

Effect of orchietomy on rat physical capacity

Efeito da orquiectomia na capacidade física de ratos

Denny Fabrício Magalhães Veloso¹, Andy Petroianu², Juliano Alves Figueiredo³,
Fernando Henrique Oliveira Carmo Rodrigues⁴, Bruno Gustavo Muzzi Carvalho e Carneiro⁵, Priscila Oliveira Cardoso⁶

ABSTRACT

Objective: Bilateral orchietomy is indicated for the treatment of patients with testicular cancer or advanced prostate tumors. The influence of hypogonadism on physical activity is still not known. The purpose of this work was to verify the effect of bilateral orchietomy on physical performance. **Methods:** Sixteen rats were divided into two groups: Group 1 (Control), in which only skin incision and suture were made ($n = 5$) and Group 2, in which the rats were submitted to bilateral orchietomy ($n = 11$). The animals were trained to run on a treadmill at the speed of 14 meters per minute until they were fatigued. The results were compared using the Mann-Whitney test. **Results:** There was no difference between the animals submitted to orchietomy and the Control Group. **Conclusions:** Bilateral orchietomy does not affect the physical performance of the rat.

Keywords: Orchietomy adverse effects; Hypogonadism; Castration; Exercise; Motor activity; Rats

RESUMO

Objetivo: A orquiectomia bilateral é indicada para tratamento de pacientes com neoplasia de testículo ou adenocarcinoma de próstata avançado. A influência do hipogonadismo na capacidade física ainda não é completamente conhecida. A proposta deste trabalho foi verificar o efeito da orquiectomia bilateral na capacidade física. **Métodos:** Dezesesseis ratos foram distribuídos em dois grupos: Grupo 1 (Controle), em que os ratos tiveram apenas incisão e sutura da pele ($n = 5$), e Grupo 2, no qual eles foram submetidos a orquiectomia bilateral ($n = 11$). Os animais foram treinados a correr em uma esteira a velocidade de 14 m/min, até sua fadiga. Os resultados foram comparados utilizando-se o teste de Mann-Whitney. **Resultados:** Não houve diferença entre os animais

submetidos à orquiectomia e o Grupo Controle. **Conclusões:** A orquiectomia não afeta a capacidade física de ratos.

Descritores: Orquiectomia/efeitos adversos; Hipogonadismo; Castração; Exercício; Atividade motora; Ratos

INTRODUCTION

Testosterone is an anabolic steroid from the androgen group that stimulates protein synthesis and promotes a high muscle mass/fat mass ratio⁽¹⁾. The interstitial cells of the testes secrete this hormone. The production is controlled by the interstitial cell-stimulating hormone/luteinizing hormone (ICSH/LH) which is produced by the anterior lobe of the pituitary gland. The testes secrete more than 95% of total testosterone in males; the remainder is produced by the adrenal cortex.

Hypogonadism is considered a risk factor for certain diseases, such as osteoporosis, osteopenia, increased blood triglyceride levels, obesity and hypertension⁽²⁻⁵⁾. In the aging male, “physiologic” hypogonadism is associated with a loss of lean body mass and an increase in fat mass with a consequent loss of physical capacity. Therefore, considering that testosterone helps maintaining muscle tone, it is possible that secondary hypogonadism may affect physical conditioning.

A review of literature produced no studies correlating orchietomy and physical performance. Most research is done by administration of testosterone or other metabolites to individuals with sex hormone deficiencies to determine their effects on body composition⁽⁶⁻⁹⁾.

Study carried out at Faculdade de Medicina of Universidade Federal de Minas Gerais – UFMG, Belo Horizonte (MG), Brasil.

¹ Master's degree from Faculdade de Medicina da Universidade Federal de Minas Gerais – UFMG, Belo Horizonte (MG), Brazil.

² Post-doctorate degree; Full professor at Faculdade de Medicina of Universidade Federal de Minas Gerais – UFMG, Belo Horizonte (MG), Brazil.

³ Master's degree from Faculdade de Medicina of Universidade Federal de Minas Gerais – UFMG, Belo Horizonte (MG), Brazil.

⁴ M.D., Faculdade de Medicina of Universidade Federal de Minas Gerais – UFMG, Belo Horizonte (MG), Brazil.

⁵ M.D., Faculdade de Medicina of Universidade Federal de Minas Gerais – UFMG, Belo Horizonte (MG), Brazil.

⁶ Medical student at Faculdade de Medicina of Universidade Federal de Minas Gerais – UFMG, Belo Horizonte (MG), Brazil.

