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Gestational Diabetes — Diagnosis, Treatment, and Outcomes

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Diana, a 26-year-old overweight Hispanic woman, arrived at the outpatient diabetes in pregnancy center at 29 $^{5}/_{7}$ weeks gestation after failing a three-hour oral glucose tolerance test (OGTT). Diana's past obstetric history was significant for gestational diabetes mellitus (GDM) during her first pregnancy two years ago. That pregnancy resulted in the delivery of a 10-lb, 1-oz stillborn baby at 38 weeks gestation. Her family history was significant for type 2 diabetes.

Diana was placed on a diet and exercise program, and learned how to check her blood sugar. A certified diabetes educator monitored her on a weekly basis and suggested small changes to her diet as needed to help control blood sugar and support the pregnancy. Diana delivered a healthy 7-lb, 7-oz baby boy at 39 $^{3}/_{7}$ weeks. Her physician advised her to have a two-hour OGTT at six weeks postpartum and continue testing once per year. She was diagnosed with GDM that was triggered sometime during the end of the second trimester or the beginning of the third trimester.

GDM is defined as "diabetes diagnosed during pregnancy that is not clearly overt diabetes," according to the American Diabetes Association (ADA).[1] If well controlled, GDM resolves after pregnancy in about 90% of women.[2] Gestational diabetes, however, isn't the only form of diabetes and pregnancy, and as early as 1949, the White Classification was introduced to identify patients according to their degree of risk.[3] This classification, updated by the American College of Obstetricians and Gynecologists (ACOG) in 2002, distinguished between GDM and preexisting diabetes, which could either be type 1 or type 2 diabetes that was diagnosed before pregnancy.[4] Preexisting diabetes is further subdivided by age of onset, duration, and micro- and macrovascular complications (see Table 1 below).

Table 1: White Classification of Diabetes During Pregnancy[4]

Gestational Diabetes

Class	Onset	Fasting Plasma Glucose (mg/dL)	Two-Hour Postprandial Glucose (mg/dL)	Treatment
A1	Gestational	< 105	< 120	Diet
A2	Gestational	> 105	> 120	Medications

Preexisting Diabetes

Class	Age of Onset	Duration (years)	Vascular Disease	Treatment
B	Older than 20	Fewer than 10	None	Insulin
C	10 to 19	10 to 19	None	Insulin
D	Under age 10	More than 20	Benign retinopathy	Insulin
F	Any	Any	Renal nephropathy	Insulin
R	Any	Any	Proliferative retinopathy	Insulin
G	Any	Any	Many pregnancy failures	Insulin

This continuing education course concentrates on the two GDM classifications: A1, which is controlled with diet and exercise, and A2, which requires the use of medications after diet and exercise fail to control a patient's blood sugar. This course also will discuss GDM diagnosis, treatment, and outcomes.

Prevalence and Incidence

According to the Agency for Healthcare Research and Quality, 6.5% of women who gave birth in US hospitals in 2008 had either pre-gestational diabetes or GDM, with a significantly higher proportion of these women having GDM (83%) compared with pre-gestational diabetes (17%).[5] Similar rates of prevalence were reported by Landon and Gabbe and supported by the ACOG in 2011.[6]

The incidence of GDM was found to be higher in women of minority groups, women of Hispanic, African, Asian, Native American, and Pacific Island ancestry, who also had a higher risk of type 2 diabetes.[5,6] The incidence of GDM in the United States has increased over the years, and studies have attributed this to the increasing rates of overweight and obesity among the general population.[7] Prepregnancy insulin resistance also can be unmasked by pregnancy hormones and be diagnosed as GDM among some of the 6 million women of childbearing age who may be misdiagnosed with diabetes, especially type 2.[1,8]

