CLINICAL PRACTICE GUIDELINE

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(REPLACES PRACTICE BULLETIN NUMBER 106, JULY 2009; PRACTICE BULLETIN NUMBER 116, NOVEMBER 2010; AND PRACTICE ADVISORY, OXYGEN SUPPLEMENTATION IN THE SETTING OF CATEGORY II OR III FETAL HEART TRACINGS, JANUARY 2022)

Intrapartum Fetal Heart Rate Monitoring: Interpretation and Management

Committee on Clinical Practice Guidelines–Obstetrics. This Clinical Practice Guideline was developed by the ACOG Committee on Clinical Practice Guidelines–Obstetrics in collaboration with Laura Mercer, MD, MBA, MPH, Aaron B. Caughey, MD, MPH, PhD, Nandini Raghuraman, MD, MSCI, and Stephanie Ros Saposnik, MD, MSCI.

PURPOSE: The purpose of this document is to provide an evidence-based framework for the evaluation and management of intrapartum fetal heart rate (FHR) patterns.

TARGET POPULATION: Pregnant individuals in the first or second stage of labor.

METHODS: This guideline was developed using an a priori protocol in conjunction with a writing team consisting of three maternal–fetal medicine subspecialists and one specialist in obstetrics and gynecology appointed by the American College of Obstetricians & Gynecologists' (ACOG) Committee on Clinical Practice Guidelines–Obstetrics. ACOG medical librarians completed a comprehensive literature search for primary literature within Cochrane Library, Cochrane Collaboration Registry of Controlled Trials, EMBASE, PubMed, and MEDLINE. Studies that moved forward to the full-text screening stage were assessed by the writing team based on standardized inclusion and exclusion criteria. Included studies underwent quality assessment, and a modified GRADE (Grading of Recommendations Assessment, Development and Evaluation) evidence-to-decision framework was applied to interpret and translate the evidence into recommendation statements.

RECOMMENDATIONS: This Clinical Practice Guideline includes an overview of intrapartum FHR monitoring nomenclature and classification systems and provides recommendations for evaluation and management of intrapartum FHR tracings. Recommendations are classified by strength and evidence quality.

INTRODUCTION

The first documentation of a fetal heart rate (FHR) being distinct from that of the mother was in the 1800s (1). The Pinard stethoscope, invented in 1895, is one of the oldest known tools used to auscultate the FHR. Decades later, in the 1960s, electronic fetal monitoring (EFM) was introduced as a means of continuously observing the FHR and uterine contractions.

In its current form, FHR monitoring may be performed externally or internally. Most external monitors use

a Doppler device with computerized logic to interpret and count the Doppler signals. This can be done intermittently or continuously throughout labor. Internal FHR monitoring is accomplished with a fetal scalp electrode, which is a spiral wire placed directly on the fetal scalp to detect electrical signals of the fetal heart.

Nearly 90% of pregnant patients in the United States undergo EFM during labor (2), with a temporal increase in use since 1990 (3), making it the most common obstetric procedure in the United States. More than one-quarter (27.3%) of primary cesarean deliveries are due to nonreassuring fetal status as detected by EFM (4). This statistic highlights the significant effect EFM has on decision making in labor and delivery units. Compared with non-Hispanic White women, Asian (5), Hispanic (5, 6), and non-Hispanic Black women (5, 6) are at significantly increased risk of cesarean delivery. Among those with unplanned cesarean deliveries, more Black and Hispanic patients are diagnosed with nonreassuring FHR as the indication for cesarean (7–11). This disparity underscores the urgent need for standardized EFM interpretation and management strategies that are applied consistently regardless of race, ethnicity, socioeconomic status, or other demographic characteristics.

The purpose of this document is to provide obstetric care clinicians with an evidence-based framework for evaluation and management of intrapartum FHR patterns.

SUMMARY OF RECOMMENDATIONS

Management of Category I, II, and III Fetal Heart Rate Tracings

ACOG recommends routine intrapartum care in the setting of category I fetal heart rate tracings. **(STRONG RECOMMENDATION, LOW-QUALITY EVIDENCE)**

ACOG recommends initial attempt(s) at intrauterine resuscitation with one or more of the following: maternal position changes, amnioinfusion, maternal intravenous fluid bolus, reduction or cessation of augmentation or induction agents, or correction of maternal pathophysiology thought to be associated with tracing changes, prior to cesarean delivery in the setting of a category II fetal heart rate tracing. **(STRONG RECOMMENDATION, MODERATE-QUALITY EVIDENCE)**

ACOG recommends against routine maternal oxygen administration for category II or III fetal heart rate tracings in the absence of maternal hypoxia. **(STRONG RECOMMENDATION, HIGH-QUALITY EVIDENCE)**

ACOG recommends expedited delivery in the setting of a category III fetal heart rate tracing not responsive to initial attempt(s) at intrapartum intrauterine resuscitation when indicated. **(STRONG RECOMMENDATION, HIGH-QUALITY EVIDENCE)**

STRENGTH OF RECOMMENDATION

STRONG

ACOG recommends:
Benefits clearly outweigh harms and burdens. Most patients should receive the intervention.

ACOG recommends against:
Harms and burdens clearly outweigh the benefits. Most patients should not receive the intervention.

CONDITIONAL

ACOG suggests:
The balance of benefits and risks will vary depending on patient characteristics and their values and preferences. Individualized, shared decision making is recommended to help patients decide on the best course of action for them.

QUALITY OF EVIDENCE

HIGH

Randomized controlled trials, systematic reviews, and meta-analyses without serious methodologic flaws or limitations (eg, inconsistency, imprecision, confounding variables)

Very strong evidence from observational studies without serious methodologic flaws or limitations There is high confidence in the accuracy of the findings and further research is unlikely to change this.

MODERATE

Randomized controlled trials with some limitations Strong evidence from observational studies without serious methodologic flaws or limitation

LOW

Randomized controlled trials with serious flaws Some evidence from observational studies

VERY LOW

Unsystematic clinical observations
Very indirect evidence from observational studies

GOOD PRACTICE POINTS

Ungraded Good Practice Points are incorporated when clinical guidance is deemed necessary in the case of extremely limited or nonexistent evidence. They are based on expert opinion as well as review of the available evidence.

ACOG suggests treating uterine tachysystole that is associated with category III or category II fetal heart rate tracings with high-risk features, and persists despite

pausing oxytocin, with a rapid-acting uterine relaxation agent. **(CONDITIONAL RECOMMENDATION, MODERATE-QUALITY EVIDENCE)**

Adjunct Modalities for Interpretation of Fetal Heart Rate Monitoring

ACOG recommends against the routine use of ST-segment analysis (STAN) for interpretation and management of the fetal heart rate in labor. **(STRONG RECOMMENDATION, HIGH-QUALITY EVIDENCE)**

ACOG recommends against the routine use of intrapartum fetal pulse oximetry for the assessment of fetal status. **(STRONG RECOMMENDATION, MODERATE-QUALITY EVIDENCE)**

ACOG recommends against primary reliance on computerized approaches for the interpretation and management of the fetal heart rate in labor. **(STRONG RECOMMENDATION, MODERATE-QUALITY EVIDENCE)**

METHODS

ACOG Clinical Practice Guidelines provide clinical management recommendations for a condition or procedure by assessing the benefits and harms of care options through a systematic review of the evidence. This guideline was developed using an a priori protocol in conjunction with a writing team consisting of three maternal–fetal medicine subspecialists and one specialist in obstetrics and gynecology appointed by the ACOG Committee on Clinical Practice Guidelines–Obstetrics. A full description of the Clinical Practice Guideline methodology has been published separately (12). The following description is specific to this Clinical Practice Guideline.

Literature Search

ACOG medical librarians completed a comprehensive literature search for primary literature within the Cochrane Library, Cochrane Database of Systematic Reviews, ClinicalTrials.gov, Ovid MEDLINE, and PubMed and searched for guidelines from ACOG and other organizations. Parameters for the search included human-only studies published in English. The search was restricted to studies from 2000 to 2023. The MeSH terms and keywords used to guide the literature search can be found in Appendix A (available online at http://links.lww.com/AOG/E272). Final supplemental literature searches were performed in January and June 2025 to ensure that any newly published, high-level sources were addressed in the final manuscript.

