Topic 4: Differential diagnosis of cardiomegaly in children
Thematic chapter: Differential diagnosis of the most common disease of the blood circulatory system in children. Emergency care in common emergency conditions
Academic hours: 6
Self-education: 4

1. SIGNIFICANCE

Differential diagnosis of cardiomegaly, seen commonly in cardiomyopathies, constitutes a significant diagnostic challenge even for the experienced physician and rarely bring much satisfaction from the therapy. Student should be always alert in respect of these illnesses and suspect it in any cases when changes in the myocardium cannot be easily explained.

2. PREREQUISITES

The skills listed below will not be taught in this lesson but are necessary to perform physical examination of the patient in the intensive care unit during practical training. Therefore, before beginning this lesson, you have to be sure of the ability to:

- Palpate the radial pulse and note heart rate and rhythm
- Palpate the carotid artery pulse and note amplitude, any variations in latter. contour, any thrills
- Measure maximal and minimal blood pressure
- Identify the jugular venous pulsations
- Identify the apical heart impulse and note location, diameter, amplitude, duration
- Auscultate heart with stethoscope and identify if murmurs are present

3. EDUCATIONAL OBJECTIVES

Student should know:
- etiology, pathogenesis, classification, clinical manifestation, differential diagnosis and treatment principles for the cardiomyopathies in children and infants.

Student should be able:
- to identify the child with myocardial disease, make correct decisions during physical examination of the patient with listed conditions, take appropriate actions based on those decisions, demonstrate skills to develop immediate and long-term care plan, foresee outcomes.

4. INTERDISCIPLINARY INTEGRATION

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<tr>
<th>Discipline</th>
<th>Student should know</th>
<th>Student should be able to</th>
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<tr>
<td>Normal anatomy, Physiology</td>
<td>Anatomic and physiologic features of the cardio-vascular system in children of different age groups</td>
<td>Use knowledge of anatomic and physiologic features of the cardio-vascular system in children for evaluation of clinical findings</td>
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<tr>
<td>Biochemistry</td>
<td>Normal ranges for the routine biochemical blood analysis</td>
<td>Assess blood biochemistry and comment on deviations from normal in a clinical context</td>
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### Differential diagnosis of cardiomegaly in children

Cardiomegaly is a condition wherein the heart enlarges in a cardiothoracic ratio of more than 0.50. It is when the heart is more than 50 percent bigger than the inner diameter of one’s rib cage.

Cardiomegaly is assumed to be the direct effect of the thickening of the heart muscles and that happens when the heart is given an increased workload. This increase workload on the other hand, may be due to other health conditions present in the body. Viral illnesses and previous heart attacks can cause the heart to overwork. Drug abuse, inflammation of the heart, and uncontrolled hypertension are the known issues that may give rise to cardiomegaly. Exercise is also a factor. It is believed that most athletes have enlarged hearts, but in this case, theirs is not considered to be a medical condition at all. So in essence, cardiomegaly is not always bad, at least not for sports people. But to a regular person, having an enlarged heart is not normal at all.

The heart’s right or left ventricle may be enlarged, and in some instances, both ventricles can be affected. This is called cardiomegaly due to ventricular hypertrophy. If the left heart is affected, it is called left ventricular hypertrophy. This condition is very common to people who have chronic systolic heart failure or cardiomyopathies. Cardiomegaly can also be due to dilation.

The summary below helps to evaluate different types of cardiomegaly

| Hypertrophic cardiomyopathy | Inheritance is autosomal dominant. Pathology: asymmetric hypertrophy of the ventricular myocardium, without chamber dilation; microscopic hypertrophy of cardiac myocytes with abnormal intercellular connections; intramural coronary arteries thickened with narrowed lumens; the anterior mitral valve leaflet may abut the septum causing LV outflow obstruction in systole. Pathophysiology: impaired filling, relaxation; hyperdynamic systolic function. LV outflow tract gradient +/- present. Patients may be asymptomatic, with or without history; may occur during |

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### ABSTRACT FOR PRE-WORKSHOP SELF-EDUCATION

1. **Differential diagnosis of cardiomegaly in children**

Cardiomegaly is a condition wherein the heart enlarges in a cardiothoracic ratio of more than 0.50. It is when the heart is more than 50 percent bigger than the inner diameter of one’s rib cage.

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The summary below helps to evaluate different types of cardiomegaly
childhood, but especially in teenagers, young adults.

Palpitations: premature ventricular contractions (PVCs), ventricular tachycardia (VT); exercise-induced chest pain; dizziness, syncope: especially with stress or activity; dyspnea on exertion: approximately 50% of patients.

Harsh systolic ejection murmur along the left sternal border: diminished with squatting, accentuated by Valsalva maneuver); systolic murmur of mitral regurgitation (MR) at LV apex; gallop rhythm, ectopic beats on examination (PVCs); rales: if significant pulmonary edema is present.

