



Policy statement

Cardiac screening for professional athletes

Introduction

Sudden death in young adults is usually caused by ventricular fibrillation (VF), a chaotic heart rhythm disturbance that causes the heart to stop pumping (cardiac arrest). It is invariably fatal unless cardiopulmonary resuscitation is immediately instituted. There are several conditions that can cause VF in young athletes. Hypertrophic cardiomyopathy (HCM) is the commonest but there are other, rarer conditions that predispose an individual to VF due to genetic mutations in the 'electrical' system that regulates the heart rhythm.

While sudden death in athletes is rare (between 1 in 50,000 and 1 in 100,000 cases annually), it is two to four times more common in athletes than in non-athletes.¹ Following the tragic death of a professional footballer in Italy in April 2012 and the on-pitch collapse of premiership footballer Fabrice Muamba with VF the month before, screening professional athletes for heart disease has once again become a topic for debate in the UK.

Policy statement

The BHF supports targeted expert assessment of families where there is a high risk of an inherited cardiac disease, or where there has been a sudden unexplained death.

However, at present we are not calling for a publicly-funded screening programme for all professional athletes. While a proportion of people may be identified that have an underlying heart condition, screening is not yet at a scientific level of precision whereby all cases at risk of sudden cardiac death can be accurately predicted. Misleading screening results can have potentially damaging consequences for healthy athletes and their families.

Many professional sports organisations offer some form of screening for their athletes. Where this occurs, it is essential that the results are interpreted by experts and that the athletes concerned are aware of both the benefits and limitations of such screening.

In the future, we anticipate that the accuracy of screening will improve to a level whereby a combination of ECG, echocardiography and genetic testing could be used to screen all athletes.

¹ Ferreira M, Santos-Silva PR, de Abreu LC, Valenti VE, Crispim V, Imaizumi C, Filho CF, Murad N, Meneghini A, Riera AR, de Carvalho TD, Vanderlei LC, Valenti EE, Cisternas JR, Moura Filho OF, Ferreira C. Sudden cardiac death athletes: a systematic review. *Sports Med Arthrosc Rehabil Ther Technol*. 2010 Aug 3;2:19. Available at: <http://www.ncbi.nlm.nih.gov/pubmed/20682064>

Background

Standard cardiovascular risk assessment screening – the type that ideally all adults over the age of 40 should have periodically – would not pick up most of the conditions that cause sudden death in young athletes. In contrast, signs of an underlying risk of sudden death can sometimes be picked up by an ECG or an echocardiogram. But these tests are often difficult to interpret, not least because athletes' hearts undergo physiological changes that produce ECG or echocardiographic features that, if found in a non-athlete, would indicate an underlying heart condition, whereas in an athlete may be normal.

Most conditions that can cause sudden death in the young are genetically determined. However, understanding of the DNA variations that do and do not lead to an increased risk of sudden death is not yet sufficiently advanced to allow reliable DNA screening for all the mutations that lead to HCM and other potential sudden death syndromes. In the future, it may be possible for a DNA test, possibly combined with an ECG and echocardiogram, to reliably identify most people at risk of developing these conditions.

High profile cases where athletes have suffered cardiac arrests have often led to calls that all athletes should be regularly screened to detect anomalies in the heart that could trigger a cardiac arrest in the future, even though, in some cases, the individuals concerned had undergone screening and been passed as normal.

The evidence

In July 2008 the BMJ carried an editorial which backed a systematic pre-participation screening programme for all competitive athletes. This would use a comprehensive personal and family history questionnaire, physical examination, and screening using an ECG to identify those at risk of sudden cardiac death. This recommendation was based on a study published in the same edition which analysed data from 30,065 Italian athletes who underwent a complete pre-participation cardiovascular evaluation including resting and exercise ECGs.² However a subsequent study of British athletes to identify HCM suggests that screening was not cost-effective, as several thousand athletes would have to be screened to identify one with HCM.³ A screening programme for all athletes may not therefore be appropriate for public funding.

The European Society of Cardiology also recommends that all European countries adopt such screening. This recommendation was based on an Italian study that found a sharp reduction in sudden deaths among athletes once mandatory screening among athletes was introduced (from 3.6 per 100,000 in 1980 to about 0.4 per 100,000 by 2004). However, there are concerns that this study included data only from the two years before the law was implemented when the sudden death rate may have been unusually high.⁴

² Drezner JA, Khan K. Sudden cardiac death in young athletes. *BMJ* 2008;337:a309. Available at: <http://www.bmj.com/content/337/bmj.a309>

