Antenatal Fetal Surveillance

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Disclosures
• None

Learning Objectives
After completion of this lecture attendees should understand:
• The various types of antenatal fetal testing used to current obstetric practice
• What role ultrasound has in these testing modalities
• How antenatal fetal surveillance is used in women with common medical and obstetrical comorbidities

Goals of Monitoring
• Predict short- and long-term intrauterine fetal morbidity and mortality
• Identify imminent fetal decompensation

Risk Factors for Stillbirth and Cerebral Palsy
• Extremes of maternal age and parity
• Obesity
• African-American ethnicity
• Tobacco use
• Concurrent medical disease
• Assisted reproductive technology (ART)
• Multiple gestation
• Fetal anomalies
• Fetal growth restriction
• Male fetal gender

Antenatal Fetal Surveillance
• NICHD workshop convened to review
• Evidence supporting antenatal fetal surveillance
• Identify gaps in current knowledge
• Recommendations for future study

Signore et al, Obstet Gynecol 2009
Evidence of Merit

• "There is a dearth of evidence from randomized trials that antepartum fetal surveillance reduces the risk of fetal death"
• Most studies are observational, and most recommendations are based on expert opinion (Level III evidence)

ACOG Practice Bulletin #9, 1999

Evidence of Merit

• The negative predictive value (NPV) of all current methods of fetal testing are superior to the positive predictive value (PPV)
  
  *In other terms, a "normal" test result is reassuring, but an "abnormal" result does not necessarily indicate fetal compromise*

Kick Counts

• Fetal movements initially perceived as early as 17 weeks with peak frequency at 38 weeks¹
• Cardiff method of "10 movements in 2 hours" is considered "reassuring"
• Maternal perception of movement²
  
  • 50% of limb movements
  • 80% of truncal/body movements

¹Signore et al, Obstet Gynecol 2009
²de Vries, Ultrasound Obstet Gynecol 2006

Methods of Assessment

• "Kick counts"
• Nonstress test (NST)
• Biophysical profile (BPP)
• Contraction stress test (CST)
• Modified biophysical profile (MBPP)
• Fetal Doppler velocimetry

Grant Trial

• N=67,879 patients recruited at gestational age of 28-32 weeks at 33 institutions and randomized to either formal daily "count to 10" protocol or no specific monitoring
• 73% powered to detect 1/3 reduction in intrauterine fetal demise (IUFD) rate
• Results: N=99 antepartum IUFD in monitored group and 100 in control group
• Conclusion: No significant improvement in fetal outcome

Grant et al, Lancet 1989
**Kick Counts**

- "Insufficient evidence that routine use reduces the incidence of stillbirth"

  Magnesi, Cochrane Database Syst Rev 2007

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**Nonstress Test**

- Fetal sleep patterns rarely persist beyond 40 minutes; monitor strip is reactive at 30 minutes in 88-90% of patients and 94% of patients by 40 minutes (*i.e. a nonreactive NST beyond 90 minutes often signifies true fetal pathology*)

- Maternal glucose administration (and possibly fetal manipulation) do not influence reactivity

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**Non-Stress Test**

- "Reactivity" is due to balance of parasympathetic/sympathetic systems influencing fetal heart rate

- Incidence of reactive testing (based on “10x10” acceleration at <32 weeks and “15x15” at >32 weeks):
  - 24-28 weeks 50%
  - 28-32 weeks 85%
  - 32 weeks until term >99%

  ACOG Practice Bulletin #9, 1999

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**Nonstress Test**

- N=1169 patients undergoing 2422 NST and compared with N=939 patients undergoing routine CST
  - IUFD rate with NST 1% and CST 3.3%
  - Conclusion: “reactive NST as predictive of good [fetal] outcome as negative CST”

  Evertson et al, Am J Obstet Gynecol 1979

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**Contraction Stress Test**

- “Oxytocin Challenge Test”

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Contraction Stress Test

• First trial published in 1975: N=120 patients underwent 189 episodes of testing
• N=9 “positive” tests with 2 IUFD within 1 week of testing
• Negative predictive value of “negative” result 100%

