Journal of Clinical & Translational Endocrinology 5 (2016) 36–41

Contents lists available at ScienceDirect

Journal of Clinical & Translational Endocrinology

journal homepage: www.elsevier.com/locate/jcte

Original Research

Effect of a macronutrient preload on blood glucose level and pregnancy outcome in gestational diabetes

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ARTICLE INFO

Article history:
Received 9 November 2015
Received in revised form 21 March 2016
Accepted 8 April 2016

Keywords
Gestational diabetes
Postprandial blood glucose
Nutrition therapy
Preload

ABSTRACT

Aim: To investigate the effect of a macro-nutrient preload (Inzone Vitality) on blood glucose levels and pregnancy outcomes of gestational diabetes. The preload method involves the ingestion of a smaller amount of a macronutrient composition half an hour before regular meals. The hypothesis was that preload treatment will reduce postprandial glycemia in gestational diabetes.
Methods: Sixty-six diagnosed cases of gestational diabetes were randomly selected from gynecology and obstetrics outpatient clinic at Xinqiao Hospital in Chongqing. The patients were divided into an intervention group (33 cases) and a control group (33 cases), according to odd–even numbers of the random cases. The intervention group was treated with a macro-nutrient preload given 0.5 h before regular meals and the control group was given a comparative treatment consisting of a milk powder with similar energy content. The two groups were studied until delivery and the measured parameters included fasting blood glucose (FBG), 2-hour postprandial blood glucose (2h-PBG), delivery mode and neonatal birth weight.
Results: The two groups showed no differences in FBG or 2h-PBG before the nutritional intervention. FBG and 2h-PBG after intervention and before delivery were significantly lower in the intervention group, treated with the macro nutrient preload compared to the control group ($P < 0.01$). Changes in FBG and 2h-PBG before and after the intervention were investigated and the difference in the intervention group was significantly greater than corresponding values in the control group ($P < 0.05$, $P < 0.01$). The neonatal birth weight and delivery mode was not significantly different ($P > 0.05$).
Conclusion: A macro-nutrient composition, used as a preload, is effective in controlling FBG and PBG of gestational diabetes.

Introduction

Gestational diabetes mellitus (GDM) refers to glucose tolerance abnormalities of varying degrees that occur or are first discovered during pregnancy. It accounts for 80–90% of diabetes in pregnancy and includes gestational impaired glucose tolerance. In 2007, the Obstetrics Branch of the Chinese Medical Association conducted a nationwide epidemiological study of patients with GDM, showing that the average prevalence of GDM in China was 6.6% with a trend of yearly increases, confirmed by a population-based study in Tianjin 2012, where the prevalence of GDM was 8.1% using the 1999 WHO criteria which was further increased to 9.3% if the 2010 IADPSG criteria were used [1]. Women with a history of GDM have an increased risk of complications during delivery and have a sevenfold increased risk of getting diabetes later in life. Likewise, their offspring have an increased risk at birth and increased risk of diabetes and obesity later in life [2]. GDM in itself can cause epigenetic "programming" of the fetal metabolism [3] and maternal hyperglycemia can therefore potentially lead to trans-generational effects with increased disease risks for the offspring. This adds to the burden many are facing in the prevention of T2DM and its micro- and macrovascular consequences. One feature of GDM is that the disease is often asymptomatic, patients rarely have any symptoms at the time of diagnosis (often at week 24–28), and an important aspect of treatment concerns life style changes [4,5]. The screening and diagnosis of GDM are important as are interventions aiming to reduce

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http://dx.doi.org/10.1016/j.jcte.2016.04.001

adverse outcomes during pregnancy, immediately after delivery and in a long term perspective. A positive screening test must be linked to a safe and effective method to treat the hyperglycemia and its feared short and long term consequences.

The need for both preventive and therapeutic measures is now urgent, where life style changes, most importantly introduction of healthy diets, are crucial. A prerequisite for the introduction of this kind of healthy nutrition to the general public is that "Medical Nutrition Therapy (MNT)" is evidence based, i.e. has a strong and undisputable scientific support. Nutritional therapy can maintain blood glucose at a normal level and ensure that the mother's physiological requirements and the fetus' developmental requirements are met. Diet control is not only beneficial for controlling maternal weight and improving hyperglycemia, it can also raise the insulin sensitivity in target tissues [6].

A new method has emerged that meet these requirements, the so called macro-nutrient preload method, which has been developed to treat and prevent obesity and type 2 diabetes (T2DM). By administration of a small load of macro-nutrients at a fixed interval before a meal (30 minutes in the majority of studies) the presence of nutrients in the small intestine induces the release of gut peptides like GLP-1, which slows gastric emptying and improves the glycemic response to the subsequent meal [7–9].

