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Resting heart rate and its change induced by physical training in patients with ischemic heart disease at various ages treated with beta-blockers

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Abstract

Background: *The present study was aimed at possible modifications of resting HR induced by systematic physical training in patients of different age populations with ischemic heart disease (IHD) subjected to chronic therapeutic beta-blockade.*

Methods: *The goal was the assessment of initial resting heart rate (HR) and its change after 6 months of physical training in two groups of patients with IHD at various ages (A: 55.5 ± ± 4.6 years; B: 72.5 ± 4.37 years) treated with beta-blockers, the dosage of which was not modified during the observation.*

Results: *Comparison between the groups A and B concerned the initial rHR (min^{-1}): 79.3 ± ± 8.3* vs. *73.6 ± 8.3 ($p < 0.01$), the after-training rHR: 70.9 ± 7.9* vs. *67.7 ± 8.4 (NS), and the delta of rHR: –8.4 ± 4.8* vs. *–5.9 ± 2.8 ($p < 0.01$). Statistically significant correlation coefficients both between the patients' ages and the initial rHR ($r = -0.377$) and the delta of rHR ($r = 0.347$) were noted.*

Conclusions: *The reduction of rHR after 6-months of training was less in the older IHD patients because of their lower initial rHR compared with the younger patients, which was probably determined more by physiological vagotonia than therapeutic beta-blockade.* (Cardiol J 2007; 14: 493–496)

Key words: resting heart rate, beta-blockers, physical training, ischemic heart disease

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Introduction

One of the most conspicuous effects of long-term physical training is the reduction of resting heart rate (HR), which is caused by a decrease of sympathetic tone resulting from a gradual physiological process of adaptation to regular exercises [1, 2]. It is commonly known that with ageing normal predominance of parasympathetic tone appears [3]. The present study was aimed at possible modifications of resting HR induced by systematic physical training in patients of different age populations with ischemic heart disease (IHD) subjected to chronic therapeutic beta-blockade.

Methods

Group A (younger) consisted of 49 patients with IHD (35 males and 14 females) with a mean age of 55.5 ± 4.6 years, and group B (older) comprised 38 patients (26 males and 12 females) with a mean age of 72.5 ± 4.37 years. The assumed inclusion criteria were: subjects having undergone acute coronary syndrome (ACS) episodes treated invasively with percutaneous transluminal coronary angioplasty (PTCA) not earlier than 3 months before the onset of cardiac rehabilitation cycle, the analyzed patients were assessed as clinically stable, and the two groups were satisfactorily comparable according to echocardiographic parameters [left ventricular end-diastole dimension (LVEDD), ejection fraction (EF) and body mass index (BMI) values]. The exclusion criteria comprised as follows: irregular participation in the training cycle, episodes of serious arrhythmias and/or anginal pain and the necessity of changing the beta-blocker regimen. Informed consent was taken from all of the study patients.

All the examined patients were taking cardioselective $beta_1$-blockers for at least two months prior to the study period. The dosage of the drugs was modified if required but only before the first exercise session; during the training cycle no changes in treatment regimen were introduced. Estimation of the beta-blockade level was performed using 24-hour ECG Holter monitoring and RAMP test, during which the dynamics of the HR increase were controlled in relation to the applied workload.

The cardiac rehabilitation program, which lasted six months, comprised cycloergometer training with the use of the ERGOLINE system. Cycloergometer loads were given at 4-min intervals, which were broken by 2-min rest with 10-Watt load. Each training session lasted 45 min and was performed three times per week. Moreover, general improvement exercises took place two times per week.

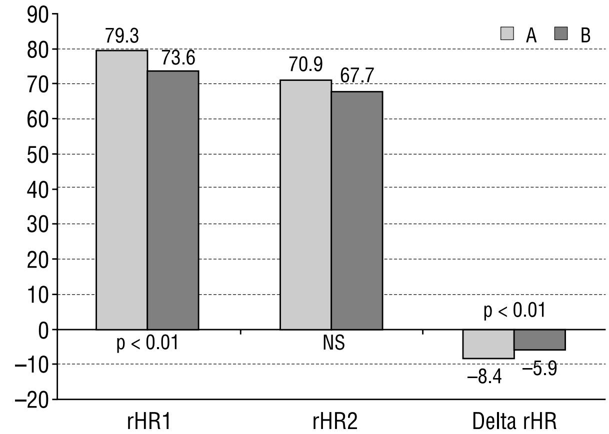

Figure 1. Comparison of initial resting heart rate before the physical training cycle (rHR1) and after finishing it (rHR2), and the delta of rHR (rHR2–rHR1) for the two groups of patients with ischemic heart disease (group A and B).

The statistical analyses were based on the group-mean values of resting heart rate (rHR), which was always measured in resting state, i.e., after 5-min relaxation, just prior to the onset of the cycloergometer training, during the first three and the last three training sessions. A comparison of the obtained results was performed using the *t*-Student test. In addition, the significance of the correlation coefficients between the age and the rHR of the examined patients was verified with the Pearson's chi square test. The significance level was assumed as $p < 0.01$.

