Introduction to Fetal Monitoring

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Learning Objectives

• Describe the components of a fetal heart rate pattern: baseline, variability, accelerations, decelerations, and uterine activity

• Identify different methods for monitoring fetal heart rate and uterine activity

• Discuss NICHD terminology to promote a common language in communicating fetal monitoring information within the health care team

• Discuss physiologic interventions to maximize uterine, uteroplacental, and umbilical blood flow and oxygenation

Options for Monitoring

• Intermittent
  – Auscultation
  – Palpation

• Continuous
  – External monitoring
  – Internal monitoring

Doppler

Auscultation: Doppler

• Audible characteristics of fetal heart rate
  – Baseline
  – Rhythm
  – Increases and decreases from baseline

• Requires listening, counting, and practice

Doppler: How-To

• Palpate maternal abdomen (Leopold’s Maneuvers)

• Place Doppler at point of maximal sound intensity
  – Curved part of fetus (over fetal back), closest to anterior uterine wall

• Monitor maternal radial pulse simultaneously
Auscultation: Benefits and Limitations

<table>
<thead>
<tr>
<th>Pros</th>
<th>Cons</th>
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</thead>
<tbody>
<tr>
<td>Comparable neonatal outcomes to using EFM.</td>
<td>Cannot assess variability and types of decelerations.</td>
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<tr>
<td>More freedom of movement and ambulation.</td>
<td>Requires education, practice, and skill in auditory assessment.</td>
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<tr>
<td>Non-invasive</td>
<td>Can pick up maternal heart rate with fetal demise</td>
</tr>
<tr>
<td>Allows for hands-on time and one-to-one patient care</td>
<td>May feel more intrusive for some patients due to frequency of auscultation</td>
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Continuous Monitoring

- Provides visual tool to identify/monitor fetal and maternal information

- External monitors
  - Ultrasound Transducer (US)
  - Tocodynamometer (TOCO)

- Internal monitors
  - Fetal scalp electrode (FSE)
  - Intrauterine pressure catheter (IUPC)

Fetal Monitor

Fetal Heart Monitor: Graph Paper

Each small box = 10 seconds
Each large box = 60 seconds

Continuous External Fetal Monitoring: Benefits and Limitations

<table>
<thead>
<tr>
<th>Benefits</th>
<th>Limitations</th>
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</thead>
<tbody>
<tr>
<td>Non-invasive*</td>
<td>Restricts patient movement*</td>
</tr>
<tr>
<td>Shows variability in fetal heart rate</td>
<td>Measures cardiac motion, not electrical activity</td>
</tr>
<tr>
<td>Potentially less labor-intensive for staff*</td>
<td>May measure maternal heart rate instead of fetal heart rate</td>
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<tr>
<td>Creates paper record of fetal heart rate</td>
<td>May double or halve fetal heart rate</td>
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External Monitoring
Ultrasound Transducer (US)

- Noninvasive
- Motion detector
- Antepartum and intrapartum use
- Continuous recording of HR
- May limit mobility*
- Assesses baseline, variability, accelerations, and decelerations
- May record maternal heart rate if positioned improperly

Uterine Tocodynamometer (TOCO)

- Assesses frequency, duration of contraction
- Does NOT assess strength
- Appropriate for second or third trimester
- Non-invasive
- Requires proper placement
- May be difficult to use in obese women

Internal Monitoring

Intrauterine Pressure Catheter (IUPC)

- Invasive
- May be transducer tipped or fluid filled
- Assesses intrauterine pressure in mmHg — Montevideo Units (MVUs)
- Risks with insertion
- Risks of infection or hemorrhage
- Patient education
Fetal Scalp Electrode (FSE)

- Used when direct fetal ECG essential
- Counts fetal R-R intervals
- Potential for fetal infection (HIV/HBV, HSV)
- Allows for maternal movement
- May record maternal pulse in absence of FHR

FSE (cont.)

