Pericardial Disease

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Learning Objectives

- Discuss the classification, signs and symptoms of pericarditis
- Describe the pathophysiology and signs of pericardial effusion
- Describe the pathophysiology and signs of pericardial tamponade
- List the causes, signs and symptoms of constrictive pericarditis
- Treatment options and indications for pericardial disease
3) Pericardial Disease

- Anatomy:
  - Fibrous pericardium – a fibrous sac
    - It holds heart in position; separates it from surrounding structures; prevents sudden dilatation of heart with hypervolemia.
  - Serous pericardium – serous membrane
    - Parietal Layer- lines fibrous pericardium
    - Visceral Layer- line epicardium
  - 15-50 cc of pericardial fluid normally.
- Yet, cardiac function may remain normal after pericardial removal or opening of pericardial sac.
Pericardial Disease
<table>
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<th>Table 1</th>
<th>Comparison of multimodality imaging modalities in the evaluation of pericardial diseases</th>
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<td><strong>Echocardiography</strong></td>
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<td><em>Main strengths</em></td>
<td>• First-line imaging test in the diagnostic evaluation of pericardial disease</td>
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<td>• Readily available</td>
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<td>• Can be performed at bedside or urgent situations</td>
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<td>• TEE available for better evaluation</td>
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<td>• High frame rate</td>
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<td>• Can be performed with respirometer</td>
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<td><strong>CT</strong></td>
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<td>• Second-line for better anatomic delineation</td>
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<td>• Evaluation of associated/extracardiac disease</td>
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<td>• Preoperative planning</td>
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<td>• Evaluation of pericardial calcification</td>
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<td><strong>CMR</strong></td>
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<td>• Second-line for better anatomic delineation</td>
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<td>• Superior tissue characterization</td>
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<td>• Evaluation of inflammation</td>
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Pericarditis - Classification

Inflammation or infection of the Pericardium

- Acute pericarditis (< 6 weeks duration)
  - The most common pathologic process affecting the pericardium.
- Subacute pericarditis (6 wks to 6 mos.)
- Chronic pericarditis (> 6 months)

- The above types may also be characterized as: serous, fibrinous, adhesive, or constrictive.
Serous & Fibrinous Pericarditis

Serous

Fibrinous
Pericarditis - Etiologies

- **Infectious**
  - Viral
  - Pyogenic (bacterial)
  - Tuberculous
  - Fungal and other

- **Noninfectious**
  - 2° to Acute MI
  - Neoplastic
  - Uremic
  - Traumatic
Pericarditis – Etiologies (cont’d)

- Hypersensitivity or autoimmune
  - Rheumatic fever
  - Collagen vascular (SLE, RA, scleroderma)
  - Drug-induced
    - Procainamide, hydralazine, phenytoin, INH.

- Postcardiac injury (1 wk to mos. afterwards)
  - Post-MI (Dressler’s syndrome)
  - Postpericardiotomy
  - Posttraumatic
Hemorrhagic & Purulent
Acute Pericarditis - Symptoms

- Chest pain – usually present; may be absent in slowly developing process.
  - Often severe, pleuritic, sharp, aggravated by breathing, coughing, and position change.
  - May be steady and mimic myocardial ischemia.
  - Classical feature of pericarditis pain:
    - Relieved by *sitting up & leaning forward*.
    - Intensified by *lying supine*.
Acute Pericarditis – Exam & EKG

- Pericardial friction rub (‘murmur’) most characteristic exam finding:
  - High/medium-pitched, scratching, grating.
  - Loudest during inspiration.
  - 2-3 component
  - May come and go

- EKG shows widespread elevation of ST segments. T waves usually do not become inverted until several days have passed, unlike acute MI.
Acute Pericarditis – EKG Findings

- Generalized ST segment elevation, usually with reciprocal depression in aVR & V1.

5.136 Acute pericarditis. In the first few days, the ECG shows ST elevation, concave upwards, with upright T waves in most leads. Classically it is more obvious in lead II than in I or III. There are no pathological Q waves, and the widespread distribution of ST–T changes without reciprocal depression, distinguishes acute pericarditis from early myocardial infarction. In the later stages of pericarditis, the T waves become inverted in most leads. The ECG changes in pericarditis are caused by the superficial myocarditis that accompanies it.
Figure 17  ECG changes showing diffuse concave ST-segment elevations consistent with acute pericarditis. Note that lead aVR shows reciprocal ST-segment depression and reciprocal PR-segment elevation.
Table 4  Criteria for acute pericarditis (the presence of two criteria is considered diagnostic)