Results

A comparison performed in relation to the two IHD patients groups, A (younger) and B (older), concerned the following parameters: the mean value of the initial (pre-training) rHR (min^{-1}): 79.3 ± ± 8.3 *vs.* 73.6 ± 8.3 ($p < 0.01$); the mean value of the final (post-training) rHR: 70.9 ± 7.9 *vs.* 67.7 ± ± 8.4 (NS); and, in turn, the mean value of the delta of rHR: –8.4 ± 4.8 *vs.* –5.9 ± 2.8 ($p < 0.01$). The results are presented in Figure 1.

In addition, two relations concerning the age of the examined IHD patients were tested. A correlation between the patients' ages and initial rHR (before the training cycle) was described by the statistically significant ($p < 0.01$) Pearson's coefficient, namely r = –0.337 (Fig. 2). A correlation coefficient for the relation between the patients' ages and the delta, expressing a difference between the initial and the final rHR, was also of significance

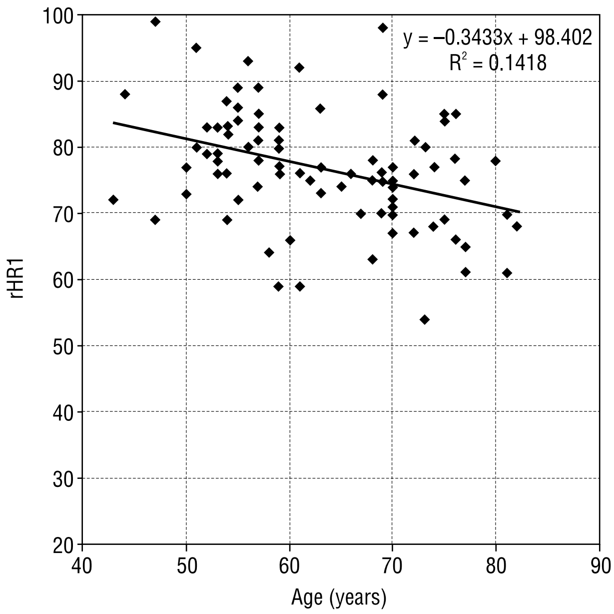

Figure 2. Diagram of the correlation between the initial resting heart rate (rHR1) and the age of the all patients with IHD subjected to the training.

($p < 0.01$), with a value of $r = 0,377$. The two abovementioned correlation values should be considered as noticeable associations.

Discussion

The results presented above enable the formation of some statements regarding not only the characteristics of rHR in the patients with IHD treated chronically with beta-blockers depending on the patients' ages, but also the rHR modifications induced by the long-term physical training. When assessing before enrolment to the rehabilitation program, rHR was significantly higher in the younger IHD patients (group A) than in the older patients (group B). After the training cycle completion, rHR turned out to have been reduced in both the analyzed patient groups (A and B), but it should be emphasized that the level of this reduction (the delta value) was significantly larger in group A, compared with group B. It is worth noting that rHR after the physical training did not show a significant difference between the two compared patient groups, which was caused by a more effective rHR reduction in the younger group. As the correlation testing revealed, the age of the examined IHD patients was significantly related both to resting HR manifested before the rehabilitation and to the changes of resting HR resulting from the training program.

As regards searching for a reliable explanation of the discrepancy observed for the reaction of rHR to the long-term physical training between the two IHD patient groups, younger (55.5 ± 4.6 years) and the older one (72.5 ± 4.37 years), one fact should be stressed: namely, that the beta-blocker dosage schedule was only conditioned by the clinical status of each of the analyzed patients with IHD, assessed prior to the rehabilitation cycle, and was applied regardless of the individual patient's age. Likewise, the treatment regimen was not subjected to any alterations during the physical training period. On that basis, it can be assumed that the established beta-blockade exerted comparable effects on the resting heart rate of all the observed patients.

As to the question of possible effects of betablockade on the results of cardiac training, no significant difference concerning attainable physical capacity improvement between the IHD patients treated or not treated with cardioselective betablockers was reported [1, 4–6].

Chronotropic heart reaction is yet another aspect. It is apparently modified by beta-blockers both at rest and during exertion. The current guidelines (2006) [7] state that beta-blockade can weaken the possibility of a patients' reaching the age-matched heart rate in response to the workload during electrocardiographic exercise testing, which is in accordance with previously published papers [8, 9].

There are some interesting observations concerning heart rate variability (HRV) examinations, which can assess autonomic nervous system balance in patients with previous myocardial infarction subjected to 4-week cardiac rehabilitation. It was found that both the patients taking beta-blockers and those without this treatment revealed comparable levels of sympathetic tone decrease and vagotonia increase. Interestingly, HRV parameters were not changed in the third group of patients, who were taking beta-blockers but did not undergo a physical training cycle [10].

Conclusions

The explanation of our observations that the older patients with IHD presented lower values of both the initial (pre-training) rHR and the delta of rHR, resulting from 6-months of physical training, is further elucidated and supported by the commonly known fact that with ageing a physiological process of elevating the vagal tone linked with decreasing reactivity of the heart adrenergic receptors to the sympathetic stimulation occurs. This phenomenon causes rHR lowering in elderly people, for whom rHR can be calculated according to the Jose-Collinson's formula: sinus heart rate = 118.1 – 0.57 × age [2, 3].

However, it should be strongly emphasized that the findings reported above do not determine the effectiveness of long-term, systematic physical training undertaken by elderly people. As was shown, persons over 65 years of age, in spite of usually lower basic physical capacity, are able to obtain even better final results through participation in physical activity and get more health benefits than the younger subjects [11].

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