Influence of Resistance Training Performed at Different Intensities and Same Work Volume over BP of Elderly Hypertensive Female Patients

EXERCISE AND SPORTS MEDICINE CLINIC

ORIGINAL ARTICLE

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ABSTRACT

Systemic arterial hypertension (HBP) is a multifactorial disease with high prevalence in the elderly population, hence resistance exercise (RE) is recommended for that disease. However, the literature lacks studies that demonstrate the acute hypotensive effect of RE in hypertensive elderly subjects. This study aimed to compare the effect of post -exercise hypotension (PEH) for 60 minutes between two sessions of resistance exercises performed at different intensities, but with the same load-repetition ratio in hypertensive elderly women. The sample consisted of 32 women, randomly divided into two groups: 16 patients in low intensity group (G1) and 16 patients in high intensity group (G2), both with the same training volume. After two weeks of adaptation, the elderly women performed three sessions of resistance exercise and immediately after them, their systolic and diastolic blood pressure were measured for 1 hour every 10 minutes. For statistical analysis Student's t test for independent samples, Fisher exact and analysis of variance one-way ANOVA, with $p \leq 0.05$ considered significant were used. There was not significant difference of systolic and diastolic blood pressure after exercise in the individuals in groups G1 and G2, neither intra-group. However, there was a tendency for blood pressure reduction in G1 compared to G2. Our data suggest that the sequence of resistance exercise with duration of three sessions did not result in PEH in hypertensive elderly patients, with no significant differences in systolic and diastolic pressure between the groups with light and high intensity.

Keywords: exercise, blood pressure, elderly, training.

INTRODUCTION

Systemic arterial hypertension or high blood pressure (HBP) is a disease of multifactorial nature with high prevalence in the elderly population and has become a determinant factor in the high rates of morbidity and mortality of those individuals. According to the world health organization (WHO)[1], the number of hypertensive patients in the world population is of approximately one billion, with 7.1 million of deaths per year. In Brazil, the prevalence of HBP ranges between 22% and 44%, increasing with age progression[2]. Among women aged over 75 years, the prevalence of hypertension may reach 80%[3].

Many authros[4-7] mention the hypotensive effects which occur post-exercise, either aerobic or resistance. Thus, exercises may be a kind of non-pharmacological treatment or prevention of HBP. Moreover, there are other benefits, such as better quality of life provided by the physical training, which reduces the deleterious physiological alterations which occur with age.

A way of reducing blood pressure (BP) is through the chronic response provided by continuous aerobic exercise. Studies in hypertensive patients demonstrated chronic reduction of BP compared to rest, ranging from 5 and 10 millimeters of mercury (mmHg) during 24 hours post-aerobic exercise, developing to 7 to 12mmHg on the following day[4,5]. Some studies[8,9] also evidenced the presence of long run resisted post-exercise hypotension (PEH).

Concerning the acute response during resistance exercise (RE), Cardoso et al.[4] report acutre hypotension in hypertensive individuals with duration between one and 10 hours, which is higher in low intensity exercise when compared with high intensity ones. Hypotension post-acute aerobic exercise (PEH) is also well-established in the literature[5], its variation in hypertensive patients is of 2 to 12mmHg with duration of four to 16 hours.

However, the literature is scarce in studies on the effects of different intensities of resistance exercises on PEH of hypertensive elderly subjects. Thus, the aim of this study was to compare the effect of PEH during 60 minutes between two sessions of resistance exercises performed with different intensities, but with the same load-repetition ratio.

METHODS

Sample selection

32 patients with diagnosis of systemic arterial hypertension recruited from the Support and Care to Blood Hypertension Program (PACHA) linked to a high complexity in cardiology hospital were evaluated. However, only 11 concluded the resistance training protocol. Therefore, there was a loss of 21 patients due to personal reasons, impossibility of transport to the training site, family commitments as well as failing in the ergometric test.

Thus, the remaining patients were randomly sorted, remaining four patients for the LREG (low intensity resistance training group) and seven patients for the HREG (high intensity resistance training group).