Study Selection

A title and abstract screen of all studies was completed by ACOG research staff. Studies that moved forward to the full-text screening stage were assessed by two authors from the writing team (L.M. and A.B.C.) based on standardized inclusion and exclusion criteria. To be considered for inclusion, studies had to be conducted in countries ranked very high on the United Nations Human Development Index (13) and published in English. Although systematic reviews, randomized controlled trials, and observational studies were prioritized, case reports, case series, and narrative reviews were considered for topics with limited evidence. A PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) flow diagram of the included and excluded studies can be found in Appendix B (available online at http://links.lww.com/AOG/E273). All studies that underwent quality assessment had key details extracted (study design, sample size, details of interventions, outcomes) and descriptions included in the summary evidence tables (Appendix C, available online at http://links.lww.com/AOG/E274).

Recommendation and Manuscript Development

A modified GRADE (Grading of Recommendations Assessment, Development and Evaluation) evidence-to-decision framework was applied to interpret and translate the evidence into draft recommendation statements, which were classified by strength and evidence quality (14, 15). The recommendations and supporting evidence tables then were reviewed, revised as appropriate, and affirmed by the Committee on Clinical Practice Guidelines–Obstetrics at a meeting. The guideline manuscript then was written and subsequently reviewed and approved by the Committee on Clinical Practice Guidelines–Obstetrics and other internal review bodies before continuing to publication.

CLINICAL OVERVIEW

Physiology of Electronic Fetal Monitoring

Prolonged or repetitive intrapartum fetal hypoxemia leads to acidemia. Fetal acidemia is associated with adverse neonatal outcomes, including neonatal encephalopathy and cerebral palsy (16). The fetal brain modulates the FHR through an interplay of sympathetic and parasympathetic forces dependent on fetal physiologic status, including oxygenation. Thus, FHR monitoring theoretically can be used to determine whether a fetus is well oxygenated. A complex interplay of antepartum complications, suboptimal uterine perfusion, placental dysfunction, and intrapartum events can result in adverse neonatal outcomes. Known obstetric conditions, such as hypertensive disease, fetal growth restriction, and preterm birth, predispose fetuses to poor outcomes, but they account for a small proportion of asphyxial injury. In

a study of term pregnancies with fetal asphyxia, 63% had no known antepartum risk factors (17).

Risks and Benefits of Continuous Electronic Fetal Monitoring Compared With Intermittent Auscultation

The intended benefit of EFM is to identify fetal hypoxia, intervene, and prevent the transition to acidemia or expedite delivery in the setting of acidemia, thereby reducing adverse neonatal outcomes. Studies evaluating EFM's effectiveness in preventing neonatal and childhood morbidity have had mixed results.

In a Cochrane review (18) of randomized trials comparing intermittent auscultation with continuous EFM, continuous EFM was associated with a 50% reduction in neonatal seizures (risk ratio [RR] 0.50, 95% CI, 0.31–0.80, N=32,386, nine trials) but no reduction in perinatal death (RR 0.86, 95% CI, 0.59–1.23, N=33,513, 11 trials) or cerebral palsy (RR 1.75, 95% CI, 0.84–3.63, N=13,252, two trials). Continuous EFM was associated with an increased risk of cesarean delivery (RR 1.63, 95% CI, 1.29–2.07, N=18,861, 11 trials) and operative vaginal delivery (RR 1.15, 95% CI, 1.01–1.33, N=18,615, 10 trials). In a 2021 systematic review and network meta-analysis of 33 trials, intermittent auscultation was associated with a reduction in emergency cesarean delivery (RR 0.83, 95% CI, 0.72–0.97) compared with cardiotocography (19). In an observational study of a national birth cohort including 1,732,211 singleton live births, Chen et al found that intrapartum EFM, compared with no EFM, was associated with lower early neonatal mortality and morbidity and, therefore, lower infant mortality (2).

Using shared decision making involving the patient, obstetric clinician, and adherence to hospital protocols, intermittent auscultation may be used during labor for patients at low risk of fetal acidemia who are not receiving oxytocin. Patients with an increased risk of stillbirth requiring antenatal testing (discussed in ACOG Committee Opinion No. 828, *Indications for Outpatient Antenatal Fetal Surveillance* [20]) may be better suited for continuous fetal monitoring rather than intermittent auscultation. Intermittent auscultation should include an assessment of FHR baseline and screening for decelerations during and after contractions. There is minimal evidence to guide the optimal frequency of such auscultation. The American College of Nurse-Midwives and the Association of Women's Health, Obstetric and Neonatal Nurses recommend an intermittent auscultation interval ranging between every 15–30 minutes during the active phase of the first stage of labor and every 5–15 minutes during the second stage, as long as the auscultated FHR and labor characteristics are normal (21, 22). Adequate nurse-to-patient staffing ratios to conduct intermittent monitoring are important (23). Intermittent auscultation should be transitioned to continuous FHR monitoring if the patient develops risk factors for fetal acidemia (eg, chorioamnionitis, prolonged labor) or there is suspicion for FHR decelerations or an abnormal baseline FHR.

Nomenclature Systems

Despite the frequency of its use, limitations of EFM include poor interobserver and intraobserver reliability, uncertain efficacy, and a high false-positive rate. In 2008, ACOG, the *Eunice Kennedy Shriver* National Institute of Child Health and Human Development (NICHD), and the Society for Maternal-Fetal Medicine recommended the use of a simple, three-tiered system for the categorization of FHR patterns (Box 1) and provided EFM definitions to standardize interpretation (Table 1) (24).

Category I FHR tracings are normal. Category I FHR tracings are strongly predictive of normal fetal acid–base status at the time of observation. Category I FHR tracings may be monitored in a routine manner, and no specific action is required.

Category II FHR tracings are indeterminate. Category II FHR tracings are not predictive of abnormal fetal acid–base status, yet, presently, there is not adequate evidence to classify these as category I or category III (25). Category II FHR tracings require evaluation and continued surveillance and reevaluation, taking into account the entire associated clinical circumstances and the specific characteristics of the FHR. In some circumstances, ancillary tests to ensure fetal well-being or intrauterine resuscitative measures may be used with category II tracings.

Category III FHR tracings are abnormal. Category III tracings are associated with abnormal fetal acid–base status at the time of observation. Category III FHR tracings require prompt evaluation and intervention. Depending on the clinical situation, efforts to expeditiously resolve the abnormal FHR pattern may include, but are not limited to, change in maternal position, discontinuation of labor stimulation, treatment of maternal hypotension, and treatment of tachysystole with FHR changes, as discussed in more detail below and summarized in Table 2. If a category III tracing does not resolve with these measures, expedited delivery should be undertaken.

Limitations of the three-tier system include the broad range of FHR patterns in category II that limit the specificity of this category and its ability to predict acidemia, as well as the modest interobserver reliability (26). Other FHR classifications have been proposed, including the five-tier system (27) in which FHR patterns are categorized into one of five color-coded categories representing varying gradations of risk for fetal acidemia (Appendix D,

available online at http://links.lww.com/AOG/E275). In a single-center case–control study (28) comparing the three-tier and five-tier classification systems, 79% of fetal acidemia was correctly characterized by the presence of an orange or red tracing using the five-tier system compared with only 12% with a category III tracing in the three-tier system. However, the sample size was small, with only 24 cases of acidemia, and there were concerns regarding the cumbersome nature of five complex categories. In another study (29), there was strong concordance at the extremes of "very normal" and "very abnormal" FHR tracings between the three-tier and five-tier classification systems, suggesting that the five-tier system may be an acceptable alternative for EFM classification. Given the limitations of both classification systems, further research is needed on the optimal FHR classification system(s) and how they may affect labor management and outcomes.

