Fetal Assessment and Safe Labor Management

Purpose of this Monograph

Safe care for mothers and babies during labor and birth is the goal of all health care professionals and is an expectation of childbearing women and their families. Fetal assessment is a key aspect of perinatal patient safety. As more evidence has been published over the last decade about what constitutes normal labor progress and associated maternal-newborn outcomes, there has been increased interest in using these data to redefine routine labor management practices.[1] One of the main objectives of this heightened focus on labor management is prevention of the first cesarean birth, which would then avoid maternal morbidity and mortality related to primary and repeat cesareans.[1, 2] When a woman in the United States has a cesarean birth, the chances of having a vaginal birth in a subsequent pregnancy are only about 10%.[3] Labor management guidelines based on current evidence and characteristics of contemporary childbearing women,[1, 2] along with efforts to minimize unnecessary interventions [4, 5,6] may result in longer labors for selected women progressing at the upper limits of normal. Although longer labors will require extended fetal surveillance, many women may be able to have a vaginal birth using the new guidelines whereas in the past, a cesarean for "failure to progress" would have likely occurred. The use of patience, which is supported by new evidence and clinical guidelines, may influence labor outcomes. In some cases, despite the best efforts of all involved, a cesarean birth may be necessary in order to have a healthy outcome.

The purpose of this monograph is to incorporate evidence-based labor management guidelines into fetal assessment during the intrapartum period. A brief review of the definitions for fetal heart rate (FHR) patterns developed by the National Institute of Child Health and Human Development (NICHD)[7, 8] is offered, followed by an algorithm for managing indeterminate (category II) FHR patterns developed by fetal monitoring researchers and expert clinicians[9] inclusive of intrauterine resuscitation measures, and a summary of the 2014 recommendations for labor management from the American College of Obstetricians and Gynecologists and the Society for Maternal-Fetal Medicine.[1, 2]

Overview of NICHD Terminology and Interpretation of Electronic Fetal Monitoring Tracings

The NICHD definitions and classifications in the "The 2008 National Institute of Child Health and Human Development Workshop Report on Electronic Fetal Monitoring" were published in *Obstetrics and Gynecology* and in the *Journal of Obstetric, Gynecologic and Neonatal Nursing*.[7, 8] NCC encourages the reader to obtain the original documents for further review and study.

Operational Principles for Using NICHD Terminology

Operational principles as the basis for defining terms and their interpretive value in assessing fetal heart rate tracings, were standardized in 1997 and reaffirmed in 2008. The most pertinent are listed below:

- Definitions are to be used for visual interpretation.
- Definitions apply to patterns obtained from a direct fetal electrode or an external Doppler device.
- Focus is on intrapartum patterns, but the definitions may also apply to antepartum observations as well.
- FHR patterns and uterine activity are determined through interpretation of tracings of good quality.
- The components of FHR tracings do not occur in isolation; therefore, evaluation of FHR patterns should take into account all components of the FHR pattern, including baseline rate, variability and presence of accelerations and/or decelerations. EFM tracings should be assessed over time to identify changes and trends.
- No differentiation between short and long term variability is made because in practice, they are visually determined as a unit.
- FHR patterns are dependent on gestational age, thus this is an essential interpretative factor for evaluating a FHR pattern. Maternal medical status, prior fetal assessment results, use of medications and other factors also may need to be considered.
- A complete description of the EFM tracing includes uterine contractions, baseline fetal heart rate, baseline variability, presence of accelerations, periodic (associated with contractions) or episodic (not associated with contractions) decelerations, and changes or trends of the FHR pattern over time.[8, 10]

NICHD Terminology and Definitions[7, 8]

Fetal Heart Rate and Uterine Activity Characteristics as per NICHD

Term	Definition
Baseline Rate	Approximate mean FHR rounded to increments of 5 bpm during a 10-minute window excluding accelerations and decelerations and periods of marked variability. There must be ≥2 minutes of identifiable baseline segments (not necessarily contiguous) in any 10-minute window, or the baseline for that period is indeterminate. In such cases, one may need to refer to the previous 10-minute window for determination of the baseline.
Bradycardia	Baseline rate of <110 bpm.
Tachycardia	Baseline rate of >160 bpm.
Baseline Variability	Determined in a 10-minute window, excluding accelerations and decelerations. Fluctuations in the baseline FHR that are irregular in amplitude and frequency and are visually quantified as the amplitude of the peak-to-trough in bpm.
Absent variability	Amplitude range undetectable.
Minimal variability	Amplitude range visually detectable but ≤5 bpm. (Greater than undetectable but ≤5 bpm)
Moderate variability	Amplitude range 6–25 bpm.
Marked variability	Amplitude range >25 bpm.
Acceleration	Visually apparent **abrupt** increase in FHR. Abrupt increase is defined as an increase from onset of acceleration to peak is <30 seconds. Peak must be ≥15 bpm, must last ≥15 seconds, but <2 minutes from the onset to return. Before 32 weeks of gestation, accelerations are defined as having a peak ≥10 bpm and duration of ≥10 seconds.
Prolonged Acceleration	Acceleration ≥2 minutes but <10 minutes in duration. Acceleration lasting ≥10 minutes is defined as a baseline change.
Early Deceleration	Visually apparent, usually symmetrical, **gradual** decrease and return of FHR associated with a uterine contraction. The gradual FHR decrease is defined as one from the onset to FHR nadir of ≥30 seconds. The decrease in FHR is calculated from onset to nadir of deceleration. The nadir of the deceleration occurs at the same time as the peak of the contraction. In most cases, the onset, nadir, and recovery of the deceleration are coincident with the beginning, peak, and ending of the contraction, respectively.

Term	Definition
Late Deceleration	Visually apparent, usually symmetrical, **gradual** decrease and return of FHR associated with a uterine contraction. The gradual FHR decrease is defined as from the onset to FHR nadir of ≥30 seconds. The decrease in FHR is calculated from onset to the nadir of deceleration. The deceleration is delayed in timing, with nadir of the deceleration occurring after the peak of the contraction. In most cases, the onset, nadir, and recovery of the deceleration occur after the beginning, peak, and ending of the contraction, respectively.
Variable Deceleration	Visually apparent **abrupt** decrease in FHR. 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 deceleration. The decrease in FHR is ≥15 bpm, lasting ≥15 seconds, and <2 minutes in duration. When variable decelerations are associated with uterine contractions, their onset, depth, and duration commonly vary with successive uterine contractions. Variable decelerations have a depth criteria; they must drop at least 15 or more bpm to be considered a variable deceleration.
Prolonged Deceleration	Visually apparent decrease in FHR from baseline that is ≥15 bpm, lasting ≥2 minutes, but <10 minutes. A deceleration that lasts ≥10 minutes is baseline change. Prolonged decelerations have a depth criteria; they must drop at least 15 or more bpm to be considered a prolonged deceleration.
Recurrent Decelerations	Occurring with ≥50% of contractions in any 20 minute window.
Intermittent Decelerations	Occurring with <50% of contractions in any 20 minute window.
Sinusoidal Pattern	Visually apparent, smooth, sine wave-like undulating pattern in FHR baseline with cycle frequency of 3-5/minutes that persists for ≥20 minutes.
Uterine Activity	Uterine activity is assessed based on the number of contractions that are occurring in a 10 minute segment, averaged over a 30 minute period.
Normal Uterine Activity	5 or less contractions in a 10 minute segment, averaged over a 30 minute period.
Tachysystole	Excessive uterine activity; more than 5 contractions in a 10 minute segment averaged over a 30 minute period. Tachysystole can be the result of both spontaneous and stimulated labor.

Derived from: Macones, G. A., Hankins, G. D., Spong, C. Y., Hauth, J. D., & Moore, T. (2008). The 2008 National Institute of Child Health Human Development workshop report on electronic fetal monitoring: Update on definitions, interpretations, and research guidelines. *Obstetrics & Gynecology*, 112(3), 661–666; and *Journal of Obstetric, Gynecologic and Neonatal Nursing*, 37(5), 510–515. [7,8]

(See Appendix A for sample EFM tracings with most of these fetal heart rate characteristics)
(See Appendix B for sample EFM tracings with normal uterine activity and tachysystole)
(See Appendix C for sample EFM tracings with sinusoidal pattern)

Factors Affecting Fetal Heart Rate Patterns

There are many factors that have an effect on the fetal heart rate. These changes can relate to pre-existing or pregnancy-related conditions, substances used by the woman before labor, and medications given to the woman in labor. Other influences include maternal positioning, excessive uterine activity and maternal pushing efforts. The changes may be transient and benign or require monitoring and/or intervention/s. In the following two charts, medications and common factors are identified along with the associated fetal heart rate change. As there are multiple challenges in conducting research related to the effects of various extrinsic and intrinsic factors on the fetus, the supportive evidence is mainly level II-3 (evidence obtained from multiple time series with or without the intervention) or III (opinions of respected experts based on clinical experience, descriptive studies, or reports of expert committees).

The Influence of Medications on Fetal Heart Rate[11]

Medication	Change in Fetal Heart Rate
Narcotics	Decrease in variability, decrease in frequency of accelerations
Butorphanol	Transient sinusoidal fetal heart rate pattern, slight increase in baseline rate
Cocaine	Decrease in FHR variability
Corticosteroids	Decrease in FHR variability with betamethasone, but not dexamethasone
Magnesium Sulfate	Decrease in FHR variability, clinically insignificant decrease in baseline rate; inhibition of increasing accelerations as gestational age advances
Terbutaline	Increase in baseline rate
Zidovudine	No change

Derived from: American College of Obstetricians and Gynecologists (2009). *Intrapartum fetal heart rate monitoring: Nomenclature, interpretation, and general management principles.* (ACOG Practice Bulletin No. 106). Washington, DC: page 7, Author.[11]

Factors with Varying Degrees of Influence on the Fetal Heart Rate[12]

Factor	Associated Rates and Patterns
Prematurity	Higher baseline rate than term fetus, less variability than term fetus, less frequency and amplitude of accelerations than term fetus
Sleep Cycle	Minimal variability, reduced frequency and amplitude of accelerations
Spontaneous fetal movement	Accelerations
Scalp or vibroacoustic stimulation	Accelerations
Vaginal examination	Accelerations
Maternal fever	Increase in baseline rate, minimal variability
Intraamniotic infection; chorioamnionitis	Increase in baseline rate, minimal variability
Maternal hyperthyroidism	Tachycardia
Maternal hypothermia	Bradycardia
Maternal hypoglycemia	Bradycardia
Maternal drugs or substances (caffeine, theophylline, nicotine, cocaine, methamphetamine)	Tachycardia, decrease in variability
Maternal hypotension	Late decelerations, prolonged
Maternal hypoxemia, poor cardiac output	Late decelerations
Maternal medications (narcotics, barbiturates, phenothiazines, tranquilizers, general anesthetics, atropine)	Minimal variability, absence of accelerations
Maternal pushing efforts	Variable decelerations, prolonged decelerations, increase in baseline rate
Excessive uterine activity	Late decelerations, prolonged deceleration, increase in baseline rate, minimal variability
Oligohydramnios / less than normal level of amniotic fluid	Variable decelerations
Uterine rupture	Variable decelerations, prolonged decelerations, minimal variability, bradycardia
Fetal tachycardia	Minimal variability, accelerations may be absent
Fetal anemia	Sinusoidal pattern, tachycardia, minimal variability; absence of accelerations
Fetal heart block	Bradycardia, minimal variability
Fetal cardiac failure	Bradycardia, minimal variability

Factors with Varying Degrees of Influence on the Fetal Heart Rate[12]

Factor	Associated Rates and Patterns
Fetal heart structural defects	Bradycardia
Fetal cardiac conduction abnormalities	Bradycardia
Fetal arrhythmia	Tachycardia, decrease in variability
Fetal viral infection (cytomegalovirus)	Bradycardia
Fetal congenital anomaly	Minimal to absent variability, decelerations
Pre-existing fetal neurologic abnormality	Minimal to absent variability, absence of accelerations
Fetal autonomic response to changes in intracranial and/ or cerebral blood flow caused by transient compression of the fetal head during uterine contractions	Early decelerations
Disruption of oxygen transfer to the fetus resulting in transient hypoxemia during a uterine contraction	Late decelerations
Transient disruption of oxygen transfer from the environment to the fetus at the level of the umbilical cord	Variable decelerations
Disruption of oxygen transfer from the environment to the fetus at one or more points along the oxygen pathway	Prolonged decelerations

Derived from: Miller, L. A., Miller, D. A., & Tucker, S. M. (2013). *Fetal monitoring: A multidisciplinary approach* (Ed 7). St. Louis: Elsevier Mosby, pages 106-147.[12]

