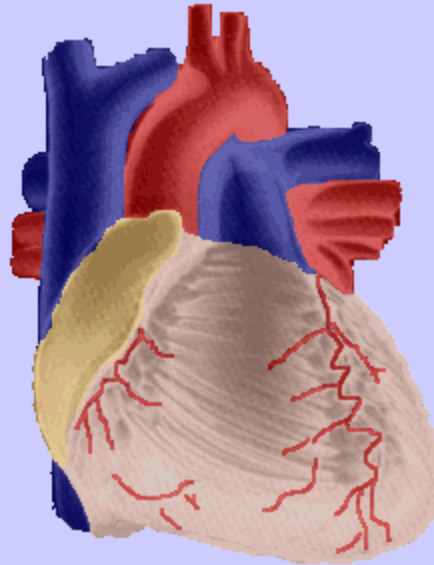


# Pericardial Diseases



Dr. Muriithi Nyamu



# Diseases of the Pericardium

- Acute Pericarditis
- Pericardial Effusion
- Constrictive Pericarditis

# **Acute Pericarditis**

# Acute Pericarditis

## *common causes*

### Outpatient setting

- usually idiopathic
- probably due to viral infections
- Coxsackie A and B (highly cardiotropic) are the most common viral cause of pericarditis and myocarditis
- Others viruses: mumps, varicella-zoster, influenza, Epstein-Barr, HIV

# Diseases of the Pericardium

## Acute Pericarditis

### – Primary:

- Usually due to viral infection Course brief and usually uncomplicated

### – Secondary

- Result from other conditions: rheumatic or collagen diseases, radiotherapy or renal failure related, often exhibit clinical feature, similar to acute pericarditis

# Acute Pericarditis

## *common causes*

### In-patient setting

T = Trauma, TUMOR

U = Uremia

M = Myocardial infarction (acute, post)

Medications (hydralazine, procainamide)

O = Other infections (bacterial, fungal, TB)

R = Rheumatoid, autoimmune disorder, Radiation

# Special Etiologic Forms of acute Pericarditis and Pericardial Effusion

- Renal failure and dialysis: more extensive dialysis and NSAID is usually successful occasionally pericardocentesis necessary
  - unexpected drop of B.P during dialysis may be the clue
- Radiation induced pericardial effusion:
  - After radiation to the mediastinum
  - May evolve into constrictive Pericarditis after many years
- Neoplastic pericardial effusion
  - Accounts for 50% of patient with tamponade
  - Lung, Breast cancers accounts for majority of causes, lymphomas and leukemia also important causes
- Purulent Pericarditis: usually requires surgical draining
- Drug induced Pericarditis: Procainamide, Minoxidil, Methysergide
- Post Cardiotomy Syndrome

# Acute Pericarditis

## *Diagnostic Clues*

- History
  - sudden onset of anterior chest pain that is pleuritic and substernal
- Physical exam
  - presence of two- or three-component rub
- ECG
  - most important laboratory clue



# Acute Pericarditis

## *Differential Diagnosis*

- Acute myocardial infarction
- Pulmonary embolism
- Pneumonia
- Aortic dissection

# Acute Pericarditis

## *Chest Pain History*

### *pericarditis vs infarction*

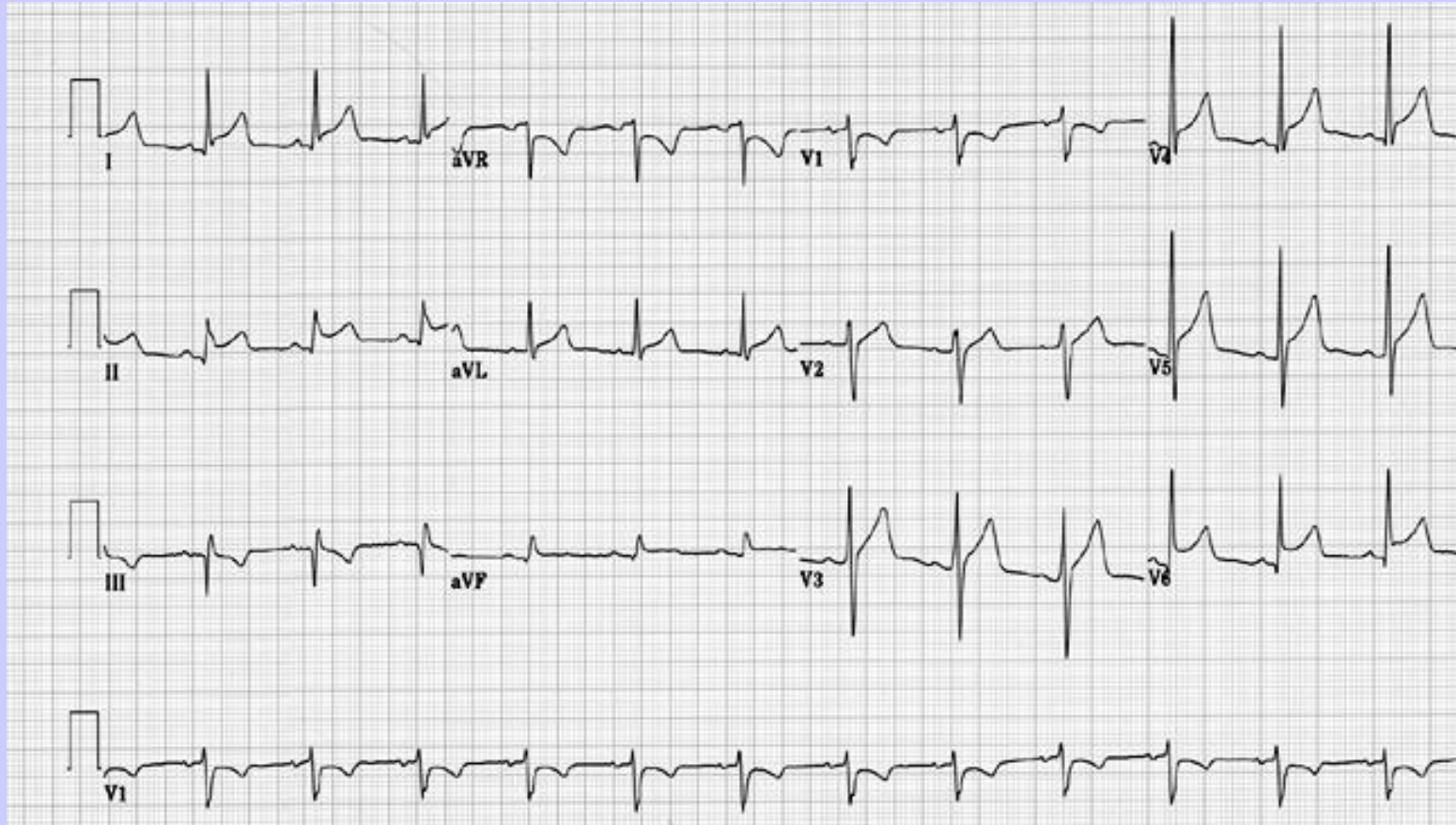
- Common characteristics
  - retrosternal or precordial with radiation to the neck, back, left shoulder or arm
- Special characteristics (pericarditis)
  - more likely to be sharp and pleuritic
  - ↑ with coughing, inspiration, swallowing
  - worse by lying supine, relieved by sitting and leaning forward

# Acute Pericarditis

## *Heart Murmurs of Pericarditis*

- Pericardial friction rub is pathognomonic for pericarditis
- scratching or grating sound
- Classically three components:
  - presystolic rub during atrial filling
  - ventricular systolic rub (loudest)
  - ventricular diastolic rub (after A2P2)

