IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)
e-ISSN: 2279-0853, p-ISSN: 2279-0861.Volume 23, Issue 10 Ser. 4 (October. 2024), PP 05-13
www.iosrjournals.org

Etiology, Epidemiology And Methods Of Preventing Sudden Death Of Cardiac Origin In Sports

Bruna Estefani Rocha De Brito [1], Matheus Guedes Fernandes Silva [2], Rafael Pinheiro Do Nascimento [3], Giovana Casarini Yamashiro [3], Isabela Marini Ferreira[3], Jaqueline De Carvalho Ferreira [3], Hamilton Roberto Moreira De Oliveira Carriço [4], Ana Laura Nogueira Ervilha [5], Júlia Da Silva Toledo[5], Gabriel Queiroz Sabbag[6], Alysson Corrêa Alves Oliveira[7], Thalita Pinheiro Morel Alineri [8], Marcone Cândido Rodrigues [8], Rafaela Del Grosso Reis [9], Filipe Jabur Lot Garcia [9], Aline Cristina Couto Da Silva [9], Lucas Fernandes T. De Syllos [9], Leonardo Tomé Da Silva [9], Giani Bianchi Soares [9], Samantha Regina G. Sanches [9], Hannah Kamarowski Fontana [9], Diego Paulino Mariz [9], Laura Aparecida Nascimento Ribeiro[9], Giovana Rocha Victorello [9], José Carlos Ferreira Da Silva [9], Márcia De Oliveira [9], Cindy Alves Vilarinho [9], Danilo Almeida De Oliveira Panebianco [9], Adriana F Viana [9], Lisandra Silva Do Amaral [9], Joseilton Vilela De Carvalho [9], Délio Tiago Martins Malaquias [9], Juliana Fontes Beltran Paschoal [9-10], Thiago A. Rochetti Bezerra [9-11]

1. Academic In Medicine. Vértice University Center. Univértix, Matipó, Minas Gerais, Brazil.
2. Hospital 9 De Julho, São Paulo, Brazil.
3. Academic In Medicine. Nove De Julho University. São Paulo, Brazil.
4. Academic In Medicine. Unisul Tubarão, Santa Catarina, Brazil.
5. Academic In Medicine. Fcmsjc, São Paulo, Brazil.
6. Doctor. Saint Leopoldo Mandic. Araras, São Paulo, Brazil.
7. Academic In Medicine. Saint Leopoldo Mandic. Brazil.
8. Academic In Medicine. Unoeste, Guarujá, São Paulo, Brazil.
9. Academic In Medicine. Unaerp, Guarujá, São Paulo, Brazil.
10. Phd In Biotechnology. Usp, São Paulo, Brazil.
11. Doctor Of Medical Sciences. Usp, Ribeirão Preto, São Paulo, Brazil.

Abstract:
Introduction: *Numerous epidemiological studies have consistently shown an association between moderate aerobic exercise and decreased risk of coronary heart disease (CHD) and death, and even a small amount of exercise provides a significant reduction in risk compared to a sedentary lifestyle*
Objective: *The aim of this study was to identify the etiology, epidemiology and prevention of sudden cardiac death in sports.*
Methodology: *The methodology used was a literature review. The research was carried out by means of an electronic search for scientific articles published on the Scielo (Scientific Electronic Library Online) and Lilacs (Latin American Health Sciences Literature) and Pubmed websites. The health terminologies consulted in the Health Sciences descriptors (DeCS/BIREME) were used; the etiology, epidemiology and ways of preventing sudden cardiac death in sports practices.*
Discussion: *An important distinction must be made between hypertrophic cardiomyopathy and "athlete's heart syndrome". In this syndrome, intense physical training leads to various morphological and physiological alterations, especially left ventricular hypertrophy.*
Conclusion: *The complete health safety of athletes consists of periodic pre-participation clinical assessment as well as emergency measures, mainly in competition venues, consisting of the availability of health professionals*

capable of performing basic life support and rapid means of communication to request advanced life support, in addition to immediate access to the main instrument capable of reversing cardiorespiratory arrest the AED.
Keywords: *Sudden Death; Physical Exercise; Hypertrophic Cardiomyopathy.*

Date of Submission: 01-10-2024 Date of Acceptance: 10-10-2024

I. Introduction

Exercise is one of the most powerful tools for improving health and has been associated with beneficial changes in most cardiovascular risk factors, including lipids, blood pressure, insulin sensitivity and weight [1,2].

Numerous epidemiological studies have consistently shown an association between moderate aerobic exercise and decreased risk of coronary heart disease (CHD) and death, and even a small amount of exercise provides a significant reduction in risk compared to a sedentary lifestyle [1,2].

Although there is controversy over the potential link between intense resistance exercise and increased risk of some heart conditions (i.e. atrial fibrillation, ventricular fibrosis), overall, exercise is clearly health-promoting for the vast majority of individuals [1,2].