Fetal Heart Rate Pattern Interpretation

The primary purpose for the use of electronic fetal monitoring is to determine if the fetus is well oxygenated. Fetal heart rate patterns provide information regarding fetal acid-base status at the time they are observed.[7,8] Because the fetal condition is dynamic, frequent reassessment is required to monitor ongoing fetal status considering the context of the complete clinical situation. The three-tiered classification system was developed based on fetal acid-base status at time of observation with the assumption that the fetal tracing changes over time.[7,8] Fetal status can move from one category to another as a result of the individual clinical situation, maternal status and various intrauterine resuscitation measures that may be initiated in response to the fetal heart rate pattern.[7,8]

Moderate variability and/or the presence of accelerations are two features of fetal heart rate patterns that reliably predict the absence of fetal metabolic acidemia at the time observed.[7,8] However, it is important to note that the absence of accelerations or an observation of minimal or absent variability alone does not reliably predict the presence of fetal hypoxemia or metabolic acidemia.[7,8]

An analysis of 48,444 EFM tracings of women in term labor in 10 hospitals in the United States found over the course of labor the majority of fetuses will have FHR pattern characteristics that are both normal (category I) and indeterminate (category II).[13] Abnormal (category III) FHR patterns are rare (0.1%). Jackson et al. reported that when all of labor was considered, 77.9% of the time the tracings were a Category I, 22.1% of the time a Category II , and 0.004% of the time a Category III. In addition, Category II FHR tracings occurred in 84% of labors. Moderate variability and/or accelerations are generally an indication of a non-acidotic fetus when the FHR is indeterminate or category II. There are a wide range of clinical implications associated with the various types of FHR patterns within category II. For example, a FHR tracing with moderate variability and intermittent variable decelerations and a FHR tracing with minimal variability and recurrent late decelerations both meet criteria to be classified as category II FHR patterns. The underlying physiologic causative factors are different, as are the levels of concern for fetal wellbeing. Therefore, using the FHR category as a major factor to make clinical decisions related to fetal status during labor when the FHR is category II can present significant challenges. Nevertheless, there is evidence to suggest that the longer the FHR remains in category II, especially during the last two hours prior to birth, the greater the risk of neonatal morbidity.[13] Jackson et al. found if more than 50% of the time was spent in category II in the last two hours prior to birth, there was an increased risk of an Apgar score less than 7 and admission to the neonatal intensive care unit.

Category II and category III tracings require evaluation of the possible etiology.[10, 11] Initial assessment and intervention may include discontinuation of any labor stimulating agent, a vaginal examination, maternal repositioning, correction of maternal hypotension, an intravenous fluid bolus of lactated Ringer's solution, assessment for tachysystole (and if noted, reduction in uterine activity), amnioinfusion, and modification of maternal pushing efforts in second stage labor (e.g. pushing with every other or every third contraction or discontinuation of pushing temporarily).[10, 14] Maternal

oxygen at 10 liters per minute using a nonrebreather face mask may be administered in the presence of minimal or absent variability or recurrent late decelerations that have not resolved with the initial intrauterine resuscitative measures.[14] Moderate variability is not an indicator of fetal hypoxemia or acidemia; therefore, maternal oxygen administration is generally not necessary or appropriate if the FHR has moderate variability.[15]

When oxygen is chosen for intrauterine resuscitation, there is the assumption that other sources of potential fetal physiologic stress have been minimized; thus, oxytocin should not be infusing concurrently with maternal oxygen administration.[15]

Fetal Heart Rate Pattern Classification and Interpretation[10]

Category	Interpretation	Features
I **Normal**	Tracings in this category are strongly predictive of normal acid-base status at the time of observation.	• Baseline rate 110 to 160 beats per minute • Baseline variability moderate • No late or variable decelerations • Early decelerations present or absent • Accelerations: present or absent
II **Indeterminate**	Tracings in this category are not predictive of abnormal acid-base status, however there are insufficient data to classify them as either category I or category III	All tracings not categorized as category I or III and may represent many tracings that are encountered in everyday clinical practice. Examples: • Baseline rate: Bradycardia not accompanied by absent baseline variability • Baseline rate: Tachycardia • Minimal variability • Absent variability without recurrent decelerations • Marked variability • Absence of induced accelerations after fetal stimulation • Recurrent variable decelerations with minimal or moderate variability • Prolonged deceleration • Recurrent late decelerations with moderate variability • Variable decelerations with "slow return to baseline", "overshoots" or "shoulders"
III **Abnormal**	Tracings in this category are predictive of abnormal acid-base status at the time of observation.	Features: • Absent variability and any of the following: —Recurrent late decelerations —Recurrent variable decelerations —Bradycardia • Sinusoidal pattern

Derived from: American College of Obstetricians and Gynecologists (2010, Reaffirmed 2015) Practice Bulletin, Management of Intrapartum Fetal Heart Rate Tracings (Practice Bulletin No 116), Washington, DC, Author. doi: 10.1097/AOG.0b013e3182004fa9[10]

(See Appendix C for sample EFM tracings in each of the categories)

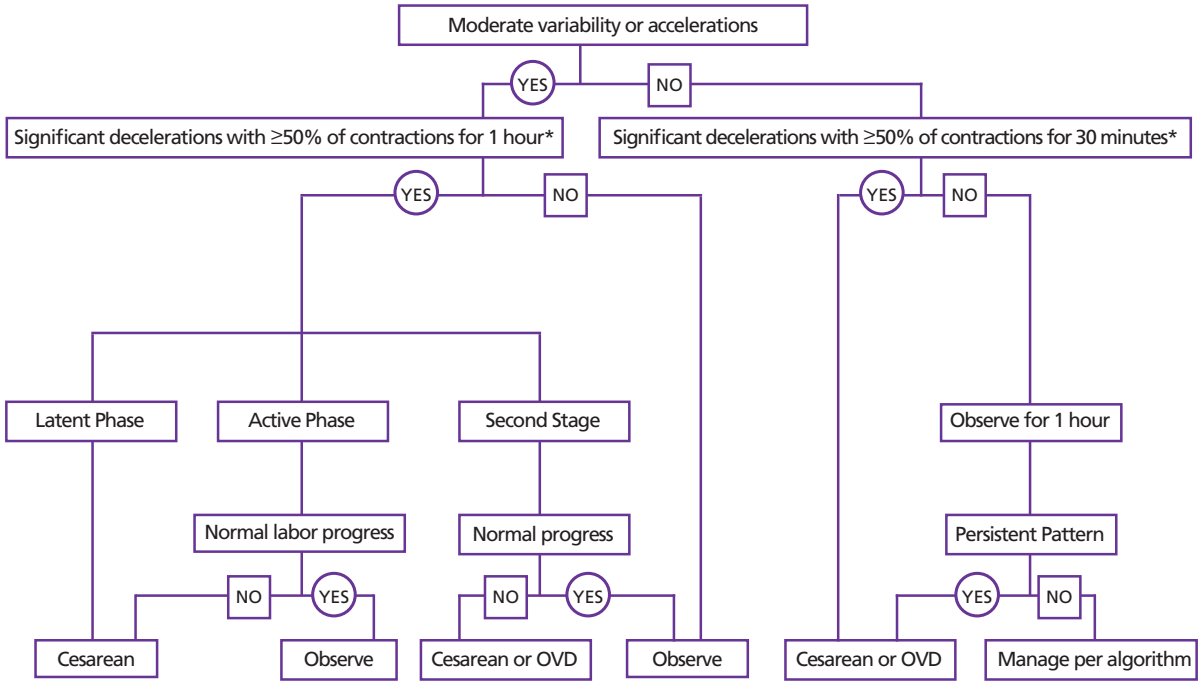
Intrauterine Resuscitation Measures[14]

Clinical Situation and/or FHR Characteristics	Goal	Techniques/Measures
Minimal or absent variability **Recurrent late decelerations** **Recurrent variable decelerations** **Prolonged decelerations** **Tachycardia** **Bradycardia** **Variable, late or prolonged decelerations occurring with maternal pushing efforts** **Tachysystole**	Promote fetal oxygenation	• Lateral positioning (either left or right) • IV fluid bolus of lactated Ringer's solution • Oxygen administration at 10 L/min via nonrebreather facemask; may be considered if there is minimal to absent variability and/or recurrent late decelerations or prolonged decelerations (discontinue as soon as possible based on fetal status) • Modification of pushing efforts; pushing with every other or every third contraction or discontinuation of pushing temporarily (during second stage labor) • Decrease in oxytocin rate • Discontinuation of oxytocin / removal of Cervidil insert / withholding next dose of misoprostol • If prolapsed umbilical is identified, elevate presenting fetal part while preparations are made for expedited operative birth
Tachysystole	Reduce uterine activity	• IV fluid bolus of lactated Ringer's solution • Lateral positioning (either left or right) • Decrease in oxytocin rate • Discontinuation of oxytocin / removal of Cervidil insert / withholding next dose of misoprostol • If no response, terbutaline 0.25 mg subcutaneously may be considered
Recurrent variable decelerations	Alleviate umbilical cord compression	• Repositioning • Amnioinfusion (during first stage labor) • Modification of pushing efforts; pushing with every other or every third contraction or discontinuation of pushing temporarily (during second stage labor)
Maternal hypotension	Correct maternal hypotension	• Lateral positioning (either left or right) • IV fluid bolus of lactated Ringer's solution • If no response, ephedrine 5 mg to 10 mg IV push may be considered

Derived from: Simpson, K. R. (2015). Physiologic interventions for fetal heart rate patterns. In A. Lyndon & Ali, L. U. (Eds.) *AWHONN's Fetal heart monitoring*. 5th ed.: Washington, DC: Kendall Hunt, page 167.[14]

Clark and colleagues [9] proposed a management algorithm for category II FHR tracings during labor based on a review of current evidence on labor progress and fetal status. The authors are well known fetal monitoring researchers and expert clinicians. The main goal of the algorithm is to promote the birth of the fetus, when possible, prior to the development of damaging degrees of hypoxemia or acidemia. To assist in delineation of FHR patterns in category II that may allow for careful observation from those that may warrant prompt action, the algorithm is based on the presence or absence of moderate variability or accelerations, "significant" decelerations and for how long; the phase and stage of labor; and response to the usual intrauterine resuscitation measures.[9] For the purposes of the algorithm, significant decelerations are defined as any of the following: variable decelerations lasting longer than 60 seconds and reaching a nadir more than 60 bpm below baseline, variable decelerations lasting longer than 60 seconds and reaching a nadir less than 60 bpm regardless of the baseline, and any late decelerations of any depth. A prolonged deceleration is also considered a significant deceleration. However, because of the wide variety of causes, the category II algorithm is not used for this type of deceleration until the deceleration is resolved. Please note that this definition is solely to be used to assist in application of the algorithm and is not an attempt to propose further definitions of FHR decelerations.

Algorithm for Management of Category II (Indeterminate) Fetal Heart Rate Tracings[9]



OVD, operative vaginal delivery.
*That have not resolved with appropriate conservative corrective measures, which may include supplemental oxygen, maternal position changes, intravenous fluid administration, correction of hypotension, reduction or discontinuation of uterine stimulation, administration of uterine relaxant, amnioinfusion, and/or changes in second stage breathing and pushing techniques.

The algorithm should be considered in the context of clarifications offered by the authors[9] (See table on next page).

The practical approach outlined in the algorithm and discussed in detail in the article encourages careful consideration of labor progress and the likelihood of vaginal birth within a timeframe that supports birth of a healthy baby when making labor management decisions. Application of intrauterine resuscitation measures as described by ACOG[10] and AWHONN[14] are recommended based on the specific features of the FHR pattern. As the labor management guidelines recommended by ACOG and SMFM[2] become widely adopted, a focus on fetal status relative to phase, stage, and normal progress of labor such as proposed in the algorithm can be useful in promoting healthy labor outcomes.

