References:

- ACOG
- UPTODATE
- SOGC
- Queensland Clinical Guideline: Intrapartum fetal surveillance (IFS)
- The Royal Australian and New Zealand College of Obstetricians and Gynecologists, Intrapartum care
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INTRODUCTION

- Labor (uterine contractions) → repeated interruptions of fetal oxygenation
- FHR pattern: changes in BP, acid-base and blood gases → fetal cardiac and CNS responses
- Inadequate vs appropriately fetal oxygenation
DOES INTRAPARTUM FHR MONITORING IMPROVE OUTCOME?

- Intrapartum death
- Long-term neurologic impairment

For both low- and high-risk pregnancies, continuous electronic FHR monitoring is not clearly superior to intermittent auscultation.
Results of continuous FHR monitoring

- fewer neonatal seizures
- no differences in long-term neurologic outcomes
- more operative vaginal and cesarean deliveries
- fewer spontaneous vaginal births
Limitations of the data

- Number and quality of studies
- Many cases of cerebral palsy are due to antepartum, rather than intrapartum.
- Perinatal deaths attributed to fetal hypoxia was significantly less common.
CANDIDATES FOR INTRAPARTUM FETAL MONITORING

- ACOG:
  - Either continuous monitoring or intermittent auscultation is acceptable in uncomplicated patients.
  - High-risk pregnancies (eg, preeclampsia, suspected growth restriction, type 1 diabetes mellitus) should be monitored continuously.
CANDIDATES FOR INTRAPARTUM FETAL MONITORING

- NIH:
  • In all birth settings, offer intermittent auscultation to low-risk women in the first stage of labor.
  • Advise continuous CTG if any of the following risk factors occur during labor:
    - Suspected chorioamnionitis, sepsis, or temperature \( \geq 38^\circ C \)
    - Severe hypertension (\( \geq 160/110 \) mmHg)
    - Oxytocin use
    - Significant meconium
    - Fresh vaginal bleeding
  • If continuous CTG was used because of concerns arising from intermittent auscultation but the tracing is normal after 20 minutes of observation, remove the CTG and return to intermittent auscultation.
Frequency and duration of monitoring

- "labor admission test"
Frequency and duration of monitoring

- Continuous monitoring:
  - low-risk: continuously monitor the FHR when possible (ie, patient is not ambulating, bathing, etc) and review:
    1. **active phase**: at least every 30 minutes
    2. **second stage**: at least every 15 minutes
  - high-risk: continuously monitor and review:
    1. **active phase**: at least every 15 minutes
    2. **second stage**: at least every 5 minutes
Frequency and duration of monitoring

- **Intermittent auscultation:** evaluate, and record the FHR **during and immediately after a uterine contraction.**
  1. **active phase:** at least every 30 minutes
  2. **second stage:** at least every 15 minutes
- If risk factors for fetal compromise are present:
  1. **active phase:** at least every 15 minutes
  2. **second stage:** at least every 5 minutes
CTG interpretation

1. Baseline FHR
2. Variability
   • Sinusoidal pattern
3. Cyclic changes:
   • Accelerations
   • Decelerations
Baseline FHR

A normal baseline FHR is 110 to 160 bpm

- **Bradycardia**: Maternal beta blocker therapy, Hypothermia, Hypoglycemia, Hypothyroidism, Fetal heart block, Interruption of fetal oxygenation

- **Tachycardia**: Maternal fever, Infection, Medications, Hyperthyroidism, Elevated catecholamines, Fetal anemia, Arrhythmia, Interruption of fetal oxygenation
Variability

- FHR variability is the result of integrated activity between the sympathetic and parasympathetic branches of the autonomic nervous system.
- Moderate baseline variability reflects the oxygenation of the central nervous system. However, the converse is not true.
- Minimal or absent variability alone is a poor predictor of fetal metabolic acidemia or hypoxic injury.
Variability

**Minimal or absent variability**
- Fetal sleep cycle
- Arrhythmia
- Medications
  - Extreme prematurity
  - Congenital anomalies
  - Preexisting neurologic injury

**Increased variability**
- Its significance is unknown
- May be response to transient interruption of fetal oxygenation
The absence of accelerations is a poor predictor of fetal metabolic acidemia or hypoxic injury
Early deceleration

- Autonomic response to changes in intracranial pressure and/or cerebral blood flow caused by intrapartum compression of the fetal head during a uterine contraction and maternal expulsive efforts
- Benign: They are not associated with an interruption of fetal oxygenation, metabolic acidemia, or hypoxic-ischemic neurologic injury.
Late deceleration

- A reflex fetal response to transient hypoxemia during a uterine contraction.
- Late decelerations related to severe hypoxemia, metabolic acidemia, and myocardial depression increase the risk of adverse neonatal outcome.
- Recurrent late decelerations with absent/minimal variability and no accelerations require prompt attention.
Variable deceleration

