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Should athletes be screened for heart disease?

PERSPECTIVES

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Elite athletes are more likely to suffer sudden cardiac arrest than their peers. In Norway there is no broad, organised screening of young athletes.

The televised cardiac arrest sustained by top footballer Christian Eriksen during the 2021 UEFA European Football Championship should encourage renewed debate on whether to screen elite athletes, and if so, how. For the vast majority, exercise, even at intense levels, brings health benefits (1). On the other hand, athletes and super-exercisers are also prone to arrhythmias and sudden cardiac arrest (2). Although these incidents are fortunately very rare, young athletes are at a considerably higher risk of cardiac arrest (a relative risk in the range 2.4 to 3.5, corresponding to an incidence of 2.6/100 000) (2). To these must be added cardiac arrests that have a non-fatal outcome.

Internationally, screening has been a topic of debate for decades. In Italy and Israel this has been mandatory for young athletes for many years (3). Sweden introduced screening in 2005 (4). Similarly, England screens all footballers in clubs linked to the Football Association (FA) (2). In Sweden, there has been a marked decrease in the number of cardiac arrests among athletes, and screening may have played a role in this (4). Screening is recommended by the major sports associations, the European Society of Cardiology (ESC), the International Olympic Committee (IOC) and the Fédération Internationale de Ski (FIS) (3). Both the international football association (FIFA) and the European football association (UEFA) require screening as a condition for playing in international matches (3). In Norway, we have no joint platform for screening of athletes. It is not obvious that this should be introduced in Norway, but it is about time that this issue be investigated.

What is an athlete's heart?

Of the body's internal organs, the heart is the only one that can drastically change its morphology in response to exercise – a phenomenon known as *athlete's heart*. The changes are mainly morphological and can be considerable in endurance athletes. In a group of 18-year-old cross-country skiers, we found that 42 % exceeded the upper reference limit for left ventricular mass, and 68 % exceeded the upper reference limit for left ventricular volume (5).

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Structural changes can also affect the heart's electrical activity. There is preponderance of arrhythmias among athletes, especially in the older age groups, but also of sudden cardiac arrest (1). Men tend to have more pronounced changes and are more subject to arrhythmias and sudden cardiac arrest than women (2).

Causes of sudden cardiac arrest in sports

The causes of sudden cardiac arrest in athletes are heterogeneous and vary according to sex, ethnicity, type of sport and age (6). In athletes under the age of 35, hereditary cardiomyopathies dominate. Although there are large variations in the post-mortem data, most studies show that arrhythmogenic cardiomyopathy and hypertrophic cardiomyopathy account for one-quarter to one-half of the cases. Examination of these patients is often challenging, since the changes observed in an athlete's heart can be similar to these conditions. They are nevertheless conditions that can often be identified by screening.

In less than one-half of the cases of sudden cardiac arrest, the heart is structurally normal (7). A considerable proportion of these will most likely have had an underlying ion channel disease which is not captured in a regular autopsy, but can be detected in a genetic autopsy. Myocarditis and congenital coronary artery anomalies are also important causes of sudden cardiac arrest. In older athletes and exercisers > 35 years, atherosclerotic coronary disease is by far the most common cause (7). This age group is most likely to suffer cardiac arrest.

Screening of athletes

The question is not only whether or not screening should be undertaken, but also what this screening should include. Internationally, three strategies are being used. The simplest consists of a systematic mapping of family history and symptoms, combined with a clinical examination. This strategy is used especially in the United States by the National Football League (NFL), Major League Baseball (MLB) and the National Hockey League (NHL).

Furthermore, resting ECG can be added to the screening protocol. Recent data show that this significantly increases diagnostic accuracy (8). Without the addition of ECG, purely clinical protocols in screening studies have been able to detect only < 10 % of potentially life-threatening cardiovascular disease (9). Adding ECG is recommended by the IOC, FIS and ESC, among others. A key argument against ECG screening is that 2–3 % of the findings will be false-positives that will need further examination (10).

The third strategy also includes echocardiography and is recommended by FIFA and UEFA, among others. The Norwegian football league system is also subject to this, and all male players in the two top divisions are screened regularly. A simplified version of this strategy proposes echocardiography in adolescence to exclude structural heart disease and in the early thirties to assess changes induced by exercise, functional anomalies and late-onset cardiomyopathies (11).

