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Analysis of Pre-participation Screening Protocols for Football Players in Europe, USA, and Libya: Possible Implications for Preventing Sudden Cardiac Death

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ABSTRACT

Sudden cardiac death is the leading cause of death in sport participants and may result from undiagnosed cardiac diseases. It has been universally agreed upon that pre-participation screening can identify those athletes at risk of sudden cardiac death, and yet, there is no commonly accepted protocol to screen athletes. Although the European Society of Cardiology (ESC) and the American Heart Association (AHA) recommend the routine screening of athletes to prevent sudden death, there is significant disagreement regarding the guidelines of the protocols. The American Heart Association protocol includes a detailed medical history and a physical examination, whereas the European Society of Cardiology protocol includes 12-lead electrocardiography with a detailed medical history and a physical examination. The cost benefit of using electrocardiography is debatable, particularly if the screening is used to prevent sudden death associated with uncommon diseases. The Libyan Football Federation established a new seasonal pre-competition medical assessment protocol for Libyan football athletes during the 2013-2014 season, which includes a medical history, physical examination, 12 lead electrocardiography, echocardiography, and blood test. Regardless of cost and differences in protocol, there is a significant value in pre-participation screening for athletes in order to decrease the incidence of sudden cardiac death, and this report examines some of these different protocols as well as their potential for identifying athletes at risk for sudden cardiac death.

Keywords: Sport cardiology, pre-participation examination, screening protocols, ECG, sudden cardiac death

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Avrupa, Amerika Birleşik Devletleri ve Libya'daki Futbol Oyuncuları için Uygulanan Spora Katılım Öncesi Tarama Protokollerinin Analizi: Ani Kardiyak Ölümü Önlemede Olası Etkinlikleri

ÖZ

Ani kardiyak ölüm, sporcular için önde gelen ölüm nedenidir ve tanısı konmamış kalp hastalıklarından kaynaklanabilir. Spora katılım öncesi değerlendirmelerle ani kalp krizi riski taşıyan sporcuların belirlenebileceği konusunda evrensel görüş birliği bulunmakla birlikte, halihazırda yaygın kabul gören bir protokol yoktur. Avrupa Kardiyoloji Derneği (ESC) ve Amerikan Kalp Derneği (AHA), sporcuların ani ölümlerini önlemek için rutin taramalar önermelerine rağmen, protokollerin yönergeleri konusunda önemli bir anlaşmazlık vardır. Avrupa Kardiyoloji Derneği'nin protokolü detaylı tıbbi geçmiş ve fizik muayene ile 12 derivasyonlu elektrokardiyografi içermesine karşın, Amerikan Kalp Derneği protokolü ayrıntılı tıbbi öykü ve fizik muayene içermektedir. Elektrokardiyografi kullanmanın maliyet-yarar oranının gözetilmesi, eğer taramalar nadir bulunan hastalıklarla ilişkili ani ölümü önlemek için kullanılıyorsa tartışmalıdır. Libya Futbol Federasyonu 2013-2014 sezonunda Libya'lı futbolcular için, tıbbi geçmiş, fizik muayene, 12 derivasyonlu elektrokardiyografi, ekokardiyografi ve kan testlerini içeren yeni bir spora katılım öncesi sağlık değerlendirmesi protokolü oluşturdu. Maliyet ve protokol farklılıkları ne olursa olsun, sporcularda ani kardiyak ölümün görülme sıklığını azaltmak için spora katılım öncesi sağlık taramaları oldukça önemlidir. Bu derleme, farklı protokolleri ve bunların ani kardiyak ölüm riski altındaki sporcuları belirlemedeki etkinliklerini incelemektedir.

Anahtar sözcükler: Spor kardiyolojisi, spora katılım öncesi değerlendirme, tarama protokolleri, EKG, ani kardiyak ölüm

INTRODUCTION

Pre-participation screening has been largely accepted as a means to identify those athletes at risk of cardiovascular diseases (CVD) which are responsible for sudden cardiac death (SCD) (1). The objectives of athlete screening are to reduce injuries, decrease disease complications, and prevent sudden death through lifestyle modification which includes restriction of participation in competitive sports (2); however, there is no single commonly adopted protocol to screen athletes. Although the European Society of Cardiology (ESC) and the American Heart Association (AHA) support routine pre-participation screening of athletes to prevent SCD, there is significant disagreement regarding the components of screening protocols used (2,3). The debate is centered on the inclusion (or not) of a resting 12-lead electrocardiography ECG, in addition to a medical history and physical examination during assessment. Therefore, the aim of this investigation was to explore the debate regarding differences

between European and the USA pre-participation screening protocols for SCD, while also considering the more comprehensive pre-competition medical assessment (PCMA) protocol used by the Libyan Football Federation (LFF).

