

# **Pericarditis**

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## Summary

Acute pericarditis is an inflammation of the pericardium that is most commonly caused by infection or myocardial infarction, or occurs following cardiac surgery. The condition typically presents with fever, pleuritic chest pain, and a pericardial friction rub heard on auscultation.



The diagnosis is established based on clinical findings, although diffuse ST segment elevations on ECG and imaging may support the diagnosis. Acute pericarditis is usually self-limiting within 2–6 weeks and is therefore managed symptomatically.



Constrictive pericarditis occurs as a complication of acute pericarditis and is characterized by thickening and rigidity of the pericardium, resulting in both backward and forward failure. Accordingly, patients present with fatigue, jugular vein distention, peripheral edema, and a characteristic pericardial knock on auscultation, caused by a sudden stop in ventricular diastolic filling.

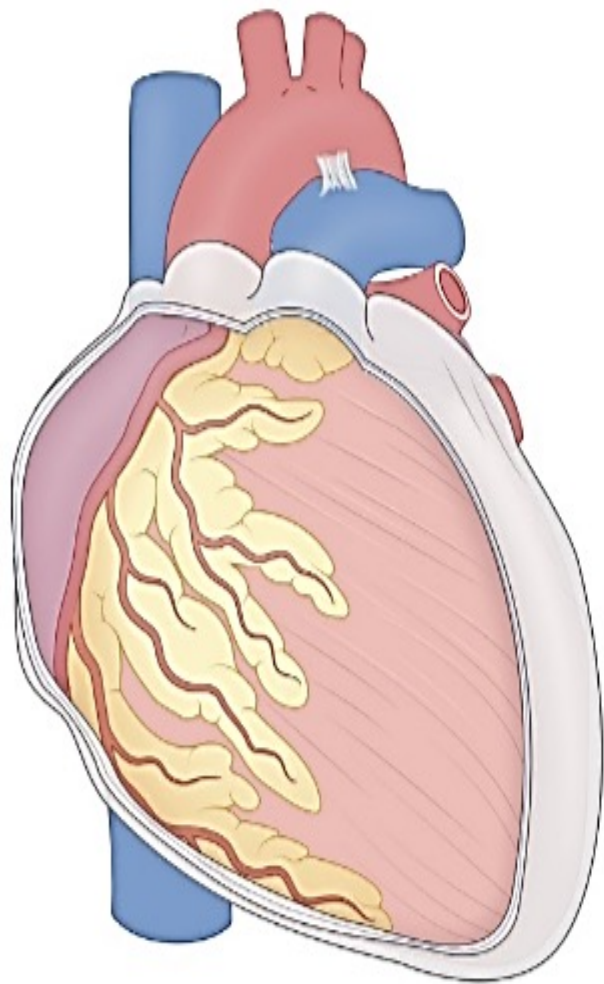


Diagnostic imaging shows typical pericardial thickening on chest x-ray and reduced blood flow on echocardiography. Management consists of treatment of heart failure (e.g., diuretics) and pericardiectomy.

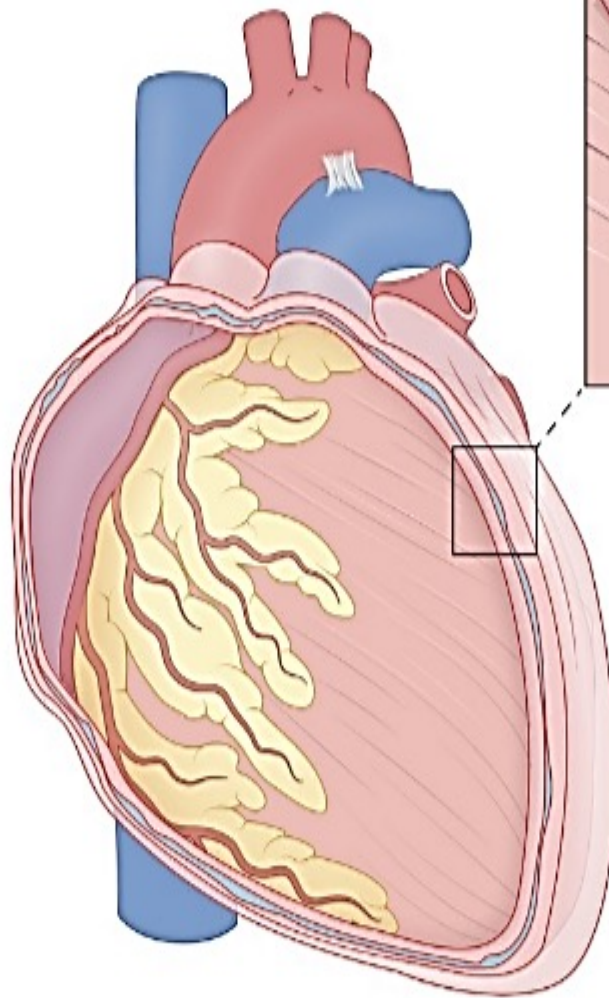
## **Definition**

Acute pericarditis is inflammation of the pericardium that either occurs as an isolated process or with concurrent myocarditis.

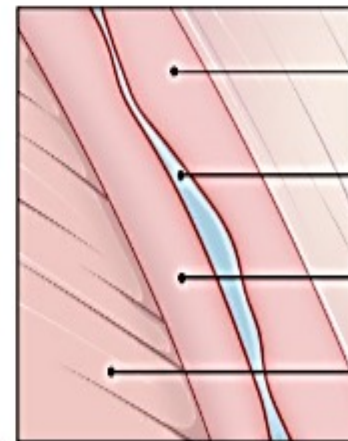
Constrictive pericarditis is characterized by compromised cardiac function caused by a thickened, rigid, and fibrous pericardium secondary to acute pericarditis.



Normal



Pericarditis



- Parietal layer of serous pericardium
- Pericardial cavity
- Visceral layer of serous pericardium (epicardium)
- Myocardium

### **Acute pericarditis**

Inflammation of the pericardial layers of the heart that is often associated with pericardial effusion.

## Etiology

- **Infectious**

- **Most commonly viral**

- Bacterial (e.g., tuberculosis, seen especially in constrictive pericarditis)


- Fungal

- Toxoplasmosis





- **Myocardial infarction:** pericarditis may occur either within 1–3 days as an immediate reaction (i.e., post-infarction fibrinous pericarditis), or weeks to months following an acute myocardial infarction (Dressler syndrome).
- Postoperative (**post-pericardiotomy syndrome**): blunt or sharp trauma to the pericardium
- Collagen vascular disease: systemic lupus erythematosus, rheumatoid arthritis
- Other causes: renal failure (uremia), tumors (Hodgkin lymphoma), radiation



Tuberculosis is the most common cause of constrictive pericarditis in developing countries.

