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The Effects of Low Frequency Ultrasound on Serum Levels of Testosterone in Male Rats

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Abstract: *There are studies showing that serum level of sex steroids might influenced by environmental factors including noise pollution. We exerted laboratory experimental research to assess the effects of ultrasound on serum level of testosterone in male rats. In our study, male Wistar rats were divided into three groups: control group which was not exposed to ultrasound waves, and rats exposed to ultrasound waves (24-25KHz) for 1h/day, and 6h/day. After 8 weeks, serum levels of testosterone were measured using ELISA method. Data were analyzed using SPSS 18 and ANOVA. Our results indicated that serum levels of testosterone did not significantly change in groups exposed to ultrasound waves compared to control animals. According to our finding, low frequency ultrasound waves may not significantly influence male reproductive in short period of time.*

Keywords: *Ultra sound, Testosterone, Rat*

1. Introduction

The term "ultrasonic" applied to sound refers to anything above the frequencies of audible sound, and nominally includes anything over 20,000 Hz. Frequencies used for medical diagnostic ultrasound scans extend to 10 MHz and beyond. Sounds in the range 20-100 kHz are commonly used for communication and navigation by bats, dolphins, and some other species. Much higher frequencies, in the range 1-20 MHz, are used for medical ultrasound.[1] Ultrasound waves are longitudinal, compressional waves, that can be periodic or pulsed, propagate at roughly 1500m/s in water or biological tissue, can leave the medium unchanged, but at higher intensities can also change it. Ultrasounds also can be used in ultrasound imaging in medicine for diagnosing diseases.[2] Ultrasounds can be used in medicine, appreciation of the characteristics of ultrasound waves and their behavior in various media is essential to understanding the use of diagnostic ultrasound in clinical medicine. [3]

Ultrasonic signals exceeding the hearing range may increase the risk of hearing damage, dizziness, balance disturbances, tinnitus and fatigue, also Workers using ultrasonic devices suffered from functional changes such as neurasthenia, cardiac neurosis, hypotension, heart rhythm disturbances (bradycardia) and adrenergic system disturbances.[4] Ultrasonic waves also have effects on production of testosterone and estradiol which both have regulatory function in male reproductive behaviors.

2. Materials and Methods

In our study, male Wistar rats were divided into three groups: control group which was not exposed to ultrasound waves, and rats exposed to ultrasound waves (24-25KHz) for 1h/day, and 6h/day. Serum levels of testosterone were measured using ELISA method. Data were analyzed using SPSS 18 and ANOVA.

3. Results

Our results indicated that serum levels of testosterone did not significantly change in groups exposed to ultrasound waves compared to control animals. (Figure I).

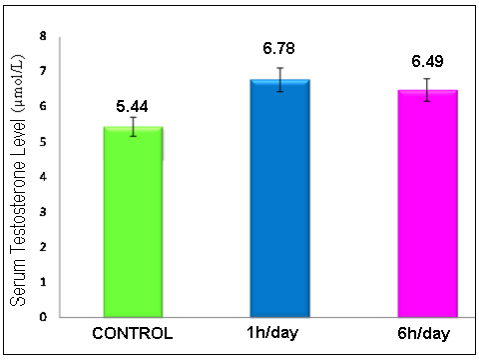

Fig. I. Serum level of testosterone in control, and groups exposed to ultrasound waves for 1h/day and 6h/day for 8 weeks.

