15 - DOUBLE PRODUCT, CARDIAC FREQUENCY AND ARTERIAL PRESSURE AT DIFFERENT INTENSITIES IN RESISTANCE EXERCISES FOR HYPERTENSION

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INTRODUCTION

Characterized as a public health problem, there are around 30 million cases of Arterial Hypertension in Brazil according to the 4th Brazilian Arterial Hypertension Consensus (2001), in 15 to 20% of the adult population and more than 50% in elderly (FLECK,1987) . According to the 2nd Brazilian Consensus, arterial hypertension is characterized as a clinical condition of multi-factor natures, where the levels of artery pressure remain elevated and sustained (GUSMÃO, 2005). In this way, the systolic artery pressure would be found above 140 mmHg and the diastolic artery pressure above 90 mmHg. Although, the pathophysiology of hypertension is not clear in the majority of the cases considered idiopathic, or of an unknown origin. It can be the result of genetic factors, or due to a diet high in sodium, obesity, physical inactivity, psychological stress, or a combination of these factors (UCHIDA *et al*. 2003).

Physical training can show a prevention in the incidence of hypertension (ROLIM & BRUM, 2005), where the American College of Sports Medicine (ACSM) recommends it among the measurements not of pharmacological control of arterial pressure. This being that physical inactivity is a rick, as according to Rolim and Brum (2005), physical exercise provokes alterations in the hemodynamics and autonomics of hypertension patients, however the mechanisms responsible for the reduction of arterial pressure are still not clear (PRABHAKAR, 2004). Although, besides the choice to exercise, monitoring and control of the sharp cardiovascular responses is important, not only in the prescribing, but also for desirable effects (BLAIR *et al*. 1989). It is fundamental to the safe condition of proposed activities, necessary when the executor of the activity are individuals whose clinical conditions suggest high cardiovascular risks, to identify which activity offers them more satisfactory results at physiological and tensional levels to short and long pleasure.

The number of individuals adept at physical activities are growing, however, with the hypertension individuals in question, it would be necessary to better the quality of life with safe exercises. The Double Product (product of cardiac frequency by systolic arterial pressure) provides an estimate of force of miocardio, thus being important in the evaluation of the security of the practiced exercise, principally for hypertension. So, the objective of this study is to show the validity of intense force training (hypertrophy) in hypertensive individuals, as a safe choice, a training proposal that can bring good results without risks.

METHODOLOGY

This research, of descriptive and experimental character, uses a sample of six individuals, all male, of which 3 were normotensive and 3 hypertensive. The participants represent the average age equal to 36,7 plus or minus 9,22 years, all practicing physical activities in a large gym in the city of Joao Pessoa. The people involved in the selection process have already practiced anti-resistance exercise at least for the last 12 months, all active, with certification of aptitude to practice hypertrophy training. The individuals were selected intentionally, excluding those who use beta-blockers, a drug used to control arterial pressure, which action does not vary the cardiac frequency during force. In order to classify the normotensive or hypertensive state, the participating candidates had an a PA measurement in three opportunities and on three different days.

The people were informed of this research orally and through a term of informed assessment about the contents of the study, and asked to sign the conforming law 196/96 (annex), and their inclusion in this would be made only by means of a signature. They were asked for an up-to-date ergometric test with certification of aptitude to weight train, aiming at the security of the involved individual in the study and confirmation of their hypertensive characteristic or lack thereof.

A percentage test of maximum weight was performed using the Lemos (1991) table before the beginning of the training. The training hour of each of the individuals was respected without alteration, hence, the same hour would be used in the study. Four exercises were performed being two for superior members (muscular groups: chest and back) and two for the inferior members (muscular groups: femoral biceps and quadriceps), following the alternating method, and keeping the same order of exercise for all of the individuals. The weight lifting equipment were used in the following order: *Hack Machine Technogym,* Pulley *Technogym,* Leg curl *Righetto,* Chest press (free weights), standing out a work with the principal muscle groups, all available in the UP gym.