Box 1. Three-Tiered Fetal Heart Rate Interpretation System

Category I

Category I FHR tracings include all of the following:

- Baseline rate: 110–160 beats per minute
- Baseline FHR variability: moderate
- Late or variable decelerations: absent
- Early decelerations: present or absent
- Accelerations: present or absent

Category II

Category II FHR tracings include all FHR tracings not categorized as category I or category III. Category II tracings may represent an appreciable fraction of those encountered in clinical care. Examples of category II FHR tracings include any of the following:

Baseline rate:

- Bradycardia not accompanied by absent baseline variability
- Tachycardia

Baseline FHR variability:

- Minimal baseline variability
- Absent baseline variability with no recurrent decelerations
- Marked baseline variability

Accelerations:

- Absence of induced accelerations after fetal stimulation

Periodic or episodic decelerations:

- Recurrent variable decelerations accompanied by minimal or moderate baseline variability
- Prolonged deceleration more than 2 minutes but less than 10 minutes
- Recurrent late decelerations with minimal or moderate baseline variability
- Variable decelerations with other characteristics such as slow return to baseline, overshoots, or "shoulders"

Category III

Category III FHR tracings include either:

- Absent baseline FHR variability and any of the following:
  - Recurrent late decelerations
  - Recurrent variable decelerations
  - Bradycardia
- Sinusoidal pattern

Abbreviation: FHR, fetal heart rate.

Data from Macones GA, Hankins GD, Spong CY, Hauth J, Moore T. The 2008 National Institute of Child Health and Human Development workshop report on electronic fetal monitoring: update on definitions, interpretation, and research guidelines. Obstet Gynecol 2008;112:661–6. doi: 10.1097/AOG.0b013e3181841395.

Table 1. Electronic Fetal Monitoring Definitions	
Pattern	**Definition**
Baseline	• The mean FHR rounded to increments of 5 beats per minute during a 10-minute segment, excluding: ◦ Periodic or episodic changes ◦ Periods of marked FHR variability ◦ Segments of baseline that differ by more than 25 beats per minute • The baseline must be for a minimum of 2 minutes in any 10-minute segment, or the baseline for that time period is indeterminate. In this case, one may refer to the prior 10-minute window for determination of baseline • Normal FHR baseline: 110–160 beats per minute • Tachycardia: FHR baseline is greater than 160 beats per minute • Bradycardia: FHR baseline is less than 110 beats per minute
Baseline variability	• Fluctuations in the baseline FHR that are irregular in amplitude and frequency • Variability is visually quantitated as the amplitude of peak-to-trough in beats per minute: ◦ Absent—amplitude range undetectable ◦ Minimal—amplitude range detectable but 5 beats per minute or fewer ◦ Moderate (normal)—amplitude range 6–25 beats per minute ◦ Marked—amplitude range greater than 25 beats per minute
Acceleration	• A visually apparent abrupt increase (onset to peak in less than 30 seconds) in the FHR • At 32 weeks of gestation and beyond, an acceleration has a peak of 15 beats per minute or more above baseline, with a duration of 15 seconds or more but less than 2 minutes from onset to return • Before 32 weeks of gestation, an acceleration has a peak of 10 beats per minute or more above baseline, with a duration of 10 seconds or more but less than 2 minutes from onset to return • Prolonged acceleration lasts 2 minutes or more but less than 10 minutes in duration • If an acceleration lasts 10 minutes or longer, it is a baseline change
Early deceleration	• Visually apparent usually symmetric gradual decrease and return of the FHR associated with a uterine contraction • A gradual FHR decrease is defined as from the onset to the FHR nadir of 30 seconds or more • The decrease in FHR is calculated from the onset to the nadir of the deceleration • The nadir of the deceleration occurs at the same time as the peak of the contraction • In most cases the onset, nadir, and recovery of the deceleration are coincident with the beginning, peak, and ending of the contraction, respectively
Late deceleration	• Visually apparent usually symmetrical gradual decrease and return of the FHR associated with a uterine contraction • A gradual FHR decrease is defined as from the onset to the FHR nadir of 30 seconds or more • The decrease in FHR is calculated from the onset to the nadir of the deceleration • The deceleration is delayed in timing with respect to the timing of the contraction, with the 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

(*continued*)

Table 1. Electronic Fetal Monitoring Definitions (*continued*)	
Pattern	**Definition**
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 less than 30 seconds • The decrease in FHR is calculated from the onset to the nadir of the deceleration • The decrease in FHR is 15 beats per minute or greater, lasting 15 seconds or greater, and less than 2 minutes in duration • When variable decelerations are associated with uterine contractions, their onset, depth, and duration commonly vary with successive uterine contractions
Prolonged deceleration	• Visually apparent decrease in the FHR below the baseline • Decrease in FHR from the baseline that is 15 beats per minute or more, lasting 2 minutes or more but less than 10 minutes in duration • If a deceleration lasts 10 minutes or longer, it is a baseline change
Sinusoidal pattern	• Visually apparent, smooth, sine wave-like undulating pattern in FHR baseline with a cycle frequency of 3–5 per minute which persists for 20 minutes or more
Tachysystole	• More than five contractions in 10 minutes, averaged over a 30-minute interval

Abbreviation: FHR, fetal heart rate.
Data from Macones GA, Hankins GD, Spong CY, Hauth J, Moore T. The 2008 National Institute of Child Health and Human Development workshop report on electronic fetal monitoring: update on definitions, interpretation, and research guidelines. Obstet Gynecol 2008;112:661–6. doi: 10.1097/AOG.0b013e3181841395.

No matter which individual classification system is used, it is crucial that both nurses and obstetric clinicians at a given institution use the same classification system and terminology. Further, although classification systems can be helpful for prompt communication about FHR tracings, they may lose the nuance of individual FHR tracing characteristics such as baseline heart rate, variability, and decelerations and the changes in these elements over time or in response to specific clinical events. Regardless of the classification system used, it is important to note that categorization of the FHR tracing evaluates the fetus at that point in time; tracing patterns can and will change. An FHR tracing may move back and forth between the categories depending on the clinical situation and management strategies used.

Challenging Circumstances for Continuous Fetal Heart Rate Monitoring

Continuous electronic FHR monitoring with the external Doppler may not be feasible in certain circumstances. For example, in the setting of maternal class III obesity, it is common to lose the FHR for periods of time. It is important to counsel patients about this issue so they are aware of the limitations of external monitoring and to consider obtaining a fetal scalp electrode tracing as early as possible.

For patients who desire to maximize their mobility in labor, wired connection to the FHR monitor may be challenging. For such patients, there are wireless devices that allow more mobility. However, with such devices and patient ambulation, the FHR signal may be disrupted or delayed. These challenges can be seen in the case of hydrotherapy as well. Although there are FHR-monitoring devices that can be used when a patient is laboring in a tub, manipulation and adjustment of the monitors are more challenging. In this scenario and in others, such as monitoring of obstetric patients on nonobstetric floors or patients with fetal arrythmia, clinicians should discuss the practical limitations of continuous monitoring and the risks and benefits of intermittent monitoring with the patient.

Few data exist to guide intrapartum management of preterm FHR monitoring, particularly at less than 32 weeks of gestation. In the absence of such data, it is reasonable to use the FHR-management approaches in this document. As with full-term pregnancies, FHR patterns in preterm gestations should be interpreted in the context of the clinical circumstance.

