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Silent Myocardial Ischemia in Master Marathon Runners

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Authors' contributions

This work was carried out in collaboration between the authors. Author MB designed the case reports, performed the table and images, and wrote the first draft of the manuscript. Author DB managed the corrections and language of the study and the literature searches. Both authors read and approved the final manuscript.

Case Study

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ABSTRACT

Background: Silent myocardial ischemia is defined as objective documentation of myocardial ischemia in the absence of angina or anginal equivalents. There are a number of reports of exercise-related sudden deaths and myocardial infarctions in aerobically trained athletes suffering from exercise - induced silent myocardial ischemia. The most appropriate and used method to discover silent myocardial ischemia is the exercise stress testing.
Case Reports: In this article the authors describe three emblematic cases of silent myocardial ischemia detected in master marathon runners during systematic prepartecipation screening. These marathon runners were asymptomatic but suffering from a severe coronary artery disease that only thanks to exercise treadmill stress test was detected and properly treated.
Conclusions: Silent myocardial ischemia is not such a rare event in athletes, indeed quite the opposite. In fact, even though athletes are asymptomatic this does not exclude the possibility that they are suffering from severe coronary artery disease.

Keywords: Silent myocardial ischemia; exercise ECG stress testing; master athletes; coronary artery disease; sports pre-partecipation screening.

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1. INTRODUCTION

Silent myocardial ischemia is defined as objective documentation of myocardial ischemia in the absence of angina pectoris [1]. Silent ischemia is an interesting phenomenon [2], and the idea that silent ischemia is causally related to serious or fatal cardiac events is certainly biologically plausible given the striking parallels in the circadian patterns of myocardial ischemia, myocardial infarction and sudden death, and their reduction by ß-blockers [3]. High-physical activity levels are associated with reduced risk of symptomatic coronary artery disease (CAD) [4]. However, there are a number of reports of exercise-related sudden deaths and myocardial infarctions in aerobically trained athletes suffering from exercise - induced silent myocardial ischemia [5-16]. Although considerable epidemiologic evidence suggests that structured aerobic exercise, increased lifestyle activity, or both, may help protect against the development of ischemic heart disease (IHD) and its adverse sequelae, exertion-related cardiovascular events have been reported in the medical literature and the lay press, suggesting that strenuous physical activity may actually precipitate sudden cardiac death (SCD) or acute myocardial infarction (AMI) in selected individuals[8]. Numerous independent studies have now shown that SCD or AMI can be triggered by vigorous physical exertion, especially among habitually sedentary individuals with underlying IHD or structural cardiovascular abnormalities, and that the risk decreases with increasing levels of regular exercise [6,17-18]. The risk of SCD varies in the different athletes series reported in the literature. It generally increases with age and is greater in men [7]. In apparently healthy adults (>35 year old), joggers, or marathon racers, the estimated rate of SCD ranges from 1:15.000 to 1:50.000 [7-8]. For many years, it was a mystery why SCD should occur in athletes, who paradoxically had previously achieved extraordinary exercise performance without complaining of any symptoms, but it is now clear that the most common mechanism of SCD during sports activity is an abrupt ventricular tachyarrhythmia as a consequence of a wide spectrum of cardiovascular diseases [9]. The culprit disease is often clinically silent and unlikely to be suspected or diagnosed on the basis of spontaneous symptoms of the athlete. Exercise testing appears to be the most suitable laboratory diagnostic test to document silent myocardial ischemia in asymptomatic individuals (ie, patients with no history of CHD) and in those with a history of CHD or exertional angina [10]. Exercise testing is frequently used to screen high risk, asymptomatic persons to identify those with asymptomatic CHD [11]. Conventional ST segment analysis during exercise treadmill test (ETT) is moderately sensitive in detecting CHD. However, it has low specificity because of an unacceptably high rate (10 to 35 percent) of false positive responses, particularly in asymptomatic persons and especially in women, but exercise testing is the basilar tool and the first choice to detect silent myocardial ischemia in athletes, particularly in master athletes [12-13].

