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Updated Recommendations for Athletes with Heart Disease

Rachel Lampert[1] and Douglas P. Zipes[2]

[1]School of Medicine, Yale University, New Haven, Connecticut 06520; email: rachel.lampert@yale.edu

[2]Krannert Institute of Cardiology, School of Medicine, Indiana University, Indianapolis, Indiana 46202; email: dzipes@iu.edu

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Abstract

Professional society recommendations to decrease sudden cardiac death in athletes, including eligibility requirements with disqualification for athletes with diagnosed disease as well as preparticipation screening and emergency preparedness, were updated in 2015. The update includes new sections on aortic disease, channelopathies, and sickle cell trait, as well as a change in format from the previous binary yes/no format to the more nuanced and contemporary "class and level of evidence" format. Eighty-four of the 246 recommendations now carry Class II designation—"reasonable," or "may be considered." New language in the document emphasizes counseling as part of the decision process. New data on athletes with implantable cardioverter-defibrillators, and on those with long QT syndrome, have led to a change from blanket restriction of competitive sports participation to a Class IIB "may be considered" recommendation.

INTRODUCTION

Sudden death in a young athlete remains a rare but tragic occurrence, occurring in 1–2 per 100,000 athletes per year (1). Although the death of any young person is heartbreaking, deaths of athletes, who seem not just healthy but in the absolute peak of health, often appear in the media and thus can impact the community as a whole. Cardiovascular death accounts for about half of sudden deaths in young athletes (2, 3). Efforts to decrease sudden cardiac arrest (SCA) include preparticipation screening of athletes, with either history and physical exam alone or (in some schools and organizations) with the addition of electrocardiogram (ECG), to identify those with occult but potentially lethal cardiovascular disease; emergency preparedness to improve survival if SCA occurs; and finally, appropriate treatment, counseling, and for some cardiovascular diseases, disqualification from continued sports participation following diagnosis. However, because sports participation carries numerous benefits to physical and emotional health, avoidance of unnecessary restriction is also a key component in the decision around return to play for the athlete diagnosed with a cardiac condition.

RECOMMENDATIONS

In order to further these goals, professional societies have come together to publish recommendations in each of these domains. In 2015, the American Heart Association (AHA) and American College of Cardiology (ACC) published an update to the ACC's 2005 "Eligibility Recommendations for Competitive Athletes with Cardiovascular Abnormalities" (4), titled "Eligibility and Disqualification Recommendations for Competitive Athletes with Cardiovascular Abnormalities" (5). This new encyclopedic compendium (see **Table 1**), addressing the broad range of heart disease, shares the goals of prior documents—"to present consensus recommendations addressing criteria for eligibility and disqualification from organized competitive sports, for the purpose of ensuring the health and safety of young athletes" (5, p. e256).

Several factors drove the recent update. As understanding of SCA in athletes has increased, new disease entities have been described, and others have become less relevant. Also, the increased survival, with good functional status, of children with congenital heart disease has led to an increased number of young people for whom sports participation with a cardiovascular condition is an important question. Finally, children and young people receive cardiac devices in increasing numbers and wish to participate in competitive sports (5). These trends have led to the inclusion of several new sections, including Task Force chapters on aortic disease, channelopathies, and sickle cell trait (SCT), as well as expansions of the recommendations for congenital heart disease and other conditions. Also important is the increasing recognition of the "chain of survival" for SCA (6), emphasizing the importance of emergency preparedness, which appears now as a full Task Force chapter.

In addition to the inclusion of new and expanded chapters, the updated recommendations differ from the prior recommendations in several important ways. First, as described in more detail below, whereas the prior recommendations were based almost entirely on expert opinion, in the intervening years, empiric data have emerged demonstrating that sports participation may be safer for athletes with some cardiovascular diseases than experts had previously hypothesized. It is important to note, however, that most recommendations do continue to be based on expert opinion alone ("level of evidence C") (7), as there remains a paucity of data on safety of sports for the diagnosed and treated athlete with most cardiac diseases. Although occult cardiac disease in an athlete can be lethal, the extent to which risk assessment and appropriate treatment may mitigate risk has been evaluated for very few conditions. The few "level of evidence A" recommendations

Table 1 Overview of Task Force chapters, entities, and number of recommendations in the 2015 AHA/ACC eligibility and disqualification recommendations for competitive athletes with cardiovascular abnormalities (5)