The resistance training consists of two sessions of training for each participant with weights of RML (of 15 to 20 repetitions) and Hypertrophy (of 8 to 12 repetitions), not allowing the training to last more than 30 minutes and with a rest interval of 48 hours between the sessions. Each session was performed with 4 exercises (the same as for RML and Hypertrophy) with three sets each, allowing a rest interval of 2 minutes between the exercises and 1 minute and 30 seconds between the sets.

After the student arrived at the gym, they spent 5 minutes seated and after, the values of PA and FC were collected during this rest, and following, a brief stretching. After the student positioned the machine to begin the exercise, the values of PA and FC were collected before the beginning of the first set, and immediately after the end of the third set, during each of the four exercises. An esfigmomanometric aneroid of the brand BD and an auscultador was used to evaluate the PA and an frequency meter of the brand Polar type S610i was used to measure the FC.

In the week that the individual was evaluated, it was asked that they not perform their regular training, so as not to interfere in the results.

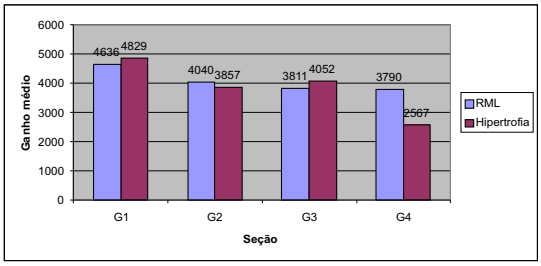
The statistic procedures applied in the comparison were executed using the statistic software SPSS, version for the Windows system (Statistical Package for the Social Sciences).The statistic treatment applied was Mann-Whitney and P-Value to analyze the data between resistance exercise of RML and Hypertrophy.

RESULTS

In order to evaluate the safety of the training, the differences obtained in the double products for the RML and Hypertrophy trainings were calculated. This difference is the gain in the double product before and after the performance of each exercise. In the manner that G1, ...,G4 are the gains in the double product obtained at the length of the exercises (1, 2, 3 and 4) in each of the sessions. Or could be: G1 = DP1after - DP1before. The values observed in G1, ...G4 for the RML and Hypertrophy is presented in Table 1.

TABLE 1
Descriptive measurements for training session and gain in the double product by session.

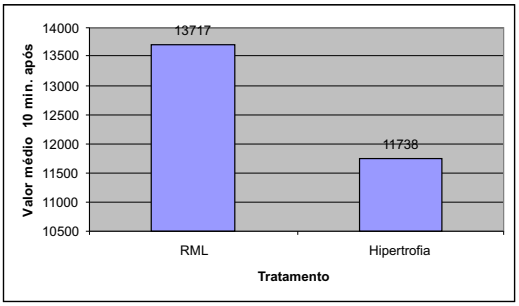
Training	Gain in the session	Descriptive Measurements			
		Minimum	Maximum	Average	Desv. Pad.
RML	G1	2425	9324	4636	2421,4
	G2	-60	10316	4040	3900,5
	G3	76	6364	3811	2236,6
	G4	1314	9548	3790	29,51,4
Hypertrophy	G1	2575	5826	4829	1287,9
	G2	405	8690	3857	2822,6
	G3	-1122	8208	4052	3196,7
	G4	1501	4388	2567	1088,4



Graph 1: Average gain per session for the RML and Hypertrophy sessions

According to Table 1 and Graph 1, it can be observed that there does not exist an average gain of double product in the four sessions. Observing the fact that under the point of clinical view, the average gains of double product behave in the following manner: better gains in RML for exercises of inferior members and better average gains in the session of hypertrophy for superior members.

After 10 minutes, the average values obtained with the RML and Hypertrophy are shown in



Graph 2: Average value observed per treatment (average value 10 min. after)

It can be observed in Graph 2 that the session of hypertrophy shows less readings of double product in recuperation, showing clinically better results. A statistic confirmation of this fact and of the presented results in Graph 1 would be analyzed with the application of the Mann-Whitney non-parameter test, that will be compared with the gains in the sessions (G1, ...,G4) and after 10 minutes.

TABLE 2
In comparison of the RML and Hypertrophy training sessions for G1, G2, G3, G4 and after 10 minutes.

