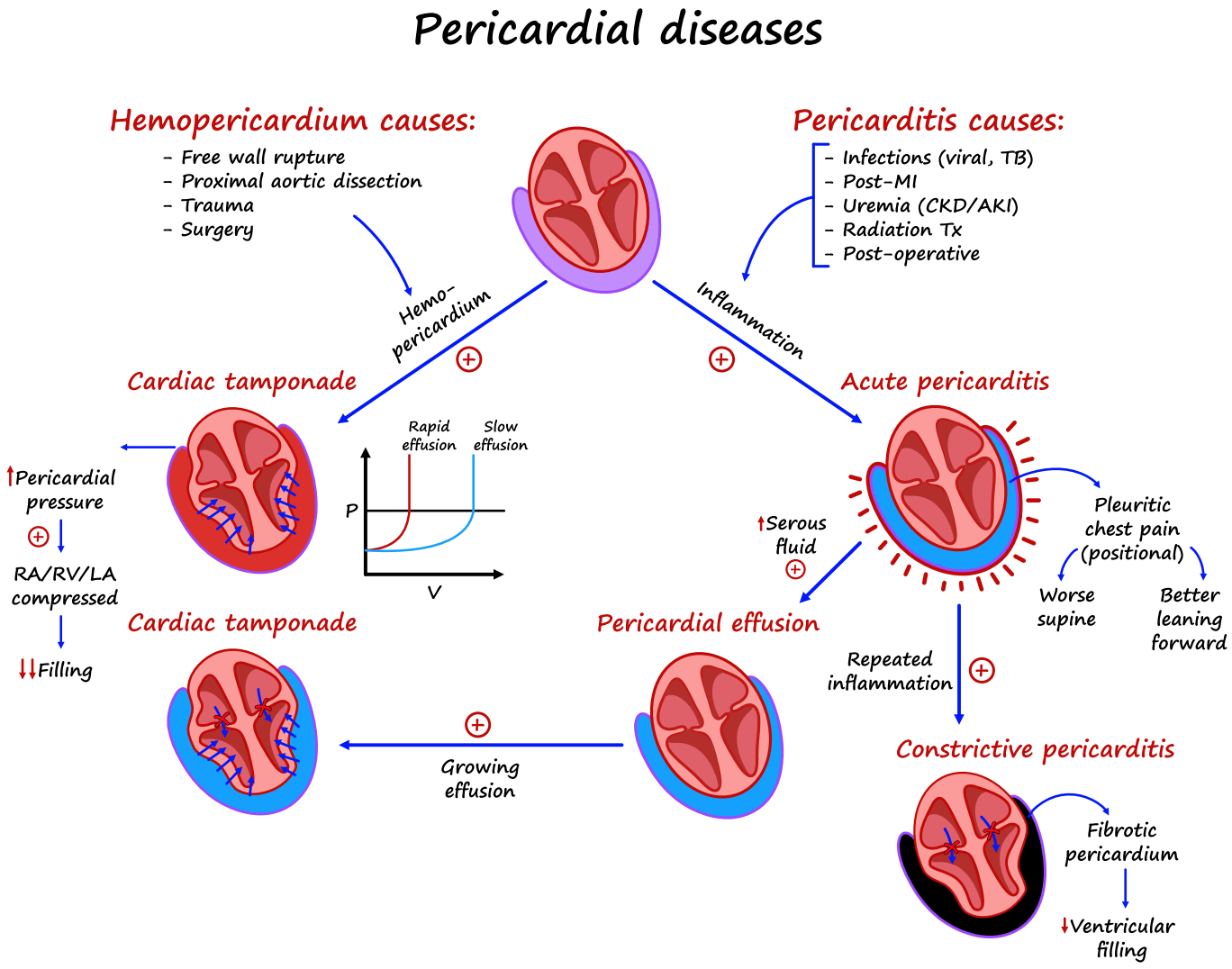
Last edited: 3/9/2024

PERICARDIAL DISEASES

00:42

I. PATHOPHYSIOLOGY



A. Acute Pericarditis 00:42

- **Pathophysiology:**
  - Inflammation of the pericardium

1. Causes:

a) Idiopathic

- Most commonly → **Viral Etiology**

b) Infections

- Viral infections such as the **Coxsackie B virus**
- Bacterial infections such as **Tuberculosis**, especially in immunocompromised patients

c) Post-MI

- STEMI and NSTEMI can create a local inflammation spreading to the nearby pericardium
  - **Fibrinous pericarditis**: occurs 1-3 days post-MI
  - **Dressler Syndrome**: occurs > 14 days post-MI

d) Uremia

- For patients with ESRD or AKI → ↑↑BUN and Creatinine → **Uremic Pericarditis**

e) Radiation Therapy

- **Chest Radiation** in patients with chest related malignancy

f) Post-Operative

- **Post-Pericardiotomy Syndrome**
  - Related to cardiac surgery or procedures (CABG, valve replacement)

