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Original Article

Dietary control plus nutrition guidance for blood glucose and pregnancy outcomes in women with gestational diabetes

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Abstract: Objective: The aim of this study was to discuss the effects of alimentary control and nutrition guidance on blood glucose and pregnancy outcomes in patients with gestational diabetes mellitus. Methods: Between January 2014 and December 2017, 100 pregnant women with gestational diabetes and with 24-28 weeks of gestational age were enrolled. They were equally randomized into two groups receiving either conventional dietary education (control group, n = 50) or individualized alimentary control and nutrition guidance (observation group, n = 50). Rates of blood glucose control abnormality, fasting blood glucose (FBG), and two-hour postprandial blood glucose were compared between the two groups after 3 months of intervention. Pregnancy complications (intrauterine infection, premature rupture of membrane, postpartum hemorrhage, and polyhydramnios) and perinatal complications (neonatal asphyxia, fetal distress, premature delivery, and infant mortality rate) were also compared. Results: After intervention, rates of blood glucose control abnormality, FBG, and two-hour postprandial blood glucose were significantly lower in the observation group than in the control group (all $P < 0.001$), as well rates of pregnancy complications and perinatal complications (all $P < 0.001$). Conclusion: Alimentary control and nutrition guidance are beneficial in controlling blood glucose and improving pregnancy outcomes of women with gestational diabetes. It is, therefore, worthy of popularization.

Keywords: Alimentary control, nutrition guidance, gestational diabetes mellitus, pregnancy outcome

Introduction

Gestational diabetes mellitus is a condition in which a woman with pro-gestational normal blood glucose or carbohydrate metabolism is diagnosed with diabetes mellitus, for the first time, during pregnancy [1, 2]. Gestational diabetes mellitus has shown a yearly increasing trend in incidence due to changes in dietary structure and improvements in living standards. Studies have shown that gestational diabetes exerts various degrees of effects on pregnant women and perinatal infants without in-time treatment. It is even life-threatening [3-5]. An active and efficient control of blood glucose is crucial in improving maternal and neonatal prognoses.

According to previous studies, unreasonable dietary structures of pregnant women may lead to gestational diabetes [6, 7]. Scientific diets can keep blood glucose in the normal range. Some studies have indicated that dietary control and nutrition guidance are necessary and play an important role during treatment for gestational diabetes. Most women with gestational diabetes successfully keep their blood glucose in the normal range with a reasonable dietary structure [8, 9]. However, few studies have reported the influence of the combination of alimentary control and nutrition guidance on gestational diabetes and perinatal outcomes [10]. Therefore, in this study, 100 gestational diabetes women, hospitalized during January 2014 and December 2017, were enrolled. The effects of dietary control and nutrition guidance on blood glucose and pregnancy outcomes were discussed, aiming to provide evidence for clinical treatment.

Table 1. General information of patients

Variable	Case	Age (year)	Gestational Age (week)	BMI (Kg/m^2)	Parity	
					Primipara	Multipara
Observation	50	29.7±2.6	27.1±1.4	25.6±1.7	24	26
Control	50	30.2±2.8	26.8±1.2	25.2±1.5	21	29
t/X^2 value		0.925	1.150	0.200	0.364	
P value		0.357	0.253	1.290	0.546	

Note: BMI denotes body mass index.

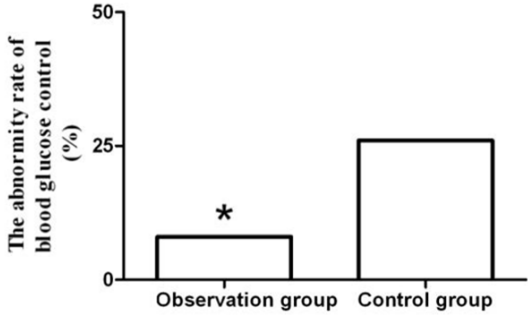

Figure 1. Comparison of abnormality rates of blood glucose control. Compared with the control group, *P < 0.05.

Materials and methods

Patients

One hundred gestational diabetes women, hospitalized during January 2014 and December 2017, were enrolled in this study. They were equally randomized into two groups, the observation group and control group. Patients in the observation group received individualized dietary control combined with nutrition guidance. Patients in the control group were given conventional dietary education. Inclusion criteria included gestational age between 24 and 28 weeks, abnormal blood glucose in sugar tolerance tests and according to diagnostic criteria of gestational diabetes, actively cooperative, smooth communication, and no antidiabetic drugs taken. Exclusion criteria included other pregnancy complications, severe cardiac malfunction, pulmonary insufficiency, hepatic impairment, renal failure, hyperthyroidism, and lack of cooperation [11, 12]. This study was approved by the Ethics Committee of Tongren Hospital. All enrolled patients provided written informed consent.

