



ORIGINAL ARTICLE

The effect of diet induced obesity on testicular tissue and serum oxidative stress parameters[☆]

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KEYWORDS

Obesity;
Male infertility;
Testosterone;
Oxidative stress;
Anastrozole

Abstract

Objective: The aim of this study was to evaluate the effects of diet induced obesity on semen parameters and serum antioxidant enzyme levels.

Material and methods: Six-week-old male rats were randomized into three groups as follows: group 1 ($n=10$) received a control diet, group 2 ($n=9$) received a high-fat diet and group 3 ($n=11$) received high-fat diet plus anastrozole. At the completion of a 10-week period, testicular tissues were obtained and spermatogenesis was evaluated with Johnsen Score System. The normal Johnsen Score was accepted as >9.39 . In addition, serum antioxidant enzyme levels, triglyceride, cholesterol, testosterone, luteinizing hormone (LH), follicle stimulating hormone (FSH) and estradiol levels were measured in serum.

Results: Body weights were significantly increased in mice fed with a high-fat diet compared to normal diet ($P<.05$). The mean triglyceride levels were 64.00 ± 20.48 mg/dl, 98.89 ± 27.80 mg/dl and 95.27 ± 15.02 mg/dl in group 1, group 2 and group 3, respectively ($P<.05$). Male rats fed with a high-fat diet had significantly lower levels of testosterone compared with the control diet male rats ($P=.005$). Testicular pathology revealed that Johnsen score were 9.60 ± 0.15 , 8.72 ± 1.81 and 9.29 in group 1, group 2 and group 3, respectively ($P=.169$). In addition serum nitric oxide (NO) levels were higher in group 2 and group 3 compared to group 1 ($P<.05$).

Conclusion: As a result it may be concluded that obesity may induce oxidative stress and decrease testosterone levels. These changes may alter testicular functions and consequently it may be speculated that obesity can be an important causative factor in the etiology of the male infertility.

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PALABRAS CLAVE

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Estrés oxidativo;
Anastrozol

Efecto de la obesidad inducida por dieta en el tejido testicular y parámetros de estrés oxidativo en el suero

Resumen

Objetivo: El objetivo de este estudio fue evaluar los efectos de la obesidad inducida por dieta en los parámetros de semen y los valores séricos de enzimas antioxidantes.

Material y métodos: Ratas macho de 6 semanas fueron distribuidas aleatoriamente en tres grupos: el grupo 1 (n = 10) recibió una dieta controlada; el grupo 2 (n = 9), una dieta alta en grasas, y el grupo 3 (n = 11), una dieta alta en grasas junto con anastrozol. A las 10 semanas se obtuvieron los tejidos testiculares y se evaluó la espermatogénesis con el sistema de puntuación de Johnson. Se aceptó > 9,39 como puntuación normal. Además, se midieron los valores séricos de enzimas antioxidantes, los triglicéridos, el colesterol, la testosterona, la hormona luteinizante (HL), la hormona estimulante del foliculo (HEF) y el estradiol en el suero.

Resultados: El peso corporal aumentó considerablemente en los ratones alimentados con una dieta alta en grasas en comparación con los que recibieron una dieta normal ($p < 0,05$). Los valores medios de triglicéridos fueron $64,00 \pm 20,48$, $98,89 \pm 27,80$ y $95,27 \pm 15,02$ mg/dl en los grupos 1 y 3, respectivamente ($p < 0,05$). Las ratas macho alimentadas con una dieta alta en grasas presentaban valores de testosterona considerablemente más bajos en comparación con las que recibieron una dieta controlada ($p = 0,005$). La patología testicular reveló que la puntuación de Johnson fue $9,60 \pm 0,15$, $8,72 \pm 1,81$ y $9,29$ en los grupos 1, 2 y 3, respectivamente ($p = 0,169$). Además, los valores de óxido nítrico (NO) en el suero fueron mayores en los grupos 2 y 3 que en el 1 ($p < 0,05$).

Conclusión: Como resultado, se puede concluir que la obesidad puede provocar estrés oxidativo y la disminución de los valores de testosterona. Estos cambios pueden alterar las funciones testiculares y, por lo tanto, se puede especular que la obesidad puede ser un factor causante importante en la etiología de la infertilidad masculina.

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Introduction

Infertility is defined as a couple's inability to achieve pregnancy following one year of unprotected intercourse, and it is considered one of the main public health issues.¹ A male factor is contributory in more than 50% of couples showing fertility evaluation.² Although the most common etiologic factor of male infertility is idiopathic, other causes are varicocele, urogenital infections, sexual and immunologic factors, cryptorchidism, testicular torsion or trauma, gonadal dysgenesis, and obstruction of the reproductive channels.¹ Additionally, many studies revealed that there is an increased likelihood of abnormal semen parameters among overweight and obese men and an elevated risk for subfertility among couples in which the male partner is overweight or obese.³

In studies reporting the relation between obesity and male infertility, several mechanisms have been proposed to explain this connection. The aromatization of testosterone is the key step in estrogen synthesis and is catalyzed by the aromatase enzyme system.⁴ Aromatase enzyme, which converts testosterone to estradiol, is highly expressed in peripheral fat tissue. It is thought that the increase in estrogens in obese males is due to increased conversion of testosterone owing to the increase in the available aromatase enzyme in the fatty tissue.⁵ This peripheral conversion may result in decreased testosterone levels and increased estradiol levels. Increased estradiol production may inhibit secretion of the gonadotropin-releasing hormone (GnRH), LH, and FSH from the hypothalamus

and pituitary glands. The main strategy in usage of aromatase inhibitors is to increase testosterone and reduce estrogen levels. Although it has been reported that body weight correlates negatively with blood testosterone levels and testosterone/estradiol ratio in some previous studies, this fact has not been understood clearly. Apart from these endocrinologic changes, it has been emphasized that metabolic syndrome or one of its components (hyperlipidemia) may cause oxidative stress in obesity cases.⁶

Oxidative stress is the condition associated with an increased rate of cellular damage induced by oxygen and oxygen-derived oxidants commonly known as reactive oxygen species (ROS).⁷ The major targets of ROS are membrane lipids and this process is called lipid peroxidation. It is also known that, the testicular tissues and spermatozoa are very sensitive to ROS attack and lipid peroxidation.⁷ Susceptibility of testicular tissues to oxidation was attributed to the highly rich polyunsaturated fatty acid content of sperm membranes.¹ In this context, although the majority of previous related studies confirmed a negative relation between sperm concentration, motility, and male obesity,⁸ some others reported different findings.⁹ So, in this study, we aimed to evaluate the effects of obesity on testicular histology and oxidative stress parameters in diet induced rat model.

Material and methods

The study was approved by the local ethical committee (Ethical approval number 2009-HADYEK-025). A total of 30

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