving in selected cases of bradycardia caused by complete heart block or abnormal function of the sinus node. Specialist advice should be sought [Good Practice Statement].

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
ECG	electrocardiogram
ILCOR	International Liaison Committee on Resuscitation
IO	intraosseus
IV	intravenous
LOE	Level of Evidence
NZRC	New Zealand Resuscitation Council

PEA	pulseless electrical activity
PLS	paediatric life support
pVT	pulseless ventricular tachycardia
RCT	randomised control trial
ST	sinus tachycardia
SVT	supraventricular tachycardia
VF	ventricular fibrillation
VT	ventricular tachycardia

1.0 | Tachyarrhythmias

Any heart rate significantly above normal-for-age should prompt consideration of a tachyarrhythmia as a possibility. This is especially so if associated with signs of poor circulation and hypotension; if the child has a history of cardiac disease or cardiac surgery; or in cases where the child may have been poisoned with cardioactive drugs. In sinus tachycardia, the elevated heart rate is a response to, rather than the cause of, poor circulation. A careful history and a 12-lead ECG may help to differentiate the likely cause.

1.1 | Supraventricular Tachycardia (SVT)

SVT is the most common spontaneous-onset arrhythmia in childhood and infancy. It may result in life-threatening hypotension. It usually presents with a heart rate of 220 to 300/min in infants, and a lower rate in older children (approximately 180/min). The QRS complex is usually narrow (< 0.08 secs) making it difficult sometimes to discern from sinus tachycardia. The heart rate in sinus tachycardia may vary with activity or stimulation, whereas in SVT it is uniform and is often of sudden onset and offset. A P-wave may be discernible in either rhythm but is often absent in SVT.

SVT may cause severe hypotension or pulselessness in which case synchronised cardioversion should be performed immediately in a dose of 1 J/kg but increased to 2 J/kg if necessary.[7]

In haemodynamically stable children, vagal stimulation should be attempted as initial treatment of SVT. For infants and young children, this may best be achieved by application of a plastic bag filled with iced water to the face or by wrapping the infant’s arms in a towel and immersing the whole face in an ice water slurry for 5 seconds. Older children, if conscious, may be coached to perform a Valsalva manoeuvre (such as blowing on a balloon or syringe).

Pharmacological management of SVT was last reviewed as part of the CoSTR 2010 process.[5] In

2020, an evidence update was performed to identify new evidence published in the last 10 years.[1] The ILCOR PLS Task Force concluded that there was insufficient new evidence to consider a change from the 2010 recommendations.

Adenosine remains the preferred first-line medication for treatment of children with SVT with a palpable pulse. Adenosine has a very short half-life and must be given as a rapid IV or IO bolus followed by a rapid flush of 0.9% sodium chloride. A dose in the range of 100 to 300 micrograms/kg reverts most SVT to sinus rhythm. The initial recommended dose is 100 micrograms/kg (maximum 6mg) but if this is ineffective, the further doses of 200 micrograms/kg then 300 micrograms/kg may be tried (maximum 12mg each single dose). If these are ineffective, then expert advice should be sought to guide further treatment options including:

- Further IV/IO Adenosine doses of 400 micrograms/kg then 500 micrograms/kg (maximum 12mg per dose).
- Synchronised cardioversion (1-2 J/kg).
- Other antiarrythmic medications.

ANZCOR suggests that, for the treatment of children with supraventricular tachycardia with a palpable pulse [Good Practice Statement]:

- Adenosine IV/IO (initial dose 100 micrograms/kg) should be considered the preferred medication.
- Synchronised cardioversion (1-2 J/kg) with the administration of suitable analgesia/sedation in conscious children may be considered in SVT with cardiovascular compromise when IV Adenosine is not able to be administered (e.g., no IV access) or is not effective.
- Amiodarone or other antiarrythmic medications (e.g., calcium channel blockers, beta-blockers) given by a slow IV infusion with careful haemodynamic monitoring may be considered for refractory SVT after expert consultation.

1.2 | Ventricular Tachycardia

Management of ventricular tachycardia (VT) with a palpable pulse was last reviewed as part of the CoSTR 2010 process.[5] In 2020, an evidence update was performed to identify new evidence published in the last 10 years.[1] The ILCOR PLS Task Force concluded that there was insufficient new evidence to consider a change from the 2010 recommendations.

ANZCOR suggests that synchronised cardioversion (1 J/kg followed by 2 J/kg if required) be used as the preferred first therapy for paediatric VT with cardiovascular compromise [Good Practice Statement].

1.3 | Polymorphic ventricular tachycardia

Polymorphic ventricular tachycardia (Torsade de pointes, ‘twisting of peaks’) describes VT with a changing axis and baseline on ECG. If a pulse is still present, IV magnesium sulfate 0.2 mmol/kg (maximum 10mmol) may be given over 20 minutes. If pulseless, treat with defibrillation, as for

pulseless VT.

1.4 | 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 VT and treated with synchronised cardioversion (1 J/kg followed by 2 J/kg if required) [Good Practice Statement].

