



Subacute behavior of the blood pressure after power training in controlled hypertensive individuals

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ABSTRACT

Several studies have shown a benefic effect of the power exercise on the reduction in the post-exercise blood pressure (BP), but there are insufficient researches involving hypertensive individuals. Thus, the present study has as main purpose to compare the BP responses on medicated hypertensive individuals after two sessions of power exercise with different training volumes. For this, it was studied 20 individuals of both genders (61 ± 12 years) with their hypertension controlled through medication, and who participated in an exercise program, but with no experience in power training. The study was performed in three non-consecutive days. First, it was determined ten maximal repetition load in each exercise of the sequence (straight supine, horizontal leg-press, stand-up-rowing, and triceps curl). In the remaining days, the same exercises were performed in one (SER1) or three (SER3) series. The BP measurement was performed through the auscultatory method in the pre-exercise period, immediately after each session, and within 60 minutes after ending the exercises. The repeated ANOVA measurements has identified in both sessions that the systolic (SBP), and diastolic blood pressure (DBP) values measured right after ending the exercises were higher ($p < 0.05$) than in the pre-exercise. The 60 minutes follow-up after the SER1 showed a reduction in the SBP only in the 40th minute, while it was found no reduction in the DBP. After the SER3, it was noted a fall in the SBP levels that lasted for the whole monitoring period. As to the DBP, it was found reductions in the 30th and 50th post-exercise minute. It can be concluded that a power training session can promote reductions in the levels of the SBP on medicated hypertensive individuals, and it seems to be necessary a higher training volume for that effect to occur.

INTRODUCTION

The blood pressure is an isolated risk factor for several heart and vascular diseases⁽¹⁾. On the other hand, the reduction in the blood pressure (BP) decreases the risk to develop such diseases⁽²⁾. Recent data suggests that antihypertensive therapies have been associated to the reduction in the incidence of cerebral vascular accident (35-40%), coronary artery disease (20-25%), and cardiac insufficiency (> 50%)⁽³⁾.

One of the strategies to reduce the resting blood pressure is the regular practice of physical exercises. Several studies have

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proved the benefic effect of the physical aerobic⁽⁴⁾ and power⁽⁵⁾ training on the resting BP levels. These effects can occur as a chronic adaptation to the training or as a reduction in the levels of the pressure after an exercise session that is called post-exercise hypotension (PEH)⁽⁶⁾.

The major part of the studies analyzing the effects of the physical activity on the post-exercise BP levels used as main strategy the aerobic exercise. The information on the behavior of the BP after the power training session is yet insufficient, mainly when the sampling is composed by hypertensive individuals. Nevertheless, it was verified that the power exercise can reduce the post-effort systolic BP both in normotensive and in hypertensive women⁽⁷⁾. In this case, it was performed five circuit exercises with 50% of the maximal load. More recently, when handling the intensity of six power exercises, it was identified a reduction in the systolic BP in healthy young individuals compared to the pre-exercise values up to 60 minutes after an activity⁽⁸⁾. Nevertheless, it was found no references on the post-effort BP when the handling an exercise volume such as the amount of series. This may be important, since the cardiovascular responses in multiple series can be higher than in a sole series⁽⁹⁾.

This way, the aim of this study was to verify the blood pressure behavior after two sessions of power exercises performed with different volumes in medicated hypertensive individuals.

MATERIALS AND METHODS

Subjects

It was recruited 20 hypertensive persons (61 ± 12 years; 70.2 ± 14.4 kg; 160.0 ± 6.2 cm) of both genders (16 men and 4 women) who was participating in a supervised physical exercises program, but with no previous experience in power training. Although all individuals were using at least one anti-hypertensive medication, there was no homogeneity as to the controlling of the medication. All individuals were instructed not to drink caffeine or alcohol during the data collection period, as well as not to perform their regular physical activities before the tests. It was considered as exclusion criteria those individuals who had any other disease that could compromise the cardiovascular responses and articular limitations that would unable them to perform the exercises.

Experimental protocol

After approved by the institutional ethic committee, it was performed three visits to the site of the test, with a 48 and 72 hours interval between them. At the first day, individuals went through an anamnesis, and they were instructed as to the procedures to be followed in the study. After such explanations, they signed a consent term, according to the Resolution 196/96 of the National Health Council. After that phase, it was performed a maximal 10 repetitions test (10RM) in the straight supine, peg-press, stand-up-rowing in the low (puxador), and triceps curl in the high handle

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(Rhigetto® Agglomerate). Each individual was given up to five tries, in order to determine the load, with a five minute interval between them.

