PedsCases: IUGR/SGA

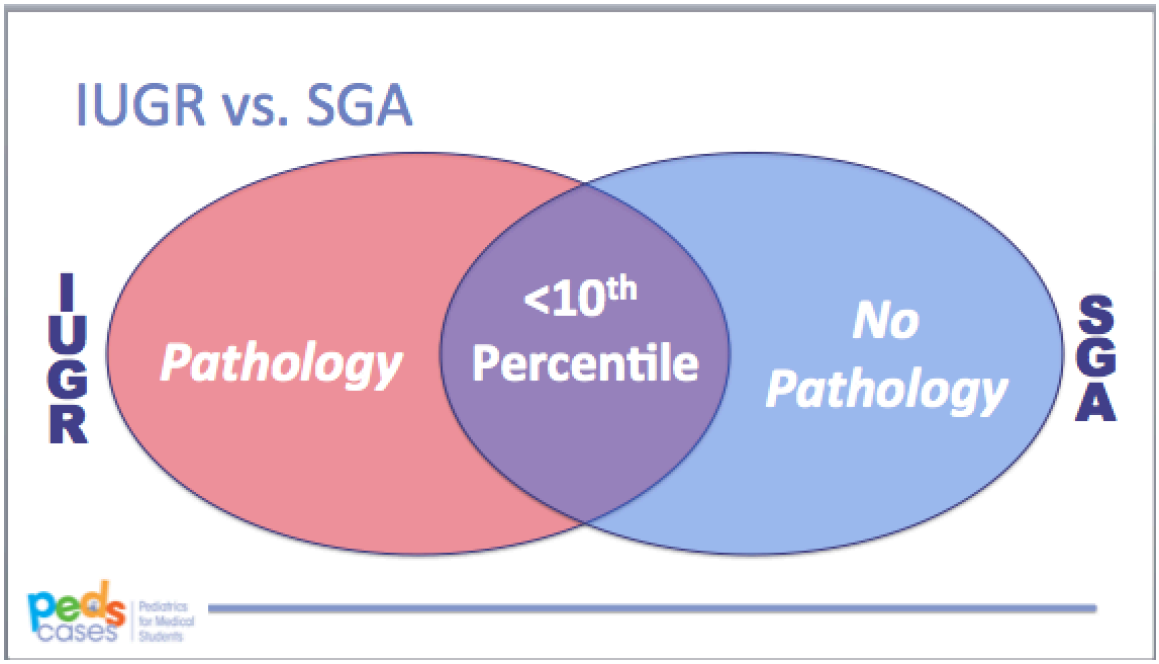
Written by Manisha Tilak, Queen's University
Reviewed by Dr. Robert Connelly, Neonatologist, Queen's University

Hi everyone, my name is Manisha Tilak, and I am a medical student at Queen's University. This podcast was developed with Dr. Robert Connelly, a neonatologist and Head of the Department of Pediatrics at Queen's University. Today's PedsCases podcast focuses on the diagnosis and management of newborns with intrauterine growth restriction, abbreviated "IUGR". Let's start by defining our learning objectives.

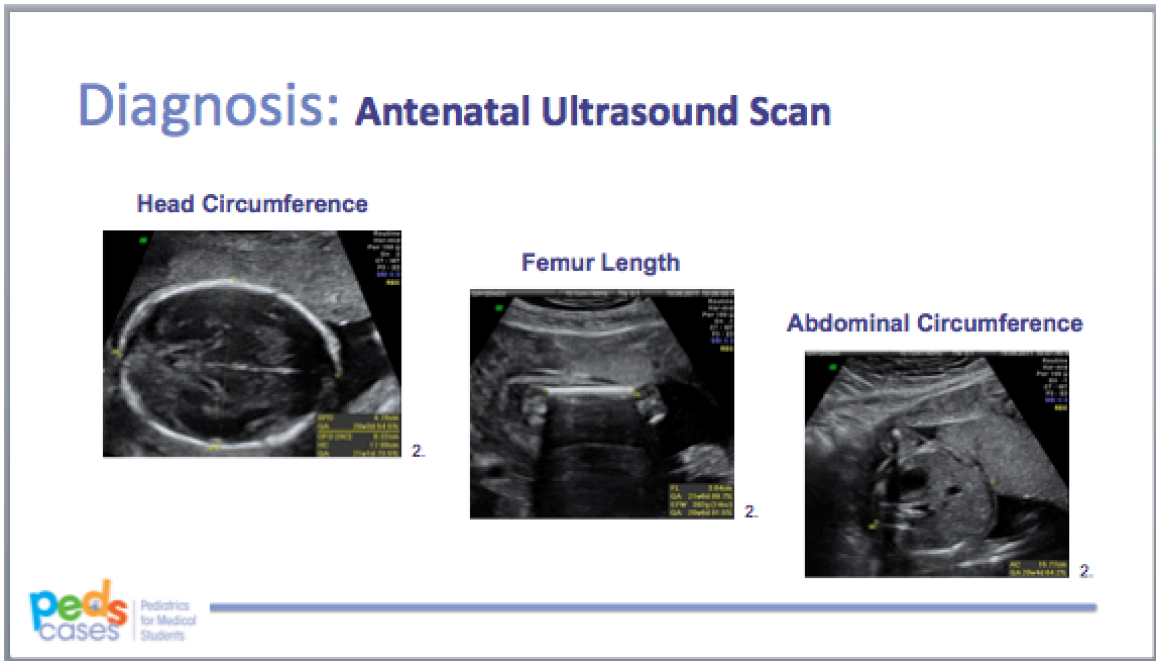
After this PedsCases podcast, the learner should be able to:

1. Define intrauterine growth restriction, and differentiate between this condition and babies who are small for gestational age
2. List maternal, fetal, and placental risk factors for IUGR
3. Describe the appropriate screening and workup of expectant mothers for IUGR
4. Describe the appropriate post-natal assessment and care of a fetus with IUGR
5. List the short-term and long-term complications of IUGR

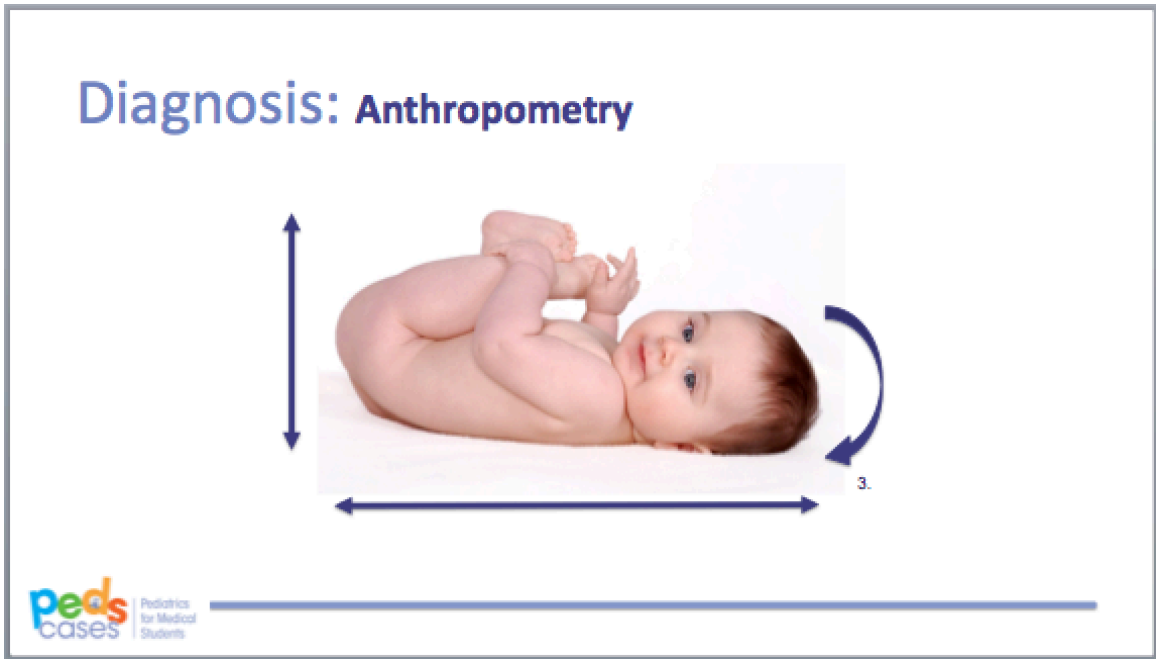
Let's start with a clinical case. You are a medical student working with the neonatal intensive care, or NICU team when you are called to attend a delivery. The mother is a 32 year old gravida 3 para 2 with two previous babies who had birth weights under the 10th percentile. This baby is at 34 weeks gestation and has an estimated fetal weight at the 5th percentile on the most recent antenatal ultrasound. Once the baby is born the nurse rapidly hands him off to you to bring to the neonatal resuscitation bed. What are your immediate and long-term management plans for this newborn? What do you expect to find on physical exam? We'll come back to this case and answer these questions as we go through the podcast.



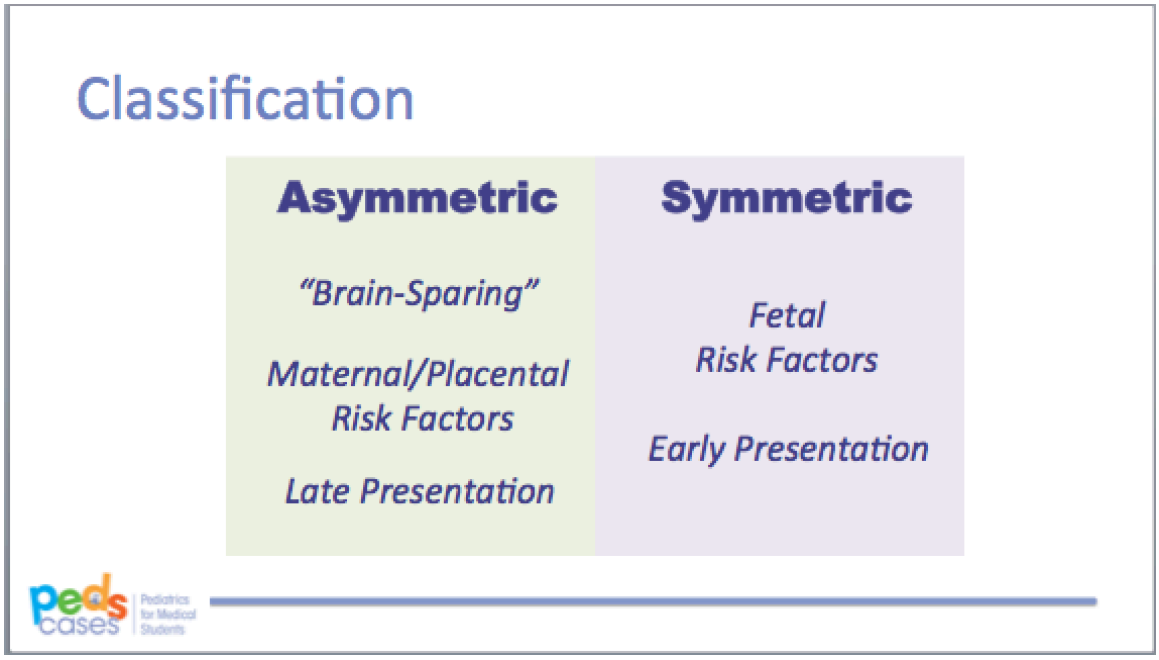
So, what is intrauterine growth restriction, and how does it differ from babies who are small for gestational age? Both IUGR and SGA babies are small, with weights that fall below the 10th percentile for all babies of the same gestational age. The difference is that IUGR babies have had their growth restricted in utero due to maternal, fetal or placental pathology. SGA babies on the other hand are just born small, without any underlying known pathological maternal, fetal or placental cause. Physicians distinguish between the two by using a variety of investigations to rule out causes of IUGR, which we'll discuss a little later in this podcast. If the baby's small size can be attributed to a pathological cause found on investigation, IUGR can be diagnosed. If no pathological cause can be found on investigation, the baby is classified as SGA. For the remainder of this podcast, we're going to focus on babies who have been diagnosed with IUGR.



