

Chest Pain: Clinical Decision-Making

I. Chest Pain - The Problem

- A. Represents 5% of ED visits (4,000,000/yr)
- B. Is the chief complaint for a wide range of disease, from the trivial to the critical (Sometimes we can't tell the difference)

II. Differential Diagnosis of Chest Pain

A. Diseases You Can't Afford to Miss

1. Myocardial Infarction (600,000/yr)

- a. We continue to miss about 2-8% of MI's
 - (1) Represents about 14-20% of malpractice \$ loss
- b. Epidemiology
 - (1) 50% of all deaths annually
 - (2) 45% of MI's in people < 65 years of age
- c. WHO Criteria: At least 2 of the following:
 - (1) Ischemic chest discomfort > 30 min
 - (2) EKG evolution: ST waves, Q waves
 - (3) Serum cardiac marker changes
- d. Risk factors for coronary artery disease
 - (1) Family history of coronary artery disease
 - (2) Men, age > 33; Women, age > 40
 - (3) Diabetes mellitus
 - (4) Hypertension
 - (5) Cigarette use
 - (6) Left ventricular hypertrophy
 - (7) Elevated cholesterol blood levels (High LDL/Low HDL/Cholesterol levels)
 - (8) History of chronic cocaine use
- e. Concerning symptoms
 - (1) Chest pain of any character: aching, burning, sharp
 - (2) Isolated pain in back, arm, jaw, shoulder
 - (3) Epigastric pain
 - (4) "Indigestion"
 - (5) "Weakness" or "fatigue"
 - (6) Syncope
 - (7) Diaphoresis
 - (8) Shortness of breath
 - (9) Women more likely to complain of neck pain, back pain or jaw pain (Goldberg, 1998)
 - (10) Men more likely to report diaphoresis (Goldberg)
- f. Traps
 - (1) "Chest wall tenderness" - 8-10% of MI's have it
 - (2) "GI cocktail"

- (3) Nitrate trial
- g. Chest Pain Policy: Acute MI with diagnostic EKG
 - (1) Rules:
 - (a) Assess for thrombolytic or other reperfusion therapy
 - (b) Anticoagulation
 - (c) Aspirin
 - (d) Nitrates
 - (e) Management of ongoing pain
 - (f) Admit
 - (2) Guidelines:
 - (a) Serial serum cardiac markers
 - (b) CXR
 - (c) Cardiac imaging
 - (d) Serial EKGs
 - (e) Mg⁺⁺ therapy if not given thrombolytics
 - (f) Beta blockers
- h. Chest Pain Policy: Low clinical suspicion of MI with nondiagnostic EKG
 - (1) Rules: None
- 2. Unstable Angina
 - a. Presentation
 - (1) New onset of chest pain > 20 mins
 - (2) Chest pain at rest > 20 mins
 - (3) Chest pain at previously tolerated levels of activity
 - (4) Chest pain not relieved by previously effective dose of NTG
 - (5) Chest pain of increased severity, duration, frequency
 - b. Chest Pain Policy: Unstable Angina: Ongoing or Recurrent Ischemia
 - (1) Rules:
 - (a) EKG
 - (b) Anticoagulation
 - (c) Aspirin
 - (d) Nitrates
 - (e) Pain management
 - (f) Admit
 - (2) Guidelines:
 - (a) Serial serum cardiac markers
 - (b) CXR
 - (c) Cardiac imaging
 - (d) Serial EKGs
 - (e) Beta blockers
- 3. Aortic Dissection
 - a. Epidemiology

