



NONINVASIVE CARDIAC EVALUATION

Since cardiovascular disease is the number one cause of death in individuals older than 40 years of age, tests to determine the presence of coronary artery disease before it causes a heart attack or death are practical and important. To date, no one test exists that is perfect in this role, and even the gold standard of invasive cardiac catheterization has its pitfalls (see Coronary Artery Disease - A New Paradigm from FYI July 2006). However, we do have a wide array of tests that are helpful in determining the presence of significant coronary artery disease before it becomes symptomatic. In addition, newer tests are being developed which will make the goal easier to attain in the future.

The oldest of all cardiac tests is the resting electrocardiogram (EKG). However, it is quite insensitive in picking up heart disease. For this reason, various forms of stress testing have been developed. In the initial stress test, an individual was exercised (initially with stairs, later with treadmills and bicycles) and the EKG was observed to see if any characteristic changes developed. Currently, the treadmill stress test is extensively used to screen individuals for heart disease and also to monitor the progress of individuals with known coronary artery disease. However, the treadmill stress test is not very sensitive for picking up mild to moderate coronary artery disease, and has at best, a 75% ability (sensitivity) to pick up significant disease. Also, the specificity is not extremely good, meaning that in low-risk individuals (such as young females) you may have more false-positive tests than you do true positive tests.

For this reason, other parameters are observed to obtain further prognostic information from the treadmill stress

test. The blood pressure response is noted, and a drop in blood pressure with exercise may indicate coronary disease while an exaggerated elevation of blood pressure signifies a tendency towards hypertension. The heart rhythm is also observed, and certain types of rhythm disturbances may also indicate underlying heart disease. Recently it was even found that if the heart rate does not decrease by more than 12 beats per minute within one minute of stopping exercise compared to the maximal heart rate during exercise, there is increased chance of heart disease. Also, it is very important to note a person's exercise tolerance. Next to the EKG tracings themselves, how far one walks on the treadmill gives the next most important piece of prognostic information. Individuals who have abnormalities developing at a high exercise tolerance (12 minutes or longer) have a good prognosis while individuals with poor exercise tolerance have a poor prognosis. This is especially true in older individuals, where the duration of their exercise tolerance is extremely valuable. Individuals who cannot walk for more than four minutes do poorly, regardless of any other changes that are noted.

In an effort to improve the sensitivity and specificity of the treadmill stress test, various types of nuclear scans have been developed and are to be done in association with a treadmill stress test. These myocardial perfusion scans use various radioactive isotopes (such as thallium, technetium and sestamibi), which are injected intravenously as part of the test. The nuclear scan machines can then form an image of the heart, showing areas of old myocardial infarction and also areas of reversible ischemia. Reversible ischemia refers to areas of the heart muscle that are inadequately perfused because of obstructed coronary arteries. MUGA scans can also be done that give information about wall motion abnormalities and to calculate the ejection fraction or pumping power of the heart. As a result of these various scans, the sensitivity of the treadmill stress test for picking up significant disease has increased up to 80-85%, as well as increasing the specificity and elimination of false positive tracings.

Another variation of the stress test is stress echocardiography. Here, an echocardiogram is performed at rest, and then compared to the echocardiogram done immediately after exercise. In areas of poor perfusion, wall motion abnormalities are noted, including areas of old myocardial infarction.

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Ejection fractions can also be calculated. The sensitivity and specificity of the stress echo is similar to the myocardial perfusion scans.

The most recent test to gain popularity is that of the ultra-fast heart scans. Initially the spiral or helical CT scan was developed. More recently the EBCT (electron beam computerized tomography) has been developed. The EBCT tends to give a clearer picture than the older ultrafast CT scans. In these heart scans, there is an attempt to identify the amount of calcium that is present within our coronary arteries. As we discussed last month, coronary artery disease is now thought to be an inflammatory process, and so the calcium score that is determined is a reflection of the total plaque burden, that is, the amount of atherosclerosis within our coronary arteries. This test does not determine to what degree our coronary arteries may be obstructed.

There has been a great deal of debate regarding the sensitivity and specificity of these heart scans. As usual with many tests, middle of the road scores may not be very helpful in predicting an individual's risk. However, scores that are extremely low (approaching 0) or very high (calcium > 300 or in the 75th or higher percentile) may provide more significant information regarding an individual's risk. Scores closer to zero indicate very little chance of coronary artery disease. The higher the calcium score, the greater the risk is of significant coronary artery disease.

One of the biggest values of the heart scans is the ease of testing and their cost. They do not involve any type of exercise or injections, can be done within a matter of minutes, and are relatively inexpensive compared to the cost of a treadmill stress test. It is important that physicians ordering this test know what to do with the results. In past years, often physicians were not certain how to follow up or what to tell an individual about their prognosis after the calcium score was determined. It is now recognized that an individual with an elevated calcium score and a higher risk of coronary disease should have further testing. The next step

would be to perform a treadmill stress test to try and see if there are any areas of significant blockage of the coronary arteries. If present, various interventions could be done to alleviate the blockage, such as angioplasty or bypass surgery. It is not appropriate to do nothing in an individual who has a high calcium score. In addition, individuals with elevated calcium scores can also have treatment started for modifiable risk factors, such as weight loss, smoking cessation, and treatment of elevated lipids.

The most recent noninvasive test is that of coronary magnetic resonance and CT angiography. With this technique, after a contrast agent is injected intravenously sophisticated scanners are able to visualize a coronary artery obstruction, similar to that observed when doing invasive coronary angiography. As such, it is quicker, safer, and cheaper. This is still in the developmental stages. Presently these types of angiography have been found to have a reasonable sensitivity and specificity for significant proximal and mid-left coronary artery disease as well as triple vessel disease. However, it is not yet developed to the point that it replaces coronary angiography, our current gold standard.

As you can see, there are a wide variety of tests that can be done. They all have various degrees of sensitivity and specificity, and they must be properly interpreted by the treating physician to maximize their usefulness in predicting whether or not an individual has heart disease. Enough prognostic information is known about these tests that underwriters can appropriately rate a person from the standpoint of future coronary disease. Not as much long term data is known about the ultrafast and EBCT heart scans, but more valuable information is being gathered all of the time. Underwriters can now appropriately debit or credit an individual depending on their calcium score.

As usual, I would be happy to answer any questions regarding these tests, either in general or as it pertains to a particular proposed insured.