Task Force	Entity	Number of Recommendations	
		Total	Class II
1. Classification of Sports: Dynamic, Static and Impact (10)	Classification	NA	NA
	Impact and anticoagulation	2	1
2. Preparticipation Screening for Cardiovascular Disease in Competitive Athletes (43)		5	1
3. Hypertrophic Cardiomyopathy, Arrhythmogenic Right Ventricular Cardiomyopathy and Other Cardiomyopathies, and Myocarditis (29)	Hypertrophic cardiomyopathy	4	1
	LV noncompaction	2	1
	Other myocardial diseases	1	
	Myocarditis	3	1
	Arrhythmogenic RV cardiomyopathy	4	0
	Pericarditis	1	0
4. Congenital Heart Disease (28)	ASD, untreated	4	0
	ASD, after repair	2	1
	VSD, untreated	2	1
	VSD, after repair	4	0
	PDA, untreated	3	0
	PDA, after repair	2	0
	Pulmonic valve stenosis (treated and untreated)	4	2
	Aortic valve stenosis, untreated	4	1
	Aortic valve stenosis, after correction	2	1
	Coarctation of aorta, untreated	2	1
	Coarctation of aorta, treated	2	2
	Elevated pulmonary vascular resistance	2	0
	Ventricular dysfunction after CHD surgery	4	1
	Cyanotic CHD, including TOF, unoperated or shunt	2	1
	Post-operative TOF	3	1
	Transposition, after switch	4	2
	Congenitally corrected transposition	5	3
	TGA, after arterial switch	4	2
	Fontan	3	1
	Ebstein anomaly	2	2
	Coronary anomalies	6	3
5. Valvular Heart Disease (44)	Aortic stenosis	5	2
	Aortic regurgitation	7	3
	Mitral stenosis	5	1
	Mitral regurgitation	7	2
	Post valve surgery	4	4

(*Continued*)

Table 1 (*Continued*)

Task Force	Entity	Number of Recommendations	
		Total	Class II
6. Hypertension (45)	Hypertension	6	4
7. Aortic Diseases, Including Marfan Syndrome (27)	Marfan, other genetic, bicuspid, dilated, dissection, post-operative	17	8
8. Coronary Artery Disease (38)	Atherosclerotic disease	8	4
	Coronary spasm	2	2
	Coronary dissection	1	1
	Myocardial bridging	3	3
	Kawasaki	6	3
	Coronary vasculitis	2	1
	Transplant vasculopathy	3	2
9. Arrhythmias and Conduction Defects (12)	Sinus bradycardia	2	0
	AV block, first degree	3	0
	AV block, second degree type I	4	0
	AV block, second degree type II	2	1
	Complete RBBB	1	0
	Complete LBBB	3	0
	Congenital AV block	3	0
	Acquired complete heart block	3	0
	Permanent pacemaker	4	0
	Atrial fibrillation	4	2
	Atrial flutter	3	1
	AVNRT, AVRT, atrial tachycardia	4	1
	Premature ventricular contractions	4	1
	Nonsustained VT	3	0
	Sustained monomorphic VT	3	0
	Ventricular flutter, fibrillation, polymorphic VT	2	0
	Syncope	5	0
	ICDs	5	2
10. The Cardiac Channelopathies (11)	Long QT, Brugada, CPVT	6	3
11. Drugs and Performance Enhancing Substances (46)	NA	5	0
12. Emergency Action Plans, Resuscitation, Cardiopulmonary Resuscitation, and Automated External Defibrillators (18)	NA	4	0
13. Commotio Cordis (41)	Commotio cordis	5	3
14. Sickle Cell Trait (40)	Sickle cell trait	4	0

(*Continued*)

Table 1 (*Continued*)

Task Force	Entity	Number of Recommendations	
		Total	Class II
15. Legal Aspects of Medical Eligibility and Disqualification Recommendations (47)	NA	NA	NA

Abbreviations: ACC, American College of Cardiology; AHA, American Heart Association; ASD, atrial septal defect; AV, atrioventricular; AVNRT, atrioventricular nodal re-entrant tachycardia; AVRT, atrioventricular re-entrant tachycardia; CHD, congenital heart disease; CPVT, catecholaminergic polymorphic ventricular tachycardia; ICD, implantable cardioverter-defibrillator; LBBB, left bundle branch block; LV, left ventricular; NA, not applicable; PDA, patent ductus arteriosis; RBBB, right bundle branch block; RV, right ventricular; TGA, transposition of the great arteries; TOF, tetralogy of Fallot; VSD, ventricular septal defect; VT, ventricular tachycardia.

address areas of general disease management, such as use of statins in coronary artery disease (CAD) or therapeutic hypothermia and implantable cardioverter-defibrillator (ICD) after cardiac arrest.

