

Chest Pain - Paediatric Full Clinical Guideline

Reference no.: CH CLIN G143/May 23/v002

1) Aim and Purpose

This guideline aims to give doctors and other health care professionals guidance on a systematic approach to the assessment and management of children (0-16years) presenting with chest pain at Queens' Hospital Burton and Derbyshire Children's Hospital.

Adopting a systematic approach should rule out serious causes of paediatric chest pain and will help the practitioner to initiate appropriate management which typically includes reassurance, simple analgesia, or rarely, investigations or onward referral thus reducing unnecessary anxiety in children and their families.

2) Introduction

Chest pain, a common presenting complaint in children, is a source of anxiety for both the patient and their carer. Unlike in adults, the cause of most paediatric chest pain is unknown but usually self-limiting; a serious cause of new chest pain is rare in a child with no previous underlying medical history, with <1% being cardiac.^{1, 2}

3) Main body of the guideline

The approach to the child presenting with new onset chest pain in the acute setting is likely to be different from a child seen in the outpatient setting. However, in both settings the clinician should assess the child for risk factors (Red flags-table 1) for serious disease, as doing so minimizes unnecessary investigations and anxiety. A detailed history and examination will usually exclude a serious cause for the pain in a vast majority of cases³.

a) History

i) **Presenting symptom:** As with any pain, consider SOCRATES, to include,

- (1) **Timing of symptom onset:** Sudden onset pain with an identifiable precipitating factor could be organic whereas pain that occurs randomly or at rest is likely to be non-organic
- (2) **Duration of symptoms** acute onset is more likely to have identifiable cause whereas chronic pain with longer history, is unlikely to present with a life-threatening cause⁴.
- (3) **Site of pain:** Chest pain localized to the chest wall is unlikely to be cardiac.
- (4) **Reproducibility:** consider exertional or positional
- (5) **Quality:** crushing central chest pain or worse with inspiration suggest organic cause
- (6) **Radiation:** a well localized pain is likely to be musculoskeletal, but a cardiac (serious cause) cause must be considered if the pain radiates to the left arm and jaw
- (7) **Associated symptoms:** consider dizziness, shortness of breath, palpitations as possible organic causes, though not necessarily cardiac.
- (8) **Aggravating and relieving factors**

ii) **Systems review:**

- (1) **Cardiac:** palpitations, syncope,
- (2) **Respiratory:** fever, shortness of breath, cough, foreign body
- (3) **Gastrointestinal:** association with eating, epigastric pain, nausea, vomiting
- (4) **Musculoskeletal:** recent vigorous exercise
- (5) **Other:** recent illnesses or vaccination (myocarditis), recent chest injury, fracture, weight loss, arthralgia, rash, hypermobility, medication e.g. OCP, recent period of immobility e.g. surgery, travel

iii) **Past medical history: eg**

- (1) Previous congenital heart disease surgery: eg arterial switch, transplant, device procedures
- (2) Kawasaki disease
- (3) Asthma
- (4) Sickle cell disease

iv) **Family history: usually in first degree relatives eg**

- (1) Sudden cardiac death under 40 years
- (2) Connective tissue disorders
- (3) Arrhythmias
- (4) Cardiomyopathy

v) **Social History:** Perform a HEEDSSS assessment in children over 12 year (see table 2)

b) RED FLAGS

If none of these features ^{4,6,7} are present the cause is unlikely to be cardiac. Non-cardiac causes should also be explored. Table 1 ⁹

RED FLAGS relevant to possible system affected.			
Cardiac	<ul style="list-style-type: none"> • First episode severe pain • Pain radiate to arm/ back • Associated dizziness, palpitations or syncope • Complex congenital/ acquired cardiac disease 	<ul style="list-style-type: none"> • Family history sudden cardiac death or arrhythmia eg Long QT, Brugada • Connective tissue disease eg Marfan syndrome • Longstanding diabetes 	<ul style="list-style-type: none"> • Chest Pain with exercise. • First degree relative with hypercholesterolaemia • History of Kawasaki disease
Pulmonary embolism	<ul style="list-style-type: none"> • Immobility • Recent surgery 	<ul style="list-style-type: none"> • Hypercoagulability • Central venous catheter 	<ul style="list-style-type: none"> • Pleuritic pain • Haemoptysis
Respiratory	<ul style="list-style-type: none"> • Fever • Cough 	<ul style="list-style-type: none"> • Lethargy • Pleuritic chest pain 	<ul style="list-style-type: none"> • Chronic respiratory disease
Gastro-intestinal	<ul style="list-style-type: none"> • Chest pain after vomiting • Recurrent vomiting • Odynophagia/Dysphagia 	<ul style="list-style-type: none"> • Food impaction • Neck pain or discomfort • Epigastric pain or discomfort 	<ul style="list-style-type: none"> • Recent heavy alcohol use • History of ingested foreign body • Suspicion button battery ingestion

