

Original Article

The effects of nutritional guidance and cinesiatrics on the insulin resistance and metabolic functions of patients with obese ovarian syndrome

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Received November 11, 2019; Accepted December 26, 2019; Epub March 15, 2020; Published March 30, 2020

Abstract: Objective: This study was designed to investigate the effects of nutritional guidance and cinesiatrics on the insulin resistance (IR) and metabolic functions of patients with obese ovarian syndrome. Methods: 109 patients with obese ovarian syndrome admitted to our hospital from January 2015 to August 2016 were included as the study cohort for a retrospective analysis and divided into two groups based on the intervention modes. The control group (n=54) was routinely intervened in dieting, while the observation group (n=55) was given nutritional guidance and cinesiatrics. The two groups were compared for changes in their IR index (homeostasis model assessment of insulin resistance, HOMA-IR), fasting blood glucose (FBG), fasting insulin (FINS), body mass index (BMI), weight, total cholesterol (TC), triacylglycerol (TG), sex hormone index, and pregnancy rate values before and after intervention. Results: Compared with the control group, the observation group had lower FINS, HOMA-IR, TC, TG, FBG, BMI, weight, testosterone, luteinizing hormone, and pregnancy rate values, and higher follicle stimulating hormone values after the intervention ($P<0.05$). More specifically, the observation group yielded a BMI and weight of (24.15 ± 1.22) kg/m² and (70.06 ± 1.02) kg, and a pregnancy rate of 38.18%, while in the control group, the values were (26.08 ± 1.32) kg/m², (73.18 ± 1.59) kg, and 20.37%, respectively ($X^2=4.168$, $P<0.05$). Conclusion: Nutritional guidance and cinesiatrics effectively control weight and improve IR, abnormal metabolic function, and sex hormone levels as well as the pregnancy rate in patients with obese ovarian syndrome.

Keywords: Nutritional guidance, cinesiatrics, obese ovarian syndrome, insulin resistance, metabolic function

Introduction

Clinically, polycystic ovarian syndrome (PCOS) is a common endocrine disorder disease in females, mainly manifested by ovarian cyst enlargement, long-term sparse or absent ovulation, core pathophysiological changes in insulin resistance (IR), and hyperandrogenemia [1, 2]. However, its specific pathogenesis is unclear and thought to be associated with life style, nutrition, region, and other factors [3].

At present, medication is the major clinical means to treat PCOS patients by promoting ovulation, recovering the menstrual cycle, and improving the pregnancy rate [4, 5]. However, obesity may interrelate with and result in more severe PCOS, which may lead to poor clinical effects of the medication used to treat it [6, 7]. In the meantime, patients with obese ovarian

syndrome are more likely to have long-term complications associated with incretion, including metabolic disorder syndrome, mammary cancer, and type 2 diabetes [8, 9]. Studies have revealed that with weight loss, patients with obese ovarian syndrome achieve effective improvements in IR, reductions in their insulin levels, androgen levels, long-term incidence of various complications, and promotion in ovulation [10, 11]. In order to effectively control the weight of patients with obese ovarian syndrome, it is necessary to carry out scientific and rational nutritional guidance and cinesiatrics [12] to explore the effect on IR and the metabolic function of patients with obese ovarian syndrome.

In the present study, patients receiving nutritional guidance and cinesiatrics were compared with those who were on a conventional diet, in

order to analyze the effect on improving the IR and metabolic function of patients with obese ovarian syndrome.

