Effect of Electrolipolysis on Lipid Profile in Female Subjects

Maher A. El Keblawy, PTD*., Omima Katabei, PTD*., Laila A. Rashed, PTD and Noran A. El-Behairy*.**
*Department of Basic Science, Faculty of Physical Therapy, Cairo University.
** Biochemistry Department, Faculty of Medicine, Cairo University.

ABSTRACT

The purpose *of this study was to investigate the effect of electrolipolysis on lipid profile in obese female subjects.* ***Subjects:*** *Forty obese female subjects with age ranged from 18 to 35years old were participated in this study. They were assigned randomly into two equal groups; The control group (A) composed of twenty obese female subjects with mean age of 24.65±7.292 years, mean height of 162.2±8.965 cm, mean weight of 93.8±13.609 Kg, mean of Body Mass Index (BMI) 35.64±3.396 Kg/m². This group was treated with diet restriction regimen and aerobic exercises only. The study group (B) consisted of twenty obese female subjects with mean age of 25.55±5.414 years, mean height of 160.15±7.414 cm, mean weight of 87.95±9.688 Kg, mean of body mass index (BMI) 34.35±3.303 Kg/m².They received electrolipolysis, diet restriction regimen and aerobic exercises. All subjects in both groups received three sessions per week for one month.* ***Methods****: Assessment was done before and after one month of treatment in both groups. It included BMI, Waist Hip Ratio (WHR) and lipid profile.* ***Results:*** *The results of this study revealed significant difference between the two groups in BMI, WHR, and Lipid profile measurements. As there were a significance decrease in BMI,WHR ,Triglycerides, total cholesterol and Low Density Lipoprotein (LDLc) with significant increase in High Density Lipoprotein (HDLc) in the study group(B) more than that in the control group(A).* ***Conclusion:*** *The findings of the current study revealed that electrolipolysis was an effective method in reducing weight and anthropometric measurements and improving the metabolic parameters in female subjects.*

Key words: *Abdominal obesity, BMI, Diet, Electrolipolysis, Exercise, Lipid profile, WHR.*

INTRODUCTION

Obesity is a worldwide epidemic that is characterized by excess adipose tissue, this epidemic has received both national and international attention because of obesity's detrimental effects on health, the enormous economic burden it imposes, and it's increasing prevalence[17].

The Excess body weight is the sixth most important risk factor contributing to the overall burden of disease worldwide. 1.1 billion adult and 10% of children are now classified as over weight or obese. The average life expectancy is already diminished[9].

The adverse health consequences associated with obesity include cardiovascular disease, stroke, type II diabetes mellitus, hypertension, dyslipidemia, and respiratory problems including asthma and sleep apnea[17].

The size of the adipose tissue compartment located within the abdominal cavity (visceral or intra-abdominal adipose tissue) was closely associated with obesity-related comorbidities such as elevated plasma levels of triglycerides and apolipoprotein B, a greater proportion of low-density lipoprotein (LDL) particles, an increased total

cholesterol/high-density lipoprotein (HDL)-cholesterol ratio, reduced HDL-cholesterol, insulin resistance, and hyperinsulinemia[7].

On the other hand, abdominal obesity measured by waist to hip ratio or waist circumference is associated with an increased risk of type two diabetes, metabolic syndrome, myocardial infraction, hypertension and stroke[4].

Obesity with its array of co-morbidities necessitates careful clinical assessment to identify underlying factors and to allow coherent management. The epidemic reflects progressive secular and age related decrease in physical activity, together with substantial dietary changes with passive over consumption of energy despite the neurobiological processes controlling food intake. Therefore, effective long term weight loss depends on permanent changes in dietary quality, energy intake and activity[9].

It was observed that, macronutrient content of energy restricted diet have significant effects on plasma lipids during the course of weight loss even when total fat composition approximates the intake of 30% of energy from fat[16]. Moreover, prolonged low intensity exercise results in improvement in lipid profiles that is largely independent of changes in cardio respiratory fitness[14].

The composition of the weight lost as results of diet restriction combined with exercise is different from that lost as a result of energy restriction alone[8].

