Antenatal Fetal Assessment

The Old and the New

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Here, There and Everywhere
Disclosures

- Speakers bureau
  - March of Dimes
  - Hologic, Inc
- Trainer
  - Nexplanon

- I will not be discussing any of these organizations or products in this presentation
Objectives

- Define the role of antenatal fetal assessment
- List the methods of antenatal fetal assessment in common use
- Understand the application and interpretation of the various methods of fetal assessment
- State the limitations of the methods of assessment
- Review clinical indications and timing of the various methods
Introduction

- **Goal**
  - Identify fetuses at risk for intrauterine injury or death to prevent these adverse outcomes
  - Recognize the fetus that will benefit from early intervention/delivery without preterm delivery of the healthy fetus

- **Premise**
  - Fetal hypoxia and acidosis is final common pathway to fetal morbidity and mortality
  - Fetus whose oxygenation in utero is challenged will respond with a series of detectable signs as hypoxemia progresses to metabolic acidemia
Example Indications

**Maternal Conditions**
- Anti-phospholipid syndrome
- Chronic renal disease
- Cyanotic heart disease
- Hemoglobinopathies
- Hypertensive disorders
- Hyperthyroidism
- Systemic lupus erythematosus
- Type 1 diabetes mellitus

**Pregnancy Related Conditions**
- Decreased fetal movement
- Intrauterine growth restriction
- Isoimmunization
- Multiple gestation
- Oligohydramnios
- Polyhydramnios
- Post-term pregnancy
  - 41 weeks’ gestation
- Pregnancy-induced hypertension
- Previous fetal demise
Introduction

- General limitations of tests of fetal surveillance
  - In the 3rd trimester
    - Fetuses spend 25% of time in a sleep state
    - Increase the risk of non-reassuring fetal testing
  - Which pregnancies should undergo antenatal fetal surveillance
    - 30 to 50 percent of perinatal deaths occur in low risk pregnancies
  - Acute catastrophic events such as abruptio placenta or cord accidents will not be detected
  - Need to be able to identify fetal compromise in enough time to make a difference with an intervention
Introduction

A combination of antenatal fetal assessment methods may be the optimal management strategy to balance the risks of false positive and false negative results.
Common Methods of Antepartum Fetal Assessment

- Fetal movement assessment
- Nonstress test
- Biophysical profile
- Modified biophysical profile
- Contraction stress test
- Fetal vascular interrogation
  - Umbilical artery
  - Middle cerebral artery
  - Ductus venosus
  - Cerebral Placental Ratio (CBR)
Fetal Movement Assessment

- Introduced by Sadovsky and Cardiff – 1970’s
- Fetal movement decreases in response to hypoxemia
  - Maternal perception of decreased fetal movement may precede fetal death in some by several days
- Many methods for fetal “kick” counting
  - No one method appears to be better/more predictive of a compromised fetus than another
- Initiated between 26 and 32 weeks’ gestation
Fetal Movement Assessment

- Common instructions
  - Patient lies on her side to count fetal movement
  - Count of 10 distinct fetal movements during a 2-hour period reassuring
  - Count fetal movements for 1 hour 3 times per week
    - Count is reassuring if it is at least equal to the previously established baseline count

- Review your individuals hospitals and/or office guidelines
Fetal Movement Assessment

- Results of studies for reduction of stillbirth are inconsistent
- Randomized trial - Denmark
  - Associated with 73% reduction in avoidable stillbirths
  - Results of studies difficult to compare due to differences in methods
- No specific fetal movement threshold as a limit for concern
- Maternal sense that fetal activity is reduced may be the most important factor
- Cochrane database review concluded
  - Insufficient evidence to recommend routine fetal movement counting to prevent stillbirth in high risk or low risk pregnancies
Fetal Movement Assessment

- ACOG July 2014 – Antenatal Fetal Testing
  - Should all women perform daily fetal movement assessment?
    - Multiple studies have shown decreased fetal movement increases risk of adverse perinatal outcomes
    - Effectiveness of fetal kick counting in preventing stillbirth uncertain
    - Evidence that formal program of fetal movement assessment in low-risk women results in reduction in fetal deaths is lacking
    - Whether fetal movement assessment adds benefit to a program of regular fetal surveillance unknown
      - Does not appear to increase number of antepartum visits or interventions (RCT)
  - Although not all women need to perform daily fetal movement assessment, if a decrease in fetal activity is noted further assessment should be performed
Nonstress Test (NST)

