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Exercise Capacity and Atrial Fibrillation Risk in Veterans: A Cohort Study

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Abstract

Objective: To assess the association between exercise capacity and the risk of developing atrial fibrillation (AF).

Patients and Methods: A symptom-limited exercise tolerance test was conducted to assess exercise capacity in 5962 veterans (mean age, 56.8±11.0 years) from the Veterans Affairs Medical Center, Washington, DC. None had evidence of AF or ischemia at the time of or before undergoing their exercise tolerance test. We established 4 fitness categories based on age-stratified quartiles of peak metabolic equivalent task (MET) achieved: least fit (4.9±1.10 METs; n=1446); moderately fit (6.7±1.0 METs; n=1490); fit (7.9±1.0 METs; n=1585), and highly fit (9.3±1.2 METs; n=1441). Multivariable Cox proportional hazards regression models were used to compare the AF-exercise capacity association between fitness categories.

Results: During a median follow-up period of 8.3 years, 722 (12.1%) individuals developed AF (14.5 per 1000 person-years; 95% CI, 13.9-15.9 per 1000 person-years). Exercise capacity was inversely related to AF incidence. The risk was 21% lower (hazard ratio, 0.79; 95% CI, 0.76-0.82) for each 1-MET increase in exercise capacity. Compared with the least fit individuals, hazard ratios were 0.80 (95% CI, 0.67-0.97) for moderately fit individuals, 0.55 (95% CI, 0.45-0.68) for fit individuals, and 0.37 (95% CI, 0.29-0.47) for highly fit individuals. Similar trends were observed in those younger than 65 years and those 65 years or older.

Conclusion: Increased fitness is inversely and independently associated with the reduced risk of developing AF. The decrease in risk was graded and precipitous with only modest increases in exercise capacity. These findings counter previous suggestions that even moderate increases in physical activity, as recommended by national and international guidelines, increase the risk of AF, with marked protection against AF noted with increasing levels of fitness.

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Atrial fibrillation (AF) is associated with increased morbidity and mortality.[1,2] Its prevalence increases with advancing age, hypertension (HTN), diabetes mellitus (DM), thyroid disease, and structural heart disease.[3] Recent evidence from observational studies suggests a higher prevalence of AF in middle-aged and older elite athletes and those participating in long-term high-intensity physical activity (PA), as compared with the general population.[4-10] This association appears to be directly related to intensity as well as number of hours or days spent per week engaged in vigorous PA.[7-10] Potential mechanisms suggested for the higher risk of AF secondary to vigorous PA include a disruption in the balance between sympathetic and parasympathetic activity and an increase in left atrial size, leading to atrial fibrosis, myocardial injury, and inflammation. Although these structural and electrophysiological cardiac changes are observed with excessive exercise or physical exertion,[6,9,11] not all studies support such an association.[12-16]

There are also limited data suggesting that regular moderate-intensity exercise, as recommended by national and international guidelines on PA and health, may increase the risk of developing AF.[6,8,10] This has not been a consistent finding. However, an increase, decrease, and no association between low- to moderate-intensity PA and the incidence of AF have been reported.[13-18] This, along with

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the well-documented health benefits of exercise regardless of age and other comorbidities,[19-26] reduce support for the concept that engaging in regular PA increases the risk of developing AF. Nonetheless, the inconsistency of the evidence and the potential public health and clinical significance of the AF-fitness association merit further exploration. In addition, although PA and fitness are certainly linked and PA is the greatest determinant of fitness, these 2 measurements may provide independent associations with cardiovascular disease (CVD) risk, including for AF.[27,28] Thus, the aim of the present study was to assess the association between cardiorespiratory fitness (CRF) assessed objectively by a standard exercise test and the incidence of AF in a cohort of middle-aged and older US veterans.

PATIENTS AND METHODS

Design and Sampling

This prospective cohort study included individuals from the Veterans Affairs (VA) Medical Center, Washington, DC. The cohort was taken from a database of 11,456 that comprises the results of the Exercise Testing and Health Outcomes Study. This is a prospective observational study designed to address the effect of exercise capacity, clinical and lifestyle factors, and their association with health outcomes. All participants completed a symptom-limited exercise tolerance test (ETT) between January 9, 1987, and May 2, 2012. The test was administered either as part of routine evaluation to establish baseline CRF status or to assess exercise-induced ischemia. This information, along with the patient's medical history (medications, risk factors, and comorbidities), was electronically stored in the VA's Computerized Patient Record System (CPRS) at the time of the exercise test.

Exclusion criteria were as follows: history of AF or the development of AF during the exercise test (n=989); history of an implanted pacemaker or the development of left bundle branch block during the test (n=438); inability to complete the test because of musculoskeletal pain or impairments; exercise capacity less than 2 metabolic equivalents (METs); instability, evidence of ischemia based on American Heart Association criteria,[29] or need for emergency intervention; impaired chronotropic response to exercise (n=556); body mass index (BMI; calculated as the weight in kilograms divided by the height in meters squared) less than 15.5 kg/m^2 or HIV/AIDS; lung disease (n=521); CVD defined as documented coronary artery disease, myocardial infarction, coronary artery bypass graft, and stroke (n=1791); and missing data (n=156).

Clinical and demographic characteristics and drug information were obtained from the patients' electronic medical record before the ETT. Each individual was asked to verify the information, including history of chronic disease, current treatments, and smoking habits. Body weight and height were assessed by a standard scale and recorded before the test and used to determine BMI. The study was approved by the VA Central Institutional Review Board, and all participants gave written informed consent before undergoing their ETT.

Exercise Assessments

Exercise capacity was assessed by a standard treadmill test using the Bruce protocol. Peak exercise time was recorded in minutes. Peak exercise capacity (in METs) was estimated using standard equations based on peak exercise time.[30] Participants were encouraged to exercise until volitional fatigue in the absence of symptoms or other indications for stopping.[29] Handrails were used in all participants for balance and safety. Medications were not altered before testing.

Determination of Fitness Categories

We stratified the cohort into 4 age categories—less than 50, 50 to 59, 60 to 69, and 70 years and more—and identified those with an exercise capacity of 25% or less, 26% to 50%, 51% to 75%, and greater than 75% of METs achieved within their respective age category, as described previously.[23,26] We then established the following 4 fitness categories based on age-stratified quartiles of peak METs achieved: least fit (4.9±1.10 METs; range, 2.0-7.0; n=1446), moderately fit (6.7±1.0 METs; range, 4.4-8.5; n=1490), fit (7.9±1.0 METs; range, 5.5-9.6; n=1585), and highly fit (9.3±1.2 METs; range, 6.6-14.5; n=1441).

Follow-Up and End Point

The primary end point was incidence of AF. Vital status was determined as of December 31, 2012. Patients who developed AF and the date of the onset were identified by an electronic search of the medical records (CPRS database)