





Advancing sports cardiology

The obstacles and opportunities that could be game changers

Sports cardiology is a growing field that continues to evolve. If you're keeping score, there have been tremendous strides in diagnostics to promote athlete safety without unnecessary limitations, but there are still gray areas contributing to continuous challenges. While more research is essential in defining future care, some experts believe emerging technologies in echocardiography will be crucial in gaining much-needed insights and providing a better understanding of the athlete's heart.



Prof. Hélder Does is the coordinator of sports cardiology and cardiac rehabilitation at Hospital da Luz Lisboa in Portugal and a cardiologist in the Health & Performance Department of Sports Lisbon and Benfica. As a leading consultant for the most decorated football club in Portugal, Prof. Does performs preparticipation screenings to help identify hidden cardiovascular diseases that might trigger cardiac events or sudden death.

While the preparticipation screening remains not mandatory in some countries, several scientific societies and sports federations recommend a comprehensive medical evaluation, including a 12-lead resting ECG.¹ Many physicians, including Prof. Does, will include echocardiography when additional clinical insight is needed. As part of his practice, Prof. Does performs transthoracic, transesophageal, and stress echoes, with Hospital da Luz Lisboa reporting more than 18,000 exams every year.

The best strategy for screening is still up for debate, but sports cardiologists are advancing the field by increasing their knowledge and understanding of the athlete's heart. Artificial intelligence and other technologies are playing a greater role in diagnostics, and helping cardiologists estimate risk and prescribe future exercise.

Prof. Does recently shared his views on the main issues dominating modern sports cardiology, which has expanded to cover elite and recreational athletes alike.

What initially sparked your interest in sports cardiology?

Prof. Does: *During my residency in cardiology, I developed a particular interest in exercise physiology. I was*

interested in cardiovascular physiological adaptations induced by exercise and also the risks and benefits of exercise in the presence of cardiovascular disease.

Sports cardiology is a growing field with multiple possibilities to perform original investigations and also to develop these in clinical practice. Gaps and challenges surrounding screening that need to be clarified and the possibility to work with athletes in multidisciplinary teams were undoubtedly positive points that contributed to this decision.

Can you describe your position with Benfica?

Prof. Does: *My role is in the Health and Performance Department of Benfica and is particularly relevant in preseason with cardiovascular evaluation and preparticipation screening of athletes. In addition, I perform consultations to athletes with symptoms or with abnormal findings in cardiac investigations that are recommended by my colleagues. I also perform and interpret ECGs, which are mandatory in Portugal. Additionally, I complete transthoracic echocardiograms (TTEs) in the club and integrate groups like emergency support teams.*

There are several athletes in the club that play in National teams, and it's important to work closely with the respective clinical departments. For example, regarding the Olympians and when needed, my colleagues in the clinical department of the Olympic Committee ask me for reassessments.

What are some of the most common conditions among these athletes?

Prof. Dore: Fortunately, the main findings during athletes' evaluations are physiological adaptations and not pathological conditions. This is an important message. When discussing the abnormal findings, there are several electrocardiographic abnormal changes. For example, ventricular repolarization, especially T wave inversion, is the most common pathological finding in the ECG. In terms of structural heart conditions, we can detect cardiomyopathies, valvular heart disease, and even coronary artery disease in veteran athletes.

What should colleagues know about sudden cardiac death?

Prof. Dore: Sudden cardiac death in athletes is a tragic event, but uncommon. This is very important to stress considering the extremely variable incidence reflecting heterogeneity of the published data. However, sudden cardiac death is very mediatic, frequently occurring live in media and affecting apparently healthy individuals, which increases concerns. Most of the reported cases occur in male athletes with black ethnicity, mainly involved in basketball and football in the U.S. and in soccer in Europe.^{2,3,4}

While coronary artery disease is the most common cause of death in veterans, inherited conditions and sudden unexplained death cases, presumably electrical based, have been reported as the predominant causes in young individuals. Among these conditions, we have cardiomyopathies such as hypertrophic, arrhythmogenic right

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ventricular, or dilated cardiomyopathy. And there are primary arrhythmias like long QT syndrome, Brugada syndrome, or catecholaminergic polymorphic ventricular tachycardia.

It is important to highlight that there are other relevant causes of certain cardiac deaths including myocarditis and coronary origin anomalies. I also need to point out the illicit use of performance-enhancing drugs as another cause.

Why is sports cardiology a source of controversy?

Prof. Dore: If you compare sports cardiology with other areas in cardiology or other specialties in sports, there are not a lot of randomized clinical trials. We are talking about very rare conditions. For example, sudden cardiac death is very, very rare. As a result, it's not easy to have a great experience to perform prospective studies because these will last several years.

There are also specific considerations regarding elite athletes. There are a lot of complications if you stop the career of an athlete, including socioeconomic implications for the athlete, family, the club, and the supporters. It's important to be sure that we are making

the best decision for each case because the implications are not only clinical. That is why sports cardiologists need to acquire special skills beyond clinical expertise. Developing the capacity to talk with other people and to implement a real shared decision-making process is very important in this context.

