Fetal heart rate monitoring: Interpretation and collaborative management

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Abstract

Effective intrapartum fetal heart rate (FHR) monitoring requires ongoing collaboration among health care providers. Nurses, midwives, and physicians must have a shared understanding of 1) how FHR tracings are interpreted, 2) which FHR patterns are associated with actual or impending fetal acidemia, 3) when and within what time frame the physician or the midwife should be notified of variant FHR patterns, 4) how quickly physicians and midwives should respond when notified of variant patterns, and 5) the indications for and optimal timing of interventions such as operative delivery. This article reviews the literature on FHR monitoring and includes a discussion of the advantages and limitations of different monitoring modalities. An overview of those FHR patterns are associated with presumed fetal acidemia is presented, as well as sample multidisciplinary FHR monitoring guidelines and an exercise in intrapartum FHR pattern evaluation that can be used to initiate development of local FHR monitoring patterns.

Introduction

Despite decades of clinical experience, there are no universally accepted, time-specific algorithms to aid providers in deciding fetal heart rate (FHR) patterns requiring clinical intervention. The need for consensus regarding FHR pattern interpretation and management is particularly important for establishing collaborative practice. If either the nurse, the certified nurse-midwife (CNM)/certified midwife (CM),* or the physician consultant assigns different levels of concern to specific patterns or has different thresholds for intervention, miscommunication can result, and overuse or under use of medical interventions may occur. Because effective communication and clear expectations are so central, FHR monitoring stands as an excellent example of how properly managed clinical collaboration translates into high-quality patient care.

This article reviews the literature on FHR monitoring and includes a discussion of the advantages and limitations associated with different monitoring modalities. FHR pattern interpretation will be discussed, with a focus on those patterns that signal the need for consultation and/or collaboration. Sample multidisciplinary FHR monitoring guidelines will be presented, along with an exercise in FHR pattern management that might be used to stimulate discussion of practice parameters and the development of local FHR monitoring guidelines.
History of electronic fetal heart rate monitoring

Although electronic fetal monitoring (EFM) is used in more than 80% of births in the United States today, there is controversy regarding its efficacy \(^{1,2}\). Multiple randomized trials and meta-analyses have evaluated the relationship between electronic FHR monitoring and neonatal outcome. These studies noted a decrease in the incidence of seizures in fetuses assessed with EFM compared with fetuses monitored with auscultation \(^3\). However, EFM was not shown to be more effective than intermittent auscultation in lowering perinatal mortality rates \(^3–5\).

Furthermore, these studies identified an increase in operative vaginal deliveries and cesarean sections in patients monitored with EFM during the intrapartum period \(^4\).

There are several reasons why individual or combined studies were unable to establish a link between EFM and improved neonatal outcomes, if one exists. In some cases, the study sample size was not large enough to adequately determine the relationship between monitoring modality and neonatal mortality and/or morbidity rates. Furthermore, differences in terminology used to define FHR pattern characteristics and differences in the criteria used manage FHR patterns associated with presumed fetal acidemia make it difficult to draw conclusions from a meta-analysis.

Wide variations in EFM interpretation make outcome evaluation extraordinarily difficult. Studies of FHR reliability have shown significant interobserver and intraobserver variation in tracing interpretation \(^6–11\). Furthermore, the elevated cesarean section rate associated with EFM could be the result of provider tendencies to make a diagnosis of fetal asphyxia on the basis of the presence of FHR patterns that have not been conclusively linked to the development of significant fetal acidosis \(^12–15\). These issues involving reliability, reproducibility, and standardization of nomenclature and practice patterns must be resolved before meaningful research on the efficacy of FHR monitoring can be conducted. With the publication of guidelines from the National Institute of Child Health and Human Development Research Planning Group, standardized, quantified nomenclature for specific FHR patterns is now available \(^16\). However, standardized practice guidelines for the management of variant FHR patterns and the timing of interventions to avoid significant fetal acidemia have yet to be developed. For the purposes of this article significant acidemia is defined as umbilical cord arterial blood pH of less than 7.1, and base excess less than \(-12\) mEq · L\(^{-1}\). In the absence of data on umbilical cord blood gases, a lack of newborn vigor at birth, defined as an Apgar score of less than 7 at 5 minutes of age, was used.

