Effect of Jiangtangning Capsule Combined with Acarbose on Blood Glucose and Islet β Cell Function in Patients with Type 2 Diabetes

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[Abstract] Objective To investigate the effect of Jiangtangning capsule combined with acarbose on blood glucose and islet β cell function in patients with Type 2 diabetes. **Methods** 92 patients with Type 2 diabetes treated in Haikou Traditional Chinese Medicine Hospital from January 2018 to May 2019 were randomly divided into 2 groups. the Control Group was treated with acarbose, and the Study Group was given Jiangtangning capsule in addition to the treatment of the Control Group. The course of treatment in both groups was 3 months. Changes in the main Traditional Chinese Medicine symptom score after treatment in the 2 groups of patients were observed, and Fasting Blood Glucose (FPG), 2 hours postprandial blood glucose (2 hPG), Glycated Hemoglobin (HbA1c), Islet β Cell Function [Fasting Insulin (FINS), Insulin Resistance Index (HOMA-IR), Insulin Secretion Index (HOMA-β), Early Insulin Secretion Index (EISI), and Modified Islet β Cell Secretion Index (MBCI)] were tested before and after treatment. Mean amplitude of glycemic excursions (MAGE), number of glycemic excursion (NGE), and mean absolute difference in blood glucose during the day (MODD) of the 2 groups were recorded before and after treatment. Comprehensive efficacy and adverse reactions in the 2 groups were compared. **Results** After treatment, scores on dry mouth and throat, fatigue and asthenia, burning sensation of five centers, thirst and desire for drinking, large appetite with rapid hungering, palpitations and insomnia, and FPG, 2 hPG, HbA1c, MAGE, NGE, MODD, and HOMA-IR were significantly reduced (all $P<0.05$), and all the indexes of the Study Group were significantly lower than the Control Group (all $P<0.05$). After treatment, FINS, HOMA-β, EISI, and MBCI were significantly increased in both groups (all $P<0.05$); and those of the Study Group were significantly higher than the Control Group ($P<0.05$). The overall effective rates of the Study Group and the Control Group were 93.5% (43/46) and 78.3% (36/46), respectively, and that of the Study Group was significantly higher than the Control Group ($P<0.05$). There was no statistically significant difference in the incidences of adverse reactions between the 2 groups ($P>0.05$). **Conclusion** The efficacy of Jiangtangning capsule combined with acarbose in the treatment of Type 2 diabetes was better than that of acarbose alone. Patients' symptoms and glycemic excursion were alleviated, and islet β cell function was improved.

[Keywords] Jiangtangning capsule; Acarbose; Type 2 diabetes; Blood glucose; Islet β cell function
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Type 2 diabetes is the main type of diabetes. With the continuous improvement of social living standards, its incidence rate is on the rise [1]. Formulating a timely and effective diabetes

treatment plan to promote the recovery of patients' blood glucose levels and reduce the stimulation of high blood glucose on various tissues and organs of the body has a positive significance for improving the prognosis. Due to insufficient knowledge about diabetes, many patients refuse to use insulin because of factors such as insulin dependence or fear of subcutaneous injection. Acarbose tablet is a new type of oral hypoglycemic drug, which can promote the decomposition of starch into oligosaccharides, delay the decomposition of sucrose into glucose, etc., thereby promoting the reduction in blood glucose levels [2]. However, patients with Type 2 diabetes may have different degrees of insulin resistance symptoms after long-term treatment, and the effect of simple acarbose treatment on glucose control is significantly affected. Jiangtangning capsule is composed of various traditional Chinese medicine ingredients. With the effects of supplementing qi, regenerating qi, and nourishing yin, it is suitable for diabetes with deficiency in both qi and yin [3]. This study observed the effect of acarbose combined with Jiangtangning capsule in the treatment of patients with Type 2 diabetes and its effect on islet β-cell function, aiming to provide a reference for clinical research. Now, the results are reported as follows:

1 Materials and Methods

1.1 General Information

92 patients with Type 2 diabetes treated in our hospital from January 2018 to May 2019 were enrolled as subjects of the study. All the patients met the diagnostic criteria for Type 2 diabetes [4], and met the traditional Chinese medicine criteria of qi and yin deficiency syndrome in *Guidelines for Clinical Research on New Drugs of Traditional Chinese Medicine*[5], manifested as dry mouth and throat, fatigue and asthenia, burning sensation of five centers, thirst and desire for drinking, large appetite with feeling hungry quickly, palpitations and insomnia, red tongue with thin coating, and fine pulse string. Patients were informed of all measures in this study, and voluntarily signed the Informed Consent Form. Patients had no obvious abnormalities in liver and kidney function. Subjects with Type 1 diabetes, severe diseases in heart, liver, lung, kidney and other important organs, allergies, or those who were known to be allergic to the drugs used in this study, or those with diabetes complications, or those who had poor compliance and did not cooperate to complete the whole study, or those who were pregnant or breastfeeding, or those with other acute and chronic infectious lesions were excluded. According to the Random Number Table Method, subjects were divided into 2 groups: There were 46 subjects in the Study Group, 27 males and 19 females; aged 23~58 (39.7±6.3) years old; course of disease 1~5 (3.2±0.8) years. There were 46 subjects in the Control Group, 25 males and 21 females; aged 25~57 (39.4±6.4) years old; course of disease 1~5 (3.7±0.8) years. There was no statistically significant difference in the male-female ratio, age, and course of disease between the two groups (all $P>0.05$), thus the two groups were comparable.

1.2 Therapeutic methods

The Control Group was given acarbose (Beijing Bayer Medical Care Co., Ltd., production batch number: 20180316, specifications: 50mg/tablet), orally administered, 50 mg/time for the first time, and the dose was increased to 100 mg/time after 1 week, 3 times per day. The Study Group was given oral Jiangtangning capsules on the basis of the treatment in the Control Group (Guangdong Luofushan Sinopharm Co., Ltd., NMPA Approval Number Z44022208, specifications: 0.4 g/capsule), 3 times a day, 2.4 g each time. The course of treatment in both groups was 3 months.

1.3 Observation Indexes

① Before and after treatment, the main symptoms of the qi and yin deficiency syndrome in the two groups of patients were graded and quantitatively scored [5], recorded to four grades as 0, 1, 2 and 3 points. Scores of each symptom were added up as the total score. ② 5 mL fasting elbow venous blood was collected in both groups before and after treatment. Fasting plasma glucose (FPG) and 2h plasma glucose (2hPG) levels were measured using hexokinase method, and glycated hemoglobin (HbA1c) level was measured using liquid chromatography. ③ Before and after treatment, dynamic blood glucose monitoring system was used to monitor blood glucose for 24 hours and record mean amplitude of glycemic excursions (MAGE), number of glycemic excursions (NGE), and mean of daily differences (MODD). ④ The immunoluminescence method was used to test fasting insulin (FINS) level, and Insulin Resistance Index (HOMA-IR) and Insulin Secretion Index (HOMA-β) were calculated. HOMA-IR = FPG ×FINS /22.5; HOMA-β = 20 × FINS /(FPG−3.5). A stable model was adopted, and Early Insulin Secretion Index (EISI) and modified Islet β-Cell Secretion Index (MBCI) were calculated according to the standard steamed bun test. ⑤ The therapeutic effect of the 2 groups was assessed after 2 months of treatment. Significant effect: Symptoms and signs were significantly reduced, FPG and 2 hPG returned to normal range or decreased by > 40%, HbA1c returned to normal range or decreased by > 30%, the symptom score decreased by ≥70%; Effect: Symptoms and signs were reduced, FPG<2hPG decreased by 20%~40%, HbA1c decreased by 10%~30%, the symptom score was decreased by ≥30%~70%; No effect: There was no change in symptoms and signs, no significant change in blood glucose indexes, and the symptom score was decreased <30%. The overall effective rate was the percentage of subjects with significant effect or effect in all subjects. ⑥ Occurrence of adverse reactions in the 2 groups of patients, including abdominal distension, diarrhea, abdominal pain, and elevated transaminases were recorded.

