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CLINICAL RESEARCH STUDY

A simple clinical score accurately predicts outcome in a community-based population undergoing stress testing

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ABSTRACT

PURPOSE: Scoring systems based on clinical variables are available but not widely applied for evaluating patients with chronic coronary artery disease. The purpose of this study was to validate the prognostic value of a simple clinical scoring system, originally developed in patients referred for a nuclear stress test at a tertiary-care medical center, in a less-selected, community-based population undergoing stress testing for known or suspected coronary artery disease.

SUBJECTS AND METHODS: Over a 4-year period, 3546 residents of Olmsted County, Minn, underwent stress testing. A previously developed clinical score was calculated for every patient by assigning 1 point each for: male sex, history of myocardial infarction, typical angina, diabetes, insulin use, and each decade of age beginning at age 40. The associations between the assigned score and clinical endpoints were tested using logistic regression. A previously established cutoff point of 5 was used to establish risk groups.

RESULTS: During follow-up (7.6 ± 2.7 years) there were 363 total deaths, 109 cardiac deaths, and 132 nonfatal myocardial infarctions. The clinical score was strongly associated with overall mortality, cardiac death, and cardiac death/myocardial infarction ($P < 0.001$ for all 3 endpoints). Annual mortality was .6% for the 3076 patients (86%) with a score ≤4, 2.4% for 275 patients (8%) with a score = 5 and 6.2% for the 215 patients (6%) with a score ≥6.

CONCLUSIONS: This study enhances the generalizability of this simple clinical score, which was highly effective for risk-stratifying this community-based population undergoing evaluation of chronic coronary artery disease.

Cardiac scoring systems based on clinical variables have been developed to aid in decision-making in different clinical settings. Examples include the use of the Framingham risk score for initiating lipid-lowering therapy in the general population[1] and the Thrombolysis in Myocardial Infarction (TIMI) risk scores for selecting a conservative or aggressive approach in patients with ST-segment elevation myocardial infarction (MI) and other acute coronary syndromes.[2,3] National guidelines advocate the use of these scoring systems in these populations.[4-6] Mathematical models and scoring systems have also been developed for assessment of patients with possible or established chronic coronary artery disease.[7-17] Although these tools can be applied to patients undergoing evaluation for chronic coronary artery disease,[18] none of them is in widespread use. Their clinical application is limited by the calculation of complex mathematical for-

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mulas, display of the data in a busy chart format, or utilization of numerous variables. In an initial study, we developed a simple 5-point scoring system for predicting severe angiographic coronary artery disease in a population of patients referred to the Mayo Clinic nuclear cardiology laboratory for exercise radionuclide angiography.[19] In a subsequent study we demonstrated this score's ability to predict clinical outcome in a separate population referred for myocardial perfusion imaging.[20] The score performed well in both of these studies consisting of highly selected patients referred for nuclear imaging at a tertiary-care medical center.

Prior studies have shown that patients referred to tertiary-care medical centers often differ from community-based patients.[21-23] Referral patients frequently are "sicker" than community-based patients. This referral bias can influence the accuracy of tests used for diagnostic and prognostic purposes. We recently reported that scoring systems derived from clinical trials or registries of acute myocardial infarction patients have variable accuracy when applied to a community-based population of acute myocardial infarction patients.[24] The goal of this study was to examine the prognostic value of this simple clinical score in a community-based population undergoing evaluation of chronic coronary artery disease.

Methods

Study population and design

This study was approved by the Mayo Clinic Institutional Review Board. The study group consisting of 3546 patients has been described previously.[25,26] Patients were included in this study if they resided in Olmsted County, Minn, and underwent a stress test between January 1, 1987, and December 31, 1990. This study design was intended to capture all residents in the community over a defined period of time who were stable enough to be evaluated with a stress test (vs patients with a more acute presentation referred directly to coronary angiography).

Olmsted County, Minn, is located 90 miles southeast of Minneapolis and St. Paul. The county consists of a small city, Rochester (where 70% of the residents live), and the surrounding rural area. In 1990, the size of the population was 106 470 people, 96% of whom were white and 82% of whom had graduated from high school. Olmsted County residents receive their medical care from only 2 institutions, the Mayo Clinic and the Olmsted Medical Group. The 2 institutions are linked by a common medical record system such that the records of all medical care provided in the county are available for review. Clinical data were abstracted from patients' medical records by nurses specifically trained to perform this task.[25,26] The databases of the stress test laboratories were used to identify the study cohort. All stress tests in Olmsted County are performed in laboratories affiliated with Mayo Clinic or Olmsted Medical Group.

The stress tests consisted of standard exercise treadmill in 78%, exercise radionuclide angiography in 8%, exercise thallium-201 imaging in 9%, and miscellaneous other tests in 5%. Stress testing methods, criteria to categorize a test as abnormal, and results have been previously published.[25,26]

Determination of the clinical score

The score was originally developed to identify patients with severe angiographic (left main or three-vessel) coronary artery disease. The initial study consisted of 680 consecutive patients who underwent exercise radionuclide angiography between July 10, 1980, and November 25, 1983, and cardiac catheterization within a 6-month period of the radionuclide angiogram at the Mayo Clinic.[19] Exclusion criteria included prior coronary revascularization, clinically significant valvular heart disease, or left bundle-branch block or paced rhythm on the electrocardiogram. Logistic regression was performed to determine which of 16 clinical and resting electrocardiogram variables were associated with severe coronary artery disease. Five variables demonstrated an independent association: age, sex, prior myocardial infarction, angina, and diabetes. Minor modifications in this model were performed to permit whole integers to be assigned to different categories of these 5 variables specifically to develop a simple score that would be easy to remember and calculate (see below). The prognostic value of the score was subsequently demonstrated in a separate cohort of patients who underwent exercise thallium-201 imaging between 1989 and 1991 at the Mayo Clinic.[20] The score can be calculated as follows:

Score = Age index (1 point for each decade beginning at 40: 40-49 years = 1; 50-59 years = 2; 60-69 years = 3; 70-79 years = 4; ≥80 years = 5)
+ Sex (female = 0; male = 1)
+ Prior myocardial infarction (no = 0; yes = 1)
+ Angina (asymptomatic or atypical = 0; typical = 1)
+ Diabetes (no = 0; no insulin = 1; insulin use = 2)

The value of the score can only be an integer that ranges between 0 and 10.

Follow-up data

Significant clinical events were defined as nonfatal myocardial infarction and death. Cardiac procedures including coronary angiography, percutaneous intervention, and bypass surgery were also recorded. Clinical events and procedures were ascertained by review of the medical records by the trained nurse abstractors. Cardiac procedures were considered early if performed within 3 months of the stress test and late if greater than 3 months. We have previously used this 3-month cutoff based on the rationale that procedures performed within 3 months of the stress test are heavily influenced by the stress test results, whereas those per-