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Effect of Focused Ultrasound on Abdominal Fat During Menopause

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Abstract : Egypt, and the countries of the Middle East in general, are typical of many middle income developing countries that have experienced a rapid rise in the prevalence of obesity. Data from the Demographic and Health Surveys show that in 1992,mothers with young children had a mean body mass index (BMI) of 26.9.By 2005, this had risen to a mean(BMI) OF 30.1with nearly half of Egyptian women of reproductive age classified as obese.Clearly,Egypt is facing extraordinary changes in the prevalence of overweight and obesity in a comparatively short period of time. Obesity has long been recognized to be an important cause of type ц diabetes mellitus, hypertension, and dyslipidemia the adverse metabolic effects of excess body fat are known to accelerate atherogenesis and increase the risk of coronary heart disease, stroke, and early death. The relationship of obesity to cancer has received less attention than its cardiovascular effects. Overweight women are known to have increased risk of endometrial cancer and breast cancer after menopause. The aim of this study was to Investigate the effect of focused ultrasound on the abdominal fat thickness during post-menopausal period. Thirty volunteer overweight menopausal women, their ages range from 45 to60 years old enrolled in the study were randomly assigned into 2 groups: control, and study. HDL, LDL, TG and TC concentration was measured for all participants pre- and post-treatment period. There was a significant difference between the two groups in the HDL,LDL,TG and TC concentrations after treatment. But there was no significant difference between the two groups regarding the HDL,LDL,TG and TC concentrations before treatment. We suggest additional focused ultrasound is a necessary adjunct to exercise to decrease abdominal fat thickness during post-menopausal period.
Key words : HDL, LDL, TC, TG.

1. Introduction

Menopause is associated with weight gain and a shift in body fat distribution. Once estrogen deficiency is established, a new pattern of fat distribution is observed (gluteo-femoral or gyencoid fat) deposition decreases and (abdominal or android fat) accumulation increases [1].During the menopausal transition, decrease in bone mineral density (BMD) occur but at the same time changes in body composition take place. Body fat distribution becomes more central, lean body mass(LBM)declines and a reciprocal increase in total body fat mass (FM) occurs [2].The increased waist circumference and waist-to-hip ratio are well established surrogate markers for relative increase of visceral fat. Fat cells in the visceral fat tissue are more active in terms of metabolism and proliferation rates than more peripherally located subcutaneous fat [3].Abdominal obesity is metabolically different from gynencoid obesity and contributes for the development of insulin resistance, type 2 diabetes mellitus, and dyslipidemia, components of metabolic syndrome, which are important risk markers of cardiovascular disease, the major cause of death among postmenopausal women [4].Abdominal obesity is assessed through measurement of waist circumference(WC).An increase in WC carries a greater risk of development future cardiovascular events and diabetes than increased body mass index (BMI).New Egyptian WC cutoff points for abdominal obesity are developed based upon data from the Egyptian National Hypertension (NHP).These are 97.5 cm for men and 80 cm for women. The prevalence of abdominal obesity in Egyptian based upon the IDF guidelines is 30.2% for men and 70.9% for women while based on new Egyptian criteria, the prevalence of abdominal obesity in men 37.1%and in women 50.8%.A positive correlation was found between waist circumference (WC) and most of the cardio metabolic risk factors.Avey high rate of obesity was reported among Egyptians, especially among hypertensive Egyptian women with age adjusted prevalence rate of 48.8% [5].

Greater demand in body aesthetic medicine for non-invasive procedures has motivated researchers to develop new techniques to replace traditional treatments for body contouring. In the past, the only way to achieve dramatic improvement in body silhouette was by removing local fat deposits through liposuction or other surgical procedures. These surgical approaches have drawbacks for patients (hospitalization, pain, post-operative bruising and swelling,)Such drawbacks prompted the development of a new device to reduce subcutaneous fat volume [6].

Recently, non- invasive focused ultrasound technology that allowing to safely achieve fat reduction without the need for invasive surgery. Focused ultrasound beam directed towards the subcutaneous fat layer , causing a mechanical rather than a thermal effect to avoid adverse skin effects. This process selectively causes the disruptions of fat cell membranes, leaving blood vessels, peripheral nerves and connective tissue intact. Triglycerides from the fat cell are released into the interstitial fluid between the cells, activating metabolic pathways that direct the water-insoluble molecules through the circulatory system. During this process, lipoproteins bind to the triglycerides and both are then catabolised into free fatty acids and glycerol molecules. Free fatty acids released from the fat cells are transported directly to liver through the bloodstream and are processed in the normal pathways for fat metabolism [7].

2. Materials and methods

Thirty volunteer overweight menopausal women between 45 and 60 years of age were selected from the outpatient clinic of the El-sahal Hospital, and were enrolled in the study. Subjects with hernias, skin disorders in the abdominal area or BMI > 35 kg/m2were excluded from the study. Written informed consent was obtained from each subject. Age, weight, height and body mass index wewe collected from each subject in the study. The study was designed as a prospective randomised clinical trial.

Subjects were randomized into 2 groups, each group consisting of 30 subjects. In group A was the control group and practiced abdominal exercises and walking on treadmill for 30 minutes twice per week for six weeks and group B was the study group and received focused ultrasound treatment sessions on their abdominal region in addition to practicing abdominal exercises and walking on tread mail for 30 minutes twice per six weeks.