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<th>Typical chest pain</th>
<th>Pericardial friction rub</th>
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<td>ECG changes consistent with pericarditis</td>
<td>New or worsening PEff</td>
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| *Elevated C-reactive protein or ultrasensitive C-reactive protein/ Westergren sedimentation rate is a confirmatory finding | *
| *LGE on CMR may be a new confirmatory finding |

Adapted from Imazio.⁴
PERICARDIAL DISEASE

Diagnosis: At least 2 of the following 4 criteria:
- Characteristic chest pain
- Pericardial friction rub
- Suggestive electrocardiographic changes
- New or worsening pericardial effusion

Yes

Consider myopericarditis if elevated levels of cardiac enzymes or evidence of myocardial dysfunction on echocardiography

Acute pericarditis

Consider alternative diagnosis

Equivocal or no

Consider CMR

High-risk features: fever, leukocytosis, large pericardial effusion, cardiac tamponade, acute trauma, oral anticoagulation, NSAID therapy failure, elevated troponin level, relapsing pericarditis

Treat as acute pericarditis if delayed enhancement on CMR

Yes

Hospital admission

Stable

Clinical testing for suspected underlying etiology

Unstable

Cardiac tamponade

No

Outpatient treatment

Aspirin or other NSAID ± colchicine No prednisone*

No relapse

Likely idiopathic or viral pericarditis

Relapse

See relapsing pericarditis algorithm (Figure 6)
TEE in midesophageal view showing small localized PEff (arrow) adjacent to the right atrium in a postcardiac procedure (left) and organized moderate effusion adjacent to the right ventricle in a patient with Dressler’s syndrome (left).
Treatment of Acute Pericarditis

- Treat the underlying disorder.

- For viral or idiopathic pericarditis:
  - Anti-inflammatory meds
    - Aspirin 600-900mg QID
    - Other NSAIDs, eg Indomethacin.
    - May need steroids (eg. Prednisone) higher recurrence rate

- Avoid anticoagulants

- Observe for signs of Tamponade
  - Pericardiocentesis may be necessary.
Colchicine- 1st Line Therapy?

The Colchicine for Acute Pericarditis (COPE) trial, a prospective randomized trial of colchicine for treatment of an initial episode of pericarditis, randomized patients to treatment with aspirin alone or aspirin with colchicine. Patients randomized to colchicine therapy were given 1 to 2 mg the first day and a maintenance dose of 0.5 to 1 mg daily for 3 months in addition to aspirin. Patients given colchicine in addition to aspirin had a more rapid resolution of symptoms, and fewer of them had recurrences (33.3% vs 11.7%, P = .009).

Treat for at least 3 months in acute pericarditis to prevent Chronic pericarditis
Take Home Message:

2 weeks of NSAIDs

3 months of Colchicine

A Randomized Trial of Colchicine for Acute Pericarditis

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ABSTRACT

BACKGROUND
Colchicine is effective for the treatment of recurrent pericarditis. However, conclusive data are lacking regarding the use of colchicine during a first attack of acute pericarditis and in the prevention of recurrent symptoms.

METHODS
In a multicenter, double-blind trial, eligible adults with acute pericarditis were randomly assigned to receive either colchicine (at a dose of 0.5 mg twice daily for 3 months for patients weighing >70 kg or 0.5 mg once daily for patients weighing ≤70 kg) or placebo in addition to conventional antiinflammatory therapy with aspirin or ibuprofen. The primary study outcome was incessant or recurrent pericarditis.

RESULTS
A total of 240 patients were enrolled, and 120 were randomly assigned to each of the two study groups. The primary outcome occurred in 20 patients (16.7%) in the colchicine group and 45 patients (37.9%) in the placebo group (relative risk reduction in the colchicine group, 0.56; 95% confidence interval, 0.30 to 0.72; number needed to treat, 4; P<0.001). Colchicine reduced the rate of symptom persistence at 72 hours (19.2% vs. 40.6%, P=0.001), the number of recurrences per patient (0.21 vs. 0.52, P=0.001), and the hospitalization rate (5.0% vs. 14.2%, P=0.02). Colchicine also improved the remission rate at 1 week (85.0% vs. 58.3%, P<0.001). Overall adverse events and rates of study drug discontinuation were similar in the two study groups. No serious adverse events were observed.