However, for a small number of individuals who have heart problems, exercise can sometimes be associated with the risk of sudden death (i.e. the exercise paradox) [1,2].

Sudden death in athletes, who are defined as all individuals involved in regular individual or collective sporting activities, whether competitive or not, is always a dramatic event that has a major impact on society, the family, the medical community and major repercussions in the media, especially in the case of professional athletes. This is because athletes are considered to be the healthiest segment of society, with the belief that their athletic qualities are a reflection of their state of health, making it difficult to understand how these models of health can die during or after practicing physical activities[1,2].

There are several definitions adopted by different authors for sudden death related to exercise and sport. Exercise-related sudden death refers to death that occurs during physical activity or up to an hour after it has finished [3].

Another definition would consider sudden death related to physical activity to be a dramatic, atraumatic and unexpected condition in apparently healthy individuals, occurring between six and 24 hours after the onset of symptoms or up to two hours after practicing the sporting activity. However, one criticism of this definition is the use of the term "atraumatic", since, in a condition known as commotio cordis (cardiac concussion), trauma to the thoracic region can trigger a cardiorespiratory arrest [4].

When trying to establish an interrelationship between physical exercise and sudden cardiac death, it can be seen that if, on the one hand, there is great preventive potential in the relationship between exercising and dying suddenly, there is also a definite risk between dying suddenly during or, especially, after physical activity [4].

In this way, exercise can play a paradoxical role: improved athletic fitness may be related to a protective effect in the prevention of coronary artery disease, beneficial changes in the lipid profile, weight loss, a reduction in heart rate and resting blood pressure, as well as being able to produce cardiovascular changes that reduce the risk of sudden death in individuals who are regular exercisers, possibly by increasing parasympathetic autonomic activity, improving the electrical stability of the heart; However, it is also capable of transiently increasing the risk of acute cardiovascular events, especially in individuals who do not practice regular physical activity, probably because it activates the sympathetic autonomic system, predisposing to cardiac arrhythmias and/or rupture of vulnerable atherosclerotic plaques [1,3,5].

Physical exercise, however, should not be seen as solely responsible for the sudden death event, but rather as a co-adjuvant in a complex system involving a pre-existing disease that is sometimes silent, and predisposing factors such as age, gender, extreme environmental conditions, severe hydroelectrolytic disorders, the use of certain ergogenic agents and the type of sport practiced, as well as a critical moment, with physical exercise as the "trigger", which can alter the balance in such a way as to start the chain of events that culminates in sudden death [3,5].

Sudden death in athletes is related to the presence of congenital or acquired cardiovascular diseases. Thus, physical activity, when practiced by the select group of people who have these diseases, does not act as a protective activity against cardiac events, but rather as a trigger for them, regardless of the person's level of fitness, whether they are a highly trained athlete or not. It is therefore essential that the doctor has a broad knowledge of the clinical specificities involved in triggering sudden cardiac death in athletes, as well as being able to accurately identify the cause of sudden cardiac death.

II. Objectives

The aim of this study was to identify the etiology, epidemiology and prevention of sudden cardiac death in sports.

III. Material And Methods

The methodology used was a literature review. The research was carried out by means of an electronic search for scientific articles published on the Scielo (Scientific Electronic Library Online) and Lilacs (Latin American Health Sciences Literature) and Pubmed websites. The health terminologies consulted in the Health Sciences descriptors (DeCS/BIREME) were used; the etiology, epidemiology and ways of preventing sudden cardiac death in sports practices.

The inclusion criteria were: original article, published in Portuguese and English, freely accessible, in full, on the subject, in electronic format and published in the last ten years (2000 - 2024), totaling 25 articles.

IV. Results And Discussion

As many of the heart conditions that cause sudden death in athletes may not present warning symptoms, there has been considerable discussion about the role of pre-participation screening tests to assess hidden cardiovascular diseases.

Sudden death in athletes is a rare event that can have its relative risk increased during exercise, although the absolute risk remains quite low. The exact incidence of this event is not well known, as there is no national database for tracking this type of death. In addition, this category of event is greatly underestimated due to the fact that there is a lack of information on the part of clubs, organizations or institutions responsible for athletes who have suffered this type of fatality [2].

In absolute numbers, the incidence of sports-related cardiac death is 0.75/100,000 for men and 0.13/100,000 for women, i.e. it is around five times more frequent in men than in women. This is probably because there is a greater total number of men taking part in competitive sports, because they are generally exposed to a greater training and competition load, and because they have a higher rate of congenital heart disease than women [6,7].

In people over 35, this ratio increases, largely due to the growing prevalence of atherosclerotic heart disease, which raises these figures to 6/100,000 deaths in middle-aged individuals [8].