How well does FHR monitoring predict neonatal vigor?

Many labors that end with the delivery of a vigorous neonate include “variant” FHR patterns. The fact that most nonacidemic, vigorous infants usually experience episodes of FHR decelerations during the course of labor has made it difficult for providers to develop definitive FHR management guidelines. In part, the difficulty in distinguishing benign variant patterns from patterns associated with significant fetal acidemia arose because FHR monitoring was introduced into clinical practice before the cause of FHR patterns was well understood. Early studies suggested that decelerations could be produced by cord compression, head compression, or placental insufficiency \(^17–21\). These patterns were thought to be associated with a continuum of developing asphyxia, resulting in significant fetal acidemia. In extreme cases, this was linked to the subsequent development of neonatal damage and cerebral palsy. Given this apparent cause-effect relationship between events known to contribute to fetal hypoxia and acidemia and the incidence of decelerations in the FHR, clinicians perceived many commonly occurring FHR decelerations as “ominous.” However, two aspects of FHR physiology not consistently acknowledged and factored into early clinical practice were the importance of FHR variability and pattern evolution over time \(^7,13,22–41\).
FHR variability

Studies examining the relationship between FHR patterns, acidemia, and neonatal morbidity have shown the presence of FHR decelerations, as an independent variable, to be poorly predictive of significant fetal acidemia, except in cases of extreme and persistent severe fetal bradycardia (sustained FHR of less than 60 bpm for 10 minutes) [15,23,25,26,30–36]. Rather, the preponderance of evidence supports the premise that the degree of baseline FHR variability that accompanies the decelerations is the most sensitive predictor of neonatal outcome [6,22,23,25–30]. The finding of a relationship between significant acidemia and FHR variability is consistent with the theory that FHR variability is the product of a functioning (ie, adequately oxygenated) neurologic pathway in which numerous impulses from the cerebral cortex, the midbrain, the vagus nerve, and the cardiac conduction system are transmitted. The production of variability is a complex process with input from fetal chemoreceptors and baroreceptors that sense changes in fetal blood oxygen tension, blood pressure fluctuations, and other physiologic phenomena. Changes in fetal cardiorespiratory state can also alter the transmission of impulses from the vagus nerve to the fetal heart and result in characteristics changes in the FHR pattern [12]. Variability, the jagged, irregular oscillation seen on the FHR tracing, therefore, can be thought of as a visual representation of an adequately oxygenated, responsive fetal brain and fetal heart. It is believed that during progressive cerebral oxygen limitation, impulse transmission activity in the fetal neurologic pathway decreases, which in turn manifests as decreased or absent variability on a FHR tracing.

Pattern evolution

The ability to appreciate pattern evolution, that is to recognize and understand changes in the FHR pattern tracing over time, is the second key element of FHR interpretations [29,31,32]. Studies support the premise that long-term FHR variability will become diminished before significant fetal acidemia develops [29,31,32–35]. As a general rule, during the intrapartum period a hypoxia-induced reduction in FHR variability develops gradually (commonly over approximately 60 minutes) and occurs in the context of recurrent late, variable, or prolonged decelerations [23,38,39].

The gradual nature of pattern evolution, as well as the reliability of FHR variability as a predictor of adequacy of fetal oxygenation, usually affords the provider ample time to arrange for consultation, request in-house evaluation of FHR pattern tracings, and, when indicated, initiate operative or surgical delivery before significant fetal acidemia develops [29,31,32–35]. The exception to this rule is the fetus that has a sustained bradycardia of 60 bpm or less or associated catastrophic obstetric events, such as prolapsed cord or complete placental abruption. When the FHR is reduced to 60 bpm or less, a significant fetal acidosis can develop quickly, and baseline variability can rapidly become reduced or absent [29,37,39,40]. The rapidity with which fetal acidemia develops is influenced by the depth of the decelerations or bradycardia. In the setting of a sustained bradycardia or recurrent decelerations, the magnitude of the decrease in the FHR is directly linked to the speed with which acidemia develops. This appears to be particularly true in FHR tracings with absent or minimal baseline variability [29,39,40].

