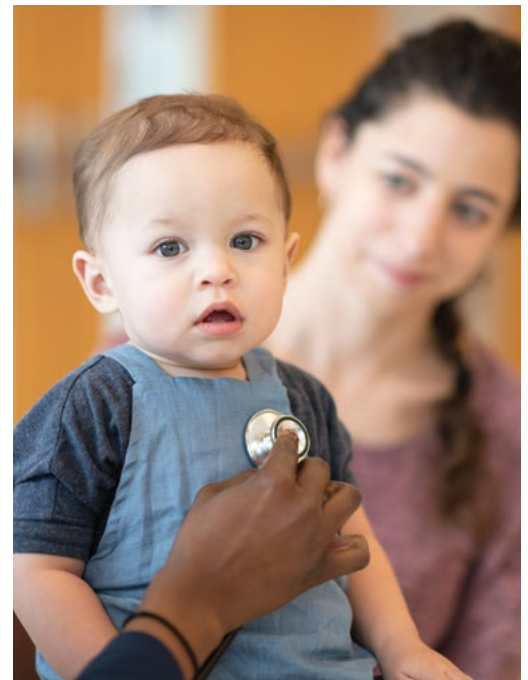


Navigating heart murmurs in children



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Background

Murmurs are a common finding in the paediatric population, with 99% being non-pathological. Cardiovascular examination is recommended to aid the detection of serious structural cardiac defects as a routine part of neonatal and child health checks. Incidentally noted murmurs are also a common finding, with a significant proportion of children developing an innocent murmur at some stage of childhood. It is therefore important for primary care physicians to be able to appropriately identify concerning features of both screening-detected and incidentally noted murmurs in children.

Objective

The aim of this article is to provide guidance around the assessment of a child with a murmur.

Discussion

In the assessment of murmurs, decision making around the level of concern for a pathological murmur and urgency for referral is predominantly based on features other than the murmur itself. Red flags for serious pathology might be obtained through history, examination and preliminary investigations.

MURMURS are a common finding in the paediatric examination. Approximately one-third to three-quarters of children will have an innocent murmur sometime between age one and 14 years.¹ Less than 1% of murmurs in children are secondary to underlying pathology of congenital heart disease (CHD).² Cardiovascular examination is recommended to aid the detection of serious structural cardiac defects as a routine part of neonatal and child health checks in Child Personal Health Records and might result in the detection of a murmur.^{1,3,4} Given the significant prognostic implications, it is imperative primary care physicians can appropriately identify features indicative of pathological disease to allow prioritisation of those with significant congenital cardiac disease and provide appropriate reassurance and follow-up for those with an innocent murmur.

This article outlines the assessment of a heart murmur in a child who does not have a previous diagnosis of congenital heart disease.

Assessment of murmurs

In the assessment of murmurs, decision making around the level of concern for a pathological murmur and urgency for referral is predominantly based on concurrent features on history (Box 1), examination

(Figures 1, 2; Table 1) and preliminary investigations (Table 2); the clinical relevance of which is discussed below.

Cardiac history

Respiratory distress

Respiratory distress due to congenital heart disease is progressive and usually due to pulmonary over-circulation, secondary to a shunting lesion such as a ventricular septal defect. In neonates and infants, it is first seen during feeding, as an equivalent of exercise tolerance. Careful attention to a history of short, frequent feeds or respiratory distress with feeding is therefore important. The prevalence of respiratory distress is dependent on the specific underlying cardiac condition and is more commonly present in a shunting lesion rather than

Box 1. Key features on cardiac history for the assessment of murmurs

- Respiratory distress at rest (or with feeds in infants) and exercise tolerance
- Poor growth
- Central cyanosis
- Exertional syncope
- Family history of congenital heart disease, cardiomyopathy or sudden unexpected death

an obstructive lesion. Therefore, although respiratory distress is not universally present in children with cardiac disorders, it is an extremely important aspect on history as it can suggest certain cardiac diagnoses and might indicate more urgent cardiac review.

Poor growth

Poor growth secondary to cardiac disease is due to increased metabolic demands imposed by the condition, as well as difficulty feeding with subsequent decreased caloric intake, secondary to symptoms such as shortness of breath. As such, current growth parameters and growth trends form an important component of the cardiac assessment; poor growth is a red flag, particularly in neonates and infants.

Cyanosis

Acrocyanosis is usually due to benign vasomotor changes. In contrast, central cyanosis (particularly oxygen saturation less than 94%) might be due to complex

congenital heart disease or many non-cardiac causes. Intermittent central cyanosis is rare but might be provoked by exertion or distress in certain lesions, or non-cardiac causes of cyanosis.