IUGR is usually diagnosed during pregnancy, but can be diagnosed after birth as well. During pregnancy, antenatal ultrasound scans are performed in order to determine how well a fetus is growing. This is done by measuring head circumference, biparietal diameter, femur length, and abdominal circumference. These parameters are then used to calculate an estimated fetal weight (EFW).



Similarly, after birth a baby's head circumference, length, and weight are measured. If the EFW on ultrasound scan or true weight at birth is less than the 10th percentile, and an underlying cause can be found, the baby is diagnosed as having IUGR.

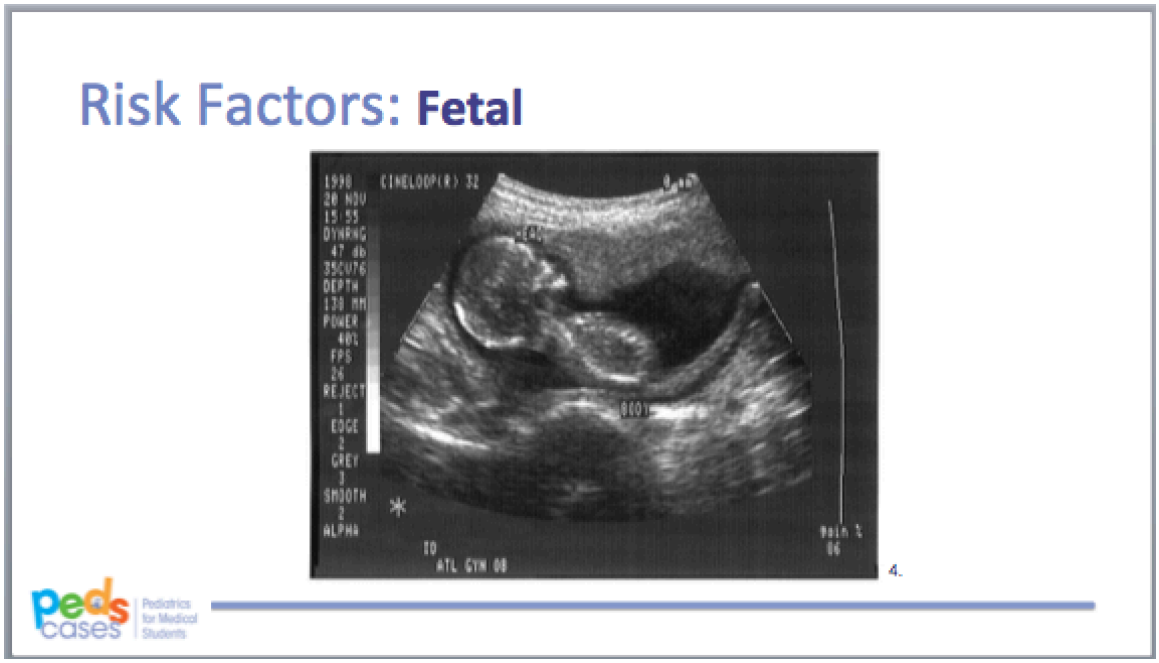


IUGR babies can be classified into two categories: those with symmetric IUGR, and those with asymmetric IUGR[2]. The main difference between these two categories is the congruence between the baby's head size and body size. We'll talk about both types of IUGR in detail, let's start with asymmetric IUGR.

Asymmetric IUGR is also sometimes called "head or brain sparing" IUGR, because these babies tend to have normal sized heads and comparatively small bodies. It is caused by maternal or placental factors, and tends to present later during the mother's pregnancy, often in the second or third trimester[2]. Antenatal ultrasound scans of these fetuses show a reduction in abdominal circumference only, with normal head circumference, biparietal diameter, and femur length[2]. After birth, the baby's weight is reduced in relation to the head circumference and length[2].