B. Pericardial Effusion 05:55

- **Pathophysiology:**
  - Inflammation of the pericardium → ↑Serous fluid production in the pericardial cavity → **Pericardial Effusion**
- **Clinical Presentation:**
  - Pleuritic chest pain similar to Acute Pericarditis

C. Constrictive Pericarditis 06:45

- **Pathophysiology:**
  - Repeated inflammation → ↑Fibrosis of pericardium → Rigid pericardium → **↓Ventricular Filling**

Causes:

a) Tuberculosis

- Chronic infection → Chronic inflammation → Fibrosis

b) Radiation Therapy

- Repeated radiation therapy → Repeated inflammation → Fibrosis of the pericardium

D. Cardiac Tamponade 09:16

1. Slow Effusion Leading to ↑ Pericardial Pressure

- **Pathophysiology of a slow-developing Effusion:**
  - Gradually enlarging pericardial effusion → **Provides time to stretch and accommodate** → Stretch limit is reached → Pericardial pressure slowly rises → **Impairs RA and RV filling** → ↓Cardiac Output
- **Causes of slow-developing Effusion:**
  - Any cause of Acute Pericarditis → **Serous Pericarditis**

2. Rapid Effusion Leading to ↑ Pericardial Pressure

- **Pathophysiology of a rapidly-developing Effusion:**
  - Rapidly enlarging pericardial effusion → **NO time to stretch and accommodate** → Stretch limit is reached quickly → Pericardial pressure quickly rises → **Impairs RA and RV filling** → ↓Cardiac Output
- **Causes of rapidly-developing Effusion:**
  - **Hemopericardium**

Causes of Hemopericardium:

Free Wall Rupture

- **Pathophysiology:**
  - LAD occlusion → LV free wall infarct → LV free wall weakening → LV free wall rupture → Hemopericardium → Tamponade

Proximal Aortic Dissection (Stanford A)

- **Pathophysiology:**
  - Aortic root dissection → Blood travels across externa and extends into pericardium → Hemopericardium → Tamponade

Trauma or Cardiac Surgery

- LV trauma or penetrating injury → Loss of wall integrity → Hemopericardium → Tamponade

14:56

II. COMPLICATIONS

A. Acute Pericarditis

1. Classic Findings

a) Pleuritic Chest Pain

- **Pleuritic** and **positional** chest pain
  - **Worse upon inspiration**
    - Inhalation → Lungs expand → Compress the pericardium
  - **Worse when supine**
    - Supine → Diaphragm moves upward → compressing heart inferiorly
  - **Better when leaning forward**
    - leaning forward → Diaphragm moves downward → Doesn't compress the heart inferiorly

b) Friction Rub

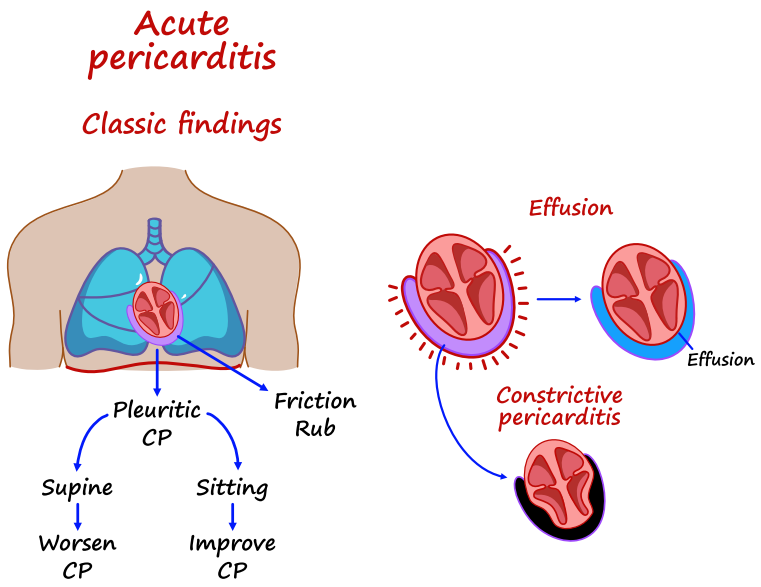
- Upon auscultation, a **friction rub** may be heard
  - This indicates the inflamed layers of the pericardium rubbing together

2. Pericardial Effusion

- **Pathophysiology:**
  - Inflammation of the pericardium → ↑Serous fluid production in the pericardial cavity → **Pericardial Effusion**
- **Clinical Presentation:**
  - Pleuritic chest pain similar to Acute Pericarditis

3. Constrictive Pericarditis

- **Pathophysiology:**
  - Repeated inflammation → ↑Fibrosis of pericardium → Rigid pericardium → **↓Ventricular Filling**
- **Clinical Presentation:**
  - Right Heart Failure Findings:
    - Kussmaul's sign
    - Pericardial Knock



