Approach to Chest Pain

Andrew Cheng, MD
Assistant Professor,
University of Washington
### Comprehensive Differential Diagnosis of Chest Pain

#### Dermatologic-related
- Herpes zoster (involving a left chest dermatome)

#### Psychiatric
- Panic/anxiety attack
- Munchausen’s syndrome

#### Musculoskeletal
- Muscle strain and related
- Costochondritis (Tietze’s syndrome)

#### Neural Compressive
- Cervical radiculitis
- Vertebral compression

#### Pleuro-Pulmonary
- Acute pulmonary embolus
- Pneumothorax
- Tumor

#### Hematologic
- Sickle cell (chest crisis)

#### Cardiovascular
- Acute coronary (ischemic) syndrome
  - STEMI, NSTEMI, Unstable angina
- Stable Angina
- Aortic aneurysm (dissecting or expanding)
- Pericarditis
- Aortic stenosis
- Myocarditis

#### Gastrointestinal
  A. Esophageal
    - Esophagitis/reflux and related
    - Esophageal dysmotility syndromes / spasm
    - Ruptured esophagus
  B. Gastro-duodenal
    - Gastritis
    - Ulcers: non-malignant vs. malignant
  C. Acute pancreato-biliary syndromes
    - Acute or recurrent pancreatitis
    - Acute cholecystitis
Case #1

You are on call, cross covering 20 patients, and you’ve just made it to your call room. RN pages you because the “ortho babysit” looks uncomfortable and has substernal chest pain. No known hx of CAD. Signout: “NTD.” What is your next step in management?

A. Order ASA and a heparin gtt
B. Call your senior
C. Order a chest x-ray
D. Order an ECG
E. Go back to sleep
Evaluation of Chest Pain

Case 1:
• Ask nurse for most current set of vital signs
• Ask nurse to get an EKG
• Obtain the admission EKG from the paper chart
• Go see the patient!
Case 1

• You go see the patient.
• Vital signs: Afebrile, **HR 38, BP 92/42, RR 16, O2 sat 94% on 2L**
• Physical exam
  • Gen – in mod distress, slightly diaphoretic
  • Lungs – CTAB, no rales/wheezes
  • Heart – Bradycardic, nl s1s2, no murmer
  • Abd – soft, NT/ND, active BS
  • Ext – b/l LEs warm and well perfused
Case #1
ECG Criteria for STEMI

• Anterior leads (V2-V3)
  • Men ≥ 40  2mm elevation
  • Men < 40  2.5mm elevation
  • Women  1.5mm elevation

• Other leads
  • 1mm ST-elevation in 2 contiguous lead

• New LBBB

• Reciprocal ST Depression
Now What??

• Key Objective – Reperfusion
• PCI is always preferred
  • Door-to-needle 60 minutes
  • Door to balloon 90 minutes
  • High risk features – shock, HF, arrhythmias

No PCI center nearby; consider fibrinolytics if
1. FMC to primary PCI will exceed 120 minutes
2. Preferably within 3 hours of presentation
3. Administer lytics within 30min of presentation
Now What??

Code STEMI → Medical Emergency
  • Get pt to cath lab as soon as possible

Antiplatelets & Anticoagulation (STEMI)
  • ASA 325mg: risk reduction of death or MI
  • Ticagrelor 180 mg x 1 or clopidogrel 600 mg x 1
  • Heparin 60 units/kg IV bolus x 1 (≤4000 units x 1), then 12 units/hr
MONA(B): morphine, O$_2$, nitro, ASA, (β-blocker)?
Inferior MI (RCA and branches) \(\rightarrow\) block in the AV node (sometimes His bundle) \(\rightarrow\) PR prolongation; \textbf{Mobitz I}; CHB (narrow complex)

Anterior MI (LAD and branches) \(\rightarrow\) infranodal block (His, R bundle, L bundle) \(\rightarrow\)\textbf{Mobitz II}, CHB (wide complex); BBBs
RV Myocardial Infarction

KEY POINT: With evidence of RV infarction, cautious with nitrates (drop in preload may cause acute hypotension)
Case 2

• Mr. M is a 67 yo man with PMHx of HTN, DM, and CAD s/p PCI in 2015. He presents with chest pain 2 hours ago - was retrosternal, 7/10, associated with nausea and diaphoresis. Before going to ER took 3 SLN – pain improved 3/10 – but not completely resolved. Received 2mg IV morphine in the ER and now CP free

REVIEW

ECGs
CXR - nml
LABs - Nml CBC, BMP, Trop 0.6
MORE HISTORY

For last 6 months pt has been noticing chest pressure with exertion...occurs whenever he walks up hills, goes up a couple flights of stairs ...

