**INTRODUCTION**

Gestational diabetes mellitus (GDM) is a common complication during pregnancy. Regardless of the time of the diagnosis, GDM has been defined as a key degree of glucose intolerance during pregnancy [1]. Recently, the American Diabetes Association (American Diabetes Association, ADA) clearly defined GDM as diabetes diagnosed in the second or third trimester of pregnancy [2]. Obesity increases in young women, and the age of women’s gestation also increases. The prevalence of GDM has also increased. The prevalence of gestational diabetes mellitus was 8.0% based on the Korea National Health Insurance Claims Database [3]. Gestational diabetes mellitus is frequently associated with gestational hypertension, increased frequency of cesarean section, complications such as impaired delivery, and dysesthesia. In addition, the probability of overt diabetes developing after delivery increases by seven fold compared to non-GDM patients [4]. For the offspring, the risk of large for gestational age (LGA), neonatal hypoglycemia, neonatal bone and nerve injuries are increased. In the long term, there is a higher risk of diabetes to occur in adolescence [5]. In view of increasing prevalence of GDM worldwide and its established association with adverse fetal, neonatal and their long term complications, we have to look into possible interventions for preventing and managing GDM.

**DIAGNOSTIC CRITERIA FOR GESTATIONAL DIABETES MELLITUS**

The screening and diagnostic criteria for gestational diabetes mellitus are conflicting. There is no unified standard tool worldwide. Controversies exist regarding selective screening...
for high-risk patients only or general screening by all pregnant women (Universal screening), timing of screening, and one-step or two-step approach.

The diagnostic criteria for gestational diabetes with the 100 g oral glucose tolerance test was proposed in 1964 by O’Sullivan and Mahan [6]. Based on the mean of four whole blood glucose and standard deviation in 752 pregnant women, glucose levels over 2 SD (about 2%) confirmed the diagnostic criteria of GDM in the United States [6]. These criteria were chosen to diagnose postpartum diabetes in women. In 1982, Carpenter and Coustan revised this criteria more precisely [7]. However, there was increasing evidence that the degree of hyperglycemia was closely related to the occurrence of perinatal complications.

The Hyperglycemia and Adverse Pregnancy Outcome (HAPO) study showed that the incidence of complications of perinatal and perinatal complications was found to be continuous in 25,000 pregnant women [8]. The International Association of Diabetes and Pregnancy Study Groups (IADPSG) suggested new criteria which increased the risk of newborn weight (> 90th percentile), cord blood C-peptide (> 90th percentile), body fat ratio (> 90th percentile) compared to the mean blood glucose group. A new diagnostic tool for gestational diabetes increases the risk by 1.75 times [9]. And that is, in the early stages of pregnancy, that recommend that the 75g oral glucose tolerance test be performed during 24 to 28 weeks of gestation in all pregnant women.

The ADA has been using the diagnostic criteria proposed by IADPSG since December 2010. But the American Congress of Obstetricians and Gynecologists (ACOG) continued to recommend a two-step approach. In 2013 World Health Organization (WHO) and the American Endocrinology Society accepted the IADPSG criteria [10,11]. However, the National Institute of Health (NIH) recommend a two step approach, because there are no intervention studies to improve pregnancy outcomes and there is a significant economic burden [12]. And now, after 2014, ADA accepted the IADPSG diagnostic criteria and two-step approach [13] (Table 1).

**SCREENING FOR GESTATIONAL DIABETES MELLITUS IN EARLY PREGNANCY**

Diabetic women who are not diagnosed during pregnancy are at risk of congenital anomalies due to uncontrolled hyperglycemia. Most current guidelines are based on the first visit of pregnancy, especially in the high-risk group, recommending screening for the pregestational diabetes [9-11]. The criteria for diagnosing diabetes early in pregnancy are fasting plasma glucose ≥ 126 mg/dL, random plasma glucose ≥ 200 mg/dL, or HbA1c ≥ 6.5%.

However, WHO does not include HbA1c in its diagnosis of diabetes [11]. In general, prior to 24 weeks of gestation, there is insufficient evidence to recommend treatment with gestational diabetes mellitus [14]. However, in the IADPSG, diabetes ≥ 92 mg/dL was diagnosed as gestational diabetes [9].

**MEDICAL MANAGEMENT OF GESTATIONAL DIABETES MELLITUS**

By diagnosing and managing gestational diabetes mellitus, perinatal complications (LGA and preeclampsia) of the population were decreased in two large randomized clinical trials [15,16]. Recently, in meta-analysis, they could reduce preeclampsia, LGA and shoulder dystocia, but neonatal hypoglycemia and future maternal metabolic abnormalities were not changed [17].