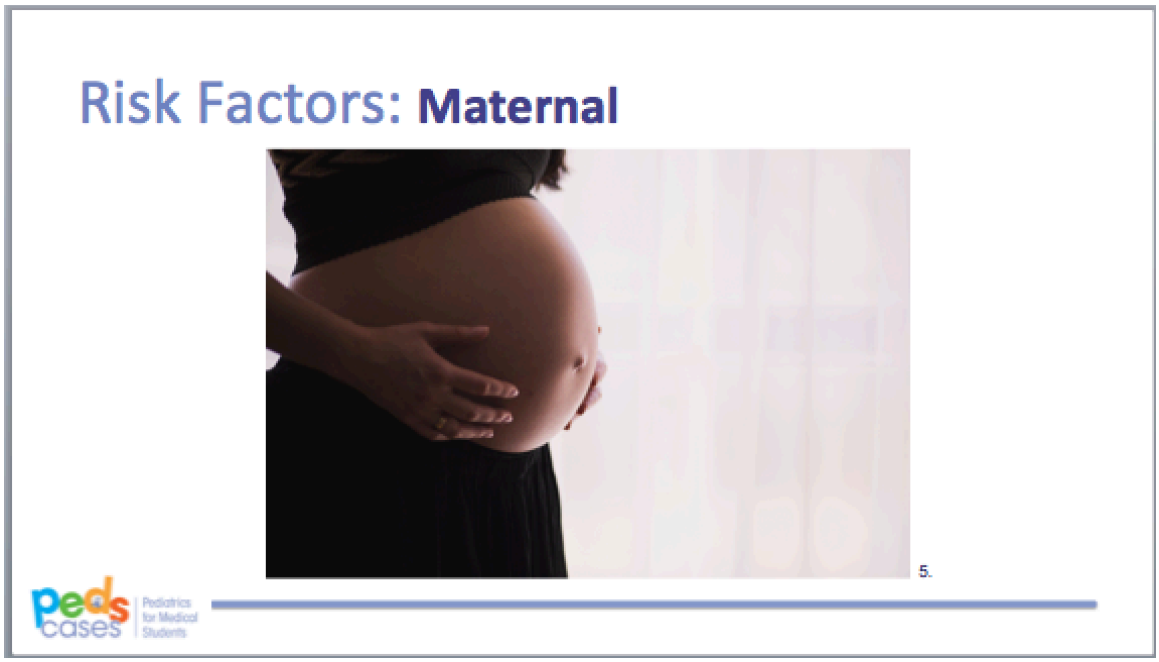
In symmetrical IUGR the whole baby is small, including the head. It is usually caused by fetal factors, and tends to present earlier in the pregnancy[2]. Antenatal ultrasound scans of these fetuses show a reduction in abdominal circumference as well as head circumference, biparietal diameter, and femur length[2]. After birth, the baby's head circumference, length, and weight are all reduced[2].

You review the mother's chart to learn more about the pregnancy and the fetus's course in utero. You review the antenatal ultrasound reports and find the fetus's head circumference, biparietal diameter, and femur length all tracked along the 50th percentile, however the abdominal circumference was consistently reduced. Being an astute medical student, you realize this baby had asymmetrical IUGR and was delivered prematurely. You then start to wonder, what could have caused this outcome, and could it have been prevented?

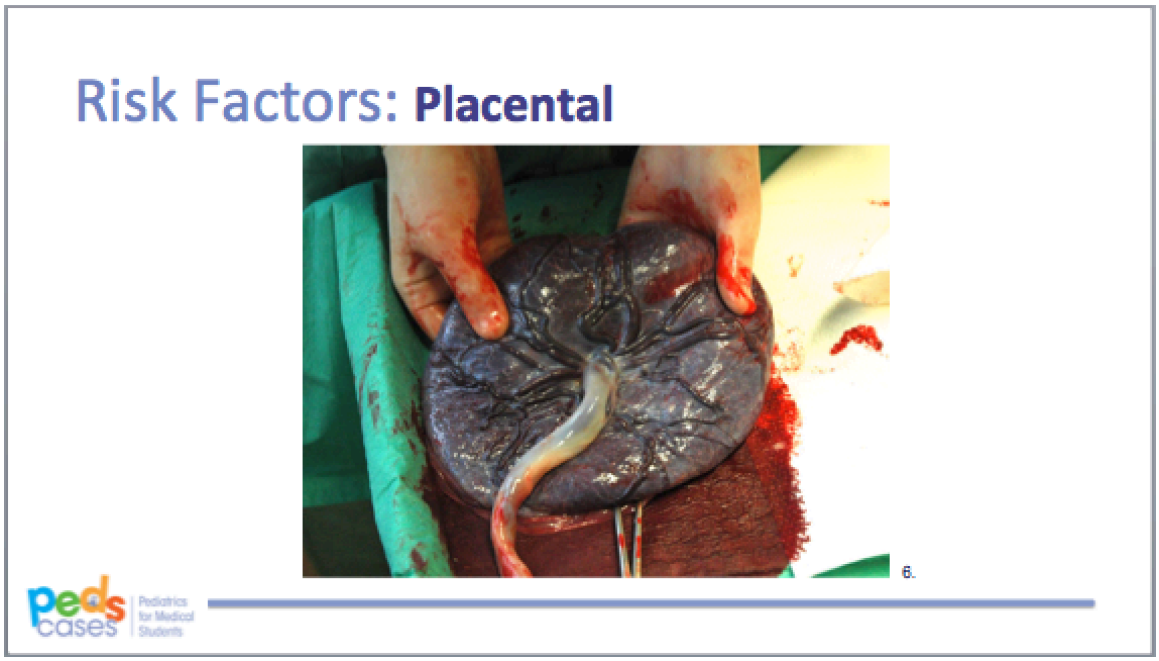


The exact etiologies of IUGR are currently unknown, however there are certain risk factors that have been linked to the development of the condition in utero. We can think of risk factors as falling into three broad categories: Fetal, Maternal, and Placental. Let's start by discussing fetal risk factors.