Among the most dramatic differences in the new document is the formatting of the recommendations. Prior recommendations utilized a "yes or no" approach to competitive sports eligibility. The current document has replaced this binary approach with the more nuanced approach now used universally in cardiology professional society guidelines statements, which recognizes different classes of recommendations and levels of evidence underlying them. Items in Class I are "recommended," those in Class IIA and IIB are "reasonable" and "may be considered," and those in Class III are "not recommended." The importance of guidelines was recognized by the ACC and AHA in the 1980s to clarify indications for interventions, to facilitate translation of data into practice, and to improve quality of care. The use of the more nuanced system of three classes began around 2000, with the recognition that evidence can conflict and opinions can diverge (7).

While the prior yes/no binary recommendations encouraged a paternalistic approach to decision making, the current graded recommendations encourage shared decision making, particularly for Class II recommendations, which make up 84 of the 246 recommendations in the updated document. The shared decision-making model, termed the "pinnacle of patient-centered care" (8, 9), simultaneously acknowledges the inherent limitations of paternalistic decision making and recognizes the fundamental role of the physician in guiding patient care decisions. This model may be most relevant when risks and benefits of the options are least certain. Situations in which return to competitive play "may be reasonable" or "may be considered" demand that the physician explain the data concerning the risks and benefits of the available options, including the limitations of the data, and help the patient understand how the options may fit into his/her own preferences and values. Although the current recommendations document does not explicitly use the phrase "shared decision making," the incorporation of Class II recommendations necessitates that physicians engage in this process with their patients. Language used for the first time in the new document also encourages shared decision making more explicitly, with numerous references to the "counseling of the athlete" and the acknowledgment that "there will always be tolerance in the system for flexibility and individual responsibility and choice, after the prevalent uncertainties have been acknowledged" (5, p. e259).

CLASSIFICATION OF SPORTS

Key to understanding many of the recommendations is understanding the classification of individual sports based on their strength component, expressed as relative intensity of static muscle

contractions, and endurance component, reflected by percentage of maximal aerobic power (VO2max) as outlined in Task Force 1 (10). Static and dynamic exercise have differing hemodynamic impacts, as reflected by the differences in cardiac adaptation to the two components. Specific cardiac conditions may be more susceptible to the physiological stress imposed by the different forms of exercise. Class IA activities (hereafter IA) are those with the lowest static and dynamic stress, such as golf and bowling. It is also important to note, however, that understanding of sports physiology has advanced since 2005, with now-recognized modulators of load including not only the specific sport but also the position played, the intensity and timing of training, and environmental conditions such as temperature and altitude.

CHANNELOPATHIES

Recommendations regarding return to play have changed dramatically in two areas: the athlete with a diagnosed cardiac channelopathy, appearing in Task Force 10 (11)—the first time these entities have been addressed in a separate chapter—and the athlete treated with an ICD, as described in Task Force 9 on arrhythmias and conduction defects (12).

In 2005, athletes with the long QT syndrome (LQTS), the most common channelopathy, were restricted to IA activities, as were those with any other channelopathy (with the possible exception of LQT3). Since then, however, two retrospective series of athletes who were diagnosed with LQTS, but who continued to participate in sports after appropriate treatment, have been published. The first described 130 athletes, including 60 with a history of symptoms or phenotypic expression of LQTS and 20 with ICDs. There was only one arrhythmic event, and that occurred in a boy already known to be at higher risk, who had an ICD and who additionally had not been taking prescribed beta-blockers (13). A second series described 103 children with LQTS participating in competitive or recreational sports with no arrhythmias (14). Based on these data, sports participation for athletes with LQTS now carries a Class IIB recommendation, "may be considered."

