

Risk Factors of Postpartum Cardiovascular Disease in Patients with Gestational Diabetes Mellitus

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Abstract: *Objective:* To investigate the risk factors of postpartum cardiovascular disease in patients with gestational diabetes mellitus (GDM). *Methods:* From December 2020 to December 2021, pregnant women who underwent 75-g oral glucose tolerance test (OGTT) between 24 and 28 weeks of gestation and were diagnosed with GDM were selected as the research subjects. These women were followed-up after delivery. *Results:* The average fasting plasma glucose (FPG) levels of these women were 6.25 ± 1.36 mmol/L before discharge and 5.01 ± 1.45 mmol/L at 42 days after delivery; the average 2-hour plasma glucose (2hPG) levels were 11.23 ± 2.01 mmol/L before discharge and 7.98 ± 1.23 mmol/L at 42 days after delivery; the average insulin levels were 8.36 ± 1.98 mmol/L before discharge and 2.98 ± 1.36 mmol/L at 42 days after delivery. There were 46 patients with postpartum cardiovascular disease, with an incidence rate of 22.89%. *Conclusion:* By improving the postpartum management of patients, the weight of GDM patients can be better controlled, their insulin sensitivity can be increased, and the occurrence of glucose and lipid metabolism disorders can be reduced.

Keywords: Pregnancy; Diabetes; Cardiovascular disease

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1. Introduction

Gestational diabetes mellitus (GDM) is a disorder involving glucose metabolism in pregnant women. GDM is closely related to pre-pregnancy overweight or obesity as well as excessive weight gain and obesity during pregnancy^[1-6]. In recent years, the incidence of GDM in China has shown an increasing trend. GDM may cause serious harm to both mother and child. Strengthening prenatal intervention is an important guarantee to reducing maternal and infant complications. Women with GDM have a higher risk of developing metabolic syndrome (MS), diabetes, and cardiovascular disease in the postpartum period^[2]. Therefore, it is extremely important to strengthen the postpartum management of GDM mothers. GDM is one of the most common complications of pregnancy, leading to a significant increase in the risk of short-term and long-term metabolic diseases for both mother and child. Except for the Carpenter-Coustan diagnostic criteria, which are based on the long-term risk of developing type 2 diabetes following GDM, the diagnostic criteria and management strategies recommended by other guidelines mainly focus on short-term risks during pregnancy and childbirth. An article that was published in *Lancet Diabetes & Endocrinology* in September 2020 has provided evidence-based medical data on the long-term disease risk of women with GDM and their offspring and suggested that there should be a shift in the focus of GDM management from short-term risks, such as macrosomia, to long-term risks, such as maternal and infant

obesity as well as cardio-metabolic diseases. Since the blood glucose level of pregnant women with GDM usually returns to normal levels after delivery, there is more emphasis on the short-term pregnancy outcomes of mothers and their offspring [7]. However, recent research has revealed that GDM, in addition to type 2 diabetes mellitus (T2DM), also increases the risk of long-term cardiovascular and metabolic diseases in mothers and their offspring. In addition to a higher risk of long-term T2DM, a series of cardiovascular and metabolic diseases, such as obesity ($\text{BMI} \geq 30 \text{ kg/m}^2$), hypertension, and dyslipidemia, may also occur in women with a history of GDM. A large cohort study also showed a higher incidence of ischemic heart disease in women with a history of GDM [8]. In addition, a recent population-based study in Canada has revealed that women who did not meet the diagnostic criteria for GDM but with hyperglycemia also had a higher risk of cardiovascular disease [9]. In conclusion, GDM and hyperglycemic states should be regarded as pre-states of cardiovascular disease, and the management strategy should be to comprehensively identify and systematically address the high-risk factors of cardiovascular disease, rather than just preventing T2DM. Moreover, women who had missed their postpartum visits appeared to be at higher risk for cardiovascular disease. Although international guidelines have recommended that women should have their blood glucose checked every 1 to 3 years, in practice, these women are often underdiagnosed, and international guidelines do not recommend screening for other risk factors of cardiovascular disease. Therefore, the effective identification and management of women with a history of GDM in the early postpartum period is crucial. This study mainly studies the risk factors of postpartum cardiovascular disease in patients with GDM.