Variant patterns

Clinical studies have shown that, in the context of moderate variability (amplitude range 6–25 bpm), FHR tracings with recurrent decelerations, bradycardia, and tachycardia are strongly predictive of a nonacidemic, vigorous fetus at birth [23,27,30–35,39–42]. Therefore, rather than identify these patterns as “abnormal” or “nonreassuring,” it is suggested that these clinically benign patterns are more appropriately characterized as “variant”—a descriptor that distinguishes them from “normal” but does not carry an association with actual or impending morbidity.

In contrast, a FHR tracing with persistent absent or minimal variability (amplitude range 5 bpm or less), with recurrent decelerations or bradycardia, holds the strongest association with fetal...
acidemia and/or the absence of fetal vigor at birth (27,43–45). Subgroups of the following FHR patterns warrant a presumptive diagnosis of significant fetal acidemia: 1) absent variability with recurrent late decelerations; 2) absent variability with recurrent variable decelerations; 3) absent variability with sustained fetal bradycardia 60 bpm or less (in the absence of congenital heart block); and 4) in clinical practice, a persistent bradycardia with a FHR of 80 bpm or less, which occurs remote from delivery, is often treated in a similar fashion (22–24,27,29,30,38,46). Because these patterns are presumed to be associated with moderate to severe intrapartum asphyxia, there is little likelihood they will be reversed with conservative treatment (maternal position change, fluid bolus, amnioinfusion, etc) Conservative treatment should be carried out only if doing so does not interfere with the move toward rapid delivery.

Although not a signal for immediate delivery, recurrent decelerations or bradycardia in the context of minimal variability should be similarly managed with heightened vigilance. The primary provider should be available for bedside evaluation, and preparations should be made to ensure the ease of initiating emergency delivery.

Management of FHR patterns associated with fetal acidemia.

The diagnosis to decision interval

Guidelines for emergency cesarean section have traditionally focused on decision to incision time (47). Of equal importance is the diagnosis to decision interval. This period begins when FHR changes associated with presumed fetal acidemia first are seen on the tracing or are appreciated through auscultation. In most settings, the nurse as the bedside provider and midwife or physician as the primary provider share responsibility for monitoring in the intrapartum period.

The bedside provider must recognize the variant FHR pattern, make a presumptive assessment of the fetal status, notify the primary provider, and accurately communicate his or her findings. The primary provider must determine the significance of the tracing or auscultated patterns and initiate appropriate management. Management options range from the initiation of conservative measures that are aimed at abolishing the variant pattern, institution of continuous monitoring (to more accurately assess variability and decelerations), physician consultation, development of a plan for collaborative management, or, in cases of presumed fetal acidemia, transfer of care and preparation for operative/surgical delivery. The selection and timing of interventions should be consistent with the patient’s condition, and, in addition, should take into account geographic constraints (travel time from birth center to hospital or physician travel time from home to hospital), institutional guidelines, and other logistic factors.

Lessons from obstetric accidents

Differences among providers in FHR interpretation and management have been cited as a factor in morbid outcomes and costly litigation (48). In the United Kingdom, a study found 70% of all legal claims related to fetal brain damage to be based on “abnormalities” noted on FHR tracings (48). This UK study, which evaluated litigated cases resulting in stillbirth or perinatal/neonatal death, found that of those cases in which the injury could reasonably be attributed to intrapartum events, “...human error was frequently a contributor to the poor outcome, many of which are avoidable.” In 15% of the cases studied, no electronic monitoring at all had been initiated. When there was monitoring, the providers were either unable to accurately identify the presence of FHR patterns consistent with fetal intolerance of labor, failed to recognize the significance of their findings, or most importantly, failed to take action consistent with the urgency of the situation. The authors of the study concluded that junior staff were not sufficiently trained in FHR tracing interpretation and that senior staff did not consistently interpret fetal heart rate tracings accurately (48). This review highlights several critical components necessary for successful collaboration. First, the bedside provider and consulting clinicians must use standardized nomenclature when describing FHR
patterns and a reliable, predictable system for interdisciplinary communication must be in place. Second, there must be a general consensus regarding interpretation of FHR patterns, particularly regarding which patterns are sufficiently complicated to warrant a presumptive diagnosis of significant fetal acidemia. Finally, all members of the team should be in agreement regarding which interventions will be used and how quickly these interventions ought to be carried out for specific FHR patterns.

