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Intrapartum Fetal Surveillance

Objectives:

- Describe the techniques of fetal surveillance.
- Interpret electronic fetal heart rate monitoring.

References:

- Team 433
- Hacker & Moore's essentials of obstetrics & gynecology 6th edition.
- Kaplan USMLE step 2 CK - Obstetrics and Gynecology

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The Importance of intrapartum fetal surveillance

1. Detect events that occurs during labor that could compromise fetal oxygenation.
2. Fetal surveillance during labor is an essential element of good obstetric care. On the basis of intrapartum maternal history, physical examination, and laboratory data.
3. 20-30% of pregnancies are designated high risk.
4. 50% of perinatal morbidity and mortality occurs in high risk group.
5. improves the management of labor and reduces perinatal morbidity and mortality.

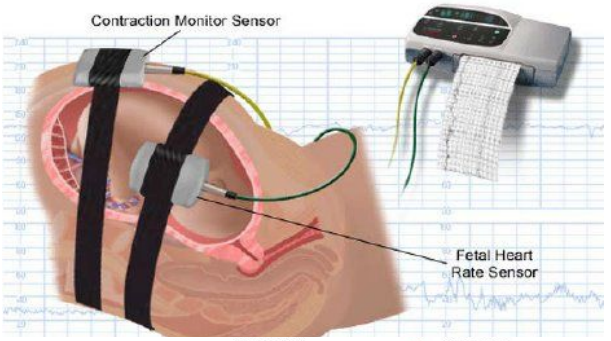
Techniques of fetal surveillance

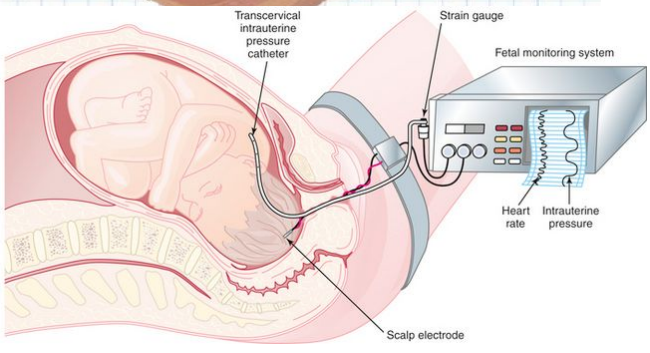
1. Auscultation of the fetal heart rate(FHR) every 30 minutes after a uterine contraction during the first stage. And at least every 15 minutes in the second stage of labor (in practice doppler US is used always).
    - If high risk :
      Auscultate the FHR every 15 minutes in the first stage of labor, and continuously or every 5 minutes in second stage.

Provides limited information about FHR variability, accelerations, or decelerations and requires one-to-one nursing care, which is costly and impractical for most maternity units

2. Continuous electronic fetal heart rate monitoring
    - **External** by transducer and tocodynamometer: Safe, detect fetal heart by first heart sound (not precise), can detect only the frequency and duration of uterine contractions.

    - **Internal** by scalp electrode and catheter: Invasive, detect heart rate by R wave of ECG (precise), precise measurement of the intensity of the contractions by using the catheter. Patients with specific infections (HIV and hepatitis) should not have a scalp electrode placed





To minimizes possible side effects and take effective monitoring combine internal scalp electrode for the heart rate and with external tocodynamometer for the contractions without the catheter.
To determine which type to start with, see if the patient have risk factors (EFM) or not (auscultation).

The pathophysiology of FHR changes

It is complex mechanism involving fetal baroreceptors, chemoreceptors, brainstem, autonomic nervous system and it is probably related to a combination of hypoxia acidosis and inflammation.

- The Hypoxia, acidosis, and FHR changes

  The fetal arterial blood oxygen tension in only 25± 5 mm HG, adults 100 mmHG.

