Exercise electrocardiogram

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Figure 1. Twelve-lead treadmill-exercise test electrocardiograms at rest (left complex of each lead) and when ST-segment change was most marked (right complex) in a 58-year-old man. See text for explanation.

A 58-year-old man sought medical attention for intermittent left-sided shoulder, arm, and neck pain that began several months earlier following an automobile accident. Because the pain had some of the characteristics of angina and because of his coronary risk factors (obesity, high blood pressure, diabetes mellitus, elevated serum triglycerides, and a low high-density lipoprotein cholesterol level), the patient underwent a treadmill exercise test.

The resting electrocardiogram showed nonspecific T-wave changes (Figure 1). His typical left-sided shoulder, arm, and neck pain appeared at 1 minute of stage 2 of a standard Bruce protocol, and ST-segment changes followed soon thereafter. He stopped at 20 seconds of stage 3 (i.e., after a total of 6 minutes and 20 seconds of exercise). During recovery, 9 leads showed ST-segment depression, and in 8 of them it was downsloping (Figure

1). Despite his changing from the supine to the sitting posture and taking sublingual nitroglycerin 6 minutes after exercise, the pain persisted another 14 minutes, and the ST segments did not return to baseline until 25 minutes after the end of exercise.

Because the subendocardial myocardium becomes ischemic before the subepicardial myocardium, the usual electrocardiographic response to exercise is ST-segment depression in the

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Figure 2. Arteriograms in the 58-year-old man whose exercise electrocardiograms are seen in Figure 1. **(a)** The left coronary arteriogram in the caudal left anterior oblique projection shows 95% narrowing of the origin of a dominant left circumflex artery (arrow). **(b)** The cranial right anterior oblique view of the left coronary artery demonstrates significant narrowings of the first (1) and very large third (3) obtuse marginal branches and of the posterior descending (p) branch of the left

circumflex artery. The left anterior descending artery (L) has a long, tight narrowing that involves the origins of its first (s) and second septal and first diagonal (d) branches. **(c)** The right coronary arteriogram in the right anterior oblique projection reveals an ostial stenosis (arrow) at its origin. This nondominant right coronary artery supplies collaterals to the second septal perforating branch (s) of the left anterior descending artery.

leads facing the left ventricle. Lead V₅ or V₆ most frequently shows ischemic ST depression in exercise electrocardiograms, and the distribution of leads showing ST-segment depression is not very helpful in localizing the culprit lesion. This is in contrast to the much less common ST-segment elevation, which usually accurately predicts the artery that is totally or subtotally occluded (1).

Several findings in the treadmill exercise test are powerful predictors of significant coronary arterial obstructions, and when 3 or more of them are present, the likelihood of left-main or 3-vessel disease is high. These variables are typical angina developing during the test, significantly reduced exercise time for age (less than two thirds predicted), ST-segment depression ≥ 2 mm, downsloping ST depression, ST depression occurring in stage 1 or 2 of a standard Bruce test, ST depression in 7 or more leads, exertional hypotension early during exercise, and persistence of ST depression or anginal pain for 10 minutes or

more after exercise (2–4). The patient described here had most of these findings, and as expected his coronary arteriograms showed extensive 3-vessel disease (Figure 2). He underwent a coronary arterial bypass graft operation utilizing a left internal mammary artery to the left anterior descending coronary artery, vein grafts to the diagonal and first obtuse marginal branches, and a sequential vein graft to the third obtuse marginal and the posterior descending artery.

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