TABLE

Management of Category II Fetal Heart Rate Patterns: Clarification for Use in Algorithm[9]

1. Variability refers to predominant baseline FHR pattern (marked, moderate, minimal, absent) during a 30-minute evaluation period, as defined by NICHD.
2. Marked variability is considered same as moderate variability for purposes of this algorithm.
3. Significant decelerations are defined as any of the following:
   - Variable decelerations lasting longer than 60 seconds and reaching a nadir more than 60 bpm below baseline.
   - Variable decelerations lasting longer than 60 seconds and reaching a nadir more than 60 bpm regardless of the baseline.
   - Any late decelerations of any depth.
   - Any prolonged deceleration, as defined by the NICHD. Due to the broad heterogeneity inherent in this definition, identification of a prolonged deceleration should prompt discontinuation of the algorithm until the deceleration is resolved.
4. Application of algorithm may be initially delayed for up to 30 minutes while attempts are made to alleviate category II pattern with conservative therapeutic interventions (e.g., correction of hypotension, position change, amnioinfusion, tocolysis, reduction or discontinuation of oxytocin).
5. Once a category II FHR pattern is identified, FHR is evaluated and algorithm applied every 30 minutes.
6. Any significant change in FHR parameters should result in reapplication of algorithm.
7. For category II FHR patterns in which algorithm suggests delivery is indicated or such delivery should ideally be initiated within 30 minutes of decision for cesarean.
8. If at any time tracing reverts to category I status or deteriorates for even a short time to category III status, the algorithm no longer applies. However, algorithm should be reinstituted if category I pattern again reverts to category II.
9. In fetus with extreme prematurity, neither significance of certain FHR patterns of concern in more mature fetus (e.g., minimal variability) or ability of such fetuses to tolerate intrapartum events leading to certain types of category II patterns are well defined. This algorithm is not intended as guide to management of fetus with extreme prematurity.
10. Algorithm may be overridden at any time if, after evaluation of patient, physician believes it is in the best interest of the fetus to intervene sooner.

Communication of Electronic Fetal Monitoring Data

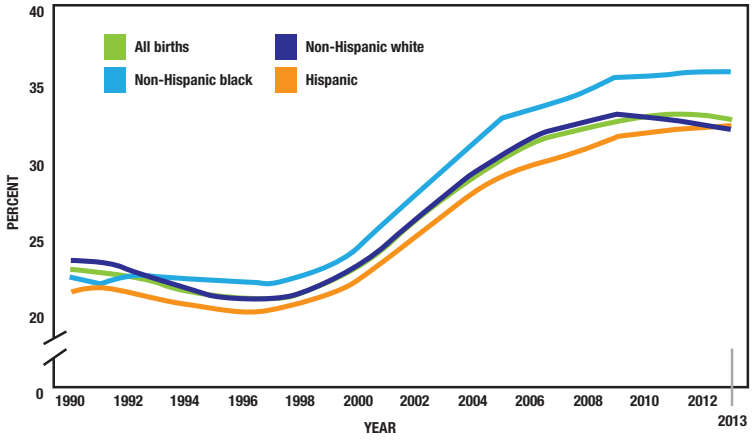
When the fetal heart rate pattern is indeterminate or abnormal, communication among members of the perinatal team is essential in ensuring appropriate and timely response to the clinical situation. Standardizing components of the data communicated can be useful in promoting patient safety. The following are suggested aspects of professional communication regarding fetal status when the fetal heart rate pattern is indeterminate or abnormal:

- Baseline rate, variability, presence or absence of accelerations and decelerations
- Clinical context of fetal heart rate pattern (e.g., cervical status, labor progress, oxytocin rate and recent titration, timing and amount of last dose of misoprostol, uterine activity, tachysystole, bleeding, timing and amount of last dose of intravenous pain meds, recent initiation or dosage change in regional anesthesia/analgesia, hypotension, length of time of ruptured membranes, amniotic fluid appearance, maternal fever, rapid labor progress, second stage labor pushing, umbilical cord prolapse; trial of labor attempting vaginal birth after cesarean birth)
- Intrauterine resuscitation measures initiated and the maternal-fetal response
- Fetal heart rate pattern evolution (e.g., how long has this been evolving?)
- Sense of urgency (e.g., now; as soon as you can; within 30 min)
- Who was notified and their response
- Next steps if there is no resolution of the fetal heart rate pattern

Labor Management Guidelines

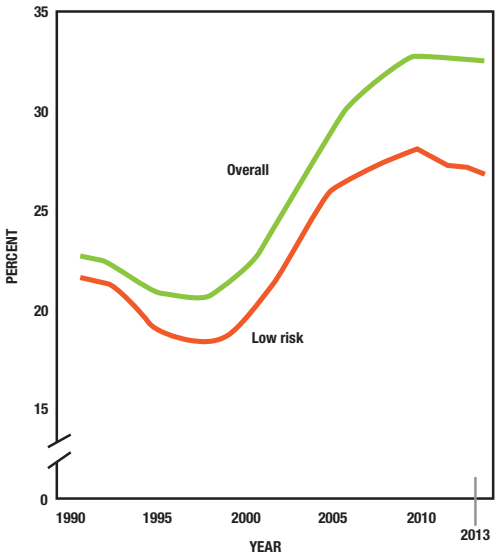
The cesarean birth rate in the United States has risen dramatically (>600%) over the past 50 years from 4.5% in 1965 to 32.7% in 2013 (last year for which data are available).[3, 17] Of particular concern is the corresponding rate increase for healthy women (women at term having their first baby with a singleton fetus in vertex presentation). These women represent the largest group for which strategies to decrease risk of cesarean birth may be effective. The two most common reasons for primary cesarean are labor dystocia and concern for fetal status based on interpretation of the FHR tracing.[2]

Caesarean delivery, by race and Hispanic origin.[3]
United States, 1990-2013



Derived from: Osterman MJK, Martin JA (2014). Trends in low-risk cesarean delivery in the United States, 1990–2013. National vital statistics reports; vol 63 no 6. Hyattsville, MD: National Center for Health Statistics.[3]

Overall cesarean delivery and low-risk cesarean delivery; United States, final 1990-2012 and preliminary 2013



Derived from: Osterman MJK, Martin JA (2014). Trends in low-risk cesarean delivery in the United States, 1990–2013. National vital statistics reports; vol 63 no 6. Hyattsville, MD: National Center for Health Statistics.[3]

In 2012, the NICHD, SMFM, and ACOG convened a workshop of perinatal experts to discuss potential solutions to minimize risk of primary cesarean birth.[1] Available evidence of possible contributing factors to primary cesarean birth was reviewed. Summaries of potentially modifiable obstetric, maternal and fetal indications were offered. Algorithms for spontaneous labor and induced labor were included, based on the most recent data about time frames that reflect normal labor progress in contemporary obstetric practice from the Consortium for Safe Labor project.[1] Recommendations were made to minimize risk of primary cesarean birth and monitor outcomes.[1] Suggestions were offered for appropriate candidates for elective induction of labor based on cervical status and gestational age. Definitions of failed induction and arrest of labor disorders were incorporated into the recommendations.

Encouragement of patience and a reconsideration of the parameters of normal labor progress for nulliparous women were major findings. In 2014, ACOG and SMFM co-published a consensus statement *Safe Prevention of the Primary Cesarean Delivery* in which these recommendations were further detailed and enhanced.

Summary of Findings in ACOG and SMFM *Obstetric Care Consensus: Safe Prevention of the Primary Cesarean Delivery*[2]

- Induction of labor < 41 0/7 weeks gestation generally should be limited to women with maternal and/or fetal indications.
- Induction of labor at ≥ 41 0/7 weeks gestation is recommended to minimize risk of cesarean birth and risk of perinatal morbidity and mortality.
- Cervical ripening should be used for women being induced with an unfavorable cervix.
- Active labor is more accurately defined as beginning at 6 centimeters (cm) cervical dilation.
- Neither active phase labor protraction nor labor arrest should be diagnosed before 6 cm.
- Most women with a prolonged latent phase will eventually begin active phase of labor with expectant management.
- A prolonged latent phase (e.g., > 20 hours in nulliparous women and > 14 hours in multiparous women) should not be an indication for cesarean birth.
- Slow but progressive labor in the first stage should not be an indication for cesarean birth.

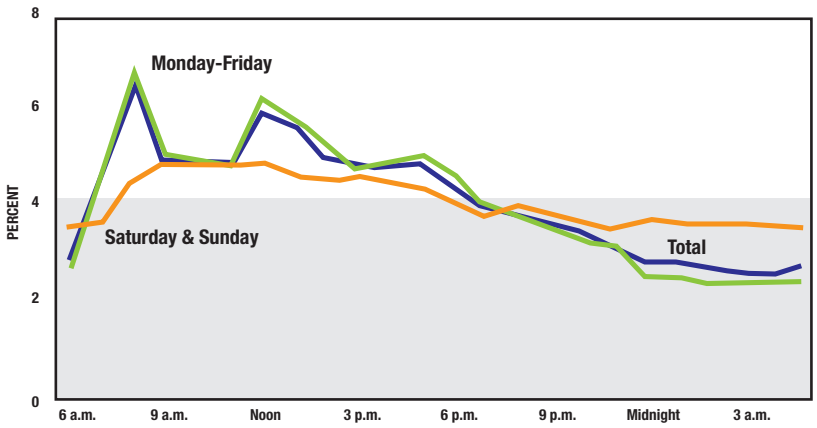
- Women with ≥ 6 cm of cervical dilation and ruptured membranes who do not progress after 4 hours of adequate uterine activity, or at least 6 hours of oxytocin administration with inadequate uterine activity and no cervical change, may have active phase arrest in first stage labor and may need cesarean birth.
- Intrauterine resuscitation measures may be useful in maintaining fetal wellbeing and thereby avoiding cesarean birth for abnormal or indeterminate fetal status.
- The ideal length of second stage labor is unknown.
- Diagnosis of arrest of second stage labor should not be made until at least 2 hours of pushing in multiparous women and at least 3 hours of pushing in nulliparous women (assuming maternal and fetal wellbeing are maintained).
- Labor epidurals may be associated with longer second stage labors.
- Operative vaginal birth and manual rotation of the fetal occiput in the context of fetal malposition in second stage labor may be viable alternatives to cesarean birth.

Avoiding elective labor induction until the woman reaches 41/0 weeks gestation at which time labor induction would no longer be considered elective as recommended by ACOG and SMFM[2] would go far to improve clinical practice. Spontaneous labor is recommended for healthy women before 41/0 weeks of gestation because it is considered safer for mothers and babies and is associated with less unnecessary interventions, less costs, less risk of cesarean birth, and less maternal risk in subsequent pregnancies.[18] Artificial peaks in patient volume and acuity can be minimized with spontaneous labor therefore reducing nurse staffing challenges caused by procedures scheduled electively on selected days of the week.[19]

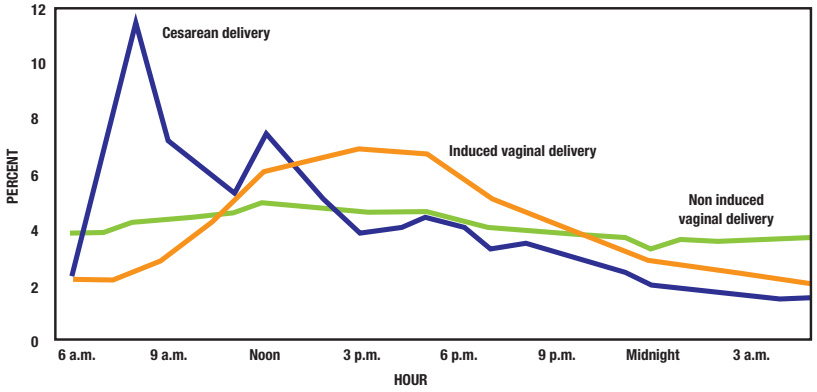
The most recent data on timing of births in the United States[20] indicate that spontaneous labor occurs generally equally over the course of the day with some slight decreases in the middle of the night, and generally equally over the course of the week including Saturday and Sunday.

The patient education initiative from ACOG[4] is consistent with recommendations for clinicians.[1, 2] Patients are advised by ACOG and SMFM that labor should start on its own whenever possible and are cautioned that higher cesarean rates result from inductions of labor when the cervix is unfavorable. Further, ACOG lets women know that their health care practitioners should discuss the risks and benefits with them before considering inductions of labor without medical indications.

Percent distribution of births, by hour and day of the week of delivery: 41 states and the District of Columbia. 2013[20]



Percent distribution of births, by hour and method of delivery and induction status: 41 states and the District of Columbia. 2013[20]



Derived from: Mathews, T. J., & Curtin, S. C. (2015). *When are babies born: Morning, noon, or night? Birth certificate data for 2013* (NCHS Data Brief No. 200). Hyattsville, MD: National Center for Health Statistics.[20]

Labor patterns have changed over the past 50 years.[21] Some of the changes are associated with the characteristics of laboring women who are now on average 2 ½ years older and have a higher body mass index, while others are associated with practices such as a much higher use of oxytocin and labor epidurals.[21] When compared to 50 years ago, first stage labor is longer by 2.6 hours in nulliparous women and by 2 hours in multiparous women even after adjusting for maternal and pregnancy characteristics.[21]

Using 6 cm rather than 4 cm as the beginning of active labor is based on evidence that progressing from 4 cm to 6 cm often takes longer than previously thought [21, 22, 23] and likely represents latent phase activity that will eventually result in vaginal birth.[2] The active upward slope of labor progress generally occurs beginning at 6 cm for most women in labor.[2]

Applying the ACOG and SMFM[2] criteria for cesarean birth for an arrest of active first stage labor may offer women having a longer than average (but still within normal limits) labor the ability to have a vaginal birth. The median and upper and lower limits of nulliparous women in spontaneous, induced and augmented labor are displayed in the following table.[22] These data are similar to findings from other researchers about the normal length of labor for contemporary women.[21, 23] Note that some women may need several hours to progress from 4 cm to 5 cm and from 5 cm to 6 cm, even those having spontaneous labor. Induced and augmented labor progression from 4 cm to 6 cm can take 11 to 12 hours for selected women. Labor duration from 3 cm to full dilation could last 16 to 17 hours for some nulliparous women having induced or augmented labor and still be considered within normal limits.[22]

Range of Labor Progress within Normal Limits for Nulliparous Women Based on Type of Labor; Median (5th percentile, 95th percentile)[22]

N = 5,388 women in 1 hospital from 2004 to 2008 who reached second-stage labor.

