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Tripollar Radiofrequency Lipolysis, Ultrasound Cavitation and Combination Therapy on Abdominal Adiposity

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ABSTRACT

***Background**: Central obesity or increased intra abdominal fat is associated with a statistically higher risk of heart disease, hypertension, insulin resistance, and diabetes mellitus type 2.* ***Purpose:** This study was conducted to investigate and compare the effectiveness of tripollar radiofrequency lipolysis (RF), ultrasound (US) cavitation and their combination on subcutaneous fat thickness and waist circumference (WC) in patients with abdominal adiposity.* ***Subjects:** Thirty patients suffering from localized fat deposits at the abdominal area aged from 25-50 years old assigned randomly into three equal groups: Group (A) consisted of 10 patients with mean age and BMI were 38.7±6.63 years and 33.55±1.31 kg/m2 respectively. Group (B) consisted of 10 patients with mean age and BMI were 34.3±7.76 years and 33.57±1.57kg/m2. Group (C) consisted of 10 patients with mean age and BMI were 34.3±7.76 years and 32.99±3.73 kg/m2.* ***Methods:** Group (A) received US cavitation (AC 220 Volt. 40 KHz) twice weekly for 10 sessions. Group (B) received tripollar RF (AC 220 Volt .1MHZ. 50 Watts) twice weekly for 10 sessions. Group (C) received combination therapy (both tripollar RF and US cavitation) twice weekly for 10 sessions. Patients in all groups were assessed using ultrasonography and tape measurement before treatment then after treatment after 10 sessions to measure abdominal subcutaneous fat thickness and WC.* ***Results:** Showed that there was statistical significant difference between pre and post treatment within each group (A, B and C) for abdominal subcutaneous fat thickness and WC. But there was a non-statistical significant difference among the three groups post treatment.* ***Conclusion**: There is no statistical significant difference among tripollar RF, US cavitation and their combination in management of abdominal adiposity.*

***Key Words:** Abdominal Adiposity, Ultrasound Cavitation, Tripollar Radiofrequency, Combination therapy, Waist Circumference*

INTRODUCTION

Obesity is often defined simply as a condition of abnormal or excessive fat accumulation in adipose tissue, to the extent that health may be impaired. [1]

Obesity consists of excessive fat deposits throughout in the body, whereas central obesity or abdominal adiposity denotes excessive fat in the mid body region, much of it in the intra-abdominal area**.** [2]

The pattern of fat distribution in the human body is affected by sex, diet, level of physical activity and mostly by genetics. One aesthetic problem for individuals, who achieve modest or even dramatic weight loss due to a diet control program combined with physical exercise, is the inability to eliminate localized fat deposits from specific anatomical sites, such as the abdomen, buttock and thighs. [3]

With the wide spread use of topical and oral medications for the treatment of obesity with its side effect and lack of accuracy for the most of these medications, dermato-functional physiotherapy has efficient resources to fight these problems. [4]

Ultrasound (US) cavitation improves the appearance of body shape, focused therapeutic US is used to reduce adipose tissue and its efficacy was determined by the change in fat thickness. [5]

Ultrasonic waves create compression cycles that exert positive pressure and expansion cycles that exert negative pressure. This pushing and pulling effect can lead to rupture of fat cells and eventually cavitation. Focusing this ultrasonic energy into the deeper fat layers can lead to cavities in the fat and theoretically reduction of the overall thickness of the adipose layer. [6]

Radiofrequencies (RF) treatments have been accepted as one of the most popular and promising procedures for the treatment of cellulite, skin tightening and body sculpting. TriPollar RF technology provided beneficial effects on the reduction of abdomen and thigh circumferences and an overall improvement in the appearance of cellulite. [7]

Ultrasound cavitation and RF lipolysis are being from the available noninvasive methods of adipose tissue removal, these devices have been developed to remove or reduce unwanted local subcutaneous fat, and combination of these treatment modalities for fat disrupter for body contouring was used to achieve synergetic effect. [8]

Based on the previous studies, Tripollar RF lipolysis, US cavitation have an effect on local subcutaneous fat thickness and waist circumference (WC) in patient with abdominal adiposity, but there is gap in comparing the effect of these two modalities and their combination on local subcutaneous fat thickness and WC in patients with abdominal adiposity, so this study was conducted to cover this gap.