On the other hand, electrolipolysis uses a weak electrical current to correct unaesthetic features related to localized or diffuse adiposity. A low frequency electrical current passing through in which the electrodes are located as a results various molecules present in the form of ions migrate outward as far as the extra cellular fluid and vice versa. These variations in the concentration of ions make it possible for the cells to break down and eliminate the metabolites and excess fluids through the normal excretion channels[1].

It was noticed that, electrolipolysis release fat in inactive adipose cells which would be conveyed as small molecules through lymphatic and vascular system. Electrolipolysis aims to reactivate fat cells. The released fatty acids stored somewhere in active cells, if not used for physical effort or body heat generation at once[3].

On the other hand, electrolipolysis might be a method help in removing fat from inactive fat cells and decreases lipid profile and the risk of cardiovascular disease. Moreover, the aim of the present study was to investigate the effect of electrolipolysis on lipid profile (Cholesterol, HDL, LDL, triglycerides) in obese female subjects.

Therefore, the current study was an attempt to introduce a program of physical therapy including non invasive method (electrolipolysis) for regulation of lipid profile which might help the physician and physical therapist to enhance the process of health care in obese female subjects.

MATERIAL AND METHODS

Subjects

Forty obese unmarried females were participated in the present study. Their ages ranged from 18 to 35 years old. They were recruited from El Hekma Hospital. Their body mass index was more than 30 kg/m^2.Their waist hip ratio was more than 0.8 cm. All participants were selected to exclude any history of chronic cardiovascular, respiratory, renal, metabolic or gastrointestinal diseases, history of diabetes, hypertension, lumbar or

knee problems. Also the participants had no hormonal disturbances and they were not athletes.

Participants were randomly classified into two equal groups (A and B):

Control group (A)

Twenty subjects received diet restriction regimen (1000 kcal/day) and 30 minutes of aerobic exercises (running on electrical treadmill) three sessions per week for one month.

Study group (B)

Twenty subjects received diet restriction regimen (1000 kcal/day) and 30 minutes of aerobic exercises (running on electrical treadmill) and electrolipolysis, three sessions per week for one month.

I- Instrumenation

a) Instrumentation and tools for evaluation

1) Standard weight and height scale: TANITA body fat monitor/ scale TBF-611 Tanita co-operation Tokyo Japan, was used to measure weight and height for each subject before treatment and weight only after one month of treatment for both groups, to calculate BMI.
2) Tap measurement: it was used to measure the waist and hip circumferences before and after the end of treatment , to calculate WHR.
3) Disposable plastic syringes: was used to withdraw blood samples.
4) Spectrophotometer: was used to measure cholesterol, HDL, LDL and triglycerides.

b) Instrumentations for treatment

1) Electrical stimulator machine: Est 12 plus (eight sequential Ottets, Vidio electronic via Vittorio Locchi 5/b 47100 Forti) was used to apply electrolipolysis for group B.
2) Motor driven treadmill: MFI model (MB618 RH) with motor 2-7 HP, its speed, indication, timer were adjustable provided with control panel to display the exercises parameters and heart level.

II- Procedures

A) Evaluative procedures

Assessment was done before and one month after treatment including:

- BMI, weight and height scale was used for measurement of weight and height and then the body mass index was calculated by dividing weight (kg)/ hight^2 (m^2).
-WHR, tape measurement was used to measure the waist circumference at the level of the umbilicus.Then the hip circumference was measured by passing posteriorly 5cm below the posterior superior iliac spines and anteriorly at the level of the upper border of symphesis pubis. Then waist/hip ratio was calculated.

*** Measurement of Lipid Profile.** Two blood samples were taken from both groups, one before and the other after one month of treatment. This was done at the biochemistry department in El-Kaser El-Eiany hospital. Spectrophotometer was used to measure triglycerides, total cholesterol, high density lipoprotein cholesterol (HDLc) by enzymatic colorimetric test. While the concentration of LDL cholesterol was calculated using the following equation:

LDL cholesterol = Total cholesterol – (HDL cholesterol – Triglycerides/5).