1.4 Statistical Methods

All the data were entered into SPSS 24.0 for processing. Quantitative data were expressed as mean ± standard deviation ($\bar{x}$ ± s). Between-group-comparisons were performed using χ^2 test or independent t-test, and within-group-comparisons were performed using paired *t*-test. *P*<0.05 suggests that the difference was statistically significant.

2 Results

2.1 Comparison of traditional Chinese medicine symptom score between 2 groups

Before treatment, differences in parched mouth and scorched throat, fatigue and asthenia, burning sensation of five centers, thirst and desire for drinking, large appetite with feeling hungry quickly, palpitations and insomnia scores between 2 groups were not statistically significant (*P* all > 0.05); after treatment, parched mouth and scorched throat, fatigue and asthenia, burning sensation of five centers, thirst and desire for drinking, large appetite with feeling hungry quickly , palpitations and insomnia scores in both groups were significantly reduced, and the scores of the above indexes in the Study Group were lower than those in the Control Group, and the differences were all statistically significant (all *P*<0.05). See Table 1.

Table 1 Comparison of traditional Chinese medicine symptom score between 2 groups of diabetic patients before and after treatment ($\bar{x}$ ± s, points)

Group	Number of Subjects	Time	Parched Mouth and Scorched Throat	Fatigue and Asthenia	Burning Sensation of Five Centers	Thirst and Desire for Drinking	Large Appetite with Feeling Hungry Quickly	Palpitations and Insomnia
the Study Group	46	Before treatment	2.18 ± 0.62	2.09 ± 0.54	1.98 ± 0.61	1.72 ± 0.49	1.53 ± 0.42	1.36 ± 0.39
		After 3 months of treatment	0.98 ± 0.21①②	0.85 ± 0.17①②	0.69 ± 0.17①②	0.62 ± 0.15①②	0.57 ± 0.14①②	0.49 ± 0.15①②
the Control Group	46	Before treatment	2.09 ± 0.65	2.03 ± 0.58	1.93 ± 0.62	1.68 ± 0.51	1.49 ± 0.43	1.29 ± 0.42
		After 3 months of treatment	1.23 ± 0.34①	1.04 ± 0.23①	0.89 ± 0.21①	0.79 ± 0.23①	0.72 ± 0.20①	0.68 ± 0.21①

Note: ①Compared with before treatment, $P<0.05$; ②Compared with the Control Group, $P<0.05$。

2.2 Comparison of blood glucose indexes between 2 groups

Before treatment, there was no statistically significant difference in FPG, 2 hPG, HbA1c between 2 groups (all $P>0.05$). After treatment, FPG, 2 hPG, HbA1c in 2 groups were significantly reduced, and FPG, 2 hPG, HbA1c in the Study Group were lower than those in the Control Group, the differences were statistically significant (all $P<0.05$). See Table 2.

Table 2 Comparison of blood glucose indexes between 2 groups of diabetic patients before and after treatment ($\bar{x} \pm s$)

Group	Number of Subjects	Time	FPG/(mmol /L)	2 hPG/(mmol /L)	HbA1c /%
the Study Group	46	Before treatment	8.92 ± 1.40	11.29 ± 2.76	7.61 ± 1.12
		After 3 months of treatment	5.68 ± 1.29①②	6.87 ± 1.59①②	6.14 ± 0.63①②
the Control Group	46	Before treatment	8.85 ± 1.38	11.16 ± 2.83	7.57 ± 1.18
		After 3 months of treatment	6.79 ± 1.27①	8.35 ± 1.90①	6.82 ± 0.89①

Note: ①Compared with before treatment, $P<0.05$; ②Compared with the Control Group, $P<0.05$。

2.3 Comparison of glycemic excursions in 2 groups

Before treatment, there was no statistically significant difference in MAGE、NGE、MODD between 2 groups (all $P>0.05$). After treatment, MAGE, NGE, MODD in both groups were significantly reduced, and MAGE, NGE, MODD in the Study Group were lower than those in the Control Group, the differences were statistically significant (all $P<0.05$). See Table 3.