When they arrived at the site of the trial in the next visit, all individuals remained for approximately ten minutes seat in a quiet and comfortable place to measure the pre-exercise BP. After that, one (SER1) or three (SER3) random series of at most ten repetitions in the proposed exercises was performed, with a two minute interval between each series and exercises.

During the execution of the sessions, the Valsalva maneuver was constantly discouraged, and there was no stimulus to motivate the volunteers. Immediately after ending each session, the BP was measured still at the site of the last exercise performed. After this measurement, individuals were transferred to a quiet site, where they remained seat for 60 minutes to record their BP, which was taken each 10 minutes. In every case, the BP measurement was taken by a sole and experienced researcher through the auscultatory method, using an aneroid sphygmomanometer (Tycos®), and a stethoscope (Sprague®).

Statistical analysis

Data were treated through the two-entry ANOVA (training volume x post-effort measurements) having the measurements repeated in the second factor. The Scheffé's post hoc test was used to identify significant differences, considering as statistical significance $p < 0.05$. To the data treatment the Statistica 5.5 software (Statsoft®, EUA) (descriptive and inferential) was used.

RESULTS

Results of the variables analyzed may be observed in table 1. The systolic (SBP) and diastolic (DBP) values measured immediately after ending the exercises were higher than in the pre-exercise in both sessions.

TABLE 1
Behavior of the systolic (SBP) and diastolic (DBP) blood pressure in the pre-exercise period, and after performing one (SER1) or three series (SER3)

	1 SERIE (SER1)		3 SERIES (SER3)	
	SBP	DBS	SBP	DBP
Pre-exercise	115.8 ± 10.4	72.6 ± 8.8	121.1 ± 14.5	75.1 ± 8.3
Post-exercise	131.8 ± 14.0*	75.0 ± 8.0*	134.5 ± 14.1*	75.7 ± 9.0*
10 min	113.2 ± 11.5	70.8 ± 9.5	115.9 ± 12.3 [†]	72.6 ± 10.2
20 min	112.7 ± 10.4	72.6 ± 8.3	114.2 ± 10.1 [†]	74.2 ± 10.6
30 min	111.5 ± 10.3	72.0 ± 10.0	113.1 ± 9.9 [†]	70.6 ± 8.4 [†]
40 min	110.7 ± 10.1 [†]	71.0 ± 9.3	113.3 ± 11.3 [†]	72.3 ± 8.4
50 min	113.7 ± 13.2	70.0 ± 9.5	114.0 ± 7.7 [†]	71.1 ± 9.1 [†]
60 min	117.8 ± 13.2	74.0 ± 10.5	115.1 ± 9.7 [†]	72.4 ± 6.7

* significant and higher difference compared to the pre-exercise period ($p < 0.05$).

[†] significant and lower difference compared to the pre-exercise period ($p < 0.05$).

After the SER1, the 60 minutes follow-up showed a reduction in the SBP only at the 40th minute, while it was found no reductions in the DBP levels.

After the SER3, it was observed a consistent fall in the post-exercise SBP levels, which lasted up to 60 minutes. It was found reductions only at the 30th and 50th post-exercise minute to the DBP.

DISCUSSION

In the present study, it was observed that immediately at the end of each session the mean SBP and DBP values were higher than in the pre-exercise, regardless the number of series. This can be explained by the variables helping to rise the BP and that ap-

pear during a highly intense physical activity with the chemoreceptor activation, due to the peripheral fatigue⁽¹⁰⁾. Thus, the exercises performed up to the exhaustion had as repercussion a higher BP response immediately after the effort⁽¹¹⁻¹³⁾, differently from exercises performed in a submaximal way⁽¹⁴⁾.

Nevertheless, the BP values in the next moments after the exercise seem to have a fast decrease through the baroreflex mechanism⁽¹³⁾, through the hyperemia occurred with the muscular contraction⁽¹⁵⁾, and through the suppression of the sympathetic activity⁽⁶⁾. Besides, BP values may have a reduction beyond the values observed in the pre-exercise. The mechanisms involved in such process are up to this moment not well clarified. It is possible that different isolated or combined physiological ways contribute to such phenomenon, such as a higher nitric oxide release⁽¹⁶⁾ and a lower adrenergic discharge⁽¹⁷⁾. Such reduction in the BP after a physical activity is considered one of the major non-pharmacological interventions to control the BP, mainly in hypertensive individuals⁽¹⁸⁾. In such a sense, the bigger magnitude and mainly the endurance of the PEH better the effect of the exercise on the cardiovascular health of the practitioner. Furthermore, it seems that the continuing succession of such hypotensive behavior after an effort has chronically reflections on the resting BP, and it becomes more reduced than the one observed in the pre-training condition⁽⁶⁾.