Use of Fetal Scalp Electrodes

There are a number of situations in which direct assessment of the FHR using a fetal scalp electrode is preferred. A fetal scalp electrode obtains a fetal electrocardiogram (ECG) through an internally placed electrode on the fetal scalp after rupture of membranes. When the FHR tracing is challenging to obtain

Table 2. Potential Interventions Based on Clinical Findings		
Finding	**Potential Underlying Pathophysiology**	**Potential Intervention(s)**
Fetal heart rate tracing changes associated with maternal hypotension (relative or absolute), commonly seen in the setting of regional anesthesia	Relative hypoperfusion of the placenta	• Maternal IV fluid bolus*,[a] • Administration of IV vasopressor medication[a] • Maternal position changes[a,b,c] • Reduction of basal epidural analgesia infusion rate (if recurrent hypotension noted)[a]
Intermittent or recurrent late decelerations without maternal hypotension	Uteroplacental insufficiency due either to impaired uterine perfusion or increased placental resistance	• Maternal IV fluid bolus*,[d] • Maternal position changes[b,c] • Reduction or cessation of induction or augmentation agents[e]
Intermittent or recurrent variable decelerations	Umbilical cord compression	• Maternal position changes[b,c] • Amnioinfusion*,[f]
Fetal tachycardia	Maternal comorbidities such as infection (including intrapartum intraamniotic infection), hyperthyroidism, dehydration, diabetic ketoacidosis	• Evaluation for and treatment of underlying maternal comorbidity, as applicable†
Absent or persistent minimal variability without decelerations	Fetal sleep cycle Medication effect Maternal dehydration Maternal acidemia Fetal acidemia	• Attempt to elicit reassuring findings with vibroacoustic or scalp stimulation†,[g,h,i,j] • Maternal IV fluid bolus*,† • Evaluation for and treatment of underlying cause, as applicable†
Uterine tachysystole associated with fetal heart rate changes	Relative vasoconstriction of uterine spiral arteries	• Reduction or cessation of induction or augmentation agents[e] • Maternal IV fluid bolus*,[d] • Short acting uterine relaxation agent (eg, terbutaline)[k]

(*continued*)

Table 2. Potential Interventions Based on Clinical Findings (*continued*)		
Finding	**Potential Underlying Pathophysiology**	**Potential Intervention(s)**
Recurrent decelerations associated with maternal expulsive efforts in the second stage of labor	Relative temporal hypoperfusion of uterine spiral arteries; Cord or head compression	• Modification of cadence of maternal expulsive efforts (eg, pushing every other contraction)† • Modification of maternal position† • Evaluation for operative vaginal delivery†

Data from:

a. Chooi C, Cox JJ, Lumb RS, Middleton P, Chemali M, Emmett RS, et al. Techniques for preventing hypotension during spinal anaesthesia for caesarean section. The Cochrane Database of Systematic Reviews 2020, Issue 7. Art. No.: CD002251. doi: 10.1002/14651858.cd002251.pub4.

b. Carbonne B, Benachi A, Lévèque ML, Cabrol D, Papiernik E. Maternal position during labor: effects on fetal oxygen saturation measured by pulse oximetry. Obstet Gynecol 1996;88:797–800. doi: 10.1016/0029-7844(9600298-0).

c. Abitbol MM. Supine position in labor and associated fetal heart rate changes. Obstet Gynecol 1985;65:481–6.

d. Simpson KR, James DC. Efficacy of intrauterine resuscitation techniques in improving fetal oxygen status during labor. Obstet Gynecol 2005;105:1362–8. doi: 10.1097/01.AOG.0000164474.03350.7c.

e. Simpson KR, James DC. Effects of oxytocin-induced uterine hyperstimulation during labor on fetal oxygen status and fetal heart rate patterns. Am J Obstet Gynecol 2008;199:34.e1–5. doi: 10.1016/j.ajog.2007.12.015.

f. Hofmeyr GJ, Lawrie TA. Amnioinfusion for potential or suspected umbilical cord compression in labour. The Cochrane Database of Systematic Reviews 2012, Issue 1. Art. No.: CD000013. DOI: 10.1002/14651858.CD000013.pub2.

g. Tejani N, Mann LI, Bhakthavathsalan A, Weiss RR. Correlation of fetal heart rate-uterine contraction patterns with fetal scalp blood pH. Obstet Gynecol 1975;46:392–6.

h. Krebs HB, Petres RE, Dunn LJ, Smith PJ. Intrapartum fetal heart rate monitoring. VI. Prognostic significance of accelerations. Am J Obstet Gynecol 1982;142:297–305. doi: 10.1016/0002-9378(8290734-7).

i. Murphy DJ, Devane D, Molloy E, Shahabuddin Y. Fetal scalp stimulation for assessing fetal well-being during labour. The Cochrane Database Syst Rev 2023;1:CD013808.

j. East CE, Smyth RM, Leader LR, Henshall NE, Colditz PB, Lau R, et al. Vibroacoustic stimulation for fetal assessment in labour in the presence of a nonreassuring fetal heart rate trace. The Cochrane Database of Systematic Reviews 2013, Issue 1. Art. No.: CD004664. doi: 10.1002/14651858.CD004664.pub3.

k. Xodo S, de Heus R, Berghella V, Londero AP. Acute tocolysis for intrapartum nonreassuring fetal status: how often does it prevent cesarean delivery? A systematic review and meta-analysis of randomized controlled trials. Am J Obstet Gynecol MFM 2022;4:100639. doi: 10.1016/j.ajogmf.2022.100639.

*With caution to avoid fluid volume overload.

†Expert opinion or best practice in the absence of quality data.

externally, the benefits and risks of placing a fetal scalp electrode should be considered. In a cohort study by Kawakita et al (30), there was a low but statistically significant risk of neonatal morbidity in the form of scalp injury and cephalohematoma with fetal scalp electrode placement, reinforcing that routine use of fetal scalp electrodes should be avoided unless clinically indicated. There are also a number of potential contraindications to the use of fetal scalp electrodes. These contraindications can be categorized as absolute contraindications (Box 2) and relative contraindications (eg, maternal hepatitis B or hepatitis C infection).

Distinguishing Maternal Heart Rate From Fetal Heart Rate

One challenge of EFM with an external Doppler is the possibility of mistakenly tracking the maternal heart rate (MHR) instead of the FHR. As labor progresses, the MHR is likely to increase, making the distinction even more challenging. During the second stage of labor, this challenge is compounded by two factors: MHR rising into the same range as the FHR and

Box 2. Absolute Contraindications to Fetal Scalp Electrode Placement

- Fetal malpresentation or unknown presenting part
- HIV with viral load greater than 1,000 copies/mL
- HSV with active genital lesions
- Placenta previa or vasa previa
- Suspected fetal hematologic disorder (ie, fetal hemophilia, NAIT, maternal ITP)

Abbreviations: HIV, human immunodeficiency virus; HSV, herpes simplex virus; NAIT, fetal and neonatal alloimmune thrombocytopenia; ITP, immune thrombocytopenic purpura.

changes in fetal positioning and station, which can affect the accuracy of external Doppler monitoring. Thus, as maternal pushing continues and the fetus moves lower into the pelvis, the FHR may become more difficult to capture, and, in some cases, the MHR may be mistakenly recorded instead. A key indicator of an MHR tracing rather than an FHR tracing is an acceleration of the heart rate in response to pushing efforts. In one study analyzing heart rate recordings (assumed to be fetal) during the second stage of labor, external monitoring showed heart rate accelerations at the same time as contractions 12% of the time, whereas internal monitoring with a fetal scalp electrode demonstrated them only 4% of the time (31). This suggests that, in approximately 8% of cases, clinicians may mistakenly believe they are monitoring the FHR when they are actually recording the MHR. To distinguish between MHR and FHR, a maternal pulse oximeter can be used. If there is ongoing difficulty in distinguishing between the two, placing a fetal scalp electrode may provide more accurate monitoring.

Electronic Fetal Monitoring Implementation

When EFM is used during labor, the nurses or obstetric care clinicians should review FHR tracings frequently. A member of the clinical care team should periodically document FHR tracing assessments at frequencies established per individual hospital protocols. Multidisciplinary tracing reviews and discussions are encouraged. It should be possible to perform EFM in conjunction with MHR monitoring to allow for clarification as indicated. The FHR tracing, as part of the medical record, should be available for review if the need arises.

Box 3. Predictive Category II Fetal Heart Rate Tracing Characteristics

Higher-risk features of a category II FHR tracing include one or more of the following:

- Absent variability
- Prolonged, otherwise unexplained, minimal variability*
- Unexplained change in baseline from normal to tachycardia
- Recurrent late, recurrent variable, or more than one prolonged deceleration

Protective features include one or both of the following:

- Moderate variability
- Accelerations

Abbreviation: FHR, fetal heart rate.

