

# Pericarditis (Pediatrics)

**Pericarditis** is an inflammatory disease of:

- Pericardium
- Pericardial space
- Adjacent tissues of the heart and large vessels

Acute viral pericarditis (causative include coxsackie viruses, adenoviruses, influenza virus, herpes viruses, ECHO viruses, and EB virus) represents one of the most common diseases in childhood, while purulent pericarditis secondary to bacterial sepsis is believed to be rare. Pericarditis can also be an accompanying symptom in diseases such as rheumatic fever, autoimmune diseases, malignancies, renal failure, tuberculosis, or fungal infections.

Sudden onset of high fever is typically present. A characteristic pericardial friction murmur is audible during systole and diastole during physical examination, intensifying when the stethoscope is pressed harder against the chest. As pericardial effusion increases, the pericardial murmur disappears and the heart sounds become noticeably quiet. The effusion can result in cardiac tamponade and sudden circulatory collapse.<sup>[1]</sup>

Common symptoms of cardiac tamponade include severe shortness of breath, tachycardia, hepatomegaly, a weakly palpable peripheral pulse, paradoxical pulse, and hypotension with a small systolic-diastolic difference (low pulse pressure). As a result of pericarditis, pericardial adhesions may occur, and may also lead to constrictive pericarditis. Fortunately, this condition is very rare in children.

## Etiology

**Etiology of pericarditis in children**

infection	autoimmunity	malignancy	other
<ul style="list-style-type: none"> <li>▪ mycoplasma</li> <li>▪ chlamydia</li> <li>▪ Lyme disease</li> <li>▪ TB</li> <li>▪ <i>Haemophilus influenzae</i></li> <li>▪ <i>Staphylococcus aureus</i></li> <li>▪ enteroviruses</li> <li>▪ adenoviruses</li> <li>▪ influenza</li> <li>▪ mumps</li> <li>▪ chickenpox</li> <li>▪ HIV</li> <li>▪ <i>Candida</i></li> <li>▪ <i>Aspergillus</i></li> <li>▪ <i>Toxoplasma gondii</i></li> </ul>	<ul style="list-style-type: none"> <li>▪ SLE</li> <li>▪ JIA</li> <li>▪ M. Kawasaki</li> <li>▪ Sarcoidosis</li> <li>▪ Inflammatory bowel disease</li> <li>▪ Rheumatic fever</li> </ul>	<ul style="list-style-type: none"> <li>▪ leukemia</li> <li>▪ lymphoma</li> </ul>	<ul style="list-style-type: none"> <li>▪ hypothyroidism</li> <li>▪ uremia</li> <li>▪ postpericardiotomy syndrome</li> <li>▪ trauma</li> <li>▪ circulatory failure</li> </ul>

**Fibrinous (dry) pericarditis** is characterized by large deposits of fibrin on the pericardium.

- It usually manifests in the early stage of exudative inflammation, in which effusions accumulate between the layers of the pericardium.
- The accumulating fluid in the pericardium can be transudate, exudate, blood, or pus.
- As a result of pericarditis, adhesions of both layers can form in the pericardium, which can sometimes result in *constrictive pericarditis*.

Of the viral causative agents, the most common culprits are coxsackieviruses, adenoviruses, influenza, herpes, and echoviruses.

- Viral pericarditis is usually preceded by an upper respiratory tract infection or other viruses.
- The prognosis is usually good, but recurrences are common (up to 30% of patients); however, their course is usually shorter and milder.

**Purulent pericarditis** is a rare, but life-threatening disease.

- Usually, it occurs as a result of hematogenous spread secondary to bacterial sepsis resulting from bacterial infections of distant sites (pneumonia, meningitis, or septic arthritis).
- The most common causative agents are *Staphylococcus aureus* and *Haemophilus influenzae* type b (Hib).
- Constrictive pericarditis may develop later on.

## Pathogenesis

**The pericardium** is a thin sac covering the heart and the proximal parts of the large blood vessels. There is a space between the visceral and parietal pericardium, which usually contains about 30 mL of serous fluid in adults (facilitates the movement of the heart in the pericardial sac). The effect of pericarditis on hemodynamic

parameters results from excessive fluid accumulation in the pericardial space or anatomical changes of the pericardium (it turns into a rigid envelope - constrictive pericarditis). Accumulation of fluid in the pericardial space can cause increased intrapericardial pressure, which reduces diastolic filling of the ventricles of the heart. This leads to a decrease in heart rate and CO along with a decrease in coronary perfusion. Rapid accumulation of pericardial fluid can cause **cardiac tamponade**: a life-threatening situation. In some cases, slow accumulation of a large volume of fluid may not lead to serious circulatory disorders.

