437 Team: Obstetrics and Gynecology

Intrapartum Fetal Surveillance

Objectives:

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

References:

- Kaplan USMLE step 2 CK - Obstetrics and Gynecology
- Online Meded videos
- Team 435

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Editing file link

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.

Fetal Heart Rate Monitoring

- Normal fetal heart rate (FHR) findings are highly reassuring of fetal well-being.
- Abnormal FHR findings are poor predictors of fetal compromise.
- Wide usage of electronic FHR monitoring has not lowered the rate of cerebral palsy (CP) because the antecedents of CP appear not to be intrapartum events, but rather antenatal events.
- The false-positive rate for electronic FHR monitoring for predicting CP is >99%.
- Both of the following modalities are equivalent in predicting fetal outcome.
- **Intermittent auscultation** of FHR is performed with a fetoscope using auditory FHR counting averaged for 10–15 s.
- **Electronic monitoring** measures the milliseconds between consecutive cardiac cycles giving an instantaneous FHR continuously.

For whom do we do intrapartum fetal surveillance? The standard is :

1. **High risk patient** [1]**:** continuous fetal monitoring until delivery.
2. **Low risk patient:** intermittent auscultation, if you suspect anything → then put the patient on continuous fetal monitoring.

Why do we do intrapartum fetal surveillance? Help to manage hypoxic fetus fast: the management depend on the stage of labor , and clinical mostly : 1st stage of labor: cesarean section 2nd stage of labor: instrumental delivery

[1] **Examples of high risk patients:**

1. Fetus with Intrauterine Growth Restriction (IUGR) : the fetus is already in state of stress due to placental insufficiency and might not tolerate labor
2. Pre-eclampsia: placental insufficiency (vasoconstriction) and decreased blood supply
3. Antepartum hemorrhage: might be abruption of the placenta
4. Multifetal gestation: more than one fetus
5. 2nd stage of labor: because it is stressful
6. Maternal medical disease: cardiac , diabetic and HTN

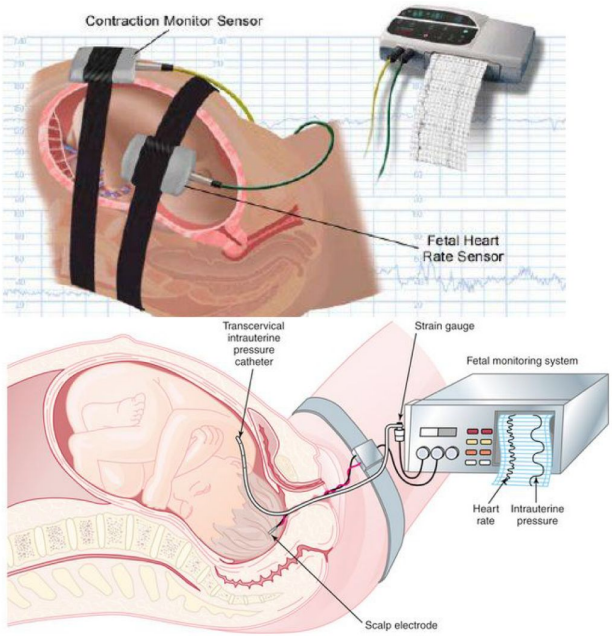
Techniques of fetal surveillance

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 DEVICES

External devices (most common) are placed on the uterine fundus.
Advantages are utilization before significant cervical dilation and membrane rupture. **Disadvantages** are poor quality tracing with maternal obesity and maternal discomfort from the device belts.

- **Fetal**. A continuous ultrasound transducer picks up fetal cardiac motion but also can register maternal great vessel pulsations.
- **Contractions**. A tocographic transducer device senses the change in uterine wall muscle tone. It can measure the beginning and ending of contractions but cannot assess contraction intensity.



INTERNAL DEVICES[2]

Internal devices are placed through the dilated cervix.
Advantages include optimum signal quality, which is unaffected by maternal obesity.
Disadvantages include limitation to labor when cervical dilation and membrane rupture have occurred.

