

Chapter E

Intrapartum Fetal Surveillance

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Published June 2011

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OBJECTIVES

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At the end of this discussion and workstation, participants will be able to:

1. List the indications for use of continuous electronic fetal monitoring (CEFM) and structured intermittent auscultation (SIA)
2. Describe guidelines for CEFM terminology including definitions and interpretation of Fetal Heart Rate tracings (NICHD 1997, revised 2008)
3. Discuss the mnemonic DR C BRAVADO and recent ACOG guidelines to develop an overall assessment and general management plan
4. Discuss future trends in fetal monitoring

INTRODUCTION

History of CEFM

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CEFM was developed and introduced in the 1960s and rapidly became part of routine obstetrical practice. From 1980 to 2002, CEFM use increased dramatically from 40 percent to over 85 percent of women in labor.¹ CEFM has resulted in an increased use of cesarean delivery, however the incidence of perinatal mortality and cerebral palsy has not fallen, and a decrease in neonatal seizures is the only demonstrable benefit.² CEFM as a screening test for fetal hypoxemia or acidemia remains limited by low specificity, as a very high proportion of abnormal fetal monitoring tracings occur in fetuses with normal pH and oxygenation.

Utilization of CEFM is limited by a lack of interobserver and intraobserver reliability in interpretation.³ The following concerns were listed in the Confidential Enquiry into Stillbirths and Deaths in Infancy (CESDI) Fourth Annual Report at the Maternal and Child Health Research Consortium:⁴

1. Failure to perform CEFM when there is a valid indication.
2. Failure to ensure a good quality tracing when it is indicated.
3. Failure to recognize a fetal heart tracing as abnormal or normal.
4. The use of uterine stimulation or regional anesthesia in the presence of unresolved abnormality of the fetal heart rate.
5. Failure to act appropriately when the fetal heart rate is abnormal.
6. Delay in expediting delivery once fetal compromise is identified or suspected.

INDICATIONS FOR CEFM

Indications for CEFM include maternal medical problems, pregnancy-related risk factors and labor complications:⁷

Maternal Indications (antenatal)

1. Hypertension (pre-eclampsia, eclampsia)
2. Diabetes
3. Cardiac disease
4. Hemoglobinopathy
5. Severe anemia
6. Hyperthyroidism
7. Collagen vascular disease
8. Renal disease

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Maternal Indications (intrapartum)

1. Vaginal bleeding in labor
2. Intrauterine infection

Fetal Indications (intrapartum)

1. Meconium-stained amniotic fluid
2. Suspicious fetal heart rate on auscultation
3. Abnormal FHR on the admission tracing (20 minute strip)
4. Post-term pregnancy

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Fetal Indications (antepartum)

1. Multiple pregnancies
2. Intra-uterine growth restriction
3. Preterm labor (< 37 weeks)
4. Breech presentation
5. Rh isoimmunization
6. Oligohydramnios
7. Abnormal umbilical artery Doppler velocimetry

Labor Indications

1. Induced or augmented labor
2. Prolonged labor
3. Regional analgesia, particularly after initial bolus and after top-ups
4. Thick meconium
5. Abnormal fetal heart rate or concerning decelerations in structured intermittent auscultation (SIA)
6. Vaginal bleeding in labor
7. Abnormal uterine activity
8. Previous cesarean section

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FACTORS TO CONSIDER IN CHOOSING FETAL SURVEILLANCE TECHNIQUE

The opportunity may or may not exist to perform SIA in any given delivery suite, leaving continuous electronic fetal monitoring (CEFM) as the only option. The American College of Obstetricians and Gynecologists (ACOG) presents intermittent auscultation as an acceptable choice in low risk pregnancies.⁶ Selection of monitoring technique depends on risk factors outlined above and the following:

Risk of Mother and Fetus

The decision to choose SIA or CEFM begins with assessing the risk of mother and fetus, in order to identify the fetus at risk for uteroplacental insufficiency, intrapartum demise or neonatal neurological damage. After categorizing the risk factors, a decision can be made on how best to proceed to achieve optimal fetal surveillance.

Staff Availability and Level of Comfort

One of the critical steps in choosing a method of fetal surveillance is a consideration of the personnel available on the labor floor, especially in the case of SIA. The comfort level of the nurses who may not be accustomed to SIA should be assessed. An in-service may be used to familiarize nurses with auscultative monitoring technique or enhance their skill and comfort level.

Informed Consent of the Patient

A discussion of how the fetus will be monitored during labor should occur before the onset of labor, so that options can be explored and any questions answered. Advantages and disadvantages of both CEFM and SIA can be reviewed at this time, and patient preferences can be more effectively determined.

Admission Fetal Monitor Strip

Most, if not all women, in the United States will be placed on the electronic fetal monitor for 20 minutes when they present to the labor floor. The method of fetal monitoring will then be determined based on the interpretation of this 20-minute strip. In some cases, mothers will be left on the fetal monitor for another 20 minutes if the strip is deemed problematic. This routine use of admission monitoring is discouraged based on a recent systematic review that has shown no significant difference compared to patients starting on SIA without an admission strip⁵ This admission monitor strip should not predetermine the type of monitoring, CEFM or SIA, and its routine use should be reconsidered by obstetrical providers.

EFFECT OF FETAL SURVEILLANCE ON PATIENT, SUPPORT PERSONNEL AND STAFF

The effect fetal surveillance has on all individuals present during labor and delivery must be considered. Use of CEFM decreases mobility, reduces contact between the woman and her partner, and eliminates the need for close contact by the labor nurse. CEFM should not be used as a substitute for continuous care during labor.

