Acute Pericarditis
Clinical & Electrocardiographic Pearls

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The Pericardium

The pericardium is the thin sac enclosing the heart.
The Pericardium
Acute Pericarditis
Illustrative Case

- A previously healthy 32-yr. aged man presented to the casualty with a h/o sharp central chest pain occurring over the past several hours.

- The pain began at rest, was exacerbated in the supine position and was relieved by leaning forward. There was no history of radiation of the pain, dyspnoea, diaphoresis, palpitations, vomiting or fever.
A few weeks ago, he had sore throat without other symptoms. He had no prior h/o chest trauma.

In the past, he had no significant medical illness and took no medications, including AKT.

He did not smoke, consume alcohol or use illicit drugs. He had no known High Risk behavior for HIV.

There was no family history of heart disease or collagen vascular disease.
Clinical Examination

- Afebrile, Pallor/ Icterus/ Cyanosis/ Clubbing/ Oedema - Nil
- Pulse Rate - 94 / min, Regular.
- Blood Pressure – 132 / 80 mm Hg. No pulsus paradoxus.
- Respiration Rate -14 / minute.
- JVP – not raised
- CVS – S1, A2, P2 – N , No murmurs; However, a two-phase friction rub was heard at the left lower sternal border. Dullness cardiac percussion - N
- The remainder of the physical examination -N.
Lab Results

- Hb – 13.6 gm%
- TLC, DLC – N
- ESR - 12 mm / hour
- BUN / S. Creat - N
- S. Electrolytes – N
- LFT - N
- Mx. Test - Negative
- ANA - Negative.
- C’Xray (PA) – Normal Lung Fields, CTR - N
The ECG revealed diffuse concave-upward ST-segment elevation with PR depression (best demonstrated in leads II and V3), ST-segment depression in aVR. Note lack of reciprocal ST-segment changes. Also note that the ST/T ratio in V6 is greater than 0.25.
ECG – Day 3
Note the echo-free space, maximal in the posterior interventricular groove (arrow) and a smaller anterior echo-free space (downward-pointing arrow).
Management

- The Δ of Acute Pericarditis was made, with the most likely etiology being either Post-viral or Idiopathic. (Viral serologies were not performed)
- The patient was treated with Aspirin, 600 mg every six hrs, and showed marked improvement by the following day.
- At the 2-week follow-up visit, the patient was doing well.
Discussion Issues:

1. Clinical Pearls -
   - Pain of Pericarditis
   - Pericardial Rub

2. Electrocardiographic Pearls -
   - Temporal Evolution of ECG
   - Important D/Ds
   - Early Repolarization Syndrome
   - PR-ST Discordance Ratio

3. Management Pearls –
   - Etiological possibilities
   - Recent Therapeutic Advances
Clinical Pearls
# Pain of Pericarditis

## Chest Pain

<table>
<thead>
<tr>
<th></th>
<th>Myocardial Ischemia or Infarction</th>
<th>Pericarditis</th>
<th>Pulmonary Embolism</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location</td>
<td>Retrosternal</td>
<td>Retrosternal</td>
<td>Anterior, posterior, or lateral</td>
</tr>
<tr>
<td>Onset</td>
<td>Sudden, often waxing and waning</td>
<td>Sudden</td>
<td>Sudden</td>
</tr>
<tr>
<td>Character</td>
<td>Pressure-like, heavy, squeezing</td>
<td>Sharp, stabbing, occasionally dull</td>
<td>Sharp, stabbing</td>
</tr>
<tr>
<td>Change with respiration</td>
<td>No</td>
<td>Worsened with inspiration</td>
<td>In phase with respiration (absent when the patient is apneic)</td>
</tr>
<tr>
<td>Change with position</td>
<td>No</td>
<td>Worse when patient is supine; improved when sitting up or leaning forward</td>
<td>No</td>
</tr>
<tr>
<td>Radiation</td>
<td>Jaw, neck, shoulder, one or both arms</td>
<td>Jaw, neck, shoulder, one or both arms, trapezius ridge</td>
<td>Shoulder</td>
</tr>
<tr>
<td>Duration</td>
<td>Minutes (ischemia); hours (infarction)</td>
<td>Hours to days</td>
<td>Hours to days</td>
</tr>
<tr>
<td>Response to nitroglycerin</td>
<td>Improved</td>
<td>No change</td>
<td>No change</td>
</tr>
</tbody>
</table>
Pain of Pericarditis