# Clinical features

## Acute pericarditis

- **Low-grade intermittent** fever, tachypnea, dyspnea, nonproductive cough
- **Chest pain:** often sharp, **pleuritic; improves on sitting and leaning forward**
- **Pericardial friction rub:** **high-pitched scratching** sound best heard on auscultation over the left sternal border **during expiration** while the patient is **sitting up and leaning forward**
- **Pericardial effusion**

## Constrictive pericarditis

- Symptoms of **fluid overload** (backward failure)
  - **Jugular vein distention**, ↑ jugular venous pressure
  - **Kussmaul sign**
  - Hepatic vein congestion → hepatomegaly, painful liver capsule distention, hepatojugular reflux
  - Peripheral edema or anasarca, ascites with abdominal discomfort



- Symptoms of **reduced cardiac output** (forward failure) Fatigue, dyspnea on exertion
- **Tachycardia**
- **Pericardial knock**: sudden cessation of ventricular filling during early diastole that is heard best at the left sternal border
- **Pulsus paradoxus**: ↓ blood pressure amplitude during deep inspiration

## **Diagnostics**

### **Acute pericarditis**

The diagnosis is based primarily on a history of pleuritic chest pain and a friction rub heard on auscultation. It is supported by the following findings:

- Blood tests: CBC (**leukocytosis**), ↑ troponin I, ↑ ESR, ↑ CRP, abnormal renal parameters (BUN, creatinine, electrolytes) if caused by underlying uremia



- **Typical ECG changes:** not present in uremic pericarditis Stage 1: initial **diffuse ST elevations**, but ST depression in aVR and V1; **PR segment depression**
- Stage 2: ST segment normalizes in ~ 1 week.
- Stage 3: inverted T waves
- Stage 4: ECG returns to normal baseline (as prior to onset of pericarditis) after weeks to months.



- **Echocardiography:** often normal; possibly signs of effusion
- **Chest x-ray normal**



## **Constrictive pericarditis**

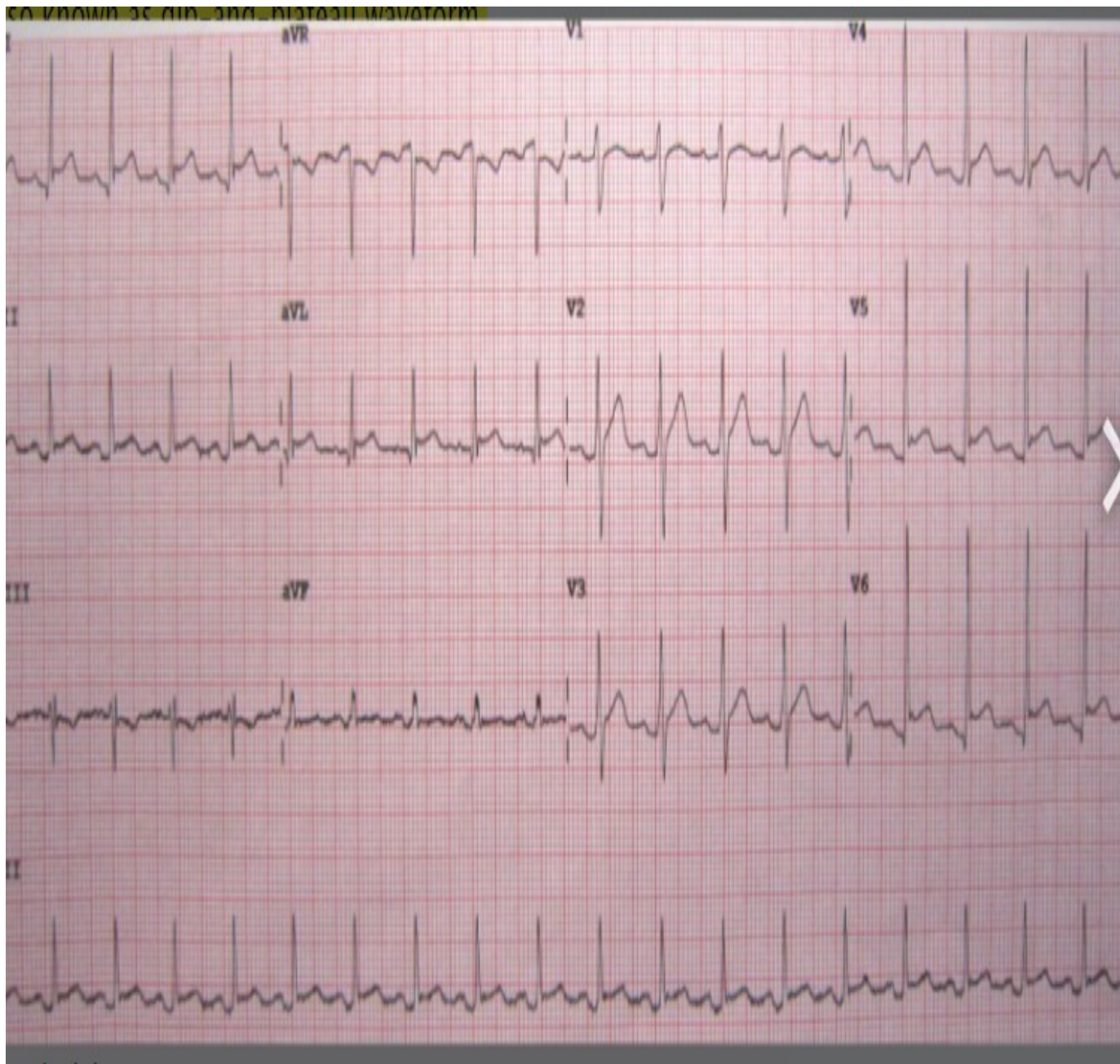
- **Chest x-ray (best initial test), CT, and MRI: pericardial thickening and calcifications, normal cardiac silhouette**



- **Echocardiography** ↑ **Pericardial thickness**
  - Abnormal ventricular filling with **sudden halt during early diastole**
  - Moderate biatrial enlargement
  - Excludes right ventricular hypertrophy and cardiomyopathy



- ECG shows no conclusive findings.
  - Atrial fibrillation can occur in severe disease.
- **Cardiac catheterization**
  - Elevated diastolic pressures in the left and right ventricles with diastolic equalization
  - **Square root sign**
    - Also known as dip-and-plateau waveform
    - Sudden dip of the right and left ventricular pressure in early diastole followed by a plateau during the last stage of diastole



## Acute pericarditis

12-lead ECG (paper speed: 25 mm/s)

Sinus tachycardia with a frequency of approx. 107/min.