B) Treatment procedure

EST12 plus electric stimulator device was used to apply electrolipolysis for the study group. The device was calibrated by the manufactory before starting the study to ensure the accuracy of its parameters. The treatment sessions were given 3 sessions/week (one session every other day) for one month.

Each patient was asked to evacuate their bladders before starting the treatment sessions, to make sure that they were comfortable and relaxed during the study. The procedure was applied while each patient was in relaxed comfortable supine lying position.

At the beginning of the treatment sessions all the knobs of the device were at zero, then the device was adjusted as following:

Phase I.

-Frequency 35 Hz. -Action time 1 sec.
-Pause time 1 sec. -Treatment time 30 min.

Phase II.

-Frequency 15 Hz. -Action time 2 sec.
-Pause time 1 sec. -Treatment time 30 min.

Phase III.

-Frequency 50 Hz. -Action time 2 sec.
-Pause time 1 sec. -Treatment time 30 min.

Then four electrodes were applied as follow for phase 1 and 2: two electrodes were applied on the right side of abdominal wall and the other two electrodes were fixed on the left side. Then four electrodes were applied on the leg muscles on the posterior aspect for phase3. Pressing the start button was done and increasing the intensity until tingling sensation was felt. The device was automatically switched off at the end of each session.

Each patient was asked to perform aerobic exercises by running on electrical treadmill for 30 minutes immediately after the electrolipolysis session before starting exercise the electrical treadmill was fixed at 0 % inclination. Maximum heart rate (HR max) was determined for each subject (220-age). Each subject in both groups started each session with five minutes warming up (25-30 % of HR max displaced on the screen). The speed of the electrical treadmill was increased to achieve at least 60 % and not more than 70 % of HR max for 20 min. Finally each exercise terminated with 5 minutes as cooling down (the speed reduce 25 to 30 % of HR max) until the heart rate returned nearly to resting level. This procedure was repeated three times /week for one month[1].

All patients of the study group followed diet restriction regimen of low calorie diet (1000kcal/day) for one month.

In control group the patients only received diet restriction regimen of low calorie diet (1000kcal/day) and aerobic exercises by running on electrical treadmill for 30 minutes for one month.

RESULTS

The dependent variables of the present study were BMI, WHR, and Lipid profile (triglycerides, total cholesterol, HDLc, LDLc). Thus dependent variables showed several positive changes following application of electrolipolysis, aerobic exercises and diet restriction regimen. On the other hand, significant change was noticed in the control group after application of, aerobic exercises and diet restriction regimen only but it was lower than noticed in the study group. (The level of significance was set at $p= 0.05$)

BMI: Table 1 and figure 1 showed the mean and standard deviation of BMI for groups, pre-treatment and post-treatment. As regards BMI was 35.46 ± 3.396 in GA changed to 32.9 ± 3.2 while in GB mean was

34.35±3.303 changed to 30.4 ± 2.9 with more improvement in GB.

Table (1): Mean and standard deviation of the, BMI and Waist Hip ratio group (A) and (B)

Variable		Group A		Group B	
		Mean	SD	Mean	SD
Body mass index (Kg/m²)	Pre -treatment	35.64	± 3.396	34.35	± 3.303
	Post-treatment	32.9	± 3.272	30.49	± 2.929
WHR	Pre -treatment	0.914	± 0.07	0.921	± 0.08
	Post-treatment	.889	± 0.07	0.843	± 0.09

SD=Standard deviation WHR: Waist hip ratio(%)

