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Chest Pain
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* *Drug doses are a guide only, always check second source and follow local practice guidelines*

Summary Pearls:

- **A-B-Cs**

- **12 lead ECG in first 10 minutes**
  - **STEMI activation for those with STEMI criteria**

- **Consider Other Lethal Diagnoses:**
  - **Acute Coronary Syndromes**
  - **Pulmonary Embolism**
  - **Thoracic Aortic Dissection**
  - **Boerhaave's syndrome**
  - **Cardiac Tamponade**
  - **Tension Pneumothorax**
  - **Incarcerated (internal) Diaphragmatic Hernia**

- **Disposition according to cardiac risk stratification:**
  - **Accelerated Diagnostic Pathways (ADPs)**
  - **HEART scoring system**

Introduction

Chest pain is the second most common chief complaint in the ED, with over 8 million visits annually in the U.S. alone. The most common critical diagnosis to make is acute coronary syndrome, which ranges from unstable angina to acute STEMI: these account for approximately 1-2 million cases annually in the US. Pulmonary embolism is less common (around 200,000/year in US) but carries a higher mortality. Other much less common but even deadlier causes include thoracic aortic dissection (2,000 cases in US/year), Boerhaave's syndrome (esophageal rupture), incarcerated diaphragmatic hernia, cardiac tamponade and tension pneumothorax.

Chest pain evaluation is challenging but very manageable with the current systems and protocols in place in many hospitals.

When it comes to the sickest patients, those with STEMI in need of urgent revascularization or those with a surgical emergency such as a dissection of the aortic arch, a good system that gets identifies these patients and gets them where they need to go quickly is essential. In some cases, this may involve emergently transporting the patient to a facility with more resources.

Most patients who present with chest pain are actually not that sick and many can be safely discharged from the ED. It is equally important that systems be in place to manage this larger group of patients. Typically they are dealt with in a "tiered" manner, with more testing and longer periods of observation for those with more concerning history and risk factors for coronary artery disease and less testing and quicker discharges home for those with less concerning histories and risk factors.

STEP ONE: RULE OUT IMMEDIATE LIFE THREATS

- Acute ST Segment Elevation Myocardial Infarction (STEMI)
  - Risk factors
    - Classic
      - Smoking, diabetes, hypertension, hypercholesterolemia and family history
    - Other
      - End stage renal disease, lupus, long term steroid use
  - Symptoms
    - Classic presentation is severe pressure-like pain, worse with exertion, that radiates to the jaw, arm or back, accompanied by nausea and vomiting and diaphoresis
    - May present less typically with shortness of breath or even generalized malaise in elderly and in women especially
  - Signs
    - May demonstrate few positive findings on physical exam
    - Findings in setting of STEMI are highly significant
      - A new murmur may represent acute valvular emergency or other mechanical (surgical) complication
      - Crackles on chest auscultation may represent heart failure necessitating aggressive intervention (e.g. IV pressors, intra-aortic balloon pump)
  - Diagnosis
    - 12 lead ECG
    - May only be apparent on second or serial ECGs - repeat frequently until STEMI is ruled out
    - Bedside echocardiography may be used by cardiologists to

help in diagnosis in equivocal cases
- Treatment
  - Emergent revascularization (Code STEMI)
    - Transport to catheterization suite OR IV thrombolytics (tPA)

- **Pulmonary Embolus (PE)**
  - Risk factors
    - Approximately half of patients have no identifiable risk factor
  - Symptoms
    - Classic presentation is sudden onset of severe respirophasic pain associated with shortness of breath
    - Syncope is a big sign - it occurs in a significant percentage of PE
  - Signs
    - Persistent tachycardia is an important sign
    - A decrease in oxygen saturation is also very important
    - Hypotension indicates life-threatening severe right ventricular outlet obstruction and shock
    - May have pleural rub or signs of atelectasis (crackles, wheezes and dullness to percussion) on chest exam
  - Diagnosis
    - Bayesian approach (based on pre-test probability)
      - PE risk is first estimated: high, moderate, low or next to none
      - Several tools are in common use to help do this including "Wells" and "PERC" scores
      - Clinical gestalt has been shown to be equally good
    - D Dimer
      - Very non-specific - elevated in may disease states
      - Used as a screening test in patients with only a low clinical suspicion of PE - positive tests followed by imaging
    - 12 lead ECG
      - Usually non-specific
      - Look for signs of acute right heart strain (see ECG in PE clip)
    - CXR
      - Usually non-specific
      - Look for signs of volume loss (see CXR in PE clip)
    - CTPA
      - Most widely used test to confirm PE, very specific
      - Often shows alternative diagnosis
    - VQ scan
      - Very sensitive for PE
      - May be used in pregnancy or when contrast for CTPA is contraindicated (e.g. in renal insufficiency)
    - Doppler ultrasound
      - May be used to confirm lower extremity deep venous thrombosis in patients in whom pulmonary imaging is not possible
  - Treatment
    - Tiered approached based on severity
    - Patients in shock (BP<90 systolic) are treated similarly to patients with acute STEMI, with IV thrombolytics or interventional Rx via cardiac catheterization