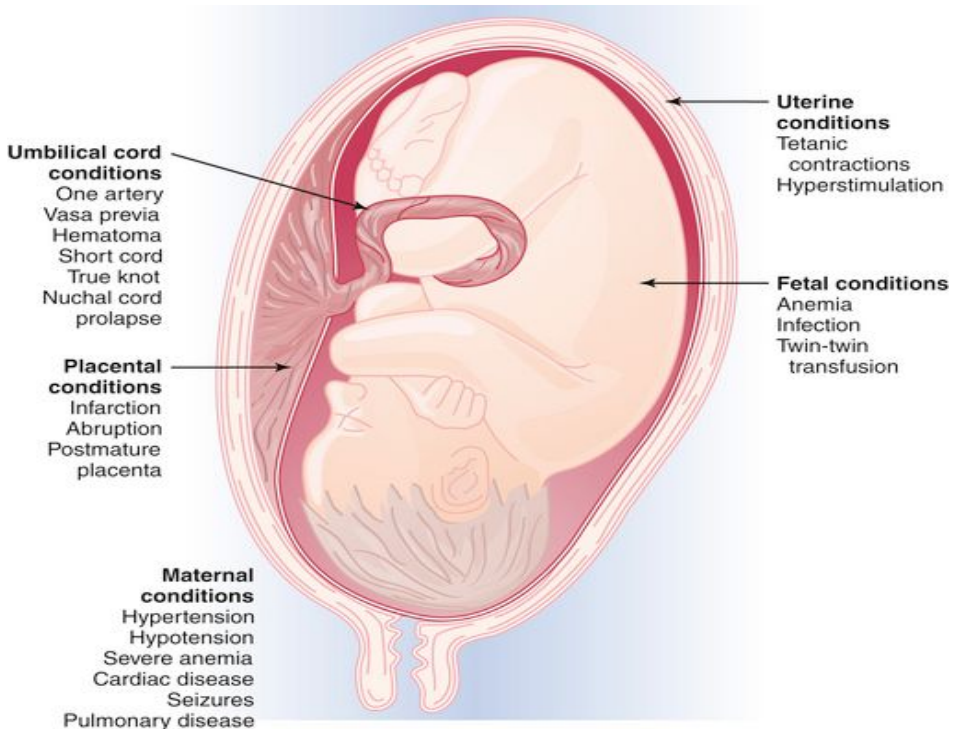
  Normal fetus can withstand the temporary reduction in blood flow to the placenta without suffering from hypoxia because sufficient oxygen exchange occurs during the interval between contractions.

  Hypoxia when sufficiently severe, will result in anaerobic metabolism, resulting in the accumulation of pyruvic and lactic acid and causing fetal acidosis.

  Fetal acidosis is measured by sampling blood from the presenting part. Normally the pH varies between 7.25-7.30.

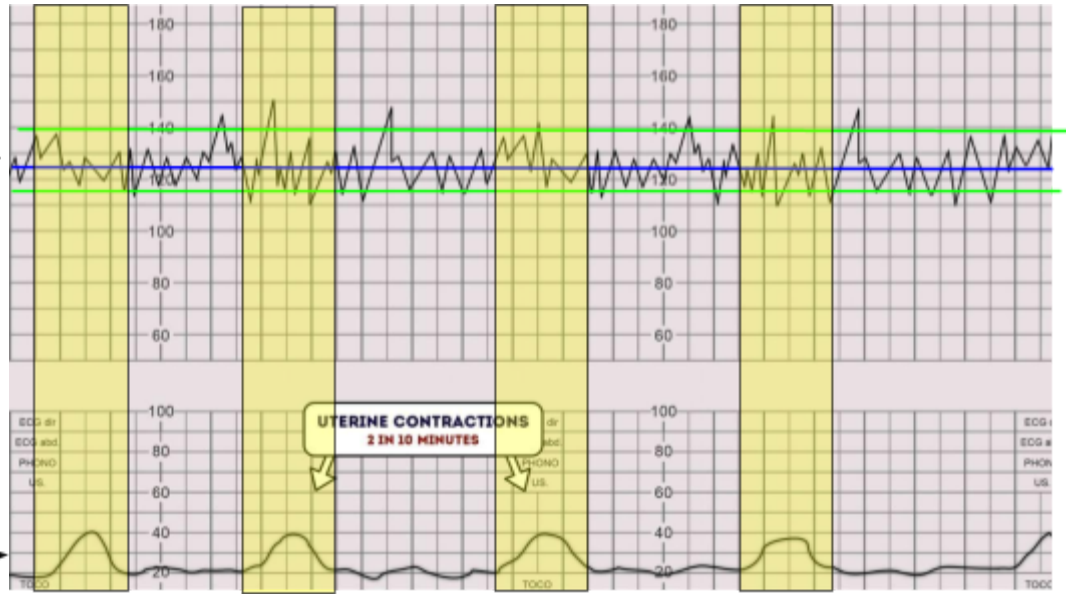
  Fetal death occurs when 50% or more of the transplacental oxygen is interrupted.