Outcomes with CEFM

The only clinically significant benefit demonstrated with routine CEFM is the reduction of neonatal seizures in the immediate newborn period, although at the end of one year these infants did not suffer any permanent sequelae.² No significant differences have been demonstrated in one-minute Apgar scores below seven, rate of admissions to neonatal intensive care units, and perinatal deaths. Even when combined with fetal scalp pH sampling, CEFM has not been shown to reduce perinatal mortality or reduce the incidence of cerebral palsy. The use of CEFM does increase the rate of cesarean and operative vaginal deliveries.²

There has been and still is an unrealized expectation that an abnormal non-reassuring FHR tracing will predict cerebral palsy. The incidence of cerebral palsy has been stable since the introduction of EFM, as expected since cerebral palsy is attributed to events prior to labor in approximately 70 percent of the cases and only four percent of cases caused by hypoxic ischemic encephalopathy (HIE) can be directly linked to intrapartum events.⁶ In newborns with estimated fetal weight ≥ 2500 g, it has been estimated that the positive predictive value of an abnormal FHR tracing in predicting cerebral palsy is 0.14 percent.⁶

Since the outcomes from CEFM have shown only minimal short-term benefit and potential for harm, any potential benefit of CEFM should be evaluated in light of risk status of the patient. A joint decision between the pregnant woman and her clinician should then be made regarding use of CEFM vs. SIA during labor. To date, no studies have been done to assess the optimal frequency for SIA in the absence of risk factors. SIA should be performed based on specific guidelines:

Table 1. Structured Intermittent Auscultation

Frequency of Auscultation ⁶	
1. Every 15 minutes in active phase of first stage of labor 2. Every five minutes in second stage of labor with pushing	
When to Auscultate ⁷	
<i>Assess FHR before:</i> 1. Initiation of labor augmentation 2. Ambulation of patient 3. Administration of medications 4. Administration or initiation of analgesia/anesthesia 5. Evaluation of analgesia/anesthesia	<i>Assess FHR after:</i> 1. Admission of patient 2. Artificial or spontaneous rupture of membrane 3. Vaginal exam 4. Abnormal uterine activity
Procedure for Auscultation ⁷	
Procedure for Auscultation⁷ 1. Palpate the abdomen to determine the position of the fetus (Leopold's maneuver). 2. Place the Doppler over the area of maximum intensity of fetal heart tones. 3. Differentiate maternal pulse from fetal pulse. 4. Palpate for uterine contraction during period of FHR auscultation to determine relationship. 5. Count FHR between contractions for at least 60 seconds to determine the average baseline rate. 6. Count FHR after uterine contraction for 60 seconds at six second intervals to identify fetal response to active labor. (This may be subject to local protocols.)	

Successful implementation of SIA can be achieved keeping in mind the following guidelines:⁸

1. The presence of nurses and practitioners experienced in the technique of auscultation, the palpation of contractions, and the auditory recognition of FHR changes are necessary.
2. Institutional policy should be developed addressing the technique and frequency of assessment.
3. Clinical interventions should follow when concerning findings are present.
4. Nurse-to-fetus ratio needs to be one-to-one since fetal heart tones are required to be heard every 15 minutes. Controlled trials comparing IA and EFM were performed with skilled OB nurses in constant attendance with each patient during labor.

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INTERPRETATION OF FETAL HEART RATE ABNORMALITIES

CEFM has been under close scrutiny due to the lack of consistent interpretation of fetal heart rate tracings, even by perinatologists.³ The National Institute of Child Health and Human Development (NICHD) in 1997 developed guidelines to "...allow identification of fetal asphyxia so that timely intervention can avoid brain damage or death." NICHD added "a major impediment is lack of agreement in definitions and nomenclature of FHR patterns."⁹ In 2008 NICHD revised their definitions, interpretation and research guidelines.¹⁰ NICHD reviewed the fetal monitoring approach used in the United Kingdom and Sweden, as well as the work of Parer.¹¹ ACOG incorporated these guidelines into a 2009 practice bulletin on electronic fetal monitoring definitions and the three-tiered fetal heart rate interpretation system (Practice Bulletin No 106).⁶ In 2010 ACOG released a second practice bulletin on management of intrapartum fetal heart tracings based on the three-tier category system and management of uterine tachysystole (Practice Bulletin No 116).⁷ ACOG describes FHR tracings as visual patterns that should be adaptable to computerized interpretation and that *definitions* should be applied to intrapartum tracings but also can be used for antepartum FHR tracings. Categorization of FHR tracings are for intrapartum only.

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When performing electronic fetal monitoring, it is recommended that the fetal strips be reviewed periodically. For uncomplicated patients, fetal monitor strips should be reviewed every 30 minutes during stage one and every 15 minutes during Stage two. If the pregnancy is complicated (e.g., IUGR, pre-eclampsia, etc), then review of monitoring is more frequent: every 15 minutes during stage one and every five minutes during stage two.⁶

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DR C BRAVADO

The mnemonic DR C BRAVADO is a systematic approach to the interpretation of FHR tracings for both CEFM and SIA. When using this mnemonic for either technique, the record of both FHR and uterine contractions should be adequate for visual interpretation for CEFM or a composite of intermittent auscultation between contractions (baseline) and during six-second intervals for 60 seconds during and after palpated contractions for SIA.¹²

DR C BRAVADO
D etermine R isk
C ontractions
B aseline R ate
V ariability
A ccelerations
D ecelerations
O verall Assessment

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Determine Risk

Before any FHR tracing can be interpreted, the background history of the patient is evaluated so that risk can be determined.¹² Fetal reserve is assessed in view of the clinical situation. Is this a term, low-risk baby, or are there risk factors present such as growth restriction, pre-eclampsia,

chorioamnionitis or meconium? Is labor progressing well, or is there associated dystocia? Is an assisted vaginal delivery likely? It is also important to consider if multiple risk factors are present, rather than focusing on one isolated risk factor. For example, smoking as an isolated risk factor may not change the approach taken clinically, when the fetus is term and normal size, whereas smoking in a teenager with iron deficiency anemia and an eating disorder may signal a high-risk situation.

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Contractions

The method of monitoring can be performed using a pressure transducer (either external or via an intrauterine pressure catheter) or palpation in order to determine the amplitude and frequency of contraction. Strength of a contraction cannot be determined with the external pressure transducer and requires placement of an IUPC or palpation. Uterine contractions are quantified as the number present over a 10 minute period, averaged over 30 minutes.

