Reviewed By
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# Gestational Diabetes Mellitus

## Objectives:

- → Define GDM and Pre-gestational DM
- → Identify how common is GDM in Saudi Arabia and worldwide.
- → Discuss how pregnancy predisposes to the development of GDM
- → Describe the maternal and fetal complications of D.M.
- → Describe the screening and diagnostic tests for GDM.
- → Identify the importance of multidisciplinary approach of management of these cases.

- → Slides
- → Important
- → Golden notes
- → Extra
- → Doctor's notes
- → Previous Doctor's notes
- → Reference

Kaplan Video

Editing File

# Preview Of Diabetes Mellitus

## Definition:

- → **Diabetes Mellitus:** a group of metabolic diseases characterized by hyperglycemia resulting from defects in insulin secretion, insulin action, or both.
- → **WHO:** diabetes is either:
  - → **Fasting blood glucose:** 7.8 mmol/l.
  - → **Blood glucose 1 - 2 hours following 75 grams of oral glucose load:** > 11 mmol/l.
- → Chronic hyperglycemia of diabetes is associated with long term damage, dysfunction and failure of various organs (**especially:** eyes - kidneys - nerves - heart - blood vessels).
  - → Pregnant diabetic patient → there will be a contribution on the fetal side.

## Epidemiology:

- → Common disease.
- → **World prevalence:** at least 100 million people, this figure may double next decade.

## Types of DM:

| | |
|---|---|
| **Type 1 Diabetes** | → B cell destruction → insulin dependent.<br>→ **Characterized by:** absolute deficiency of insulin secretion (5 - 10% of those with diabetes). |
| **Type 2 Diabetes** | → Non-insulin dependent.<br>→ **Characterized by:** ↑ insulin resistance + relatively ↓ insulin secretion. |
| **Gestational Diabetes** | → State of ↑ insulin resistance.<br>→ **Classification:**<br>→ **A1:** controlled by diet.<br>→ **A2:** controlled by insulin.<br>→ **Pathophysiology**: diabetogenic effect of **human placental lactogen (hPL)** - placental insulinase - cortisol - progesterone.<br>→ Mix of Type 1 & Type 2.<br>→ **Treatment:** variable, could be only diet, hypoglycemic or insulin. |
| **Other Types** | → **Pancreatic disease:** pancreatitis.<br>→ **Drug induced:** steroids - diuretics.<br>→ **Endocrine disease:** acromegaly - cushing's syndrome - thyrotoxicosis.<br>→ **Abnormal insulin or its receptor:** rare.<br>→ **Genetic disorders:** lipoatrophic diabetes (rare).<br>→ Malnutrition related. |

# Pre-Gestational & Gestational Diabetes Mellitus

## Pregnancy & GDM Development:

→ Significant hormonal changes affects carbohydrate metabolism during pregnancy → pregnancy is potentially diabetogenic.
  → ↑ insulin antagonist (human placental lactogen **HPL** + **cortisol**).
    → **To balance changes:** maternal pancreas secrete ↑ insulin to maintain carbohydrate metabolism.
  → Most marked during the 3rd trimester.
→ Diabetes may be aggravated by pregnancy.
→ **Normal pregnancy is characterized by:**
  → **Mild fasting hypoglycemia:** ↑insulin level.
  → Postprandial hyperglycemia.
  → Hyperinsulinemia.
  → **Suppression of glucagon:** role of glucagon in pregnancy is not fully understood.
→ Glucose cross the placenta by facilitated diffusion and fetal blood level closely follows the maternal level.
→ **Effect of pregnancy on diabetes:**
  → Insulin antagonism due to **HPL** action (produced by placenta) + estrogen + progesterone → difficulty in controlling diabetes.
  → ↑ infection rate.

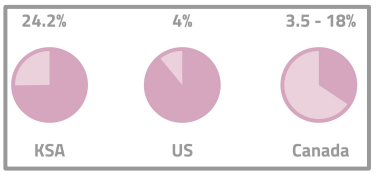
## Pre-Gestational DM:

→ **Pre-gestational diabetes mellitus:** the preexisting type 1 or type 2 diabetes that is diagnosed before pregnancy.
→ direct relationship between blood glucose level & fetal and maternal complications → good glycemic control during pregnancy or even before is needed.
  → Any diabetic woman who plan to get pregnant should insure that their diabetes is optimally controlled to reduce the risk of obstetrical complications.
→ **Incidence of pre-gestational diabetes:**
  → **Europe:** 1 - 2%.
  → **North America:** 3 - 8%.

# Gestational Diabetes Mellitus

## Gestational DM:

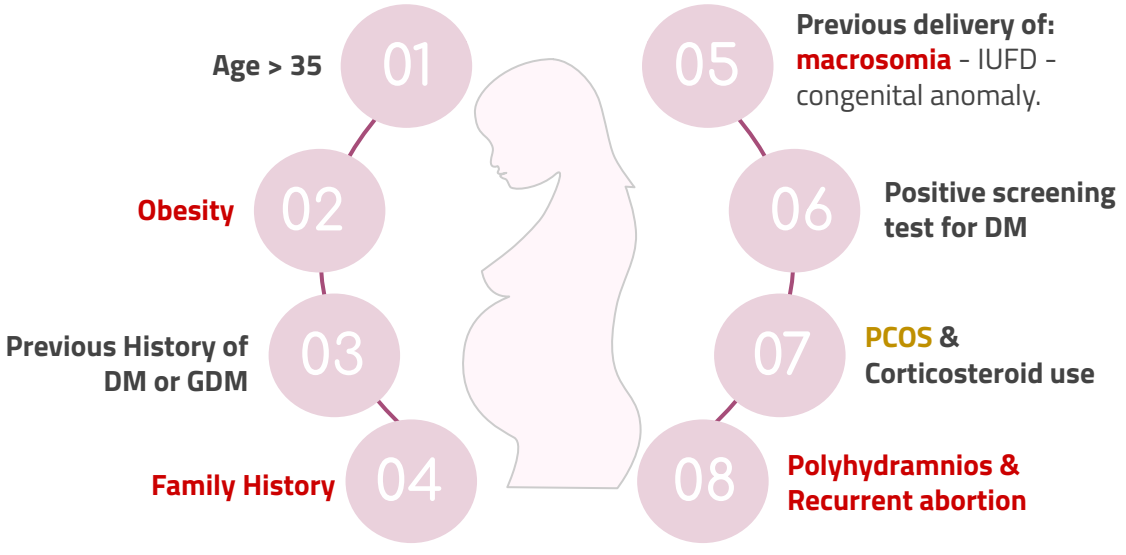
- → **Gestational diabetes mellitus:** any degree of glucose intolerance with onset of or first recognition during pregnancy.
- → **Gestational diabetes mellitus:** any pregnant women who is unable to maintain fasting blood glucose or post-challenge glucose value in the normal pregnant range before or after a standard 100 g glucose challenge.
- → **Definition applies regardless of:**
  - → Whether insulin or only diet modification is used for treatment.
  - → Whether the condition persists after pregnancy or not.
- → Does not exclude the possibility that unrecognized glucose intolerance may have antedated or begun concomitantly with the pregnancy.
- → **Incidence:** 1 - 2% of women will develop gestational diabetes during pregnancy.
- → Within 5 - 10 years after delivery, 35% of women with GDM will develop overt diabetes.
- → Diagnosed usually after **20 - 24 weeks**.
  - → Diagnosis prior to 24 weeks of gestation → overt diabetes, not gestational.
    - → Diabetes can be diagnosed for the 1st time during pregnancy.
  - → Pregnant woman at high risk of gestational diabetes → screen early before 24 weeks.
- → **Presentation:** hyperglycemia - glucosuria - ketoacidosis → easy to diagnose.




## Pathophysiology:

- → **Pregnancy:** ↑ human placental lactogen (**HPL**) - progesterone - prolactin - cortisol → progressive insulin resistance.
- → Women who develop GDM have chronic insulin resistance & GDM is a "stress test" for the development of diabetes later in life.

