

Noninvasive Screening: Vittoria's Fear of CAD



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Presented at Cardiology Update, October 2005

Meet Vittoria

- Vittoria, 51, is in a high-pressure executive position.
- She has a family history of premature coronary artery disease (CAD).
- She recently discontinued her one pack-a-day smoking habit.
- Vittoria has been on effective treatment for elevated lipids and hypertension for two years.
- She wants to know her risk level for CAD and she wants to know how she can avoid her family history.



How should you proceed?
Go to page 25 to find out.

Formal exercise testing for the diagnosis of coronary artery disease (CAD) began 70 years ago with the Master's two-step exercise test. Currently, we have a wealth of noninvasive tests, some requiring highly advanced technology, to assist the clinician in the assessment of patients with known or suspected CAD.

Bayes theorem

Before choosing a test for an asymptomatic patient, one must look to the Bayes theorem. The theorem states that the predictive value of any test depends on the sensitivity and specificity of the test and on the prevalence of the condition in the population being tested. For example, Figure 1 illustrates how there will be a large number of false positive results in a low CAD prevalence population when using electrocardiographic stress testing. Consequently, there will be a poor predictive accuracy for the test.

Noninvasive tests for CAD diagnosis

Table 1 lists some of the available noninvasive stress tests for the diagnosis of CAD. The stress mechanism used to test for CAD can be exercise-based, pharmacologic or pacing-based. To detect ischemia, a physician can rely on:

- electrocardiography,
- wall motion or myocardial perfusion using echocardiography,
- nuclear studies, or
- magnetic resonance imaging.

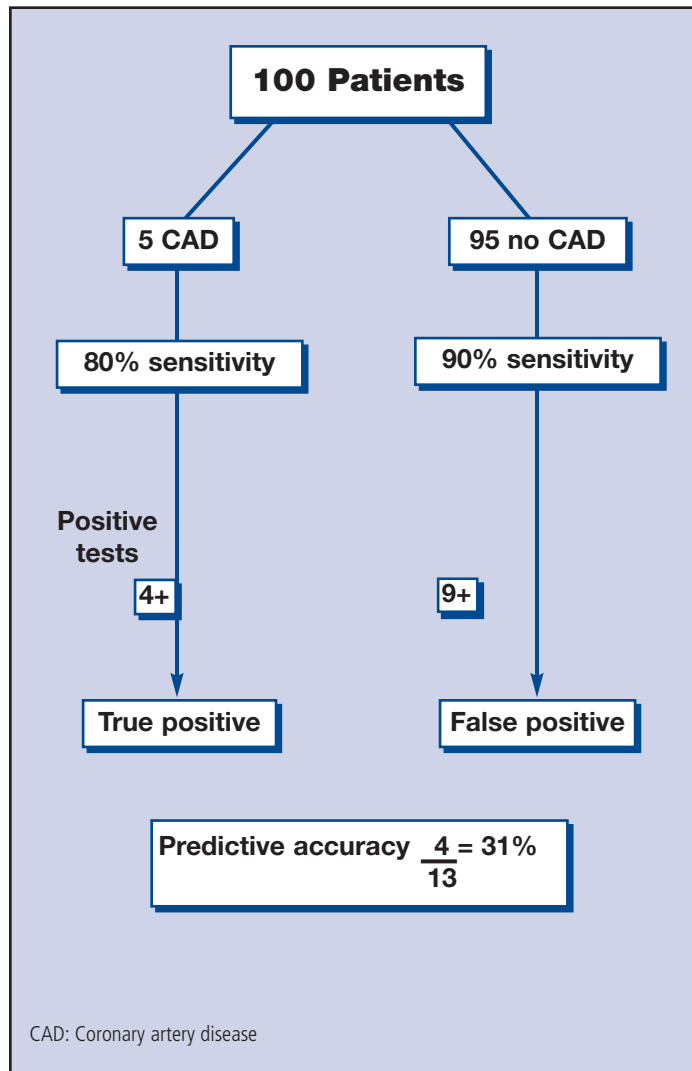


Figure 1. Predictive accuracy of electrocardiographic stress testing in a low prevalence CAD population.

Table 1

Stress tests for CAD diagnosis

- Electrocardiographic treadmill or bicycle exercise test
- Exercise stress echocardiography (Echo)
- Dobutamine stress echocardiography
- Cardiac pacing echocardiography
- Exercise myocardial perfusion SPECT
- Dipyridamole or adenosine myocardial perfusion SPECT or PET

CAD: Coronary artery disease
SPECT: Single photon computed emission tomography
PET: Positron emission tomography

The choice of a specific stress method used to test for CAD depends on:

- patient characteristics,
- local availability of new technologies,
- local interpretive expertise and
- the diagnostic question that needs to be answered.