Contractions are classified as normal (\leq five contractions in a 10 minute period) or tachysystole ($>$ five contractions in a 10 minute period).¹⁰ Tachysystole is qualified as to the presence or absence of decelerations and the term applies to both spontaneous and stimulated labor. Hyperstimulation and hypercontractibility are not defined and these terms should be abandoned.¹⁰

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Baseline Rate

Baseline rate is calculated by averaging the rate rounded to five bpm intervals over a 10 minute segment. Segments should be excluded that have marked variability ($>$ 25 bpm) are greater than or equal to 25 bpm above or below the baseline or containing accelerations or decelerations. There must be at least a two-minute identifiable segment within any 10 minute window. The normal range is 110 to 160 bpm.¹⁰ When performing SIA, average baseline rate should be determined between contractions. A change in baseline rate can be due to prematurity, change in fetal status, maternal fever, position, or medication.

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Bradycardia

Bradycardia is defined as a baseline $<$ 110 bpm.¹⁰ Mild bradycardia (100 to 109 bpm) is associated with post-dates infants and occipito-posterior position.¹⁰ Rates less than 100 bpm may be seen in fetuses with congenital heart disease or myocardial conduction defects.¹²

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Tachycardia

Tachycardia is defined as a baseline rate $>$ 160 bpm.¹⁰ Fetal movement, maternal anxiety or fever, maternal dehydration or ketosis and beta-adrenergic agents all may cause fetal tachycardia unassociated with hypoxia.¹² Fetal immaturity, thyrotoxicosis and anemia may also cause mild tachycardia.¹² Persistent tachycardia greater than 180 bpm, especially if maternal fever is present, suggests chorioamnionitis.¹² A fetal heart rate greater than 200 bpm is frequently due to fetal arrhythmia or other congenital anomaly.¹²

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Variability

The fetal heart rate normally exhibits fluctuations in baseline heart rate activity that is irregular in amplitude and frequency. The variability is linked to the central nervous system (CNS) reflecting cerebral activity. It is therefore a vital clue in determining the overall fetal condition.⁶ Detection is most accurate with a scalp electrode, although newer external transducers have improved ability to detect variability. Absent baseline variability is the finding that is most strongly associated with fetal

asphyxia,⁶ but has very poor specificity with estimated positive predictive value ranged from 2.6 to 18.1 percent.¹³ The presence of moderate variability as defined is highly predictive of a nonacidotic fetus.⁷ For structured intermittent auscultation, it is difficult to interpret variability using the same nomenclature for CEFM.

NICHD guidelines state that variability is no longer to be described as short-term (beat-to-beat) or long-term. Definitions to characterize variability are specifically classified as follows: absent, minimal, moderate, or marked.¹⁰

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Absent variability	amplitude range is undetectable.
Minimal variability	amplitude range detectable but \leq five bpm
Moderate variability	amplitude range is six to 25 bpm
Marked variability	amplitude range is $>$ 25 bpm

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The amount of variability is affected by the fetal state and by multiple causes other than uteroplacental insufficiency resulting in acidosis. Normal babies may have decreased variability with no known cause. Sleep cycles of 20 to 40 minutes or longer may cause a normal decrease in variability. Medications including analgesics, anesthetics, barbiturates, tranquilizers, atropine, and magnesium sulfate may also induce quiet periods in the FHR tracing without fetal compromise. Steroid administration to induce fetal lung maturation also reduces variability. A fetus with anencephaly will have a relatively flat baseline.¹²

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Accelerations

Accelerations are visually apparent abrupt increases in FHR tracing above the most recent baseline with an onset to peak in $<$ 30 seconds. The peak of the acceleration is \geq 15 bpm (\geq 10 bpm if $<$ 32 weeks gestation) and lasts for \geq 15 seconds (\geq 10 seconds if $<$ 32 weeks gestation).⁹ The return to baseline is within two minutes. If the acceleration lasts \geq two minutes but $<$ 10 minutes, then it is defined as a prolonged acceleration. The absence of accelerations does not necessarily indicate fetal compromise, but does warrant the need for further evaluation. When used in antenatal testing, a contraction stress test (CST) or biophysical profile (BPP) would be required to clarify fetal status in the presence of a nonreactive stress test (NST). The presence of spontaneous or stimulated accelerations is highly predictive of a nonacidotic fetus.⁷

When accelerations are seen in association with contractions and variable decelerations, they may indicate partial cord compression. Their disappearance may signal fetal hypoxia, especially with other indicators of compromise, such as worsening variable decelerations, decreased baseline variability, baseline tachycardia or bradycardia.¹²

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Decelerations

Decelerations are defined in terms of their relationship to uterine contractions. If they occur with \geq 50 percent of contractions in any 20 minute window they are considered to be recurrent decelerations. If they occur $<$ 50 percent of contractions in any 20 minute window they are termed intermittent decelerations. Decelerations are classified as early, variable or late.¹⁰

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Early Decelerations

Early decelerations are visually apparent, gradual decrease in FHR with return to baseline in association with a uterine contraction. The onset to nadir is \geq 30 seconds and the nadir occurs at the

same time as the peak of the contraction.¹⁰ They are nearly always benign if no other abnormalities of the FHR tracing are noted and represent transient local changes in blood flow as a result of stimulus of the vagal nerve centers due to head compression.

