

Preparticipation Screening of Young Athletes: Why Still Open Questions on Performing an Electrocardiogram?

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Abstract

Sudden cardiac death of a young athlete has a tremendous impact on the public attentiveness and the medical community as well, because it is hardly acceptable that trained and healthy individuals might die suddenly. Over the last years, questions have arisen on whether this occurrence could be prevented by a proper medical screening. This article deals with some aspects of ECG-implementation in preparticipation screening protocols.

Sudden cardiac death (SCD) of a young athlete has a tremendous impact on the public attentiveness and the medical community as well, because it is hardly acceptable that a 'trained and healthy' individual might die suddenly. Over the last years, questions have arisen on whether this occurrence could be prevented by a proper medical screening [1,2].

We read with interest the article recently published by Carissa M. Baker-Smith and Sudhir Vashist in the *Journal* [3]. The authors deal with the most common causes and mechanisms of this dramatic occurrence in the pediatric population, and report annual rates of 0.6 to 7.5 (mean 1.7) cases of SCD per 100,000 person-years (hereinafter, risk rate values refer to 100,000 person-years).

Historical knowledge of SCD in a young athlete dates back in 490 BC, when a marathon runner was announcing the Greek victory over the Persians. Despite the rarity of this event, eligibility of athletes with potentially lethal cardiovascular disease is still debated [1,2,4-7].

Even though expensive high-tech is overrunning our clinical practice, open controversies are still centered upon the additional value of resting 12-lead ECG as a framework of the preparticipation screening program (PSP). Time-honored clinical experience supports both physical examination and medical history to be performed in each athlete before competitions [1,2,7]. On the other hand, daily clinical practice demonstrates their challenging value in most cases.

Is it Possible to Establish the True Incidence of SCD in Wide Athletes' Populations?

Several studies have been addressed toward establishing the incidence of SCD in young athletes' cohorts. However, both lacking databanks (i.e. newspapers, media news, national health system, database of sports' societies) and individual variables (training level, traumatic or non-traumatic competitions, doping practice), surely represent important limitations to attain statistical information that can be reproduced worldwide [7-10].

Corrado et al. [9] reported a 2.8-fold higher relative risk of SCD in athletes compared to nonathletes. Male gender has been considered an additional independent prognosticator, likely due to high-intensity training and greater prevalence of genotype-positive pathways for cardiomyopathies [1-9].

However, studies indicate that risk of SCD is not higher among competitive athletes as a whole than among non-athletes. Maron et al. [1] demonstrated a SCD rate of 1.0 in high-school athletes from Minnesota, which was much lower than 3.54 reported by Corrado et

al. [4,8]. Based upon these findings, US athletes are discouraged from having an ECG performed for eligibility [7].

In a large retrospective (1976-2009) web-based research from all marathon medical directories in the US, Webner et al. [10] confirmed a low occurrence of SCD (1.0 per 171,005 participants), but also reported 1.75 incidence of cardiac arrest, even if 56% of these victims were promptly resuscitated. Of interest, the last 4 miles were the most critical for athletes of older age.

Greater occurrence (2.54) was observed in Israel during a period of 12 years (1985-1997), without any relevant improvement after the ECG-inclusive PSP enact in 1997 [11].

Despite the body of literature, establishing the rate of juvenile SCD accurately is further hampered by the incapacity to obtain a reliable denominator for athletic population more or less at risk of non-traumatic cardiac events. Given that comprehensive medical registries of sudden cardiac arrests are unavailable in the majority of Countries, it is likely that a consistent number of events had been missed by media when occurring in non-professional athletes or during recreational activities, out of the public domain and records [11-14].

The Role of ECG in the Decision Making

To date, the European Society of Cardiology and the International Olympic Committee recommend the ECG to be included in the PSP and periodically over training [2,15], whereas the American Heart Association just confines screening to personal history and physical examination [7].

The clinical value of ECG was first demonstrated by Corrado et al. [2,4] through a famous observational study in the Veneto Region (Italy) where the occurrence of SCD was significantly reduced thanks to the

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Italian PSP (from 3.6 to 0.4). Protocols like this are now performed in Japan, France, Israel and other Countries.

