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Olympic athletes and sudden cardiac death risk

Olympic athletes are not immune from cardiovascular disease with risk of sudden cardiac death, as discussed from the Institute of Sports Medicine and Science in Rome, Italy

In 2009, the International Olympic Committee (IOC), the international body governing Olympic Games, established a panel of experts to discuss the topic of medical care and cardiovascular (CV) evaluation of athletes. The impetus to approach the hot topic of CV preparticipation evaluation echoed the scientific debate circulating at that time regarding the best strategy to assess athletes to prevent (or at least reduce) the devastating experience of sudden cardiac death (SCD) in elite athletes. The IOC eventually released a position statement (*The International Olympic Committee Consensus Statement on periodic health evaluation of elite athletes. Br J Sports Med* 2009;43:631–643) that acknowledged the position statement of the ESC and supports, as appropriate and legitimate strategy to preserve the health of elite athletes while avoiding sport-related injuries and cardiac events, the implementation of a periodical medical evaluation, including cardiac assessment with electrocardiography.

The statement, however, did not claim this preventive strategy as a mandatory policy and was not followed by a change of medical policy by international Federations, which have been so far, reluctant to implement a CV evaluation with ECG, with the remarkable exception of the Fédération Internationale de Football Association (FIFA) and Union Cyclist International (UCI). Majority of other international sport bodies were unable to solve the resistances related to the logistical difficulties and the legal consequences of a mandatory screening program. Therefore, currently the recommendation of the IOC has remained largely unapplied in the world of elite athletes.

Indeed, there was considerable scepticism regarding the real utility of screening to identify CV abnormalities of clinical relevance in a subset of professional top-class competitors, that not only are free of symptoms and of any patent diseases, but are capable of training intensely and attain astonishing physical performances. It appears counterintuitive that these individuals may harbour any serious cardiac disease and might ever be at risk of SCD.

In this regard, the Italian Olympic Committee, the governing body of sport policy in Italy, has implemented a dedicated program for Olympic and Paralympic athletes, at the Institute of Sport Medicine and Science in Rome, which aims to assess an athlete's potential and to increase physical performance to attain Olympic success. In the context of this multidisciplinary program, a CV evaluation has been introduced since the 1980's, which nowadays routinely includes both electrocardiogram and imaging (echocardiogram) testing.

Recently, we had the opportunity to reassess the efficacy of the CV evaluation program (*Br J Sports Med* 2017;51:238–243). We considered all athletes evaluated in a 10-year period (from the Olympic Games in Athens 2004 to Sochi 2014). The study population comprised 2352 Italian elite athletes, of young age (mean 25 $\pm$ 6), of both gender (64% males), competing in a variety of summer or winter sport disciplines. Athletes have been involved in training for a substantial period of time (averaging, 6 years) before entering our medical program and continued to train intensely at the time of the study. All were world-class competitors and a large proportion (45%), had participated in more than one Olympic Games.

As expected, the vast majority of the Olympic athletes had completely normal cardiac findings (84.2%) or presented minor CV changes of no clinical significance (11.9%). However, and unexpectedly, we found evidence of CV abnormalities in a large subset (3.9%) of this cohort. Among cardiac abnormalities we identified a small, but not negligible, proportion of serious pathological conditions, including hypertrophic and arrhythmogenic cardiomyopathy (0.2%), complex ventricular tachyarrhythmias, Wolf–Parkinson–White (WPW) or long QT syndrome (0.4%), all conditions known to be at increased risk for SCD/CA during participation in sports.

Most of the remaining abnormalities comprised valvular diseases (mitral valve prolapse, bicuspid aortic valve), congenital (atrial septal defect, pulmonary stenosis, *patent ductus arteriosus*), systemic hypertension, or isolated premature ventricular beats, which are considered to have benign clinical outcome and do not represent a reason for restriction from competitive sport according to current guidelines (*Figure 1*).

This analysis clearly demonstrates that the highest level of physical performance, such as that required for participation in the Olympic Games, does not guarantee an absence of serious cardiac disorders. In our experience, even the athletes engaged in the most demanding sports (such as cycling, swimming, or triathlon) denied symptoms or impairment in physical performance. Our experience therefore demonstrates, that Olympic athletes may be exposed to the unforeseen risk of underlying, life-threatening CV diseases, and confirms that identification of most of these diseases was made possible by our screening program.

Similar results were obtained in a previous analysis on Paralympic athletes (*Br J Sports Med* 2016 Sep;50(17):1075–1080). This analysis was prompted by the consideration that exercise programs and dedicated sporting events have seen an increasing participation by individuals with physical impairments, including those selected for the Paralympic Games. In this analysis, we assessed the data of 267 Paralympic athletes, examined within our program during the period 2000–2012. These athletes achieved recognition in World Championships, and were selected to compete in the Paralympic Games.

