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Original Article

Influence of standardized treatment for GDM on maternal blood glucose level, pregnancy outcomes and morbidity in mother and infant

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Abstract: Objective: To observe the changes of maternal blood glucose level, pregnancy outcomes and morbidity in mother and infant after performing the standardized treatment for patients with gestational diabetes mellitus (GDM). Methods: A before-after comparison was designed in this study. Sixty-two pregnant women with GDM who received check-ups during pregnancy in our hospital from January 2013 to October 2014 were selected for routine treatment, and then were classified as control group. Seventy-eight pregnant women with GDM who underwent check-ups during pregnancy and performed standardized treatments in our hospital from November 2014 to November 2016 were selected and classified as standardized treatment group. The treatment success rate of GDM, the levels of fasting blood glucose, 2-h postprandial blood sugar and HbA1c were compared between the two groups; the occurrences of adverse pregnancy outcomes like hydramnios, premature rupture of fetal membranes, caesarean section and premature birth were compared between the two groups, and the incidences of fetal macrosomia, fetal distress, neonatal asphyxia and fetus anomaly were also compared between the two groups. Results: The success rate of GDM treatment in the standardized treatment group (69/78, 88.46%) was higher than that in the control group (43/62, 69.35%), P=0.008. Before the treatment, there were no statistically significant differences in the levels of fasting blood glucose, 2-h postprandial blood glucose and HbA1c between the two groups (all P>0.05). After the treatment, whether before delivery or at one week after delivery, the levels of fasting blood glucose, 2-h postprandial blood glucose and HbA1c in the standardized treatment group were lower than those in the control group (all P<0.05). And there were no statistically significant differences in the incidences of hydramnios, premature rupture of fetal membranes, caesarean section and premature birth between the two groups (all P>0.05). The incidences of fetal macrosomia and fetal distress in the standardized treatment group were lower than those in the control group (all P<0.05). However, there were no statistically significant differences in the incidences of neonatal asphyxia and fetus anomaly between the two groups (all P>0.05). Conclusion: Patients who received the standardized treatments for GDM were able to well control the blood glucose level; meanwhile had less adverse pregnancy outcomes and lower neonatal morbidity.

Keywords: Gestational diabetes mellitus (GDM), blood glucose, maternal and neonatal complication

Introduction

Gestational diabetes mellitus (GDM) is a type of diabetes mellitus (DM) that may occur during the gestation period. And it has shown an increasing incidence trend in recent years [1]. In one case, the patient is originally suffered from the DM before pregnancy, and become a GDM patient after pregnancy. In another case, the patient doesn't develop DM before pregnancy, but had elevated blood glucose after pregnancy [2]. Either way, it might cause serious adverse effects on the health of both pregnant women and fetuses. Some studies have shown that the occurrences of abortion, fetus anomaly and dysembryoplasia have a certain relationship with the hyperglycemia in early pregnancy [3]. In addition, some studies also claimed that GDM has a higher incidence in middle and late pregnancy, which can increase the maternal and infant morbidity and may also cause complications such as neonatal hypoglycemia, fetal macrosomia, jaundice and so on [4]. Related studies confirmed that the pregnant women who developed DM during their gestation periods had higher risks to inherit the DM to their further generations when compared to those without DM [5]. Since our hospital per-

Table 1. Comparison of general information between two groups

Group	Age	Gravidity	Parity
Control group	28.13±5.12	1.97±0.39	1.31±0.32
Standardized treatment group	27.38±3.94	1.87±0.38	1.25±0.17
t value	0.980	1.539	1.423
P value	0.165	0.064	0.078

formed the standardized treatment for patients with GDM, we have achieved favorable results which are now reported as follows.

Materials and methods

General information

Our hospital has participated in the training of standardized diagnosis and treatment for DM from August 2014, and started the formal implementation since November 2014. Sixty-two pregnant women with GDM who received check-ups during pregnancy in our hospital from January 2013 to October 2014 were selected as research subjects and classified as control group to receive the conventional therapy. Seventy-eight pregnant women with GDM who received check-ups during pregnancy and underwent treatments in our hospital from November 2014 to November 2016 were selected and classified as standardized treatment group to undergo the standardized treatment.

Inclusion criteria: Patients who met the diagnostic criteria for GDM and were diagnosed by their attending doctors; patients who had 23-27 gestational weeks, less than 3 gravidities and less than 2 parities; patients whose families and themselves were informed about the purpose of this study and had signed the informed consents.

