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Pathologic Substrates of Sudden Cardiac Death During Sports
Cristina Basso, Elisa Carturan, Kalliopi Pilichou, Stefania Rizzo, Domenico Corrado, and Gaetano Thiene 1

Cardiovascular diseases account for 40% of all deaths in the Western countries, and nearly two-thirds of the deaths occur suddenly. Effort is a trigger with a 3-fold risk in athletes compared with nonathletes, and sports disqualification is by itself lifesaving in people with underlying concealed cardiovascular diseases. Several causes of cardiac sudden death (SD) may be identified at postmortem. The spectrum of cardiovascular substrates is wide and includes congenital and acquired diseases. In up to 20% of cases, the heart is grossly and histologically normal at autopsy. The use of molecular techniques is nowadays mandatory in cases of unexplained cardiac SD.

Primary Prevention of Sudden Death in Young Competitive Athletes by Preparticipation Screening
Domenico Corrado, Alessandro Biffi, Federico Migliore, Alessandro Zorzi, Ilaria Rigato, Barbara Bauce, Georgiane Crespi Ponta, Fernando Cardoso Bianchini, Maurizio Schiavon, Cristina Basso, and Gaetano Thiene 13

Competitive sports activity is associated with an increase in the risk of sudden cardiovascular death in adolescents and young adults with clinically silent cardiovascular disorders. Strategies for primary prevention include screening programs based on history and physical examination alone or including electrocardiogram (ECG). ECG screening is more sensitive and has a higher cost–benefit ratio than that based on history and physical examination alone. Modern criteria for athletes’ ECG interpretation significantly improves the screening accuracy by reducing the false-positive rate (increased specificity), with the important requisite of maintaining the ability to detect life-threatening heart diseases (preserved sensitivity).

Secondary Prevention of Sudden Death in Athletes: The Essential Role of Automated External Defibrillators
Ashwin L. Rao, Irfan M. Asif, and Jonathan A. Drezner 23

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 for SCA. Public access defibrillation programs shorten the time interval between SCA and shock delivery and train likely responders in CPR and AED use. SCA should be assumed in any collapsed and unresponsive athlete. Prompt management of SCA can be life saving for athletes with SCA. This article reviews strategies for effective secondary prevention of sudden death in athletes and the critical role of AEDs.
Regular physical activity induces significant health benefits and most middle-aged/senior individuals should therefore be encouraged to increase their level of physical activity. Sporting activity may be especially beneficial because it is intense enough to increase cardiovascular, muscular, and metabolic fitness, compared with everyday physical activity. The rationale for evaluation of middle-aged/senior individuals is to ensure their safe participation in leisure-time sports, with the aim of maximizing the benefits while minimizing the risks of exercise. This article reviews the existing recommendations on evaluation of master athletes and middle-aged/senior individuals before they take part in physical activity and sports.

The reported incidence of sudden death in marathons varies widely from 0.54 to 2.1/100,000. Death in marathon runners is frequently observed in the fifth and sixth decade of life, and most deaths occur in relatively experienced runners who have participated in previous marathons. A recent study showed that runners who suffered a sudden cardiac arrest due to hypertrophic cardiomyopathy were younger and less likely to survive compared with those with coronary artery disease.

Exercise testing is an important diagnostic tool that creates an environment of automaticity at the electrical membrane, which tolerates premature beats and re-entrant arrhythmogenic circuits. Exercise testing mimics the authentic situation of physical activity and stress, recognized as a fatal trigger of critical arrhythmias in cases of underlying cardiac risk constellation. Although it is established as a second-line diagnostic tool, exercise testing can provide crucial information in an earlier setting, if there are exercise-dependent symptoms in an athlete’s history, clinical suspicion of an underlying structural or primarily electrical heart disease, or known structural or electrical disease.

Several cardiomyopathies are associated with increased risk for sudden cardiac death during exercise. Physicians are required to have updated knowledge about modalities of exercise prescription relative to the type, intensity, and frequency of exercise programs that expose patients with cardiomyopathy to the lowest risk of clinical deterioration or cardiac arrest. This article offers a comprehensive overview of the current concepts governing exercise prescription and sport participation in patients with cardiomyopathies, based on the experience and insights of experts and published guidelines. The risk of sport participation in patients with cardiomyopathies is analyzed, and the main points the physician should consider in advising exercise are summarized.
ST-Segment Elevation and Sudden Death in the Athlete

Alessandro Zorzi, Mohamed ElMaghawry, Federico Migliore, Ilaria Rigato, Cristina Basso, Gaetano Thiene, and Domenico Corrado

A minority of sudden deaths in young athletes is caused by primary electrical diseases. In the setting of preparticipation screening, appropriate differential diagnosis between physiologic and pathologic J-point/ST-segment elevation is important not only to prevent sport-related sudden deaths but also to avoid unnecessary disqualification from competition for changes that fall within the normal range for athletes. This article addresses the potential relationship between the arrhythmogenic mechanism of ST-segment elevation and the risk of sudden death during sports. In addition, the differential diagnosis between malignant ST-segment elevation and benign early repolarization associated with “athlete’s heart” is discussed.

