Cardiovascular Clearance for Sports Participation

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Sudden cardiac death (SCD) in a young athlete is a rare but tragic occurrence. The goal of this article is to provide information about the risks of sudden cardiac death in athletes by reviewing the epidemiology and describing the current screening recommendations of the American Heart Association/American College of Cardiology. [1] The specifics of and reasons for differences between screening guidelines in the United States and the screening guidelines in Europe are highlighted. Electrocardiogram (ECG) changes that can be expected in the setting of conditioning vs pathology are described. Intrinsic cardiac pathologies and disorders, with related cardiac findings, are reviewed, including prevalence and inheritance patterns. Also included is a brief medical-legal discussion about physician liability in the course of making sports clearance decisions. In an area in which there is no single national standard but in which there is an expectation by almost all states for a clearance examination, this article aims to help physicians make thoughtful decisions when evaluating a seemingly healthy patient in order to detect those rare athletes who may be at increased risk of succumbing to a sudden cardiac death during sports participation. [21]

Curr Probl Pediatr Adolesc Health Care 2018; 000:1−9

Introduction

Each year millions of scholastic athletes are required to have a Preparticipation Physical Examination (PPE) clearing them to participate in school-sponsored sports. The two primary objectives of the PPE are to screen for conditions that may be life-threatening or disabling and to screen for conditions that may predispose to injury or illness. Identifying a cardiovascular related condition that might risk the health or well-being of a student athlete is a major priority of the evaluation. Ultimately the main goal of the cardiovascular component of the PPE is to determine, on the basis of the history and/or physical examination, those rare athletes who may be at increased risk of succumbing to a sudden cardiac death during sports participation.

Sudden cardiac death (SCD) in a young athlete is a rare but tragic occurrence.[1] The tragedy often leads to outcries from the general public, raising questions about why the medical community has not done more to prevent these heartbreaking events. Methods to reduce the risk of death on the field secondary to cardiovascular disease were initially investigated at the 1985 Bethesda Conference #16 of the American College of Cardiology (ACC) in which an expert panel established consensus guidelines for eligibility and disqualification of athletes with cardiovascular abnormalities. Bethesda Conferences #26 and #36 in 1994 and 2005, respectively, worked to update those initial recommendations.[2] In the United States, screening athletes using a PPE to identify previously undiagnosed heart conditions is recommended by the American Academy of Family Physicians (AAFP),[4] American Academy of Pediatrics (AAP),[3] ACC, and American Heart Association (AHA).[1] The goal of this section is to

1. provide information about the risks of sudden cardiac death in young athletes,
2. describe the various screening recommendations,
3. review the cardiac conditions that warrant further investigation and discuss their management, and
4. help practitioners develop a framework to use when faced with the challenging task of providing a sports clearance for a young athlete who has a history or physical examination finding that increases the practitioner's suspicion of an undiagnosed heart condition.

Epidemiology

The ACC defines SCD as a ‘‘non-traumatic and unexpected sudden death that may occur from a

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Curr Probl Pediatr Adolesc Health Care 000;000:1−9
1538-5442/$ -see front matter

https://doi.org/10.1016/j.cppeds.2018.06.003

cardiac arrest, within 6 hours of a previously normal state of health''.[5] The incidence of SCD among athletes is often debated. United States (US) based estimates range as widely as 1:3000 athlete years (AY) to 1:917,000 AY.[6] The broad range can be attributed to a lack of standardized event reporting protocols, variable hospital diagnosis coding procedures, and inconsistent definitions in the literature regarding who qualifies as an athlete (i.e. organized vs recreational sports). Furthermore, what qualifies as exertional stress on an athlete's heart is also variable across the literature.[7] In a study of Minnesota high school athletes over a 12-year period, from 1985−1986 to 1996−1997, data was collected from a catastrophic injury insurance program that was uniquely mandated for all interscholastic athletes; this study resulted in a widely quoted incidence of SCD in athletes of 1 in 200,000.[8] In 2013, the same authors expanded their analysis and reported an incidence in high school athletes closer to 1:150,000, citing a longer study length and more comprehensive inclusion criteria.[9] The overall estimated incidence of SCD for children and adolescents ranges from 0.6 to 6.2 per 100,000 children in the US, with as many as 25% of deaths occurring during sports.[10]

The US National Registry of Sudden Death in Athletes reviewed athlete-related deaths over a 27-year period and obtained patient death, survival, and demographic information.[11] Approximately 37% of the 1866 athlete sudden death events recorded were determined to be secondary to documented structural cardiac disease, with hypertrophic cardiomyopathy (HCM) being the most common diagnosis, followed by coronary anomalies. The average age of patients was 19 years old and the number of cardiovascular deaths per year was 66, with a range of 50 to 76 deaths annually. In the cohort studied, 70% of athletes with SCD events were engaged in middle school or high school level sports.[11]

Females are less likely than males to die from sudden cardiac death during sports.[12] Approximately 90% of fatalities during sports occur in males. This may be secondary to a discrepancy in the numbers of women vs. men participating at baseline, differences in the intensity of training, and/or different rates of diagnosis of high risk cardiac conditions.[13]

The US National Registry of Sudden Death in Athletes showed that cardiac events were more common in non-white athletes (mostly African-Americans) and deaths due to cardiovascular disease were more common in non-white than white athletes. Statistically significant racial differences were seen in the diagnosis of HCM (20% for non-whites vs. 10% for whites), coronary anomalies (10% for non-whites vs. 5% for whites) and ion channelopathies (0.3% for non-whites vs. 2% for whites).[11] Racial differences with respect to prevalence are widely noted in the literature. True variance in predisposing genetics factors may play a role but researchers have also noted differences that may be secondary to external influences, such as socioeconomic status, health care access, and provider index of suspicion.[14]

The Athlete's Heart

Acknowledging and understanding that there are physiologic changes in cardiac structure and function that occur in trained athletes is fundamental in assessing the need for further cardiac evaluation and/or treatment in children and adolescents. The term "athlete's heart" was introduced in the literature in the late 1800s by the Swedish clinician, Henschen.[15] Via auscultation and percussion, he was one of the first researchers to describe increased cardiac dimensions in athletes through his evaluation of Nordic skiers. In the same time period, similar physical examination findings were noted in rowers by the Harvard researcher, Darling. These findings were later confirmed with the development of the plain radiograph.[16] The electrocardiogram (ECG) furthered the conversation on perceived structural adaptations and associated rhythm changes in the athletic heart, showing patterns of left ventricular enlargement and bradycardia. In the 1970s, with the development of M-mode echocardiography, cardiologists were able to provide more specific descriptions and develop criteria for normal cardiac size and function in laypersons vs. athletes.[17] Further advancements in technology have allowed for cardiologists and researchers to extensively study the physiologic changes of an athlete's heart.[16]

Regular intensive exercise puts chronic stress on the cardiovascular system. Physiologic responses vary in relation to the type of athletic activity performed. Isometric (static) activity vs. isotonic (dynamic) activity place different pressure and/or volume demands on cardiac muscle; with most exercise being neither completely static nor dynamic. During static exercise, such as weight lifting or shot putting, exercise involves muscle contraction without an associated change in muscle length or joint angle. This is in contrast to dynamic activity, such as