- (1) Relatively rare (2000/yr)
- (2) 2-3 times more common in males
- (3) Patients usually 50-70 years of age
- b. Risk factors
 - (1) Hypertension
 - (2) Congenital disease of ascending aorta or aortic valve
 - (3) Inflammatory disease of aorta
 - (4) Connective tissue disease
 - (5) Pregnancy
 - (6) Arteriosclerosis
 - (7) Cigarette use
- c. Presentation
 - (1) Sudden, excruciating chest pain
 - (2) Often "tearing" and radiating to back
 - (3) May have neurologic abnormalities, CHF, syncope
 - (4) May have BP differential between arms
 - (5) May have murmur of AI
- d. Diagnostic options
 - (1) CXR: Rarely diagnostic
 - (2) Angiography: traditional gold standard
 - (3) Transesophageal echocardiography: can be done at bedside
 - (4) CT: May make diagnosis but often more info needed
 - (5) MRI: May present emergent logistic problems
- e. Strongly consider medical Rx before Dx
 - (1) Beta blockers **then** nitroprusside
- f. Chest Pain Policy: Aortic Dissection
 - (1) Rules
 - (a) Blood type and crossmatch
 - (b) EKG
 - (c) Management of BP/contractility
 - (d) Management of ongoing pain
 - (e) Immediate surgical consultation
 - (f) Admit
 - (2) Guideline: Aortic imaging
4. Pericarditis
 - a. Risk factors
 - (1) Infection (eg, tuberculosis, viral)
 - (2) Autoimmune/systemic disease (eg, lupus erythematosus)
 - (3) Acute rheumatic fever (autoimmune)
 - (4) Recent MI or cardiac surgery
 - (5) Malignancy
 - (6) Radiation therapy to mediastinum
 - (7) Uremia

- (8) Drugs (Procainamide, Hydralazine, INH, etc)
- (9) History of a prior episode of pericarditis
- b. Sharp, central chest pain
- c. Pain worse recumbent; better leaning forward
- d. Pericardial friction rub is pathognomonic (LLSB)
- e. EKG findings
 - (1) Diffuse concave-upward ST segment elevation
 - (2) Sometimes PR-segment depression
- f. ? Cardiac echo to evaluate for effusion
- 5. Cardiac Tamponade
 - a. Chest pressure/discomfort with SOB
 - b. May see elevated JVP, hypotension, tachypnea, narrow pulse pressure, pulsus paradoxus
 - c. May see electrical alternans on EKG
 - d. Echocardiography is diagnostic (ED or formal US)
- 6. Pulmonary Embolus
 - a. Epidemiology
 - (1) 650,000 diagnosed cases/year
 - (2) Approx 10% mortality
 - (3) 28% of patients < 40 with PE have no risk factors
 - b. Risk factors
 - (1) Prolonged immobilization
 - (2) Surgery lasting >30 minutes within the last 3 months
 - (3) History of DVT or pulmonary embolus
 - (4) Malignancy
 - (5) Pregnancy or recent pregnancy
 - (6) History of pelvis or lower extremity trauma
 - (7) Oral contraceptive use combined with cigarette smoking
 - (8) Congestive heart failure
 - (9) Chronic obstructive pulmonary disease
 - (10) Obesity
 - (11) Hypercoagulability (Antithrombin III deficiency, etc)
 - c. Presentation
 - (1) 96% will have either dyspnea, pleuritic pain or tachycardia
 - (2) Sx: Chest pain (88%), dyspnea (84%), apprehension/anxiety (59%), syncope (13%)
 - (3) Findings: RR > 16 (92%) [but who counts, anyway], rales (58%), HR > 100 (44%), Temp > 37.8 (43%)
 - d. Diagnostic Modalities:
 - (1) CXR - Usually non-contributory
 - (2) EKG - May see sinus tach or rarely S1-Q3-T3
 - (3) V/Q Scan - 85% Sensitive. Must interpret in light of your pre-test probability.
 - (4) Pulmonary angiogram - Still the gold standard: 96-98%