- Physiology
  - For reactivity an intact central nervous system-cardiac loop must be present
  - Brain modulates the heart rate
Nonstress Test (NST)

- **Premise**
  - Fetal heart rate of non-compromised fetus will accelerate with fetal movement
  - Described in the 1970’s

- **Predictive value**
  - Low false negative rate
    - 0.19% to 1%
  - High false positive rate
    - 55% to 90%
  - Absence of reactivity not necessarily pathologic
    - Sleep cycle
    - Acidosis
  - 15% of all NSTs will be nonreactive
    - 25% will have a positive contraction stress test
    - Stillbirth rate (corrected) was 1.9 per 1000 live births
  - Negative predictive value is 99.8%
Interpretation Guidelines

- Follow a systematic approach
  - Baseline rate
  - Baseline FHR variability
  - Presence of accelerations
  - Periodic or episodic decelerations
  - Changes or trends of FHR patterns over time
  - Frequency and intensity of uterine contractions
Interpretation Guidelines

- Reactive
  - Two or more fetal heart rate accelerations within a 20-minute period
- Non reactive
  - Lack of sufficient fetal heart rate accelerations over a 40-minute period

- <32 weeks’ gestation
  - >10 BPM above baseline for >10 seconds

- >32 weeks’ gestation
  - >15 BPM above baseline for > 15 seconds
Biophysical Profile (BPP)

- Combines NST with fetal ultrasound assessment
- More time intensive than NST alone and requires training
- Predictive value
  - Low false negative rate
    - ~0.07%
  - High false positive rate
    - Slightly lower than NST alone
### The Biophysical Profile

#### BPP Scoring Factors

<table>
<thead>
<tr>
<th>Factor</th>
<th>NORMAL (Score = 2)</th>
<th>ABNORMAL (Score = 0)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fetal Breathing Movements (FBM)</td>
<td>1 episode of FBMs of 30 seconds duration</td>
<td>&lt; 30 seconds of sustained FBMs</td>
</tr>
<tr>
<td>Fetal Movements (FM)</td>
<td>3 discrete body/limb movements</td>
<td>&lt; 2 episodes of FMs</td>
</tr>
<tr>
<td>Fetal Tone</td>
<td>1 episode of active extension with rapid return to flexion of fetal limb(s), trunk, or hand</td>
<td>Either slow extension with return to partial flexion or absent fetal movement</td>
</tr>
<tr>
<td>Nonstress Test</td>
<td>2 accelerations of 15 bpm peak amplitude lasting 15 seconds at the baseline within 20 minutes</td>
<td>Lack of criteria for reactivity</td>
</tr>
<tr>
<td>Amniotic Fluid Volume</td>
<td>Amniotic fluid index greater than 5 cm or maximum vertical pocket of greater than 2 cm</td>
<td>Decreased AFV</td>
</tr>
</tbody>
</table>
The Biophysical Profile

- Biophysical profile: **8-10**
  - Reassuring
  - Follow-up as clinically indicated

- Biophysical Profile: **8**
  - Reassuring
  - Delivery considerations
  - Oligohydramnios

- Biophysical Profile: **6**
  - Equivocal
  - Repeat Biophysical Profile in 24 hours

- Biophysical Profile: **4**
  - Non-reassuring
  - Delivery considerations
    - Gestational age >36 weeks

- Biophysical Profile: **0-2**
  - Alarming
  - Continue monitoring for max of 2 hours
  - Calls for delivery

Oligohydramnios calls for further monitoring or delivery
Biophysical Profile

- Factors which may affect fetal parameters assessed
  - Hypoxemia
  - Acidosis
  - Gestational age
  - Maternal betamethasone administration
  - Magnesium sulfate
  - Excessive transducer pressure on the maternal abdomen
  - Others
The Biophysical Profile

- No randomized trials have been performed comparing BPP with no testing

- Additional studies needed to make any reasonable conclusions regarding benefits of the BPP in high risk pregnancies to reduce fetal morbidity and mortality
Modified Biophysical Profile

- NST and amniotic fluid volume assessment
  - Combination of short-term marker of fetal acid base status with the chronic marker of amniotic fluid
  - Amniotic fluid assessment
    - AFI
      - Sum of measurements of deepest cord free amniotic fluid pocket in each of the uterine quadrants
      - Single deepest vertical pocket without fetal parts or umbilical cord
  - Normal
    - NST reactive and amniotic fluid volume greater than 2 cm in deepest vertical pocket
  - Negative predictive value similar to full BPP
Modified Biophysical Profile

