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Original Article

Effects of effective blood glucose control on pregnancy outcomes and neonatal complications in pregnant women with gestational diabetes

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Abstract: Objective: The aim of this study was to evaluate the effects of effective blood glucose control on pregnancy outcomes and neonatal complications in women with gestational diabetes mellitus (GDM). Methods: A total of 100 pregnant women with gestational diabetes mellitus were enrolled in this study from January 2014 to June 2017 in Zhangqiu District Maternal and Child Health Care Hospital. All patients were given insulin to control blood glucose level during pregnancy. According to the level of blood glucose control, 39 pregnant women without ideal blood glucose control were assigned to group I, while 61 pregnant women with ideal blood glucose control were assigned to group II. Complications, pregnancy outcomes, and neonatal complications were compared between the two groups. Results: The incidence of complications during pregnancy in group I was significantly higher than that in group II ($P<0.001$). Whereas, the rate of cesarean section in the group I was also much greater than that in the group II ($P<0.001$). In addition, numbers of premature infants, low birth weight infants and macrosomia delivered by subjects in group I were more than those in group II (all $P<0.05$). In terms of neonatal complications, the incidence of infection, hypoglycemia, or respiratory distress syndrome in group I was markedly higher than those in the group II ($P<0.05$). Conclusion: Control of blood glucose in pregnant women with gestational diabetes is of great significance in improving pregnancy outcomes and reducing pregnancy and neonatal complications.

Keywords: Insulin, gestational diabetes mellitus, pregnancy outcome, neonatal complication

Introduction

Gestational diabetes mellitus (GDM) refers to diabetes in pregnant women, which includes impaired glucose tolerance and diabetes onset [1]. GDM is a high-risk complication of pregnancy. The incidence of GDM in China is around 1%-5%, and has been increasing yearly [2, 3]. Statistical analyses have revealed that the incidence of type 2 diabetes in women with GDM is significantly higher than that in women without GDM after delivery, suggesting that GDM can be a high-risk factor for type 2 diabetes [4, 5].

Previous studies have documented that gestational diabetes is harmful to pregnant women and babies/newborns [6, 7]. GDM could induce hypoglycemia, infection, and premature rupture of membranes. It could also increase the occurrence of neonatal asphyxia, respiratory distress syndrome, and hypoglycemia, and even led to newborn death [6, 7]. Therefore, it is important to improve the quality of blood glucose control for pregnant women with gestational diabetes. However, these studies were conducted with a small number of cases enrolled.

To better clarify the effects of blood glucose control on pregnant women and newborns in pregnant women with gestational diabetes, 100 cases of pregnant women with gestational diabetes were retrospectively analyzed in this study. All pregnant women with gestational diabetes were divided into two groups: group I (without ideal control of blood glucose) and group II (with ideal control of blood glucose).

The pregnancy complications, pregnancy outcome, and neonatal complications were analyzed and compared between the two groups.

Materials and methods

Patient enrollment

Inclusion criteria were as follows: 1) pregnant women with gestational diabetes who had inspection and delivery in Zhangqiu District Maternal and Child Health Care Hospital; 2) patients who were primipara; 3) patients without histories of diabetes or other chronic diseases; 4) patients who receive did receive insulin treatment for the control of blood glucose during pregnancy. Exclusion criteria included: 1) patients without intact clinical data; 2) patients with a history of diabetes; 3) patients with severe heart, lung, liver or kidney diseases.

Diagnostic standards of GDM: patients undertook a 75 gram oral glucose tolerance test at 24-28 weeks of pregnancy. The normal levels of fasting blood glucose, 1-hour postprandial glucose and 2-hour postprandial blood glucose were <5.1 mmol/L, <10.0 mmol/L, and <8.5 mmol/L respectively. Diagnosis of GDM was confirmed if the abnormal blood glucose level was detected above these normal levels. After diagnosis, exercise and diet treatment were given first. Insulin treatment only began if satisfactory control of blood glucose was not obtained during two weeks. This study was approved by the Ethics Committee of our hospital, and informed consent was obtained from each patient.

Data collection

Clinical data were collected from Electronic Medical Record System (EMRS), including age, gestation, BMI, history of diabetes, fasting blood glucose level, HbA1c level, complications of pregnant women and newborns, pregnancy outcome, and birth status.

Outcome measures

The incidence of complications, pregnancy outcome, and birth status during pregnancy was analyzed in pregnant women in the two groups.