Some series point to soccer and basketball as the sports that most often lead to death. However, other studies suggest that sudden death occurs more frequently in marathon runners than in other sports, with an estimated incidence of 1/50,000 in these runners [3,9].

Most cases of sudden cardiac death in athletes occur during or immediately after vigorous exercise. Exercise can trigger complications in individuals with predisposing factors, and this risk is higher in those with little contact with physical activity compared to those who exercise regularly.

A study carried out in the early 1990s found that the relative risk of suffering an acute myocardial infarction is 5.9 times higher within one hour of strenuous physical activity. However, this relative risk decreases significantly when exercise is practiced regularly and the weekly frequency is increased. It is important to note that moderate, controlled exercise does not increase the risk of sudden death, while more vigorous and poorly-oriented forms are associated with a five to seven times greater risk [2,10].

The largest studies available estimate that 1/100,000 and 1/300,000 sudden deaths occur each year in American high school and college athletes, respectively. This represents 50 to 100 cases each year in this population [8].

The impact of these events generally takes up a lot of space in the media. In recent years, three events of sudden death on the pitch have shaken the soccer world, such as the case of Cameroonian Marc-Vivien Foé in 2003, Hungarian Miklos Fehér in 2004 and Brazilian Paulo Sérgio de Oliveira Silva, Serginho, also in 2004, and recently Uruguayan Isquierdo in 2024, which has once again focused attention on the importance of screening for cardiovascular diseases in athletes [11].

There have also been recent cases reported in the Brazilian media of aborted sudden death in which the rapid and correct intervention of club doctors using an automatic external defibrillator (AED) was able to save lives, such as those of Cruzeiro footballer Diogo Mucuri in 2006 and Ituiutaba player Leandro Moreno in 2007.

These are just a few of the cases that have had the most repercussions, but episodes like this possibly occur every day all over the world, whether with professional athletes or not. Certainly, these reported cases are just the “tip of the iceberg” of a much wider problem that needs measures to be taken to prevent it.

Based on numerous studies on this subject, it can be said that the vast majority of people who die suddenly during physical activity have a heart disease that justifies their death. In this way, it is imperative to assume that an athlete who dies from sudden death already had a heart problem, since it is extremely difficult to trigger sudden death in an athlete with a healthy heart [8,10].

Ventricular tachyarrhythmia is the mechanism responsible for sudden death in 80% of cases, with bradyarrhythmia and asystole accounting for the other 20%. These mechanisms do not occur at random, but rather in hearts with underlying pathological processes that result in hypertrophy, structural changes in cardiac fibers, fibrosis or necrosis in the myocardium, with the exception of deficiencies in ion channels that can also trigger ventricular arrhythmias, even in structurally normal hearts. However, it is often not enough for there to be

structural problems in the heart, there must be pathophysiological factors acting on it, the so-called "triggers" capable of activating mechanisms that, together, can lead to electrical instability in the heart and, consequently, to a fatal arrhythmia and sudden death.

Some of these factors that can act on a susceptible myocardium during exercise are: high myocardial oxygen demand and simultaneous reduction in diastole and coronary perfusion time; altered sympathetic or parasympathetic tone; release of thromboxane A2 and other coronary vasoconstrictors; blood hypercoagulability; lactic acidosis and intra- and extracellular electrolyte alterations; high concentrations of free fatty acids and excessive rise in body temperature [8,10].

Reduced cardiac output, secondary to myocardial ischemia or arrhythmia, reduced cerebral blood flow and loss of consciousness are events that always precede sudden cardiac death during exercise, regardless of the mechanism responsible for its occurrence. In the immediate post-exercise interval, the occurrence of syncope, arrhythmias and cardiac arrest is due to the sudden cessation of physical activity, when arterial vasodilation is still maintained, associated with the lactic acidosis typical of this period [8,10].

The causes of sudden death in young athletes - those under 35 years of age - are mostly related to congenital anomalies of cardiac origin. Among these, hypertrophic cardiomyopathy stands out the most, being the main cause of sudden death in almost all studies, followed by congenital anomalies of the coronary artery and idiopathic left ventricular hypertrophy7 (Table 1). In sportsmen over 35, the main causes are acquired heart diseases, especially coronary artery disease [12].

Table 1. Distribution of Cardiovascular Causes in Sudden Death in Athletes ≤ 35 years 18. [19].

Hypertrophic cardiomyopathy	36%
Coronary artery anomalies	17%
Idiopathic left ventricular hypertrophy	8%
Myocarditis	6%
Arrhythmogenic right ventricular dysplasia	4%
Mitral valve prolapse	4%
Myocardial bridge	3%
Coronary artery disease	3%
Aortic stenosis	3%
Ionic cannulopathies	3%
Dilated cardiomyopathy	2%
Aortic rupture	2%
Sarcoidosis	1%
Other congenital heart diseases	2%
Other	3%
Normal heart	3%

Special note should be made of commotio cordis which, although traditionally classified as a rare cause of sudden death, in some studies has been reported as the second leading cause, second only to hypertrophic cardiomyopathy [8,13].