- Adequate data does not exist to recommend or not recommend the modified BPP
- Similar reassuring false-negative rate and potentially a lower false-positive rate than the nonstress test alone

Limitations
- False-positive rate high
  - 60% of those delivered because of an abnormal antepartum test had no evidence of fetal compromise
  - Led to preterm delivery in 1.5% of those tested before term
Contraction Stress Test

- Fetal heart rate response to uterine contractions
- Premise
  - Compromised fetus will have transient worsening in oxygen status with uterine contraction due to lack of reserve resulting in late decelerations
- Common Method
  - External monitoring of FHR and uterine activity
  - Three contractions of 40 seconds duration or longer in a 10-minute period
    - Spontaneous or induced contractions
  - Interpreted according to presence or absence of late decelerations
Contraction Stress Test

- Interpretation
  - Negative
    - No late or significant variable decelerations
  - Positive
    - Late decelerations following 50% or more of contractions
  - Equivocal
    - Intermittent late decelerations/significant variable decelerations
    - FHR decelerations with contractions more frequent than every 2 minutes or lasting longer than 90 seconds
  - Unsatisfactory
    - Fewer than 3 contractions in 10 minutes or an uninterruptable tracing
Contraction Stress Test

- Predictive value
  - Negative predictive value of greater than 99.9%
- Time consuming
- Usually requires intravenous infusion of oxytocin
- Contraindications limit use of the contraction stress test in many high-risk situations
- Few demonstrated benefits over other methods of fetal assessment
- Should not be used routinely
Doppler Assessment
Doppler

- Doppler transducer placed on skin and aimed at an angle, $\theta$
- Blood vessel contains blood flowing with velocity of $u \text{ m/s}$
- Transducer emits ultrasound waves of frequency, $f_o$
- Echoes generated by moving reflectors in blood have frequency, $f_r$
- $\Delta f = f_o - f_r$
- $\Delta f = \frac{2f_o u \cos \theta}{c}$
  - $c$ is the speed of sound in the fluid
Fetal Doppler Assessment

- Uses ultrasound to measure blood flow velocities in fetal vessels that reflect downstream vascular resistance by calculations in differences between the peak systolic and the end-diastolic velocity within blood vessels of interest in each fetal cardiac cycle.
Doppler Assessment

- Fetal-placental circulation is evaluated in the umbilical artery
  - Measured by systolic/diastolic (S/D) ratio
  - S/D indirectly measures impedance or resistance downstream within the placental vessels
  - As placental resistance increases, diastolic flow decreases and the S/D ratio rises
Fetal Vascular Doppler

- Primarily reserved for evaluation of the fetus with suspected or known growth restriction
- Most vigorously studied method to assess fetal well-being
- Almost all fetal vessels have been studied
- Umbilical artery Doppler interrogation most useful
  - Directly reflects status of fetoplacental circulation
    - systolic/diastolic ratio
    - resistance index
    - pulsatility index
IUGR

- Sonographic estimated fetal weight below 10th percentile or abdominal circumference less than 5th percentile for gestational age
- Monitoring the growth-restricted fetus
  - Serial assessment of fetal biometry
  - Amniotic fluid volume
  - Antenatal surveillance
    - BPP
    - NST
  - Doppler flow assessment of the umbilical artery
- Antenatal surveillance should not begin before a gestational age when delivery would be considered
<table>
<thead>
<tr>
<th>Gestational Age Range*</th>
<th>Method of Measurement</th>
<th>Discrepancy Between Ultrasound Dating and LMP Dating That Supports Redating</th>
</tr>
</thead>
<tbody>
<tr>
<td>8 6/7 wk or less</td>
<td>CRL</td>
<td>More than 5 d</td>
</tr>
<tr>
<td>9 0/7 wk to 13 6/7 wk</td>
<td>CRL</td>
<td>More than 7 d</td>
</tr>
<tr>
<td>14 0/7 wk to 15 6/7 wk</td>
<td>BPD, HC, AC, FL</td>
<td>More than 7 d</td>
</tr>
<tr>
<td>16 0/7 wk to 21 6/7 wk</td>
<td>BPD, HC, AC, FL</td>
<td>More than 10 d</td>
</tr>
<tr>
<td>22 0/7 wk to 27 6/7 wk</td>
<td>BPD, HC, AC, FL</td>
<td>More than 14 d</td>
</tr>
<tr>
<td>28 0/7 wk and beyond t</td>
<td>BPD, HC, AC, FL</td>
<td>More than 21 d</td>
</tr>
</tbody>
</table>

Abbreviations: AC, abdominal circumference; BPD, biparietal diameter; CRL, crown-rump length; FL, femur length; HC, head circumference; LMP, last menstrual period.

