BARÇA
INNOVATION HUB
Universitas

PATHOLOGY IN TEAM SPORTS

LIFE-THREATENING RESPIRATORY DISEASE AND SUDDEN DEATH IN SPORTS

2.2 Non-Cardiovascular Disease Risks in Sports

Drobnic, F.[1,2], Salac, A.[3], Labrador, M.[3], and Cardona, V.[3]

[1] FC Barcelona Medical Services.

[2] GIRSANE-CAR.

[3] Allergy Service H. Valle de Hebrón, Barcelona.

Introduction

Playing sports recreationally or professionally presupposes excellent physical condition and a healthy and disease-free state of physical health. Regular, scheduled exercise, as well as the care athletes take in looking after themselves, help them stay healthy, prevent injuries, recover better, avoid complications associated with certain conditions that can be provoked by intense exercise, or even improve the prognosis of such conditions. Nevertheless, athletes, just like the general population, can suffer from birth defects or hereditary abnormalities, which are difficult to diagnose and prevent if we lack the relevant information we need to identify them. Athletes may also suffer from diseases that may become aggravated during high level athletic performance, either due to characteristics that are specific to the disease or environment or as a result of performing physical exercise in certain conditions (Drobnic, Salac, Labrador, Unnithand, and Cardona, 2014).

The positive effects of exercise and an active lifestyle on chronic diseases, respiratory diseases and asthma has been widely documented. The tragedy of an athlete – a seemingly healthy individual – suddenly dying while playing sports, forces us to question the meaning of prevention and to rethink how we manage diseases. Such an incident mobilizes specialists to focus on preventive diagnosis of pathologies that can cause death in sports (Drobnic et al., 2014).

Sudden death in sports

> The term sudden death (SD) has been used in different ways by epidemiologists, clinicians, pathologists and legal medicine specialists. From the clinical perspective, sudden death is considered to be death due to natural causes, which excludes accidents, poisonings, suicides, etc., within the first hour after symptoms begin.
>
> There are multiple systems in the body that can cause sudden death, however, sudden cardiac death represents almost 90% of sudden death cases. Hence, amongst the general public and even in the scientific world, sudden death is considered only from the cardiogenic perspective. (Drobnic et al., 2014, p. 36).

Ischemic heart disease is present in more than 80% of individuals who die suddenly, and higher still for people aged between 35-40 years. Prior to this age, hypertrophic cardiomyopathy is a frequent cause, especially in young athletes, as is subclinical myocarditis (Drobnic et al., 2014). Other diseases associated with this age group, but in a small number of cases, are Wolff-Parkinson-White type preexcitation syndrome (Torner et al., 1991), arrhythmogenic right ventricular dysplasia (Thiene, Nava, Corrado, Rossi, & Pennelli, 1988), mitral valve prolapse and other valvular diseases, as well as congenital coronary anomalies. Sudden death rates vary from one country to another according to the prevalence of ischemic heart disease, which is much more pronounced in Northern Europe and the United States than in the Mediterranean Basin. According to the World Health Organization (WHO), the incidence of sudden cardiac death in industrialized regions varies from 20 to 160 per one hundred thousand inhabitants per year among men between 35 and 64 years of age (Drobnic et al., 2014).

Sudden cardiac death (SCD) in athletes is considered as such when it occurs within 24 hours of a sports event. The reason for this extended time period is for it to be long enough that a diagnosis can encompass all possible processes that may cause a sports-related death. If the relationship between exercise and sudden death is better understood, preventive, diagnostic and therapeutic models can be established in order to prevent these deaths (Drobnic et al., 2014). The prevalence of SCD is estimated to be 1 in 200,000 inhabitants per year among people under the age of 35 and 1 in 18,000 in those over 35 (MacAuley, 1998). "As with non-athletes, most have a cardiovascular origin,

where SCD in individuals under the age of 35 is associated with undetected structural heart diseases" (Drobnic et al., 2014, p.36), as well as the diseases previously mentioned.