- A fetal autonomic reflex response to transient mechanical compression of the umbilical cord
- Recurrent variable decelerations with absent/minimal variability and no accelerations prompt attention is required because ongoing hypoxic injury cannot be excluded by the tracing alone
Prolonged deceleration

- A fall in FHR by $\geq 15$ bpm, lasting $\geq 2$ but $< 10$ minutes.
- Same physiologic mechanisms responsible for late or variable decelerations, but interruption of fetal oxygenation occurs for a longer period of time.
- Absent/minimal variability and no accelerations require prompt attention.
- If the fall in FHR lasts $\geq 10$ minutes, it is defined as a baseline change.
- A baseline change with absent/minimal variability and no accelerations requires prompt attention.
Sinusoidal pattern

- A smooth, sine-wave like undulating pattern in FHR baseline with a cycle frequency of three to five cycles per minute that persists for at least 20 minutes.
- Is associated with severe fetal anemia and administration of opioids.
## NICHD Classification

### Category I
- A baseline FHR of 110 to 160 bpm
- Moderate FHR variability (6 to 25 bpm)
- Absence of late or variable FHR decelerations
- Early decelerations may or may not be present
- Accelerations may or may not be present

### Category II
- All FHR patterns that are not classified as category I (normal) or category III (abnormal)

### Category III
- Absent variability with recurrent late decelerations
- Absent variability with recurrent variable decelerations
- Absent variability with bradycardia
- A sinusoidal pattern
<table>
<thead>
<tr>
<th>Category I</th>
<th>Category II</th>
<th>Category III</th>
</tr>
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<td>- Moderate variability</td>
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<td>- A sinusoidal pattern</td>
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<tr>
<td>- Accelerations may or may not be present</td>
<td>- Absent variability with bradycardia</td>
<td>- Increased likelihood of severe hypoxia and metabolic acidemia</td>
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</table>

**Minimal likelihood of metabolic acidemia and hypoxic injury**

99 percent

**Increased likelihood of severe hypoxia and metabolic acidemia**

0.1 percent
Pitfalls in attributing category II and category III:

1. Fetal sleep cycle: may last up to 40 minutes
2. Technical factors
3. Maternal heart rate artifact: maternal heart rate accelerations during uterine contractions can be mistaken for FHR accelerations
4. Drug effects: opioids and magnesium sulfate can decrease variability, butorphanol can cause a sinusoidal pattern, and beta-blockers and atropine can increase FHR
5. Maternal fever
6. Fetal cardiac arrhythmias
7. Preexisting fetal neurologic injury: The most commonly described pattern is a persistent nonreactive heart rate and a persistent fixed baseline with minimal or absent variability
Standardized algorithm for the management of category II FHR tracings:

Fetal monitor tracings that demonstrated moderate (or marked) variability and significant decelerations with >50 percent of contractions for 30 minutes were managed as follows:

- If cervical dilation was <4 cm and recurrent decelerations did not resolve with conservative corrective measures, delivery was accomplished.
- If cervical dilation was ≥4 cm, labor was permitted to continue only if progress was normal (1st stage: dilation ≥1 cm/hour; 2nd stage: descent with pushing, total duration ≤90 minutes).
- Delivery was indicated if criteria for normal labor progress were not met or if the FHR tracing demonstrated a persistent pattern of minimal-absent variability.
Category I pattern:

- No intervention is warranted
- If the maternal and fetal conditions appear stable, it is reasonable to interrupt monitoring a category I EFM pattern for up to 30 minutes to facilitate ambulation, bathing, position changes, or other activities for maternal comfort.
MANAGEMENT

- **Category III pattern:**
  - **Scalp stimulation** to provoke an FHR acceleration should be attempted to further clarify fetal status. When scalp stimulation induces an acceleration, the probability of fetal acidosis is less than 10% Vs approximately 50% when no acceleration occurs.
  - Preparations for operative delivery
  - A 10-minute period of a category III pattern, particularly with a large total area of deceleration, has a significant association with acidemia.
  - It is important to consider the probable underlying cause(s) of the category III pattern
In utero resuscitation

- Reposition
- Administer an intravenous fluid bolus
- Discontinue uterotonic drugs
- If the FHR pattern persists after discontinuation of uterotonic drugs or in the absence of their use, administer a tocolytic (eg, terbutaline 250 mcg SQ), unless abruption is suspected.
- Consult the anesthesia team in patients who were recently given neuraxial drugs for labor pain.
- Uterine hypertonus may be reversed with one or two doses of (IV) nitroglycerin (50 mcg). The onset of uterine relaxation occurs within 30 seconds to two minutes and lasts only a minute or two
**CATEGORY II PATTERN:**