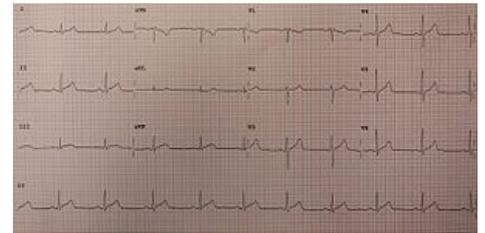
In pericardial tamponade, several compensatory mechanisms are involved, with the most effective being an increase in heart rate (tachycardia compensates for a decrease in diastolic heart filling). **Pulsus paradoxus** is a common symptom of acute tamponade. It is defined as a fall of systolic blood pressure of >10 mmHg during the inspiratory phase. At the same time, this finding can be accompanied by a weak pulse in the periphery, which weakens during inspiration and can even disappear. During inspiration, venous return to the right atrium and ventricle increases, but at the same time more blood accumulates in the lungs, which leads to a paradoxical decrease in left ventricular output. Pulsus paradoxus is also found in constrictive pericarditis and during an asthma attack.



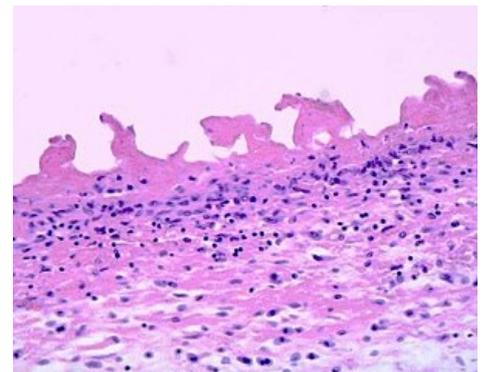
Skiagram of pericarditis

## Clinical picture

- The onset of pericarditis is usually sudden. It is often accompanied with a **high fever**.
- Cough and respiratory pain indicate a current pleural impairment.
- Fibrinous pericarditis causes **pain behind the sternum**, which radiates up to the shoulder and neck.
- Dyspnea and a tickly, dry cough can be present.
- A **pericardial friction murmur** is audible during systole and diastole. The murmur is a result of the displacement and friction between the inflammatory altered layers of the pericardium during heart movements. The loudest murmurs are heard when standing forward. The murmur is reminiscent of the sound of crushing snow under a shoe. It amplifies when the stethoscope is pressed harder against the chest and disappears with increasing fluid accumulating in the pericardium.
- Exudative pericarditis is manifested by **increasing dyspnea**. The heart sounds are noticeably quiet and the friction murmur disappears.
- The liver is enlarged and often edema is present.
- Cardiomegaly can compress the left lung lobe, resulting in weakened and altered breathing (Ewart's symptom).



ECG in acute pericarditis



Microscopic finding in fibrinous pericarditis

## Cardiac tamponade

- A rapidly developing effusion in the pericardium can cause **cardiac tamponade**.
- It occurs with reduced diastolic filling of the heart in diastole and increased central venous pressure.
- In advanced cases, cardiac output decreases and blood circulation collapses rapidly.
- The main subjective symptom is severe **dyspnea**.
- During physical examination, one can observe the dilatation of the jugular veins (the visibility may be limited in children), tachycardia, and hepatomegaly.
- **Pulse paradoxus and a decrease in systemic arterial pressure** with a small systolic-diastolic difference are symptoms of cardiac tamponade that appear in advanced stages, which can result in sudden cardiac arrest.
- **Clinical triad of critical cardiac tamponade**: cyanosis, tachycardia and hypotension.

 For more information see *Cardiac tamponade*.

## Diagnostics

### ECG and X-ray examination

ECG changes depend on the stage of the disease. In the initial stage, one can observe **the elevation of the ST segments** and a positive T wave. Later on, the T wave becomes isoelectric, and eventually it becomes inverted symmetrically. The voltage of QRS complexes is low. During the recovery period, the described changes gradually normalize.

On X-ray, one can notice that the heart shadow is enlarged in both directions during the pericardial effusion with a balanced left contour and a shortened and wide heart apex. If a large pericardial effusion is not present, the heart can have a normal shape and size.

