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Advanced Sports Medicine Concepts and Controversies

Is There a Role for Limited Echocardiography During the Preparticipation Physical Examination?

Deanna L. Kerkhof, MPH, BS, Courtney N. Gleason, MD, Frederick C. Basilico, MD, Gianmichel D. Corrado, MD

Abstract

Sudden cardiac death (SCD) is the leading cause of death during exercise for athletes younger than 35 years. Structural cardiac abnormalities are responsible for the majority of SCDs among competitive athletes. The screening protocol that is best for detecting athletes at risk for SCD has been the subject of considerable and long-standing debate. The American Heart Association recommends the use of a 14-element history and physical examination (H&P), whereas European standards call for a focused H&P and 12-lead electrocardiogram (ECG). The use of ECG screening has been repeatedly rejected in the United States because of the high rate of false-positive results and an abundance of evidence suggesting that it is a cost-ineffective tool for screening. Attempts have also been made to prescreen athletes for cardiac disease with echocardiography (ECHO) performed by a cardiologist; however, this technique also proved to be cost-ineffective. The use of ECHO performed by a frontline physician reflects recent advancements in ultrasound technology utilization, including the advent of portable ultrasound, and introduces a new, promising screening method to the debate. Portable ECHO by a frontline physician (PEFP) has the ability to directly visualize structural components of the heart that are part of the gold standard ECHO evaluation performed by a cardiologist. The Early Screening for Cardiac Abnormalities with Preparticipation Echocardiography (ESCAPE) protocol developed at Northeastern University is the first attempt to implement the PEFP. Initial inquiries into the reliability and feasibility of the PEFP are promising. Measurements obtained by frontline physicians were not statistically different from those obtained by a cardiologist, focused ECHO was found to reduce the referral rate to cardiology by 33%, and PEFP was completed significantly faster than H&P and an ECG. Early results are encouraging, but continued research to support the widespread use of PEFP for preparticipation examination in all competitive athletes is needed prior to recommending implementation.

Introduction

Sudden cardiac death (SCD) in a young, seemingly fit and healthy athlete is a shocking event for families, communities, and all those committed to the prevention of devastating sports-related injuries. SCD is defined as any nontraumatic, unexpected death due to cardiac causes that occurs within 1 hour of the onset of symptoms [1,2]. The overall incidence of SCD is estimated to be between 1 in 40,000 and 1 in 80,000 young athletes [3]. The prevalence of the cardiac anomalies that predispose an athlete to SCD are rare (Figure 1), with the most common cause of SCD, hypertrophic cardiomyopathy (HCM), being found in only 0.1% to 0.2% of the population [1]. These numbers may be underestimations of the actual incidence of SCD, however. A recent review of SCD in athletes concluded that the incidence is likely higher than traditional estimates as a result of "lack of mandatory reporting requirements in most settings, the inclusion or exclusion of cases based on time and location of the event, inclusion of all cardiac events (including survivors) versus only those resulting in death, and the population examined" [3]. Despite the low prevalence of cardiac disease that can result in SCD, SCD is still the leading cause of death during exercise for athletes younger than 35 years [3].

Episodes of SCD among high-profile athletes such as Hank Gathers and Reggie Lewis captured the nation's attention. Widespread media coverage of their stories brought awareness of SCD and its inherent threat to young athletes [1]. Despite the attention that high-profile SCDs attract, a multitude of preventable deaths continue to occur among young, otherwise healthy athletes throughout the United States every year. Many

