Low Frequency Ultrasound Cavitation Versus Phosphatidylcholine Injection on Fat Adiposity in Women with Gynoid Obesity

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Abstract: Overweight and obesity is a world epidemic problem, many therapeutic approaches are used to overcome the problem of overweight and localized obesity. Low frequency ultrasound cavitation and mesotherapy injection were recommended as non-invasive way to get rid of localized adiposity. The aim of the current study was to compare between the effect of low frequency ultrasound cavitation versus phosphatidylcholine injection on fat adiposity in females with gynoid obesity. Forty overweight females with age ranged from 30-40 years and their body mass indices ranged between 25-30kg/m were included in the study. The subjects were divided into two equal groups: group I received low frequency ultrasound cavitation twice weekly and group II received phosphatidylcholine injection every two weeks and both groups received treatment for 4 months. The mean values of waist/hip ratio, fat percentage and skin fold thickness were significantly changed from 0.71 ± 0.03, 30.7 ± 1.88 and 35.4 ± 1.26 to 0.77 ± 0.004, 25.6 ± 1.89 and 26.1 ± 2.02 respectively, in group I and from 0.69 ± 0.004, 32 ± 3.36 and 36 ± 0.81 to 0.73 ± 0.009, 27.1 ± 1.66 and 31.1 ± 1.66 respectively, in group II. Also, there was a significant difference between the two groups after treatment on waist/hip ratio and skin fold thickness variables. It is suggested that low frequency ultrasound cavitation is more effective and safe to decrease fat adiposity than phosphatidylcholine injection in females with gynoid obesity.

Key words: Low frequency ultrasound cavitation · Phosphatidylcholine · Gynoid obesity

INTRODUCTION

Overweight and obesity are a result of energy imbalance over a long period of time. The cause of energy imbalance for each individual may be due to a combination of several factors. Individual behaviors, environmental factors and genetics, all contribute to the complexity of the obesity epidemic. Recent studies have shown that overweight and obesity affect over half the adult population in many countries. In many countries, overweight and obesity have reached epidemic levels and obesity is now well recognized as a disease in its own right [1]. The prevalence of obesity is increasing globally and also in undeveloped countries as Egypt due to the westernization of lifestyles [2,3].

A large number of physical and mental conditions have been associated with obesity. Health consequences can be categorized by the effects of increased fat mass (osteoarthritis, obstructive sleep apnea, social stigmatization) or by the increased number of fat cells (diabetes, cancer, cardiovascular disease, non-alcoholic fatty liver disease). Increases in body fat alter the body's response to insulin, potentially leading to insulin resistance. Increased fat also creates a pro-inflammatory state, increasing the risk of thrombosis [4].

Fat distribution refers to pattern of body fat located in different regions of the body both central and truncal locations. Persons with central (abdominal) fat are commonly referred to as “apple shaped” and android (male) and those with truncal (gluteofemoral) or peripheral fat are
called “pear shape” or gynoid (female). Regional fat can be estimated by skin fold measurements, by waist hip ratios or methods such as computed tomography [5].

Short- and long-term weight reduction programs both resulted in a significant decrease in the waist/hip ratio (WHR) among obese premenopausal women. In matched groups of women with gynoid and android obesity, the latter demonstrated a greater decrease in WHR after one year's weight reduction and, at the same level of body weight loss, a consistently lower decrease in the lean body mass. Gluteal fat cells were found to empty at a slower rate than those in the abdominal region, particularly in gynoid obesity. After one year's weight reduction, the decrease in WHR correlated significantly with decreases in body weight, blood pressure and metabolic variables [6].

One method of managing localized obesity is low frequency ultrasound cavitation, which is used both in cosmetology and in aesthetic medicine and surgery. It is an innovative technique mainly for reducing localized adiposity and cellulite in a non-surgical manner, which uses low frequency ultrasound (from 30 to 70 KHz). It is a safe, efficient method, which is non-invasive, causes no pain or collateral effects, consisting of diluting fat through movement, safely, with no anesthetic or recovery time required [7].