**RETROSTERNAL**
- Myocardial ischemic pain
- **Pericardial pain**
- Esophageal pain
- Aortic dissection
- Mediastinal lesions
- Pulmonary embolization

**SHOULDER**
- Myocardial ischemic pain
- **Pericarditis**
- Subdiaphragmatic abscess
- Diaphragmatic pleurisy
- Cervical spine disease
- Acute musculoskeletal pain
- Thoracic outlet syndrome

**INTERSCAPULAR**
- Myocardial ischemic pain
- Musculoskeletal pain
- Gallbladder pain
- Pancreatic pain

**ARMS**
- Myocardial ischemic pain
- Cervical/dorsal spine pain
- Thoracic outlet syndrome

**RIGHT LOWER ANTERIOR CHEST**
- Gallbladder pain
- Distention of the liver
- Subdiaphragmatic abscess
- Pneumonia/pleurisy
- Gastric or duodenal penetrating ulcer
- Pulmonary embolization
- Acute myositis
- Injuries

**EPIGASTRIC**
- Myocardial ischemic pain
- **Pericardial pain**
- Esophageal pain
- Duodenal/gastric pain
- Pancreatic pain
- Gallbladder pain
- Distention of the liver
- Diaphragmatic pleurisy
- Pneumonia

**LEFT LOWER ANTERIOR CHEST**
- Intercostal neuralgia
- Pulmonary embolization
- Myositis
- Pneumonia/pleurisy
- Splenic infarction
- Splenic flexure syndrome
- Subdiaphragmatic abscess
- Precordial catch syndrome
- Injuries
Pericardial Friction Rub

- It is almost **pathognomonic** for pericarditis
- Auscultation with the **diaphragm** of the stethoscope over the **left lower sternal edge** allows its best detection.
- **Serial** examinations may be necessary for detection.
- Scratching or grating sound similar to **leather rubbing against leather**.
- Classically **3 components** : > 50% cases
  - an atrial systolic rub that precedes S1,
  - a ventricular systolic rub between S1 and S2 & coincident with the peak carotid pulse, and
  - an early diastolic rub after S2 (usually the faintest).
Pericardial Friction Rub

- $V_S$: Ventricular systole
- $V_d$: Ventricular diastole
- $A_S$: Atrial systole
Pericardial Friction Rub

- In 24% cases it is **biphasic** to-and-fro rub. It can occur with tachycardia and is due to summation of the atrial and early diastolic rub.
- **Monophasic** rubs (the ventricular systolic) are the least common but may occur in patients with atrial fibrillation.
- Especially when it is monophasic, the pericardial friction rub can be mistaken for a systolic murmur.
- Pericardial rubs may be differentiated if the rub does not change with usual respiratory or positional maneuvers, if 3 components are present, and if the findings on the ECG are typical.
Electrocardiographic Pearls
## 4 Stages of Acute Pericarditis on ECG

<table>
<thead>
<tr>
<th>Stage</th>
<th>Changes on ECG</th>
</tr>
</thead>
</table>
| **Stage I** | - diffuse up-sloping ST elevation with reciprocal ST depression (aVR, V1)  
               - PR depression in the inferolateral leads (II, III, AVF, V5-6)  
               - PR elevation in aVR                                                                                                             |
| (1st. Hr. to Days) |                                                                                                                                               |
| **Stage II**| Normalization of the ST and PR segments, T wave flattening                                                                                     |
| **Stage III**| Diffuse T wave inversions  
               (Generally after the ST segments have become isoelectric. However, this phase is not seen in some patients) |
| **Stage IV** | ECG may become normal or the T wave inversions may persist indefinitely ("chronic" pericarditis) |
D/D of Acute Pericarditis by ECG

