Original Article

Impact of ten weeks interval training on femoral strength and estrogen hormone

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ABSTRACT

With increasing age, bone tissue is destroyed and menopause is associated with low bone mass. The purpose of current study is to examine impact of ten weeks interval training on femoral strength and estrogen hormone in ovariectomy Sprague Dawley rats. Material and Methods: 40 Sprague dawley female rats were randomly selected from Medical Sciences Laboratory, they were anesthetized and their ovaries were removed. After 12 weeks they were divided into 2 equal groups: control group (C), and exercise group (E). Exercise program, which was executed on flatted treadmill. After the rest period and the beginning of menopause 10 rats in each group was selected to perform pre-test. And end of 10 weeks exercises training all rats from each group was bleeding for determination of estrogen hormone and then killed for assigning of strength of femur. Results: in this research it was observed that there is significant difference in strength of femur and estrogen hormone ($P<0.05$). Conclusion: The findings of this research showed exercise would significantly increase the production of estrogen, thereby increases the strength of the femur. On the other hand, due to the decrease in the natural production of estrogen and complications of osteoporosis in postmenopausal to reduce injury and prevent fractures.

Keywords: Exercise, electromagnetic, strength of femur, estrogen hormone.

Introduction

The loss of estrogen after menopause plays a vital role in osteoporosis. Estrogen increases the rate of bone growth and the bones reach final length to 2 to 4 years after maturity makes it can also improve bone density. In this regard, Swaim-Rachelle et al results showed that estrogen is useful to prevent osteoporosis and fractures associated with it [1]. In general, decreased luteinizing hormone resulting in decreased production of estrogen and Reduction of estrogen caused amenorrhea & bone mineral density and lead to osteoporosis [2]. In other words, with increasing age, bone tissue is destroyed and menopause is associated with low bone mass. So that in sedentary postmenopausal women, bone mass decreases [3]. With the expansion of population aging Menopause, and hormonal changes caused by it, osteoporosis and fractures may quickly turned into a public health problem the substantial economic burden on health care resources creates [3].

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Many scientists believe that walking is suitable sports and physical activity to maintain and improve physical and mental health is in society and repeatedly reliable sources and article in this field claimed this. On this basis researcher as Puntila in 2001 showed that active young and post-menopausal women, and, are less prone to loss of bone density are less exposed to loss of bone density. The most common model of sport is mentioned these women walk [4]. Also Korpelaninen et al in 2006 showed that 35 minutes three times a week of walking for 3 months in middle-aged women Created significant changes in serum estrogen levels over baseline and the control group thus maintains bone density among people increases [5].

Minor et al in 2006, the studies showed that the strength of the femur and tibia in patients who were exposed to physical exercise and estrogen were higher and biomechanical properties in the exercise group receiving estrogen significantly increased [6]. Doing a proper exercise training program, in menopause women many of the problems caused by estrogen deficiency, such as reduced risk of osteoporosis decrease also aging process changes in the body system like skeletal changes the role of sport and its effects on bone-building hormones. Such as estrogen and eventually its effects on skeletal bone strength could be introduced as a strategy to society. So, the purpose of this study is the impact of ten weeks interval training and electromagnetic therapy on femoral strength in ovariectomy Sprague Dawley female rats.

Materials and Methods

Frothy female 2 months old Sprgue Dawley rats with the weight of 200±5 gram provided from Laboratory Animal Center of Shiraz University of Medical Sciences. They were anesthetized and their ovaries were removed. After 12 weeks of rest to reach menopause 10 rats in each group were selected to perform pre-test at first anesthetized with a mixture of 2% xylazine and 10% ketamine (8 and 90 mg/kg respectively) then for investigate the biomechanical properties of the femur and measure the hormone estrogen were killed then remaining rats were divided to 2equal groups: control group (C) and exercise group (E).

All animals were housed identically as five rats per cage in a condition of 12 hours light/dark cycles with environmental temperature of 21±2°C and relative humidity of 50%. They were fed with standard pellets and had access to food and water ad libitum. The enrolled rats were in all menstrual cycles (protestors, estrous, diestrous, metestrous). Animal selection, all experiments, subsequent care and sacrifice procedure were all adhered to the same guidelines under supervision of Animal Care Committee of Iran Veterinary Organization. All experiment were carried out under aseptic conditions in Comparative Medicine Research Center of Shiraz University of Medical Sciences. The protocol of anesthesia, surgical procedure, postoperative care and sacrifice were identical for all animals.

Exercise training

The exercise training consisted of running on a flatted treadmill (Shiraz, Iran) 3 days/weak for 10 weeks. The speed of treadmill gradually increased from 15 m/min to 19 m/mins and the duration of each exercise started from 6 min in the first week and reached1 8 mins in the last week of exercise training (10^{th} week) (Table 1). All exercises were performed in the morning and for adaptation to further experiments, they underwent exercise for one week (5 times/week) with a speed of 12 m/mins and the duration of 3 mins. No electric shock or artificial stimulation was used at during the study.

