Case Report

Pathological Electrocardiogram in a Young Sports Champion: Sign of Athlete's Heart or Sub-Clinical Heart Disease?

Stavros Kounas, Aris Anastasakis, Christodoulos Stefanadis

Special Heart Centre for Young and Athletes, Unit of Inherited Cardiac Diseases, 1st Department of Cardiology, University of Athens, Greece

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The resting electrocardiogram (ECG) is an essential tool in modern cardiological practice and its recording is part of the basic cardiovascular examination. Nevertheless, it may be a cause of concern even in asymptomatic individuals when it is not entirely normal. We present the case of a young sports champion with a pathological resting ECG and the consequent dilemmas in relation to eligibility for competitive athletic activity.

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Address:
Stavros Kounas

9 Ioanninon St.
15121 Pefki
Athens, Greece
e-mail:
spkounas@yahoo.com

Cardiovascular pre-participation screening is established practice for athletes. The obvious purpose is to verify the cardiovascular condition of the person examined before participation in some systematic and competitive exercise programme. The prevention of sports-related sudden cardiac death is a further aim,[1] since data from observational studies have confirmed an elevated risk of sudden cardiac death in athletes harbouring undiagnosed cardiovascular diseases.[2]

Case presentation

A 23-year-old white man (height 175 cm, weight 71 kg, body surface area 1.86 m^2), a judo champion, was referred to our department for examination and medical clearance of fitness to compete, following the finding of an unusual resting ECG during a pre-match check. He was asymptomatic, with no history of chest pain, dyspnoea, or palpitations, either at rest or during exercise. He reported one syncopal episode at a young age, with vasovagal characteristics. The rest of his personal and family history was negative for any manifestations of cardiovascular disease.

Clinical examination revealed a mid-systolic murmur of mild intensity (2/6) over the left parasternal border, with the features of an innocent "functional" murmur that disappeared when he was in an upright position. All other findings were also normal. The resting ECG in the supine position showed an unusual repolarisation pattern in leads V_2-V_4, with a high onset of the ST interval and wide, double-peaked T waves (Figure 1A). However, during deep inspiration we observed normalisation of the resting ECG (Figure 1B).

On transthoracic echocardiography the left ventricle had normal wall thickness (8-10 mm) and contractility (fractional shortening 35%, ejection fraction 64%), without regional wall motion abnormalities, and with internal dimensions within the upper normal range (end-systolic diameter 57 mm, end-diastolic diameter 37 mm). Indexes of contractile function were also normal and compatible with the individual's young age. Transmitral Doppler flow showed greater early (E) than late (A) diastolic filling, E/A >2, deceleration time 180 ms, with A-wave duration 122 ms. Waveforms from the right pulmonary vein had systolic flow velocity less than diastolic