- Myocardial infarction
- Early repolarization
- Myocarditis
- Pulmonary embolus
- Cerebrovascular accident
- Pneumothorax
- Hyperkalemia
- Pneumopericardium
- Subepicardial hemorrhage
- Ventricular aneurysm
Note the degree of ST-segment elevation is greater in the pericarditis complex than in the early repolarization complex. Important findings of acute infarction include the presence of Q waves and a more convex upward ST segment.
## D/D of Acute Pericarditis by ECG

<table>
<thead>
<tr>
<th>ECG feature</th>
<th>Acute Pericarditis</th>
<th>Early Repolarization</th>
<th>Myocardial Infarction</th>
</tr>
</thead>
<tbody>
<tr>
<td>ST-segment shape</td>
<td>Concave upward</td>
<td>Concave upward</td>
<td>Convex upward</td>
</tr>
<tr>
<td>Q waves</td>
<td>Absent</td>
<td>Absent</td>
<td>Present</td>
</tr>
<tr>
<td>Reciprocal ST-segment changes</td>
<td>Absent</td>
<td>Absent</td>
<td>Present</td>
</tr>
<tr>
<td>Location of ST-segment elevation</td>
<td>Limb and precordial leads</td>
<td>Precordial leads</td>
<td>Area of involved artery</td>
</tr>
<tr>
<td>ST/T ratio in V6</td>
<td>&gt;0.25</td>
<td>&lt;0.25</td>
<td>N/A</td>
</tr>
<tr>
<td>Loss of R-wave voltage</td>
<td>Absent</td>
<td>Absent</td>
<td>Present</td>
</tr>
<tr>
<td>PR-segment depression</td>
<td>Present</td>
<td>Absent</td>
<td>Absent</td>
</tr>
</tbody>
</table>
Acute MI: ECG Features

- The ST elevation is more localized, usually convex, may be > 5 mm, often merging with the T wave, often associated with reciprocal ST segment changes
- Simultaneous ST elevation and T wave inversions
- Evolving Q waves
- Hyperacute T waves
- PR segment abnormalities uncommon
- Definite QT prolongation
Acute MI: ECG

ST Elevation due to Myocardial Infarction

01/DEC/94 18:22

12/DEC/94 18:23

Isoelectric line

13/DEC/94 12:30
Acute Pericarditis: ECG features

- ST-segment elevation
  - reflecting epicardial inflammation
  - leads I, II, aVL, and V3-V6
  - lead aVR and V1 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

Imp. - Arrhythmias are uncommon in acute pericarditis, its presence is suggestive of concomitant myocarditis
Acute Pericarditis: ECG
The syndrome of benign early repolarization, first described in 1936* by Shipley and Hallaran, is felt to be a normal variant and is not indicative of underlying cardiac disease.

BER: Incidence

- About 1% of the general population will have early repolarization on their ECG, with an increased incidence among younger individuals.

- BER has been reported in men and women of all age groups and ethnic backgrounds.

- Men manifest more often than women.

- For unknown reasons, it is more often encountered in black males between the ages of 20-40 years.
BER: Incidence

In a large population-based study of BER, the mean age of patients with this ECG finding was 39 years, with an age range of 16-80. The syndrome was seen predominantly in patients younger than 50 years of age and was rarely encountered in individuals over 70 (3.5%).
Among adult ED chest pain patients, BER is seen at an ↑ frequency and is encountered in 12% of such cases.

BER is seen on the ECG in 23-48% of adult ED chest pain patients who have used cocaine.
Benign Early Repolarization: ECG Features

- 50% of BER have no ST deviations in the limb leads (whereas in Acute pericarditis, diffuse ST elevations in both the limb and precordial leads occur in most cases, 47/48 in one study)
- Absence of PR deviation
- Absence of the ST and T-wave evolution
- PR-ST Discordance Ratio in V6 < 0.25
Benign Early Repolarization
PR-ST Discordance Ratio

The ratio of the amplitude of the onset of the ST segment to the amplitude of the T wave measured from end of PR segment in Lead V6 is a reliable discriminator.

