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# Impact of Cold Laser on Lipid Profile In Abdominal Obese Women

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**Abstract : Background:** Regional body fat distribution has an important influence on metabolic and cardiovascular risk factors. High cholesterol serum levels associated with the risk of coronary heart disease**.** LLLT may suppress cholesterologenesis and thereby reduce cholesterol and triglyceride serum levels by altering gene expression and inducing cellular modifications. The purpose of this study was to find out the effect of low level laser therapy on lipid profile in women with abdominal obesity. **Subjects and methods**: Forty women with abdominal obesity, their age ranged from 30 to 40 years old and their BMI ranged from 30 to 34.9 kg/m2, were divided randomly into two equal groups, Study group: received LLLT on the abdomen using (Lumislim Prolaser, manufactured by Daeyang Medical Co., LTD.) with 4 laser pads strapped around patient abdomen emitting 650 nm (red) laser light. Duration of treatment was 30 minutes, 2 times per week for 6 weeks (12 sessions) .Control group: receieved sham LLLT for same duration as study group. Lipid profile was measured before and after the study. **Results**: Statistical analysis revealed that LLLT has significant effect on triglycerides (decreased 13.26%), total cholesterol (decreased 7.28%), low density lipoprotein(decreased 6.79%), waist circumference (decreased 3.31%)compared to control group and non significant effect on high density lipoprotein in both groups. **Conclusion**: LLLT can be used to improve blood lipid profile as well as decrease of the waist circumference in women with abdominal obesity.
**Keywords:**low level Laser- cholesterol- lipoproteins- triglycerides-abdominal obesity.

## Introduction

Obesity is defined as abnormal or extensive fat accumulation that negatively affects health. According to the World Health Organization, obesity is defined as body mass index (BMI) ≥ 30 kg/m 2 and central obesity as a waist circumference greater than 102 cm in men and 88 cm in women[1].

Abdominal obesity, especially visceral obesity, is associated with coronary risk, although causality is not well established. The relation is not simply a function of overall obesity, because increased waist-to hip ratio (WHR) is associated with increased coronary risk even in non-obese persons. This raises the question of why intraabdominal fat mass is so strongly related to several diseases and their risk factors. Insulin resistance may be a key factor in this link. Many studies have pointed to an association between insulin resistance and intraabdominal fat accumulation[2]**.**

Obesity is associated with increased basal lipolysis in adipose tissue, elevated circulating free fatty acids (FFAs) and is accompanied by abnormalities in both glucose and lipid metabolism[3]**.**

Hypertriglyceridemia, reduced high density lipoprotein (HDL), and small, dense low density lipoprotein (LDL) particles characterize the dyslipidemia associated with increased abdominal fat. Regional body fat distribution has an important influence on metabolic and cardiovascular risk factors. Many prospective studies have shown that increased abdominal (visceral) fat accumulation is an independent risk factor for CAD, hypertension, stroke, and type 2 diabetes [4]**.**

Low level laser Therapy (LLLT) is the therapeutic application of laser light at low intensity. It is commonly performed using lasers in the near infrared or visible, red portions of the spectrum. As a contrast to surgical lasers which usually have outputs greater than 30 watts, therapeutic lasers have a maximum power output of 500 milliwatts or less and are classified by the FDA as nonsignificant risk devices [5].

It has been proposed that Low-level laser therapy (LLLT) may suppress cholesterologenesis and thereby reduce cholesterol and triglyceride serum levels by altering gene expression and inducing cellular modifications. Lipoprotein subpopulations including low-density lipoproteins (LDL), very low-density lipoproteins, triglycerides, and high density lipoproteins (HDL) are evaluated to assess patient risk. Positive associations have been found between body fat and lipid profile even it has been suggested that an increased percent body fat can predict an increase LDL[6].

Abdominal fat loss has been associated with variable changes in lipid profile in obese individuals specifically reductions in triglycerides, Cholesterol, LDL and HDL[7].

Therefore, the current study was conducted to find out the effect of low level laser therapy on lipid profile (serum total cholesterol, serum triglyceride, HDL and LDL levels)and waist circumferene in women with abdominal obesity.

## Materials and Methods:

### Subjects:

Forty women, Forty women with abdominal obesity, their age ranged from 30 to 40 years old and their BMI ranged from 30 to 34.9 kg/m2were recruited from the outpatient-clinics of internal medicine at Kasr Al-Aini Hospital.

Exclusion criteria 1) Severe hypo or hypertension. 2) women who follow simultaneous weight reduction methods., 3) Current use of medications known to affect weight levels, blood cholesterol or to cause bloating or swelling.,4) Certain medications such as corticosteroids, oral contraceptives, diuretics, and some antibiotics avoided as they may affect the accuracy of the test results.5) Renal and/or Hepatic disorders.,6)Photosensitivity.,7)Active infection, wound, or other external trauma within the area to be treated with the laser or ultrasound cavitation.

Subjects were divided randomly into two equal groups; study group: (n=20) received LLLT on the abdomen for 6 weeks (2 sessions/week), Control group: (n=20), received sham LLLT on the abdomen for the same period.