# Acute Pericarditis

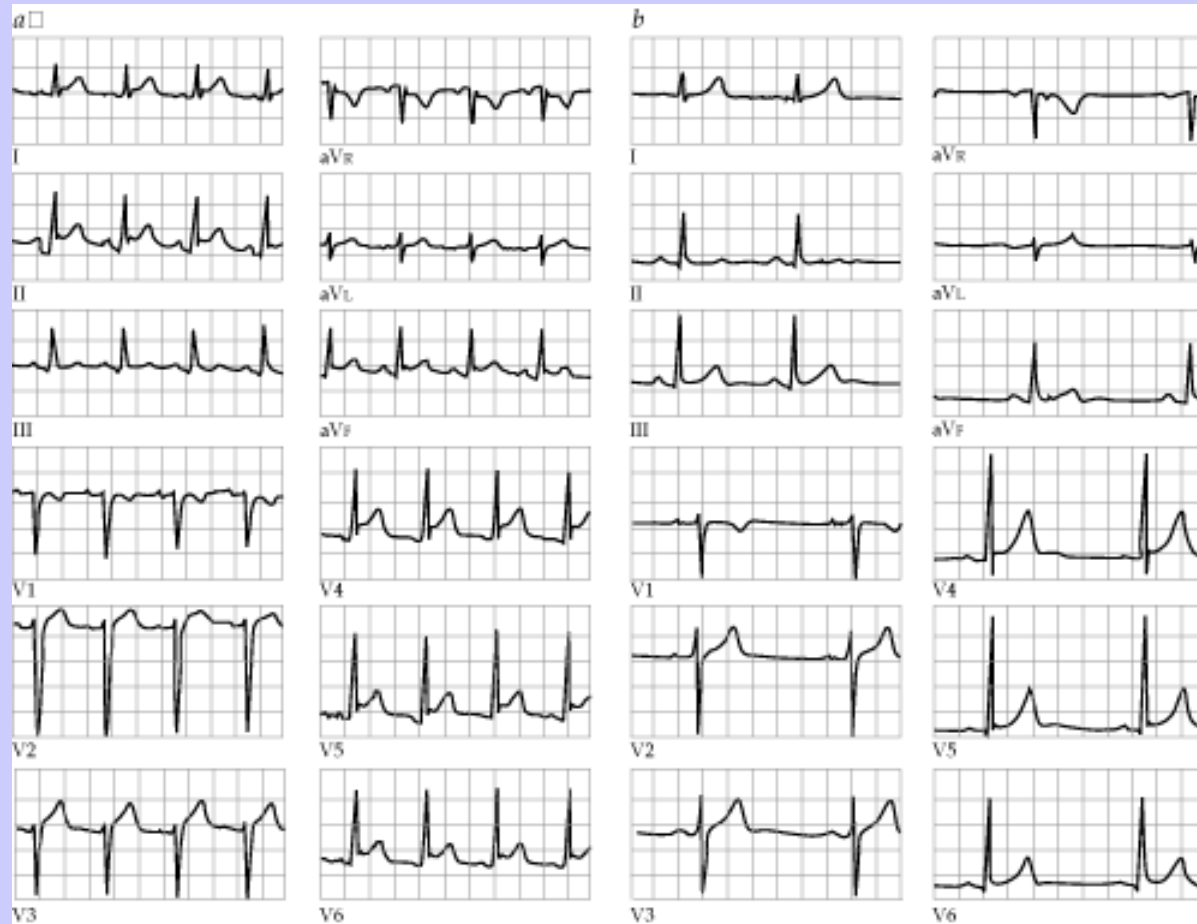


**ECG in stage 1 of pericarditis shows PR segment depression and ST elevations.**

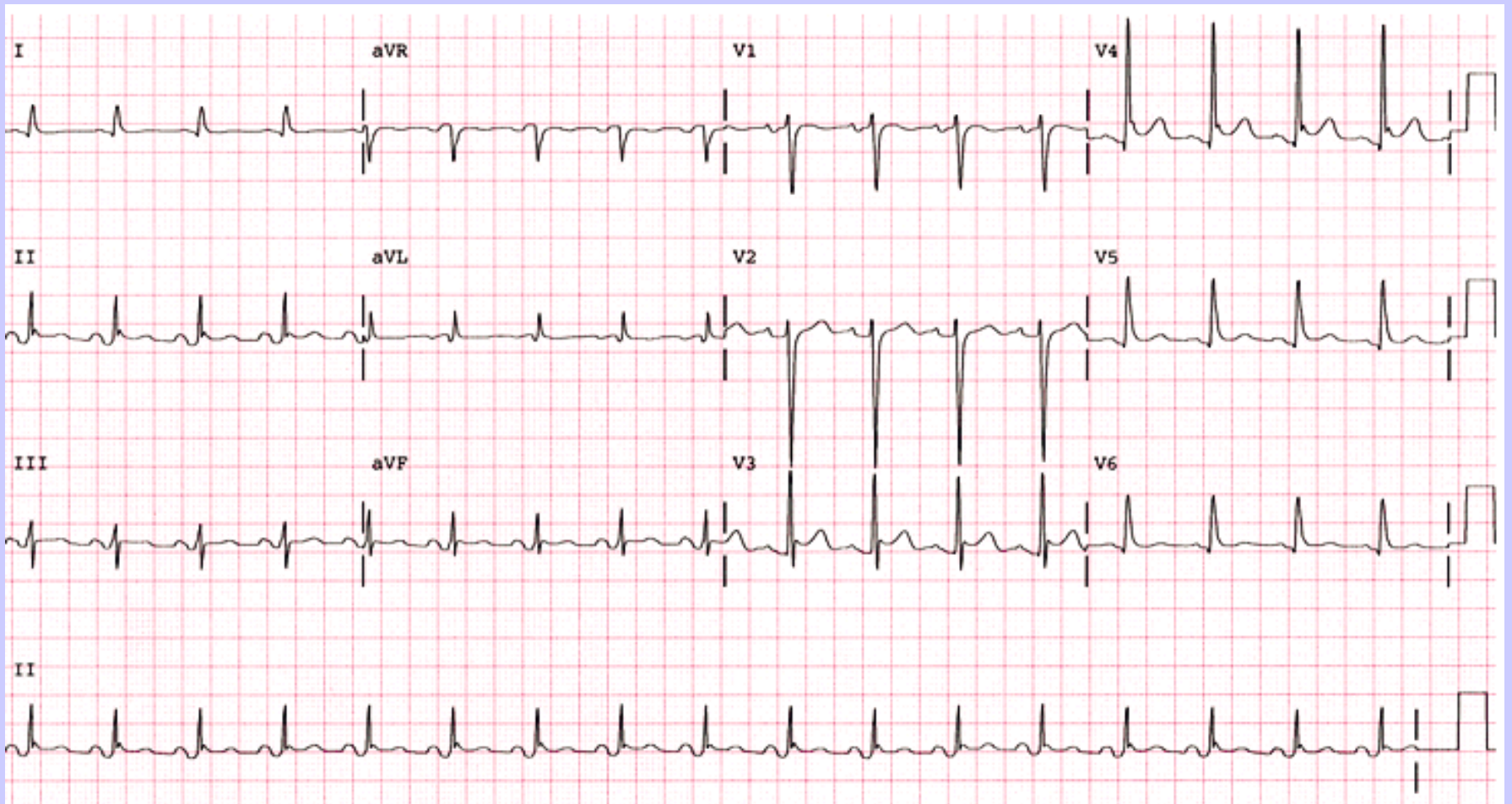
## Stages of ECG Evolution in Acute Pericarditis

Stage	PR segments	ST segments	T waves
1	Depressed	Elevated	Upright
2	Isoelectric	Isoelectric	Flat
3	Isoelectric	Isoelectric	Inverted
4	Isoelectric	Isoelectric	Upright

# ECG in Acute Pericarditis



**EKG contrast the pattern of ST segment elevation characteristic of acute pericarditis (*a*) with the normal variant (early repolarization) pattern of ST segment elevation (*b*). The normal variant pattern is associated with a normal or slow heart rate and has relatively tall R waves and T waves in V4, V5, and V6. The ST segment elevation is less than 25% of the T wave amplitude. In contrast, the acute pericarditis has PR depression and lower T wave.**



# Acute Pericarditis

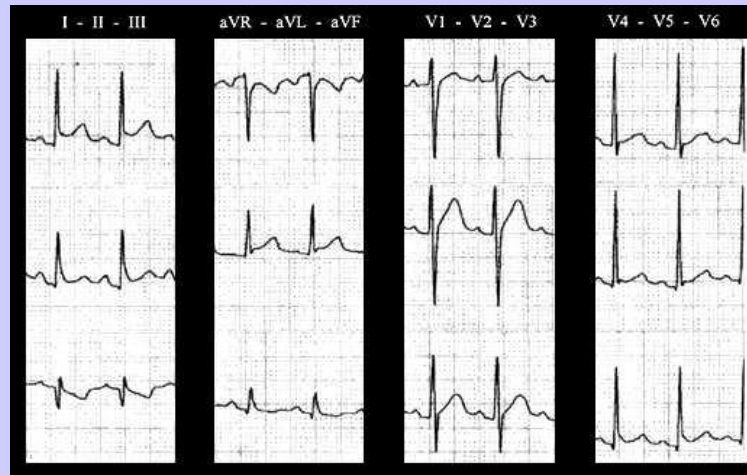
## ECG features

- **ST-segment elevation**
  - reflecting epicardial inflammation
  - leads I, II, aVL, and V3-V6
  - lead aVR usually shows ST depression
- **ST concave upward**
  - ST in AMI concave downward like a “dome”
- **PR segment depression**
  - early stage
- **T-wave inversion**
  - occurs after the ST returns to baseline

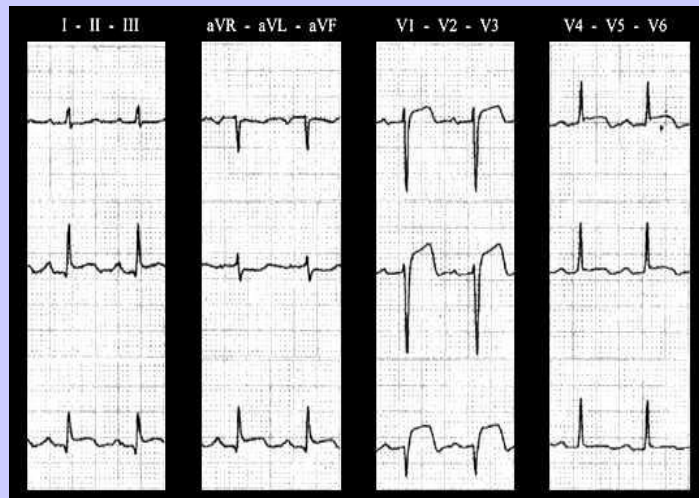




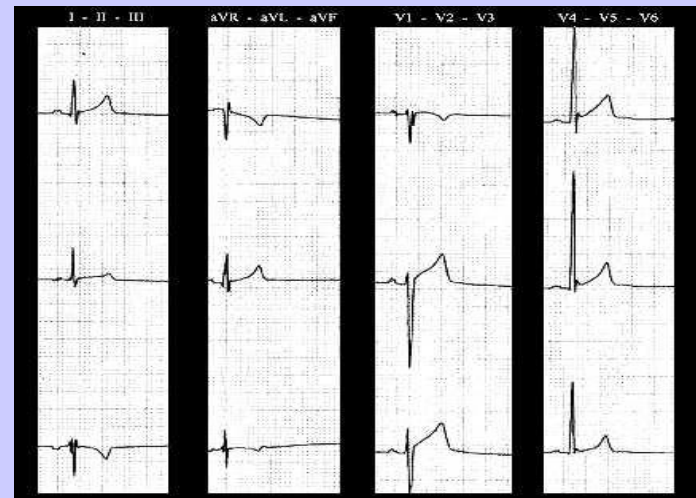
# Pericarditis



# Acute apical infarction



# Early Repolarization



# Acute Pericarditis

## Management

- Analgesic agents
  - codeine 15-30 mg q 4-6 hr
- Anti-inflammatory agents
- Treat underlying cause
  - ASA 648 mg q 3-4 hrs
  - NSAID (indomethacin 25-50 mg qid)
  - Corticosteroids are symptomatically effective ,  
but preferably avoided

# Acute Pericarditis

- *Diagnosis*

- Chest pain
- Friction rub, fever, Tachycardia
- EKG changes are common (diffuse ST-T changes with absence of reciprocal ST depression when ST elevation is present, depressed PR segment)
- Mild elevation of cardiac enzymes

- *Treatment*

- Analgesics – codeine, hydrocodone
- NSAID – Indomethacin (100 mg/d)
- Corticosteroids – (40 – 60 mg/d) , slow tapering (2 – 4 weeks) due to possible recurrence after steroid withdrawal

# Other forms of Acute Pericarditis

- *Relapsing Pericarditis*
  - Acute Pericarditis of any etiology may relapse
  - Treatment: Colchicine, Prednisone or immunosuppressants
- Progression to constriction
  - Rarely acute pericarditis progresses to subacute / chronic