B. Constrictive Pericarditis

18:14

1. Right Heart Failure (RHF)

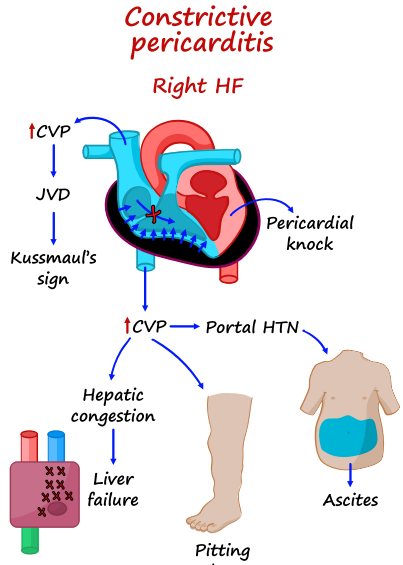
- **Pathophysiology:**
  - Repeated inflammation → ↑Fibrosis of pericardium → Rigid pericardium → **↓RV filling** → ↑CVP → IVC and SVC backflow
- **Clinical Presentation of RHF:**
  - Jugular venous distention related to SVC backflow
  - Hepatomegaly related to IVC backflow
  - Ascites related to IVC backflow
  - Pitting edema related to IVC backflow

Kussmaul's sign:

- **Mechanism of Kussmaul's Sign:**
  - Normal physiology:
    - During inspiration → ↑Intrathoracic pressure develops → ↑Venous return to the heart
  - **Constrictive Pericarditis** Pathophysiology:
    - Fibrotic pericardium → ↓Filling of the right heart during inspiration → **Paradoxical increase in JVD due to ↓filling**

2. Pericardial Knock

- **Mechanism of Pericardial Knock:**
  - Abrupt halt in ventricular filling due to the inability of fibrotic pericardium to accommodate stretching → Produces an abnormal heart sound referred to as **pericardial knock**



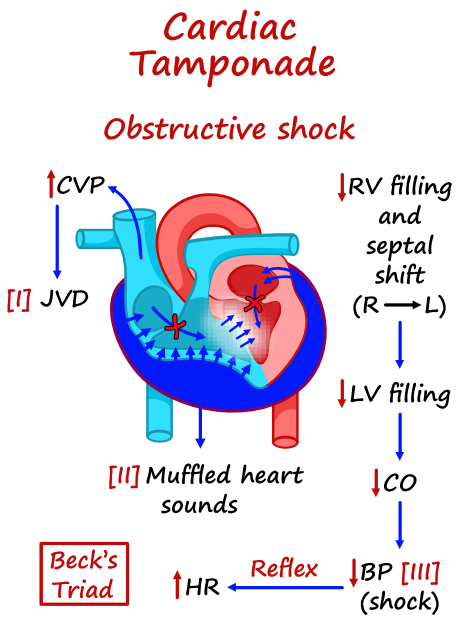
C. Cardiac Tamponade

22:30

1. Obstructive Shock

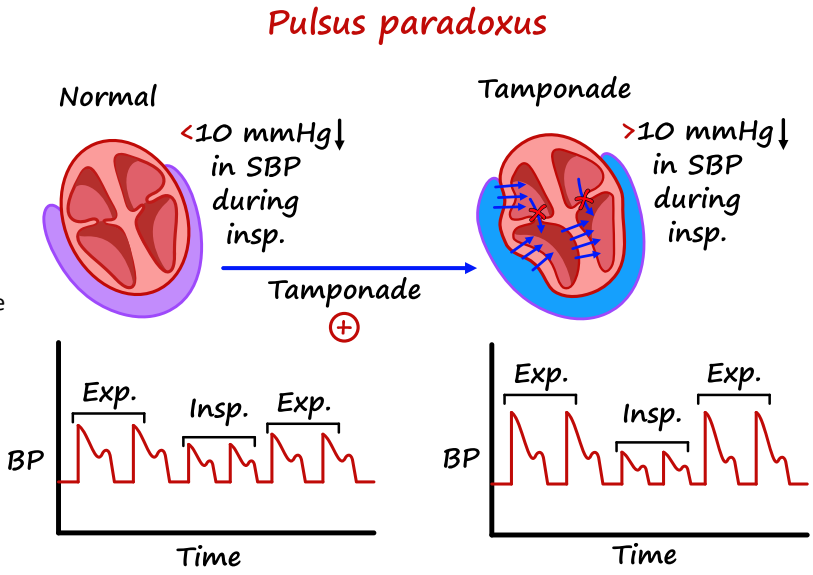
- **Pathophysiology:**
  - ↑Pericardial pressure → ↑Right heart compression (RV and RA)→ ↓RV filling →↓Preload and ↑RV pressures → ↓RV Preload leading to ↓LV filling → ↑RV pressures **trigger septal shifting** towards the LV → Both factors ↓LV filling → ↓LV stroke volume and ↓Cardiac Output → ↓Blood Pressure (**Hypotension**) → **Shock**
- **Clinical Presentation of Obstructive shock due to tamponade**
  - Hypotension and compensatory tachycardia (shock)
  - Jugular venous distention related to ↓RV filling
  - Muffled heart sounds related to effusion blocking heart sounds

