Newborn infants: The bigger the better?

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Definitions

- **Body Mass Index (BMI)**
  - measurement of body fat

- **Macrosomia**
  - greater than 4 kg at any gestation

- **Large for gestational age**
  - greater than 90% for weight adjusted for gestational age
Statistics

- US infant mortality rate is 6.8/1000 live births
- Ranked 25th in the world
- Lowest risk for infant death is for birth weight between 3-4 kg
The bigger the better?

World wide increase in obesity

Obesity is on the rise among pregnant women for most developed countries

The mean birth weight is also on the rise
Maternal weight gain

- Gestational weight gain is associated with fetal weight
- Increasing BMI has been associated with macrosomia, fetal hyperinsulinism and fetal adiposity
Maternal and other factors associated with the diagnosis of LGA

- BMI
- Age
- Parity
- Completed weeks at delivery
- Gestational weight gain
- Pregravid weight
- Maternal and paternal height
- Ethnicity
The obesity epidemic and its impact on reproductive age women means that an ever increasing number of fetuses will experience this abnormal milieu.
Currently 17 million people in the US have some form of diagnosed diabetes

New cases of Type 2 diabetes are occurring at an increased rate among some populations

Prevalence of gestational diabetes has increased by 35%
Definitions

- Type I diabetes: chronic condition where the pancreas produces little or no insulin
- Type II diabetes: involves insulin resistance or decreased insulin sensitivity
- Gestational diabetes: glucose intolerance arising during pregnancy and is almost always due to insulin resistance
Women with poorly controlled pregestational diabetes

- Increased perinatal mortality
- 15-20% incidence of spontaneous abortion
- 4-10% incidence of major birth defects
- 2-3x risk of developing pre-eclampsia

- 28-45% rate of LGA birth
- Increased risk of birth injury.
- Increased likelihood of C-section
- Increased rate of NICU admission
Women with gestational diabetes

〜4% incidence of major birth defects
〜LGA rate 〜15%
Diabetes in pregnancy

Perinatal mortality and morbidity in diabetic pregnancies have decreased 30 fold since the discovery of Insulin in 1922 and the advent of intensive obstetrics and neonatal care in the 1970s.
Improvements in maternal care

- Perinatology
  - Rigorous control of maternal metabolism
  - Improved fetal surveillance
- Neonatal intensive care
Maternal metabolic control

- Decreases the overall risk to women and infants
- Normal glucose is the key to prevention
- Fasting glucose <80 mg/dl
- 2 hour postprandial glucose <120 mg/dl
Fetal surveillance

- Level II US at 18-20 weeks gestation
- Quad screen
- Tests for fetal well being beginning in the 2nd trimester at 28-32 weeks
  - Daily fetal movement counts
  - Bi-weekly biophysical testing or non-stress testing with an AFI
Delivery complications

- Are proportional to the level of maternal hyperglycemia
- Fetal size is the biggest contributing factor
- C-section rates of 30-50%
- Severe lacerations
- Postpartum hemorrhage
- Increased length of hospitalization
Infants of diabetic mothers
IDM
The critical period of teratogenesis is in the first 3-6 weeks after conception. One study found that the frequency of congenital anomalies was proportional to the maternal HbA1C:
- 3.4% if <8.5 and 22.4% if >8.5

Hyperinsulinism
Congenital malformations associated with IDM

- Sacral agenesis/
  Caudal regression
- Neural tube defects
- Transposition of the great vessels
- ASD/VSD
- Hydronephrosis
- Renal agenesis
- Cystic kidneys
- Extra ribs
Caudal agenesis/ caudal regression syndrome
Neural tube defects
Transposition of the great vessels
Transposition of the great vessels
ASD/ VSD

- Atrial septal defect
- Ventricular septal defect
Normal chest x-ray
Hydronephrosis
Renal agenesis

Figure 56.2. The facies in Potter syndrome.
Cystic kidneys

Normal Kidney  Polycystic Kidney
Fetal physiologic response to hyperglycemia

- Glucose but not insulin crosses the placenta
- Maternal hyperglycemia stimulates the fetal pancreas to increased levels of fetal insulin resulting in fetal hyperinsulinism and excess fetal growth
Physiologic results of hyperinsulinism

- Promotes storage of excessive nutrients resulting in fetal macrosomia
- Catabolism of the excess fuel uses energy which can deplete oxygen stores and lead to fetal hypoxia
Physiologic results: Hypoxia

- Increases catecholamines, resulting in hypertension and cardiac remodeling
- Stimulates erythropoiesis, resulting in polycythemia
- Decreases GI motility, resulting in GI abnormalities and/or polyhydramnios
- May cause sudden intrauterine fetal demise
Physiologic results: Macrosomia