**BLOOD GLUCOSE GOALS AND MONITORING**

ADA suggested glycemic control as follows: pre-eclampsia ≤ 95 mg/dL, 1 hour postprandial blood glucose ≤ 140 mg/dL, and 2 hours postprandial blood glucose ≤ 120 mg/dL [13,18]. The goals of ADA presented are not based on randomized clinical trials, it came from expert opinions. Therefore, we have to research about what’s the optimal target of maternal glucose levels.

GDM patients usually check their blood glucose levels four to seven times a day (fasting and three postprandial 1~2 hours). There have been reports that postprandial blood glucose is more effective in decreasing the neonatal outcomes than fasting
blood glucose [19].

**LIFESTYLE INTERVENTIONS**

Clinical nutrition is the basis of gestational diabetes management. All Diabetes mellitus patients should be educated by experienced clinical dieticians. Clinical nutrition therapy of gestational diabetes mellitus offers appropriate meal plans that provide carbohydrates to prevent ketogenesis. The meal plans should be individualized, based on nutritional assessment per patient which considers factors such as pre-pregnancy weight, level of physical activity, and weight gain during pregnancy.

In the obese mother, calorie-restriction has been suggested as a useful method for controlling blood glucose, but limitations in caloric intake can cause ketosis. Excessive caloric restriction can have a negative effect during pregnancy. To adequately control postprandial blood glucose, a water-restricted diet (50% in Korea) is recommended. Three meals and two to three snacks distributed throughout the day is recommended.

Regular exercise can improve blood glucose levels. So GDM patients are recommended to exercise regularly. Cardiovascular effect of exercise can lower blood glucose and avoid unnecessary insulin therapy. It takes 20 to 30 minutes of exercise time to effectively lower blood glucose. However, exercise should be avoided during pregnancy, if patients have hypertension, premature rupture of amniotic membrane, delayed fetal growth, history of preterm delivery, persistent bleeding, and cervical incompetence.

**PHARMACEUTICAL INTERVENTIONS**

Insulin can control maternal hyperglycemia even if they did extensive lifestyle therapy during pregnancy. Medical nutritional therapy and exercise should be performed at least 1 to 2 weeks. If blood glucose couldn’t be controlled, doctors have to start insulin therapy. If maternal blood glucose level is well controlled, fast fetal growth with respect to gestational age require insulin therapy [20]. In pregnancy, various insulin preparations that can be used include fast-acting insulin analogs (Lispro, aspart), human insulin (RI, NPH), and long acting insulin analogs (detemir). Insulin glargine (Glargine) is not allowed due to lack of randomized clinical trial data [10]. And insulin treatment should be adjusted to individual needs.

Over the past 30 years, insulin has been used in the medical treatment of gestational diabetes as 1st choice medication. However, the use of oral hypoglycemic agents increased in the recent 10 to 20 years. Metformin and glibenclamide are evaluated for insulin alternatives. In metformin-treated studies, equivalent pregnancy outcomes were shown, such as decreased weight gain and maternal hypoglycemia [21]. However, in a Meformin in Gestational Diabetes (MIG) study, 46.3% of the metformin group required insulin treatment [22]. ADA recommends insulin treatment for GDM, while ACOG recommends metformin or glyburide in addition to insulin [23,24]. However, there is no long-term clinical data in the offspring exposed to oral medication in the prenatal period. So insulin treatment is recommended to control hyperglycemia of GDM.

**MEDICAL MANAGEMENT AFTER DELIVERY**

Women with gestational diabetes mellitus usually have normal blood glucose after delivery. But overt diabetes can develop over time [4]. Therefore, women with gestational diabetes mellitus are considered a high-risk group. Therefore, postpartum diabetes education and lifestyle modifications are important to prevent diabetes mellitus.

There is still controversy about the timing and methods to detect diabetes after delivery. The ADA and Endocrinology Society reported that postpartum 75 gram oral glucose tolerance test is recommended at six to 12 weeks [10,13,23]. Moreover, screening of diabetes should be done every one to three years afterwards [13]. Currently, we can use HbA1C, fasting plasma glucose, and 75 g oral glucose tolerance test to assess glucose abnormality. Aggressive lifestyle modification therapy such as regular exercise can prevent or delay the development of diabetes after GDM [25].

**CONCLUSION**

All pregnant women should be recommended to be screened for diabetes mellitus. The IADPSG diagnostic criteria were the first criterion based on perinatal complications of GDM. Controversies over whether to apply this criterion globally are still ongoing and the issue is a hot topic for management of GDM. For this, we need nationwide clinical trials to be established for diagnostic criteria of GDM for the Korean population. The treatment of GDM through clinical nutrition
and exercise therapy must be a priority. Insulin is the primary treatment choice when blood glucose is not controlled. Women who have been diagnosed with GDM should be screened for diabetes on a regular interval. And precise mechanism about the development of GDM, and postpartum diabetes mellitus should be consistently researched and studied.

REFERENCES