Beck's Triad: Classic for cardiac tamponade
- Jugular Venous Distention (JVD)
- Muffled Heart Sounds
- Hypotension (shock in some cases)



2. Pulsus Paradoxus

- **Mechanism of Pulsus Paradoxus:**
  - **Normal physiology:**
    - During inspiration → ↑Intrathoracic pressure develops → ↑Venous return to the heart → Minimal septal shifting → Minimal ↓LV filling → **Minimal ↓LV CO**
      → **Minimal ↓SBP during inspiration (< 10 mmHg drop)**
  - **Cardiac Tamponade Pathophysiology:**
    - During inspiration → ↑Intrathoracic pressure develops → ↑Venous return to the heart → ↑Pericardial pressures due to Cardiac Tamponade → ↑RV pressures from impaired RV filling → Triggers significant septal shifting → Severe ↓LV filling → **Severe ↓LV CO**
      → **Severe ↓SBP during inspiration (> 10 mmHg drop)**



30:28

III. DIAGNOSTIC APPROACH

TABLE 1. DIAGNOSTIC APPROACHES TO DIFFERENT PERICARDIAL DISEASES.

Pericardial Disease	Clinical Presentation	ECG	Echocardiogram	Additional Studies/comments
Acute Pericarditis	▪ Pleuritic Chest pain ▪ Friction rub	▪ Diffuse ST elevation and ▪ PR-segment Depression	▪ Possible Pericardial Effusion	▪ ≥ 2/4 findings suggests pericarditis
Constrictive Pericarditis	▪ Right Heart Failure ▪ Kussmaul's Sign ▪ Pericardial Knock	▪ Low voltage QRS	▪ Thick pericardium ▪ Septal bounce ▪ Abrupt ↓ in Ventricular filling	▪ Cardiac CT/MRI and Cath (differentiates between RCM)
Pericardial Effusion	▪ Muffled Heart sounds ▪ No Becks Triad or Pulsus Paradoxus	▪ Low voltage QRS ▪ Electrical alternans	▪ Pericardial Effusion	
Cardiac Tamponade	▪ Becks Triad ▪ Pulsus Paradoxus	▪ Low voltage QRS ▪ Electrical alternans	▪ Pericardial Effusion ▪ Chamber collapse during diastole	

A. ACUTE PERICARDITIS

31:44

1. ECG

- **Findings Suggestive of Acute Pericarditis:**
  - o Diffuse ST elevation with a concave appearance
  - o PR-segment depression

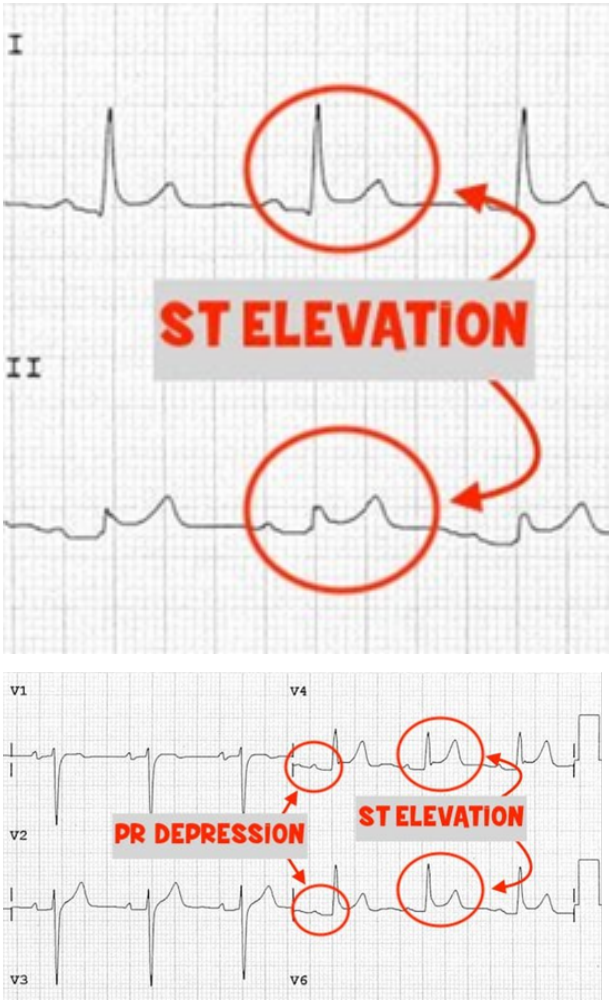


FIGURE 1. ECG FINDINGS IN ACUTE PERICARDITIS INCLUDE DIFFUSE ST ELEVATION AND PR-SEGMENT DEPRESSION.