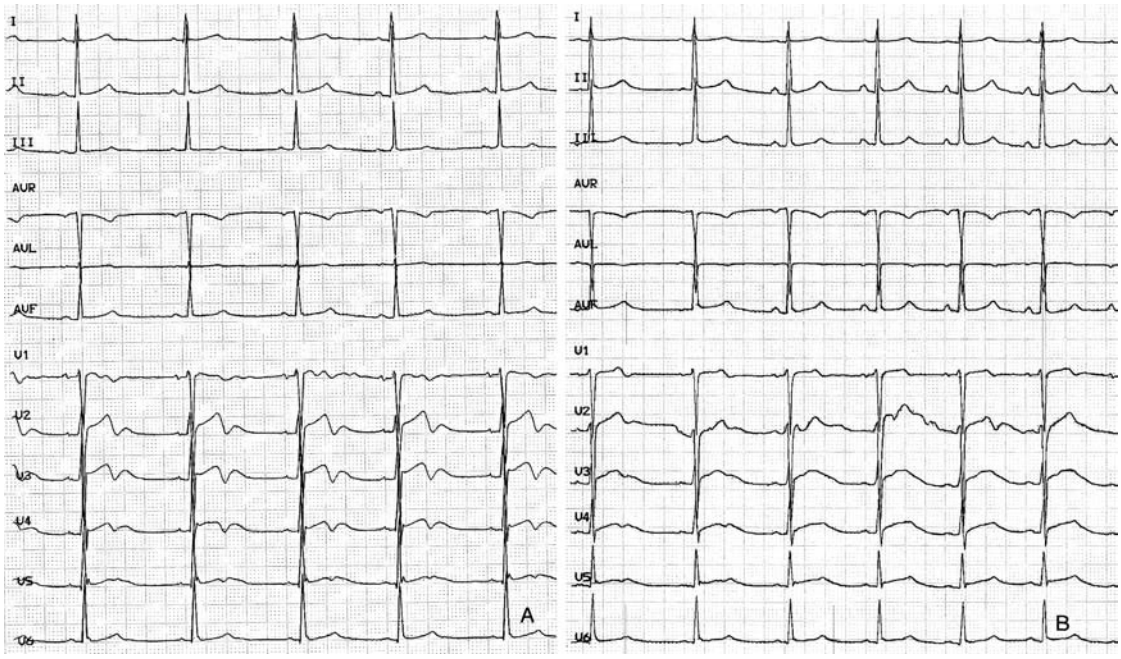

Figure 1. A: resting electrocardiogram. B: electrocardiogram during deep inspiration.

and an atrial reversal wave (Ar) with duration 113 ms. Tissue Doppler recorded early diastolic velocity (Ea) 23 cm/s at the lateral mitral annulus and the E/Ea ratio was 6. Finally, a detailed study of the right ventricle, in accordance with our department's echocardiographic protocol, showed normal size (outflow tract 27 mm, inflow tract 31 mm) and contractility (Ea 18 cm/s at the tricuspid annulus) without regional wall motion abnormalities.

Discussion

Cardiovascular pre-participation screening of athletes with a view to avoiding cases of sudden cardiac death is now considered a medical necessity. However, there is still discussion concerning the design and application of appropriate prevention strategies. The role of the ECG in pre-participation screening protocols is a fundamental point of concern. Economical and easy to use, it is an ideal tool for detecting cardiovascular diseases. Cases of hypertrophic cardiomyopathy, one of the main causes of sudden cardiac death in athletes,[3] are likely to be detected early and the individuals concerned can be barred from athletic competition.[4] Unfortunately, the high sensitivity of the ECG comes at the cost of low specificity. In a large unselected population of young individuals, a borderline or pathological ECG is found in 4.8-11.8% of cases, in the majority of which no cardiac disease is detected on subsequent examination.[5]

The case described here points up the diagnostic dilemmas that follow the detection of a pathological ECG in high-performance athletes. Possible explanations could be the athlete's heart "syndrome", or an idiopathic ECG variation of unknown aetiology. On the other hand, sub-clinical forms of hereditary diseases (e.g. cardiomyopathies or ion channel disorders) may also show a similar picture. Phenotype-genotype correlations in families with hypertrophic cardiomyopathy have shown that individuals with a positive genotype may have ECG abnormalities as the sole expression of the disease.[6,7] In addition, cardiac ion channel disorders, such as the long-QT syndrome, can have similar incomplete or latent manifestations[8] with a structurally normal heart.

Once incompletely expressed cardiac diseases cannot be ruled out, the question of medical eligibility for athletic competition becomes problematic. There are no data concerning risk stratification in such cases, while the published recommendations for sports or recreational activities are based mainly on the opinions of specialists.[9,10] The current European guidelines do not suggest banning the individual from sports; however, they do emphasise the additional assistance that can be provided by a check of the family, cardiopulmonary exercise testing, and annual follow up.[11]

Following the above guidelines, we requested and analysed ECG recordings from all our young athlete's first-degree relatives; all were normal. In addition,

the athlete underwent a cardiopulmonary exercise test, during which the indexes of maximal and sub-maximal exercise were those expected for a high-performance sports champion. Peak oxygen consumption (VO_2max) was 56 ml/kg/min (16 METs), corresponding to 133% of that predicted on the basis of the individual's age and body type. The cardiopulmonary exercise parameters, combined with the excellent left ventricular diastolic function and family screening without suspicious findings, made the probability of sub-clinical hypertrophic cardiomyopathy even more remote.[12] Repolarisation disturbances in high-performance athletes with structurally normal hearts usually have a good prognosis, without clinical consequences.[13] Finally, the incidental observation of respiration-related ECG changes allayed our concerns even further. Indeed, the normalisation of the resting ECG during deep breaths (Figure 1B) suggested changes related either to the position of the heart in the chest, or to autonomic nervous system tone. Similar changes in repolarisation, drawn from various physiological tests, have already been described.[14]

Conclusions

During the pre-participation screening of an athlete, unusual or strange ECG findings may be a cause for concern. A detailed individual and family history, accompanied by a thorough physical examination and family screening can assist in the explanation of such findings and in the differential diagnosis between the normal syndrome of athlete's heart and possibly dangerous sub-clinical forms of cardiac disease.

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