How to Approach Intrapartum Category II Tracings

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KEYWORDS
- Fetal heart rate monitoring • Neonatal encephalopathy • Patient safety

KEY POINTS
- Standardized nomenclature for describing electronic fetal heart rate (eFHR) patterns has enabled better care.
- Category II FHR patterns are by far the most common and most diverse patterns, leading to broad variation in management.
- Standardization of management following an algorithm utilizing both FHR pattern and progress in labor should provide a starting point for both improved neonatal outcomes and new clinical trials.

INTRODUCTION

In 2008, a Eunice Kennedy Shriver National Institute of Child Health and Human Development (NICHD) consensus panel proposed a uniform system of terminology classifying fetal heart rate (FHR) patterns as category I, II, or III based on well-defined characteristics of the FHR.1 This was done in an effort to standardize and thus improve the interpretation and management of FHR patterns. Since that time, the American Congress of Obstetricians and Gynecologists (ACOG) has issued specific guidelines for the management of category I (normal) and category III (pathologically abnormal) FHR patterns; the former are managed conservatively, and the latter are generally indications for prompt delivery.2 However, ACOG guidelines for the management of category II FHR patterns are less specific and reflect the relatively low positive predictive value of many category II FHR patterns for the detection of fetal hypoxia/acidemia. The following is an attempt to provide a framework for the management of category II FHR tracings, which are seen in 80% of all fetuses in
labor. These recommendations are based on the best available evidence and are directed at optimizing fetal outcomes without significantly increasing rates of cesarean section.

DISCUSSION

Essential to any discussion of the management of FHR tracings is a standardized interpretation of those tracings. Based on the NICHD guidelines, a full description of external fetal monitoring requires evaluation of

- Uterine contractions
- Baseline FHR
- FHR variability
- Presence of accelerations
- Periodic or episodic decelerations
- Changes in FHR patterns over time

The uterine contraction pattern should be described in terms of frequency, duration, and intensity. For purposes of this discussion, the issue is contraction frequency:

- Normal: no more than 5 contractions in 10 minutes, averaged over 30 minutes
- Tachysystole: more than 5 contractions in 10 minutes, averaged over 30 minutes

Baseline FHR is based on the mean FHR in increments of 5 beats per minute during a 10 minute window, at least 2 minutes of which must be spent in identifiable baseline segments.

- Bradycardia: less than 100 beats per minute
- Normal: 110 to 160 beats per minute
- Tachycardia: greater than 160 beats per minute

Baseline FHR variability is defined as fluctuations in the baseline FHR (in that same 10-minute window) that are irregular in amplitude and frequency, exclusive of accelerations and decelerations:

- Absent: amplitude range undetectable
- Minimal: no more than 5 beats per minute
- Moderate: 6 to 25 beats per minute
- Marked: greater than 25 beats per minute

An acceleration is an abrupt increase in FHR lasting at least 15 seconds and rising at least 15 beats per minute above baseline. Abrupt is defined as reaching the peak/nadir in less than 30 seconds. Gradual is defined as reaching the peak/nadir in 30 seconds or more. Prolonged accelerations last at least 2 minutes but no more than 10 minutes. Beyond 10 minutes, such patterns are considered a change in baseline.

Decelerations are classified as variable, early, or late based on their timing and characteristics (Box 1).

Utilizing these definitions, the NICHD system classifies the FHR into 3 tiers. Category I tracings are normal:

- Baseline 110 to 160 beats per minute
- Variability: moderate
- No late or variable decelerations
- Early decelerations: present or absent
- Accelerations: present or absent
Category II tracings are indeterminate and account for about 80% of FHR tracings:

- Baseline rate tachycardia or bradycardia (not accompanied by absent variability)
- Baseline variability minimal, marked or absent (no accompanied by recurrent decelerations)
- Absent accelerations (even after stimulation)
- Periodic or episodic decelerations including recurrent variable decelerations, prolonged deceleration, recurrent late decelerations with moderate variability, variable decelerations with slow return to baseline, overshoots, or shoulders

Category III FHR tracings are abnormal:

- Absent variability and recurrent late decelerations, recurrent variable decelerations, or bradycardia
- Sinusoidal pattern

Although the management of category I and category III FHR patterns is clear, the breadth of category II FHR tracings makes strict delineation of management much more difficult. This is made even more problematic by the level of interobserver and intraobserver reliability, noted to be moderate for categories I and II and poor for category III FHR tracings (although the main variation was classifying minimal versus absent variability). Additionally, although the amount of time spent with a category II tracing prior to delivery has been shown to increase short-term neonatal morbidity (higher rates of low Apgar scores and neonatal intensive care unit [NICU] admissions), there is no generally accepted stratification of risk within the category II tracings.