- **Fetal**. A direct scalp electrode precisely senses each QRS complex of the fetal cardiac cycle. Complications can include fetal scalp trauma and infection.
- **Contractions**. An intrauterine pressure catheter (IUPC) placed into the uterine cavity precisely registers intrauterine hydrostatic changes with each contraction.

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).

[2]**Can we use both internal and external monitoring in intrapartum and antepartum?**
We can't use internal monitoring antepartum because the membranes had to be ruptured so you could insert it.

The pathophysiology of FHR changes

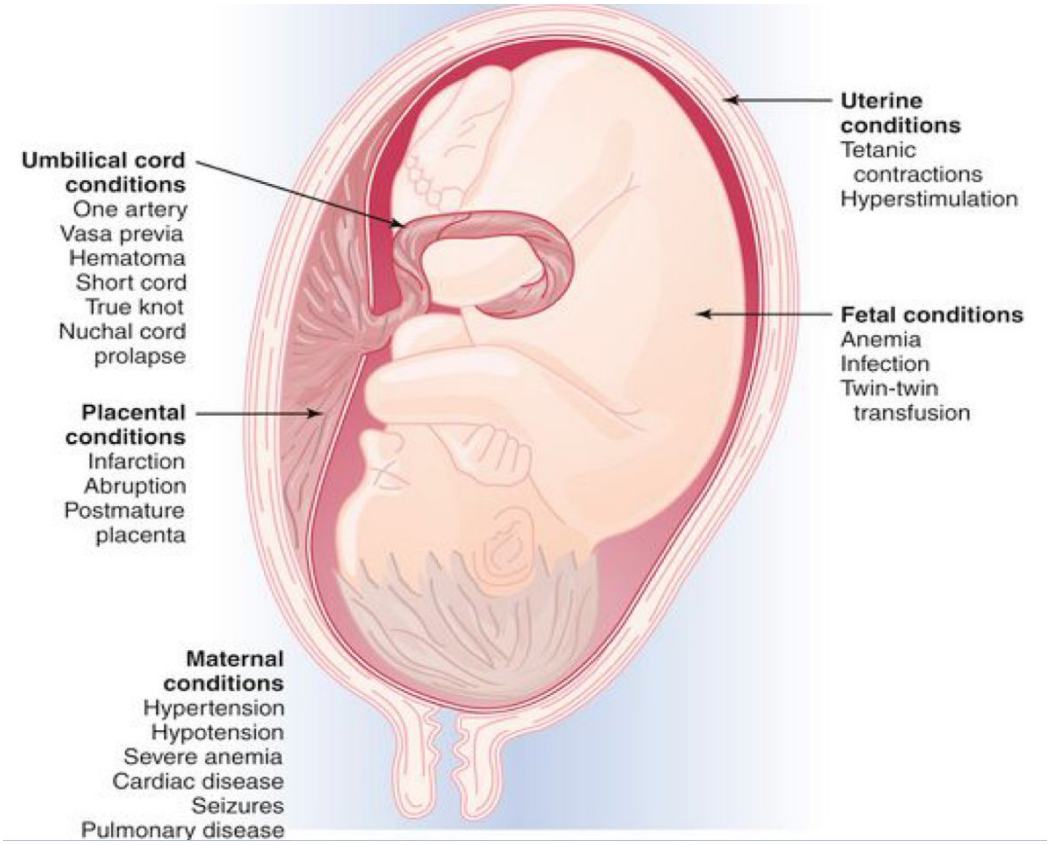
It is complex mechanism involving fetal baroreceptors, chemoreceptors, brainstem, autonomic nervous system and it is probably related to a combination of hypoxia acidosis and inflammation.