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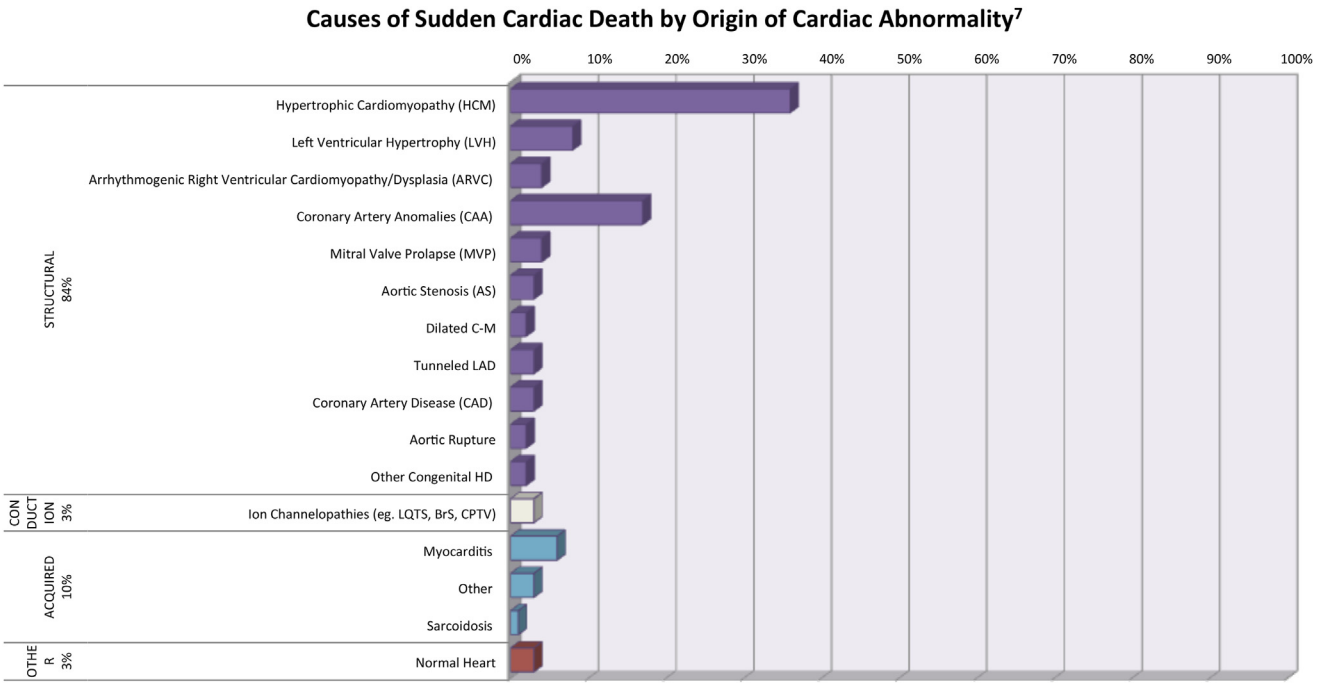

Figure 1. Causes of sudden cardiac death by origin of cardiac abnormality. Data from Maron et al [7].

parents who have experienced the tragic loss of a child to SCD and others touched by these tragedies have initiated grassroots efforts to help identify at-risk athletes in an attempt to prevent future episodes. Organizations such as Defibtech and The National Center for Early Defibrillation have launched efforts to place public-access automated external defibrillators in critical areas, including schools, with the hope that rapid defibrillation could prevent SCD [4,5]. Other groups, such as Screen Across America, have fought for improved preparticipation screening methodologies because they believe "heart screenings like EKGs could detect problems, and save lives" [6].

Structural cardiac abnormalities are by far the leading cause of sudden death among competitive athletes, representing 84% of SCDs [7]. Alone, HCM accounts for 36% of all SCD events in athletes younger than 35 years (C. N. Gleason, MD, et al, unpublished data, September 2014). If episodes of left ventricular hypertrophy (LVH) are included along with HCM, the percentage increases from 36% to 44% of cases. Acquired diseases and conduction-related conditions are responsible for the remainder of SCDs, with the exception of the 3% who are considered to have a normal heart. Conduction disorders such as long QT syndrome, Brugada syndrome, and catecholaminergic polymorphic ventricular tachycardia cause the fewest number of SCDs, triggering only 3%. In theory, HCM should be detectable with history and physical examination (H&P), electrocardiogram (ECG), and echocardiogram (ECHO). In reality, in a majority of instances, athletes with HCM are asymptomatic until the episode that results in sudden death. Because of the discrepancies between the theoretical potential of screening tests such as the H&P and 12-lead ECG to identify underlying cardiac abnormalities and the practical results of these 2 screening methods that have been born out in the literature, significant debate continues regarding the methodology of cardiac screening. Considering the distribution of conditions that cause SCD, the ideal screening protocol for SCD prevention must focus heavily on detecting structural heart disease.

Table 1 [1,7-16] highlights 3 screening methods—H&P, 12-lead ECG, and ECHO—and examines their functionality and ability to detect disease. The abnormalities that may or may not be present during H&P, ECG, and ECHO for the most common causes of SCD in athletes are highlighted in Table 2 [1,7,10,12,14,17-31]. In the United States, research suggests that the H&P is the most cost-effective screening method, whereas in Europe a focused H&P and 12-lead ECG is the accepted practice. Both methods, the H&P and the ECG, have significant shortcomings due to high false-negative and false-positive rates. Recent studies have suggested that there may be a role for portable ECHO performed by a frontline physician (FLP) in preparticipation screening for SCD. The gold standard for detecting HCM is direct visualization of the heart with a comprehensive ECHO performed by a cardiologist. Portable ECHO performed by an FLP (PEFP) provides direct visualization of the heart, including its structural components, which allows for detection of HCM and LVH. Direct visualization enables FLPs to perform more accurate cardiac screening for structural abnormalities compared with H&P and