The overall prevalence of CV disorders in this population was 12% (i.e. 33/267), including structural CV abnormalities in 24 athletes (9%), and major supraventricular or ventricular tachyarrhythmias (in the absence of structural cardiac abnormalities) in 9 (3%). Of note, a not small proportion of the CV diseases comprised dilated and hypertrophic cardiomyopathy (1%), aortic root

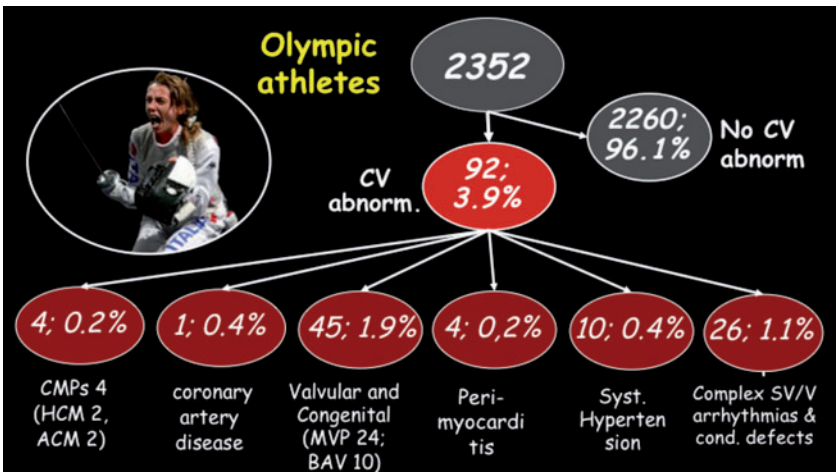

Figure 1 Schematic flow diagram of CV screening program in Olympic athletes. ACM, arrhythmogenic cardiomyopathy; BAV, bicuspid aortic valve; CMPs, cardiomyopathies; CV, cardiovascular; Cond., conduction; MVP, mitral valve prolapse; SV, supraventricular; V, ventricular; HCM, hypertrophic cardiomyopathy.

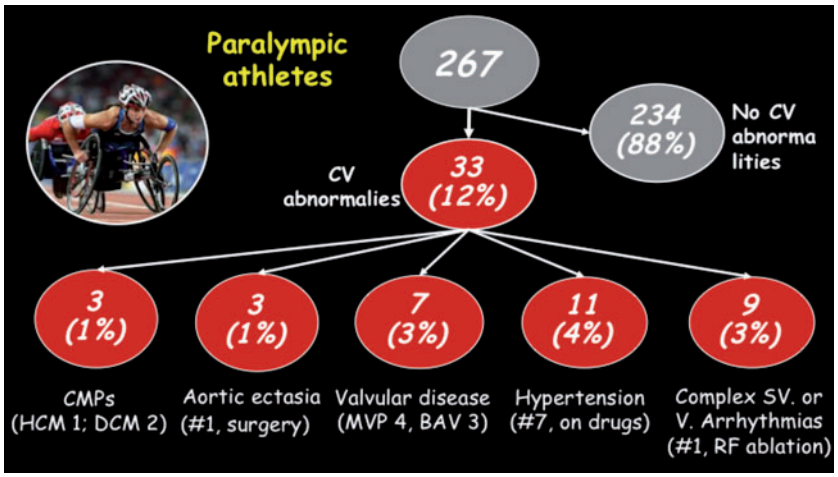

Figure 2 Schematic flow diagram of the CV screening program in Paralympic athletes. BAV, bicuspid aortic valve; CMPs, cardiomyopathies; CV, cardiovascular; DCM, dilated cardiomyopathy; MVP, mitral valve prolapse; RF ablation, radio frequency ablation; SV, supraventricular; V, ventricular; HCM, hypertrophic cardiomyopathy.

aneurysm (1%), complex ventricular or supraventricular tachyarrhythmias (3%), other valvular diseases (3%), or systemic hypertension (4%) (*Figure* 2).

The observed prevalence of CV diseases in Paralympic athletes was particularly surprising, being three times larger than that observed in Olympic athletes. We assumed that certain characteristics might partially explain the larger occurrence of CV abnormalities in individuals with physical impairments, such as their relative older age, as well as the larger presence of cardiac risk factors.

However, the prevalence of CV abnormalities in Olympic and even more in Paralympic athletes was greater than expected, considering that all these athletes have been competing at local and national level for several years and have been previously examined within the national screening program, before entering our Olympic program.

The identification of serious pathological conditions (such as cardiomyopathies, or serious electrical diseases) in a sizeable subset of Olympic and Paralympic athletes legitimately raises the question of the real efficacy of the ECG-screening protocol implemented nationwide in Italy.

We conducted a retrospective analysis in athletes with cardiomyopathies and channelopathies and realized that in most of these athletes the ECG abnormalities were already present at previous evaluations, but diagnosis was missed possibly because of incorrect ECG interpretation. This observation underlines the need of

improving the ability of clinical cardiologists to appropriately interpret an athlete's ECG.

In other instances, the ECG abnormalities were either not yet evident or dismissed because they were not associated with evident structural cardiac alterations at subsequent imaging testing. Finally, other CV diseases occurred later in time (such as the cases of peri-myocarditis), or were not evident due to the age-related progression (i.e. atherosclerotic heart disease and non-phenotypically expressed cardiomyopathies), which suggests that repetition of screening over the years increases the diagnostic yield to identify cardiac diseases.

In conclusion, our experience revealed an unexpected prevalence of CV abnormalities in Olympic and Paralympic athletes, including a small but not negligible proportion of conditions at risk of SCD/CA. This observation suggests that elite athletes, despite their astonishing performance and absence of symptoms, are not immune from potentially lethal CV disorders. Therefore, our data legitimates the need of a tailored screening program in the selected cohort of top class Olympic and Paralympic athletes.

This concept, already supported by the position paper of the IOC, is still neglected and is waiting for greater support by medical societies and wider implementation by international Sport Federations.

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