2. Materials and methods

2.1. General information

A total of 201 women who underwent obstetric examination at the obstetric outpatient department of the Affiliated Hospital of Hebei University from December 2020 to December 2021 and were diagnosed with GDM through the 75-g glucose tolerance test (OGTT) between 24 and 28 weeks of gestation were selected as the research subjects. The patients were followed-up for 1 year postpartum from January 2021 to December 2021. Inclusion criteria: (1) patients who met the diagnostic criteria of GDM; (2) patients without serious organic diseases that involved the liver and kidney; (3) patients who are able to cooperate with the investigation and biological specimen collection. Exclusion criteria: (1) patients who had been diagnosed with type 2 diabetes before pregnancy; (2) patients with severe acute and chronic infectious diseases; (3) patients with serious organic diseases that involve the liver and kidney; (4) patients with endocrine diseases, such as hyperthyroidism, hypothyroidism, polycystic ovary syndrome, *etc.*; (5) patients who are unable to cooperate with the investigation. This study was approved and supported by the hospital ethics committee, and all the subjects signed an informed consent.

2.2. Methods

Pregnant women with GDM were followed-up postpartum. and the patients were called for a follow-up visit at the outpatient clinic about 42 days after delivery. Subsequent follow-ups were done six months and one year after delivery.

(1) Demographic data: name, age, height, pre-pregnancy weight, ethnicity, education level, past medical history, occupation, income, and general information of spouse. Basic information during pregnancy: weight gain during pregnancy, previous pregnancy history, gravidity, parity, OGTT results at 24–28 weeks of pregnancy, blood pressure during pregnancy, and nutritional supplements during pregnancy. Basic information of women with GDM 1 year postpartum: weight recovery, blood pressure, breastfeeding, and physical activity 1 year after delivery.

- (2) Physical measurements: height and weight (height and weight were measured by trained investigators). Pre-pregnancy weight was provided by the pregnant woman herself, but the height and weight during pregnancy were measured using a height-weight scale, in which the height measurement was accurate to 0.1 cm, while the weight measurement was accurate to 0.1 kg. The subjects were seated to measure their blood pressure after resting for ten minutes in a quiet environment, and the measured limb was the right upper limb.
- (3) Detection of biochemical indicators: a plain test tube without additives was used to collect 5 mL of fasting venous blood taken from the cubital fossa of the subjects; the blood was allowed to stand for 2 hours to set well and centrifuged at 3,000 r/min for 10 min in a centrifuge precipitator; the supernatant was separated into a clean Eppendorf (EP) tube and stored in a refrigerator at -80°C until use.

2.3. Statistical analysis

SPSS 22.0 was used for data analysis, measurement data were expressed as mean \pm standard deviation ($\bar{x} \pm s$), t test was used to compare the data between groups and within groups, and chi-squared test was used to compare the count data, which were expressed as n/%. $P < 0.05$ indicated that the difference was statistically significant.

3. Results

3.1. Demographics

The average age (years), gravidity, parity, insulin usage (n/%), family history (n/%), basal BMI (kg/m^2), weight gain during pregnancy (kg), admission BMI (kg/m^2), basal systolic blood pressure (SBP, mmHg), basal diastolic blood pressure (DBP, mmHg), admission SBP (mmHg), admission DBP (mmHg), and admission gestational age (W) of the 201 patients were 30.26 ± 3.69 , 2.16 ± 1.23 , 1.01 ± 0.69 , 26 (12.94%), 84 (41.79%), 21.36 ± 4.01 , 14.23 ± 3.45 , 26.21 ± 3.69 , 104.92 ± 9.01 , 68.25 ± 6.89 , 117.69 ± 10.36 , 70 ± 14.01 , and 36.98 ± 2.01 , respectively (**Table 1**).