- Major problem in diabetic pregnancies
- Follow a unique pattern of in utero growth
- Growth velocity of the abdominal circumference begins to rise after 24 weeks
- Excessive adipose deposition, visceral organ hypertrophy and acceleration of body mass accretion
Complications during delivery are directly related to macrosomia

- Shoulder dystocia

- Birth trauma including fractures of the clavicle and humerus and brachial plexus injury
Shoulder dystocia

- Defined as difficulty delivering the fetal body after expulsion of the head
- Obstetric emergency
- Occurs in 0.3-0.5% of normal vaginal deliveries
- Occurrence increases by 10 fold for infants with weight of > 4 kg
Fracture of the clavicle
Fracture of the humerus
Brachial plexus injury

- Provide movement and feeling to the arm and the hand
- Injury can occur with a shoulder dystocia
- May be associated with a fracture of the clavicle or humerus
Brachial plexus injury
Brachial plexus injury
IDM: Neonatal complications

- LGA
- Hypoglycemia
- Respiratory distress syndrome
- Cardiac hypertrophy
- Hypocalcemia and Hypomagnesemia
- Polycythemia
- Hyperbilirubinemia
- Renal vein thrombosis
- Small left colon
- Poor feeding
- Asphyxia
LGA

- Weight >90% for gestational age
- Obese
- Plethoric
- Large abdominal circumference
Hypoglycemia

- Related to maternal glycemic control over the last 6-12 weeks prior to delivery
- Sudden interruption of glucose supply at birth
- Can occur whether or not the infant is LGA
- Nadir is reached at 30-90 minutes after birth
Hypoglycemia

- Serum glucose < 40 mg/dl
- Usually resolves spontaneously
- May require IV fluids
- Medications
- Surgery
Signs/ Symptoms of hypoglycemia

- Jitteriness
- Tachypnea
- Apnea
- Cyanosis
- Tremulousness
- Irritability
- Lethargy
- Poor feeding
- Sweating
- Hypothermia
- Seizures
Respiratory distress syndrome

- Insulin antagonizes the maturing affect of cortisol
- 99% of infants born to non-diabetic mothers reach full lung maturation by 37 weeks gestation
- Infants born to diabetic mothers reach full lung maturation at 38.5 weeks gestation
Cardiac hypertrophy

- Develops after 34 weeks
- May be asymptomatic or have heart failure
- Thickened myocardium
- Septal hypertrophy
- Decreased LV size
- Left outflow tract obstruction
Hypocalcemia/Hypomagnesemia

- Usually transient
- May require treatment in an infant with heart failure or severe respiratory distress
- Jitteriness is the most common symptom
Polycythemia

Erythropoietin mechanism for regulating the rate of erythropoiesis (Figure 18.6)

Stimulus: Hypoxia due to decreased RBC count, decreased availability of $O_2$ to blood, or increased tissue demands for $O_2$

Reduced $O_2$ levels in blood

Kidney releases erythropoietin

Erythropoietin stimulates

Enhanced erythropoiesis

Red bone marrow

More RBCs

Increased $O_2$-carrying ability of blood

Normal blood oxygen levels
Polycythemia

- Diagnosed as a central Hct > 65
- Promotes vascular sludging
- May cause ischemia and infarction
- Hyperbilirubinemia
- Renal Vein thrombosis
Hyperbilirubinemia
Hyperbilirubinemia

- Risk for kernicterus
- Treatment is phototherapy
Renal vein thrombosis
Renal vein thrombosis

- Results in decreased drainage of blood from the kidney
- Can lead to hypertension and renal failure
- Often treated with anticoagulants
Small left colon

- Etiology is unknown
- Functional disease
- Presents at 24-48 hours of age with symptoms of obstruction
- Treated with radiographic enemas
Small left colon
Poor feeding

- Feeding is the most complex task of infancy
- May reflect immature brain development
- May require NG feedings and in rare instances placement of a G-tube
Asphyxia

- Difficult birth
- Decreased biophysical profile (BPP)
- Respiratory distress
- Pulmonary hypertension
IDM: long term complications

- There is significant evidence over recent decades linking aberrant fetal growth with long term metabolic derangements including obesity, type II diabetes, cardiovascular disease and metabolic syndrome
IDM: long term complications

- Decrease ability of infants to recognize their own mother’s voice
- Some studies have shown a decrease in fine and gross motor coordination into school age
- Some studies have shown long term motor delays
- Most studies have not shown cognitive impairment
Conclusion

- We are seeing more LGA infants
- Likely to be related to the obesity epidemic not improved nutrition
- Diabetes is on the rise in women of child-bearing age
- The risks associated with being LGA and/or IDM are significant
Bigger is not better!