Non-reassuring FHR tracing: What is it and what to do about it?

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FHR interpretation

“What does it mean?”

Intrapartum FHR monitoring is intended to assess the adequacy of fetal oxygenation.
What Constitutes Fetal Distress?

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By Jeffrey P. Phelan, MD, JD
That decision has left the task of defining fetal distress squarely on the shoulders of those who've always had to make the tough call-the Obstetricians who pore over yards and yards of FHR strips, scrutinizing the peaks and troughs of intrapartum tracings in an attempt to distinguish the physiologically compensated fetus from the one in jeopardy of neurological or other damage, or even death. We asked several of those practitioners how they define fetal distress in their practices.

Here is what your colleagues said:

David E. Abel, MD, Morrisville, Vt-We don’t use the term fetal distress. Rather, we have instituted a broad definition for a nonassuring pattern. Decreased long-term variability, repetitive (or any suggestion of late) decelerations, a sinusoidal FHR pattern, or repetitive severe variations, beat to beat.

Leslie Breiten, MD, Binghamton, NY-Fetal distress to me is a FHR of <100 bpm for >60 seconds.

Timothy P. Canavan, MD, Lancaster, Pa-We define fetal distress as a deceleration of the fetal heart rate to 60 bpm for >2 minutes, unresponsive to medical management such as a change in maternal position, C2, or intravenous fluids, in the face of a medically compromised fetus or abnormal labor; or a deceleration =60 bpm for greater than 5 minutes, unresponsive to medical management, in a normal fetus and normal labor.

Joel Cohen, MD, Pleasanton, Calif-Fetal distress is fetal bradycardia that doesn’t respond to intrauterine resuscitation attempts.

June Williams Colman, MD, Houston, Tex-We define fetal distress as the presence of late decelerations in >60% of the contractions in a 30-minute period, with decelerations not resolving with intrauterine resuscitation. Also, we believe there is fetal distress when there are deep variabilities >60 bpm below baseline, and they do not respond to resuscitation.

Robert Cowan, MD, Austin, Tex-Repetitive late decelerations or one prolonged fetal bradycardiac episode indicates fetal distress to us. We have the nurses call us when the FHR tracing shows repetitive, late decelerations; prolonged fetal bradycardia; or deep, variable decelerations.

Joseph H. Cutchin, Jr. MD, Salisbury, Md.-To me, fetal distress is a term used by the legal profession after an obstetrician has a bad outcome. I have been practicing obstetrics for 30 years and I still do not know what fetal distress is, nor have I seen any studies that define it.

Mary S. David, MD, Dyersburg, Tenn-We define fetal stress and try to avoid distress. The nurse should call me if she is worried or if the FHR tracing shows severe variabilities, bradycardia, decreased variability, or late decelerations.

Robert Grover, MD, Bangor, Me-Fetal distress is repetitive severe decelerations (<60 bpm, >60 seconds); persistent fetal tachycardia (>160 bpm) with the loss of beat-to-beat variability; or persistent late deceleration and loss of
Definitions

• “To me, fetal distress is a term used by the legal profession after an obstetrician has a bad outcome. I have been practicing obstetrics for 30 years and I still do not know what fetal distress is, nor have I seen any studies that define it.”

• “We define fetal distress as the presence of late decelerations in >50% of the contractions in a 30-minute period, with decelerations not resolving with intrauterine resuscitation. Also, we believe there is fetal distress when there are deep variables >60 bpm below baseline, and they do not respond to resuscitation.”
Definitions

• “Fetal distress is fetal bradycardia that doesn't respond to intrauterine resuscitation attempts.”

• “Fetal distress to me is a FHR of <100 bpm for >60 seconds.”

• “We don't use the term fetal distress. Rather, we have instituted a broad definition for a nonreassuring pattern: Decreased long-term variability, repetitive (or any suggestion of late) decelerations, a sinusoidal FHR pattern, or repetitive severe variations, beat to beat.”