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Variable Decelerations

Variable decelerations are visually apparent abrupt decrease in FHR below the baseline with onset to nadir ≤ 30 seconds. The decrease in FHR is ≥ 15 bpm with duration of ≥ 15 seconds but < 2 minutes and may not be associated with contractions.¹⁰ Variable decelerations are most commonly the result of cord compression resulting in a rise in peripheral resistance and change in oxygenation. This causes sudden fetal hypertension, increased parasympathetic outflow and slows the fetal pacemaker. Interpretation is complicated, however, because decreased arterial oxygen concentration, secondary to uteroplacental insufficiency from other causes, can also result in variable decelerations. Characteristics of benign variable decelerations (good fetal reserve) include rapid descent and recovery, good baseline variability and accelerations at the onset and at the end of the contraction. Concerning signs include late onset, slow recovery, decreased variability, baseline tachycardia, loss of accelerations (or “shoulders”) if previously present, and increased depth of the variable decelerations.¹²

Late Decelerations

Late decelerations are visually apparent gradual decreases in FHR with return to baseline where the onset to nadir ≥ 30 seconds. The onset, nadir and recovery of the deceleration occur after the beginning, peak and ending of the contraction.¹⁰ If uncorrected, repetitive late decelerations are frequently associated with uteroplacental insufficiency and fetal hypoxemia leading to acidemia and myocardial depression. When combined with decreased variability or other FHR abnormalities, there is an increased likelihood of significant fetal compromise and immediate evaluation and intervention are indicated. Subtle, shallow late decelerations are easily missed but clinically significant. They can be detected by holding a straight edge along the baseline.

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Prolonged Decelerations

Prolonged decelerations are visually apparent decreases in FHR baseline ≥ 15 bpm, lasting ≥ 2 minutes, but < 10 minutes.¹⁰

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A sudden deterioration in the fetal heart rate pattern can be seen after vaginal examination, amniotomy, uterine tachysystole secondary to oxytocin or a cervical ripening agent, maternal hypotension (e.g., secondary to regional anesthesia), maternal seizures, fetal scalp sampling, or fetal movement producing transient cord compression. If the fetus was not previously compromised, recovery will usually occur with discontinuation of the inciting event or agent, position change, increased intravenous fluids, maternal oxygen supplementation or a combination of these measures. When accompanied by change in variability, decelerations are more likely to be associated with fetal acid/base abnormalities. Factors known to cause these changes should be sought and corrected.

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Overall Assessment

Having assessed the contraction and the FHR patterns and defined risk, an overall assessment of the situation and management plan should be made. The terms “fetal distress” and “birth asphyxia” are inappropriate and have no place in the assessment. In the past, terms describing the FHR tracing were “reassuring” and “non-reassuring”, but since the recent report from the 2008 NICHD work-

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shop, the assessment of fetal status has been organized into a three-tiered system: Category I, II or III. Management of the mother must be based on clinical context, fetal tracing category and include a plan for further fetal surveillance if labor is allowed to continue.

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Generally, Category I tracings are considered normal and can be followed routinely. Category II tracings are indeterminate and not predictive of abnormal fetal pH status. These tracings require prompt evaluation and efforts to resolve the tracing. Category III tracings are clearly abnormal and predictive of abnormal pH status. Prompt evaluation and consideration for immediate delivery is required. The green, yellow, and red Stoplight colors correlate with the NICHD categories.

ACKNOWLEDGEMENT: The ALSO® Program thanks and acknowledges Mr. Kim Hinshaw, MB, BS, FRCOB for the creation of the DR C BRAVADO mnemonic. Mr. Hinshaw is a consultant obstetrician and past chair of ALSO® United Kingdom.

NICHD FHR CLASSIFICATION SYSTEM¹⁰

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Category I FHR tracings

Category I tracings are normal tracings that are strongly predictive of normal fetal pH status at the time of observation and must include all of the following:

- Baseline of 110 to 160 bpm
- Moderate baseline variability
- Late or variable decelerations are absent
- Early decelerations may be present or absent
- Accelerations may be present or absent

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Category II FHR Tracings

Indeterminate tracings are not predictive of fetal acid-base status and cannot be classified as either I or III. The presence of moderate variability or accelerations is highly predictive of normal fetal acid-base status.⁷ These tracings require prompt evaluation and efforts to resolve the tracing. Category II tracings may show any of the following:

- Tachycardia
- Baseline with absent, minimal, or marked variability
- Recurrent variable decelerations with minimal to moderate variability
- Recurrent late decelerations with moderate variability
- Variable decelerations with slow return, overshoot or “shoulders”
- Prolonged deceleration
- No acceleration after fetal stimulation

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Category III FHR Tracings

These tracings are predictive of abnormal fetal pH status. These require prompt evaluation and consideration of immediate delivery. These include:

- Sinusoidal pattern

OR

- Absent FHR variability with any of the following:
 - Recurrent late decelerations
 - Recurrent variable decelerations
 - Bradycardia

When using CEFM, tracings should be reviewed by both clinicians and labor and delivery nurses regularly during labor.⁸ The periodic review includes ensuring that a good quality tracing is present and that abnormalities are appropriately communicated. Some institutions are now using tools for risk management and patient safety including communication strategies. An example would be the SBAR (Situation-Background-Assessment-Recommendation) developed by the Kaiser Permanente Group in Colorado. This technique provides a framework for communication between members of the health care team about a patient's condition.¹⁴

Adequate documentation is necessary and many institutions are now employing flow sheets, clinical pathways or fetal tracing archival processes. Any written information on the tracing, i.e., emergent situations during labor, should coincide with these automated processes to minimize litigation risk.¹⁶

Documentation of the fetal heart tracing and categorization during labor should include:

1. Fetal heart rate data (i.e., baseline rate, variability, periodic changes and categorization)
2. Uterine activity characteristics obtained by palpation or pressure transducer (i.e., frequency, duration, intensity and whether tachysystole is present)
3. Specific actions taken when changes in FHR occur
4. Other maternal observations and assessments
5. Maternal and fetal responses to interventions
6. Subsequent return to normal findings

Suggested FHR Management⁷

The 2010 ACOG Practice Bulletin on management of intrapartum fetal heart rate tracings presents a standardized approach.⁷ This is based in part upon the framework developed by Parer,¹⁶ who analyzed studies of fetal heart rate tracings to consider four hypotheses:

1. Moderate variability is associated with an absence of acidemia and a non-depressed infant
2. Minimal or absent variability in the presence of late or variable decelerations is associated with acidemia and a depressed infant
3. The depth of the deceleration is directly proportional to infant depression and acidemia
4. After an initial normal FHR tracing, progressive decelerations in the absence of catastrophic events, results in acidemia that develops over a significant amount of time

This study concluded that presence of moderate variability had a 98 percent negative predictive value for the fetal acidosis or an Apgar < 7. Minimal or absent variability with late or variable decelerations was predictive of neonatal acidosis or neonatal depression with 23 percent of neonates having these adverse findings and some evidence that absent variability is more strongly predictive. The depth of decelerations has a stronger association with fetal acidosis for late decelerations than for variable decelerations. Acidosis in the fetus with decreased variability and decelerations was shown to develop slowly over time, except in the setting of a sudden bradycardia as may occur with placental abruption or cord prolapse. In the absence of these potential obstetrical catastrophes there should be at least an hour from the development of decreased variability with decelerations until the development of significant fetal acidosis. As response times for urgent operative delivery varies across maternity care units, the decision point for urgent delivery will be different for each institution.