There are important caveats to this recommendation. Most importantly, these studies suggest that appropriate treatment with beta-blockade, cardiac sympathectomy, or ICD can decrease the risk conferred by exercise in undiagnosed and untreated LQTS. The studies also confirm that adequate treatment is imperative, and the clinician must have appropriate expertise in treating heart rhythm disorders or have the input of a specialist in genetic cardiology. Precautions also need to be in place, including avoidance of arrhythmogenic factors such as relevant drugs, dehydration, and hyperthermia; a personal automated external defibrillator (AED) is also recommended. For athletes with other channelopathies, recommendations and precautions are analogous, with the exception of catecholaminergic polymorphic ventricular tachycardia (VT). Although one very small series describes athletes with catecholaminergic polymorphic VT participating in sports (15), participation in sports beyond IA is not recommended because of the highly arrhythmic effect of catecholamines in this disease, the potential for breakthrough on beta-blockers, and reported inefficacy of ICDs due to incessant VT (16, 17).

The channelopathy recommendations highlight two important themes in the document. First, informing and counseling the athlete and family is an explicit directive, as described above. Second, establishment of an emergency action plan is a key component of the required precautionary measures. Emergency preparedness is now also the focus of a new, dedicated chapter, Task Force 12 (18). With appropriate programs, survival of SCA in student athletes can be as high as 89% (19). These plans include anticipation of events, as well as education of coaches and trainers to recognize SCA, perform cardiopulmonary resuscitation, and deploy an AED. Appropriate placement of AEDs is critical; the goal is availability within 5 min to a potential SCA victim in all settings, including training as well as competition. Also essential is appropriate training in the use

and maintenance of AEDs. Identification of facilities with appropriate SCA care, including hypothermia for transfer, is also key—one of the few recommendations in the document supported by "level of evidence A" (18). Recent guidance from the National Collegiate Athletic Association also emphasizes emergency preparedness, which requires multidisciplinary coordination (20).

IMPLANTABLE CARDIOVERTER-DEFIBRILLATORS

The other important change from prohibition of competitive sports participation (more intense than IA) in 2005 to "may be considered" in 2015 is for the athlete with an ICD, as described in Task Force 9 (12). Hypothesized dangers of sports for a patient with an ICD, as enumerated in 2005, included an increase in risk of arrhythmia, with an unknown efficacy of the ICD in the changing autonomic and metabolic milieu of competitive, vigorous activity, as well as injury to the athlete due to loss of control from an arrhythmia and/or ICD shock, and possibility of damage to the ICD system. Based on these unknowns, in 2005, "The ICD [could] not be regarded as protective." Since that time, however, prospectively collected data have been published on a large series of athletes who continued to compete after receiving an ICD.

In the initial report of the ICD Sports Registry, published in 2013 (21), 372 athletes competed in organized and/or dangerous sports, for a median follow-up time of 2.5 years. Although many did receive shocks, both appropriate and inappropriate, during competition, as well as during other physical activity and at rest, there were no incidences of any of the primary endpoints—no death or resuscitated arrest due to failure of the ICD, and no significant injury. Most athletes who received shocks during sports resumed their sports afterward, suggesting that the benefit of sports participation for their quality of life outweighed the negative psychological impacts of the shock. Longer-term data were recently published, now on 440 athletes with close to 4 years of follow-up, with similar results (22). Based on these data, return to play, even for sports of greater-than-IA intensity, may now be considered for the ICD patient. Again, counseling of the athlete and family is critical, including information about the data and their limitations, as well as the possibility of shocks during sports. It is important to note that the indications for the ICD are the same for athletes as for other patients, and an ICD should not be implanted for the primary purpose of sports participation.

ARRHYTHMIAS

The Arrhythmia Task Force recommendations are mostly similar to prior recommendations. For most entities (premature ventricular contractions, left bundle branch block, etc.), the prognostic import and safety of continued competitive sports participation depend on the presence or absence of underlying structural heart disease (12). As understanding of athletic adaptation of the heart continues to expand, there are concomitant changes in what is considered a "normal" ECG for an athlete, and, conversely, what requires investigation for structural abnormalities. As of 2015, when the eligibility statement was published, the most current guideline for interpretation of ECG findings in the athlete was the 2013 "Seattle criteria" (23); these have since been supplanted by the 2017 "International Criteria" (24) with several minor changes (e.g., right bundle branch block is now considered a normal finding). Differentiation of athletic adaptation from pathology, with resultant imaging as well as initial ECG reading, is crucial, and evaluation by cardiologists with expertise in care of the athlete can often be helpful (25).

The approach to asymptomatic pre-excitation has also evolved since 2005, as effective risk-stratification strategies to detect and treat accessory pathways at higher risk have been demonstrated. These strategies begin with stress testing, followed by electrophysiology study if stress testing does not demonstrate loss of accessory pathway conduction (26).