GDM is the most common complication in pregnancy, and 50% to 60% of women with GDM have a higher risk of developing type 2 diabetes later in life.[6,9] About 5% of women, typically those who are lean with early GDM, develop type 1 diabetes.[10-12] The recurrence rate of GDM also is high and varies from 30% to 84%, with lower rates among non-Hispanic white women and higher rates among minorities in the United States.[2]

Screening and Diagnosis

GDM screening and diagnosis criteria have been controversial for decades, and the debate over universal screening vs. screening for only risk groups continues. Historically, pregnant women with clinical risk factors, such as a family history of diabetes, previous stillbirth, or previous delivery of a macrosomic baby, were screened for GDM, but later it was demonstrated in a population-based study that about 50% of women with GDM don't possess these risk factors.[13] In 2001, the ACOG recommended universal screening of all pregnant women at 24 to 28 weeks gestation in a two-step method that includes a 50-g glucola one-hour loading test followed by a 100-g glucola three-hour tolerance test for diagnosis (see Table 2 below).[7] Despite several studies and recommendations by different national and international

organizations, debate continues over whether universal screening is cost-effective and leads to improved maternal and fetal outcomes.

Table 2: The Two-Step Method for Diagnosing GDM[9,11]

	Step 1: Screening	**Step 2: Diagnosis**	**Postpartum**
Testing Period	• First prenatal visit if high risk factors present • 24 to 28 weeks: all pregnant women not previously identified as having gestational diabetes mellitus (GDM)	• If positive screening, test in one week • Repeat at 32 to 34 weeks if one elevated value, plus risk factors	• 6+ weeks postpartum • Postweaning • Annually for women diagnosed with GDM, per American Diabetes Association guidelines
Fasting (no food or beverage, other than water, for eight to 14 hours before testing)	No	Yes	Yes
Grams of Glucola	50	100	75
Times of Blood Collection	One hour	Fasting and one, two, and three hours	Fasting and one and two hours
Diagnostic Values	• 140 to 189 mg/dL: follow with three-hour oral glucose tolerance test within one week • 190 mg/dL or above: schedule fasting blood glucose test as soon as possible. If value is greater than 95 mg/dL, treat for GDM.	• Fasting: 95 mg/dL or greater • One hour: 180 mg/dL or greater • Two hours: 155 mg/dL or greater • Three hours: 140 mg/dL or greater If two or more values are met or exceeded, treat as GDM.	**Impaired Glucose Tolerance:** Fasting: 100 to 125 mg/dL; post-glucose load– 140 to199 mg/dL **Type 2:** Fasting: ≥ 126 mg/dL; postglucose load ≥ 200 mg/dL Repeat testing to confirm.

Based on results from the Hyperglycemia and Adverse Pregnancy Outcomes study, the International Association of Diabetes in Pregnancy Study Group developed a one-step method in which a 75-g two-hour OGTT is used for diagnosis, requiring one or more blood glucose readings to exceed guidelines[14,15] compared with the 100-g method, which necessitates at least two blood sugar levels higher than the guidelines. The one-step method, though endorsed by the ADA, is more expensive and could increase the incidence of GDM by as much as 18%, which increases health care costs.[6]

Today, even though most of the world uses the one-step method for diagnosing GDM, the ACOG Committee on Obstetric Practice continues to support universal screening using the two-step method. The committee argues that there's not enough evidence to demonstrate that the one-step approach can significantly improve maternal and fetal outcomes to justify the high costs involved.[7]

Pathophysiology, Risks, and Outcomes

During a normal pregnancy, the body undergoes many metabolic changes to provide adequate nutrients for the developing fetus. In the first trimester, estrogen and progesterone levels rise, promoting increased pancreatic insulin secretion and increased hepatic glycogen storage. Additionally, during weeks four to eight, when organogenesis takes place, peripheral glucose utilization increases.[16] All these changes result in lower fasting glucose levels that can last up to weeks 13 to 15 of pregnancy. During this phase, women also have a higher risk of developing hypoglycemia, especially if they're experiencing nausea and vomiting.[17]