Who should undergo preparticipation screenings? Should it go beyond elite athletes?

Prof. Dore: Regarding the evaluation of athletes, the methodology varies according to several characteristics—especially age. That's because the main causes of sudden cardiac death are different between younger athletes and veterans. The core components for younger athletes are a detailed personal and family history, physical examination, and ECG. For veteran athletes, 35 years or older, the main concern is coronary artery disease, so cardiovascular risk stratification with the application of risk scores and exercise testing are additional relevant steps. Further second-line exams, including echo, should be performed on a case-by-case basis. I think that the screening of younger athletes is fundamental for early detection of cardiac abnormalities, especially those associated with an increased risk of sudden death. In this context, mandatory screening should begin at an early age, for example 12 years old. It is controversial, but this evaluation should be repeated on a yearly basis—at least in competitive athletes. Also important, are findings that don't limit exercise, but may evolve over time, such as some congenital heart diseases, indicating that athletes should be closely monitored.

In my opinion, the methodology and the reason to do these evaluations should include other characteristics of exercise beyond competitive level. Why? You can be a non-competitive athlete and perform a great amount of exercise per week, compared to other individuals who are competitive but don't perform the same intensity or volume of exercise. A good example is comparing a professional golfer to someone who does triathlons and Iron Man. Instead, we need to look at the overall characteristics related to the exercise and the characteristics of the person.

In younger athletes in Europe, we perform a history, physical examination, and ECG, but is that enough for an individual who performs extreme exercise (Iron Man competitions and triathlons)? Should we include an echo or other exams? In my clinical practice, I have access to all these exams, but it's not easy to implement because of the costs and financial burden so we have to integrate all the available data with specific clinical skills to detect these conditions.

What tools and technologies are most helpful in echocardiography?

Prof. Does: *When indicated, a detailed and full echocardiographic evaluation should be performed, including all the available modalities and tools. This comprehensive evaluation is especially important in the cases that are in the gray zone due to the overlap between physiological and pathological findings. Structural evaluation is essential to evaluate for example the left ventricular wall thickness, cavity dimensions, coronary origin, valves and/or artery.*

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The use of the conventional 2D or M mode remains relevant in this setting. The flow evaluation with color Doppler, PW, and CW, is also important, such as the tissue Doppler evaluation. Functional assessment of both left and right ventricle is very important, mainly with the calculation of left ventricular ejection fraction and the global longitudinal strain in this setting. The evaluation of the diastolic function is also very relevant in athletes because it's supernormal in a great number of them.

In short, for a more accurate athlete evaluation, I think we should use all the available echocardiographic tools with some individualized adaptations based on the clinical context.

You currently have access to many Vivid systems, ranging from the Vivid E95 to the Vivid iq. What are some of the benefits of echo versus other modalities?

Prof. Does: *I think that echo has some advantages over other imaging modalities, particularly access, portability, and lower costs. On the other hand, with integration of different modalities and tools, I think echo allows a complete real-time evaluation of cardiac morphology and function with high spatial and temporal resolution. I believe those are the main benefits and advantages of echo versus other imaging techniques.*

Portable devices are also useful in sports cardiology and sports medicine because several times exams are performed in club facilities and not in hospitals or clinics. In my practice, I perform most of my exams at the hospital, but I have also evaluated teams using portable devices.



Do you utilize strain imaging as part of assessment?

Prof. Dores: *Strain is relevant for a more detailed evaluation of the systolic function and the most used parameter is Global Longitudinal Strain (GLS). For example, it's useful in the early detection of myocardial dysfunction. However, the interpretation of GLS in asymptomatic athletes is frequently challenging because studies have showed mildly reduced GLS at rest, especially in high-level endurance athletes.*

This topic will possibly be clarified in the near future, but integration of strain with other echo parameters, and eventually during exercise stress echo, could be helpful in athlete's evaluation.

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How frequently do you use artificial intelligence and automated features such as Easy AutoEF, Easy AFI?

Prof. Dores: *I utilize some AI features in practice. Auto ejection fraction and Easy AFI are the most common and useful in our standard, and I think incorporating these already validated and effective tools seem really useful. Among the main advantages of these automative and AI-related tools are clearly time saving and of course, reproducibility.*

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How do you think AI will play a role in advancing sports cardiology?

Prof. Dores: *With the help of AI technologies and more robust data with large samples of individuals from multi-center practices, I think we can evolve and find answers for some controversial questions.*

Similar to how AI is impacting our daily lives, we already have evidence, tools, and devices that show the relevance of AI in sports cardiology. I believe the advantage is not only helping physicians to do exams faster, but also increasing the probability of detecting mild and early signs of abnormalities. I think there are a lot of automatic tools that can improve—and sometimes improve with more

precision than the human eye—the detection of these mild changes.