This evening noticed same chest tightness, but more intense while brushing his teeth - persisted and got worse, even while sitting – felt nauseous, SOB – had some jaw pain – took 3 nitro– pain improved with nitro – completely resolved with 2mg IV morphine in the ED.

EXAM

- Vital signs: Afebrile, HR 88, BP 160/70, RR 16, O2 sat 96% on RA
- Physical exam
  - Looks comfortable
  - Lungs – CTAB, no rales/wheezes
  - Heart – nl s1s2, no murmurs
  - Abd – soft, NT/ND, active BS
  - Ext – b/l LEs warm and well perfused
Is This ACS?

• STEMI, NSTEMI, and unstable angina
• History + ECG + enzymes (2 of 3 = MI)
• Physiology: plaque rupture vs. supply/demand
  • Troponin = injury
  • ↓ supply: hypotension, hemorrhage, anemia
  • ↑ demand: tachy, hypertension, HF
• STEMI, time is key
• NSTEMI – less time sensitive
Now What?
TREAT AS NSTEMI / ACS

Admit Telemetry
- Anti-platelets
  - Aspirin
  - Plavix/Ticagrelor
- Anti-thrombotic
  - Heparin / Lovenox
- Treat Lipids
  - High dose statin
- Treat CP
  - Nitro
  - Morphine
- Treat BP
  - Consider B-blocker
- Echo
- Serial Labs
- Cardiac Cath
Case 2 continued

You are now the night float intern, and the patient is signed out to you at 10PM.

You follow up on his trops $0.6 \rightarrow 1.9$

At midnight, you are called, pt had been CP free – but just got up to the bathroom and is now complaining of more chest tightness radiating to the neck
Next steps?

- Assess patient in person
- Review ECG
Next steps?

• (7/10 diffuse chest tightness)
• Vitals BP 155/90 HR 138 02 Sat 97%
• Tachycardic no murmers, lungs clear
• Repeat SLN
• IV Metoprolol

• Dose additional morphine
• start IV nitroglycerin after 3-4 doses of SL nitroglycerin
  • Start 5 mcg/min
  • Increase by 5mcg/min every 20 minutes
Inability to ELIMINATE chest pain in a patient with ACS using maximal medical therapy

Or

Hemodynamic Instability = Urgent call to cardiology for consideration of immediate catheterization

Significant ongoing/worsening CP; repeat ECGs to ensure not an evolving STEMI
- You are the on call resident on Med Blue at the VA
- it’s 2am Saturday and you get called from the ED:
  - 58 y/o M with hx of DM, HTN, rheumatoid arthritis come to the ER complaining CP for the last 3-4 hours.
  - No hx of chest pain before --- was trying to go to sleep when started feeling the discomfort...couldn’t sleep
  - Started just at rest ....5/10 in intensity – constant, sharp...stabbing pain
  - GLANCE AT CXR and ECG
History and Physical

• Go See Pt

Appears uncomfortable, chest pain is sharp – worse when taking deep breaths or coughing. Fairly active...walks around Greenlake regularly. No recent illness or sick contacts. On insulin for DM, HTZ for HTN

Exam

- HS: slightly tachycardic, regular...nml S1S2, no m/g/r, neck veins flat
- Lungs: CTA/b
- Abd: benign
- Ext: warm, no LE edema
What Next

A. Aspirin, Plavix, Heparin Drip – transfer to UW for STEMI / PCI
B. CTA – rule out PE
C. Stat Echo
D. Start Iupuprofen and colchicine
E. Start Steroids
Acute Pericarditis

- Refers to inflammation of pericardial sac

- Idiopathic pericarditis typically preceded by viral prodrome, i.e. flu-like symptoms

- Typically, patients have sharp, pleuritic chest pain relieved by sitting up or leaning forward