**Guidelines for assessment and management of FHR patterns**

Providers have traditionally been hesitant to codify guidelines for managing FHR pattern tracings. The reasons commonly cited include the weak association between variant patterns and significant fetal acidemia and fears that written guidelines will be used to scrutinize clinical practice in a court of law. Nonetheless, every physician and midwife has some time frame within which they expect to be called for specific pattern tracings, and every nurse has expectations regarding the speed with which the physician or midwife should comply with a request for in-house tracing evaluation. Furthermore, although few institutions have detailed written guidelines, it is a clinical reality that practitioners base their interventions on their interpretation of the FHR tracing. Providers must be able to explain what interpretive construct they used as the basis for any decisions they make relative to FHR tracings. In a court proceeding, they will be asked when and by whom they should have been notified, particularly if there was an unwarranted delay in notification.

**Setting the alarm: physician/midwife notification of variant patterns**

Institutions can respond to the challenges previously described by developing consensus guidelines for the interpretation and management of FHR patterns. Consensus guidelines should include an identification of: 1) FHR patterns that will trigger midwife and/or physician notification; 2) time frames within which notification should be accomplished; 3) which providers should be notified (on the basis of the degree of accompanying variability, type of pattern, duration and the severity of the decrease in FHR; and 4) which patterns require midwife and/or physician bedside evaluation and management.

Pattern definitions and management recommendations are intended to: 1) outline interventions that may reverse the causes of fetal hypoxia, 2) assist the provider to quickly and accurately diagnose FHR patterns associated with significant acidemia, 3) outline notification and preparation steps so that emergency operative vaginal deliveries or cesarean sections can be initiated in a timely fashion, and 4) assist the provider to recognize those situations in which operative vaginal deliveries and cesarean sections should be undertaken. Sample notification guidelines for variant FHR patterns are presented in Table 1. These guidelines are not exhaustive, nor are they meant to be adopted without review by any institution.
Table 1. Sample Notification Guidelines for Variant FHR Patterns

<table>
<thead>
<tr>
<th>Pattern</th>
<th>Admission Guidelines</th>
<th>Labor Guidelines</th>
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<tbody>
<tr>
<td>Minimal variability (amplitude range &gt; undetectable and &lt; 5 bpm) of 20-min duration Normal baseline FHR No decelerations</td>
<td>Continue FHR monitoring. Notify the midwife if tracing remains nonreactive for &gt; 20 min. If minimal variability is accompanied by FHR decelerations, midwife should be present or en route for bedside evaluation. If pattern develops decelerations, physician should be notified and available.</td>
<td>Notify midwife. If the minimal variability is accompanied by recurrent FHR decelerations, midwife should be present or notified within 20 min. If pattern persists with decelerations, physician should be available or en route for bedside evaluation.</td>
</tr>
<tr>
<td>Absent variability (amplitude range undetectable) of continuous 20-min duration Normal baseline FHR No decelerations</td>
<td>Notify midwife/physician within 20 min. If absent variability is accompanied by FHR decelerations, physician should be notified within 10 min and should be en route for bedside evaluation.</td>
<td>May be observed, but midwife should be present if pattern persists for 30 min. If pattern persists, midwife should present and physician should be notified. If absent variability is accompanied by FHR decelerations, the physician should be en route for bedside evaluation.</td>
</tr>
<tr>
<td>Recurrent decelerations of any type, defined as decelerations occurring &gt; 50% of the time or with 50% of the contractions in two consecutive 10-min windows, identified by EFM or auscultation</td>
<td>Midwife should be present or notified within 20 min. If recurrent decelerations occur in the context of absent variability or decelerations get progressively deeper or longer, midwife/physician notification should occur within 10 min. Physician should be available or en route for bedside evaluation.</td>
<td>Midwife should be present or notified within 20 min. If recurrent decelerations occur in the context of absent variability or decelerations get progressively deeper or longer, midwife/physician notification should occur within 10 min. Physician should be available or en route for bedside evaluation.</td>
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Rather, they are provided as an example of the type of collaborative practice guidelines that could be developed.