Table 1. Demographic analysis

Demographic factors	GDM group (n = 201)
Age (years old)	30.26 ± 3.69
Gravidity	2.16 ± 1.23
Parity	1.01 ± 0.69
Insulin usage, n (%)	26 (12.94%)
Family history, n (%)	84 (41.79%)
Basal BMI (kg/m^2)	21.36 ± 4.01
Weight gain during pregnancy (kg)	14.23 ± 3.45
Admission BMI (kg/m^2)	26.21 ± 3.69
Basal SBP (mmHg)	104.92 ± 9.01
Basal DBP (mmHg)	68.25 ± 6.89
Admission SBP (mmHg)	117.69 ± 10.36
Admission DBP (mmHg)	70.36 ± 14.01
Admission gestational age (W)	36.98 ± 2.01

3.2. Blood glucose level and insulin function of patients

The fasting plasma glucose levels of the patients were 6.25 ± 1.36 mmol/L before discharge and $5.01 \pm$

1.45 mmol/L at 42 days postpartum; their 2-hour plasma glucose (2hPG) levels were 11.23 ± 2.01 mmol/L before discharge and 7.98 ± 1.23 mmol/L at 42 days postpartum; their insulin levels were 8.36 ± 1.98 before discharge and 2.98 ± 1.36 mmol/L at 42 days after delivery. There were 46 patients with postpartum cardiovascular disease, with an incidence rate of 22.89%.

4. Discussion

GDM is a high-risk pregnancy-related disorder that seriously affects the prognosis of both mother and child^[10]. The adverse effect of GDM on both mother and child is not only restricted to the gestation period; patients are also at risk of developing cardiovascular disease and type 2 diabetes mellitus after delivery. The impact of GDM on both mother and child depends on the severity of GDM and the control of blood sugar levels. In addition to controlling postpartum blood glucose levels in GDM patients, postpartum body weight recovery is also the focus of obstetric work. Some studies have shown that poor postpartum weight recovery in GDM patients is a high-risk factor for long-term diabetes, hypertension, and obesity, while being overweight or obese is an independent risk factor for cardiovascular disease^[11]. For women with GDM, the majority of them experience greater weight gain during pregnancy. Therefore, strengthening the management and control of body weight after delivery is essential in order to reduce the risk of postpartum cardiovascular disease. A study has reported that an average postpartum weight loss of 1.6 kg in women with GDM can reduce the risk of developing type 2 diabetes by 53% in the next 3 years^[12].

According to several surveys and studies, the number of diabetic patients worldwide was 463 million in 2019, and the number of diabetic patients in China had reached 122 million, ranking first globally^[13-15]. Diabetes has become one of the major threats to people's health. Some experts have predicted that the number of diabetic patients worldwide may reach up to 700 million by 2045^[16,17]. The physical morbidity caused by diabetes is extremely serious. Due to the rapid population aging, the number of diabetic patients is gradually increasing, and there is also a higher mortality rate as a result of diabetic complications. After a large number of clinical trials, it has been concluded that the effective control of blood sugar and lipid levels in patients can significantly reduce the risk of diabetic complications. In order to achieve stable blood lipid and blood glucose levels, dietary modifications and exercise guidance are needed in addition to standardized drug treatment^[18]. In addition, the family members of diabetic patients should be encouraged to be actively involved in the treatment process, especially in the aforementioned areas. Their active involvement in the treatment process has high clinical application value in improving the compliance rate of patients after discharge.

Diabetes mellitus is a metabolic disorder, with hyperglycemia as the main clinical indicator, accompanied by insufficient insulin secretion and action, resulting in glucose, lipid, and metabolic disorders. Patients may show increased blood pressure, glucose, and lipid levels, along with a series of symptoms. Due to long-term metabolic abnormalities, many diabetic patients have multiple organ damage, with chronic changes to their heart, eyes, kidneys, blood vessels, nerves, and other organs, thus leading to poor functioning or even failure of these organs. Macrovascular (heart disease, hypertension, and lower extremity peripheral vascular disease), microvascular (diabetic retinopathy and diabetic nephropathy), and neuropathic complications are the main chronic complications of T2DM. Among them, heart disease and hypertension are the main causes of mortality in diabetics. It is suggested that strengthening the management of body weight can reduce the postpartum body weight in GDM patients, in which this reduction can improve postpartum glucose and lipid metabolism. Studies have reported that the risk of diabetes in GDM patients is more than 4 times that of normal women. Improving patients' glucose and lipid metabolism can help reduce the risk of GDM progressing to diabetes. Postpartum BMI is closely related to postpartum glucose metabolism recovery in GDM patients.

In conclusion, strengthening the management of postpartum body weight in GDM patients can improve

postpartum weight control, improve insulin sensitivity, and reduce glucose and lipid metabolic disorders.

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Disclosure statement

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