Category I EFM Tracings

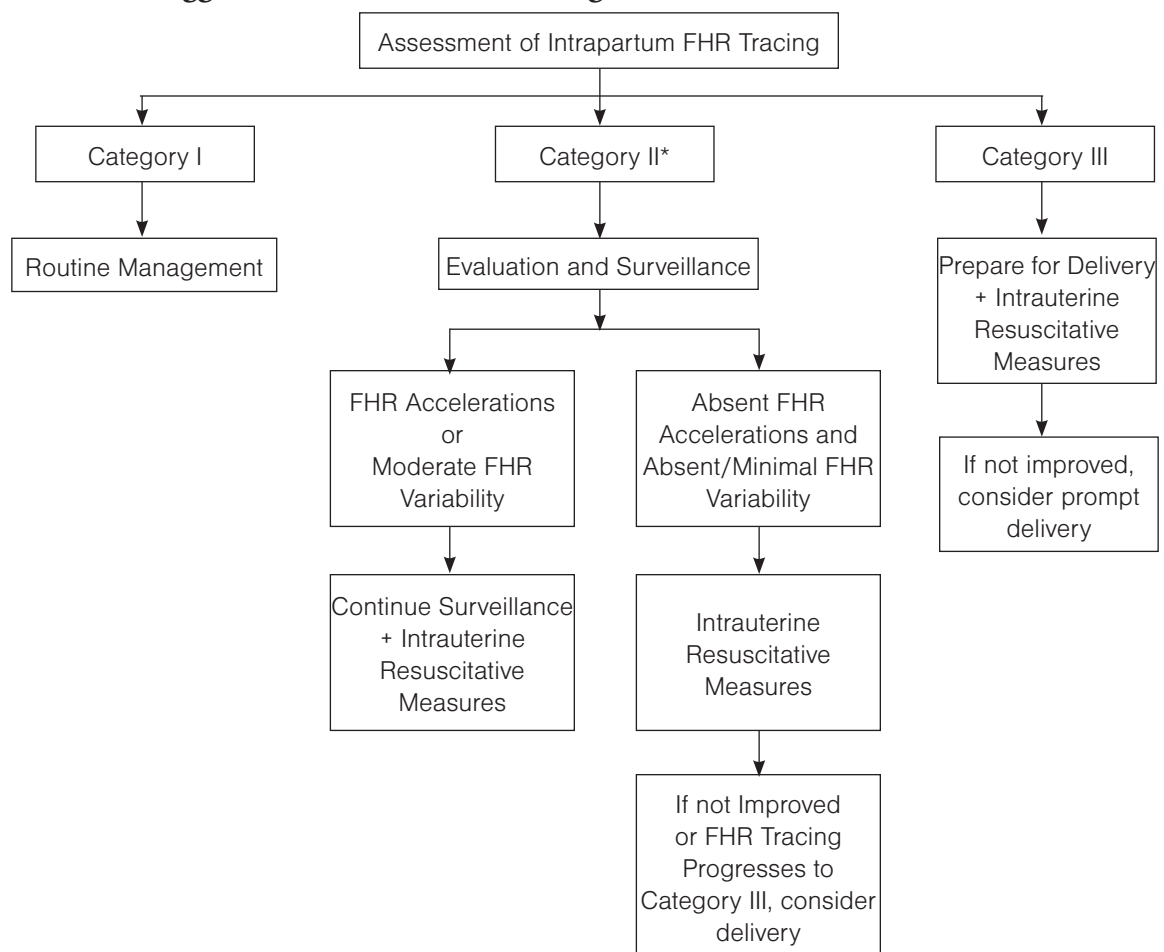
Category I tracings are considered normal and are not associated with fetal acidemia. Recommendations are to continue the current monitoring, either intermittent auscultation or electronic fetal monitoring, periodically evaluate and document the clinical status, underlying risk factors and tracings and to change management only if the tracing were to change to a category II or III.

Category II EFM Tracings

Category II tracings include all tracings that are not classified as Category I or III. Since these tracings may represent fetal compromise, recommendations are to evaluate and continually survey the tracing, perform appropriate corrective measures when indicated, and then reevaluate. Given that Category II tracings represent such a wide variety of concerns, the presence of accelerations (spontaneous or induced) or moderate variability are useful in predicting fetal well-being (Figure 1). If neither of these characteristics is present after appropriate intrauterine resuscitative measures or if the tracing progresses to a Category III tracing, consider delivery of the infant. If the tracing reverts to a category I after appropriate intervention, then previous monitoring may be initiated or resumed.

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FIGURE 1. Suggested Fetal Heart Rate Management



*Given the wide variation of FHR tracings in Category II, this algorithm is not meant to represent assessment and management of all potential FHR tracings, but provide an action template for common clinical situations.

ACOG Practice Bulletin #116, Management of Intrapartum FHR Tracings, *Obstet Gynecol.* 2010 Nov; 116(5) 1232-40.

Category III EFM Tracings

Category III tracings are considered abnormal and recommendations are aimed at correcting fetal acidemia or reducing outcomes of neonatal encephalopathy, cerebral palsy and neonatal acidosis. Preparation for delivery and a time frame for delivery are essential as well as performing intrauterine resuscitative measures. If tracings do not improve with appropriate corrective maneuvers, then prompt delivery of the infant is indicated.