## Risk Factors:



# Diabetes Mellitus in Pregnancy

## White Classification of Diabetes in Pregnancy:

→ Most obstetricians use the White classification of diabetes during pregnancy to further refine the categories for GDM and pregestational diabetes.
→ Helpful for assessing disease severity & complications likelihood.

| Class | Description |
|---|---|
| $A_1$ | → **Gestational** diabetes (diagnosed in pregnancy).<br>→ **Controlled with: diet** alone. |
| $A_2$ | → **Gestational** diabetes (diagnosed in pregnancy).<br>→ **Controlled with:** diet + glyburide or insulin. |
| B | → **Pregestational** diabetes of both:<br>→ Developing **after** the age of **20 years**.<br>→ **Duration: < 10** years.<br>→ **Controlled with:** diet + insulin. |
| C | → **Pregestational** diabetes of either:<br>→ Developing between the age of **10 and 19 years**.<br>→ **Duration: 10 - 19** years.<br>→ **Controlled with:** diet + insulin. |
| D | → **Pregestational** diabetes of either:<br>→ Developing **before** the age of **10 years**.<br>→ **Duration: > 20** years.<br>→ **Controlled with:** diet + insulin. |
| F | → **Pregestational** diabetes at any age or duration with **nephropathy**.<br>→ **Controlled with:** diet + insulin. |
| R | → **Pregestational** diabetes at any age or duration with **proliferative retinopathy**.<br>→ **Controlled with:** diet + insulin. |
| H | → **Pregestational** diabetes at any age or duration with **arteriosclerotic heart disease**.<br>→ **Controlled with:** diet + insulin. |

# Gestational Diabetes Mellitus

## Diagnosis and Screening:

- → **Screening depends on history:**
  - → Positive history → patient at risk → immediately glucose tolerance test.
    - → Negative first-trimester (first prenatal visit) screen → repeat at 24 - 28 weeks of gestation.
  - → Negative history → screening at between **24 - 28 weeks** of gestation.
- → Urinary glucose → completely unreliable.
- → Full glucose tolerance test → ideal but expensive & time consuming.
- → Random blood sugar of 5.8 mmol, **sensitivity:** 60%.
- → **American College of Obstetricians & Gynecologists (ACOG) recommends a 2-step method to test for GDM (**no single test proved to be perfect**):**

### 50g, 1-hour oral glucose challenge test (OGCT)

- → **Screening** for gestational diabetes between **24 - 28** weeks' gestation.
- → **Sensitivity:** 80 - 90%.
- → Given without regard to most recent oral intake (*no fasting required*).
- → A 50g glucose load is given → serum glucose is measured after 1 hour.
- → **Normal value:** < 140 mg/dL.
- → **Abnormal values:** > 130 - 140 mg/dL (> 7.8), 15% of pregnant women.

### ★ 100g, 3-hour oral glucose tolerance test (OGTT) ★

- → Performed on all patient with abnormal screening test (first step) .
- → 1-hour screening (50g of oral glucose) plasma glucose **> 200 mg/dL** → OGTT is not required & may **dangerously** ↑ blood glucose.
- → **Definitive** test.
- → Overnight fast (8 hours fasting state is required) → fasting blood glucose is drawn:
  - → **FBG >125** mg/dL → **overt diabetes mellitus** → no further testing is performed.
  - → **FBG <126 mg/dL** → administer 100g glucose load → glucose level at 1, 2 & 3 h → total of 4 glucose values are obtained.
    - → **Normal values:**
      - → FBS < 95 mg/dL (5.8).
      - → 1 hour <180 mg/dL (10.6).
      - → 2 hours <155 mg/dL (9.2).
      - → 3 hours <140 mg/dL (8.1).
- → 2 ≥ abnormal values on 3- hour OGTT → patient is diagnosed with GDM.

### ★ 75g, 2-hour oral glucose tolerance test (OGTT) ★

| Units | Fasting | 1 hour | 2 hours |
|---|---|---|---|
| mg/dL | < 92 | < 180 | < 153 |
| mmol/L | < 5.1 | < 10 | < 8.5 |

- → Best, easiest and the most sensitive one.
- → Fasting state is required (8 - 14 hours) → take one reading.
  - → Overnight fast after 3 ≥ unrestricted diet days (>*150g carbs/day*) + unlimited physical activity.
- → If someone asked you about screening test, ideally do 75 gm 2-hours oral glucose.
- → Performed on all women at 24 - 28 weeks not previously found to have overt diabetes or gestational DM during early pregnancy testing.
- → 1 ≥ of the values must be equaled or exceeded for the diagnosis of GDM.
- → Fasting plasma glucose >7 mmol/L (126 mg/dl) → diagnostic of overt diabetes.
- → Screening postpartum is done with 75 gm glucose at **6 weeks after** delivery.

# Diabetes Mellitus in Pregnancy

## Approach in High-Risk Patients:

→ Screening for GDM is advised at the **first prenatal visit** in women with risk factors.
  → Previous pregnancy with GDM.
  → History of polycystic ovarian disease.
  → Obesity.
→ **OGCT:** glucose values > 130 - 140 mg/dL → abnormal.

## Management:

→ Diabetic pregnant women should be managed in a joint clinic with an obstetrician and physician.
→ Team approach.
  → **Includes:** patient - obstetrician - maternal-fetal medicine specialist - clinical nurse specialist - nutritionist - social worker - neonatologist.
    → The patient is an active participant in formulating management strategies.
→ Patient education and counseling.
→ Medical-nursing assessments and interventions.
→ Strategies to achieve maternal euglycemia.
→ Avoidance of fetal-neonatal compromise.

**Achieving Euglycemia:**

→ Strict metabolic control before & during pregnancy → ↓ incidence of congenital anomalies, perinatal morbidity, perinatal mortality, & preterm labor.
  → Congenital anomalies occur in 1st trimester & GDM ocuur in 2nd trimester → not correlated.
  → GDM → placental insufficiency + polyhydramnios → pressure on uterus → preterm labor.
→ **To achieve an optimal outcome (***above these values → intervention required***):**
  → Fasting blood glucose level < 95 mg/dL.
  → 1-hour postprandial glucose level < 140 mg/dL.
  → 2-hour postprandial glucose level < 120 mg/dL.
→ **Principal of treatment:** maintain blood sugar level within the normal range with the mean of 24 hours profile around 5 mmol/l, using the blood sugar series BSS.
  → **According to BSS:** we can adjust the dose and frequency of the insulin.
    → Oral hypoglycemic agents are **not used in pregnancy** (may cause fetal anomalies).
→ **Long term control check:** glycosylated hemoglobin HbA1c.

**Diet:**

→ An input from dietician is important to help to adjust the diet.
→ 80% of GDM patients can maintain glucose control with diet therapy
→ **Carbohydrate:** 45-50%.
  → Encourage complex carbohydrates.
→ **Protein:** 20-25%.
→ **Fat:** 20-25%.
→ **Fiber:** generous amount.
→ **Caloric intake:** 20% at breakfast - 30% at lunch - 30% at dinner - 20% at a bedtime snack.
  → Usually 1800 calories, role of dietitian.

**Exercise:**

→ Mild to moderate aerobic exercise (**example:** brisk walking) for about half an hour after meals.
  → To burn calories.

# Diabetes Mellitus in Pregnancy

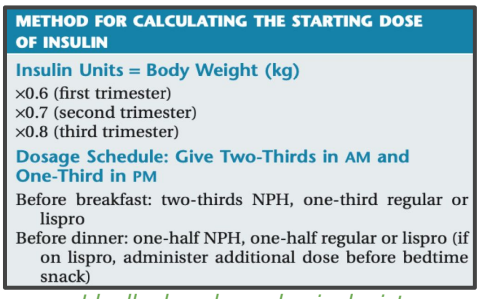
## Management:

**Pharmacologic Therapy:**

→ Usually managed with diet and exercise alone, but if euglycemia cannot be achieved → add an oral hypoglycemic agent (glyburide) or insulin.
  → Don't jump to medication unless not controlled:
    → Diet & exercise → oral hypoglycemic (Glyburide) → insulin.

→ **Glyburide:**
  → Doesn't appear to enter the fetal circulation in appreciable quantities.
  → Used successfully to treat gestational diabetes after the first trimester.

→ **Insulin:**
  → Medication of choice to maintain euglycemia in pregnancy, recommended therapy in pregestational diabetes.
  → **Peak action of insulin lispro:** 30 - 90 minutes after injection.
  → **Peak action of regular insulin:** 2 - 3 hours after injection.
    → Regular insulin → fast → before meals.
  → **Peak action of neutral protamine Hagedorn (NPH) insulin:** 6 - 10 hours after injection.
    → NPH → slow acting → cover all day.



*Ideally done by endocrinologist*

→ Combination of rapid- or short-acting (lispro or regular) + intermediate-acting (NPH) insulin is usually given in split morning & evening doses or more frequently → euglycemia.

## Complications:

→ Diabetes often coexists with **metabolic syndrome**.
  → **metabolic syndrome:** a group of risk factors for diabetes, coronary heart disease, & stroke that occur together (central obesity - insulin resistance - hyperlipidemia).
→ **Most fetal & neonatal effects are attributed to the consequences of:**
  → Maternal hyperglycemia.
    → Affects the baby after delivery since it gets used to constant hyperglycemia.
  → Maternal vascular disease (in more advanced classes).
→ Glucose crosses the placenta easily by facilitated diffusion → fetal hyperglycemia → stimulated pancreatic β-cells → fetal hyperinsulinism.
  → Fetal hyperglycemia during the period of embryogenesis is **teratogenic**.
→ **First trimester:** direct correlation between birth defects in diabetic pregnancies & ↑ glycosylated hemoglobin A1C (HbA1C) levels.
→ **Later in pregnancy, especially 3rd trimester:** Fetal hyperglycemia and hyperinsulinemia → fetal overgrowth and macrosomia → predispose to birth trauma (shoulder dystocia - Erb palsy).
  → Change in fat distribution → broad shoulders + small head → stuck shoulders during birth → emergency caesarean section.
→ Acidosis / hypotension from osmotic diuresis / hypoxia from ↑ metabolism + inadequate placental oxygen transfer → fetal demise.