AORTIC DISEASE

Aortic disease receives new emphasis and a full Task Force chapter in the current eligibility statement. Aortic dissection or rupture due to aortopathies is a significant cause of sudden death in athletes, who also may be particularly vulnerable to the hemodynamic changes of increased systolic blood pressure with exercise (27). Correct measurement of the aortic diameter is critical, and current approaches now use z scores that incorporate height, weight, age, and sex. The hemodynamic changes of intense physical exertion may increase aortic dimension, but these changes are mild, as are differences due to height. Aortic dilation in an athlete should trigger an evaluation for aortopathy. In general, athletes with aortopathy are restricted to IA (low-intensity) sports, and for those with severe dilation, aneurysm, or dissection, even IA may be prohibitively dangerous. For some conditions, such as Marfan's syndrome with low-risk features, moderate static sports "may be considered" (Class IIB). For any competing athlete with an aortic abnormality, there is a new emphasis on routine surveillance of aortic dimension every 6–12 months. For the athlete with a mildly dilated aorta, and no features of a known syndrome, sports participation remains a difficult individual choice, requiring full discussion among physicians, athletes, families, and coaches/trainers, and is given a Class IIB recommendation, "may be considered."

CONGENITAL HEART DISEASE

Congenital heart disease represents a spectrum of disorders including simple shunts, valvular malformations, cyanotic heart disease, transposition, and congenital coronary anomalies, which can be untreated or postoperative. They are covered in Task Force 4 with 65 recommendations (28). There are no empiric data on exercise or sports in individuals with congenital heart disease, so recommendations are made largely on the basis of hemodynamic findings on exercise testing and the known physiology of each disorder. The most common of these are atrial septal defect, ventricular septal defect, and patent ductus arteriosis. As long as these are hemodynamically insignificant either open or after closure, there are no restrictions, as these lesions are not associated with SCA. For these or any other lesions, the presence of pulmonary hypertension represents significant risk, and sports are restricted to IA. Less common conditions are also discussed in depth. Further research is critical to better understand the impact of sports participation for the growing population of young people now thriving many years after repaired congenital lesions.

Most athletes with a diagnosed anomalous origin of a coronary artery will undergo repair and should be restricted from sports pending surgery. At three months postoperative, most can return to full activity, unless there have been sequelae such as infarction or LV dysfunction. An anomalous right coronary from the left sinus of Valsalva does not always undergo repair. For the unrepaired athlete, competition can be considered after a negative stress test, although the importance of counseling is again stressed, given the uncertain accuracy of the test.

CARDIOMYOPATHIES

Recommendations for cardiomyopathies, the subject of Task Force 3, remain largely unchanged (29). Some (3), though not all (30, 31), series have shown hypertrophic cardiomyopathy (HCM), the most common genetic cardiomyopathy, to be the most common cause of SCA in athletes. Because some series suggest that most deaths in athletes found on autopsy to have HCM occur with exercise (32), participation in sports beyond IA is "not recommended" (Class III) for HCM patients. Once an individual is diagnosed with HCM, risk-stratification algorithms can identify those at highest risk, and ICDs are effective at treating arrhythmias (33); the current mortality

rates in diagnosed, risk-stratified, and treated HCM patients is only 0.5% per year (34). Risk stratification is imperfect, however, and those without identified risk can also die suddenly, although the risk appears to be very low. Whether exercise increases risk of SCA in an HCM patient who has been diagnosed, risk stratified, and appropriately treated is an avenue of ongoing research (Exercise in Genetic Cardiovascular Disease, **http://livehcm.org/**). An exception to the exclusion from exercise is the athlete who is found to be genotype positive but has no phenotypic expression of HCM demonstrated on ECG or cardiac magnetic resonance imaging. This population is increasing as the strategy of family cascade screening (35) gains acceptance. The risk for SCA in these individuals is low (36), and participation in sports for these individuals is felt "reasonable" (Class IIA), particularly in the absence of a family history of HCM-related sudden death. The approach to the athlete with HCM and an ICD is not addressed in Task Force 3, but the reader is directed to Task Force 9, in which sports participation for ICD patients "may be considered." In the ICD Sports Registry, the 75 athletes with HCM showed no adverse events, including death, cardiac arrest, injury, or multiple shocks with exercise (21, 22).