So, there are many potential applications for advancing the evaluation of care of athletes, including wearable devices, and applications for automatic ECG interpretation, and analysis of echo images. Machine learning could offer opportunities to improve risk stratification, diagnosis, monitoring, and even therapeutic interventions.

Of course, it must be a balanced approach. I think combining the expertise of physicians with these technologies will lead to enhanced athlete care and better outcomes. However, we must consider ethical and legal issues at the same time.

The heart of sports cardiology and military medicine



You have extensive experience working with the military. What inspired you to work with Portuguese Army?

Prof. Does: *One particular aspect of interest was exercise physiology, especially in extreme conditions. In fact, such as the competitive athletes, the military should be also regularly evaluated. As a military doctor of the Portuguese Army, I was involved in several real and training missions with the Special Forces, and additionally, I completed training in aeronautical medicine and was involved in the evaluation of Air Force pilots.*

The members of special forces and pilots are submitted to a more specific and deeper clinical evaluation, including some exams, namely ECG, blood tests, echo and exercise testing. At admission in the Armed Forces, the most relevant concerns are similar to those present in the preparticipation screening of young athletes, and the cardiovascular evaluation aims the

early diagnosis of conditions potentially associated to sudden cardiac death. Beyond this mandatory evaluation, individual monitoring during some military activities could be important, especially in those more physically demanding or carried out in extreme conditions. These facts inspired my work in the Army.

How does sports cardiology relate to military evaluations?

Prof. Does: *Regular exercise training induces several cardiac adaptations. This is true both in athletes and in military, mainly in the Special Forces, traditionally involved in activities characterized by exercise with high intensity and volume. These physiological adaptations that we call 'athlete's heart' would be evident at the electrical, structural, and functional level. In this setting, in the evaluation of the candidates at admission into the Portuguese Armed Forces and regularly after admission, the most relevant*

concerns are similar to those for young athletes, especially cardiac conditions.

How are military soldiers screened and are there specific considerations?

Prof. Does: *There are mandatory cardiovascular evaluations for the early diagnosis of conditions potentially associated with sudden cardiac death. Military have some particularities and are exposed to conditions that should be stressed, including emotional stress, environmental conditions, heavy equipment, and G-forces.*

As a result, the military are regularly evaluated at cardiovascular level. Beyond mandatory evaluations, individual monitoring could be important in extreme conditions and more physically demanding activities. Members of the Special Forces and Air Force are submitted to more specific and deeper clinical evaluations, including an ECG, echo and exercise testing.

You emphasize the importance of innovation in sports cardiology. What other areas need attention?

Prof. Dores: *I think that sports cardiology remains an attractive and growing field of cardiology with several controversial points that need to be clarified and research possibilities.*

As we move forward, we need to define the most appropriate methodology for athlete screening and prospective registries to avoid sudden cardiac death in sports. At a professional level, I believe sports cardiology could evolve as a subspecialty with more cardiologists integrated into clinical departments of sports federations and clubs, as well as hospitals and other health systems.

Exercise should not only be integrated in primary prevention, but also in secondary prevention, and in the treatment of patients with several conditions. That is connected to another topic that needs more attention: how to prescribe exercise.

We know there are several conditions associated with an increased risk of sudden death during exercise. While exercise is the trigger for potential arrhythmias and death, we also know that exercise could be good for some of these conditions. We need more discussion about how much exercise these people can do to have benefits and minimize risks.

You are a huge proponent of exercise to improve heart health. Can you tell us about your advocacy efforts?

Prof. Dores: *I think that exercise is medicine and it's important that people move more. Physical inactivity and sedentarism are real public health problems and affect children and adolescents. To change this, it's essential and urgent to implement measures at several levels.*

I regularly share a podcast with a colleague to educate the general population on how to have a healthier lifestyle to prevent and decrease the burden of cardiovascular disease. I am also publishing a new book on the topic and address it in papers and in the media. As a doctor, I believe I have a relevant role in this context, but I think this effort must be shared by all of us. ■



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- 1 D'Ascenzi, Flavio & Ragazzoni, Gian & Boncompagni, Alex & Cavigli, Luna. (2023). Sports cardiology: A glorious past, a well-defined present, a bright future. *Clinical cardiology*. 46. 10.1002/clc.24112.
- 2 Chandra N, Bastiaenen R, Papadakis M, Sharma S. Sudden cardiac death in young athletes: practical challenges and diagnostic dilemmas. *J Am Coll Cardiol*. 2013 Mar 12;61(10):1027-40. doi: 10.1016/j.jacc.2012.08.1032. PMID: 23473408.
- 3 Egger F, Scharhag J, Kästner A, et al. FIFA Sudden Death Registry (FIFA-SDR): a prospective, observational study of sudden death in worldwide football from 2014 to 2018. *Br J Sports Med*. 2022;56(2):80.
- 4 Risgaard B, Winkel BG, Jabbari R, et al. Burden of sudden cardiac death in persons aged 1 to 49 years: nationwide study in Denmark. *Circ Arrhythm Electrophysiol*. 2014;7(2):205-11.

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