> It is worth noting that accurately diagnosing sudden death is a difficult task, and cases of SCD even more so. Most cases that are recorded as sudden cardiac death use data that appear in the media as shared by professionals presumed to be knowledgeable on the topic, which makes the validity of such information questionable (Drobnic et al., 2014, pp. 36-37).

Sudden death is an umbrella term for a fatal outcome that occurs in a very dramatic manner, and which could occur on the sports field. If these deaths were called something else, incident rates would drop and in turn so would its prevalence, as the deaths would only be looked at in terms of cause of death. This would incorrectly disregard the seriousness of the problem, which demands, among other things, appropriate testing and monitoring of athletes. As determined by the statistics collected thus far, sudden death in sports has thus far only really been associated with the heart and assessed on this basis, especially in terms of criteria for diagnosing an athlete (Maron, 2007, Crawford, 2007). However, there are multiple causes of death during physical activity.

> Besides the cardiocirculatory system, exercise puts other adaptation systems to the test, such as the metabolic, nervous, endocrine and respiratory systems. Thermal shock, cerebral hemorrhage, life-threatening hemoptysis or anaphylactic shock associated with exercise are some of the multiple diseases that can occur in an apparently healthy individual.

> Today, the concept of unknown, undiagnosed diseases and an excellent state of health prior to sudden death, has become obsolete thanks to technological advances in preventive diagnoses. What is clearly important is that the identification process be underway; that is, that either a diagnosis is made, could be made or is intended to be made as a necessary and basic step. (Drobnic et al., 2014, p. 37).

Thus, given that sudden death is related to these characteristics, from a preventative point of view, it is more useful to start to use the term life-threatening pathology or disease. That is, pathologies that under certain determined conditions can lead to a fatal outcome. From the point of view of physical activity and sports medicine, exercise is considered to be a trigger, aiding cause or fundamental cause. By examining it as a life-threatening pathology, we can define and work on preventing this sudden or unexpected death (Drobnic et al., 2014).

The respiratory patient and the risk of death during exercise

> When a specialist physician is consulted by a respiratory patient who plays sports or intends to start, or engages in a recreational activity that requires physical effort and puts stress on adaptation systems, it is the physician's responsibility to be aware of the patient's idiosyncrasies, of any diseases they have and of the interactions of both of the these with medication, effort intensity, the environment where the activity will take place and what the individual will be exposed to. (Drobnic et al., 2014, p. 37).

A history of spontaneous pneumothorax, certain lung birth defects, chronic airflow limitation, sensitivity to certain foods, insect bites and asthma in particular would be the most common factors that we must take into account (Drobnic et al., 2014).

> In the field of pneumology, most pathologies produce respiratory distress in response to exercise that in practice would never put the patient's life at risk, given that the exercise intensity is limited by the respiratory disease itself. Nonetheless, it is also true that there are diseases that must be considered due to their particular characteristics, especially if the body is subjected to environmental stress in addition to physical stress. It is not necessary to look at unique and special cases, which more often than not do not really justify an excess of zeal. (Drobnic et al., 2014, p. 37).

Nonetheless, these cases do serve to warn the athlete and patient of the importance of following their doctor's advice and prescriptions (Drobnic et al., 2014). This is especially the case when an athlete's life could be at risk.

The main group of people suffering from respiratory illnesses that may engage in high-intensity structured exercise and sports, including at the elite level, are asthma sufferers. Some asthma patients that also suffer from other diseases, due to ease of movement and new technologies, may perform certain activities and access places that will certainly test their cardiorespiratory system, such as hiking, mountaineering, diving or hot air ballooning, all popular recreational activities (Drobnic et al., 2014).

> About 300 million people in the world suffer from asthma, 250,000 of whom die each year, mostly as a result of not being diagnosed, inadequate treatment or delayed medical care in an asthma crisis. In Spain, this rate is calculated to be 0.4/100,000 inhabitants for men and 0.1 for women between the ages of 5 and 34. This rate is similar to other countries with the same socioeconomic rank and for the same age range, although the risk of death associated with asthma has fallen in general. Hospital admissions for acute life-threatening asthma exacerbated by exercise are 0.2% in Spain, from 300 to 350 cases, and 0.5% in Latin America, from 600 to 700, covering all causes. The age range is broad and these numbers include not only athletes, but people who have engaged in all types of physical activity. (Drobnic et al., 2014, p. 38).