Methods

The intervention started right after the groups were established. Intervention durations were from three months up to parturition. Individualized dietary control combined with nutrition guidance was given to patients in the observation group. Dietary control included daily gross energy calculation. Energy levels were kept over 1,500 kcal at early pregnancy, over 1,700 kcal at middle and late pregnancy, and over 1,800 kcal at late pregnancy. Daily gross energy = ideal body weight (kg) * energy coefficient (kcal/kg). Ideal body weight = height -105. Energy coefficient corresponded with BMI as: those with BMI between 18.5 and 24.9 had an energy coefficient between 30 and 35 and those BMI > 25 had an energy coefficient between 25 and 30. Daily dietary structure was adjusted as carbohydrate, protein, and fat taking up 50%, 20% and 30%, respectively. Daily food exchanges were regulated as breakfast, lunch, and supper, taking up respectively 10%, 30% and 30% of total energy. Additionally, 2-3 extra meals were allowed but were kept under 30% of daily total energy. Nutrition guidance included nutrition assessments made for every pregnant patient. Their daily nutritional conditions were recorded. Health brochures were handed out to make them aware of nutrition knowledge and the importance of nutrition management. Their dietary structure was adjusted as needed and reasonable dietary plans were made according to their daily dietary conditions. Their daily food exchange was kept within total daily gross energy requirement divided by 90. They were offered guidance on proper exercise, such as gymnastics, Tai Chi, and walking, according to their body conditions. Exercise lasted for 20-30 minutes beginning 40-60 minutes after meals. Those failing to follow the guidelines were excluded from the group.

Women in the control group were offered conventional dietary education, such as oral dietary guidance. Patients and their family members were told to eat light food and eliminate sugary, greasy, and fried foods. They were advised to choose boiling, stewing, and steaming for cooking as opposed to decocting and frying. Additionally, they were advised to have more than three meals a day (but less food at each meal), to limit intake of sweet or fat-rich food, and eat foods with a glycemic index < 55, such as black rice, bitter gourd, celery, eggplant,

Table 2. FBG and two-hour postprandial blood glucose before and after intervention

Variable	Case	FBG (mmol/L)		Two-hour postprandial blood glucose (mmol/L)	
		Before intervention	After intervention	Before intervention	After intervention
Observation	50	6.3±0.7	4.4±0.5	10.9±1.1	6.7±0.8
Control	50	6.5±0.9	4.9±0.7	10.6±0.9	7.5±1.0
t value		1.240	4.110	1.493	4.417
P value		0.218	< 0.001	0.139	< 0.001

Note: FBG denotes fasting blood glucose.

milk, apples, and cherries. Alcohol was in the inadvisable list. Pungent and irritating foods were prohibited. Patients were advised to carry out appropriate indoor or outdoor activities. They were followed up during antenatal examinations to ensure their compliance in controlling blood glucose. Those failing to follow the guidelines were excluded from the group.

Outcomes assessment

Rates of blood glucose control abnormality were compared between the two groups. Before and after intervention, as well as during the weekly antenatal examinations or follow-ups till parturition, 4 mL of venous blood was drawn from each patient in both groups. Fasting blood glucose (FBG) and two-hour postprandial blood glucose were detected by the glucose oxidase method. FBG < 5.1 mmol/L and two-hour postprandial blood glucose < 8.5 mmol/L were considered normal.

All women received routine weekly prenatal examinations and follow-ups till parturition. Rates of complications, including intrauterine infection, premature rupture of membrane, postpartum hemorrhages, and polyhydramnios, were compared between the two groups. Perinatal complications, including neonatal asphyxia, fetal distress, and premature delivery and mortality rates, were also compared.

Statistical analysis

All analyses were performed with SPSS 21.0 software. Measurement data are presented as mean ± standard deviation. Independent-sample t-test was used for comparison between groups. Intra-group comparisons, before and after intervention, were made using paired *t*-test. Enumeration data are presented as rates. Chi-squared test was applied for comparison between groups. *P*-values less than 0.05 indicate statistical significance.

Results

General information

No differences were observed comparing age, gestational age, body mass index (BMI), and parity (**Table 1**).

Rates of blood glucose control abnormality

Four patients in the observation group failed to keep normal blood glucose, leading to an 8% rate of abnormality. The control group had 13 such cases with a 26% abnormality rate. Differences between the two groups were statistically significant (X^2 = 5.741, P = 0.017; **Figure 1**).

FBG and two-hour postprandial blood glucose before and after intervention

The two groups showed insignificant differences regarding FBG and two-hour postprandial blood glucose. Intervention led to significant decreases in FBG and two-hour postprandial blood glucose in both groups, compared to before intervention (P < 0.001). Patients in the observation group had statistically lower FBG and two-hour postprandial blood glucose than in the control group (P < 0.001; **Table 2**).

Pregnancy complications

The observation group had a rate of 10% for pregnancy complications (5 out of 50 cases), significantly lower than that (64%, 32 out of 50 cases) of the control group (P < 0.001). Incidence of intrauterine infections, premature rupture of membranes, postpartum hemorrhages, and polyhydramnios was significantly lower than that in the control group (all P < 0.05; **Table 3**).