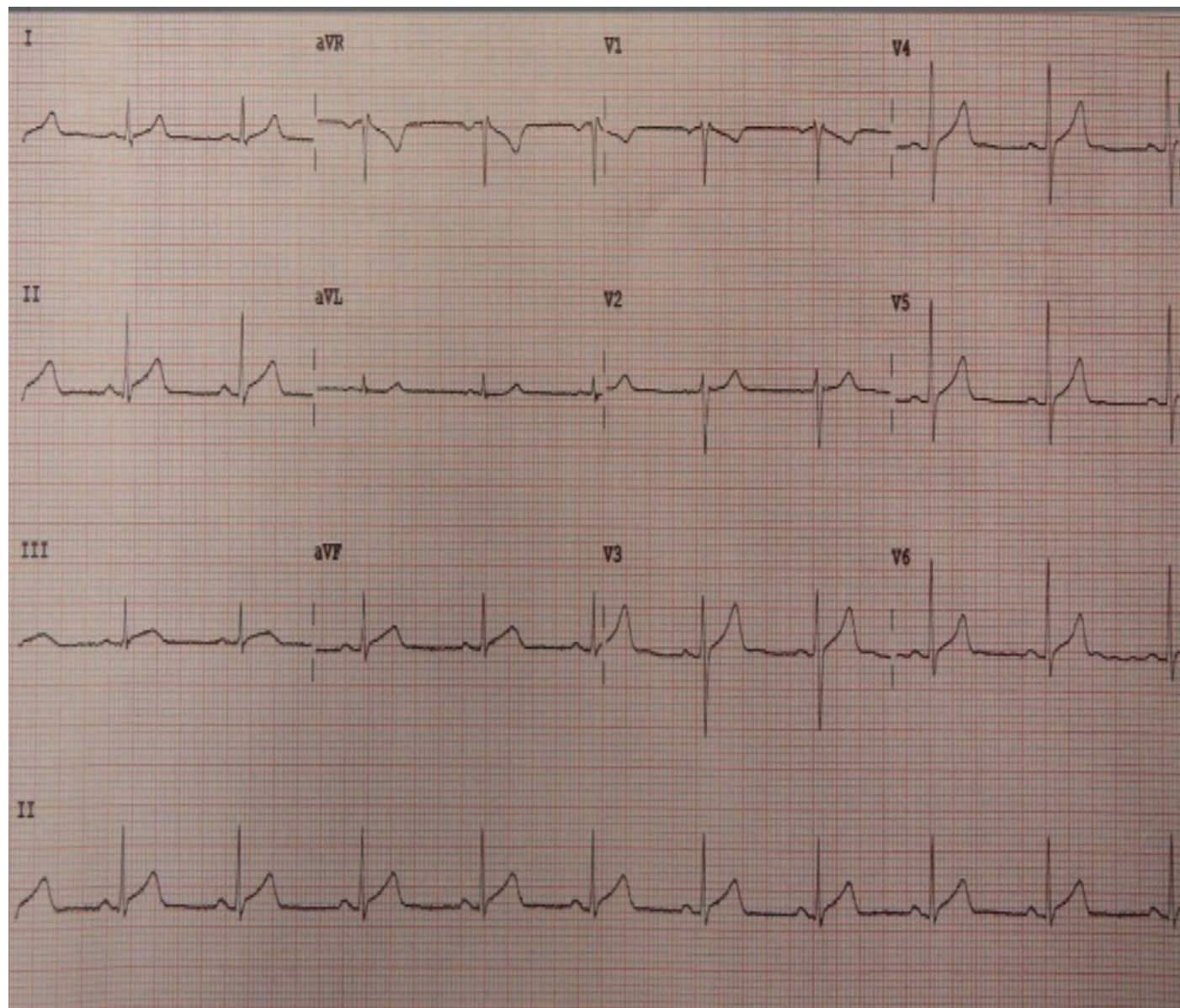
Normal heart axis ( $R > S$  in both I and aVF).

P waves have normal morphology.

Diffuse PR depressions with reciprocal, concave ST elevations (best seen in aVL and aVR). Note the notching at the end of the QRS complexes (creating the "fish hook" morphology; best seen in aVL). Discordant T wave in V1.

PR interval normal (approx. 120 ms), QRS interval borderline narrow (approx. 80 ms), QT interval prolonged (approx. 400 ms;  $QTc = 534$  ms).

These findings are typical for stage 1 in acute pericarditis.