In a recent study of patients with Type 2 Diabetes (T2DM) the ingestion of a macro nutrient preload before major meals, significantly reduced 2h-PBG, HbA1c, total cholesterol/LDL and CRP at the end of a 12-week treatment period [10]. The tested macro nutrient preload was a blend of three different protein sources, slow-release carbohydrates, dietary fibres, omega3/6 fatty acids and other components. The mode of action of macronutrient preloads is assumed to be increased satiety, reduced gastric emptying and attenuated postprandial blood sugar response [11]. Based on this study and previous studies of the macro-nutrient preload method, we hypothesized that the nutritional composition used in the above mentioned T2DM study (Inzone Preload – a macro-nutrient blend with low-GI and low calorie content) would reduce postprandial glycemia in GDM patients when compared to controls consisting of a regular milk powder. To test this hypothesis, we performed a controlled clinical study which aimed to explore the potential effects on blood glucose levels and pregnancy outcomes in women diagnosed with GDM for the first time.

Subjects and methods

Subjects

We collected 80 patients, 26–38 years old who received a definite diagnosis of GDM at our hospital's obstetrics and gynecology outpatient clinic from November 2013 to May 2014. Subject inclusion criteria: (1) definite diagnosis of GDM at our hospital's outpatient clinic; (2) voluntarily signed the informed consent form; (3) deemed suitable for treatment by a dietitian. Subject exclusion criteria: (1) continuously positive for urine ketone bodies; (2) fasting blood glucose and postprandial blood glucose remaining high after 1–2 weeks of nutritional intervention. In line with our clinical experience, patients with fasting blood glucose >6.1 mmol/L and two-hour postprandial blood glucose >11.1 mmol/L after 1–2 weeks of nutrition intervention will be treated with insulin to reduce blood glucose; (3) gestational hypertension, and severe hepatic or renal dysfunction; (4) refusing to follow the dietitian's instructions regarding diet. During the study all of the GDM women only used diet to control blood sugar and were not in need for any pharmacological treatment. Ethical permission was obtained from the Third Military Medical University Ethics Committee (no ChiCTR-IoR-14005522).

Diagnostic criteria

Patients who met any of the following criteria were diagnosed with GDM: (1) Fasting blood glucose ≥5.1 mmol/L; (2) blood glucose ≥10.0 mmol/L one hour after a 75-g OGTT performed after fasting for eight hours at 24–28 weeks of gestation; (3) blood glucose ≥8.5 mmol/L two hours after an OGTT. These different criteria has the following distribution: a total of 30 subjects with fasting blood glucose ≥5.1 mmol/L in line with the GDM diagnostic criteria (16 subjects in the intervention group, 18 in the control group); a total of 43 subjects in weeks 24–28 of pregnancy with blood glucose ≥10 mmol/L one hour after administration of 75 g OGTT″ (23 subjects in the intervention group, 20 in the control group); and a total of 45 subjects with blood glucose ≥8.5 mmol/L two hours after administration of OGTT″ (23 subjects in the intervention group, 22 in the control group).

Methods

Randomized design where one group received a macro nutrient preload (intervention) and the other group received a comparator consisting of a milk powder (control). All patients were numbered by the time of hospitalization and grouped by the random numbers, namely, intervention group (macro nutrient preload) by odd number and control group by even number, each with 40 cases. During the experiment, 7 cases from each group were canceled due to hyperglycemia or failure to follow the dietitian's instructions, thus 33 cases from each group were selected to participate in the study (Fig. 1). A total of 6 subjects were excluded due to excessive hyperglycemia, 2 subjects in the intervention group and 4 subjects in the control group. The remaining 8 subjects did not comply with the instructions of the nutritionist or moved to another part of the country. Subjects that were excluded due to excessive hyperglycemia were those who had fasting blood glucose >6.1 mmol/L and two-hour postprandial blood glucose >11.1 mmol/L after 1–2 weeks of nutrition intervention in blood glucose taken by nurses from the clinical laboratory at Xinqiao Hospital once per week after starting on nutrition intervention. These patients were treated with insulin to reduce blood glucose, in line with the clinical experience of our hospital's gynecologist, and were considered withdrawn from observation.

The mean age of intervention group was 32.7 ± 4.9 years and the one of the control group was 30.8 ± 4.7 years, showing no significant difference ($P > 0.05$). In this study the patients were randomly selected to be given intervention or control treatment and the subjects were not aware if they received intervention or comparator treatment. The project leaders were aware of which treatment that was given.

Intervention measures: a record consisting of basic personal information, health status and pregnancy outcome was kept by Xinqiao Hospital where also follow-up visits were conducted. All subjects in each group were given nutritional education, and were given dietary recommendations; diets were formulated according to the daily energy demand of GDM patients up to 30–38 kcal/kg ideal body weight and was adapted to the actual weight of patients, weight increment in pregnancy, age, physical activities, family history, etc. These mainly consisted of six meals per day, consisting of three regular meals and three snacks. For the intervention group, a macronutrient preload nutrition powder (Inzone Vitality; imported from Sweden, original packing, provided by Tianjin Health Promotion Technology Co., Ltd.) was given as three pre-meals 30 minutes before ordinary meals (meal times were: 7:30, 11:30, and 17:30). The Inzone Vitality product consists only of natural food ingredients (pea-protein, whey protein, egg albumin, Ω 3/6 fatty acids, whole eggs, apple, rosehip and sugar beet fiber). Each serving of Inzone Vitality (18 gram) contains 7.6 g protein, 1.8 g fat (saturated and