Table 1: Exercise program protocol (Ivamoto 2005)

Week	1^{st}	2^{nd}	3^{rd}	4^{th}	5^{th}	6^{th}	7^{th}	8^{th}	9^{th}	10^{th}
Speed (meters / minute)	15	15	15	15	15	19	19	19	19	19
Time (minute)	6	6	9	9	12	12	15	15	18	18

Blood sample

They were bled under anesthesia from their heart. The blood sample was centrifuged (Model: Behdad Iran) with 3000 rpm speeds for 10 mins.

The collected serum samples were transferred into tubes and were kept in -20°C for further tests. Then using ELISA tests, estrogen (Monobind, USA, 92630) levels were determined.

Biomechanical Testing

Mechanical strength of the diaphysis longs bones was evaluated by compression test using a material testing machine (H505ks, Hounsfield, England) in the Fars Standard Institute.

Each bone was placed horizontally between two quadrate plate shapes and was to cut using an electric saw at medial of diaphysis. A speed of 50mm/min for femur fracture occurred ultimate load was determined from the load number by connected computer.

Statistical analysis

Statistical analysis was performed using SPSS software (version 20, Chicago, IL, USA), which allows a variety of descriptive, and inferential statistics were analyzed provides. However, to analyze the hypothesis of descriptive indicators mean and inferential tests Independent- Samples T Test and Paired-Samples T Test was used. Also, to evaluate the relationship between estrogen and femoral strength test, Pearson correlation coefficient was used.

Findings

As the results of (Table 2) shows, the mean scores of estrogen after ovary removal hipbone strength in animals studied groups were significantly increased ($P<0.05$). In other words, menopauses, in ovariectomy rats significantly reduce the production of estrogen and reduced bone strength in hip. Thus, it can be expected that there is a significant difference between the variance of the studied groups. The next review will be discussed.

Table 2: Average statistical indicators estrogen and hip bone strength before and after menopause in ovariectomy rats

Variable	Groups		N	Mean	SD	Maximum	Minimum	P
Bone Strength	Control	Before Examine	10	7.05	0.720	8.12	6.23	0.005
		Next Examine	10	5.65	1	7.64	4.35	
	Exercise	Before Examine	10	8.29	0.918	9.68	6.56	0.026
		Next Examine	10	7.55	0.539	8.69	6.74	
Estrogen	Control	Before Examine	10	10.45	3.428	15.74	5.10	0.000
		Next Examine	10	3.41	1.29	5.67	1.69	
	Exercise	Before Examine	10	11.33	3.65	20.1	7.75	0.021
		Next Examine	10	6.78	1.39	9.22	4.38	

The amount of estrogen and femoral strength after testing in the two groups are shown in (Table 3). As the following table shows the results of this exercise, the production of the hormone estrogen ($m = 6.78$; $df = 17.88$; $t = -5.597$; $p = 0.000$) and femoral strength ($m = 7.55$; $df = 13.77$; $t = -5.261$; $p = 0.000$) in rats of exercise training significantly increased compared to control group ($p<0.05$). Consequently, the research hypothesis is verified in these components and statistical hypothesis is rejected.

Table 3. Comparison of variables estrogen and femoral strength between the exercise and control groups

Variable	Groups	Mean ± Std.Deviation	Df	T	P
Bone Strength	Control	5.65 ± 1	13.77	-5.261	0.000
	Exercise	7.55 ± 0.539			
Estrogen	Control	3.41 ± 1.29	17.88	-5.597	0.000
	Exercise	6.78 ± 1.39			

In other words, we can say that practicing sport as a reinforcing agent for the production of estrogen and femoral strength in ovariectomy rats acts. Also, according to the results between the mean values of estrogen (m = 1.36; df = 9; t = 3.14; p = 0.011) and femoral strength (m = 0.738; df = 9; t = 2.65; p = 0.026) before and after there is a significant difference exercise. And this relationship is approved by two-tailed significance level ($p<0.05$). In other words, it can be concluded that 10 weeks of exercise training led to increased production of estrogen and bone strength in the hip (Table 4).

Table 4: Paired- Samples T Test results to changes in estrogen and hip bone strength before and after exercise

Variable	Paired Differences			T	Df	P
	Mean	Std.Deviation	Std.Error Mean			
Bone Strength	0.738	0.88	0.278	2.65	9	0.026
Estrogen	1.36	1.64	0.457	3.14	9	0.011

As (Table 5) shows the correlation between the variable estrogen and hipbones are straight and strong and this relationship is approved at a significance level of 95% ($p<0.01$).

Table 5: Correlations

	Bone Strength		
	N	R	Sig (2-tailed)
Estrogen	20	0.720**	0.000

Based on these findings, we can say that for every unit increase in variable estrogen, thighbone strength, ovariectomy in rats increased by 0.720.
Thus, we can say that the hormone estrogen is a strengthening factor for the hipbones for animal acts.