As the pregnancy progresses into the second and third trimesters, other hormones come into play, including human placental lactogen, cortisol, prolactin, progesterone, and estrogen, and their increasing levels and interactions result in insulin resistance. To compensate for this resistance, the pancreas must secrete two to three times more insulin. Women with normal pancreatic function can achieve this, but those who are predisposed to diabetes usually experience a delayed or insufficient pancreatic insulin secretion, resulting in carbohydrate intolerance and GDM.[9]

Poor maternal glycemic control is associated with fetal hyperglycemia and hyperinsulinemia that promote fat storage and macrosomia, which describes an infant with a birth weight of 4,000 g or higher and affects about 20% of women with GDM.[18] Macrosomia may result in birth trauma such as shoulder dystocia. Postpartum hypoglycemia occurs in about 50% of macrosomic infants and is directly related to fetal hyperinsulinemia caused by poor maternal glycemic control during the second half of pregnancy.[16] Hyperbillirubinemia among newborns of women with GDM also is more common compared with women without diabetes.[18]

Infants of mothers diagnosed with GDM don't have a higher risk of congenital malformations because hyperglycemia in GDM occurs later in pregnancy and usually not during the embryogenesis stage. However, when treatment is lacking and with poor glycemic control during GDM, the risk of perinatal mortality increases fourfold compared with pregnancies without diabetes.[19]

In terms of maternal morbidity due to GDM, studies show increased risks of preeclampsia, polyhydramnios, and C-sections.[20,21] As previously mentioned, women with GDM have a higher risk of GDM occurring in future pregnancies as well as developing diabetes later in life. Studies that followed women with GDM for five to six years postpartum showed significantly higher risks of hyperlipidemia and hypertension, which are direct indicators of higher cardiovascular risks.[22]

These risks and outcomes demonstrate that detecting and controlling diabetes during pregnancy is critical for preventing adverse complications for both mothers and infants. Target

glycemic goals during pregnancy are shown in Table 3 (below).[6,23] Two studies from 2011 indicate that postprandial blood sugar levels better predict fetal complications than preprandial levels; however, these values are recommended for clinical use, and the authors suggested that more prospective trials are needed to evaluate lower therapeutic blood sugar targets to prevent fetal macrosomia and other fetal and maternal morbidities.[24,25]

Table 3: Therapeutic Target Blood Glucose Levels in Pregnancy[6,23]

Time of Testing	Diagnostic Values
Fasting blood sugar	60 to 90 mg/dL
Before meals and overnight	60 to 105 mg/dL
One hour postprandial	120 to 140 mg/dL
Two hours postprandial	≤ 120 mg/dL
Hemoglobin A1c	6%

Treatment

The three components of diabetes management for women with GDM are nutrition therapy, physical activity, and medications as needed. If properly applied, these components can improve perinatal outcomes and promote the health of both mothers and infants. RDs should become facilitators and encourage pregnant women with diabetes to take control of their treatment after being provided with the proper tools and instructions.[26]

Even though GDM usually is triggered and diagnosed in late pregnancy, mothers need to check their blood sugar levels at least four times daily and continue until they deliver. Patients should report their blood sugar levels to a perinatologist weekly for follow-up and treatment evaluation. In many cases, the RD also is a CDE and, as part of the perinatology team, is involved in all aspects of patient care, which includes providing instructions for self-monitoring blood sugar, medical nutrition therapy and exercise, and medication recommendations.

Diet Therapy

The diet for pregnant women with diabetes usually is a healthful, well-balanced eating plan aimed at supporting the pregnancy and promoting blood sugar control. Consistency in meal and snack timing as well as consuming a variety of nutrients offered through individualized meal planning should be emphasized, as this can help promote normal glycemia in pregnancy and improve maternal and fetal outcomes.

To help motivate and empower patients, diabetes education and nutrition counseling should be sensitive to cultural preferences and special patient needs.[27] Written material in multiple languages should be available for patients, including menu ideas and food choices that best match their individual food habits and ethnic background.