Table 3 Comparison of MAGE、NGEMOD between 2 groups of diabetic patients before and after treatment ($\bar{x}$ ± s)

Group	Number of subjects	Time	MAGE/(mmol /L)	NGE/(times/d)	MODD/(mmol /L)
the Study Group	46	Before treatment	7.19 ± 2.04	5.09 ± 1.52	5.19 ± 1.52
		After 3 months of treatment	2.36 ± 0.72①②	2.17 ± 0.63①②	1.48 ± 0.34①②
the Control Group	46	Before treatment	7.08 ± 2.13	5.01 ± 1.56	5.12 ± 1.61
		After 3 months of treatment	3.14 ± 0.86①	2.80 ± 0.78①	1.89 ± 0.53①

Note: ①Compared with before treatment, P<0.05; ②Compared with the Control Group, P<0.05。

2.4 Comparison of islet β cell function between 2 groups

Before treatment, there was no statistically significant difference in FINS, HOMA-IR, HOMA-β, EISI, and MBCI between 2 groups (all P>0.05). After treatment, HOMA-IR was significantly reduced, and FINS, HOMA-β, and EISI, and MBCI were significantly increased in both groups, and HOMA-IR in the Study Group was significantly lower than the Control Group, and FINS, HOMA-β, EISI, and MBCI were significantly higher than the Control Group, the differences were statistically significant (all P<0.05). See Table 4.

Table 4 Comparison of FINS, HOMA-IR, HOMA-β, EISI, and MBCI between 2 groups of diabetic patients before and after treatment ($\bar{x}$ ± s)

Group	Number of subjects	Time	FINS /(pmol /mL)	HOMA-IR	HOMA-β	EISI	MBCI
the Study Group	46	Before treatment	4.29 ± 1.08	3.51 ± 0.89	42.03 ± 6.89	1.02 ± 0.33	1.67 ± 0.54
		After 3 months of treatment	15.75 ± 3.06①②	1.92 ± 0.63①②	67.14 ± 9.36①②	3.17 ± 0.84①②	2.91 ± 0.72①②
the Control Group	46	Before treatment	4.50 ± 1.12	3.48 ± 0.91	42.60 ± 6.92	1.05 ± 0.36	1.70 ± 0.58
		After 3 months of treatment	13.26 ± 2.48①	2.54 ± 0.72①	59.25 ± 7.87①	2.39 ± 0.65①	2.26 ± 0.65①

Note: ①Compared with before treatment, P<0.05; ②Compared with the Control Group, P<0.05。

2.5 Comparison of traditional Chinese medicine therapeutic effects between 2 groups

The overall effective rate in the Study Group was significantly higher than that in the Control Group (P<0.05). See Table 5.

Table 5 Comparison of comprehensive efficacy of traditional Chinese medicine between 2 groups of diabetic patients after treatment for 3 months

Group	Number of subjects	Significant effect/number	Effect/number	No effect/number	Overall effective rate/%
the Study Group	46	27	16	3	93.5①
the Control Group	46	19	17	10	78.3

Note: ①Compared with the Control Group, $P<0.05$.

2.6 Comparison of adverse reactions between 2 groups

There were 1 case of abdominal distension, 2 cases of diarrhea, and 1 case of abdominal pain in the Study Group during treatment. The incidence rate was 9.5%. There were 1 case of abdominal distension, 1 case of diarrhea, and 1 case of increased transaminases in the Control Group. The incidence rate was 7.1%. There was no statistically significant difference in the incidence rate of adverse reactions between 2 groups ($P>0.05$).