# Diabetes Mellitus in Pregnancy

## Obstetric Management:

**Preconception:**

- → **Counseling:** weight & exercise.
- → Blood sugar control.
- → HA1C.
- → Early dating and FU of the pregnancy.

**Antepartum:**

- → **Newly diagnosed:**
  - → Put patient on **diet** x 3 days.
  - → 30 - 35 kcal/kg of ideal body weight.
  - → 40 - 50% carbs + 12 - 20% proteins + 30 - 35% fat.
  - → **Do blood sugar series (BSS):**
    - → Controlled → continue monitoring.
    - → Uncontrolled → start insulin.
  - → **2 / 3 am:** ⅔ NPH – ⅓ reg.
  - → **1 / 3 pm:** ½ NPH – ½ reg.
- → Aside from achieving euglycemia, adequate surveillance should be maintained during pregnancy to detect and possibly maternal and fetal complications.
  - → Regular US + urine cultures for infections + follow up with dietitian & endocrinologist.
  - → Appropriate screening tests.
  - → Detailed ultrasound anomaly scan + fetal echocardiography.
  - → Serial growth scan for macrosomia & polyhydramnios.
  - → Fetal surveillance with biophysical profile BPP
  - → Doppler ultrasound.
  - → Cardiotocography CTG.
- → GDM → fetal macrosomia is common → should be investigated.
- → Abnormalities of fetal growth are most likely to be present in 3rd trimester → confirmed by US.
- → Serial antepartum testing should be performed in 3rd trimester.
  - → Usually delayed until at or after 36 weeks, or later in women with well-controlled GDM.
  - → Detect all possible complications before labor.

**Timing & Mode of Delivery:**

- → **Time of delivery:** depends on fetal & maternal status + degree of glucose control.
  - → Well-controlled GDM without complications → spontaneous onset of labor at term.
    - → Earlier intervention is indicated if these conditions are not met.
      - → Macrosomic babies → avoid ↑ birth trauma to both mother & fetus.
  - → Controlled → give her chance to extend pregnancy until term.
  - → Uncontrolled → might induce labor at 37 weeks.
  - → On insulin → might not extend pregnancy to 38 weeks.
- → **Mode of delivery:** cesarean delivery elected for large fetuses (> 4500 g).
  - → Management would attempt to achieve vaginal delivery between 38 - 40 weeks.
  - → Diabetes alone is not an indication for cesarean section.

# Diabetes Mellitus in Pregnancy

## Obstetric Management:

**Intrapartum:**

- → Intrapartum management of a patient with diabetes requires the establishment of maternal euglycemia during labor.
  - → Because the patient aren't eating normally → might develop hypoglycemia.
- → Plasma glucose levels are measured frequently, and, if elevated, a continuous infusion of regular insulin is given.
- → Insulin dosage is adjusted as needed to maintain a plasma glucose level **80 - 120** mg/dL.
- → Many insulin-dependent patients will not require exogenous insulin during labor.
  - → Depends on readings.
- → Continuous electronic fetal heart rate monitoring is recommended for all patients with diabetes.
  - → Not like normal labor!! any deceleration → induce labor.
- → **Diabetic on insulin or uncontrolled diabetes: IOL** if completed **38 weeks**.
- → **Controlled diabetes: IOL** at **term**.
- → Cesarean section for obstetric indications.
- → **In labor (induced or spontaneous):** maintain normoglycemia by sliding scale of insulin administration.
- → Blood glucose level should be tested at two hourly intervals.
- → Fetal scalp blood sampling should be taken in case of abnormal CTG.

**Postpartum:**

- → **After delivery of the fetus and placenta:** sharply ↓ insulin requirements.
  - → Because placenta (source of many insulin antagonists) is removed.
- → **Insulin-dependent diabetes:**
  - → Many patients may not require exogenous insulin for the first 48 - 72 hours after delivery.
  - → Plasma glucose levels should be monitored.
  - → ↑ plasma glucose levels → lispro or regular insulin.
- → **Gestational Diabetes Mellitus treated with insulin or oral hypoglycemic agents:**
  - → Frequently do not need treatment postpartum.
  - → Undergo a 75-g OGTT at 6 - 12 weeks postpartum.
  - → **Everything stops:** no medication
  - → Follow up patient after 6 weeks:
  - → High OGTT → patient has DM2.
  - → Majority return to normal in 2 weeks.
- → **Pregestational DM:**
  - → ↑ doses during pregnancy due to ↑ demand and stress.
  - → **After delivery:** doses are returned to normal.

**Counselling:**

- → Patients should be counselled about changes in diet.
- → American Diabetes Association diet with the same distribution of carbohydrates, proteins, and fat should be maintained.
- → Breastfeeding mother → add 500 calories/day to the pre-pregnancy diet.

# Gestational Diabetes Mellitus

## Maternal Complications:

| Obstetric Complications | |
|---|---|
| **Polyhydramnios** | → **Close prenatal surveillance:** blood glucose monitoring - US. |
| **Preeclampsia** | → Evaluation for signs and symptoms. |
| **Infections (UTI & candidiasis)** | → Urine culture & wet mount.<br>→ Appropriate therapy. |
| **Cesarean delivery** | → Blood glucose monitoring.<br>→ Insulin and dietary adjustment → 🚫 fetal overgrowth. |
| **Genital trauma**<br>*Due to macrosomic baby* | → Ultrasonography → detect macrosomia.<br>→ Cesarean delivery for macrosomia. |
| **Diabetic Emergencies** | |
| **Hypoglycemia** | → Teach signs and symptoms.<br>→ Blood glucose monitoring.<br>→ Insulin and dietary adjustment. |
| **Diabetic coma** | → Urgent medical management required. |
| **Ketoacidosis** | → Check for ketones if glucose >200 mg/dL. |
| **Vascular & End-Organ Involvement or Deterioration (*pregestational diabetes mellitus patients*)** | |
| **Cardiac** | → **Electrocardiogram:** first visit & as needed. |
| **Renal** | → **Renal function studies:** first visit & as needed. |
| **Ophthalmic** | → **Funduscopic evaluation:** first visit & as needed. |
| **Peripheral vascular** | → Check for ulcers & foot sores.<br>→ **Noninvasive Doppler studies:** as needed. |
| **GI disturbance** | → Symptomatic treatment as needed. |
| **Neurologic** | |
| **Peripheral neuropathy** | → Neurologic and gastrointestinal consultations as needed. |
| **After Pregnancy** | |
| **Type 2 diabetes** | → Postpartum glucose testing of GDM.<br>→ **Lifestyle changes:** diet & exercise. |
| **Metabolic syndrome** | → **Lifestyle changes:** diet & exercise. |
| **Obesity** | → **Lifestyle changes:** diet & exercise. |
| **CVS disease** | → Annual check-up by physician.<br>→ **Lifestyle changes:** diet & exercise. |

*All the usual complications of diabetes*

# Gestational Diabetes Mellitus

## Fetal and Neonatal Complications:

| Fetal and Neonatal Complications | |
|---|---|
| **Macrosomia with traumatic delivery** | → Ultrasonography for estimated fetal weight before delivery (*shoulder dystocia - Erb palsy*).<br>→ Offer cesarean delivery if EFW >4500 g. |
| **Delayed organ maturity** | → Pulmonary, hepatic, & neurologic.<br>→ No maternal-fetal respiratory distress syndrome indications → avoid delivery before 39 weeks in GDM.<br>→ Unless amniocentesis indicates lung maturity. |
| **Neonatal hypocalcemia & hypoglycemia** | → Maintain maternal euglycemia especially intrapartum. |
| **Congenital Defects**<br>*More related to pregestational DM* | |
| **Cardiovascular anomalies** | → Preconception counseling and glucose control. |
| **Neural tube defects** | → Maternal serum α-fetoprotein screening.<br>→ Fetal ultrasonography and echocardiogram. |
| **Caudal regression syndrome** | |
| **Other defects** | → **Example:** renal. |
| **Fetal Compromise** | |
| **Intrauterine growth restriction** | → Serial ultrasonography for fetal growth and estimated fetal weight.<br>→ Serial fetal antepartum surveillance.<br>→ Avoid postterm pregnancy. |
| **Intrauterine fetal death** | → Doppler |
| **Abnormal FHR patterns** | → NST |

# Effect of Diabetes on Pregnancy

## Effect of Diabetes on Pregnancy:

→ **Diabetes complicates pregnancy either:**
  → Preexisting diabetes which is controlled on diet, oral hypoglycemic agents or insulin.
  → Developing diabetes during pregnancy course → gestational diabetes (GDM).