*Based on LMP.

†Because of the risk of redating a small fetus that may be growth restricted, management decisions based on third-trimester ultrasonography alone are especially problematic and need to be guided by careful consideration of the entire clinical picture and close surveillance.

Fetal Vascular Doppler

- Abnormal flow velocity waveforms
  - Correlated histopathologically with small-artery obliteration in placental tertiary villi
  - Fetal hypoxemia and academia
  - Increases in perinatal morbidity and mortality
Umbilical Artery Doppler

- Waveforms obtained near placental cord insertion site show higher end-diastolic flow velocity than waveforms obtained near abdominal cord insertion.
  - Due to the distance from point of resistance.
- To optimize reproducibility, SMFM suggests interrogating umbilical artery at abdominal cord insertion.
- S/D ratio and PI should be obtained in the absence of fetal breathing.
- Waveforms should appear uniform.
Umbilical Artery Doppler
Umbilical Artery Doppler

- Normal wave form
Umbilical Artery Doppler

- Elevated umbilical artery Doppler
Umbilical Artery Doppler

- Absent end diastolic flow
- Increasing resistance in blood flow to placenta and decreased number of functioning tertiary villi
- Associated with perinatal morbidity/mortality and fetal acidosis
- Occurs days to weeks prior to abnormalities on other methods of fetal assessment
Umbilical Artery Doppler

- Embolization experiments in the sheep placenta suggest that absent end-diastolic flow velocities are not achieved until more than 50% of functional villi have been obliterated.
**Umbilical Artery Doppler**

- Reversed end diastolic flow
- Advanced stage of placental compromise
- Obliteration of 70% of arteries in placental tertiary villi
- Associated with severe IUGR (birth weight less than 3rd percentile) and oligohydramnios
Clinical Considerations

- Betamethasone administration in the growth-restricted fetus with abnormal umbilical artery Doppler studies
  - Original trial showed increased risk of fetal deaths among women with hypertension and IUGR
    - Due to transient increased physiologic and metabolic demands associated with administration of glucocorticoids
    - Consider close observation for 48-72 hours following betamethasone administration
  - Fetus with absent or reversed umbilical artery end-diastolic flow
    - Betamethasone can result in transient return of end diastolic flow in about two thirds of the cases
      - Due to altered tone of the placental vasculature
Umbilical Artery Doppler

- Cochrane meta-analysis of randomized trials on use of umbilical artery Doppler in pregnancies with risk factors for adverse perinatal outcome demonstrates a clear reduction in perinatal mortality in normally formed fetuses

- This is the only form of fetal surveillance that has been shown to improve perinatal mortality in randomized controlled trials
Ductus Venosus

- Doppler waveforms from the fetal central venous circulation reflect the physiologic status of the right cardiac ventricle.
- Continuous forward flow throughout the cardiac cycle is normal.
- Decreased, absent, or reversed flow in the A wave (atrial contraction) can represent myocardial impairment (increased ventricular end-diastolic pressure).
  - Associated with increased neonatal mortality rate in the fetus with growth restriction.
Ductus Venosus

S = Ventricular systole
D = early diastole
a = atrial contraction
Ductus Venosus

- Normal wave form
Ductus Venosus

- Reversed Flow
Fetal Vascular Changes in Hypoxemia

- Blood flow redistribution
- “Cerebral sparing” - MCA resistance indices fall as umbilical arterial resistance increases
  - Does not correlate with final stages of asphyxiation and not useful in choosing timing for delivery
- Increased resistance in umbilical arteries leads to increase in right ventricular (RV) end-diastolic pressure
  - Deterioration of RV dilatation leads to tricuspid regurgitation
    - Increased pulsatility in ductus venosus
      - Highly correlated with impending asphyxiation and acidosis
- Increased systemic venous pressures lead to dilatation of the ductus venosus and transmission of cardiac impulses to umbilical vein resulting in umbilical venous pulsations
  - Highly correlated with severe acidosis and fetal demise
Progression of Abnormalities in Fetal Vessels

Abnormal Doppler findings (%)

Days prior to delivery

5 7 9 11 14 19 21 25 26

Observed fetuses (n)