CONCLUSIONS
In patients with acute pericarditis, colchicine, when added to conventional antiinflammatory therapy, significantly reduced the rate of incessant or recurrent pericarditis. (Funded by former Azienda Sanitaria Locale 3 of Turin [now Azienda Sanitaria Locale 2] and Aecarpia; ICAP ClinicalTrials.gov number, NCT00128453.)
Relapsing pericarditis

Diagnosis: Acute pericarditis plus chest pain and 1 of the following:
- Fever
- Pericardial rub
- Electrocardiographic changes
- Pericardial effusion
- Elevation in WBC, ESR, or CRP

Yes

Aspirin or other NSAID ± colchicine
No prednisone

Multiple relapses

Consider addition of prednisone or immunosuppressive therapy

Slow taper of prednisone

Medical treatment failure

Consider pericardiectomy

No

Consider further clinical testing for underlying etiology
Consider echocardiography, cardiac CT, or CMR

If persistent large effusion, consider pericardiectomy
Constrictive Pericarditis

5.143 Pericardial calcification is clearly seen around the left and inferior borders of the heart. This patient has a normal-sized heart, but the calcification may progress further, leading to constrictive pericarditis.
Constrictive Pericarditis

- Result of scarring and consequent loss of normal elasticity of pericardial sac
- Cardiac Filling is impaired by extrinsic or external Force. (In contrast to restrictive CM which is intrinsic)
- When severe, pericardium is virtually inelastic resulting in minimal ability to adapt to volume changes
- As a result, ventricular interdependence is greatly enhanced- greater influence of ventricles on each other

Keep this in mind when we discuss tamponade
Constrictive Pericarditis

**Normal Pericardium**: during inspiration decrease Intrathoracic pressure → inc. venous return to right Heart → increased right heart size → increased pericardial size, so left heart filling not impaired

**Constrictive Pericardium**: normal inspiratory decrease in intrathoracic pressure is not transmitted to heart chamber. Pericardium does not expand to accommodate the increase in right heart size from venous return. Reduction in LV filling. Septum shifts into LV and further impairs LV filling. Hence, stroke volume and Cardiac output are impaired
Constrictive Pericarditis - Causes

- Rarely follows Acute Pericarditis (1.8%)
  - Idiopathic or viral 42-55%
  - Post-Surgery 11-37%
  - Post-Radiation 6-31% (Hodgkin's/Breast CA)
- Connective Tissue Disorders 3-7%
- TB (less common now)
Constrictive Pericarditis- Clinical Presentation

1) **Fluid Overload**: peripheral edema to Anasarca
2) **Diminished Cardiac Output in response to exertion/exercise:**
   a) Fatigability
   b) Dyspnea on exertion (DOE)

**Physical Findings:**
1) Increased JVP (JVD)
2) Pericardial Knock
3) Pulsus Paradoxus (will discuss in Tamponade)
4) Kussmaul’s sign- inc. JVP with inspiration
Fig. 9. Example of a patient who has constrictive pericarditis. Marked circumferential thickening of the parietal pericardium (white arrows) is demonstrated on (A) breath-held, segmental cineMRI and (B) T2-weighted, double inversion-recovery black-blood imaging. (C-E) Real-time cineMRI performed during free breathing. There is flattening and inversion of the interventricular septum (yellow arrow) during early inspiration (diaphragm marked by dotted yellow line).
Figure 13  (A) Fibrinous pericarditis shows diffuse fibrin deposits over the parietal and visceral surfaces as commonly seen in the setting of uremia. (B) Fibrinohemorrhagic exudate is most commonly associated with neoplasms. (C) Fibrous pericarditis with thickening of both parietal and visceral pericardium causes constriction in a case of radiation pericarditis. Collagen deposition is evident as a thick gray continuous line over the LV myocardium. There are fibrous adhesions between the parietal pericardium, mediastinal pleura, and visceral pleura of the lung.
Constrictive Pericarditis-
work up, differential, treatment

• **Work-up:** CXR (calcifications may be present),
  TEE (ECHO)- thickness of pericardium and others
  CT/CMR/CATH

• **Differential Dx:** Restrictive Cardiomyopathy
  Tamponade (effusion)

• **Treatment:** Pericardietomy
Pericardiocentesis

5.142 Aspiration of pericardial fluid is indicated in cardiac tamponade or to obtain fluid for diagnostic purposes. A wide-bore needle is inserted in the epigastrium below the xiphoid process and advanced in the direction of the medial third of the right clavicle. If the needle is connected to the V lead of an ECG monitor, ST elevation will usually be seen if the needle touches the epicardium. This can be useful in distinguishing a bloody pericardial effusion from accidental puncture of the heart. Other complications of the procedure may include arrhythmias, vasovagal attack and pneumothorax.
Pericardial Effusion