Meaning, sports is the main cause of asthma exacerbation that precipitates hospital admission,

> In any case, there is no explicit record of deaths that have occurred during physical activity. One may assume that this phenomenon is of very little interest given the lack of literature on the topic, but in reality the problem is it is quite complicated to obtain data on these deaths. (Drobnic et al., 2014, p. 38).

It is important to highlight that severe exacerbation of asthma is due to upper airway infections in 65% of cases, aeroallergens in 3.6% of cases and medications in 0.5% of cases. These are the triggers that make the respiratory and digestive systems more sensitive to effort, especially in athletes (Drobnic et al., 2014).

In the presence of severe respiratory exacerbation, where exercise is involved, it is not always possible to add in asthma as a coadjuvant or definite trigger, but it is possible to consider it as one of the main stimuli. In any case, sudden death due to asthma or anaphylactic crisis are not, in principle, defined as cases of sudden death, although they do occur relatively quickly and unexpectedly. These are defined as deaths due to an asthma crisis, either caused by exercise alone, exercise in combination with certain foods to which the individual is especially sensitive, a prior severe case or other contributing factors, such as infections, aeroallergens, hymenoptera stings, use of medications, etc. (Drobnic, 2007). In any case, the underlying illness is typically well known by the patient, their physician and on occasion, those surrounding the sufferer. It is largely preventable, if we consider some types of asthma in combination with sports as a life-threatening disease.

First and foremost, patients with asthma must be aware of triggers that exacerbate their asthma. Prior hospitalizations, undertreatment for whatever reason, and obesity are the most influential causes (Drobnic et al., 2014). It is vital that the relationship between asthma severity and risk of death is analyzed, taking into account: the number and severity of hospital admissions in the previous 12 months, the prescription of three or more drugs or the introduction of oral corticotherapy, as well as potential psychosocial problems. These are all significant factors that help us more accurately identify severe asthmatics with a greater risk of death. These are also factors that must be considered when discussing exercise options with these individuals (Drobnic et al., 2014).

In short, the common denominator among asthma-related deaths in sports is the severity of the underlying disease; persistent, moderate or severe asthma; poor adherence to treatment, and an underestimation of the disease in general (Drobnic et al., 2014). This underestimation is not necessarily related to alexithymia, that is, a lack of recognition of the severity of the crisis, but more to a general lack of concern for one's asthma disorder. This relates to more of a psychosocial disorder, in some individuals due perhaps to their age or their stage of maturity and development, such as pre-adolescence or adolescence, and how they relate to their illness. These issues can be addressed through quality education and monitoring.

Comorbidity and weather

Through patient education and assessment, we must uncover the causes of a crisis in a patient with asthma. Comorbidity of acute asthma in patients who in addition to asthma

suffer from rhinitis, for example, and even how these conditions relate to weather conditions typical of outdoor sports activities, many of which are recreational sports practiced by a large percentage of the population (Drobnic et al., 2014). From an epidemiological point of view, a severe asthma crisis does not only depend on socioeconomic or intellectual differences or adherence to treatment, but it also significantly relates to how suitable the weather conditions are, a factor which affects asthma in a number of ways. Storms, rain or a lack of rain, wind speed and direction, atmospheric pressure or temperature can all drastically worsen baseline asthma. Not surprisingly, emergency hospital admissions for asthma increase when humidity is high and atmospheric pressure drops, as well as when the temperature is lower and there is a wider temperature range (Drobnic et al., 2014).

> Storms facilitate the osmotic breakage of pollen grains into breathable particles, increasing the likelihood that a rhinitis patient will suffer an acute crisis. In the same way that cold and dry air are important triggers for a stress asthma crisis, other climatic factors are equally significant in the destabilization of baseline asthma. (Drobnic et al., 2014, p. 39).

