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Effect of Intermittent Pneumatic Compression Belt on Post-Partum Abdominal Fat Thickness: A Randomized Controlled Trial

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Abstract: The purpose of the study was to examine the effect of intermittent pneumatic compression belt on post-partum abdominal fat thickness. Forty post-partum females suffering from bulged abdomen. Their age ranged between 25 years and 35 years. They were assigned to two equal groups randomly. Group (A) received Intermittent pneumatic compression belt with pressure 70 mmHg for one hour/day, 3 times a week for 6 weeks, 1200 kcal/day diet, abdominal exercises program consisted of (static abdominal contraction, posterior pelvic till, straight leg raising and trunk twist) 3 times a week for 6 weeks and. Group (B) only received 1200 kcal/day diet and the abdominal exercises program. Waist circumference and Sonographic Assessment was done to assess Abdominal fat thickness before and after treatment. Statistical analysis reported that the waist circumference and fat thickness of the post - treatment condition were significantly reduced ($p<0.05$) compared to the pre - treatment one in both groups. There was a significant decrease in waist circumference ($p < 0.05$) and fat thickness in group A comparing to group B in the subject effects. We concluded that Intermittent Pneumatic Compression Belt can be used as an effective modality to decrease the fat thickness and belly abdomen after delivery.

Key words: Intermittent pneumatic compression belt · Post-partum · Abdominal fat

INTRODUCTION

During pregnancy, woman gain 15-35 pound on average. Also, there is a change in the body weight distribution and an increasing the pressure on the pelvic and spinal muscles. The increased weight in pregnancy may significantly increase the force across joints and lead to extra collections of fats to form in the abdominal area [1].

Traditionally, it takes time for the abdominal muscles to restore their strength and tone after delivery, even though the uterus begins to decrease directly back to its pre pregnancy size, the abdominal muscles persist in their lengthened state. This makes the belly sound ' soft and flaccid ' from the muscle's weakness, making it appear ' enlarged ' with the pressure of the intestines and abdominal organs that stretch the flexible muscles [2].

It is known that excess adiposity has harmful health effects, particularly on cardiovascular well - being. Research has shown that the location of specific adipose depots has an important role to play in the development of cardio - metabolic disease [3] Several studies have recorded a relationship between body fat distribution, metabolism and circulatory diseases in obesity [4]. Krotkiewski *et al*. [5] analyzed the relationship in both body fat distribution and metabolism in 1983, showing people having high waist to hip ratio (WHR) had higher blood pressure, lower carbohydrate tolerance and higher plasma insulin concentration compared to those having low WHR [5].

Measurements of abdominal obesity are independent predictors of incidents of ischemic stroke in women, but not in adult men. Therefore, preventing central obesity may be of particular importance to women in order to decrease the risk of ischemic stroke [6].

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Greater intra-abdominal adipose or visceral fat is positively associated with hypertension prevalence and incidence [7, 8], Cross-sectional data from the Framingham Heart Study in Caucasian subjects found that hypertension is associated with computed tomography (CT) measured visceral and abdominal subcutaneous adipose volumes [9].

Sonography has proved to be an excellent noninvasive and reliable tool for abdominal fat measurement [10], as it appeared helpful for tracking small abdominal and intra - abdominal fat thickness variations [11]. Intermittent pneumatic compression has many physiological effect including minimization of edema accumulation, improve metabolite removal and improve muscle efficiency [12]. The abdominal belt achieves instantly waist reduction as the soft flesh tissues are compressed, squeezed and redistributed above and below the waist line. This also helps keep the abdominal muscles at the right tension and prohibits them from becoming floppy and expanding; the belt must apply the right pressure without strangulation and exert the necessary pressure on the abdominal muscles at the same time [13].

Unfortunately, the literature review was unable to identify the effect of intermittent pneumatic compression belt on post-partum abdominal fat thickness Consequently, we conducted this study to explore its effect.

MATERIALS AND METHODS

Study Design: The study was conceived as a randomized, prospective, controlled trial. The study followed the Helsinki Declaration Guidelines on Human Research Conduct.

Participants: This study was carried out on forty postnatal female (delivered normally) with bulged abdomen, they were selected from out-patient clinics of Cairo university hospitals. Their age varied between 25 years and 35 years. Their index of body mass (BMI) was 25 - 35 kg / m2. Any participant was excluded if she meets one of the following criteria: Any skin disease or sensitivity that interferes with the use of intermittent pneumatic compression belt, Any chest disease, cardiac disease, any abdominal herniation or surgery.

Randomization: Each participant was informed of the nature, purpose and benefits of the study, the right to refuse or withdraw at any time and the confidentiality of all data obtained. Women were allocated randomly to two equal groups (group A and group B) with the use of a computer-based randomization program. No dropping out of subjects from the study was reported after randomization.