CCMS	Spontaneous (Hours) (5th / 95th percentiles)	Induction (Hours) (5th / 95th percentiles)	Augmented (Hours) (5th / 95th percentiles)
4-10	**3.8** (1.2, 11.8)	**5.5** (1.8, 16.8)	**5.4** (1.8, 16.8)
3-4	**0.4** (0.1, 2.3)	**1.4** (0.2, 8.1)	**1.2** (0.2, 6.8)
4-5	**0.5** (0.1, 2.7)	**1.3** (0.02, 6.8)	**1.4** (0.3, 7.6)
5-6	**0.4** (0.06, 2.7)	**0.6** (0.1, 4.3)	**0.7** (0.1, 4.9)
6-7	**0.3** (0.03, 2.1)	**0.4** (0.05, 2.8)	**0.5** (0.06, 3.9)
7-8	**0.3** (0.04, 1.7)	**0.2** (0.03, 1.5)	**0.3** (0.05, 2.2)
8-9	**0.2** (0.03, 1.3)	**0.2** (0.03, 1.3)	**0.3** (0.05, 2.0)
9-10	**0.3** (0.04, 1.8)	**0.3** (0.04, 1.9)	**0.3** (0.05, 2.4)

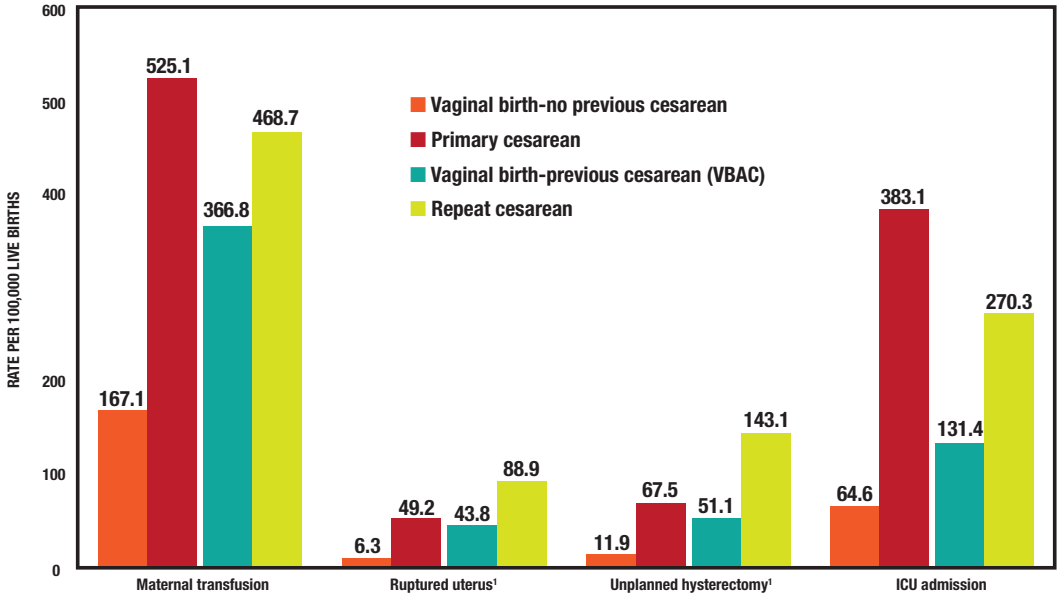
Derived from: Harper LM, Caughey AB, Odibo, AO, Roehl KA, Zhao Q, Cahill, AG (2012). Normal progress of induced labor. Obstet Gynecol.;119(6):1113-1118.[22]

The ideal length of the second stage labor to promote best outcomes for mothers and babies is unknown.[2] However, some recommendations were offered as general guidelines. If maternal and fetal conditions permit, clinicians should allow for at least 2 hours of pushing for multiparous women and at least 3 hours of pushing for nulliparous women before making the diagnosis of second stage labor arrest that may lead to operative vaginal birth or cesarean birth.[2] It was acknowledged that second stage care should be individualized because some women may have longer second stage durations such as those with epidural analgesia or with fetal malposition. Fetal wellbeing and progress should be assessed and documented in these cases.[2]

It is worth noting that not all experts agree with the findings about normal labor that contributed to the ACOG and SMFM labor management guidelines. Drs. Friedman and Cohen, well known experts on normal labor parameters research, contend that statistical analyses of some of the data were not robust, did not include clinical observations, and that the longer labors that may result from the guidelines could increase risk of maternal and fetal harm.[24, 25] Drs. Zhang, Troendle, Grantz and Reddy, [26] authors of much of the most recent research on normal labor parameter analysis, acknowledged the concerns of Cohen & Friedman but offered detailed explanations for their methods and findings. As with many aspects of obstetrical care, achieving consensus among experts is sometimes challenging.

The labor management guidelines from ACOG and SMFM [2] are aimed at reducing risk of cesarean birth. Although to date, effective strategies to reduce risk of cesarean birth in healthy women have proven elusive, this is a worthy goal.[27] Cesarean birth is associated with more risk to the mother than vaginal birth.[2, 28, 29] These risks include higher rates of maternal death, overall severe morbidity, placental abnormalities, postpartum hemorrhage, blood transfusions, unplanned hysterectomy, uterine rupture, and admission to the intensive care unit.[2, 29] Recent data from birth certificates confirm that women having vaginal birth have less morbidity than women having cesarean birth.[29] All measures of maternal morbidity measured via birth certificate data are less with vaginal birth.[29] As the number of cesareans a woman has increases so does risk of morbidity such as hysterectomy, blood transfusions, adhesions, surgical injuries, and placental problems including placenta previa, and placenta accreta.[30] Costs of cesarean and associated hospital length of stay for cesareans are twice that of vaginal births.[31] Cost implications are nearly equally split between government and commercial insurance, however the financial implications are beyond payer source.[31] This public health problem represents a current and future burden on the healthcare system and affected women because of maternal morbidity and mortality risks and increased use of financial health resources that could otherwise be allocated to improving maternal and infant outcomes.[18]

Maternal morbidity, by method of delivery and previous cesarean history; 41-states and District of Columbia reporting area. 2013[29]



[1]Difference in rates between primary cesarean and VBAC is not statistically significant.
NOTES: The birth certificate reporting area represented 90% of all U.S. births in 2013. ICU is intensive care unit.
SOURCE: CDC/NCHS, National Vital Statistics System

Derived from: Curtin, S. C., Gregory, K. D., Korst, L. M., & Uddin, S. F. G. (2015). Maternal morbidity for vaginal and cesarean deliveries, according to previous cesarean history: New data from the birth certificate, 2013. *National Vital Statistics Reports*, 64(4), 1-14.[29]

Conclusion

Electronic fetal monitoring can be useful in assessing fetal status during labor. While EFM has limitations and benefits, it has the potential to be most helpful when all members of the perinatal team who are providing care to women in labor use standardized language such as that published by NICHD and supported by ACOG and AWHONN in communicating data obtained from the fetal monitor. The value of a standardized set of definitions and classifications for fetal heart rate pattern interpretation and professional communication is that everyone is speaking and hearing the same language and is more likely to have the same understanding of fetal status based on the fetal heart rate pattern tracing. Expectations for intrauterine resuscitative measures and bedside evaluation by the primary care provider should be based on the NICHD definitions and classifications. Interdisciplinary case review using the EFM strip as a basis for discussion and considering parity and the stage, phase and progress of labor can be useful to support ongoing education and teamwork. Standardized communication of fetal data is one method to promote perinatal patient safety by minimizing risk of errors and avoiding miscommunication among members of the perinatal team during labor. New labor guidelines may be helpful in promoting vaginal birth by allowing labor to progress based on more recent evidence about normal labor parameters of the contemporary population of childbearing women. Maternal age, weight, and co-morbidities are some of the factors that have changed the expectations for normal labor progress today. Use of oxytocin and epidural anesthesia are clinical practices that are influential as well. Application of a FHR tracing management algorithm for category II tracings may be useful in maintaining careful fetal surveillance in the context of potentially longer labors and in application of a common- sense approach to safe care during labor for mothers and babies.

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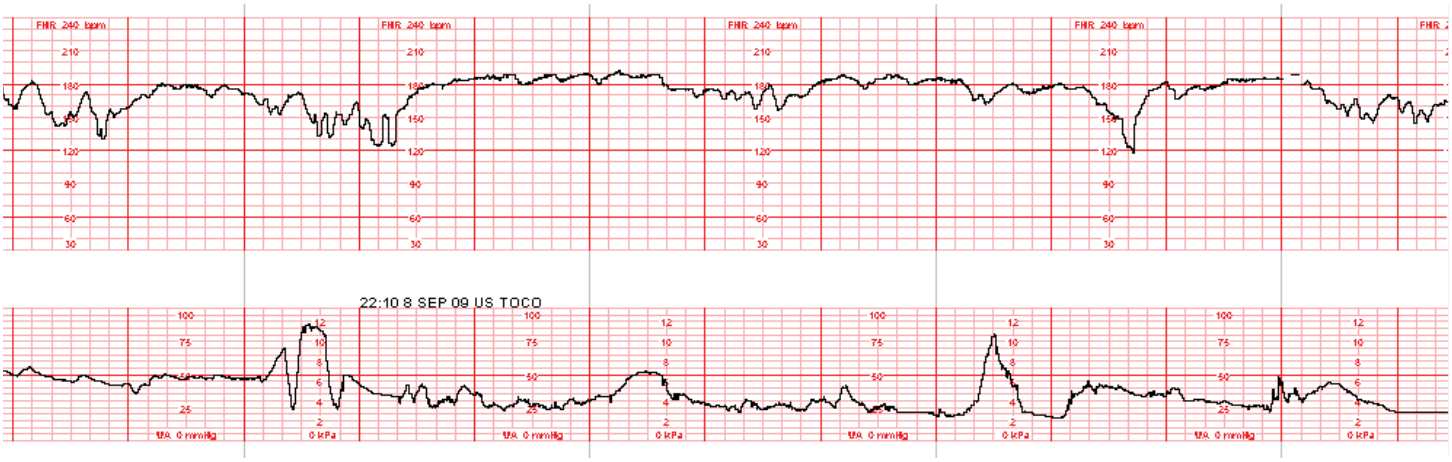
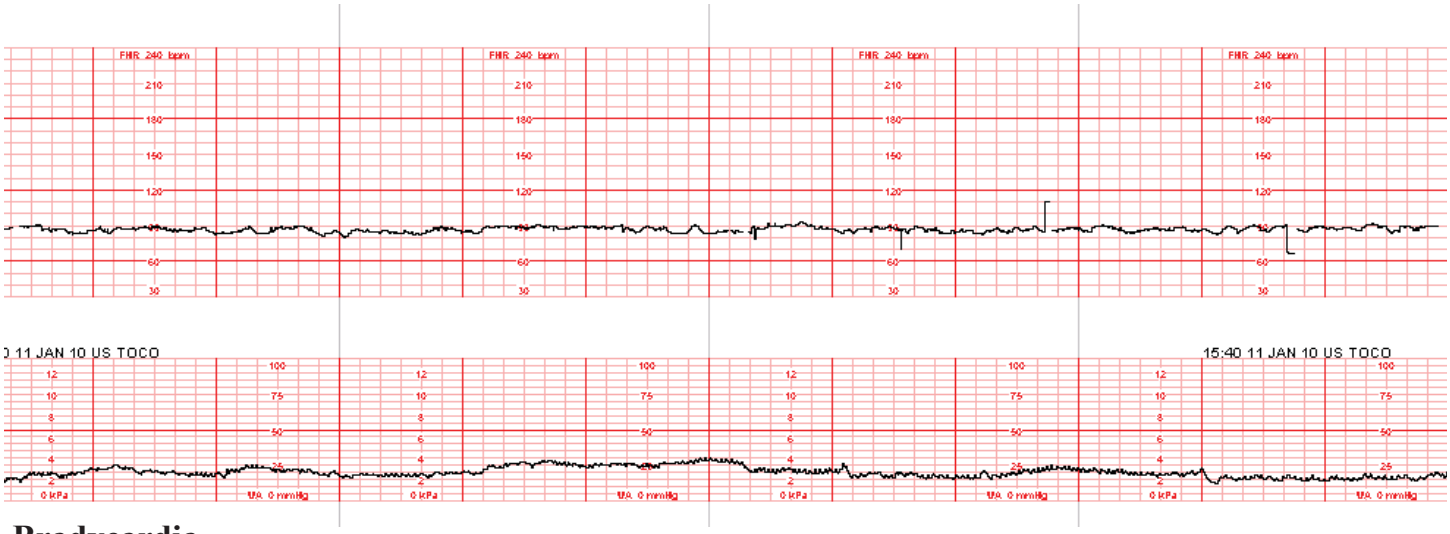
Appendix A - Characteristics of Fetal Heart Rate Patterns