2. CASE REPORT

The authors describe three emblematic cases of silent myocardial ischemia detected in master marathon runners during systematic pre-partecipation screening, as provided for by Italian law and COCIS 2009 protocols (CARDIOVASCULAR GUIDELINES FOR ELIGIBILITY IN COMPETITIVE SPORTS 2009). All the data and the characteristics of the athletes are shown in Table 1.The first case concerns a 55 year-old male marathon runner, with personal best of 2h 30 minutes, who is annually checked for physical fitness for competitive sports with no significant previous medical history and completely asymptomatic for chest pain, palpitations and shortness of breath. The physical examination was unremarkable; his height was 175 cm and body weight was 60 kg. The resting electrocardiography (ECG) (Fig. 1 – Panel A) and blood pressure were both completely normal. The electrocardiographic monitoring during exercise treadmill testing with Astrand protocol shows at the end of maximal exercise, in the early stages of active recovery, a significant down sloping ST-segment depression of more than 3 mm to 0.08 seconds after the J point in more precordial leads with a normal ventricular repolarization after only 6 minutes of recovery. (Fig. 1 – Panel B) This ECG finding was suggestive of severe coronary artery disease, and suspected of left main coronary artery disease for the pattern of ST segment depression and its feature to show up significantly in the recovery phase for several minutes. A subsequent coronary angiography confirmed the diagnosis and the marathon was immediately operated on by coronary artery bypass grafting. (Fig. 1- Panel C). The second case concerns another expert male marathon runner of 46 years old, with personal best of 2h 37 minutes, without cardiovascular risk factors but with a strong family history of coronary artery disease (CAD). He also was asymptomatic for chest pain, palpitations and shortness of breath. The physical examination, the resting ECG (Fig. 2 – Panel A) and blood pressure were within normal limits. However, the exercise ECG testing, always performed with A strand protocol, was positive (Fig. 2 – Panel B) for reduced coronary reserve as showed by significant ST segment depression at high workload corresponding to the anaerobic threshold heart rate, in absolute lack of symptoms. When in doubt of a false positive ST segment depression, a myocardial scintigraphyis requested. In this case it was slightly positive for a deficit of reversible myocardial perfusion. Despite the weak positivity of myocardial scintigraphy in the asymptomatic athlete a coronary angiography was required. This showed a bi-vessel critical coronary artery disease (ie, obstructive atherosclerotic disease of the anterior descending artery and the first diagonal branch) (Fig. 2 Panel C – n° 1) which required a dual angioplasty with stent placement (Fig. 2 Panel C – n° 2). Six months after the dual angioplasty, the marathon runner was suitable for competitive sports. The third case concerns another male marathon runner of 50 years old, with personal best of 2h 43 minutes, bearer of cardiovascular risk factors such as hypercholesterolemia and previous smoking. Physical examination was normal, as well as resting ECG (Fig. 3 – Panel A) and blood pressure. At the initial stages of exercise treadmill testing this athlete showed a marked ST segment depression in precordial leads, from V4 to V6. (Fig. 3 – Panel B) suggestive of three-vessel coronary disease. Also in this case the athlete remained asymptomatic. A subsequent coronary angiography (Fig. 3 Panel C) confirmed the diagnosis and at the same time he proceeded to myocardial revascularization by angioplasty with stent application on the three diseased vessels. Twelve months after angioplasty, the exercise test was negative then the athlete took up competitive sports.

Table 1. Clinical data

	Gender	Age	Cardiovascular risk factor	BMI	Marathon experience (year)	TC	Glucose
1.	Male	55	hypercholesterolemia	20	15	270	90
2.	Male	46	family history for CAD	21	10	180	92
3.	Male	50	hypercholesterolemia smoking	19	15	265	88

Legend: TC = Total Cholesterol BMI = Body Mass Index
CAD= coronary artery disease