In this study, the BP reduction in the next moments to the exercise was influenced by the training volume. In the SER3 it was observed a significant reduction of the SBP values within the 60 minutes checking.

But it was identified only statistical differences in the DBP in those measurements taken 30 and 50 minutes after the exercise. It was found no standard behavior of reduction both to the SBP and the DBP in SER1.

In relation to the aerobic exercise, it seems that a higher volume causes a longer PEH⁽¹⁹⁾. This fact is associated to the results found in this study, i.e., that the mechanisms to reduce the BP after an activity would not be different in relation to the type of the exercise performed. One of the possible explanations to such fact lies in the increase of the vasodilator substances release, such as the nitric oxide and prostaglandin that increase the blood flow and decrease the vascular resistance⁽²⁰⁾. Nevertheless, aside the possible vasodilator agent responsible by the PEH, it is important to consider that the increasing blood flow can occur in a located and systemic way. In the first case, the blood flow only increases after the exercise in the requested spot. This was evidenced in the study performed by Legramante *et al.*⁽²¹⁾, when the authors only identified a reduction in the peripheral vascular resistance in the calf (which was requested during a maximal test), but they did not observe any alteration in the forearm. On the other hand, Cleroux *et al.*⁽²²⁾ have verified that after a 30 minute exercise on the cycloergometer at 50% of its maximum capacity, the peripheral resistance of the forearm was lower than the resting one. Thus, it can be supposed that the higher work volume, as in the case of this study in the SER3, would be related to the systemic alterations non-identified in SER1.

Nevertheless, even with a higher volume, the PEH was verified only in the SBP. These results confirm some studies found in the literature, in which it is found consistent reductions in the SBP values^(7,8,23), but the same pattern is not observed in the DBP both in normotensive and hypertensive women⁽⁷⁾, and in normotensive young individuals^(8,24,25). One of the possible explanations to the changing DBP is the value of the pre-exercise.

It is suggested in the literature that the reduction in the BP after an effort is directly related to its pre-exercise value⁽¹⁹⁾. For this reason, hypertensive individuals would present a higher absolute reduction in the pressure values than the normotensive individuals. Nevertheless, the individuals were under the action of medications in the present study, and this may have be the responsible

by the few variations in the DBP. Nevertheless, as to this study, any reduction in the BP, even not significant, can be understood as clinically important, since it is a physiological procedure to reduce the BP (even being temporary) in a hypertensive individual who was already being controlled through medication.

In fact, even without using any drugs, the PEH is not still a consensus as consequence of the power exercise. While there is information on the important reduction in the BP after the exercises⁽⁸⁾, other results did not show any alteration⁽²⁴⁾ or even showed an increase⁽²⁶⁾. The inconsistency of information may be associated to several variables involved, such as the way the BP measurement was performed and the post-effort follow-up period, and as to the prescription, to factors such as the volume, intensity, interval between series, and training status. This way, it is difficult to make a comparison between studies whose methodological features vary.

Finally, some limitations and observations in the present study need a further comment. First of all, the absence of a controlling or homogenization of the drugs used does not allow assert that the activity performed had exerted the same hypotensive effect in all individuals. Besides, individuals performed maximal repetitions as a way to homogenize the training intensity. But the de-

scription of maximal repetitions as a power training form for hypertensive individuals must be discouraged, due to potential commitments such as cerebral vascular accident, consequence of a sudden and intense elevation in the BP during the activity⁽²⁷⁾. Thus, the results attained in this study may not be reproduced with different workloads or repetitions.

Summarizing, it can be concluded that: a) power training exercises can promote reductions in the pressure level mainly to the SBP up to 60 minutes after the exercise in hypotensive individuals controlled through medication; b) it seems to be necessary a higher training volume for such effect to occur.

Nevertheless, it is necessary to perform further studies of the same nature in hypertensive individuals, mainly with a better control on the medication used.

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