Calorie consumption should be calculated to promote adequate weight gain and fetal-placental growth. The ADA recommends an intake of 2,000 to 2,500 kcal/day, which is based on 35 kcal/kg of present pregnancy weight, but these recommendations should be adjusted for each patient based on weight gain and blood sugar control.[28]

A few studies have shown that the ADA recommendations lead to significant weight gain and elevated postprandial blood sugar, which required insulin therapy in about 50% of women. Based on these findings, the researchers recommended calculating energy intake based on 30 kcal/kg of present pregnancy weight for normal-weight women, 24 kcal/kg for overweight women, and 12 kcal/kg for morbidly obese women.[29,30]

A study of obese women with GDM showed that restricting calories to about 1,800/day improved their glycemic control and still promoted fetal and placental development.[31] The study authors assumed that similar outcomes could be achieved for obese women with type 2 diabetes who have severe insulin resistance in pregnancy. However, consuming fewer than 1,800 kcal/day isn't recommended because of the risk of ketonemia and ketonuria, which are associated with childhood neurobehavioral complications.[32]

The ADA recommendations for macronutrients in pregnancy and diabetes are 50% to 60% of daily calories from carbohydrates (complex, high fiber), 10% to 20% from protein, and 25% to 30% from fat (less than 10% saturated).[9] One recently published study indicated that consuming carbohydrates at 55% of calories vs. 40% didn't change the need for insulin in women with GDM and didn't affect pregnancy outcomes.[33]

However, other recent studies have shown that consuming more than 50% of calories from carbohydrates promoted maternal weight gain and postprandial hypoglycemia, which increased the risk of fetal macrosomia.[28,34] This led to the suggestion that carbohydrate consumption in pregnant women with diabetes should be limited to 33% to 40% of daily calories.[28]

A recent study that evaluated the benefits of low-glycemic-index (GI) diets in women with GDM indicated a decreased need for insulin as a result of consuming low-GI foods without adverse fetal outcomes.[35]

According to a 2010 article by Hone and Jovanovic, women with GDM often miss the first-phase insulin response to food, which normally prevents the liver from breaking down glycogen into extra glucose at the onset of eating.[34] To overcome this phenomenon, high-fiber and low-GI carbohydrates are recommended to delay food absorption and prevent a postprandial glucose surge.[34] Table 4 (below)[6,34,36-41] presents a summary of dietary recommendations and restrictions for diabetes and pregnancy.

Table 4: Dietary Recommendations and Restrictions During Pregnancy

Carbohydrates	A minimum of 175 g/day is recommended.[36] Complex carbohydrates are preferred over simple carbohydrates.[6,39] The portions should be distributed over three meals and two to three snacks to minimize postprandial hyperglycemia. Patients should avoid sweets, desserts, and sweetened beverages, including all fruit juices. Fruit should be limited to two servings per day and should be avoided at breakfast or at night.
Protein	During the second half of the pregnancy, patients should consume 1.1 g/kg/day. Vegetarian and vegan patients should be offered