Perinatal complications

The observation group had a perinatal complication rate of 12% (6 out of 50 cases), signifi-

Table 3. Pregnancy complications

Variable	Case	Intrauterine infection	Premature rupture of membranes	Postpartum hemorrhage	Polyhydramnios	Total incidence
Observation	50	1	2	1	3	5
Control	50	6	10	7	15	32
X^2 value		4.231	6.550	5.454	10.496	31.274
P value		0.040	0.010	0.020	0.001	< 0.001

Table 4. Perinatal complications

Variable	Case	Neonatal asphyxia	Fetal distress	Premature delivery	Mortality rate	Total rate of complications
Observation	50	1	2	3	1	6
Control	50	7	6	10	3	22
X^2 value		5.454	4.255	4.376	1.088	12.698
P value		0.020	0.039	0.036	0.297	< 0.001

cantly lower than that (44%, 22 out of 50 cases) of the control group (P < 0.001). Incidence of neonatal asphyxia, fetal distress, and premature rupture of membranes was significantly lower than that in the control group (all P < 0.05). No significant differences were observed comparing infant mortality rates (P = 0.297; **Table 4**).

Discussion

Gestational diabetes is clinically considered a high-risk pregnancy, posing a great threat to mothers and infants. Studies have demonstrated that gestational diabetes women are prone to suffering from headaches, urinary tract infections, and polyhydramnios, as well as delayed postpartum recovery and vulnerability to puerperal infections and postpartum hemorrhaging. In addition, fetal malformation, stillborn fetus, or premature delivery may occur [13, 14]. Therefore, proper treatment for gestational diabetes presents a great challenge to obstetricians.

Gestational diabetes is a special type of diabetes. Oral administration of hypoglycemic drugs may induce severe fetal hypoglycemia. The drugs easily pass through placenta, thus the drugs are inappropriate for gestational diabetes women [15, 16]. Current consensus advocates using dietary control and insulin to regulate blood glucose for patients with gestational diabetes. The American Diabetes Association stated in the *Diagnostic criteria for diabetes* that the aim of nutrition guidance is to strictly monitor blood glucose and BMIs of pregnant women, based on the healthy status of pregnant women as well as the growth and development of fetuses. The aim is to reasonably adjust the proportion of energy supply of fat, protein, and carbohydrates and to offer guidance to pregnant women regarding proper nutrients [17]. A total of 100 pregnant women of gestational age, between 24 and 28 weeks, were assigned into observation and control groups. They were, respectively, given individualized dietary control combining with nutrition guidance and conventional dietary education. Strict follow-ups were conducted during every weekly antenatal examination, guaranteeing the compliance of patients and liability of the acquired data. Those failing to follow the guidelines were excluded from the study. Dietary control and nutrition guidance were conducted by calculating necessary daily energy and nutrition, according to the conditions of pregnant women, and simultaneously regulating the dietary plans and secured reasonable dietary structure. Appropriate regulation of the blood glucose of pregnant women should be guaranteed, as the mothers supply energy and nutrition for the growth and development of the fetuses. The data was secured as scientifically reliable by calculating the average blood glucose attained in every weekly antenatal examination. The present study showed that patients in the observation group had significantly lower abnormality rates of blood glucose control than those in the control group. In addition, the FBG and two-hour postprandial blood glucose in the observation group were significantly lower than that in the control group. These outcomes suggest that alimentary control under nutrition guidance with planned individualized separate meals and regular monitoring of blood glucose,

along with in-time regulation of dietary structure in cases of abnormal blood glucose, may keep blood glucose levels normal for gestational diabetes patients. This is in accordance with reports by Zareei et al. and Facchinetti et al. [18, 19].

Levels of blood glucose are directly related to the occurrence of maternal and neonatal complications. Glucose is one of the main factors influencing prognosis. Favorable control of blood glucose is important in lowering incidence of complications [20]. Studies have revealed that excessively low FBG may lead to insufficient glycogen storage, causing fasting hypoglycemia to the mother due to the increasing need for energy of the fetus. It may even give rise to ketoacidosis. However, high blood glucose in the mother may lead to hyperinsulinemia for the infant. Suppression of lipolysis may promote synthesis of fat and protein, leading to macrosomia [21]. The current study revealed that incidence of intrauterine infections, premature rupture of membranes, postpartum hemorrhages, and polyhydramnios were significantly lower than those in the control group, as well as incidence of neonatal asphyxia, fetal distress, and premature delivery and mortality. Results indicate the obvious therapeutic effects of dietary control combined with nutrition education regarding intervention for gestational diabetes, improving maternal and neonatal prognosis. These outcomes are in accord with reports by Thomaz de Lima et al. and Moreno-Castilla et al. [22, 23].

In conclusion, dietary control and nutrition guidance for gestational diabetes women are effective in controlling blood glucose, lowering perinatal complications, and improving maternal and neonatal prognosis. Therefore, this method is worthy of clinically generalization. However, limitations existed in the present study, These limitations include a small sample size, mono-center study design, and lack of long-term follow-ups.

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Disclosure of conflict of interest

None.

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