Other method of treating localized adiposity is mesotherapy. Mesotherapy is a form of medical treatment based on affecting tissue derived from the embryonic mesodermal layer. The development of mesotherapy is attributed to Dr. Pistor in France and is accepted as a part of medical studies in Europe. It is often used for various types of medical problems and recently has been advocated for the improvement of localized areas of fat deposition and cellulite. It is said to break down fat beneath the skin and shrink fat cells; the fat dissolves and is carried through the bloodstream before being excreted. It is often paired with aminophylline (an asthma medication) which stimulates the release of fat into the bloodstream. Lidocaine (an anesthetic) is used to improve the absorption of the drugs. L-carnitine (an amino acid), that metabolize the stored fats [8,9].

Phosphatidylcholine is a phospholipids extracted from soybean lecithin present in abundance in cell membranes, actively participating in the structure and transport between the cells. This substance can alter cholesterol and other triglycerides metabolism. It seems to be able to increase cholesterol solubility, alter the composition of fat deposits and inhibit plaque aggregation[10]. Therefore the purpose of this study was to investigate the influence of low frequency ultrasound cavitation versus phosphatidylcholine injection on fat adiposity in women with gynoid obesity. On comparing the results, the most appropriate and effective method to decrease fat adiposity can be determined.

MATERIALS AND METHODS

Study Subjects: Forty women suffering from localized fat deposits at the buttocks area were selected from the outpatient clinics of the general institute of health insurance, nonsmokers and non-hypertensive, having tumor or fragile skin, taking oral weight loss medications, free from respiratory, kidney, liver and metabolic disorders as well as chronic cardiac problems as heart failure, ischemic heart disease and coronary artery bypass graft. Their age ranged from 30 to 40 years and not involved in any physical therapy program.

Subjects were randomly assigned to two groups equal in size: Group I received low frequency ultrasound cavitation twice weekly and Group II received phosphatidylcholine injection every two weeks. Both groups received treatment for 4 months. All sessions were supervised and participation assessed. The purpose, nature and potential risks of the study were explained to all participants before providing their informed consent.

General Experimental Design

Evaluated Parameters: The subjects of both groups underwent measurement of waist/hip ratio, fat percentage and skin fold thickness before, after 2 months, at the end of treatment program after 4 months and Follow up measurement after 3 months of program termination. Waist was measured midway between the lower rib margin and iliac crest, with a horizontal tape at the end of gentle expiration while hip was measured around the maximum circumference of the buttocks; for women this is usually at groin level [11,12]. Skin fold thickness was measured by gripping the skin about 1cm above the selected site and the calipers applied below this site, the grip was removed and the measurement noted to the nearest 0.2mm. Body composition was measured using body fat analyzer device, subject data entered including (age, sex, weight and height). Subject skin was cleaned with alcohol and four electrodes were used; two electrodes on wrist level and the other two electrodes placed on ankle level of the same side of the body, then running a small electrical signal through the body [13].
All participants were free to withdraw from the study at anytime. If any adverse effects had occurred, the experiment would have been stopped. However, no adverse effects occurred and so the data of all the patients were available for analysis.

**Detailed Training Regimen:**

**Group (I) Low Frequency Ultrasound Cavitation:** Subjects were instructed not to eat at least for 3 hours before the session and to drink plenty of water before the treatment session. Patient lied on abdomen with buttocks area exposed. A 63 Applicator to treat large and wide areas with Voltage (100-240V), frequency (50-60 Hz) and output level: 100%; Treatment applied for 30 min using Auto mode.

**Group (II) Phosphatidylcholine Injection:** Subjects received subcutaneous injection of phosphatidylcholine in buttocks area, received one treatment session every two weeks; for a complete 4 successive months. The medication administered (250mg/ml phosphatidylcholine), have been injected pure into the area to be treated [8]. Injections were applied in the subcutaneous tissue using Point By Point technique with 0.1 to 0.3ml for each point; a separation distance of 0.5-2cm between the points and application depth from 2 to 12mm below the cutaneous surface. The total volume of phosphatidylcholine injected was not more than two vials (10ml) applied per session.

Patient was instructed to use analgesics especially in the first 2 days [10]. In the post-application care, all subjects of both groups received massage and lymphatic drainage by an experienced professional following the session for duration of 15 minutes to help fat absorption and reduce edema [14].

**Statistical Analysis:** The mean values of WHR, fat percentage and skin fold thickness obtained before and after four months in both groups were compared using the paired "t" test. Unpaired "t" test was used for the comparison between the two groups (P < 0.05).