Hypertrophic cardiomyopathy (FIGURE 1) is the most common form of cardiovascular disease of genetic origin, with an estimated prevalence in the general population of around 0.2%, which is equivalent to one case for every 500 individuals [7,14].

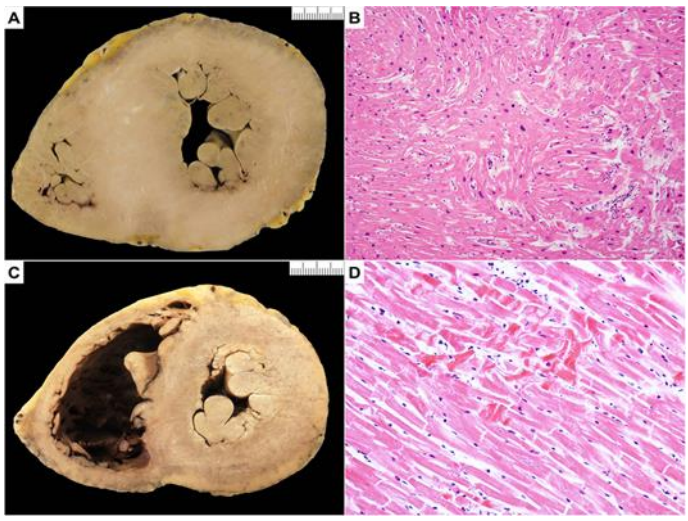

Figure 1. Hypertrophic cardiomyopathy (HCM) and pitfall (post-mortem hypercontraction). Macroscopic

section of the short axis with circumferential hypertrophy of the left ventricle. There is also prominent septal hypertrophy with an irregular anteroseptal scar. Also note prominent papillary muscles and trabeculae in the left ventricle. B Microscopic section shows individual myocytes and bundles with hyperchromatic nuclei. There is an increase in interstitial collagen, findings consistent with HCM (hematoxylin and eosin staining). C Macroscopic short-axis section with circumferential thickening of the left ventricle due to hypercontraction. There are no scars or prominent septal hypertrophy. Also note the prominent papillary muscles and trabeculae in the left ventricle. D The microscopic section shows hypercontraction of myocytes with bands of contraction in normal myocytes. There is no increase in interstitial collagen (hematoxylin and eosin stain)

It is an autosomal dominant congenital disease in which 12 genes are known to be involved, resulting in more than 400 genetic mutations related to myocardial contractile proteins. It is characterized by non-dilated hypertrophy of the ventricle, which occurs more frequently in the left ventricle, asymmetrically and with involvement of the interventricular septum, which may or may not have obstruction in the outflow tract.

This leads to significant myofibrillar disorganization, hypercontractility and hypodiastolia. Most patients with hypertrophic cardiomyopathy are completely asymptomatic, which means that sudden death is often the first clinical manifestation of the disease [2,5,7].

An important distinction must be made between hypertrophic cardiomyopathy and "athlete's heart syndrome". In this syndrome, intense physical training leads to various morphological and physiological alterations, especially left ventricular hypertrophy, which is benign and reversible as a result of high energy demand. This differentiation must be made to avoid endangering the life of an athlete at high risk of sudden death or to avoid wrongly disqualifying a fully healthy athlete [10].

The congenital anomaly of the coronary artery (FIGURE 2) most commonly related to sudden death is that in which the left coronary artery trunk arises from the right sinus of Valsalva. The triggering mechanism for sudden death is presumed to be myocardial hypoperfusion secondary to the formation of a sharp acute angle at the origin of this anomalous artery, when it passes between the aorta and the pulmonary arterial trunk. Physical exercise aids the development of ischemia by stimulating vigorous cardiac contractions that end up mechanically compressing the anomalous coronary artery between the aorta and the pulmonary trunk.

Like hypertrophic cardiomyopathy, the congenital anomaly of the coronary artery is usually asymptomatic, with sufferers of the disease even having normal electrocardiograms and exercise tests, which makes it very difficult to identify this pathological condition [5,15].