Throughout this document, recommendations regarding notification of the midwife/physician by the bedside provider are made. Several patterns require the presence and review by a senior clinician, namely the attending midwife, chief resident, and/or attending physician. These patterns are: 1) recurrent mild to moderate variables, 2) tachycardia greater than 180 bpm with moderate or minimal variability, 3) recurrent late decelerations with moderate variability; 4) prolonged deceleration with moderate variability, and 5) bradycardia less than 110 bpm and greater than 80 bpm.

In addition, a clinician who can perform an operative delivery should evaluate the following patterns. These patterns are: 1) absent variability with or without variant patterns, 2) recurrent late decelerations with absent or minimal variability, 3) recurrent variable decelerations or prolonged decelerations, 4) tachycardia greater than 200 bpm, 5) sinusoidal pattern, and 6) bradycardia less than 80 bpm.
Communicating findings

Accurate, consistent, and timely communication plays an important role in the successful execution of consensus guidelines. When the primary provider is not in-house, fax machines are particularly helpful in ensuring the accuracy of the information exchanged between providers. If a fax machine is not readily available, verbal renderings of the FHR tracing must be detailed enough to allow the recipient to create a complete mental image of the tracing’s characteristics. Communications involving descriptions of FHR tracings should include a detailed description of the following characteristics: 1) the variability (absent, minimal, moderate, or marked including whether accelerations are present (reactivity); 2) a description of any decelerations, including their type or shape, repetitiveness (recurrent, intermittent), severity (nadir), and their relationship to uterine activity; 3) the baseline FHR; 4) the evolution of the FHR tracing (baseline admission tracing through current status, including the duration of the current pattern); and 5) the association of the FHR patterns with any evident or suspected maternal condition (vaginal bleeding, maternal hypotension, recent epidural administration, narcotic administration, increased uterine activity, preeclampsia, maternal medical conditions, etc) See Table 2.

<table>
<thead>
<tr>
<th>Pattern Characteristic</th>
<th>Documentation</th>
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<tbody>
<tr>
<td>Variability</td>
<td>Absent, minimal, moderate, marked, other</td>
</tr>
<tr>
<td>Baseline FHR</td>
<td>Normal, tachycardia, bradycardia</td>
</tr>
<tr>
<td>Accelerations (reactivity)</td>
<td>Present or not, magnitude of FHR increase (bpm) and duration</td>
</tr>
<tr>
<td>Decelerations</td>
<td>Type (early, variable, late, or prolonged), repetitiveness (recurrent or intermittent), severity (nadir), and relationship to uterine activity</td>
</tr>
<tr>
<td>Pattern evolution</td>
<td>Description of baseline tracing through current status including the duration of the current pattern</td>
</tr>
<tr>
<td>Clinical associations</td>
<td>Association of FHR patterns to clinical event (vaginal bleeding, maternal hypotension, recent epidural administration, narcotic administration, increased uterine activity, etc)</td>
</tr>
<tr>
<td>Urgency</td>
<td>Was recipient notified or asked to come for an evaluation?</td>
</tr>
</tbody>
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Communicating the gravity of the situation

After presenting the details of the FHR tracing, the bedside provider should clearly state the gravity of the situation and a time frame within which they think the tracing should be evaluated. For example, “The tracing warrants an in-house evaluation within 30 minutes,” or “A bedside evaluation of the tracing is needed immediately.” If the recipient of the information is unable to complete the bedside evaluation in the requested time frame, an alternative arrangement should be made (eg, a different physician or midwife should be sought to review the tracing).
Monitoring modalities

The fetus may be monitored during labor by means of intermittent auscultation with a Doppler or by intermittent or continuous EFM that generates a tracing. Selection of the monitoring modality depends on a number of factors, including known or suspected fetal or maternal risk factors, characteristics of the FHR pattern, and expected travel time to a hospital setting. Significant differences exist in the usefulness of various techniques of FHR monitoring, the most significant being the ease with which providers can accurately identify the various features of the FHR tracing. Although no firmly established guidelines mandate which modality should be used, the FHR monitoring technique used can have a major impact on provider decision making regarding selection and timing of interventions [4,49].