# Other Forms of Pericarditis

## Dressler's Syndrome

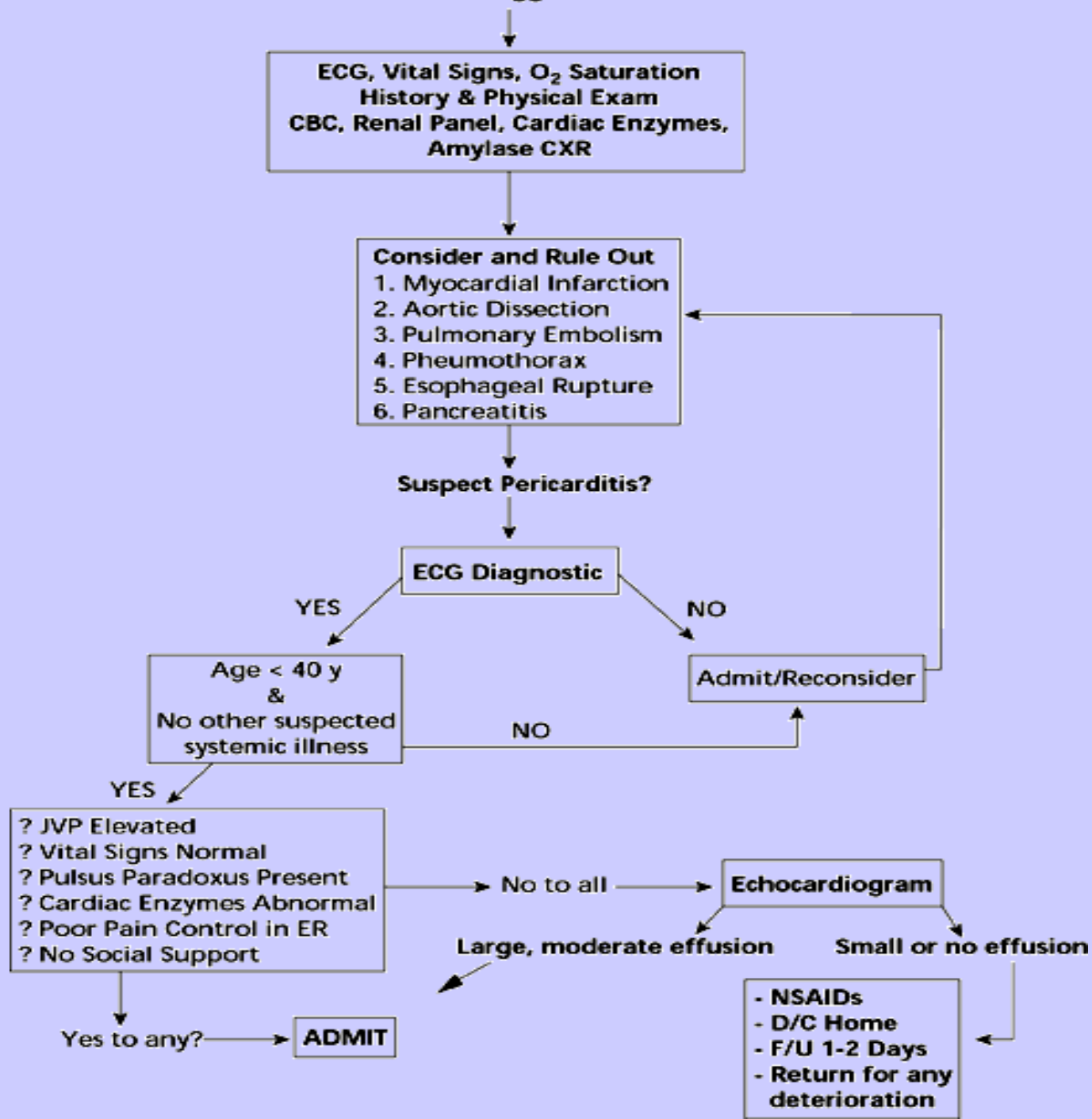
- Described by Dressler in 1956
- fever, pericarditis, pleuritis  
(typically with a low grade fever and a pericardial friction rub)
- occurs in the first few days to several weeks following MI or heart surgery
- incidence of 6-25%
- treat with high-dose aspirin

# Other Forms of Pericarditis

## *Bacterial Pericarditis*

- Rare condition in antibiotic era (steadily decreased over last 40 years)
- Typically arises from contiguous spread of intrathoracic infection (pneumonia, empyema, mediastinitis, endocarditis, trauma, surgery)
- Usually fatal without adequate treatment
- Diagnosis frequently missed
- Often lacks characteristic features of acute pericarditis

# Chest Pain That Suggests Pericarditis



# Acute Pericarditis

## *Key Points*

- Acute pericarditis is accompanied by pericardial effusion in 60% of cases and tamponade in as many as 15% of cases.
- Outpatient management of acute idiopathic pericarditis is acceptable if there is no effusion at predischARGE echocardiography and surveillance can be provided at home.
- In the care of patients in clinically stable condition who are being hospitalized, echocardiography should be performed in the first 24 hours because a large effusion is the best predictor of poor outcome



# **Pericardial Effusion and Cardiac Tamponade**

# Pericardial Effusion and Cardiac Tamponade

- Fluid can accumulate in the pericardium in any form of pericardial disease
  - Transudate
  - Exudate
- **Serosanguineous**: Idiopathic, dialysis-related, neoplastic, radiation induced, TB, coagulopathies
- **Bloody**: Coagulopathies, trauma, rupture in MI and in aortic dissection
- **Cardiac Tamponade** is the most important complication of fluid accumulation

# Cardiac Tamponade

## *pathophysiology*

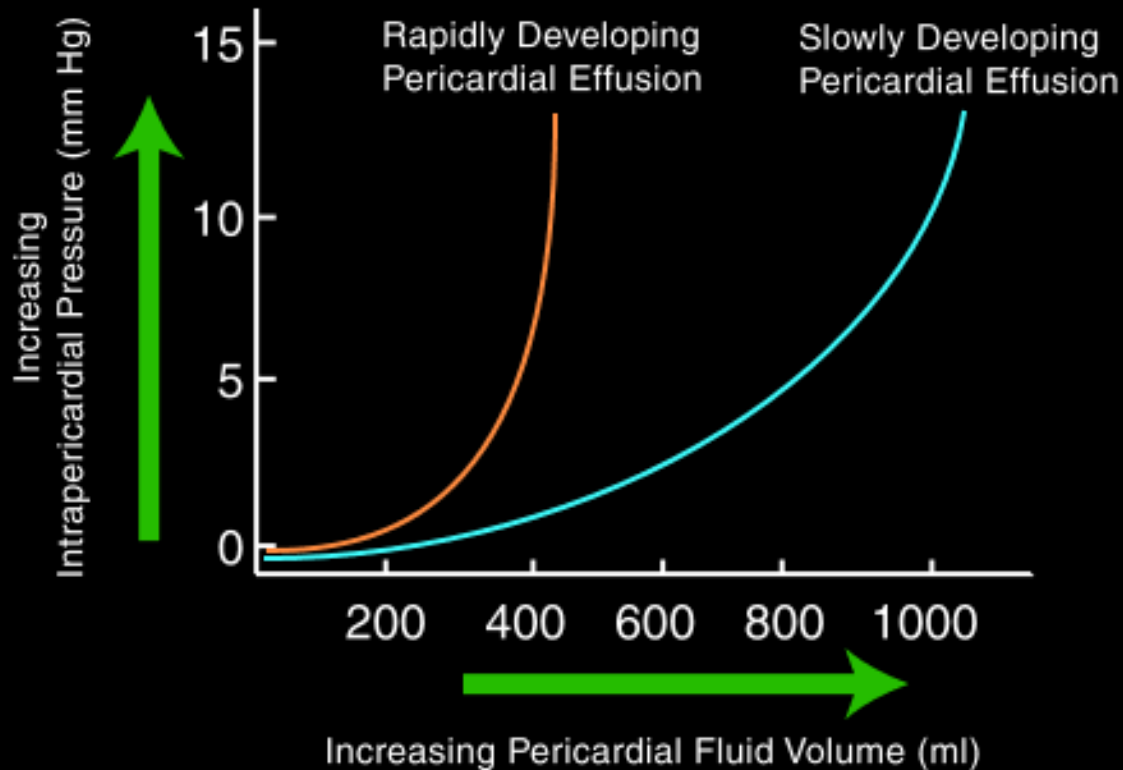
Fluid accumulation within the pericardial space resulting in

- increased intracardiac pressure
- progressive limitation of ventricular diastolic filling
- reduction of stroke volume and cardiac output

# Cardiac Tamponade

- The physiological effect depends on the rate of fluid accumulation
- Gradually the pericardium may stretch and accommodate > 2,000 ml
- Acutely as little as 200 ml of accumulated fluid may raise the intrapericardial pressure to cause tamponade
- JVD elevated (rarely not in low pressure tamponade)
- B.P variable, paradoxical pulse (>10 mm HG  $\Delta$ )
- Echocardiography
- Treatment: fluids, pericardiocentesis, cardiac surgery.

## Rise In Intrapericardial Pressure As A Result Of Pericardial Effusion



# Cardiac Tamponade

## *Beck's Triad*

- Described in 1935 by thoracic surgeon Claude S. Beck
- 3 features of acute tamponade
  - Decline in systemic arterial pressure
  - Elevation in systemic venous pressure (e.g. distended neck vein)
  - A small, quiet heart

# Etiologies of Cardiac Tamponade

- malignancy
- idiopathic pericarditis
- uremia
- acute myocardial infarction
- diagnostic procedures with cardiac perforation
- bacterial
- tuberculosis
- radiation
- myxedema
- dissecting aortic aneurysm
- post pericardiotomy syndrome
- systemic lupus erythematosus
- cardiomyopathy

# Cardiac Tamponade

- Early stage
  - mild to moderate elevation of central venous pressure
- Advanced stage
  - ↑ intrapericardial pressure
  - ↓ ventricular filling, ↓ stroke volume
  - hypotension
  - impaired organ perfusion



# Cardiac Tamponade

## *Clinical Features*

- Symptoms
  - dyspnea, fatigue, agitation and restlessness, syncope, shock, anuria
- Physical examination
  - pulsus paradoxus
  - tachycardia
  - increased jugular venous pressure
  - hypotension

# Cardiac Tamponade

## *Pulsus Paradoxus*

tamponade without pulsus

- atrial septal defect
- severe aortic stenosis
- aortic insufficiency
- left ventricular dysfunction  
LVH with  $\uparrow$  LVEDP
- decreased intravascular volume (low-pressure tamponade)

pulsus without tamponade

- COPD
- RV infarct
- pulmonary embolism
- effusive constrictive pericarditis
- restrictive cardiomyopathy
- extreme obesity
- tense ascites

