The Oral Glucose Tolerance Test and Short-Term Adverse Outcomes Among Patients with Gestational Diabetes Mellitus

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Summary

Purpose: To investigate the relationship between oral glucose tolerance test (OGTT) findings and short-term adverse pregnancy outcomes among women with gestational diabetes mellitus.

Methods: We retrospectively collected 387 cases of pregnant women with gestational diabetes mellitus from 2020 to 2021 at the Maternity & Child Care Center of Dezhou and analyzed laboratory results. According to OGTT values, patients were divided into three groups, and pregnancy outcomes were analyzed; these included gestational weight gain, gestational hypertension, cesarean section, preterm birth, dead fetus, fetal distress, fetal growth restriction, congenital disabilities, macrosomia, and low birth weight. In group 1,277 patients had abnormal OGTT values, and short-term adverse outcomes were studied.

Results: Three abnormal OGTT points were accompanied by significant gestational weight gain, gestational hypertension incidence, and low birth weight incidence; the risks of cesarean section and preterm birth increased. Abnormal fasting plasma glucose was associated with gestational hypertension.

Conclusion: OGTT findings can be used to alert clinicians to short-term adverse outcomes in mothers and infants. Clinicians should be aware of abnormal OGTT findings.

Keywords: Diabetes Mellitus; Obstetrics: Medical Problems in Pregnancy; Primary Care, Gestational weight gain

Abbreviation: GDM: Gestational Diabetes Mellitus; OGTT: Oral Glucose Tolerance Test; GWG: Gestational Weight Gain

Introduction

Gestational diabetes mellitus (GDM) is an abnormality of glucose metabolism during pregnancy [1]. Several studies showed that GDM could increase the risk of adverse outcomes in mothers and fetuses in the perinatal period [2-4]. GDM is usually diagnosed using the oral glucose tolerance test (OGTT). Participants underwent a standard OGTT using a 75 g glucose solution between 24 and 28 weeks of gestation. According to the criteria of the International Association of Diabetes and Pregnancy Study Groups IADPSG [5], a diagnosis of GDM was made when any of the following plasma glucose values were reached: (a) fasting plasma glucose (FPG) ≥92mg/dL (5.1mmol/L), (b) 1-h plasma glucose (1-h PG) ≥180mg/dL (10.0 mmol/L), or (c) 2-h plasma glucose (2-h PG) ≥153mg/dL (8.5mmol/L).

Aim

This study aimed to determine which abnormal value of FPG, 1 h PG, and 2 h PG on the OGTT had the most significant impact on short-term maternal and infant complications and whether more abnormal points indicate a higher incidence of complications.

Material and Methods

There were 387 pregnant women with GDM from 2020 to 2021 in the Maternity & Child Care Center of Dezhou, China. The average age was 31 years. The GDM group met the diagnostic criteria for GDM in the guidelines for the prevention and treatment of type 2 diabetes in China formulated by the Chinese

Diabetes Society for single pregnancies. Exclusion criteria were insufficient information concerning gestational weight during pregnancy, multiple pregnancies, history of diabetes, high blood pressure, and other severe conditions. Data were extracted from the electronic medical records of the Maternity & Child Care Center of Dezhou. The Maternity & Child Care Center ethics committee of Dezhou approved the study. All health care procedures were carried out following approved guidelines and regulations. We recorded age, birth rate, gestational weight gain, OGTT value, newborn birth weight, and maternal and infant complications of 387 pregnant women.

The GDM group was divided into three sub-groups according to the number of abnormal OGTT points: the GDM1 group (one abnormal OGTT point), the GDM2 group (two abnormal OGTT points), and the GDM3 group (three abnormal OGTT points). The GDM1 group was further divided into the GDM1a group

(abnormal FPG), the GDM1b group (abnormal 1-h PG), and the GDM1c group (abnormal 2-h PG). The incidence of maternal and infant complications in each group was analyzed retrospectively. All analyses were performed using SPSS software version 22.0 (Chicago, IL, USA). The normality and homogeneity tests were conducted first. Results were expressed as median and interquartile ranges. Comparisons were made using nonparametric tests (Kruskal-Wallis or Mann-Whitney U-Test). When $P < 0.05$, the difference was considered statistically significant.