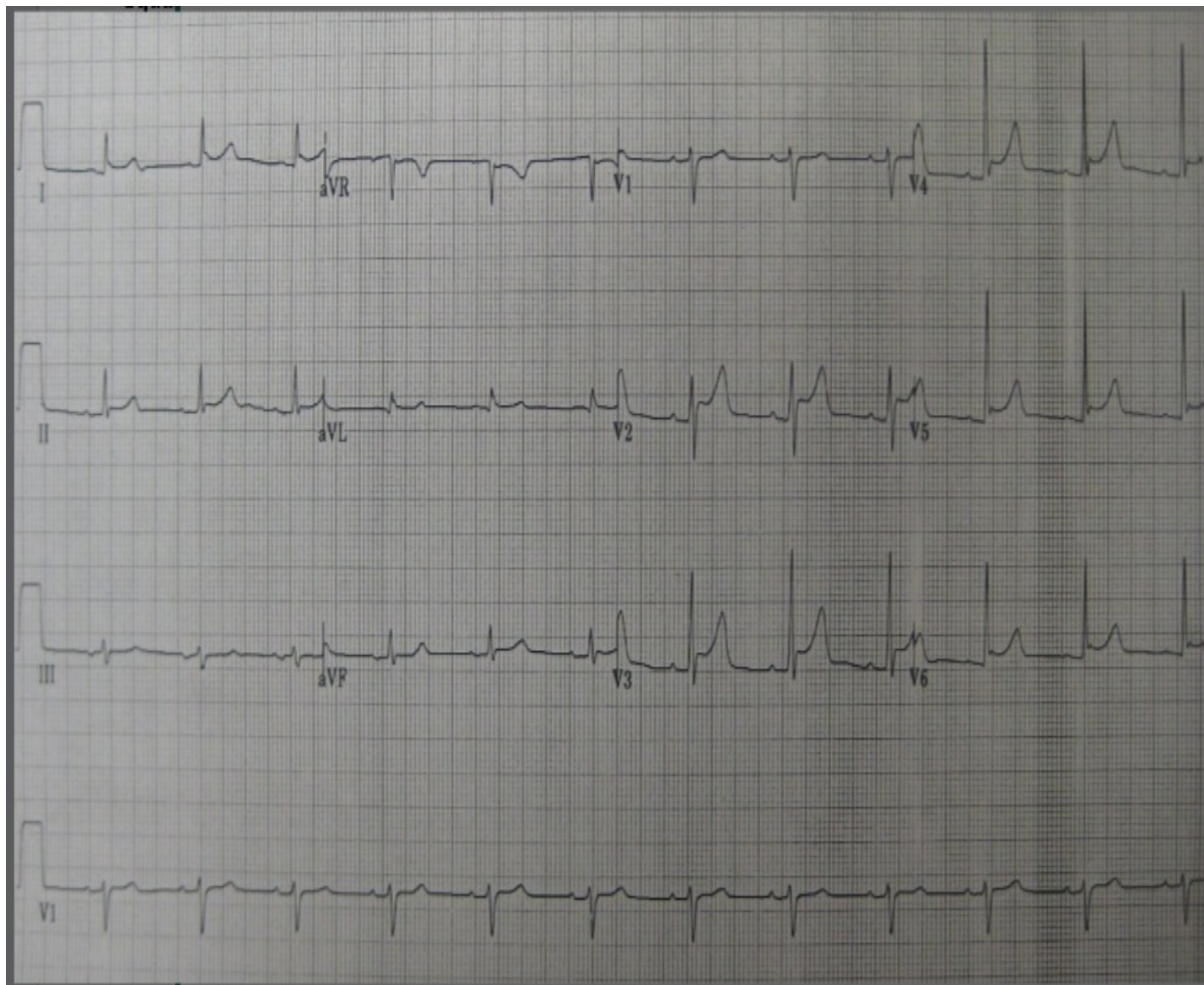


## Acute pericarditis

12-lead ECG (paper speed: 25 mm/s)

Regular sinus rhythm with a rate of approx. 60/min. Normal heart axis ( $R > S$  in both I and aVF). PR interval normal (approx. 140 ms) QRS complexes narrow (approx. 70 ms), and QT interval normal (approx. 400 ms;  $QTc = 400$  ms). Diffuse concave to upward ST elevation is seen in I, II, aVF, V3–V6 with reciprocal ST depression in aVR and V1.

These findings are consistent with acute pericarditis.



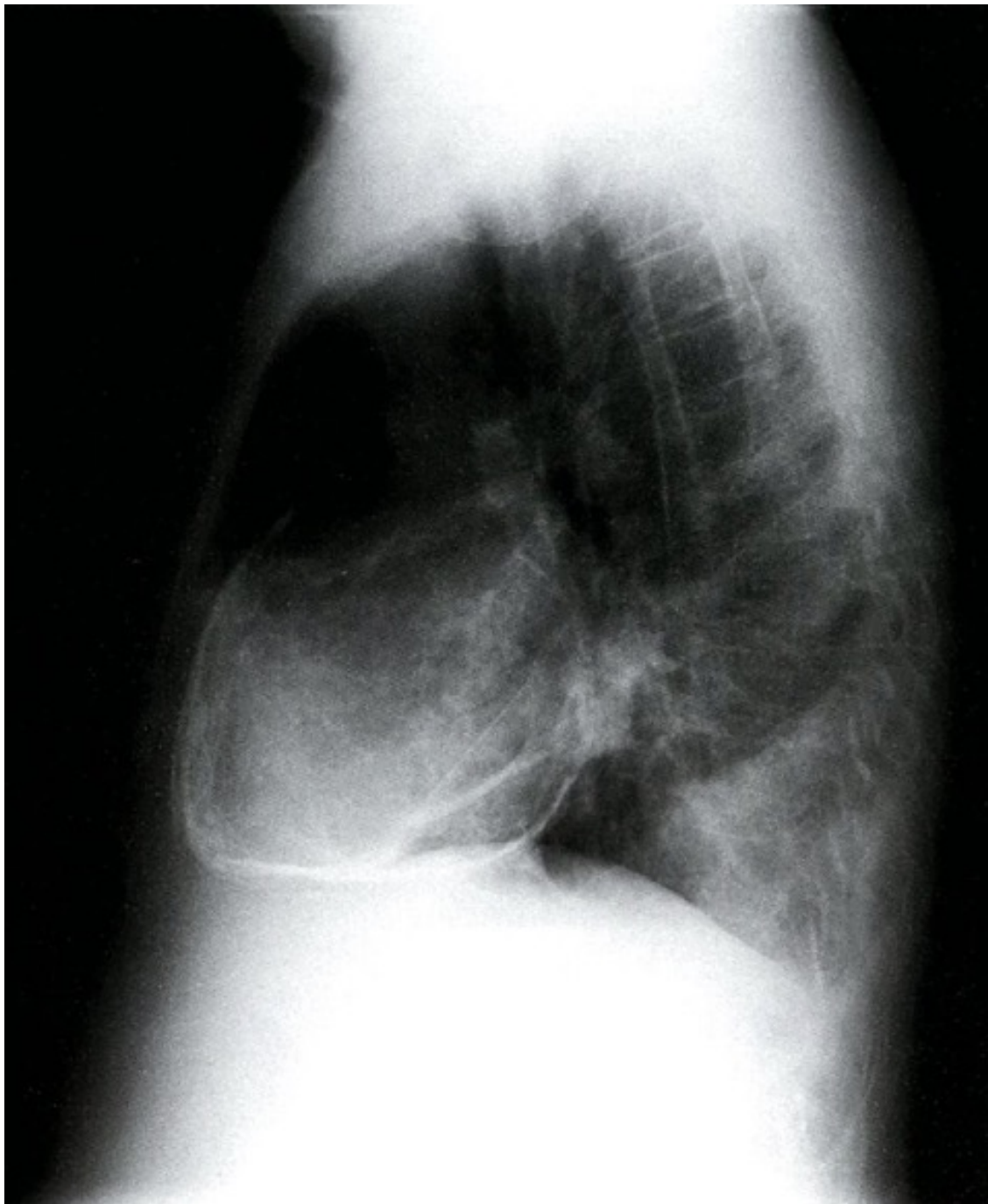
## Pericarditis

12-lead ECG (paper speed: 25 mm/s)

Concave ST elevations in multiple leads (I, II, aVL, V2-6) with ST depression in aVR.

Additionally, there is ST depression and PR elevation in aVR.

These findings are typical for pericarditis.