# Cardiac Tamponade

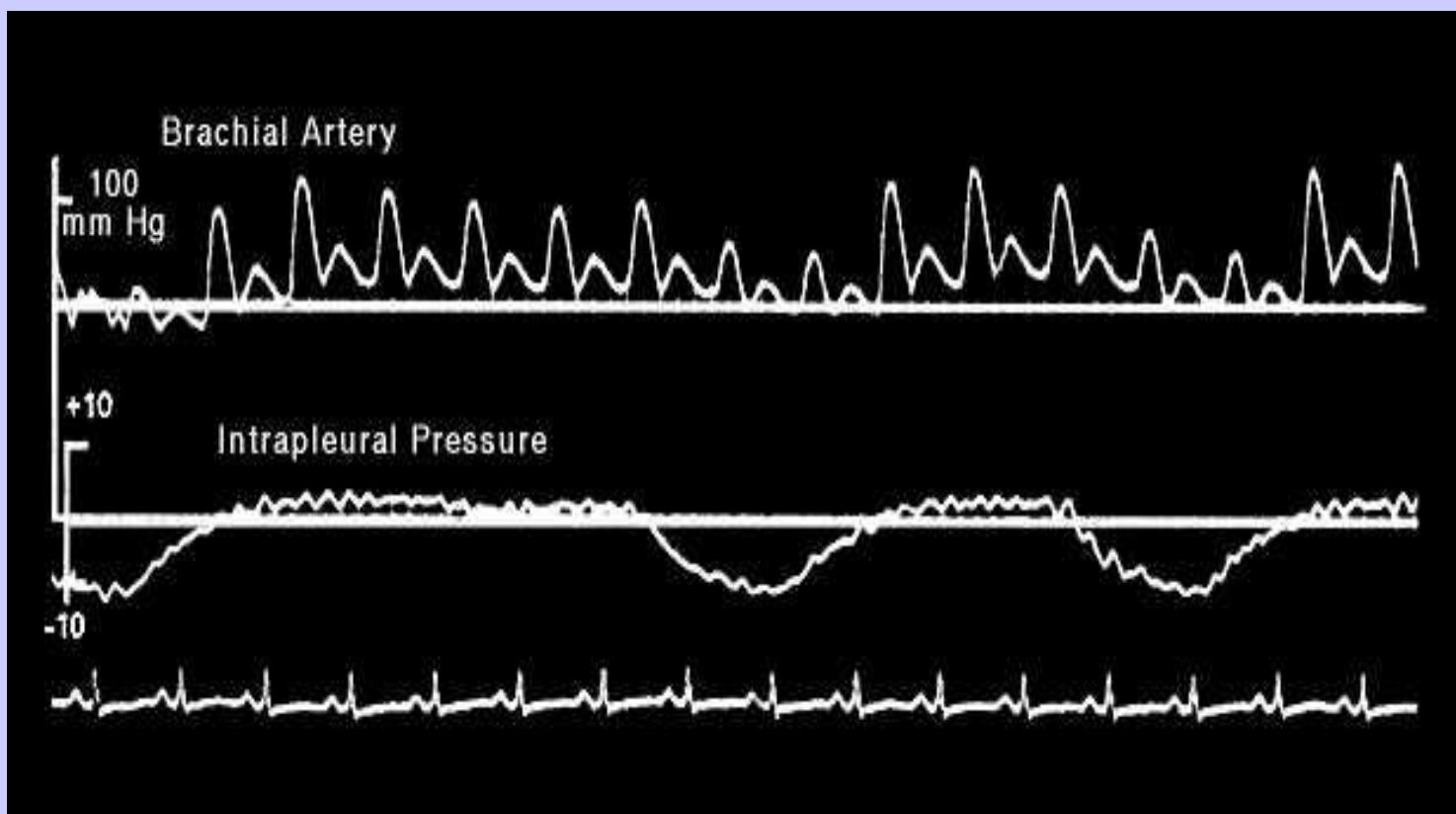
## *Central Venous Pressure*

- **X - descent**
  - **descent of the base in systole**
- **Y - descent**
  - **occurs as the tricuspid valve opens and ventricular filling begins from the high-pressure right atrium**
  - **in constrictive pericarditis, filling is truncated in early to mid diastole**
  - **in tamponade, filling is restricted throughout diastole**
- **Kussmaul's Sign**
  - **in constriction, venous return increases with inspiration and a high right atrial pressure resists filling resulting in an increased JVP**

# Cardiac Tamponade

## *Pulsus Paradoxus*

an exaggerated drop in SBP with inspiration (>10mmHg)



# Cardiac Tamponade

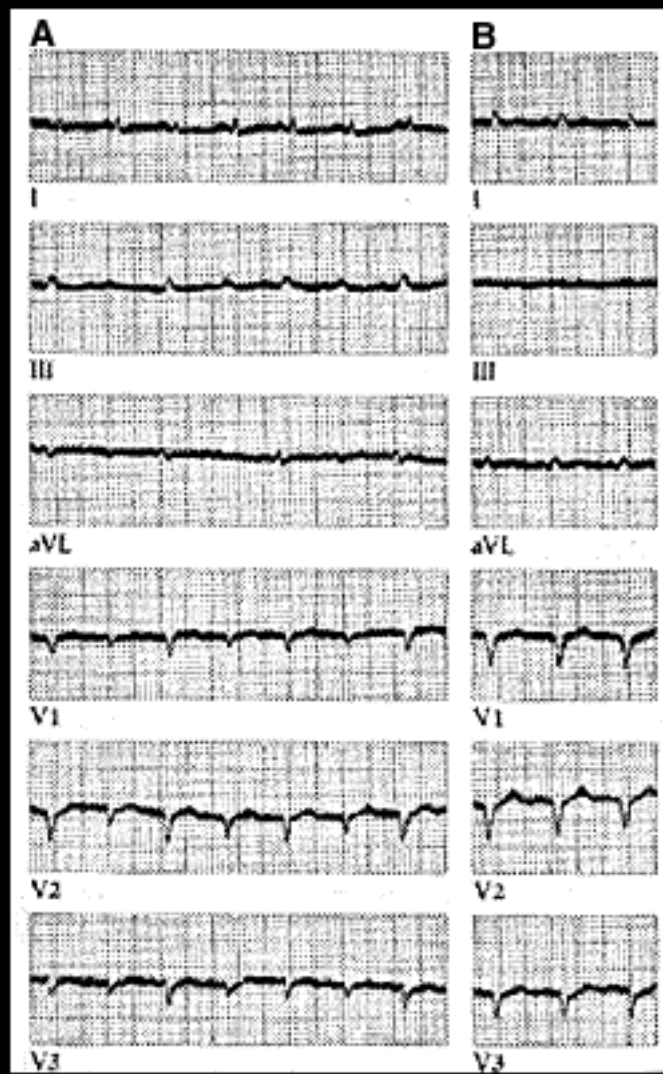
## *Diagnostic Evaluation*

- Chest x-ray
  - usually requires  $> 200$  ml of fluid
  - cannot distinguish between pericardial effusion and cardiomegaly
- Echocardiography
  - standard for diagnosing pericardial effusion
  - convenient, highly reliable, cost effective
  - false positives (M-mode)- left pleural effusion, epicardial fat, tumor tissue, pericardial cysts

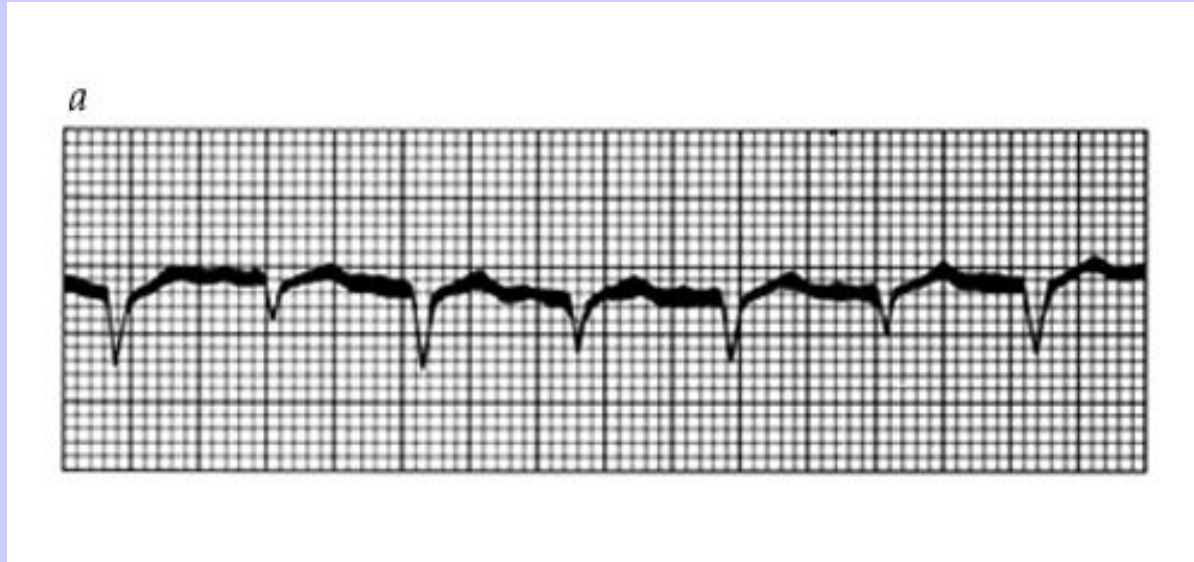
# ECG in Pericardial Effusion

- Diffuse low voltage
  - amount of fluid
  - electrical conductivity of the fluid
- Electrical alternans
  - alternating amplitude of the QRS
  - produced by heart swinging motion
  - also seen in PSVT, HTN, ischemia

## Electrical Alternans In Pericardial Effusion



## ECG: Pericardial Effusion



**The electrocardiogram (V2 lead) from a patient with pericardial effusion caused by malignant melanoma reveals a low voltage and electrical alternans.**