4. Discussion

Testosterone produced by the leydig cells is essential for proper functioning of reproductive and accessory reproductive organs as well as non-reproductive tissues as muscle, skin or liver. Secretion and synthesis of testosterone by leydig cells are under the control of endocrine, paracrine and autocrine factors.[5][6] Testosterone is the primary androgen in men. Testosterone is necessary for normal sperm development. Secreting testosterone by Leydig cells has a key role in maintenance of spermatogenesis and fertility. Experiments show that the level of testosterone is not considerably changes during ultrasounds radiation, although there are reports show ing that the level of testosterone decreases. Studies show that low-intensity pulsed ultrasound (LIPUS) can act as a treatment for erectile dysfunction in a rat model of type I diabetes mellitus induced by streptozotocin . in this regard, LIPUS therapy significantly improved erectile function in diabetic rats, as evidenced by increased endothelial and smooth muscle content, a higher collagen I/collagen III ratio, increased quantity of elastic fibers, and elevated eNOS and nNOS expression [7]. The protein expressions of neurotrophic factors also can be enhanced by low-intensity pulsed ultrasound (LIPUS) stimulation in the brain. Studies show the protective effect of LIPUS stimulation against aluminum-induced cerebral damage in Alzheimer's disease rat model [8]. The results of research indicate that ultrasound waves might be applied in modulation of cardiac rhythm in neonatal rat ventricular cardiomyocytes [9]. Focused low-intensity pulsed ultrasound also can enhance bone regeneration in rat [10]. The results of studies also demonstrate alterations induced by ultrasound in the connective tissue of the cervix and suggests the therapeutic application of ultrasound for the facilitation of labor and delivery [11]. It has also been shown that Low-intensity Ultra Sound can reduce RBC edema [12]. Studies have also shown that increase in the expression of ciliary neurotropic factor gene, as a nerve growth factor, is occurred following ultrasound radiation, which can be considered as the reason of the effect of ultrasound on the rate of injured nerve regeneration [13]. Osteogenic effect of low intensity pulsed ultrasound on rat adipose-derived stem cells also has been observed in recent studies [14]. In line with many studies indicating the improving effects of ultra sound waves on various tissues, we also demonstrated that ultrasound waves have no harmful effect on male hormonal system – particularly testosterone level s - in short period of time.

5. Conclusion

According to our finding, low frequency ultrasound waves may not significantly influence male reproductive in short period of time. .

6. Acknowledgements

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7. References

[1] http://hyperphysics.phy-astr.gsu.edu/hbase/sound/usound.html
[2] https://www.ucl.ac.uk/medphys/staff/people/bcox/USlecturenotes_Jan2013.pdf
[3] http://ymk.k-space.org/Ultrasound_HO.pdf
[4] http://archiwum.ciop.pl/59815
[5] http://nopr.niscair.res.in/bitstream/123456789/23265/1/IJEB%2043(11)%20939-962.pdf
[6] http://www.nature.com/articles/srep24807
[7] Lei H, Xin H, Guan R, Xu Y, Li H, Tian W, et al. Low-intensity Pulsed Ultrasound Improves Erectile Function in Streptozotocin-induced Type I Diabetic Rats. Urology. 2015 Dec;86(6):1241.e11-8 http://dx.doi.org/10.1016/j.urology.2015.07.026
[8] Lin WT, Chen RC, Lu WW, Liu SH, Yang FY. Protective effects of low-intensity pulsed ultrasound on aluminum-induced cerebral damage in Alzheimer's disease rat model. Sci Rep. 2015 Apr 15;5:9671. http://dx.doi.org/10.1038/srep09671
[9] Fleischman A, Vecchio C, Sunny Y, Bawiec CR, Lewin PA, Kresh JY, et al. Ultrasound-induced modulation of cardiac rhythm in neonatal rat ventricular cardiomyocytes. J Appl Physiol (1985). 2015 Jun 1;118(11):1423-8.
[10] Jung YJ, Kim R, Ham HJ, Park SI, Lee MY, Kim J, et al. Focused low-intensity pulsed ultrasound enhances bone regeneration in rat calvarial bone defect through enhancement of cell proliferation. Ultrasound Med Biol. 2015 Apr;41(4):999-1007. http://dx.doi.org/10.1016/j.ultrasmedbio.2014.11.008
[11] Luo D, Yu H, Garfield RE, Shi SQ, Towe B. Treatment with focused ultrasound waves softens the rat cervix during pregnancy. Ultrasound Med Biol. 2014 Sep;40(9):2107-12 http://dx.doi.org/10.1016/j.ultrasmedbio.2014.02.028
[12] Lim MH, Seo AR, Kim J, Min BH, Baik EJ, Park SR, et al. Effects of low-intensity ultrasound on gramicidin D-induced erythrocyte edema. J Ultrasound Med. 2014 Jun;33(6):949-57. http://dx.doi.org/10.7863/ultra.33.6.949
[13] Jahromy FZ, Behnam H, Mansoori K, Rahimi AA, Edalat R, Mobarake JI. The effect of ultrasound on the expression of CNTF gene, a possible cause of ultrasound influence on the rate of injured peripheral nerve regeneration. Australas Phys Eng Sci Med. 2013 Sep;36(3):323-9. http://dx.doi.org/10.1007/s13246-013-0216-y
[14] Jiang T, Xu T, Gu F, Chen A, Xiao Z, Zhang D. Osteogenic effect of low intensity pulsed ultrasound on rat adipose-derived stem cells in vitro. J Huazhong Univ Sci Technolog Med Sci. 2012 Feb;32(1):75-81. http://dx.doi.org/10.1007/s11596-012-0013-y