2. Echocardiogram

- **Findings Suggestive of Acute Pericarditis**
  - o Assess for a pericardial effusion evident on echocardiogram
    - → Can assist in the diagnosis of Acute Pericarditis

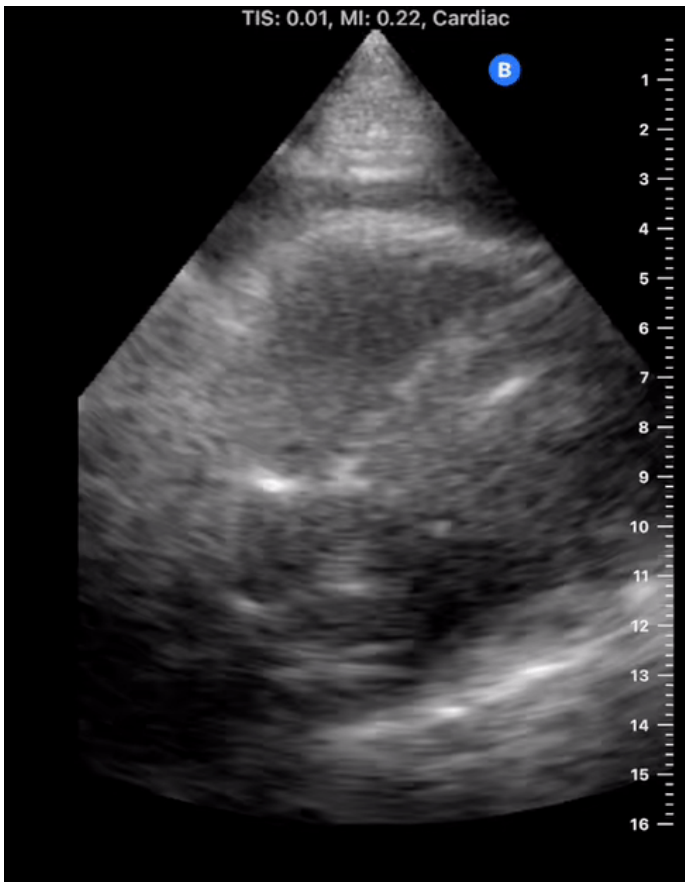


FIGURE 2. ECHOCARDIOGRAPHY OF PERICARDIAL EFFUSION SECONDARY TO ACUTE PERICARDITIS.

B. Constrictive Pericarditis

31:44

1. ECG

- **Findings Suggestive of Constrictive Pericarditis:**
  - Low voltage QRS

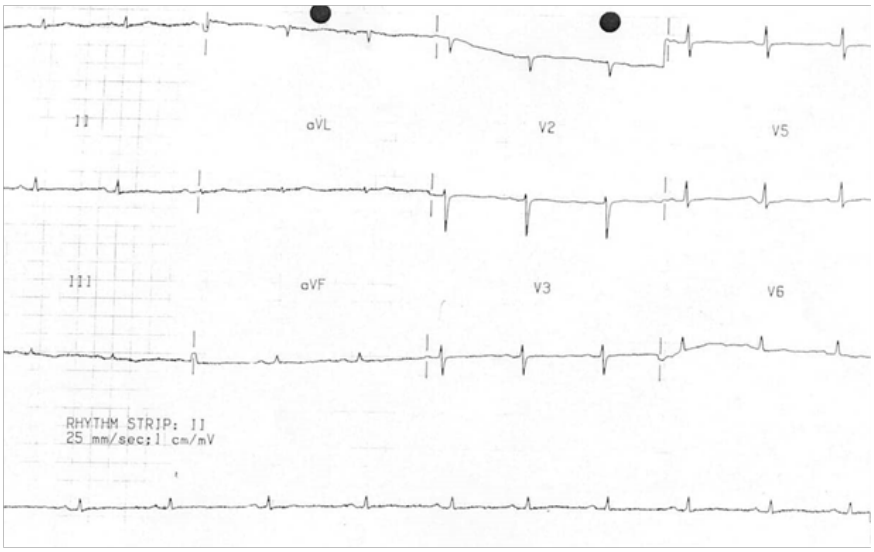


Figure 3. ECG depicting Low Voltage QRS Complexes.