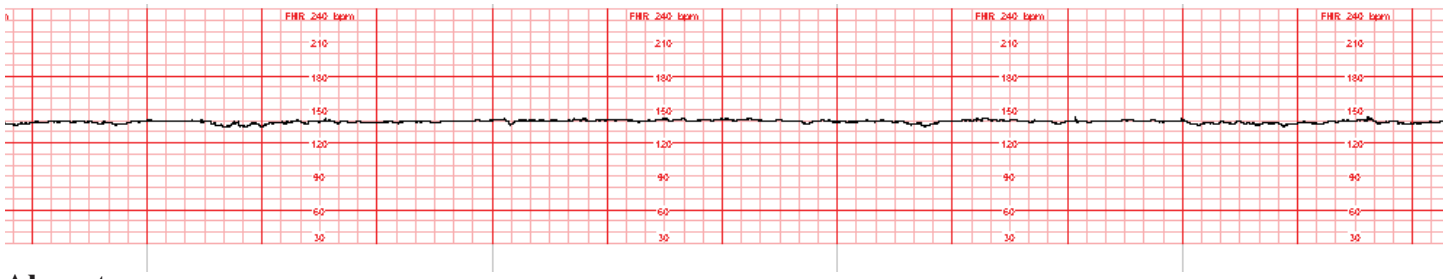
Tachycardia



Bradycardia

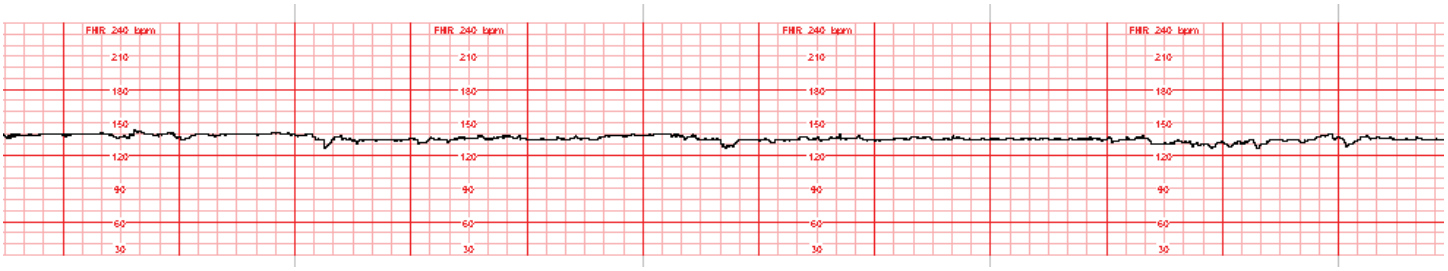
Appendix A - Characteristics of Fetal Heart Rate Patterns

Baseline Variability



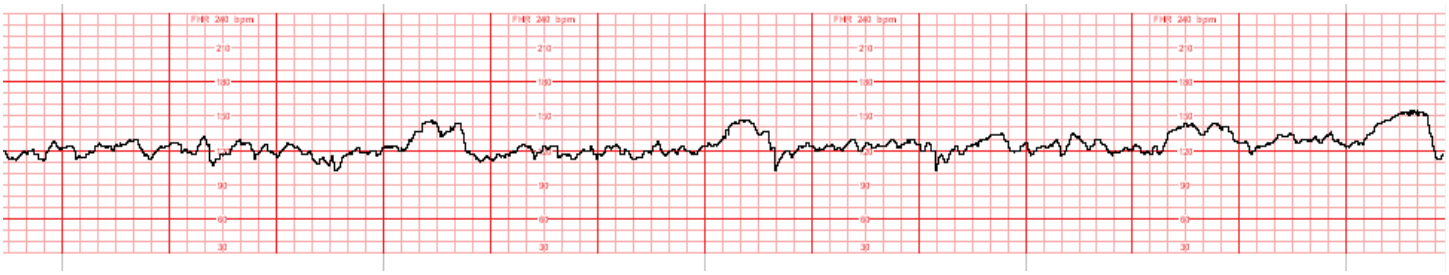
Absent

Undetectable from baseline



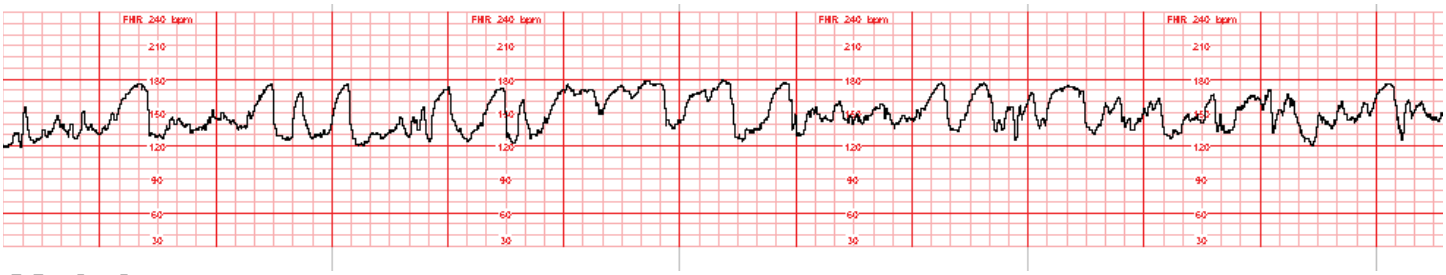
Minimal

Greater than undetectable but ≤5 bpm



Moderate

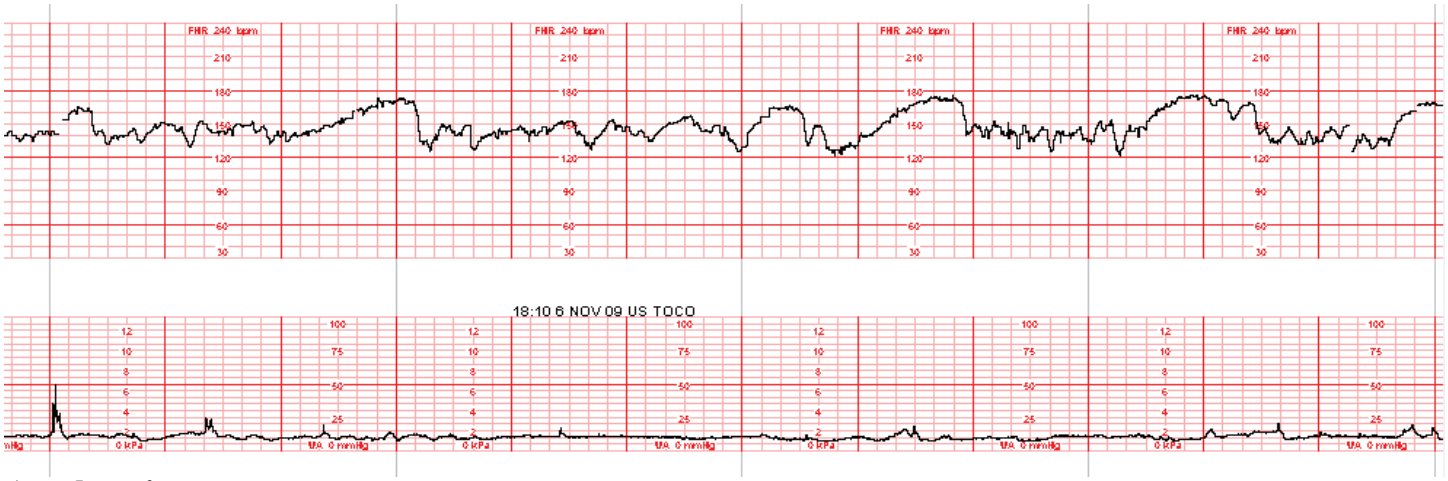
6 – 25 bpm



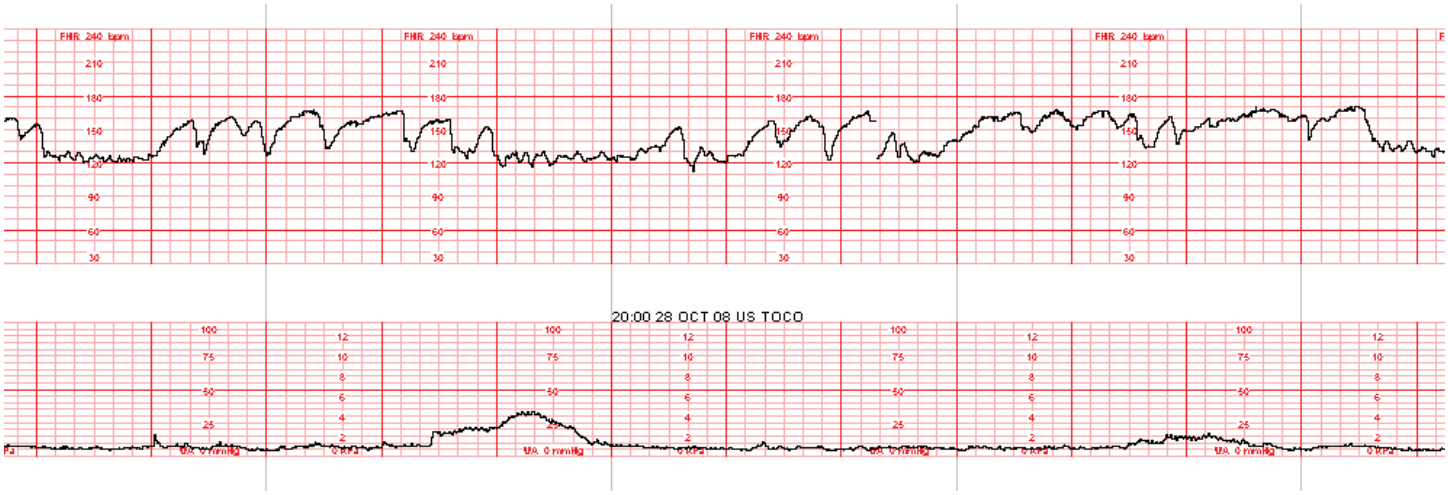
Marked

>25 bpm

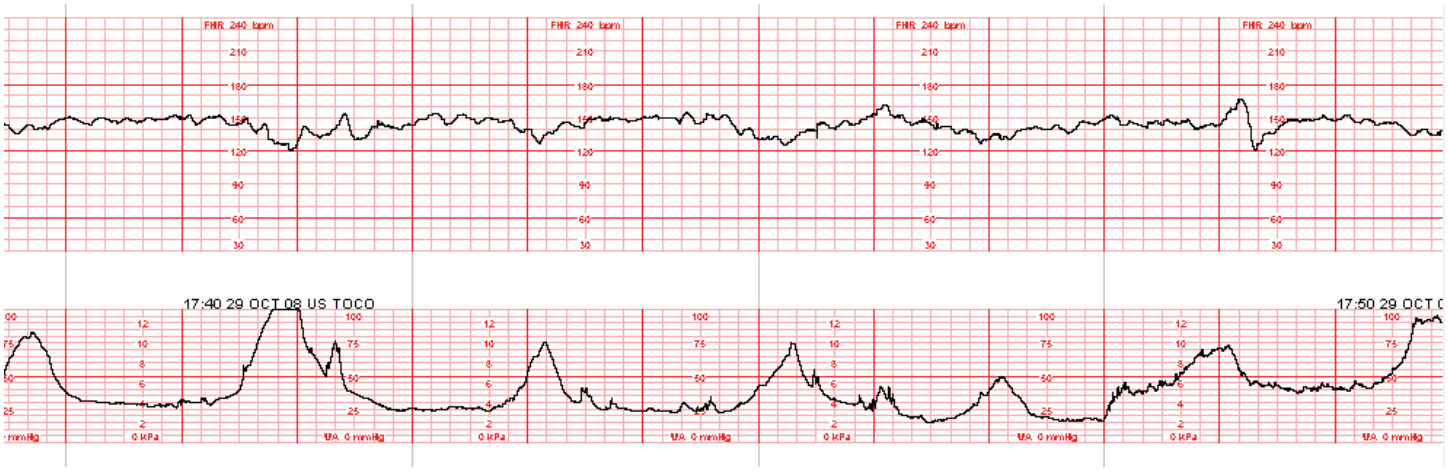
Appendix A - Characteristics of Fetal Heart Rate Patterns