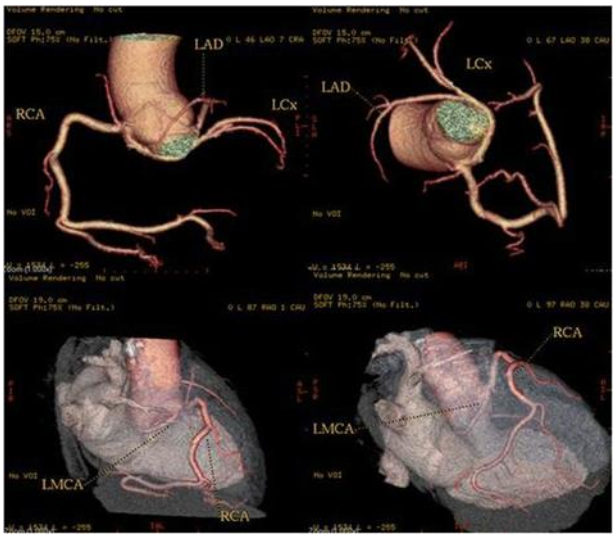

Figure 2. Patient with anomalous origin of the left coronary system from the right coronary cusp (separate ostium). Images and 3D volume renderings show the anomalous origin of the LM, its course and the detailed anatomical relationship

Idiopathic left ventricular hypertrophy (FIGURE 3) is a hypertrophy in which, inexplicably, the left ventricle exceeds the normal size of an athlete's physiological heart hypertrophy. Unlike hypertrophic cardiomyopathy, this disease presents symmetrical and concentric hypertrophy, is not genetic in nature and there is no myofibrillar derangement in the myocardium. The exact mechanism by which this disease results in sudden death is not yet known, but it seems to be similar to that of hypertrophic cardiomyopathy [2,16].

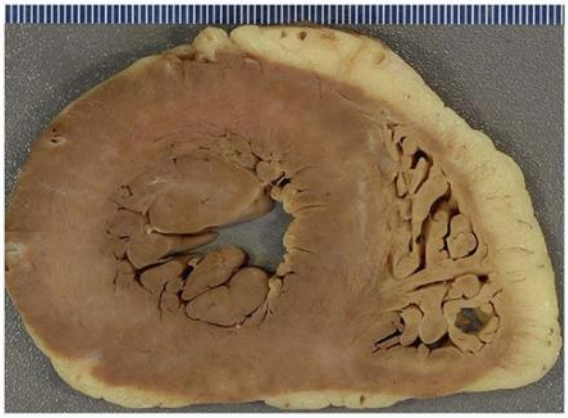

Figure 3. Concentric left ventricular hypertrophy. There is concentric thickening of the left ventricular wall, with normal cavity diameter. The patient had hypertension and a heart weighing 550 grams.

Atherosclerotic coronary artery disease is the leading cause of sudden death in athletes over the age of 35. Strong evidence indicates that physical activity reduces the risk of cardiovascular events in patients with this diagnosis, since exercise, when practiced regularly and in moderation, is capable of reducing the lipid profile and causing parasympathetic autonomic stimulation, which improves the electrical stability of the athlete's heart.

However, despite the beneficial effects of exercise, when it is practiced occasionally and at an inadequate intensity by people with coronary artery disease, the risk of acute myocardial infarction and consequent sudden death increases significantly.

The mechanism of this infarction is probably due to sympathetic autonomic activation, predisposing to electrical instability of the heart, development of cardiac arrhythmias and/or rupture of vulnerable atherosclerotic plaques, which leads to coronary thrombosis and consequent myocardial ischemia [5,8,17].

Commotio cordis or cardiac concussion is an electrophysiological event caused by a non-penetrating impact in the precordial region, which occurs in individuals with no underlying heart disease or structural lesions of the heart [2,7].

It has a predilection for children and adolescents, probably because the chest wall of young people is thinner and more malleable, which facilitates the transmission of the impact energy from the chest to the myocardium [17].

Cardiac concussion occurs in a wide variety of sports, but is most common in baseball, football, and martial arts, with the trauma usually caused by sports projectiles, such as baseballs and hockey pucks, or by a direct impact from an opponent [7,17].

The main preventive measure to reduce the risk of sudden death in athletes, whether high-performance or not, is the pre-participation clinical evaluation. This evaluation should be performed annually and aims to diagnose the presence of existing diseases, in addition to screening for possible diseases that may develop and that have physical-sports activity as the necessary “trigger” for the occurrence of a fatal event [5,7].

According to the American Heart Association, the pre-participation clinical evaluation should consist of a detailed anamnesis and a rigorous physical examination, while the European Society of Cardiology recommends the routine inclusion of a 12-lead electrocardiogram. However, both societies recommend that additional tests should be performed, which vary according to the greater or lesser suspicion of disease affecting the athlete [11,18]. During the anamnesis, the patient's natural history, previous illnesses, family history of heart disease, sudden premature death and other comorbidities should be investigated with special emphasis. It is important to be aware of the chronological history of the patient's sports life, including the type of sport practiced, its load, duration and frequency, as well as episodes of dyspnea disproportionate to the intensity of the effort performed, precordial pain, dizziness and syncope during or immediately after physical activity and the use of substances, many of which are prohibited in competitions, that promote greater physical performance in the athlete [2,5,19].

In addition, in the Brazilian reality of great migration from rural to urban areas in search of opportunities, many of which are in the sports area, attention should be paid to the possible presence of Chagas disease due to its high prevalence in this environment [5].