○ = MCA PI
□ = UA AEDF
△ = DV S/a
■ = UA RF
▲ = DV RF

Outcomes

Figure 4 Doppler abnormalities and perinatal mortality in intrauterine growth-restricted fetuses > 28 weeks of gestation.
Middle Cerebral Artery Doppler
Fetal Middle Cerebral Arterial (MCA) Doppler

- Fetal cardiovascular distress
- Fetal anemia
- Fetal hypoxia
Fetal Middle Cerebral Arterial (MCA) Doppler

- Fetal head in the transverse plane
- Axial section of the brain, including the thalami and the sphenoid bone wings
- MCA vessels found with color or power Doppler overlying anterior wing of sphenoid bone near base of the skull
- Reading should be obtained close to origin of the circle of Willis
- Angle of insonation <15° should be used; typically
  - Angle that approximates 0° is optimal
Figure 1

Middle Cerebral Artery

Umbilical Artery
Cerebroplacental Doppler Ratio (CPR)

- Ratio of middle cerebral artery pulsatility index (MCA-PI) to the umbilical artery pulsatility index (UA-PI)
- Increasing use as a predictor of adverse pregnancy outcome in fetuses with suspected fetal growth restrictions
  - Increase risk of abnormal fetal heart tones in labor
  - Higher rate of cesarean delivery for fetal distress in labor
  - Higher rate of Apgar scores less than 7 at 5 minutes
  - Increased rate of neonatal acidosis
  - Increased rate of newborn intensive care unit admissions and adverse neonatal outcome
  - Greater incidence of perinatal death
- Earlier predictor of adverse outcome than the biophysical profile, umbilical artery, or middle cerebral artery
# CBR Normal Ranges

**Umbilical Artery to Middle Cerebral Artery Ratio**

Prediction of fetal outcome in small for gestational age fetuses: comparison of doppler measurements obtained from different fetal vessels.


<table>
<thead>
<tr>
<th>GA (wks)</th>
<th>50th Percentile</th>
<th>5th Percentile</th>
<th>95th Percentile</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>0.67</td>
<td>0.24</td>
<td>1.11</td>
</tr>
<tr>
<td>21</td>
<td>0.67</td>
<td>0.23</td>
<td>1.1</td>
</tr>
<tr>
<td>22</td>
<td>0.66</td>
<td>0.22</td>
<td>1.09</td>
</tr>
<tr>
<td>23</td>
<td>0.65</td>
<td>0.21</td>
<td>1.08</td>
</tr>
<tr>
<td>24</td>
<td>0.64</td>
<td>0.2</td>
<td>1.08</td>
</tr>
<tr>
<td>25</td>
<td>0.63</td>
<td>0.2</td>
<td>1.07</td>
</tr>
<tr>
<td>26</td>
<td>0.62</td>
<td>0.19</td>
<td>1.06</td>
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<tr>
<td>27</td>
<td>0.61</td>
<td>0.18</td>
<td>1.05</td>
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<tr>
<td>28</td>
<td>0.61</td>
<td>0.17</td>
<td>1.04</td>
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<tr>
<td>29</td>
<td>0.6</td>
<td>0.16</td>
<td>1.03</td>
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<td>30</td>
<td>0.59</td>
<td>0.15</td>
<td>1.02</td>
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<tr>
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<td>0.58</td>
<td>0.15</td>
<td>1.02</td>
</tr>
<tr>
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<td>0.57</td>
<td>0.14</td>
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<td>33</td>
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</tr>
<tr>
<td>41</td>
<td>0.5</td>
<td>0.06</td>
<td>0.93</td>
</tr>
</tbody>
</table>

**UMBILICAL ARTERY - MIDDLE CEREBRAL ARTERY RATIO**

*J Perinat Med 1992;20:29*

- 50th PERCENTILE
- 5th PERCENTILE
- 95th PERCENTILE
Absent or reversed end-diastolic flow in the umbilical artery associated with an increased risk of perinatal mortality.

Rate of perinatal death reduced by ~29% with umbilical artery Doppler added to standard antepartum testing for suspected fetal growth restriction.

