Resting ECG as screening tool for Sudden Cardiac Death: PRO and CON

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Abstract

During our Annual meeting of the Society for Pediatric Sports Medicine in Basel 2017 one of the highlight sessions was the PRO-CON discussion about the use of a resting ECG as screening tool to detect youth at risk for sudden cardiac death. We present the two statements of the cardiology experts that were finally not so controversial as the PRO-CON may suggest.

Well as often in medicine, it is the choice of each of you, how to deal with the situation. On one side we are taught to know and listen to the "evidence in medicine", but on the other side we so often end up in our traditional professional perspective as decision maker that is not always wrong…

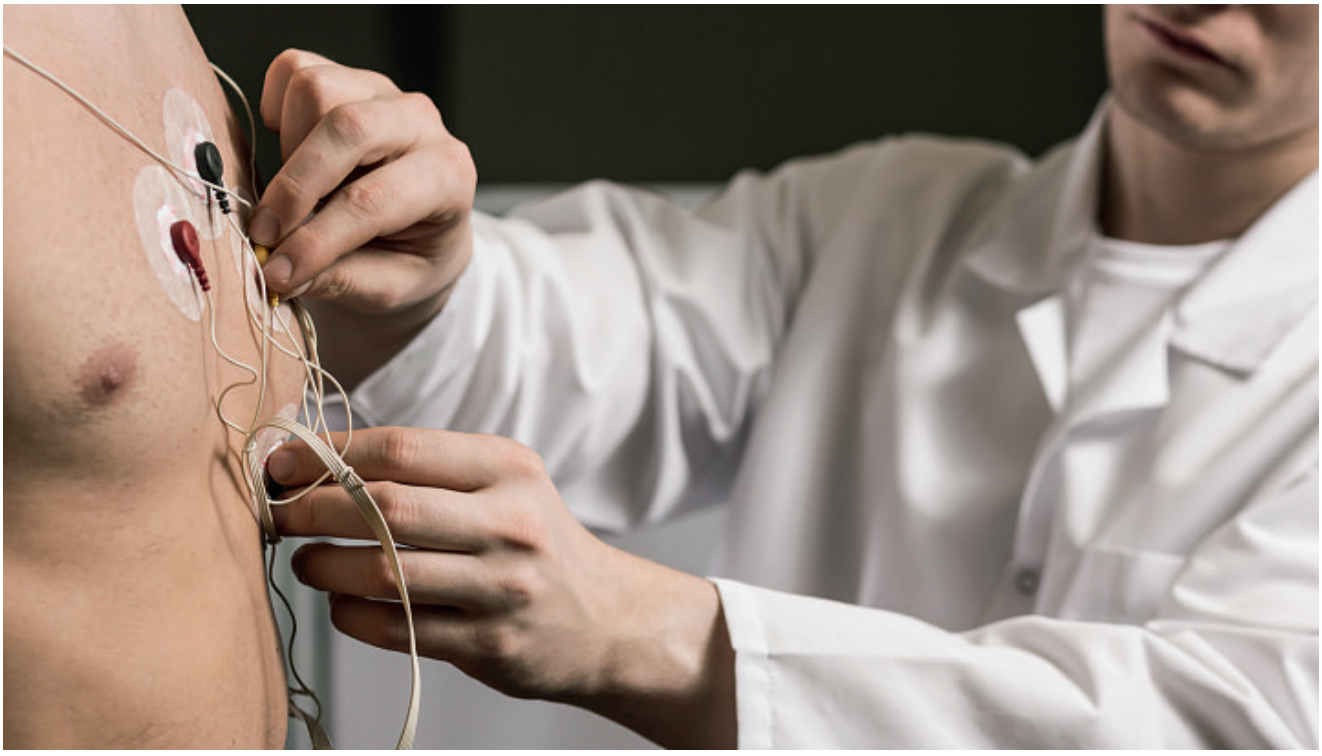
Key words: ECG, competitive exercise, screening, sudden cardiac death

Zusammenfassung

Eine der Highlight-Sessions der Jahrestagung der Gesellschaft für Pädiatrische Sportmedizin in Basel 2017 war die PRO-CON-Diskussion über den Nutzen des Ruhe-EKG zum Screening von Jugendlichen bezüglich des Risikos für einen plötzlichen Herztod beim Sport. Wir stellen die statements der kardiologischen Experten vor, die letztendlich nicht so kontrovers waren wie das PRO-CON erwarten lässt.