## **Constrictive pericarditis**

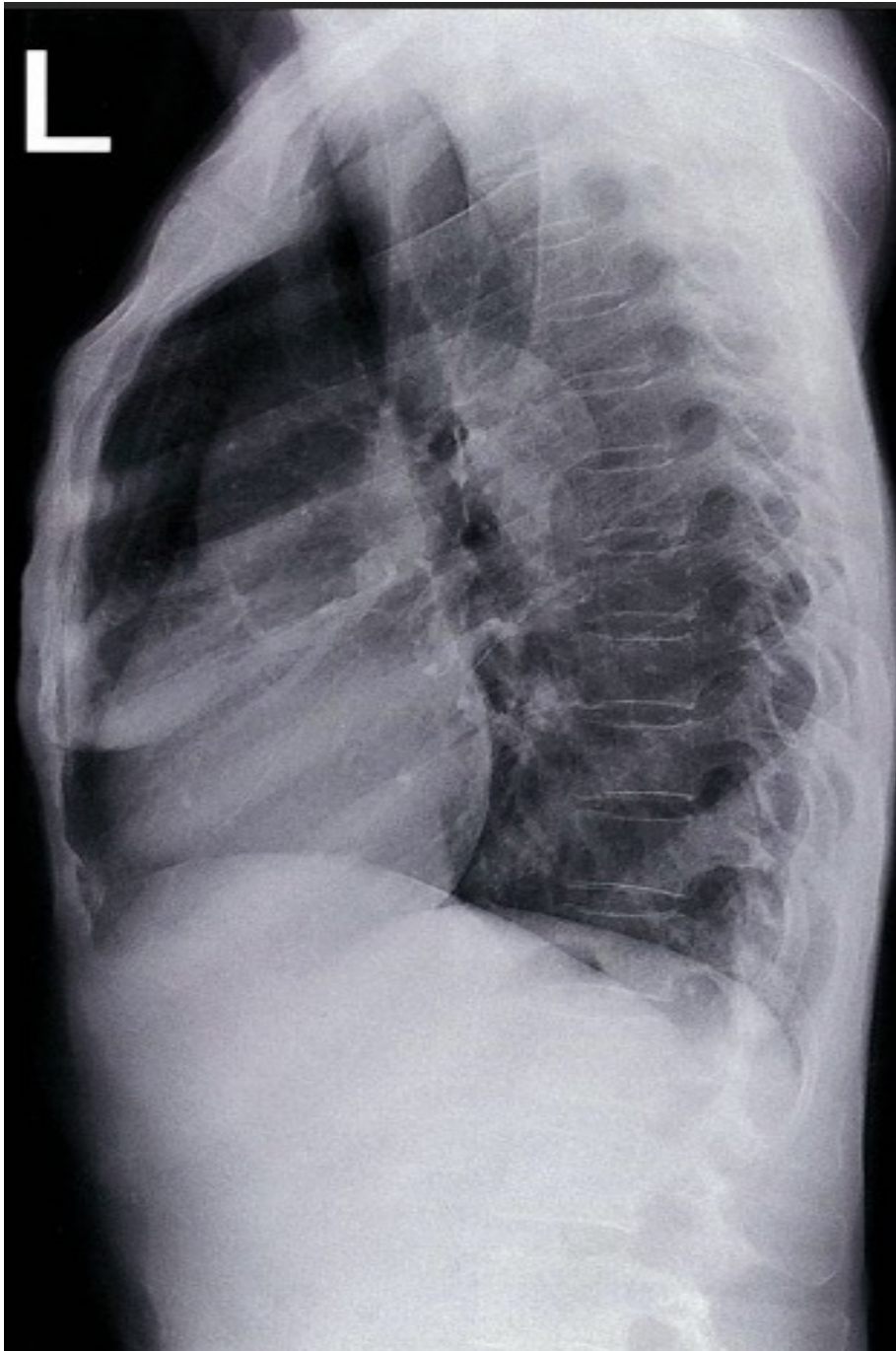
Chest x-ray (lateral view)

Thickened pericardial contour from the apex to the upper cranial half of the heart, indicating fibrosis of the outer layer of the heart (green overlay).

Diagnosis: constrictive pericarditis

Additional findings:

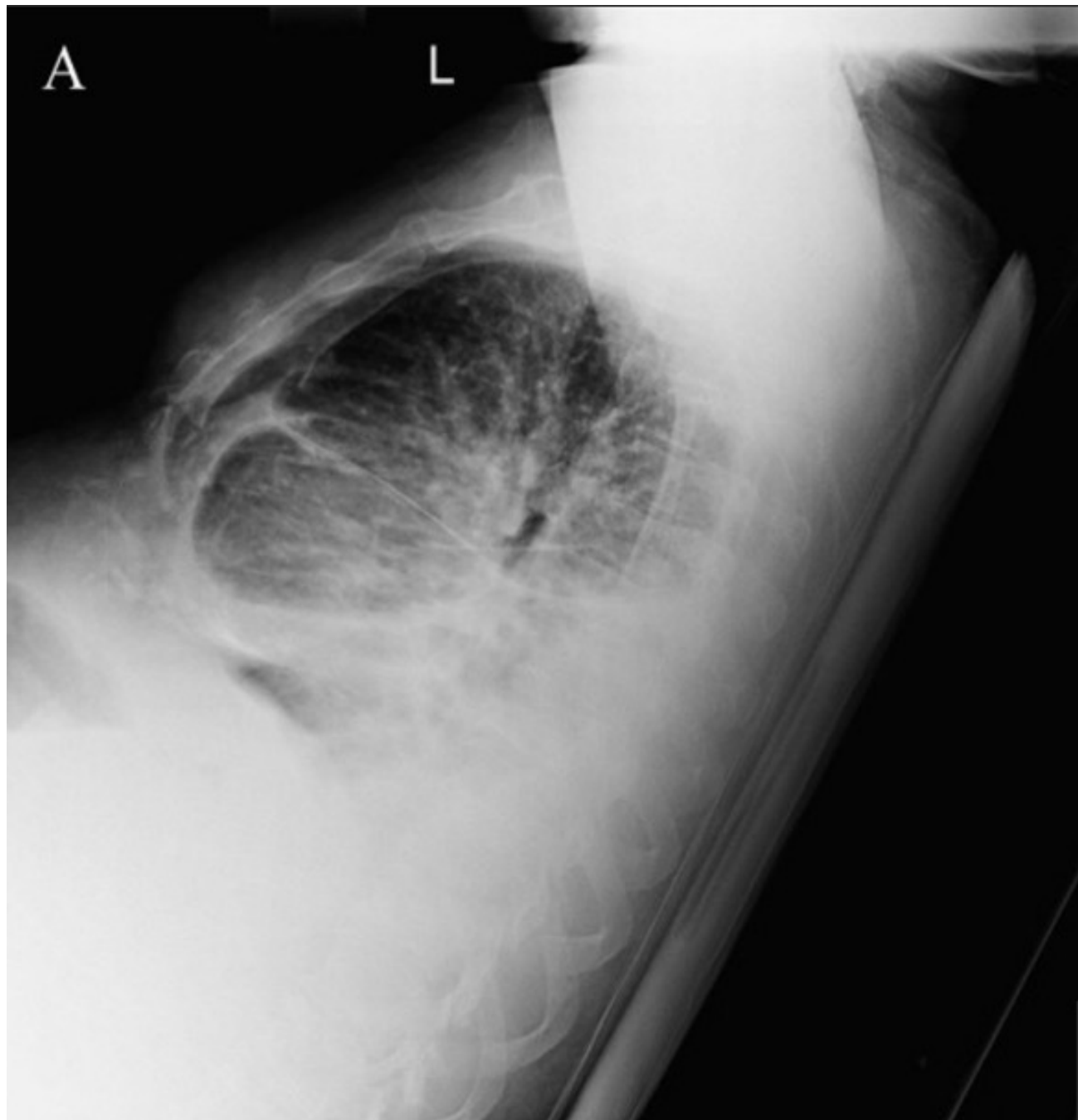
- (1) Wedge-shaped, extensive opacity, in the basal portion of the left lung, consistent with pleural effusion (green hatched overlay).
- (2) Increased perihilar lung markings (red overlay), consistent with pulmonary stasis.