**RESULTS**

Forty women had localized fat deposits at the buttocks area participated in this study. Table 1 represents the significance difference between both groups of low frequency ultrasound cavitation and phosphatidylcholine injection before treatment. The mean values of WHR, fat percentage and skin fold thickness were significantly changed from 0.71 ± 0.03, 30.7 ± 1.88 and 35.4 ± 1.26 to 0.77 ± 0.004, 25.6 ± 1.89 and 26.1 ± 2.02 respectively, in group I and from 0.69 ± 0.004, 32 ± 3.36 and 36 ± 0.81 to 0.73 ± 0.009, 27.1 ± 1.66 and 31.1 ± 1.66 respectively, in group II (Table 2,3). Also, there was a significant difference between the groups after treatment (Table 4).

### Table 1: Clinical characteristics of study subjects of both groups at baseline

<table>
<thead>
<tr>
<th></th>
<th>Group A</th>
<th>Group B</th>
<th>p-value</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>36.3 ± 2.75</td>
<td>37.2 ± 2.09</td>
<td>0.42</td>
<td>NS</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>80.9 ± 4.77</td>
<td>79.3 ± 2.31</td>
<td>0.35</td>
<td>NS</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>167.5 ± 2.79</td>
<td>166.2 ± 2.04</td>
<td>0.25</td>
<td>NS</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>28.8 ± 0.78</td>
<td>28.71 ± 0.75</td>
<td>0.78</td>
<td>NS</td>
</tr>
<tr>
<td>WHR</td>
<td>0.71 ± 0.03</td>
<td>0.69 ± 0.004</td>
<td>0.11</td>
<td>NS</td>
</tr>
<tr>
<td>Fat percentage</td>
<td>30.7 ± 1.88</td>
<td>32 ± 3.36</td>
<td>0.3</td>
<td>NS</td>
</tr>
<tr>
<td>Skin fold thickness</td>
<td>35.4 ± 1.26</td>
<td>36 ± 0.81</td>
<td>0.22</td>
<td>NS</td>
</tr>
</tbody>
</table>

BMI: Body mass index; p value: Probability value; NS: Non significant

### Table 2: Mean values and significance of low frequency ultrasound cavitation in first group before and after treatment

<table>
<thead>
<tr>
<th></th>
<th>Pre treatment</th>
<th>Post I</th>
<th>Post II</th>
<th>Post III</th>
<th>p-value</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>WHR</td>
<td>0.71 ± 0.03</td>
<td>0.71 ± 0.01</td>
<td>0.77 ± 0.01</td>
<td>0.77 ± 0.004</td>
<td>0.0001</td>
<td>S</td>
</tr>
<tr>
<td>Fat percentage</td>
<td>30.7 ± 1.88</td>
<td>27.3 ± 2.21</td>
<td>25.8 ± 1.81</td>
<td>25.6 ± 1.89</td>
<td>0.0001</td>
<td>S</td>
</tr>
<tr>
<td>Skin fold thickness</td>
<td>35.4 ± 1.26</td>
<td>30.4 ± 2.06</td>
<td>26.9 ± 2.33</td>
<td>26.1 ± 2.02</td>
<td>0.0001</td>
<td>S</td>
</tr>
</tbody>
</table>

WHR: waist hip ratio; Sig.: significant; P-value: probability value

### Table 3. Mean values and significance of phosphatidylcholine injection in the second group before and after treatment

<table>
<thead>
<tr>
<th></th>
<th>Pre treatment</th>
<th>Post I</th>
<th>Post II</th>
<th>Post III</th>
<th>p-value</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>WHR</td>
<td>0.69 ± 0.004</td>
<td>0.72 ± 0.008</td>
<td>0.73 ± 0.008</td>
<td>0.73 ± 0.009</td>
<td>0.0001</td>
<td>S</td>
</tr>
<tr>
<td>Fat percentage</td>
<td>32 ± 3.36</td>
<td>29.9 ± 1.19</td>
<td>27.5 ± 1.58</td>
<td>27.1 ± 1.66</td>
<td>0.0001</td>
<td>S</td>
</tr>
<tr>
<td>Skin fold thickness</td>
<td>36 ± 0.81</td>
<td>34.1 ± 1.19</td>
<td>31.5 ± 1.95</td>
<td>31.1 ± 1.66</td>
<td>0.0001</td>
<td>S</td>
</tr>
</tbody>
</table>

WHR: waist hip ratio; SD: standard deviation; S: significant; P-value: probability value
Table 4: Comparing mean values and significance of both groups after treatment

