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# Preparticipation Athletic Screening Including an Electrocardiogram: An Unproven Strategy for Prevention of Sudden Cardiac Death in the Athlete

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**Abstract** One of the fundamental principles of evidence-based medicine is that clinical practice should be based on evidence derived from sufficiently robust data to ensure that the benefits, risks, and costs of an intervention are known. Although intuitively appealing, athletic screening programs with routine electrocardiograms (ECGs) followed by restriction of at-risk individuals have not been demonstrated to be effective in decreasing the inherent risk of athletic sudden death. The incremental use of a screening ECG to a history and physical examination remains debatable because of insufficient evidence to conclusively resolve the issue. Long-term outcomes with a large group of athletes undergoing screening and restriction are limited to a small number of observational trials. One supports and many do not support ECG screening with athletic restriction of at-risk athletes. Although programs and policies to decrease sudden death are laudable, they need further evaluation before being implemented on a large-scale basis. Currently, athletes are best protected by a strategy of secondary prevention with improvements in resuscitation and emergency action plans. (Prog Cardiovasc Dis 2012;54:451-454)


*Keywords:* Screening; Athletes; Sudden cardiac death; Resuscitation

## Case report

A 17-year-old asymptomatic male hockey player had athletic preparticipation screening with an unremarkable history and examination. His electrocardiogram (ECG), included as part of routine screening, demonstrated an incomplete right bundle-brunch block (RBBB) with secondary repolarization changes. He was referred by the team doctor, a family medicine physician, to a local cardiologist who performed another history, examination, and ECG. An echocardiogram performed showed borderline right ventricular enlargement and no other diagnostic abnormalities. The cardiologist consulted with a local electrophysiologist who recommended a signal-averaged ECG (SAECG) and cardiac magnetic resonance imaging (MRI) with gadolinium to exclude arrhythmogenic right ventricular dysplasia/cardiomyopathy. The SAECG was positive by 2 criteria, and the MRI was normal. Referral was then made to a regional referral center for arrhythmogenic right ventricular dysplasia/cardiomyopathy because the local cardiologist was uncomfortable providing clearance for athletic participation. The referral center electrophysiologist found an unremarkable history and examination. The previously performed echo was reviewed by an experienced echocardiographer and was determined to show right ventricular enlargement consistent with an athletic heart and no other abnormalities. The previously performed MRI was reviewed by an imaging cardiologist, and its results were determined to be normal. A stress test was done, and the hockey player exercises for 19 minutes

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**Abbreviations and Acronyms**

**ECG** = electrocardiogram

**SAECG** = signal-averaged ECG

**SCD** = sudden cardiac death

before stopping due to fatigue with persistence of the incomplete RBBB. The blood pressure and heart rate trends were appropriate with no abnormal findings. The initial SAECG was determined to be technically inadequate due to high noise levels and was repeated. It remained abnormal by 2 criteria. The SAECG was considered to be a false-positive result because of the incomplete RBBB. Because the athlete had no symptoms, no concerning history, and no diagnostic findings of any cardiac abnormality, clearance for athletic participation was given by the referral center electrophysiologist 6 weeks after the initial screening ECG.

Sudden cardiac deaths (SCDs) in young athletes assume a high public profile because of their particularly tragic nature and the general perception that athletes represent the healthiest segment of society.[1-4] These events also bring to the forefront the ongoing debate regarding inclusion of the ECG in the screening of athletes.[5-11] With the reported decrease in incidence of athletic sudden deaths in Italy attributed to ECG screening and athletic restriction, multiple countries and organizations including the International Olympic Committee have mandated preparticipation screening that includes a baseline ECG.[12-16] The intent of this strategy is to detect cardiovascular conditions that predispose to sudden death and then to restrict athletes from competitive sports to reduce sudden athletic deaths.[12-16]

Recent observational data with inclusion of ECGs in athletic screening in multiple countries have not reproduced the Italian experience.[11,17] These studies undermine 2 fundamental premises of the Italian strategy. The first premise is that inclusion of the ECG in athletic screening has benefit in identifying cardiac conditions that predispose to SCD. The second is that athletic restriction of at-risk individuals saves lives. Whether the inclusion of an ECG in the screening process provides incremental value to a history and physical examination alone remains uncertain by the standards of evidence-based medicine.[18,19] Athletic restriction also has not been subject to evaluation by robust studies to ensure that such an approach improves outcomes.[18,19] Based on the absence of proof of these tenets of the Italian program and other epidemiologic, ethical, and evidence considerations, the most reasoned approach currently is improving the available evidence by robustly evaluating the risks, costs, and benefits of the strategy of athletic screening with a routine ECG while advancing proven secondary prevention measures.[19-23]

Although the underlying causes of sudden death in the athlete are known, the frequency with which athletic deaths occur remains to be precisely defined by sex, age, race, nationality, and sport.[19,24-31] In the United States and many countries, the incidence is derived from media reports and estimated participation rates.[19,24-31] Fundamental issues such as lack of standard definitions of a competitive athlete, athletic, and sudden death exist.[19,24-31] Lack of mandatory reporting requirements for SCD also hinders accurate assessment of the true incidence in the athletic and nonathletic populations.[19] Accurate incidence and prevalence data are essential for assessing the efficacy of strategies for primary prevention thorough preparticipation screening as well as secondary prevention with emergency response systems. This lack of precision makes it impossible to know if athletic participation actually increases the risk of SCD.[19,24-31] Thus, the evidence that the risk of sudden death in young athletes is higher than in nonathletes has significant limitations.[19]

The only comparative data supporting the increased risk of SCD in athletes come from the Italian reports in which the risk of SCD in athletes was higher than that in nonathletes (2.3 vs 0.9 in 100,000 per year).[12-14] Multiple recent observations indicate that the risk of sudden death in the athletic population may not be as high as was used for the baseline rate in the Italian screening program.[10,11,17,19] Registry data from a consortium evaluating the epidemiology and outcomes from cardiac arrest in children indicate that the general nonathlete population may have a similar or even higher risk of sudden death compared with athletes.[26] Overall, the annual risk of cardiac arrest in all children younger than 19 years is 8/100,000 person year.[26,30] Using these estimates and 2009 US census data that the US population younger than 19 years is approximately 79 million, there are between 3000 and 5000 SCDs annually in this age group.[30] The best available data indicate that the total number of athletic deaths annually is up to 150 in the United States.[30] Of the estimated 3000 to 5000 SCDs in the youth population each year in the United States, approximately 150 are associated with athletic participation.[19,27] Advancing a strategy of inclusion of ECG athletic screening without accurate data on this essential information would be unwise. Furthermore, it would be impossible to assess the impact of this screening strategy on SCD outcomes without high-quality baseline and follow-up incidence data.

The lack of data regarding the rates of sudden death in the athlete vs nonathlete highlights multiple important yet unresolved ethical questions. Fundamental to the Italian screening program is the belief that athletes represent a special subset of the general population who are at higher risk for sudden death.[12-14,19] Accordingly, a higher priority is assigned to the detection of cardiovascular disease in athletes compared with nonathletes.[12-14,19] Whether it is acceptable to selectively screen athletes for cardiovascular conditions that predispose to sudden death without broader, more inclusive screening of nonathlete youth remains unresolved. Some countries have taken the approach of ECG-inclusive screening in all adolescents.[7,10-14,16,19,32] This approach has also not been demonstrated to prevent sudden deaths on or off the athletic field.[19,32]