- Build-up of fluid within pericardial space.
- As fluid increases, friction rub may disappear and heart sounds may become faint.
- CXR reveals cardiac enlargement, with “water bottle” appearance.
- EKG may show *low voltage of QRS*.
- *Echocardiogram is diagnostic test of choice.*
**Pericardial Effusion - CXR**

5.138 *Pericardial effusion*. The heart shadow appears generally enlarged, but the appearance is not diagnostic. A similar appearance can be seen in cardiac failure, in myocarditis or in dilated cardiomyopathy.
Etiology of Pericardial Effusion:

- **Acute pericarditis** (viral, bacterial, tuberculous, or idiopathic in origin) - serous or purulent

- Autoimmune disease

- Postmyocardial infarction or cardiac surgery - serous or hemorrhagic

- Sharp or blunt chest trauma, including a cardiac diagnostic or interventional procedure - hemorrhagic
Etiology of Pericardial Effusion cont;

- Malignancy, particularly metastatic spread of noncardiac primary tumors
- Mediastinal radiation
- Renal failure with uremia - serous usually
- Myxedema
- Aortic dissection extending into the pericardium - hemorrhagic
- Selected drugs
**Pericardial effusion** should be suspected in the following clinical settings:

- All cases of acute pericarditis.
- Unexplained new radiographic cardiomegaly without pulmonary congestion.
- Unexplained persistent fever with or without an obvious source of infection.
- Presence of isolated left (or left larger than right) pleural effusion.
- Fever or hemodynamic deterioration in a patient with another disease process that can involve the pericardium.
Pericardial Effusion - Analysis

- Gram stain and bacterial and fungal culture
- Cytology
- AFB stain and mycobacterial culture along with Polymerase chain reaction for virus

Parameters such as protein, LDH, glucose, red cell count, and white cell count are often sent but do not reliably distinguish exudative from transudative effusions.

Bloodwork - CBC, Chem 20, rest based on history
Grading of severity of hemodynamic compromise caused by pericardial effusion. Most pericardial effusions cause abnormalities in hemodynamic parameters as measured in the Cath lab. Some of these patients have echocardiographic findings of tamponade, while only a relative minority of these patients have overt clinical tamponade.
5.139 Malignant pericardial effusion. The heart shadow is generally enlarged, but the odd, irregular outline of the enlargement suggests the presence of secondary tumour deposits in the pericardium. This patient had a primary ovarian carcinoma.
EKG in Large Pericardial Effusion

- Low voltage
- QRS less than 0.5mV

5.140 Pericardial effusion. Large quantities of pericardial fluid produce an ECG of generally low voltage, with generalized T-wave flattening or inversion; this is partly the result of the insulating effect of the fluid, and partly because of superficial myocarditis. Note that this patient has also developed atrial fibrillation.
Pericardial Effusion- Treatment

1) If minimal or no evidence of hemodynamic compromise do not require immediate intervention for therapeutic reasons (fluid sampling for diagnostic purposes may be indicated)

2) Such patients may be treated conservatively, with careful hemodynamic monitoring, serial echocardiographic studies, avoidance of volume depletion, and therapy aimed at the underlying cause of the pericardial effusion.

3) Effusions that progressively enlarge, lead to worsening symptoms suggesting definite cardiac tamponade, or that are otherwise refractory to a conservative approach should be treated with pericardial fluid drainage.

4) In reality, since may be related to pericarditis in many cases are often treated with either NSAIDS or Steroids, and judicious diuresis.
Proposed management strategy for patients with moderate or severe pericardial effusion accompanying acute pericarditis.
Pericardial Effusion - Treatment

Chronic and recurrent effusions — Pericardial effusions may persist for extended periods and can also recur with repeated episodes of pericarditis. As in other cases of pericardial effusion, management in these settings is based upon the treatment of the underlying disorder, with percutaneous drainage of the effusion reserved for hemodynamically significant or persistently symptomatic effusions.

Pericardial Window

The pericardium being incised in the area of left pericardiophrenic recess
Pericardial Tamponade

- When pericardial fluid accumulates in an amount sufficient to cause serious obstruction to inflow of blood into the ventricles="tamponade."
  - Amount may be as little as 200 cc.

- Three most common causes are:
  - Neoplasia
  - Idiopathic pericarditis
  - Uremia – renal failure
Figure 32 M-mode echocardiogram obtained from a patient with a pericardial effusion (PEff) and cardiac tamponade. When the right ventricle (RV) enlarges with inspiration (insp), the left ventricle (LV) becomes smaller (dashed arrows). The opposite changes are seen on expiration (exp).
Pericardial effusion w/tamponade

“Electrical alternans” is sometimes a finding in effusion with tamponade. Note the alternating size of the QRS complexes:
**Beck's Triad**

Beck's triad was described by the thoracic surgeon Calude S. Beck in 1935.