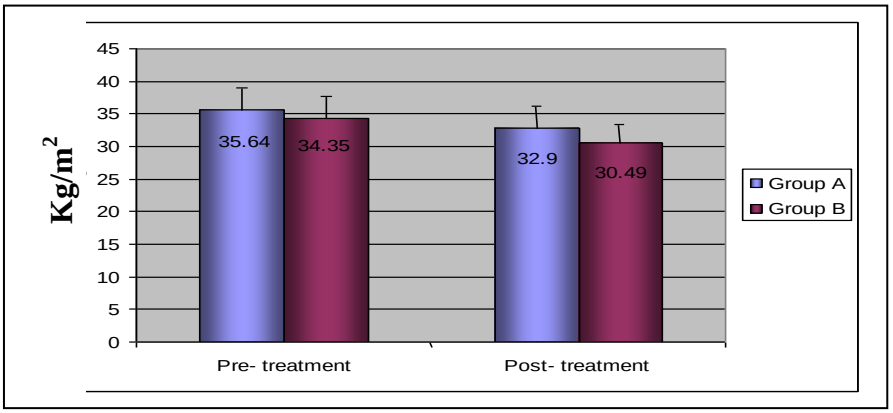

Fig. (1): Mean and standard deviation of the BMI for group (A) and (B).

WHR: Table 1 and figure 2 showed the mean and standard deviation of WHR for both groups, pre- treatment and post- treatment. As regard pre treatment in GA was 0.914 ± 0.07 changed to post treatment to 0.889 ±0.07 while in GB it changed from 0.92 ± 0.08 pre treatment to 0.84±0.09 post treatment with significant improvement noticed in GB.

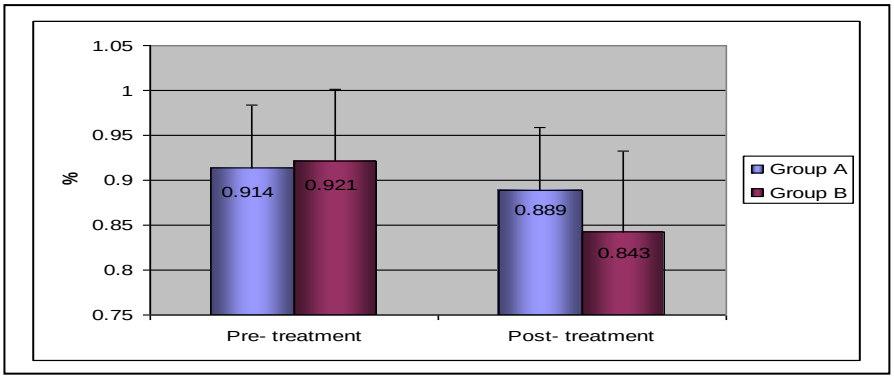

Fig. (2): Mean and standard deviation of the WHR for group (A) and (B).

Lipid profile

Triglycerides (TG): Table 2 and figure 3 showed the mean and standard deviation of TG for both groups, pre- treatment and post – treatment. Comparing the values pre and post- test of each group using the t-paired test for difference in both groups, it was 227.35±60.333 pre treatment and reduced post treatment to 175.25 ±55.141 in GA while it was 206.85±47.352 pre treatment and reduced to 120.45±34.308 in GB with more significant difference. There was a significant difference between the two groups in TG as t-value was 3.77.

Total cholesterol (TC): Table 2 and figure 4 showed the mean and standard deviation of TC for both groups, pre- treatment and post- treatment. Comparing the values pre and post - test of each group using the t-paired test for difference in both groups, as regards it was 250.85±32.199 pre treatment and changed to 208.95±33.6 post treatment in GA. While in GB it was 242.8±32.91 pre treatment reduced to 165.65±43.22 post treatment with more significant reduction in GB. There was a significant difference between the two groups in TC as t-value was 3.53.

HDL: Table 2 and figure 5 showed the mean and standard deviation of HDL for both groups, pre- treatment and post -treatment Comparing the values pre and post -test of each group using the t-paired test for difference in both groups, as regards the men value of HDL pre treatment in GA was 39.75± 7.166 and after treatment changed to 44.65± 7.828 while in GB it was 43.0±6.46 pre treatment and changed to 54.35±5.99 post treatment with more significant differences in GB. There was a significant difference between the two groups in HDL as t-value was 4.40.

