# 34 - EFFECT OF A STRENGTH TRAINING PROTOCOL AND THE TESTOSTERONE PROPIONATE ADMINISTRATION IN BODY WEIGHT, HEART WEIGHT AND LEFT VENTRICLE WEIGHT OF WISTAR RATS.

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## INTRODUCTION

Several studies have shown the effects of regular physical activities on organs and tissues. Concerning the cardiovascular system these effects are blood pressure and heart frequency control, among others 1,2. These results are based on the effects the exercises in the long and regular term and that have been practiced since adolescence. That authors state that such benefits are due to adaptive response to exercise. Many individuals only learnt the positive effects of the the practice of exercise later in their lifes or by doctoral prescriptrion for such practice. In these cases the exercises, besides promoting the already mentioned heart effects, also promote the reduction of the incidence of obesity, reduce cholesterol levels, prevent diabetes and all consequences of aterosclerosis, such as acute myocardial infarction (AMI), stroke and grangrene, besides osteoporosis, rheumatic symptoms, anxiety and depression 1,2,3.

Age-related changes in cardiovascular system are responsible for aortic dilatation, myocardic hypertrophy and left ventricle dilatation associated to a discrete blood pressure increase. These alterations tend to be different for each indvidual. The ratio of heart mass hypertrophy is about 1 to 1.5 g/year, between 30 and 90 years of age. The LV wall and interventricular septum increase discretely in thickness, but maintining normal ecocardiographic index. Within the LV wall, there is a collagen deposition, mainly in their posterior region, increasing the heart stiffness 4,5.

During the aging process, besides the mentioned heart alterations, hormone level alterations are also observed. The decrease in Testosterone levels is the most important phenomenon for men during aging. According to Martits 6 from the forties the testosterone levels fall to 1.6% a year.

The anabolic androgenic steroids (AAS) were initially synthesized for therapeutic purposes, and then, used in treatment of natural androgenic deficits, surgery recover and muscular atrophy, because they improve the nitrogen balance in catabolic status, avoiding loss of lean body mass and reducing the fat tissue increase. AAS is also used in osteoporosis, breast cancer and anaemia treatment because they stimulate the blood elements production. Although the AAS possible benefits in both physical development and physical appearance, AAS in excess can bring a number of deleterious alterations, mainly concerning the cardiovascular system, such as patological left ventricle hypertrophy and mitochondrial disorder, among others 8.

The heart weight and body weight coefficient analysis has been used in the characterization of myocardic hypertrophy (Almeida et al., 1979). This study aims to analyse the possible alterations in the heart weight of Wistar rats, in the left ventricle weight and the heart weight/body weight and left ventricle weight/heart weight coefficient in young and old-aged rats undergoing streght exercises with testosterone propionate administration.

## METHOD

For this study we used 27 male Wistar thirteen-month-old rats. The groups were divided as follows: Group C (Control), with 4 adult rats, sacrified at the age of thirteen months; Group S (Sedentary), with 6 rats sacrified at the age of sixteen months; Group ST (sedentary treated with testosterona propionate), with 6 rats sacrified at the age of sixteen months; Group T (Trained), with 5 rats undergoing a strength training programme at the age of sixteen months and Group TT (Trained with testosterone propíonate), with 6 rats undergoing a strengh training program from the ages of thirteen to sixteen months. Group C has not taken part since the animals were sacrified at the age of 13 months.

The animals went through a previous adaptation to the training register and to the equipment for 5 days. The equipment used to carry out the strength training programme with the animals was a vertical ratio designed in wood with irons steps. The height of the equipment (ratio) is 110 cm inclination of 80º. The top of the equipment has a plastic box lined with newspaper for the animals accommodation in the interval between the series 9,10.

The training program was based on the principle of overload with numbers of repetitions and rest that comes closest to the training in humans. So every week we added an overload on the animal's tail near the body with lead dumbdells. The rats climbed up the ladder in order to reach a rest area on top. This procedure was repeated for 6 times for 5 days of the week when we completed the process of adaptation.

The animals in group C carried out tasks for climbing the ladder once, 5 times a week with no overload untill their sacrifice. The groups S and ST carried out tasks climbing the ladder once, 5 times a week without overloads throughout the training register (16 weeks) in order to cause a similar stress to the trained group. The animals training from groups T and TT consisted of 6 repetitions 5 times a week for 16 weeks a resting interval of 45 secs betweem the repetitions.

The overload was established from proposal of HEYWARD 15. He points out that the classification of muscle strength is based on the relationship between the overload used to perform a given task the individual's body weight. In the literature there is no established model overload feed. Therefore, we adapted the table (1RM) for the human elderly proposed by Heyward 15 to animals. As the increase in overload was related to the animal's body weight every week all animals were weighed and had their charges adjusted.