TABLE 1
Etiology of Pericarditis

<table>
<thead>
<tr>
<th>Etiology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Idiopathic (nonspecific, probably viral)</td>
</tr>
<tr>
<td>Infectious causes</td>
</tr>
<tr>
<td>Viruses: coxsackievirus A and B, hepatitis viruses, human immunodeficiency virus, measles virus, mumps virus, varicella virus</td>
</tr>
<tr>
<td>Bacteria: gram-positive and gram-negative organisms; rarely, Mycobacterium species (tuberculosis)</td>
</tr>
<tr>
<td>Fungi (most often in immunocompromised patients): Blastomyces dermatitidis, Candida species, Histoplasma capsulatum</td>
</tr>
<tr>
<td>Noninfectious causes</td>
</tr>
<tr>
<td>Acute myocardial infarction*</td>
</tr>
<tr>
<td>Renal failure†</td>
</tr>
<tr>
<td>Malignancy: breast cancer, lung cancer, Hodgkin's disease, leukemia, lymphoma by local invasion</td>
</tr>
<tr>
<td>Radiation therapy (usually for breast or lung cancer)</td>
</tr>
<tr>
<td>Autoimmune disorders: mixed connective tissue disorder, hypothyroidism, inflammatory bowel disease, rheumatoid arthritis, systemic lupus erythematosus, Wegener's granulomatosis, Takayasu's arteritis^</td>
</tr>
<tr>
<td>Trauma (including surgery): closed procedures and pacemaker implantation (puncture of myocardium)</td>
</tr>
<tr>
<td>Drugs+: hydralazine (Apresoline), procainamide (Pronestyl), phenytoin (Dilantin), isoniazid (e.g., Nydrazid); with rifampin (Rifamate), phenylbutazone, dantrolene (Dantrium), doxorubicin (Adriamycin, Rubex), methysergide (Sansert), penicillin, mesalamine (Rowasa)®</td>
</tr>
</tbody>
</table>
### ECG Change

**TABLE 3**

**Electrocardiographic Differentiation of Pericarditis**

<table>
<thead>
<tr>
<th>Acute pericarditis</th>
<th>Acute myocardial infarction</th>
</tr>
</thead>
<tbody>
<tr>
<td>ST-segment elevation in many leads, with no</td>
<td>ST-segment elevation in anatomically contiguous leads, with</td>
</tr>
<tr>
<td>ST-segment depression</td>
<td>possible reciprocal ST-segment depression</td>
</tr>
<tr>
<td>Upward concave ST-segment elevation</td>
<td>Upward convex ST-segment elevation</td>
</tr>
<tr>
<td>No T-wave inversion in leads with ST-segment elevation</td>
<td>T-wave inversion in leads with ST-segment elevation as myocardial</td>
</tr>
<tr>
<td>PR-segment depression</td>
<td>infarction evolves</td>
</tr>
<tr>
<td>Q waves during evolution</td>
<td>No PR-segment depression</td>
</tr>
<tr>
<td></td>
<td>May have Q waves during evolution</td>
</tr>
</tbody>
</table>

**A Characteristics of ST-segment elevations caused by ischemia**

Convex, Straight upsloping, Straight horizontal, Straight downsloping

ST-segment elevations caused by ischemia typically display a convex or straight ST-segment. Such ST-segment elevations in presence of chest discomfort are strongly suggestive of transmural myocardial ischemia. Note that the straight downsloping variant is unusual.

**B Typical non-ischemic ST-segment elevation**

Concave

Non-ischemic ST-segment elevations are extremely common in all populations. They are characterized by a concave ST-segment and a greater distance between the J point and the T wave apex.
Treatment

• High Dose NSAIDS -- Ibuprofen 800mg TID

  +

• Colchicine 0.6mg BID x 3 months

Avoid Steroids if possible
Case 4

• You are working at the UW ER - you see a 42 yo man for “ACS rule out”.
• Mr T is has NO PMH presenting with severe retrosternal chest pain. Radiates to neck. Began 3 hours ago; has subsided slightly but is still 8/10 in severity.
You take report, quickly review chart, and assess the patient.

- **VS:** T37.1, HR120, BP168/80, RR16, Pox 97% 4L NC
- Focused Exam:
  - **GEN:** In discomfort but mentating well
  - **HEENT:** JVP at clavicle
  - **CV normal s1/s2, diastolic murmer at RUSE**
  - **PULM:** Crackles on both lung fields
  - **EXTR:** Cool
LABS

- NA : 138
- K: 4.1
- Hgb 12
- Hct 42
- Creat: 0.8
- BNP: 212
- Trop: 0.82
What do you

A. Call STEMI Code; activate cath lab
B. Give ASA, Plavix, start heparin drip
B. Order stat CT angiogram
C. Give a GI cocktail
D. Order a stat echo
Thoracic aortic dissection

Diagnosis

- CT angiography – first line
  - 83-100% sensitive, specificity 87-100%
- TEE – second line; good for proximal
- MRI – useful for surveillance
### ACUTE DISSECTION

Electrocardiographic changes ($n = 159$).