2. Echocardiogram

- **Findings Suggestive of Constrictive Pericarditis:**
  - Thick pericardium
  - Septal bounce
  - Abrupt ↓ in RV ventricular filling during inspiration

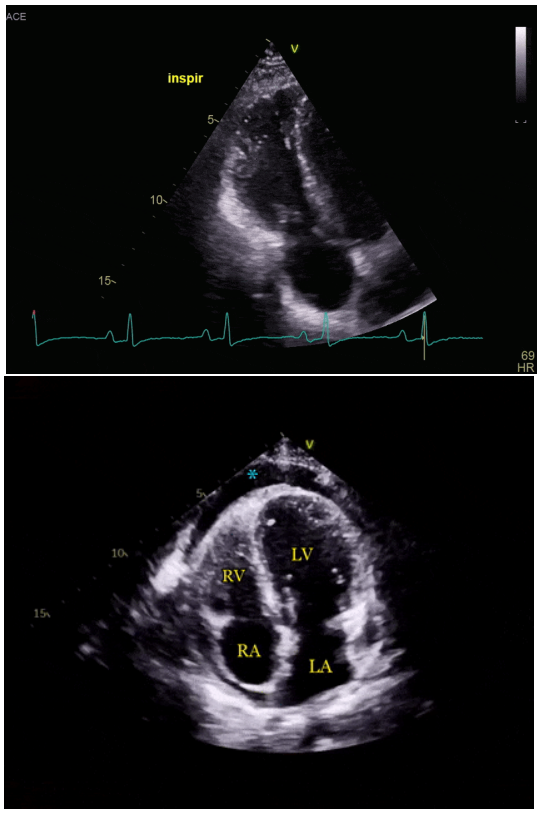


Figure 4. Echocardiography in patients with constrictive pericarditis.

3. Cardiac CT or MRI

- **Findings suggestive of Constrictive Pericarditis:**
  - Thickened and fibrotic pericardium

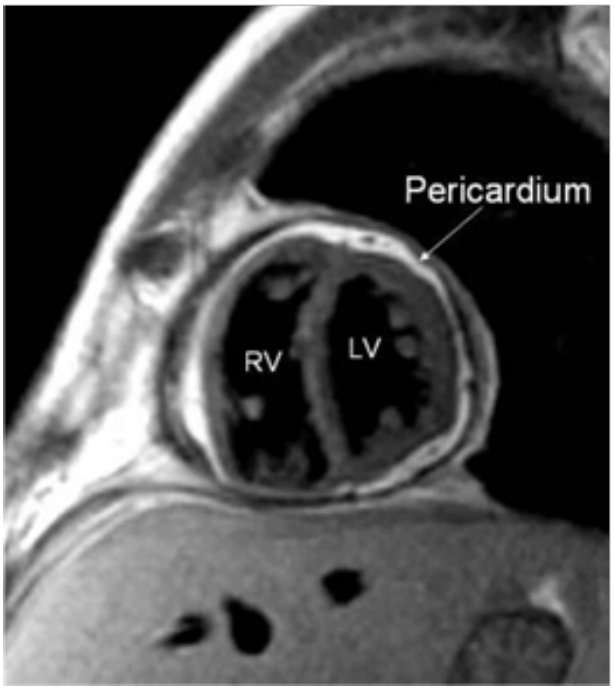


Figure 5. Thickened pericardium as evidenced in Cardiac MRI of a patient with constrictive pericarditis.

C. Pericardial Effusion

32:40

1. ECG

- **Findings suggestive of pericardial effusion:**
  - Low voltage QRS
  - Electrical alternans
    - Pericardial effusion → Apex of heart oscillates in pericardial fluid → Alterations in the amplitude of QRS complexes with oscillations of apex movement during the cardiac cycle

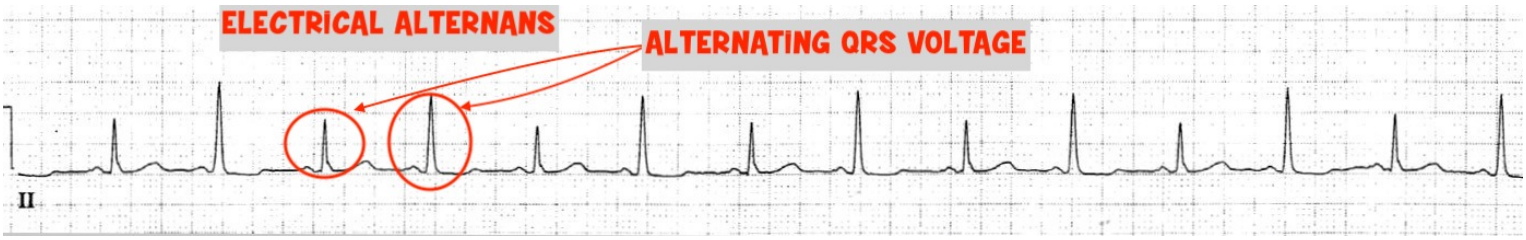


Figure 6.3 ELECTRICAL ALTERNANS & ALTERNATING QRS VOLTAGES

2. Echocardiogram

- **Findings suggestive of pericardial effusion**
  - Fluid in the pericardial cavity