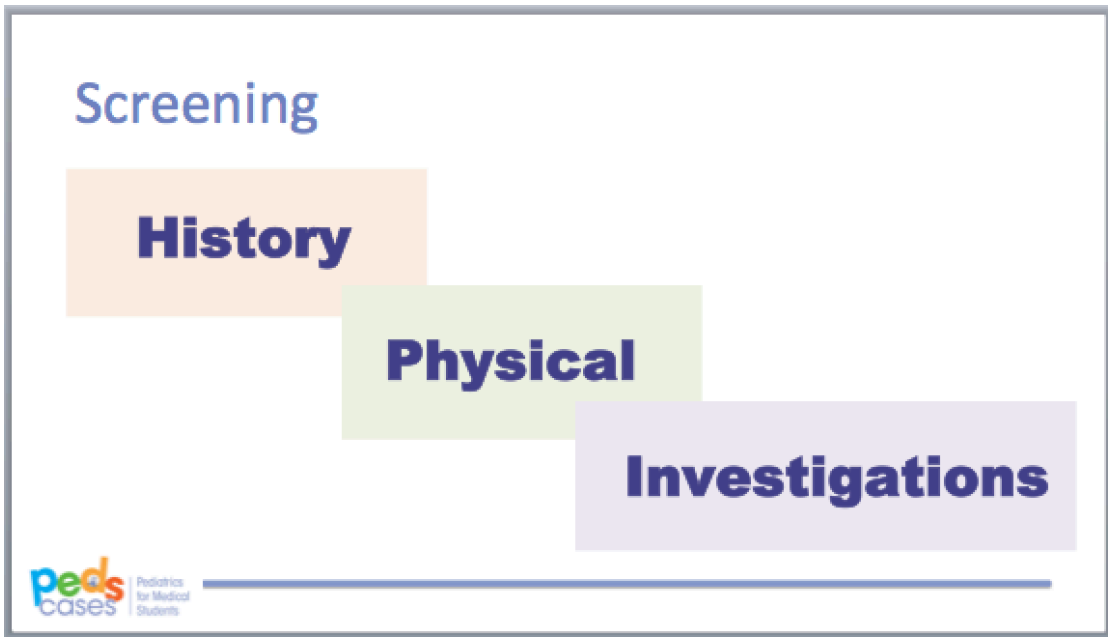
Fetal risk factors for IUGR are factors that are innate to the fetus, and generally lead to symmetric IUGR[2]. Examples include multiple gestation, chromosomal abnormalities such as trisomy 21, 18, or 13, genetic syndromes such as Bloom syndrome or Russell-Silver syndrome, congenital anomalies such as tracheoesophageal fistulas or congenital heart defects, congenital infections such as rubella or varicella, or metabolic disorders such as galactosemia or phenylketonuria. Many of these risk factors can be identified through prenatal screening, although unfortunately cannot be reversed once they are diagnosed. However congenital infections can be prevented through maternal screening before pregnancy, with treatment being offered as appropriate.



Maternal risk factors affect the fetus' growth and development which then often leads to asymmetric IUGR in the fetus[2]. Examples include age under 16 or over 35, maternal hypoxia, maternal malnutrition, maternal substance abuse, and history of previous IUGR babies. While certain factors such as age and history of IUGR cannot be changed, modifying maternal habits during pregnancy can have a tremendous impact on fetal health and wellbeing. Pregnant women are often quite motivated to make positive lifestyle changes, and so should be counseled on smoking cessation[1], substance use, and maintaining good nutrition during pregnancy.



Placental risk factors affect the placenta's ability to supply oxygen and nutrients to the fetus, once again affecting the fetus' growth and development. Examples include abnormal placental vasculature, placental infarction, placental abruption, placental dysfunction, or partial molar pregnancy[2]. While these risk factors often cannot be changed during pregnancy, they can be detected using ultrasound, and potentially managed as the pregnancy progresses.

