

## Case for the week of 4/8/2013 - 4/14/2013

| Time    | Patient Name   | Age  | Type    | Notes      |
|---------|----------------|------|---------|------------|
| 9:40 AM | Payne, Charles | 60 M | WALK-IN | Chest pain |

\*NOTE: This is not a real patient!

A 60-year-old man with hypertension and asthma presents for evaluation of a 4-month history of chest pain. He describes the pain as left-sided, mild in intensity, and burning in character. It occurs both with exertion and inactivity, and it is relieved by rest and eating. Episodes typically last for 10-15 minutes. He denies shortness of breath, leg swelling, or palpitations.

His asthma symptoms are generally controlled with inhaled fluticasone and as-needed albuterol, which he uses frequently. He states that he is capable of jogging across the length of his neighborhood if he pretreats himself with albuterol.

**PMH:**

HTN  
Asthma since 8yo  
Hyperlipidemia  
Laparoscopic cholecystectomy  
@ 55yo (gallstones)

**Meds:**

Aspirin 81 mg daily  
Lisinopril 40 mg daily  
Chlorthalidone 25 mg daily  
Metoprolol succ 25 mg daily  
Spironolactone 25 mg daily  
Pravastatin 40 mg QHS  
Fluticasone 250 mcg inh BID  
Albuterol 90 mcg MDI inh PRN

**Soc Hx:**

30 pack-year smoker  
1-2 drinks/week  
No drugs  
Carpenter

**ROS:**

(-) acid reflux  
(-) cough, (-) fever

**Allergies/ADR's:**

Amlodipine (edema)

**Fam Hx:**

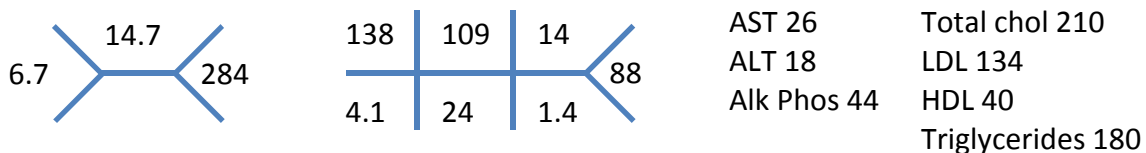
Father: MI @ 60yo

**Exam:**

VS: T 36.4 HR 72 BP 112/72 RR 16 SpO<sub>2</sub> 98% (RA) BMI 28.6  
Gen: NAD  
CV: Normal S1S2, RRR, no M/R/G, apical impulse normal  
CVP 6 cm, no pedal edema, pulses full throughout  
MSK: No chest wall tenderness  
Resp: Easy work of breathing, lungs CTAB, no wheezing  
GI: Abdomen soft, NT/ND, NABS, no HSM

**Data:**

From 3 months ago:

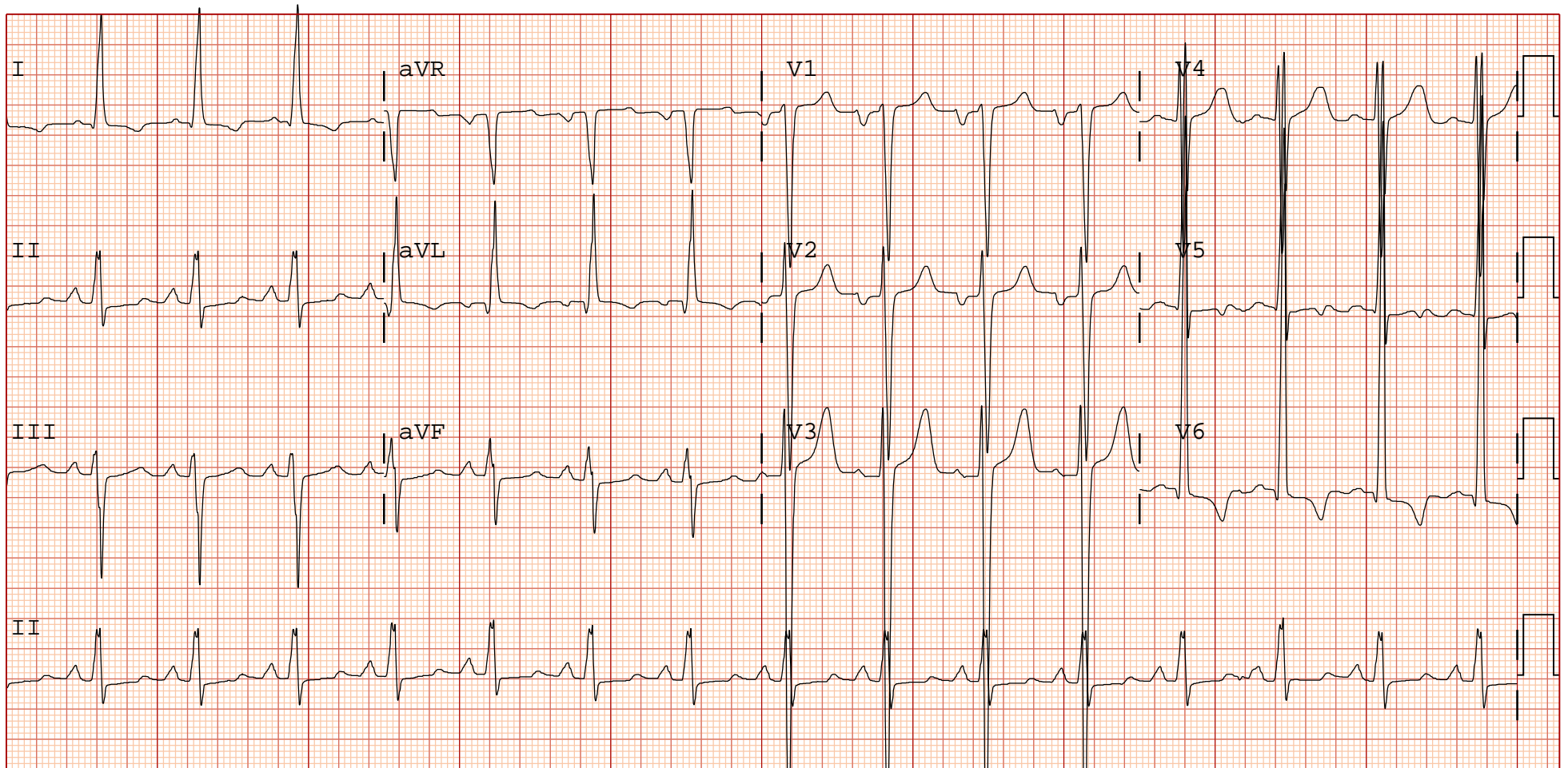


TTE (2 years ago): no wall motion abnormalities, normal LVEF, severe LVH.

ECG: obtained today in clinic (see next page.). No priors available.



**NOTE: To view this ECG properly, please click the DOWNLOAD or PRINT icon on the TOP-LEFT within the Google Docs window.**



Which of the following is the MOST APPROPRIATE diagnostic test for evaluating his chest pain?

- A. Exercise (treadmill) ECG stress test
- B. Exercise stress echocardiography
- C. Dobutamine stress echocardiography
- D. Dipyridamole (Persantine) thallium perfusion stress test
- E. Coronary angiography

In preparation for his study, which of the following is the MOST IMPORTANT recommendation to make?

- A. Avoid caffeine for 12-24 hours before the study
- B. Stop aspirin for 7 days before the study
- C. Stop beta blocker for 48 hours before the study
- D. Hold lisinopril on the morning of the study
- E. Drink plenty of water the day before and immediately after the study

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**Answers:**

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**Discussion Points:**

1. This high-risk patient's recent chest pain, though atypical in description, warrants further evaluation.

2. His ECG is notable for severe LVH causing intraventricular conduction delay (QRS duration > 100ms), secondary repolarization abnormality, pronounced left atrial abnormality, and left axis deviation.

- His ST-segment and T-wave abnormalities are characteristic of a **secondary repolarization abnormality** resulting from severe, longstanding ventricular hypertrophy. Note that his T- and ST- vectors are positioned generally opposite to his major QRS vector (i.e., his T wave deflection is generally negative in leads where the QRS is positive, and it is generally positive when the QRS deflection is negative.).
- The q waves in the lateral leads are typical of “**septal q waves found in severe ventricular hypertrophy**.” Remember that within the QRS complex, the Q wave represents septal depolarization, which is difficult to visualize on most normal ECG’s because its electrical footprint is relatively small. In patients with severe LVH or RVH, septal depolarization often becomes easier to visualize due to greater mass within the muscular septum; this more noticeable q wave is termed the septal q.

Septal q waves are most noticeable in leads containing the tallest R deflection. In patients with LVH, these are typically the lateral leads, especially aVL. With RVH, septal q waves are more noticeable in leads oriented across the hypertrophied right ventricle, i.e., V1 and the inferior leads, especially III.