Statistic Test	**G_1**	**G_2**	**G_3**	**G_4**	**After 10 min**
Mann-Whitney	12,0	17,0	17,0	15,0	7,0
Valor-P	0,394	0,937	0,937	0,699	0,093

Table 2 shows a comparison between RML and Hypertrophy for the variables of gain in each session for the product after 10 minutes. This statistic comparison was performed with the Mann-Whitney non-parametric test and it can be concluded that there was not a significant statistic difference (P-value > 0,05) in terms of safety, taking into consideration the average gain of the double product in both sessions.

DISCUSSION

Studies demonstrate that elevated levels of pressure in infancy, although within the normal limits, tend to increase as time pasts. Physical activities during childhood may reduce the risk of hypertension in the future, as was demonstrated in studies that state the blood pressure is inversely proportional to the physical activity during free time (TANASESCUM *et al,* 2000). Epidemiological studies show inverse relationship between physical fitness, level of physical activities, and development of cardiovascular diseases (PAFFENBARGER *et a.l*, 1993 BLAIR, *et al*. 1989). The better trained one is, the less the risk of having hypertension, which shows that regular physical activities are important factor in prevention and treatment of arterial pressure.

One of the goals of physical activities is the increase in physical strength, this is associated with good health and quality of life, allowing more efficiency in daily routines, (SUZUKI *et al.* 2001*)* minimizing the risk of accidental falls for elders (BUCHNER *et al.* 1997), decreasing cardiac stress (GUSMÃO *et al.* 2005, Mc CARTNEY *et al.* 1993), and decrease in cardiovascular diseases (TANASESCUM *et al.* 2002). The planning of strength training involves the control of variables such as the type of contraction, the number of repetition, number of training sessions, speed of execution, and resting time.

The execution of the Valsava maneuver during Hypertrophy resistance exercise contributed to elevate the arterial pressure (LINSENBARDT *et al.* 1992). During very intense requests, the Valsava maneuver is almost unavoidable, since it stabilizes the upper body and favors the execution. However, the statistical treatment of the results (Mann-Whitney and P-Value), was that the average value of the gain was not different in the training sessions (Mac DOUGALL *et al.* 1992*)*.

The goal of this study was to compare the cardiovascular responses during exercise sessions with residues of RML and Hypertrophy. Two sessions were conducted. The first was a RML, with three consecutive sets of 15 RM. The second session was for

Hypertrophy, with three consecutive sets of 10 RM. Both sessions were made up of the same exercises, alternating segmentation, and with two minute interval between repetition. The results clearly show that all the cardiovascular measurements increased significantly.

There are central mechanisms that control impulse and affect the cardiovascular response during the subjective sensation of stress in training sessions, either in resistance or aerobic exercise. This implies in a considerate high stress to elevate the cardiovascular response, during an intense exercise (MITCHELL *et al.* 1980). The increase in arterial pressure can also be influenced by the number of moving units requested during the exercise, and by the muscular mass involved. This is due to the muscular compression in the vascular basin, which partially blocks circulation of the blood. This mechanism of cardiovascular adjustment is noticed by structures that are sensible to the increase in the movement strength (mecanoreceptors, informing the cardiovascular control center, the need to change the cardiovascular responses (PRABHAKAR & PENG, 2004).

In the Forjaz *et al.* (2003) study, it was verified that resistance exercises present different cardiovascular effects in relation to intensity, being those of low intensity (RML) can be a complement to aerobic exercises for hypertensives.

In a study by Polito *et al.* (2004), it was affirmed that exercises executed bilaterally assume the tendency to increase PAS, FC and DP, in relation to exercises executed unilaterally, explained by the muscle mass involved or the amount of muscles used, the resistance exercise leads towards a great vascular occlusion by muscles in activity.

Miranda and collaborators (2005), in their study (analysis of cardiac frequency), discovered that the DP is less for the muscular mass involved, as in the choice of exercises and the form of execution is important when taking into consideration the cardiovascular situation of the client.

Polito and Farinati (2004) relate that the PA in exercises with weight has an equivalent or higher increase compared to continuous exercises. However, the smallest increase of FC can not exceed 70% of the FC maximum inducing to a smaller DP and consequently to a low cardiac risk. The intervals between the sets make the FC level return to pre-exercise levels.