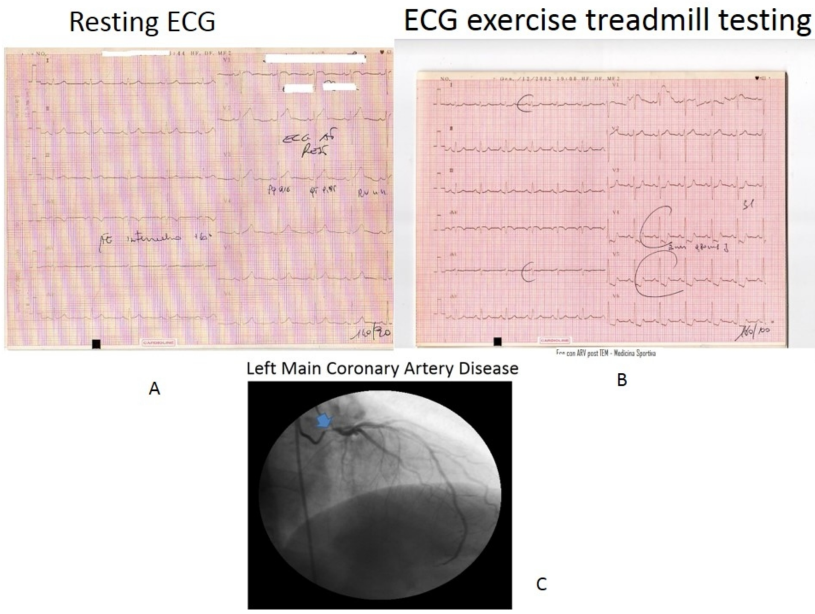

Fig. 1. Panel A shows a normal resting ECG; Panel B shows the marked down sloping ST depression on the precordial leads, from V4 to V6, during ECG recovery; Panel C: the picture shows a critical ostial stenosis of the left main coronary artery (see arrow)

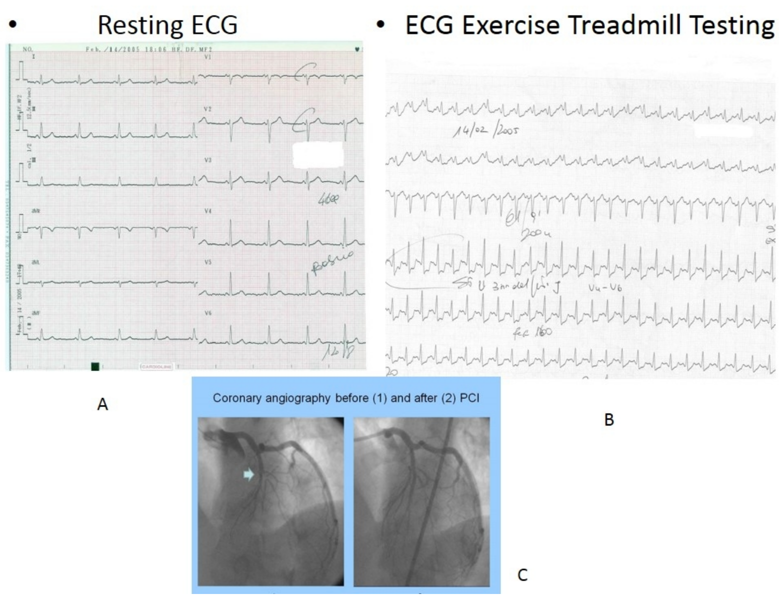

Fig. 2. Panel A shows a normal resting ECG; Panel B shows the ST depression on the precordial leads (V4-V5-V6) at the peak of exercise treadmill testing; Panel C: the picture shows the critical atherosclerotic disease of the proximal anterior descending and first diagonal brunch of the left coronary artery (see arrow - n°1), before and after a dual angioplasty with stent placement (n° 2)