Corresponding author: Denny Fabrício Magalhães Veloso – Rua dos Pampas, 538 – apto. 1.103b – Prado – CEP 30410-580 – Belo Horizonte (MG), Brasil – Tel.: (31) 8741-0372/3295-0372 – e-mail: dennyfmv@yahoo.com.br

Received on: Jun 13, 2008 – Accepted on: Oct 01, 2008

OBJECTIVE

The purpose of this study was to assess the aerobic performance of hypogonadal rats.

METHODS

This study was conducted in accordance with the recommendations of the Guiding Principles in the Care and Use of Animals, and was approved by the Ethics Committee of the Surgery Department of the Medical School of Universidade Federal de Minas Gerais (UFMG)⁽¹⁰⁻¹¹⁾.

Sixteen male Wistar rats (*Rattus norvegicus albinus*) with a mean weight of 359.6 ± 38.2 g were divided into two groups: Group 1 (Control), made up of five rats that underwent only skin incision and suture; Group 2, made up of 11 rats submitted to bilateral orchiectomy.

All animals were anesthetized with an association of ketamine, at the dose of 60 mg/kg of body weight, and xylazine, at the dose of 10 mg/kg of body weight. The anesthetics were applied intramuscularly in the right gluteal region. Orchiectomy was done through an anterior median incision in the scrotum. Each testicle was exposed through the surgical incision. The ductus deferens were isolated, ligated, and severed allowing the testicle to be removed. The incision was then closed and sutured with 3-0 chromic catgut.

In Group 1, the sham operation involved the exposure of the testes without isolation. The incision was closed and sutured with 3-0 chromic catgut.

Five months after the operation, the animals were trained to run on a treadmill (Modular Treadmill, Columbus Instruments, USA) at a constant speed of 14 m/min., with zero inclination, for five minutes each day, during four consecutive days (Figure 1).

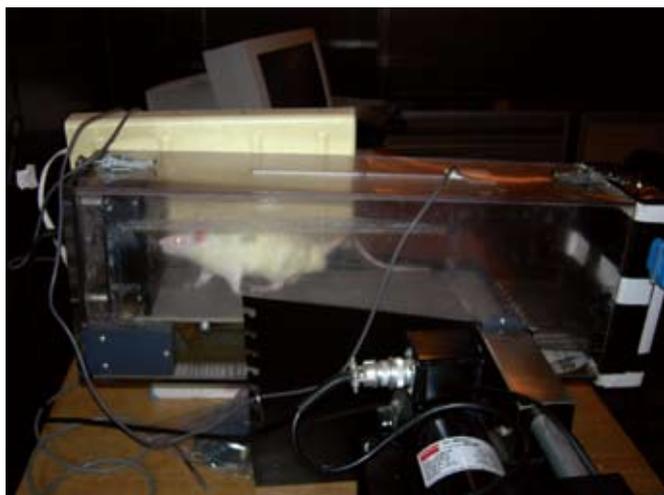


Figure 1. Rat training to run on a treadmill

Before initiating the definitive exercise, the animals were weighed. To test their physical performance, the rats ran on the treadmill at a constant speed of 20 m/min., with zero inclination, until they were fatigued. The test was interrupted when the animal could not keep running at a determined velocity, when it kept falling off or spent more than ten seconds off the treadmill. The number of falls and the time during which the rats remained off the treadmill were determined by observation of the animals⁽¹²⁾.

The results were assessed by the non-parametric Mann-Whitney test, to compare the independent samples to the variable of interest. The p value < 0.05 was considered statistically significant.

RESULTS

Upon evaluation of results (Table 1), no differences were found in the body weight of animals in each group. Table 1 also reveals that the mean total exercise time was slightly higher among the orchiectomized rats. However, this difference was not statistically significant when compared to the Control Group.

Table 1. Body weight and total exercise time on treadmill of control rats (Group 1) and orchiectomized rats (Group 2)

Parameters	Group 1 (n = 5)	Group 2 (n = 11)	p
Weight (g)	327.1 ± 25.4	359.6 ± 38.2	0.2573
Time (min)	81.6 ± 40.3	100.9 ± 44.2	0.1405

Mean ± standard deviation of mean and p value calculated by the Mann-Whitney test

DISCUSSION

Testosterone is important for the maintenance of muscle tone in animals and men. Replacement therapy with testosterone and its metabolites promotes changes in body composition of fat and muscle mass. Regular physical activity also affects body composition. However, there is still a paucity of information concerning the influence of hypogonadism on physical performance.

An increased body weight, mainly due to fat mass, in men who underwent chemical or surgical castration for therapeutic purposes has been described⁽¹³⁾. On the other hand, the body fat and muscle mass of healthy men diminish after testosterone administration⁽⁶⁻⁸⁾. An increase in muscle mass with a consequent increase in lean body mass, without fat change, was observed in HIV positive hypogonadal patients who received testosterone replacement^(9,14).