Table 1. Table proposed by Heyward [15] to assess muscle strength in the elderly.

| Classification | Men | | Women | |
|---|---|---|---|---|
| | 50 - 59 years | > 60 years | 50 - 59 years | > 60 years |
| Superior | > 0.90 | > 0.82 | > 0.56 | > 0.55 |
| Excelent | 0.80 - 0.89 | 0.72 - 0.81 | 0.49 - 0.55 | 0.48 - 0.54 |
| Good | 0.72 - 0.79 | 0.67 - 0.71 | 0.44 - 0.48 | 0.43 - 0.47 |
| Weak | 0.64 - 0.71 | 0.58 - 0.66 | 0.40 - 0.43 | 0.39 - 0.42 |
| Bad | < 0.63 | < 0.57 | < 0.39 | < 0.38 |

Due to the animal's sedentary lifestyle and old age we've started from the rating index "Good" (reference for men), because the animals were in good health. The reference "Good" represents 75% of the animals' body weight similar to that found in a human training program and from the 4th week of training every 2 weeks we increased the references in 0.80, 0.90, 100, 110 and 120 representing 120% of the animal's body weight respecting the overload principle, bnesides the increase in the references every week we ajusted the overload according to animal's body weight, however if the animal's body weight reduced, the greater charge would be kept because the animals were used to the charge.

The hormone used was PERINON® (testosterone propiate, vets use) from Perini, in 100ml flask, having 1g testosterone propionate and peanut oil q.s.p. 100ml. The shgot was added acoording to the animal's weight, in the same ratio as the one used in humans. The dosage given to an adult wearing 70kg is of 200mg testosterone propionate.

The medicine administration was carried out three times a week. Aplication were done troughout the whole training register, summing up 33 intramuscular shots.

At the ages prescribed before the animals were anesthetized and sacrificed. Soon after they had their hearts removed, sectioning the base vessels near the organ, and weighed on a digital analytical scale with digital accuracy of 0.001g, using Scherle16 method(immersion in saline solution within a Becker, suspended by one wire without touching the walls of the container). Then the hearts were cut transversely at the level of the coronary sulcus, and the left ventricle was weighed separately.

Data are presented on means standard deviation and to detect the difference between the groups we used the Analysis of Variance (ANOVA) and the Tukey post-test with significance level at 5%. The data were analyzed with the statistics programme SPSS, version 12.0.

**RESULTS**

Analyzing body weight, heart weight, left ventricle weight, heart weight / body weight and LV weight / heart weight, we have found statistically significant difference in LV weight of the group C animals in relation to group S. The animals in group S had higher LV weight in relation to the animals in group C. There were no statistical differences in other parameters analysed (Table 2).

What concerns body weight there was an increase of 2.53% in group S when compared to group C. Group T,ST and TT animals presented a decrease in body weight of 7% when compared to group C.

Analyzing the heart weight we have concluded that an increase of 15.2% in group S in relation to group C. The group T ans ST animals have maintained the same weight as group C animals. Group TT animals showed an increase of 10% compared to group C animals. Comparing the LV weight between the groups, there was an increase of 31.16% in group S compared to group C. Group T, ST and TT animals showed an increase of 15% compared to animals of group C. The ratio heart weight / body weight of group S showed an increase of 14.25% compared to group C. The animals in group T and ST have maintained the same rate as group C. Whereas in group TT this rate has increased 21.42%. Regarding the LV weight / heart weight rate animals from group S, T, ST and TT, showed an increase of 12.28% compared to group C.

Table 2 - Effect of a strength training register and administration of testosterone propionate on body weight, heart weight, LV weight.

| Group | B wt, g | H wt, g | LV wt, g | H wt / Body wt % | LV wt / H wt% |
|---|---|---|---|---|---|
| (C) n=4 | 541.5 ± 51.70 | 1.51 ± 0.09 | 0.91 ± 0.06* | 0.28 ± 0.032 | 60.42 ± 7.74 |
| (S) n=6 | 546.6 ± 42.15 | 1.74 ± 0.12 | 1.20 ± 0.11 | 0.32 ± 0.034 | 69.61 ± 8.03 |
| (T) n=6 | 543.0 ± 69.15 | 1.52 ± 0.12 | 1.03 ± 0.13 | 0.28 ± 0.021 | 68.06 ± 4.21 |
| (ST ) n=5 | 517.5 ± 70.12 | 1.51 ± 0.19 | 1.01 ± 0.08 | 0.29 ± 0.065 | 68.15 ± 13.58 |
| (TT) n=6 | 485.8 ± 60.20 | 1.67 ± 0.25 | 1.10 ± 0.16 | 0.34 ± 0.051 | 66.39 ± 6.68 |

Means ± Standard deviation, n = n° of rats, B wt = body weight, H wt = heart weight, LV wt = left ventricle weight, H wt/B wt = relation heart weight/body weight, LV wt/ Hwt = realtion left ventricle weight/ heart weight, *p<0.05 vs S.