- sensitive and specific
- (5) Helical CT - Becoming more popular. Sensitivity close to V/Q. Will it replace it?
- (6) MRI - Under evaluation. May prove quite useful.
- (7) Lower extremity doppler ultrasound - Helpful if positive. Not helpful if negative.
- (8) D-Dimer - Degradation product of fibrin. Disagreement about utility at this time.
- (9) ABG - 10-15% have normal A-a gradient. Little utility unless pre-test probability is very low.
- e. Chest Pain Policy: Pulmonary Embolus
 - (1) Rules:
 - (a) ABG/oximetry
 - (b) CXR
 - (c) ECG
 - (d) Anticoagulation
 - (e) Admit
 - (2) Guidelines:
 - (a) Assess for thrombolytic therapy
 - (b) Venous imaging
 - (c) Consult for filter placement if recurrent PE
- 7. Pneumothorax
 - a. Risk factors
 - (1) History of previous pneumothorax
 - (2) Valsalva maneuver
 - (3) Lung disease (obstructive, cancer, infection, connective tissue disease)
 - (4) Cigarette use
- 8. Acute Chest Syndrome of Sickle Cell Disease
 - a. Adult presentation (Vichinsky, 1997)
 - (1) Chest pain: 84% (Severe, 44%)
 - (2) Fever: 64%
 - (3) Cough: 63%
 - (4) Shortness of breath: 47%
 - (5) Chills: 39%
 - (6) Diagnosis made by new infiltrate on CXR
- 9. Esophageal Rupture (Boerhaave's Syndrome)
 - a. Violation due to
 - (1) Forceful emesis (most common outside hospital)
 - (2) Foreign body
 - (3) Penetration
 - (4) Chemical necrosis
 - b. Presentation
 - (1) Severe chest pain, usually pleuritic

- (2) Dyspnea, SOB, cyanosis
 - (3) Odonophagia
 - (4) Pain on neck flexion
 - (5) Pale, diaphoretic, severely ill appearing
 - (6) Subcutaneous emphysema
 - (7) Hamman's crunch
 - (8) CXR: May see pneumomediastinum, pleural effusion, pneumothorax, widened mediastinum
 - c. Undiagnosed, is uniformly fatal
- B. Diseases You Would Like Not to Miss
- 1. Pneumonia
 - a. Risk factors
 - (1) Chronic lung disease
 - (2) Altered consciousness/impaired gag reflex
 - (3) Neuromuscular disease
 - (4) Thoracic cage deformity
 - (5) Cigarette use
 - (6) Preceding viral respiratory infection
 - (7) Immunodeficiency
 - 2. Esophageal Disease (Spasm, Reflux, Inflammation)
 - 3. Peptic or Gastric Ulcer (with or without perforation)
 - 4. Cholecystitis
 - 5. Early Disseminated Lyme Disease
 - May present with chest pain, syncope, dizziness, SOB, A-V block
- C. Benign Diagnoses (Relatively)
- 1. Panic Disorder
 - a. Intense fear accompanied by chest pain, dyspnea, nausea
 - b. Seen in 30-50% of patients with chest pain and normal coronary arteries (Tueth, 1997)
 - 2. Depression
 - 3. Herpes Zoster
 - 4. Hyperventilation
 - 5. Chest Wall Pain / Costochondritis
- D. Zebras
- 1. Gastric Anisakiasis after eating raw saltwater fish
 - 2. Thoracic endometriosis
 - 3. Delayed rupture of splenic hematoma

III. Making the Diagnosis of Myocardial Infarction

- A. History
 - 1. Worry more: males, older, h/o MI, pain > 1 hour, diaphoresis
 - 2. Worry less: "sharp" pain, age < 40
- B. Physical Examination
 - 1. Worry more: rales

C. EKG

1. 50-60% of AMI patients will have diagnostic changes
2. Normal or non-diagnostic EKG -> low risk patients
3. Comparison with old EKG may not change admission decision, but may change level of acuity
4. Abnormalities:
 - a. ST-T elevation > 1mm in standard pattern
 - b. Q waves (.04 sec, 1/3 height of R wave) (except in III)
 - c. T wave inversion (unless only in III or V1)
 - d. Hyper-acute T waves in 2 or more leads
 - e. LBBB (even if old), in light of ischemic pain should be treated aggressively
 - f. Suspect RV infarction with distended neck veins & clear lungs: ST-T elevation of >1mm in V4R is diagnostic
5. Increased sensitivity thru automated serial 12-lead EKG (Fesmire, 1998)