LDL: Table 2 and figure 6 showed the mean and standard deviation of LDL for both groups, pre -treatment and post –treatment Comparing the values pre and post- test of each group using the t-paired test for difference in both groups, as regards the mean value of LDL in GA pre treatment it was 142.4±21.04. But in post treatment changed to 121.95±20.56. While in GB pre treatment the value was 144.25±13.88 and changed post treatment to be 97.25±14.02 with more significant improvement in GB than GA. There was a significant difference between the two groups in LDL as t-value was 4.43.

Table (2): Mean and standard deviation of the of Triglycerides, Total Cholesterols, HDL and LDL levels in group (A) and (B)

Variable		Group A		Group B	
		Mean	SD	Mean	SD
Triglycerides (Mg/dl)	Pre treatment	227.35	±60.333	206.85	±47.352
	Post treatment	175.25	±55.141	120.45	±34.308
Total Cholesterols (Mg/dl)	Pre treatment	250.85	±32.199	242.8	32.917
	Post treatment	208.95	±33.600	165.65	±43.220
HDL (Mg/dl)	Pre treatment	39.75	±7.166	43.0	±6.464
	Post treatment	44.65	±7.828	54.35	±5.993
LDL (Mg/dl)	Pre treatment	152.4	±21.049	144.25	±13.886
	Post treatment	121.95	±20.564	97.25	±14.022

SD: Standard deviation HDL: High density lipoprotein LDL: Low density lipoprotein

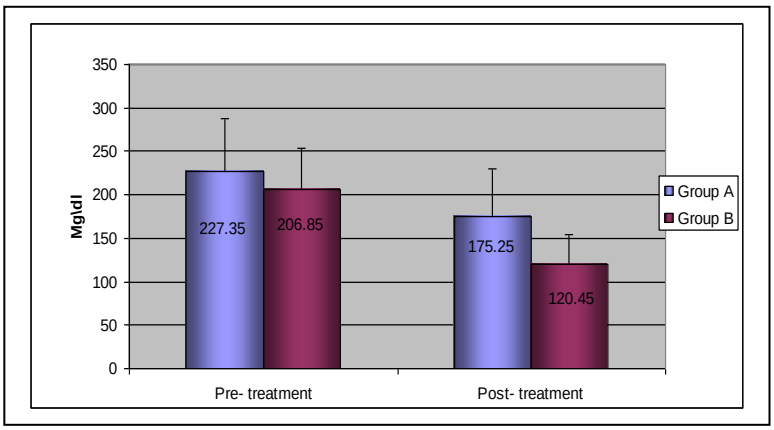

Fig. (3): Mean and standard deviation of the Triglycerides for group (A) and (B).

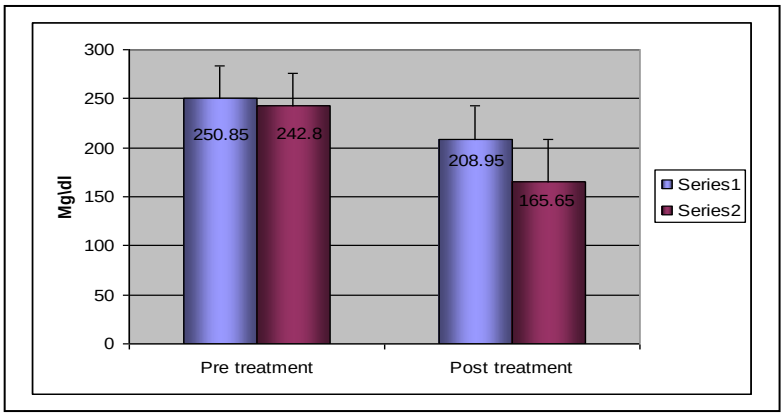

Fig. (4): Mean and standard deviation of the Total Cholesterols forGroup (A) and (B).