Sudden Cardiac Death (SCD)

Even though SCD of a young athlete is uncommon, it is an emotional and powerfully tragic event that can devastate the athlete's family and community (2). SCD is the leading cause of non-traumatic mortality in young athletes during exercise and may result from undiagnosed CVD (3). SCD results from a range of CVD, and an increased incidence has been reported in the United States and Europe (4). Most at-risk athletes present no signs or symptoms of cardiac disease, and therefore, screening is the only strategy with potential to identify CVD (5). The incidence of SCD, however, varies widely. In the US, college athletes have been estimated to be 1 in 100,000 SCD cases per year. In Italy, the incidence is about 3 in 100,000 SCD cases per year in ages 12 to 35 years (6). The difference of the incidence is due to age range and gender differences, as the incidence of sudden death increases with age and is more common in men than women athletes (5). Young athletes have an estimated 2.8 times greater risk of SCD than non-athletes, because undiagnosed CVD may be exacerbated with sport and exercise, thereby triggering potential arrhythmic cardiac arrest (7).

This supports the concept that sport medicine physicians should ensure that athletes are systematically screened to identify those with lethal CVD and to protect them from complication of disease. The most common cause of SCD in old athletes (>35 years old) is atherosclerotic coronary artery disease, whereas genetic or congenital cardiovascular abnormalities are the most common causes of SCD in younger athletes (<35 years old) (1,2). The second most common cause of SCD is coronary artery anomalies, and the third most common cause is abnormal left ventricular hypertrophy (8). Some diseases are more prevalent in certain demographics such as the higher incidence of arrhythmogenic right ventricular cardiomyopathy found in northern Italy (9). Although most SCD in athletes are caused by CVD, it must be remembered that there are other causes of sudden death not attributed to SCD such as commotio cordis, asthma, heat stroke, drug abuse, and trauma that causes structural cardiac injury. Nonetheless, pre-participation screening has been implemented in Europe and the US in the last 25 years, and what follows is an examination of the different protocols.

European Screening protocol

In 2005, the ESC developed a consensus statement in which the main purpose was to reinforce the need for pre-participation evaluation and medical clearance for all young athletes involved in organized sports programs to prevent athletic field fatalities. The ESC therefore recommended a common European athlete cardiovascular screening protocol to prevent SCD (9). The screening protocol consists of a medical history (family and personal history), physical examination, and 12 lead ECG. The International Olympic Committee, Federation Internationale de Football Association (FIFA), and the Union of European Football Associations (UEFA) support the routine use

of ECG as part of the screening protocol (9,14). The incidence of SCD in young competitive athletes has significantly reduced since implementing ECG in the screening protocol (10). The 12 lead ECG is very sensitive in diagnosing hypertrophic cardiomyopathy and thus allows for the identification of athletes at risk of SCD due to underlying, and previously undiagnosed CVD (11-13).

Despite the fact the screening protocol is commonly accepted worldwide, the protocol is not standardized. Most countries have no government-regulated screening protocol requirements (15). In 1982, the Italian national program implemented pre-participation screening based on ECG (16,17). Italian law mandates that every athlete engaged in competitive sport must participate in screening to be eligible for competition (18). About 10% of the Italian population (6 million athletes) is screened every year (19), and the screening protocol is directed by qualified Italian physicians who completed residency training programs in sports medicine and work in sports medicine centers (9,10). The Italian protocol has been shown to be valuable in identifying asymptomatic athletes with underlying CVD, and in fact, this protocol might be as sensitive as echocardiographic examination (16,20).