Exclusion criteria: Patients with multifetation or other chronic diseases and infectious diseases; patients who were originally suffered from DM before pregnancy.

Therapeutic methods of GDM

Control group: Before the implementation of the standardized treatment for GDM in our hospital, we mainly conducted the health preaching for GDM patients, performed the blood glucose monitoring, and provided the insulin treatment according to the actual situation of patients.

Standardized treatment group: The standardized treatment for GDM was performed in all the GDM patients after doctors' learning and training. And the specific details were as follows: the patients' diet were strictly controlled and their daily recipes listed by their attending doctors were required to be enforced strictly; the exercises of patients were ensured and the sport plans were made according to the physical conditions of pregnant women; the blood glucose levels were monitored on time, and the insulin treatments were performed strictly.

The intervention time was determined according to the patients' actual situations in the two groups. Once the patients' blood glucose levels were recovered to normal and remained stable, the intervention should be stopped while the blood glucose monitoring was required to continue until the end of delivery. After the delivery, the follow-up was performed for patients weekly and lasted for one month.

Observation indexes

All research subjects' general information including age, gestational weeks, gravidity, parity, etc. were recorded.

Main observation indexes: The glycemic control level (it was recorded as well-controlled if the blood glucose level was dropped markedly within a week, while it was recorded as poorly-controlled if there was not much change on the blood glucose level within one week after treatment), the pregnancy outcomes (various of conditions including premature birth, caesarean section, hydramnios and premature rupture of fetal membranes were counted) and the conditions of newborn (various of conditions such as fetal macrosomia, fetal distress, neonatal asphyxia and fetus anomaly were counted).

Secondary observation indexes: The levels of postprandial blood glucose, 2-h postprandial blood glucose and HbA1c. These indexes were measured before and after treatment (before delivery and at one week after delivery).

Statistical method

SPSS17.0 software was used for the comparative analysis. The measurement data were

Table 2. Comparison of blood glucose levels before and after treatment between two groups

Index	Group	Before treatment	Before delivery	One week after delivery
Fasting blood glucose level (mmol/L)	Control group	12.89±2.11	6.58±0.93	6.94±0.52
	Standardized treatment group	13.56±1.93	4.01±1.04*	4.08±1.23*
Blood glucose level 2 h after meal (mmol/L)	Control group	18.49±3.24	12.49±1.93	8.85±1.41
	Standardized treatment group	19.02±3.04	7.03±1.11*	5.38±1.29*
HbA1c level (%)	Control group	9.49±0.98	8.89±1.29	6.45±0.55
	Standardized treatment group	10.03±1.39	5.43±1.02*	5.01±0.59*

Note: Compared with the control group at the same time points, *P<0.05.

Table 3. Comparison of patients' pregnancy outcomes between two groups

	Hydramnios	Premature rupture of fetal membranes	Caesarean section	Premature birth
Control group	3 (4.84)	4 (6.45)	13 (20.97)	2 (3.23)
Standardized treatment group	1 (1.28)	1 (1.28)	10 (12.82)	1 (1.28)
χ^2	10.147	1.390	1.670	0.041
P value	0.457	0.238	0.196	0.840

expressed in terms of mean and standard deviation; the level changes of blood glucose and HbA1C before and after treatment were analyzed by the repeated-measures analysis of variance and other continuous variable data at different observation time points were compared using the two independent samples t-test. The enumeration data was expressed as frequency and rate; the Chi square test was applied for the comparison among groups. When the *P* value was less than 0.05, the difference was statistically significant.

Results

Comparison of general information between the two groups

There were no statistically significant differences in age, gravidity, parity and other general information between the two groups (all P>0.05), which showed that all these information were comparable. See **Table 1**.

Comparison of blood glucose levels at different observation time points between the two groups

The treatment success rate in the standardized treatment group (69/78, 88.46%) was higher than that in the control group (43/62, 69.35%, P=0.008). Before the treatment, there were no statistically significant differences in the levels of fasting blood-glucose, 2-h postprandial blood sugar and HbA1c between the two groups (P=0.183, P=0.427, P=0.402). The fasting blood-glucose level before delivery in the standardized treatment group was distinctly lower than that in the control group (P=0.033), and the level at one week after delivery in the standardized treatment group was also significantly decreased than that in the control group (P=0.021). Moreover, the 2-h postprandial blood glucose level before delivery in the standardized treatment group was obviously lower than that in the control group (P=0.013), and the level at one week after delivery was also clearly decreased than that in the control group (P=0.022). Furthermore, the HbA1c level before delivery in the standardized treatment group was visibly lower than that in the control group (P=0.022), and the level at one week after delivery in the standardized treatment group was also apparently decreased than that in the control group (P=0.036). See **Table 2**.