Materials and methods

Materials

109 patients with obese ovarian syndrome admitted to our hospital from January 2015 to August 2016 were included as the study cohort for retrospective analysis and divided into two groups based on the intervention modes. The patients in the control group (n=54), between 21 and 36 years old, were routinely intervened in dieting, while the patients in the observation group (n=55), between 22 and 37 years old, were given nutritional guidance and cinesiatrics. (1) Inclusion criteria: patients who had neither been treated with any hormone drugs in the past 3 months before inclusion nor manifested severe dysfunctional diseases in the heart, liver, or kidneys; and who were preparing for pregnancy were included. The researchers obtained written informed consents from those patients and the approval of the medical ethics committee. (2) Exclusion criteria: patients who had psychological dependence, mental and cognitive dysfunction, communication and hearing disorders, angiocardopathy, abnormal liver or kidney functions, organic lesions in reproductive system, endocrine diseases such as diabetes, thyroid disease and hyperprolactinemia, or a concurrent malignant tumor and cervical lesions were excluded from the study.

Methods

Both groups were treated with ovulation stimulants and administered with 10,000 U human chorionic gonadotropin (HCG) (Manufacturer: Serono Europe Co., Ltd., Approval Document No.: GYZ No. S20130091, Specification: 250 µg (6500IU) via intramuscular injection on the fifth day after the maturation of follicle and clomiphene (Manufacturer: Medochemie Ltd., Approval Document No.: Registration Certificate No.: H20140688, Specification: 50 mg*10 tablets) at 50 mg qd orally for 5 days from the fifth day of the menstrual cycle on. The treatment consisted of 3 cycles.

The control group was routinely guided in its dieting, which was low in calories and carbohydrates, high in dietary fiber and protein, and the

patients in the group were required to quit smoking and alcohol. Meanwhile, psychological guidance was consolidated to relieve them from any mental pressure, and the patients were guided on intercourse and medication, and informed of the necessity and importance of taking medicines according to their doctor's advice.

The observation group was subject to nutritional guidance and cinesiatrics.

Nutritional intervention

Based on their basal metabolic rates and labor intensity, the patients were provided with targeted nutritional intervention recipes and advised to follow a low-calorie diet structure, with the proportion of fat, proteins, and carbohydrates controlled at 30%, 20% and 50%, respectively. Referring to this standard, an intuitionistic food model was built to help patients master the "food exchange method" comprehensively, and they were guided to, based on the food exchange lists, make rational selections and collocations of low-calorie diets with food characterized by low glycemic indexes, including fresh fruits and vegetables, beans, food without sugar and milk, whole grains and potatoes. The patients were required to formulate recipes for the 3 meals each day and to record what they ate accordingly. The patients were allowed to make a proper adjustment of the recipes in this process, including food selection and calorie estimation, which were distributed according to the proportion of 1/5 for breakfast at, 2/5 for lunch and 2/5 for supper. In addition, individualized monitoring goals were established for them.

Cinesiatrics

Understanding the advantages, the patients with obese ovarian syndrome were asked to participate in 30-60 min of scientific and rational exercising 1 h after breakfast and after supper at the frequency of 3 to 5 times per week in the forms of aerobic exercise and resistance exercises, such as jogging, walking, playing Taijiquan, and swimming to consume calories as much as possible. The patients were instructed to record their exercise results and comply with the principle of gradual improvement in this process by starting with low amount of exercise and increasing gradually.

Table 1. Comparison of the clinicopathological characteristics in the observation the groups [n (%)]/ ($\bar{x} \pm s$)

Characteristic	Observation group (n=55)	Control group (n=54)	t/X ²	P
Age (y)	32.08±1.28	32.05±1.19		
BMI (kg/m ²)	29.86±3.28	29.92±3.19		
Weight (kg)	75.15±2.25	75.09±2.16		
Marriage				
Married	42 (76.36)	40 (74.07)	1.7728	0.782
Unmarried	13 (23.64)	14 (25.93)		
Educational Background				
Junior high school and below	3 (5.45)	2 (3.70)	0.028	0.996
High school or technical secondary school	13 (23.64)	11 (20.37)		
Undergraduate and junior college	28 (50.91)	29 (53.70)		
Graduate students and above	11 (20.00)	12 (22.22)		

According to the criteria in *Clinical Nutriology* [13], the ideal result is 0.5 kg weight loss each week or 2-5 kg each month based on the patients' obesity degree after consuming 500 kcal each day in addition to their normal daily work activities.