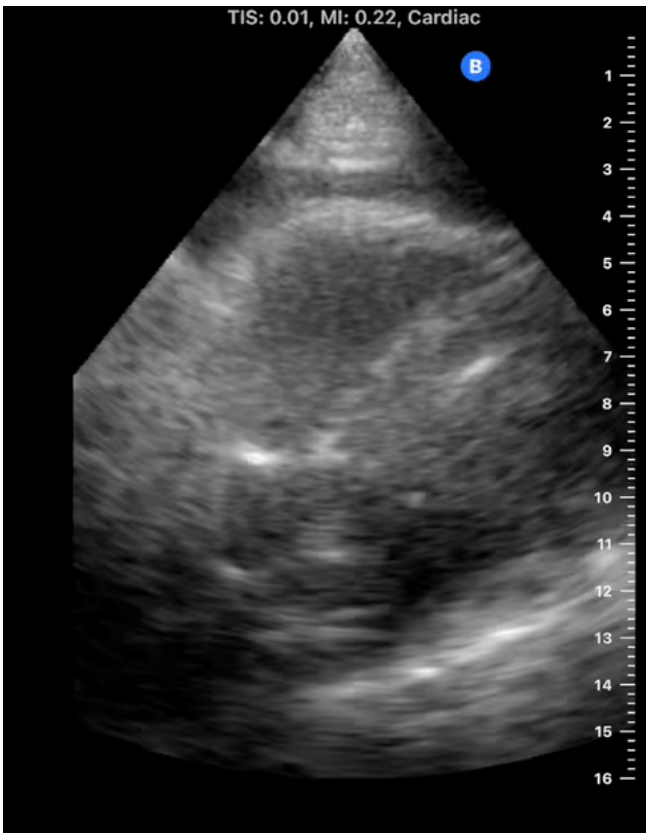


Figure 74. Pleural Effusion on Echocardiogram.

D. Cardiac Tamponade

33:25

1. ECG

- **Findings suggestive of cardiac tamponade:**
  - Low voltage QRS
  - Electrical alternans
    - Pericardial effusion

2. Echocardiogram

- **Findings suggestive of cardiac tamponade:**
  - Pericardial effusion
  - **RA and RV Chamber collapse** during diastole

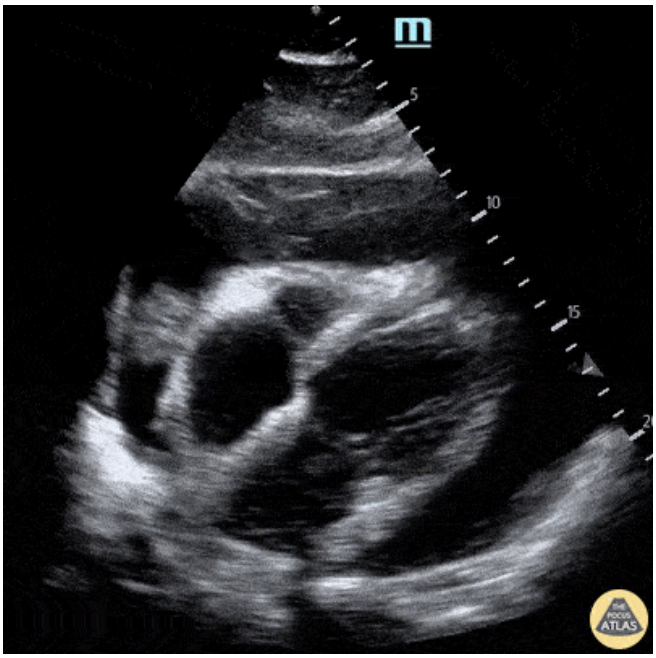


Figure 85. Echo findings of cardiac tamponade show chamber collapse.

IV. CONSTRICTIVE PERICARDITIS VS RESTRICTIVE CM

TABLE 2. SUMMARY OF CONSTRICTIVE PERICARDITIS AND RESTRICTIVE CARDIOMYOPATHY.

	Constrictive Pericarditis	Restrictive Cardiomyopathy
Physical Exam	▪ Kussmaul's Sign ▪ Pericardial Knock	▪ Kussmaul's sign
Echocardiogram	▪ Thick pericardium ▪ Septal Bounce ▪ Abrupt ↓ in Ventricular filling	▪ Biatrial enlargement ▪ Diastolic dysfunction
Cardiac CT/MRI	▪ Thick pericardium	▪ Normal pericardium
Cardiac Catheterization	▪ Discordance of EDP	▪ Concordance of EDP

1. Cardiac Catheterization

- **Constrictive Pericarditis**
  - Fibrotic pericardium → Myocardial septum is normal → When inspiration is triggered during ventricular filling the septum **CAN** shift **allowing discordance of LVEDP and RVEDP**
- **Restrictive Cardiomyopathy**
  - Normal pericardium → Myocardial septum is rigid → When inspiration is triggered during ventricular filling the septum is **UNABLE** to shift allowing a **concordance of LVEDP + RVEDP**