«A national screening programme should be constructed according to the same model and based on the experience gained from other national screening programmes»

Because sudden cardiac arrest is so rare, it is not practicable to conduct randomised trials of the effect of systematic screening. However, a number of large observational studies have been undertaken both in the United States and in Europe (12). Perhaps the best-known study is from the Veneto region in Italy, which has screened athletes since 1982. The results have been promising, with a considerable decline in fatality rates. However, some weaknesses have been pointed out in its methodology (13).

In 2018, the results from 20 years of mandatory screening of 16-year-olds in the English football league system were published in the New England Journal of Medicine (14). Of 11 168 young footballers, eight died from sudden cardiac arrest. With an incidence of 6.8/100 000, the rate of sudden cardiac arrest was higher than might be expected among athletes, and higher than the rate of traffic fatalities among young people. Six of these eight had normal screening findings. The remaining two were among the 42 footballers who were disqualified because of screening findings, but nevertheless chose to continue with high-intensity exercise. The study can be read as a defence of screening, in that it prevented a considerable proportion of 40 disqualified athletes from succumbing to sudden cardiac arrest. However, it can also be given the opposite interpretation, in that despite massive resource use, it failed to achieve a lower incidence of sudden cardiac arrest than in non-screened populations.

Choice of screening strategy

There are considerable geographical and cultural variations in the approaches to screening of athletes. We nevertheless believe that there is increasing evidence to indicate that a screening consisting of medical history, a clinical examination and ECG is the best strategy. This view is supported by the European sports cardiology community. Cost-benefit analyses have estimated a cost of NOK 650 000 to NOK 850 000 per year of life saved (3). These estimates do not include the possible cooling effect that dramatic cases of sudden cardiac arrest may have on general participation in sports.

A national screening programme should be constructed according to the same model and based on the experience gained from other national screening programmes. It should include athletes who are active from adolescence and who compete at a high national or international level or are students in elite sports colleges, and be implemented at regular intervals. The optimal interval period has not been established, but annually or every other year is most common elsewhere.

Screening content

A number of structured protocols are available for medical examinations prior to participation in competitive sports.

Both the European Society of Cardiology (ESC) and the American Heart Association (AHA) have protocols for use in elite sports (3). The medical history and the clinical examination are largely overlapping. The medical history is a key component and must contain questions on relevant symptoms, as well as identification of any suspicious or serious health incidents in the family.

> ***«In the debate on screening, care must be taken to avoid creating the impression that cardiac arrest is always preventable»***

ECG is a key screening tool. However, the interpretation of ECG in athletes can be challenging, since changes that often give rise to suspicion of pathology in the general population may be normal in a young athlete. For example, a large proportion of endurance athletes will meet the Sokolow-Lyon criteria for left ventricular hypertrophy without this raising suspicion of underlying pathology. To adequately assess an ECG in an athlete, both sufficient training and experience are necessary.

Challenges in screening

In the debate on screening, care must be taken to avoid creating the impression that cardiac arrest is always preventable. Christian Eriksen had undergone annual screening with echocardiography performed by some of the world's foremost British cardiologists, without any underlying pathology being detected.

Another question concerns what should be done with athletes with underlying heart disease, irrespective of whether this was detected by screening or other means. International recommendations have been prepared in recent years, and a key principle is that such decisions must be made jointly (15). This calls for good and extensive collaboration between the doctor, the athlete and the support apparatus.

Conclusion

Exercise has a considerable effect on the hearts of both athletes and exercisers. For most of them, the effect will be positive and prevent cardiovascular disease, but it is important to capture those in whom it has the opposite effect. Although sudden cardiac arrest is rare among athletes, they are far more exposed to this than non-athletes.

Elite athletes are key role models for thousands of children and adolescents, and safe participation in sports is highly important for all age groups. An introduction of screening in Norway would, however, require compliance with internationally acknowledged protocols and thorough training of the participating doctors. A national ECG screening programme would be resource-intensive and would be unable to prevent all cases of sudden cardiac arrest. On the other hand, there is solid scientific evidence that it will prevent some deaths. We therefore believe that screening of athletes should be considered by the Norwegian Directorate of Health in consultation with the sports associations and the Norwegian Cardiological Society.

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