Chest Pain Syndromes

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Learning objectives

• Identify and compare the description of common causes of cardiac chest pain
• Identify and compare the common causes of non-cardiac chest pain
• Describe the pathophysiology of the acute coronary syndromes and relate this to angina, myocardial infarction and sudden cardiac death

Learning objectives (cont)

• Classify angina pectoris
• Describe and employ the physical findings in acute coronary syndromes
• Explain and interpret the use of the EKG and stress testing in the diagnosis of ACS
• Explain and interpret the use of cardiac biomarkers in the diagnosis of ACS
Learning objectives (cont)

- Compare and contrast the 4 “Killer chest pains” that lead to catastrophic outcomes if missed.
- Discover the difficulties in the accurate diagnosis of chest pain

The clinical challenge

- Frequent overlap of signs and symptoms
- Common mechanisms of pain perception
History and Physical

• History of pain – (quality, location, radiation, provocation, palliation, situation, temporal and severity)
• Physical exam – (General appearance, vital signs, cardiac exam, pulmonary auscultation, abdomen)
• Ancillary studies – EKG, CXR, CT/PE, Venous duplex, CT Aortogram, Stress testing.

Epidemiology (Non-emergent Chest pain)

• Musculoskeletal (13% costochondritis) 36%
• Gastrointestinal (13% reflux esoph.) 19%
• Cardiac 16%
• (stable angina) (UA or MI) (Other cardiac) 10.5% 1.5% 3.8%
• Psychiatry 8%
• Pulmonary 5%
• Other /Unknown 16%
Killer Chest Pains

- Acute Coronary Syndromes
- Pulmonary Embolism
- Aortic Dissection
- Tension Pneumothorax

Common cardiac causes of chest pain

- Angina
- Myocardial infarction
- Aortic valve disease
- Hypertrophic or congestive cardiomyopathy
- Aortic dissection
- Pericarditis
- Mitral valve prolapse

Angina Pectoris

Classic Angina Pectoris

Location, Location, Location.....

Chest pain: Frequency of cardiac vs. other causes

- Crushing pain, pressure, tightness: 100%
- Ache: 57%
- Sharp stabbing pain: 46%
- Burning indigestion: 72%
- Other pain: 80%

Other chest pain:

- Myocardial infarct
- Unstable angina
- Other chest pain
Physical Signs in Acute CAD

- Pallor
- Sweating
- Anxiety
- Tachycardia
- Rise in blood pressure
- S₄ gallop
- Mitral regurgitation murmur
- Paradoxically split S₂
- Pulsus alternans

Acute Coronary Syndrome

- Unstable Angina
- NSTEMI
- STEMI
Vulnerable Atherosclerotic Plaque

Asymptomatic, Unstable Angina, or Non-Q MI

Nonvulnerable Atherosclerotic Plaque

Minor Plaque Rupture

Major Plaque Rupture

Nonocclusive Thrombus

MI or Sudden Cardiac Death

Hypothetical Method by Which Daily Activities May Trigger Coronary Thrombosis

Physical or Mental Stress

Triggers Plaque Rupture

Coagulability Increase

Triggers Complete Occlusion by Thrombus

Q = Q wave, MI = myocardial infarction.


Hypothetical Method by Which Daily Activities May Trigger Coronary Thrombosis

Initial ECG in Acute MI

Normal 10%

Abnormal, nondiagnostic 40%

Typical 50%

Unstable Angina: A Candidate for Angioplasty

Unstable Angina: A Candidate for Angioplasty

A

B

Initial ECG in Acute MI
Electrocardiographic Features of Acute Infarction

- Characteristics: Elevated ST Segments, inverted T Waves, development of Q Waves
- EKG “Impostors”: Pericarditis, J-Point elevation, W-P-W Syndrome.
- Limitations: LBBB; Permanent Pacemaker.
- Posterior Infarction: Reciprocal changes in anterior leads (depressed ST Segments, Tall upright T Waves, prominent R Waves in V1 – V3); can be subtle.

EKG signs of unstable angina or NSTEMI

Inferior Myocardial Infarction
Inferior myocardial infarction with rupture

Acute Anterior Myocardial Infarction

Anterior myocardial infarction
**Troponinkomplex**

- Tnl
- TnC
- TnT
- Ca$^{2+}$

**Tropomyosin**

**Actin**

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**Troponin I & T**

- Specific for cardiac injury
- Most sensitive when you take the diagnostic window out to 24 hours
- It is not an earlier marker!
  - The majority of Troponins are not elevated in the first few hours
- It remains elevated for many days!
- When elevated is a marker for increased risk with non-ST elevation Acute Coronary Syndrome

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**Cardiac enzymes in early AMI**

- Admission:
  - CK
  - CKMB
  - Tnl

- +4 hours:
  - CK
  - CKMB
  - Tnl
Stable angina

Angina that occurs at a predictable amount of energy expenditure or emotion
Canadian Classification of Angina