# Maternal Effects of Diabetes on Pregnancy

## Maternal Effects of Diabetes on Pregnancy:

→ **Maternal morbidity:** generally related to severity of diabetic related disease preceding the pregnancy.
→ **Maternal mortality:** rare, those at most risk are women with coronary heart disease.

| | |
|---|---|
| **Obstetric complications** | → **Preeclampsia/eclampsia:** ↑ 4x even in absence of vascular disease.<br>→ **Polyhydramnios** → cardio respiratory symptoms.<br>→ **Infections:** UTI - fungal (candidiasis) - chorioamnionitis.<br>→ **Injury to birth canal & genital trauma** → due to macrosomia.<br>→ ↑ **operative delivery** rate (cesarean delivery).<br>→ **Miscarriage** in early pregnancy. |
| **Spontaneous abortion** | → Loss of pregnancy before 20 weeks, higher in poorly controlled. |
| **Preterm labor** | → Twice as common.<br>→ 20% risk.<br>→ Polyhydramnios → distension of the uterus → early rupture of the membrane → leakage of fluid. |
| **Diabetic emergencies** | → Severe hypo and hyperglycemia.<br>→ Diabetic coma.<br>→ Ketoacidosis. |
| **Vascular and end-organ involvement or deterioration** | → **In patients with pregestational DM:**<br>  → Cardiac.<br>  → Peripheral vascular.<br>  → Renal nephropathy & particular risk to develop pre-eclampsia.<br>  → Diabetic retinopathy.<br>  → Thromboembolic disease. |
| **Neurologic** | → Peripheral neuropathy.<br>→ Gastrointestinal disturbance. |
| **Long-term outcome** | → Type 2 diabetes.<br>→ Metabolic syndrome.<br>→ Obesity.<br>→ Cardiovascular disease. |

# Fetal Effects of Diabetes on Pregnancy

## Fetal Effects of Diabetes on Pregnancy:

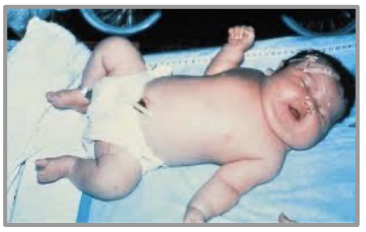
→ Babies of diabetic mothers should be cared on special care baby unit for the first 24 - 48 hours of their life.
→ Morbidity is less with good glycemic control.
→ ↑ risk of abortion, perinatal death, and preterm labor.

| | |
|---|---|
| **Delayed organ maturity** | → **Delayed lung maturity:** hyperglycemia + hyperinsulinemia → ⃠surfactant synthesis → delayed pulmonary surfactant production → delayed pulmonary maturation → RDS.<br>→ **Neonatal Hypocalcemia:**<br>→ Failure to ↑ normal parathyroid hormone synthesis after birth.<br>→ Occurs at ↑ rate in infants of diabetic mother. |
| **↑ Stillbirth** | → Sudden unexplained late stillbirth in poorly controlled diabetes especially with vascular disease (possibly due to chronic hypoxia).<br>→ **Causes of IUFD in GDM patient:**<br>→ **Pre-eclampsia (8% of cases):** diabetes → narrowing & vasospasm of spiral arterioles→ ↓ flow through intervillous space → intrauterine hypoxia→ ↑ IUGR & IUFD.<br>→ **Diabetic Ketoacidosis:** diabetes → dehydration → hypovolemia → hypotension → intrauterine hypoxia → ↑ IUGR & IUFD.<br>→ **Derangement in maternal metabolism:** diabetes → abnormal embryogenesis → congenital malformation (*3x expected rate*) → 30 - 50% of perinatal mortality NND exceeds SB → ↑ IUGR & IUFD.<br>→ **Fetal Hyperinsulinemia:**<br>→ Glucose crosses placenta → fetal hyperglycemia → stimulates β-cells in pancreas → fetal hyperinsulinism.<br>→ Diabetes → ↑ fetal metabolic rate → ↑ $O_2$ consumption → ↓ arterial $O_2$ content → intrauterine hypoxia → ↑ IUGR & IUFD.<br>→ **Alterations in red blood cell oxygen release & placental blood flow:** diabetes → diabetic vasculopathy → ↓ uterine blood flow→ intrauterine hypoxia → ↑ IUGR & IUFD. |
| **Fetal malformation** | → HbA1C < 8.5% → **malformation rate:** 3.4%.<br>→ HbA1C > 9.5% → **malformation rate:** ≈ 22%.<br>→ That's why we care about HbA1C In preconception care. |
| **Macrosomia** | → Maternal hyperglycemia → placenta (facilitated diffusion) → fetal hyperinsulinemia → fat cell hypertrophy → ↑ total body & muscle fat & organomegaly (brain growth is not ↑).<br>→ **Predispose to:** shoulder dystocia - traumatic birth injury - asphyxia - brachial nerve injury (Erb's' palsy). |
| **Hyperbilirubinemia** | → **Predisposing factors:** bruising - polycythemia - RDS - prematurity.<br>→ **Reducing Incidence:** early feeding - vitamin K - phenobarbitone - exchange transfusion. |
| **Neonatal Hypoglycemia (< 2.2 mmol/L)** | → **Influenced by:**<br>→ Maternal glycemic control during the latter half of pregnancy.<br>→ Maternal glycemic control during the labour & delivery (< 5 mmol/L).<br>→ Fetal hyperinsulinemia → ↓ free fatty acids levels → ↑ glycogenolysis → neonatal hypoglycemia.<br>→ Clamping umbilical cord → rapid ↓ plasma glucose → neonatal hypoglycemia<br>→ **Infant feeding:** begin by 2 hours of age & continue at 3 - 4 hours interval. |

# Neonatal Effects of Diabetes on Pregnancy

## Neonatal Effects of Diabetes on Pregnancy:

- → **Neonatal morbidity:** birth injury - shoulder dystocia.
- → **Macrosomic with birth asphyxia and traumatic birth injuries:** brachial nerve injury.
- → Respiratory distress syndrome.
- → Hypoglycaemia.
- → Hypocalcaemia and hypomagnesaemia.
- → Polycythaemia.
- → Hyperbilirubinemia.
- → Inheritance of diabetes or its predisposition.



# Congenital Malformations in IDM

## Congenital Malformations in IDM:

- → **Congenital abnormality:** most important cause of mortality & morbidity in diabetic pregnancy.
  - → Seen 2 - 4x more often than in normal pregnancy.
- → Mechanism of the congenital anomalies is not fully understood but hypoglycemia at the time of organogenesis may be the underlying cause (pre pregnancy diabetes).
- → Accelerated fetal growth occurs in late 2$^{nd}$ and 3$^{rd}$ trimester due to poorly controlled diabetes.
- → Congenital anomalies and abortion are not a risk with gestational DM.

| | |
|---|---|
| **Cardiovascular** | → Congenital heart disease.<br>→ Transposition of the great vessels.<br>→ Ventricular septal defect (VSD).<br>→ Atrial septal defect (ASD).<br>→ Hypoplastic left ventricle (poor prognosis).<br>→ Situs inversus.<br>→ Anomalies of the aorta. |
| **Central nervous** | → Anencephaly.<br>→ Encephalocele.<br>→ Meningomyelocele.<br>→ Holoprosencephaly.<br>→ Microcephaly. |
| **Skeletal** | → Caudal regression syndrome.<br>→ Neural tubal defect like Spina Bifida. |
| **Genitourinary** | → Absent kidney (Potter syndrome).<br>→ Polycystic kidneys.<br>→ Double ureter. |
| **Gastrointestinal** | → Tracheoesophageal fistula.<br>→ Bowel atresia.<br>→ Imperforate anus. |

## Doctor's Notes:

→ Based on her history, age , family history, BMI, and HbA1c → we assess the risk of the mother before getting pregnant.

**Before Getting Pregnant:**

→ If there is high risk the mother need to modify her lifestyle: diet, exercise, stop smoking.
→ Diabetic mother need to maintain HbA1c < 6, screen for retinopathy, neuropathy, and nephropathy.

→ Screen for patient with previous macrosomia, previous gestational DM, or family history.
→ Gestational diabetes need to be > 24 weeks, because placenta has its own hormones cortisol and human placental lactogen and these get accelerated after advance GA (second trimester), at that time disbalance between metabolizing the glucose and the releasing of the insulin will occur.
→ Then patient will be categorized as gestational DM based on blood glucose test: glucose challenge test or glucose tolerance test. (one abnormal reeding is enough to diagnose).

**Complications:**

→ **Maternal:**
→ High risk for infection (UTI and vaginl) → screen for any kind of infection in each trimester).
→ Make sure pt get hydrated well because she is at high risk for ketoacidosis.
→ Preeclampsia: monitor BP.
→ Fetal: macrosomia,
→ In gestational diabetes no fetal abnormality only increase in size
→ In established diabetes the may be fetal abnormality: CVS, CNS, spina bifida, fetal demise.