- Patients with category II patterns are evaluated for factors that may reduce fetal oxygenation, taking into account associated clinical circumstances (e.g., abruption, trial of labor after a previous cesarean delivery, intrauterine growth restriction), and the stage and progress of labor.
- Resuscitative measures can be initiated with frequent reassessment to determine whether to perform an operative intervention and the urgency of the intervention.
MANAGEMENT

• CATEGORY II PATTERN:
  • Continued surveillance and frequent reassessment are indicated until the pattern resolves to category I or progresses to category III.
  • The duration of time for which it is safe to closely monitor a category II tracing with late decelerations without loss of either variability or accelerations depends on the specific clinical setting.
<table>
<thead>
<tr>
<th></th>
<th>Normal Tracing Previously “Reassuring”</th>
<th>Atypical Tracing Previously &quot;Non-reassuring&quot;</th>
<th>Abnormal Tracing Previously &quot;Non-reassuring&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Baseline</strong></td>
<td>110–160 bpm</td>
<td>Bradycardia 100–110 bpm</td>
<td>Bradycardia &lt; 100 bpm</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Tachycardia &gt; 160 for &gt; 30 min. to &lt; 80 min.</td>
<td>Tachycardia &gt; 160 for &gt; 80 min.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Rising baseline</td>
<td>Erratic baseline</td>
</tr>
<tr>
<td><strong>Variability</strong></td>
<td>6–25 bpm</td>
<td>≤ 5 bpm for 40–80 min.</td>
<td>≤ 5 bpm for &gt; 80 min.</td>
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<tr>
<td></td>
<td>≤ 5 bpm for &lt; 40 min.</td>
<td></td>
<td>≥ 25 bpm for &gt; 10 min.</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Sinusoidal</td>
</tr>
<tr>
<td><strong>Decelerations</strong></td>
<td>None or occasional uncomplicated variables or early decelerations</td>
<td>Repetitive (≥ 3) uncomplicated variable decelerations</td>
<td>Repetitive (≥ 3) complicated variables:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Occasional late decelerations</td>
<td>deceleration to &lt; 70 bpm for &gt; 60 secs.</td>
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<tr>
<td></td>
<td></td>
<td>Single prolonged deceleration &gt; 2 min. but &lt; 3 min.</td>
<td>loss of variability in trough or in baseline</td>
</tr>
<tr>
<td><strong>Accelerations</strong></td>
<td>Spontaneous accelerations present</td>
<td>Absence of acceleration with fetal scalp stimulation</td>
<td>biphasic decelerations overshots</td>
</tr>
<tr>
<td></td>
<td>(FHR increases &gt;15 bpm lasting &gt; 15 seconds</td>
<td></td>
<td>slow return to baseline</td>
</tr>
<tr>
<td></td>
<td>(32 weeks’ gestation increase in the FHR &gt; 10 bpm lasting &gt;10 seconds)</td>
<td></td>
<td>baseline lower after deceleration</td>
</tr>
<tr>
<td></td>
<td>Accelerations present with fetal scalp stimulation</td>
<td></td>
<td>baseline tachycardia or bradycardia</td>
</tr>
<tr>
<td><strong>ACTION</strong></td>
<td>EFM may be interrupted for periods up to 30 min. if maternal-fetal condition stable and/or oxytocin infusion rate stable.</td>
<td>Further vigilant assessment required, especially when combined features present.</td>
<td>ACTION REQUIRED</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Review overall clinical situation, obtain scalp pH if appropriate/prepare for delivery.</td>
</tr>
</tbody>
</table>

*Usually absent, but if accelerations are present, this does not change the classification of tracing.*
CONCLUSION

- Confirm that the monitor is recording the FHR and uterine activity adequately to permit appropriately-informed management decisions. Ensure that the maternal heart rate is not being recorded.
- Assess uterine activity along with baseline FHR, variability, accelerations, decelerations, and sinusoidal pattern, and place the tracing in a category. If the tracing is category I and the patient is low-risk, initiate routine intrapartum fetal surveillance.
- If the tracing is not category I, evaluate the integrity of the fetal oxygen pathway (maternal lungs, heart, and vasculature, as well as the uterus, placenta, and umbilical cord).
- Attempt to correct the problem, if possible, by initiating measures to improve fetal oxygenation, such as maternal position changes, intravenous fluid bolus, correcting hypotension, stopping or reducing uterine stimulants, administering a uterine relaxant, amnioinfusion, and/or modifying maternal pushing efforts.
- If the FHR pattern does not improve within a reasonable period of time, begin planning for the possible need for rapid delivery (availability of an operating room and specialized equipment, notification of anesthesia and pediatrics, consent forms, and laboratory tests).