Schifrin et al, Obstet Gynecol 1975

Biophysical Profile (BPP)

• During a 30 minute interval:
  • Fetal breathing motion for 30 seconds consecutively
  • Tone: one episode of flexion of extension (limb or hand)
  • Three episodes of limb or trunk movements
  • Amniotic fluid pocket of ≥2cm in depth
  • NST (may be omitted if all other components are normal)

ACOG Practice Bulletin #9, 1999

CST Interpretation

<table>
<thead>
<tr>
<th>Result</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Negative</td>
<td>No decelerations with at least 3 contractions/10min</td>
</tr>
<tr>
<td>Positive</td>
<td>Late decelerations with 30% or more of contractions</td>
</tr>
<tr>
<td>Suspicious</td>
<td>Late decelerations with fewer than 30% of contractions</td>
</tr>
<tr>
<td>Hypersensitization</td>
<td>Late decelerations following excessive contractions (more frequent than q2 minutes or duration &gt;90 seconds)</td>
</tr>
<tr>
<td>Unsatisfactory</td>
<td>Less than 3 contractions/10 minutes or inadequate tracing</td>
</tr>
</tbody>
</table>

Assessment of Amniotic Fluid Volume

Maximum Vertical Pocket (MVP)

• Scan the uterus to select the single deepest amniotic fluid pocket free of umbilical cord and fetal parts
• Measure the greatest vertical dimension
• Oligohydramnios defined as single deepest pocket <2cm

Assessment of Amniotic Fluid Volume

Amniotic Fluid Index

• Position patient supine and divide the uterus into 4 quadrants
• Transducer parallel to maternal sagittal plane and perpendicular to maternal coronal plane
• Deepest unobstructed pocket, measured in vertical direction
• Sum all 4 quadrants
• Interpretation
  • >25—polyhydramnios
  • 10-24—normal
  • 5-9—equivocal
  • <5 oligohydramnios
Initial Description of BPP

- Originally described in N=216 “high-risk” patients who underwent testing (inclusive of NST) within 1 week of delivery; negative predictive value of combined variables better than any individual parameter.


Original BPP Prospective Trial

- N=1184 “high-risk” patients who underwent biophysical profile testing
- Unexplained IUFD occurred in 1 patient, for false negative rate 0.8/1000
- Additionally, 13 major congenital fetal anomalies were detected
- Conclusion: BPP may be used for antenatal monitoring


BPP Interpretation

<table>
<thead>
<tr>
<th>Score</th>
<th>Interpretation</th>
<th>Management</th>
</tr>
</thead>
<tbody>
<tr>
<td>10/10</td>
<td>Normal (non-asphyxiated)</td>
<td>Repeat weekly or 2x/wk in diabetic &amp; post-term</td>
</tr>
<tr>
<td>8/8</td>
<td>NORMAL FLUID</td>
<td>No intervention</td>
</tr>
<tr>
<td>8/10</td>
<td>LOW FLUID (w/0 PPROM)</td>
<td>Suspected chronic fetal asphyxia; Deliver if EGA ≥ 36wks; otherwise typically follow BPP protocol</td>
</tr>
<tr>
<td>8/10</td>
<td>NL FLUID (w/o PPROM)</td>
<td>Possible chronic fetal asphyxia; EGA ≥ 36wks and favorable cervix – deliver; EGA &lt; 36wks consider amniocentesis for fetal lung maturity or repeat in 4-24hrs</td>
</tr>
<tr>
<td>6/10</td>
<td>LOW FLUID</td>
<td>Deliver (unless PPROM or fetal anomaly)</td>
</tr>
<tr>
<td>4/10</td>
<td>Probable fetal asphyxia</td>
<td>Deliver if PPROM; otherwise repeat test in 6 hrs; if ≤ 6 – deliver</td>
</tr>
<tr>
<td>0/2/10</td>
<td>Almost certain fetal asphyxia</td>
<td>Deliver immediately</td>
</tr>
</tbody>
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BPP Performance