All subjects received a through explanation of the objectives and procedures of the study and a written informed consent was signed by each women before participation in the study. Before starting the program, a complete history and physical examination was taken for all women. This study was reviewed and was approved by the Ethics Committee of Faculty of Physical therapy, Cairo University.

### II-Material:

### A-Evaluation equipment:

1. Standard weight and height scale (floor type, Shanghai Yaohua, made in China)was used to measure body weight and height of each subject to calculate body mass index.
2. Stretch resistant tape measurement: was used to measure the waist circumferences before and after the end of the treatment for both groups.
3. Disposable plastic syringes were used for drawing venous blood samples.

4. Polypropylene tubes with EDTA for keeping blood samples.
5. Analyzing chemicals and kits to measure levels of total cholesterol, triglyceride, HDL and LDL levels.
6. Spectrophotometer: was used to measure cholesterol, triglycerides before and after the study.

**B) Therapeutic equipment:**

**Low Level Laser Therapy device**(Lumislim Pro, Daeyang Medical Co., LTD., Korea)**:** was emitting diode laser type, wavelength 650 nm (red laser light) and delivering total energy output of (1.44W) through 28 laser diodes. Four laser pad applicators on the abdomen and two more laser probes for the region of the lymphatic nodes closest to the treatment zone.

Safety glasses used to avoid exposure from reflection for both researcher and subjects to protect the eyes from laser radiation.

**III-Methods:**

Each subject in both groups passed through the following steps of measurements by the physician and the physical therapist. The parameters were recorded at the beginning and the end of the total study period (6 weeks).

The laboratory investigations were done before and after the study (6 weeks).

**A) Evaluation procedures:**

**I- Measurement of body weight and height:**

The weight and height of each patient were measured using weight and height scale and then BMI for each subject was calculated to select just grade I obesity patients (BMI 30-34.9 $Kg/m^2$) using the following formula:

**BMI= weight (kg) / [height (m)]** [28]

**II-Measurement of waist circumference:**

The waist circumference should be measured at the midpoint between the lower margin of the last palpable rib and the top of the iliac crest, using a stretch resistant tape that provides a constant tension, with the tape parallel to the floor. For measurements, the individual should stand with feet close together, arms at the side and body weight evenly distributed, and should wear light clothing. The subject should be relaxed, and the measurements should be taken at the end of a normal expiration. The measurement should be repeated twice; if the measurements are within 1 cm of one another, the average should be calculated. If the difference between the two measurements exceeds 1 cm, the two measurements should be repeated [9]**.**

**III –Laboratory Investigations:**

Assessment of lipid profile for both groups was done before and after the study (i.e. after 6 weeks).

About 5ml of venous blood was withdrawn then centrifuged and then the serum was collected and kept frozen at -80ºC until biochemical analysis. This samples were taken to measure: Concentration of total cholesterol, Concentration of HDL cholesterol, Concentration of triglyceridesandconcentration of LDL cholesterol.

**B) Treatment procedures:**

Each subject in the study group received low level laser therapy across the consecutive 6 weeks (2 procedures per week, each one 3 days apart) i.e 12 sessions. The subjects entered the procedure room and laid comfortably flat on their back, fully relaxed and supported . The women were instructed to wear goggles each time on laser procedure to protect their eyes.

**Operation method**:

Four treatment pads containing the laser diodes are placed over the abdomen across navel, secured in direct contact with the skin using elastic straps. Then two more laser probes are positioned onto the region of the inguinal nodes ;the lymphatic nodes closest to the treatment zone. Total energy output was 1.44W,Pulse was 1000 Hz, Wavelength was 650 nm and treatment time was 30 mn.

**Statistical procedures**

The data obtained were analyzed using SPSS(version 17 for windows; statistical package, 2008). Descriptive statistics were presented in terms of mean and standard deviation for age, height, weight, BMI. Dependentand independent t- tests were used to determine the differences in mean values of lipid profile levels and WC within and between both groups. Significance was set at $p < 0.05$.

## Results

Table (1)show the statistical analysis of age, height, weight andbody mass index of study and control groups,there was no significant difference between the twogroups, p-value > 0.05.

**Table 1: Descriptive data of subjects of both groups**

| ***Variables*** | **Mean± SD** | | ***T*** | ***p*** |
|---|---|---|---|---|
| | **Study group** | **Control group** | | |
| **Age (years)** | 35.4± 3.1 | 35.15± 2.99 | 0.25 | 0.79**** |
| **Weight (kg)** | 83.28± 6.06 | 83.07± 5.73 | 0.11 | 0.91**** |
| **Height (m)** | 160.1± 4.06 | 159.5± 4.31 | 0.41 | 0.68**** |
| **BIM (Kg/m$^2$)** | 32.45±1.45 | 32.55±1.49 | -0.21 | 0.83**** |

SD: Standard Deviation, , P- value: Probability Level,*** :** Significant****** : Non-Significant

Comparison of the changes between both groups in the measurements of waist circumference and lipid profile (totalcholesterol**, t**riglycerides, high density lipoprotein,low density lipoprotein) were represented in table (2)