The cases eligible were the ones which presented clinical stability, stages 1 and 2 of systemic blood hypertension classification according to the V Brazilian Guidelines of Arterial Hypertension[10], female sex, age equal or above 60 years. The patients who presented inappropriate blood pressure response or heart rate and/or ventricular arrhythmias induced by exertion ion the previous ergometric test were excluded from the study. Those with severe pulmonary hypertension or severe pulmonary disease, use of anxiolytic or sedative medication, confusion or dementia, orthopedic limitation and/or cognitive deficit which could hamper the tests' execution were not elected either. Besides these criteria, the women who needed to alter medication during the research period, as well as those with number of absences higher than 10% of the proposed period for the training were also excluded from the sample.

All patients had previously signed the Free and Clarified Consent Form which contained all the procedures to be developed. This study was approved by the Ethics Committee of the institution under the file number 208/09.

Study dynamics

In this prospective and longitudinal study, the selected patients were submitted to a clinical evaluation to enter the engage in the resistance training, including an ergometric test.

Evaluation of the systemic blood pressure

The systolic and diastolic blood pressure was checked in seven distinct moments by the same evaluator, who was a physiotherapist. The first moment was at rest, followed by 10-minute intervals after the end of the resistance training until completion of an hour. Systemic blood pressure was measured with a BD® stethoscope, adult model MDF 747-duo sonic and the analog sphygmomanometer BD®. The systemic blood pressure measurement followed the recommendations of the V Brazilian Guidelines of Arterial Hypertension[10].

Resistance training protocol

Initially, the patients performed two weeks of adaptation to the exercises to learn the correct performance technique, normal range of motion and suitable breathing. During this period, the exercises were performed with no load.

After the adaptation period, the patients performed tests of eight maximum repetitions (8-RM) for the muscular groups to be trained. The 8-RM test corresponded to the maximum load which can be lifted by the participant in the entire normal range of motion with maintenance of the suitable technique (without compensations) in eight repetitions. The tests occurred with each individual performing maximum of five trials in each exercise with interval of five minutes between them[11,12]. Modified Borg's scale[13] was sued to question on the perceived exertion with the load intensity in each trail. The tests were developed during a single day for the eight exercises, immediately after the adaptation period.

The exercises were always performed in the following order: leg press, bench press, knee extension with extensor chair, front pull, knee flexion on flexor table, upper limbs lateral elevation with dumbbells, hip abduction with cross over and barbell front curl. The order followed hence the recommendations by the *American College of Sports Medicine* (ACSM)[14], which mentions the priority demand of the large muscular groups before the small ones, alternating exercises for the lower and upper limbs.

The 32 recruited patients were randomly drawn in two groups: G1, or low intensity resistance training group (LREG), composed of 1 patients; and G2, or high intensity resistance training group (HREG), composed of 16 patients as well.

The training intensities were based on the proposal by Polito et al.[15], in which different intensities were used, but with the same load-repetition ratio (training volume). The LREG participants performed two sets of 16 repetitions with half of the 8-RM load and the HREG participants performed two sets of eight repetitions with 8-RM load.

Thus, regardless of the group to which she was drawn, the patient would perform the same total training volume, changing only the number of repetitions (intensity). However, this volume was specific to each patient, considering the individual 8-RM test.

During the exercises, the patients were told to perform an expiration during the concentric contraction and an inspiration during the eccentric contraction, in each repetition to avoid the Valsalva's manouver. The performance velocity of the exercises was of 2:2, which equals to the time in seconds concerning the concentric and eccentric phases of the movements, and the recovery interval was of two minutes between sets.

Before the exercises, the patients performed five minutes of warm-up with light gait, followed by self-stretching of the main muscles to be demanded. After the training, they performed cooling through self-stretching exercises of the main demanded muscles.