Methods

Subjects and Methods

Thirty patients suffering from localized fat deposits at the abdominal area. They were recruited from Mallawy hospital outpatient clinics during period from first of February 2016 till April 2016. Their ages ranged from 25-50years old, Egypt, Elminya. Body mass index (BMI) was more than 30kg/m^2 and their WC was more than 90 cm in male and 80 cm in female. The patients were excluded if they had serious diseases, such as heart disease, gastric ulcer, serious gastropathy, duodenal ulcer, and uncontrolled diabetes or hypertension. They were divided randomly and equally into three equal groups (Maximize statistical power). Group (A) Ten patients managed with US cavitation for ten sessions. Group (B) Ten patients managed with tripollar RF lipolysis for ten sessions. Group (C) Ten patients managed with combination of US cavitation and tripollar RF lipolysis for ten sessions.

Procedures

1) Evaluation procedures

1) Ultrasonography examination

Ultrasound imaging is based on the different acoustic properties of different tissues. During measurement; the patient was in a supine position. It was necessary to remove any air bubble prior to examination by immersing the tip of the probe in saline and massaging the tip very gently with a bent swab. When imaging, the transducer was positioned perpendicular to the skin to avoid obliquity and to prevent errors during determination of skin thickness. A thick layer of ultrasound gel was applied to improve near field visibility and avoid tissue compression, which would alter measurements of tissue thickness. Ultrasonographic examination was done by radiology specialist at 2 times for all subjects before and after treatment sessions. [9] The technique which was used measured the distance between the epidermis and the superficial fascia (Camper' s fascia) separating the superficial and deep subcutaneous layer at a specific and consistent distance from an anatomical landmark of abdomen. Each measurement was evaluated on two planes by radiologist: the first plane was parallel to the long axis of the abdomen, and the second plane was perpendicular to the first one**.** Ultrasonographic examination was done by radiology specialist at 2 times for all subjects before and after treatment sessions**.** [10]

2) Waist circumference measurement

Abdominal circumferences was measured in centimeter with the patient in standing position by applying a plastic tape at the midpoint between the rib cage and the top of the lateral border of the iliac crest during minimal respiration.[11]

B) Therapeutic procedures

Procedures of Tripollar Radiofrequency Application

Patient was placed into a comfortable supine lying position.

2. The treated area covered by glycerol oil.

3. The treatment was applied 2 days per week for 10 sessions.

4. Apply tripollar RF using the head on spot fat areas, the applicator was

employed with slight pressure in a continuous sweeping movement over the skin.

5. Treatment duration was 40 minutes in each session. [12]

Procedures of Ultrasound Cavitation

The session protocol was performed under the following methods:

1**.** The patients should drink some water before the treatment.

2. Clean the skin with alcohol cotton.

3. Application of conductive gel on the area to be treated.

4. Application treatment of ultrasound cavitation for approximately 20 minutes on each side of abdomen.

5. Cavitation frequency will be 40 KHz.

6. Treatment was applied 2 times per week for 10 sessions**.** [13, 14]

Statistical analysis

All statistical analyses were carried out by using the statistical package for the social sciences (SPSS, version 19 for windows; SPSS Inc., Chicago, Illinois, USA).The Kolmogorov– Smimov test was used to check the normality of the data. Descriptive statistics were used for comparison of the mean age, height, weight, and body mass index. Multivariate Analysis of Variance (MANOVA) test was used to show the difference in difference between pre and post treatment result among three groups (A, B and C).The level of significance for all statistical tests was≤ 0.05. A preliminary statistical power analysis determined that a sample size of 30 for this study was adequate to achieve more than 80% power and significant level was ≤ 0.05.

Results

A comparison of the demographic data of 30 participants in three groups revealed no significant differences between the three groups as regards to mean age, height, weight, body mass index (Table 1).

