

Sudden cardiac death and guidelines for pre-participation examination in athletes

Ljubica Georgijević^{1,2}, Lana Andrić³, Aleksandar Klačnja⁴

¹Child and Youth Health Care Institute of Vojvodina, Department of Cardiology, Novi Sad, Serbia;

²University of Novi Sad, Medical Faculty, Department of Pediatrics, Novi Sad, Serbia;

³Health Center "Bečej", Department of Women and Children's Health Care, Bečej, Serbia;

⁴University of Novi Sad, Medical Faculty, Department of Physiology, Novi Sad, Serbia

SUMMARY

Incidence of sudden cardiac death (SCD) in athletes under 35 years of age is between 0.4 and 4.4 in 100,000. The highest mortality is seen in older athletes (≥ 35 years) who engage in running, mostly because of complications of atherosclerotic coronary ischemic disease. Majority of European countries are guided by European Society of Cardiology's (ESC) pre-participation screening (PPS) recommendations that include electrocardiography (ECG), while in the United States of America the ECG is not a routine part of the PPS examination. In Serbia, the ESC guidelines are being used, but there are no references prescribed by the Ministry of Health. The authors of this study believe that the national strategy for sport improvement should be accompanied with clear and well defined PPS recommendations that could be tenable in our health system.

Keywords: athlete screening; cardiac death; competition

INTRODUCTION

Sudden cardiac death (SCD) in athletes usually happens unexpectedly, to someone who seemed "perfectly healthy", but it can also happen to those with a diagnosed health condition who did not discontinue sports engagement contrary to physician's advices. Practicing sports can potentiate the development of cardiovascular diseases in genetically susceptible individuals or accelerate phenotypic expression. Intensity and extent of a sports activity can influence the manifestation and progression of the pathology; therefore, professional athletes represent a high risk group [1].

The incidence of SCDs in athletes under 35 years of age is between 0.4 in 100,000 in Italy, and 4.4 in 100,000 in the United States of America (USA), but it can be as high as 6 in 100,000 [2–7]. SCD death rate among athletes who are members of the National Collegiate Athletic Association (NCAA) was found to be 2.3 in 100,000 [8]. Harmon et al. [8] concluded that basketball players at USA's Division I universities (rank I indicates the biggest engagement in sports and the highest premiums) were dominantly exposed to sudden deaths of cardiac origin with the incidence of 8.3 in 100,000 athletes yearly. The authors report that, concerning all three ranks, the risk of SCD is three times higher in black race basketball players. The literature data show marked incidence of SCDs among black race athletes [2, 6, 8, 9]. Other sports with high incidence of SCDs are football, swimming, lacrosse, and cross-country running/skiing [2, 8, 9]. Actually, the greatest incidence of SCDs (1 in 7,620)

is seen among athletes above 35 years of age, more precisely in the fifth decade of life, who dominantly engage in running and it is most often the result of complications of atherosclerotic coronary ischemic disease [6, 10]. More than 70% of leisure athletes aged 18 to 70 years exercise in intensities above recommended for their individual risk level [11]. Among American military recruits, the incidence of SCDs is 1 in 9,000, and those are mostly young people between 18 and 35 years of life, exposed to everyday strenuous exercises [6]. In relation to sex, there is a dominance of SCDs in males. In the above mentioned study of Harmon et al., male to female ratio was 2.3, although that number is much lower than the ones reported by other authors [5, 8, 10, 12]. The prevalence of cardiovascular diseases that can lead to SCD is 0.3% in a population of young athletes [13].

By comparison, the causes of death in individuals aged 1–18 years it was determined that SCDs happened in 5.8% of all deaths, 14% of which happened during moderate to extreme workout [14]. Out-of-hospital cardiac arrest in children and young adults within King County (WA, USA) was related to physical activity in 25% of cases. In Texas, research conducted on a cohort of children with out-of-hospital cardiac arrest, aged 0–18 years, has shown that arrest appeared in 40% of older children during physical exercise [3].

