Secondary Prevention of Sudden Death in Athletes

The Essential Role of Automated External Defibrillators

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KEYWORDS

• Sudden cardiac death • Cardiac arrest • Public access defibrillation • Emergency planning

KEY POINTS

- Sudden cardiac arrest (SCA) is the leading cause of death in exercising young athletes.
- Automated external defibrillators (AEDs) are an integral link in the "chain of survival" and their prompt use promotes higher survival rates from SCA.
- Public access defibrillation (PAD) programs shorten the time interval between SCA and shock delivery and train likely responders in cardiopulmonary resuscitation (CPR) and AED use.
- SCA should be assumed in any collapsed and unresponsive athlete.
- Prompt management of SCA, including rapid recognition of SCA, immediate initiation of chest compressions, and retrieval and use of an AED as soon as possible can be life saving for athletes with SCA.

INTRODUCTION

The sudden loss of life from cardiac arrest is a tragic event with broad reach and impact. More than 300,000 individuals die annually from sudden cardiac arrest (SCA) in the United States, and historically, the rate of survival from these events is poor.[1–5] In recent years, media coverage has focused attention on athletic cardiac arrest, in cases of both death (ie, Miklos Feher, Wes Leonard, and Hank Gathers) and survival (ie, Fabrice Muamba, Anthony Van Loo, and Jiri Fischer). Cases of SCA in athletes typically raise questions regarding proper emergency planning for such events and the role of automated external defibrillators (AEDs) at sporting venues.

The strongest determinant of survival from SCA is the time from arrest to defibrillation. Survival drops by 7% to 10% with each minute that defibrillation is delayed.[6] Several studies evaluating public access defibrillation (PAD) programs in areas of high population density have demonstrated improved survival rates from SCA.[7–10] PAD programs shorten the time between cardiac arrest and shock delivery to restore spontaneous circulation. Publicly available AEDs have been particularly helpful in areas where the emergency medical service (EMS) call-to-shock interval cannot be consistently achieved within 5 minutes of SCA.[8,9,11] This article reviews strategies for effective secondary prevention of sudden death in athletes and the critical role of AEDs.

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SUDDEN DEATH IN ATHLETES: WHAT IS THE RISK?

SCA is the leading cause of death in exercising young athletes.[12] In the United States, a minimum estimate of between 100 and 150 cases of SCA occur per year in competitive athletes.[13] Studies consistently show that 0.2% to 0.7% of competitive athletes harbor underlying cardiovascular disease associated with SCA.[14–21] Causes of sudden cardiac death (SCD) in athletes include diseases that affect the myocardium, coronary arteries, and proximal aorta, and primary electrical diseases (**Table 1**). Intense physical exercise places mechanical and metabolic stresses on the cardiovascular system and can produce lethal ventricular arrhythmias in athletes with pathologic cardiac disease. Studies demonstrated that competitive young athletes are 2.8 to 4.5 times more likely to die from SCA than age-matched peers, and more than 80% of SCD in athletes occurs in relation to physical exertion.[12,14,22]

Corrado and colleagues[23] reported the incidence of SCD in athletes aged 12 to 35 to be 3.6/100,000 athletes per year before implementation of a nationwide screening program. Within the United States, the exact incidence of SCA in young athletes is unknown. Initial estimates of SCD of 0.3 to 0.6 per 100,000 athletes per year relied heavily on media reports, catastrophic insurance claims, and other nonmandatory databases to identify cases and likely underestimate the true magnitude of the problem.[12,24,25] Defining the incidence of SCA/SCD in any population requires both the capacity to accurately identify cases and a defined study population. In recent years, several studies have used more rigorous methodology reliant on these principles to estimate the incidence of SCA in selected active populations (**Table 2**).[12,21,23–32] Using a mandatory reporting system and autopsy-based study from the Department of Defense, Eckart and colleagues[26] reported an incidence of SCD in US military personnel aged 18 to 35 of 1/25,000 persons per year. Atkins and colleagues[27] studied all cases of out-of-hospital cardiac arrest with EMS response in 11 North American cities demonstrating an SCA incidence of 3.75/100,000 for individuals aged 14 to 24. Meyer and colleagues[28] recently conducted a 30-year review of SCA in individuals younger than 35 years of age from King County, Washington, using an EMS Cardiac Arrest Database. The incidence of SCA in adolescents and young adults aged 14 to 24 was 1.44/100,000.

In US competitive athletes, the rate of SCA may be higher than in studies of the general population. Drezner and colleagues[33] reported an annual SCA incidence of 4.4/100,000 in competitive high school athletes based on a cross-sectional survey of 1710 high schools. Harmon and colleagues[29] reported on the incidence of sudden death in National Collegiate Athletic Association (NCAA) athletes between 2004 and 2008. In that 5-year period, SCD was the leading medical cause of death in collegiate athletes, accounting for 76% of cases of SCD during exertion and 16% of all-cause mortality. The annual incidence of SCD in all athletes was 2.28/100,000 athletes per year, with higher rates in males (3.0/100,000) and black athletes (5.89/100,000). Notably, the rate of

Table 1
Causes of sudden cardiac death in athletes

	Specific Cardiac Pathology
Myocardium	Hypertrophic cardiomyopathy (HCM) Arrhythmogenic right ventricular cardiomyopathy (ARVC) Dilated cardiomyopathy (DCM) Myocarditis
Coronary arteries	Anomalous origin coronary arteries Premature atherosclerosis
Primary electrical diseases	Long QT syndrome Short QT syndrome Catecholaminergic polymorphic ventricular tachycardia (CPVT) Brugada syndrome Wolff-Parkinson-White syndrome (WPW)
Proximal aorta	Marfan syndrome – aortic rupture Aortopathy associated with bicuspid aortic valve Aortic stenosis
Traumatic	Commotio cordis