The algorithm presented in the remainder of this article follows the one developed by Clark and colleagues in 2013. Previously

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**Box 1**

**Characteristics of decelerations**

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Late deceleration</td>
<td>Visually apparent, usually symmetric gradual decrease and return of the FHR associated with a uterine contraction</td>
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<tr>
<td></td>
<td>Delayed in timing, with the nadir occurring after the peak of the contraction</td>
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<tr>
<td></td>
<td>Typically, the onset, nadir, and recovery of the deceleration occur after the beginning, peak, and ending of the contraction.</td>
</tr>
<tr>
<td>Early deceleration</td>
<td>Visually apparent, usually symmetric gradual decrease and return of the FHR associated with a uterine contraction</td>
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<tr>
<td></td>
<td>Nadir of the deceleration occurs at the same time as the peak of the contraction</td>
</tr>
<tr>
<td></td>
<td>Typically, the onset, nadir, and recovery of the deceleration are coincident with beginning, peak, and ending of the contraction</td>
</tr>
<tr>
<td>Variable deceleration</td>
<td>Visually apparent abrupt decrease in FHR</td>
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<tr>
<td></td>
<td>Decrease is greater than 15 beats per minute, lasts greater than 15 seconds but less than 2 minutes</td>
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<td></td>
<td>If associated with contractions, appearance will vary with successive contractions</td>
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presented algorithms recognize many of the same issues but lack definitive recommendations for timing of intervention and are more subject to interobserver reliability.6–8

The goal of any algorithm should be to deliver a fetus prior to development of metabolic academia, thus reducing the risk of avoidable intrapartum neurologic injury. To achieve this goal, Miller and Miller presented several fundamental principles that have guided the development of all algorithms for intrapartum FHR interpretation:

1. Oxygen is carried from the environment to the fetus by maternal and fetal blood along a pathway that includes the maternal heart, lungs, vasculature, uterus, placenta, and umbilical cord.
2. Interruption of fetal oxygenation has the potential to result in hypoxic neurologic injury.
3. Acute intrapartum interruption of fetal oxygenation does not result in neurologic injury in the absence of significant fetal metabolic academia.

Prior to any discussion of a specific algorithm, a review of the pathophysiology of decelerations is warranted to explain why the algorithm is structured the way it is. Since 1967, decelerations have been referred to as early, late, or variable based on their timing and shape.9 These were thought to be caused by head compression, placental insufficiency, and cord compression, respectively. Early decelerations are likely of no clinical importance. Late decelerations, especially with minimal-to-absent variability, represent a protective fetal response to contraction-induced hypoxia, and often represent an already compromised fetus (Fig. 1). In reality, most decelerations that occur in labor are variables. Although most of these are benign, there is good evidence that deep, frequent variable decelerations may lead to significant fetal compromise.10,11

Although there is no direct relationship between uterine artery blood flow and umbilical venous blood flow, a reduction in maternal blood flow to the placenta may negatively affect oxygenation of fetal blood flowing from the placenta. Janbu and Nesheim demonstrated a nearly linear fall in uterine artery blood flow during contractions.12 In fetal lambs, there is good evidence that fetal hypoxia results from decreased umbilical venous blood flow.13 Although such repetitive contraction-induced hypoxia is a feature of normal labor, and is tolerated well in most cases, the marginally oxygenated or developmentally compromised fetus may exhibit a protective hypoxia-induced reduction in FHR (late deceleration) in response to such stress.