## **Normal chest x-ray**

**Lateral chest x-ray of a 46-year-old patient: no pathological findings**





## **Constrictive pericarditis**

Chest x-ray (lateral view)

Pericardial thickening and calcifications of the pericardial contour (particularly in the region of the apex; green overlay) can be seen, which indicate pericardial fibrosis.

Additionally, right-sided pleural effusion and prominent perihilar lung markings (suggesting pulmonary stasis) are visible.

These radiographic features indicate constrictive pericarditis.

# Treatment

## Acute pericarditis

Acute pericarditis is **often self-limiting** and resolves within approx. 2–6 weeks.

- Treat underlying cause
- Restricted physical activity
- **NSAIDs** plus colchicine (alleviates symptoms, reduces rate of recurrence)
- Glucocorticoids if NSAIDs are ineffective



## **Constrictive pericarditis**

- Treat underlying condition
- Symptomatic therapy (manage fluid overload with diuretic therapy)
- **Pericardiectomy** (complete removal of the pericardium)

## **Complications**

- Constrictive pericarditis
- **Cardiac tamponade**

# **Pericardial effusion and cardiac tamponade**

## Summary

Pericardial effusion is the acute or chronic accumulation of fluid in the pericardial space (between the parietal and the visceral pericardium) and is often associated with a variety of underlying disorders.



The fluid can be either bloody (e.g., following aortic dissection) or serous (usually idiopathic). As the pericardium is rather stiff, the capacity of the pericardial space is limited. In chronic effusion, the pericardium can stretch to a certain degree, accommodating slightly more fluid.



In the acute setting, however, the added volume quickly exceeds the maximum capacity of the pericardial space. In both cases, the end result is often cardiac tamponade: compression of the heart which can lead to a life-threatening reduction in cardiac output. Pericardial effusion is initially asymptomatic, but cardiac tamponade has a distinct clinical presentation, including hypotension, tachycardia, jugular venous congestion, and pulsus paradoxus. Echocardiography is the most important diagnostic procedure and usually reveals an anechoic pericardial space.





## **Cardiac Tamponade :**

Cardiac tamponade is a medical emergency in which blood or fluids acutely fill the space between the sac that encases the heart muscle. This places extreme pressure on the heart muscle producing hypotension and shock .

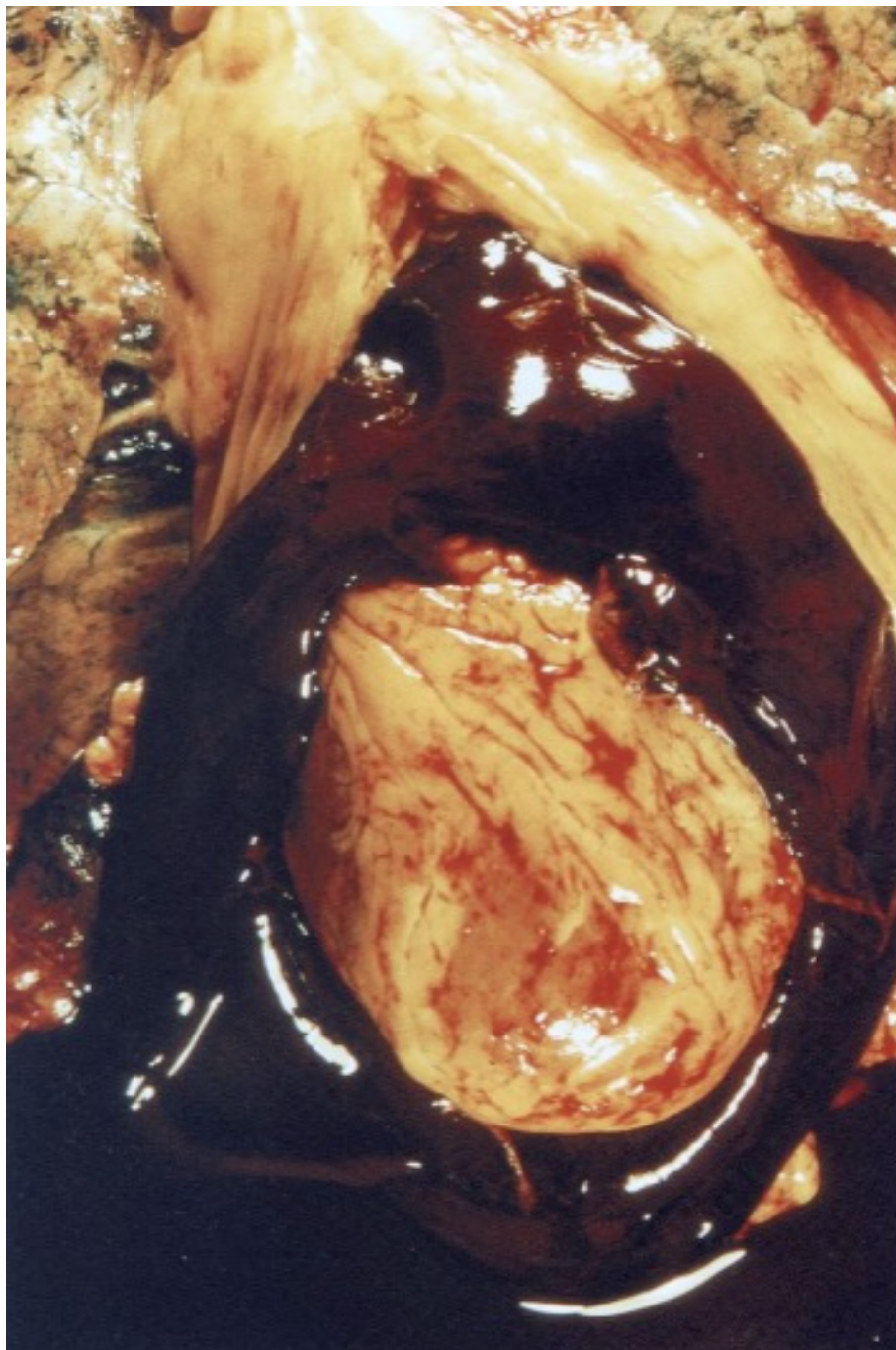
Treatment depends on hemodynamic stability: unstable patients require quick pericardial fluid drainage, through either pericardiocentesis or surgery, whereas in stable patients, treatment focuses on the underlying disease.