- Fetal oxygenation can be impaired at different anatomic locations:
  1. Maternal conditions: Such as in hypertensive or anemic mothers
  2. Fetal conditions: Such as in hemolytic anemia (in Rh-isoimmunization)
  3. Uterine conditions: Such as in hyperstimulation
  4. Placenta conditions: Such as in infarction or abruption
  5. Umbilical cord conditions: Such as in hematoma of the cord, short or true knot of the cord.



Fetal Heart Rate Tracing

Example for how to read the FHR



To read the FHR follow these steps:

1st step > draw a straight line between the fluctuations (the blue line) and see the number it cross, this is the heart rate. (if there is accelerations or decelerations in this step just ignore them)

2nd step >look at the fluctuation (green lines) and count the boxes between them, (each small box is 10 bpm) this is the variability eg. here there is two and half small boxes, you can say the variability is 25 bpm. (again ignore any accelerations or decelerations).

3rd step > Now search for accelerations or decelerations (Periodic fetal heart rate changes), and compare the time of deceleration with the uterine contractions (the yellow area), but nothing is here.

1st and 2nd steps are the baseline pattern, 3rd step is the periodic change.

After this you have to interpret the results and classify it into categories (see Fetal Heart rate patterns and interpretation below)

It depends on the evaluation of the baseline pattern and the periodic changes related to the uterine contractions.

1. Baseline assessment

Normal FHR baseline is from 110 to 160 beats/min[1], and variability (how far the change in beats goes from the baseline) can be divided into: (the doctor didn't mention this, also the video case and kaplan, save time and go to the table)

- Short term or beat to beat variability:

  Normally fluctuates between 5-25 beats\minutes. If decreased may indicate fetal acidosis, hypoxia, CNS and cardiac anomalies, quiet sleep state, prolong UC, or maternal sedation with drugs (morphine, magnesium).