- Requires skill for insertion
- Invasive
- Placed over bony surfaces or buttocks
  - No face, fontanelles, or genitalia
- Used with sticky leg plate or US gel
- Patient education

1997

- NICHD recommended terminology changes to define fetal heart rate characteristics
  (published by ACOG/AWHONN)

  Allows the predictive value of monitoring to be assessed more meaningfully and to allow evidence based clinical management of intrapartum fetal compromise

Evaluating the Fetal Heart Rate

- Uterine activity
- Baseline
- Variability
- Accelerations
- Decelerations

Uterine Activity

- Frequency
  - Assess from beginning of contraction to beginning of next contraction
  - Normal: ≤ 5 contractions in 10 minutes, averaged over a 30 minute window
  - Tachysystole: >5 contractions in 10 minutes, averaged over a 30 minute window
- Duration
- Intensity
  - Mild
  - Moderate
  - Firm
  - Resting tone
FHR: Baseline

- Approximately average or mean heart rate rounded to nearest 5 beats per minute (bpm) during a 10 minute segment
- Normal: 110-160 beats per minute (bpm)
- Excludes changes in baseline
  - Periodic changes = with a contraction
  - Episodic changes = independent of uterine activity
  - Periods of marked variability

- Need at least 2 minutes in a 10 minute window of time to document baseline
  - Otherwise, baseline is indeterminate and may require further monitoring

Fetal Tachycardia

- Baseline > 160 bpm over 10 minutes
- Maternal causes
  - Fever
  - Infection
  - Dehydration
  - Illicit substance use
- Fetal causes
  - Hypoxia
  - Infection or sepsis
  - Anemia
  - Cardiac arrhythmias
  - Prolonged stimulation

Fetal Bradycardia

- Baseline <110 bpm for more than 10 minutes
- Baseline 90-110 with moderate variability often well-tolerated
- Potential causes
  - Maternal medications (beta-blockers)
  - Hypothermia
  - Change in maternal-fetal oxygen status
    - Prolapsed cord
    - Uterine rupture for TOLAC
    - Maternal hypotension following epidural
    - Fetal/uterine abruption
    - Maternal seizure
FHR: Variability

- Visual assessment of the amplitude of short and long term complexes
- Looking at how “rough” the FHR line is
- Most accurate predictor of fetal oxygenation and neurological well-being during labor
- Not measured during accelerations or decelerations

FHR: Moderate Variability

- Amplitude rate between 6-25 bpm
- Looks like jagged, unpredictable line
- Represents intact nervous system
- No intervention required

FHR: Minimal variability

- Amplitude range detectable, but ≤ 5 bpm
  - May still have some jagged and unpredictable qualities
- Requires further monitoring and possible intervention

FHR: Absent Variability

- Undetectable changes in fetal heart rate
- Looks like a flat line
- May indicate fetal metabolic acidemia or a pre-existing neurological insult
- Requires intervention

FHR: Marked Variability

- Amplitude range > 25 bpm
- Often indicates an acute episode of mild fetal hypoxia
- Line appears jagged and chaotic
- May require intervention

FHR: Variability (cont.)

<table>
<thead>
<tr>
<th>Increased Variability</th>
<th>Decreased Variability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fetal stimulation</td>
<td>Fetal sleep</td>
</tr>
<tr>
<td>Mild hypoxia</td>
<td>Prematurity</td>
</tr>
<tr>
<td>Maternal drugs</td>
<td>Maternal medications</td>
</tr>
<tr>
<td>Artifact</td>
<td>Fetal anomalies</td>
</tr>
<tr>
<td></td>
<td>Cardiac dysrythmias</td>
</tr>
<tr>
<td></td>
<td>Fetal hypoxia</td>
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Medications and FHR

- Narcotics
  - Decrease in variability and accelerations
- Magnesium Sulfate
  - Decrease in variability
  - Inhibits increase in accelerations in advancing gestational age
- Terbutaline
  - Increase in FHR baseline and incidence of fetal tachycardia
- Steroids
  - Decreased variability

FHR: Patterns

- Accelerations and decelerations categorized as either **periodic** or **episodic**
- **Periodic** patterns are associated with uterine contractions
- **Episodic** patterns are not associated with uterine contractions

FHR: Accelerations

- Visually apparent abrupt increases in fetal heart rate above the baseline
  - Onset to peak in < 30 seconds
- **Age** matters
  - > 32 weeks gestation
    - 15 bpm above baseline, lasting at least 15 seconds
  - < 32 weeks gestation
    - 10 bpm above baseline, lasting at least 10 seconds
- Indicates adequate oxygenation at time of acceleration
- Fetal sympathetic stimulation
- If occurring with contractions, may indicate umbilical cord venous compression

FHR: Decelerations

- Four types
  - Early
  - Late
  - Variable
  - Prolonged
- **Frequency**
  - Recurrent: occur with at least 50% of contractions in a 20 minute period
  - Intermittent: occur with less than 50% of contractions in a 20 minute period

Early Decelerations

- Visually apparent, usually symmetrical, gradual decrease and return of the FHR associated with uterine contractions.
- Onset to nadir is > 30 seconds
- In some cases the onset, nadir, and recovery of the deceleration mirror the beginning, peak, and ending of the contraction.
Late Decelerations

- Visually apparent usually symmetrical gradual decrease and return of FHR associated with a uterine contraction.
- Onset, nadir, and recovery of the deceleration typically occur after the beginning, peak, and ending of the contraction.
- Caused by uteroplacental insufficiency.
- Requires intervention.