c) Examination

- Height and weight
- Basic observations including right arm blood pressure.
- General appearance: syndromic features, colour, dyspnoea, evidence of anxiety
- Chest scars
- Pulse volume/rate/ rhythm e.g. gallop rhythm
- Heart murmur e.g. harsh medium pitched systolic murmur in HCM, mid to latesystolic murmur in mitral valve prolapse
- Muffled heart sounds
- Chest auscultation for wheeze, crackles or friction rub
- Major peripheral pulses
- Palpate chest wall for tenderness and localized swelling
- Palpate the abdomen for masses and epigastric tenderness.
- Examine the calves for evidence of DVT (rare in children)

4) Investigations

Investigations are not usually indicated. However, Electrocardiogram (ECG), CXR and blood tests should be considered for children with risk factors (Red flags) identified on history and examination. Echocardiography or CT pulmonary angiogram is rarely required but do discuss with senior colleagues if the clinically warranted.

a) Chest X-ray

This is not normally needed. It may be appropriate if a pneumothorax or foreign body is suspected, or if the heart sounds are muffled.

b) Echocardiography

This is not required in most cases. On rare occasions, urgent echocardiography may be obtained following consultant to consultant discussion with the paediatrician with expertise in cardiology (PEC) on call. If the PEC is unavailable, speak to the regional tertiary paediatric cardiology Centre. Main Indications for echocardiogram in children with chest pain include⁵

- (1) Exertional chest pain at presentation
- (2) Non-exertional chest pain with abnormal ECG
- (3) Chest pain with family history of sudden cardiac death in young adults or cardiomyopathy

c) Electrocardiogram (ECG)

This should be available as a first line investigation if cardiac red flags are present. Two notes of caution when dealing with paediatric ECGs

- (1) "Automated" reports are unreliable, DO NOT rely on it.
 - (2) The ECG is dynamic and only reflects the cardiac rhythm at the time of the test; it does not preclude/indicate future rhythm changes.
- ii) Key changes to look out for are:
- (1) **Abnormal rate**, rhythm, axis, long QTc
 - (2) **Signs of ischaemia**, myocarditis or pericarditis: ST segment changes, abnormal Twave morphology for age, the presence of pathological Q waves
 - (3) **Abnormal Left Ventricular Large Voltage** ("LVH")⁹
Use only V6 (the *left* most precordial lead)
 If R wave of V6 intersects with baseline of V5, this is ABNORMAL.
 - (4) **Abnormal Right Ventricular Large Voltage** ("RVH")⁹
Use only V1 (the *right* most precordial lead)
Upright T wave in V1: In first week of life is NORMAL. Between week 1 and adolescence this is ABNORMAL
RSR' in V1: If R' is taller than R – this is ABNORMAL.
Pure R wave in V1: If child > 6 months old – this is ABNORMAL.

d) Laboratory investigations

These are not normally required. If myocardial ischaemia is strongly suspected, troponin must be checked. If pericarditis is suspected then investigations include inflammatory markers, blood cultures and viral titers.

e) Other

- i) **24-hour Holter ambulatory ECG:** consider if the pain is associated with palpitations, to identify arrhythmias or heart block.
- ii) **Exercise stress test:** for exertional chest pain. CMD will not accept children <11years or with high risk of arrhythmia, hence liaise with CMD or PEC team before requesting.

5) Differential diagnosis

Combining a detailed history and thorough physical examination with or without investigations will help you reach a diagnosis; you should always be vigilant for red flags which may suggest uncommon, sometimes rare, serious causes of chest pain in children. The list is by no means exhaustive.

a) Musculoskeletal

Causes	History	Assessment & investigations
Muscle Strain / Trauma	<ul style="list-style-type: none"> • Recent trauma • Recent overuse (activities, hobbies, jobs) • Chronic cough • Localised area of chest pain • Worse with movement or deep breathing 	<ul style="list-style-type: none"> • Localised area or muscle groups of tenderness • Reproducible with palpation, movement, deep breathing • Bruising
Precordial Catch	<ul style="list-style-type: none"> • Sudden and sharp onset chest pain • Pain along left lower sternal border or apex • Onset during rest or activity but not sleep • Shallow breathing to cope with pain and feelings of intense anxiety due to pain • Intense but usually brief lasting 30 seconds to 3 minutes 	<ul style="list-style-type: none"> • Normal exam • No special investigations
Costochondritis	<ul style="list-style-type: none"> • Sharp or dull chest pain • Gradual or rapid onset • Pinpoint area to 2 or 3 adjacent ribs • Reproducible with palpation, movement or deep breathing 	<ul style="list-style-type: none"> • Tenderness of costochondral junctions • Reproducible localized pain or discomfort • Usually unilateral to ribs 2 to 5 • No swelling
Bone disease: Osteomyelitis / Bone neoplasm	<ul style="list-style-type: none"> • Localised chest pain • Can be subacute or chronic pain • Nighttime pain or awakening from sleep • Pain persisting after minor trauma 	<ul style="list-style-type: none"> • May be well clinically. • Non-specific localized tenderness • Localized soft tissue swelling • CXR changes possible