High doses of the testosterone metabolite, dehydroepiandrosterone, were given to women with adrenal insufficiency, but no changes in their physical performance or body content were observed⁽¹⁵⁾. No changes in physical performance or organic structure occurred in healthy elderly men that received testosterone metabolite⁽¹⁶⁾.

CONCLUSIONS

The effects of testosterone on the rat physical activity and muscle strength did not seem to be significant; other organic processes may be considered in further investigation.

ACKNOWLEDGMENTS

Special thanks to professor Dr. Nilo Rezende Viana Lima, Dr. Heather Lynn Hauter and Fundação de Amparo à Pesquisa do Estado de Minas Gerais (FAPEMIG) for their essential support and assistance to the study.

REFERENCES

- Herbst KL, Bhasin S. Testosterone action on skeletal muscle. *Curr Opin Clin Nutr Metab Care*. 2004;7(3):271-7.
- Daniell HW, Dunn SR, Ferguson DW, Lomas G, Niazi Z, Stratte PT. Progressive osteoporosis during androgen deprivation therapy for prostate cancer. *J Urol*. 2000;163(1):181-6.
- Reckelhoff JF, Zhang H, Granger JP. Testosterone exacerbates hypertension and reduces pressure-natriuresis in male spontaneously hypertensive rats. *Hypertension*. 1998;31(1 Pt 2):435-9.
- Alexandersen P, Haarbo J, Byrjalsen I, Lawaetz H, Christiansen C. Natural androgens inhibit male atherosclerosis: a study in castrated, cholesterol-fed rabbits. *Circ Res*. 1999;84(7):813-9.
- Ross RW, Small EJ. Osteoporosis in men treated with androgen deprivation therapy for prostate cancer. *J Urol*. 2002;167(5):1952-6.
- Snyder PJ, Peachey H, Hannoush P, Berlin JA, Loh L, Lenrow DA, et al. Effect of testosterone treatment on body composition and muscle strength in men over 65 years of age. *J Clin Endocrinol Metab*. 1999;84(8):2647-53.
- Katznelson L, Finkelstein JS, Schoenfeld DA, Rosenthal DI, Anderson EJ, Klibanski A. Increase in bone density and lean body mass during testosterone administration in men with acquired hypogonadism. *J Clin Endocrinol Metab*. 1996;81(12):4358-65.
- Bhasin S, Storer TW, Berman N, Callegari C, Clevenger B, Phillips J, et al. The effects of supraphysiologic doses of testosterone on muscle size and strength in normal men. *N Engl J Med*. 1996;335(1):1-7.
- Bhasin S, Storer TW, Javanbakht M, Berman N, Yarasheski KE, Phillips J, et al. Testosterone replacement and resistance exercise in HIV-infected men with weight loss and low testosterone levels. *JAMA*. 2000;283(6):763-70.
- Cooper JE. Ethics and laboratory animals. *Vet Rec*. 1985;116(22):594-5.
- Petroianu A. Ética, moral e deontologia médicas. Rio de Janeiro: Guanabara Koogan; 2000.
- Rodrigues LO, Oliveira A, Lima NR, Machado-Moreira CA. Heat storage rate and acute fatigue in rats. *Braz J Med Biol Res*. 2003;36(1):131-5.
- Smith MR, Finkelstein JS, McGovern FJ, Zietman AL, Fallon MA, Schoenfeld DA, et al. Changes in body composition during androgen deprivation therapy for prostate cancer. *J Clin Endocrinol Metab*. 2002;87(2):599-603.
- Strawford A, Barbieri T, Van Loan M, Parks E, Catlin D, Barton N, et al. Resistance exercise and supraphysiologic androgen therapy in eugonadal men with HIV-related weight loss: a randomized controlled trial. *JAMA*. 1999;281(14):1282-90.
- Callies F, Fassnacht M, van Vlijmen JC, Koehler I, Huebler D, Seibel MJ, et al. Dehydroepiandrosterone replacement in women with adrenal insufficiency: effects on body composition, serum leptin, bone turnover, and exercise capacity. *J Clin Endocrinol Metab*. 2001;86(5):1968-72.
- Arlt W, Callies F, Koehler I, van Vlijmen JC, Fassnacht M, Strasburger CJ, et al. Dehydroepiandrosterone supplementation in healthy men with an age-related decline of dehydroepiandrosterone secretion. *J Clin Endocrinol Metab*. 2001;86(10):4686-92.