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Practical aspects of echocardiography in sports medicine

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1. Introduction

The introduction of M-mode echocardiography in the 1970's and then of two-dimensional and Dopler echocardiography, has lead to significant advancement in the field of cardiological diagnostics. It has become, not only for cardiologists, but also for specialists in sports medicine, a useful tool for repeatable, noninvasive investigations, allowing for considerably more detailed characterisations of the term "athlete's heart".

The difference between physiologic and pathologic conditions of this organ may also be determined more precisely.

The aim of the study was to characterize in detail the structure and function of hearts of leading Polish athletes by means of echocardiographic methods.

2. Material and methods

The study was carried out in the group comprising 97 men, top-level Polish athletes. Their mean age amounted 21 ± 3 years, the mean period of intensive training prior to the examination - to 7.8 ± 4.4 years, and their physical aerobic capacity assessed by means of a direct method during maximal exercise test was very high - 70 ml/min/kg (VO2max/kg). The investigation group consisted of 23 cyclists, 8 biathlonists, 30 medium and long distance runners, and 36 football players. The results were compared with those obtained in 30 men constituting a control group with corresponding mean age and good physical capacity(52ml/min/kg).

Two-dimensional echocardiographic study was performed using Acussen 128 apparatus. The size and function of the heart was measured according to the method recommended by the Echocardiographical Society in parasternal projection in the long and short axis, as well as in four- and five-chamber apical projection.

The statistical comparison between the groups were performed using student-t-test.

3. Results and discussion

In the first part of the study, the "left heart" structure and function of training subjects were characterised. Main LVEDD of the athletes amounted to 51,3±5,2 mm and was significantly higher than that observed in the control group - 48,5±5,1 mm. The value of this measurement may be classified as belonging to the highest range of values considered as normal in non-training subjects (37 - 56 mm according to Feigenbaum).

Interventricular septum thickness in diastole (IVS d) was significantly higher in the athletes than in the controls (10,0±1,5 vs 9,7±1,5). It approximated the values of upper normal limits for non-training adult population (8 - 11 mm according to Feigenbaum).

A similar direction of changes was observed in analyzing left ventricular posterior wall thickness (PWd): the values obtained in the training group were 9,7±1,5 mm, in the controls - 9,1±1,2 mm, while the normal values range, according the literature data, from 8 to 12 mm. A symmetrical hypertrophy of the interventricular septum and left ventricular posterior wall was observed. The ratio of intraventricular septum thickness to left ventricular posterior, has been often quoted as a borderline value in the diagnostics of pathological heart hypertrophy. The index of symmetry of left ventricular hypertrophy was also within normal limits and amounted to 0,38±0,04. The mean left ventricular muscle mass was 247±66 g and was significantly higher than observed in the controls - 205±60 g. The obtained results point to the high incidence of values exceeding the upper normal limit set at the value of 294 g according to Levy. The size of the left atrium, although significantly larger than in the control group (32,5±4,2 mm vs 29,6±4,1 mm) remained within the range considered as normal for adult population.

Own investigations have demonstrated efficient left ventricular haemodynamic function at rest. The stroke volume was 105±17 ml, and it was significantly higher than that observed in the controls - 89±17 ml. The ejection fraction approximated the lower normal limit (61±8%) and percentage fractional shortening of the left ventricle, amounting to 36±7% was always higher than the normal value - 25%.

The second part of the study presents the characteristics of the right ventricle of athlete's heart. In parasternal projection, mean end - diastolic diameter of the athlete's right ventricle amounted to 33±4 mm and was significantly higher that observed in the control group - 31±3 mm. According to the world leading specialists in echocardiography, the upper normal limit of this diameter should not exceed 32 mm. Right ventricular wall thickness in diastole was 7,8±1,3 mm. It exceeded significantly the values obtained in the controls, as well as the critical value quoted in the literature (7 mm).

In the study the heart muscle mass and heart volume have been calculated. The mean heart muscle mass was 514±132 g. Thus, it rather exceeded the value of 500 g regarded as critical for physiological hypertrophy of the heart muscle. The heart volume amounted, on the average to 15,6±2,6 cm^3 and was significantly larger than that observed in the control group i.e. 13,5±2,2 cm^3.

4.Conclusions

4.1. Anatomical indices for "left heart" of athletes with very high physical aerobic capacity reach the upper limits of value ranges accepted as normal for non-training adults population.
IVS thickness in the hearts of Polish athletes with very high aerobic capacity did not exceed 13 mm, left ventricular posterior wall thickness - 12 mm and left ventricular end-diastolic diameter - 60 mm.

4.2. Anatomical indices for "right heart" of athletes often exceed the upper limit for the population of non-trained adults males;

4.3. Haemodynamic function of athlete's heart is efficient and economical.