**Management:**

→ **Diet:** increase protein , reduce glucose and carbohydrates intake.
→ Pt should control diet,Diabetic mother need to maintain HbA1c < 6, screen for retinopathy, neuropathy, and nephropathy, exercise, and do blood sugar testing at home.
→ Pt who need insulin or oral hypoglycemic as management in gestational diabetes are more toward developing diabetes after.
→ Monitoring the weight of the patient is important, to decrease the complications.
→ After delivery monitor blood glucose for 6-12 weeks to make sure it is well controlled.

**Diabetic pregnant complication:**

→ Third trimester → congenital abnormalities and miscarage.
→ Second trimester → IUGR, polyhydramnios, PROM,
→ Metabolic syndrome.

→ We start a serial growth assessment from the beginning, because of the serious complication.
→ We try not to proceed 38 weeks, and deliver the fetus before (between 37-38 week).
→ If pt on oral hypoglycemic, glucose is controlled and fetus is stable we could wait up to 40 week.
→ But if she is on insulin we could not.
→ Check the placenta for placentomegaly, polyhydramnios, any resistance.
→ Check on the fetal well being as well.
→ C-section indication: macrosomia, malpresentation, or prev history of c-section.
→ The laboring fetus is prone more into acidosis → NICU.

## Doctor's Notes:

- Gestational diabetes is diagnosed after 24 weeks,if the mother is diagnosed with diabetes or glucose intolerance before 24 weeks it means she has underlying diabetes before pregnancy.
- Pregnancy is a potentially diabetogenic, diabetes may be aggravated by pregnancy.
- The mild hypoglycemia is considered normal physiology during pregnancy due to increased levels of insulin.
- Before the diagnosis of gestational diabetes Make sure that the patient never had diagnosis of DM in her life.
- Usually patients come with a presentation of hyperglycemia (she feels not well, sweating, etc..) Glucosuria, Ketoacidosis.
  - Glucosuria: is normal during pregnancy but if it is in excess amount then it might raise concerns.
  - Ketoacidosis due to hyperinsulinemia.
- We do not need to wait till we diagnose it by laboratory. It is very important in the antenatal visit to take patient history, age, family history, BMI.
- If she has a high risk of diabetes we don't need to wait till 24 week to screen her because that may affect her or her baby especially in the 1 trimester.

**Risk Factors of Gestational Diabetes:**

- Family history.
- **Obesity:** we have to screen her earlier if she's obese.
- History of previous GDM.
- History of previous abortion or IUFD.
- **Age:** advanced maternal age >35.
- In these cases we have to screen them early before 24 weeks.

- It is important to tell the patients that the gestational diabetes will go away after delivery but they have a high risk of getting DM later in life, the risk increased 50% Compared to women who did not get gestational diabetes.

**Screening of Gestational Diabetes:**

- **50 gm one-hour oral glucose challenge test (GCT):** screening test, in the past we used to do this then we confirm by (oGTT) , but Nowadays we only use oGTT.
- **100 gm 3-hours oral glucose tolerance test (oGTT):** diagnostic or confirmatory test. We ask patients to fast for 8 hours, then we take 4 readings.
  - If 2 values are abnormal we labeled the patient as diabetic.
- **75 gm 2-hours oral glucose:** recommended internationally and nationally, many studies found this is the best, easiest and the most sensitive one, we ask patients to fast for 8 hours, then we take one reading.

- In exam or when someone ask you about the screening test, the ideal is to do 75 gm 2-hours oral glucose.
  - A pregnant lady diagnosed with gestational diabetes she's on insulin, delivered a healthy baby weighted 4500 grams. What is your best plan for her after delivery? Stop insulin, do Serial sugar testing, followed by GTT.
  - A 26-year-old woman Gravida 3 P2+0 comes to the antenatal clinic at 26 weeks of gestation. She had gestational diabetes mellitus in her previous pregnancies. Which one of the following tests is the gold standard for the diagnosis of gestational diabetes? Glucose tolerance test.

## Doctor's Notes:

**Maternal Effects of Gestational Diabetes:**

- → **Preeclampsia:** the risk increases 4 folds compared to non diabetic patients.
- → **Infections:** due to immunity suppression and delayed wound healing.
- → **Injury to birth canal:** due to macrosomia.
- → **Increase Incidence of cesarean sections**: due to macrosomia.
- → **Polyhydramnios:** if there is increase of fluid that means there is over distinction in uterine cavity so the patient is at risk of developing preterm labour.
- → **Maternal Mortality:** if the patient is not treated well she might develop ketoacidosis and she might die.

**Fetal Effects:**

- → Increase risk of congenital anomalies especially CNS and cardiac, in type I and II diabetes.
  - → Which type of diabetes is associated with congenital anomalies? Type I and II DM, NOT gestational diabetes (gestational diabetes diagnosed after 24 weeks after the organogenesis happening).
  - → Most first trimester complications are associated with type 1 and 2.
  - → Gestational diabetes affects the growth of the fetus rather than development in early pregnancy.
- → Increase risk of abortion.
- → Macrosomia
- → Risk of preterm birth: could be idiopathic or iatrogenic, Sometimes we need to deliver patients early if she is uncontrolled or she has high risk.
- → Neonatal morbidity: when the baby is big this will increase the risk of birth injury (fracture of clavicle, brachial plexus injury, ets..).
- → Respiratory distress syndrome, due to delayed development of the lung.
- → **Hypoglycemia**, all through the pregnancy the baby is under the effect of insulin of the mother, the minute he is out he is now depending on himself so the baby usually develops hypoglycemia.
- → Inheritance of diabetes: if the mother is diabetic there is a high chance that her baby will develop diabetes.

**Management:**

- → Before Conception: If the woman has a high risk (obesity, ets..) it is better to control her HbA1c and modify her lifestyle before getting pregnant.
- → First step is Change her lifestyle by strict carbohydrates, increase protein intake.
- → Follow her in 1 or 2 weeks, if it is controlled that's good , if it is not controlled we have to start her on hypoglycemic medication or insulin.
- → Oral hypoglycemic medication: you might read in the books that we don't give oral hypoglycemic medication yes that was in the past, now we give hypoglycemic agents for pregnant women, it is relatively safe.

**Mode of Delivery:**

- → Usually in diabetic patients we induce the labour in 37 weeks, Especially if the patient is using insulin.
- → If she is on diet it is better to wait 40 weeks for spontaneous labour.
- → Gestational diabetes alone is not an indication for C-section.

- → **Standard management:** start with diet > not controlled > oral hypoglycemic medication > not controlled > give insulin.

# 439 Summary

## Gestational Diabetes Mellitus

**Definition:**

- **Gestational DM:** glucose intolerance with onset or first recognition during pregnancy. Usually diagnosed at 24-28 weeks.
  - **Pregestational DM:** diabetes present before pregnancy and may be either type 1 or type 2 DM
- Rising levels of human placental lactogen, progesterone, prolactin, and cortisol **(insulin antagonists)** in pregnancy are some of the primary factors associated with progressive insulin resistance during pregnancy. **These changes are most marked during the 3rd trimester.**

**Risk factors:**

- **Obesity (BMI >30)**
- **Extreme maternal age**
- **Family hx of DM**
- **Obstetric:**
  - Hx of previous GDM
  - Previous delivery of macrosomia
  - **Unexplained IUFD**, Recurrent pregnancy loss
  - Polycystic ovarian syndrome

**Screening & Diagnosis:**

- Screening is performed in all pregnancies between 24 and 28 weeks of gestation
- Screening of patients with risk factors → first prenatal visit ***and*** **repeat** at 24 and 28 weeks.
- Unreliable diagnostic methods of GDM but used in nonpregnancy:
  - **HbA1C**: used as **preconceptional investigation of DM** (not to diagnose GDM).
    - Increased HbA1c in diabetic pregnancy → congenital anomaly in 1st trimester. Figure shows fetal malformation rate.

| Hemoglobin A1c | Fetal Malformation Rate |
|---|---|
| <7 | baseline |
| 7.2-9.1 | 14% |
| 9.2-11.1 | 23% |
| > 11.2 | 25% |

    - **Miscarriage rate:**
      - HbA1C>8: miscarriage rate is 14%
      - **HbA1C>11: miscarriage rate is 44%**

