Preparticipation Screening of Young Athletes

Identifying Cardiovascular Disease

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KEYWORDS

• Preparticipation physical examination • Cardiovascular screening
• Sudden cardiac death • ECG • Sports physical • Athlete's heart

KEY POINTS

- A major goal of the preparticipation physical examination (PPE) is to prevent sudden cardiac death in young athletes. This has proven to be difficult because many sudden cardiac deaths in young athletes are "unexplained."
- Highly trained athletes may develop physiologic cardiovascular changes that can sometimes result in abnormal electrocardiogram (ECG) tracings and borderline echocardiographic findings ("athlete's heart").
- The PPE should include the American Heart Association 14-element preparticipation cardiovascular screening checklist.
- There is insufficient evidence to recommend screening ECGs and echocardiograms for all young athletes during PPEs.
- Providers should be aware of the American Heart Association and American College of Cardiology recommendations for further evaluation when abnormal findings arise during the PPE.

INTRODUCTION: NATURE OF THE PROBLEM

The preparticipation physical examination (PPE), or sports physical examination, is an encounter familiar to most primary care physicians. Each year in the United States, thousands of children and young adults undergo PPEs, to screen for conditions that may be life threatening or disabling. Given recurrent, high-profile cases, a common

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question physicians face is how best to screen for conditions that predispose young athletes to sudden cardiac death (SCD). Cardiovascular disorders account for nearly 75% of all sudden deaths in athletes.[1] Estimates of SCD rates in high school– and college-age athletes range from as high as 1:75,000 to 1:300,000.[2–4] Currently, there are no universally agreed upon standards to clear young athletes for sports participation. There remains considerable controversy in the sports medicine community as to what constitutes adequate cardiac screening. The use of ECG and echocardiography as screening tools are ongoing topics of debate. In addition, despite the broad implementation of routine PPE across the country, there has been little, if any, impact on the overall morbidity and mortality in young athletes.[5] This article explores current guidelines and controversies in preparticipation screening.

Overview of Athlete's Heart

It can be difficult to distinguish between normal physiologic changes (also known as athlete's heart or athletic heart syndrome) and pathologic cardiac changes.[6] This complicates the ability to accurately assess cardiovascular risk in athletes. Exercise of sufficient quantity and intensity can cause structural and electrical changes in the heart.[6] Endurance and strength training athletes have different cardiac adaptations as a result of sustained volume and pressure loads.[6] Intense endurance exercise can induce increased ventricular dilation and biventricular eccentric hypertrophy.[6] Pressure loads associated with strength training, in contrast, tend to cause concentric ventricular hypertrophy.[6] Eccentric hypertrophy is symmetric chamber dilation and wall thickening caused by repetitive ventricular stretching to increases cardiac output.[7,8] Concentric hypertrophy refers to significant wall thickening with little to no ventricular chamber dilation caused by repetitive sharp increases in blood pressure during strength training.[7] In the setting of concentric hypertrophy, increased contractility occurs without ventricular dilation.[7]

Exercise can also induce electrical changes in the heart. These electrical changes in the athlete's heart are primarily due to 1 of 2 causes. First, with training, a gradual response to catecholamines and increased parasympathetic tone leads to a decreased resting heart rate.[6] As a result of chamber dilation and hypertrophy, cardiac output is maintained at a lower heart rate. Second, electrical changes can occur as a result of the structural changes associated with both concentric and eccentric hypertrophy (**Boxes 1–3**).[6,9] In

Box 1
Normal electrocardiogram findings in the athlete (no further workup required)

Increased QRS voltage for left ventricular hypertrophy (LVH) or right ventricular hypertrophy (RVH)

Incomplete right bundle branch block (RBBB)

Early repolarization/ST segment elevation

ST elevation followed by T-wave inversion V1–V4 in black athletes

T-wave inversion V1–V3 age less than 16 years old

Sinus bradycardia or arrhythmia

Ectopic atrial or junctional rhythm

First-degree atrioventricular (AV) block

Mobitz type I second-degree AV block

Data from Drezner JA, Sharma S, Baggish A, et al. International criteria for electrocardiographic interpretation in athletes: consensus statement. Br J Sports Med 2017;51(9):704–31.