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The purpose of this column is to review the types of maternal diabetes, the complications that can occur in the infant of a diabetic mother (IDM), the keys to prevention of complications, and the major outcomes of IDMs.

BACK TO BASICS

INFANTS OF DIABETIC MOTHERS (IDMs) can vary in presentation, symptomatology, and outcome. Maternal diabetes increases the risk of various complications; therefore, these infants must be evaluated carefully.

There are three main types of diabetes mellitus. Type 1 diabetes develops when the pancreatic β cells do not produce enough insulin, causing high blood glucose levels. Type 1 diabetes used to be called insulin-dependent diabetes mellitus or juvenile diabetes. Type 1 diabetes can be caused by genetic or environmental influences or an autoimmune response that destroys the β cells. Type 2 diabetes is the non-insulin-dependent or adult-onset type of diabetes. Type 2 diabetes usually involves insulin resistance or reduction in insulin sensitivity so the body does not respond well to high glucose levels. This type of diabetes mellitus can occur with advancing age, obesity, or previous history of gestational diabetes. The third type of diabetes is gestational diabetes mellitus (GDM). With this disorder, there is an increase in blood glucose levels or glucose intolerance during pregnancy. Usually, GDM disappears after pregnancy; however, 35–60 percent of these women will develop diabetes, usually type 2, in the years following the pregnancy.¹

In the past, most diabetes during pregnancy has been either gestational or type 1 (requiring insulin), with about 80 percent being gestational diabetes and 20 percent being type 1 diabetes.² Recently, there has been an increase in type 2 diabetes in young women because of increasing obesity and an increase of diabetes within certain populations, such as American Indian, Asian/Pacific American, African American, Hispanic, and Latino populations.^{1,2} The increase in pregnant women with diabetes will require careful perinatal assessment and management of the infants.

MORBIDITY AND MORTALITY

Perinatal mortality related to diabetes has decreased over the past 30–40 years because of improvements in the care

Infants of Diabetic Mothers

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ABSTRACT

Infants of diabetic mothers (IDMs) can present with various symptoms and disorders. The neonatal nurse must be able to assess the infant for glucose control and other anomalies.

Keywords: maternal diabetes; IDM

given to diabetic mothers. In the early 1900s, many women with type 1 diabetes mellitus did not survive past childhood or adolescence without insulin. The discovery of insulin in 1921 led to an improvement in care and a rapid decrease in the mortality rates of these women. But pregnancy occurring in a woman with diabetes still resulted in a high number of stillbirths and complications for the mother and infant. A further drop in mortality and morbidity occurred with improved specialized pregnancy care (perinatology).

Fetal monitoring, improved perinatal care, and high-level neonatal care have resulted in an improvement in fetal and infant mortality and morbidity rates among the IDMs. Women with poorly controlled type 1 diabetes prior to or during early pregnancy have a 4–10 percent incidence of a major birth defect and a 15–20 percent incidence of spontaneous abortion.^{1,2} Women with type 2 diabetes have a 4.3 percent incidence of a major birth defect.² Women with well-controlled diabetes have a much lower incidence of birth defects and other complications.^{1,2} The incidence of birth defects appears to be related to the level of glycemic control during embryogenesis (first 4–6 weeks of gestation).^{2,3} Poor glycemic control in the second or third trimesters, which occurs with gestational diabetes, usually results in a large-for-gestational-age (LGA) infant. See Table 1 for comparison of morbidity and mortality rates of various abnormalities in pregnant women with type 1 and gestational diabetes.³

NEONATAL COMPLICATIONS OF THE IDM

Most of the problems that occur in the infant of the diabetic mother are the result of fetal hyperglycemia and hyperinsulinism. Infants born to diabetic mothers who have good control of their glucose during pregnancy will have fewer complications. The main problems that can occur in infants of diabetic mothers are outlined in Table 2.

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TABLE 1 ■ Maternal and Neonatal Morbidity/Mortality Rates in Women with and without Diabetes³

	Type 1 Diabetes	Gestational Diabetes	No Glucose Issues
Delivery <37 weeks	21.0%	8.6%	5.1%
Stillbirth	1.5%	0.4%	0.3%
RDS	1.0%	0.3%	0.2%
LGA	31.0%	15.1%	3.6%
Erb's palsy	2.1%	0.7%	0.2%

Abbreviations: LGA = large for gestational age; RDS = respiratory distress syndrome.

Macrosomia versus Small for Gestational Age

Infants born to mothers with poorly controlled insulin-dependent diabetes usually have a fairly consistent presentation. Most of these infants are macrosomic or LGA, measuring more than the 90th percentile for age. They can be plethoric, appear chubby, and may be tremulous shortly after birth. As the severity of the disease worsens in the mother, the infant's presentation also changes. Infants could be of normal weight if mother's diabetes is well-controlled, or if significant vascular disease is present the infants can be growth restricted and small for gestational age.

The infant's large size is a result of fetal hyperglycemia. Glucose from the mother crosses the placenta, but the insulin does not cross the placenta. Therefore, the fetus produces increased amounts of insulin, resulting in pancreatic islet cell (β cell) hyperplasia and fetal hyperinsulinism. Insulin is a growth hormone, and the hyperinsulinemia of the fetus

TABLE 2 ■ Complications in IDMs

Main Problem	Associated Problems
Macrosomia	Septal hypertrophy of the heart Cardiomegaly LGA Birth trauma (fractures, palsy) C-section delivery (failure to descend)
Metabolic abnormalities	Hypoglycemia Hypocalcemia Hypomagnesemia
Relative hypoxemia	Polycythemia/hyperviscosity Renal vein thrombosis Hyperbilirubinemia
Respiratory distress syndrome	Respiratory distress (grunting, flaring, and retractions)
Congenital anomalies	Caudal or sacral agenesis Neural tube defects Small left colon syndrome VSD (or other cardiac defects)

Abbreviations: LGA = large for gestational age; VSD = ventricular septal defect.

causes accelerated fetal growth and macrosomia. The insulin causes an enlarged liver, spleen, and heart; however, the brain is not affected by the hyperinsulinemia.⁴ There is a resultant increase in the fat and glycogen stores in the liver.