Syncope

Exertional syncope is concerning for serious pathology, whereas vasovagal syncope is more benign. Key features to elicit on history in a child with a murmur and syncope include triggers, preceding symptoms and activity, period of recovery and associated cardiac symptoms. In the setting of a murmur, the presence of exertional syncope is a concerning feature, as it could suggest a left ventricular outflow tract obstruction or aortic stenosis. Syncope with a clear trigger such as postural change or typical triggers of vasovagal syncope (eg postural changes, pain) is less concerning.⁵

Palpitations

Palpitations are not usually a sign of congenital heart disease, unless it is in

association with certain conditions such as Ebstein's anomaly. Although an important symptom that general practitioners (GPs) might have to assess and manage, palpitations largely fall outside the scope of this article. Rhythm disturbances, sinus tachycardia and anxiety can all cause palpitations. Key features to elicit in the presence of a history of palpitations include onset and offset (whether gradual or sudden) and associated cardiac symptoms. If symptom–rhythm correlation can be determined through an electrocardiogram (ECG) at the time of symptoms, this is very helpful in determining the cause.

Family history

A family history of repaired congenital heart disease in young children, or cardiomyopathy or left heart obstruction in older children can be relevant in assessing risk.

Examination findings

Oxygen saturations

Although oxygen saturation is checked as part of the neonatal examination prior to discharge from hospital, this should not be relied upon to rule out congenital heart disease, as oxygen saturations can lower following this period. For example, a cardiac condition with a duct-dependent circulation might become more symptomatic and have progressively lower oxygen saturations as the ductus arteriosus closes (usually within the first six weeks of life), which might be after discharge from hospital. The cardiac assessment of a child, especially a neonate, should always include assessment of oxygen saturation. An age-appropriate probe should be used to obtain accurate readings. This can be used to assess for cyanotic congenital heart disease, as this might be present even in the absence of appearing overtly cyanotic on examination.

Pulses

Assessment of a pulse in neonate/young infant

This is a crucial component of the examination, even if the pulses have been previously palpable. This is particularly relevant in the diagnosis of the coarctation of the aorta, which can be delayed in presentation and accounts for 7% of congenital heart disease. Coarctation of the

Vital signs

- Heart rate
- Respiratory rate
- Oxygen saturations
- Four-limb blood pressure

Growth parameters

- Weight
- Length
- Trend over time (plot on centile chart)

Central cyanosis

Femoral and brachial pulses

- Volume
- Comparison between upper and lower limb pulses

Respiratory distress at rest or with feeds

- Tracheal tug
- Subcostal recession
- Intercostal recession

Heart sounds

Murmur – location, radiation, intensity, persistence (beyond acute illness), variability (with posture, respiratory or intercurrent illness)

Liver span

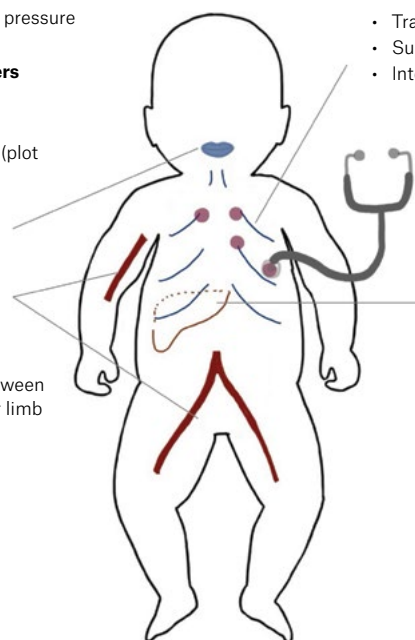


Figure 1. Key features on the cardiac examination of the neonate or infant.

aorta is a narrowing at some point along the aorta, with the most common location at the aortic isthmus near the origin of insertion of the ductus arteriosus. The ductus arteriosus normally closes in the first six weeks after birth, and ectopic ductal tissue (which normally constricts postnatally) can be present within the aortic arch and will narrow the aortic arch as the duct constricts. As such, pulses that were previously palpable might no longer be palpable. This makes assessment of an infant's pulses an essential feature of the two-week and six-week check with the GP, as well as any cardiac examination in a child. Difficult to palpate or absent femoral pulses are a concerning feature. Pulses might also be present but might be weaker. As such, it is important to compare them to the upper limb (brachial) pulse volume. Infants with coarctation of the aorta can present very unwell in haemodynamic collapse or poor perfusion, similar to the clinical picture of

sepsis. Detecting absent or weak femoral pulses in a neonate can allow identification of coarctation of the aorta before severe collapse.

Assessment of pulses in an older child

Symptoms of coarctation of the aorta can vary depending on the location and severity, with some not being diagnosed until adulthood. An older child with a coarctation can present with a murmur and hypertension. In this scenario, it is also important to assess the femoral pulses and compare them to their upper limb pulses. An upper and lower limb blood pressure differential of at least of 20 mmHg might be present.