Syncope in the Athlete

Yousef H. Bader and Mark S. Link

Syncope during sports is concerning because it may be secondary to nonsustained ventricular arrhythmias and a precursor of sudden cardiac death. Not all syncope is life threatening. It is important to quickly identify the cause and begin to manage these conditions. Syncope during exercise is usually concerning, whereas syncope after exertion is more often benign. Neurocardiogenic syncope and postexercise collapse usually occur after cessation of exercise and are generally benign. Persistent delirium after collapse is life threatening and generally caused by hyperthermia or hyponatremia. In the work-up of syncope the history is vital and guides further work-up and management.

Exercise-Induced Arrhythmogenic Right Ventricular Cardiomyopathy: Seek and You Will Find

Andre La Gerche and Hein Heidbuchel

Exercise-induced arrhythmogenic right ventricular cardiomyopathy refers to the clinical syndrome of electrical, structural, and functional changes in endurance athletes, which more commonly affect the right ventricle (RV) than the left ventricle. This clinical entity overlaps with familial arrhythmogenic right ventricular cardiomyopathy, with both conditions resulting in chronic RV remodeling (although more severe in some familial cases) and potentially life-threatening arrhythmias. With increasing awareness and a focus on the RV in athletes with suspicious symptoms, practitioners may be able to identify, treat, and prevent serious arrhythmic complications.

Bradyarrhythmias: How Slow Is Too Slow in the Athlete?

Ricardo Stein and Anderson Donelli da Silveira

Chronic aerobic training can lead to different morphologic and functional adaptations that are directly correlated to the type, duration, intensity, and years of practice. Sinus bradycardia is by far the most common bradyarrhythmia in the athlete and can result in extremely low heart rates at rest. Sinus arrhythmia, sinus pauses, wandering atrial pacemaker and atrioventricular delayed conduction are also more prevalent in athletes compared with the general population. Besides the contribution of the autonomic nervous system, sinus automaticity and atrioventricular node conduction changes of endurance athletes are related to intrinsic physiology. Unless associated with symptoms or with other arrhythmias, bradyarrhythmias are a benign finding in the athlete.
Prevalence and Management of Atrial Fibrillation in Middle-Aged/Older Athletes

Stefania Sacchi, Giuseppe Mascia, Luigi Di Biase, Pasquale Santangeli, John David Burkhardt, Luigi Padeletti, and Andrea Natale

Atrial fibrillation (AF) is the most common arrhythmia in the athletic community. Many studies have shown that the prevalence of AF is higher in athletes who are involved in long-term sports participation compared to the general population of the same age, and AF is more frequently observed in middle-aged than in young athletes. Sports activity may represent a facilitating factor anticipating the AF onset but does not represent the cause of AF. Catheter ablation is a particularly attractive option for athletes with AF.

Implantable Cardioverter-Defibrillator Therapy in Athletes

Mohamed ElMaghawry, Federico Migliore, Alessandro Zorzi, Barbara Bauce, Loira Leoni, Emanuele Bertaglia, Sabino Iliceto, and Domenico Corrado

Although sports participation improves quality of life and lowers cardiovascular risk, sport may represent a hazard for certain high-risk groups, such as young athletes with cardiovascular conditions necessitating an implantable cardioverter-defibrillator (ICD). There are few data weighing the risks and benefits of sports participation for patients with ICDs. Sports participants with ICDs incur the potential risk of failure of therapy, inappropriate interventions, and device injury. Severe exercise may worsen the course of the cardiovascular disease of the athlete, predisposing to more adverse clinical events. This article reviews the potential risks and recommendations for sports activity in patients with ICDs.

Erratum

An error was made in the December 2012 issue of Cardiac Electrophysiology Clinics, volume 4, number 4, on page 645. One of the authors of “Infra-Hisian Atrioventricular Block” was incorrectly listed as Ryan Foley. The author’s correct name is T. Raymond Foley.