3. The simplest way to conceptualize the different cardiac stress test options available is to think of a stress test as being a combination of two components: **1) a “stressor,”** and **2) a diagnostic modality.**

- The 3 “stressor” options:
  - 1) **exercise** (preferred in patients who are capable)
  - 2) **a vasodilator agent** (e.g., **adenosine**, or **dipyridamole** [Persantine])
  - 3) **a sympathomimetic (chiefly, dobutamine**, which is sometimes used with atropine)
    - Pharmacologic agents can be combined with milder forms of exercise, e.g., arm or leg exercises
- The diagnostic modality options:
  - 1) **ECG alone** (for exercise ECG testing)  
or ECG PLUS any of the following imaging:
    - 2) **Transthoracic echocardiography** (used with exercise and/or dobutamine)
    - 3) Nuclear myocardial perfusion imaging (MPI): **SPECT** (AKA Tc-99m sestamibi or thallium) or **PET** (AKA rubidium)
      - Used with exercise and/or vasodilator (e.g., adenosine or dipyridamole) to visualize cardiac perfusion
    - 4) **Cardiac MRI** (used with vasodilator or dobutamine)
- Thus, we can derive *Persantine thallium, dobutamine stress echo, adenosine PET, exercise thallium*, and so on.

**Table 1.** Sensitivity and Specificity of Noninvasive Stress Tests for the Diagnosis of Coronary Artery Disease.

| Noninvasive stress test               | Sensitivity | Specificity |
|---------------------------------------|-------------|-------------|
| Exercise electrocardiography          | 0.68        | 0.77        |
| Exercise SPECT                        | 0.87        | 0.73        |
| Adenosine SPECT                       | 0.89        | 0.75        |
| Adenosine PET                         | 0.89        | 0.86        |
| Exercise echocardiography             | 0.86        | 0.81        |
| Dobutamine echocardiography           | 0.82        | 0.84        |
| Dobutamine magnetic resonance imaging | 0.89        | 0.84        |
| Adenosine magnetic resonance imaging  | 0.84        | 0.85        |

PET = positron emission tomography; SPECT = single-photon emission computed tomography

Adapted from Cassar A, Holmes DR Jr, Rihal CS, Gersh BJ. Chronic coronary artery disease: diagnosis and management. Mayo Clin Proc. 2009 Dec;84(12):1130-46.

4. Patients capable of exercise should preferentially undergo exercise-based stress testing, which provides information about exercise tolerance and exercise hemodynamics, rather than pharmacologic stress testing.
  - **Exercise ECG testing is lower-cost and recommended in most, except those with baseline ECG findings that may interfere with test interpretation** (e.g., ST-T abnormalities due to LVH, LBBB, ventricular pacing, digoxin, and others).
  - Patients with baseline ECG abnormalities should instead undergo stress testing using an imaging modality, e.g., echocardiography or nuclear MPI.
5. Pharmacologic stress testing is primarily performed in patients who are unable to tolerate exercise, though in some select situations, it may be preferred over exercise testing (e.g., preference for vasodilators in LBBB or ventricular pacing).
  - **Vasodilator stress agents include adenosine, dipyridamole (Persantine), and regadenoson.** They induce coronary vasodilation and are used to visualize myocardial perfusion defects.
    - They should be avoided in patients with hypotension, AV block, and in those already taking vasodilators.
    - Adenosine and dipyridamole should also be avoided in patients with bronchospastic airway disease.
  - Alternately, **dobutamine** is used for its inotropic and chronotropic properties in patients who cannot perform exercise. Atropine is also occasionally added in order to increase effects on heart rate.
    - Contraindications to dobutamine include uncontrolled HTN, recent ACS, history of VT.

6. Though our patient is capable of exercise, because his baseline ECG has a pronounced secondary repolarization abnormality, exercise ECG testing is not an option. Of the remaining choices, only exercise echocardiography—the correct answer—is exercise-based. An exercise-based alternative would be an exercise SPECT (or exercise thallium); this option was not given.

Because he has reactive airways disease, dipyridamole (Persantine) perfusion imaging should be avoided.

Coronary angiography would be indicated in this patient if he were having ACS, if his stress test returned positive, or if he had other convincing evidence of ischemic heart disease (e.g., wall motion abnormality on TTE). He lacks these.

7. Beta blockers reduce cardiac work by decreasing heart rate, contractility, and BP. They should be avoided before stress testing, especially exercise and dobutamine testing.
- Calcium channel blockers and nitrates have anti-anginal properties and should also be avoided before stress testing.
  - Ideally, the medication should be withheld for sufficiently long to permit reversal of its physiologic effects.
8. Methylxanthines such as caffeine may decrease the sensitivity of vasodilator-based (e.g., adenosine, dipyridamole) stress testing and should be avoided before these studies.

**Reference for further reading:**

Cassar A, Holmes DR Jr, Rihal CS, Gersh BJ. Chronic coronary artery disease: diagnosis and management. *Mayo Clin Proc.* 2009 Dec;84(12):1130-46.

Emory Pubmed link: <http://www.ncbi.nlm.nih.gov.proxy.library.emory.edu/pubmed/19955250>