Complications of pregnant women during pregnancy included pregnancy-induced hypertension (PIH), preeclampsia and excessive amniotic fluid.

Pregnancy outcomes included premature rupture of membranes, cesarean section, postpartum hemorrhage, and postpartum infection.

Newborns included preterm, giant, low birthweight newborns.

Neonatal complications included infection, hypoglycemia, respiratory distress syndrome, and myocardial damage.

Statistical treatment

SPSS19.0 software was used for data analysis. The measurement data are expressed as mean ± standard deviation and were compared by independent t-test. The count data are expressed as a percentage. Chi-square test was used for the comparison between groups. A value of $P<0.05$ was considered statistically significant.

Results

Clinical data

A total of 100 pregnant women were enrolled in this study who had the inspection and delivery in Zhangqiu District Maternal and Child Health Care Hospital from January 2014 to June 2017. The clinical data of pregnant women was retrospectively analyzed. According to the level of blood glucose control, they were divided into two groups: group I (without ideal blood glucose control, 39 cases) and group II (with ideal blood glucose control, 61 cases). The standard of ideal blood glucose control is as follows: fasting blood glucose <5.8 mmol/L, and 2-hour postprandial blood glucose <6.7 mmol/L. As shown in **Table 1**, no statistically significant differences in the general clinical data was found between the two groups (P>0.05).

Complications during pregnancy in the two groups

As shown in **Table 2**, there were totally 27 cases (69.2%) of complications, including 9 cases of PIH, 9 cases of preeclampsia, and 8 cases of polyhydramnios in the group I, while in the group II, there were 4 cases (6.6%) of PIH, 3 cases (4.9%) of preeclampsia, and 3 cases (4.9%) of polyhydramnios (all P<0.05). The inci-

Table 1. Clinical data in the two groups

	Group I (n=39)	Group II (n=61)	P
Age (range, year)	23-36	20-39	0.310
Average age (year)	30.19±6.36	33.06±4.61	0.208
Gestation (range, week)	33-39	34-38	0.331
Average gestation (week)	35.39±3.31	36.01±3.29	0.191
BMI (kg/m^2)	26.6±1.08	26.3±1.21	0.188
History of diabetes (month)	4.0±0.6	3.9±0.7	0.281
Fasting blood glucose (mmol/L)	6.1±0.5	5.8±0.3	0.301
HbA1c (%)	6.3±0.3	6.1±0.3	0.339
Complication (n, %)	4/10.3	4/6.6	0.506

Note: HbA1c, hemoglobin A1c.

Table 2. Complications during pregnancy in the two groups

	Group I (n=39)	Group II (n=61)	P
Pregnancy induced hypertension (n, %)	9/23.1	4/6.6	0.017
Preeclampsia (n, %)	9/23.1	3/4.9	0.006
Polyhydramnios (n, %)	8/20.5	3/4.9	0.015
Total (n, %)	27/69.2	10/16.4	<0.001

Table 3. Pregnancy outcomes in the two groups

	Group I (n=39)	Group II (n=61)	P
Cesarean section (n, %)	19/48.7	7/11.5	<0.001
Premature rupture of fetal membranes (n, %)	1/2.6	2/3.3	0.838
Postpartum hemorrhage (n, %)	1/2.6	1/1.6	0.747
Postpartum infection (n, %)	1/2.6	2/3.3	0.838

dence rates of PIH, preeclampsia, and polyhydramniosin the group I were much higher than those in the group II (23.1% vs. 6.6%, 23.1% vs. 4.9%, and 20.5% vs. 4.9%, all P<0.05).

Pregnancy outcomes in the two groups

As shown in **Table 3**, the incidence of cesarean section in group I was 19/48.7%, which was significantly higher than that in the group II 7/11.5% (P<0.05). In addition, there were no statistical differences with respect to the incidences of premature rupture of fetal membranes, postpartum hemorrhage, and postpartum infection in the two groups (P>0.05).

Births in the two groups

As shown in **Table 4**, there were 7 cases of pre-term birth, 6 cases of giant infants and 6 cases of low weight infants in the group I, yielding incidence rates of 17.9%, 15.4% and 15.4%, respectively, which were significantly higher than those in the group II (preterm infants (4.9%), macrosomia (3.3%) and low birth weight infants (3.3%), P<0.05).