	plant-based protein choices and should consider the carbohydrate content of these foods.
Fat	Monounsaturated fat is preferred. Saturated fat consumption should be limited to less than 10% of total calories.
Artificial Sweeteners	Excessive use of artificial sweeteners should be avoided. Aspartame (Nutrasweet, Equal), acesulfame K (Sunnette, Sweet One), and sucralose (Splenda) are allowed in moderation in pregnancy with three to five servings per day.[37]
Fiber	Patients should consume at least 28 to 30 g/day. Consuming as much as 50 g/day can result in slower gastric emptying time and can help avoid postprandial hyperglycemia.[36]
Multivitamin and Mineral Supplements	These are recommended for treating deficiencies or for special groups, such as vegan women or smokers. Oversupplementation of vitamins A and D should be avoided.[36] The Recommended Dietary Allowance for vitamin A in pregnancy is 3,300 IU, and doses higher than 10,000 IU are considered teratogenic and could increase the risk of birth defects.[38,39] For vitamin D, the recommended daily dose is 1,000 to 2,000 IU, and a dose higher than 4,000 IU is considered toxic.[40] The use of any dietary supplement should be discussed and approved by an OB/GYN.
Alcohol	Patients should avoid consuming alcohol during pregnancy.
Caffeine	Intake should be restricted to no more than 300 mg/day (about 2 cups).
Smoking	Patients should avoid smoking during pregnancy.
Milk	Patients should consume 2% or whole milk to improve the absorption of vitamin D and calcium and reduce insulin resistance.[41]
Weight Gain	During the second half of pregnancy, patients should gain 1/2 to 1 lb per week for a single baby and 1 to 2 lbs/week for twins.
Breakfast	Patients should consume a small breakfast and restrict carbohydrates to no more than two servings along with one to two servings of protein to help control increased insulin resistance in the morning and avoid postprandial hypoglycemia.[34] Fruit and milk should be avoided at breakfast.
Schedule	Patients' diets should be individualized. Recommend consuming meals and snacks at scheduled times to avoid fluctuations in blood sugar levels. A bedtime snack (if recommended) should include one to two servings of high-fiber carbohydrates with one to two servings of protein. Evaluate the need for this snack based on fasting blood sugar levels.

Carbohydrate restriction in the morning and at night is intended to improve blood sugar regulation throughout the day and prevent hyperglycemia caused by the nocturnal activity of steroid hormones such as cortisol along with other placental hormones that promote insulin resistance.[9,16] Table 5 (below) shows an example of meal planning and exchange distribution

for a 2,200-kcal ADA diet. It consists of 219 g of carbohydrates (40% of total calories), 123 g of protein (23% of calories), and 91 g of fat (37% of calories). These proportions should be calculated and adjusted based on each patient's calorie requirements.

Table 5: 2,200-kcal Meal Plan for Pregnant Diabetes Patients

Time	Number of Exchanges/Choices
Breakfast	2 Carbohydrate 2 Starch 1 Meat (medium) 1 Fat
Midmorning snack	2 Carbohydrate 1 Starch 1 Fruit 1 Meat
Lunch	3 Carbohydrate 2 Starch 1 Fruit √ Vegetables 3 Meat (lean/medium) 2 Fat
Afternoon snack	2 Carbohydrate 1 Starch 1 2% milk
Dinner	3 Carbohydrate 2 Starch 1 2% milk √ Vegetables 4 Meat (lean/medium) 2 Fat
Evening snack	2 Carbohydrate 1 Starch 1 2% milk 1 Meat

√ = free food

While the three main meals are strongly recommended for each patient, snacks can be optional based on the patient's needs, lifestyle, and blood sugar levels. Women who use insulin should be educated about carbohydrate counting and provided with an insulin-to-carb ratio to determine premeal insulin doses. Nutrition counseling must be tailored to the individual patient and ideally provided by an RD/CDE specializing in diabetes and pregnancy.

Physical Activity

Exercise is a complementary treatment to diet therapy. Unless a pregnant woman with diabetes is on bed rest or medically limited for physical activity, she should be instructed to exercise. For women with GDM, exercise can delay the need for insulin or reduce the dose when insulin is required.[42]

During his recent lecture at a conference in Orlando, Florida, Stuart Shelton, MD, suggested an exercise regimen of about 30 minutes of brisk walking three to four times per week.[43] This also has been supported by the ACOG and the ADA.[44,45]

Women should be advised to take precautions while exercising to avoid loss of balance and fetal trauma. Those who are taking insulin should monitor their blood sugar before, during, and after exercise and adjust their insulin and carbohydrate intake to avoid exercise-induced hypoglycemia.[46] The ADA recommends women consume carbohydrates before exercise if their blood sugar levels are below 100 mg/dL and avoid exercise if their blood sugar levels are 250 mg/dL or higher to prevent ketoacidosis due to increased activity of counterregulatory hormones.[47]