<table>
<thead>
<tr>
<th></th>
<th>Group I Mean±SD</th>
<th>Group II Mean±SD</th>
<th>P-Value</th>
<th>Level of Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>WHR</td>
<td>0.77±0.004</td>
<td>0.73±0.009</td>
<td>0.0001</td>
<td>S</td>
</tr>
<tr>
<td>Fat Percentage</td>
<td>25.6±1.89</td>
<td>27.1± 1.66</td>
<td>0.07</td>
<td>NS</td>
</tr>
<tr>
<td>Skin Fold Thickness</td>
<td>26.1±2.02</td>
<td>31.1±1.66</td>
<td>0.0001</td>
<td>S</td>
</tr>
<tr>
<td>WHR: waist hip ratio</td>
<td>SD: Standard Deviation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>p value: Probability value</td>
<td>NS: Non significant</td>
<td>S: Significant</td>
<td></td>
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</tr>
</tbody>
</table>

**DISCUSSION**

The aim of this study was to find out the efficacy of low frequency ultrasound cavitation versus phosphatidylcholine injection in fat adiposity in women with gynoid obesity after 4 months of treatment. The mean values of WHR, fat percentage and skin fold thickness were significantly improved in both group I and group II. Also, there was a significant difference between the groups after treatment. This means low frequency ultrasound cavitation is more effective and safe in reducing fat adiposity in buttocks area than phosphatidylcholine injection.

Phosphatidylcholine (PPC) is an antioxidant that is derived from natural soy lecithin. PPC alters the metabolism of fatty substances like cholesterol and triglyceride in the body. PPC is reported to penetrate the adipocyte (fat cell) through the double lipid layer (cell wall) where it acts as a detergent (emulsifying and tensoactive agent). The triglyceride breaks down to monoglycerides by certain enzymes released from the mitochondria of adipocytes nucleus, this means that fat affected by PPC becomes water soluble. The fat is dissolved and carried to liver over high density lipoproteins (HDL) and metabolized via citric acid cycle through beta oxidation. The end-product is CO and \( \text{H}_2\text{O} \) and a small amount less than 1% exerted via the renal system in the form of very short chained fatty acids [15,16].

Low frequency ultrasound cavitation causes heating of adipose tissue to a temperature range of 40-41.5°C, which is non-destructively thermally encourage the release of natural lipolysis hormones thus accelerate the body's own lipolysis processes and disrupting the adipocytes own phospholipids layer [17].

Application of ultrasound stimulates lipolysis in adipose tissue by increasing secretion of nor-epinephrine and the irradiation of ultrasound frequency may cause lipolysis and consequently inch was lost in treated area [18]. Ultrasound technology acting indirectly on the adipocytes and enabling the stimulation of sympathetic nerve terminals which release catecholamines, particularly nor-adrenaline which shows a remarkable lipolysis effect [19].

The result of the present study showed a significant reduction in subcutaneous fat thickness, this reduction comes in agreement with the study of Enrico who reported a reduction of subcutaneous fat after low frequency ultrasound application and considered the low frequency ultrasound treatment as a valuable tool in the treatment of localized fat in the esthetic field.

The present study agrees with Baker and his associates [20] who reported that low frequency ultrasound can be used for reducing adipose cell volume in a human body by non-invasive, non-destructive and non-traumatic method through increasing lipolysis rate at the adipose tissue of the treated area as the low frequency ultrasound raise the temperature of the adipose tissue between 40.0° to 41.5°C; leading to increase in the lipolysis rate and cause release of FFAs, thereby reducing the volume of adipose cells.

The present study agreed with Karl [21] who reported that injection of PPC seems to offer a non-surgical alternative to liposuction in patients objecting to surgery. It appears to be safe and effective in the correction of fat deposits.

Also the results of the present study come in agreement with the study of Palmer and his associates [22] as they reported that PPC injection was efficacious in reducing the fatty pads in the treated areas, with few side effects including swelling, redness and bruising at sites of injection which lasts for few days.

**CONCLUSIONS**

In summary, both low frequency ultrasound cavitation and phosphatidylcholine injection are effective modalities in reducing fat adiposity in females with gynoid obesity yet, this study confirmed and added strong evidence that low frequency ultrasound is considered a more effective modality in fat reduction in buttocks area as well as, it's simple and non -invasive modality.
REFERENCES