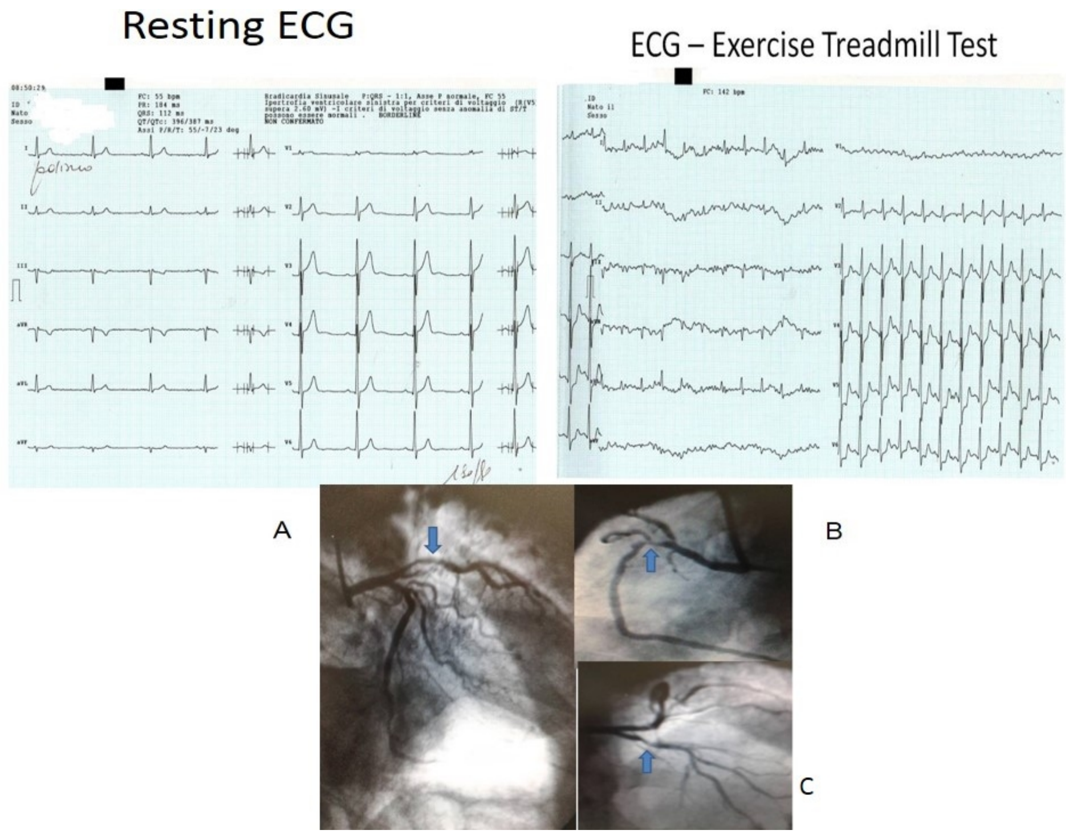

Fig. 3. Panel A shows the normal resting ECG; Panel B shows the significant ST segment depression on the precordial leads (V4-V5-V6) recorded during the treadmill ECG stress test; Panel C: the picture shows the three-vessel coronary artery disease with >70 % critical narrowing by coronary angiography (see arrows on the LAD – CDx – Cx coronary artery)

3. DISCUSSION AND CONCLUSIONS

Silent myocardial ischemia is increasingly recognized as a common phenomenon among a variety of people with coronary artery disease, including high-level competitive athletes. Little is known about incidence, threshold, and predictors of prognostically relevant silent ischemia. In agreement with some data reported in the literature regarding the interpretation of ST segment depression as a possible false positive test [14], the authors believe that a really positive stress exercise test (ie ECG findings of subendocardial ischemia by exercise stress testing) in asymptomatic athletes should never be underestimated and therefore absolutely requires further investigation that may exclude with certainty the presence of coronary artery disease, which protects both the athlete and physician [15]. In fact, although the athlete is asymptomatic this does not exclude the possibility of a severe coronary artery disease. Indeed frequent cases of sudden death from coronary heart disease have occurred in recent years to professional athletes and in particular to master marathon runners. Therefore more attention and knowledge by physicians of the silent myocardial ischemia are required. These clinical cases show that asymptomatic exercise-induced ST-segment depression was a common finding in middle-aged men with no prior coronary artery disease and it was associated with greatly increased risk of sudden cardiac death, especially in smokers and hypercholesterolaemic men [19]. The main clinical implication of our findings is that silent myocardial ischemia induced by exercise stress testing is a significant prognostic marker for sudden cardiac death in older marathon runners, especially when conventional risk factors are present.

CONSENT

The authors declare that 'written informed consent was obtained from the patient (or other approved parties) for publication of this case report and accompanying images.

ETHICAL APPROVAL

The authors hereby declare that this section is not applicable in their paper.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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