Pregnant women should stop exercising and call for medical assistance in cases of shortness of breath, chest pain, dizziness, headache, feet swelling, vaginal bleeding, amniotic fluid leakage, and painful contractions.[42]

Insulin

If diet and exercise fail to achieve glycemic goals within one to two weeks of treatment, women with GDM should begin an insulin regimen. The rapid-acting insulin analogs lispro (Humalog) and aspart (Novolog) as well as intermediate-acting NPH insulin are classified as pregnancy category B medications and are the preferred types of insulin to use in such cases.[48] Starting insulin doses are calculated based on the number of weeks of gestation and body weight of an individual as presented in Table 6 (below).

Table 6: Suggested Starting Total Daily Insulin During Pregnancy[34]

Weeks Gestation	Total Daily Insulin (units/kg of actual body weight)
1 to 12	0.7
13 to 28	0.8
29 to 34	0.9
35 to 39	1

Approximately two-thirds of the total insulin dose should be administered in the morning, of which one-third is rapid-acting insulin and two-thirds is intermediate-acting insulin. The remaining one-third should be administered in the evening, of which one-half is rapid-acting insulin before dinner and one-half is intermediate-acting insulin before bed.[34] These are only starting doses and should be adjusted based on the patient's blood sugar levels, as reported one to two times weekly, and periodic hemoglobin A1c tests.

A recent multinational study on the basal insulin detemir (Levemir) for pregnant women with diabetes demonstrated that this type of insulin is comparable to insulin NPH in safety and efficacy but, unlike NPH, it doesn't cause hypoglycemia since it's a flat insulin that releases at a slow constant rate in the body, and does not have a significant peak in action.[49,50] Based on

these results, detemir recently was classified by the FDA as category B for pregnancy and can be recommended in comparable doses to NPH one to two times per day.[51]

The use of insulin pumps is encouraged when possible and based on insurance considerations. Pump therapy, which uses rapid-acting insulin, is the most flexible and fastest way to better regulate blood sugar. It's frequently used with continuous glucose monitoring (CGM) technology, which has been tested recently and found to be effective in detecting trends of either hyper- or hypoglycemic episodes and in allowing the patient to be proactive in treatment by self-adjusting insulin and food intake to better control blood sugar levels.[34]

In pregnancy, CGM can be effective for alerting users to nocturnal hypoglycemia and hypoglycemia unawareness.[52] Since GDM usually is diagnosed during the second to third trimester, the use of pumps and CGM in these patients is rare, but it still occurs, especially in those who have severe insulin resistance and need tight blood sugar control.

Oral Hypoglycemic Agents

The FDA hasn't approved any oral diabetes medications for pregnancy.[53] Subsequently, using them during pregnancy is considered off label. Some studies have examined glyburide and metformin use for treating GDM, but none have addressed type 2 diabetes in pregnancy.[54,55] Glyburide, a sulfonylurea that stimulates the pancreas to increase insulin secretion and increases peripheral insulin sensitivity, is the most commonly used oral agent in GDM.

Several studies on the effect of glyburide on maternal glycemic improvement and fetal outcomes recently have been published,[6,34,53] but there's still debate over whether this drug crosses the placenta in significant amounts and could potentially affect the baby.[36] When women with GDM take this medication, they're advised to stop taking it two weeks before delivery because of an increased risk of postpartum fetal hypoglycemia. Glyburide is contraindicated in women who are breast-feeding and those who are allergic to sulfa.[53] Moreover, the drug isn't particularly effective for controlling fasting blood sugar levels higher than 115 mg/dL.

