M01: Pediatrics - Cardiac Emergencies

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Introduction

In the pediatric population, cardiac emergencies originating from the cardiac system are much less frequent than in adults. Cardiac chief complaints stem predominantly from respiratory causes or other systems in the body being out of homeostasis, creating a secondary cardiac issue. The exception to these cases is pediatric patients with congenital heart defects or cardiac dysfunction diseases. The importance of the history and physical examination cannot be overemphasized in the evaluation of infants and children with suspected cardiovascular disorders (1). Unlike adults, ACS is not in the top list of differentials for pediatric chest pain complaints. Understanding the nature of the complaint, pediatric physiology, paired with a PAT assessment will aid BCEHS practitioners in further treatment and conveyance options to best suit these pediatric patients.

Essentials

- A slow (bradycardic)heart rate is often a result of hypoxia.
- Effective airway management is paramount in pediatrics with low heart rates. Ensuring adequate oxygen and ventilation while correcting the source of hypoxia is crucial.
- Concerning Cardiac Signs/Symptoms:
  - For infants:
    - Decreased growth
    - Decreased feeding
    - Cyanosis
    - Respiratory Distress

    For older children:

    - Poor exercise tolerance
    - Fatigue
    - Dyspnea
    - Orthopnea

Additional Treatment Information

- **Differential Diagnosis of Chest Pain in Pediatric Patients**

  Arrhythmias: Supraventricular Tachycardia (SVT), Ventricular Tachycardia (V-Tach), Bradycardia

  Structural abnormalities: Cardiomyopathies, Pulmonary Stenosis, Murmurs, Mitral Valve Prolapse, Aortic stenosis, Marfan syndrome (dissecting aortic aneurysm)

  Infection/Inflammation: Pericarditis, Myocarditis, Pancreatitis, Cholecystitis, Pneumonia, Esophagitis, Herpes simplex

  Coronary Artery: Ischemia/infarction. Vasospasm

  Trauma: Overuse injury (Sprain/Strains), Pneumothorax,

  Substance: sympathomimetic ingestion

  Psychosocial: Anxiety, Hyperventilation

  (Kliegman, 2020)

General Information

- Sinus arrhythmia is a normal variant seen in children and is described as a variation in heart rate over time without symptoms. The variation coincides with breathing. Typically, the rate increases during inhalation and decreases during exhalation. There is no concern if this is the lone finding.
- Tachycardia is a sustained increased heart rate. A heart rate > 180 bpm in a child, or > 220 bpm in an infant, is unlikely to be rapid sinus tachycardia and more likely to be an arrhythmia.
  - Narrow complex tachycardia (QRS < 0.09 seconds) with visible p-waves is considered to be sinus tachycardia and a primary cause should be determined. No specific cardiac management of sinus tachycardia is needed. Treat the underlying cause (e.g., pain, fever, hypovolemia, hypoxia, or anemia) as appropriate.
  - Narrow complex tachycardia with no visible p-waves, with abrupt onset or termination and no change with activity, is considered to be SVT. Stable patients with no previous history and no hemodynamic compromise require support with oxygen, continuous cardiac monitoring, and conveyance to ED, with equipment for electrical cardioversion immediately available. Symptomatic patients should be treated with a vagal maneuver, adenosine, or cardioversion if unstable.
  - Wide complex tachycardia (QRS > 0.08 seconds) in a conscious patient with adequate perfusion and a heart rate > 150 bpm is probably in stable ventricular tachycardia and requires support with oxygen, continuous cardiac monitoring, and conveyance to ED, with equipment for electrical cardioversion immediately available.
  - Wide complex unstable tachycardia in a child with poor perfusion should be considered ventricular tachycardia and be treated rapidly with synchronized cardioversion with sedation if readily available.
  - In refractory cases or situations where appropriate treatment options are unclear, contact Clinicall.
- Bradycardia is a sustained decreased heart rate. In the pediatric populations, bradycardia is usually secondary to a different pathology and treatment focuses on the underlying cause.
  - As hypoxia may be a contributor, ensure optimized oxygenation and ventilation, including bag-valve mask if needed.
  - Consider a 20cc/kg crystalloid bolus to address hypotension.
  - In a pediatric patient with a HR < 60 bpm coupled with poor perfusion, CPR is indicated. Ensure maximal oxygenation and bag-valve mask ventilation is provided. If heart rate remains < 60 bpm for 30 seconds of effective oxygenation and ventilation, begin chest compressions. Signs of poor perfusion include cyanosis, mottling, decreased LOC, and lethargy.
  - Epinephrine 0.01 mg/kg IV/IO is indicated for bradycardia unresolved by oxygenation, ventilation, and chest compressions.
  - Atropine is only indicated when increased vagal tone or primary AV block is the suspected etiology of the bradycardia; with all other causes, epinephrine is preferred.
  - Bradycardia with complete heart block or a history of congenital or acquired heart disease, pacing may be indicated.
- BRUE (Brief Resolved Unexplained Event) and ALTE (Apparent Life Threatening Event) are not specific disorders but terms for a group of alarming symptoms that can occur in infants. They involve the sudden appearance of respiratory symptoms (such as apnea), change in colour or muscle tone, and/or altered responsiveness. Events typically occur in children < 1 year with peak incidence at 10 to 12 weeks. Some of these events are unexplained (and designated BRUEs), but others result from numerous possible causes including digestive, neurologic, respiratory, infectious, cardiac, metabolic, or traumatic (e.g., resulting from abuse) disorders.