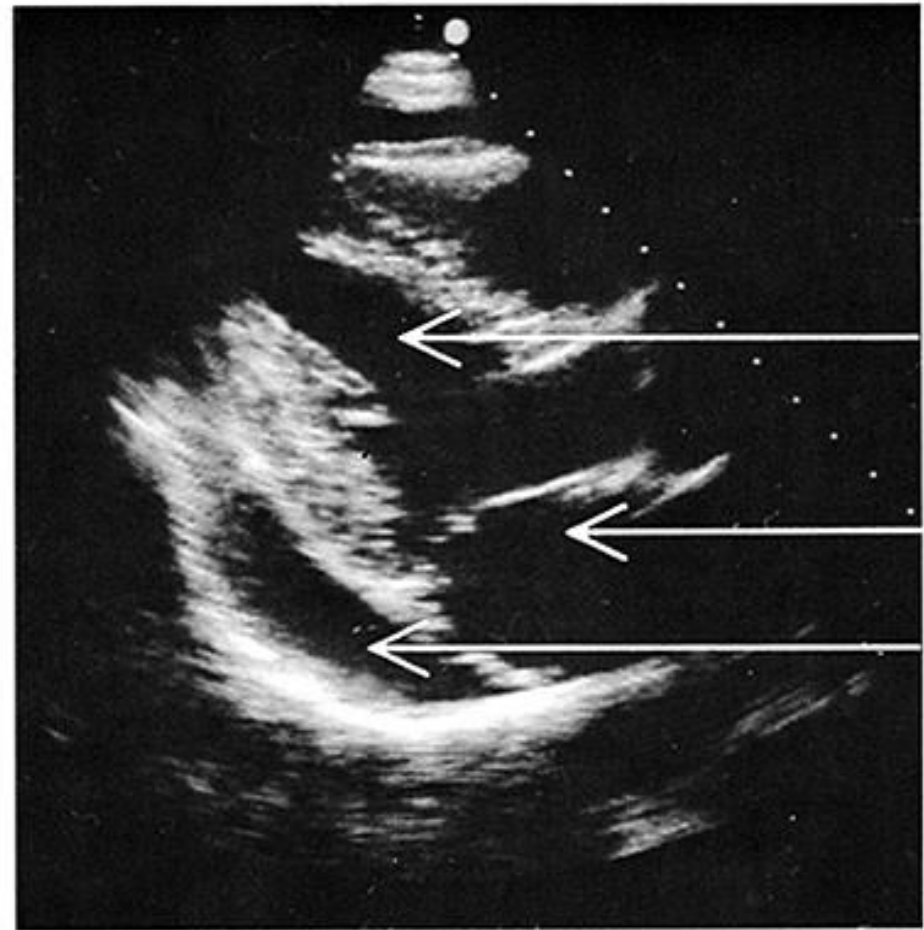
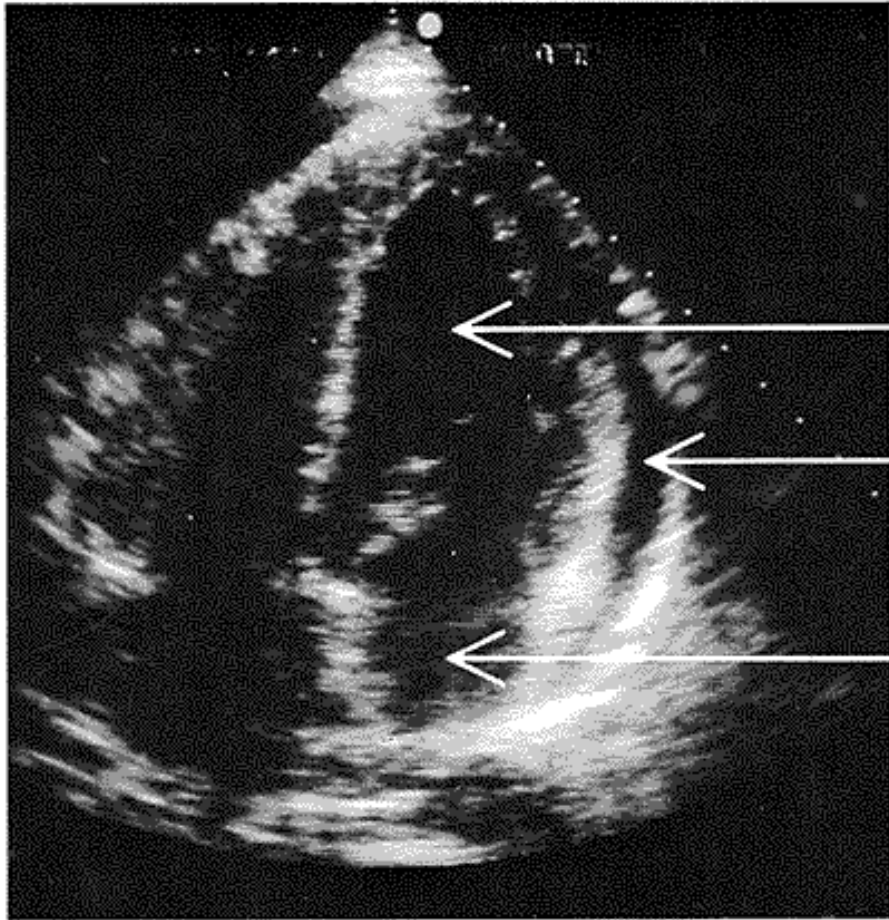


# Cardiac Tamponade

## *Echocardiographic Diagnosis*

- Pericardial effusion
  - highly reliable
- Cardiac tamponade
  - RA and RV diastolic collapse
  - reduced chamber size
  - distension of the inferior vena cava
  - exaggerated respiratory variation of the mitral and tricuspid valve flow velocities

## Pericardial Effusion-Echocardiography



**Pericardial effusion is seen in the two-dimensional echocardiogram as an echo-free space outside the cardiac chambers. Two characteristic sites are lateral to the left ventricle in the apical four-chamber view (shown here) and posterior to the left ventricle in the parasternal long-axis view (see Figure 3b).**