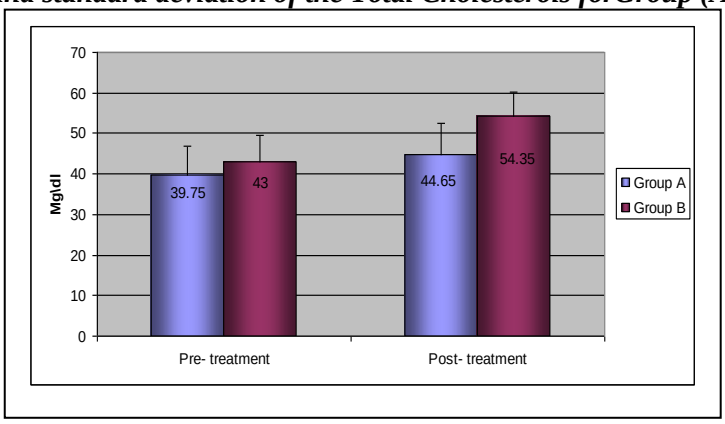

Fig. (5): Mean and standard deviation of the HDL for group (A) and (B).

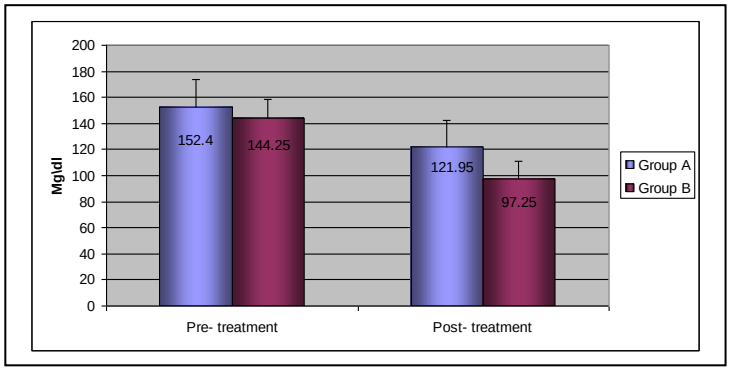

Fig. (6): Mean and standard deviation of the LDL for group (A) and (B).

DISCUSSION

The results of the present study showed that there was a significant difference between both groups with a significant decrease in triglyceride, total cholesterol, and LDLc with a significant increase in HDLc and a significant decrease in BMI, WHR in the study group more than that in the control group.

These results can be explained by the work of many investigators**,** whom reported that the low frequency electrical current passing through the electrodes creates a magnetic field in the area in which the electrodes are located; as a result, various molecules present in the form of ions migrate outward as far as the extracellular fluid and vice versa[6]. These variations in the concentration of ions make it possible for the cells to breakdown and eliminate the metabolites and excess fluid through the normal excretion channels.

Furthermore, it was noticed that electrical stimulation stimulates the adrenergic interstitial nerve endings and leads to release of catecholamine hormone leading to stimulation of adenilate cyclase which converts adenosine triphosphate to cyclic adenosine monophosphate thus activating lipases,which hydrolyzes fat into glycerol and fatty acids[13].

On the other hand when a muscle contracts as a result of electrical stimulation, the chemical changes taking place within the muscle are similar to those associated with voluntary contractions in normal exercising. These chemical reactions utilize glycogen, fat and other nutrients stored in the muscle[12].

Therefore the current and pulse frequency which the electrodes send through the tissues cause splitting of the triglycerides into free fatty acids. Triglycerides can not be excreted through the cell membrane, but free fatty acids can freely pass through the cell wall and out into tissue fluid, to be further transported by the lymph vessels. Lymph drainage greatly speeds up and facilitates this process[18].

The results of the current study had an agreement with the work of several researchers, whom treated abdominally obese subjects with non dependent pulse-synchronized transpercutaneous electrical abdominal stimulation (30, 000 muscle contractions /day) for 4 weeks These subjects showed significant improvement with reduction in body weight, intra-abdominal visceral fat, abdominal subcutaneous area at

the level of umbilicus, blood pressure, heart rate and total cholesterol[19].

On the other hand, it was concluded that application of low frequency electrical impulse near the abdominal aorta in rabbits lead to decrease in the atherosclerotic deposition in the abdominal aorta[15].

