Introduction to Fetal Monitoring

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Learning Objectives

• Identify different methods for monitoring fetal heart rate and uterine activity
• Discuss National Institute of Child Health and Human Development (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
• Describe the components of a fetal heart rate pattern: baseline, variability, accelerations, decelerations, and uterine activity

Options for Monitoring

• Intermittent
  – Auscultation
  – Palpation
• Continuous
  – External monitoring
  – Internal monitoring

Intermittent Auscultation (IA) : Doppler

• Audible characteristics of fetal heart rate
  – Baseline
  – Rhythm
  – Increases and decreases from baseline
• Cannot assess the types of decelerations or variability
• 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
• Evaluate FHR after contractions for 30-60 seconds
• Monitor maternal radial pulse simultaneously
• Document rate, rhythm, increases or decreases in the fetal heart rate

IA: 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>
</tr>
<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>
</tr>
</tbody>
</table>
### Guidelines for Frequency of IA

<table>
<thead>
<tr>
<th>Latent Phase</th>
<th>Active Phase (in minutes)</th>
<th>Second Stage (in minutes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>AWHONN – Low Risk</td>
<td>None given</td>
<td>15-30</td>
</tr>
<tr>
<td>AWHONN – High Risk</td>
<td>None given</td>
<td>15</td>
</tr>
<tr>
<td>ACOG &amp; AAP – Low Risk</td>
<td>None given</td>
<td>30</td>
</tr>
<tr>
<td>ACOG &amp; AAP – High Risk</td>
<td>None given</td>
<td>15</td>
</tr>
</tbody>
</table>

### Electronic Fetal 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 Heart Monitor: Graph Paper

- Records at 3cm/min
- Each small box = 10 seconds
- Each large box = 60 seconds

### Ultrasound Transducer (US)

- Noninvasive
- Motion detector
- Antepartum and intrapartum
- 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

### Continuous External Fetal Monitoring: Benefits and Limitations

<table>
<thead>
<tr>
<th>Benefits</th>
<th>Limitations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-invasive</td>
<td>US may detect maternal heart rate</td>
</tr>
<tr>
<td>US shows variability in fetal heart rate</td>
<td>US may double or halve the fetal heart rate</td>
</tr>
<tr>
<td>Creates permanent record of fetal heart rate and uterine activity</td>
<td>US signal influenced by maternal obesity, fetal position, placental placement</td>
</tr>
<tr>
<td></td>
<td>TOCO unable to detect true intensity and resting tone</td>
</tr>
<tr>
<td></td>
<td>TOCO and US are location sensitive</td>
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<tr>
<td></td>
<td>May restrict patient movement</td>
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</tbody>
</table>
Internal Monitoring

**Maternal/Fetal Anatomy**

Intrauterine Pressure Catheter (IUPC)

- Assesses intrauterine pressure in mmHg
- Montevideo Units (MVUs)
- Allows for amnioinfusion
- Requires skill for insertion
- Risks of infection or hemorrhage
- Patient education

Fetal Scalp Electrode (FSE)

- Monitors electrical activity
- Electronic logic counts fetal R-R intervals in consecutive QRS complexes
- Waveform looks like an irregular horizontal line
- Used with sticky leg plate or gel as grounding pad
- May record maternal pulse in absence of FHR

FSE (cont.)

- Invasive
  - Potential for fetal infection (HIV/HBV, HSV)
  - Requires skill for insertion
  - Placed over bony surfaces or buttocks
    - No face, fontanelles, or genitalia
  - Allows for maternal movement
  - Patient education

Continuous Internal Fetal Monitoring: Benefits and Limitations

<table>
<thead>
<tr>
<th>Benefits</th>
<th>FSE provides continuous detection of FHR</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>FSE not affected by maternal position</td>
</tr>
<tr>
<td></td>
<td>IUPC provides quantitative reading of contraction intensity and resting tone</td>
</tr>
<tr>
<td></td>
<td>Creates permanent record of fetal heart rate and uterine activity</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Limitations</th>
<th>Invasive – requires ROM and cervical dilation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>FSE has small risk for infection or fetal injury</td>
</tr>
<tr>
<td></td>
<td>FSE may record fetal heart rate in fetal demise</td>
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<tr>
<td></td>
<td>IUPC has risk of uterine or placental perforation with placement</td>
</tr>
<tr>
<td></td>
<td>IUPC may become displaced</td>
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<tr>
<td></td>
<td>Maternal position changes may affect reading of IUPC</td>
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</table>

1997

- NICHD recommends 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

- Approximate 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

FHR Baseline (cont.)

- 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 (betablockers)
  - Hypothermia
  - Change in maternal-fetal oxygen status
    - Prolapsed cord
    - Uterine rupture for TOLAC
    - Maternal hypotension following epidural
    - Placental 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

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NICHD Baseline Variability

- Undetectable from baseline
- Absent
- > Undetectable from baseline, ≤ 5 bpm
- Minimal
- 6 – 25 bpm
- Moderate
- > 25 bpm
- Marked

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 dysrhythmias</td>
</tr>
</tbody>
</table>

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

FHR: Accelerations (cont.)

- Indicates adequate oxygenation at time of acceleration
- Fetal sympathetic stimulation
- If occurring with contractions, may indicate umbilical cord venous compression

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

- Steroids
  - Decreased variability
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 a uterine contraction.
- Onset to nadir is > 30 seconds
- In most 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
- Onset to nadir is less than 30 seconds.
- 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</td>
<td>Cord compression</td>
</tr>
<tr>
<td>Early</td>
<td>Head compression</td>
</tr>
<tr>
<td>Accelerations</td>
<td>O.K.</td>
</tr>
<tr>
<td>Late</td>
<td>Placental insufficiency</td>
</tr>
</tbody>
</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 of more in a fetus whose pattern evolves from normal to abnormal with decreased variability

References