Wie oft in der Medizin ist es letztendlich die Entscheidung jedes Einzelnen, wie er mit der Situation umgeht. Auf der einen Seite lernen wir, dass wir uns an die «Evidenz in der Medizin» orientieren sollen, auf der anderen Seite treffen wir unsere Entscheidungen oft auch auf der Basis unserer persönlichen Erfahrungen, was nicht immer falsch ist …

Schlüsselwörter: EKG, Wettkampfsport, Screening, plötzlicher Herztod



PRO – Good gut feeling, no evidence

An electrocardiogram (ECG) provides the potential to detect cardiac conditions associated with sudden cardiac death (SCD) in asymptomatic athletes [1]. Already in 1998, Marti et al. suggested to include a single ECG in the Swiss pre-participation examination (PPE) protocol of young athletes when they have reached the age of 15 years [2]. In 2005, the Sports Cardiology Section of the European Society of Cardiology proposed a PPE algorithm prescribing an ECG every two years, starting at an age of 12–14 years [3].

This position paper was based on a single observational study of a mandatory PPE program in the Veneto region of Italy, which started in 1982 [4]. Corrado et al. demonstrated a 89% decrease of the annual incidence of SCD (from 3.6/100,000 person-years in 1979–1980 to 0.4/100,000 person-years in 2003–2004) in young, competitive athletes, while the incidence of SCD in unscreened non-athletes remained stable (0.9/100,000 person-years) [4]. Importantly, the decrease of sports-related SCD was mainly driven by a lower incidence of SCDs due to arrhythmogenic right ventricular cardiomyopathy, which is prevalent in this region [1]. This observation has not been replicated in other countries after their implementation of a PPE program, including Switzerland [5,6]. There are several explanations for these inconsistent results. Most importantly, the most common causes of SCD in athletes show regional differences (e. g. hypertrophic cardiomyopathy [7], coronary artery disease [6,8], or sudden unexplained death [9]), and not all underlying causes are detectable by ECG screening or have the same risk of exercise-induced arrhythmias [9]. Moreover, the overall incidence of SCD in athletes is low (around 2.5/100,000 person-years overall [10], and 0.1/100,000 person-years in high-school athletes [11]), limiting the power of studies to demonstrate a causative effect over an association by chance due to annual variations in SCD rate [5].

Despite the scarce scientific evidence, major international sporting federations have a pre-participation cardiovascular screening policy for professional athletes [12]. A 2016 position paper of the European Heart Rhythm Association, endorsed also by Asian, and Latin-American Heart Rhythm Societies, supports the concept of an ECG-based PPE, respecting cultural, social and legal aspects in different countries [12]. Of note, sport organizations, such as the International Olympic Committee and national and international federations, share the responsibility to properly inform elite and professional athletes of the benefits and limitations of the PPE and to advise PPE in professional athletes on the basis of perceived responsibility and public scrutiny [12].

In Switzerland, the ECG has become an integrative part in the PPE of squad athletes since the first report by Marti et al. [2]. It has been shown to be feasible at reasonable costs per diagnosis [13]. Using modern criteria for ECG interpretation [14], the proportion of abnormal ECGs may be as low as 1–3% in Caucasian Swiss elite athletes, limiting additional costs for downstream testing [15]. Swiss sports physicians are adequately trained in ECG interpretation based on modern criteria during the courses for their board exam.

