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Editorial Comment

Exercise Testing After Myocardial Infarction: A Perspective*

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Background. In subjects without known coronary artery disease, an abnormal exercise test is an adverse prognostic indicator with respect to future coronary events (1,2). In patients with angiographically documented coronary disease, poor exercise tolerance and exercise-induced ST depression are associated with a poor prognosis (3,4). Exercise testing provides additional prognostic data even when the extent of coronary disease and left ventricular dysfunction are known (3,4).

Ten years ago in North America, exercise testing was considered to be contraindicated within 2 to 3 months after myocardial infarction (5). Studies since then have concluded that an exercise test done soon after myocardial infarction can reveal abnormalities associated with an increased subsequent risk: ST depression (6–8), poor exercise tolerance (9–11), an inappropriate blood pressure response (12,13), ventricular arrhythmias during exercise (10,12), exercise-induced myocardial hypoperfusion (14) and exercise-induced left ventricular dysfunction (15). Controversy exists as to which of these predictors are best and to what extent they add prognostic information to clinical data already available (16).

The MILIS database. The study by Stone et al. (17) in this issue of the Journal provides new and interesting information relevant to this controversy. Two-thirds (473) of 719 survivors at 6 months after infarction underwent maximal exercise testing. Their mortality over the next 12 months was 3%, compared with 16% in patients not tested because of cardiac limitations. Clinical findings (angina and heart failure) predicted mortality only among patients who were not tested. Exercise-induced ST elevation, an inadequate blood pressure response, exercise-induced ventricular premature beats and poor exercise tolerance all presaged an increased mortality. How should these results influence our management of patients after myocardial infarction? Specifically, when should patients undergo exercise testing, and which patients should be tested?

The timing of the test. The survival curve after myocardial infarction is nonlinear. Gilpin et al. (18), in a study of three large patient populations from three countries, found that mortality from day 2 to day 365 after infarction could best be expressed by two exponential distributions with a change point at 21 days. The mortality rate was 11.4% from day 2 to day 21 and 10.5% from day 22 to day 365. The number of deaths between day 21 and day 100 was equal to the number thereafter. The outlook brightens after the first year: in our series (12), the mortality rate was 11% from hospital discharge to 1 year, but averaged only 3% a year during the next 4 years.

If the purpose of exercise testing after myocardial infarction is to identify high risk patients, these statistics indicate that the test should be done early, preferably before exposing the patient to the risk of out of hospital death. In the study of De Feyter et al. (9), 179 patients were assessed by exercise testing and coronary arteriography 6 to 8 weeks after infarction. During a mean follow-up period of 28 months, only 11 patients died (6.1%); however, 3 additional patients had died after hospital discharge but before the assessment at 6 to 8 weeks. As reported by Stone et al. (17), 15% of the MILIS patients died between study entry and 6 months, compared with only 3.7% between 6 and 18 months.

Patient selection. Identifying low risk patients after infarction is helpful because further investigation and unnecessary treatment can be avoided. An asymptomatic patient with a mortality risk of less than 2% from hospital discharge to 1 year is unlikely to benefit from either additional tests or medication.

Identifying high risk patients is important only if their prognosis can be improved by treatment. The factors predictive of an increased risk early after infarction are more likely to reflect myocardial ischemia and, later, left ventricular dysfunction (12). As noted by Stone et al. (17), the predictors derived from an exercise test at 6 months tend to be markers of left ventricular dysfunction.

Myocardial ischemia after infarction is associated with a high mortality (19,20); in contrast, patients with postinfarction angina who undergo early revascularization are reported to have a good prognosis (21,22). In selected patients with myocardial ischemia detected by exercise testing, revascularization probably improves survival (23), but this has not been proved. When the poor prognosis is a consequence of severe left ventricular damage, treatment to increase cardiac output or relieve congestive symptoms has not been shown to influence survival. In the subgroup with malignant ventricular arrhythmias, amiodarone or newer surgical approaches probably improve outcome (24).

The pretest risk for death during follow-up in the MILIS

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patients who had exercise tests was 3%. The posttest risk was 0.3% for the 354 patients (75% of those tested) with no or only one exercise test risk factor and was 17% for the 30 patients (6.3% of those tested) with three or four risk factors. Thus, exercise testing provides useful prognostic data even in a low risk population 6 months after infarction.

As shown by DeBusk et al. (25), testing low risk patients early after infarction, with ST depression as the criterion for a positive test, also provides useful prognostic data. Testing relatively high risk patients, such as those with previous angina, infarction or bypass surgery or those with angina in the hospital, appears justified in our experience because the test is safe and adds additional independent prognostic information (12).

The interventions tested in the MILIS study did not reduce infarct size, and now seem quaint and passé in an era of thrombolysis. Nevertheless, the MILIS patients continue to teach us, as shown by this study.

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