The physical examination should be complete, with emphasis on the cardiovascular system. Blood pressure should be measured with the patient sitting, the femoral artery pulse should be assessed to rule out cases of coarctation of the aorta, signs characteristic of Marfan syndrome should be looked for, and the presence of adventitious sounds during cardiac auscultation should be investigated with the patient lying down and then standing up.

It is worth noting that in high-level athletes, due to “athlete’s heart syndrome”, findings such as systolic

murmurs, third and fourth heart sounds, hyperphonetic heart sounds or bradycardia may be normal, and it is up to the physician to identify in which patients these findings are adventitious and in which they are physiological.

The applicability of complementary tests in the pre-participation clinical evaluation of the athlete is governed not only by their diagnostic need but also by the cost/benefit ratio of these tests. Therefore, due to the high cost of these tests and the low prevalence of heart disease in the general population, most of them are only performed when there is suspicion of some disease, which is not the case in the case of high-performance professional athletes, in whom the use of complementary tests is a commonly adopted conduct, not only to protect their physical integrity, but also because there is an interest of the clubs and agents of these athletes in protecting the health of their "assets", which makes the use of routine complementary tests completely justifiable [4,5,7].

The 12-lead electrocardiogram is an exam that provides important information about changes in the myocardium, such as conduction disorders, arrhythmias, overload, previous infarction, ischemia, etc. It can help diagnose diseases such as hypertrophic cardiomyopathy (the exam is altered in 70% to 95% of cases), long QT syndrome, Brugada syndrome and Wolf-Parkinson White syndrome [5,7].

This exam has the advantage of being relatively low cost, simple and widely available. However, it has some limitations, mainly low specificity for elite athletes, since electrocardiographic changes that simulate malignant diseases are common in this group, but which are actually the result of "athlete's heart syndrome", posing no risk to their lives [4,5,8].

The echocardiogram is a very useful exam for detecting structural changes that affect the myocardium, valves and aorta. It has become important in the diagnosis of hypertrophic cardiomyopathy, arrhythmogenic right ventricular dysplasia, Marfan syndrome, aortic valve stenosis, mitral valve prolapse, etc [4,5,19].

A point that draws attention to this test is the large number of false-negative and false-positive results. False-negative results are due to the fact that the phenotypic expression of hypertrophic cardiomyopathy is not expressed or is only partially expressed until the individual reaches adolescence; false-positive results are due to the fact that there is doubt when the dimensions of the heart are at borderline values, and it is not clear whether it is hypertrophic cardiomyopathy or a benign physiological alteration [4].

However, the echocardiogram is still one of the most sensitive and specific methods for differentiating hypertrophic cardiomyopathy from physiological changes in the athlete's heart. The ergometric test aims to assess the athlete's cardiovascular function and functional capacity during physical exertion, their physiological limits and their evolution with physical preparation, in addition to being able to diagnose some silent heart diseases, especially coronary artery disease [19].

The ergometric test is therefore more useful in athletes over the age of 35 than in young athletes, since in older athletes, coronary artery disease is the main cause of sudden death related to exercise [8].

The electrophysiological study is a type of cardiac catheterization that uses special electrodes connected to computerized polygraphs that are placed inside the heart cavities, guided by sophisticated x-ray equipment. This procedure, through programmed electrical stimulation, allows the evaluation of the formation and normal and pathological conduction of the heart's electrical stimulus. Electrophysiological studies are widely used in patients who have survived a cardiac arrest episode, in order to establish the diagnosis of the heart rhythm disorder that caused the event and, consequently, guide the most appropriate treatment.

Since this study is capable of identifying mainly tachycardia syndromes, it is almost always necessary to indicate treatment with an implantable cardioverter defibrillator (ICD). The latter has become the main therapeutic measure for the treatment of tachycardia and ventricular fibrillation, significantly reducing the number of sudden deaths [20,21].

Athletes with a probable clinical diagnosis of hypertrophic cardiomyopathy should be excluded from almost all competitive sports, with the exception of low-intensity sports. This conduct is independent of age, sex, presence or absence of symptoms, obstruction to flow in the left ventricle, treatment with medications, surgical intervention, placement of an implantable defibrillator, etc [7].

Athletes who have been identified with congenital coronary artery anomalies should be excluded from any participation in competitive sports. However, those who have undergone corrective surgery and do not present episodes of ischemia, tachyarrhythmia or dysfunction during exercise testing are allowed to participate in any type of sports activity three months after surgery [17].

For athletes with atherosclerotic coronary artery disease, recommendations will vary according to each patient's risk. In the case of moderate risk, the athlete can participate in low-load dynamic exercises or low-to-moderate static exercises, but should avoid intense competitive situations. Those with high risk should generally be restricted to low-intensity competitive sports. All athletes with atherosclerotic disease need to aggressively combat their risk factors, since reducing them stabilizes the coronary disease and reduces the risk of sudden death [17].

