

Cardiac Arrhythmias

Definition / Supporting Information

Cardiac arrhythmias comprise a spectrum of variations to normal heartbeat.

- A wide range of normal heart rates is present in young people.
- Arrhythmias in the young are common.
 - Usually benign but may be life-altering or fatal
- Arrhythmias may begin at any age.
 - Higher incidence in early infancy and mid-adolescence
- Sudden cardiac death
 - Most common in mid-adolescence

Keywords / also known as: atrial fibrillation, heart problem, heart rhythm, rhythm disturbance, supraventricular tachycardia (STV), ventricular tachycardia (VT)

Essential History

Evaluation should proceed only when the ABCs (airway, breathing, circulation) have been addressed.

Ask about:

- Typical symptoms of cardiac dysfunction
 - Palpitations
 - Lightheadedness
 - Sweating, especially when feeding
 - Syncope
 - Chest pain
 - Shortness of breath (see Dyspnoea)
- Non-specific signs and symptoms of arrhythmia
 - Fatigue
 - Malaise
 - Poor feeding (see Appetite Loss)
 - Nausea
 - Pallor
 - Medication history – to include medicines prescribed for the child as well as possible intentional / unintentional ingestion:
 - Tricyclic antidepressants
 - Sympathomimetics

- Stimulant drugs
- Catecholamine use
- Drugs that prolong the QT interval
 - Domperidone
 - Macrolides (eg, Erythromycin)
 - Quinolones (eg, Ciprofloxacin)
 - Fluconazole
 - Ondansetron
 - Tacrolimus
 - Antipsychotics (eg, Haloperidol)
- Use of street drugs (eg, cocaine)
- Perinatal history
 - Congenital cardiac malformations
 - Repaired and unrepaired congenital cardiac lesions
 - Mother with overt or occult autoimmune disease (~50% of affected patients)
 - Premature birth
 - Congenital deafness (Romano–Ward form)
- Kawasaki's disease
- Family history of:
 - Sudden or premature death
 - Syncope
 - Recurrent arrhythmias

'Red Flag' Symptoms and Signs

Ask about:

- Typical symptoms of cardiac dysfunction
 - Palpitations
 - Lightheadedness
 - Sweating, especially when feeding
 - Syncope (particularly recurrent episodes)
 - Chest pain, particularly in association with other symptoms / signs
 - Shortness of breath (see Dyspnoea)
- Non-specific signs and symptoms of arrhythmia
 - Fatigue
 - Malaise
 - Poor feeding (see Appetite Loss)
 - Nausea
 - Pallor

Look for:

- Signs of congestive cardiac failure
 - Tachycardia
 - Gallop rhythm
 - Hepatomegaly
- Diminished pulses
- Bradycardia
 - Sinus rate below that expected for patient's age
 - Greater reason for alarm than fast rates
 - Sinus bradycardia
 - Neonates and infants: < 100 bpm, awake
 - Children up to 3 years: < 100 bpm
 - Children 3–9 years: < 60 bpm
 - Adolescents 9–16 years: < 50 bpm
 - Adolescents > 16 years: < 40 bpm

Differential Diagnosis / Conditions

Premature beats

- Escape or late beats occurring when higher pacemaker cells fail to produce an impulse at the expected interval
- Premature atrial contractions (PACs)
 - Usually asymptomatic to the patient
 - Seen in 50–75% of paediatric patients
- Premature ventricular contractions (PVCs)
 - Benign if:
 - No evidence of heart disease
 - QTc is normal (≤ 0.44 s)
 - Family history is not adverse
 - PVCs are uniform in appearance
 - For those children seen in hospital, new appearance of PVCs in the setting of a febrile illness should raise the question of myocarditis.

Supraventricular tachycardia (SVT)

- Duration
 - Ranges from a few seconds to several hours
- Heart rate
 - Infants: 230–300 bpm but usually between 260 and 280 bpm
 - Older patients: 180–240 bpm

- Commonly associated with signs and symptoms of congestive heart failure in infants (less so in older children who can communicate symptoms)

Atrial flutter

- Neonates
 - Atrial rate typically between 350 and 500 bpm
 - Congestive heart failure may be seen.
- Atypical form (intra-atrial re-entrant tachycardia)
 - Slower atrial rate

Ventricular tachycardia (VT)

- Signs and symptoms of cardiac dysfunction
- Cardiac output is frequently compromised to a greater degree than in SVT.
- Heart rate may be extremely rapid (up to 500 bpm) and slightly irregular.
- All wide QRS tachycardias should be considered VT until proven otherwise.