Result

Compared with GDM1 and GDM2, pregnancy age and the incidence of gestational hypertension in GDM3 were significantly higher. Gestational weight gain (GWG) in GDM2 and GDM3 was lower than GDM1. The GDM3 group had the highest risk of cesarean section and preterm birth (Table 1).

Table 1: Short-term adverse outcomes of pregnant women with different numbers of abnormal OGTT points.

GDM	GDM1(n=277)	GDM2(n=84)	GDM3(n=26)	P
Pregnancy age (X̄±S)	30.62±4.64	31.60±4.55	34.04±4.46	0.001*
Gestational weight gain (X̄±S)	14.20±4.97	12.82±4.47	12.54±5.36	0.023*
Gestational hypertension [n (%)]	17(6.14%)	4(4.76%)	5(19.23%)	0.028*
Cesarean section [n (%)]	129(46.57%)	38(45.24%)	17(65.38%)	0.16
Preterm birth [n (%)]	15(5.42%)	4(4.76%)	3(11.54%)	0.401
Dead fetus [n (%)]	1(0.36%)	0	0	0.73

* The difference was statistically significant.

Discussion

There are two diabetic conditions of pregnancy; one is preconception diabetes based on pregnancy, also known as diabetes, complicated with pregnancy; the other is GDM, characterized by normal glucose metabolism before pregnancy and abnormal metabolism during pregnancy. GDM is the more common complication. The reasons include improvements in economic status; therefore, the prevalence continues to rise [6]. GDM is a critical public health problem in China, with increased incidence since 2000 [7,8]. A systematic review of GDM on the Chinese mainland in 2019 reported a prevalence of 14.8% [9]. GDM is a high-risk condition associated with adverse pregnancy outcomes, including abnormal infant growth and long-term metabolism disorders during adolescence.

For patients with GDM, not all abnormal OGTT values are directly representative of adverse results; therefore, retrospective analysis of a population with adverse results may identify types and numbers of abnormal OGTT results that predict pregnancy outcomes and risk of maternal and infant complications. In this study, compared with pregnant women with only one or two abnormal OGTT values, those with three were older and had more significant gestational weight gain, the incidence of gestational hypertension, and the rate of low birth weight (Table 1-2). For pregnant women with only one abnormal OGTT value, the association between fasting hyperglycemia and gestational hypertension was more pronounced (Table 3), and the risk of microcephaly increased (Table 4). This is consistent with Papachatzopoulou et al. [10], who found an increased risk of high birth weight in patients with abnormal fasting glucose only.

Table 2: Short-term adverse perinatal outcomes with different numbers of abnormal OGTT points [n (%)].

GDM	GDM1 (n=277)	GDM2 (n=84)	GDM3 (n=26)	P
Fetal distress	3 (1.08%)	1 (1.19%)	1 (3.85%)	0.49
Fetal growth restriction	2 (0.72%)	0	0	0.672
Birth defects	3 (1.08%)	1 (1.19%)	1 (3.85%)	0.49

Macrosomia	28 (10.11%)	12 (14.29%)	2 (7.69%)	0.485
Low birth weight	6 (2.17%)	4 (4.76%)	3 (11.54%)	0.029*

* The difference was statistically significant.

Table 3: Short-term adverse outcomes of pregnant women in GDM1 group.

GDM1	GDM1a (n=182)	GDM1b (n=42)	GDM1c (n=53)	P
Pregnancy age (X̄±S)	30.47±4.44	30.07±5.39	31.56±4.63	0.35
Gestational weight gain (X̄±S)	14.53±5.16	13.36±4.35	13.75±4.75	0.46
Gestational hypertension [n (%)]	16(8.79%)	0	1(1.89%)	0.037*
Cesarean section [n (%)]	85(46.7%)	19(45.24%)	25(47.17%)	0.981
Preterm birth [n (%)]	8(4.39%)	2(4.76%)	5(9.43%)	0.356
Dead fetus [n (%)]	1(0.55%)	0	0	0.77

* The difference was statistically significant.