Interventions

First Responder

- Keep the patient at rest
- Position the patient: if symptoms suggest hypotension, position supine
- Provide supplemental oxygen as appropriate
  - → A07: Oxygen Administration
- Manage airway as appropriate
  - → B01: Airway Management
- If HR < 60 bpm with signs of poor perfusion, provide 100% oxygen and bag-valve mask ventilation; if no improvement after 30 seconds, begin CPR
  - → PR06: High Performance CPR
  - → M06: Pediatric Cardiac Arrest

- Consider underlying causes
  - → M03: Pediatric Respiratory Emergencies
  - → M04: Pediatric Neurological Emergencies

Emergency Medical Responder – All FR interventions, plus:

- Initiate rapid conveyance with notification
- Consider intercept with additional resources

Primary Care Paramedic – All FR and EMR interventions, plus:

- Consider vascular access (in patients ≥ 12 years of age)
  - → D03: Vascular Access
  - CliniCall consultation required prior to fluid administration for pediatric fluid requirements

Advanced Care Paramedic – All FR, EMR, and PCP interventions, plus:

→ PR16: 12-Lead ECG

Tachycardia

- Asymptomatic: no treatment required
  - Consider crystalloid bolus if no cardiac history
- Unstable narrow complex tachycardia
  - Vagal maneuver
    - → PR28: Modified Valsalva
  - Adenosine
    - Do not use adenosine if the patient is taking carbamazepine or dipyridamole
  - Synchronized cardioversion; initial at 1 J/kg, repeat at 2 J/kg
    - → PR20: Synchronized Cardioversion
    - For sedation prior to cardioversion, consider:
      - MIDAZOLam
        - MIDAZOLam may depress respiratory rate and blood pressure
      - KetAMINE
        - KetAMINE should be used with caution where the shock index is > 1 – have push dose EPINEPHrine readily available in these cases
- Unstable wide complex tachycardia
  - Vagal maneuver
    - → PR28: Modified Valsalva
  - Synchronized cardioversion; initial at 0.5 – 1 J/kg, repeat at 2 J/kg
    - → PR20: Synchronized Cardioversion
  - CliniCall consultation required for refractory cases or where treatment options are unclear.

Bradycardia

- Asymptomatic: no treatment required
  - Consider crystalloid bolus if no cardiac history
- Unstable bradycardia
  - EPINEPHrine
  - Atropine – if increased vagal tone suspected
    - CliniCall consultation required prior to repeat dose Q 3-5 min to a maximum total dose of 0.4 mg/kg or 1 mg, whichever is less (1-833-829-4099)
  - Transcutaneous pacing
    - → PR19: Transcutaneous Pacing
    - CliniCall consultation required prior to transcutaneous pacing (1-833-829-4099)

Critical Care Paramedic – All FR, EMR, PCP, and ACP interventions, plus:

- Tachyarrhythmias

- Amiodarone
- Lidocaine
- Digoxin has many drug incompatibilities and administration should be done in consultation with BC Children's Cardiology

Evidence Based Practice

Pediatric Bradycardia

Supportive

Neutral

Against

Pediatric Tachycardia

Supportive

- Vagal Maneuver / ice water
- Adenosine
- Amiodarone
- Electrical Cardioversion

Neutral

- Digoxin

Against

- Verapamil