In the case of athletes who have survived an episode of commotio cordis with consequent ventricular fibrillation, they should undergo a cardiological evaluation that includes at least a 12-lead electrocardiogram, an echocardiogram and a Holter [7].

Due to the scarcity of data on the recurrence of this pathology, there is still no consensus on the matter, which means that the decision to allow an athlete to return to sports activities is, to date, a matter of individual judgment by each physician [17].

An important point to highlight is that the pre-participation clinical evaluation can often be hampered by the omission of symptoms, data on the use of prohibited substances or other information by the athletes themselves, as they are afraid of being removed from their activities. Furthermore, even when it is possible to collect an adequate history and physical examination and perform additional tests that prove a certain disease in the athlete, it is not uncommon for them, their family members, managers or businessmen to ignore the recommendation to completely cease their sports life, most often due to the economic issues involved [10,19].

Performing a pre-participation clinical evaluation of the athlete is the best way to prevent fatalities during sports practice. However, failure to perform this assessment by most athletes currently in activity or even false-negative results after performing tests may lead to the risk of collapse for these athletes during exercise. And that is why, in addition to preventive measures, there must also be emergency measures always in place and ready to be used in any place where sports activities are carried out.

Schools, colleges, sports arenas, gyms, training centers, stadiums, etc. are common places where physical activities are carried out and, therefore, they must always have an emergency response plan to be activated whenever necessary. This plan must include professionals qualified to perform basic life support who have the necessary equipment for this purpose, mainly the automated external defibrillator (AED), and fast and efficient communication with teams trained in advanced life support [5,22].

The American Heart Association's "Chain of Survival" encompasses the current understanding of the best approach to treating people with sudden cardiac arrest. The four links in the "Chain of Survival" are: rapid access, early cardiopulmonary resuscitation (CPR), early defibrillation and early advanced life support. Rapid access includes early recognition of signs of cardiac and respiratory arrest and immediate activation of the emergency response system. CPR is the best treatment for patients in cardiac arrest until a defibrillator or advanced life support arrives; it is important because it provides the victim with a small but critical amount of blood flow to the heart and brain and is therefore most effective when initiated immediately after the victim collapses.

Early defibrillation is the link in the "Chain of Survival" that most increases survival rates for victims of cardiac arrest with ventricular fibrillation. Therefore, the rapid availability of AEDs is of fundamental importance for a favorable outcome for the victim of an arrest of this type. Just to give you an idea of the importance of early defibrillation, for every minute that passes without performing this procedure, the probability of achieving successful cardiac defibrillation is reduced by 3% to 4% per minute, if good CPR is being performed, and by 7% to 10% per minute, if CPR is not being performed. Early advanced support is essential, as it consists of carrying equipment to support ventilation, establishing venous access for drug administration, controlling arrhythmias and stabilizing the victim for transport [22,24].

The presence of AEDs in places where competitions are held or where there are large numbers of people is essential to prevent sudden death processes, since most of them are triggered by ventricular fibrillation and consequent cardiorespiratory arrest, and defibrillation is the only way to reverse this situation [5,25].

V. Conclusion

The complete health safety of athletes consists of periodic pre-participation clinical assessment as well as emergency measures, mainly in competition venues, consisting of the availability of health professionals capable of performing basic life support and rapid means of communication to request advanced life support, in addition to immediate access to the main instrument capable of reversing cardiorespiratory arrest the AED.

References

[1]. Rosa, Thaís Souza; Leite, Marilene Oliveira. Risco De Infarto Agudo Do Miocárdio Em Praticantes De Musculação De Uma Academia Da Cidade De Itatiaia-Rj. Revista Brasileira De Nutriçao Esportiva, V. 8, N. 44, P. 2, 2014.
[2]. Batista, Raquel Daione Et Al. Rastreio De Sinais De Alarme Cardiovascular Para Morte Súbita Cardíaca Em Desportistas De Participação De Um Clube Recreativo/Desportivo Da Capital Mineira. 2018.
[3]. Santos, Bruna Raquel Luna Pedroso Et Al. Eletrocardiograma: Um Estudo Acerca Da Sua Utilização Na Triagem De Atletas Para Práticas Esportivas. Brazilian Journal Of Implantology And Health Sciences, V. 6, N. 7, P. 552-561, 2024.
[4]. De Morte Súbita, Em Atletas. Quando E Como Estratificar O Risco. Rev Soc Cardiol Estado De São Paulo, V. 33, N. 2, P. 184-91, 2023.
[5]. Cavalheiro, Carla Maria Nogueira Et Al. Prevalência De Óbito Em Via Pública Por Infarto Agudo Do Miocárdio No Brasil Em 10 Anos. Importância Do Conhecimento Sobre Suporte Básico De Vida. Revista De Saúde, V. 11, N. 1, P. 55-63, 2020.
[6]. Licarião, Emanoel Gledeston Dantas. Síncope Na Cardiomiopatia Hipertrófica Obstrutiva. Journal Of Cardiac Arrhythmias, V. 31, N. 3, P. 121-125, 2018.
[7]. Peres, Meyre Cristiane. Alimentação E Sua Influência No Infarto Agudo Do Miocárdio. Revista Farol, V. 21, N. 21, P. 124-142, 2024.
[8]. Jurubeba, Adriana Koury Xavier Et Al. Etiologia, Possíveis Fatores De Riscos E Aspectos Relacionados À Identificação E Prevenção Da Morte Súbita Cardíaca. Epitaya E-Books, V. 1, N. 59, P. 145-172, 2024.