- ST/T ratio in V6 ≥ 0.25 diagnosed all patients with pericarditis (PPV=1.0, NPV=1.0)
- ST/T ratio in V4, V6, and lead I ≥ 0.25 were also highly suggestive (PPV=0.90, NPV=0.88)
PR-ST Discordance Ratio

A

Benign early repolarization with ST/T ratio less than 0.25.

B

Acute pericarditis with ST/T ratio greater than 0.25.

This PR segment-ST segment discordant ratio may also be helpful in discriminating between the STE resulting from BER and acute pericarditis. It is objectively assessed by comparing the heights of the ST segment and T wave in lead V₆—the ST segment/T wave magnitude ratio. Using the PR segment as the baseline for the ST segment and the J point as the beginning of the T wave, the heights are measured with calculation of the ratio. If the ratio is greater than 0.25, pericarditis is the likely diagnosis; with results less than 0.25, one should consider BER.
PR-ST Discordance Ratio

How to measure?
BER : Effect of Exercise

“... the elevated ST-segment of BER usually comes to baseline on exercise... making it an important differentiating feature, in case there exists any doubt.”
Management Pearls
Etiologies of Acute Pericarditis

Infectious
- Viral
  - Coxsackievirus*
  - Echovirus
  - Epstein-Barr virus
  - Influenza virus
  - HIV
  - Mumps virus
- Bacterial
  - Tuberculosis *
  - Staphylococcus
  - Hemophilus
  - Pneumococcus
  - Salmonella
  - Meningococcus
  - Syphilis
- Miscellaneous
  - Histoplasmosis
  - Blastomyces
  - Coccidioidomycosis
  - Aspergillosis
  - Echinococcosis
  - Amebiasis
  - Rickettsia

Rheumatologic
- Sarcoidosis
- Lupus*
- Rheumatoid arthritis
- Dermatomyositis
- Scleroderma
- Polyarteritis nodosa
- Vasculitis
- Ankylosing spondylitis

Neoplastic
- Metastatic
  - Breast
  - Lung
  - Lymphoma
  - Melanoma
  - Leukemia
- Primary
  - Sarcomas
  - Mesothelioma

Drugs
- Hydralazine*
- Procainamide*
- Others

Immunologic
- Celiac sprue
- Inflammatory bowel disease

Other
- Chest trauma
- Uremia*
- Myxedema
- Aortic dissection
- Radiation therapy
- Myocardial infarction*
- Post-MI (i.e., Dressler's) synd.
- Postpericardiotomy*
- Idiopathic*

*--Some of the more common etiologies of pericarditis.
## Acute Pericarditis: Major Etiologies

<table>
<thead>
<tr>
<th>Etiology</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Idiopathic/viral</td>
<td>78%</td>
</tr>
<tr>
<td>Coxsackie A, coxsackie B, echovirus, adenovirus</td>
<td></td>
</tr>
<tr>
<td>Neoplasms</td>
<td>7%</td>
</tr>
<tr>
<td>Lung carcinoma, breast carcinoma, leukemia, lymphoma</td>
<td></td>
</tr>
<tr>
<td>Tuberculosis</td>
<td>5%</td>
</tr>
<tr>
<td>Infectious</td>
<td>4%</td>
</tr>
<tr>
<td>Bacterial, fungal, toxoplasmosis</td>
<td></td>
</tr>
<tr>
<td>Collagen vascular diseases</td>
<td>3%</td>
</tr>
<tr>
<td>Rheumatoid, systemic lupus erythematosus, scleroderma</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>3%</td>
</tr>
<tr>
<td>Uremia, post myocardial infarction, postcardiac surgery, radiation-induced, drugs</td>
<td></td>
</tr>
</tbody>
</table>
# Etiological Possibility & Treatment