Accelerations

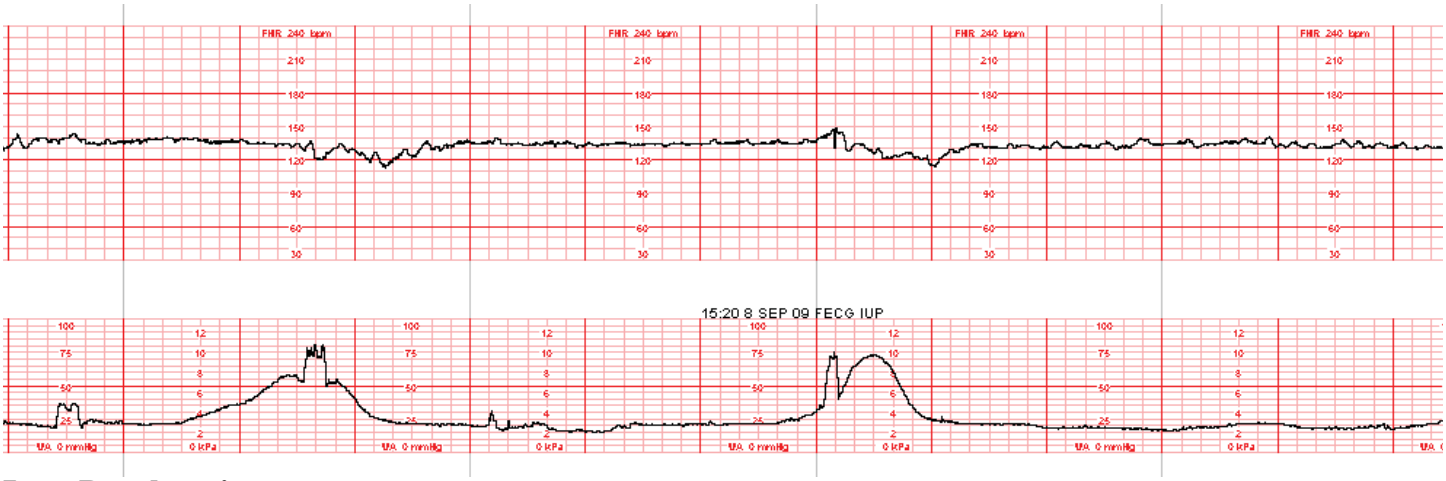


Prolonged Accelerations

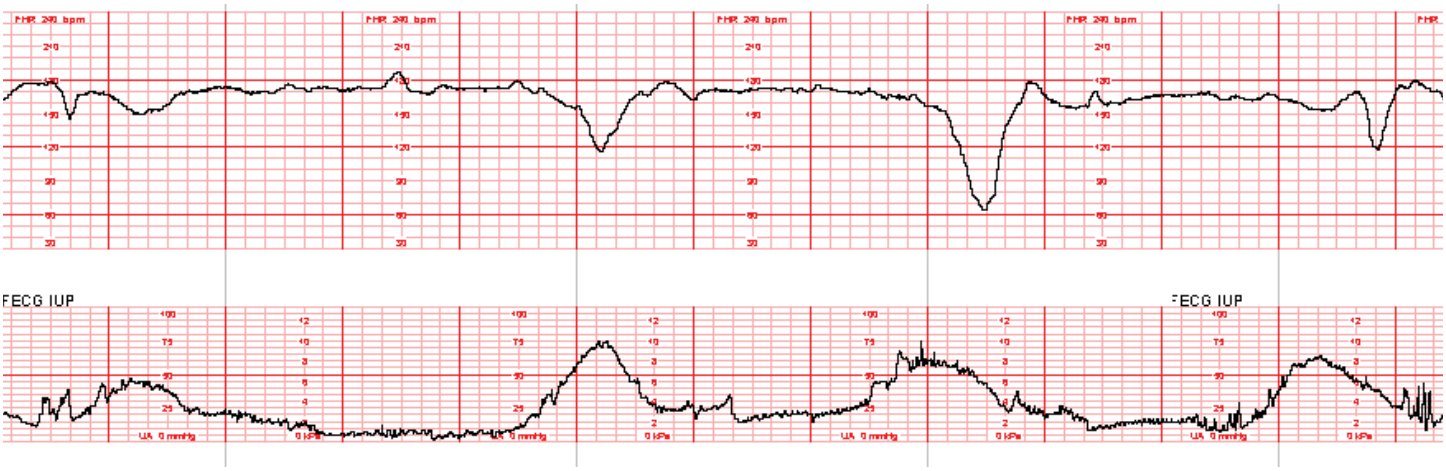


Early Decelerations

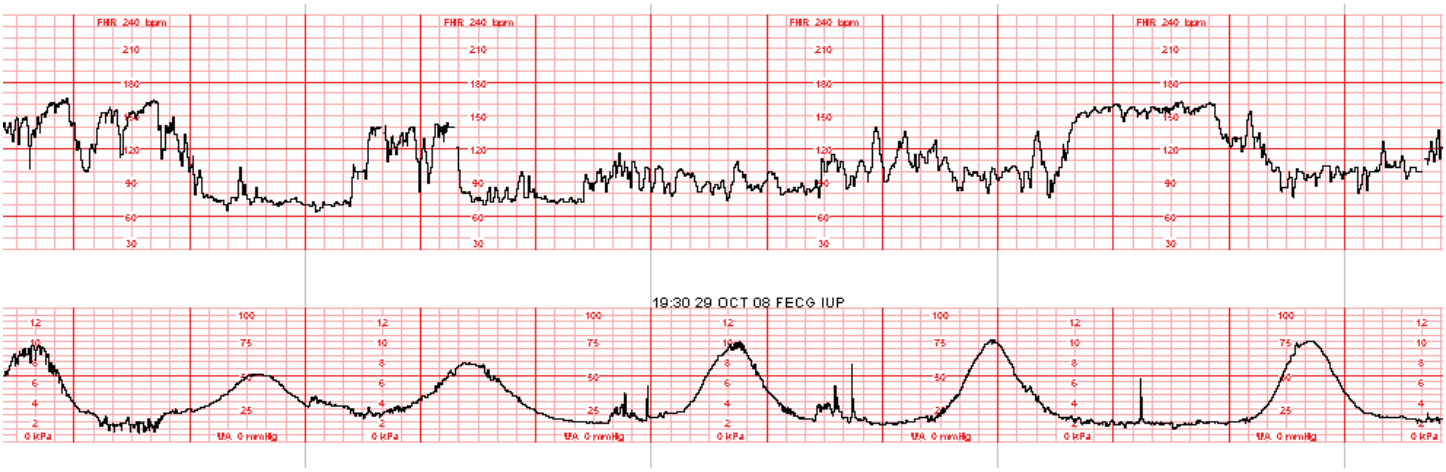
Appendix A - Characteristics of Fetal Heart Rate Patterns