STATISTICAL ANALYSIS

The data were analysed with the statistical program SPSS, version 17.0 (SPSS Inc., Chicago, IL, USA), with significance level of 5%. After descriptive analysis, presented in mean and standard deviation (SD) normality of the variables of the study was verified through the Kolmogorov-Smirnov test (K-S). Student's t test for independent samples was used to verify the differences in the clinical characteristics between G1 and G2, as well as in the comparison between groups concerning each evaluation sequence. In order to compare the prevalence of the comorbidities and medication between G1 and G2, Fisher exact test was used Moreover, variance analysis (one-way ANOVA) for repeated measurements was also used with Tukey post hoc for comparison of systolic blood pressure (SBP) and diastolic blood pressure (DBP) intragroup in each sequence of evaluation concerning rest.

RESULTS

Table 1 shows the clinical variables of the patients in groups G1 (LREG) and G2 (HREG). There were not significant differences between groups concerning the assessed variables. The individuals of both groups were approximately the same age, had similar height, body mass index (BMI), weight as well as SBP and DBP during rest.

Concerning comorbidities of both groups, significant differences have not been found yet about the presence of diabetes mellitus, osteoporosis, hypercholesterolemia, arthritis and obesity.

Tables 2 and 3 demonstrate the mean values of SBP and DBP obtained during rest and after each of the evaluation sequences. There were not significant differences when the SBP and DBP values

of both groups, low and moderate intensities, in each post-training evaluation sequence were compared. Significant intragroup differences concerning the post-exercise SBP (F = 0.3; p = 0.9) and DBP (F = 0.2; p = 0.9) concerning rest were not observed either.

Table 1. General characteristics of the studied population.

Variables	Group 1 (n = 4)	Group 2 (n = 7)	p value
Age (years)	71.3 ± 10.4	68.3 ± 6.3	0.56
Weight (kg)	75.3 ± 13.4	62.5 ± 8.4	0.08
Height (m)	157 ± 14.3	153 ± 5	0.55
BMI (kg/m2)	30.4 ± 2.7	26.6 ± 3.9	0.12
Hemodynamic variables (rest)			
SBP (mmHg)	130 ± 18.3	127.1 ± 12.5	0.62
DBP (mmHg)	67.5 ± 17.1	70 ± 8.2	0.96
HR (bpm)	75.5 ± 16	75.4 ± 6.3	0.99
Comorbidities			
Diabetes mellitus	1 (25%)	1 (14%)	0.20
Hypercholesterolemia	2 (50%)	3 (43%)	0.21
Osteoporosis	1 (25%)	1 (14%)	0.20
Arthritis	1 (25%)	1 (14%)	0.20
Anti-hypertensive medication			
Beta blocker	0	1 (14%)	0.16
ACE inhibitor	1 (25%)	0	0.06
Diuretics	3 (75%)	4 (57%)	0.25
Calcium channels inhibitor	0	1 (14%)	0.16

ACE-angiotensin converting enzyme; SBP – systolic blood pressure; DBP – Diastolic blood pressure; HR – Heart rate; BMI – Body mass index.

Table 2. Description of the mean values, standard deviation and p value for the systolic blood pressure in each evaluation sequence in the low and high intensity groups.

SBP			
Sequences	G1 (n = 4)	G2 (n = 7)	p value
Rest	130 ± 18.2	127.1 ± 12.5	0.76
10 min	116.2 ± 4.7	125 ± 19.3	0.29
20 min	115 ±5.7	121.4 ± 17.4	0.39
30 min	120 ± 14.7	125 ± 23	0.70
40 min	121.2 ± 10.3	125 ± 23.2	0.72
50 min	117.5 ± 5	128.5 ± 24.1	0.28
60 min	123.7 ± 7.5	130 ± 25.8	0.56

SBP – systolic blood pressure; G1 – low intensity training group; G2 – high intensity training group; min. – minute.

Table 3. Descrição dos valores médios, desvios padrão e p valor para a pressão arterial diastólica em cada sequência de avaliação nos grupos de baixa e alta intensidades.

DBP			
Sequences	G1 (n = 4)	G2 (n = 7)	p value
Rest	67.5 ± 17.0	70.0 ± 8.1	0.74
10 min	63.7 ± 11.0	66.4 ± 8.9	0.67
20 min	63.7 ±13.7	66.4± 8.5	0.69
30 min	66.2 ± 12.5	66.4 ± 8.9	0.97
40 min	63.7 ± 13.1	67.1 ± 8.0	0.66
50 min	66.2 ± 11.0	67.1 ± 8.0	0.88
60 min	68.7 ± 10.3	68.5 ± 7.4	0.78

DBP – diastolic blood pressure; G1 – low intensity training group; G2 – high intensity training group; min. – minute.