³ Basavarajaiah S, Wilson M, Whyte G, Shah A, McKenna W, Sharma S. Prevalence of Hypertrophic Cardiomyopathy in Highly Trained Athletes: Relevance to Pre-Participation Screening. *J Am Coll Cardiol.* 2008 Mar 11;51(10):1033-9. Available at: <http://www.ncbi.nlm.nih.gov/pubmed/18325444>

⁴ Steinvil A, Chundadze T, Zeltser D, Rogowski O, Halkin A, Galily Y, Perluk H, Viskin S. Mandatory Electrocardiographic Screening of Athletes to Reduce Their Risk for Sudden Death: Proven Fact or Wishful Thinking? *J Am Coll Cardiol.* 2011 Mar 15;57(11):1291-6. Available at: <http://www.ncbi.nlm.nih.gov/pubmed/21392644>

Since 1997, Israel has required ECG screening not only for competitive athletes, but for anyone who wants to join in an 'organised' activity: this includes joining a gym. A 2011 study focused on Israel looked at the decade preceding the screening laws implementation. Researchers compared rates of sudden death from cardiac arrest during the decade before the law with rates in the decade after. Findings indicated that before the law, there were about 2.5 deaths per 100,000 athletes each year; after the law, there were roughly 2.6 deaths per 100,000 each year – the authors therefore concluded that mandatory ECG screening of athletes had no apparent effect on their risk for cardiac arrest.⁵

A 2010 US study screened 510 Harvard athletes with an ECG, with researchers also using echocardiography. Echocardiography results showed that 11 of the athletes had heart disease. But when limited to screening using medical history and physical examination alone only five of these cases were picked up, with two potentially serious heart abnormalities missed.⁶ However, there are potential issues concerning false positive results. In the study, one in six athletes who were tested turned out to be a false positive – the authors reported that 'about 20 per cent of ECG screening results could be expected to turn up a potential problem, most of which would be false-positives'.⁷ A false positive result could have serious ramifications not just for the career of a young athlete, but also their chances to get life or medical insurance in the future, and for their families. Both the American Heart Association and American College of Cardiology do not recommend the use of ECGs for cardiovascular screening of athletes at any level.⁸

In a British Cardiovascular Society comment piece in 2012, it was highlighted that were results from other programmes replicated in the UK, 40 of the 196 sudden cardiac deaths that are expected each year could be prevented.⁹ However, for each death prevented, it is estimated that 40,000 individuals would need screening and 791 athletes would be disqualified.¹⁰ This net good/harm ratio does not therefore compare favourably with other national screening processes such as for colon or breast cancer, but may still be considered worthwhile in view of the consequences of sudden cardiac death in this young population. However, the editorial stated that before such a scheme could be introduced in the UK further cost-effectiveness analysis would be necessary, and the infrastructure and funding would need to be put in place to provide trained experts to conduct screening, analyse the ECGs, and deal with the significant number of further specialist consultations that would be generated.

The UK National Screening Committee, who advise Ministers and the NHS in all four UK nations about all aspects of screening policy, considered its policy for HCM screening in 2008. The policy review concluded that the evidence did not support the introduction of screening, and that pre-participation screening of athletes for HCM or other causes of sudden cardiac death should not be instituted at present.¹¹ This

⁵ Ibid.

⁶ Baggish AL, Hutter AM Jr, Wang F, Yared K, Weiner RB, Kupperman E, Picard MH, Wood MJ. Cardiovascular Screening in College Athletes With and Without Electrocardiography: A Cross-sectional Study. *Ann Intern Med*. 2010 Mar 2;152(5):269-75. Available at: <http://www.ncbi.nlm.nih.gov/pubmed/20194232>

⁷ Ibid.

⁸ <http://www.theheart.org/article/1426513.do>

⁹ Taylor R. Editorial: Pre-participation screening for athletes in the UK. British Cardiovascular Society; 2012. Available at: http://www.bcs.com/pages/news_full.asp?NewsID=19792061

¹⁰ Elston J, Stein K. Public health implications of establishing a national programme to screen young athletes in the UK. *British Journal of Sports Medicine*, 2011. 45(7): p. 576-582. Available at: <http://www.ncbi.nlm.nih.gov/pubmed/19622527>

¹¹ <http://www.screening.nhs.uk/hcm>

policy is due be reviewed again in 2012-13.¹²

Existing screening programmes in the UK

The charity Cardiac Risk in the Young (CRY) runs a subsidised screening programme, which costs £35 per person, offering ECG and echocardiogram screening to all young people between the ages of 14 and 35. The charity advocates mandatory screening for all young athletes. CRY currently provides screening services for a number of professional sporting bodies, including the English Institute of Sport, the Rugby Football Union, Rugby Football League, Lawn Tennis Association and a number of FA football teams including Manchester City.¹³