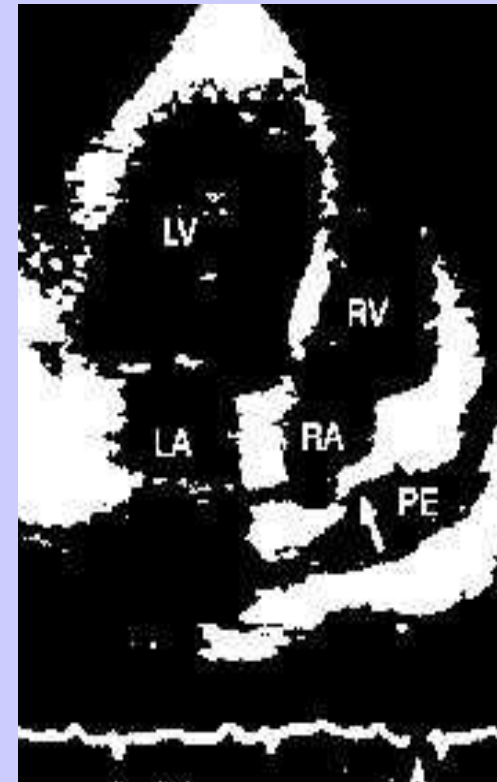
# RA and RV diastolic collapse

systole

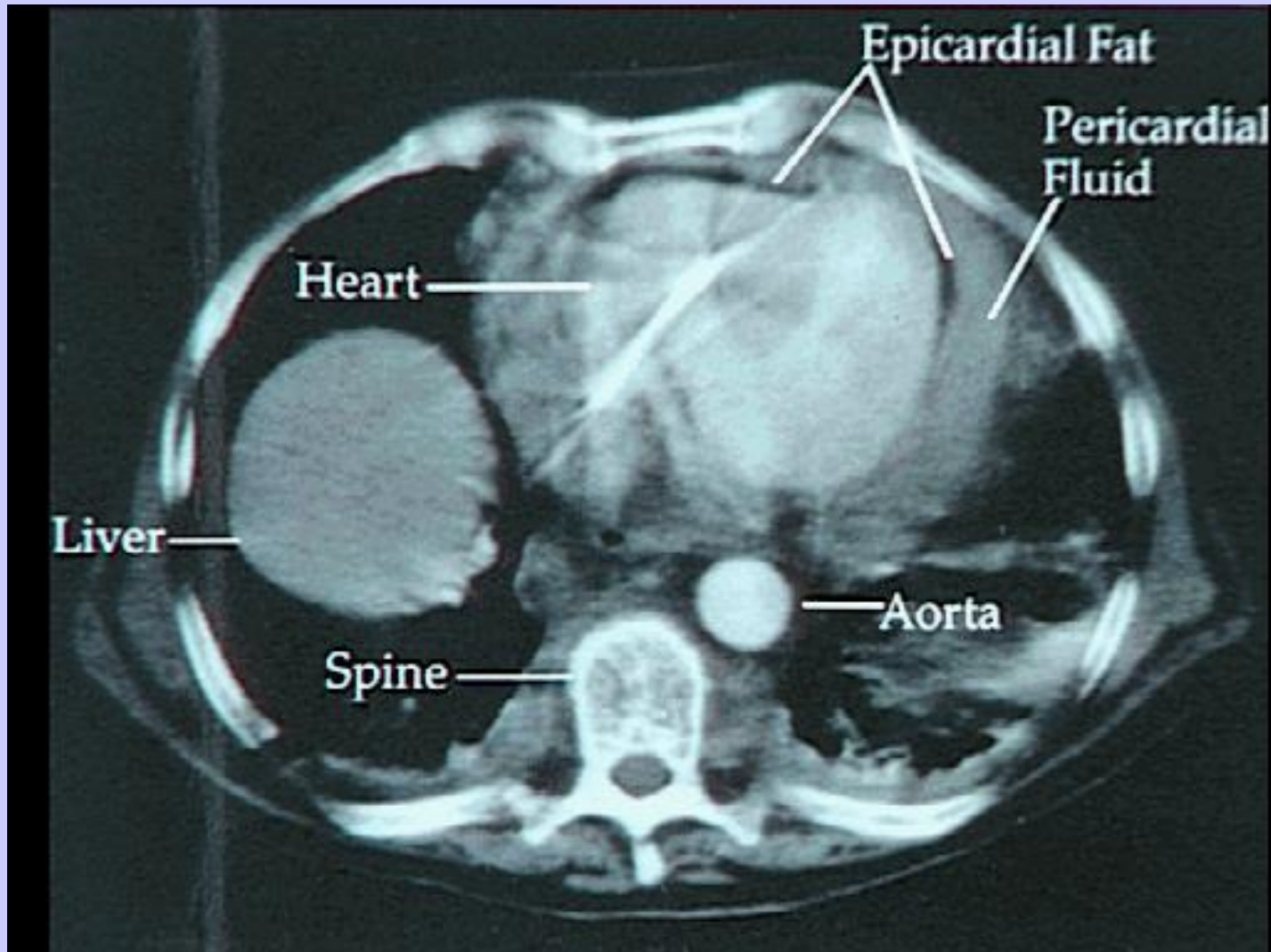


late  
diastole

early diastole

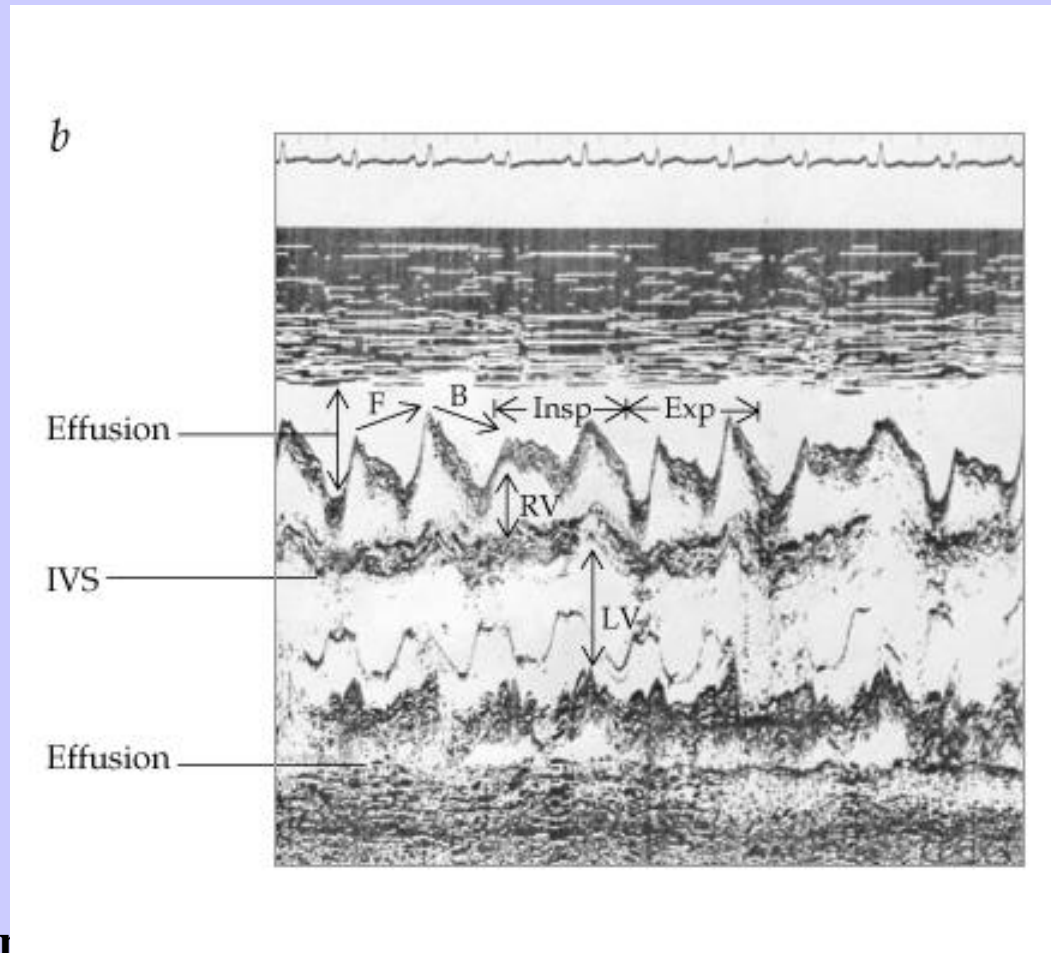


## CT Scan: Pericardial Effusion



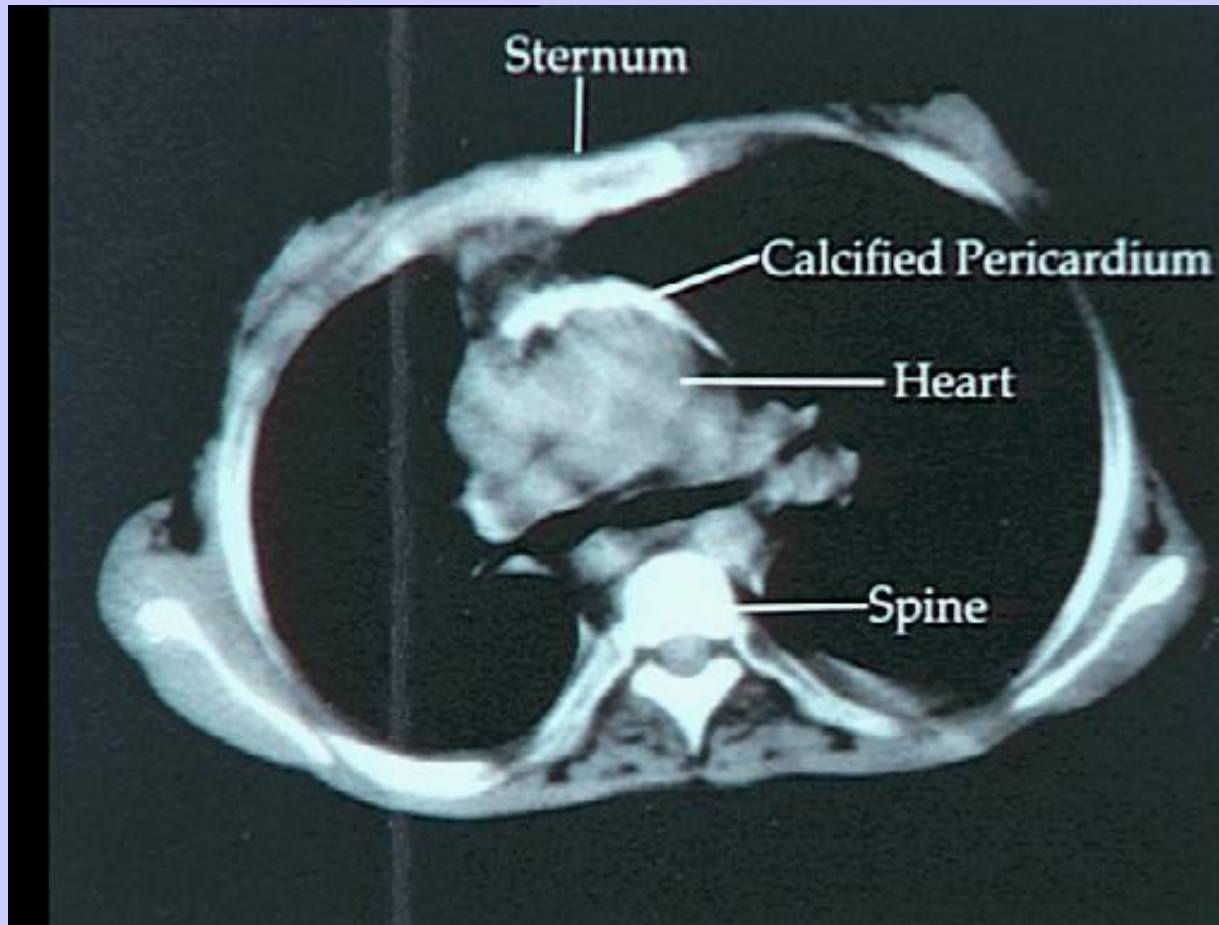
**A chest CT scan of a patient with pericardial effusion, pericardial fluid appears less dense than the heart and is separated from the myocardium by epicardial fat in some areas.**

# Echocardiogram: Pericardial Effusion



The echocardiogram shows the heart moving forward (F) and backward (B) within the effusion on alternate beats, thus producing the alternation of the QRS axis characteristic of electrical alternans. The heart also moves with inspiration (Insp) and expiration (Exp), which accounts for a change in anterior wall motion with every two cardiac cycles.

## CT Scan in Chronic Constrictive Pericarditis



**In this CT scan of the chest of a patient with chronic constrictive pericarditis, the dense layer on the anterior surface of the heart represents thickened and partially calcified pericardium.**

# Cardiac Tamponade

## *Treatment Options*

### Nonsurgical

- pericardiocentesis
  - blind
  - ECG guided
  - Echo guided
  - CT guided
- balloon pericardiotomy

### Surgical

- subxiphoid
- video-assisted thoracoscopy
- pericardial-peritoneal
- pericardial window
- pericardiectomy

# Cardiac Tamponade

## *Pericardiocentesis*

- Diagnostic tap
  - usually not indicated
  - rarely have positive cytology or infection that can be diagnosed
- Therapeutic drainage
  - indicated for significant elevation of the central venous pressure



# Cardiac Tamponade

## *Pericardial Window*

- Balloon dilatation of a needle pericardiostomy
- subxyphoid surgical pericardiostomy
- video-assisted thoracoscopy with localized pericardial resection
- anterolateral thoracotomy with parietal pericardial resection

# Cardiac Tamponade

## *Localized and Low Pressure*

- Localized tamponade  
due to loculated pericardial effusion
- Low pressure tamponade  
due to relative intravascular volume  
depletion

## Clinical Features That Differentiate Constrictive Pericarditis from Amyloidosis and Idiopathic Restrictive Cardiomyopathy

Clinical Feature	Constrictive Pericarditis	Cardiac Amyloidosis	Idiopathic Restrictive Cardiomyopathy
Early diastolic sound (S <sub>3</sub> or pericardial knock)	Frequent	Occasional	Occasional
Late diastolic sound (S <sub>4</sub> )	Rare	Frequent	Frequent
Atrial enlargement	Mild or absent	Marked	Marked
Atrioventricular or intraventricular conduction defect	Rare	Frequent	Frequent
QRS voltage	Normal or low	Low	Normal or high
Mitral or tricuspid regurgitation	Rare	Frequent	Frequent
Paradoxical pulse	Frequent but usually mild	Rare	Rare
Exaggerated variation in mitral and tricuspid flow velocity with respiration, out of phase	Usual	Rare	Rare

# Constrictive Pericarditis

*(concretio cordis)*

# Constrictive Pericarditis

An uncommon post inflammatory disorder

- the encasement of the heart by a rigid, nonpliable pericardium
- characterized by a thickened, fibrotic, and frequently calcified pericardium
- rarely develop after an episode of acute idiopathic pericarditis
- more likely to develop after subacute pericarditis with effusion that evolve over several weeks