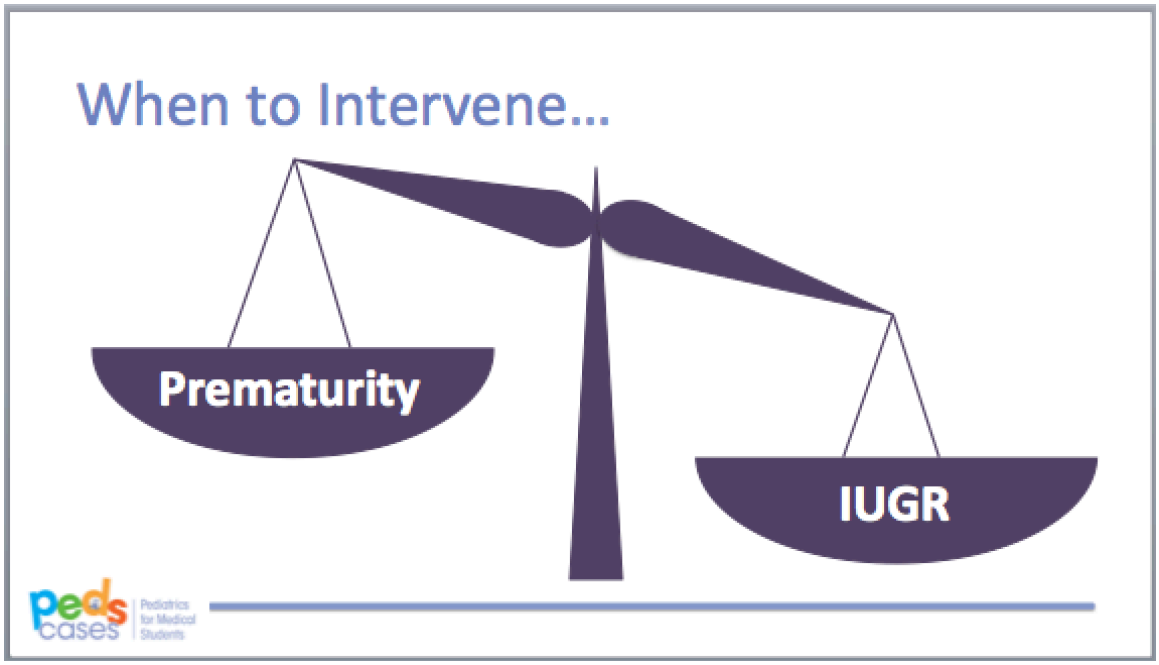


All expectant mothers should be screened for IUGR during their pregnancy, in order to plan for appropriate post-natal care for the fetus. There are three components to appropriate pre-natal screening for IUGR: taking a maternal health history, performing a physical exam, and ordering appropriate investigations.

The first thing that should be done when evaluating a pregnancy is to take a health history from the mother[1]. You should determine the date of the mother's last normal menstrual period in order to calculate her estimated due date, and to calculate fetal gestational age at any point going forward in the pregnancy[1]. You should also ask about maternal and fetal risk factors for IUGR[1].

The second step in screening is to perform a physical exam. There is only one physical exam maneuver that can be used to estimate fetal growth throughout the pregnancy, which is measuring symphysis-fundal height. SFH should be measured at every pre-natal visit, and should correlate with gestational age in weeks. If the SFH continually measures smaller than the gestational age by 3 cm or more, the fetus may have IUGR[1]. However this measurement is not the most accurate way to assess fetal growth, and so should not be relied upon alone to diagnose IUGR[1]. This is where further investigations come in handy.

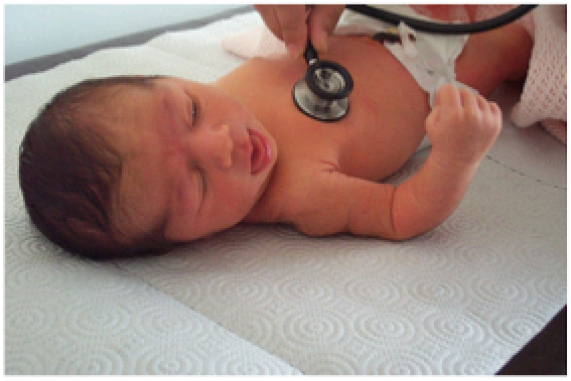
If IUGR is suspected based on history and physical exam, an estimated fetal weight should be calculated in order to confirm the diagnosis[1]. Once the diagnosis is confirmed, a few more tests need to be ordered. Estimated fetal weight should continue to be calculated every two weeks to monitor fetal growth[1]. Fetal biophysical profiles should be done weekly to monitor for fetal wellbeing[1]. The biophysical profile measures the fetus' heart rate, and uses ultrasound to look for episodes of fetal breathing, episodes of fetal movement, fetal tone, and amount of amniotic fluid present[2]. Umbilical artery dopplers should be done to assess for blood flow to the fetus, as well as a detailed ultrasound of the placenta to identify any abnormalities[1].



So why do we do all this monitoring? We're looking for signs that the fetus is still doing well in the womb, despite having its growth restricted. In general we prefer to keep babies in utero for as long as possible due to the risks associated with premature birth. However sometimes the risks associated with staying in the intrauterine environment outweigh the risks associated with premature birth, and urgent delivery may be required. Signs that the baby is not doing well include a plateau in EFW over a few weeks, decreased fetal movement or breathing on BPP, or abnormal umbilical artery doppler results[1]. If the decision to deliver is made before 34 weeks gestation, the mother should receive a course of antenatal corticosteroids in order to promote fetal lung maturation[1,2].