Interventions: Group (A) was composed of 20 women received Intermittent pneumatic compression belt: pressure 70 mmHg for one hour/day, 3 times a week for 6 weeks, 1200 kcal/day diet and abdominal exercises program consisted of (static abdominal contraction, posterior pelvic till, straight leg raising and trunk twist) 3 times a week for 6 weeks and Group (B) composed of 20 women only received 1200 kcal/day diet and the abdominal exercises program.

Instrumentation: The following instruments were used:

Ultrasonography Machine: It was used for measurement of the abdominal fat thickness before and after the study.

Tap Measurement: it was used at the end of gentle expiration to measure the waist perimeter pare skin between the costal margin and the iliac crest at the narrowest level.

Intermittent Pneumatic Compression Belt: Applied for each participant with pressure 70 mmHg for one hour/day, 3 times a week for 6 weeks.

Procedure: Waist circumference and Sonographic Assessment was done to assess Abdominal fat thickness before and after treatment procedures for each participant in both groups (A & B).

Group A: Contains 20 post natal women who had applied intermittent pneumatic compression belt with pressure 70 mmHg for one hour/day, 3 times a week for 6 weeks, abdominal exercises program composed of (static abdominal contraction, posterior pelvic till, straight leg raising and trunk twist) 3 times a week for 6 weeks and 1200 kcal/day diet.

Group B: Contains 20 postnatal women who performed the abdominal exercises program that consisted of (static abdominal contraction, posterior pelvic till, straight leg raising and trunk twist) 3 times a week for 6 weeks plus 1200 kcal/day diet.

Data Analyses: All statistical measures were carried out using the Windows version 23 of the Social Science Statistical Package (SPSS) program. Before the final analysis, data were monitored for normality assumption,

variance homogeneity and extreme scores There was a linear relationship, as assessed by scatterplot, between the dependent variables and no evidence of multicollinearity as evaluated by the Pearson correlation ($|r| < 0.9$). There were no univariate outliers in the data as evaluated by a boxplot examination and there were no multivariate outliers in the data as evaluated by distance from Mahalanobis.

Waist circumference and fat thickness were normally distributed, as assessed by Shapiro-Wilk's test ($p > .05$). There was similarity of variances, as assessed by Levene's ($p > .05$) for all dependent variables. Therefore, MANOVA used 2 variables of mixed design to compare the tested variables of interest at different test groups and measuring periods. The level of alpha was set at 0.05.

RESULTS

In the final data analysis, a total of 40 participants were included. They were split into two equal groups (group A and group B). The independent t-test reported that there were no major differences ($p>0.05$) between the two tested groups in the mean values of age, weight, height and BMI (Table 1).

Thirty patients were analyzed using MANOVA assigned to two equal groups using mixed design. It revealed that there were significant within subject effect ($F = 200.677$, $p = 0.0001$) and treatment*time effect ($F = 3.912$, $p = 0.034$). while there was not significant between subject effect ($F= 1.897$, $p = 0.173$). Table (2) present descriptive statistic (mean ± SD) and multiple pairwise comparison tests (Post hoc tests) for the all dependent variables. In the same context, the multiple pair comparison tests revealed that the waist circumference and fat thickness of the post - treatment condition were significantly reduced ($p<0.05$) compared to the pre-treatment in both groups. Multiple comparisons of subject effects revealed that there was a significant reduction in waist circumference ($p < 0.05$) and fat thickness in favor of group A than group B.

DISCUSSION

The results of the study revealed that there was significant reduction in waist circumference and fat thickness in favor of group A in compared to group B. There was a reduction in the waist circumference and abdominal fat thickness estimated by abdominal

Table 1: Demographic characteristics of patients in both groups.

	Group A	Group B	Comparison		
Items	Mean ± SD	Mean ± SD	t-value	P-value	S
Age (years)	34.35±5.21	33.65±4.88	0.438	0.664	
Body mass (kg)	78.08±9.47	80.56±11.01	-0.661	0.514	
Height (cm)	160.06±2.91	161.26±3.01	-1.109	0.277	
BMI (kg/m^2)	30.38±3.03	30.84±3.43	-0.388	0.701	

*SD: standard deviation, P: probability, S: significance, NS: non-significant.

Table 2: Descriptive statistics and Multiple pairwise comparison tests (Post hoc tests) for the all dependent variables for both groups at different measuring periods

	Group A		Group B	
Variables	Pre	Post	Pre	Post
Waist Circumference	102.76±6.91	91.69 ±5.79	106.61 ±8.24	98±6.63
Fat Thickness	24.3±6.79	12.61 ±3.73	26.3 ±5.97	17.84±4.68
Within groups (Pre Vs. post)				
p-value		Waist Circumference		Fat Thickness
Group A		0.0001*		0.0001*
Group B		0.001*		0.004*
Between groups (group A Vs. group B)				
		Waist Circumference		Fat Thickness
Pre treatment		0.21		0434
Post treatment		0.016*		0.004*

*Significant at the alpha level ($p < 0.05$).