### Echocardiography

One can demonstrate the accumulation of fluid in the pericardium during echocardiographic examination. Invasion (inherniation) of the wall of the right atrium or even the right ventricle during massive pericardial effusion is a warning indirect sign of cardiac tamponade. If the accumulating fluid is exudate, which has a high protein content, there are often clear dense bands in the fluid corresponding to the fibrin deposits.

Every child with cardiomegaly should be examined using X-ray imaging and echocardiography.

### Laboratory examination

In the case of pericarditis of unclear etiology, laboratory tests are focused mainly on the detection of viral or bacterial etiology. In addition to standard examinations, blood cultures and serum are collected for examination (PCR, serology). At the same time, autoimmune markers are looked for to rule out autoimmune origin of pericarditis. Fluid accumulation in the pericardium may also occur secondarily in malignant mediastinal disorders. In this case, CT of the mediastinum is performed.

Pericarditis should always be considered when a child presents with fever and chest pain.

### Therapy

- Treatment of viral pericarditis is **symptomatic**. Bed rest and NSAIDs are highly recommended (e.g., ibuprofen 10 mg/kg, 3 times a day). Corticoids are added only if treatment fails after 48 hours. Pericardiocentesis is indicated for more severe effusion.
- Treatment of purulent pericarditis usually requires surgical drainage of the pericardium and intravenous antibiotic treatment. Most often aminopenicillins or third-generation cephalosporins are chosen and administered for up to 3 or 4 weeks.
- Pericardiocentesis is indicated in urgent cases with clear signs of cardiac tamponade and severe circulatory alterations. It is usually ineffective in terms of total elimination of effusion, due to the high viscosity of the accumulating fluid and its high protein content.

### Pericardiocentesis

In the case of a large pericardial effusion, especially if there is a risk of cardiac tamponade, therapeutic drainage of the pericardial cavity is indicated. Pericardiocentesis in children is performed under general anesthesia with echocardiographic control and continuous ECG monitoring. The patient is in the supine position with the head of the bed elevated. A pig tail catheter is inserted below xiphoid process. Alternatively, one can introduce a chest drain through a subxiphoidal incision. After the initial evacuation of the fluid to release the cardiac tamponade, the rest of the effusion is discharged slowly while replenishing the blood volume. This approach allows severe hypotension from relative hypovolemia to be prevented by redistributing the circulating blood volume after tamponade release. The obtained puncture is sent for microbiological and virological examination, and for biochemical analysis. The total protein content is determined and lipoprotein electrophoresis is performed to detect the presence of chylomicrons when chylous pericardium (chylopericardium) is suspected.

### Constrictive pericarditis

Constrictive pericarditis is very rare in children, mostly associated with TB infection. Clinically, it manifests as exertional dyspnea, weakness, fatigue, edema, chest pain, and sometimes syncope (passing out). Poor physical findings relating to the heart are present, and a small heart is visible on a chest X-ray: this is crucial for the diagnosis. The ECG may show P-wave changes, reduced voltage of QRS complexes, and T-wave changes: it can be flattened or even inverted. On echocardiography, one can sometimes see the thickening of the pericardium. The indirect signs are atypical septal movement in diastole, dilatation of the inferior vena cava, and enlarged atrium. Pericardiectomy is recommended.

### Postpericardiotomy Syndrome

**Postpericardiotomic syndrome** is a non-specific reaction of the pericardium, epicardium, and pleura, manifested by general inflammatory manifestations and increased production of pericardial and pleural effusions. It can occur days, even weeks after heart surgery. Clinical manifestations include subfebrile illness, chest pain, abdominal pain, and rarely vomiting. Laboratory findings can show elevation of FW (erythrocyte sedimentation) and CRP. The pharmacological treatment consist of administering NSAIDs with corticosteroids. Overall prognosis is good.

## Links

### Related articles

- Pericarditis (internal)
- Heart inflammation: Infectious endocarditis (pediatrics) • Myocarditis (pediatrics)

### Reference

1. LEBL, J, J JANDA and P POHUNEK, et al. *Clinical pediatrics*. 1st edition. Galén, 2012. 698 pp. 513-514. ISBN 978-80-7262-772-1 .

### Source

- HAVRÁNEK, Jiří: *Srdeční záněty*. (upraveno)