# Causes of constrictive pericarditis

- **idiopathic**
- **infectious**
  - tuberculosis
  - virus
  - bacteria
  - histoplasmosis
- **drugs**
  - hydralazine
  - cromolyn sodium
  - procainamide
  - penicillins
  - isoniazid
  - minoxidil
  - phenylbutazone
  - methysergide
- **radiation**
- **chest trauma or surgery**
- **epicardial defibrillator patches**
- **connective tissue disease**
  - SLE, RA, dermatomyositis
- **renal failure (on dialysis)**
- **myocardial infarction**
- **neoplasm**
- **sarcoidosis**
- **porphyria cutanea tarda**
- **asbestosis**
- **Whipple disease**

# Constrictive Pericarditis

## *Differential Diagnosis*

- restrictive cardiomyopathy
- right ventricular failure
- mitral and tricuspid valve disease
- cardiac tamponade

# Constrictive Pericarditis

## *Clinical Findings*

- Jugular venous elevation 96%
  - prominent X- and Y-descent, “M” or “W” 94%
  - ↑ with inspiration (Kussmaul’s sign)
- Heart
  - diastolic pericardial knock 30-70%
  - absent or decreased apical impulse
- Abdomen:
  - ascites 57%
  - pulsatile hepatomegaly 70%
- Extremities: peripheral edema
- Pulsus paradoxus
  - almost always < 10 mm Hg; otherwise, considered tamponade



# Constrictive Pericarditis

## Diagnosis

- insidious onset , often not recognized in its early phases by exam, x-ray, ECG, echo
- average duration of symptoms before diagnosis was 23.4 months ( range 1 to 264 months)
- tendency to overlook elevated JVP

	chronic	subacute
diastolic knock	+	++
Kussmaul's	+	++
pulsus paradoxus		< 10 mm Hg
	+	

# Constrictive Pericarditis

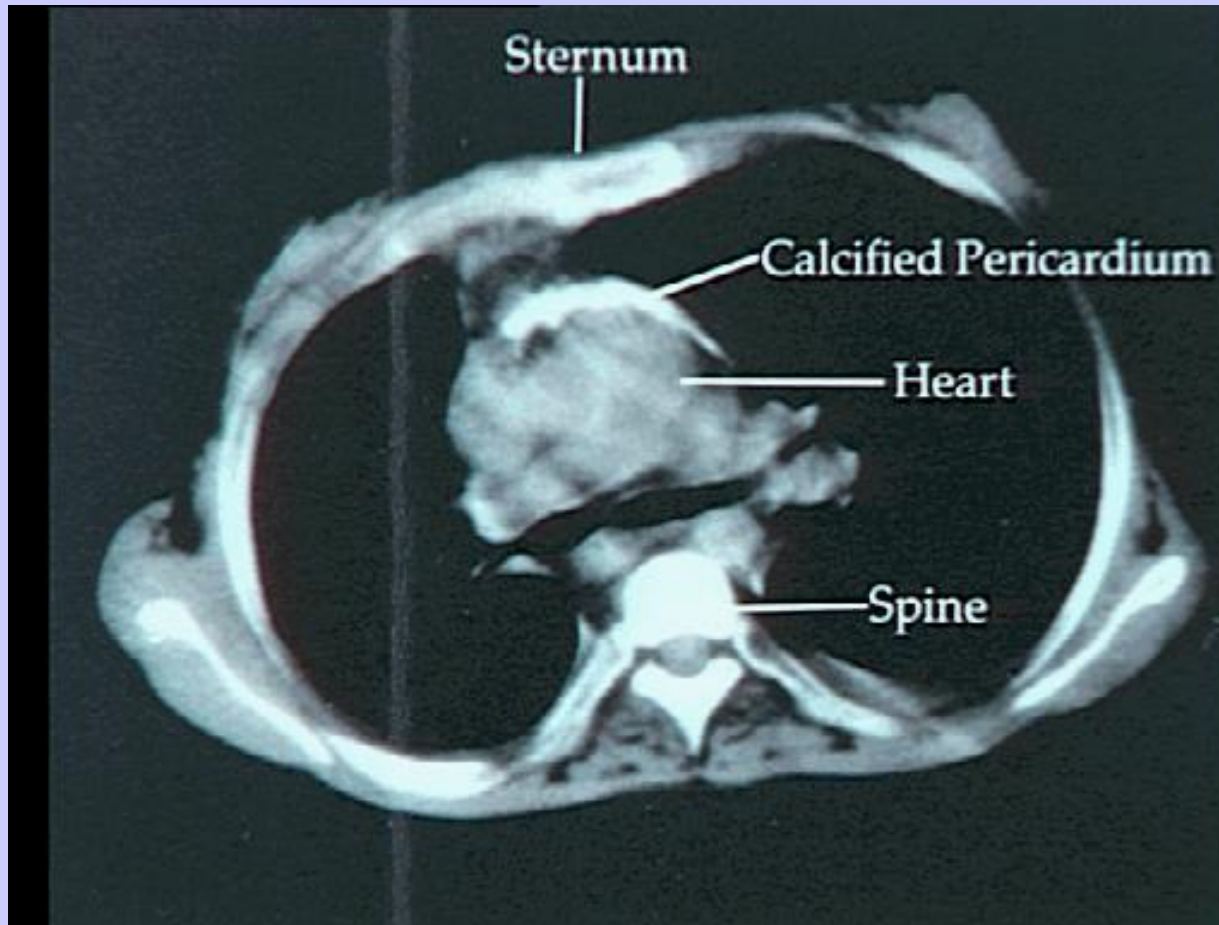
## *Diagnostic Tests*

- Electrocardiogram
  - sinus tachycardia, atrial fibrillation, ST flattening, T-wave inversion, low QRS voltage, right axis deviation / RVH
- Chest radiograph
  - pericardial calcification (44% to 70% in the past), must be distinguished from left ventricular aneurysm calcification
- MR I and computed tomography
  - pericardial thickening over the right ventricle (sensitivity 88%, specificity 100%, diagnostic accuracy 93%)

# Pericardial Calcification



## CT Scan in Chronic Constrictive Pericarditis

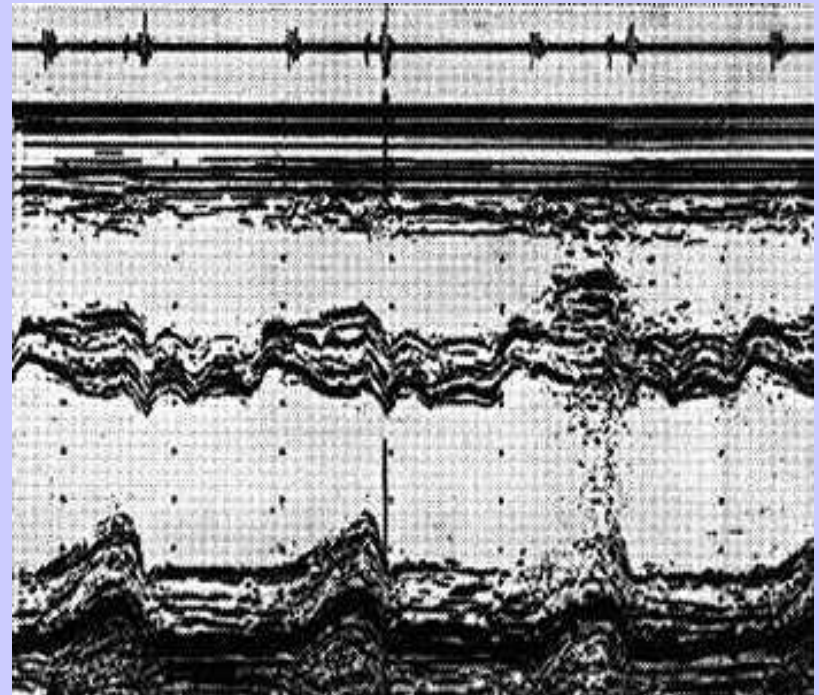


**In this CT scan of the chest of a patient with chronic constrictive pericarditis, the dense layer on the anterior surface of the heart represents thickened and partially calcified pericardium.**

# Constrictive Pericarditis

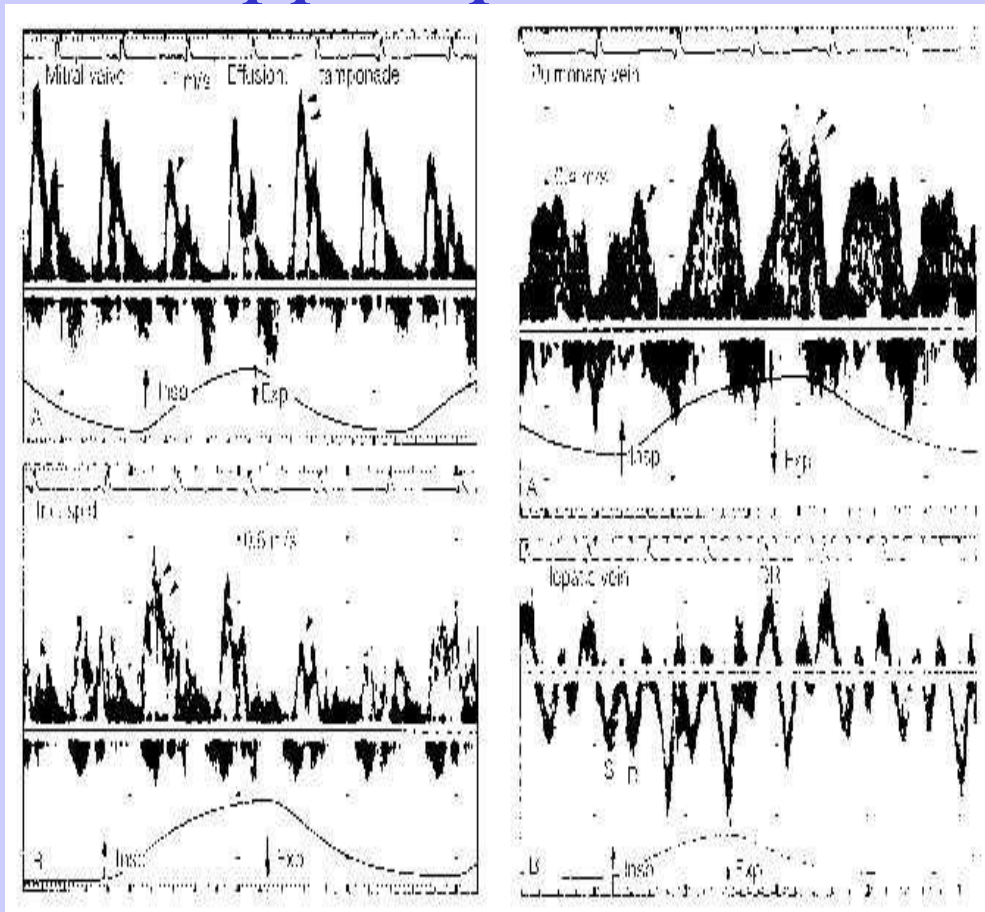
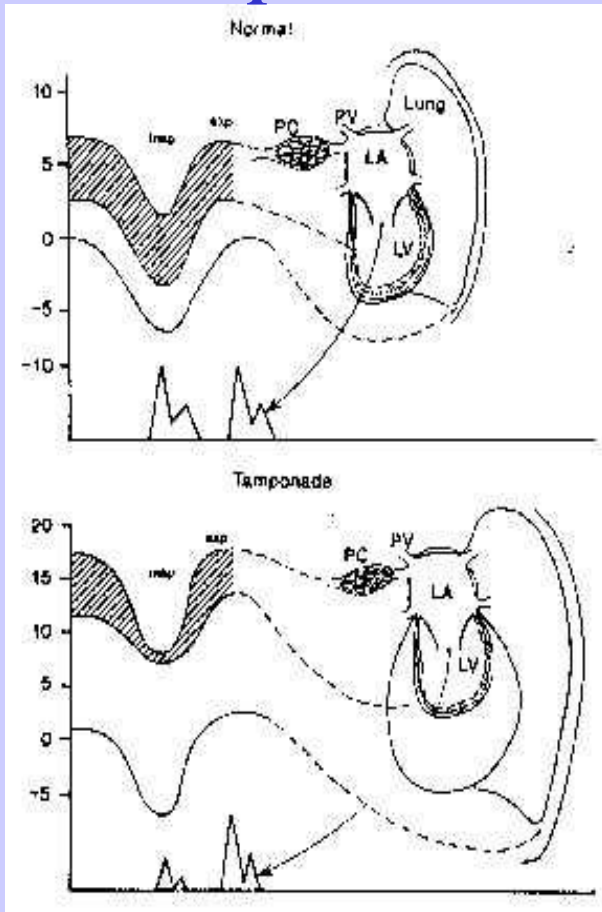
## *Echocardiography*