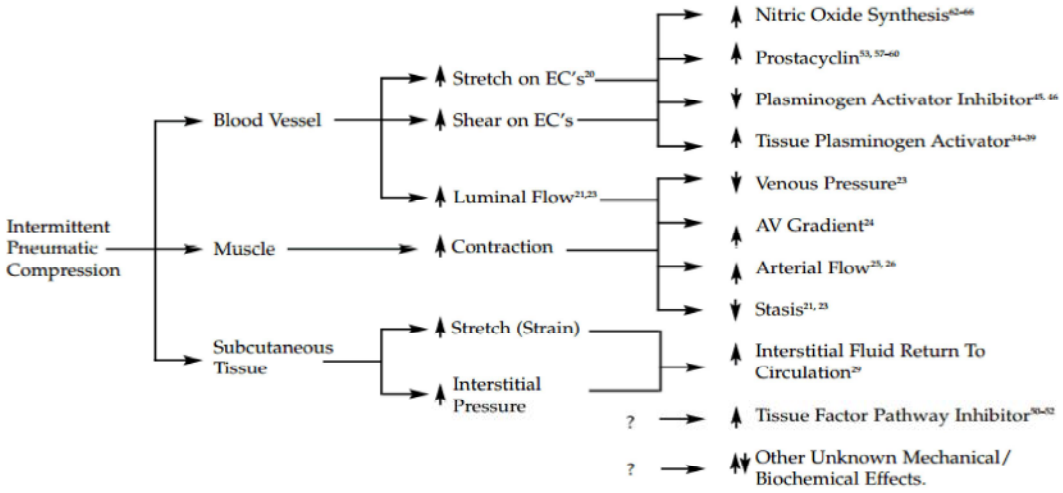

Fig. 1: The effect of intermittent pneumatic compression belt.

sonography in both group (A and B) in the post treatment than pre treatment measures and this reduction was more in group A than group B which can be explained due to the superimposed effect of intermittent pneumatic compression belt.

Classical compression effects improve venous return and speed up metabolic waste removal [14], limiting of edema, increasing arterial blood flow [15] and increasing oxygen delivery to the tissue [12].

The importance of compression is often indicated as reducing the accumulation of metabolites, especially the reduction of blood lactate that can influence muscle contractile function and peak power production (via PH - mediated changes) [16].

Compression therapy is encouraging because stress applied on the body not only limited to improves lymphatic and venous circulation but also stimulate muscle [17] Increase in the blood flow and subsequent muscle oxygenation increased as the intensity of contractions increased [18].

One hour of intermittent pneumatic compression (IPC) with 70 mmHg target inflation pressure significantly alters gene expression of skeletal muscle genes associated with inflammation, redox, hypoxia and metabolism [19].

IPC transmits additional stress to the subcutaneous tissue and muscle groups, compression increases interstitial pressure in the extracellular space, fluids are pushed back into circulation when the interstitial pressure is higher than hydrostatic pressure This pattern successfully decreases the cross - sectional area and decreases the shear stretch on the cutaneous tissue. The decreased surface tension can lead to better transcutaneous oxygenation and clearance of metabolic toxicity [20].

Previous studies showed that muscles recovery is significantly more effective and produce greater muscle performance than passive recovery when intermittent pneumatic compression is applied. EMG studies showed that muscles fire more effectively when treated with IPC [21].

Chen *et al*., 2001 summarized the effect of intermittent pneumatic compression belt in the following Figure (1) [22].

The decrease in waist circumference and abdominal fat thicknesses detected by abdominal sonography following abdominal exercise program in group (B) explained by Boutcher [23] who stated that therapeutic exercise burns glycogen, fat and other nutrients in the muscle. This also increases energy usage, resulting in increased oxidation of carbohydrates and skeletal muscle fat and the absorption of whole body glucose, thus reducing body diameter.

As well, Irving *et al*. [24] verified that abdominal muscle exercises focus on giving high enhancing intensity workouts that provoke fat burning acceleration, especially abdominal fat, likely to result in significant reduction of waist circumference. There are some limitations of this study. Firstly, the lack of follow-up. Secondly, certain secondary outcome variables such as functional activity and muscle strength were not assessed.

CONCLUSION

It can be concluded that intermittent pneumatic compression belt is an effective on decreasing post-partum abdominal fat thickness.

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