The difficulties in feasibility and liability issues for recommending ECG need to be acknowledged but must be dealt with within those national health systems. On ethical grounds, the reasons not to screen young athletes with an ECG should be clearly declared by the Medical Societies and/or Health Ministries. In fact, ECG has been demonstrated to be cost-effective in the general population for silent cardiomyopathies (hypertrophic cardiomyopathy, arrhythmogenic right ventricular dysplasia) and electrical diseases like channelopathies, pre-excitation WPW, Brugada pattern, and the more recent early repolarization pattern [16], which are main causes of SCD even among athletes. As a result, SCD related to hypertrophic cardiomyopathy now accounts for 2% of total deaths in Italy vs 36% in the US [1,4,5,8].

In the Veneto Region study [4,8] the most important advantage of ECG was demonstrated for cardiomyopathies, whereas it was poor for other diseases (coronary atherosclerosis or congenital anomalies, cardiac valve diseases, myocarditis, etc), which still remain a diagnostic challenge.

Therefore, physicians should not pretend the ECG to provide more information that it can (Table 1). Skilful interpretation of findings remains a mainstay into daily clinical practice, because lacking experience is potentially harmful to many athletes in case of either false positive or false negative test results [5,12,13].

Especially in athletes suspected to have hypertrophic cardiomyopathy [17,18], the ECG identifies those who should undergo further testing (cardiac ultrasound, magnetic resonance imaging, cardiopulmonary, detraining counter-evidence, others) to validate the diagnosis. In fact, according 2011 American Heart Association and American College of Cardiology guidelines on Hypertrophic Cardiomyopathy ECG is in Class I, level of evidence C [19].

Economic Bias

One of the most recurring reasons against the extensive use of ECG is its high cost-effectiveness. It cannot be denied that Medicare costs have rapidly risen all over the world, and this significantly biases our clinical choices. Notwithstanding, some differences exist, for instance, in the rate of ICD implants, 3 to 4-fold higher in the US than in Europe. However, cost-effectiveness analyses of ICD studies confirm that this therapy is “economically attractive” compared with medical therapy [20].

The ECG is one of the oldest tools for cardiologists to make diagnosis of heart disease, but its cost dramatically varies among Countries. Average spending in the US is approximately 1,500 \$, whereas in Europe is 120 \$, often covered by the National Health Ministry. These differences (Table 2) do give explanation for counter-evidence of PSP in the US, also taking into consideration the high number of ECG (approximately 70,000) needed to recognize just one athlete likely to die suddenly.

Conclusions

The major objective of preparticipation athletic screening is detection of potentially lethal cardiovascular disease that may lead to cardiac arrest on exercise. Identification of underlying diseases becomes an important item when strategies for reducing the risk of juvenile SCD are validated by studies and warranted by Nationwide Healthcare Systems. Fortunately, the absolute risk for SCD in athletes is rather low, but it should be politically correct to get priority for public wellness rather than, for example, unnecessary military spending.

	Useful	Likely Useful
Arrhythmogenic Right Ventricular Dysplasia		•
Hypertrophic Cardiomyopathy	•	
Coronary disease		•
Coronary anomalies		•
Arrhythmias	•	
Catecholaminergic Ventricular Tachycardia		•
Short - Long QT Syndrome	•	
Brugada pattern	•	
Pre-excitation Wolff-Parkinson-White	•	
Congenital disease	•	
Aortic valve disease	•	
Mitral valve disease		•
Marfan disease		•
Dilated cardiomyopathy	•	
Myocarditis		•
Myocardial storage disease		•

Table 1: Preparticipation screening value of resting ECG.

	Medicare Public System	Private cost
USA*	NA	480-2,850
Italy	28 (covered or shared)	64-192
United Kingdom	Covered for residents	60-200
France**	18 (70% covered)	65-250
Japan	25-35 (shared)	NA

Values are US \$. Change 1.0\$ =0.78€; 1.0€ =1.28\$

* data from *New Choice Health* Medical Cost Comparison

** data from *Mutualité Française*, Fédération nationale de la Mutualité Française

Legend: NA-not available

Table 2: Spending differences for ECG testing.

Based on the aforementioned considerations, ECG implementation should be considered as a cost-effective tool, even thinking of the high number of athletes to be screened to save just one. On the other hand, would our opinion be different if that athlete were our child?

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