The limited scientific evidence should not be the driver to remove an established diagnostic tool from the PPE of young athletes. It is unlikely that an adequately powered study will ever be feasible, not least for ethical reasons. Therefore, we should continue performing ECGs in our athletes, being well aware of its limitations. Importantly, a normal ECG gives athletes, trainers, and sports physicians a good gut feeling.

Practical implications

- The resting ECG of an athlete should be interpreted with modern criteria, to reduce false positive results, and costs for downstream testing.
- Abnormal ECGs should be discussed with a cardiologist.
- The risk of serious cardiac diseases is very low in asymptomatic athletes, even in the presence of an abnormal ECG. Athletes counselling should start after the cardiological workup.

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CON – False diagnoses, no evidence

Before participating in competitive exercise a medical examination is recommended both in adults and youth [1;2;3;4;5;6;7]. One important aspect is screening for cardiovascular disease to avoid exercise-induced sudden cardiac death (eiSCD). The role of resting ECG as part of the preparticipation screening is discussed controversially [8;9;4;10;2]. In the USA the preparticipation examination comprises a medical history, a family history and a physical examination [3;4], whereas in many European countries an ECG is additionally recommended [e. g. 5;6].

The recommendation to perform an ECG as part of preparticipation examination is mainly based on an observational study from the region Veneto, Italy [9,11]. After implementation of a mandatory preparticipation examination in 12- to 35-year-old competitive athletes, including medical history, family history, physical examination and an ECG, the incidence of eiSCD was reduced from 4.19/100,000 person years to 0.43/100,000 person years after 20 years of screening [11]. However, in this study screening with and without ECG was not compared, and there is no information about the number of athletes with pathological ECG alone and no other signs of cardiac disease in history, family history and physical examination. So, even in this study the additional benefit of screening with ECG remains unclear. Furthermore, similar results have not been reproduced in other studies. In contrast, a retrospective study in Israel in 10- to 40-year-old athletes failed to show a reduction of the incidence of eiSCD after implementation of mandatory preparticipation screening, although an exercise test was performed additionally to the resting ECG [12].

A variety of cardiac diseases can cause eiSCD [1]. Data from a German register suggest that in athletes under 35 years at least 50-60% of the causes of eiSCD cannot be identified by ECG screening [13]. Similar data were found in athletes in Minnesota, where only 40% of the causes of eiSCD were detectable by ECG screening [14;15]. Even channelopathies like long QT syndrome and Brugada syndrome are not reliably diagnosed by ECG screening, as the characteristic changes in ECG are not always present. Likewise, in catecholamine sensitive polymorphic ventricular tachycardia (CPVT) the resting ECG is normal. So, a normal ECG does not reliably predict a low risk for eiSCD.

On the other hand, the rate of abnormal findings in ECG screening varies from 8 to 36% [11,16;17;18;19], leading to further examinations, e. g. echocardiography, Holter ECG, or even MRI. Only in a small number of athletes with abnormal ECG a high risk for eiSCD is identified [16, 19]. Applying the Seattle criteria, the rate of false positive ECG findings is reduced, but still, the predictive value of an abnormal ECG in respect of the risk of eiSCD is low.

Furthermore, none of the studies deals with the negative effects of ECG screening. False positive findings may lead to temporary or lifelong disqualification from competitive sports [29]. The psychological effects of being confronted with the false diagnosis of a potentially life-threatening disease are not discussed in any of the statements recommending screening with ECG.

Up to now, the data base for preparticipation screening of competitive athletes with an ECG to reduce the incidence of eiSCD is not convincing. There is only one observational study in favour of screening with ECG [11]. As sensitivity and specificity of screening with ECG is so low, the ECG should not be part of preparticipation screening.

Practical implications

Preparticipation screening before competitive exercise in children and adolescents should comprise medical history, family history and physical examination. When the basic screening shows hints for an elevated risk for exercise induced sudden cardiac death additional examinations, like ECG, echocardiography, Holter ECG or an exercise test should be performed.

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