- M-mode echo
  - abrupt flattening of mid to late diastolic movement of the LV posterior free wall
  - diastolic septal bounce
- TTE / TEE
  - normal pericardium  $1.2 \pm 0.8$  mm
  - 3 mm cut off has a sensitivity of 95% and specificity of 86%



# Constrictive Pericarditis

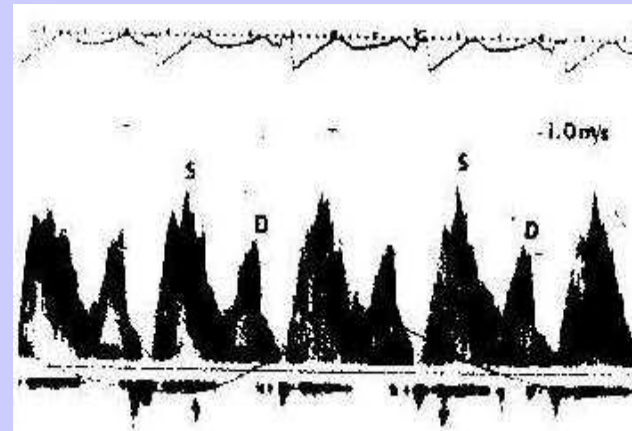
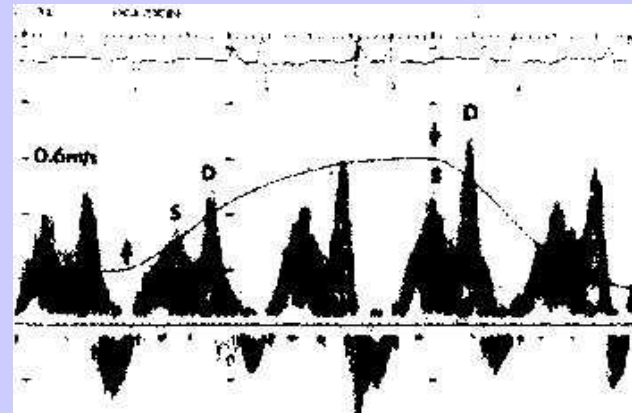
## *Effect of respiration on pulsed-wave Doppler pattern*



# Constrictive Pericarditis

## Doppler vein flow velocities

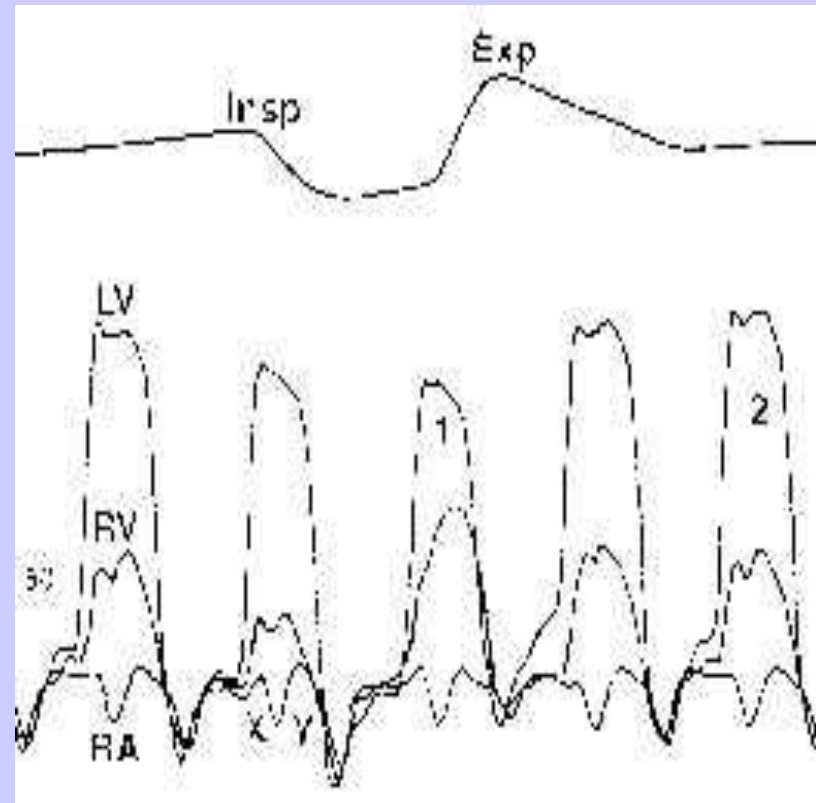
- pulmonary venous flow velocity
  - **peak systolic and diastolic values decrease with inspiration**



# Constrictive Pericarditis

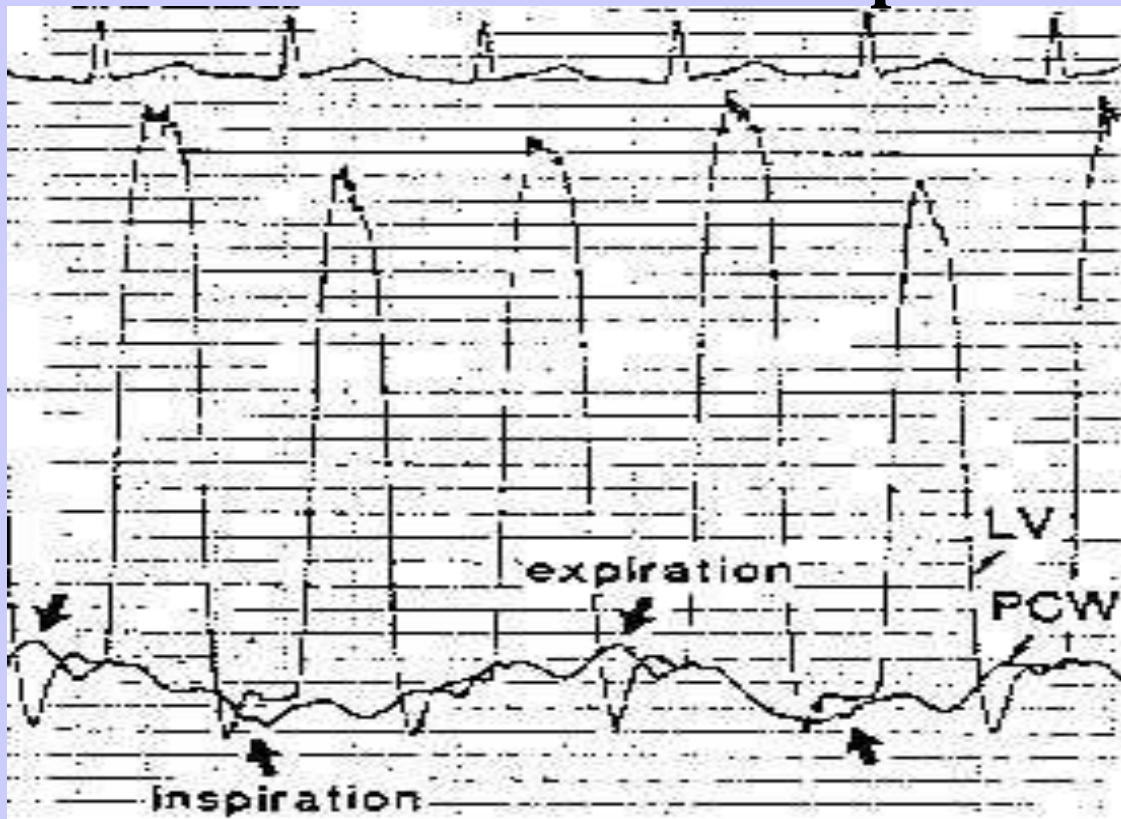
## *Hemodynamics*

- **End-diastolic pressures**
  - elevated and equalized (<5 mm Hg difference)
- **RA pressure tracing**
  - rapid X- and Y-descent, “W” or “M” pattern
  - failure to decrease with inspiration (Kussmaul’s sign)
- **RV pressure**
  - RVEDP > 1/3 of RVSP
  - dip and plateau configuration of RVDP (square root sign)
- **LV and RV pressures**
  - discordant changes





# Hemodynamics of Constrictive Physiology variability in early-diastolic PCW-LV gradient with respiration



# Constrictive Pericarditis

## *Pericardiectomy*

### *cardiac decortication*

- In hospital mortality vary between 0% and 10%
- predictors of poor outcome:
  - underlying malignancy
  - radiation-induced
  - previous paracardial surgery
  - NYHA class IV symptoms
  - myocardial atrophy
  - myocardial inflammation and scarring