Comparison of patients' pregnancy outcomes between the two groups

There were no statistically significant differences in the incidences of hydramnios, premature rupture of fetal membranes, caesarean section and premature birth between the two groups. See **Table 3**.

Comparison of neonatal morbidity between the two groups

The incidences of fetal macrosomia and fetal distress in the standardized treatment group

Table 4. Comparison of neonatal morbidity between two groups

Group	Fetal macrosomia	Fetal distress	Neonatal asphyxia	Fetus anomaly
Control group	7 (11.29)	7 (11.29)	2 (3.23)	1 (3.23)
Standardized treatment group	1 (1.28)	1 (1.28)	1 (1.28)	0
χ^2	4.70	4.70	0.04	0.01
P value	0.030	0.030	0.840	0.908

were lower than those in the control group (P<0.05). However, there were no statistically significant differences in the incidences of neonatal asphyxia and fetus anomaly (P>0.05). See **Table 4**.

Discussion

This study found that the blood glucose levels of GDM patients were reduced and the neonatal morbidity was declined after the standardized treatment, which was similar to the previous studies [6-8]. The content of the standardized treatment for GDM is extensive, including dietary and movement therapy. As a chronic metabolic disease, GDM takes diet and exercise as its main treatments, which is not only helpful to control the blood glucose levels of pregnant women, but also beneficial to control their weights. And it can lay a good foundation for their future deliveries [9-11]. The standardized treatment for GDM is started from patients' daily lives, and it may achieve good results. The results of this study showed that there were no statistically significant differences in the levels of fasting blood glucose, 2-h postprandial blood glucose and HbA1c between the two groups. After the treatment, whether before delivery or at one week after delivery, the levels of fasting blood glucose level, 2-h postprandial blood glucose and HbA1c in the standardized treatment group were lower than those in the control group. It showed that the standardized treatment could play a good regulatory role for patients' blood glucose levels. And the results of this study were consistent with the research results of Fei et al. [12].

In the results of Qian Cheng's study, there were significant differences in the fetal premature rupture of membranes, infection and premature birth between the two groups [13, 14]. The microvascular disease in GDM patients can thicken the basement membrane in blood capillary and narrow the lumen. The extensive microvascular disease has promoted the occurrence of hypertensive disorders in the gestation period. If the fetus lives in the hyperglycemic environment, the hypertonic diuresis can cause the increase of meconium excretion, which leads to the increase of amniotic fluid and the rise of amnion cavity pressure. Moreover, it may also induce the premature rupture of fetal membranes, infection and premature birth. However, the results of this study showed that there were no statistically significant differences in the incidences of hydramnios, premature rupture of fetal membranes, caesarean section and premature birth between the two groups, which might because that the blood glucose levels of patients who didn't not receive the standardized treatment were also under control and thus the hyperglycemic environment where the fetus lived was not particularly obvious, so it turned out that there was no difference between the two groups. However, if the fetus lives in the environment of hyperinsulinemia, it can stimulate the proliferation of fetal pancreatic cells and insulin secretion, promote the synthesis of protein and fat, and inhibit the fat metabolism, which may easily result in the fetal macrosomia, the increase of fetal metabolism and the rise of oxygen consumption in the body. In this way, the fetal intrauterine hypoxia can be caused readily [15-18]. Furthermore, the incidence of neonatal asphyxia can also have an increase. Hyperinsulinemia could also inhibit the synthesis of fetal lung cells and the release of pulmonary surfactant, delay the fetal lung maturation and increase the incidence of neonatal respiratory distress syndrome [19]. Compared with the study of Cheng et al., the results of this study were similar [20].

This study also had some limitations. For example, the time for follow-up was short and there was no follow-up investigation about the GDM on the prevalence of type 2 diabetes after delivery. Therefore, the time for follow-up can be extended in later studies to investigate the incidence of type 2 diabetes after delivery among the GDM patients.

In summary, the standardized treatment for GDM has a certain clinical value, since it is ben-

eficial to reduce the patients' blood glucose level, improve the pregnancy safety and decrease the occurrence of macrosomia.

Disclosure of conflict of interest

None.

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