If pulses are absent, the rhythm should be regarded as pulseless VT and treated accordingly with defibrillation at doses of 4 J/kg [CoSTR 2010, LOE IV].[5]

2.0 | Bradyarrhythmias

Bradycardia is rare in children and may be caused by intrinsic dysfunction or injury to the heart's conduction system (eg. heart block) or by extrinsic factors acting on a normal heart and its conduction system (eg. sinus bradycardia secondary to vagal stimulation).

2.1 | Medications for the treatment of bradycardia

The management of bradycardia was last reviewed as part of the CoSTR 2010 process.[5] In 2020, two evidence updates were performed to identify new evidence published since the 2010 review.[1] The ILCOR PLS Task Force concluded that there was no new evidence that would justify a change from the 2010 recommendations.

ANZCOR suggests that, for the treatment of children with bradycardia [CoSTR 2010, Good Practice Statements]:

- IV/IO Adrenaline (epinephrine) 10 micrograms/kg (maximum 1mg per dose) may be administered to infants and children with bradycardia and poor perfusion that is unresponsive to treating the underlying cause, for example hypoxia.
- IV/IO Atropine 20 micrograms/kg (maximum 600 micrograms) may be administered for bradycardia caused by increased vagal tone.

2.2 | Transcutaneous pacing for the treatment of bradycardia

External pacing for bradycardia was last reviewed by the Paediatric Task Force in 2000.[8] An evidence update was performed in 2020 to identify new evidence published since the 2000 review.[1] The ILCOR PLS Task Force concluded that there was no new evidence that would justify a change from the 2000 recommendations.

ANZCOR suggests that, for the treatment of children with bradycardia [CoSTR 2020, Good Practice Statements]:

- Transthoracic pacing may be lifesaving in selected cases of life-threatening bradycardia caused by complete heart block or abnormal function of the sinus node. Specialist advice should be sought.
- Pacing is not helpful in children with bradycardia secondary to a postarrest hypoxic/ischemic myocardial insult or respiratory failure.

References

1. Maconochie IK, Aickin R, Hazinski MF, Atkins DL, Bingham R, Couto TB, Guerguerian AM, Nadkarni VM, Ng KC, Nuthall GA, Ong GYK, Reis AG, Schexnayder SM, Scholefield BR, Tijssen JA, Nolan JP, Morley PT, Van de Voorde P, Zaritsky AL, de Caen AR; Pediatric Life Support Collaborators. Pediatric Life Support: 2020 International Consensus on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science With Treatment Recommendations. Resuscitation. 2020 Nov; 156: A120-A155.
2. Van de Voorde P, Turner NM, Djakow J, de Lucas N, Martinez-Mejias A, Biarent D, Bingham R, Brissaud O, Hoffmann F, Johannesdottir GB, Lauritsen T, Maconochie I. European Resuscitation Council Guidelines 2021: Paediatric Life Support. Resuscitation. 2021 Apr; 161: 327-387.
3. Topjian AA, Raymond TT, Atkins D, Chan M, Duff JP, Joyner BL Jr, Lasa JJ, Lavonas EJ, Levy A, Mahgoub M, Meckler GD, Roberts KE, Sutton RM, Schexnayder SM; Pediatric Basic and Advanced Life Support Collaborators. Part 4: Pediatric Basic and Advanced Life Support: 2020 American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care. Circulation. 2020 Oct 20;142(16_suppl_2): S469-S523.
4. Maconochie IK, de Caen AR, Aickin R, Atkins DL, Biarent D, Guerguerian AM, Kleinman ME, Kloeck DA, Meaney PA, Nadkarni VM, Ng KC, Nuthall G, Reis AG, Shimizu N, Tibballs J, Pintos RV. Part 6: Pediatric basic life support and pediatric advanced life support 2015 International Consensus on cardiopulmonary Resuscitation and emergency Cardiovascular Care Science with Treatment Recommendations. Resuscitation 2015: 95: e147-e168.
5. de Caen AR, Kleinman ME, Chameides L, Atkins DL, Berg RA, Berg MD, Bhanji F, Biarent D, Bingham R, Coovadia AH, Hazinski MF, Hickey RW, Nadkarni VM, Reis AG, Rodriguez-Nunez A, Tibballs J, Zaritsky AL, Zideman D, On behalf of the Paediatric Basic and Advanced Life Support Chapter Collaborators. Part 10: Paediatric basic and advanced life support: 2010 International Consensus on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science with Treatment Recommendations. Resuscitation 2010;81:e213–e259.
6. Consensus on Resuscitation Science & Treatment Recommendations. Part 6, Paediatric basic and advanced life support. Resuscitation 2005; 67: 271-291.
7. Tibballs J, Carter B, Kiraly NJ, Ragg P, Clifford M. Biphasic DC shock cardioverting doses for paediatric atrial dysrhythmias. Resuscitation 2010; 81: 1101-1104.
8. The American Heart Association in collaboration with the International Liaison Committee on Resuscitation. Guidelines 2000 for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care. Part 10: pediatric advanced life support. The American Heart Association in collaboration with the International Liaison Committee on Resuscitation.

Circulation 2000; 102: I291-342.

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
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