<table>
<thead>
<tr>
<th>Change Description</th>
<th>Count (Percentage)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acute change</td>
<td>79 (49.7)</td>
</tr>
<tr>
<td>ST elevation ($\geq 0.1$ mV)</td>
<td>13 (8.2)</td>
</tr>
<tr>
<td>ST depression</td>
<td>54 (34.0)</td>
</tr>
<tr>
<td>$\geq 0.1$ mV and $&lt;0.2$ mV</td>
<td>28 (17.6)</td>
</tr>
<tr>
<td>$\geq 0.2$ mV and $&lt;0.3$ mV</td>
<td>18 (11.3)</td>
</tr>
<tr>
<td>$\geq 0.3$ mV</td>
<td>8 (5.0)</td>
</tr>
<tr>
<td>T inversion</td>
<td>34 (21.4)</td>
</tr>
<tr>
<td>AVB</td>
<td>3 (1.9)</td>
</tr>
<tr>
<td>New Af</td>
<td>1 (0.6)</td>
</tr>
<tr>
<td>PAC/PVC</td>
<td>5 (3.1)</td>
</tr>
<tr>
<td>Sinus brady</td>
<td>18 (11.3)</td>
</tr>
<tr>
<td>Chronic change</td>
<td>58 (36.5)</td>
</tr>
<tr>
<td>LVH with strain</td>
<td>15 (9.4)</td>
</tr>
<tr>
<td>LVH voltage</td>
<td>17 (10.7)</td>
</tr>
<tr>
<td>Q waves</td>
<td>6 (3.8)</td>
</tr>
<tr>
<td>BBB</td>
<td>8 (5.0)</td>
</tr>
<tr>
<td>Chronic Af</td>
<td>8 (5.0)</td>
</tr>
<tr>
<td>Pacing</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td>Both acute and chronic</td>
<td>21 (13.2)</td>
</tr>
<tr>
<td>Normal</td>
<td>43 (27.0)</td>
</tr>
</tbody>
</table>
Thoracic aortic dissection

Risk Factors

- Hypertension
- Atherosclerosis
- Preexisting aneurysm (known history in 13% of patients)
- Inflammatory conditions affecting aorta (Takayasu, Giant Cell Arteritis, RA, syphilis)
- Collagen disorders (Marfan, Ehlers-Danlos)
- Bicuspid aortic valve
- Aortic coarctation
- Turner syndrome
- Trauma
• Type A = ascending = surgical emergency
• Type B = descending = medical management unless malperfusion requires emergent procedure

Aortic dissection, surgical management
Which of the following pharmacologic therapies is most appropriate in the early acute management of aortic dissection?

A. IV hydralazine
B. IV nitroglycerin
C. IV sodium nitroprusside
D. IV labetalol
E. IV diltiazem
Aortic dissection, pharmacologic therapy

- **IV labetalol**: 20 mg load → 0.5-2 mg/min, max 2400 mg/day

- **IV esmolol**: Load 0.5 mg/kg or 300-500 mcg/kg over 1 minute → 50 mcg/kg/min for 4 minutes, titrated upward in 50 mcg/kg/min increments q4 mins to a maximum of 300 mcg/kg/minute

- If SBP still high **after BB**, nitroprusside (0.25-0.5 mcg/kg/min) can be added, consider nicardipine, IV verapamil/diltiazem

- **Avoid hydralazine**: vasodilation alone induces reflex activation of the sympathetic nervous system leading to enhanced ventricular contraction and increased aortic wall shear stress
Complications Associated with Aortic Dissection

- True lumen
- False lumen
- Aortic dissection flap
- Aortic regurgitation
- Compromised blood flow to left renal artery

Pericardial Tamponade

- Blood in between heart and pericardium
- Tear in wall of aorta
- Blood in wall of artery (aorta)

http://heart.templehealth.org/content/aortic_dissections.htm
TREATMENT

• Acute Ascending Aortic Dissection

CALL CT SURGERY – GET TO THE OR!!!
Angina

Typical

• Characterized as discomfort/pressure rather than pain
• Time duration: several mins
• Provoked by activity/exercise
• Radiation (i.e. arms, jaw)
• Does not change with respiration/position
• Associated with diaphoresis/nausea
• Relieved by rest/nitroglycerin
PRESENTATION FOR ACS CAN BE QUITE DIFFERENT

Onset can be sudden; at rest, without previous hx of CP
Final Thoughts

Approach to Chest Pain
  Keep a Differential in Your Mind
Stable or Unstable
  Vitals: Focused History and Physical
Rule out bad things first
Always look at new and OLD ecgs if possible
Review CXR
You are the cross cover intern on the Medicine team. At 6PM you are called by the nurse because pt has developed chest pain. Ms. Z is a 62 yo F with PMHx of CAD s/p PCI to the LAD 1 year ago, COPD and right knee replacement 3 weeks ago. Pt was admitted for SOB presumed to be a COPD exacerbation.