- Treatment may need to begin empirically before the diagnosis of PE is confirmed by imaging in unstable patients with a high clinical suspicion of PE
- More stable patients are placed on heparin or heparin-like agents
- Dosing of heparin (and tPA) is important - assistance by pharmacist is preferable
- If heparin is contraindicated, things get complicated - one option is to place a filter in the IVC to prevent further embolization of DVT to lungs

- **Thoracic Aortic Dissection (TAD)**
  - Risk factors
    - Hypertension, connective tissue disease (e.g. Marfans), late term pregnancy
  - Symptoms
    - Classic presentation is severe tearing or ripping pain radiating to the back with severe distress and diaphoresis
    - May cause signs of infarction/ischemia anywhere along the aorta (arms, legs, bowels, kidneys, brain, spinal cord)
    - Approximately a third of patients have neurologic complaints/findings
    - Syncope is a big sign - it occurs in a significant percentage of TAD
  - Signs
    - Pulse deficits
    - Full exam important to look for other signs of ischemia
    - Jugular venous distention may indicate a cardiac tamponade
    - A new murmur may represent acute aortic regurgitation
  - Diagnosis
    - CXR if low clinical suspicion
    - Bedside US can identify tamponade in proximal dissections
    - Chest CT with contrast most frequently used make definitive diagnosis and define anatomy of dissection
    - ECG may show a STEMI as a result of dissection of coronary ostia
  - Treatment
    - Emergency stabilization
      - BP and pain control
      - Titratable IV narcotics and beta blockers followed by afterload reducers (e.g. IV nitroprusside, nicardipine, fenoldopam) are typical Rx
      - Titrate BP to relieve pain - use arm with higher BP as guide
    - Type A Dissection (involving the aortic arch)
      - Emergency surgery, interventional techniques
    - Type B Dissection (involving the descending aorta only)
      - Often managed non-surgically with strict BP control

- **Boerhaave's syndrome (esophageal rupture)**
  - Think of this diagnosis in alcoholics (who may not give a history of retching) and those with recent procedures
  - Important clinical clues include:
    - Ill appearing, septic and febrile
    - Subcutaneous air (crepitus)

- CXR
  - Left sided pleural effusion
  - May show mediastinal air
- CT Chest will help in defining injury
- Rx: Emergent surgical consult, broad spectrum antibiotics and fluids

- Tension pneumothorax
  - Can occur for many reasons including iatrogenic (e.g. from central lines)
  - Defined by clinical presence of shock and hypoxia
  - Bedside CXR, US can make diagnosis
  - Rx: Do not wait for imaging to insert needle or chest tube

- Cardiac tamponade
  - Defined by clinical presence of shock
  - Bedside US diagnosis
  - Rx:
    - Bolus of fluids
    - US guided bedside pericardiocentesis
    - Transfer to OR, interventional suite radiology suite, open surgery in some cases

- Incarcerated Diaphragmatic hernia
  - CXR, CT Chest will help identify and define
  - Rx: STAT surgical consult

INITIAL STEPS

- Primary survey and vital signs
  - The primary survey is extremely important to identify and treat the life threatening causes of chest pain
    - Jugular venous distention could indicate a backup of cardiac flow in pulmonary embolism, cardiac tamponade or acute heart failure
    - The chest examination should identify cases of tension pneumothorax
    - Pulses should be taken in all extremities - a pulse deficit in any extremity could indicate an aortic dissection

- Cardiac monitor
  - Arrhythmias of all varieties from dead slow to scary fast may accompany any of the serious diagnoses above

- Cardioversion paddles
  - We thus need to be ready to shock or pace critically ill patients with chest pain

- IV access
  - Most adult patients with chest pain will have blood drawn and an IV is usually placed initially for IV medications

- O_2
  - No longer considered a standard therapy - not necessary if O_2 sat >94%

- ECG
  - May be transmitted to ED by paramedics prior to patient arrival
  - Should be performed and interpreted within 10 minutes of arrival (AHA guideline)