In our country, according to Sports Association of Serbia's data for 2009, there were 18,263 registered athletes actively competing in all branches of sport. Data of the Alliance for Leisure Sport in Serbia from 2010 state that there were 73,600 members at the time. University

Correspondence to:

Lana ANDRIĆ
Health Center "Bečej"
Braće Tan 3, 21220 Bečej,
Serbia
lanaandric@yahoo.com

Sports Federation of Serbia claimed 10,000 members in the same year, and Serbian School Sports Federation regarded all students of elementary and high schools (close to one million children) as active athletes [15]. Health statistics related to SCDs in athletes does not exist. According to Health and Statistics Yearbook for 2014, there were 1,503 deaths in individuals under 35 years of age, and 25 of them had a diagnosis of cardiac arrest, with predominance in male sex [16].

The US National Registry of Sudden Death in Athletes was instituted in 1992 under the Minneapolis Heart Institute Foundation and it encompasses information about young athletes who engage in competitive sports [12]. Additionally, there are several other ways for gathering information about SCDs in athletes [8].

The Minnesota High School League insists that every athlete has insurance in case of a catastrophic event. Such insurance policy includes compensation for deaths related to sports activity that happened during games or practice [17].

PRE-PARTICIPATION CARDIOVASCULAR SCREENING PROTOCOLS

American Heart Association (AHA) asserts that a competitive athlete is one who participates in organized group or individual sports that require systematic training and regular competitions in goal of achieving impeccable results. Leisure athlete is a middle-aged person (≥ 35 years) who participates in various, informal sport activities of recreational type, in permanent regime or with pauses, which do not require systematic training and are not necessarily directed towards achieving impeccable results [1, 6].

According to the Italian law from 1982, pre-participation screening (PPS) of athletes is mandatory and it contains a precise description and extent of examinations that physicians are obliged to follow, for in the contrary they may be found criminally negligent. In USA there are no legal rules for screening. AHA adopted the 36th Bethesda conference consensus and established PPS guidelines on its basis, which were published in 2007. The screening protocol comprises two parts – there are seven questions from personal and three questions from family history in the first part, while the second part covers four examination points [18]. A recent American study showed that out of 257 Division I universities, PPS was mandatory in 100% before any sports activity, of whom 4% required electrocardiography (ECG) and in 0.4% echocardiography was performed on every new-coming athlete [19]. In the majority (63%) of these athletes, with the beginning of a new season, those that had been previously examined were only required to go through personal history questionnaire, usually with their trainer, without the need for a new examination. In addition, in 40% of the cases the questionnaires lacked crucial questions from the AHA recommendations. In conclusion, 92% did not satisfy given PPS standards [19].

Most European countries follow guidelines of the European Society of Cardiology (ESC) that originated in 2005.

In 2010, the same group had published guidelines for pre-participation analysis of 12-lead ECG [20].

In general, the biggest difference between European and American beliefs regarding the subject is that the USA does not promote inclusion of ECG in PPS protocol underlining that routine ECG is not cost-beneficial for screening a large number of athletes due to its low specificity and high cost [1, 18, 21]. Interestingly, the ESC guidelines for ECG interpretation in athletes were twice revised in order to give them better specificity, and both times the conferences were organized in the USA – “the Stanford criteria” from 2011 and “the Seattle criteria” from 2012 [22, 23]. By using the Seattle criteria, the number of “abnormal” ECGs appears to be the smallest and there is less need for further diagnostic evaluation [6, 24]. When the 2010 ESC guidelines were used, there were no differences in sensitivity and specificity in detection of abnormal ECG patterns between cardiologists and primary care specialists; however, cardiologists did, with significantly greater sensitivity, correctly diagnose the abnormal patterns [4, 13].

The authors from Bethesda applied a statistical model – the Markov model – in order to compare economical reflections of the following modes of screening: 1) history and examination with referral to cardiologist if a suspicion of an abnormality occurred; 2) history and examination, followed by ECG and referral to cardiologist if anything pointed to an abnormality; and 3) only ECG, with referral to cardiologist if an abnormality was suspected. As a result, a screening based only on ECG had the most favorable profitability [7].

The Survival of Myocardial Infarction Long-term Evaluation (SMILE) study comprises the results of the still active ESC’s project – the SMILE project. The project was started in 2006. It was designed to interconnect sports centers in Greece, Germany, France, and Algeria with a center in Italy and with expert members of the ESC sports cardiology study group in case of need for second and, possibly, third opinion. ECG recordings are being digitalized for standardization and history and examinations are being conducted according to 36th Bethesda guidelines. The authors believe that this way of collaboration increases the efficacy of screening without increasing the costs [25, 26].