Table 4: Short-term adverse outcomes of perinatal infants in the GDM1 group [n (%)].

GDM1	GDM1a (n=182)	GDM1b (n=42)	GDM1c (n=53)	P
Fetal distress	3 (1.65%)	0	0	0.454
Fetal growth restriction	2 (1.09%)	0	0	0.592
Birth defects	2 (1.09%)	1 (2.38%)	0	0.516
Macrosomia	21 (11.54%)	4 (9.52%)	3 (5.66%)	0.455
Low birth weight	5 (2.75%)	1 (2.38%)	0	0.48

Relevant studies are consistent with this conclusion, Sesmilo G et al. [4] confirmed FPG is an early marker of GDM, and Zhou Z et al. [11] demonstrated higher FPG was more strongly linked to adverse pregnancy outcomes among GDM patients, both linearity and non-linearity of associations between glucose and complications should be taken into account. Hyperglycemia causes extensive microvascular lesions. Narrowing vessel lumens leads to insufficient blood and oxygen supply to tissues, significantly increasing the incidence of hypertension in pregnancy. In patients with GDM, the glucose delivered by the mother through the placenta is increased due to high blood glucose levels. The fetal pancreas responds by secreting insulin, resulting in excess insulin. The combination of hyperinsulinemia and high blood glucose leads to increased fetal fat and protein reserves, resulting in large fetuses for gestational age [3,12].

What was noteworthy was that GWG in GDM3 group was similar to GDM2, and much lower than GDM1, and the incidence of low birth weight was increased as the abnormal OGTT number increased (Table 2), the most probable reason for this phenomenon was severe hyper glycaemia caused by other factors, such as unhealthy nutrition and low physical activity before or during pregnancy affected maternal and fetal nutrient intake, restricted fetal growth and development [13-15]. A high-quality diet during pregnancy may have positive effects on fetal growth and nutritional status at birth, which was associated with a reduced risk of low birth weight in the group of pregnant Mexican women [16,17]. Although our study didn't present, the incidence of fetal hyperosmolar diuresis in the uterus increases and pregnant women produce excessive amniotic fluid, and then the probability of premature rupture of membranes, premature delivery, and non-vaginal birth will also increase. The mechanism of increased risk of respiratory distress syndrome is related to the integrity of fetal lung surfactant [3].

Conclusion

We analyzed many cases and compared pregnancy outcomes at different levels of abnormal OGTT. We found that abnormal OGTT helps predict short-term pregnancy outcomes, establishing the importance of FPG. These findings can help make reliable assessments in patients with GDM as soon as possible to guide treatment and improve outcomes in mothers and infants. There were some limitations in our study. Only poor short-term outcomes of OGTT levels were studied in mothers and infants; long-term adverse outcomes data were not collected. Mothers with GDM and their infants may experience both short- and long-term complications [18]. Furthermore, the particular relationships between abnormal OGTT and long-term adverse outcomes must be explored.

References

1. American Diabetes Association (2018) 2. Classification and Diagnosis of Diabetes: Standards of Medical Care in Diabetes-2019. Diabetes Care 42(Suppl 1): S13-28.

2. Billionnet C, Mitanchez D, Weill A, Nizard J, Alla F, et al. (2017) Gestational diabetes and adverse perinatal outcomes from 716,152 births in France in 2012. Diabetologia 60(4): 636-644.

3. Kc K, Shakya S, Zhang H (2015) Gestational Diabetes Mellitus and Macrosomia: A Literature Review. Ann Nutr Metab 66(Suppl 2): 14-20.