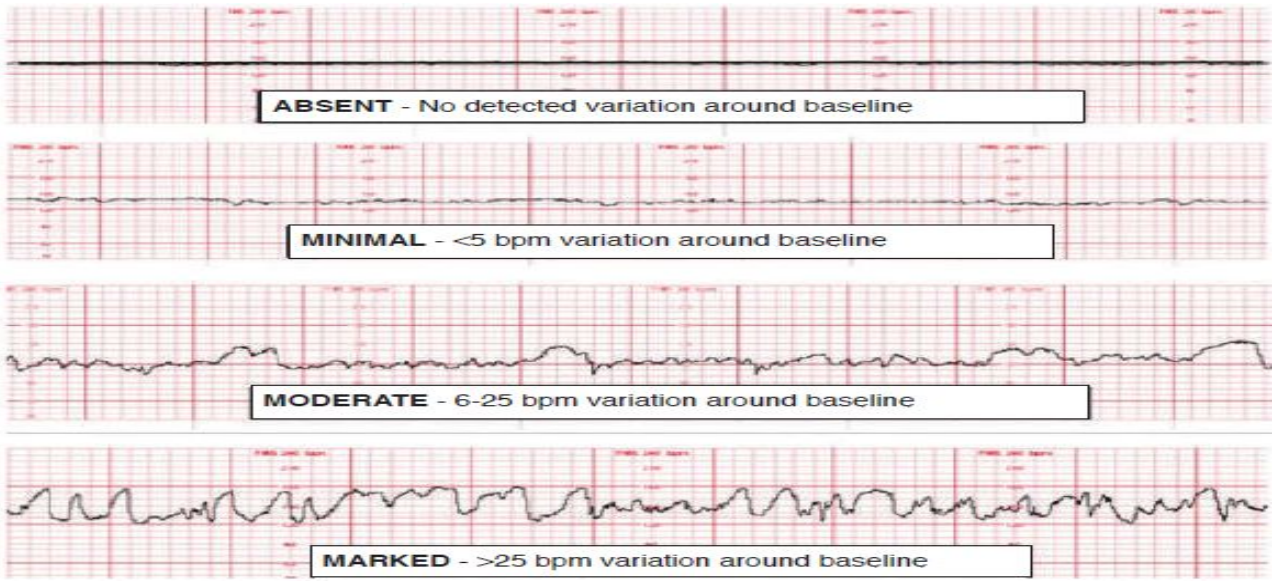
- Long term variability:

  The frequency and amplitude of changes in the baseline rate.
  Normally 3 to 10 cycles per minute. Physiologically decreased during the sleep of the fetus, which usually lasts for about 25 minutes.

Important table

Moderate variability is reassuring

Types of variability	Variability
Absent	None
Minimal	<5
Moderate	6-25
Marked	>26



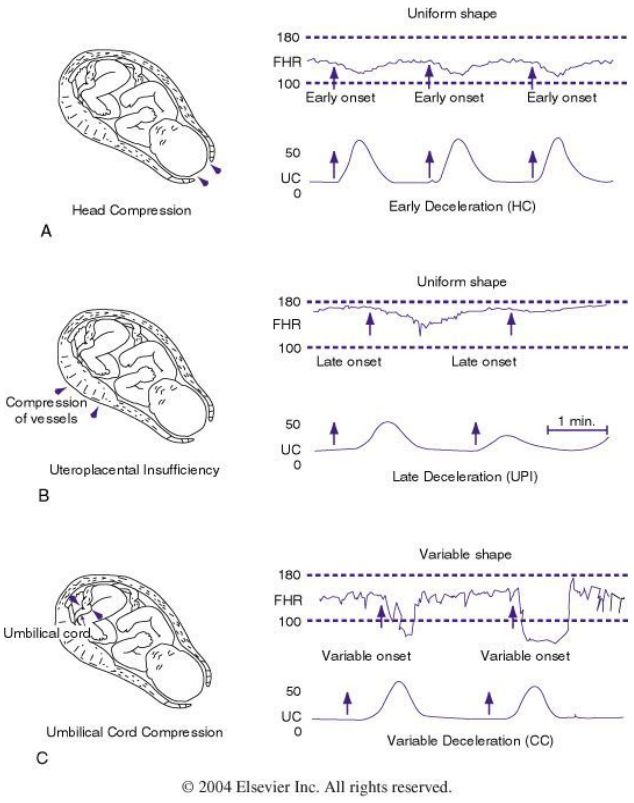
[1] If tachycardia, Non-hypoxic explanations include: medications (β -adrenergic agonists [terbutaline], atropine, scopolamine), maternal fever, maternal thyrotoxicosis, repetitive accelerations (from fetal movements), fetal tachyarrhythmias, prematurity
If bradycardia: Non-hypoxic explanations include: medications: β -adrenergic blockers, labor local anesthetics, Fetal arrhythmia: congenital heart block (associated with maternal lupus).