[9]. Vieira, Marina Belizário Et Al. Percepção De Homens Após Infarto Agudo Do Miocárdio. Revista Brasileira Em Promoção Da Saúde, V. 30, N. 3, 2017.
[10]. Lippi, Giuseppe; Favaloro, Emmanuel J.; Sanchis-Gomar, Fabian. Sudden Cardiac And Noncardiac Death In Sports: Epidemiology, Causes, Pathogenesis, And Prevention. In: Seminars In Thrombosis And Hemostasis. Thieme Medical Publishers, 2018. P. 780-786.
[11]. Robles, Antonio Gianluca Et Al. Sport Related Sudden Death: The Importance Of Primary And Secondary Prevention. Journal Of Clinical Medicine, V. 11, N. 16, P. 4683, 2022.
[12]. Schmied, Christian; Borjesson, Mats. Sudden Cardiac Death In Athletes. Journal Of Internal Medicine, V. 275, N. 2, P. 93-103, 2014.
[13]. Compagnucci, Paolo Et Al. Myocardial Inflammation, Sports Practice, And Sudden Cardiac Death: 2021 Update. Medicina, V. 57, N. 3, P. 277, 2021.
[14]. Mont, Lluís Et Al. Pre-Participation Cardiovascular Evaluation For Athletic Participants To Prevent Sudden Death: Position Paper From The Ehra And The Eacpr, Branches Of The Esc. Endorsed By Aphrs, Hrs, And Solaece. Ep Europace, V. 19, N. 1, P. 139-163, 2017.
[15]. Solberg, Erik Ekker Et Al. Sudden Cardiac Arrest In Sports–Need For Uniform Registration: A Position Paper From The Sport Cardiology Section Of The European Association For Cardiovascular Prevention And Rehabilitation. European Journal Of Preventive Cardiology, V. 23, N. 6, P. 657-667, 2016.
[16]. Vancini, Rodrigo Luiz Et Al. Prevention Of Sudden Death Related To Sport: The Science Of Basic Life Support—From Theory To Practice. Journal Of Clinical Medicine, V. 8, N. 4, P. 556, 2019.
[17]. Chugh, Sumeet S.; Weiss, Joseph B. Sudden Cardiac Death In The Older Athlete. Journal Of The American College Of Cardiology, V. 65, N. 5, P. 493-502, 2015.
[18]. Jouven, Xavier Et Al. Sudden Cardiac Death And Sports. 2017.
[19]. Finocchiaro, Gherardo Et Al. Etiology Of Sudden Death In Sports: Insights From A United Kingdom Regional Registry. Journal Of The American College Of Cardiology, V. 67, N. 18, P. 2108-2115, 2016.
[20]. Vicent, Lourdes Et Al. Exercise-Related Severe Cardiac Events. Scandinavian Journal Of Medicine & Science In Sports, V. 28, N. 4, P. 1404-1411, 2018.
[21]. Hamad, Adel Khalifa Sultan. Risk Of Sudden Cardiac Death And Preventive Measures In Athletes. Risk, V. 8, N. 4, P. 89-95, 2022.
[22]. Bohm, Philipp Et Al. Sports-Related Sudden Cardiac Arrest In Germany. Canadian Journal Of Cardiology, V. 37, N. 1, P. 105-112, 2021.
[23]. Zhao, Shan Et Al. Association Between Time Of Day Of Sports-Related Physical Activity And The Onset Of Acute Myocardial Infarction In A Chinese Population. Plos One, V. 11, N. 1, P. E0146472, 2016.
[24]. Rodrigues, Lais Pioli Righeti Et Al. A Elevação Da Disautonomia Do Sistema Cardiovascular Pós-Covid. Revista Cpaqv-Centro De Pesquisas Avançadas Em Qualidade De Vida, V. 15, N. 2, 2023
[25]. Rodrigues, Heloise Bo Et Al. The Epidemiology Of Heart Disease In Brazil Between 2021 And 2022. International Journal Of Medical Science And Clinical Research Studies, V. 3, N. 11, P. 2662-2668, 2023.