Table (1): Demographic data of patients for groups (A, B and C)

Variables	Group A	Group B	Group C	F-value	P-value	Level of significant
Age (years)	38.7±6.63	34.3±7.76	35.4±8.89	0.858	0.435	N.S
Weight (kg)	77.97±5.07	85.74±2.41	84.95±10.52	3.643	0.05	N.S
Height (m)	1.58 ± 2.05	161.5 ± 1.9	160.4 ± 2.8	2.282	0.115	N.S
BMI (kg/m^2)	33.55±1.31	33.57±1.57	32.99±3.73	0.179	0.837	N.S

***Significant at alpha level <0.05**

SD = standard deviation M = meter P = probability BMI = Body Mass Index

NS = non significance KG = kilogram SIG = significance

1. Waist Circumference

There was significant reduction of WC at post treatment when compared to pre treatment in groups (A, B and C). While, there was no significant difference of the mean values of the "post" treatment among (group A versus C), (group A versus B) and (group B versus C) with (P=0.519, P=0.101 and 0.089) respectively. **Tables (2 and 3).**

Table (2): The Waist circumference pre and post treatment within groups A, B, and C.

Waist circumference	Time of measurement		MD	% of improvement	P- value	Sig.
	Pre treatment Means ±SD	Post treatment Means ±SD				
Group A	107.22±11.67	95.88 ±8.43	11.33	%10.57	*0.002	S
Group B	113.33±4.12	101.66 ±5.59	11.66	%10.29	*0.001	S

Group C	105.44 ±4.74	92.55 ±13.62	12.88	%12.21	*0.001	S

*Significant at alpha level <0.05 SD: standard deviation P: probability
NS: Non significance SIG: significance

Table (3): Bonferroni multiple comparison tests (Post hoc tests) of Waist circumference between groups (A, B, and C) pre and post treatment.

Waist circumference		Mean difference	P-value	Sig
Pre treatment	Group (A) Vs. Group (B)	-6.11	0.31	NS
	Group (A) Vs. Group (C)	1.77	1.00	NS
	Group (B) Vs. Group (C)	-7.88	0.166	NS
Post treatment	Group (A) Vs. Group (B)	-5.77	0.101	NS
	Group (A) Vs. Group (C)	3.33	0.519	NS
	Group (B) Vs. Group (C)	9.11	0.089	NS

2. Ultrasound Measurements of Abdominal Subcutaneous Fat Thickness

There was significant improvement of at abdominal subcutaneous fat thickness post treatment when compared to pretreatment in groups (A, B and C). While, there was no significant difference of the mean values of the "post" treatment among (group A versus B), (group A versus C), and (group B versus C) with (P=0.176, 0.098 and 1.00) respectively. **Tables (4 and 5).**

Table (3): The US Measurements of Abdominal Subcutaneous Fat Thickness Pre and Post Treatment within Groups (A, B, and C).

US measurements	Time of measurement		MD	% of improvement	P- value	Sig
	Pre treatment Means ±SD	Post treatment Means ±SD				
Group A	2.7 ±0.23	2.14 ±0.27	0.55	%20.74	*0.0001	S
Group B	2.25±0.40	1.83±0.33	0.42	%18.66	*0.0001	S
Group C	2.42±0.46	1.78±0.37	0.63	%26.44	*0.0001	S

Table (4) : Bonferroni multiple comparison tests (Post hoc tests) of US Measurements of Abdominal Subcutaneous Fat Thickness between groups (A, B, and C) pre and post treatment.

US measurements of abdominal subcutaneous fat thickness		Mean difference	P-value	Sig
Pre treatment	Group (A) Vs. Group (B)	0.44	0.063	NS
	Group (A) Vs. Group (C)	0.278	1.00	NS
	Group (B) Vs. Group (C)	-0.167	0.407	NS
Post treatment	Group (A) Vs. Group (B)	0.311	0.176	NS
	Group (A) Vs. Group (C)	0.356	0.098	NS
	Group (B) Vs. Group (C)	0.044	1.00	NS

DISCUSSION

Abdominal obesity, also known as beer belly, beer gut, pot belly or clinically as central obesity, is when excessive abdominal fat around the stomach and abdomen has built up to the extent that it is likely to have a negative impact on health. There is a strong correlation between central obesity and cardiovascular disease. [15]

This study was conducted to investigate and compare the effect of tripollar RF lipolysis, US cavitation and their combination (US cavitation and tripollar RF) on subcutaneous fat thickness and WC in patients with abdominal adiposity.