Causes of decrease variability include fetal hypoxia, acidemia, tachycardia, CNS and cardiac anomalies, drugs that depress the fetal CNS such as Morphine and Magnesium, also prolonged uterine contractions.

2. Periodic fetal heart rate changes

The changes in the baseline FHR are related to the uterine contraction. You can see one of these:

- No change. Same baseline (like our example above)
- Acceleration. FHR increases 15 beats per minute above the baseline in response to the uterine contractions with a duration of 15 seconds (normal "OK")
- Deceleration. FHR decrease in response to the uterine contractions. Divide into:
  -**Early** (normal due to head compression). Mirror image of contraction. A in the figure
  -**Late** (uteroplacental insufficiency). Slow fall & recovery, delayed in relation to contractions. B in the figure
  -**Variable** (cord compression): Rapid fall & recovery. Variable in relation to contractions. C in the figure, it is not necessarily related to uterine contractions
  -**Mixed** (characteristic of any of the above mentioned patterns)



To remember this use the mnemonic VEAL CHOP
VARIABLE > CORD COMPRESSION
EARLY > HEAD COMPRESSION
ACCELERATION > OK
LATE > PLACENTAL INSUFFICIENCY

Strategies for Intervention

After knowing the characteristic of the FHR you can classify into 3 categories

- **Category I** (Normal)

strongly predictive of normal fetal acid-base status at time of observation

- Baseline rate: 110-160 beats/min
- Baseline FHR variability: moderate
- Late or variable decelerations: absent
- Early decelerations: present or absent
- Accelerations: present or absent

- **Category II** (Intermediate/Possible Early Dysregulation)

not predictive of abnormal fetal acid-base status

- Every thing between category I & III

- **Category III** (Abnormal)

associated with abnormal fetal acid-base status at time of observation, because after delivery the baby may be healthy

- Absent baseline FHR variability and any of the following:
  - Recurrent late decelerations
  - Recurrent variable decelerations
  - Bradycardia
  - Sinusoidal pattern (Mostly caused by fetal anemia)*

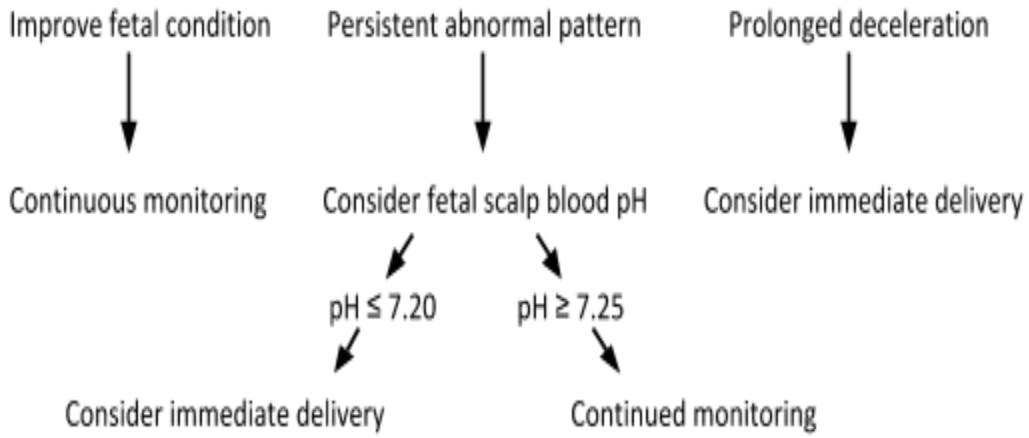
*A sinusoidal fetal FHR pattern is defined as a pattern of fixed, uniform fluxuations of the FHR, cycle frequency: 3.5 \ minute for > 20 minutes. Require immediate delivery.