Variable decelerations resulting from umbilical cord compression are at the heart of any discussion of category II FHR tracing management. Fletcher and colleagues14 showed that the initial fall in FHR is an adaptation that decreases myocardial work and oxygen requirements. Fetal lamb studies have shown that the depth of the deceleration is related to the severity of the hypoxia.15,16 The frequency of decelerations is also important, as umbilical cord occlusion studies in fetal sheep show that fetuses exposed to more frequent cord occlusion (1 every 2.5 minutes vs 1 every 5 minutes) experience a larger fall in pH and increase in base deficit.17,18 Additionally, Hamilton and colleagues19 showed that only 3 subtypes of variables were associated with increased risk of fetal acidosis: those with prolonged duration, those with loss of internal variability, and those with “sixties” criteria. “Sixties” criteria are met if 2 or more of the following conditions are present in a variable deceleration: depth of 60 beats per minute or more, nadir of 60 beats per minute or less, and duration of 60 seconds or longer. Thus, any useful algorithm would need take into account the frequency, length, and depth of variable decelerations.
Fig. 1. FHR tracing exhibiting minimal variability with recurrent late decelerations. Expedited delivery is indicated. (Courtesy of Advanced Practice Strategies Inc, Boston, MA; with permission.)
What happens between decelerations is likely an even better predictor of fetal well being. Parer and colleagues\textsuperscript{20} recently demonstrated that a fetus with moderate variability is coping well with the demands of labor and is unlikely to have significant acidosis. That same review noted that the most consistent predictor of newborn academia was absent or minimal variability with late or variable decelerations. In a similar manner, spontaneous or induced accelerations reliably exclude significant fetal metabolic acidemia.\textsuperscript{5} With this background, the authors present an algorithm for the management of category II FHR patterns that requires only standard cardiotocography equipment available in all labor and delivery units (Fig. 2). It utilizes standard NICHD definitions and is consistent with, but more specific than, that document with respect to management recommendations. The algorithm begins with an assessment of baseline variability, as the presence of moderate variability allows one to effectively rule out clinically significant metabolic acidemia. Because variability within decelerations cannot reliably exclude fetal acidemia, this type of variability is not considered when evaluating the FHR. Then, with the goal of predicting/preventing the development of significant acidemia prior to delivery, the focus shifts to decelerations. The algorithm cannot change the outcome for a previously injured fetus or one that experiences a catastrophic event during labor (abruption, uterine rupture, cord prolapse) (Box 2, see Fig. 2).

While following the algorithm, it is often appropriate to first make conservative attempts to relieve potential causes of the category II tracing. Amnioinfusion for oligohydramnios-associated variable decelerations is well supported.\textsuperscript{21} Maternal positioning out of the supine position may also increase fetal oxygenation. On the other hand, the commonly utilized administration of oxygen to the mother, in concentrations

![Fig. 2. Algorithm for management of category II FHR patterns. 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. (From Clark SL, Nageotte MP, Garite TJ, et al. Intrapartum management of category II fetal heart rate tracings: towards standardization of care. Am J Obstet Gynecol 2013;209(2):90; with permission.)](image-url)
normally available on labor and delivery units, does not improve fetal oxygen saturation; no evidence exists that such therapy improves neonatal outcomes.\(^\text{22,23}\) Finally, attempts to reduce uterine tachysystole or tetanic contractions should also be made, especially if the labor is being augmented.

Phase of labor and expected time to delivery also play important roles in the algorithm. A fetus exhibiting deep variables in a rapidly progressing second stage may be able to tolerate them until spontaneous delivery, while a fetus with the same FHR pattern in latent labor is less likely to be able to tolerate them for the expected amount of time to delivery (Fig. 3). This is important to consider when evaluating a patient with a potential arrest disorder, as recent data suggest that a more conservative approach with longer periods of observation is warranted before that diagnosis is made in the fetus with a reassuring heart rate pattern. For purposes of this algorithm, which

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**Box 2**

**Management of category II fetal heart rate patterns: clarifications for use in algorithm**

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 beats per minute below baseline
   - Variable decelerations lasting longer than 60 seconds and reaching a nadir less than 60 beats per minute regardless of the baseline.
   - Any late decelerations of any depth
   - Any prolonged deceleration, as defined by the NICHD; because of 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 (eg, 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, such delivery should ideally be initiated within 30 minutes of decision for cesarean section

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 reinstated 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 (eg, minimal variability) nor ability of such fetuses to tolerate intrapartum events leading to certain types of category II patterns is 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 best interest of the fetus to intervene sooner