Considerations in preparing for an operative delivery in the setting of a Category III tracing should be made judiciously and expeditiously. The standard rule of “30 minutes from decision-to-incision”, although used frequently, has not been supported in the literature to reduce adverse neonatal outcomes.⁷ In addition, immediate delivery of an infant with an unknown duration of a Category III tracing, may not improve outcomes if the infant has experienced a pre-existing hypoxic insult.⁷

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Intrauterine Resuscitative Measures⁷

Table 2. Various Intrauterine Resuscitative Measures for Category II or Category III Tracings or Both

Goal	Associated Fetal Heart Rate Abnormality*	Potential Intervention (s)
<ul style="list-style-type: none"> - Promote fetal oxygenation and improve uteroplacental blood flow - Reduce uterine activity - Alleviate umbilical cord compression 	<ul style="list-style-type: none"> - Recurrent late decelerations - Prolonged decelerations or bradycardia - Minimal or absent fetal heart rate variability - Tachysystole with Category II or III Tracing - Recurrent variable decelerations - Prolonged decelerations or bradycardia 	<ul style="list-style-type: none"> - Initiate lateral positioning (either left or right) - Administer maternal oxygen administration - Administer intravenous fluid bolus - Reduce uterine contraction frequency - Discontinue oxytocin or cervical ripening agents - Administer tocolytic medication (eg, terbutaline) - Initiate maternal repositioning - Initiate amnioinfusion - If prolapsed umbilical cord is noted, elevate the presenting fetal part while preparations are underway for operative delivery

Always: check cervix, maternal vital signs

ACOG Practice Bulletin #116, Management of Intrapartum FHR Tracings, *Obstet Gynecol.* 2010 Nov; 116(5) 1232-40.

Various intrauterine resuscitative measures to be undertaken for category II or III FHR tracings.⁷ The goals of these corrective measures are aimed at the underlying suspected cause of the abnormality in the FHR tracing. They are also dependent upon the associated fetal heart rate abnormality identified.

Possible interventions include:

- Change in maternal positioning to initiate lateral positioning (left or right)
- Administer maternal oxygen
- Administer intravenous fluid bolus
- Reduce uterine contraction frequency

- Discontinue oxytocin or cervical ripening agents
- Administer tocolytic medication
- Initiate amnioinfusion
- If prolapsed umbilical cord is noted, elevate the presenting fetal part while preparations are made for operative delivery.

Other important areas to consider are:

- Assess maternal vital signs
- Vaginal exam
- Change method of FHR monitoring

Administration of maternal oxygen remains a common intervention supported by one study.¹⁷ Tocolysis should be considered, especially in the setting of tachysystole. The use of terbutaline compared to untreated controls showed an improvement in FHR tracings, however, clinical outcomes of perinatal mortality, low five minute APGAR scores and admission to neonatal intensive care units were not improved.¹⁸

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Ancillary testing for Category II and III FHR Tracings

Fetal scalp pH testing is no longer commonly performed in the United States and has been replaced with fetal stimulation or immediate delivery (by operative vaginal delivery or cesarean section). A meta-analysis showed that if there is absent or minimal variability without spontaneous accelerations, the presence of an acceleration after scalp stimulation or fetal acoustic stimulation indicates that the fetal pH is > 7.20 .¹⁹ If the fetal heart tracing remains abnormal then these tests may need to be performed periodically and consideration for emergent cesarean or operative vaginal delivery is usually recommended.¹¹ Cord blood gases are recommended after a delivery for an abnormal fetal heart rate tracing.

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Amnioinfusion

Amnioinfusion should be considered for *suspected cord compression*, to reduce the occurrence of variable heart rate decelerations and lower the use of cesarean delivery in those settings where cesarean delivery is done for abnormal fetal heart rate alone.²⁰ Amnioinfusion has also been shown to be associated with a reduction in the incidence of both neonatal and maternal hospital stay greater than three days. No improvement in long-term neonatal outcomes has been detected.

Although generally considered safe, amnioinfusion carries a few precautions and potential complications. Amnioinfusion is only indicated for recurrent variable decelerations and is not indicated for late decelerations, fetal bradycardia, thick meconium, or oligohydramnios with a normal heart rate tracing.²⁰

Amnioinfusion should also not be attempted when cesarean delivery is indicated, such as in transverse lie or placenta previa. It should never be carried out when doing so would result in a delay of more definitive treatment. With breech presentation or multiple gestation, or when placental abruption is suspected, caution should be taken in performing amnioinfusion. Complications include umbilical cord prolapse, rupture of a previous cesarean scar, amniotic fluid embolism, acute uterine hypertonus with a Category II or Category III fetal heart tracing, and acute polyhydramnios.

GUIDELINES FOR PERFORMING AMNIOINFUSION:

Amnioinfusion can be done by either continuous or intermittent technique. A randomized controlled trial showed that there was no difference in between the two for resolving variable decelerations.²¹