• “Fetal distress is repetitive severe decelerations (<60 bpm, >60 seconds); persistent fetal tachycardia (>160 bpm) with the loss of beat-to-beat variability; or persistent late deceleration and loss of variability. We've had instances of being called by overanxious or excessively worried nurses, and of not being called by those who are overconfident. We need some standardization to help prevent an increase in cesarean sections for fetal distress.”
Three-Tier Fetal Heart Rate System

Category III

- Category III FHR tracings include:
  - Absent baseline FHR variability and any of the following:
    - Recurrent late decelerations
    - Recurrent variable decelerations
    - Bradycardia
    - Sinusoidal pattern

Macones et al, Obstet Gynecol, 2008
Category III

- Predictive of abnormal fetal acid-base status
- Require prompt evaluation
- Attempt to quickly resolve the abnormal FHR pattern
- May include maternal oxygen, change in maternal position, discontinuation of labor stimulation, treatment of hypotension

Macones et al, Obstet Gynecol, 2008
Three-Tier Fetal Heart Rate System

Category I

- Baseline rate: 110-160 bpm
- Baseline FHR variability: Moderate
- Late or variable decelerations: Absent
- Early decelerations: Present or Absent
- Accelerations: Present or Absent

Macones et al, Obstet Gynecol, 2008
FHR Category Interpretation

Category I

• Predictive of normal fetal acid-base status
• Follow in routine manner
• No specific intervention required

Macones et al, Obstet Gynecol, 2008
FHR Category Interpretation

Category II

- Indeterminate
- Not predictive of abnormal fetal acid-base status
- Requires evaluation, continued surveillance, and reevaluation
- Need to account for associated clinical circumstances

Macones et al, Obstet Gynecol, 2008
Main Point #1

- FHT is a poor screening tool to identify fetal acidemia

In most cases:
An abnormal fetal heart rate does not equal metabolic acidemia
FHR Monitoring at Intermountain Healthcare

- All patients on L&D have FHR assessment recorded in “Storkbytes”
- FHR tracing is evaluated every 20 minutes
- Recorded at bedside workstation:
  - Baseline
  - Variability
    (absent, minimal, moderate, marked)
  - Presence or absence of decels and accels
  - Presence of tachysystole
Intermountain FHR Dataset

- 50,635 patients
- 27,639,853 minutes of FHR monitoring
- Average time in labor 9.1 hours
- Mean age 26.9 years
- Ethnicity:
  - 81.3% White
  - 12.2% Hispanic
- Parity:
  - Nullipara 54.9%
  - Multipara 45.1%
- Married 82.5%
- Tobacco use 3.2%
• What are the relative frequencies of the three FHR Categories in term labor?
FHR Category Distribution

• 14.1% patients were in Category I for their entire labor
• 0.5% patients were in Category II for their entire labor
• About 85% of patients spend time in both Category I and Category II
• Only 58 (0.11%) spent time in Category III
  • 1 in 874

Jackson et al, Obstet Gynecol, 2011
Conclusions:

- The large majority of patients spend time in Cat I and Cat II
- The proportion of time in Cat II increases significantly in the Last 2 Hours of Labor
- Category III is exceedingly rare during singleton term labor

Jackson et al, 2011
• Do the NICHD FHR categories really predict outcome?

• How bad are the outcomes with Category III FHR?
Category III FHR

- 7 patients were identified at IMC in 2008
- Reviewed FHR tracings for all babies with adverse outcome to determine if any FHR categories were improperly assigned
  - None were incorrectly assigned

Denney et al, Abstract 561, SMFM 2010
Category III FHR

- 86% had AP complication and FHR testing
- 86% delivered by Cesarean section
- Newborn outcomes:
  - 43% had 5-min Apgar < 7
  - 57% admitted to NICU
  - 100% Arterial cord pH ≤ 7.20 (6/6)
  - 14% Neonatal seizures
  - 57% Hospitalized ≥ 7 days
  - All newborns had at least two complications, including the above plus mec aspiration, sepsis, and O2 need

Denney et al, Abstract 561, SMFM 2010
• How can you tell “good” Category II from “bad” Category II FHR tracings?
Category II

- We sought to describe fetal heart rate tracing characteristics associated with Category II, specifically those related to adverse neonatal outcomes.
- Category II tracings were comprised of 45 different characteristic combinations.
### Most Common FHR Tracing Combinations Making Up Category II

<table>
<thead>
<tr>
<th>Category II Characteristic</th>
<th>Time Spent (minutes)</th>
<th>% of Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variable Decelerations (non recurrent)</td>
<td>134939.7</td>
<td>83.8%</td>
</tr>
<tr>
<td>Late Decelerations (non recurrent)</td>
<td>4826.3</td>
<td>3.0%</td>
</tr>
<tr>
<td>Tachycardia</td>
<td>3125.7</td>
<td>1.9%</td>
</tr>
<tr>
<td>Prolonged bradycardia</td>
<td>2653.2</td>
<td>1.7%</td>
</tr>
<tr>
<td>Absent variability</td>
<td>8.1</td>
<td>0.005%</td>
</tr>
<tr>
<td>Minimal variability</td>
<td>3420.5</td>
<td>2.1%</td>
</tr>
<tr>
<td>Marked variability</td>
<td>1896.9</td>
<td>1.2%</td>
</tr>
<tr>
<td>Variable decelerations and minimal variability</td>
<td>1108.5</td>
<td>0.7%</td>
</tr>
<tr>
<td>Variable decelerations and late decelerations</td>
<td>1419.8</td>
<td>0.9%</td>
</tr>
</tbody>
</table>