# Etiology

## ▪ Hemopericardium

- Cardiac wall rupture (e.g., complication of myocardial infarction)
- Chest trauma
- Aortic dissection
- Cardiac surgery (e.g., heart valve surgery, coronary bypass surgery)





## **Pericardial tamponade: opened pericardium (2/2)**

Photograph of a heart at autopsy  
(close-up of the left ventricle in  
longitudinal section)

There is coagulated, brown blood  
in the opened pericardium.

Coagulation indicates previous  
hemorrhage from the heart  
chambers into the pericardium.  
The coagulated blood compresses  
the heart (pericardial tamponade),  
leading to cardiac arrest.

## ■ **Serous pericardial effusion**

- Idiopathic
- Acute pericarditis (especially viral, but also fungal, tuberculous or bacterial)
- Malignancy
- Poststernotomy syndrome
- Uremic
- Autoimmune disorders
- Hypothyroidism

## **Pathophysiology**

Limited elasticity of the pericardium → ~ 150–200 mL of fluid → ↑ pressure in pericardial space → compression of the heart, especially of the right ventricle due to a thinner wall → interventricular septum shifts towards the left ventricle chamber → ↓ ventricular diastolic filling → ↓ stroke volume (+ venous congestion) → ↓ cardiac output

## **Clinical features of cardiac tamponade (emergency ) and cardiac effusion (usually chronic condition) :**

- Usually initially asymptomatic
- Shortness of breath, especially while lying down (orthopnea)
- Beck's triad



- **Beck's triad**
  - **Hypotension**
  - **Muffled heart sounds**
  - **Distended neck veins**





- Tachycardia, **pulsus paradoxus**
- **Retrosternal chest pain**
- Apical impulse difficult to locate or nonpalpable



- Pallor, cold sweats
- Symptoms of left heart failure and symptoms of right heart failure
- Cardiogenic shock, asystole



Beck's triad for cardiac tamponade: hypotension, muffled heart sounds, distended neck veins!

## **Diagnostics**

- **Echocardiography (gold standard)**
  - Anechoic space  
between pericardium and epicardium
  - Reduced ejection fraction
  - Reduced wall motion



- **CXR** : enlarged cardiac silhouette, clear lungs, in severe cases a globular "**water bottle-shaped**" heart contour



- **ECG**
  - Low voltage
  - **Electric alternans**



- **Pericardial fluid drainage:** used to sample the effusion in cases of unclear etiology



Echocardiography is a quick and safe diagnostic tool for detecting pericardial effusions and pericardial tamponade!