Neonatal complications in the two groups

As shown in **Table 5**, there were 6 cases of neonatal respiratory distress syndrome, 6 cases of infection, and 8 cases of hypoglycemia in the group I. The incidence rates were 15.4%, 15.4% and 20.5%, respectively, which were significantly higher than those in the group II (neonatal respiratory distress syndrome (3.3%), infection (1.6%) and hypoglycemia (6.6%), all P<0.05). There was no significant difference in the incidence of myocardial damage between the two groups of newborns (P>0.05).

Discussion

The rising incidence of GDM has exerted a tremendous influence on the health of the pregnant women and fetus/newborns. Several studies have shown that the pregnancy outcomes in pregnant women and fetus/newborns can be improved through careful monitoring and control of blood glucose. Therefore, early diagnosis and active intervention are of clinical significance for pregnant women with GDM [8, 9].

The results of this study show that incidences of PIH, polyhydramnios, and preeclampsia in GDM pregnant women without ideal blood glucose control were significantly higher than in those under ideal blood glucose control, the differences were statistically significant. Furthermore, the number of cesarean sections was also much more in GDM pregnant women without ideal blood glucose control than in those with ideal blood glucose control, the differences were statistically significant. In addition, the incidences of premature infants, low birth weight, macrosomia, neonatal hypoglyce-

Table 4. Births in the two groups

	Group I (n=39)	Group II (n=61)	P
Preterm birth (n, %)	7/17.9*	3/4.9	0.034
Giant infant (n, %)	6/15.4*	2/3.3	0.030
Low weight infant (n, %)	6/15.4*	2/3.3	0.030

Note: *P<0.05 vs. the group II.

Table 5. Neonatal complications in the two groups

	Group I (n=39)	Group II (n=61)	P
Neonatal respiratory distress syndrome (n, %)	6/15.4*	2/3.3	0.030
Infection (n, %)	6/15.4*	1/1.6	0.009
Myocardial damage (n, %)	1/2.6	2/3.3	0.838
Hypoglycemia (n, %)	8/20.5*	4/6.6	0.036

Note: *P<0.05 vs. the group II.

mia, and neonatal respiratory distress syndrome in GDM pregnant women without ideal control of blood glucose were also much higher than in those with ideal blood glucose control, and the differences were statistically significant. These results are consistent with previous reports, as they both showed that the control of blood glucose significantly reduced the incidence of PIH, polyhydramnios, and preeclampsia in pregnant women with GDM, as well as the incidence of premature infants, low birth weight, macrosomia, neonatal hypoglycemia and neonatal respiratory distress syndrome [10, 11]. All the findings indicate that GDM can increase the incidence of multiple complications in perinatal period, and through controlling the blood glucose level during pregnancy. Therefore, GDM can effectively prevent or reduce the incidence of these adverse events.

Some studies have reported that microangiopathy can occur in pregnant women with GDM, which can further lead to basement membrane thickening of the capillary wall, and eventually causes PIH [12]. Especially for patients with renal vascular lesions, the incidence of PIH can exceed 50%. Moreover, PIH can also cause severe preeclampsia and eclampsia, which can lead to the occurrence of premature [13-15]. Being consistent with these theories, this study found that GDM patients without ideal control of blood glucose presented a higher incidence of PIH and premature delivery. In addition, when the blood glucose in the pregnant woman passes through the placenta, the fetal blood glucose increases, which can further increase the urine volume of fetus and bring about excessive amniotic fluid. The excessive amniotic fluid can also cause premature delivery. A previous study has demonstrated that hyperglycemia can stimulate fetus to secrete more insulin, which then promotes their own growth and leads to weight gain [16]. Therefore, the incidences of macrosomia and cesarean section can increase if blood glucose control are not ideal. Some studies have documented that reactive hypoglycemia of the newborn can occur in the first 1-2 hours after birth, and there are no obvious symptoms at this time [17]. Due to the hyperinsulinemia, the newborn is removed from the maternal hyperglycemia environment, which leads to reactive hypoglycemia [18, 19].

Therefore, it is necessary for us to strengthen the monitoring of mother and baby [20, 21].

There are still some limitations to this study, as the study was a retrospective study with a small sample size and a lack of long-term follow-up data for pregnant women and newborns. Therefore, in order to obtain more valuable results and guide clinical practice in a more effective way, a multi-center prospective study with a larger sample size and an optimized design of experiment will be necessary in the future. In conclusion, GDM can increase the incidence of perinatal adverse events. The pregnancy outcomes can be improved and the incidence of neonatal complications can be reduced effectively through strengthening blood glucose monitoring, performing an active intervention, and controlling blood glucose levels.

Disclosure of conflict of interest

None.

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