Data from Cahill AG, Roehl KA, Odibo AO, Macones GA. Association and prediction of neonatal acidemia. Am J Obstet Gynecol 2012;207:206.e1–8. doi: 10.1016/j.ajog.2012.06.046; Parer JT, King T, Flanders S, Fox M, Kilpatrick SJ. Fetal acidemia and electronic fetal heart rate patterns: is there evidence of an association? J Matern Fetal Neonatal Med 2006;19:289–94. doi: 10.1080/14767050500526172; Krebs HB, Petres RE, Dunn LJ, Smith PJ. Intrapartum fetal heart rate monitoring. VI. Prognostic significance of accelerations. Am J Obstet Gynecol 1982;142:297–305. doi: 10.1016/0002-9378(8290734-7); and Spencer JA. Predictive value of a fetal heart rate acceleration at the time of fetal blood sampling in labour. J Perinat Med 1991;19:207–15. doi: 10.1515/jpme.1991.19.3.207.

* Expert opinion in the setting of limited data.

CLINICAL RECOMMENDATIONS AND EVIDENCE SUMMARY

Evaluation of Category II Fetal Heart Rate Tracings

The evaluation and interpretation of FHR tracings is most challenging when the obstetric care clinician is confronted with a tracing that is defined as category II using the NICHD's three-tier system. The heterogeneity within this group makes it difficult to determine whether a category II FHR strip is indicative of current or impending fetal acidemia. Within the category II group, it is critical to further characterize the FHR features and their development over time. Characteristics of an FHR tracing that have a greater likelihood of indicating fetal hypoxia or acidemia are shown in Box 3. Notable concerns in the

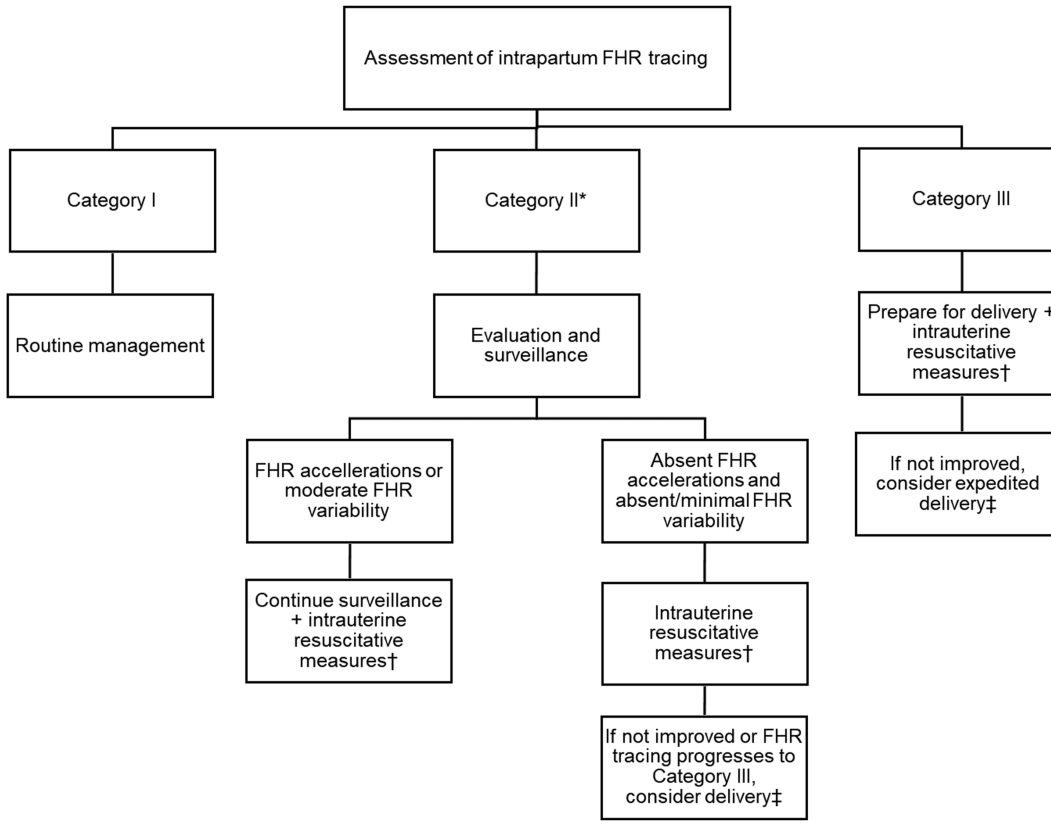

Fig. 1. Management algorithm of intrapartum fetal heart rate (FHR) tracings based on the three-tiered category system. *Given the wide variation of FHR tracings in category II, this algorithm is not meant to represent assessment and management of all potential FHR tracings but to provide an action template for common clinical situations. †See Table 2 for a list of various intrauterine resuscitative measures. ‡Timing and mode of delivery based on feasibility and maternal–fetal status.

literature are the interobserver variability when categorizing FHR tracings (32) and the lack of concordance between suspected fetal acidemia based on FHR tracing and confirmation of acidemia on evaluation of the neonate (18, 33–36).

Fetal scalp stimulation often is used in the setting of minimal or absent variability. A 2023 Cochrane review (37) evaluated the available evidence regarding the use of fetal scalp stimulation to assess fetal well-being. The data are limited, but the conclusion of the review is that there is no clear evidence that this method is a safe or effective way to determine fetal well-being. In many countries, assessment of fetal pH or lactate is done by fetal scalp blood sampling, but this practice is not generally performed in the United States.

Management of Category I, II, and III Fetal Heart Rate Tracings

ACOG recommends routine intrapartum care in the setting of category I fetal heart rate tracings. (STRONG RECOMMENDATION, LOW-QUALITY EVIDENCE)

A category I FHR tracing is indicative of reassuring fetal status without evidence of hypoxia or acidosis (38). As such, there are no studies investigating management of category I tracings. Given the low likelihood of fetal acidemia, it is appropriate to proceed with routine intrapartum management for patients with a category I tracings, as seen in Figure 1.

ACOG recommends initial attempt(s) at intrauterine resuscitation with one or more of the following: maternal position changes, amnioinfusion, maternal intravenous fluid bolus, reduction or cessation of augmentation or induction agents, or correction of maternal pathophysiology thought to be associated with tracing changes, prior to cesarean delivery in the setting of a category II fetal heart rate tracing. (STRONG RECOMMENDATION, MODERATE-QUALITY EVIDENCE)

Though there are limited data to definitively guide management of category II tracings (39), largely owing to the heterogeneity of the category and the variability in interpretation (32), there are data to suggest that

intrauterine resuscitation efforts are useful in a majority of patients (40). Category II FHR tracings are those tracings that are not definitively reassuring (ie, category I) nor definitively pathologic (ie, category III) and therefore represent the most complex group of tracings to analyze and manage. As such, a comprehensive assessment of the specific FHR characteristics as well as of the patient's comorbidities, risk factors, and labor progress should be undertaken in the context of the evolution of fetal status.

Intrauterine resuscitation efforts can help optimize fetal oxygenation and potentially facilitate a return to a category I tracing or at least improved high-risk FHR characteristics. Observed elements in the tracing or clinical scenario can help guide the health care team toward the intrauterine resuscitation attempts most likely to help and are summarized in Table 2.

The presence of moderate variability, fetal accelerations, or both are considered markers of fetal well-being; it is suggested that the presence of these factors can be used to help clarify fetal status in the setting of a category II tracing (Figure 1). Currently, there is insufficient high-quality data to support the use of these factors alone. Clinicians should continue to integrate all available clinical information to make management decisions.

Because a comprehensive assessment of the patient's clinical picture is paramount, clinicians must consider labor progress (normal vs protracted or arrested) and proximity to delivery when determining next steps in management of a persistently category II FHR tracing. In a patient whose labor is progressing through the active phase, resuscitation interventions that do not stall or halt progress should be exhausted before those interventions that may interfere with labor progress toward a successful delivery. The comprehensive assessment is similarly essential in identifying a pattern of fetal status over time, to determine whether ongoing resuscitative efforts are likely to become effective or whether the patient is making adequate progress toward vaginal delivery to justify the persistence of the category II tracing despite resuscitative efforts. Of importance, owing to a lack of definitive data, in the simple algorithm shown in Figure 1, there are no particular times allotted to each intervention nor an amount of time to allow for ongoing observation of the category II tracing—clinical decision making and how much time to wait should be individualized based on the particular FHR tracing features and the specific clinical scenario.