The Hypoxia, acidosis, and FHR changes

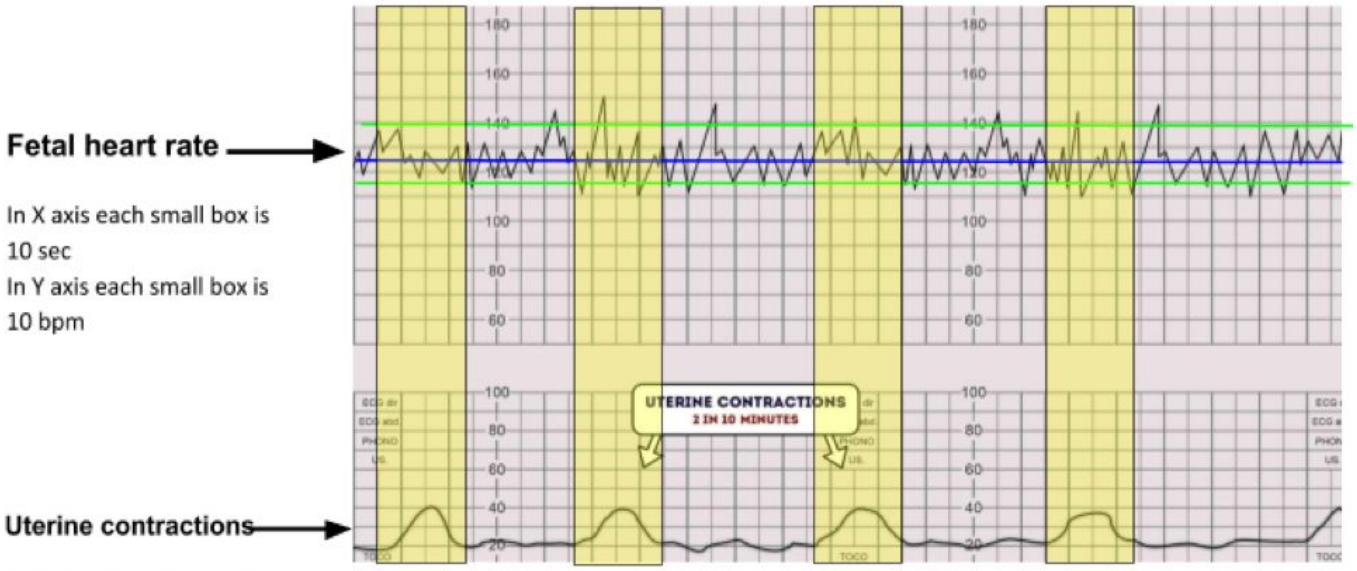
- The fetal arterial blood oxygen tension in only 25± 5 mm HG, adults 100 mmHG.
- Normal fetus can withstand the temporary reduction in blood flow to the placenta without suffering from hypoxia because sufficient oxygen exchange occurs during the interval between contractions.
- Hypoxia when sufficiently 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.



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)

Intrapartum Fetal Heart Rate Monitoring

1. Baseline Fetal Heart Rate (FHR): The mean FHR rounded to increments of 5 beats/min during a 10-minute segment. Normal FHR baseline is 110–160 beats/minute.

Tachycardia: FHR baseline is >160 beats/min.	Bradycardia: FHR baseline is <110 beats/min.
Non-hypoxic explanations include: • **Maternal**: medications (β-adrenergic agonists [terbutaline], atropine, scopolamine), fever, thyrotoxicosis • **Fetal**: repetitive accelerations (from fetal movements), fetal tachyarrhythmias, prematurity	Non-hypoxic explanations include: • **Maternal medications:** β-adrenergic blockers, local anesthetics • **Fetal arrhythmia:** congenital heart block (associated with maternal lupus)

Deceleration V.S bradycardia:

Deceleration :

- It is a drop in the fetal heart rate from the baseline but with return to baseline and it has 3 types

Bradycardia:

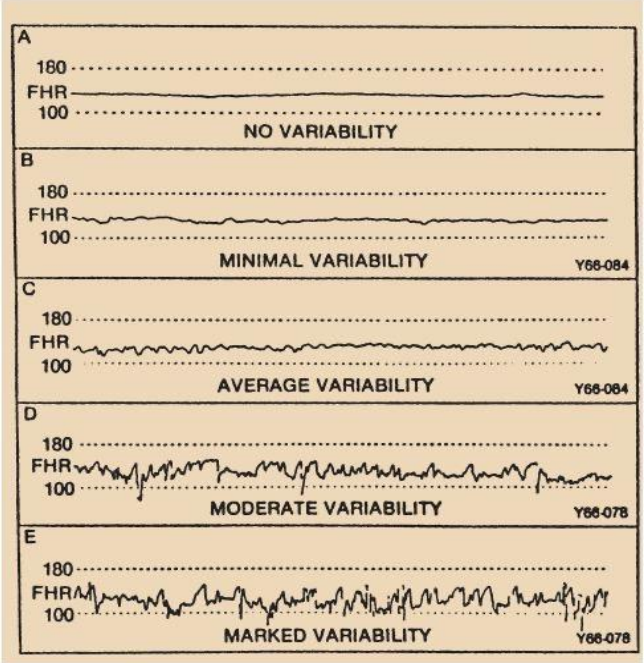
- Drop in the fetal heart rate from the baseline but it lasts long, it continues up to 10 minutes worrisome, and might mandate taking the patient to the OR for C-section , Example: pregnancy complicated by abrupt placenta, then there will be decelerations, if recovered, it means that the abruption is partial because there still is blood supply to fetus, if bradycardia it means sever abruption and there is no supply and I have to get this baby out as soon as possible.

Baseline variability describes fluctuations in the baseline FHR that are irregular in amplitude and frequency. It is a reflection of the autonomic interplay between the sympathetic and parasympathetic nervous system.

What is variability? It reflects hypoxia, if the oxygenation for the baby is enough or not. Because decrease supply of oxygen will stimulate the sympathetic and parasympathetic systems and the heart rate of the fetus will change in response, and hence it will be reflected in the CTG. **It is the most important aspect in evaluation of fetal heart tracing**

Types of variability	Variability
Absent amplitude	undetectable
Minimal amplitude	≤5 beats/min
Moderate (normal)	6–25 beats/min
Marked	>25 beats/min

Causes of reduced variability: Fetal hypoxia, acidemia, tachycardia, Drugs (morphine and magnesium), fetal CNS and cardiac anomalies, prolonged uterine contractions



NST is non stress because no contractions we look for fetal heart rate, variability and acceleration. Fetal normal HR is between 110-160, bradycardia less 110 tachycardia greater than 160. Normal variability should be consistent and not so much changes in the fetal HR, if you see a flat line with no variability this isn't a good sign and too much variability is also bad

CST is used while there are contractions this is usually done in a setting of labor you want to look for deceleration and present and absent of bradycardia
You can normally see acceleration and variability but not bradycardia. For it to be adequate you need to have at least 3 contractions every 10 minutes with a force of contractions 200

Cardiotocography (CTG) V.S Non Stress Test (NST):

CTG :

1. continuous fetal heart monitoring while in labor
2. there is decelerations and uterine contractions

NST:

1. monitor fetal heart rate at the clinic while the patient not in labor, to check on the status of the baby
2. no uterine activity (contractions)
3. it is also called unprovoked deceleration
4. since there is no uterine contractions we cannot classify decelerations to early, late or variable
5. if there is decelerations during this test then it is worrisome because there was no stress and the fetal heart rate decelerated (fetus is in a state of hypoxia)

2. Periodic fetal heart rate changes

Acceleration	A visually apparent abrupt increase (onset to peak in <30 seconds) in the FHR. These are mediated by the sympathetic nervous system in response to fetal movements or scalp stimulation. At ≥32 weeks gestation, an acceleration has a peak of **>15 beats/min** above baseline, with a duration of **>15 seconds** but < 2 min from onset to return. At <32 weeks gestation, an acceleration has a peak of ≥10 beats/min above baseline, with a duration of ≥10 sec but <2 min from onset to return. Example: a fetus baseline was 120 bpm then it became 150 bpm for 20 seconds Is this considered acceleration ? yes Acceleration are going to be increase HR for a certain amount of time in a certain window you want to see a good variability and see the heart rate rises for a certain amount of time which is twice every 20 min and 15/15 represents the change of HR rise 15 and last for at least 15 seconds. If greater than 32 weeks 15/15, 2 in 20 if younger 10/10, 2 in 20