**Grading of Angina Pectoris According to Canadian Cardiovascular Society Classification**

<table>
<thead>
<tr>
<th>Class</th>
<th>Description of Attack</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>&quot;Ordinary physical activity does not cause... angina,&quot; such as walking or climbing stairs. Angina occurs with strenuous, rapid, or prolonged exertion at work or recreation.</td>
</tr>
<tr>
<td>II</td>
<td>&quot;Slight limitation of ordinary activity.&quot; Angina occurs on walking or climbing stairs, rapid or slow climbing after meals or in bed, or under emotional stress, or only during the few hours after meals. Angina occurs without effort, but before the onset of normal activities on the job and climbing more than 1 flight of ordinary stairs at a normal pace and under normal conditions.</td>
</tr>
<tr>
<td>III</td>
<td>&quot;Marked limitation of ordinary physical activity.&quot; Angina occurs on walking one to two blocks or on level and climbing one flight of stairs under normal conditions and at a normal pace.</td>
</tr>
<tr>
<td>IV</td>
<td>&quot;Inability to carry on any physical activity without discomfort — anginal symptoms may be present at rest.&quot;</td>
</tr>
</tbody>
</table>

**Exercise Stress testing**

**Indications**

1. Evaluation of chest pain
2. Estimating progress and severity of disease
3. Evaluation of therapy
4. Screening for latent coronary disease
5. Evaluation of arrhythmias
**BRUCE Protocol**

<table>
<thead>
<tr>
<th>STAGE</th>
<th>SPEED (mph)</th>
<th>GRADE</th>
<th>TIME (min)</th>
<th>TOTAL TIME</th>
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<tbody>
<tr>
<td>1</td>
<td>1.7</td>
<td>10</td>
<td>3</td>
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<tr>
<td>2</td>
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<td>12</td>
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<tr>
<td>3</td>
<td>3.4</td>
<td>14</td>
<td>3</td>
<td>9</td>
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<tr>
<td>4</td>
<td>4.2</td>
<td>16</td>
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<td>12</td>
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<tr>
<td>5</td>
<td>5.0</td>
<td>18</td>
<td>3</td>
<td>15</td>
</tr>
</tbody>
</table>

**Normal stress ECG - Upsloping**

- [Graph showing normal stress ECG with upsloping waves]

**Abnormal stress ECG changes**

- [Graph showing control V4 and exercise ECG with abnormal changes]

Markedly abnormal stress ECG

Control V<sub>6</sub>  Exercise

Reversible and Irreversible Myocardial Perfusion Defects Detected by Thallium-201 Scans

Exercise  After 3 h rest

Reversible

Irreversible

Myocardial Infarction: Diagnostic Pitfalls

- Dissecting Aortic Aneurysm
- Pericarditis
- Pulmonary Embolism
- Pneumonia
- Costochondritis
- Esophageal Disease
- Peptic Ulcer Disease
- Biliary Colic
Natural History of AS

- Onset of symptoms heralds poor prognosis regardless of age
  - CHF: 2 years
  - Syncope: 3 years
  - AP: 5 years
- Asymptomatic
  - Natural history unknown
  - Occasional patient dies suddenly
  - Usually have have strain pattern
- Some patients have measurable worsening of obstruction within a few years, others don’t
Severe LVH seen in Aortic Stenosis

Aortic Stenosis

IHSS

A cardiomyopathy characterized by marked hypertrophy of the left ventricle with asymmetrical hypertrophy of the LV septum out of proportion to the LV free wall (ASH), often resulting in a dynamic obstruction of the LV outflow tract.
Noncardiac causes of chest pain:

- Gastrointestinal
  - Gastroesophageal reflux
  - Diffuse esophageal spasm
  - Cholecystitis and cholelithiasis

- Pulmonary
  - Pulmonary hypertension
  - Pneumothorax
  - Pulmonary embolism

- Emotional
  - Anxiety states (hyperventilation)
  - Depression

- Neuromuscular
  - Herpes zoster
  - Cervical arthritis
  - Chest wall pain and tenderness
GERD

Herpes Zoster as a cause of Chest Pain

Chest Pain ??
Killer Chest Pains

• Acute Coronary Syndromes
• Pulmonary Embolism
• Aortic Dissection
• Tension Pneumothorax

The DeBakey Classification of Aortic Dissection

Aortic Dissection

Pain
Cataclysmic onset
Most severe at onset, “tearing”, “stabbing”
Tendency to migrate
Anterior thorax (proximal); interscapular (distal)

Signs
Pulse deficit (proximal), aortic regurgitation (proximal)
Neurological deficits (proximal) - CVA, paraparesis, peripheral neuropathy, vasovagal
Aortic Dissection

Men 2x, 50 - 60 year old, proximal 2x

Predisposing factors: HTN, pregnancy, congenital (bicuspid aortic valve, coarctation, Marfan, Ehlers-Danlos)

Widened Mediastinum

CT of Thorax with contrast…Descending Aortic Dissection
Noncardiac Causes of Chest Pain

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  - Cervical arthritis
  - Chest wall pain and tenderness
D-dimer will be elevated whenever there is activation of thrombin, to form crosslinked fibrin AND fibrinolysis, i.e. thrombosis and fibrinolysis.
Pneumothorax

- Air in the pleural space
- Spontaneous
- Secondary
- Tension pneumothorax can be quickly fatal
A tension pneumothorax is a life-threatening condition that results from a progressive deterioration and worsening of a simple pneumothorax, associated with the formation of a one-way valve at the point of rupture.

Problems in the Workup

1. Cardiac and GI and other causes of chest pain are often indistinguishable
2. At least 30% of patients with chest pain are found to have GI disease
3. The ECG and challenge tests (ie, nitroglycerin, hyperventilation, stress tests) are nonspecific
4. Myocardial enzyme levels can be falsely elevated myocarditis, CHF, arrhythmia.
5. GI and other studies do not eliminate the possibility of ischemic heart disease
6. Lung scans and CT do not absolutely rule out pulmonary emboli
7. Gold standard for CAD still angiography