Metformin, a biguanide that helps reduce hepatic gluconeogenesis and helps increase insulin sensitivity, often is used in prediabetes or for polycystic ovary syndrome (PCOS). It's associated with increased ovulation and pregnancy promotion.[53] No studies on the long-term safety of metformin have been published, but when used for treatment of PCOS, women who got pregnant often were advised by their physicians to continue using it up to 20 weeks of gestation to prevent miscarriages. Metformin is known to cross the placenta, but in a few studies on GDM patients, it wasn't shown to have negative fetal outcomes.[53,56]

Until more prospective studies on oral hypoglycemic agents are published, the ACOG suggests that "clinicians must inform women with GDM that although relative short-term risks of currently used oral agents appear to be minimal if any compared with insulin, theoretical concerns do exist about long-term safety. This disclosure must be considered before a decision is reached concerning their use."[6]

Link Between Diet, Exercise, and Medications
All pregnant women with diabetes are considered high risk and should be cared for by a perinatologist and a CDE, preferably an RD/CDE. Patients play a major role in this process and need to take responsibility for their own treatment since they must monitor their blood sugar, report results to the health care team, and make adjustments to their diet and medications when recommended. Without patients' active participation and adherence to instructions, the health care team can't help them control their blood sugar and can't be responsible for pregnancy outcomes.

If patients are placed on insulin, often they will be advised to monitor their blood sugar before and one hour after the start of each meal. Insulin should be adjusted based on blood sugar levels, food intake, and physical activity.

In cases where fasting blood sugar is elevated, bedtime NPH must be adjusted as follows: The patient should be asked to test her blood sugar at 3 AM to rule out the rebound (Somogyi) effect, which shows hypoglycemia at 3 AM and fasting hyperglycemia later in the morning. In this case, the patient should have a bedtime snack with a carbohydrate and may need to reduce bedtime NPH based on the morning fasting blood sugar level. If her 3 AM blood sugar level is normal and morning fasting blood sugar is high, the patient probably has experienced the dawn phenomenon in which counterregulatory hormones such as cortisol and growth hormone promote hepatic-induced hyperglycemia at around 3 to 4 AM. In this case, exercise after dinner should be recommended along with continued blood sugar testing, since the dawn phenomenon doesn't necessarily occur every night. If blood sugar readings are high at 3 AM and high in the morning, bedtime NPH should be increased, and the bedtime snack should be restricted to only protein choices or eliminated in some cases.

If blood sugar readings are high one hour after meals, the premeal rapid-acting insulin analog must be increased and carbohydrate portion control should be emphasized. If blood sugar levels are high one hour after lunch, the morning NPH, which has a late peak, should be increased. If premeal blood sugars are high, the amount and quality of snacks should be evaluated and restricted as needed.

This fine-tuning of diet and insulin is harder to implement when women are using oral hypoglycemic agents. In many cases, patients need to switch to insulin to achieve better glycemic control.[6,34]

Postpartum Needs
After delivery, insulin requirements decrease to prepregnancy levels and, in most cases, GDM resolves. However, it's recommended that women be screened for diabetes six to eight weeks postpartum and once per year thereafter.[6,9]

Breast-feeding has been strongly recommended and known to provide health benefits for both mothers and infants. For mothers, it's associated with a reduced risk of breast and ovarian cancer and also helps with postpartum weight loss. In women with GDM, breast-feeding has been shown to reduce the risk of type 2 diabetes.[57]

For infants, breast-feeding has been found to help control weight during early childhood, and it may reduce the risk of developing chronic diseases, including diabetes, later in life.[57,58]

Since breast-feeding increases insulin sensitivity, both insulin doses and carbohydrate intake should be adjusted to prevent hypoglycemia in mothers who are taking insulin during lactation.[53] While insulin isn't excreted in breast milk and is considered safe for infants, glyburide and metformin both pass this barrier and are contraindicated during lactation.[53]

Future Considerations

With the increasing prevalence of diabetes worldwide, including diabetes in pregnancy, many new technologies and tools are being evaluated and established to improve maternal and fetal outcomes. This includes, for example, the development of new monitoring systems, such as A1c machines and CGM; new drugs that are safe for diabetes and pregnancy; the implementation of universal GDM screening; and the introduction of alternative, more cost-effective GDM diagnosis methods other than OGTT.[14,53]

More studies are needed to evaluate the long-term metabolic and micro- and macrovascular effects on both mother and infant, and women should continue to be counseled on the importance of postpartum healthful lifestyles and well-being.