These are all circumstances that can certainly contribute to a fatal outcome.

The above information is represented in Table 1, which summarizes the characteristics of asthma, the asthma-sufferer and the factors to take into account to prevent an acute asthma crisis and the associated risks. Table 1 also serves as a summary of this chapter.

The occurrence of sudden cardiac death is unusual during childhood and adolescence (Byard, James, & Gilbert, 2002); however, it must be taken into account for children and adolescents with asthma, given that half of such cases occur between the ages of 10 to 20 years of age, with no difference found between competitive or recreational sports practice, which is significant given that although not all children play competitive sports, all children do play recreationally (Drobnic et al., 2014).

> The relationship between asthma and exercise is complex and though it does not need to be feared, it does need to be respected. The message to the patient must be clear, and although active participation in sports should not be discouraged, it is important to reaffirm that asthma is a

life-threatening disease, with serious potential health consequences, and that it needs to be carefully monitored.

Whether deaths of a respiratory origin that occur during exercise are defined as sudden death or not is ultimately not important. What matters is that it is a phenomenon that occurs, that can be identified, measured and evaluated in order to direct our efforts at preventing such deaths, or at least at decreasing their prevalence, which is already the case with sudden deaths of a cardiovascular origin. (Drobnic et al., 2014, p. 40).

We do not believe we are incorrect in thinking that SCD related to the respiratory and allergic systems exists, has diverse origins and is avoidable if we improve our knowledge and act accordingly (Drobnic et al., 2014).

Table 1: Circumstances related to episodes of asthma exacerbation and fatal asthma crises

Scope	Asthma exacerbation	Fatal asthma
Sports	Intrinsic severity of the asthma	Hospital admissions in the last year.
	Level of adherence to treatment.	Psychosocial problems.
In general	Comorbidity of asthma and rhinitis.	Prescription of three or more drugs.
	Neutrophilic asthma.	Commencement of oral corticotherapy.
	Low sociocultural status.	
	Weather-related factors.	
	Women: menstruation.	
	Obesity and poor physical condition.	

Source: adapted from Drobnic et al., 2014.

References

Byard, R. W., James, R. A., & Gilbert, J. D. (2002). Childhood Sporting Deaths. *American Journal of Forensic Medicine Pathologies. 23*(4), 364-367.

Crawford, M. H. (2007). Screening Athletes for Heart Disease. *Heart, 93*(7), 875-879. Retrieved from https://bit.ly/2k6yy4k

Drobnic, F. (2007). Muerte súbita de origen respiratorio y deporte. *Archivos de Bronconeumología, 44*(7), 343-345. Retrieved from http://www.archbronconeumol.org/es/muerte-subita-origen-respiratorio-deporte/articulo/S0300289608704460/#cor1

Drobnic, F., Salac, A., Labrador, M., Unnithand, V., & Cardona, V. (2014). Enfermedad de riesgo vital de origen respiratorio o alérgico en el deporte. *Apunts. Medicina de l'esport, 50*(185), 35-42. Retrieved from www.raco.cat/index.php/Apunts/article/download/289814/378106

MacAuley, D. (1998). Does Preseason Screening for Cardiac Disease Really Work? The British Perspective. *Medicine and Science of Sports Exercise 30*(10), 345-350.

Maron, B. J. (2007). Hypertrophic Cardiomyopathy and other Causes of Sudden Cardiac Death in Young Competitive Athletes, with Considerations for Preparticipation Screening and Criteria for Disqualification. *Cardiology Clinic, 25*(3), 399-414.

Thiene, G., Nava, A., Corrado, D., Rossi, L., & Pennelli, N. (1988). Right Ventricular Cardiomyopathy and Sudden Death in Young People. *New English Journal of Medicine, 318*, 129.

Torner, P., Brugada, P., Smeets, J., Bayés de Luna, A. et al. (1991). Ventricular Fibrillation in the Wolff- Parkinson-White Syndrome. *European Heart Journal, 12*, 144-50.