**Table 2: Comparison of lipid profile and waist circumference between study and control groups pre and post study.**

| **Variables** | | **Study group mean ± SD** | **Control group mean ± SD** | **t-value** | **P-value** |
|---|---|---|---|---|---|
| Waist circumference ( cm) | Pre | 101.95±7.67 | 101.82±7.48 | 0.052 | 0.96 |
| | Post | 98.57 ± 7.82 | 103.37 ± 5.86 | -2.19 | 0.034***** |
| Totalcholesterol(mg/ dl) | Pre | 193.75 ± 16.25 | 194.25 ± 15.25 | -0.10 | 0.9 |
| | Post | 179.65 ± 15.71 | 194.35 ± 15.45 | -2.98 | 0.005***** |
| Triglycerides (mg/dl) | Pre | 96.90 ±24.54 | 97.95 ± 25.02 | -0.13 | 0.89 |
| | Post | **84.05 ±** 21.48 | **99.65 ±** 23.56 | -2.18 | 0.03***** |
| High Density Lipoprotein(mg/dl) | Pre | 55.70 ± 12.24 | 57.00 ±11.80 | -0.34 | 0.73 |
| | Post | 55.45 ± 11.99 | 57.75 ± 11.62 | -0.35 | 0.70 |
| Low Density Lipoprotein(mg/dl) | Pre | 102.40 ± 9.05 | 102.70 ± 8.93 | -0.10 | 0.92 |
| | Post | 95.45 ± 9.69 | 102.85 ± 9.14 | -2.48 | 0.01***** |

SD: Standard Deviation, , P- value: Probability Level, *** :** Significant****** : Non-Significant, Pre= at base line measurement, Post= after 6 weeks of study.

## Discussion

Accumulation of fat in the abdominal region or abdominal obesity is an important risk factor for several diseases, and represents a differentiated risk when compared to other forms of body fat distribution. Abdominal obesity in adults and in the elderly correlated with most cardiovascular risk factors, especially high levels of triglycerides (TG) and reduced levels of high-density lipoproteins (HDL), with an impact on blood pressure levels[10]**.**

The purpose of this study was to find out the effect of low level laser therapy on lipid profile among central obese women. It was found that after 12 sessions of LLLT, two sessions weekly, there was a significant decrease in total cholesterol**, t**riglycerides, low density lipoprotein and waist circumference levels with a percentage of improvement (decrease) of 7.28%, 13.26, 6.79 and 3.31% respectively in pre study compared to post study. While high density lipoprotein show no significant change.

The results of this study agreed with[11] who reported that LLLT can reduce cholesterol, triglyceride and low-density lipoproteins(LDL) levels. It has been noted that terminal enzymes photoactivation may be the primary response inducing cholesterol genesis suppression. It has also been shown that the initial physical and/or chemical changes of cytochrolme C oxidase alter the intracellular redox state. The latter is proposed to regulate cellular signaling pathways which control gene expression.

**Avci et al.,**[12] also suggest that LLLT has a potential to be used in fat and cellulite reduction as well as in improvement of blood lipid profile without any significant side effects. One of the main proposed mechanism of actions is based upon production of transient pores in adipocytes, allowing lipids to leak out. Another is through activation of the complement cascade which could cause induction of adipocyte apoptosis and subsequent release of lipids.

It had been hypothesized that fat released following LLLT treatment may appear in the bloodstream where it might adversely affect the lipid profile, but, a nonrandomized, uncontrolled pilot study by **Maloney et al.,**[13] demonstrated an actual reduction in serum cholesterol and triglyceride following LLLT which agreed with the current study.

Waist circumference (WC) is a simple and convenient way of measuring abdominal or central obesity and is a major determinant of the National Cholesterol Education Program Adult Treatment Panel III and International Diabetes Federation criteria for the definition and diagnosis of metabolic syndrome. WC has been proposed to be routinely used as part of clinical cardiovascular risk assessments and interpretation of obesity-related health risks [14]**.**

The results of the current study is supported by **Jackson et al.,** [15]who reported a significant reduction in the circumferential measurements across waist. They used diode laser with wavelength 635nm. Transmission electron microscopic images have demonstrated the formation of transitory specialized cell membrane-associated pores in adipocytes followed by collapse of adipose cells after brief treatment with LLLT.

The results of **Caruso-Davis et al.,**[16] also coincistent with the current results as they reported significant reduction in the circumferential measurements across waist through use of laser treatment which increases fat loss from adipocytes by release of triglycerides, without inducing lipolysis or cell lysis. The fat loss was probably a consequence of the laser creating temporary pores in the fat cells through which triglycerides were leaked.

The results showed by **Elmet al.,**[17] contradicted with the results of this study as they evaluated the efficacy of diode laser for body contouring and circumference measurements revealed no statistically significant reduction at either 7days or 1 month post treatment. but the difference between his study and the results of the current study may be due to different duration of treatment.

## Conclusion:

It can be concluded thatLLLT can improve blood lipid profile as well as decrease of the waist circumference in women with abdominal obesity which may decrease risk of cardiovascular disease.

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