Late Decelerations

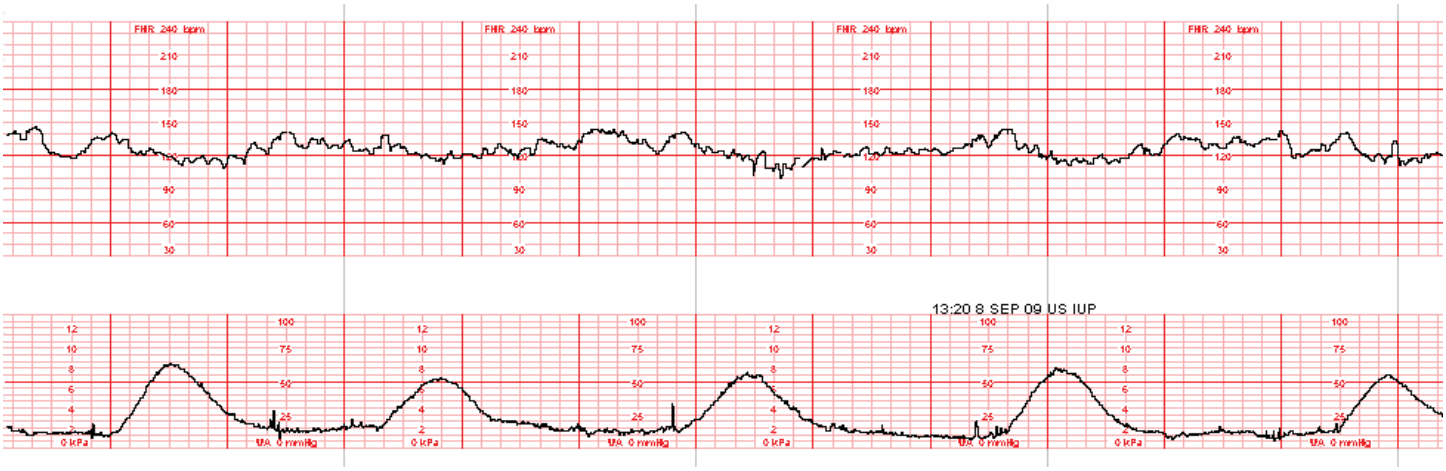


Variable Decelerations

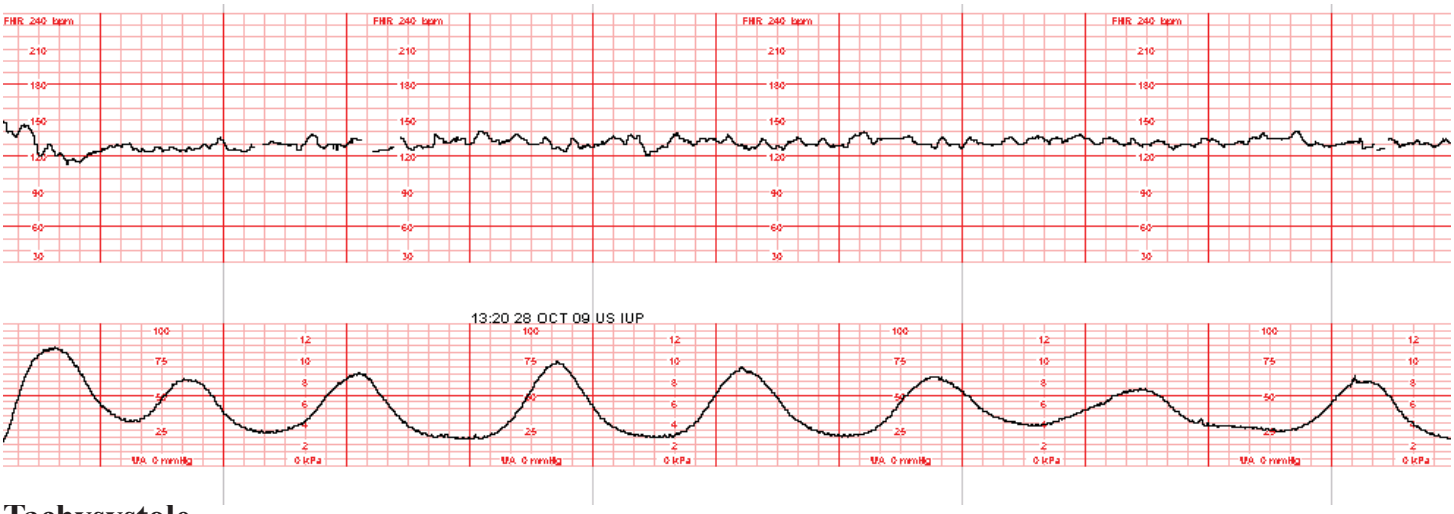


Prolonged Decelerations

Appendix B - Uterine Activity



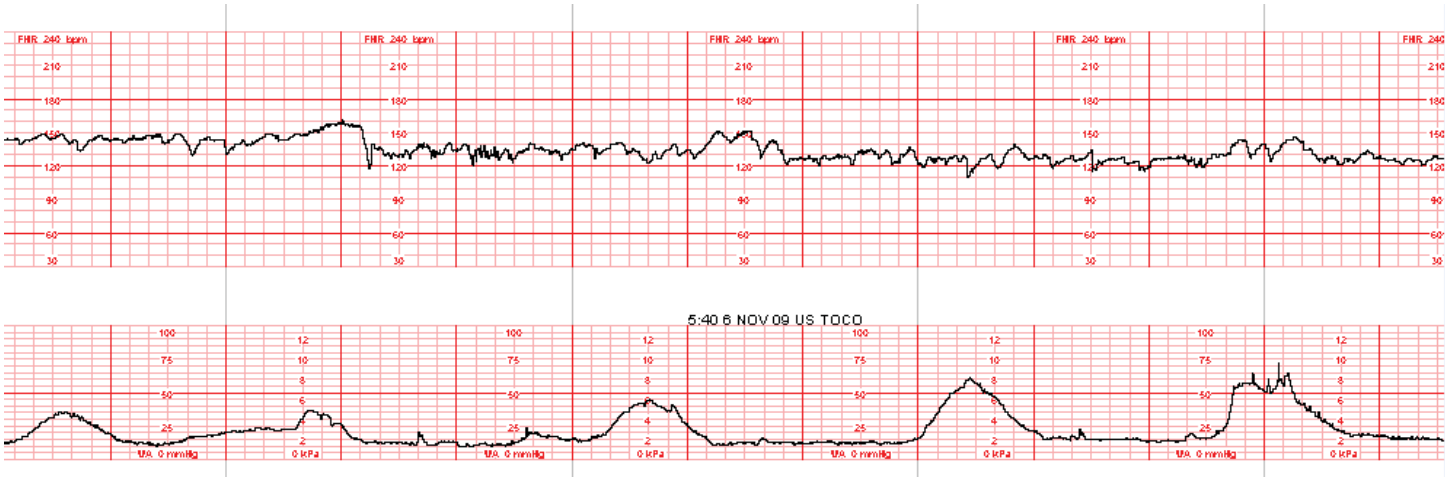
Normal Uterine Activity



Tachysystole

Appendix C - Categories of Fetal Heart Rate Tracings

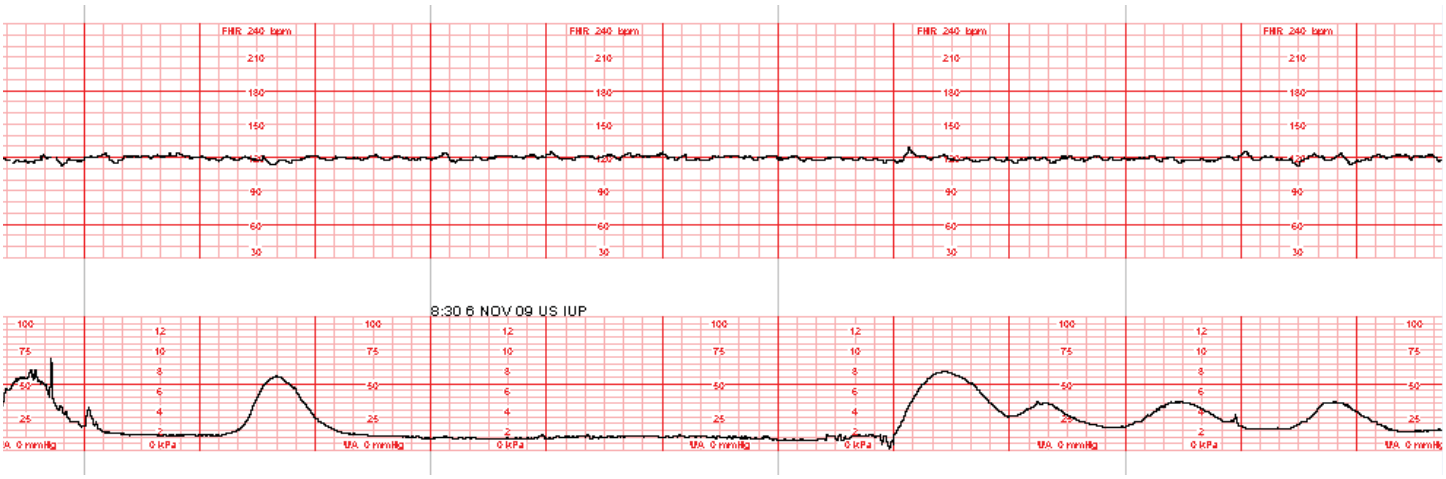
Category I (Normal) Tracing



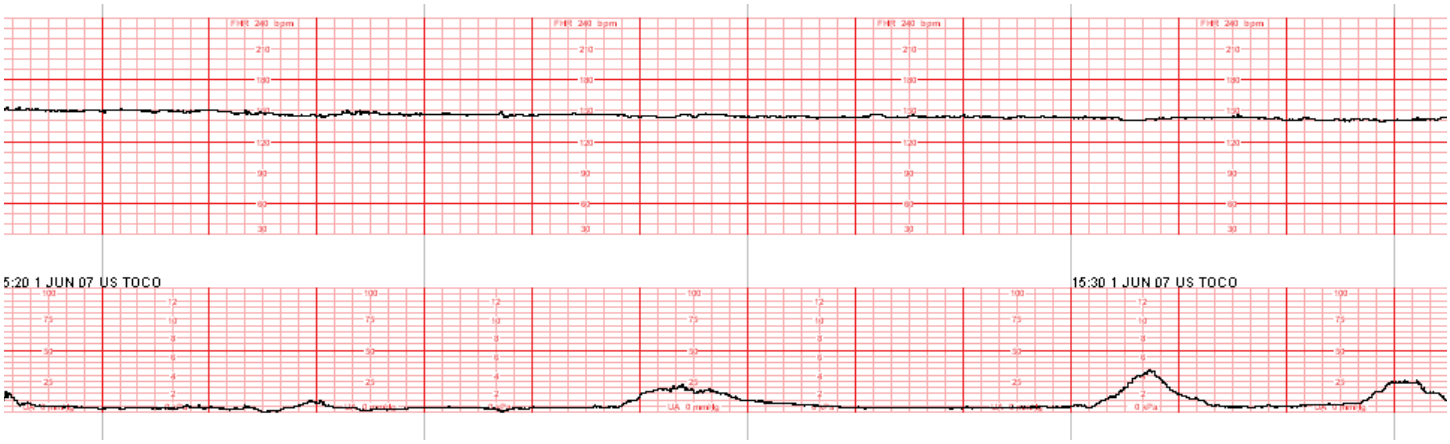
Criteria: Baseline rate 110 to 160 beats per minute; baseline variability moderate; late or variable decelerations absent; early decelerations present or absent

Appendix C - Categories of Fetal Heart Rate Tracings

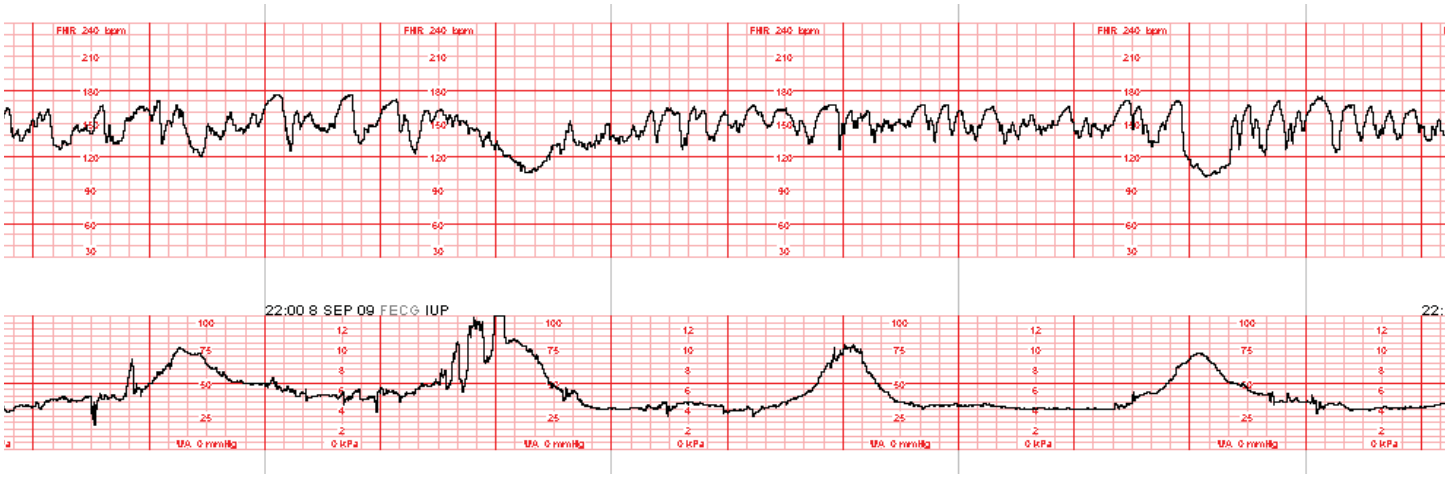
Category II (Indeterminate) Tracings



Criteria: Minimal variability



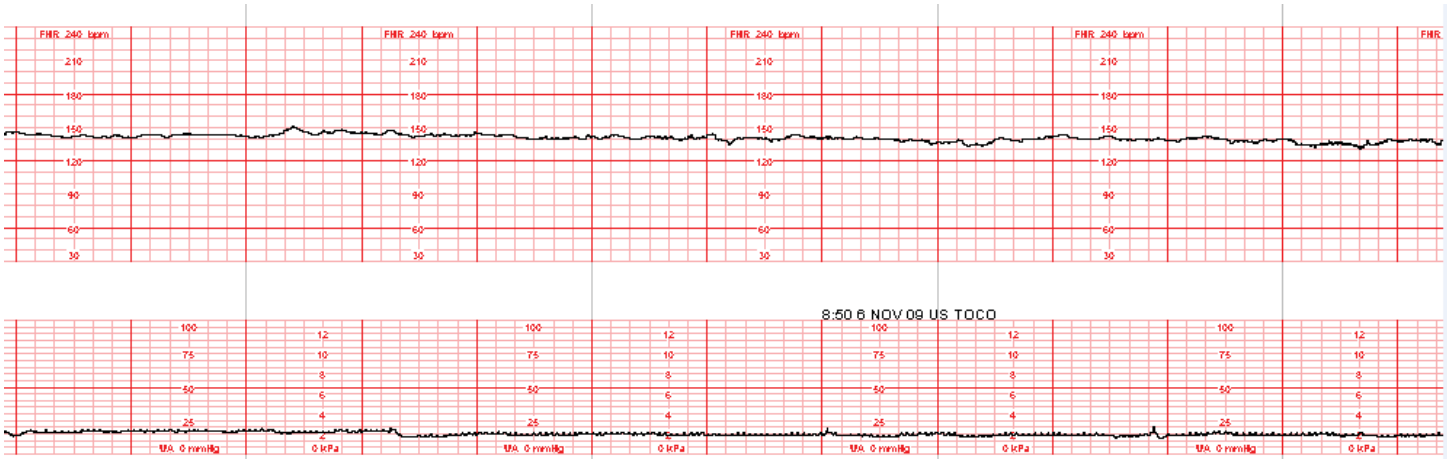
Criteria: Absent variability without recurrent decelerations