<table>
<thead>
<tr>
<th>Condition</th>
<th>Estimated Incidence†</th>
<th>Clinical Indications and Tests</th>
<th>Usual Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Idiopathic</td>
<td>85–90%</td>
<td>Acute and convalescent viral titers, viral cultures, serologic test for HIV</td>
<td>Aspirin, NSAIDs</td>
</tr>
<tr>
<td>Infectious</td>
<td></td>
<td>Acute and convalescent viral titers, viral cultures, serologic test for HIV</td>
<td>Aspirin, NSAIDs</td>
</tr>
<tr>
<td>Viral</td>
<td>1–2%</td>
<td>Fever, elevated white-cell count; examination of pericardial fluid</td>
<td>Antibiotics, drainage of pericardial fluid</td>
</tr>
<tr>
<td>Bacterial</td>
<td>1–2%</td>
<td>Chest radiography, tuberculin skin test, histologic examination, cultures, and measurement of adenosine deaminase level in pericardial fluid and tissue</td>
<td>Multidrug antituberculous therapy and prednisone</td>
</tr>
<tr>
<td>Tuberculous</td>
<td>4%</td>
<td>Electrocardiography, serum troponin or creatine kinase, echocardiogram</td>
<td>Aspirin (avoid NSAIDs)</td>
</tr>
<tr>
<td>Acute myocardial infarction</td>
<td>NA (occurs in 5–10% of patients with myocardial infarction)</td>
<td>Magnetic resonance imaging, computed tomography, transesophageal echocardiography</td>
<td>Urgent surgery</td>
</tr>
<tr>
<td>Aortic dissection</td>
<td>Rare (≤1%)</td>
<td>Clinical history</td>
<td>NSAIDs (avoid aspirin)</td>
</tr>
<tr>
<td>Trauma</td>
<td>NA</td>
<td>Constitutional symptoms, lymphadenopathy, chest radiography, examination of pericardial fluid</td>
<td>NSAIDs, glucocorticoids (by intrapericardial instillation)</td>
</tr>
<tr>
<td>Neoplasm</td>
<td>7%</td>
<td>Clinical history</td>
<td>NSAIDs</td>
</tr>
<tr>
<td>Chest-wall irradiation</td>
<td>Rare (≤1%)</td>
<td>Serum blood urea nitrogen and creatinine levels</td>
<td>Initiate or intensify dialysis</td>
</tr>
<tr>
<td>Uremia</td>
<td>NA (occurs in approximately 5% of patients with chronic renal disease before initiation of dialysis and 13% after initiation of dialysis)</td>
<td>Clinical history</td>
<td>Aspirin, NSAIDs</td>
</tr>
<tr>
<td>Cardiomyopathy or thoracic surgery</td>
<td>Rare (≤1%)</td>
<td>Clinical history, evidence of polyserositis; chest radiography, erythrocyte sedimentation rate</td>
<td>Aspirin, NSAIDs</td>
</tr>
<tr>
<td>Autoimmune or inflammatory disease</td>
<td>3–5%</td>
<td>Rheumatoid factor, complement levels, antinuclear antibodies</td>
<td>Aspirin, NSAIDs, glucocorticoids</td>
</tr>
<tr>
<td>Adverse drug reaction†</td>
<td>Rare (≤1%)</td>
<td>Clinical history; eosinophil count</td>
<td>Discontinue drug; aspirin, NSAIDs</td>
</tr>
</tbody>
</table>
Treatment: Recent Advances


Colchicine in Addition to Conventional Therapy for Acute Pericarditis: Results of the COLchicine for acute PERicarditis (COPE) Trial

... Colchicine is effective and safe for the treatment and prevention of recurrent pericarditis and for the treatment of the first episode of acute pericarditis, it might ultimately serve as the initial mode of treatment, especially in idiopathic cases, as an adjunct to conventional therapy........
Thank You!

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