Discussion

According to the study, the removal ovary animals and create menopausal leads to reduced bone strength in hip. Which can result in stopping production of estrogen caused by menopause since this hormone is a vital hormone and plays a key role in the bone building?
This finding is consistent with results of other studies [1, 3, 7] are similar. The results of this research suggest that following reduce the activity of ovaries and reduce the estrogen production in menopause symptoms, such as osteoporosis threatens the health of postmenopausal women and menopause is associated with low bone mass. In other words, it can be concluded that a lack of estrogen during menopause plays a vital role in osteoporosis after menopause and addition to physical symptoms Such as cancer [8], can have a negative effect on quality of life and mental health [9, 10].
In general, studies have shown that lower estrogen levels have been observed in patients after menopause, bone mass is associated with low levels [11]. This has led to fractures caused by osteoporosis in menopause to become one of the most important problems facing the health status. So, impose many annual health problem and economics pressure on communities. On the other hand, it should be noted that although the rate of bone loss during menopause significantly increases but also fractures related osteoporosis decades after it reaches its widest. Several decades later, reaches to its maximum. It is estimated that more than 30% female fetuses of that age over 90 years will experience a hip fracture. About 20% of them within 3 months after the fracture complications of prolonged immobility will be lost [12]. One of the most important health implications for postmenopausal is bone loss and fractures of the hip Because of the difficulties of life lost.
Experts also believe that this may lead to mortality. Therefore, given that osteoporosis is a major public health problems and a major cause of fractures and disability in postmenopausal women during menopause [13]. Suitable assessment of bone mineral density, prevention, and treatment of osteoporosis in postmenopausal women is very necessary [14]. On the other hand, as the results showed a strong correlation and direct between estrogen and femoral strength. Which is to treat osteoporosis without taking hormone replacement becomes impossible. To explain these findings, several studies have shown that low levels of estrogen after menopause is associated with low bone mass, there is a direct linear relationship between estrogen and bone mass strength. Consequently, the lack of estrogen after menopause plays a vital role in osteoporosis, so these findings aligned with studies cited. In fact, osteoporosis occurs after menopause due to estrogen deficiency. Estrogen deficiency causes increased bone resorption from your body and the production of progesterone at this time also stops. Reduced levels of progesterone may reduce severe bone formation as a result, osteoporosis process improved rapidly [15, 16].
It should be noted that there is another type of osteoporosis in older postmenopausal that osteoporosis will occur. On the other hand, it is expected that sporting activities are a useful part in regulating the hormones and decreasing bone loss. In this study, the results showed that after 10 weeks of exercise training the production of estrogen and hipbone strengths occurs in rats which have been exercising, significantly increased compared to control group. In other words, these results suggest that exercise training as a reinforcing agent for the production of estrogen and femoral strength in ovariectomy rats acts. The results of the findings with other studies [5, 17] aligned. In analyzing this finding, we can say that several studies indicate him effectiveness of exercise in order to promote and maintain bone density improve bone mass, bone strength and balance so exercise can reduce the risk of bone fracture [18].
Also, many studies have been done at a young age before menopause and researchers studied the effect of exercise on the different age and its impact on older age like after menopause. All of these studies indicated the benefits of exercise on bone density and bone strength [19, 20]. Fonseca et al researched about effects of voluntary exercise on osteocytes and bone strength in Ovariectomy rat. And they concluded that voluntary exercise can prevent the death of osteocytes and this protective effect is associated with increased bone strength, that this research finding is similar to this paper [20]. They observed that 5 days a week for 13 weeks with 30 to 60 minutes exercise increase bone mass compared to the control groups in 63 days old rats [21]. In general, studies show that exercise is effective on bone strength and bone structure. Also in 2004, Iwamoto et. al. in his research reported that treadmill exercises increase the weight-bearing tibia bones mineral content on bone mass [16]. Of course, type of training on bone density is an important issue that can affect the results of various studies. Therefore, it is important that effectiveness of physical activity, particularly for adolescents is more than in adults [16].
The results support this idea That physical activity during adolescence is associated with lifestyle in youth. As a result, physical activity can be a way to prevent osteoporosis. The results of this research showed an increase in bone mass due to physical activity during the period of growth are associated with the greater bone mass in adulthood and menopause. And given the evidence that has been obtained from some of the athletes. Bone

mineral content can be remaining many years after retiring from the sports athletes because these results are obtained on the basis of longitudinal studies with great accuracy These results provide a great evidence for this hypothesis that physical activity can affect bone health, especially in the teenage years. Also, exercise can improve the size and shape the bones more than other factors such as bone mineral content and this decreases the risk of fractures in weight-bearing bones, particularly in people who are physically more active. Therefore, physical activity in adolescents and young adults recommended preventing osteoporosis and reducing the risk of fractures caused by osteoporosis in menopausal women and elderly.

Conclusion

The findings of this research showed exercise practice significantly increase the production of estrogen, thereby increasing the strength of the femur. On the other hand, due to the decrease in the natural production of estrogen and complications of osteoporosis in postmenopausal to reduce injury and prevent fractures caused by osteoporosis in menopausal women and elderly, exercise and physical activity and sports participation on the part of everyday life prevented osteoporosis and it's an effective treatment for people. This is an important finding that experts and authorities should pay attention to the health of the elderly and postmenopausal women and consider these findings more seriously.

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