In November 2013 at an AHA yearly meeting in Dallas, four experts from USA and Europe defended their views regarding PPS in front of a live audience. After their presentation the audience was asked to vote, and 60% of live audience voted for ECG in screening protocols. Of those that voted through the internet, 58% were in favor of PPS with history, examination, and ECG. In the USA there was a slight predominance of those agreeing that ECG should be done (45%) in relation to those who consider history and examination sufficient (35%), while in Italy the majority voted for screening according to ESC guidelines [27].

The target group for implementation of these guidelines is high school children and young adolescents, since this is the age range in which sport participation culminates. However, the guidelines are equally applicable to those under 12 and those above 35 years of age [1, 5].

RECOMMENDATIONS IN SERBIA

In our country, according to the current Law on Sports and Regulation on Determining Medical Fitness in Athletes Regarding Engagement in Sports and Participation in Sports Competitions on the territory of the Republic Of Serbia, general and exceptional sports ability of a competitive athlete is determined in competent health institutions, i.e. institutes for sports and sports medicine. The above mentioned regulation also contains a questionnaire with detailed set of personal and family history questions and a medical examination form. This is in fair accordance with global recommendations [28].

Serbia follows the ESC guidelines. The Republic of Serbia's Ministry of Health website does not display the national guideline regarding PPS. Subjects of screening and SCDs are less represented in scientific literature in comparison to other countries. When using keywords *screening*, *athletes*, and *sudden cardiac death*, a small number of, mostly, review articles originating from Serbia occur as the result of index databases search. References in these articles are predominantly from foreign authors and auto- or hetero-citations [29–32].

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CONCLUSION

The national strategy for health improvement foresees that by the year 2018 there will be 70% of children engaged in organized sports activities minimally three hours per week and 40% of adults will participate at least once a week in sports and recreation. The strategy also predicts better results of our athletes at international competitions of the highest rank.

The authors believe that this strategy should be accompanied with clearly defined recommendations for pre-participation cardiovascular screening that will be tenable in the existing health system. Also, it is expected that trends in Serbia will follow the world's trend of increase in number of recreational athletes. Having this in mind, our viewpoint is that primary care physicians should be introduced to the policy of cardiovascular examinations in sportsmen through educative courses, as it is not unreasonable to think that a health certificate with health risk assessment will very soon be needed before engagement in any organized athletic recreation.

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Напрасна срчана смрт и препоруке за препартиципациони преглед спортиста

Љубица Георгијевић^{1,2}, Лана Андрић³, Александар Клашња⁴

¹Институт за здравствену заштиту деце и омладине Војводине, Одељење кардиологије, Нови Сад, Србија;

²Универзитет у Новом Саду, Медицински факултет, Катедра за педијатрију, Нови Сад, Србија;

³Дом здравља „Бечеј“, Служба за здравствену заштиту деце и жена, Бечеј, Србија;

⁴Универзитет у Новом Саду, Медицински факултет, Завод за физиологију, Нови Сад, Србија

КРАТАК САДРЖАЈ

Инциденција напрасних срчаних смрти код спортиста млађих од 35 година креће се између 0,4 и 4,4 на 100.000. Највећи mortalitet среће се код спортиста старијих од 35 година који се баве трчањем и најчешће је резултат атеросклерозом посредоване коронарне исхемијске болести. Већина европских земаља руководи се препорукама за препартиципациони скрининг (ППС), које обухватају и електрокардиографију (ЕКГ), објављених од стране Европ-

ског удружења кардиолога (*European Society of Cardiology, ESC*), док се ЕКГ рутински не ради приликом ППС унутар Сједињених Америчких Држава. У Србији су у употреби *ESC* препоруке, али не постоје водичи препоручени од стране Министарства здравља. Аутори рада сматрају да је у оквиру националне стратегије за развој спорта потребно наћи јасне и добро дефинисане ППС препоруке које би биле примењиве у постојећем здравственом систему.

Кључне речи: скрининг спортиста; срчана смрт; такмичење

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