Differential diagnosis: murmur: fibrous subaortic stenosis or valvar aortic stenosis; LVH: secondary effects of systemic hypertension;

ECG: PVCs with normal QT interval, LV hypertrophy by voltage criteria, T-wave flattening or inversions diffusely.

Chest radiography: **hypertrophic**: normal in approx 50% of patients;

Echocardiography: left atrial enlargement (LAE); MR; systolic anterior motion (SAM) of the mitral valve; asymmetrical, thick ventricular septum or other ventricular wall; abnormal LV diastolic performance. A resting LV outflow tract gradient may or may not be demonstrated by Doppler echocardiography;

Holter monitoring: check for PVCs, VT, SVT or atrial fibrillation in dilated cardiomyopathy (embolic risk).

Cardiac catheterization: 1) to check degree of LV outflow obstruction at rest and provocative testing (ie, dobutamine); 2) to perform myocardial biopsy to confirm diagnosis; and 3) to assess LV outflow gradient with verapamil, beta-blockade and ventricular pacing;

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**Hypertrophic cardiomyopathy**

“Idiopathic” postviral (coxsackie B and A, echo virus) myocarditis, mitochondrial disorders, carnitine deficiency; HIV;

Congestive heart failure: exercise intolerance, Dyspnea on exertion, altered growth, sweating; palpitations, chest pain. May occur in all age groups from infancy on.

May get a history of preceding febrile illnesses, viruses, rashes.

Tachycardia: with or without gallop rhythm; tachypnea for age: with or without rales; systolic murmur of mitral regurgitation (MR) at LV apex; hepatomegaly: with late dependent edema

Acquired inflammatory carditis (Kawasaki disease, rheumatic fever)

Anomalous origin of the left coronary artery from the pulmonary artery (ALCAPA).

Acquired LV dysfunction: toxin-mediated post-anthracycline therapy, hemochromatosis, or related to untreated tachyarrhythmias.

ECG: PVCs with normal QT interval, LV hypertrophy by voltage criteria, T-wave flattening or inversions diffusely.

Chest radiography: cardiomegaly with left atrial and LV enlargement, pulmonary edema.

Echocardiography: globular dilated left ventricle with poor systolic contractility, normal LV wall thickness, mitral annular dilation with MR and LAE. Look for valve disease or regional wall motion abnormalities.

Holter monitoring: check for PVCs, VT, SVT or atrial fibrillation in dilated cardiomyopathy (embolic risk).