Both groups were intervened for 3 months.

Observation indices

IR index: the fasting insulin (FINS) of the two groups was measured before and after the intervention using radioimmunoassays (the double antibody method) and calculated for the IR index (homeostasis model assessment of insulin resistance, HOMA-IR) by multiplying the FINS by the FINS/22.5.

Glycolipid metabolic index: the two groups were compared for changes in their total cholesterol (TC), triacylglycerol (TG), and fasting blood glucose (FBG) before and after the intervention.

Index of weight loss: the two groups were compared for changes in their BMI and weight before and after the intervention.

Sex hormone index: a fasting, venous blood sample was drawn in the morning before and after the intervention to measure the sex hormone levels such as total testosterone (T), follicle stimulating hormone (FSH), and luteinizing hormone (LH), etc.

Pregnancy rate: the pregnancy rates of the two groups were compared after the intervention.

Statistical analysis

Statistical analysis was performed with SPSS 22.0. In the case of numerical data expressed as means $\pm$ standard deviations, the comparison studies were carried out using independent-samples T tests for the data which were normally distributed, and Mann-Whitney U tests for the data which were not normally distributed; in the case of nominal data expressed as [n (%)], the comparison studies were carried out using X² tests for the intergroup comparisons. For all the statistical comparisons, $P < 0.05$ was considered statistically significant.

Results

Comparison of the clinicopathological data in the observation and control groups

No statistical significance was observed between the observation group and the control group in terms of mean age, mean BMI, weight, marriage or educational background ($P > 0.05$, **Table 1**).

Comparison of the IR indexes in the observation and control groups

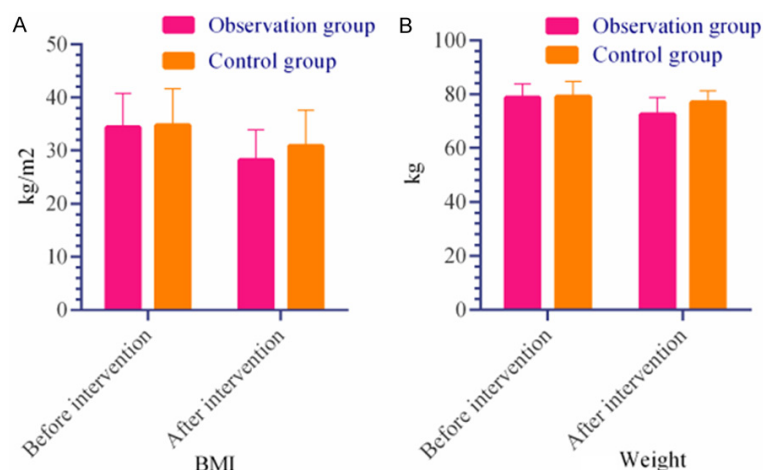
FINS and HOMA-IR decreased significantly in both groups after the intervention ($P < 0.05$) and were more significant in the observation group ($P < 0.05$, **Table 2**), while no significant differences were observed in both groups before the intervention ($P > 0.05$).

Table 2. Comparison of the IR indexes in the observation and control groups ($\bar{x} \pm s$)

Group	FINS ($\mu\text{IU/ml}$)		HOMA-IR	
	Before intervention	After intervention	Before intervention	After intervention
Control group (n=54)	12.69 $\pm$ 2.15	10.89 $\pm$ 1.29	3.32 $\pm$ 0.52	2.56 $\pm$ 0.48
Observation group (n=55)	12.72 $\pm$ 2.09	9.02 $\pm$ 0.28	3.39 $\pm$ 0.48	2.02 $\pm$ 0.15
t	0.074	10.502	0.730	7.957
P	0.941	0.000	0.467	0.000

Table 3. Comparison of the glycolipid metabolic indexes in the observation and control groups ($\bar{x} \pm s$)