b) Gastrointestinal

Cause	History	Assessment and investigation
Gastro-oesophageal reflux/oesophagitis	<ul style="list-style-type: none"> Heartburn, epigastric discomfort or pain Non-specific chest pain Recurrent vomiting Odynophagia or Food refusal 	<ul style="list-style-type: none"> Possible epigastric discomfort/tenderness

c) Psychogenic

Cause	History	Assessment and investigation
Psychogenic/Anxiety	<ul style="list-style-type: none"> Mental health history Drug/alcohol use Social stressors Consider HEEDSSS screen 	<ul style="list-style-type: none"> Transient hyperventilation +/- tachycardia Normal exam Normal ECG

d) Respiratory

Causes	History	Assessment & Investigations
Pulmonary embolus	<ul style="list-style-type: none"> Recent surgery or immobility Malignancy Hypercoagulability history CVAD in situ or recent Pleuritic pain Haemoptysis, Dyspnoea 	<ul style="list-style-type: none"> Hypoxia with no other cause Tachycardia with no other cause Tachypnoea with no other cause ECG changes possible (eg tachycardia, RBBB, right sided T wave changes) CXR changes possible
Pneumothorax	<ul style="list-style-type: none"> Tall/thin adolescents Acute pain or dyspnoea after cough/Valsalva manoeuvre Acute onset, severe, stabbing pain Can be pleuritic 	<ul style="list-style-type: none"> Can have normal exam Sweating Tachypnoea and or tachycardia Decreased/absent breath sounds Hyper resonance on percussion Asymmetric lung expansion or CXR changes
Acute Chest Syndrome	<ul style="list-style-type: none"> Known sickle cell disease Current or recent infection, surgery, dehydration, fever, hypoxia, sedatives 	<ul style="list-style-type: none"> Fever/dehydration signs Tachypnoea/tachycardia CXR changes possible
Exercise Induced Asthma	<ul style="list-style-type: none"> Exercise induced chest pain with dyspnoea/cough Previous history asthma Other atopic history 	<ul style="list-style-type: none"> Tachypnoea Talking short sentences Hypoxia Widespread wheeze
Pneumonia	<ul style="list-style-type: none"> Fever Cough Increased WOB 	<ul style="list-style-type: none"> Lethargic and Fever Tachypnoea, hypoxia, WOB Localized crackles or absent breath sounds
Pleural Effusion and Empyema	<ul style="list-style-type: none"> Chest pain, can be pleuritic Fever >48 hrs despite antibiotics Lethargy, Dyspnoea/WOB Unilateral chest pain or refusing to lie on one site 	<ul style="list-style-type: none"> Localized decreased air entry. Localized dull percussion. Decreased chest expansion. Apparent scoliosis: pain/muscle spasm CXR changes
Pleurisy	<ul style="list-style-type: none"> Sharp stabbing localised chest pain Pain worse with deep breathing, coughing, movement, certain positions May have current cough or fever May be entirely well with pleuritic pain 	<ul style="list-style-type: none"> Pleuritic rub over area of chest pain CXR normal (unless underlying condition causing pleuritic pain eg pleural effusion)
Inhaled Foreign Body	<ul style="list-style-type: none"> High degree suspicion children <4 yrs High degree suspicion older children with developmental impairment May present days to weeks after event. Persistent cough, fever, wheeze or consolidation Haemoptysis, Increased WOB, stridor Colour changes if acute event 	<ul style="list-style-type: none"> May have normal exam. Stridor/voice changes or focal wheeze Unexplained tachypnoea and hypoxia Localised decreased air entry. Asymmetrical chest movement CXR might appear normal, or air trapping Request lateral decubitus views