In an effort to standardize care, management strategies for a category II tracing have been proposed (41) and adopted by some institutions or collaboratives. A systematic approach can be useful to ensure clear communication in a team-based and comprehensive assessment. Attention to high-risk features of category II FHR tracings (Box 3) can help teams identify those tracings that may benefit most from intervention.

ACOG recommends against routine maternal oxygen administration for category II or III fetal heart rate tracings in the absence of maternal hypoxia. **(STRONG RECOMMENDATION, HIGH-QUALITY EVIDENCE)**

Though maternal supplemental oxygenation historically has been suggested as a strategy to increase fetal oxygenation, studies have not demonstrated its effectiveness. A 2021 meta-analysis of 16 randomized trials examined intrapartum maternal oxygen administration. There was no improvement in the primary outcome of umbilical artery pH nor in the secondary outcomes of other umbilical artery gas analysis, Apgar scores, or admissions to the neonatal intensive care unit (42). Though not specifically studied in the context of fetal oxygenation, it is recommended to administer oxygen to patients experiencing hypoxia.

ACOG recommends expedited delivery in the setting of a category III fetal heart rate tracing not responsive to initial attempt(s) at intrapartum intrauterine resuscitation when indicated. **(STRONG RECOMMENDATION, HIGH-QUALITY EVIDENCE)**

Category III FHR tracings are rare (less than 1%) and are not monolithic—they may suggest fetal acidemia (absent variability), prolonged fetal hypoxia that can develop rapidly into fetal acidemia (bradycardia), or fetal anemia (sinusoidal pattern without variability for more than 30 minutes). Additionally, the clinical conditions accompanying a category III tracing demand different immediacy of responses. In the setting of a likely uterine rupture and bradycardia, an emergent operative delivery performed as quickly as is safely possible is the best approach. However, in the setting of a tetanic uterine contraction, an intervention of ceasing uterotonic agents or giving a short-acting uterine relaxation agent (eg, terbutaline) might precede an emergent delivery. With a sinusoidal pattern lasting more than 30 minutes, there are no resuscitative measures that can provide intrapartum fetal benefit, so moving toward an operative delivery expeditiously is the best approach. In general, owing to the concerning nature of a category III FHR tracing, immediate intrauterine resuscitation efforts should be initiated. If the tracing remains category III after interventions, the clinician should proceed with expeditious delivery, whether vaginally (including operative vaginal delivery if appropriate) or by cesarean.

ACOG suggests treating uterine tachysystole that is associated with category III or category II fetal heart rate tracings with high-risk features, and persists despite pausing oxytocin, with a rapid-acting uterine relaxation agent. **(CONDITIONAL RECOMMENDATION, MODERATE-QUALITY EVIDENCE)**

In the setting of a category II or III FHR tracing, when FHR changes are associated with uterine tachysystole,

reduction or cessation of augmentation or induction agents (eg, oxytocin) is an appropriate intervention to improve placental perfusion and increase time between contractions for normal fetal gas exchange to occur (43). The administration of a rapid-acting uterine relaxation agent is a reasonable next step when reduction or cessation of augmentation agents does not sufficiently improve uterine tachysystole and associated FHR changes (44). As with all intrapartum interpretation and management of EFM, it is important for clinicians to comprehensively assess the individual patient's clinical status and labor progress, because expedited vaginal delivery with or without operative assistance may be more appropriate than administering a tocolytic. Though data examining when augmentation or induction agents can be restarted or increased safely are limited, it is reasonable to consider this once a reassuring FHR tracing has returned and uterine tachysystole has resolved.

Adjunct Modalities for Interpretation of Fetal Heart Rate Monitoring

ACOG recommends against the routine use of ST-segment analysis (STAN) for interpretation and management of the fetal heart rate in labor. **(STRONG RECOMMENDATION, HIGH-QUALITY EVIDENCE)**

With acute changes in fetal oxygenation, FHR decelerations occur, but it is unclear how many decelerations need to occur and for how long before fetal acidemia and subsequent fetal neurologic injury develops. Longstanding evidence suggested that changes to fetal ECG occurred with the development of fetal acidemia, particularly ST-segment elevation and increased T-wave amplitude. Based on these pathophysiologic changes, fetal ECG analysis was developed for clinical use to report out these changes through ST-segment analysis (STAN). In 1993, a trial in England randomized 2,434 patients to either STAN plus EFM for FHR management decisions or standard care (ie, EFM alone). They found a statistical trend (P=.09) indicating a reduction in metabolic acidemia, along with a 46% reduction in operative deliveries (P=.001) (45). In 2001, a prospective, randomized trial in Sweden of 4,966 patients demonstrated a reduction in metabolic acidemia in neonates as well as a reduction in operative deliveries for fetal indications (46). The 2003 Cochrane systematic review consistently demonstrated reductions in neonatal acidemia and lower rates of operative deliveries (47). This prior work, predominantly from Europe, led the Maternal-Fetal Medicine Units Network to conduct a randomized clinical trial comparing STAN with usual FHR monitoring (48). This trial randomized 11,108 women to "open" or "masked" monitoring. The open mode displayed the additional information used for detecting and interpreting uncertain FHR patterns as well as specific protocols related to the STAN FHR findings, whereas the masked monitoring was consistent with usual FHR monitoring. The study's primary outcome was a composite of intrapartum fetal death, neonatal death, 5-minute Apgar score 3 or lower, neonatal seizure, umbilical-artery blood pH 7.05 or less with a base deficit of 12 mmol/L or more, intubation for ventilation at delivery, or neonatal encephalopathy. In the open group, 0.9% of the neonates experienced the primary outcome, compared with 0.7% of the neonates in the masked group (RR 1.31, 95% CI, 0.87–1.98; P=.20). The subsequent Cochrane review and an additional meta-analysis did not find statistically significant results for the use of STAN to change neonatal metabolic acidemia, neonatal encephalopathy, or cesarean delivery rates (49, 50). Thus, there is inadequate evidence to support the routine use of STAN for patients in labor.

ACOG recommends against the routine use of intrapartum fetal pulse oximetry for the assessment of fetal status. **(STRONG RECOMMENDATION, MODERATE-QUALITY EVIDENCE)**

During variable and late FHR decelerations, there is some degree of fetal hypoxia. How long that hypoxia lasts and whether there are baseline changes in fetal hypoxia that lead to fetal or neonatal injury remain challenging to ascertain. Furthermore, with the introduction of continuous FHR monitoring, the rates of cesarean delivery rapidly increased; thus, a more specific measure of fetal compromise was needed (51). One potential fetal-assessment approach was to measure fetal oxygenation with a fetal pulse oximeter (52). Studies in the 1990s established an association of fetal O_2 saturation less than 30% for a prolonged time with the development of fetal or neonatal acidemia (53–55).

In a trial that randomized 1,010 patients to the use of fetal pulse oximetry plus EFM monitoring compared with EFM monitoring alone, there was no difference in cesarean delivery rates between the two groups (study group: 29% vs control group: 26%; P=.49). Although there was a reduction in the rate of cesarean deliveries performed for nonreassuring fetal status (study group: 4.5% vs control group: 10.2%; P=.007), there was a higher rate of cesarean delivery for labor dystocia in the control group. Otherwise, there were no significant differences in maternal or neonatal outcomes (56). This finding of FHR decelerations being associated with labor dystocia was documented subsequently in a prospective study (57).

The largest randomized trial of fetal pulse oximetry was conducted by the Maternal-Fetal Medicine Units Network and randomized 5,341 nulliparous women at term and in early labor to open compared with masked use of the fetal pulse oximeter (58). There were no differences in the rates of cesarean delivery in the two groups (open: 26.3% vs

masked: 27.5%; *P*=.31), including no differences in the rates of cesarean delivery for either nonreassuring FHR or dystocia, and no difference in neonatal outcomes. In the most recent Cochrane systematic review of fetal pulse oximetry, which summarized seven trials, there was no difference in the rate of cesarean delivery (summary risk ratio using random-effects, 0.99, 95% CI, 0.86–1.13, four studies, N=4,008) or neonatal outcomes (59). An additional recent systematic review also found no difference overall in either neonatal acidemia or cesarean delivery (60). It is important to note that a subgroup analysis that excluded two studies (ie, the Maternal-Fetal Medicine Units Network trial (58), because of a lack of protocol to manage the timing of delivery for an abnormal fetal oxygen saturation; and another, smaller trial for comparing fetal pulse oximetry with FHR and fetal ECG monitoring rather than fetal pulse oximetry with FHR monitoring against FHR monitoring alone with or without the use of fetal blood sampling) found a reduction in cesarean delivery rates (odds ratio 0.61, 95% CI, 0.39–0.96) associated with fetal oxygen saturation monitoring among the other studies (60). Thus, although the data do not support routine use of fetal pulse oximetry, additional studies, particularly around protocols for how to manage abnormal fetal oxygen saturation values, may be beneficial.