Than intervention depend on the category:

- Category I : No specific action
- Category II : evaluation and continued surveillance and reevaluation, taking into account the entire associated clinical circumstances, consider In utero resuscitation (see the box), can change to category I or III.
- Category III : In utero resuscitation, prepare for delivery

In utero resuscitation:
Alter position to left or right side.
100% O2 by face mask.
Discontinue oxytocin.
Rule out cord prolapse.
Preform fetal scalp stimulation.
Consider terbutaline, 25 mg subcutaneously

After In utero resuscitation there is three possible outcomes



Non pattern signs of fetal distress

- Fetal Tachycardia

  Exclude infections, medications, maternal high temperature

- **Meconium**

Early passage:
Anytime before the rupture of membranes.

Light passage is not associated with poor outcome, but heavy passage is associate with lower 1- and 5- minute Apgar scores and associated with meconium aspiration.

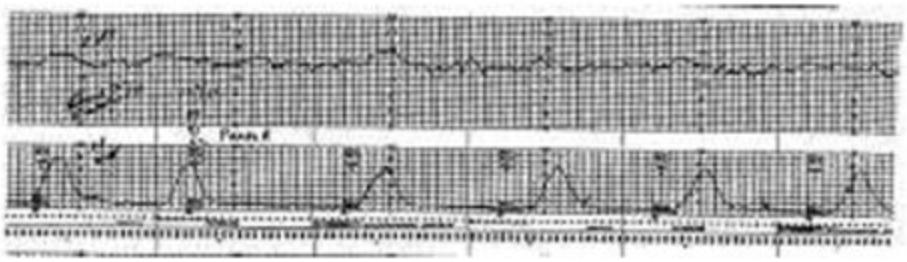
2) Late passage:
During the second stage of labor after clear amniotic fluid has been noted.

Usually heavy and associated with some event (e.g., umbilical cord compression, or uterine hypertonus) that causes fetal distress.

Case

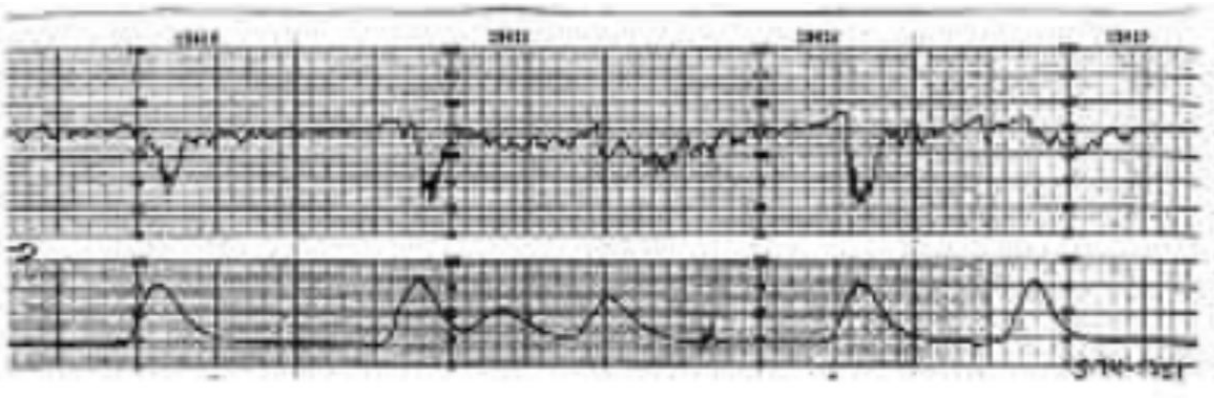
A 27 year-old G3P2 woman at 39 weeks gestation is admitted to the labor and delivery unit in early labor. She has had an uncomplicated pregnancy similar to her other two pregnancies, both of which delivered vaginally. Her last labor was 4 hours in length, and the infant's birth weight was 3900 grams after an uncomplicated delivery.