Decelerations[1]	**Early deceleration** has to be mirror image of the uterine contraction	A visually apparent usually symmetrical gradual decrease and return of the FHR associated with a uterine contraction. These are mediated by parasympathetic stimulation and occur in response to **head compression.** • A gradual FHR decrease is defined as from the onset to the FHR nadir of ≥30 seconds. • The decrease in FHR is calculated from the onset to the nadir of the deceleration. • The nadir of the deceleration occurs at the same time as the peak of the contraction. When the deceleration mirror the contractions the peak of contractions occur at the exact same time as the vale of fetal HR this indicates ead compression most benign type require no action
	Late Decelerations after uterine contraction	A visually apparent usually symmetrical gradual decrease and return of the FHR associated with a uterine contraction. These are mediated by either vagal stimulation or myocardial depression and occur in response to **placental insufficiency.** (abrupt placenta, IUGR, pre-eclampsia) • A gradual FHR decrease is defined as from the onset to the FHR nadir of ≥30 seconds. • The decrease in FHR is calculated from the onset to the nadir of the deceleration. • The deceleration is delayed in timing, with the nadir of the deceleration occurring **after** the peak of the contraction. The deceleration starts when contractions peaks, that is the peak of contractions near the onset of deceleration representing utero placental insufficiency you need to deliver the fetus, how? Depends on gestational age -Slow recovery from deceleration means that the fetus is compensating but not very well because he is taking time and the decelerations might proceed to bradycardia -Late and bradycardia emergency C-section
	Variable Decelerations variable in relation to contractions -not consistent-sometimes before and sometimes after	A visually apparent abrupt decrease in FHR then rapid recovery to baseline. These are mediated by **umbilical cord compression.** (oligohydramnios, IUGR and premature rupture of membranes) • An abrupt FHR decrease is defined as from the onset of the deceleration to the beginning of the FHR nadir of <30 seconds. • The decrease in FHR is calculated from the onset to the nadir of the deceleration. • The decrease in FHR is ≥15 beats per minute, lasting ≥15 seconds, and <2 minutes in duration. Sinusoidal pattern: A visually apparent, smooth, sine wave-like undulating pattern in FHR baseline with a cycle frequency of 3–5/min which persists for ≥20 min. The deceleration have nothing to do with the contractions at all this this is a results of cord compression require no action - it is common to see during 2nd stage of labor - it is worrisome if it was continuous and not responding to resuscitation

Doctor's notes:

Important for you to know:

- what do we mean by acceleration
- what do we mean by deceleration
- what do we mean by bradycardia
- what is the normal range for fetus heart rate (110-160)
- Types of decelerations and the differences between them
- Categories of fetal heart tracing are important for the exam

Fetal Heart Rate Categories

A three-tiered system for the categorization of FHR patterns is recommended. Categorization evaluates the fetus at that point in time; tracing patterns can and will change. FHR tracing may move back and forth between the categories depending on the clinical situation and management strategies used.

Category I: FHR tracings are normal	Criteria include all of the following: • **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: FHR tracings are indeterminate	These include all FHR tracings not categorized as category I or III and may represent an appreciable fraction of those encountered in clinical care.
Category III: FHR tracings are abnormal	Criteria include absent baseline FHR variability and any of the following: • **Recurrent late decelerations** • **Recurrent variable decelerations** • **Bradycardia** • **Sinusoidal pattern** *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.

Intrauterine Resuscitation

- **Decrease uterine contractions:** Turn off any IV oxytocin infusion or administer terbutaline 0.25 mg subcutaneously to enhance intervillous placental blood flow.
- **Augment IV fluid volume:** Infuse the parturient with a 500 mL bolus of intravenous normal saline rapidly to enhance uteroplacental infusion.
- **Administer high-flow oxygen:** Give the parturient 8–10 L of oxygen by facemask to increase delivery of maternal oxygen to the placenta.
- **Amnioinfusion** is useful for eliminating or reducing the severity of variable decelerations.
- **Change position:** Removing the parturient from the supine position decreases inferior vena cava compression and enhances cardiac return, thus cardiac output to the placenta. Turning the parturient from one lateral position to the other may relieve any umbilical cord compression that may be present.
- **Vaginal examination:** Perform a digital vaginal examination to rule out possible prolapsed umbilical cord.
- **Scalp stimulation:** Perform a digital scalp stimulation observing for accelerations, which would be reassuring of fetal condition.