Holmgren et al, Abstract 669, SMFM 2010
• Isolated variable decelerations were the most common fetal heart rate tracing characteristic associated with Category II
• 85% of the patients with adverse outcome had more than one FHR tracing characteristic associated with Category II
• Decelerations with minimal variability were the characteristics most often associated with a pH < 7.10

Holmgren et. al, Abstract 669, SMFM 2010
What We Learned....

- Category II is a problem
  - Really broad, very heterogenous
- Hard to account for time
- All fetuses are not the same
- Other intrapartum concerns:
  - Meconium
  - Chorioamnionitis
  - Contractions
Main Point #2

- No single feature of the fetal heart rate reliably predicts metabolic acidemia.

Moderate variability and the presence of accelerations predict the **absence** of metabolic acidemia.

Increasing numbers of abnormal findings are associated with a higher Probability of fetal acidemia.
Diagnostic Accuracy of EFM

- Retrospective study
  - Cases (39) had HIE
  - Controls (78) normal pH
- 3 reviewers read last hour of tracing
  - Assigned characteristics and categories
  - Calculated the debt 30 and debt 60
- \( \frac{1}{2} \times \text{width} \times \text{depth of variables} \) essentially how long and severe are the variables

## Fetal heart rate characteristics in the last hour monitoring prior to delivery

<table>
<thead>
<tr>
<th>Category</th>
<th>Cases n=39</th>
<th>Controls n=78</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>4 (10.3%)</td>
<td>7 (9.0%)</td>
<td>0.18</td>
</tr>
<tr>
<td>II</td>
<td>30 (76.9%)</td>
<td>70 (89.7%)</td>
<td></td>
</tr>
<tr>
<td>III</td>
<td>5 (12.8%)</td>
<td>1 (1.3%)</td>
<td></td>
</tr>
<tr>
<td>Baseline (bpm)</td>
<td>148±18</td>
<td>141±14</td>
<td>0.054</td>
</tr>
<tr>
<td>Time baseline &gt; 160 bpm (min)</td>
<td>0, 0</td>
<td>0, 0</td>
<td>0.11</td>
</tr>
<tr>
<td>Time baseline &lt; 110 bpm (min)</td>
<td>0, 2</td>
<td>0, 0</td>
<td>0.22</td>
</tr>
<tr>
<td>Decreased variability</td>
<td>13 (33.3%)</td>
<td>15 (19.2%)</td>
<td>0.17</td>
</tr>
<tr>
<td>Reactive</td>
<td>16 (41.0%)</td>
<td>48 (61.5%)</td>
<td>0.047*</td>
</tr>
<tr>
<td>Accelerations</td>
<td>1, 3</td>
<td>2, 4</td>
<td>0.34</td>
</tr>
<tr>
<td>Total Decelerations</td>
<td>8, 11</td>
<td>6, 7</td>
<td>0.18</td>
</tr>
<tr>
<td>Late decelerations</td>
<td>1, 6</td>
<td>1, 2</td>
<td>0.01*</td>
</tr>
<tr>
<td>Variable decelerations</td>
<td>3, 5</td>
<td>3, 4</td>
<td>0.85</td>
</tr>
<tr>
<td>Severe variables</td>
<td>0, 1</td>
<td>0, 0</td>
<td>0.50</td>
</tr>
<tr>
<td>Early decelerations</td>
<td>0, 0</td>
<td>0, 1</td>
<td>0.06</td>
</tr>
<tr>
<td>Prolonged decelerations</td>
<td>1, 1</td>
<td>0, 1</td>
<td>0.11</td>
</tr>
<tr>
<td>Nadir (bpm)</td>
<td>62, 29</td>
<td>70, 35</td>
<td>0.60</td>
</tr>
<tr>
<td>Length (min)</td>
<td>4, 3</td>
<td>3, 3</td>
<td>0.17</td>
</tr>
<tr>
<td>Contractions/Hour</td>
<td>16.5±9.8</td>
<td>16.9±7.7</td>
<td>0.80</td>
</tr>
<tr>
<td>Lates/Contraction</td>
<td>0.1, 0.3</td>
<td>0, 0</td>
<td>0.21</td>
</tr>
<tr>
<td>Variables/Contraction</td>
<td>0.2, 0.4</td>
<td>0, 0.2</td>
<td>0.48</td>
</tr>
<tr>
<td>Debt 30 (sec bpm)</td>
<td>9,458; 14,019</td>
<td>3,942; 6,630</td>
<td>0.008*</td>
</tr>
<tr>
<td>Debt 60 (sec bpm)</td>
<td>13,347; 20,612</td>
<td>6,082; 8,871</td>
<td>0.003*</td>
</tr>
</tbody>
</table>