Group	TC (mmol/L)		TG (mmol/L)		FBG (mmol/L)	
	Before intervention	After intervention	Before intervention	After intervention	Before intervention	After intervention
Control group (n=54)	8.85 $\pm$ 1.28	6.35 $\pm$ 0.58	2.96 $\pm$ 0.85	2.15 $\pm$ 0.25	5.46 $\pm$ 1.05	4.89 $\pm$ 0.52
Observation group (n=55)	8.89 $\pm$ 1.16	5.25 $\pm$ 0.28	2.99 $\pm$ 0.82	1.82 $\pm$ 0.18	5.49 $\pm$ 1.03	4.26 $\pm$ 0.26
t	0.171	12.645	0.188	7.920	0.151	8.022
P	0.865	0.000	0.852	0.000	0.881	0.000


Figure 1. Comparison of the BMI and weight in the observation and control groups before and after the intervention. The observation group was compared with the control group in terms of BMI and weight before the intervention ($P>0.05$), and the values were lower than they were in the control group after the intervention ($P<0.05$).

Comparison of the glycolipid metabolic indexes in the observation and control groups

TC, TG, and FBG decreased significantly in both groups after the intervention ($P<0.05$) and were more significant in the observation group ($P<0.05$, **Table 3**), while no significant differences were observed in both groups before the intervention ($P>0.05$).

Comparison of the BMI and weight in the observation and control groups

Before the intervention, there were no significant differences in BMI or weight in both groups

ups ($P>0.05$). After the intervention, the BMI and weight of the observation group were (24.15 $\pm$ 1.22) kg/m² and (68.06 $\pm$ 1.02) kg, which were lower than of the corresponding values (26.08 $\pm$ 1.32) kg/m² and (74.18 $\pm$ 1.59) kg in the control group ($P<0.05$, **Figure 1**).

Comparison of the sex hormone indexes in the observation and control groups

T and LH decreased significantly and FSH increased significantly in both groups after the intervention ($P<0.05$), and the values were more significant in the observation group ($P<0.05$, **Table 4**), while there

were no significant differences in both groups before the intervention ($P>0.05$).

Comparison of the pregnancy rates in the observation and control groups

After the intervention, the observation group reported 21 (38.18%) cases of pregnancy, while the corresponding value in the control group was 11 (20.37%) ($\chi^2=4.168$, $P<0.05$, **Figure 2**).

Discussion

PCOS is a heterogeneous disease with a high incidence and an obvious impact on 6%-18% of

Table 4. Comparison of the sex hormone indexes in the observation and control groups ($\bar{x} \pm s$)

Group	T (nmol/L)		FSH (IU/L)		LH (IU/L)	
	Before intervention	After intervention	Before intervention	After intervention	Before intervention	After intervention
Control group (n=54)	3.25±0.62	2.68±0.52	7.89±1.52	8.12±1.63	9.25±1.22	8.16±0.58
Observation group (n=55)	3.29±0.59	2.32±0.45	7.92±0.49	9.16±1.88	9.28±1.19	7.12±0.26
t	0.345	3.867	0.139	3.083	0.130	12.116
P	0.731	0.000	0.890	0.003	0.897	0.000

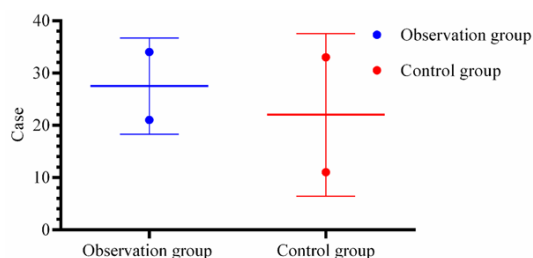


Figure 2. Comparison of the pregnancy rate in the observation and control groups before and after the intervention. The observation group reported a pregnancy rate of 38.18% after the intervention, which was higher than the control group's rate of 20.37% ($P<0.05$).

the women of childbearing age [14, 15]. It results in hypertrichiasis, obesity, infertility, and menoxenia. Studies have indicated that more than half of PCOS patients are concurrent with obesity, which plays a vital role in the development and progression of PCOS, and also causes infertility and fertility reduction [16].

