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The occasional stress test

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Introduction

Your patient, 50-year-old Mr. Smith, has just had an uncomplicated, inferior myocardial infarction (MI). He was not on any medications. At your community hospital you gave him thrombolytic agents and then placed him on heparin, aspirin, a beta-blocker, an ACE inhibitor, a statin, and other medications according to the ever-changing evidence. Now comes the difficult part: getting a timely appointment with the cardiologist. How soon does Mr. Smith need to be seen?

Another patient is a 40-year-old woman who experiences chest pain on exertion or when she eats, but the pain is relieved by antacids. Is this dyspepsia or ischemic heart disease?

These clinical questions can be answered by the rural practitioner through the use of an exercise stress test.

The post-MI patient

Post-MI patients have always been at risk of reinfarction. With the availability of thrombolysis in many rural hospitals,1 many more patients who in the past would have died are now at risk of suffering a second stenosis. Hospitalized patients experiencing angina obviously need urgent referral. But what about the seemingly uncomplicated MI patient such as Mr. Smith?

These patients should either have a stress test before they are discharged from the hospital or as an outpatient within 3 weeks of their MI. Stress testing will risk-stratify post-MI patients into 2 groups: those who are high risk and should be seen urgently and have an angiographic assessment and those who are at low risk and can wait to see a specialist. Patients in the latter group may not need to see a specialist at all, because no additional investigation or treatment will be required.2

You already have a stethoscope, a blood pressure cuff, the ECG machine and the crash cart — and you know how to use them. All you need in additional equipment is an exercise machine. Once you have an exercise machine, you will also be able to use it to help you diagnose coronary artery disease (CAD). The benefits of diagnosis and risk stratification in the clinical setting rather than when the patient is shovelling snow at home are significant. Not only will this be a service to your community, an added bonus is that stress tests are done during the day.



Fig. 1. Stationary bicycle ergometer for exercise stress testing.

Many Europeans prefer the stationary bicycle ergometer for exercise stress testing. For under a few thousand dollars, you have an exercise machine that produces little movement artifact on the cardiogram, and it doesn't take up much floor space. An ergometer with a protocol that raised exertion by 25 watts every 3 minutes was the standard at my rural hospital for many years (Fig. 1).

The not insignificant advantages of using the more expensive treadmill in North America are that consultants are more familiar with it, and most patients prefer walking to bicycling. For the past 12 years our hospital has used a $7000 electronically controlled model (Fig. 2).



Fig. 2. Electronically controlled treadmill

Recently the hospital bought a $40 000 computerized treadmill model with integrated ECG analysis (Fig. 3).



Fig. 3. Computerized treadmill model with integrated ECG analysis.

Certain patients should be excluded from testing. It is dangerous to submit people with the following problems to stress testing: systolic murmurs of suspected aortic stenosis, hypertrophic cardiomyopathy, findings of suspected dissecting aneurysm, unstable angina, or ongoing ischemia at rest; they should be referred directly to a specialist.

Clinical conditions such as diabetes, thyrotoxicosis, myxedema, electrolyte abnormalities, severe hypertension, significant anemia, high degree atrioventricular block and pulmonary embolism, should first be controlled.

Nuclear imaging or chemical stress testing is suited for patients who are unable to exercise or who have ECG abnormalities such as left bundle branch block, Wolff-Parkinson-White syndrome, or digoxin-induced changes that mask ischemia-induced ST depression.

Testing for risk stratification

At our hospital we would have given Mr. Smith a stress test after discharge. Because he is at higher risk and we are testing for prognosis and an exercise and rehabilitation prescription, submaximal testing would be done, limited to 85% of his estimated maximal heart rate ([220 - age in years] × 85% = 144). Some physicians would repeat the test on a maximal basis at 4 or more weeks post-MI, when the heart has had a chance to heal.

At 1 week post-MI, Mr. Smith was only able to exercise up to 4 METS (metabolic equivalents [multiples of resting oxygen uptake]) with a heart rate of 110 beats/min before he experienced angina with 2mV ST-segment depression in inferior leads and a drop in blood pressure. The ST changes lasted 8 minutes in recovery. The cardiologist in the regional referral centre was contacted by phone, and angiography was performed the next day. The patient is back to work now, after undergoing coronary artery stenting and being put on a cardiac rehabilitation program.

If Mr. Smith had passed the stress test his risk would have been low (Table 13) and he would have needed only secondary prevention interventions. Those who have ST-segment depression but at high workloads may warrant elective referral to an internist.

Diagnostic testing

Patient selection is crucial to give meaningful results when performing a stress test to aid in diagnosis. The major consideration is the pre-test probability, based on age, sex and symptoms (Table 24). The stress test is most useful in evaluating patients at intermediate pre-test risk of coronary artery disease (CAD). Testing asymptomatic patients runs the risk of producing false-positive results because only about 6% of asymptomatic people with ECG changes have CAD diagnosed as a result of angiography. Testing someone with typical chest pain symptoms and risk factors runs the risk of a false-negative result because the pre-test risk is in the 90% range, but it is useful to estimate prognosis and to stratify for possible further testing and treatment.

The stress test achieves maximal sensitivity when testing occurs to actual maximum heart rate as limited by patient symptoms. This will be approximately 220 beats/min less the person's age in years ± 12 beats/min. By convention, 85% of the calculated maximum (i.e., submaximal testing) is considered an adequate test for diagnosis and in testing high-risk patients such as those who are less than 2 weeks post-MI.

Most stress tests are done with the Bruce Protocol,5 and this is the only protocol that has been programmed into the treadmill at my hospital. If the patient appears to be unfit we switch the treadmill to manual and advance more slowly. Other protocols may be superior but they exist mostly in the standard texts.6,7 A typical procedure is outlined in Appendix 1, which cites Fig. 4.

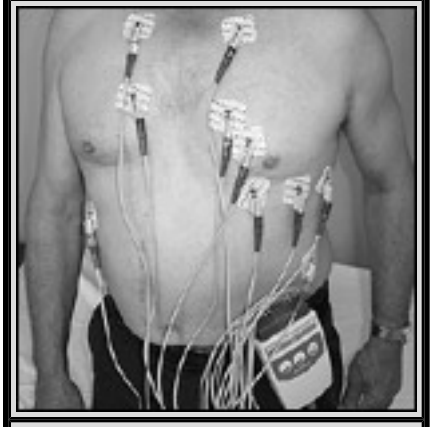


Fig. 4. Apply electrodes for ECG and cardiac monitor (see Step 6 of Appendix 1).

A negative test is when a patient achieves 85% or greater of his or her maximum estimated heart rate without ST changes or chest pain and achieves a physiological increase in blood pressure. Failure to reach this target is not a negative test but

uninterpretable.

Positive test results occur when there is over 1mV horizontal or down-sloping ST-segment depression or over 2mV up-sloping depression. The prognosis is worse if many leads are involved, the ST depression is more marked, recovery is prolonged, there is marked ventricular ectopy in recovery,8 the blood pressure drops, or the ischemia occurs at low workload (< 5 METS).

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