Heaves and thrills

A heave is an exaggerated precordial impulse that can be palpated and is secondary to ventricular hypertrophy, which can occur in the setting of an obstructive lesion such as aortic stenosis. A thrill is a palpable

murmur, which feels like a vibratory sensation under the fingertip. The presence of a thrill is required to grade a murmur at four in intensity. The presence of a heave or thrill in conjunction with a murmur is suggestive of a pathological cause.

Innocent murmurs

Innocent murmurs develop secondary to normal blood circulation through the heart. Two of the most common innocent murmurs are a pulmonary flow murmur and Still's murmur.² A pulmonary flow murmur is a soft, low-pitched ejection systolic murmur heard at the upper sternal borders, without radiation, which often disappears when upright. A Still's murmur is a vibratory or musical systolic murmur heard maximally at the left lower sternal edge and apex. The murmur intensity reduces on sitting up and extension of the neck.

Innocent murmurs are characterised by lack of concurrent symptoms or signs, such as desaturation, respiratory distress, heaves, thrills, hepatomegaly or oedema. ECG and chest X-ray are also normal.

Innocent murmurs are accentuated during periods of acute illness, therefore re-assessment when the child is well is recommended. A majority resolve by adolescence, though rarely can persist into adulthood or recur during pregnancy or periods of haemodynamic stress. The management of innocent murmurs is documentation, monitoring and reassurance. Referral to a paediatrician might provide further reassurance.

Pathological murmurs in children

Pathological murmurs in children can be congenital or acquired. Murmurs due to congenital heart disease are often either due to an obstructive lesion (eg aortic stenosis, pulmonary stenosis, left or right ventricular outflow tract obstruction, coarctation of the aorta) or a shunt lesion (eg ventricular septal defect, patent ductus arteriosus). Usually present early in life, most severe lesions will be persistent, progressive and associated with other findings. Acquired murmurs are largely due to new valve dysfunction, present in older children with systemic illness and signs of infection, and are most suspicious

Vital signs

- Heart rate
- Respiratory rate
- Oxygen saturations
- Four-limb blood pressure (BP)

Femoral and brachial pulses

- Volume
- Comparison between upper and lower limbs
- Radiofemoral delay
- Upper and lower BP differential ≥ 20 mmHg

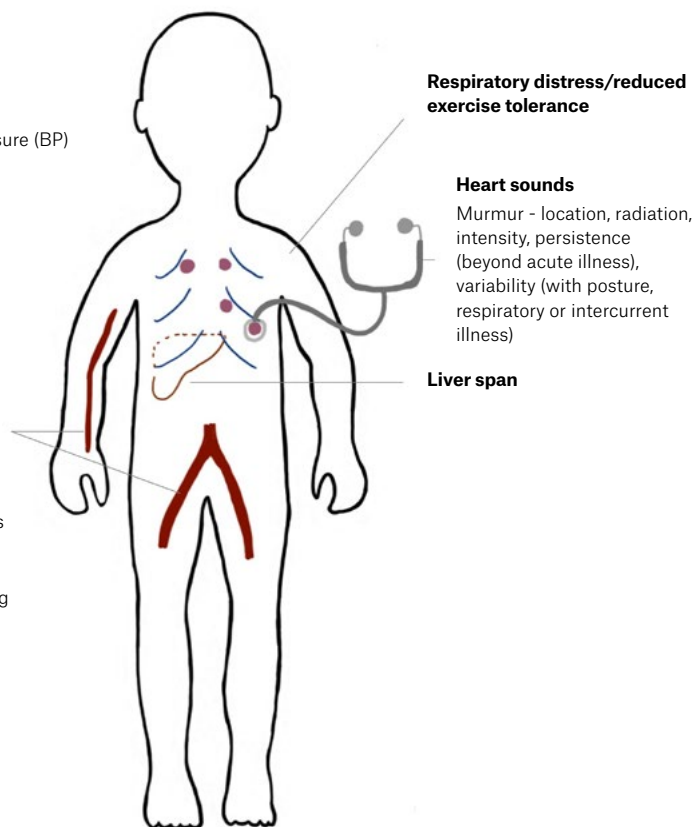


Figure 2. Key features on the cardiac examination of a child.

in the setting of prolonged fever. Most pathological murmurs will be harsh, easy to auscultate and not resolve with sitting upright or on serial examination.