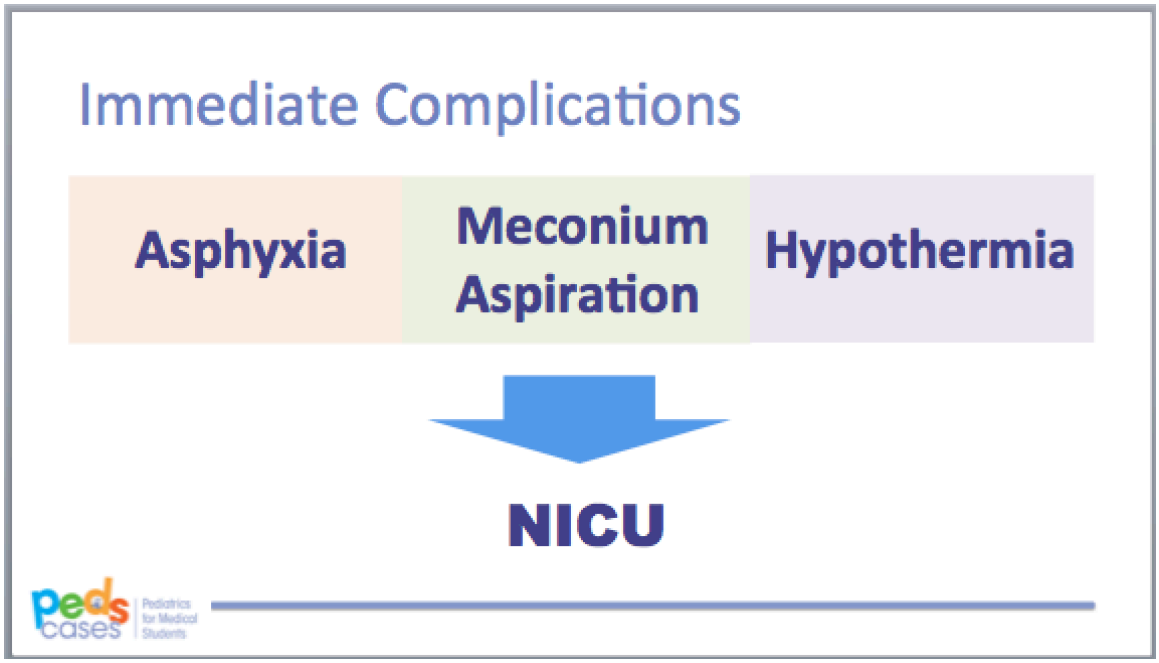
You review this case with the obstetrician and find out that the mother is a 32 year old well woman, with two previous IUGR babies. She has no history of malnutrition or substance abuse, but smokes about 10 cigarettes/day. During the pregnancy, the baby's estimated fetal weight tracked around the 10th percentile until 30 weeks gestation, then fell to the 5th percentile by 33 weeks. Umbilical artery doppler results were also abnormal, so the decision to deliver the baby prematurely was made. The mother was given a course of antenatal corticosteroids to promote fetal lung maturation, and delivered at 34 weeks gestation. Knowing this, how do you expect the baby to appear at delivery?

Clinical Exam Findings



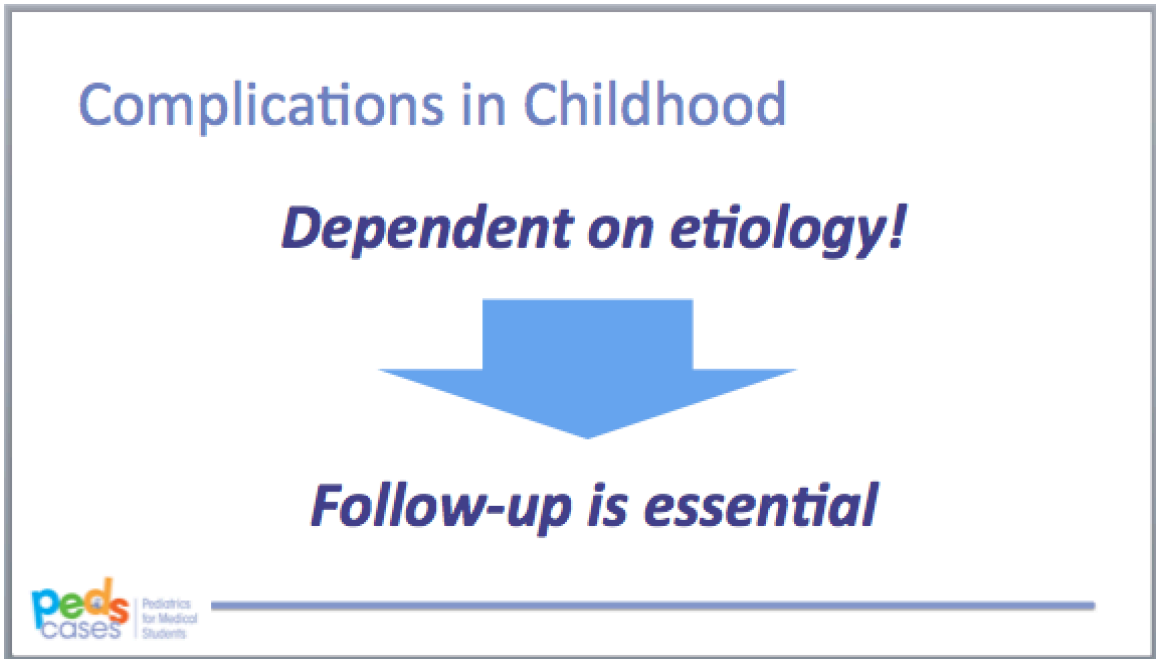
7.

At birth, babies with IUGR are visually distinguishable from normal newborns of the same gestational age. IUGR babies may have large heads, decreased total body fat, increased skin folds, small scaphoid abdomens, long, thin limbs, long fingernails, or thin umbilical cords[2]. Basically, these newborns appear small and malnourished. It is important to assess IUGR babies for their degree of malnutrition, as nutritional support is often required after birth. Investigations to look for the underlying cause of IUGR should also be performed if they have not already been done prenatally. This includes examinations and imaging to look for congenital abnormalities, testing for genetic or chromosomal conditions, and investigations for congenital infections, such as Rubella and CMV.