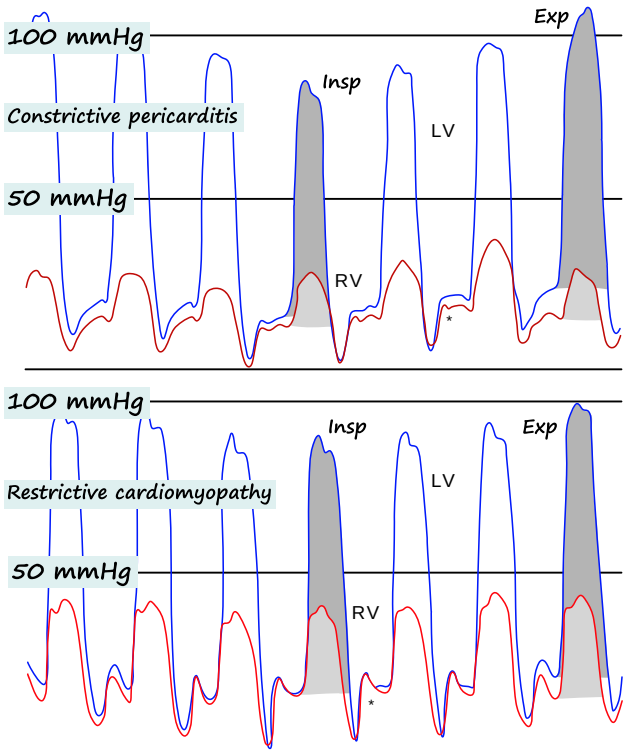


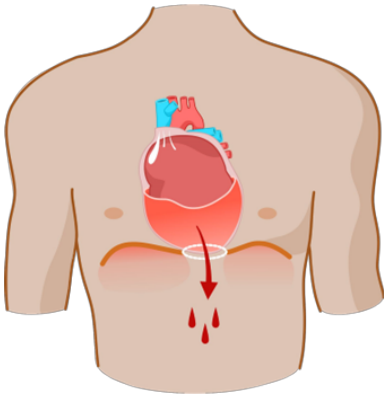
FIGURE 9.6 INTERPRETATION OF CARDIAC CATHETERIZATION FINDINGS.

35:05

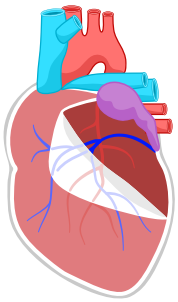
V. TREATMENT

TABLE 3. SUMMARY OF TREATMENT IN PERICARDIAL DISEASES.

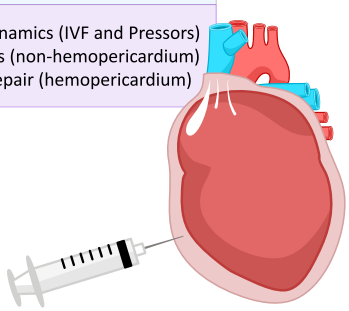
Pericardial Disease	Treatment
Acute Pericarditis	▪ NSAIDS + Colchicine (Viral) ▪ ASA + Colchicine (Post MI) ▪ Dialysis (Uremia)
Constrictive Pericarditis	▪ Pericardiectomy
Pericardial Effusion	▪ Observation (serial TTE) ▪ Pericardial window (if recurrent effusions)
Cardiac Tamponade	▪ Stabilize Hemodynamics (IVF and Pressors) ▪ Pericardiocentesis (non-hemopericardium) ▪ Surgical drain + repair (hemopericardium)



Pericardial window



Pericardiectomy



Pericardiocentesis

A. Acute Pericarditis

Treatment of Underlying Cause

- Treatment of pain
  - **Viral:** NSAIDs + Colchicine
    - NSAIDS: ↓Inflammation acutely
    - Colchicine Helps with recurrence prevention
  - **Post-MI:** ASA + colchicine
  - **Uremia:** **Dialysis**

B. Constrictive Pericarditis

Pericardiectomy

- Indications:
  - Constrictive pericarditis is **refractory** to medical management

C. Pericardial Effusion

- Asymptomatic Pericardial Effusions:
  - Observation through serial transthoracic echocardiogram (TTE)
- Progressively Enlarging Pericardial Effusion (Malignant in origin)
  - **Pericardial window**

D. Cardiac Tamponade

1. Stabilize the Blood Pressure

- **IV Fluids** (↑Preload) and **Vasopressors** (↑SVR)
- **Goal:** MAP > 65mmHg

2. Pericardiocentesis

- Indications:
  - Cardiac tamponade with Hemodynamic Instability
- Diagnostic and Therapeutic Utility of Pericardiocentesis:
  - Treats cardiac tamponade → If hemodynamics drastically improves → This supports **cardiac tamponade as the cause of HD instability**
  - Hemopericardium → Pericardiocentesis is likely not sufficient and will require surgical repair to prevent reaccumulation

3. Surgical Drain + Repair

- Indications:
  - **Hemopericardium**
    - Related to a free wall rupture, Stanford A, Aortic Dissection, or complication of cardiac surgery/trauma