Mimickers of congenital heart disease

Hyperdynamic circulation in the normal heart can result in a flow murmur. This includes anaemia; hence a complete blood examination and iron studies are useful to undertake in a child with a murmur. Similarly, a murmur can be present in a child with acute illness such as sepsis (Box 2). Acute rheumatic fever can lead to rheumatic heart disease, an acquired form of cardiac disease in children and is an important consideration in children of a high-risk background (eg Aboriginal and/or Torres Strait Islander peoples,

Māori and/or Pacific Islander peoples, people living in an acute rheumatic fever-endemic setting or those with a personal history of acute rheumatic fever or rheumatic heart disease aged <40 years⁶) or those who have other clinical features of acute rheumatic fever.

A note on the use of antenatal ultrasound findings

Although the detection rates of congenital anomalies on antenatal scans have improved, a history of a normal morphology scan does not exclude congenital heart disease, and clinical suspicion should warrant consideration of this diagnosis. A morphology scan includes a number of selected views of the fetal heart and, if abnormal, a dedicated fetal echocardiogram is subsequently performed. This fetal echocardiogram is

also unable to exclude conditions that might develop in late pregnancy or infancy. This is particularly relevant for coarctation of the aorta, which might not be present until after closure of the ductus arteriosus, and ventricular septal defects, which might have minimal flow during fetal physiology.

Therefore, attention to the history and examination of the newborn remains important, and a normal antenatal ultrasound should not be relied upon to exclude congenital heart disease.

Investigations

Preliminary investigations for a child presenting with a murmur include a chest X-ray and ECG (Table 2). Chest X-ray should include assessment of cardiothoracic ratio and pulmonary vascular markings, which if increased, suggest a shunting lesion. ECG findings of right or left ventricular hypertrophy might suggest obstructive lesions, and cardiac axis abnormalities can be present in septal wall abnormalities. There are some key differences in interpreting paediatric ECGs; several guidelines are available for this.^{7,8}

Referral to a paediatric cardiology clinic and when to perform an echocardiogram

The presence of red flags (Box 3) or ongoing clinical concern warrants referral to a paediatric cardiology service. In most services, it is preferred that a paediatric echocardiogram be performed in consultation with a paediatric cardiologist. Although centre-specific triaging might vary slightly, history, examination and investigation findings discussed in this article are useful information to include when making a referral to a paediatric cardiology clinic, who can help coordinate an appropriate echocardiogram.

Table 1. Key features on a paediatric cardiac examination

Vitals signs	<ul style="list-style-type: none">• Heart rate• Respiratory rate• Oxygen saturation• Four-limb blood pressure
Femoral and brachial pulses	<ul style="list-style-type: none">• Volume• Comparison between upper and lower limbs
Apex	Heave/thrill
Heart sounds	<ul style="list-style-type: none">• Murmur: location, radiation, intensity• Persistence: is the murmur only present during intercurrent illness?• Variability: does the murmur vary significantly with posture, respiratory or intercurrent illness?
Chest examination	<ul style="list-style-type: none">• Increased work of breathing• Crackles (rare in children)
Liver span	Centimetres below costal margin

Table 2. Preliminary cardiac investigations in the community for a child with a murmur

Investigation	Findings
Chest X-ray	<ul style="list-style-type: none">• Increased cardiothoracic ratio• Pulmonary vascular markings (increased or decreased)
Electrocardiogram	<ul style="list-style-type: none">• Cardiac axis• Evidence of left or right ventricular hypertrophy

Box 2. Mimickers of congenital heart disease

- Anaemia
- Sepsis
- Acute rheumatic fever/rheumatic heart disease

Box 3. Red flags for paediatric heart murmurs

- Shortness of breath or diaphoresis with feeds (neonates, infants) or reduced exercise tolerance (children)
- Poor growth
- Central cyanosis or abnormal oxygen saturation (might have abnormal levels without appearing overtly cyanotic)
- Abnormal pulses
- Upper and lower limb blood pressure differential
- Hypertension with a murmur
- Abnormal chest X-ray or electrocardiogram concerning for a cardiac pathology

Follow-up of innocent murmurs

In the absence of red flags, options include monitoring and reassurance, or if you have ongoing clinical concern, referral to a general paediatrician or paediatric cardiologist. The presence and nature of the murmur should be documented and checked when the child is well without intercurrent illness.

Although no specific follow-up is required for innocent murmurs, it is reasonable to check for the absence of red flags at routine childhood check-ups.

Conclusion

Murmurs are a very common finding in the paediatric population and are usually benign. Assessment of concurrent history, examination and preliminary investigations allow reassurance and safe monitoring in the community. The presence of red flags or ongoing clinical concern warrants further assessment to identify children at higher risk of congenital heart disease, allowing appropriate referral and management.

Key points

- Murmurs are a very common finding in a paediatric examination.
- The majority of murmurs in children are benign.
- Innocent murmurs are not associated with other findings of concern.
- History, examination and simple investigations allow identification of red flags.
- Red flags or ongoing clinical concern warrant referral for further assessment.

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