D. Serum Markers

1. Which Ones

- a. CK - not used by itself
- b. CK-MB total activity (IU/ml)
- c. CK-MB mass (ng/ml) - The current gold standard
- d. CK-MB Index (CK-MB mass / CK total activity)
- e. CK-MB Subforms - In development
- f. Myoglobin - Sensitive but not specific; narrow window
- g. Troponin-T - Very sensitive; may help risk-stratify unstable angina
- h. Troponin-I - Most specific for cardiac injury
- i. Combining markers, eg myoglobin/CK-MB mass
- j. Delta measurements: Ongoing work to evaluate utility of rise in marker value while still in normal range

2. Problems with comparing serum marker studies

- a. Assay under evaluation often used as dx criterion of AMI
- b. Inconsistencies in cut-off values used for marker
- c. Wide variation in populations studied
- d. Few studies are outcome-based

3. Clinical Policies Committee Evidence-Based Assessment

E. Neural Networks

1. Network is trained
2. Network establishes its own decision basis
3. Feedback over time can improve decision process
4. Significant potential
5. Shortcomings
 - a. Individual diagnosis based
 - b. Each system a different interface

- c. Feedback of local data probably required
- 6. Baxt's Data: 1070 patients
 - a. 21 Data points for diagnosis of AMI
 - (1) Current Hx: Age, sex, left anterior location of pain, radiation of pain, nausea and vomiting, sweating, faintness, SOB, palpitations, response to NTG
 - (2) Past Hx: AMI, angina, diabetes, hypertension
 - (3) Physical Examination: JVD, rales
 - (4) EKG: 2mm ST elevation, 1mm ST elevation, ST depression, T wave inversion, significant ischemic change
 - b. Physicians: Sensitivity: 73% Specificity: 81%
 - c. Neural Network: Sensitivity: 96% Specificity: 96%
- F. Ancillary Studies
 - 1. Exercise Tolerance Test (ETT)
 - a. Least expensive
 - b. Most available
 - c. Can be utilized as part of a "rapid r/o" protocol
 - d. Only 65-70% sensitivity for CAD
 - 2. Stress Echocardiography
 - a. Intermediate expense
 - b. Operator dependent
 - c. About 80% sensitive for CAD
 - d. Availability?
 - 3. Thallium Perfusion Scan
 - a. Short window due to rapid wash-out
 - 4. Sestamibi
 - a. Better image, 1-2 hour window
 - b. May be as sensitive as stress echo but needs more study
- G. Special Cases
 - 1. The Elderly
 - 2. Cocaine-Chest Pain

IV. Management Plan for Cardiac Chest Pain

- A. Risk Stratification
 - 1. High Risk
 - a. Ischemic or new EKG findings
 - b. Ongoing chest pain
 - c. Abnormal vital signs
 - d. Rales
 - 2. Moderate Risk
 - a. Nondiagnostic EKG
 - b. Symptoms > 20-30 minutes, now resolved
 - 3. Low Risk
 - a. Normal EKG

- b. Symptoms < 20-30 minutes, now resolved
- B. Evaluation, including EKG must be prompt
- C. Infarcting
 - 1. Have a standard procedure
 - 2. Lytics: Fair evidence: up to 6 hrs, delay increases infarct size
 - 3. Angioplasty
- D. Who to admit where?
 - 1. High risk: CCU
 - 2. Medium/Low risk: Telemetry/Chest Pain Observation
 - a. Immediate Exercise Testing in Low Risk Pts (Kirk, 1998)
 - b. Immediate Myocardial Perfusion Imaging in Low Risk Pts (Tatum, 1998)
- E. ED Chest Pain Evaluation Units
 - 1. Pros
 - a. More rapid throughput of low risk chest pain patients
 - b. More cost-effective evaluation of same
 - c. An additional alternative to admission or discharge
 - d. Additional service line for ED
 - e. Potential for improved patient satisfaction (Rydman, 1997)
 - 2. Cons
 - a. Additional responsibility and effort for emergency physicians
 - b. Potential for lost revenue for hospital
 - c. Potential for higher charges for patients admitted to hospital after evaluation unit stay
 - d. Potential requirement for capital improvement and increased staffing
 - e. Potential for inappropriate use as disposition
 - 3. Requirements
 - a. Interdisciplinary planning
 - b. Location, monitoring/resuscitation equipment
 - c. Appropriate staffing
 - d. Protocol driven
 - 4. Clinical Policies Committee Evidence-Based Assessment
- F. Chest Pain Observation Unit - Our Experience
 - 1. 3 years - About 540 patients; 12+ hours/day
 - 2. Mean OBS LOS: 10.7 hours (Ward-Tele: 40 hours)
 - 3. Charge savings over telemetry admissions: \$200,000 / year
 - a. Is this lost revenue?
 - 4. Criteria for admission
 - a. Normal or unchanged EKG
 - b. No previous objective evidence for CAD
 - c. Age < 80
 - d. No evidence for CHF
 - e. No malignant dysrhythmias in ED