Intermittent auscultation

Each year, approximately 40,000 out-of-hospital births occur in the United States, representing about 1% of all births in the country [50–52]. In these settings, assessment of the FHR by auscultation is a common practice [53]. Most out-of-hospital births occur in free-standing birth centers, where intrapartum FHR monitoring is most often accomplished using a hand-held ultrasound Doppler or fetoscope. Only 7.5% of patients who deliver in free-standing birth centers have their FHR continuously evaluated in labor with electronic fetal monitoring [52]. When midwives practice in hospital-based settings, studies show that they are more likely than physicians to use auscultation as a routine part of intrapartum fetal surveillance [53]. As is the case with EFM, many important questions remain about the usefulness of intermittent auscultation of the FHR. How frequently should auscultation be performed in the latent, active, and second stages of labor? Which patterns are sufficiently complicated to warrant a move to EFM? Which patterns suggest the need for consultation, collaboration, or transfer of care from midwife to physician? Which patterns are sufficiently complicated that an out-of-hospital birth should be abandoned in favor of hospital-based care? In light of current knowledge about the physiology of the fetal response to hypoxia, the two issues most germane to the use of intermittent auscultation protocols are: 1) can intermittent auscultation accurately detect FHR patterns, specifically those that signify the possibility of significant fetal acidemia and 2) how should other clinical indicators of risk be factored into the decision about which FHR monitoring modalities to choose?

Auscultation and FHR pattern recognition

The accuracy with which providers are able to identify the full spectrum of FHR patterns with auscultation has long been a source of debate. Auscultation has been shown to reliably detect FHR accelerations in studies that used auscultation to perform nonstress tests [54–57]. Studies evaluating the efficacy of using auscultation with Doppler fetoscopes to accurately detect FHR patterns associated with the fetus at risk for significant acidemia have yielded contrasting results [5,58]. A 1984 study evaluated the reliability with which 16 physicians and 16 nurses were able to discriminate base FHR characteristics (baseline rate, variability) and FHR patterns (episodic and periodic changes) with auscultation [58]. Study participants listened to recordings of FHR tracings in a quiet, distraction-free, classroom setting. Auscultation proved a reliable method of identifying normal FHR patterns; 97% of participants accurately identified the FHR tracing with a normal baseline rate, moderate variability, and no periodic changes. In contrast, diminished and increased variability was often missed; 72% of the participants identified the presence of random accelerations of the FHR and only 25% identified the saltatory pattern. In addition, significant deficiencies were found in provider ability to accurately identify periodic and episodic changes. Variable decelerations were identified with only 75% accuracy. Late decelerations with moderate variability were incorrectly identified by 27% of the study participants. The finding of most concern was that late decelerations with absent variability were missed by 19% of the participants. The
authors concluded that, although auscultation was in large part a reliable means of evaluating FHR patterns, the failure to recognize late decelerations with and without variability fell below the acceptable threshold (58).

The role of clinical indicators of risk

These findings notwithstanding, the outcomes of planned home births (using auscultation) are comparable to the outcomes of similar populations of patients delivered in hospital settings monitored with EFM (51, 52). This similarity suggests that auscultation and EFM are equally adequate, or that neither modality is very good, or that a type II error occurred (sample size is too small to detect a difference when in fact there may be). Furthermore, it is not clear whether the risk screening that is inherent in determining eligibility for an out-of-hospital birth is an independent variable predicting a healthy newborn or whether the auscultation protocols that are followed result in adequate monitoring. It must be kept in mind that adverse neonatal outcomes are extremely rare events and that large studies must be conducted before the effectiveness of any FHR monitoring method can be established.