3 Discussion

The main pathogenesis of Type 2 diabetes is decreased insulin secretion and insulin resistance, and factors such as decreased islet β cell function, insulin resistance, insufficient β cell secretion are important causes of pancreatic islet dysfunction in diabetic patients [6]. With the development of diabetes, the function of islet β cells gradually weakens, thus the condition of diabetes are further aggravated. Long-term hyperglycemia stimulates various organs and tissues of the body and increases the burden of islet β cells, which can further lead to apoptosis of β cells, and thus insulin secretion is reduced, promoting the occurrence of insulin resistance [7]. HOMA-IR is an important index to evaluate insulin resistance. Its level is positively correlated with the degree of resistance [8]. HOMA-β is an important index to evaluate the function of pancreatic islet β cells, with higher levels indicating better function. Combined with testing EISI, MBCI and other indexes, HOMA-β is of important clinical significance to evaluate and understand the function of patients' islet β cells [9].

At present, there is still a lacks of radical treatment for Type 2 diabetes. The clinical control is still based on blood glucose control, meanwhile it is necessary to reduce glycemic excursions as much as possible in order to better control disease development [10]. Acarbose is an alpha glucosidase inhibitor that can competitively inhibit the activity of small intestine alpha-glucosidase, to delay the conversion of starch to glucose, slow down the intestinal absorption of glucose, and improve hyperglycemia symptoms [11]. However, with the prolongation of acarbose administration, some patients will develop insulin resistance, and the effect of blood glucose control is significantly reduced [12]. How to improve the clinical efficacy of Type 2 diabetes has become a research hotspot for doctors.

Traditional Chinese medicine believes that the fundamental pathogenesis of Type 2 diabetes is qi and yin deficiency. Patients are consistently yin-deficient with extreme heat, mostly caused by factors such as inconsistent diet, excessive workload, and emotional disorders, and long after qi and yin deficiency occurs. Qi deficiency is unable to promote blood circulation, leading to slow blood circulation and blocked blood stasis. Chronic illness enters the meridian, thus this disease occurs [13-14]. Jiangtangning capsule is composed of ginseng, radix astragali, rhizoma anemarrhenae, gypsum, yam, cornus, rehmannia, radix ophiopogonis, licorice, corn stigma, poria, and other traditional Chinese medicines, has the functions of tonifying the spleen and qi, nourishing yin and promoting fluid, relieving muscles and expeling heat, etc. It is suitable for

Type 2 diabetes due to qi and yin deficiency. Modern pharmacological studies have shown that ginseng can promote the body's blood flow and energy metabolism, improve glucose utilization, and stimulate glucose and lipid metabolism [15]. Radix astragalus can enhance the body's the immune function and improve energy metabolism of body tissues [16]. In addition to effects such as antibacterial and anti-inflammation, rhizoma anemarrhenae has obvious hypoglycemic effects [17]; yam can resist oxidative stress response, regulate the body's immune function, reduce the symptoms of insulin resistance, and reduce the body's blood glucose level [18]. Oleanolic acid and ursolic acid contained in cornus have certain hypoglycemic effects [19]; the oligosaccharides in rehmannia can regulate glucose metabolism disorders of diabetes and prevent or reduce hyperglycemia [20]. Radix ophiopogonis can increase liver glycogen levels, promote islet β cell function recovery, and reduce blood glucose levels [20]. The study of Liu Chenggong [22] shows that on the basis of exenatide in treating Type 2 diabetes, combining Jiangtangning capsule can further control blood glucose levels, reduce oxidative stress response and inflammation of the body, and improve insulin resistance.

Results of this study show that, after treatment, the relevant traditional Chinese medicine symptom score and FPG, 2 hPG, HbA1c, MAGE, NGE, MODD, HOMA-IR of the Study Group were lower than the Control Group, and FINS、HOMA-β、EISI、MBCI were higher than the Control Group. It is suggested that Jiangtangning capsule can effectively reduce the symptoms of Type 2 diabetes, further reduce blood glucose levels, reduce glycemic excursions, improve islet β cell function, and help to further improve blood glucose control efficiency in patients. It has important clinical research applications value.

Conflict of interest: All authors declare no conflict of interest.

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