Fig. 3. When close to delivery, with normal progress in the second stage, this fetus may be watched or considered for operative vaginal delivery if the pattern persists. When remote from delivery, cesarean section should be done per the algorithm. (Courtesy of Advanced Practice Strategies Inc, Boston, MA; with permission.)
applied only to fetuses with a category II FHR pattern, normal progress in labor refers to the older Friedman time limits.⁵

Although no management algorithm for FHR tracings will ever predict unexpected sentinel events, 2 clinical situations should be specifically addressed. Patients with vaginal bleeding and a category II FHR tracing should be considered for expedited delivery, as abortion may be the underlying cause and may progress precipitously to frank fetal asphyxia.²⁴ Patients undergoing a trial of labor after cesarean section should also be carefully watched for any sudden FHR tracing changes, as the further decline may be much more rapid in the case of uterine rupture than in a patient with an otherwise similar FHR tracing.²⁵

Decelerations may fall outside the strict parameter of the algorithm, yet still be clinically important (Fig. 4). Prolonged decelerations as defined by the NICHD are not addressed by the algorithm, as the variability in causation, timing, and management is too great to be addressed by any single algorithm. Additionally, in a mixed pattern including variable and late decelerations, precedence should always be given to the late decelerations.

Minimal variability and absent variability in the FHR are considered as one for the purposes of this algorithm for 3 reasons. First, discussed earlier, is the lack of interobserver and intraobserver reliability in distinguishing between the two. The other is the presumption that a fetus with a moderate variability will pass through a stage of minimal variability as its condition worsens. Finally, while variability must be absent to correlate with severe fetal acidemia with a high degree of statistical reliability, the goal of electronic FHR monitoring during labor is to deliver infants prior to the development of such acidemia. Any concerns about the quality of the tracing and the ability to determine variability should be addressed by the placement of a fetal scalp electrode unless contraindicated.

Some fetuses may present with persistent minimal-to-absent variability but have no significant decelerations (Fig. 5). This most likely represents pre-existing insults, and a brief period of observation is reasonable and appropriate. Although the fetus may have been damaged, no further damage is occurring in the absence of significant decelerations.

As noted previously, this algorithm is designed for use in any obstetric unit. Other technologies such as fetal scalp sampling and fetal pulse oximetry have been evaluated and found not to offer a significant advantage over eFHR.²⁶ Newer technologies may arise that will alter the use of the algorithm.

In 1990, Roger Freeman observed that the saga of electronic FHR monitoring had been “a disappointing story” in that such monitoring had failed to result in any significant reduction in rates of neonatal encephalopathy and subsequent neurologic impairment but had contributed to the rise in cesarean section delivery rate. A quarter of a century later, the situation remains unchanged, yet the approach to FHR interpretation and management has remained static. Recent data suggest that variation in interpretation and response to abnormal FHR patterns is largely to blame and that, as in many other areas of medicine, standardization will yield improved outcomes. In a series of over 14,000 patients undergoing oxytocin induction of labor, those women who were managed with a standardized protocol that included unambiguous definition of normal and abnormal FHR patterns and prescribed specific actions in response to specific patterns experienced fewer low 1- and 5-minute Apgar scores, fewer infant NICU admissions and a lower cesarean section delivery rate.²⁷ Along with the authors of the original algorithm discussed here, the authors believe that such an approach to the management of category II FHR patterns is likely to yield similar results. In addition, such an algorithm represents 1 approach to FHR
Fig. 4. The etiology of this prolonged deceleration is unknown. The management of this type of FHR pattern is not covered by the algorithm and needs to be tailored to the clinical picture. (Courtesy of Advanced Practice Strategies Inc, Boston, MA; with permission.)
Fig. 5. The absence of decelerations excludes ongoing hypoxia in a neurologically intact fetus, but this fetus may not tolerate labor; delivery should be considered if the pattern persists for 1 hour. (Courtesy of Advanced Practice Strategies Inc, Boston, MA; with permission.)
interpretation that is, in the opinion of the 18 clinician–investigators responsible for the bulk of authoritative work on this subject in the past 30 years, reasonable given the current understanding and available data, and it should be viewed as such during any scientifically valid, objective review of such tracings. Although other approaches may be equally reasonable, the authors feel this approach will be particularly useful to clinicians and provide a starting point for well-designed clinical trials to further refine a uniform approach to this issue.

REFERENCES