* indicates P < 0.05
FHR Tracings and Acidemia

- Moderate variability predicts pH > 7.15
  - Negative predictive value 98%

- Minimal/absent variability AND decels associated with pH < 7.15
  - Though predictive value still poor (23%)

- Likelihood of acidemia increases with depth of recurrent decelerations
  - Especially late and with min/absent variability

Category II with Meconium

- Meconium incidence ~12-16% overall
  - ~20-30% after 41 weeks
- Category II FHR tracings*
  - About 1 in 5 will have meconium (21%)

*For ≥40’ of the last 60’ before delivery
Category II with Meconium

<table>
<thead>
<tr>
<th>Variable</th>
<th>Sensitivity, %</th>
<th>Specificity, %</th>
<th>Positive predictive value, %</th>
<th>Negative predictive value, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meconium</td>
<td>38.4</td>
<td>80.0</td>
<td>12.1</td>
<td>94.7</td>
</tr>
<tr>
<td>Meconium + tachycardia</td>
<td>27.4</td>
<td>88.9</td>
<td>25.6</td>
<td>89.9</td>
</tr>
<tr>
<td>Meconium + absent accelerations</td>
<td>84.5</td>
<td>28.1</td>
<td>13.9</td>
<td>92.9</td>
</tr>
<tr>
<td>Meconium tachycardia + absent accelerations</td>
<td>26.2</td>
<td>91.2</td>
<td>29.3</td>
<td>89.9</td>
</tr>
</tbody>
</table>

a For the prediction of adverse neonatal outcome in pregnancies with category II fetal heart rate tracing.

Non-reassuring FHT

• 3 Scenarios
  • Gradual evolution and development of acidemia
    • Recurrent decelerations represent intermittent blockage of flow of O2 to the fetus
  • Sudden, catastrophic event that causes prolonged deceleration
  • A combination
Main Point #3

- Metabolic acidemia is an evolving process that should have an identifiable progression
Evolving Fetal Compromise

- Recurrent variable/late decelerations
- Progressively deeper decelerations
- Reflexive fetal tachycardia (+/-)
- Progressive reduction in variability moderate to minimal to absent
- Terminal bradycardia

What To Do

• Step 1 – Determine the status of the fetus and need for immediate delivery

• Step 2 – Identify and correct potential causes

• Step 3 – Assess and overcome obstacles to delivery
Step 1 Slowly Evolving Process

- What is the current fetal status and is immediate delivery needed?
- For slowly evolving acidemia, when was the last time you were reassured
- When was there moderate variability or accelerations
- What is the risk of further evolution
- Preexisting IDDM, Pree, IUGR
Timecourse to Acidemia

- With minimal/absent variability and recurrent decelerations, acidemia evolves over ~60 minutes.
- In the setting of a visibly normal tracing, acidemia can occur quickly with acute events such as abruptio placentae, uterine rupture, cord prolapse.
- Sudden and profound fetal bradycardia is a hallmark.

Evidence is limited but general expert consensus is “about one hour”.

Low JA Obstet Gynecol 1999;93:85-91
Williams KP Am J Obstet Gynecol 2003;188:820-3
Eilimian A Obstet Gynecol 1997;89:373-6
Clark S Am J Obstet Gynecol 1982
Step 1 – Sudden Prolonged Deceleration

- What is the current fetal status and is immediate delivery needed?
- For sudden prolonged deceleration, What was happening right before?
- How long have FHT been down?
Sudden Prolonged Deceleration

- Timing of delivery
  - Remember the 'Rule of 3' for fetal bradycardia:
    - 3 minutes – call for help
    - 6 minutes – move to operating room
    - 9 minutes – prepare for assisted/operative delivery
    - 10-12 minutes – aim to deliver the baby

For decelerations > 10 minutes move immediately to delivery regardless of cause
Step 2 – Slowly Evolving Process

- Identify potential causes
  - Maternal hypoxia
  - Maternal hypotension
  - Tachysytole
  - Placental dysfunction
- Correct potential causes
“A B C D”

A: Assess oxygen delivery
B: Begin corrective measures
C: Clear obstacles to rapid delivery
D: Decision to delivery time
Oxygen transfer can be interrupted at any point along this pathway.