Furthermore, these findings are consistent indirectly with the findings of many authors**,** whom postulated that at least a portion of intracellular TG in skeletal muscle is constantly being synthesized and hydrolyzed during electrical stimulation. Exogenous FFA is also oxidized during electrical stimulation[11]. The amounts of exogenous FFA esterified and oxidized and TG hydrolyzed during electrical stimulation vary with the type of electrical stimulation protocol and the frequency of stimulation employed. At similar frequencies and amounts of work less exogenous FFA esterification and more exogenous FFA oxidation and TG hydrolysis occur during continuous stimulation than during intermittent stimulation. However as the frequency of intermittent stimulation increases the amount of exogenous FFA oxidized and TG hydrolyzed increase. Those researchers**,** used frequencies of 1 and 5 Hz because muscle tension was able to be generated throughout the 1 hour period of continuous and intermittent stimulation respectively, During 1 Hz continuous electrical stimulation each electrical stimulus results in an isometric contraction and complete relaxation, and during each 30 sec. period of stimulation at 5 Hz, a summation of successive contractions occurred[11].

The findings of the current study are contradicted by the work of many investigators**,** whom stated that the lipid used by skeletal muscle during work induced by electrical stimulation is derived entirely from plasma FFA. This suggestion was based on the findings that intracellular TG content in skeletal muscle was not decreased during electrical stimulation. Therefore the contribution of the stored intracellular TG pool as substrate for electrically stimulated electrical muscle remains equivocal[10].

In addition it was reported that, the effect of exercise program or electrolipolysis program to determine which method is more effective in treating infertile obese women, and concluded that both aerobic exercise and electrolipolysis program are effective in treating infertile obese women but electrolipolysis program is more effective than exercise program in treating infertile obese women specially when there is android type of obesity. Also electrolipolysis decreased the WHR and improved the hormonal profile of obese infertile women[1].

Moreover it was noticed, the effect of abdominal electrolipolysis versus abdominal exercises on the abdominal obesity that both abdominal electrolipolysis and abdominal exercise are effective in reducing abdominal skin fold thickness but electrolipolysis, is more effective in reducing abdominal fat[2].

Conclusion

According to the results of this work Electrolipolysis could be suggested to be used in improving lipid profile and decreasing BMI and WHR in female subjects.

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الملخص العربى

تأثيراذابة الدهون كهربائيا على نسبة الدهون فى الدم فى الاناث

اجرى هذا البحث بهدف دراسة تاثير اذابة الدهون كهربائيا على نسبة الدهون فى الدم و معدل كتلة الجسم و نسبة الخصر الى الحوض فى حالات السمنة فى الاناث. تم اجراء هذا البحث على اربعين شخصا من الاناث الذين يعانون من السمنة و تم تقسيمهم الى مجموعتين من الافراد. قامت هذة الدراسة على قياس التغير فى نسبة الدهون فى الدم ومعدل كتلة الجسم و نسبة الخصر الى الحوض قبل و بعد علاجهم باثنتى عشرة جلسة بمذيب الدهون الكهربائى و اتباع المرضى لنظام غذائى و التمارين الهوائية (الجرى على جهاز الجرى الكهربى) فى مجموعة الدراسة و مقارنتها بالتغير فى نسبة الدهون فى الدم ومعدل كتلة الجسم و نسبة الخصر الى الحوض بعد علاجهم باتباع النظام الغذائى و التمارين الهوائية (الجرى على جهاز الجرى الكهربى) فقط فىالمجموعة الضابطة. وقد اسفرت النتائج عن وجود فروق ذو دلالة احصائية بين المجموعتين فى معدل كتلة الجسم ونسبة الخصر الى الحوض و قياس نسبة الدهون وكان هناك نقص ذو دلالة احصائية فى معدل كتلة الجسم ونسبة الخصر الى الحوض والدهون الثلاثية و الكولستيرول و البروتين الدهنى منخفض الكثافة مع زيادة ذو دلالة احصائية فى البروتين الدهنى مرتفع الكثافة فى مجموعة الدراسة اكثر من المجموعة الضابطة. وقد خلصت الدراسة الى ان تاثير اذابة الدهون كهربيا تعتبر وسيلة فعالة فى اقلال الوزن و قياسات الجسم و يحسن نسبة الدهون فى الاناث.