What would you do next?
Evaluation of Chest Pain

Case 5:
• Ask nurse for most current set of vital signs
• Repeat EKG - compare to old ECG
• Go see the patient!
Case 5

- You go see the patient. She had been feeling better after getting duonebs, but now developed chest pain that is L-sided, 8/10 and worse with breathing. Also complaining of SOB

- Vital signs: Afebrile, HR 120, BP 117/70, RR 28, O2 sat 91% on 4L (was 95% on RA this morning)

- Physical exam
  - Gen – in distress, using accessory muscles of respiration
  - Lungs – CTAB, no rales/wheezes
  - Heart – tachycardic, nl s1, loud s2, no mumurs
  - Abd – soft, NT/ND, active BS
  - Ext – b/l LEs warm and well perfused

- Labs:
  - CBC wnl, BNP = 84, Troponin = 0.12
Now What?

A. Order a chest CTA
B. Order a D-dimer, and if (+) order a CTA
C. Start oxygen, IV heparin, and obtain chest CTA
D. Start oxygen and increase morphine dose
E. Start ASA, Plavix and lovenox
Pulmonary Embolism

- One of the “great masqueraders”
  - Sinus tachycardia the most common sign
- Use the Wells score
- D-dimer (-) rules out in low risk pt, does not apply to most hospitalized patients
- CTA preferable to V/Q scan
  - CT 83% sensitive, 96% specific
  - (-) CTA does not definitively rule out PE in high probability patient
Modified Wells Criteria

- Symptoms of DVT (3 points)
- No alternate better diagnosis (3 points)
- Tachycardia (1.5 points)
- Immobile >3d or surgery within 4 weeks (1.5 points)
- Prior DVT or PE (1.5 points)
- Hemoptysis (1 point)
- Malignancy (1 point)

> 4 points = PE likely → CTA or V/Q scan
≤ 4 points = PE unlikely → rule out with D-dimer
Pulmonary Embolism

• Heparin anticoagulation
  • If PE likely, may start heparin while awaiting confirmatory test. Can stop if PE ruled out.
  • 80 units/kg IV bolus, then continuous infusion of 18 units/kg/hr
PE with hypotension/Shock

**Lytics if patient in shock**
- Clinical diagnosis
- Echo may show RV failure, but echo alone should not prompt lytics
- Involve Pulmonary/MICU consultant
- Alteplase (TPA) 100 mg IV x 2 hours

**Catheter based thrombectomy**
- For failure of thrombolysis or likelihood of shock/death before thrombolysis can take effect (hours)

**Surgical thrombectomy**
- Failure of above therapies
Which of the following is an absolute contraindication for thrombolytic therapy?

A. Any previous hx of hemorrhagic stroke
B. Acute pancreatitis
C. Pregnancy or within 1 week postpartum
D. Active peptic ulceration
E. Uncontrolled hypertension (SBP>180 mm Hg, DBP >110 mm Hg)
ABSOLUTE CONTRAINDICATIONS
- Any previous history of hemorrhagic stroke
- History of stroke, dementia, or central nervous system damage within 1 year
- Head trauma or brain surgery within 6 months
- Known intracranial neoplasm
- Suspected aortic dissection
- Internal bleeding within 6 weeks
- Active bleeding or known bleeding disorder
- Traumatic cardiopulmonary resuscitation within 3 weeks

RELATIVE CONTRAINDICATIONS
- Oral anticoagulant therapy
- Acute pancreatitis
- Pregnancy or within 1 week postpartum
- Active peptic ulceration
- Transient ischemic attack within 6 months
- Dementia
- Infective endocarditis
- Active cavitating pulmonary tuberculosis
- Advanced liver disease
- Intracardiac thrombi
- Uncontrolled hypertension (SBP>180 mm Hg, SBP >110 mm Hg)
- Puncture of noncompressible blood vessel within 2 weeks
- Previous streptokinase therapy
- Major surgery, trauma, or bleeding within 2 weeks
Major Causes of Chest Discomfort
(Always remember: Worsts First)

*Cardiovascular*
- Acute coronary (ischemic) syndromes
- Aortic dissection
- Pericarditis, especially with effusion/tamponade
- Severe aortic stenosis

*Pleuro-Pulmonary*
- Acute pulmonary embolus
- Pneumothorax

*Gastrointestinal*
- Ruptured esophagus
- Gastric-duodenal ulcers (esp with bleeding or rupture)
- Acute pancreato-biliary syndromes