The ACSM suggest that the exercise statistics offer a lesser probability for the occurring of episodes of chest angina in patients with coronary arterial sickness when compared to dynamic exercise, due to the increased coronary flux during a systole. The American Heart Association already affirmed that exercises with weight for individuals with cardio-circulatory compromises offers a less FC during the activity, when compared to aerobic exercise of moderate to high intensity, provoking less elevations in the DP.

Ten minuted after the end of the exercises, independent of the character and intensity, all of the cardiovascular variables decrease. In the meantime, the hypertrophy session (graph 2) presents a less average of double product in recuperation, showing clinically better results.

There was a rapid decline of the values of the cardiovascular variables at the end of the exercise, arriving closely and near levels to those of rest. However, the total recuperation of the arterial pressure and cardiac frequency can be observed approximately 10 minutes after the ending of the session, even in front of an important increase taking place during activity. This reduction can be explained by the abrupt blood perfusion by the vasodilation in musculature that was occluded and by the barrorecptor and cardiopulmanary reflex mechanisms, in response to the elevation or arterial pressure at the end of exercise (Mac DOUGALL *el al.* 1985).

In this manner, independently of the type of exercise, the PAD and FC reduces at the end of the exercise sessions, however the average gain of the lesser value for the DP post-exercise occurs in the hypertrophy activity. This represents for hypertensive individuals, less effort of miocardio in the recuperation of resistance activity.

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DOUBLE PRODUCT, CARDIAC FREQUENCY AND ARTERIAL PRESSURE AT DIFFERENT INTENSITIES IN RESISTANCE EXERCISES FOR HYPERTENSION

SUMMARY

Studies demonstrate that more intense resistance exercises better the cardio respiratory condition and neuromuscular without increased hypertension risks. This study took place with the objective to investigate the cardiovascular responses and security through the Double Product (FC X PAS), during two distinct sessions of resistance hypertrophy exercise and localized muscular resistance (RML). The arterial pressure (PA) was verified using the indirect stethoscope and cardiac frequency (FC) method, using the brand Polar frequency meter, model S610i, performing two measurements for every four sets of exercise, before beginning the first repetition of the first set and soon after the last repetition of the third set. The sample was composed of six male individuals, 3 with hypertension and 3 with normal tension, with the average age being equal to 37,7 plus or minus 9,22 years of age, excluding from the sample individuals that use beta-blocker. This session of hypertrophy concluded that due to the low number of repetitions by time of exposition to the exertion, the FC rises less than 70% of the maximum FC. Although, when compared, the RML resistance training and hypertrophy by the Mann-Whitney and P-value statistic treatment, it was observed that the average gain did not differ in the training sessions. However, it is necessary to conduct new studies utilizing a larger sampling in order to validate this interpretation. The other conclusions of this study could be reviewed using a larger sample size.

Key Words: Hemodynamic responses, Force Exercise, Arterial Hypertension

DOUBLE PRODUIT, FREQUENCE CARDIAQUE ET PRESSION ARTERIELLE DANS DE DIFFERENTES INTENSITES NOUS EXERCICES CONTRE RESISTES POUR HIPERTENSOS

RÉSUMÉ

Des études démontrent que les exercices contre résistés aussi améliorent le conditionnement cardiorrespiratório et neuromuscular sans offrir des risques aux hipertensos. Cette étude il a été réalisé en objectivant enquêter les réponses cardiovasculaires et la sécurité à travers le Double Produit (FC X PELLES), pendant deux sessions distinctes d'exercice contre résisté de hipertrofia et de résistance musculaire localisée (RML). S'est vérifiée pression artérielle (Pará), en s'utilisant la méthode indirecte auscutatório et fréquence cardiaque (FC), avec frequencímetro de la marque polaire, du modèle S610i, en réalisant deux prises pour chaque série de quatre exercices, avant initier première répétition de première série et bientôt après la dernière répétition de troisième série. L'échantillon a été constitué par 6 personnes tous hommes, en étant 3 hipertensos et 3 normotensos, avec moyenne d'âge de moyenne d'âge égal à 36.7 ± 9.22 ans, en excluant de l'échantillon personnes qui faisaient utilisation de beta-bloqueador. Pendant la session de hipertrofia, dû à la basse nombre de répétitions par le temps d'exposition à l'effort, FC monte moins que 70% de FC maxima. Néanmoins, quand comparée les sessions de formation contre résistée de RML par le traitement statistique de Mann-Whitney et de Valor-P, il s'est observé que les valeurs de je gagne demi ne diffèrent pas concernant sécurité.