The results obtained in the present study indicated that there was a significant improvement for US cavitation, tripollar RF and their combination post treatment on abdominal subcutaneous fat thickness and WC in all groups, but there was a non significant difference among the three groups pre and post treatment

In an attempt to confirm the previous results, It was reported that, treatment of localized adiposity with unstable cavitation which termed ultra sound cavitation, producing the opening of the interstitial liquid triglycerides. The damage occurring to adipocytes results in an inflammatory response composed primarily of macrophages, neutrophils, and plasma cells attracted to engulf and transport the damaged cells lymphocytes. **[16]**

Another study used ultrasound cavitation in order to stimulate the metabolic activity in subcutaneous adipose tissue in order to evaluate the effectiveness of this technique in increasing the strength of the connective tissue and decreasing subcutaneous fat thickness. There was an increase in cell permeability in the short term, which stimulated the exchange of substances of fat cells and the activation of enzymes that break down fat. The protective and therapeutic effects of acoustic waves are complex and include stimulation of lipolysis, the release of toxic aldehyde products of lipid oxidation, reduction of oxidative stress, reinforcement of antioxidants, a better synthesis of collagen and measurable and visible improvement skin condition. This improves the skin condition was clearly observed by the final evaluation. This was confirmed by ultrasound examination which showed increased density and firmness of the collagen elastic fibers in the dermis and decrease in local subcutaneous fat tissue. **[17]**

Also, Donofrio [19] reported that one of the newest fat reduction technologies is radiofrequency, which delivers energy to the areas of fat by driving controlled heat deep within the fat cells and subsequently destroys them. It is being widely used by dermatologists with much success for people with pockets of excess fat. Since there is no downtime with this procedure, patients can resume their regular activities immediately. Furthermore, the author reported that radiofrequency is a very versatile procedure that can be used on any area of the body, from large areas like the abdomen to very small areas such as the chin with the same degree of success. People who are not considered overweight but have stubborn pockets of unwanted fat that are not responding to diet and exercise, radiofrequency is a good. Another benefit of radiofrequency is its ability to both reduce fat and tighten the skin by directing energy to target collagen. For example, a patient with flabby upper arms may have more loose skin than fat in this area. In this instance, it might use radiofrequency to tighten the skin first and then remove excess fat.

Also, Goldberg et al. [20] demonstrated that tripollar RF alone is a technology that provided beneficial effects on the reduction of abdomen and thigh circumferences and an overall improvement in the appearance of cellulite.

In addition, Fatemi and Kane [18] showed a favorable effect of cavitation only than combined with other modalities in reduction of localized fat. Moreover, these results persist because the accumulation of fat in the treated field is terminated. Cavitation alone is not only used for reduction of localized fat, but also to effectively fight cellulite, fibrous tissue (orange peel) is destroyed, and not just "squeezed out" as in other procedures.

Our results were disagreed with the results of Teitelbaum et al. [22] who found a significant effect on circumference reduction and body contouring by US cavitation when combined with tripollar RF. Significant circumference reduction effect may indicate a 50% greater mean circumference reduction than was achieved by a single treatment session of US cavitation alone.

Also, Coldiron et al. [21] stated that while the disruption of adipocytes is achieved only by the US cavitation, the application of RF treatment may increase its effect and the free fat clearance from the treated area. How ever, the combination of therapies does not add up to a thermal injury to adjacent tissues such as blood vessels, nerves or skin**.**

Conclusion

According to the findings of this study, it was concluded that US cavitation, tripollar RF lipolysis and their combination are effective modalities in reduction of subcutaneous fat thickness and WC in patients with abdominal adiposity and there is no statistical significant difference among tripollar RF, US cavitation and their combination in management of abdominal adiposity.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/ her/their images and other clinical information to be in the journal. The patients understand that names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

REFERENCES

1-World Health Organization. The problem of overweight and obesity 2000; 1.

