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# Sudden Cardiac Death in Athletes

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Sudden cardiac death (SCD) in a young athlete is a significant public health concern, especially for athletic trainers and sports medicine physicians. A number of high-profile athletes in the United States have suffered from SCD, including Hank Gathers and U.S. Olympic gold medalist, Flo Hyman.[1] The prevention of SCD is at the core of screening preparticipation evaluations (PPE) that are carried out all over the world. Recent studies have shown that autopsy-negative sudden unexplained death is the leading cause of SCD in young athletes, which means that electrical and ion channel diseases likely play a more prominent role in these deaths than previously considered.[2] This review presents the most common causes of SCD in athletes and how they may be managed once diagnosed.

## Key Points

- The American Heart Association recommends complete physical examinations, including a cardiac auscultation exam and review for any concerning cardiac symptoms and any family history of sudden unexplained death in relatives under age 50.
- The systematic use of history, physical, and diagnostic tools such as electrocardiogram, 2D echocardiogram, magnetic resonance imaging, and an electrophysiologic study may be necessary to detect a lethal cardiac cause of sudden cardiac death.
- However, all causes of sudden cardiac death may not be detected with a good preparticipation examination, so a solid emergency action plan and automatic external defibrillator program is important to assist in saving lives of athletes when an incident occurs.

## Nature of the Screening Process

The PPE is typically conducted in athletic training rooms at university institutions and high schools in large group sessions coordinated by the athletic trainer and attended by the team physicians.[3] The PPE monograph points out that the optimal location for the PPE is with the primary care physician who cares for the athlete, but at many institutions, to reduce the burden on college athletes, a group PPE is coordinated that includes the team physicians and staff athletic trainers. Medical personnel that complete such an exam must be proficient in cardiac auscultation, according to guidelines. A number of international guidelines on the PPE have been published. The American Heart Association (AHA) 12-element Recommendations for competitive athletes advocate a complete physical examination, including a cardiac auscultation exam and review for any concerning personal cardiac symptoms such as syncope, chest pain, shortness of breath, palpitations, and others. In addition, the AHA recommends inquiring about any family history of sudden unexplained death in relatives under age 50.[4]

## Importance of an Emergency Action Plan

Every school or institution that sponsors athletic activities needs a written and structured emergency action plan (EAP).[5] The EAP should be developed and coordinated in consultation with emergency medical services (EMS) personnel and school officials, as well as on-site first responders and the team

physicians. All personnel who cover athletic events should be familiar with the location and operation of the closest automatic external defibrillator (AED), since defibrillation is most effective within 3–5 min.[6] The AED placement should be in a location in proximity to the various athletic fields where athletic trainers cover events, or in the main athletic training room. In some cases, multiple AEDs are necessary. Regular drilling of the EAP with the medical staff is critical to seamless care being delivered in life-threatening situations. A full description of the development of an EAP is beyond the scope of this article, but the reader is referred to the literature.[5,6]

## Epidemiology of Sudden Cardiac Death

Previous thinking held that hypertrophic cardiomyopathy (HCM) was the most common cause of SCD in the under 35 age group.[7] For those over 35, coronary artery disease was most common.[8] New data are now available from recent epidemiological studies using autopsy results and National Collegiate Athletic Association (NCAA) data. One such study by Eckart et al. suggests that 30% of all unexplained cases of SCD may occur due to an arrhythmia such as ventricular tachycardia, Wolff-Parkinson-White syndrome, or channelopathies (e.g., Long QT syndrome).[2] In addition, the prevalence of HCM causing unexplained SCD was much lower in this study. Male black athletes who play basketball and football are at greatest risk for SCD based on NCAA epidemiologic data.[9] The incidence of sudden cardiac death is different based on what population is studied.[9] Table 1 compares the most common etiologies of SCD based on two respected studies.[7,10]

### Hypertrophic Cardiomyopathy

Hypertrophic cardiomyopathy (HCM), a common, autosomal dominant, inherited condition, characterized by some heterogeneity of presentation, has a prevalence of 1/500.[11] Pathological changes include anterior septal hypertrophy being more dominant than the left ventricular hypertrophy (LVH). Individuals with HCM may be asymptomatic with exercise. When premonitory symptoms are present, they may include syncope, presyncope, shortness of breath, or dizziness during or after exercise.

Physical findings such as a systolic ejection heart murmur, heard loudest at the left lower sternal border,

**Table 1 Etiology of Sudden Cardiac Death in Sport and in Young Competitive Athletes: A Comparison of Two Studies**

| Etiologies of Sudden Cardiac Death in NCAA Athletes[10] | | Sudden Deaths in Young Competitive Athletes[7] | |
|---|---|---|---|
| **Cause** | **Percentage** | **Cause** | **Percentage** |
| Sudden unexplained death | 31% | Hypertrophic cardiomyopathy | 36% |
| Coronary artery abnormality | 14% | Coronary artery anomalies | 17% |
| Myocarditis | 8% | Possible hypertrophic cardiomyopathy | 8% |
| Dilated cardiomyopathy | 8% | Myocarditis | 6% |
| Possible hypertrophic HCM/LVH | 8% | Arrhythmogenic right ventricular dysplasia | 4% |
| Aortic dissection | 8% | Ion channel channelopathies | 4% |
| Other | 6% | Mitral valve prolapse | 4% |
| Myocardial infarction | 5% | Left anterior descending bridge | 3% |
| Hypertrophic cardiomyopathy | 3% | Coronary artery disease | 3% |
| Possible HCM/LVH/Sickle cell trait | 3% | Aortic rupture | 3% |
| Channelopathy | 3% | Aortic stenosis | 3% |
| Arrhythmogenic right ventricular dysplasia | 3% | Dilated cardiomyopathy | 2% |
| | | Wolff-Parkinson-White syndrome | 2% |
| | | Other | 5% |

*Note*. NCAA = National Collegiate Athletic Association; HCM = hypertrophic cardiomyopathy; LVH = left ventricular hypertrophy.