DISCUSSION

According to the presented results, there were not significant differences in the general characteristics or in the clinical characteristics of the two groups, evidencing hence the homogeneity of our sample.

The great majority of the studies[4,5] demonstrates the onset of blood pressure decrease after performance of aerobic exercises; however, there are few studies which refer to resisted PEH[7,14] and, out of these, it is rare the ones which inform on the resisted PEH in hypertensive elderly subjects[8].

According to Polito et al.[15], in their study on PEH in healthy and trained adults, decrease of SBP after 50 minute post RE was verified. However, Hardy and Tucker[16] verified in the blood pressure infirmary monitoring reduction of SBP and DBP one hour after the RE session in 24 young sedentary and hypertensive individuals. Melo et al.[17] observed significant decrease of pressure for 10 hours; nevertheless, the patients of this study were under the effect of captopril, which suggests a possible interaction between exercise and hypotensive drug.

There are also a few investigations in the literature indicating the absence of resisted PEH. O'Connor et al.[18] obtained increase of SBP up to 15 minutes after a training session performed by women, using 80% of the 1-RM load. In the performed study, significant PEH was not verified in any of the investigated groups. This fact may be partly explained by the sample characteristics: hypertensive elderly women. It is known that as body ages, the arteries become more rigid due to progressive fragmentation and destruction of the elastic fibers of the tunica media and greater collagen deposition; moreover, the arterioles become thicker concerning the vascular light, leading to greater vascular resistance and limiting the responses to the vasoconstrictor and vasodilatator agents[19].

Therefore, there is decrease in the capacity to suitably respond to the pressure alterations. In addition to this, there is also lack of decrease in the sympathetic nervous activity after the resistance training and the decrease which occurs with aging of the neurons quantity of the dorsal nucleus of vagus (cardio inhibitor), resulting in reduction of the cardiac chronotropic activity. Thus, besides the tendency of maintenance of high BP derived from genetics and the environment, aging seems to contribute to the BP increase[4].

Some studies[20,21] evidenced higher PEH in training with lower intensity loads compared to those with higher intensities. In our study, tendency to reduction of the mean values of SBP and DBP was observed in the LREG when compared to the HREG, but no significant difference was observed between those groups.

Nevertheless, the lack of significant differences between the post-exercise blood pressure when G1 and G2 groups were compared corroborated the results found by Brown et al.[22], who did not verify alterations in BP during one hour when compared to sequences which used 40% and 70% of 1-RM, performing, respectively, from 20 to 25 and 8 to 10 repetitions. Focht and Koltyn[23] did not observe SBP alterations in 80% or 50% of 1-RM protocols. These authors observed only DBP reduction during 20 minutes after a sequence performed at 50% of 1-RM in 84 individuals.

In this study, BP increase after resistance exercise was not observed. This fact may be justified by the intensity of the performed

exercise; that is to say, the fact that exercise presents higher isotonic or isometric component may also influence on the post-exercise response[23].

Another important aspect in the study of the cardiovascular responses during resistance exercises is due to promotion of improvement in the musculoskeletal system, increasing muscular strength, power and endurance, besides increasing bone density, especially in older and hypertensive women[24]. Thus, the low and high intensity resistance trainings represent different stimuli to the body, and hence result in distinct muscular and cardiovascular adaptations.

This study here presented some limitations, such as the kind of used material for measurement (analog sphygmomanometer BD® and stethoscope BD® type MDF 747-duo sonic), which presented accuracy below the expectation, as well as the reduced sample size.

CONCLUSION

The data of this study suggest that the sequence of the resistance exercises with duration of three training sessions did no t result in post-exercise hypotension in hypertensive elderly women and significant differences in systolic and diastolic blood pressure of the low and high intensity groups have not been found.

All authors have declared there is not any potential conflict of interests concerning this article.

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