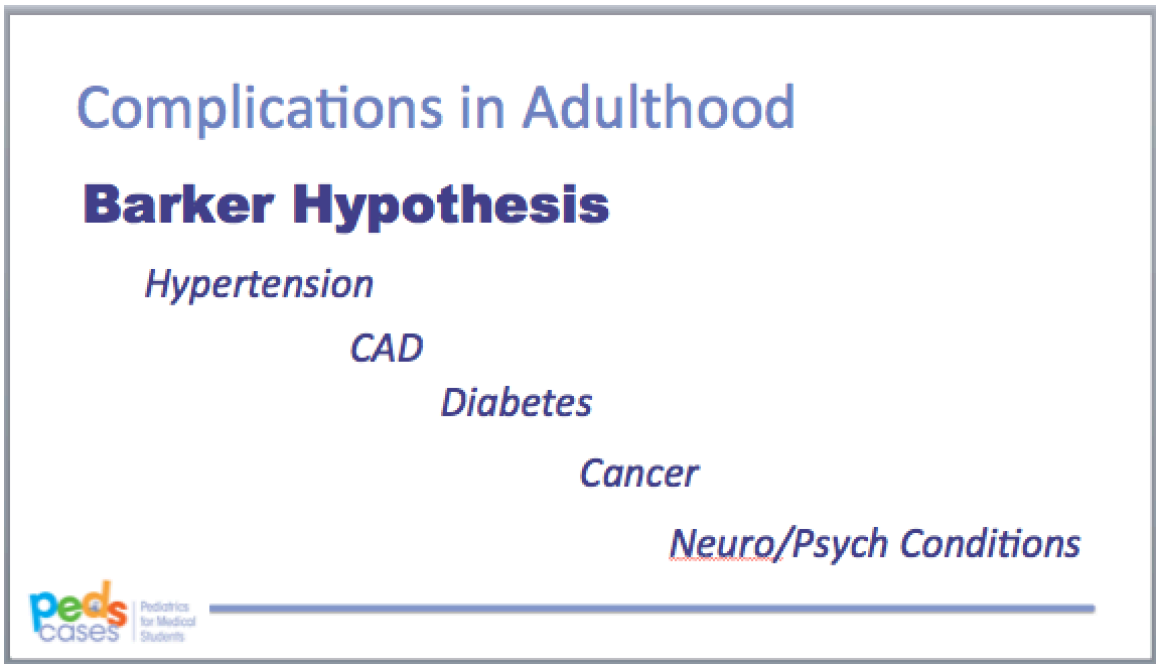


IUGR babies are at an increased risk of many complications immediately following delivery, both because of their small size and potential prematurity. Perinatal asphyxia is a major concern for these newborns[2,3], so their airways should usually be suctioned clear at birth, and should be resuscitated according to Neonatal Resuscitation Program, or NRP guidelines. These newborns are also at an increased risk of meconium aspiration syndrome, so should be monitored closely if meconium is present[2,3]. Finally, these newborns may become hypothermic very quickly due to decreased total body fat, and so should be placed in warm blankets on a warmer right away[2,3].

Close monitoring should continue after delivery to assess for further short-term complications. In general, most IUGR infants with low birth weight are initially managed in the NICU. Short-term complications to watch out for include jaundice, polycythemia, hypoglycemia, retinopathy of prematurity, persistent pulmonary hypertension, necrotizing enterocolitis, and late-onset sepsis[2,3]



As these babies grow into children, they may experience further complications such as short stature and growth retardation, vision problems, decreased intelligence, ADHD, behavioural issues, difficulties in school, and poor social skills[2,3]. The long term outcomes for these children, especially those with symmetric IUGR, will vary depending on the underlying etiology of IUGR. Regular follow-up with a pediatrician is essential for children born with IUGR, in order to diagnose these issues as they come up and initiate appropriate treatment in a timely manner.



Many chronic diseases of adulthood have also been linked to IUGR; this is called the Developmental Origin of Health and Disease[2]. The most widely accepted theory to explain this link is the Barker Hypothesis, which states that when the fetus is developing in sub-optimal antenatal conditions, it adapts to survive in this environment. This leads to permanent epigenetic changes leading to decreased fetal insulin and IGF-1 sensitivity and production, upregulation of the hypothalamic-pituitary-adrenal axis, and promoting brain development while sacrificing growth of other organs[2]. These changes predispose IUGR infants to developing many chronic conditions in adulthood such as hypertension, coronary artery disease, diabetes, cancer, neurologic conditions, and psychiatric conditions[2].

Lets return to our clinical case. You bring the baby to the neonatal resuscitation bed, suction out the baby's airway, and check for signs of meconium aspiration. There are no signs of respiratory distress or other immediate complications, so you help to transfer the baby to the NICU. The baby develops jaundice within the first three days of life and is treated using phototherapy; he goes on to make a full recovery and is discharged home two weeks later. Before discharge, you arrange for follow-up in two weeks with the family's pediatrician, and counsel the family on potential complications during childhood and beyond.

Key Points

1. SGA and IUGR newborns both weigh <10th percentile
2. Risk factors are classified as maternal, fetal, or placental
3. All expectant mothers should be screened for IUGR
4. IUGR babies require close monitoring in the NICU

Before we conclude this PedsCases podcast, let's review some key points from this podcast to remember:

1) SGA and IUGR newborns both weigh below the 10th percentile, however SGA newborns are constitutionally small, whereas IUGR infants are small due to underlying pathology
2) Risk factors for IUGR can be thought of as either maternal, fetal, or placental. Maternal and placental risk factors lead to asymmetric IUGR, whereas fetal risk factors lead to symmetric IUGR.
3) Expectant mothers should be screened for IUGR using ultrasound to calculate estimated fetal weight. Physicians should balance the risks of prematurity against the risk of ongoing fetal malnourishment when deciding whether or not to deliver an IUGR fetus prematurely.
4) IUGR babies require close monitoring post-natally to treat any complications that may arise. These infants also require regular follow-up with a pediatrician, as long-term complications of IUGR may present later in life.

This concludes our PedsCases podcast on intrauterine growth restriction. We hope you enjoyed listening, and learned something new about the pre-natal and post-natal aspects of caring for newborns with IUGR. Thank you!