Electrocardiographic treadmill testing is the least expensive stress test and provides a large amount of correlative clinical outcome information. However, the treadmill test is less sensitive and less specific than more sophisticated technologies.

An exciting recent addition to the list of noninvasive tests to diagnose CAD is the advent of techniques for the noninvasive imaging of coronary arteries (Table 2).

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Answering Vittoria

- Using the Framingham risk score, the estimated 10 year risk for a major coronary event in Vittoria is in the intermediate category at 10%.
- Vittoria underwent a treadmill exercise test with electrocardiographic monitoring and stopped because she felt fatigued and dyspneic. She exceeded her target heart rate and reached an exercise level of 7 METS with no ST depression on the electrocardiogram. This response reduces her 10 year risk for major coronary events from 10% to 5%. An ischemic response would have increased her risk to 33%.
- The appropriate management for Vittoria is to continue the treatment of risk factors for atherosclerosis. An early positive response by electrocardiographic criteria (< 5 METS of exercise) would have justified going on to an imaging stress test (*i.e.*, stress echocardiogram or nuclear study) and if found to be consistent with multi-vessel coronary disease, coronary angiography and revascularization would need to be considered.

Table 2

Noninvasive imaging techniques for diagnosing CAD

- Multi-slice spiral computed tomography (MSCT)
- Coronary magnetic resonance angiography (MRA)
- Electron-beam computed tomography (EBCT)

High quality noninvasive coronary imaging

The Holy Grail for noninvasive diagnosis of CAD is the high quality coronary angiogram obtained without the need for coronary artery catheterization. Functional tests are also important but are less specific, especially when there are confounding variables such as:

- valve disease,
- cardiomyopathy,
- cardiac conduction disturbance,
- drug therapy and
- female gender.

When compared with invasive coronary angiography, multi-slice spiral computed tomography has a reported 82% to 100% sensitivity and 78% to 98% specificity for coronary artery stenosis which is at least 50% of lumen diameter. Its greatest strength is a negative predictive value of 95% to 97%. Up to this point, cardiovascular resonance angiography (MRA) has been less accurate in depicting the degree of stenosis, but one of its very promising possibilities is the localization of vulnerable plaques by using markers which attach themselves to macrophages in inflamed plaques. This could predict the future risk for an acute coronary syndrome due to plaque rupture of non-flow limiting coronary lesions. Electron beam computed tomography (EBCT), which utilizes a coronary calcification score, is a sensitive test for detecting coronary atherosclerosis that has become popular, especially where self-referral for this test is allowed. Its role in the armamentarium of diagnostic tests for the noninvasive detection of CAD awaits further clarification with long-term clinical outcome studies.

Choosing the most appropriate noninvasive test for CAD

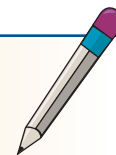
Choosing the most appropriate noninvasive test will depend on the diagnostic question posed by your patient. If the purpose of testing is to determine whether coronary disease is the cause of a dilated cardiomyopathy, then delineating the coronary anatomy on a multi slice spiral computed tomography would answer the question. On the other hand, if the question is how to assess the risk of future coronary events in a patient who has recovered from a recent MI, then a functional test such as a treadmill electrocardiographic exercise test can provide prognostic information in a relatively simple and cost effective manner. If the purpose of the test is to assess the risk of perioperative cardiac events in a patient with peripheral vascular disease and claudication, a pharmacologic stress test such as a dobutamine stress echocardiogram or dipyridamole perfusion scan would be indicated. For screening asymptomatic patients at low or intermediate risk for coronary events, a safe, accurate and cost effective investigation is required.

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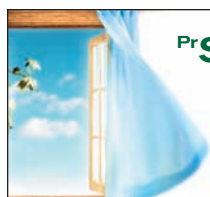
Additional Reading

1. Greenland P and Gaziano JM: Selecting asymptomatic patients for coronary computed tomography or electrocardiographic exercise testing. *N Engl J Med* 2003; 349(5):465-73.
2. Escolar E, Weigold G et al: New imaging techniques for diagnosing coronary artery disease. *CMAJ* 2006; 174(4):489-95.

Take-home message



- We have at our disposal a wide variety of noninvasive tests for diagnosing coronary artery disease (CAD).
- The electrocardiographic stress test has been available for a longer period of time than coronary angiography. Furthermore, it provides the most extensive correlative clinical outcome data.
- Echocardiographic and nuclear stress tests have superior sensitivity and specificity but are more technically demanding and more expensive.
- A recent exciting diagnostic advance has been the advent of noninvasive coronary artery imaging with methods such as multi-slice spiral computed tomography and cardiac magnetic resonance angiography.
- The physician's role is to select the most appropriate test to answer specific clinical questions that will have a positive impact on patient outcome in a safe and cost effective manner.



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