e) Cardiac

Causes	History	Assessment & Investigations
Myocarditis	<ul style="list-style-type: none"> • Non-specific respiratory or sepsis symptoms • Recent viral illness eg coxsackie, parvovirus, influenza, Covid • Recent (1-14 days post) mRNA vaccine received (higher risk adolescent males and after 2nd dose) • Dizziness or syncope, palpitations 	<ul style="list-style-type: none"> • Abnormal BP and or heart rate • ECG changes (eg sinus tachycardia, non-specific ST segment and T wave changes) • CXR changes possible. • Troponin, CRP/ESR rise possible
Pericarditis	<ul style="list-style-type: none"> • Retrosternal chest pain • Pain improved by sitting upright or leaning forward. • Recent mRNA vaccine received (higher risk adolescent males and after 2nd dose) 	<ul style="list-style-type: none"> • Tachycardia, Pericardial rub • ECG changes (eg diffuse ST elevation with PR depression; T wave flattening; deep symmetrical T wave inversion) • CXR changes (if effusion present) • Raised troponin, CRP/ESR possible
Endocarditis	<ul style="list-style-type: none"> • Fever of unknown origin • Congenital or acquired cardiac disease. • Cardiac surgery history • Valvulopathy or replacement • Aboriginal or Torres Strait Islander • Recent dental procedure • Recent skin infection or procedure 	<ul style="list-style-type: none"> • Dukes Criteria for IE • CXR changes possible • Cardiac echo
Aortic dissection	<ul style="list-style-type: none"> • Acute onset 'tearing' chest pain. • Pain radiates to back. • Known connective tissue disease eg Marfan, Ehlers-Danlos • History of Kawasaki disease • Known aortic root dilatation 	<ul style="list-style-type: none"> • New murmur with no alternative aetiology • Difference in BP's upper limbs • Pericardial effusion • Pleural effusion • CXR changes possible
Arrhythmias	<ul style="list-style-type: none"> • Palpitations, Exertional chest pain • Syncope or Dizziness • Family history of arrhythmias eg Brugada • Family history of sudden cardiac death 	<ul style="list-style-type: none"> • Abnormal BP +/- heart rate • ECG abnormalities possible • Electrolytes abnormalities
Cardiac ischaemia	<ul style="list-style-type: none"> • Pain radiating to arm or neck • Blunt chest trauma • Cocaine, methamphetamine or cannabinoids • Known cardiac disease or cardiac surgery • Kawasaki disease history • Hypercoagulability history eg SLE • Hyperlipidaemia history or family history • Long standing diabetes history 	<ul style="list-style-type: none"> • Abnormal BP and or heart rate • Arrhythmias • ECG changes (ST and T wave changes) • Raised troponin
Pericardial effusion	<ul style="list-style-type: none"> • Infective: recent viral, bacterial, TB, fungal • auto-immune history eg lupus • neoplastic eg neoplastic • post Op: recent cardiac/thoracic surgery • uremic (chronic renal failure) • recent treatment radiation or drugs (rare) 	<ul style="list-style-type: none"> • Hypotension • Distended neck veins • Muffled heart sounds • CXR changes possible

f) Others

Cause	History	Assessment and investigation
Breast tenderness	<ul style="list-style-type: none"> • Localised to breast tissue area • Premenstrual or cyclic: PMS • Non-cyclic pain: consider fibroadenoma, breast cyst or abscess 	<ul style="list-style-type: none"> • Breast lump under the areola = breast bud • Features of puberty supports seen. • Ultrasound if breast pathology suspected. • Fever, redness or axillary lymphadenopathy suggestive of infection
Shingles	<ul style="list-style-type: none"> • Prodrome of pain or hyperalgesia over one or more dermatome that does not cross midline. • History of previous shingles, contact 	<ul style="list-style-type: none"> • If rash present: clusters of vesicles on red bases that is confined to one more dermatome that does not cross midline

6) Management principles

This largely depends on the setting in which the child is reviewed.

In Outpatients, usually reassurance is all that is required. Offering unnecessary investigations may create avoidable anxiety; except when there are red flags, investigations should be avoided.

Acute presentation, with evidence of injury, clinical compromise should have senior review as early as possible. Identified causes should be treated and offer simple analgesia.

7) Audit standards

It is expected this guideline will be audited every 3 years or after a major update. Consider the following areas for auditing:

- a) % of children presenting with chest pain assessed for cardiac and respiratory red flags
- b) % of children with chest pain in ED who gets a 12 lead ECG before discharge
- c) % of children, under 16yrs with chest pain but no prior cardiac history tested for troponin

8) Document control

Development of Guideline:	Dr B Etuwewe Dr E Pascall (version 1, 2020)
Consultation with:	Paediatric Consultants QHB/RDH
Approved By:	<i>Paediatric Business Unit Guidelines Group, Women and Children's Division - May 2023</i>
Review Date:	April 2026
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9) References (including any links to NICE Guidance etc.)

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Systematic approach to assessment of paediatric chest pain