*Think of the mechanism of injury*

It's components are:

1. Distended neck veins - elevated JVD
2. Distant heart sounds - muffled
3. Hypotension

Patients may exhibit: Tachycardia, Tachypnea, Anxiety, Signs of Low Cardiac Output. Orthostatic, Pulsus Paradoxus (>10mmHg) Decreased Voltage, Electrical Alternans
Paradoxical Pulse

- Also called “pulsus paradoxus”
- Defined as a greater than normal (10 mmHg) reduction in systolic BP during inspiration.
  - May be detected as reduced pulse during inspiration. Check BP during inspir & exhalation.
- Since both ventricles are w/in the confines of the reduced pericardial space, inspiration results in increased blood flow into the right ventricle, reducing space for left ventricular filling, hence temporarily reducing LV output.
Two-dimensional echocardiogram shows a moderate anterior PEff (white arrow) and large pleural effusion (red arrow). There is early RV diastolic collapse combined with tamponade physiology, as noted on M-mode (white arrowhead).
Cardiac Tamponade

These patients are sick and unstable

- ABC - Oxygen, IV Fluids, T+C, CXR/ECHO (Do not send to Radiology)
- DO NOT give pain medications, sedate or intubate
- ECHO guided Pericardiocentesis, only sedate once fluids hooked up and ready to decompress
References

References


2c) Restrictive Cardiomyopathy

Normal myocardium

Amyloid heart disease
2c) Restrictive Cardiomyopathies

- Hallmark: abnormal diastolic function
- Rigid ventricular wall with impaired diastolic ventricular filling.
- Has some functional resemblance to constrictive pericarditis.
- Importance lies in its differentiation from operable constrictive pericarditis—can’t correct it with surgery.
- The least common form of
2c) Classification

- Idiopathic
- Myocardial
  1. Noninfiltrative
     - Idiopathic
     - Scleroderma
  2. Infiltrative
     - Amyloid
     - Sarcoid
     - Gaucher disease
     - Hurler disease
- Storage Disease
  - Hemochromatosis
  - Fabry disease
  - Glycogen storage
- Endomyocardial
  - Endomyocardial fibrosis
  - Hypereosinophilic syndrome
  - Carcinoid
  - Metastatic malignancies
  - Radiation, Adriamycin
2c) Clinical Manifestations

- Symptoms of right and left heart failure
- Jugular Venous Pulse prominent
- Echo-Doppler
  - abnormal mitral inflow pattern (from LA to LV)
  - evidence of ↑ LA pressure
- Diagnosis confirmed by endomyocardial biopsy.
2c) Restriction vs. Constriction

History can provide important clues:

- Constrictive pericarditis
  - history of TB, trauma, pericarditis, collagen vascular disorders
- Restrictive cardiomyopathy
  - amyloidosis, hemochromatosis
- Mixed
  - mediastinal radiation, cardiac surgery
2c) Amyloidosis
Myeloma-associated & Primary Systemic Amyloidosis

• The most common cause of restrictive cardiomyopathy in USA is amyloidosis.
• Amyloid on myocardial biopsy could be due to primary amyloidosis, or secondary to multiple myeloma and hypergammaglobulinemia.
• > 25% have symptomatic heart failure
2c) Hemochromatosis

- Characterized by iron overload
- Clinical presentation
  - cirrhosis, diabetes, hyperpigmentation, cardiac dysfunction
  - congestive heart failure is the leading cause of death, with transition from restrictive disease to dilated cardiomyopathy
- Treatment
  - phlebotomy, chelation therapy
  - cardiac function may normalize
2c) Treatment of Restrictive CM

- No satisfactory medical therapy
- Drug therapy must be used with caution
  - diuretics for extremely high filling pressures
  - vasodilators may decrease filling pressure
  - ? Calcium channel blockers to improve diastolic compliance
  - digitalis and other inotropic agents are not indicated
PEff characteristics on CT. Computed tomographic images demonstrate characteristic attenuation changes of Pffs (white asterisks) (relative to contrast-enhanced myocardium [black asterisks]) for transudative fluid (lower), exudative fluid (slightly lower), and bloody effusions/hematoma (equal), which are inherently higher attenuating than non-contrast-enhanced blood (open circle).