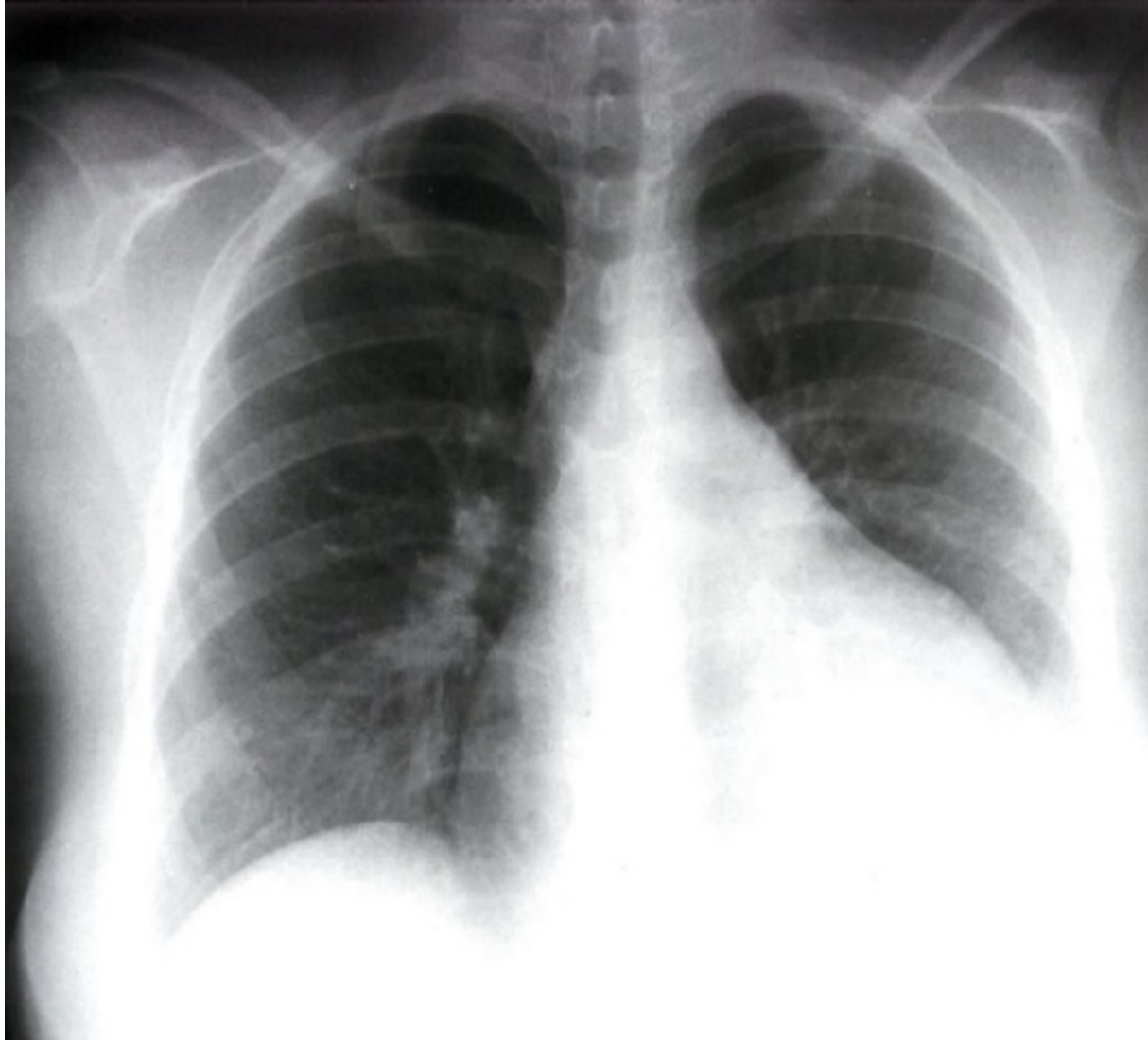


## **Pericardial effusion in myocarditis**

Transthoracic echocardiogram (parasternal window; long axis; ventricular diastole)

The mitral valve (M) is open. An anechoic space surrounds the heart, indicating pericardial effusion (green overlay).

LV: left ventricle; RV: Right ventricle

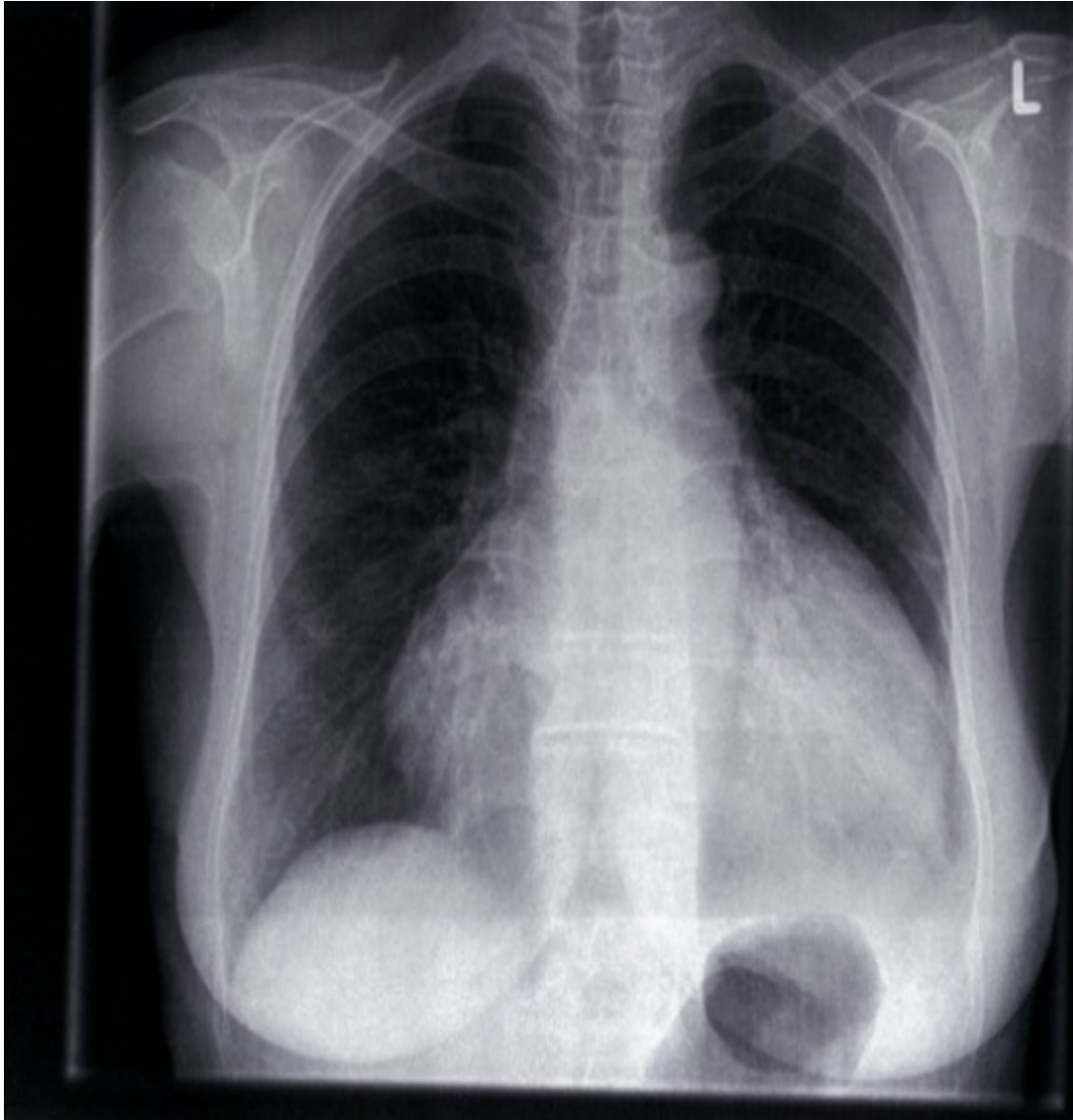


## **Pericardial effusion in exudative pericarditis**

Chest x-ray (AP view)

A bilaterally enlarged cardiac silhouette (globular "water bottle-shaped") with complete loss of normal cardiac contour is visible (dashed line: normal cardiac silhouette; hatched overlay: enlarged silhouette). In addition, two crescent-shaped opacities ( $L > R$ ) can be seen at both costophrenic angles (light green shaded area).

These findings indicate pericardial effusion in addition to pleural effusion.



**Pericardial effusion due to  
pericarditis in systemic  
lupus erythematosus**

Chest x-ray (PA)

Enlarged cardiac silhouette  
(globular/water bottle shape) due  
to pericardial effusion in  
pericarditis.

## Treatment

- **Hemodynamically unstable**
- **Pericardial fluid drainage:** ultrasound-guided pericardiocentesis or surgical drainage
- Subsequent surveillance in an intensive care unit (ICU)



Acute pericardial effusion with pericardial tamponade is a life-threatening condition, requiring immediate pericardial decompression!

## **Hemodynamically stable**

- Treatment of underlying cause
- **Pericardial window:** an incision in the pericardium is made that allows continual drainage from the pericardial space into the pleural cavity to prevent a cardiac tamponade
  - Commonly indicated for effusion due to underlying malignancy
- Hemodynamic monitoring