So far, there's no clear evidence that GDM can be prevented; however, adopting healthful habits before, during, and after pregnancy always is suggested, as this can help with women's general well-being, reduce the risk of reoccurring GDM, and help control birth weight in newborns.[59-61]

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Examination

1. Based on the case study at the beginning of the article, how should Diana's diabetes be classified?

A. A1
B. A2
C. B
D. C

2. Glyburide is contraindicated in women with gestational diabetes mellitus (GDM) who meet which of the following characteristics?

A. They're obese.
B. They skip breakfast and can't take medications on an empty stomach.
C. They're allergic to sulfa.
D. They're in their third trimester of pregnancy.

3. Which of the following is not a possible risk factor for developing GDM?

A. Obesity
B. Proteinuria
C. Family history of diabetes
D. Previous stillbirth

4. Rosa, a 24-year-old obese Hispanic woman, presented to the clinic at 30 1/7 weeks gestation. Her past obstetric history was significant for GDM in her first pregnancy two years before. The pregnancy resulted in the delivery of a 10-lb, 2-oz stillborn son at 38 weeks gestation. Rosa's family history was positive for type 2 diabetes. A three-hour oral glucose tolerance test (OGTT) showed the following:

Time	Plasma Glucose (mg/dL)
Fasting blood sugar (FBS)	132
1 hour	250
2 hours	224
3 hours	190

As a result, Rosa was diagnosed with GDM, placed on a diet, and taught how to monitor her blood glucose. Which result from the three-hour OGTT was abnormal?

A. FBS only
B. FBS and one hour
C. All except FBS
D. All results

5. After one week, Rosa's blood glucose readings were 86 to 95 mg/dL fasting, 100 to 130 mg/dL two hours after breakfast and lunch, and 120 to 140 mg/dL two hours after dinner. Based on these blood sugar readings, what's the best recommendation for Rosa?

A. Start an insulin regimen.
B. Review diet, modify bedtime snack if needed, and encourage 30 minutes of walking each day.
C. Start taking glyburide.
D. Start taking metformin.

6. At week 35, Rosa's blood glucose levels were 110 to 130 mg/dL fasting, 100 to 130 mg/dL two hours after breakfast and lunch, and 120 to 140 mg/dL two hours after dinner. Based on these blood sugar readings, what will be the next step of Rosa's treatment?

A. Start Rosa on the smallest dose of glyburide at night to help with FBS levels.
B. Instruct her to continue her current diet and exercise regimen.
C. Start her with a small dose of NPH at bedtime and emphasize the importance of diet.
D. Admit Rosa to the hospital because of noncompliance.

7. Which is not a likely complication from fetal hyperglycemia in women with GDM?

A. Macrosomia
B. Mental retardation
C. Shoulder dystocia
D. Postpartum hypoglycemia

8. Which of the following exchange groups should be avoided at breakfast?

A. Starches and fruits
B. Fruit and milk
C. Protein
D. Meat

9. Which insulin should be adjusted for a patient whose blood sugar levels are high after lunch (around 2 PM) but normal during the rest of the day?

A. Increase morning fast-acting insulin
B. Reduce morning fast-acting insulin
C. Increase morning NPH
D. Add some fast-acting insulin before lunch

10. Which of the following daily calorie intakes is recommended for morbidly obese women?

A. 12 kcal/kg of actual pregnancy weight
B. 35 kcal/kg of actual pregnancy weight
C. 2,000 kcal
D. 1,800 kcal

ANSWER: A