Arrhythmogenic right ventricular cardiomyopathy is one of the few disease entities for which increasing data demonstrate danger with vigorous exercise. Sports participation accelerates progression of the disease, as well as triggering arrhythmias (37), which can require multiple shocks for termination (22). Sports participation for the athlete with definitive, borderline, or even possible arrhythmogenic right ventricular cardiomyopathy is "not recommended," Class III (with possible exceptions for IA sports).

CORONARY ARTERY DISEASE

Coronary artery disease (CAD), discussed in Task Force 8 (38), is the most common cause of SCA in athletes over 30 years old (39). For the athlete with diagnosed CAD, recommendations focus on standard disease management and careful evaluation of residual ischemia after myocardial infarction and/or revascularization, as well as evaluation of "clinically concealed" CAD such as that demonstrated on coronary computed tomography calcium scoring. Here, as elsewhere in the document, there is an important emphasis on stress testing using customized protocols that simulate the cardiac and metabolic demands of the specific sport and training in which the athlete engages.

SICKLE CELL TRAIT

Another important new section is Task Force 14, addressing sickle cell trait (SCT), (40), which was not addressed in prior recommendations. Present in 8% of black Americans, SCT can be a cause of death during training and competition in athletes. Known precipitating factors include training at high temperatures or high altitudes, particularly after deconditioning. Unlike other causes of SCA, in which loss of consciousness is immediate, death due to SCT has a distinctive prodrome, including cramping, dyspnea, and muscle pain and weakness. Identified SCT thus represents a rare opportunity to put precautionary measures in place to increase safety while allowing continued sports participation without disqualification. Recommendations, all Class I, are preventive: hydration and rest, awareness of acute medical strategies for an emerging event, and caution in high temperatures or altitudes.

COMMOTIO CORDIS

Commotio cordis—ventricular fibrillation due to a chest blow during a vulnerable period—is addressed in Task Force 13 (41). Commotio cordis remains an important cause of sudden death

in athletes, although it is encouraging that survival has increased from 15% in 2002 to >50% in recent years (42), likely due to improvements in resuscitation. Recommendations remain largely similar to those of 2005, including emergency preparedness, evaluation of survivors for underlying heart disease, and protective mechanisms, including safety baseballs and rules for sports to decrease chest blows. There remains a paucity of data on safety of return to play; in 2005, individual clinical judgment was recommended. At this time, recommendations are somewhat more reassuring. The possibility of individual susceptibility to commotio cordis is raised, and avoidance of further sports with likelihood of chest blows mentioned, but, "If no cardiac abnormality is identified, then individuals can safely resume training and competition after resuscitation from commotio cordis, Class IIa" (41, p. e341).

SUMMARY POINTS

1. The updated American Heart Association (AHA)/American College of Cardiology's (ACC) Eligibility and Disqualification Recommendations for Competitive Athletes with Cardiovascular Abnormalities (5) provides a comprehensive and in-depth reference for the practitioner caring for athletes with cardiovascular disease. The overarching goal is to maximize safety while minimizing unnecessary restrictions. Crucial data continue to emerge to guide decisions.
2. Decision making around return to sports for athletes with heart disease requires discussion among all involved—athlete, often family, cardiologist, often team physician, and school or sporting organization, based on professional society guidelines. The goal is safe participation as often as possible without unnecessary restriction.
3. The type of sport may influence risk based on pathophysiology of the underlying cardiac disease.
4. Prospective data demonstrate that competitive sports may be safer than hypothesized for many athletes with implantable cardiac defibrillators (ICDs), and presence of an ICD now has received a Class II (may be considered) recommendation.
5. Data have also demonstrated that competitive sports may be safe for many patients with the long QT syndrome (LQTS) and other channelopathies, provided efficacy of treatment has been demonstrated, appropriate precautionary measures are in place, and counselling of the athlete (and family) has occurred.
6. Sickle cell trait is an important contributor to death in athletes. Education of the athlete and sports personnel regarding appropriate precautions and recognition of prodromal symptoms is critical for safe sports participation for athletes with this disorder.
7. Aortic disease is also an important contributor to death in athletes. Appropriate measurement technique is key for diagnosis, as well as avoidance of unnecessary restriction.
8. Emergency preparedness is critical for survival of the athlete with sudden cardiac arrest.

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13. Retrospective series of athletes with long QT syndrome, no adverse events. First to describe "shared decision making" for athletes with heart disease.

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