Fetal pH Assessment

Intrapartum:

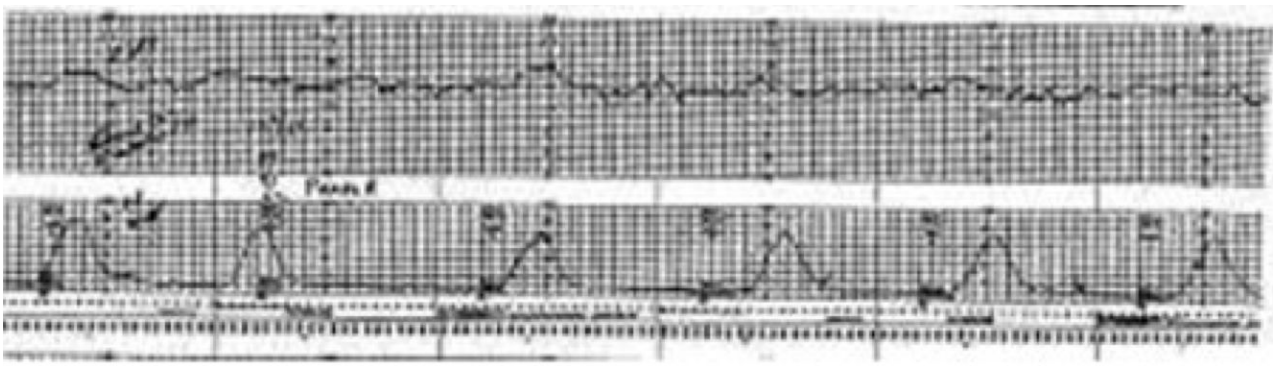
- **Fetal scalp blood pH** may be used in labor if the EFM strip is equivocal. Prerequisites include cervical dilation, ruptured membranes, and adequate descent of the fetal head. Contraindications are suspected fetal blood dyscrasia. A small, shallow fetal scalp incision is made resulting in capillary bleeding. The blood is collected in a heparinized capillary tube and sent to the laboratory for blood gas analysis. Normal fetal pH is ≥7.20. This procedure is seldom performed today.

Postpartum

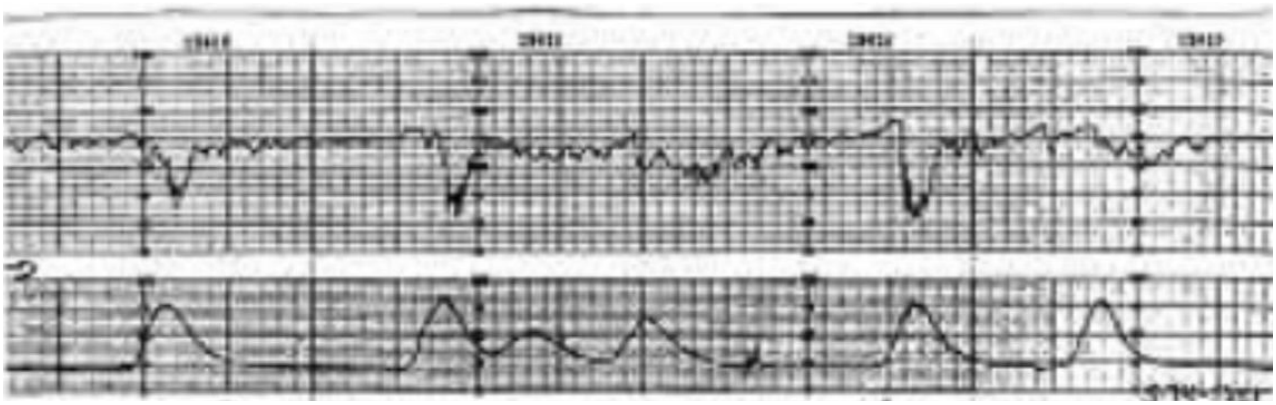
- **Umbilical artery blood pH** is used to confirm fetal status at delivery. It involves obtaining both umbilical cord venous and arterial samples. Arterial Pco2 and base deficit values are higher than venous, but pH and Po2 are lower. Normal fetal pH is ≥7.20.

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.



Case

1. 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.
2. 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)
3. 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.
4. 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).
5. 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