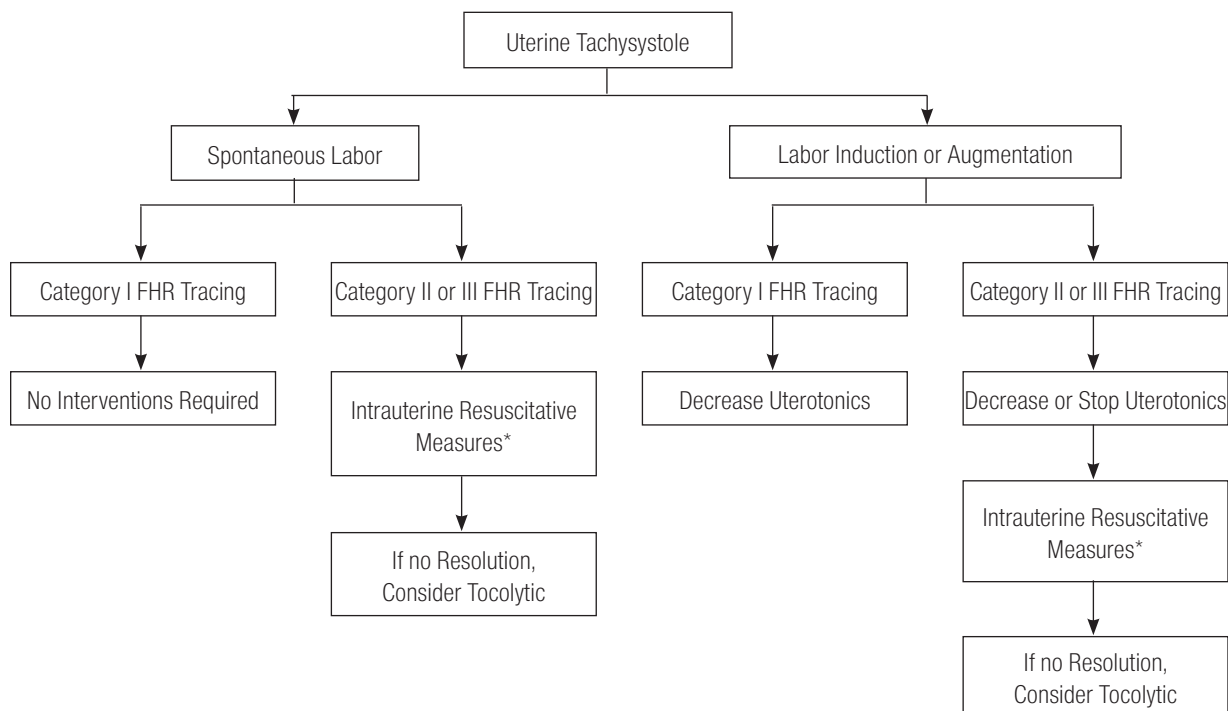
For continuous infusion:

1. Perform a vaginal examination to determine presentation, dilation, and to rule out cord prolapse.
2. Obtain informed consent.
3. Place the patient in the left lateral position. Place an intrauterine pressure catheter (IUPC) and consider placement of a fetal scalp electrode. Use a double lumen catheter, if available, for saline infusion.
4. If a double lumen catheter is not available, attach an 18 - gauge needle to IV tubing connected to normal saline or lactated Ringer's solution using a blood warmer. Attach extension tubing filled with distilled water between the IUPC and the transducer. Insert the 18 - gauge needle into the side port of the extension tubing.
5. Infuse fluid, giving 250 to 500 ml initially, followed by 50 to 60 ml per hour maintenance infusion until fetal heart rate abnormalities resolve.

**NOTE: Resting tone will be increased while the infusion is running, but elevated baseline tone prior to infusion is a contraindication.*

FIGURE 2. Suggested Management of Tachysystole⁷

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**See Table 2 for list of various intrauterine resuscitative measures.*

ACOG Practice Bulletin #116, Management of Intrapartum FHR Tracings, Obstet Gynecol. 2010 Nov; 116(5) 1232-40.

Tachysystole is defined as greater than five contractions over 10 minutes over a 30-minute period. Management of this condition is dependent upon the FHR tracing abnormality. For women with spontaneous labor and a Category I FHR tracing, no intervention is required. If a Category II or III FHR tracing exists, intrauterine resuscitative measures depend on the clinical situation coupled with associated FHR characteristics of variability and accelerations. If labor is induced or augmented, regardless of the FHR tracing categorization, the oxytocin dose should be reduced or if cervical ripening agents are being used, they should be discontinued. If there is the presence of a Category II or III FHR tracing, then initiation of intrauterine resuscitative measures may help to alleviate FHR tracing abnormalities. If tachysystole does not resolve with intervention measures, then tocolytic medication (e.g. terbutaline) should be considered.

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Areas for Future Development

Although CEFM continues to be the “gold” standard for fetal monitoring, active research is being performed to enhance CEFM with computerized interpretation or to develop newer methodologies to monitor fetal well-being during labor.

Fetal hypoxemia results in biphasic changes in the ST segment of the fetal ECG (fECG) waveform and an increase in the T/QRS ratio. The ST segment automated ANalysis (STAN, Neoventa Medical, Goteberg, Sweden) software can record the frequency of ST events and combined with changes in CEFM can be used to determine if intervention during the labor process is indicated. Several studies have evaluated fECG analysis documenting the effectiveness to reduce operative vaginal deliveries, fetal scalp sampling, neonatal encephalopathy and fetal acidosis (pH < 7.05).²²⁻²⁵ One drawback to this technology is that it requires rupture of the membranes and internal fetal scalp monitoring.

Another area of research is the use of computer analysis of key components of the fetal tracing²⁶⁻²⁸ or decision analysis for the interpretation of the EFM tracing.²⁹ These have not been demonstrated to improve clinical outcomes.

Fetal pulse oximetry was developed using an internal monitor, requiring rupture of membranes, to continuously monitor fetal oxygenation during labors.³⁰⁻³² Trials have not demonstrated significance differences in reducing cesarean section rates or interventions with the use of fetal oximetry.

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SUMMARY

Initiation of fetal monitoring begins with assessment of maternal and fetal risk. Since CEFM has a low positive predictive value and can result in increased rates of cesarean delivery, intermittent auscultation is recommended for low risk pregnancies. However, staff availability and experience must be considered before deciding on this technique. Providers should be ready to change monitoring to CEFM if a high-risk situation develops.

If CEFM is selected for fetal surveillance, interpretation needs to be done in light of the clinical background, the overall pattern, stage of labor, and in conjunction with fetal scalp or acoustic stimulation. This combination maximizes the benefit to infant without increasing operative delivery rates. Outcomes may still be unaffected using this technique, even in high-risk pregnancies. Efforts have recently been undertaken to standardize the definitions, interpretation and general management of FHR tracings. It is critical that institutions and hospitals insure that all labor and delivery personnel

are trained in these categorization rankings. Communication among team members is also critical and tools or strategies to maximize accuracy and completeness of transfer of information should be utilized (i.e. SBAR) to minimize medical errors and for patient safety.