Macrosomia occurs because of the increased insulin production and its effects on the growth of the infant in utero. Infants are born with increased adipose tissue or fat, increased liver glycogen, and increased size of other organs (e.g., the heart).⁴ With many of these infants being LGA, the delivery process becomes more complicated. Birth trauma can occur because of the infant's large size. Fractures of the clavicles and humerus can occur as the physicians struggle to deliver these large infants. Brachial plexus palsy and other birth injuries can occur during a difficult vaginal birth. Many LGA infants will be delivered by cesarean surgery to prevent birth trauma.

Septal Hypertrophy

One fairly common occurrence (30 percent) in IDMs is thickened myocardium and septal hypertrophy within the heart.² Cardiomegaly is seen on x-ray of the chest, often with resultant respiratory distress and/or tachycardia. The respiratory distress symptoms can cause the provider to initially mistake this symptom for surfactant deficiency. Septal hypertrophy occurs because of the higher levels of insulin in utero, making the septum larger than normal, increasing the risk of heart failure after birth. Blood pressures and perfusion need to be watched closely in IDMs with septal hypertrophy, and inotropes may be required to prevent neonatal death.

Hypoglycemia

Hypoglycemia in an IDM results from the sudden interruption of the glucose supply from the mother at birth. The high insulin production of the fetus continues, and the infant's glucose level can drop to a dangerous level. The signs of hypoglycemia are irritability, jitteriness, tremors, hypotonia, poor feeding, sweating, hypothermia, and seizures. As with hypoglycemia in term or preterm newborns, some IDMs could remain asymptomatic even with low glucose levels. If hypoglycemia goes unrecognized, the seizures can result in brain damage. Therefore, monitoring glucose levels is imperative in all IDMs. Infants of poorly controlled insulin-dependent diabetic mothers are more likely to have significant hypoglycemia and prolonged need for therapy.

Electrolyte Disturbances

Hypocalcemia and hypomagnesemia are believed to occur in IDMs as a result of a poor response by the infant's parathyroid gland because the maternal parathyroid hormone and vitamin D do not cross the placenta.⁴ This transient lack of response usually resolves within 72 hours after birth. Signs of hypocalcemia and hypomagnesemia are similar to the signs of hypoglycemia but present later than the hypoglycemia symptoms.⁴ Monitoring for electrolyte abnormalities needs to be included in the care of these infants during the first 72 hours.

Polycythemia, Hyperbilirubinemia, and Thrombosis

A relative hypoxemia can occur in utero as a result of maternal and fetal hyperglycemia and, subsequently, hyperinsulinism in the fetus. There is an increase in the metabolic rate and oxygen consumption because of these two factors as the body attempts to metabolize the excess sugar substrate.⁴ With this relative hypoxemia in utero, the fetus produces more erythropoietin, resulting in more red blood cells to transport oxygen. Therefore, the red blood cell number increases (polycythemia) and may result in sluggish blood flow (hyperviscosity) and higher levels of jaundice following breakdown of the red blood cells after birth (hyperbilirubinemia). Renal vein thrombosis can occur as a result of the sluggish blood flow, causing clots to form in the renal vein as well as other areas.

Respiratory Distress Syndrome

Respiratory distress is another common occurrence in IDMs. The hyperinsulinemia occurring in utero results in a suppression of surfactant production and immature lungs. Even with term infants, respiratory distress syndrome (RDS) can occur, resulting in a large baby with grunting, flaring, and retractions and a chest x-ray consistent with RDS.

Congenital Anomalies

Congenital anomalies are another problem seen in approximately 4–12 percent of infants born from type 1 diabetic mothers (there is no increased incidence among gestational diabetic mothers).⁵ The high glucose levels early in pregnancy can cause abnormalities in the developmental processes. Caudal agenesis is one of the more common anomalies associated with insulin-dependent diabetes during pregnancy. Other abnormalities that have occurred are ventricular septal defect and other cardiac abnormalities, neural tube defects, small left colon syndrome, and genitourinary abnormalities.⁶

MATERNAL MANAGEMENT

It is important for the mother to maintain meticulous management of her diabetes during pregnancy, watching for hypoglycemia during the evening and night hours, and also to prevent ketoacidosis. Maintaining normal blood glucose levels is key to the prevention of many infant problems. It is important to recognize and treat other disorders that can occur, such as preeclampsia and urinary tract infections that can interfere with normal glucose metabolism and use. Many infants are delivered early because of the increasing size and fear of stillbirth if the infant remains in utero. Fetal nonstress testing is often instituted to assure fetal well-being during this time. An amniocentesis can be performed to determine lung maturity as one attempts to determine the best time for delivery of the infant. An individualized plan for the mother and delivery of the infant is necessary.⁷ At delivery, these infants should also have their umbilical cord clamped early to prevent excessive blood transfusion from the placenta.

OUTCOMES

The infant outcomes are related to the type and extent of complications that occur. Major congenital anomalies can result in death or severe disability. Severe and persistent hypoglycemia can result in neurodevelopmental difficulties later in life as well as other types of brain damage (intelligence).⁵ But these results may be confounded by the increased asphyxia, hyperviscosity, hypoxemia, and metabolic acidosis that can occur in these infants during the birth process, making the prognosis difficult for them. A thorough examination is a priority in each infant of a diabetic mother after birth. Nursing observations and quick responses can prevent further damage or disability.

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