At the time of admission, her physical examination reveals a healthy appearing woman in moderate distress with contractions every 4-6 minutes, described as 7 on a pain scale of 1-10, with 10 being most severe. Her weight is 165 pounds, blood pressure is 135/82, and fundal height is 37 cm. The estimated fetal weight is around 4000 grams, the fetus is in the vertex presentation and her pelvic examination reveals a gynecoid pelvis with cervix dilated to 5 cm/80% effacement/-1 station. Fetal heart rate is noted to be 120 beats per minute when the external monitor is applied.



This patient appears to be having a normal labor at term. The fetal heart rate is normal and the fetus is having accelerations of the fetal heart rate, also a reassuring finding. You determine she has a "category 1" tracing. Her contraction pattern appears normal, and we should expect a vaginal delivery in the next few hours.

Two hours later, the nurse calls you to the labor suite to review the fetal heart tracing below. She expresses concern about the changed appearance of the fetal heart tracing and asks for your opinion.



- What is the purpose of intrapartum fetal heart rate monitoring?

The goal of intrapartum fetal monitoring is to recognize changes in fetal oxygenation that could result in adverse outcomes.

- What are the commonly used methods of intrapartum fetal monitoring?

Electronic fetal monitoring is performed externally using a Doppler technology with computerized processing that interprets and counts the Doppler signals. Internal monitoring is performed using a fetal electrode in the form of a spiral wire placed on the fetal scalp or presenting fetal part.

(in multiple pregnancy must be sure the two pulses is not to one fetus)

- What is the most important aspect in the evaluation of any fetal heart tracing?

Baseline variability is the most important aspect and is defined as the fluctuation of the baseline FHR in amplitude and frequency. It is defined as absent, minimal (amplitude detectable to 5 beats per minute), moderate (amplitude 6-25 beats per minute), and marked (amplitude greater than 25 beats per minute). Moderate variability has been associated with an arterial umbilical cord pH higher than 7.00-7.15, and with reassuring fetal well-being and the absence of metabolic academia.

- What are the periodic changes that occur in the FHR? What is the physiology, and what interventions, if any, would be appropriate?

Accelerations - The FHR increases in response to uterine contractions. (This is a normal response and is reassuring that the fetal status is normal)

Decelerations - The FHR decreases in response to uterine contractions. May be early (pressure on the fetal head resulting in a physiologic vagal reflex response with acetylcholine release at the fetal sinoatrial node, and therefore not concerning. Intervention is not required), late (nonreassuring and a result of uteroplacental insufficiency, decreased intervillous exchange of oxygen and carbon dioxide, and worsening hypoxia and acidemia. Interventions would include maternal repositioning, oxygen supplementation, intravenous fluid administration, and in some cases delivery of the fetus), variable (mediated by the vagus nerve's sudden release of acetylcholine at the fetal sinoatrial node; these are associated with umbilical cord compression. Interventions may include maternal position change or amnioinfusion.). All except early decelerations are abnormal and are categorized according to a three-tier FHR interpretation system).

- Define the three-tiered FHR interpretation system?

Category of FHR tracings	
Normal pattern or category I, comprising	• Baseline rate: 110–160 bpm • Baseline FHR variability: moderate • Late or variable decelerations: absent • Early decelerations: present or absent • Accelerations: present or absent
Indeterminable pattern or suspicious pattern or category II, comprising FHR tracing not categorized as category I or III	• Bradycardia not accompanied by absent baseline variability • Tachycardia • Minimal baseline variability • Absent baseline variability not accompanied by recurrent decelerations • Marked baseline variability • Absence of induced accelerations after fetal stimulation • Recurrent variable decelerations accompanied by minimal or moderate baseline variability • Prolonged deceleration>2 min but<10 min • Recurrent late decelerations with moderate baseline variability • Variable decelerations with other characteristics such as slow return to baseline, "overshoots", and "shoulders"
Ominous pattern or category III, including either	• Absent baseline FHR variability and any of the following: -Recurrent late decelerations -Recurrent variable decelerations -Bradycardia • Sinusoidal pattern

FHR: Fetal heart rate