Additionally, the Football Association runs the ‘Association Football Medical Screening Programme for Youth Trainees’. Co-ordinated by the Association’s Sports Medicine & Sports Science Department, the programme is for youth players attached to Football Academies and Centres of Excellence. It involves over 750 youth players (16 years old) attached to professional clubs and new recruits to Academies of Football. The annual medical screening programmes comprise of a cardiological and orthopaedic assessment based at 18 regional cardiological and 18 orthopaedic assessment centres.¹⁴

Established as a pilot by the Scottish Government, the Cardiac Assessment of Young Athletes (CAYA) programme was set up in 2008. This has been run in partnership with the Scottish Football Association and the University of Glasgow the service offers young athletes a series of tests to determine whether they are at increased risk of sudden cardiac death and includes a detailed family history questionnaire, clinical examination, an ECG and transthoracic echocardiogram.

Nicola Sturgeon MSP, the Scottish Minister for Health, has stated that more than 800 athletes took part in the first two years of the CAYA programme. One case of cardiomyopathy was identified and the Scottish Government stated that ‘early intervention has prevented more serious complications arising and none of the young people have had to give up competitive sport.’¹⁵ In 2010 it was announced that funding for CAYA would continue for an additional two years. The expansion of the scheme has included satellite assessment units that can be taken to rural parts of Scotland.

International examples of screening programmes

The International Olympic Committee (IOC) has recommended, but not mandated, that all countries screen their athletes to minimise the risk of sudden cardiac death. According to the IOC, if an ECG raises suspicion of an underlying serious problem in an athlete, further tests should be performed.¹⁶

In Italy, under a law first passed in 1971 and revised in 1982 Italian athletes participating in organized competitive sports must undergo a physical examination, ECG and 3-minute exercise step test.¹⁷ It is the legal responsibility of the athletic

¹² House of Commons Debate, 16 January 2012, c539W. Available at: <http://www.theyworkforyou.com/wrans/?id=2012-01-16b.89622.h>

¹³ <http://www.c-r-y.org.uk/ecg.htm>

¹⁴ Football Association. *About The FA Sports Medicine & Sports Science Department*. Available at: <http://www.thefa.com>

¹⁵ <http://www.scotland.gov.uk/News/Releases/2010/10/15162227>

¹⁶ http://www.olympic.org/Assets/ImportedNews/Documents/en_report_1448.pdf

¹⁷ Pelliccia A, Maron BJ. Preparticipation cardiovascular evaluation of the competitive athlete: perspectives from the

team's manager to ensure that this testing is done, although compliance with this law has not been universal.¹⁸ The Italian screening is funded by the Italian Government and performed by sports medicine physicians that have undergone an additional 4 years of postgraduate training in sports medicine and sports cardiology.

In Japan, a national screening system for cardiovascular diseases was introduced in 1973, making it mandatory for school children to be screened.¹⁹ The primary screening process includes a questionnaire and an ECG for all students, regardless of athletic participation.

In the United States, a large-scale screening program has not been implemented to date. Screening is being done by industry and grass roots groups but without a systematic protocol or follow-up in many instances.²⁰ Some screenings include ECG, some include echocardiography, and some include both.

A National Sport Law was enacted in Israel in 1997, which mandates screening of all athletes with resting ECG and exercise testing.

BHF Activity

- We will monitor screening programmes in Scotland and abroad for developments that could influence UK-wide screening of athletes.
- We provide a Genetic Information Service in partnership with the Department of Health, which helps relatives deal with the consequences of losing a loved one to an inherited heart condition. This service supports bereaved families to get an assessment by experts in an appropriate clinic. This could potentially save hundreds of lives by detecting and treating an inherited heart condition in other family members.

30-year Italian experience. *Am J Cardiol.* 1995; 75: 827–829. Available at: <http://www.ncbi.nlm.nih.gov/pubmed/7717289>

¹⁸ Thompson PD. Preparticipation Screening of Competitive Athletes. *Circulation.* 2009; 119: 1072-1074. Available at: <http://circ.ahajournals.org/content/119/8/1072.full>

¹⁹ Tanaka Y, Yoshinaga M, Anan R, Tanaka Y, Nomura Y, Oku S, Nishi S, Kawano Y, Tei C, Arima K. Usefulness and cost effectiveness of cardiovascular screening of young adolescents. *Med Sci Sports Exerc.* 2006; 38: 2–6

²⁰ Vetter VL, Elia J, Erickson C, Berger S, Blum N, Uzark K, Webb CL. Cardiovascular Monitoring of Children and Adolescents With Heart Disease Receiving Medications for Attention Deficit/Hyperactivity Disorder. *Circulation.* 2008; 117: 2407-2423. Available at: <http://circ.ahajournals.org/content/117/18/2407.full>