- Nitroglycerin (NTG)
  - May be given in the field by oral/sublingual spray or tablet
  - Make sure that you have IV access prior to administering NTG as it may cause dramatic drops in blood pressure
  - Don't give if patient taking medication for erectile dysfunction (e.g. sildenafil - Viagra) in past 2 days
  - Improves anginal chest pain but may also resolve pain from esophageal spasm
  - In STEMI, NTG may not help at all (and may hurt)

- Aspirin (ASA)
  - Give 162 mg PO (crush and swallow) or more unless ASA allergy

- IV Pain Meds
  - Opioids may be titrated to pain, also help with anxiety
    - Consider shorter acting fentanyl in critically ill patients
  - May need to also give something for nausea

- Initial tests
  - CBC, Electrolytes, PT/INR are performed in most cases but not all!
  - Troponin
    - If concern for acute coronary syndrome
    - May need to be repeated as not immediately elevated after myocardial injury/infarction
  - D-Dimer
    - If concern for pulmonary embolism
    - For patients with some (but not no) risk
    - Not for in patients with obvious signs of PE
    - This test has led to an explosion in the number of (mostly negative) CT pulmonary angiograms which are not without risk
  - CXR
    - Should identify pneumonia and pneumothorax
  - CT imaging
    - Protocol may depend on what diagnosis you suspect
      - For PE → CT Pulmonary angiogram (CTPA)
      - For Dissection → CT Chest with contrast
      - Renal insufficiency (elevated creatinine) may complicate decision to administer IV contrast /VQ/ECHO
  - Ultrasound
    - Check for cardiac or pleural effusions
    - In suspected biliary disease, RUQ US is best test
  - MRI
    - Impractical in most cases, but may play a role in selected stable patients

OTHER IMPORTANT DIAGNOSES

- Cholecystitis
  - RUQ US, LFTs
  - Rx: Admit, fluids, NPO, antibiotics

- Esophageal Spasm
  - Clinical + response to Rx
  - Rx: nitrates, calcium channel blockers, GI referral

- Gastroesophageal Reflux
  - Clinical + response to Rx
  - Rx: diet, acid suppression meds

- Herpes Zoster (Shingles)
  - Clinical (dermatomal distribution, skin findings)
  - Rx: acyclovir and derivatives, pain meds

- Pericarditis
  - ECG, troponins, US
  - Make sure it's not a) tamponade risk and b) myocarditis
  - Rx: NSAIDs for viral etiology, follow-up

- Pneumonia
  - CXR
  - Rx: Antibiotics

- Pneumothorax
  - CXR / Bedside US
  - Rx: Heimlich flutter valve, small chest tube

- Pyelonephritis
  - Urinalysis
  - Rx: Antibiotics

DISPOSITION

Cardiac Risk Stratification

- Unless another diagnosis is reached, patients with negative initial testing are generally discharged from the ED according to their level of cardiac risk (e.g. the risk that they really have coronary artery disease that could kill them)

- A new term to describe these systems is Accelerated Diagnostic Pathways (ADPs)

- The HEART score is a 10 point score which includes history, ECG, age, risk factors and troponin. It is a predictor of a major cardiac event in 6 weeks.

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TABLES

1. Wells score for PE risk stratification

- Clinically suspected DVT — 3.0 points
- Alternative diagnosis is less likely than PE — 3.0 points
- Tachycardia (heart rate > 100) — 1.5 points
- Immobilization (≥ 3d)/surgery in previous four weeks — 1.5 points
- History of DVT or PE — 1.5 points
- Hemoptysis — 1.0 points
- Malignancy (with treatment within six months) or palliative — 1.0 points

Traditional interpretation

- Score >6.0 — High (probability 59% based on pooled data)
- Score 2.0 to 6.0 — Moderate (probability 29% based on pooled data)
- Score <2.0 — Low (probability 15% based on pooled data)

Alternative interpretation

- Score > 4 — PE likely. Consider diagnostic imaging.
- Score 4 or less — PE unlikely. Consider D-dimer to rule out PE.

(Modified from Stein PD, et al.)

2. The HEART score for chest pain patients at the emergency department

History	Highly Suspicious	**2**
	Moderately Suspicious	**1**
	Slightly or non-suspicious	**0**
ECG	Significant ST-depression	**2**
	Nonspecific repolarization disturbance	**1**
	Normal	**0**
Age	> 65 years	**2**
	>45 - <65 years	**1**
	< 45 years	**0**
Risk factors	> 3 Risk factors or history of atherosclerotic disease	**2**
	1 or 2 Risk factors	**1**
	No risk factors known	**0**
Troponin	> 3x normal limit	**2**