ACOG recommends against primary reliance on computerized approaches for the interpretation and management of the fetal heart rate in labor. **(STRONG RECOMMENDATION, MODERATE-QUALITY EVIDENCE)**

Despite findings from one of the earliest randomized trials that the use of continuous FHR monitoring reduced the risk of neonatal seizures (61), there is not consistent evidence that the use of FHR monitoring has reduced the risk of long-term neurologic injury (62). One concern is that human error and inconsistency in usual practice lead to missed opportunities to improve fetal and neonatal outcomes. An approach that might minimize such issues is the use of computer-based interpretation that helps guide clinicians. There have been studies examining the use of artificial intelligence (AI) to create approaches to interpreting the FHR and to better predict fetal acidemia. For example, in one study, a deep-learning algorithm was associated with fetal acidemia, but, for an umbilical artery pH less than 7.05, sensitivity was 79% and specificity was 78%, meaning that 22% of patients would need preventive deliveries but more than 20% of cases of fetal acidemia would still be missed (63). In a systematic review and meta-analysis of data from more than 55,000 patients, use of AI in the interpretation of intrapartum FHR did not change the incidence of neonatal acidosis (64). Thus, these approaches are still inadequate to independently guide clinical care.

In INFANT (Computerised Interpretation of Fetal Heart Rate During Labour), a large, randomized trial of a computer-based approach conducted in the United-Kingdom, patients gave consent and were and randomized to continuous FHR monitoring with and without the support of the INFANT software (65). The underlying premise of the study was that better identification of concerning FHR patterns being brought to the attention of the obstetrician or midwife would lead to a reduction in neonatal compromise. Data from 46,042 women and their neonates in the trial were analyzed. There were no differences in the primary composite outcome of stillbirth, neonatal death, moderate or severe neonatal encephalopathy, or admission to the neonatal intensive care unit with evidence of mild perinatal asphyxia; 0.7% of neonates experiencing the composite outcome in each arm of the trial. Additionally, more than 6,000 neonates were followed to 2 years of life, and there was no difference in long-term neurologic outcomes at that timepoint either. Of note, of the neonates with an adverse outcome and metabolic acidosis at birth, expert review identified similar opportunities for improved care in 38% of cases overall (40% in the decision-support group, 36% in the control group). This study suggests that clinical outcomes may not improve based on identification of FHR problems alone.

At this time, there are no clinical trials that support the notion that computer-based FHR interpretation improves neonatal outcomes, nor are there case–control or cohort studies that have AI approaches that appear to improve the prediction of FHR monitoring for fetal hypoxia or acidemia.

CONCLUSION

Despite being available for more than four decades, the evidence supporting the optimal approaches to interpretation and management of intrapartum FHR tracings remains inadequate. The current three-category classification system has clear limitations, particularly in the need for better refinement of category II FHR tracings. Five-tier classification systems have been proposed; however, data supporting their effectiveness are also limited. Although adjunctive tools have been developed to enhance FHR assessment and interpretation, none have been shown to improve perinatal outcomes. There is a critical need for large, prospective studies on FHR assessment and management strategies to provide clearer guidance and improve the care of pregnant patients during labor.

Use of Language

ACOG recognizes and supports the gender diversity of all patients who seek obstetric and gynecologic care. In original portions of this document, the authors seek to

use gender-inclusive language or gender-neutral language. When describing research findings, this document uses gender terminology reported by the investigators. ACOG's policy on inclusive language can be reviewed at https://www.acog.org/clinical-information/policy-and-position-statements/statements-of-policy/2022/inclusive-language.

REFERENCES

1. Goodlin RC. History of fetal monitoring. Am J Obstet Gynecol 1979;133:323–52. doi: 10.1016/0002-9378(79)90688-4
2. Chen H, Chauhan SP, Ananth CV, Vintzileos AM, Abuhamad AZ. Electronic fetal heart rate monitoring and its relationship to neonatal and infant mortality in the United States. Am J Obstet Gynecol 2011;204:491.e1–10. doi: 10.1016/j.ajog.2011.04.024
3. Ananth CV, Chauhan SP, Chen H, D'Alton ME, Vintzileos AM. Electronic fetal monitoring in the United States: temporal trends and adverse perinatal outcomes. Obstet Gynecol 2013;121: 927–33. doi: 10.1097/AOG.0b013e318289510d
4. Boyle A, Reddy UM, Landy HJ, Huang C, Driggers RW, Laughon SK. Primary cesarean delivery in the United States. Obstet Gynecol 2013;122:33–40. doi: 10.1097/AOG.0b013e3182952242
5. Yee LM, Costantine MM, Rice MM, Bailit J, Reddy UM, Wapner RJ, et al. Racial and ethnic differences in utilization of labor management strategies intended to reduce cesarean delivery rates. *Eunice Kennedy Shriver* National Institute of Child Health and Human Development (NICHD) Maternal-Fetal Medicine Units (MFMU) Network. Obstet Gynecol 2017;130:1285–94. doi: 10.1097/AOG.0000000000002343
6. Fishel Bartal M, Chen H, Mendez-Figueroa H, Wagner SM, Chauhan SS. Racial and ethnic disparities in primary cesarean birth and adverse outcomes among low-risk nulliparous people [published erratum appears in Obstet Gynecol 2023;141:228]. Obstet Gynecol 2022;140:842–52. doi: 10.1097/AOG.0000000000004953
7. Williams A, Little SE, Bryant AS, Smith NA. Mode of delivery and unplanned cesarean: differences in rates and indication by race, ethnicity, and sociodemographic characteristics. Am J Perinatol 2024;41:834–41. doi: 10.1055/a-1785-8843
8. Getahun D, Strickland D, Lawrence JM, Fassett MJ, Koebnick C, Jacobsen SJ. Racial and ethnic disparities in the trends in primary cesarean delivery based on indications. Am J Obstet Gynecol 2009;201:422.e1–7. doi: 10.1016/j.ajog.2009.07.062
9. Stark EL, Grobman WA, Miller ES. The association between maternal race and ethnicity and risk factors for primary cesarean delivery in nulliparous women. Am J Perinatol 2021;38: 350–6. doi: 10.1055/s-0039-1697587
10. Carlson NS, Carlson MS, Erickson EN, Higgins M, Britt AJ, Amore AD. Disparities by race/ethnicity in unplanned cesarean birth among healthy nulliparas: a secondary analysis of the nuMoM2b dataset. BMC Pregnancy Childbirth 2023;23:342–6. doi: 10.1186/s12884-023-05667-6
11. Langen E, Bourdeau A, Ems J, Wilson-Powers E, Low LK. Unplanned cesarean for abnormal or indeterminate fetal heart tracing varies significantly by race and ethnicity. J Midwifery Womens Health 2025;70:279–91. doi: 10.1111/jmwh.13720
12. Clinical practice guideline methodology. American College of Obstetricians and Gynecologists. Obstet Gynecol 2021;138: 518–22. doi: 10.1097/AOG.0000000000004519
13. United Nations Development Programme. Human Development Index (HDI). Accessed July 3, 2025. https://hdr.undp.org/data-center/human-development-index#/indicies/HDI
14. Guyatt GH, Oxman AD, Vist GE, Kunz R, Falck-Ytter Y, Alonso-Coello P, et al. GRADE: an emerging consensus on rating quality of evidence and strength of recommendations. GRADE Working Group. BMJ 2008;336:924–6. doi: 10.1136/bmj.39489.470347.AD
15. Guyatt G, Oxman AD, Akl EA, Kunz R, Vist G, Brozek J, et al. GRADE guidelines: 1. Introduction-GRADE evidence profiles and summary of findings tables. J Clin Epidemiol 2011;64: 383–94. doi: 10.1016/j.jclinepi.2010.04.026
16. American College of Obstetricians and Gynecologists. Neonatal encephalopathy and neurologic outcome. American College of Obstetricians and Gynecologists; 2019.
17. Low JA, Pickersgill H, Killen H, Derrick EJ. The prediction and prevention of intrapartum fetal asphyxia in term pregnancies. Am J Obstet Gynecol 2001;184:724–30. doi: 10.1067/mob.2001.111720
18. Alfirevic Z, Gyte GM, Cuthbert A, Devane D. Continuous cardiotocography (CTG) as a form of electronic fetal monitoring (EFM) for fetal assessment during labour. The Cochrane Database of Systematic Reviews 2017;2:CD006066. doi: 10.1002/14651858.CD006066.pub3
19. Al Wattar BH, Honess E, Bunnewell S, Welton NJ, Quenby S, Khan KS, et al. Effectiveness of intrapartum fetal surveillance to improve maternal and neonatal outcomes: a systematic review and network meta-analysis. CMAJ 2021;193:E468–77. doi: 10.1503/cmaj.202538
20. Indications for outpatient antenatal fetal surveillance. ACOG Committee Opinion No. 828. American College of Obstetricians and Gynecologists. Obstet Gynecol 2021;137:e177–97. doi: 10.1097/AOG.0000000000004407
21. Intermittent auscultation for intrapartum fetal heart rate surveillance: American College of Nurse-Midwives [published erratum appears in J Midwifery Womens Health 2016;61:134]. J Midwifery Womens Health 2015;60:626–32. doi: 10.1111/jmwh.12372
22. Fetal heart monitoring. Association of Women's Health, Obstetric and Neonatal Nurses. J Obstet Gynecol Neonatal Nurs 2024;53:e5–9. doi: 10.1016/j.jogn.2024.03.001
23. Standards for professional registered nurse staffing for perinatal units. Association of Women's Health, Obstetric and Neonatal Nurses. J Obstet Gynecol Neonatal Nurs 2022;51:e5–98. doi: 10.1016/j.jogn.2022.02.003
24. Macones GA, Hankins GD, Spong CY, Hauth J, Moore T. The 2008 National Institute of Child Health and Human Development workshop report on electronic fetal monitoring: update on definitions, interpretation, and research guidelines. Obstet Gynecol 2008;112:661–6. doi: 10.1097/AOG.0b013e3181841395
25. Zullo F, Di Mascio D, Raghuraman N, Wagner S, Brunelli R, Giancotti A, et al. Three-tiered fetal heart rate interpretation system and adverse neonatal and maternal outcomes: a systematic review and meta-analysis. Am J Obstet Gynecol 2023; 229:377–87. doi: 10.1016/j.ajog.2023.04.008
26. Blackwell SC, Grobman WA, Antoniewicz L, Hutchinson M, Gyamfi Bannerman C. Interobserver and intraobserver reliability of the NICHD 3-Tier Fetal Heart Rate Interpretation System.

