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Editorial

Course of acute myocarditis in athletes: Does the sport pattern really matter?

Acute myocarditis is as an inflammatory disease of the myocardium, whose incidence in the general population is not well established, due to frequent asymptomatic and undiagnosed cases [1]. Although definite data is lacking, highly trained athletes seem to be at higher risk of developing myocarditis [1]. Intense exercise training is linked to a transient immunological depression (leukocytopenia, reduction in salivary IgA) leading to increased susceptibility to infections, particularly of the upper respiratory tract, both after single bouts of physical activity (the so called "open window" theory) [2,3] and during chronic training [2,4,5]. Myocarditis can have different etiologies but they are frequently caused by respiratory and gastro-intestinal viruses [1]. Hence, immune modulation after intense exercise may, in theory, increase athletes' susceptibility to acute myocarditis and impact on its clinical course. Animal models have shown that the course of both viral and immune acute myocarditis worsens with strenuous physical exercise [6,7,8], but evidence in humans is lacking. Granted that, there is a clear demand for extending knowledge on myocarditis risk and course in sportspeople.

In this issue of the *International Journal of Cardiology: Heart & Vasculature,* Bouchau et al. [9] performed a single-center retrospective analysis, exploring the association between type/intensity of sport disciplines and "complicated myocarditis" (defined as left ventricular disfunction and/or use of inotropic drugs or mechanical circulatory support). They retrospectively included 82 young individuals who were engaged in regular physical exercise (>2.5 h/week) at the time of admission for acute myocarditis. They found a significant association between high static component sports (class IIIA according to the Mitchell's classification [10]) and complicated myocarditis; moreover, a higher training load (>6 h/week) was associated with complicated course. On the contrary, people practicing endurance activities (class IC) more frequently presented uncomplicated disease. At multivariable analysis, only power sports activity, but not training load, remained predictor of complicated myocarditis.

This paper offers food for thought. Firstly, the connection between the type of sport practiced and the severity of myocardial inflammation. Though the effect of intensity/frequency of training observed in the study is in line with previous data coming from animal models [6–8], the observation that endurance exercise has a "protective role" on the clinical course of acute myocarditis (opposite to the negative effect of static exercise) is counterintuitive. According to the Authors, this observation might be explained by exercise-induced lymphocyte T suppression associated with endurance sports, possibly leading to a decrease in myocardial inflammation and necrosis that are recognized promoters of myocarditis-related damage. On the contrary, power disciplines would be associated with upregulation of the immune system, particularly cellular immunity, and increased cytotoxic damage [11] (Fig. 1). This hypothesis is not in contrast with the observed increased susceptibility to viral infections of endurance athletes: in theory, they may be more prone to myocarditis than the general sedentary population but less to complicated disease than those engaged in power sports. However, these preliminary findings need to be confirmed by future prospective studies, with the aim to clarify the role of exercise-induced immunomodulation in conditioning the disease's course. We can speculate that other factors (psychological stress linked to competition, international travel with sleep wake rhythm disturbance, nutritional factors, use of doping substances…) may also play a role in modulating the immune system and therefore the course of myocarditis in sportspeople [1].

The study by Bouchau et al. [9] also addressed the follow-up of sportspeople with acute myocarditis and reported that, over a mean follow-up of 2.8 years, all but 1 patient normalized the left ventricular ejection fraction. However, the majority of those who underwent follow-up cardiac magnetic resonance showed a persistent non-ischemic myocardial scar (late gadolinium enhancement). Non-ischemic left ventricular scars may be caused by previous myocarditis or inherited cardiomyopathies such as arrhythmogenic cardiomyopathy, and are emerging substrates of sudden cardiac death in the athletes because of their potential to generate re-entrant ventricular tachycardia [12]. As also demonstrated by the present study, echocardiography has a limited sensitivity for detection of non-ischemic scars in the athlete because they affect the sub-epicardial left ventricular layer that contributes less to systolic thickening [12]. Maximal exercise testing has the ability to induce ventricular ectopic beats (with a typical right-bundle-branch block configuration) in athletes with an underlying non-ischemic left-ventricular scar and, for this reason, cardiac magnetic resonance is indicated when this arrhythmic pattern is observed irrespective from a history of previous myocarditis and normal echocardiography [13]. Exercise testing is also indicated in the follow-up of athletes with clinically healed acute myocarditis because, according to current guidelines [14], competitive sports activity is not recommended in those with persistent late gadolinium enhancement and frequent or complex forms of ventricular arrhythmias. At present, a post-myocarditis scar in the absence of ventricular dysfunction or arrhythmias is not deemed as a contraindication to resume sport activity but, being a potential source of life-threatening ventricular arrhythmias, case-by-case judgment seems appropriate.

Several limitations of this study should be considered. The relatively small sample size, leading to the need for larger studies to confirm these results. The retrospective design, with patients interviewed years after the event, which could have led to selection bias and inexact data on the characteristics of sport activities performed. The lack of information

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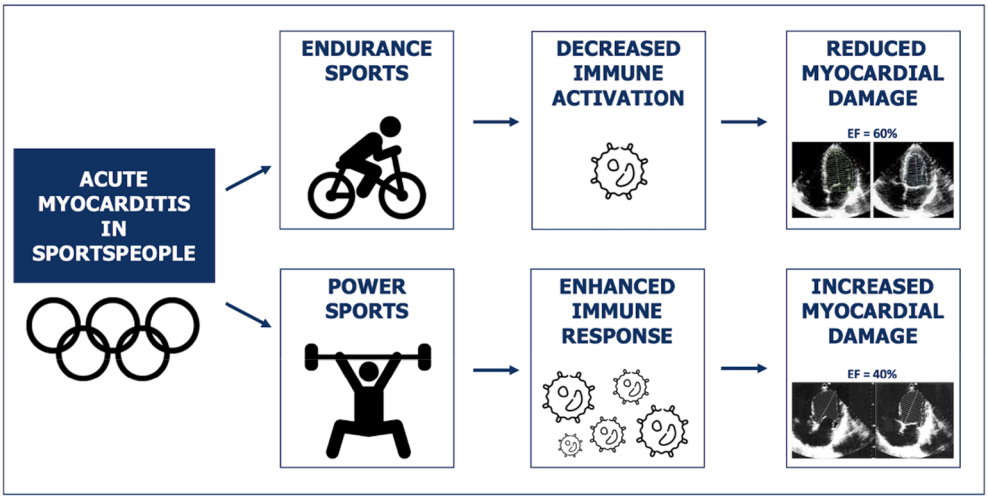

Fig. 1. Postulated physiopathological mechanism linking the type of sport to the severity of the disease in sportspeople admitted for acute myocarditis.

about personal and family history, useful to exclude insidious differential diagnosis such as left-dominant arrhythmogenic cardiomyopathy, known to be aggravated by intense sport practice [15]. Furthermore, a large prevalence of male patients (94%) was included in the analysis, leading to possible sex-confounded results, also considering the potentially higher susceptibility of the female sex to exercise-related infections [16]. Sex difference in this field will represent an interesting focus of research.

In summary, the results of this study offer some interesting points for discussion about the effects of different sport intensity and types on myocarditis course in sportsmen. We should recognize the gaps in knowledge in this field and the need for additional clinical research to refine risk stratification for complicated acute myocarditis and post-myocarditis scar in the athletes.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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