- f. (Lack of pain is **not** an admission criterion)
- 5. Procedure
 - a. VS Q4H, cardiac monitor; rhythm strip Q4H; pulse oximetry; nasal canula oxygen at 2 l/min
 - b. CK/CK-MB at ED admission and 8 hours later
 - c. EKG at ED admission and 6 hours later
 - d. Patient seen by cardiology prior to discharge
- 6. 1997 Data:
 - a. Admitted from chest pain OBS: 15%
CCU: 8% Tele: 4% Ward (Non-Tele): 3%
 - b. Home/jail/nursing home: 79%
 - c. Left AMA: 6%
 - d. Sample of 30 consecutive chest pain OBS patients:
 - (1) 90% had cardiology consult
 - (2) 10% left AMA without consult
 - e. Sample of 31 consecutive Tele R/O admits
 - (1) 45% had cardiology consult
 - (2) 55% had no consult (none left AMA)
- 7. Have we lowered the bar too much for a cardiac workup?

V. Documentation of the Chest Pain Visit

- A. The Minimum (HCFA & JCAHO not withstanding) (ACEP, 1995)
 - 1. Character of pain
 - 2. Age
 - 3. Associated symptoms
 - 4. Past history
 - 5. Vital signs
 - 6. Cardiovascular exam
 - 7. Pulmonary exam
- B. When MI is in the Differential
 - 1. Pain: Quality, onset/duration, location, radiation, made worse by, made better by
 - 2. Associated symptoms: Diaphoresis, nausea/vomiting, SOB/DOE, fatigue, syncope
 - 3. Past cardiac history, risk factors (above)
 - 4. Vital signs
 - 5. Cardiovascular exam: JVD, heart (rhythm, murmurs, gallops)
 - 6. Pulmonary exam (rales, wheezes)
 - 7. Extremities: peripheral edema
 - 8. EKG, CXR
- C. Other additional documentation based on diagnostic suspicion
- D. Dictated versus written charts (Cole, 1995)
 - 1. 28 "critical" items for chest pain evaluation
 - a. Dictated charts: 19.6±4.0

- b. Written charts: 15.8 ± 4.0 ($P < .001$)
- E. The Discharged Chest Pain Patient
 - 1. Are your discharge instructions adequate?
 - 2. Is your record completed at the time of discharge?
 - 3. Re-read your record in your head from the witness stand
 - a. Is your record consistent with the chief complaint, the triage note and the nurses notes?
 - b. Does your record support your diagnosis and disposition?
 - c. "Not documented, not done"
 - d. Does your record address those things we can't afford to miss?
 - e. If you don't think it's cardiac (or other problems you can't afford to miss), say so
 - 4. How does your ED deal with patient phone calls?
 - 5. We lose the most \$ on the youngest MI's
- F. AMA patients require special care and documentation
 - 1. Don't get into an ego-duel
 - 2. Provide the best treatment and follow-up you can
 - 3. Explain the life threat
 - 4. Carefully document the refusal of care
 - 5. If you have an AMA form, fill it out **completely**
 - 6. Use a second person witness; family member is best
 - 7. Always offer future care

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