**DISCUSSION**

It was observed that old-aged animals have higher LV weight in relation to young animals due to an increase in the cardiomyocytes and interstitium partial volume during aging17. In our study, this sharp increase between group S and C may be caused by aging. While in the other groups we observed a moderate increase. In groups T and TT moderate increase was due to physiological hypertrophy due to physical exercise and testosterone-administration.

Woodiwiss 18 in their study with rats who practiced aerobic exercise (running) and received nandrolone decanoate-administration presented significant differences in all parameters examined in our study, ie, body weight, heart weight and left ventricle weight. Comparing the animals body weight in this study there was statistical difference in the sedentary group with testosterone when compared to other groups. In our study there was a slight decrease (7%) of body weight in groups T, TT and ST, this decrease may be related to the administration of testosterone and physical exercise which in our study was anaerobic. Comparing the aforementioned study on heart weight there was an increase in weight in the group exercised and exercised with testosterone, these results were also observed in our study. In the mean time, Liang 19, in their study (aerobic exercise) did not observe differences in these same parameters. This disparity found in the results may be due to the difference in the register of the exercise and the frequency of steroids-administration 19. We suggest more studies that might elucidate the influence of exercise on body weight and heart weight is suggested.

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**EFFECT OF A STRENGTH TRAINING PROTOCOL AND THE TESTOSTERONE PROPIONATE ADMINISTRATION IN BODY WEIGHT, HEART WEIGHT, LEFT VENTRICLE WEIGHT OF WISTAR RATS.**

**ABSTRACT.**

The objective of our study was to compare body weight, heart weight, left ventricle (LV), heart weight/body weight (HW/BW) and LV weight/heart weight (LVW/HW) coefficient of adult and old-aged rats submitted to an exercise protocol with testosterone-administration. Twenty seven male Wistar rats, divided into Group C (Control), 4 thirteen-month-old rats; Group S (Sedentary), 6 sixteen-month-old rats; Group ST (sedentary with testosterone), 6 sixteen-month-old rats; Group T (trained), 5 rats submitted to an exercise protocol from 13 to 16 months old; and Group TT (Trained with testosterone), 6 rats submitted to an exercise protocol from 13 to 16 months old. At 16 months old the animals were submitted to anesthesia, sacrified and had their hearts removed, seccioning the base vessels near the organ. All hearts were weighed in a digital analytical scale using Scherle method. Body and heart, left ventricle (LV) weights, HW/BW, LVW/HW were analyzed. For the statistical analysis ANOVA and Turkey post-test with significance levels of 5% were used. The body weight increased 2.5% in group S compared to group C. The other groups showed decrease of 7% compared to C. The heart weight increase in 15,2% in group S in relation to group C. Groups T, ST and TT have shown that the exercise associated with testosterone propionate produced weight and LV weight changes.

**KEY-WORDS:** left ventricle, anaerobic exercise, testosterone propionate.

**EFFET D'UN PROTOCOLE D'ENTRAÎNEMENT DE LA FORCE ET L'ADMINISTRATION DE PROPIONATE DE TESTOSTÉRONE SUR LE POIDS CORPOREL, LE POIDS DU CŒUR, LE POIDS DU VG CHEZ LES RATS WISTAR.**

**SOMMAIRE**.

L'objectif de cette étude était d'analyser les modifications de poids corporel, ventricule gauche (VG), relations poids du cœur/poids du corps et poids du VG/poids du coeur chez les rats adultes et les rats âgés soumis à l'exercice avec l'administration de testostérone. Nous avons utilisé 27 rats mâles Wistar qu'ont été divisés en groupe C (contrôle), groupe S (sédentaires), groupe ST (sédentaires/testostérone), groupe T (formés), 5 rats soumis à l'exercices à compter de 13 à 16 mois et le groupe FT (formés/testostérone), 6 rats soumis à l'exercice de 13 à 16 mois. Ont été analysés: le poids corporel, le poids du cœur, le poids du VG, les relations poids du cœur/poids corporel, poids du VG/poids du cœur. Nous avons utilisé ANOVA et le post-test de Tukey avec un niveau de signification de 5%. Le poids corporel a augmenté de 2,5% dans le groupe S par rapport à C. Les autres groupes ont montré une diminution de 7% par rapport à C. Le poids du coeur augmenté de 15,2% en S par rapport à C. Le groupe T et ST avaient les mêmes valeurs de C. Le groupe FT ont montré une augmentation de 10% par rapport à C. Le poids du VG augmenté de 31,16% en S par rapport à C. Les groupes T, ST et FT a presenté 15% d'augmentation du poids du VG par rapport à C. Les résultats ont montré que l'exercice de la résistance et l'utilisation de la testostérone propionate cause des modifications mineures du poids corporel et prononcée dans le poids du VG.

