MAYO CLINIC

ORIGINAL ARTICLE

Impact of Stress Testing for Coronary Artery Disease Screening in Asymptomatic Patients With Diabetes Mellitus: A Community-Based Study in Olmsted County, Minnesota

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Abstract

Objective: To evaluate the impact of screening stress testing for coronary artery disease in asymptomatic patients with diabetes in a community-based population.

Patients and Methods: This observational study included 3146 patients from Olmsted County, Minnesota, with no history of coronary artery disease or cardiac symptoms in whom diabetes was newly diagnosed from January 1, 1992, through December 31, 2008. With combined all-cause mortality and myocardial infarction as the primary outcome, weighted Cox proportional hazards regression was performed with screening stress testing within 2 years of diabetes diagnosis as the time-dependent covariate. For descriptive analysis, participants were classified by their clinical experience during the first 2 years postdiagnosis as screened (asymptomatic, underwent stress test), unscreened (asymptomatic, no stress test), or symptomatic (experienced symptoms or event).

Results: Among the screened and unscreened participants, 54% (1358 of 2538) were men; the mean (SD) age at diabetes diagnosis was 55 years (13.8 years), and 97% (2442 of 2520) had type 2 diabetes. In event-free survival analysis, 292 patients comprised the screened cohort and 2246 patients comprised the unscreened cohort. Death or myocardial infarction occurred in 454 patients (32 patients in the screened cohort and 422 in the unscreened cohort [5-year rate, 1.9% and 5.3%, respectively]) during median (interquartile range) follow-up of 9.1 years (5.3-12.5 years). Screening stress testing was associated with improved event-free survival (hazard ratio, 0.61; P=.004), independent of cardiac risk factors. However, while stress test results were abnormal in 47 of the 292 screened patients (16%), only 6 (2%) underwent coronary revascularization.

Conclusion: Although screening cardiac stress testing in asymptomatic patients with diabetes in this community-based population was associated with improvement in long-term event-free survival, this result does not appear to occur by coronary revascularization alone.

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Currently, 9.3% of the US population has diabetes mellitus,[1] and coronary artery disease (CAD) is the leading cause of morbidity and death in these persons.[2] Among patients with diabetes, however, symptoms of CAD are often absent even with advanced disease.[3] Despite intuitive appeal and previous guideline support, screening for CAD in asymptomatic patients with diabetes remains controversial.[4] In 2013, the European Society of Cardiology acknowledged that routine screening could be considered for patients at particularly high risk.[5] Nevertheless, the 2016 American Diabetes Association[6] guidelines do not recommend screening of asymptomatic patients with diabetes, stating that "it does not improve outcomes as long as atherosclerotic cardiovascular disease risk factors are treated." These recommendations cite the Detection of Ischemia in Asymptomatic Diabetics (DIAD) study,[7] which found no clinical benefit for routine screening of

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asymptomatic persons with type 2 diabetes and normal results on electrocardiography (ECG). However, cardiac event rates were low in all patients in the DIAD trial (5-year cardiac event rate, 2.9%), limiting the study's power to identify small differences. Additionally, a healthier cohort may have been selected because previous stress testing was an exclusion criterion.

To our knowledge, a community-based estimate of the effect of cardiac stress testing in asymptomatic patients with diabetes has not been reported in the literature. Community-based research has many advantages[8] and is facilitated in Olmsted County, Minnesota, by the Rochester Epidemiology Project (REP), which allows nearly complete enumeration of the population and linkage of persons with their lifetime inpatient and outpatient medical records.[9] Our study evaluated the impact of screening stress testing for CAD in asymptomatic patients with diabetes in a community-based cohort.

PATIENTS AND METHODS

Using REP resources, we compared outcomes of asymptomatic diabetic patients who did or did not undergo a screening cardiac stress test within 2 years of their diabetes diagnoses according to the judgment of their physicians. This retrospective cohort study was approved by both the Mayo Clinic and Olmsted Medical Center institutional review boards. All participating patients had provided previous written permission approving the use of their medical records for research.

Study Population

Olmsted County has an estimated population of 144,248 persons, of whom 85.7% are white[10]; sociodemographically, the community is similar to the United States white population, except for higher education and income levels.[9,11] Medical care is virtually self-contained within the community, and all major health care providers (Mayo Clinic and its affiliated sites, Olmsted Medical Center, and Rochester Family Practice) participate in the REP, which serves to link persons with their lifetime medical records across these institutions. Each year, 80% of Olmsted County residents are seen at least once by a health care professional and 93% of residents have at least one health care encounter in any given 3 years.[12,13] Death data are collected through Mayo Clinic records, Olmsted County and Minnesota state death certificates, and the National Death Index. Cause of death is captured with *International Classification of Diseases, Tenth Revision* codes.

Identification of the Study Cohort

Using REP resources, we identified 10,079 Olmsted County residents older than 18 years who received a new diagnosis of type 1 or type 2 diabetes from January 1, 1992, through December 31, 2008. The *index date* was defined as the date of diabetes diagnosis cited in the medical record. The codes used to identify these patients included the *International Classification of Diseases, Ninth Revision* codes for diabetes and its complications and the comparable Hospital International Classification of Disease Adaptation system codes.[14] Excluded from the study were patients with a clinical diagnosis of heart failure or evidence of CAD before the diabetes diagnosis. Two experienced, trained data abstractors (R.E.B. and M.O.) reviewed medical records to ascertain the eligibility and symptom status of patients at baseline and during follow-up.

The Olmsted County residents with diabetes who had undergone stress testing (exercise ECG, nuclear perfusion imaging, or stress echocardiography) were identified through cross-reference of the previous codes with Current Procedural Terminology codes 78452, 78465, 93015, 93016, 93017, 93018, 93024, and 93350. The first stress test performed after diabetes diagnosis was considered for analysis. Of the 3950 potential cases identified, 2014 met the criteria. For these patients, stress test data sets were interrogated to identify which patients had testing for screening purposes and which had testing prompted by dyspnea or chest pain. Among the 6129 patients with diabetes who did not undergo stress testing, a random sample of 2265 patients was selected for review. From this sample, 1133 patients were excluded according to the study criteria; the remaining 1132 were included. The final study population included 3146 persons.

Clinical Data

Clinical characteristics at diabetes diagnosis, including cardiac risk factors, cardiovascular medications, and laboratory data, were