- Confirmatory method to diagnose GDM: Oral glucose tolerance test
  - Normal values:

| 3-hour Oral Glucose Tolerance Test | | |
|---|---|---|
| **State** | **Maximal Normal Blood Glucose** | |
| Fasting plasma glucose | <5.3 mmol/l | 95 mg/dl |
| Glucose level after 1 hour | <10.6 mmol/l | 180 mg/dl |
| Glucose level after 2 hours | <8.9 mmol/l | 155 mg/dl |
| Glucose level after 3 hours | <6.8 mmol/l | 140 mg/dl |

| | |
|---|---|
| **Old guidelines** | **1. Initial screening: 50 gm, 1-hour oral glucose challenge test (GCT):**<br>a. Fasting state is not required<br>b. 50g glucose load is given→ serum glucose is measured after 1 hr<br>c. Normal value: <140 mg/dL. (cutoff ranges from 130-140; on the test it won't be close to this range)<br>i. Positive **(>140)**: go to 3-oGTT test as confirmation<br>ii. Negative (< 140): stop screen |
| | **2. Conformation test: 100gm, 3-hours oral glucose tolerance test (3GTT):**<br>a. Fasting state is required, after an overnight fast:<br>b. Blood glucose is drawn→ FBG >125 mg/dL indicates overt diabetes mellitus and no further testing is performed.<br>c. If <126 mg/dL→ administer a 100g glucose load, followed by glucose level at 1, 2 and 3 hrs, a total of 4 glucose values are obtained<br>d. GDM is diagnosed if ≥2 values are abnormal and impared glucose tolerance is diagnosed if only 1 value is abnormal |
| **NEW guidelines** | • **75gm, 2-hours oral glucose tolerance test (2GTT): diagnostic/gold standard test for gestational DM**<br>○ Fasting state is required, after an overnight fast:<br>○ Blood glucose is drawn→ FBG >125 mg/dL indicates overt diabetes mellitus and no further testing is performed<br>○ If <126 mg/dL→ administer a 75g glucose load, followed by glucose level at 1, 2 hrs, a total of 3 glucose values are obtained (normal values above)<br>○ **GDM is diagnosed if ≥1 values are abnormal** |

**Management:**

| | |
|---|---|
| **Glycemic control** | • **1st step: Dietary** modifications and regular exercise (walking) with strict blood **glucose monitoring** (4x daily)<br>• Insulin therapy if glycemic control is **insufficient** with dietary modifications<br>• Oral hypoglycemic agents are not used in pregnancy, may cause fetal anomalies (**Amboss AND Hacker & Moore**): Metformin and glyburide in patients who are unwilling or unable to use insulin)<br>• Intrapartum management of a patient with diabetes requires the establishment of maternal euglycemia during labor |
| **Obstetric management** | • Detailed ultrasound anomaly scan and fetal echocardiography<br>• Doppler ultrasound<br>• Serial growth scan for macrosomia and polyhydramnios.<br>• Fetal surveillance with biophysical profile BPP<br>(Management would attempt to achieve vaginal delivery between 38-40 weeks) |
| **Labor** | • Diabetes alone is not an indication for cesarean section<br>• **Well-controlled without complications:** spontaneous onset of labor at term<br>• **Poor glycemic control or occurrence of complications: consider inducing delivery** at week 39–40 |
| **Postpartum** | • Insulin requirements stop sharply because the source of insulin antagonists (placenta) has been removed<br>• **Women with GDM treated with insulin or oral hypoglycemic agents during pregnancy frequently DO NOT need treatment postpartum**<br>• **Plasma glucose should be monitored** and insulin is given when plasma glucose levels are elevated<br>• **Women with GDM should undergo a 75-g OGTT at 6-12 weeks postpartum** |

**Prognosis:**

- In most cases, gestational diabetes resolves after pregnancy.
- Increased risk of gestational diabetes recurring in subsequent pregnancies
- Increased risk of developing T2DM

**Complications of DM on pregnancy:**

| | |
|---|---|
| **Maternal complications** | • Obstetric:<br>○ Gestational hypertension<br>○ Preeclampsia, eclampsia, and HELLP syndrome<br>○ Infections (e.g. UTI, candidiasis)<br>○ C-Section<br>○ Polyhydramnios<br>○ Preterm labor & spontaneous abortion<br>• Diabetic emergencies: hypoglycemia, diabetic coma & ketoacidosis<br>• Neurological: peripheral neuropathy<br>• After pregnancy: type 2 DM, metabolic syndrome, obesity, cardiovascular disease |
| **Fetal compromise** | • IUGR (From long-standing pregestational DM)(GDM is more associated with macromia than IUGR)<br>• Fetal demise/**IUFD**: due to acidosis, hypoxia or hypotension from osmotic diuresis<br>• Abnormal FHR patterns |
| **Fetal & Neonatal complications** | • Glucose crosses the placenta easily by facilitated diffusion, causing fetal hyperglycemia that results in fetal hyperinsulinism.<br>• Fetal hyperglycemia during period of **embryogenesis** (1st trimester) is **teratogenic**.<br>• First trimester:<br>○ Increased HbA1c → congenital anomaly<br>• Third trimester<br>○ Fetal hyperglycemia and hyperinsulinemia → fetal overgrowth and macrosomia |
| | **Macrosomia** +/- traumatic delivery: • Predisposes to shoulder dystocia, erb palsy, traumatic birth injury and asphyxia<br>• It is most likely to occur in advanced/severe GDM<br>• Pt. starting insulin, fetus is at inc. risk of? macrosomia |
| | Delayed organ maturity *(pulmonary, hepatic, neurologic)*: • Pulmonary: hypoglycemia & hyperinsulinemia → inhibition of surfactant synthesis & delayed pulmonary maturation → **respiratory distress syndrome** |
| | **Diabetic fetopathy**: • A constellation of features that can develop in the fetus of a pregnant woman with diabetes. Features include **macrosomia, postnatal hypoglycemia, and polycythemia** (High Hb) due to fetal hyperinsulinemia during gestation |
| | Neonatal hypocalcemia, neonatal hypoglycemia, neonatal hypomagnesemia, neonatal hyperbilirubinemia |
| **Congenital defects**<br>**Pre-gestational DM** is more associated with congenital anomalies than GDM (GDM develops ***after*** the critical period of organogenesis (in T1)) | Cardiovascular anomalies: •Congenital heart disease •Ventricular septal defect •Atrial septal defect<br>Skeletal anomalies: •Caudal regression syndrome •Neural tube defects - spina bifida<br>CNS anomalies: •Anencephaly •Meningiomyelocele •Microcephaly<br>Genitourinary: •Potter's syndrome (renal agenesis) |

# Quiz

## Question 1:

→ **Gestational diabetes usually gets back to normal after delivery?**

A. True
B. False

## Question 2:

→ **Screening of gestational diabetes for low risk patients is usually done during:**

A. 12 to 14 weeks of pregnancy
B. 32 to 36 weeks of pregnancy
C. 24 to 28 weeks of pregnancy
D. 16 to 18 weeks of pregnancy

## Question 3:

→ **If gestational diabetes is left untreated in the mother, how does it affect the baby?**

A. Macrosomia
B. Hypoglycemia
C. Respiratory distress syndrome
D. All of the above

## Question 4:

→ **Which one of the following is NOT considered a risk factors of gestational diabetes?**

A. Advanced maternal age
B. History of previous abortion
C. History of previous GD
D. History of previous placenta previa

| 1 | 2 | 3 | 4 |
|---|---|---|---|
| A | C | D | D |

# Quiz

## Question 1:

→ **A 35-year-old lady G4 P2 +1, presented at 30 weeks' gestation to the clinic with abnormal OGTT result that ultimately required insulin therapy. Which one of the following places her fetus at an increased risk?**

A. Congenital heart disease
B. Intrauterine growth restriction
C. Down syndrome
D. Macrosomia

## Question 2:

→ **A lady with diabetes on insulin. What fetal anomalies that she might have when she get pregnant?**

A. Renal agenesis
B. Cataract
C. Caudal regression
D. Pyloric stenosis

## Question 3:

→ **A 27-year-old Pregnant lady, she is diabetic on insulin, which one of the following complication might she has?**

A. Intrauterine growth restriction (IUGR)
B. Polycystic ovarian disease (PCO)
C. Respiratory distress syndrome

## Question 4:

→ **A known diabetic is G3 P2 + 0 , both were normal deliveries. She has been in insulin throughout this pregnancy, which has been otherwise uneventful. She is now 40 weeks of gestation. Which one of the following is the best management?**