Regardless of which technology is employed, the patient/support relationship is paramount during the labor process. Providers should not allow any monitoring approach to substitute for personal attention to mother and fetus throughout labor.

If your institution has a risk management or patient safety committee, regular monitoring and compliance with all aspects of fetal surveillance should be undertaken. The team should be composed of physicians, nurses, administrators and all other pertinent staff for successful implementation.

SORT: KEY OF RECOMMENDATIONS FOR PRACTICE

<i>Clinical Recommendation</i>	<i>Evidence Rating</i>	<i>Reference</i>
Structured intermittent auscultation should be offered to low risk women as an alternative to continuous electronic fetal monitoring (CEFM). CEFM does not decrease perinatal mortality. CEFM reduced neonatal seizures (NNT= 661) but does not reduce the incidence of cerebral palsy. CEFM increased cesarean section rates (overall) (NNT = 20) and instrumental vaginal births (NNT = 33).	A	2
The presence of moderate fetal heart rate variability is predictive of normal fetal acid-base status.	B	7, 16
A category III fetal monitoring tracing increases the likelihood of fetal acidosis and requires prompt measures for intrauterine resuscitation and consideration of the need for urgent delivery if these measures do not result in improvement.	B	7, 16
A period of CEFM upon maternity unit admission versus auscultation results in significant increased interventions including epidural analgesia (NNT = 19), CEFM (NNT = 7) and fetal blood scalp testing (NNT = 45).	A	5
Compared to EFM alone, the addition of fECG analysis results in a reduction in operative vaginal deliveries (NNT = 50) and fetal scalp sampling (NNT = 33).	A	22
Amnioinfusion for umbilical cord compression in the presence of decelerations reduced fetal heart rate decelerations (NNT = 3), cesarean section overall (NNT = 8), Apgar score less than seven at five minutes (NNT = 33), low cord arterial pH (< 7.20) (NNT = 8), neonatal hospital stay greater than three days (NNT = 5) and maternal hospital stay greater than three days (NNT = 7).	A	20

SUMMARY TABLE

CEFM Findings	Significance	Management
Category I		
Normal		
Moderate variability, no decelerations, accelerations and normal baseline	Normal pH and fetal well-being	<ul style="list-style-type: none"> - Continue current monitoring method (structured intermittent auscultation [SIA] or continuous electronic fetal monitoring [CEFM])
Category II		
Indeterminate		
Baseline changes (bradycardia or tachycardia) or prolonged deceleration	<p><i>Tachycardia</i> – Medication (terbutaline, cocaine or other stimulants), maternal anxiety, infection (chorioamnionitis, pyelonephritis or other maternal infection), fever, maternal medical disorders (hyperthyroidism), obstetrical conditions (placental abruption or fetal bleeding, fetal tachyarrhythmias)</p> <p><i>Bradycardia</i> – rupture of membranes, occiput-posterior, post-date pregnancy, congenital anomalies, maternal hypotension, umbilical cord prolapse, rapid fetal descent, tachysystole, placental abruption or uterine rupture</p>	<ul style="list-style-type: none"> - Intrauterine Resuscitative Measures aimed at promoting fetal oxygenation and improving uteroplacental blood flow - Evaluate fetal heart rate variability - Consider prompt delivery (assisted vaginal or cesarean section) for bradycardia with minimal or absent variability or prolonged decelerations or both that do not resolve
Change in variability (minimal)	<p><i>Medications</i> (opioid or magnesium sulfate); should resolve in one to two hours</p> <p><i>Sleep cycle</i> (generally lasts 20 minutes but can persist up to 60 minutes)</p> <p><i>Possible fetal hypoxia / acidemia</i></p>	<ul style="list-style-type: none"> - For possible decreased oxygenation, Intrauterine Resuscitative Measures aimed at promoting fetal oxygenation and improving uteroplacental blood flow - No improvement and no FHR accelerations then digital scalp or vibroacoustic stimulation - Consider prompt delivery (assisted vaginal or cesarean section) if fetal acidemia is suspected and unresolved
Decelerations without absent variability	<p><i>Intermittent Variable Decelerations</i> – common and do not require treatment</p> <p><i>Recurrent Variable Decelerations</i>- evaluate frequency, depth and duration. The presence of moderate FHR variability or spontaneous or induced accelerations suggests no acidemia.</p> <p><i>Late Deceleration</i>– maternal hypotension (ie., postepidural), uterine tachysystole, and maternal hypoxia.</p>	<ul style="list-style-type: none"> - Intrauterine Resuscitative Measures aimed at relieving umbilical cord compression - Intrauterine Resuscitative Measures aimed at promoting fetal oxygenation and improving uteroplacental blood flow - Reevaluate for improvement of FHR tracing (accelerations or moderate variability) - Consider prompt delivery (assisted vaginal or cesarean section) if no accelerations or minimal variability and late decelerations persist.

Category III	Abnormal	
Absent baseline variability and recurrent decelerations (variable or late)	Uteroplacental insufficiency Fetal hypoxia / acidemia	Intrauterine Resuscitative Measures aimed at promoting fetal oxygenation and improving uteroplacental blood flow - Prepare and consider time frame for delivery (30 minute rule) - Consider prompt delivery (assisted vaginal or cesarean section) for unresolved FHR tracings
Tachysystole		
Uterine tachysystole	<i>Spontaneous labor with Category II or III FHR tracing</i> <i>Labor induction or augmentation and Category I FHR tracing</i> <i>Labor induction or augmentation and Category II or III FHR tracing</i>	- Intrauterine Resuscitative Measures aimed at reducing uterine activity - If no resolution, consider tocolytic - Decrease uterotonics - Decrease or stop uterotonics - Intrauterine Resuscitative Measures aimed at reducing uterine activity - If no resolution, consider tocolytic

* See Table 2 "Intrauterine Resuscitative Measures"

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