- Risk of IUFD within 1 week of normal BPP in N=19,221 pregnancies was 0.8/1000


Modified BPP

- Initially described by Eden in 1988
- Consists of a reactive NST in combination with a “normal” amniotic fluid volume (AFI ≥ 5cm)
- Validated in study of N=2774 patients undergoing 17,429 episodes of antenatal testing

1Eden et al, Obstet Gynecol 1988
Assessment of Amniotic Fluid Volume

Oligohydramnios—MVP vs. AFI
• Choice of criteria for oligohyramnios does not effect fetal outcome
• Use of AFI < 5 leads to more intervention
• Additional testing
• More indicated deliveries
• ACOG leaves it to provide discretion

Test Performance

<table>
<thead>
<tr>
<th>Test</th>
<th>False Neg. (%)</th>
<th>False Pos. (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CST</td>
<td>0.004</td>
<td>35-65</td>
</tr>
<tr>
<td>NST</td>
<td>0.2-0.65</td>
<td>55-90</td>
</tr>
<tr>
<td>BPP</td>
<td>0.07-0.08</td>
<td>40-50</td>
</tr>
<tr>
<td>mBPP</td>
<td>0.08</td>
<td>60</td>
</tr>
</tbody>
</table>

Hypertension
• Insufficient data to make specific recommendations for patients with chronic hypertension
• National Working Group has recommended weekly NST for patients who develop mild preeclampsia prior to term
  1Mulrow et al, Evid Rep Tech Assess 2000

Specific Indications:

Hypertension

Diabetes
• No method of antenatal surveillance is preferred
• Most testing strategies employ 1-2x/weekly protocols, commencing earlier for patients with hypertension, renal disease, or fetal growth restriction
• No role for antepartum surveillance in diet-controlled gestational diabetes
  Signore et al, Obstet Gynecol 2009

Fetal Growth Restriction
• No randomized trials regarding either method or frequency of antenatal monitoring
• Most protocols employ 1-2x/weekly testing with 1-2x/weekly umbilical artery Doppler velocimetry
  Signore et al, Obstet Gynecol 2009
Multiple Gestation

- Twin pregnancy
  - Concordant growth: NST/BPP weekly starting at 32 weeks
  - Discordant growth: MBPP 2x/week starting at time of diagnosis
  - Minimal data on triplets; some authors suggest 2x/weekly BPP starting at 28 weeks

Signore et al, Obstet Gynecol 2009

Oligo/Polyhydramnios

- Oligohydramnios (AFI <5 cm or MVP <2cm)
  - NST/MBPP 2x/weekly starting at diagnosis
  - 40% will “resolve” during repeat sonography
  - Polyhydramnios (AFI ≥ 24 cm of MVP ≥ 8cm)
  - No specific recommendations


Decreased Fetal Movement

- Recommendations include either NST or MBPP
  - If normal results, no further evaluation is required
  - No current role for Doppler velocimetry

ACOG/AAP Guidelines for Perinatal Care 2007

Post-Term

- No clearly defined gestational age at which testing should be initiated; ACOG recommends initiating at > 40 weeks
- AFI may overestimate incidence of oligohydramnios when compared to MVP without improvement in perinatal outcomes
- Twice-weekly monitoring is usually (empirically) recommended from 41-42 weeks
- No current role for Doppler velocimetry

ACOG Practice Bulletin #55, 2004
Alfirevic et al, Br J Obstet Gynecol 1995

Previous IUFD

- Recurrence risk in subsequent pregnancy 2-10x increase (approximately 1/300)
- Initiate testing:
  - 1 week prior to previous IUFD
  - 32-34 weeks gestation
  - Any testing modality is appropriate

Reddy, Obstet Gynecol 2007

VibroAcoustic NST

- Reduces the incidence of nonreactive NST and reduces testing time without affecting negative predictive value
- May result in transient increases in fetal heart rate baseline and breathing/body movements

Tan et al, Cochrane Database Syst Rev 2007
Petrovic et al, J Matern fetal Neonatal Med 2009
Insufficient Data

• AMA
• African-American Race
• ART
• Low PAPP-A (<5%)
• 2 abn Quad markers
• Obesity
• Smoking
• Thrombophilia
• Thyroid Disease
• Low-educational status

Questions???

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