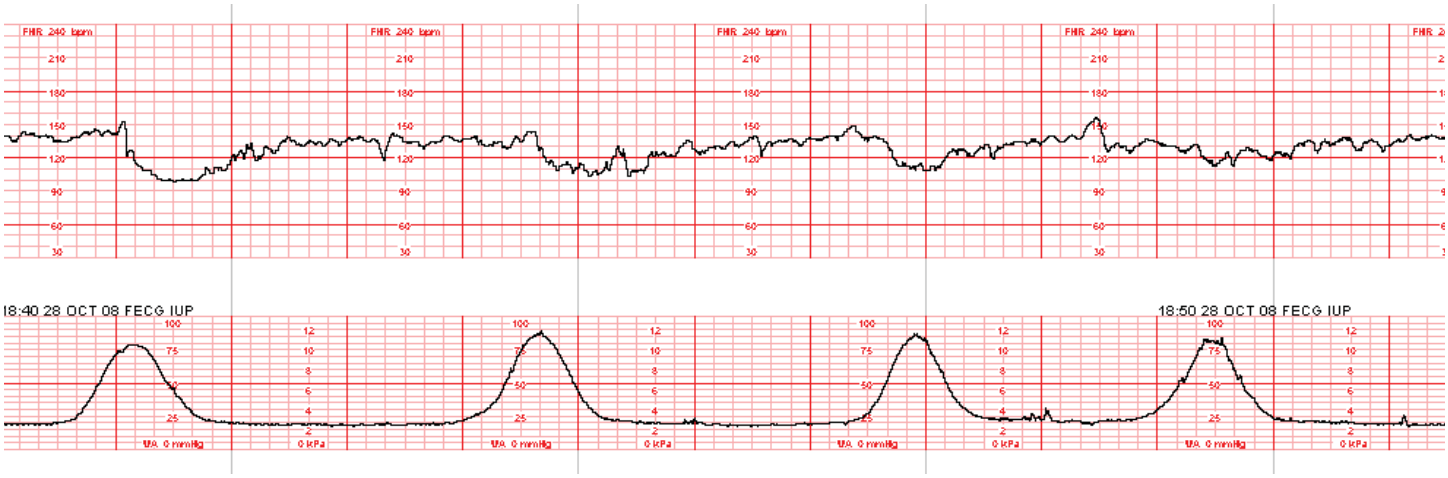
Criteria: Marked variability

Appendix C - Categories of Fetal Heart Rate Tracings

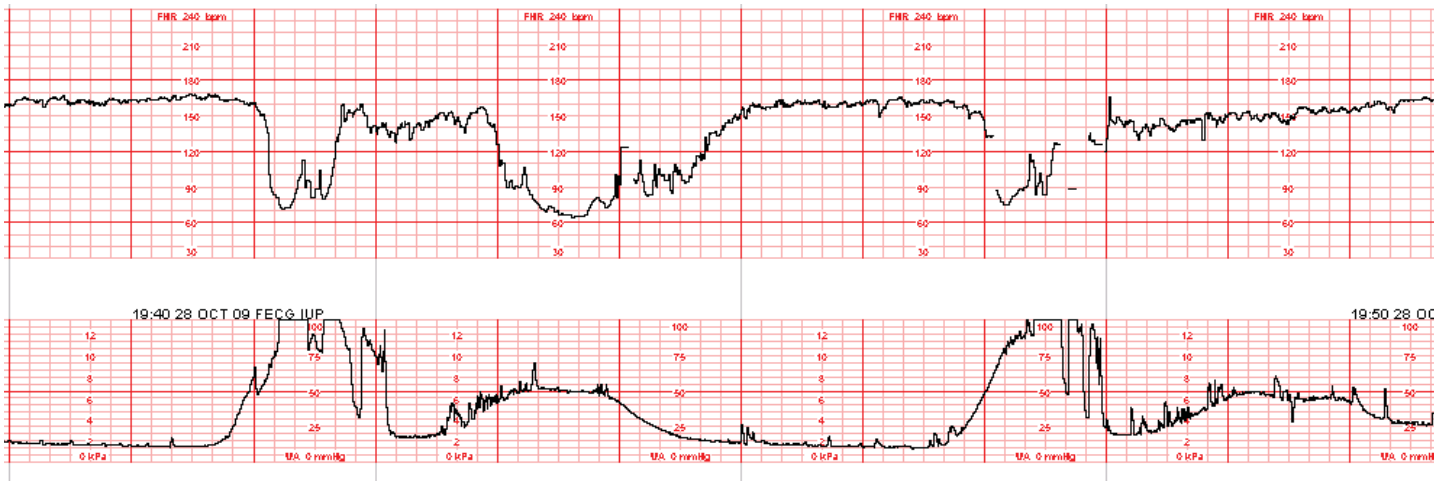
Category II (Indeterminate) Tracings



Criteria: Absence of induced accelerations after fetal stimulation



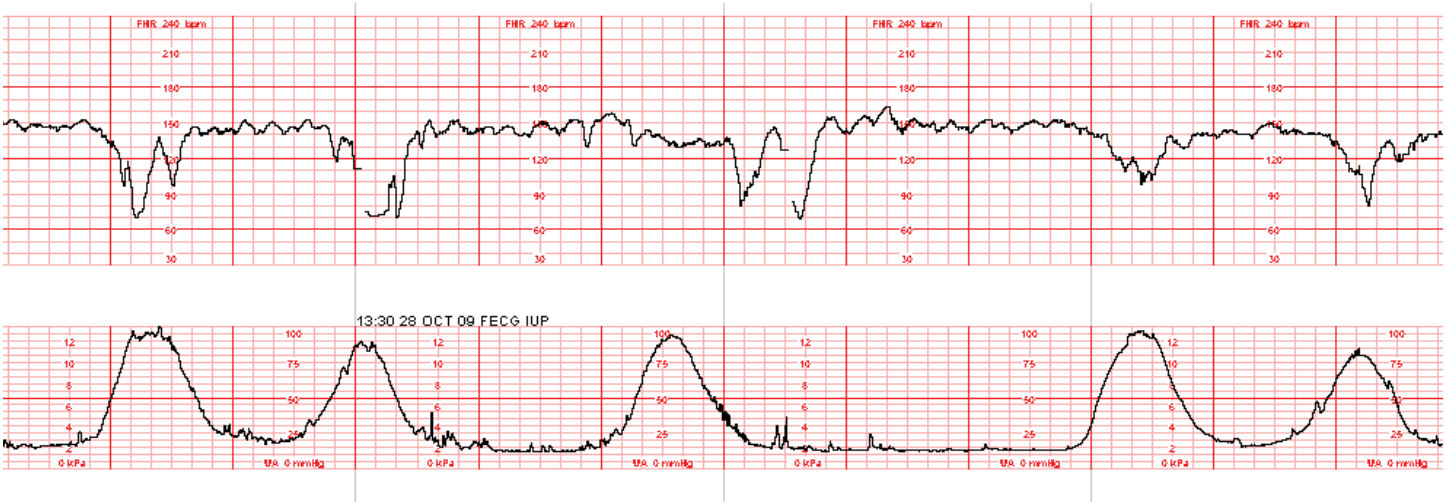
Criteria: Recurrent late decelerations with moderate variability



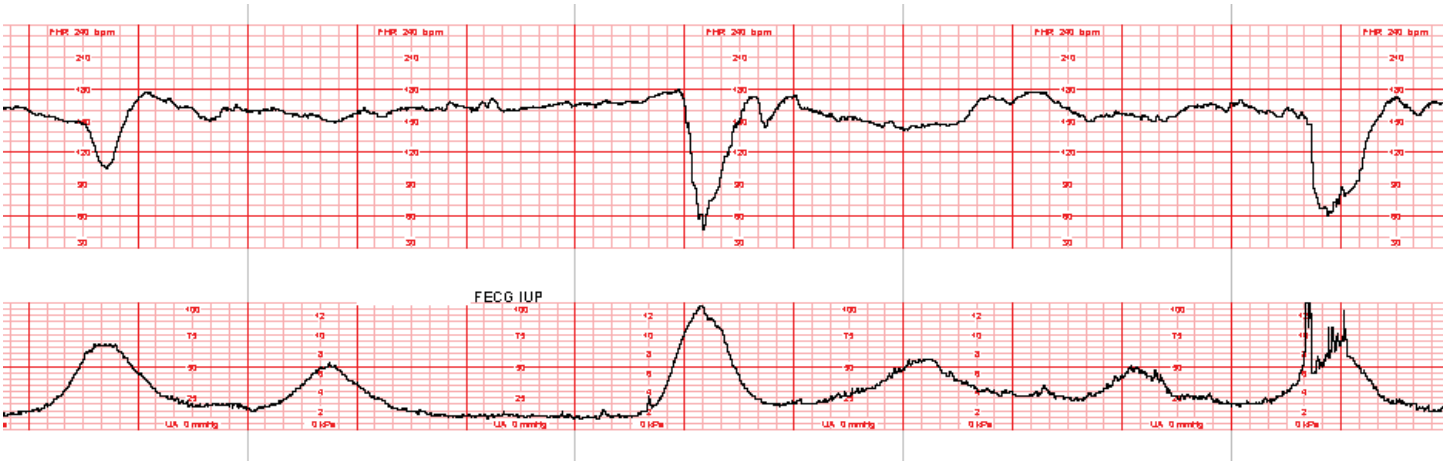
Prolonged deceleration

Appendix C - Categories of Fetal Heart Rate Tracings

Category II (Indeterminate) Tracings



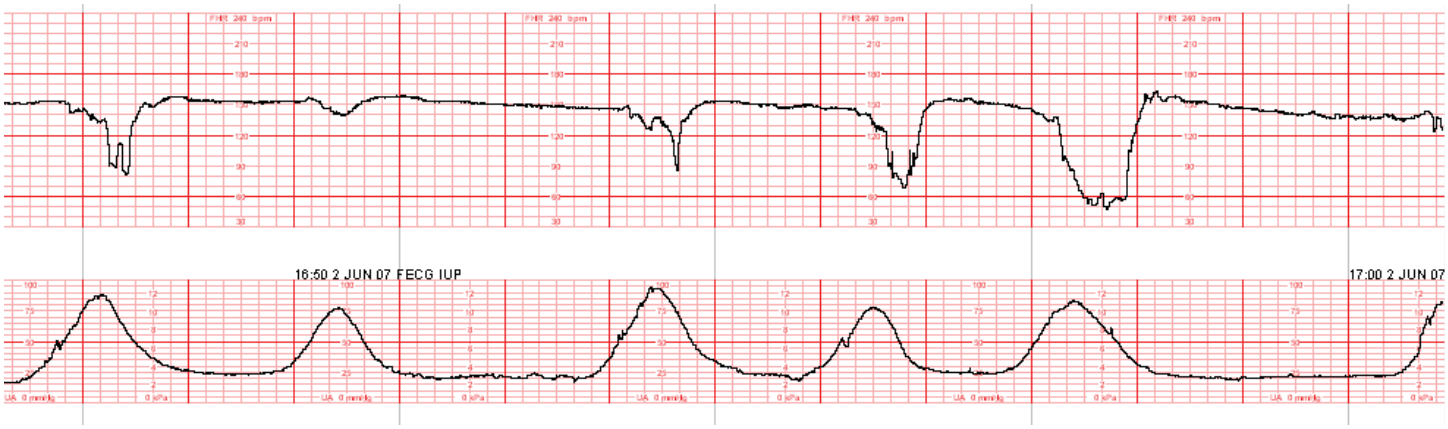
Criteria: Recurrent variable decelerations with moderate variability



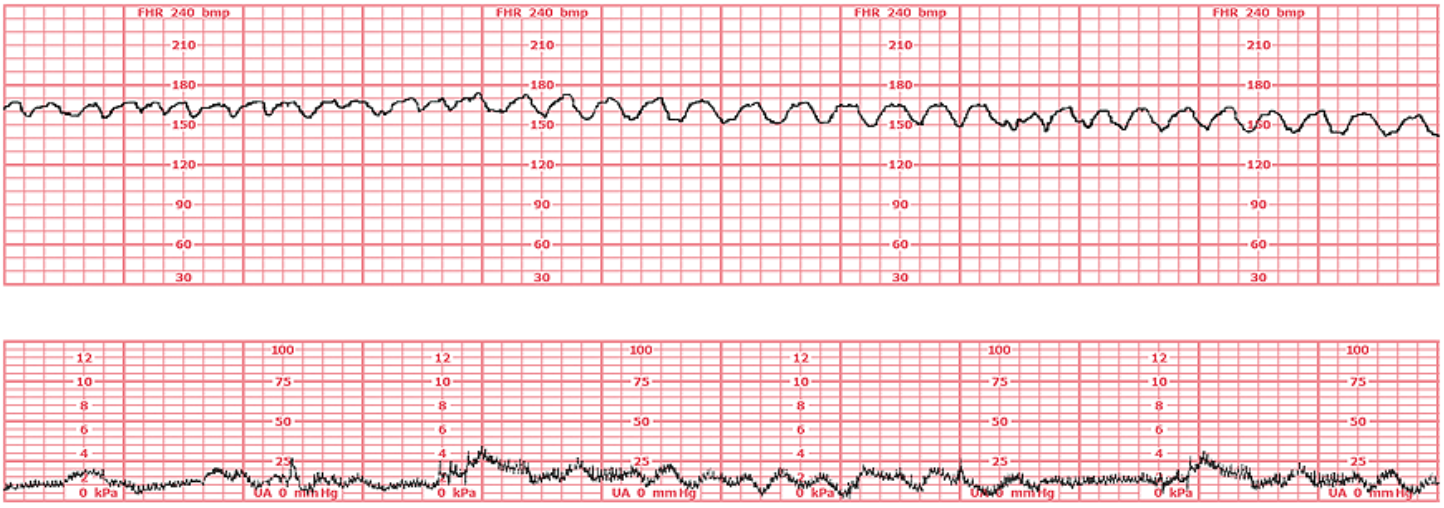
Criteria: Variable decelerations with “slow return to baseline”, “overshoots” or “shoulders”

Appendix C - Categories of Fetal Heart Rate Tracings

Category III (Abnormal) Tracings



Absent variability and recurrent variable decelerations



Sinusoidal pattern

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NCC thanks the author for the development of this monograph.

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