4. Sesmilo G, Prats P, Garcia S, Rodriguez I, Rodriguez-Melcon A, et al. (2020) First trimester fasting glycemia as a predictor of gestational diabetes (GDM) and adverse pregnancy outcomes. Acta Diabetol 57(6): 697-703.

5. Boyd EM, Steven GG, Bengt P, Thomas AB, Patrick AC, et al. (2010) International Association of Diabetes and Pregnancy Study Groups Recommendations on the Diagnosis and Classification of Hyperglycemia in Pregnancy. Diabetes Care 33(3): 676-682.

6. Zhu Y, Zhang C (2016) Prevalence of Gestational Diabetes and Risk of Progression to Type 2 Diabetes: a Global Perspective. Curr Diab Rep 16(1): 7.

7. Leng J, Shao P, Zhang C, Tian H, Zhang F, et al. (2015) Prevalence of Gestational Diabetes Mellitus and Its Risk Factors in Chinese Pregnant Women: A Prospective Population-Based Study in Tianjin, China. PLoS One 10(3): e0121029.

8. Zhang F, Dong L, Zhang C, Li B, Wen J, et al. (2011) Increasing prevalence of gestational diabetes mellitus in Chinese women from 1999 to 2008. Diabet Med 28(6): 652-657.

9. Gao C, Sun X, Lu L, Liu F, Yuan J (2019) Prevalence of gestational diabetes mellitus in mainland China: A systematic review and meta-analysis. Journal of Diabetes Investig 10(1): 154-162.

10. Papachatzopoulou E, Chatzakis C, Lambrinoudaki I, Panoulis K, Dinas K, et al. (2020) Abnormal fasting, post-load or combined glucose values on oral glucose tolerance test and pregnancy outcomes in women with gestational diabetes mellitus. Diabete Res Clin Prac 161: 108048.

11. Zhou Z, Chen G, Fan D, Rao J, Li P, et al. (2020) Size and Shape of Associations of OGTT as Well as Mediating Effects on Adverse Pregnancy Outcomes Among Women With Gestational Diabetes Mellitus: Population-Based Study From Southern Han Chinese. Front Endocrinol (Lausanne) 11: 135.

12. Mirabelli M, Chiefari E, Tocci V, Greco E, Foti D, et al. (2021) Gestational diabetes: Implications for fetal growth, intervention timing, and treatment options. Curr Opin Pharmacol 60:1-10.

13. Seghieri G, Anichini R, De Bellis A, Alviggi L, Franconi F, et al. (2002) Relationship Between Gestational Diabetes Mellitus and Low Maternal Birth Weight. Diabetes Care 25(10): 1761-1765.

14. Agarwal P, Morriseau TS, Kereliuk SM, Doucette CA, Wicklow BA, et al. (2018) Maternal obesity, diabetes during pregnancy and epigenetic mechanisms that influence the developmental origins of cardiometabolic disease in the offspring. Crit Rev Clin Lab Sci 55(2): 71-101.

15. Zhang C, Ning Y (2011) Effect of dietary and lifestyle factors on the risk of gestational diabetes: review of epidemiologic evidence. Am J Clin Nutr 94(Suppl 6): 1975S-1979S.

16. Reyes-Lopez MA, Gonzalez-Leyva CP, Rodriguez-Cano AM, Rodriguez-Hernandez C, Colin-Ramirez E, et al. (2021) Diet Quality Is Associated with a High Newborn Size and Reduction in the Risk of Low Birth Weight and Small for Gestational Age in a Group of Mexican Pregnant Women: An Observational Study. Nutrients 13(6): 1853.

17. Mahajan A, Donovan LE, Vallee R, Yamamoto JM (2019) Evidenced-Based Nutrition for Gestational Diabetes Mellitus. Curr Diab Rep 19(10): 94.

18. Filardi T, Panimolle F, Crescioli C, Lenzi A, Morano S (2019) Gestational Diabetes Mellitus: The Impact of Carbohydrate Quality in Diet. Nutrients 11(7): 1549.