Late Decelerations: Interventions

- Maternal position change
- IV fluid bolus
- Decrease uterine activity
- Oxygen*
- Notify provider
- Prepare for operative delivery if unable to correct

Variable Decelerations

- Visually apparent abrupt decrease in FHR below baseline
- The decrease in FHR is at least 15 bpm, lasting at least 15 seconds, and is less than 2 minutes in duration.
- Most commonly caused by umbilical cord compression
- Requires further monitoring and likely intervention

Variable Decelerations: Interventions

- Maternal position change
- SVE to rule out cord prolapse
- Amnioinfusion
- Decrease uterine contractions
- Alter pushing techniques
- Oxygen*
- Notify provider

Prolonged Deceleration

- Visually apparent decrease in FHR from the baseline that is at least 15 bpm, lasting more than 2 minutes, but less than 10 minutes before returning to baseline.
- Requires intervention.
Just remember... VEAL CHOP

<table>
<thead>
<tr>
<th>Decelerations</th>
<th>Cause</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variable decelerations</td>
<td>Cord compression</td>
</tr>
<tr>
<td>Early decelerations</td>
<td>Head compression</td>
</tr>
<tr>
<td>Accelerations</td>
<td>O.K.</td>
</tr>
<tr>
<td>Late decelerations</td>
<td>Placental insufficiency</td>
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</table>

Unusual FHR Characteristics: Sinusoidal Rhythm

- A smooth, sine wave-like undulating pattern in FHR baseline
- Can indicate severe fetal hypoxia, anemia, or recent maternal narcotic use
- Requires prompt intervention

Uterine Contractions

- Normal
  - Five or less contractions
- Tachysystole
  - More than five contractions in 10 minutes
  - Note presence (or absence) of decelerations
  - Applies to both spontaneous or induced contractions

NICHD Categories

- Method for standardizing communication among all caregivers
- Applies to LABOR
  - Category I
  - Category II
  - Category III

Category I: Normal

- Baseline: 110-160 bpm
- Moderate variability
- Early decelerations may be present or absent
- No variable or late decelerations
- Accelerations may be present or absent
Category I (cont.)

• Strongly predictive of normal fetal acid-base status at the time of observation
• Routine management

Category II: Indeterminate

• Anything not in Category I or Category III
• Baseline: bradycardia with variability or fetal tachycardia
• Variability: minimal, absent without recurrent decelerations, marked variability
• Absence of accelerations after scalp stimulation
• Periodic or episodic decelerations

Category II (cont.)

• Not predictive of abnormal fetal acid-base status
• Requires further surveillance, evaluation, and re-evaluation and the context of the entire clinical circumstances

Category III: Abnormal

• Absent variability and
  — Recurrent late decelerations OR
  — Recurrent variable decelerations OR
  — Fetal bradycardia
• Sinusoidal pattern

Category III (cont.)

• Predictive of abnormal fetal acid-base status at time of observation
• Requires prompt evaluation and intervention
  — Maternal position change
  — Decreasing uterine contractions
  — IV fluid bolus
  — Prepare for operative delivery
FHR and Fetal Acidemia
(Parer et al, JMF&N Medicine, 2006)

- Moderate variability in association with recurrent decelerations of any type and/or second stage bradycardia
  - 98% associated with fetal pH > 7.15 mEq/L and 5 minute Apgar of > 7
- Minimal or less FHR variability with decelerations has 23% association with pH < 7.15 or 5 minute Apgar < 7

Parer et al, JMF&N Medicine, 2006 (cont.)

- Likelihood of acidemia increases with depth of decelerations, especially with late decelerations, and with minimal variability
- Potentially hazardous acidemia develops over an hour or more in a fetus whose pattern evolves from normal to abnormal with decreased variability

References