Corrado et al (9,17) reported that among 33,735 athletes who went through the screening protocol, ~9% were referred for further examination (echocardiography) and about ~2% (621 athletes) were identified as having CVD. Twenty two asymptomatic athletes were diagnosed with hypertrophic cardiomyopathy, 18 athletes showed one or more ECG abnormalities, and five athletes had premature ventricular beats. Conversely, only five athletes had a family history or a cardiac murmur or both (19). Additionally, the authors found a ~89% decrease in SCD with including ECG in the screening protocol (16). Mortality reduction was mainly due to a lower incidence of SCD from cardiomyopathies that paralleled the increasing identification of athletes with cardiomyopathies at screening. In these instances, ECG was a specific screening test, and the percentage of false positives did not exceed 9% (6). In addition, the German screening protocol includes medical history, physical examination, 12 lead ECG, exercise testing, and echocardiography (20). Even though echocardiography is the key diagnostic test of hypertrophic cardiomyopathy, it is expensive, impractical and not clinically effective for screening large numbers of athletes (9,21,22). The challenge remains with the diagnosis and differentiation of extreme adaptation to training that looks like the early stages of some heart diseases (23).

USA Screening Protocol

In 1996 the AHA consensus panel recommendations stated that pre-participation screening for young competitive athletes is justifiable on ethical, legal, and medical grounds (9). The AHA updated these recommendations in 2007 with relatively little change from the original consensus recommendations from 1996. The screening protocol in the USA includes 12 key pre-screening points, medical history, and physical examination without ECG assessments (21,24). Athletes, who have positive results are referred for further examination. The AHA recommends that screening should be repeated for high school and college athletes every two years. The AHA has agreed that ECG can enhance the diagnostic level of the screening protocol, but did not recommend

the addition of the ECG as a pre-participation screening tool in the USA. The AHA made these recommendations upon the following significant concerns: 1) the large number of athletes to be examined annually (10 million athletes per year) and the low incidence of SCD, 2) the lack of qualified sport medicine physicians and deficiency of infrastructure for execution and interpreting the screen, 3) the low specificity of ECG and cost of ECG, and 4) the low experience of USA (11,20).

Libyan Screening Protocol

During the 2006 World Cup in Germany, FIFA implemented a screening protocol called the pre-competition medical assessment (PCMA) (25). The PCMA protocol consists of a medical history, general physical examination, cardiovascular and musculoskeletal examination, a 12 lead ECG in supine position after 5 minutes rest, blood laboratory test, and echocardiography (26). In 2013, the LFF implemented a mandatory screening for Libyan football players using the same protocol implemented by FIFA (PCMA). The sport medicine committee of LFF supervised the screening program which was carried out by general physicians at private clinics. In Benghazi city, 1236 male football players were screened in the 2013-2014 season. Only one player was diagnosed with a 2nd degree heart block (Mobitz type 2) identified using ECG, while his medical history, physical examination, echocardiograph, and blood tests were normal (27). Although the PMCA is endorsed by FIFA, it is not practical to implant this in Libya for many reasons. In Libya, there is no accredited sport medicine or sport cardiology residency program. According to the Italian recommendations, the pre-participation screening should be supervised by an accredited sports medicine physician to interpret normal ECG changes associated with the athlete's heart which overlap with hypertrophic cardiomyopathy ECG changes (9,10,11). Personal and family history questionnaires originally written in English do not translate well to Arabic, which has potential for misinterpretations by players. In addition, using echocardiography is still controversial and clinically not effective in young athletes (21,22), although it has been shown that echocardiography does contribute slightly to the diagnosis of CVD in young athletes (28).

Finally, the PCMA is very expensive, and most of Libyan football clubs cannot afford it. It is recommended that the LFF conduct further research to examine the validity of PCMA for the prevention of SCD, as well as the predictive validity of echocardiography in the screening protocol. LFF and health care policymakers should develop strategies and implement pre-participation screening protocols based on scientific foundations and the specific national health and socio-economic systems. In the meantime, the LFF should follow the recommendations of ESC and the Italian guidelines for the pre-participation screening protocol. It is recommended that the screening protocol include a combination of ways to identify personal symptoms and family history, as well as a physical examination and ECG due to its high sensitivity in identifying CVD. Any athlete with a positive finding from the screening protocol should be referred for further investigations.

Summary

Pre-participation screening aimed at minimizing the complications of CVD, reducing the incidence of injuries and preventing SCD should be compulsory for every athlete engaged in competitive sport. According to the implementation of the Italian protocol,

the screening should be directed by accredited physicians who are specialist in sport medicine or sport cardiology. The pre-participation screening protocol for assessing young athletes being fundamentally based on ECG is a valid clinical strategy that adequately meets the criteria for a robust screening program. Including ECG during screening decreases the risk of SCD in competitive athletes. ECG in the protocol is currently recommended by the International Olympic Committee, as well as by most European Cardiologic Societies and Sports Medical Federations, and thus this practice should become the standard for pre-screening for SCD.

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