A. Cesarean section
B. Blood sugar series
C. Induction of labor
D. Wait for spontaneous labor

| | | | |
|---|---|---|---|
| C | A | C | D |
| 4 | 3 | 2 | 1 |

# Reference

CHAPTER 16

# Common Medical and Surgical Conditions Complicating Pregnancy

LONY C. CASTRO • JOSEPH C. GAMBONE

**CLINICAL KEYS FOR THIS CHAPTER**

- Diabetes and thyroid disorders are among the most common and consequential medical conditions that occur during pregnancy, labor, and the postpartum period. Diabetes may precede pregnancy or may occur because of pregnancy, with a return to the prepregnancy state after delivery. *Gestational diabetes mellitus* (GDM) is defined as glucose intolerance with onset or first recognition during pregnancy. Pregestational diabetes mellitus may be type 1 (insulin-dependent) or type 2. Thyroid abnormalities occur in about 2% of pregnancies, and the presentation and course of the disease may be affected by the pregnancy.
- Other important medical conditions include heart, autoimmune, renal, gastrointestinal (GI), lung, and thromboembolic disorders. Preexisting cardiovascular disease and conditions such as asthma and cystic fibrosis are encountered more commonly because of modern medical management that has allowed more women than in the past to consider pregnancy. As a general rule, most pregnancies complicated by these medical conditions are considered "high risk" for maternal and fetal morbidity and mortality. Good outcomes often require frequent maternal and fetal assessment and the ability to respond in a timely fashion to changes in the clinical status of either the mother or her fetus.
- Elective delivery for medical and surgical conditions is indicated when deteriorating maternal or fetal status occurs in the presence of a term fetus or when there is evidence of fetal lung maturity. When a preterm delivery before 34 weeks' gestation is necessary, steroids (betamethasone) should be given to enhance fetal lung maturity and improve fetal outcomes. In some cases, cesarean delivery is indicated.
- Obstetricians and other providers should focus on the mitigation of the effects and prevention of medical conditions that may complicate pregnancy. The increased prevalence of obesity in pregnant women in the United States and elsewhere has resulted in metabolic dysregulation (metabolic syndrome) that increases inflammation and insulin resistance. The risk of some medical disorders, such as diabetes, hypertension, and heart disease, is increased due to excessive body weight during pregnancy. Women should be encouraged to lose weight before pregnancy and to limit weight gain during pregnancy. Physical activity and a healthy diet are very important before, during, and after pregnancy.
- Surgical conditions that may complicate pregnancy include appendicitis, cholecystitis and cholelithiasis, acute pancreatitis, bowel obstruction, abdominal trauma, or torsion of an adnexal structure such as an ovarian tumor. When trauma is evaluated during pregnancy, the possibility of intimate partner abuse must be ruled out, as in women who are not pregnant. Strongly indicated but nonemergent surgery is most safely performed in the second trimester. Laparoscopy is becoming more common during pregnancy, and guidelines have been published that should increase the safety for both the pregnant woman and her fetus.

Most of the conditions discussed in this chapter are not unique to pregnancy and understanding the causes, diagnosis, and management of them is based on the same principles that would apply in the nonpregnant woman. **Important issues** for the management of medical and surgical problems during pregnancy include **how the physiologic changes of pregnancy may affect the diagnosis and clinical course** of the disease, as well as **how the disease may affect the pregnancy,** with particular attention to the fetus.

The most common medical and surgical disorders that may complicate pregnancy are covered in this chapter. Common and important infectious diseases of both nonpregnant and pregnant women are covered in Chapter 22, including perinatal infections (toxoplasmosis, others [syphilis, varicella zoster, parvovirus B19], rubella, cytomegalovirus [CMV], and herpes, referred to together as *TORCH infections*), human immunodeficiency virus (HIV) infection, and acquired immunodeficiency syndrome (AIDS).

## Endocrine Disorders

Diabetes mellitus and thyroid disease are the two most common endocrine disorders complicating pregnancy.

### DIABETES MELLITUS

#### Incidence and Classification

**The prevalence of diabetes mellitus has greatly increased in the last 20 years.** In the United States, rates appear to range from 6-12%, depending on the population studied and the diagnostic criteria used. **Overall, 80-90% of diabetes in pregnant women is gestational, and about 10% is pregestational.**

***Gestational diabetes mellitus* (GDM) is defined as glucose intolerance with onset or first recognition during pregnancy.** Rising levels of **human placental lactogen, progesterone, prolactin, and cortisol in pregnancy are some of the primary factors associated with progressive insulin resistance during pregnancy.** Studies suggest that women who develop GDM have chronic insulin resistance and that GDM is a "stress test" for the development of diabetes later in life.

*Pregestational diabetes mellitus* refers to diabetes present before pregnancy and may be either type 1 or type 2 diabetes. Most obstetricians use the **White classification of diabetes during pregnancy to further refine the categories for GDM and pregestational diabetes.** This classification is helpful for assessing disease severity and the likelihood of complications (Table 16-1).

TABLE 16-1

**WHITE CLASSIFICATION OF DIABETES IN PREGNANCY**

| Class | Description |
|---|---|
| $A_1$ | Gestational diabetes; diagnosed in pregnancy and controlled with diet alone |
| $A_2$ | Gestational diabetes; diagnosed in pregnancy and controlled with diet and glyburide or insulin |
| B | Pregestational diabetes developing after age 20 yr and duration <10 yr; controlled with diet and insulin |
| C | Pregestational diabetes developing between ages 10 and 19 yr or duration 10-19 yr and controlled with diet and insulin |
| D | Pregestational diabetes developing before age 10 yr or duration 20 yr or more or background retinopathy; controlled with diet and insulin |
| F | Pregestational diabetes at any age or duration with nephropathy; controlled with diet and insulin |
| R | Pregestational diabetes at any age or duration with proliferative retinopathy; controlled with diet and insulin |
| H | Pregestational diabetes at any age or duration with arteriosclerotic heart disease; controlled with diet and insulin |

#### Complications

Maternal and fetal complications of diabetes are listed in Table 16-2. **Diabetes often coexists with the metabolic syndrome.** This syndrome consists of a group of risk factors for diabetes, coronary heart disease, and stroke that occur together (central obesity, insulin resistance, and hyperlipidemia). Most fetal and neonatal effects are attributed to the consequences of maternal hyperglycemia or, in the more advanced classes, to maternal vascular disease. **Glucose crosses the placenta easily by facilitated diffusion, causing fetal hyperglycemia that stimulates pancreatic β-cells, and results in fetal hyperinsulinism. Fetal hyperglycemia during the period of embryogenesis is teratogenic.** There is a direct correlation between birth defects in diabetic pregnancies and increasing glycosylated hemoglobin A1C (HbA1C) levels in the first trimester. **Fetal hyperglycemia and hyperinsulinemia later in pregnancy, especially in the third trimester, cause fetal overgrowth and macrosomia that predispose to birth trauma, including shoulder dystocia and Erb palsy. Fetal demise is most likely due to acidosis, hypotension from osmotic diuresis, or hypoxia from increased metabolism, coupled with inadequate placental oxygen transfer.**

Pregestational diabetes is generally associated with a higher rate of maternal and fetal complications due to the greater difficulty in achieving glycemic control, the higher rate of congenital malformations, and the higher likelihood of vascular disease. Maternal complications include worsening nephropathy and retinopathy, a greater incidence of preterm preeclampsia, and a higher likelihood of diabetic ketoacidosis. **Hypoglycemia is also much more common** because of the need for insulin therapy and stricter glycemic control attempted during pregnancy. **Fetal complications include an increased rate of abortions, anatomic birth defects, fetal growth restriction, and prematurity.**

#### Diagnosis of Gestational Diabetes Mellitus

**The American College of Obstetricians and Gynecologists (ACOG) recommends a two-step method to test for GDM. The first step involves universal screening for gestational diabetes between 24 and 28 weeks' gestation with a 50-g, 1-hour oral glucose challenge test (OGCT), given without regard to most recent oral intake.** This timing recognizes the progressive nature of insulin resistance in pregnancy due to rising levels of hormones such as human placental lactogen, and the test will identify most women with gestational diabetes while allowing for several weeks of therapy to reduce potentially adverse consequences. **Screening is advised at the first prenatal visit in women with risk factors** such as a previous pregnancy with GDM, a history of polycystic ovarian disease, or obesity. If overt signs and symptoms of diabetes are present, the patient's fasting blood sugar should be checked first. **If a first-trimester screen is done and is found to be negative, it should be repeated at 24 to 28 weeks. Glucose values above 130 to 140 mg/dL on an OGCT are considered abnormal** and have an 80-90% sensitivity in detecting GDM.

**The second step involves performing a diagnostic 3-hour, 100-g oral glucose tolerance test (OGTT) if the screening test is abnormal.** This involves checking the patient's fasting blood glucose after an overnight fast, having the patient consume a 100-g glucose drink, and checking her glucose levels hourly for 3 hours. **If there are two or more abnormal values on the 3-hour OGTT, the patient is diagnosed with GDM (Table 16-3). If the 1-hour screening (50 g of oral glucose) plasma glucose exceeds 200 mg/dL, an OGTT is not required and may dangerously elevate blood glucose values.**