Conduction abnormalities

- First-degree atrioventricular (AV) block
 - Prolongation of the PR interval beyond the upper limit of normal for age, with all impulses conducted
 - Seen with:
 - Congenital cardiac malformations (especially AV septal defects)
 - Electrolyte disorders
 - Rheumatic fever
 - Myocarditis
 - Congenital muscular disorders
 - Antiarrhythmic drugs
- Second-degree AV block
 - Type I
 - Progressive prolongation of the PR interval until a dropped ventricular beat (non-conducted P wave) occurs
 - Generally benign unless syncope occurs
 - Normal finding in healthy children during sleep
 - Normal finding in highly conditioned athletes at rest
 - Type II
 - Intermittent loss of AV conduction without preceding lengthening of the PR interval
 - Implies an abnormal conduction system
- Complete AV block
 - No atrial impulses are conducted to the ventricles.

- Long QT syndrome (LQTS)
 - Electrolyte abnormalities
 - Hypokalaemia
 - Hypocalcaemia
 - Hypomagnesaemia
 - Myocardial ischaemia or injury
 - Acute central nervous system events
 - Cardiomyopathy

Sudden cardiac death

- Exertion or emotional stress triggers one of:
 - Syncope
 - Atypical seizures
 - Cardiac arrest

Investigations

Evaluation should proceed only when the ABCs (airway, breathing, circulation) have been addressed.

To be undertaken by non-specialist practitioners (eg, General Practitioner (GP) Team) or specialist practitioners (eg, Emergency Department / Paediatrician / Paediatric Cardiology Team(s)):

- 12-lead electrocardiography (ECG)
 - Must be obtained when an arrhythmia is being considered
 - Rhythm alterations may be quite subtle and not always identified on a rhythm strip.
 - ECG will detect chamber enlargement.
 - Calculate corrected QT interval: $QTc = QT \text{ interval (s)} / \sqrt{\text{preceding RR interval (s)}}$
 - Analyse arrhythmia in an organised fashion.
 - Is the rhythm fast or slow?
 - Is the rhythm regular or irregular?
 - Are the QRS complexes narrow or wide?
 - What is the relationship between the P waves and the QRS complexes?
- Where indicated:
 - Urea and electrolytes and bone biochemistry
 - Specifically, serum potassium, calcium, and magnesium

To be undertaken by specialist practitioners (eg, Paediatric / Paediatric Cardiology Team(s)):

- Echocardiography

Treatment Approach

To be undertaken by non-specialist practitioners (eg, GP Team) or specialist practitioners (eg, Emergency Department / Paediatric / Paediatric Cardiology Team(s)):

- Airway, breathing, and circulation (ABC) should be addressed in any child with a symptomatic arrhythmia.

Specific Treatment

To be undertaken by specialist practitioners (eg, Emergency Department / Paediatric / Paediatric Cardiology / Paediatric Intensive Care Team(s)):

- Non-emergency treatment will be determined by the type of arrhythmia and should be guided by the Paediatric Cardiology team.
- Emergency treatment for cardiac arrhythmias is as per [Paediatric Advanced Life Support Guidelines](#) (pdf) (Resuscitation Council (UK))

Premature beats

- PACs
 - Therapy not necessary unless:
 - PACs initiate SVT.
 - PACs block impulses in a newborn infant dependent on heart rate to maintain adequate cardiac output.
 - If suppressive therapy is required (only with advice from Paediatric Cardiology Team)
 - Digoxin
 - Propranolol hydrochloride
- PVCs
 - Neither treatment nor curtailment of exercise is required, even if a bigeminal rhythm is present.
 - If PVCs are not benign, the need for therapy should be determined by a paediatric cardiologist.

SVT

- Vagal stimulation (if no delays)
 - Diving reflex with ice water / immersing infant's face in ice water for 5 seconds
 - One-sided carotid sinus massage
 - Valsalva manoeuvre (older children)

- If intravenous access (whether or not cardiogenic shock present):
 - Adenosine via intravenous bolus with ECG monitoring is effective in approximately 90% of episodes.
 - 100 micrograms/kg; if no response after 2 minutes:
 - 200 micrograms/kg; If no response after 2 minutes:
 - 300 micrograms/kg; If no response after 2 minutes, consider:
 - 500 micrograms/kg, **or**:
 - Direct current (DC) synchronised 1 Joule/kg with the largest paddles to allow effective chest contact, followed by 2 Joules/kg if no response in 2 minutes **or**
 - Amiodarone hydrochloride **or** digoxin **or** verapamil hydrochloride only with advice from specialist practitioners (eg, Paediatric Cardiology / Paediatric Intensive Care Team)
 - If cardiogenic shock present and no intravenous access:
 - DC synchronised 1 Joule/kg with the largest paddles to allow effective chest contact, followed by 2 Joules /kg if no response in 2 minutes **or**
 - Amiodarone hydrochloride only with advice from specialist practitioners (eg, Paediatric Cardiology / Paediatric Intensive Care Team)