Cardiac catheterization: 1) to check ventricular end-diastolic pressure (worst prognosis >25 mmHg) and cardiac index, 2) to perform myocardial biopsy, and 3) to perform coronary arteriography to rule out congenital or acquired coronary disease (ie, anomalous coronary origin or aneurysms).
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<th>Condition</th>
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<td>Subaortic stenosis or valvular aortic stenosis</td>
<td>Symptoms depend on the severity of the obstruction. Severe aortic stenosis - left ventricular failure and signs of low cardiac output. Heart failure, cardiomegaly, and pulmonary edema. Pulses are weak in all extremities. Skin may be pale or grayish. Urine output may be diminished. If cardiac output is significantly decreased, the intensity of the murmur at the right upper sternal border may be minimal. Most children with less severe forms of aortic stenosis remain asymptomatic and display normal growth and development. The murmur is usually discovered during routine physical examination. Rarely, fatigue, angina, dizziness, or syncope may develop in an older child with previously undiagnosed severe obstruction to left ventricular outflow. Sudden death has been reported with aortic stenosis but usually occurs in patients with severe left ventricular outflow obstruction in whom surgical relief has been delayed. In mild stenosis, the pulses, heart size, and apical impulse are all normal. With increasing degrees of severity, the pulses become diminished in intensity and the heart may be enlarged, with a left ventricular apical thrust. Mild to moderate valvular aortic stenosis is usually associated with an early systolic ejection click, best heard at the apex and left sternal edge. Normal splitting of the 2nd heart sound is present in mild to moderate obstruction. The chest radiograph frequently shows a prominent ascending aorta, but the aortic knob is normal. Heart size is typically normal. Valvular calcification has been noted only in older children and adults. Echocardiography identifies both the site and the severity of the obstruction.</td>
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<td>Glycogen storage disease (Pompe)</td>
<td>Deficiency of acid α-glucosidase (acid maltase) Cardiomegaly, hypotonia, hepatomegaly; Onset: birth–6 mo Cardiorespiratory failure leading to death by age 2 yr</td>
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<td>Kawasaki disease</td>
<td>Principal Diagnostic Criteria for Kawasaki Disease Fever of at least 5 days' duration Presence of four of the following: Changes in extremities consisting of induration of the hands and feet with erythematous palms and soles Polymorphous rash Bilateral conjunctival injection Erythematous mouth and pharynx, strawberry tongue, and red, cracked lips Cervical lymphadenopathy Tachycardia</td>
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<td>Cardiomegaly with rheumatic fever</td>
<td>Modified Jones criteria for the diagnosis of acute rheumatic fever Major manifestations Carditis Polyarthritis Chorea</td>
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<td><strong>Erythema marginatum</strong> Subcutaneous nodules Minor manifestations Arthralgia Fever Elevated acute phase reactants: ESR and C-reactive protein Prolonged PR interval Supporting evidence Positive throat culture for group A Streptococcus or positive, rapid streptococcal test, elevated or rising streptococcal antibody titer</td>
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<td><strong>Cardiomegaly in SLE</strong> Associated with: Malar (butterfly) Rash Discoid-Lupus Rash Photosensitivity Oral or Nasal Mucocutaneous Ulcerations Nonerosive arthritis Pleuritis or Pericarditis Cytopenia Positive Antinuclear Antibody Test Nephritis** - Proteinuria &gt;0.5g/day - Cellular Casts Encephalopathy** - Seizures - Psychosis Positive Immunoserology** - Antibodies to nDNA - Antibodies to Sm Nuclear Antigen - Positive LE-Cell Preparation - Biologic False-positive Test for Syphilis</td>
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<td><strong>Cardiomegaly due to systemic hypertension</strong> May present with congestive heart failure</td>
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<td><strong>Cardiomegaly with bacterial endocarditis and aortic stenosis</strong> History of: Fever and sweating. Easy fatigability, malaise. Palpitations. Weight loss and anorexia. Splenomegaly. Splinter hemorrhages Pulmonary embolism. Blood cultures: at least 2–3 over a 24-hour period (not only with temperature spike!) prior to instituting antibiotic therapy Acute phase reactants: sedimentation rate (ESR), C-reactive protein (CRP). Urinanalysis: hematuria. Echocardiography: standard transthoracic echocardiography may adequately image a moderate to large valve vegetation, and also demonstrate leaking valves; Remember: a negative echocardiogram does not rule out endocarditis!</td>
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6.1. Quiz
1. What is the differential diagnosis of hypertrophic cardiomyopathy?
2. What is the differential diagnosis of dilated cardiomyopathy?
3. What is the differential diagnosis of congenital subaortic stenosis?
4. What is the differential diagnosis of cardiomegaly associated with Pompe disease?
5. What is the differential diagnosis of cardiomegaly associated with Kawasaki disease?
6. What is the differential diagnosis of cardiomegaly associated with rheumatic fever?
7. What is the differential diagnosis of cardiomegaly associated with SLE?
8. What is the classification of cardiomyopathies?
10. Explain etiology of dilated cardiomyopathies.
11. Which are the peculiarities in epidemiology of dilated cardiomyopathies?
12. Which are the peculiarities in epidemiology of hypertrophic cardiomyopathies?
13. What are the symptoms and signs of the hypertrophic cardiomyopathies?
14. What are the symptoms and signs of the dilated cardiomyopathies?
15. What investigation would you prescribe for the patients with cardiomyopathies?
16. What are complications of the cardiomyopathies?
17. What are diseases ruled out in hypertrophic cardiomyopathy?
18. What are diseases ruled out in dilated cardiomyopathy?
19. What is the treatment aims for cardiomyopathies?
20. What are measures concerning lifestyle and diet in cardiomyopathies?
21. What is pharmacologic treatment for hypertrophic cardiomyopathy?
22. What is pharmacologic treatment for dilated cardiomyopathy?
23. What is nonpharmacologic treatment for dilated cardiomyopathy?
24. What is nonpharmacologic treatment for hypertrophic cardiomyopathy?
25. What is prognosis for hypertrophic cardiomyopathy?
26. What is prognosis for dilated cardiomyopathy?

6.2. Multi-choice questions
Hypertrophic cardiomyopathy:
1. Inherits as an autosomal dominant trait*
2. Has postviral (coxsakie B and A echovirus) etiology
3. Develops for the carnitin deficiency
4. Adenoviral infection may play a role in
5. Develops after bacterial endocarditis

6.3. Sample case report
A 16-year-old male patient was admitted to our hospital for syncope that was not preceded by symptoms. The status of the patient had already improved by the time the ambulance arrived. He had a regular heart rate and was perfectly orientated. Before this event he had been in New York Heart Association functional class III (dyspnea after climbing one floor, no dyspnea at rest and no angina). Over the past 3 years, he had experienced recurrent episodes of pre-syncope. On heart ultrasound he presented with enlargement of all the heart chambers with a left ventricular ejection fraction of 20%. On arrival at hospital his blood pressure was 100/60 mmHg, with a heart rate of 76 beats, min-1. ECG demonstrated a complete left bundle branch block. There was no ST-segment elevation. During the hospital stay 24-h Holter monitoring was conducted, demonstrating a normal sinus rhythm with no pauses and no ventricular arrhythmia <1% premature ventricular contractions, and no symptoms. The chest radiograph demonstrated a normal pulmonary interstitial structure, with the pulmonary bases clear of any interstitial effusion. The cardiothoracic index was 55%, left heart catheterization showed normal coronary arteries.
1. What is a complete diagnosis?
2. What is the treatment?

**Suggested reading**

**Additional reading**