Standards of care for auscultation

As with EFM, efforts to measure clinical outcomes associated with auscultation have been hampered by wide variations in practice. Auscultation technique and observation intervals vary from institution to institution and from provider to provider, and no study has definitively established the superiority of one technique over another (49, 59). The American College of Obstetricians and Gynecologists (ACOG) has published guidelines that specify the frequency with which auscultation should be performed during labor (60, 61). Most auscultation protocols have called for the FHR rate to be evaluated immediately after a contraction (49). Because variations in FHR patterns that coincide with the beginning or end of a contraction may be missed if such a protocol is used, more recent auscultatory protocols have advocated listening both during and after a contraction (61). When auscultation is used and maternal or fetal risk factors are present, ACOG recommends that the FHR be evaluated and recorded at least every 15 minutes, after a uterine contraction during the first stage of labor, and at least every 5 minutes during the second stage of labor. In the absence of risk factors, there are no good data regarding the optimal interval for intermittent auscultation of the FHR. In these low-risk patients, ACOG recommends that providers evaluate and record the FHR at least every 30 minutes in the first stage of labor and every 15 minutes in the second stage of labor (60).

Recommendations for midwifery practice

As stated earlier, the results from studies comparing the efficacy of auscultation to EFM show no significant difference in perinatal mortality or Apgar scores (3, 4, 49). EFM has been shown in some studies and meta-analyses to be associated with a reduction in newborn seizures and a reduced incidence of significant neonatal acidemia at birth, although the long-term value of these findings is unclear (3, 4). The principle benefits offered by EFM appear to result from the greater ease it affords providers in detecting FHR patterns associated with significant acidemia, particularly the ability to reliably and precisely identify the degree of baseline variability.

Given the advantages and limitations associated with the different monitoring modalities, providers should consider the following guidelines when selecting the type of intrapartum FHR surveillance to be used:
1. Intermittent auscultation of the FHR is a reasonable method of intrapartum surveillance for most patients, as long as staffing patterns can guarantee a frequency of surveillance that meets national standards (including 1:1 nursing care).

2. If auscultation is used, a change to continuous or intermittent electronic monitoring should be considered when a patient has recurrent decelerations, prolonged decelerations, fetal bradycardia, persistent fetal tachycardia, or an audibly unchanging/fixed baseline FHR. When these patterns are identified by auscultation, studies suggest that the use of EFM can enhance the providers' ability to evaluate the accompanying baseline FHR variability and, consequently, to more easily determine the clinical significance of the variant pattern.

3. Continuous EFM should be reserved for patients whose antenatal or intrapartum clinical course suggests that the mother and/or fetus are at risk for or are currently experiencing significant intrapartum complications.

4. For patients without significant risk factors, intermittent EFM or auscultation may be used. Basing the selection of the monitoring modality on fetal/maternal risk factors and/or clinical events allows for the identification of a small group of high-risk patients who require continuous monitoring. The remainder of patients can generally be managed effectively with intermittent EFM or auscultation, which minimizes the well-documented risk for iatrogenic interventions associated with continuous EFM.

**Conclusion**

The avoidance of metabolic acidosis is the desired outcome of FHR monitoring. The preponderance of evidence supports the premise that FHR variability is the most sensitive predictor of the absence of fetal acidemia and presence of fetal vigor. Providers who choose to determine the significance of FHR decelerations without considering the accompanying variability are likely to overstate the implications of variant FHR patterns, overuse medical interventions, and have a higher operative delivery rate.

The choice of monitoring modality, accurate identification of FHR patterns, and an appreciation of a given pattern's significance are all vital aspects of FHR pattern management. Because FHR monitoring during labor is a truly multidisciplinary exercise, all members of the health care team should have a common goal, a shared method for interpreting FHR patterns, and an agreed on guideline for management of specific patterns. The exercise in FHR pattern evaluation presented in the Appendix can be used to identify intradisciplinary and interdisciplinary differences regarding perceptions of pattern significance, expectations regarding notification, and response times. The information gathered from such an exploration of discipline-specific assumptions and expectations can serve as a starting point in the development of local FHR monitoring guidelines.
References


Publishing and Reprint Information

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- CNMs/CMs and midwives as used herein refers to those midwifery practitioners who are certified by the American College of Nurse Midwives (ACNM) or the ACNM Certification Council Inc.; Midwifery refers to the profession as practiced in accordance with the standards promulgated by the ACNM.

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