Mots - Clé : Réponses hemodinâmicas, Exercice de Force, Hipertensão Artérielle

DOBLE PRODUCTO, FRECUENCIA CARDÍACA Y PRESIÓN ARTERIAL EN DISTINTAS INTENSIDADES NOSOTROS EJERCICIOS CONTRA RESISTIDOS PARA HIPERTENSOS

RESUMEN

Estudios demuestran que los ejercicios contra resistidos también mejoran el acondicionamiento cardiorrespiratório y neuromuscular sin ofrecer riesgos a los hipertensos. Este estudio se realizó en que objetivaba investigar las respuestas cardiovasculares y la seguridad a través del Doble Producto (FC X PALAS), durante dos sesiones distintas de ejercicio contra resistido de hipertrofia y resistencia muscular localizada (RML). Se comprobó presión arterial (Pará), utilizándose el método indirecto auscutatório y frecuencia cardíaca (FC), con frequencímetro de la marca polar, del modelo S610i, realizando dos tomas para cada serie de cuatro ejercicios, antes de iniciar primera repetición de primera serie y pronto después de la última repetición de tercera serie. La muestra ha estado constituida por 6 personas a todos los hombres, siendo 3 hipertensos y 3 normotensos, con media de edad de edad media igual a 36.7 ± 9.22 años, excluyendo de la muestra personas que hacían utilización betabloqueador. Durante la sesión de hipertrofia, debido bajo entre repeticiones en el caso de exposición al esfuerzo, FC sube menos que 70% de FC máximos. Sin embargo, cuando comparada las sesiones de formación contra resistida de RML por el tratamiento estadístico -Whitney mann y Valor-P, se ha observado que los valores de gano mitad no difiero acerca de seguridad.

Palabras clave: Respuestas hemodinâmicas, Ejercicio de Fuerza, Hipertensão Arterial

DUPLO PRODUTO, FREQÜÊNCIA CARDÍACA E PRESSÃO ARTERIAL EM DIFERENTES INTENSIDADES NOS EXERCÍCIOS CONTRA RESISTIDOS PARA HIPERTENSOS

RESUMO

Estudos demonstram que os exercícios contra resistidos também melhoram o condicionamento cardiorrespiratório e neuromuscular sem oferecer riscos aos hipertensos. Este estudo foi realizado objetivando investigar as respostas cardiovasculares e segurança através do Duplo Produto (FC X PAS), durante duas sessões distintas de exercício contra resistido de hipertrofia e resistência muscular localizada (RML). Verificou-se pressão arterial (PA), utilizando-se o método indireto auscutatório e freqüência cardíaca (FC), com frequencímetro da marca polar, modelo S610i, realizando duas tomadas para cada série de quatro exercícios, antes de iniciar a primeira repetição da primeira série e logo após a última repetição da terceira série. A amostra foi constituída por 6 indivíduos todos homens, sendo 3 hipertensos e 3 normotensos, com média de idade de média de idade igual a 36,7 ± 9,22 anos, excluindo da amostra indivíduos que faziam uso de beta-bloqueador. Durante a sessão de hipertrofia, devido ao baixo número de repetições pelo tempo de exposição ao esforço, a FC suba menos que 70% da FC máxima. Contudo, quando comparada as sessões de treinamento contra resistido de RML pelo tratamento estatístico de Mann-Whitney e Valor-P, observou-se que os valores de ganho médio não diferem em relação a segurança.

Palavras - Chave: Respostas hemodinâmicas, Exercício de Força, Hipertensão Arterial.