Variable decelerations

Late decelerations

FETUS
## A and B

<table>
<thead>
<tr>
<th>Oxygen Transfer Pathway</th>
<th>“A” Assess Oxygen Delivery</th>
<th>“B” Begin Corrective Measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lungs</td>
<td>Airway/breathing</td>
<td>Supplemental oxygen</td>
</tr>
<tr>
<td>Heart/Vascular</td>
<td>Heart rate, BP, Volume status, caval compression</td>
<td>Correct hypotension/hypovolemia, position change</td>
</tr>
<tr>
<td>Uterus</td>
<td>UC frequency, strength, basal tone, consider risk of uterine rupture</td>
<td>Stop/reduce uterine stimulation, alter pushing strategy, tocolysis</td>
</tr>
<tr>
<td>Placenta</td>
<td>Consider abruption</td>
<td></td>
</tr>
<tr>
<td>Cord</td>
<td>SVE to exclude cord prolapse</td>
<td>Amnioinfusion</td>
</tr>
</tbody>
</table>

Step 2 – Sudden Prolonged Deceleration

- Identify potential causes
  - Amenable to treatment
    - Maternal hypotension
    - Tachysystole
    - Cord occlusion
  - Not amenable to in utero resuscitation
    - AFE
    - Abruption
    - Cord Prolapse
Step 3

- Assess and overcome obstacles to delivery
- Can vaginal delivery be accomplished before significant acidemia develops?
  - Where did you start from?
  - How long has the process been going on?
  - How long will it take to perform an operative delivery?
### C and D

<table>
<thead>
<tr>
<th>Variables to Consider</th>
<th>“C” Clear Obstacles to Rapid Delivery</th>
<th>“D” Determine Decision to Delivery Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Facility</td>
<td>OR availability</td>
<td>Anticipate response time</td>
</tr>
<tr>
<td>Staff</td>
<td>Notifications: OB, Anesthesia, Peds, OR staff</td>
<td>Staff availability, training, experience</td>
</tr>
<tr>
<td>Mother</td>
<td>Consent, IV access, anesthesia, labs, foley</td>
<td>BMI, parity, prior surgery, willingness</td>
</tr>
<tr>
<td>Fetus</td>
<td>Assess EFW, presentation, position</td>
<td>EFW, position</td>
</tr>
<tr>
<td>Labor</td>
<td>IUPC to better assess FHR tracing, power</td>
<td>Progress, expulsive efforts</td>
</tr>
</tbody>
</table>

### ACOG Algorithm

#### Category I
- **Surveillance**
  - "Low risk" 1st stage q 30 min, 2nd stage q 15 min
  - "High risk" 1st stage q 15 min, 2nd stage q 5 min

#### Category II AND Category II - III
- **Conservative Measures “A & B”**
  - Assess Oxygen Pathway:
    - Lungs
    - Heart
    - Vasculature
    - Uterus
    - Placenta
    - Cord
  - Begin Corrective Measures:
    - Supplemental oxygen
    - Position change
    - Fluid bolus
    - Correct hypotension
    - Stop/reduce uterine stimulant
    - Consider uterine relaxant
    - Consider amnioinfusion

- **Clear obstacles to delivery**
  - Facility
  - Staff
  - Mother
  - Fetus
  - Labor

- **Prepare for Delivery “C & D”**

- **Delivery Decision**
  - Is immediate delivery indicated? No
  
  - Evolution of metabolic acidemia ~ 60 min
  - Subtract 50% safety margin ~ 30 min
  - Subtract “decision-delivery estimate” ~ X min
  - Allow the remaining time for vaginal delivery or correction of the FHR tracing

  - If vaginal delivery does not occur in this time frame and the FHR abnormalities have not been corrected, it is reasonable to offer operative delivery

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Summary General Approach

• Recognize potential for fetal compromise –
  • what are the specific risk factors
  • Is there evidence of acidemia already
  • Is there continuing hypoxemia

• Attempt to improve oxygen delivery
  • Begin corrective measures

• Anticipate time to delivery
  • “Do you think she can do it???”
    • Parity, labor progress, fetal size/station/position, etc

• Account for potential complicating factors
  • time to mobilize care teams (operative delivery)
  • maternal factors (BMI, prior surgery, willingness)