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Review article

Echocardiography in the prevention of sudden cardiac death in athletes

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Abstract Sudden cardiac death (SCD) in an athlete is always shocking. It is of the utmost importance to better understand the causes of SCD in athletes and to discover optimal strategies for prevention. Echocardiography is a noninvasive first-line imaging technique in the identification of structural heart disease and is also irreplaceable in distinguishing an athlete's heart from cardiomyopathy. Therefore echocardiography is important in the prevention of sudden cardiac death during sports activities.

Key words sudden cardiac death, sport, echocardiography

Sudden cardiac death (SCD) is defined as unexpected, non-traumatic death during and shortly after training, usually within 1 h, in a person considered healthy[1]. That is a very rare event. Current estimates of the incidence of SCD in competitive athletes range from almost 1 in a million to 1 in 5000 athletes per year. It affects male athletes 10 times more than female[2,3]. After trauma SCD is the most frequent cause of death in sportsmen and two times more often than in the general population[4].

Otherwise, athletes are individuals of young and adult age, either amateur or professional, who are engaged in exercise training on a regular basis and participate in official sports competitions. The problem with that definition is that persons who do regular physical exercise, and at times very intense, but never participate in organized competitions are left out. Although the general opinion is that professional athletes are at higher risk of SCD considering they aim to win which can lead to exaggerated training, one must remember that individual exercisers often practice very intense training totally unsupervised[5].

In older athletes (>35y) the most frequent cause of SCD is coronary artery disease and in young structural heart diseases. Many structural heart diseases are clinically silent and preparticipation evaluation of athletes is of the utmost importance. In presumably healthy young athletes prevalence of SCD-related structural malformations is 0,3%[6].

Basic cardiovascular screening encompasses history, physical exam, and ECG and it has unique challenges and limitations. Transthoracic echocardiographic exam (TTE) is recommended when there is a justified clinical suspicion (athletes who are symptomatic, who have abnormal physical findings including abnormal electrocardiogram (ECG), and/or positive family history for SCD).

It is estimated that nearly 30% of potentially fatal structural heart diseases cannot be discovered without echocardiography. Diseases like aortic dilatation, bicuspid aortic valve, mitral valve prolapse, Ebstein anomaly, congenital anomalies of coronary arteries, congenitally corrected transposition of the great arteries as well as 10-30% cardiomyopathies can not be detected without echocardiography. Still, echocardiography which can identify all these structural malformations is still not included in routine screening[2].

Coronarary artery (CA) anomalies are rare congenital malformations, potentially fatal, and sometimes asymptomatic, Coronary vessels can have an abnormal origin, course, destination, size and number. Anomalous origins can have right CA from left coronary or noncoronary sinus, and left CA when it originates from the right coronary sinus of the aorta or the non-coronary sinus. Besides, coronary arteries can originate directly from the ascending aorta or pulmonary artery[7].

Key to the recognition of anomalous CA origin is absence of typical echocardiographic visualization during meticulous screening.

Athletic training promotes structural and functional heart adaptation. These changes are considered benign but they may overlap with the phenotypic manifestations of a cardiomyopathy which are the commonest cause of SCD in young competitive athletes. Echocardiography, escpecially in elite ethlete, is necessary in diferentiating physiologic from pathologic remodeling[8].

Information needed for interpretation of echocardiographic exam are[9,10]

- gender (female athlete rarely have findings that are out of normal range)
- Age (heart of young athlete also show adaptive changes but in lesser degree compared to older athlete)
- Ethnicity (heart of black athlete sportista always show greater degree of hypertrophy and left artial enlargement. Left ventricular wall thickness greater than 12mm in Caucasian and greater than 14mm in black male athlete and 13mm in black female athlete always requires further functional examination)

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Figure 1. Bicuspid aortic valve

Figure 2. Dilated thoracic aorta

Figure 3. Ebstain anomaly

Figure 4. CCTGA (Congenitally corrected transposition of the great arteries)

- Body surface area (BSA). In extreme big BSA >2,3m2 non indexed left ventricular wall thickness and enddiastolic dimension should not excede 14mm and 65mm respectively)
- Symptoms (special attention should be paid to exertional chest pain, fainting and blurred vision, iregular heart beat, tiredness dispropotional to the intensity of training)
- ECG changes
- Type of sport

If TTE is done, it is wrong to do qiuck targeted exam. One should perform comprehensive standard echocardiographic exam with assessment of left ventricle diastolic function and right ventricle structure and function[11-13]. Echocardiographic clues to differentiate athlete's heart from cardiomyopathies are symmetrical enlargement and normal function of both left and right ventricle in healthy athletes.

Examples of some structural heart diseases which can be missed if screening of athlete if done without echocardiography are presented in Figures 1-4.

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Sažetak

Ehokardiografija u prevenciji iznenadne srčane smrti kod sportista

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Iznenadna srčana smrt (ISS) kod sportiste je uvek užasavajuća. Izuzetno je važno bolje razumeti uzroke ISS kod sportista i razviti najbolje strategije za prevenciju. Echocardiografija je neinvazivna tehnika prvog izbora u identifikaciji strukturne bolesti srca i takođe nezamenljiva u razlikovanju sportskog srca i kardiomiopatije. Zbog svega navedenog ehokardiografija je važna u prevenciji iznenadne srčane smrti tokom sportskih aktivnosti.

***Ključne reči**: iznenadna srčana smrt, sport, ehokardiografija*