TABLE 16-2

**MATERNAL AND FETAL COMPLICATIONS OF DIABETES MELLITUS**

| Entity | Monitoring |
|---|---|
| **Maternal Complications** | |
| *Obstetric Complications* | |
| Polyhydramnios | Close prenatal surveillance: blood glucose monitoring, ultrasonography |
| Preeclampsia | Evaluation for signs and symptoms |
| Infections (e.g., UTI and candidiasis) | Urine culture, wet mount, and appropriate therapy |
| Cesarean delivery | Blood glucose monitoring, insulin and dietary adjustment to prevent fetal overgrowth |
| Genital trauma | Ultrasonography to detect macrosomia, cesarean delivery for macrosomia |
| *Diabetic Emergencies* | |
| Hypoglycemia | Teach signs and symptoms; blood glucose monitoring; insulin and dietary adjustment |
| Diabetic coma | Urgent medical management required |
| Ketoacidosis | Check for ketones if glucose >200 mg/dL |
| *Vascular and End-Organ Involvement or Deterioration (in patients with pregestational diabetes mellitus)* | |
| Cardiac | Electrocardiogram, first visit and as needed |
| Renal | Renal function studies, first visit and as needed |
| Ophthalmic | Funduscopic evaluation, first visit and as needed |
| Peripheral vascular | Check for ulcers, foot sores; noninvasive Doppler studies as needed |
| Gastrointestinal disturbance | Symptomatic treatment as needed |
| *Neurologic* | |
| Peripheral neuropathy | Neurologic and gastrointestinal consultations as needed |
| *After Pregnancy* | |
| Type 2 diabetes | Postpartum glucose testing of GDM, lifestyle changes (diet and exercise) |
| Metabolic syndrome | Lifestyle changes (diet and exercise) |
| Obesity | Lifestyle changes (diet and exercise) |
| Cardiovascular disease | Annual check-up by physician, lifestyle changes (diet and exercise) |
| **Fetal and Neonatal Complications*** | |
| Macrosomia with traumatic delivery | Ultrasonography for estimated fetal weight before delivery (shoulder dystocia, Erb palsy), offer cesarean delivery if EFW >4500 g |
| Delayed organ maturity (pulmonary, hepatic, neurologic) | Avoid delivery before 39 weeks in GDM in the absence of maternal-fetal respiratory distress syndrome indications, unless amniocentesis indicates lung maturity |
| Neonatal hypocalcemia, neonatal hypoglycemia | Maintain maternal euglycemia especially intrapartum |
| *Congenital Defects* | |
| Cardiovascular anomalies | Preconception counseling and glucose control |
| Neural tube defects | Maternal serum α-fetoprotein screening; fetal ultrasonography and fetal echocardiogram |
| Caudal regression syndrome | |
| Other defects (e.g., renal) | |
| *Fetal Compromise* | |
| Intrauterine growth restriction | Serial ultrasonography for fetal growth and estimated fetal weight, serial fetal antepartum surveillance; avoid postterm pregnancy |
| Intrauterine fetal death | Doppler |
| Abnormal FHR patterns | NST |

*EFW,* Estimated fetal weight; *FHR,* fetal heart rate; *GDM,* gestational diabetes mellitus; *NST,* nonstress test; *UTI,* urinary tract infection.
*Maintenance of maternal euglycemia (normal glucose levels) will decrease most of these complications.

TABLE 16-3

**THREE-HOUR ORAL GLUCOSE TOLERANCE TEST**

| Test | Maximal Normal Blood Glucose (mg/dL) |
|---|---|
| Fasting | 95 |
| 1 hr | 180 |
| 2 hr | 155 |
| 3 hr | 140 |

From Berggren EK, Boggess KA, Stuebe AM, et al: National Diabetes Data Group vs Carpenter-Coustan criteria to diagnose gestational diabetes. *Am J Obstet Gynecol* 205:253.e1-e7, 2011.

BOX 16-1

**METHOD FOR CALCULATING THE STARTING DOSE OF INSULIN**

**Insulin Units = Body Weight (kg)**
×0.6 (first trimester)
×0.7 (second trimester)
×0.8 (third trimester)

**Dosage Schedule: Give Two-Thirds in AM and One-Third in PM**
Before breakfast: two-thirds NPH, one-third regular or lispro
Before dinner: one-half NPH, one-half regular or lispro (if on lispro, administer additional dose before bedtime snack)

*NPH,* Neutral protamine Hagedorn.

### Management

**TEAM APPROACH.** Management of gestational and pregestational diabetes requires a team approach involving patient education and counseling, medical-nursing assessments and interventions, strategies to achieve maternal euglycemia, and avoidance of fetal-neonatal compromise. Ideally, this team should include the patient, obstetrician, maternal-fetal medicine specialist, clinical nurse specialist, nutritionist, social worker, and neonatologist. The patient is included as an active participant in formulating management strategies.

**ACHIEVING EUGLYCEMIA.** The importance of strict metabolic control before and during pregnancy to decrease the incidence of congenital anomalies, perinatal morbidity, and perinatal mortality has been established. To achieve an optimal outcome, the patient's fasting blood glucose level should be less than 95 mg/dL, with the 1-hour postprandial glucose level less than 140 mg/dL and the 2-hour postprandial glucose level less than 120 mg/dL.

**DIET.** Caloric requirements are calculated on the basis of ideal body weight: 30 kcal/kg for those patients 80-120% of ideal body weight, 35 to 40 kcal/kg for those patients less than 80% of ideal body weight, and 24 kcal/kg for gravidas who are 120-150% of ideal body weight. The diet is composed of about 45-50% carbohydrate, 20-25% protein, and 20-25% fat. The diet should also contain a generous amount of fiber. Caloric intake is divided into 20% at breakfast, 30% at lunch, 30% at dinner, and 20% at a bedtime snack.

**EXERCISE.** Patients with diabetes should be encouraged to engage in mild to moderate aerobic exercise (e.g., brisk walking) for about half an hour after meals.

**PHARMACOLOGIC THERAPY.** Patients with GDM are usually managed with diet and exercise alone, but if euglycemia cannot be achieved, an oral hypoglycemic agent (glyburide) or insulin should be added. Glyburide does not appear to enter the fetal circulation in appreciable quantities, and it has been used successfully to treat gestational diabetes after the first trimester.

Insulin is the medication of choice to maintain euglycemia in pregnancy and is the recommended therapy in women with pregestational diabetes. The peak action of insulin lispro occurs between 30 and 90 minutes after injection, that of regular insulin occurs between 2 and 3 hours after injection, and that of neutral protamine Hagedorn (NPH) insulin occurs between 6 and 10 hours after injection. A combination of rapid- or short-acting (lispro or regular) and intermediate-acting (NPH) insulin is usually given in split morning and evening doses or more frequently to achieve euglycemia. A method for calculating insulin dosage is shown in Box 16-1.

#### Antepartum Obstetric Management

Aside from achieving euglycemia, adequate surveillance should be maintained during pregnancy to detect and possibly mitigate maternal and fetal complications. In addition to routine prenatal screening tests for

# Reference

women with pregestational diabetes, **a detailed obstetric ultrasonic study, fetal echocardiogram, and maternal serum α-fetoprotein should be obtained in the second trimester to check for congenital malformations.** This is **especially important if the first trimester HbA1C is significantly elevated (>8.5%).** Maternal renal, cardiac, and ocular function must be closely monitored. **In women with GDM as well as those with class B or C pregestational diabetes, fetal macrosomia is common and should be investigated,** whereas for women with classes D, F, or R pregestational diabetes, fetal growth restriction occurs more commonly. Abnormalities of fetal growth are most likely to be present in the third trimester and can be confirmed by ultrasound.

**Serial antepartum testing should be performed in the third trimester.** This testing can usually be delayed until at or after 36 weeks, or later in women with well-controlled GDM. In patients with pregestational diabetes, fetal testing should be initiated between 32 and 34 weeks, or sooner if complications develop.

**The timing of delivery depends on fetal and maternal status and the degree of glucose control. In general, in the setting of well-controlled GDM without other complications, spontaneous onset of labor at term may be awaited.** Earlier intervention is indicated if these conditions are not met. For macrosomic babies, increased birth trauma to both mother and fetus should be avoided. **Cesarean delivery may be elected for large fetuses (>4500 g).**

### Intrapartum Management

**Intrapartum management of a patient with diabetes requires the establishment of maternal euglycemia during labor.** Plasma glucose levels are measured frequently, and, if elevated, a continuous infusion of regular insulin is given. **Insulin dosage is adjusted as needed to maintain a plasma glucose level between 80 and 120 mg/dL.** Many insulin-dependent patients will not require exogenous insulin during labor. Continuous electronic **fetal heart rate monitoring is recommended for all patients with diabetes.**

### Postpartum Period

**After delivery of the fetus and placenta, insulin requirements drop sharply because the placenta, which is the source of many insulin antagonists, has been removed.** Many patients with insulin-dependent diabetes may not require exogenous insulin for the first 48 to 72 hours after delivery. **Plasma glucose levels should be monitored and lispro or regular insulin given when plasma glucose levels are elevated.** Women with pregestational diabetes can be restarted on two-thirds of the prepregnancy insulin dosage, with adjustments made as necessary. Women with GDM treated with insulin or oral hypoglycemic agents during pregnancy frequently do not need treatment postpartum. **Women with GDM should undergo a 75-g OGTT at 6 to 12 weeks postpartum.**

Patients should be counseled about changes in diet. The American Diabetes Association diet with the same distribution of carbohydrates, proteins, and fat should be maintained. If the mother is breastfeeding, 500 calories/day should be added to the prepregnancy diet.

Contraception counseling should involve advising the patient that estrogen-containing oral contraceptives are not recommended for women with advanced-stage diabetes with vascular disease.

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# Good Luck!

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