Blood sample analysis was used to measure the concentration of total cholesterol (TC),triglyceride(TG),high density lipoprotein-cholesterol (HDL-C) and low density lipoprotein-cholesterol (LDL-C) before and after treatment.

Statistics

A statistical package program was used to evaluate the data obtained from the study. Descriptive statistical methods (mean, and standard deviation) were used in the evaluation of research data as well as the Kolmogorov–Smirnov distribution test for examining normal distribution. In comparing quantitative data, the unpaired samples t-test was used in intergroup comparison of parameters. The Paired samples t-test was used for intragroup comparisons. The results were calculated at the 95% confidence interval, $P < 0.05$ significance level and $P < 0.01$ advanced significance level.

3. Results

No study participant left the research project for any reason. No side effects or complications were observed during the treatment. Baseline characteristics of the subjects are shown in Table 1. The average age was 51.33 ± 3.15years in the study group and 52.53 ± 4.40years in the control group. The average height was 159.40 ± 3.88cm in the study group and 158.87 ± 3.56cm in the control group. The average weight was 83.73 ± 4.84kg in the study group and 81.47 ± 4.54kg in the control group. The average boby mass index was 32.93 ± 1.62Kg /m²in the study group and 32.33 ± 1.75Kg /m² in the control group.

No statistically significant difference was found between the 2groups in terms of age, height, weight, and boby mass index ($P > 0.05$).

The increase in the HDLconcentrationsfor the study group at the end of the treatment was statistically significant in comparison to the control group ($P < 0.05$), as shown in Table 2.

The LDL concentrationsdecrease in the study group at the end of the treatment was significantly significant in comparison to the control group ($P < 0.05$), as shown in Table 3.

The decrease in the TG concentrations for the study group at the end of the treatment was statistically significant in comparison to baseline concentrations ($P < 0.05$), as shown in Table 4.

The decrease in the TC concentrations for the study group at the end of the treatment was statistically significant in comparison to baseline concentrations ($P < 0.05$), as shown in Table 5.

Table 1.Baseline characteristics of the subjects.

Characteristics	control (n = 15)	study (n = 15)	p
Age (years, mean ± SD)	52.53 ± 4.40	51.33 ± 3.15	0.398
Weight (kg, mean ± SD)	81.47 ± 4.54	83.73 ± 4.84	0.197
Height (cm, mean ± SD	158.87 ± 3.56	159.40 ± 3.88	0.698
Bodymass index(Kg/m^2)	32.33 ± 1.75	32.93 ± 1.62	0.340

Data are presented as mean ± SD or number of subjects.

Table 2.HDL concentration.

Leptin hormone	control (n = 15)	study (n = 15)	p
Baseline	43.73± 4.27	46.20± 4.74	0.145
At the end of the treatment	48.27± 4.43	53.53± 4.16	0.002*

Data are presented as mean ± SD. *$P < 0.05$.

Table 3.LDL concentration.

Leptin hormone	control (n = 15)	study (n = 15)	p
Baseline	169.67± 5.80	170.07± 4.95	0.840
At the end of the treatment	150.87± 6.83	144.07± 7.78	0.017*

Data are presented as mean ± SD. *$P < 0.05$.

Table 4.TG concentration.

Leptin hormone	**control (n = 15)**	**study (n = 15)**	**p**
Baseline	215.80± 5.12	216.07± 5.28	0.889
At the end of the treatment	185.27± 5.59	180.60± 3.70	0.012*

Data are presented as mean ± SD. *P < 0.05.

Table 5.TC concentration.

Leptin hormone	**control (n = 15)**	**study (n = 15)**	**p**
Baseline	247.93± 3.92	248.87± 4.26	0.537
At the end of the treatment	230.67± 4.27	225.00± 6.36	0.008*

Data are presented as mean ± SD. *P < 0.05.

4. Discussion

Focused ultrasound is anew device that is capable of removing stored fat with the same efficacy as liposuction but without the invasive component and complications associated to it. Multiple treatments using this device can be effective as an non invasive method for reducing unwanted fat deposits. Focused ultrasound is to generate primary mechanical effect and in doing so, rupture the adipocyte membrane with minimal dam age to neighboring blood vessels, nerves and connective tissue. No discomfort during or after treatment and no complications have been reported [8].

The results of the present study are supported by that of Shek et al., 2014 who reported a study of 123 healthy men and women with BMI not more than 30 kg /m^2 and Sat ≥2.5 cm at the treatment site, whose anterior abdomens were treated with an average of 161 j/cm^2. At 12 weeks there was an average decrease in waist circumference of 2.1 cm[9].

The results of the present study are supported by that of Solish et al., [10] who studied the effect of different fluencies on fat reduction using HIFU in a randomized, single blinded postmarketing study.At the 1 week follow up visit, there was an average abdominal circumference reduction of 2.51 cm, with no statistically significant difference between the different fluencies and the amount of reduction in circumference [10].

In conclusion, additional focused ultrasound is suggested to be a necessary adjunct to exercise to decrease abdominal fat thickness during post-menopausal period.

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