Atrial flutter

- Digoxin
- DC cardioversion

VT

- For any child or adolescent who collapses suddenly with no discernible cardiac output:
 - Manage as per cardiac arrest protocol with early defibrillation.
- If cardiogenic shock present:
 - DC synchronised cardioversion
 - 1 Joule/kg 'shock' with the largest paddles to allow effective chest contact, followed by 2 Joules/kg if no response every 2 min
 - If no response after second DC 'shock', consider:
 - Amiodarone hydrochloride (only with advice from specialist practitioners (eg, Paediatric Cardiology / Paediatric Intensive Care Team))
- If cardiogenic shock not present:
 - Amiodarone hydrochloride (only with advice from specialist practitioners (eg, Paediatric Cardiology / Paediatric Intensive Care Team)) and consider:
 - DC synchronised cardioversion (seek specialist advice)

Conduction abnormalities

- No therapy is required for most cases of first-degree AV block or type 1 second-degree AV block.
 - There is a potential need for pacemaker implantation in type II second-degree AV block.
- For complete AV block, early pacemaker implantation is advised in infants with risk factors or symptoms of inadequate cardiac output.
 - Liaise with specialist practitioners (eg, Paediatric Cardiology / Paediatric Intensive Care Team)

Long QT syndrome

- For any child or adolescent who collapses suddenly with no discernible cardiac output
 - Manage as per cardiac arrest protocol with early defibrillation
- Rapid correction of electrolyte abnormalities
- Further treatment as directed by Paediatric Cardiology Team may include:
 - β -blocker therapy
 - Cardiac pacing
 - Left stellate ganglionectomy
 - Implantation of cardioverter–defibrillator

When to Refer

Refer to specialist practitioners (eg, Emergency Department / Paediatric / Paediatric Cardiology Team(s)) if:

- Any 'red flag' signs or symptoms
- Underlying heart disease
- Family history of premature (before age 35 years) sudden cardiac death
- Premature ventricular beats that increase with exercise

Escalate care to Paediatric Cardiology Team if:

- Arrhythmias associated with syncope or low cardiac output
- Symptomatic high-grade AV block
- Difficult-to-control SVT, atrial flutter
- VT
- LQTS with syncope
- Any arrhythmia of concern

'Safety Netting' Advice

- Risk reduction to decrease the incidence of sudden death in the young may be achieved by asking two critical questions in pre-sports 'clearance' evaluations
 - Has the patient ever passed out, or experienced symptomatic palpitations, during strenuous exercise?
 - Has any family member died suddenly and unexpectedly before the age of 35 years?
- **If the answer to either question is YES, this should prompt a cardiology referral before participation in competitive sports.**
- Advise parents of children under investigations for arrhythmias:
 - If symptoms occur out of hours to present to an emergency department for capturing the abnormal rhythm.
 - The specialist practitioner investigating the rhythm problem should ideally provide a letter to be held by patients in this regard.
 - Avoid:
 - Competitive sports
 - Drugs capable of prolonging the QTc (see above)
 - Sympathomimetics

Patient / Carer Information

****Please note: whilst these resources have been developed to a high standard they may not be specific to children.***

- [Heart rhythm problems](#) (Web page), the NHS website

Resources

National Clinical Guidance

[Paediatric Advanced Life Support Guidelines](#) (Web site), Resuscitation Council (UK).

Suggested Resources

****Please note: these resources include links to external websites. These resources may not have national accreditation and therefore PCO UK cannot guarantee the accuracy of the content.***

Advanced Paediatric Life Support: the practical approach. 5th ed. London: BMJ Books; 2011.

Deal BJ, Wolff GS, Gelband H, eds. Current Concepts in Diagnosis and Management of Arrhythmias in Infants and Children. Armonk, NY: Futura; 1998.

Zeigler VL, Gillette PC, eds. Practical Management of Pediatric Cardiac Arrhythmias. Armonk, NY: Futura; 2001.

[European Paediatric Life Support \(EPLS\) course](#), Resuscitation Council (UK).

[Time to 'Think Kawasaki Disease'](#) (Webinar), Royal College of Paediatrics and Child Health

Acknowledgements

Content Editor: Dr Tina Sajjanhar

Clinical Expert Reviewers: Dr P Venugopalan and Dr Madhu Gangadhara

GP Reviewer: Dr Richard Pratt

AAP Reviewer: Jane Meschan Foy, MD, FAAP

Paediatric Trainee Reviewer: Dr Tatiana Hyde

Paediatric Specialty Group: [Paediatricians with Expertise in Cardiology Special Interest Group](#)

Update information

Created: 2017

Date last updated: -

Next review due: 2020