Obese women have higher a possibility of abortion compared with women of normal weight, and obese PCOS patients have more severe IR manifestations compared with non-obese PCOS patients, including a reduced insulin sensitivity index (ISI) and hyperinsulinemia, and a markedly elevated incidence of metabolism syndrome [17, 18]. Furthermore, obesity results in the abnormal activation of aromatase in the peripheral adipose tissue and stimulates and transforms androgen into estrogen. The long-term absence of ovulation in patients leads to a markedly increased possibility and length of endometrial exposure in estrogen. Therefore, effective weight control is extremely necessary in obese PCOS patients [19, 20].

According to the present study, the BMI and weight of the observation group were ($24.15 \pm$

1.22 kg/m² and (70.06 ± 1.02) kg, which were lower than those of (26.08 ± 1.32) kg/m² and (73.18 ± 1.59) kg in the control group ($P<0.05$), indicating that nutritional guidance and cinesiatrics effectively controlled the weight of the patients with obese ovarian syndrome. This may be because strengthening the nutritional guidance and the strict control of caloric uptake during dieting is advantageous to weight control [21, 22]. In addition, exercise is one of the most effective, economic, and safe auxiliary methods to promote the recovery of ovarian morphology, during which, the skeletal muscles participate in increasing the uptake of glucose and oxygen consumption significantly, accelerating the decomposition of muscle glycogen, so as to improve IR in the liver and effectively control the patients' weight [23, 24].

The study revealed that, as compared with the control group, the observation group reported lower FINS, HOMA-IR, TC, TG and FBG after the intervention ($P<0.05$), indicating that nutritional guidance and cinesiatrics improved the IR and glycolipid metabolic functions of the patients with obese ovarian syndrome. The reasons lie in diet intervention dominated by food low in carbohydrates. According to the actual conditions of each patient, individualized weight control goals were established, and the food exchange method was taught to make sure patients can manage the method by themselves and elevate their compliance in diet intervention. The low calorie and low carbohydrate diet promoted the secretion of hepatic glycogen, accelerated gluconeogenesis and reduced body weight, resulting in a significant reduction in free fatty acids in the plasma, an increase in the glucose uptake of fats and muscles, and an enhancement of the bonding force between insulin and its receptors, so as to improve IR [25, 26]. Secondly, in obese PCOS patients, the suppression of insulin in free fatty

acids is markedly compromised, followed by the depressed activity of EST and free fatty acids after dinner. With the weight loss, metabolism returns to normal level. Besides, as compared with the control group, the intervention yielded lower T and LH, and higher FSH, and a pregnancy rate of 38.18%, higher than that of the 20.37% in the control group after intervention, indicating that nutritional guidance and cinesiatrics can effectively improve the sex hormone levels and pregnancy rates of patients with obese ovarian syndrome, which may be associated with the effective control of their weight and improvement in their IR after a low-carbohydrate diet and cinesiatrics intervention, which boosted the development of follicles, reduced the incidence of hyperandrogenism, and improved ovulation and the pregnancy rate. Garbossa et al. [27] found that the control of obese PCOS patients' weight can effectively block various adverse reactions arising from the long-term progression of the disease, heighten the pregnancy rate and improve the quality of life, which corresponds to the results of the present study.

In conclusion, nutritional guidance and cinesiatrics can effectively control weight, and improve the IR, abnormal metabolic function, and sex hormone levels as well as the pregnancy rate in patients with obese ovarian syndrome.

However, the study had a small cohort, which leads to an insufficient representativeness of the results. Therefore, future studies need a larger sample size, a longer duration and a wider coverage.

Disclosure of conflict of interest

None.

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