Doppler assessment of other fetal blood vessels not shown to improve perinatal outcome and role of these measures in clinical practice remains unclear.
Algorithm Guideline for Management of IUGR

IUGR diagnosis: EFW < 10th percentile

Well dated pregnancy? No

Early or symmetric IUGR:
- consider TORCH infections
- offer karyotype assessment

No

Treatment:
- Modified BR and hydration
- No strenuous activity
- Stop substance use

Surveillance:
- Fetal activity counts once or twice daily
- Interval growth ultrasounds every 2–4 weeks

Antepartum (AP) Testing: biophysical profile (BPP; 10 point) weekly or modified BPP 2-times per week
(8-point BPP acceptable alternative < 28 weeks — NST often nonreactive, but may be used to exclude decels)

- EFW < 10th percentile and normal UmA and MCA Dopplers: Dopplers q 2 weeks
- EFW < 10th percentile and abnormal UmA or MCA Doppler: Dopplers weekly
- EFW < 5th percentile or AC < 5th percentile: Dopplers weekly

Ultrasound velocimetry

Absent/reverse (A/R) flow or oligohydramnios

Treatment:
- Hospitalize
- BMZ (<34 weeks gestation)
- NICU consultation
- Once or twice daily BPP or NST
- Daily or every other day UmA and venous (ductus venous) Doppler

Normal or resistance > 95th percentile but with forward flow velocity & normal AP Testing

Continue AP testing and weekly umbilical artery Doppler

P1 > 95th percentile Normal

Deliver 36–37 wks Deliver 38–40 wks

Delivery Triggers (any one bullet can serve as trigger)

< 28 weeks
- BPP<4 or FHR tracing repetitive decelerations
- Venous Dopplers with persistent reverse flow (may do continuous monitoring for BMZ)

28–32 weeks
- BPP<4 or FHR tracing repetitive decelerations
- Venous Dopplers with persistent A/R a-wave flow
- Umbilical artery with persistent reverse flow unless Venous Dopplers normal

32–34 weeks
- BPP<4 or FHR tracing repetitive decelerations
- Venous Dopplers with A/R flow
- Umbilical artery with reverse flow
- Oligohydramnios or arrested growth after BMZ
- Documented lung maturity

A/R, absent or reverse; BMZ, betamethasone
Initiation of Surveillance

- Depends upon combination of several factors
  - Prognosis for neonatal survival
  - Severity of maternal disease
  - Risk of fetal death
  - Risks of iatrogenic prematurity complications
- Initiating testing at 32-34 weeks of gestation is appropriate for most at-risk pregnancies
- Fetal surveillance can be initiated earlier if multiple or very concerning high-risk conditions exist
Management of Abnormal Surveillance

- Abnormal antepartum fetal test result should be interpreted in the context of the overall clinical picture
  - Certain acute maternal conditions can result in abnormal test results that normalize as maternal condition improves
- Stepwise approach for assessment of the fetal condition should be undertaken
  - Antepartum fetal surveillance tests have high false-positive rates and low positive predictive values
  - Minimizes the potential for unnecessary delivery based on a single false-positive test result
- Response to abnormal test result should be tailored to the clinical situation
Management of Abnormal Surveillance

- The growth restricted fetus
  - No definitive RCTs to guide timing of delivery
  - Umbilical artery Doppler velocimetry considerations
    - Absent end-diastolic flow
      - Delivery considered at or beyond 34 0/7 weeks of gestation
    - Reversed end-diastolic flow
      - Delivery considered at or beyond 32 0/7 weeks of gestation
    - Elevated cord Doppler with end diastolic flow
      - Delivery considered at or beyond 37 0/7 weeks of gestation
- In the absence of obstetric contraindications, a trial of induction of labor with continuous monitoring okay
Management of Abnormal Surveillance

- Umbilical artery Doppler velocimetry in addition to NSTs or BPPs, or both, is associated with improved outcomes.

- Unclear if evaluation of middle cerebral artery or venous system improves perinatal outcome.

- Role of these measures in clinical practice remains uncertain.
Clinical Considerations

- Results can be affected by maternal behaviors
  - Tobacco, alcohol, methadone
    - Decrease fetal movement, breathing, and heart rate reactivity
  - Corticosteroids
    - Decrease movement, breathing, and heart rate reactivity
  - Maternal medical conditions - DKA, pulmonary compromise
    - Non-reassuring fetal surveillance
    - Delivery of the infant in this precarious setting is often ill advised and dangerous
    - Stabilize maternal status – fetal status also improves
Final Thoughts

- No large clinical trials to guide frequency of antenatal testing
  - Literature on ideal use of antenatal testing and benefit in reducing fetal morbidity and mortality based on observational studies and expert opinion
- No one ideal test for every high risk pregnancy/fetus(es)
- Predictive value of test relies on the suspected underlying pathophysiology
  - Before choosing a test of fetal well being – necessary to have an idea of the underlying pathophysiology placing the fetus at risk