2-Wen-Yuan L, Xavier P, Chiu L, Chia L, Lance E, Davidson. Central Obesity and Albuminuria: Both Cross-

Sectional and Longitudinal Studies in Chinese .2013; 12(7):94-102.
3- Avram M, Avram A, James W. Subcutaneous fat in normal and diseased states: 1. Introduction. J Am Acad Dermatol. 2005; 53(4):663– 70.
4-Zampronio F, Dreher D. Actuation of dermato-functional physiotherapy on dysfunctional resulting from pregnancy, regional university northwest state of Rio Granddo Sul-UNIJUI.2012; 8: 122-5.
5- Cooter R, Babidge W, Mutimer K. Ultrasound-assisted lipoplasty.anz j surg 2011;7:309-17.
6- Kyle M, Coleman D, William P. Coleman I, Arie B. Non-invasive external ultrasonic lipolysis, Seminars in Cutaneous Medicine and Surgery. 2009;28, (4), 263– 7.
7- Alster T, Lupton J. Non-ablative cutaneous remodeling using radiofrequency devices. Clinical in Dermatology. 2007; 25: 487-91.
8-Després, Jean P, Isabelle L. Review Article Abdominal Obesity and Metabolic Syndrome. J.Inter sci. 2012; 444:881-7.
9-Rallandand, Harland C. Ultrasound in dermatology--basic principles and applications.ClinExpDermatol. 2003; 28(6):632-8.
10-Querleux B, Cornillon C, Jolivet O, Bittoun J. Anatomy and physiology of subcutaneous adipose tissue by in vivo magnetic resonance imaging and spectroscopy: relationships with sex and presence of cellulite. Skin Res Technol 2002; 8: 118– 24.
11- Jensen M. Is visceral fat involved in the pathogenesis of the metabolic syndrome Human model? Obesity (Silver Spring) .2006; 14(1): 20-4 .
12- Khan M, Victor F, Rao B, Sadick N. Treatment of cellulite: Part II. Advances and controversies [review]. J Am Acad Dermatol. 2010; 62(3): 373- 386.
13- Scorza A, Figueiredo M, Liao O, Borges S. Comparative study of the side effect of electrolipolysis with of TENS brust mode and normal mode in treatment of located abnormal adiposity, Essays and science : Biological, Agricultural and Health science. 2008; 12(2):49-62.
14- Saber M., shalaby S., kharbotly A., Taher N, saber L, Medhat A. effect of ultra sound cavitation therapy as a non invasive approach on adipose tissue thickness in egyption women , J. Appl. Sci.Res.2013; 9(11):5964-9.
15- Yusuf S, Hawken S, Ounpuu S, Dans T, Avezum A, Lanas F, McQueen M, Budaj A, Pais P, Varigos J, Lisheng L, Interheart Study Investigators. "Effect of potentially modifiable risk factors associated with myocardial infarction in 52 countries (the Interheart study): case-control study". American J.heart.Lancet 2004 ; 364 (9438): 937– 52.)
16-Coleman M, Coleman W, Benchetrit A. Non-invasive, external ultrasonic lipolysis. Semin Cutan Med Surg.2009 ; 28(4):263-7.
17- Christ C, Brenke R, Sattler G, Siems W, Novak P, Daser A. Improvement in skin elasticity in the treatment on cellulite and connective tissue weakness by means of extracorporeal pulse activation therapy. Aesthet Surg J. 2008; 28(5):538-44.
18- Fatemi A, Kane M. High-intensity focused ultrasound effectively reduces waist circumference by ablating adipose tissue from the abdomen and fanks: a retrospective case series. Aesthetic Plast Surg. 2010; 34(5):577-82.
19- Donofrio. New non-invasive fat removal technologies offer alternative to liposuction for removing stubborn fat. Academy of Dermatology (AAD).2012; 6: 45-49.
20- Goldberg D, Fazeli A, Berlin A. Clinical, laboratory, and MRI analysis of cellulite treatment with a unipolar radio-frequency device. Dermatol Surg.2008; 34:204– 9.
21- Coldiron B, Healy C, Bene N. Office surgery incidents: what seven years of Florida data show us? Dermatol Surg.2008; 34 (3):91-285.
22- Teitelbaum S, Burns J, Kubota J. Noninvasive body contouring by focused ultrasound: safety and efficacy of the contour I device in multicenter ,controlled, clinical study .plast reconstr surg 2007;120:779-789.