**MOTS-CLÉS:** Coeur, les exercices de résistance, la testostérone.

**EFECTO DE UN PROTOCOLO DE ENTRENAMIENTO DE LA FUERZA Y LA ADMINISTRACIÓN DE PROPIONATO DE TESTOSTERONA EN EL PESO CORPORAL, EL PESO DEL CORAZÓN, EL PESO VENTRÍCULO IZQUIERDO EN RATONES WISTAR.**

**RESUMEN**

El objetivo de este estudio fue analizar los cambios en el peso corporal, ventrículo izquierdo (LV), la relacion del peso cardiaco/peso corporal y LV/peso cardiaco de ratones, sometidas a un ejercicio con la administración de testosterona. Fueron usados 27 ratones divididos en Grupo C (control), 4 ratones de 13 meses, el grupo S (sedentarios), 6 ratones de 16 meses, el grupo ST (sedentario/testosterona), 6 ratones de 16 meses, el Grupo T (estrenado), 5 ratones ejercitados de 13 a 16 meses y

Grupo TT (estrenado/testosterona), 6 ratones ejercitados de 13 a 16 meses. En cierta edad los animales fueron anestesiados, sacrificado, los corazones fueron removidos, seccionados los vasos grandes, pesados en una balanza analítica con una precisión de 0,001g usando el método de Scherle. Se analizaron: peso corporal, el peso del corazón, el peso LV, las relaciones, el peso cardiaco/peso corporal, el peso LV/peso cardiaco. Se utilizó ANOVA, post test de Tukey, p<0,05. Peso corporal se incrementó 2,5% en comparación con C. S Los otros grupos mostraron una disminución de 7% en comparación con C. El peso del corazón aumentó 15,2% en comparación con C. S El grupo T y ST tenía los mismos valores de C. El grupo TT aumentaron un 10% en comparación con C. El peso LV aumentó 31,16% en comparación con C. S Los animales en los grupos T, ST y TT mostró un aumento de 15% en comparación con C. la conclusión de que el ejercicio y el uso de la testosterona causó pequeñas alteraciones en el peso corporal y gran alteracion en el peso de LV.

**PALABRAS CLAVE**: Corazón, actividad física, testosterona.

**EFEITO DE UM PROTOCOLO DE TREINAMENTO DE FORÇA E ADMINISTRAÇÃO DE PROPIONATO DE TESTOSTERONA NO PESO CORPORAL, PESO CARDÍACO, PESO DO VENTRÍCULO ESQUERDO DE RATOS WISTAR.**

**RESUMO.**

O objetivo desse trabalho foi analisar alterações no peso corporal, no ventrículo esquerdo (VE), relações peso cardíaco/peso corporal e peso VE/peso cardíaco em ratos adultos e idosos submetidos a exercícios com administração de testosterona. Foram utilizados 27 ratos machos Wistar, divididos em Grupo C (controle), 4 ratos de 13 meses; Grupo S (sedentário), 6 ratos de 16 meses; Grupo ST (sedentário/testosterona), 6 ratos de 16 meses; Grupo T (treinado), 5 ratos submetidos a exercícios dos 13 aos 16 meses e Grupo TT (treinado/testosterona), 6 ratos submetidos a exercícios dos 13 aos 16 meses. Nas idades determinadas os animais foram anestesiados, sacrificados, corações foram retirados, seccionando-se os vasos da base próximos ao órgão, pesados em balança analítica com acurácia de 0,001g, utilizando o método de Scherle. Foram analisados: peso corporal, peso cardíaco, peso do VE, relações peso cardíaco/peso corporal, peso VE/peso cardíaco. Foi utilizada a ANOVA e pós teste de Tukey com nível de significância de 5%. O peso corporal aumentou 2,5% no grupo S comparado a C. Os demais grupos apresentaram diminuição de 7% em relação a C. O peso cardíaco aumentou 15,2% em S comparado a C. O grupo T e ST apresentaram os mesmos valores de C. O grupo TT apresentou um aumento de 10% em relação a C. O peso do VE aumentou 31,16% em S comparado a C. Os grupos T, ST e TT apresentaram 15% de aumento do peso do VE em relação a C. Os resultados mostraram que o exercício resistido e o uso do propionato de testosterona provocaram alterações discretas no peso corporal e pronunciadas no peso do VE.

**PALAVRAS-CHAVE**: Coração, exercício resistido, testosterona.

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