

Cardiovascular Screening of Adolescent Athletes

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KEYWORDS

- Young athletes • Electrocardiography • Sudden cardiac death
- Preparticipation screening

Preparticipation screening of competitive athletes refers to the “systematic practice of medically screening large populations of athletes before participation in sports for the purpose of identifying abnormalities that could provoke disease progression or sudden death.”¹ The main objective of screening is to identify athletes who have cardiovascular risk factors so that timely evaluation and management can be initiated and appropriate decisions made about the level of physical activity or sport participation.^{1–6}

Screening and prevention are the most important strategies for several reasons.^{7–13} It is commonly believed that automated external defibrillators (AEDs) placed at strategic locations at athletic venues and public places will help in improving survival after a sudden cardiac arrest (SCA).⁷ Results of studies done to evaluate survival after an SCA on the athletic field with timely use of an AED by reasonably trained personnel are at best equivocal.^{7–13} Thirty percent to 50% of all sudden cardiac deaths (SCDs) are the first clinical manifestation of an underlying pathology.¹² Various aspects related to cardiovascular screening of young athletes and SCD are subjects of a voluminous published research and excellent reviews, commentaries, and editorials.^{1–6,14–21} This article provides an overview of key aspects of cardiovascular screening currently recommended in the United States for young athletes. The main concern and impetus for such an intense focus on cardiovascular screening is the risk of SCD during sport participation.

SCD

SCD refers to “nontraumatic and unexpected sudden death that may occur from a cardiac arrest, within 6 hours of a previously normal state of health.”³ In the modern

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era of competitive sports, there have been instances of athlete deaths in almost all sports but more commonly in basketball, soccer, and football.¹⁻⁴ Sudden death in athletes is especially disconcerting because exercise has proved to decrease the risk of life-threatening cardiovascular disease.¹

Epidemiology

Although the exact incidence of SCD during sport participation in young athletes is not known, several studies provide an estimate of the incidence and data on other epidemiologic characteristics of SCD.^{1-6,22-24} The incidence of SCD is estimated to be 1 in 200,000 in high school athletes and 1 in 65,000 in collegiate athletes in the United States.^{1-6,22} The incidence of cardiovascular collapse as the cause of athletic fatalities is twice that of death caused by trauma.^{14,15} SCD is more common in men than in women at a ratio ranging from 5:1 to 9:1; this may be because of the higher participation rate in men in competitive sports.^{1,5,16} The incidence is higher in African American athletes; the disparity could be because of a higher number of competitive athletes (almost 40%) who are African American.^{1,5,23} In previous studies from Italy, the incidence of SCD in athletes was reported at 3 in 100,000.^{2,25} This difference between the United States and Italy is thought to be due to the younger age of the American athletes and the inclusion of a larger number of female athletes.^{2,18} In the United States, the most common sports associated with SCA are football, basketball, and ice hockey whereas in Europe it is soccer.¹⁻⁶

Causes

Pathophysiology of SCD is explained by exercise acting as a trigger for precipitation of sometimes lethal arrhythmias in the presence of underlying structural heart diseases or other susceptibilities.^{1-6,25,26} In the United States, the most common cause of SCD in young athletes (26%) is hypertrophic cardiomyopathy (HCM).^{1-6,27-31} The second most frequent cause of SCD in athletes (14%) is anomalous origin of the coronary artery, most commonly the left coronary artery arising from the right sinus of Valsalva.^{32,33} This group of patients may have a completely normal electrocardiogram (ECG) and exercise stress test and first manifests symptoms with exertion while playing sport.³² Other heart-related conditions that increase the risk for SCA in young athletes are listed in **Box 1**.^{1-6,10,11}

In young children, commotio cordis is an important cause of sudden death. Commotio cordis results from a blunt trauma to the chest by a fast moving projectile, such as a baseball or ice hockey puck.^{10,11} The mechanism of cardiac arrest is ventricular fibrillation. The blow should be inflicted within a narrow window of time (within 10–30 milliseconds) just before the peak of the T wave during repolarization.^{1,10,11} Commotio cordis accounts for 20% of SCD in children on the field.^{1,10,11}

CARDIOVASCULAR SCREENING

History and Physical Examination

The current American Heart Association (AHA) recommendations for cardiovascular screening of competitive young athletes consist of a review of 12 items (**Box 2**).¹ A positive response to 1 or more of these items is considered an indication for additional cardiovascular evaluation. Information that should be ascertained in the cardiovascular screening history of young athletes is listed in **Box 3**.¹⁻⁶

In the United States there is no mandate or law regarding preparticipation screening. The responsibility of providing screening services for student athletes rests with the institutions organizing sports. Personal physicians are expected to conduct

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