Am J Obstet Gynecol 2011;205:378.e1–5. doi: 10.1016/j.ajog.2011.06.086

27. Parer JT, Ikeda T. A framework for standardized management of intrapartum fetal heart rate patterns. Am J Obstet Gynecol 2007;197:26.e1–6. doi: 10.1016/j.ajog.2007.03.037

28. Coletta J, Murphy E, Rubeo Z, Gyamfi-Bannerman C. The 5-tier system of assessing fetal heart rate tracings is superior to the 3-tier system in identifying fetal acidemia [published erratum appears in Am J Obstet Gynecol 2012;207:513]. Am J Obstet Gynecol 2012;206:226.e1–5. doi: 10.1016/j.ajog.2011.12.014

29. Gyamfi Bannerman C, Grobman WA, Antoniewicz L, Hutchinson M, Blackwell S. Assessment of the concordance among 2-tier, 3-tier, and 5-tier fetal heart rate classification systems. Am J Obstet Gynecol 2011;205:288.e1–4. doi: 10.1016/j.ajog.2011.06.065

30. Kawakita T, Reddy UM, Landy HJ, Iqbal SN, Huang C, Grantz KL. Neonatal complications associated with use of fetal scalp electrode: a retrospective study. BJOG 2016;123:1797–803. doi: 10.1111/1471-0528.13817

31. Nurani R, Chandraharan E, Lowe V, Ugwumadu A, Arulkumaran S. Misidentification of maternal heart rate as fetal on cardiotocography during the second stage of labor: the role of the fetal electrocardiograph. Acta Obstet Gynecol Scand 2012;91:1428–32. doi: 10.1111/j.1600-0412.2012.01511.x

32. Hernandez Engelhart C, Gundro Brurberg K, Aanstad KJ, Pay AS, Kaasen A, Blix E, et al. Reliability and agreement in intrapartum fetal heart rate monitoring interpretation: a systematic review. Acta Obstet Gynecol Scand 2023;102:970–85. doi: 10.1111/aogs.14591

33. Triebwasser JE, Colvin R, Macones GA, Cahill AG. Nonreassuring fetal status in the second stage of labor: fetal monitoring features and association with neonatal outcomes. Am J Perinatol 2016;33:665–70. doi: 10.1055/s-0036-1571316

34. Althaus JE, Petersen SM, Fox HE, Holcroft CJ, Graham EM. Can electronic fetal monitoring identify preterm neonates with cerebral white matter injury? Obstet Gynecol 2005;105:458–65. doi: 10.1097/01.AOG.0000152383.27220.26

35. Rimsza RR, Frolova AI, Kelly JC, Carter EB, Cahill AG, Raghuraman N. Intrapartum electronic fetal monitoring features associated with a clinical diagnosis of nonreassuring fetal status. Am J Obstet Gynecol MFM 2023;5:101068. doi: 10.1016/j.ajogmf.2023.101068

36. Clark SL, Hamilton EF, Garite TJ, Timmins A, Warrick PA, Smith S. The limits of electronic fetal heart rate monitoring in the prevention of neonatal metabolic acidemia. Am J Obstet Gynecol 2017;216:163.e1–6. doi: 10.1016/j.ajog.2016.10.009

37. Murphy DJ, Devane D, Molloy E, Shahabuddin Y. Fetal scalp stimulation for assessing fetal well-being during labour. The Cochrane Database of Systematic Reviews 2023, Issue 1. Art. No.: CD013808. doi: 10.1002/14651858.CD013808.pub2

38. Dellinger EH, Boehm FH, Crane MM. Electronic fetal heart rate monitoring: early neonatal outcomes associated with normal rate, fetal stress, and fetal distress. Am J Obstet Gynecol 2000;182:214–20. doi: 10.1016/s0002-9378(00)70515-1

39. Bullens LM, van Runnard Heimel PJ, van der Hout-van der Jagt MB, Oei SG. Interventions for intrauterine resuscitation in suspected fetal distress during term labor: a systematic review. Obstet Gynecol Surv 2015;70:524–39. doi: 10.1097/OGX.0000000000000215

40. Reddy UM, Weiner SJ, Saade GR, Varner MW, Blackwell SC, Thorp JM, et al. Intrapartum resuscitation interventions for category II fetal heart rate tracings and improvement to category I. *Eunice Kennedy Shriver* National Institute of Child Health and Human Development (NICHD) Maternal-Fetal Medicine Units (MFMU) Network. Obstet Gynecol 2021;138:409–16. doi: 10.1097/AOG.0000000000004508

41. Clark SL, Nageotte MP, Garite TJ, Freeman RK, Miller DA, Simpson KR, et al. Intrapartum management of category II fetal heart rate tracings: towards standardization of care. Am J Obstet Gynecol 2013;209:89–97. doi: 10.1016/j.ajog.2013.04.030

42. Raghuraman N, Temming LA, Doering MM, Stoll CR, Palanisamy A, Stout MJ, et al. Maternal oxygen supplementation compared with room air for intrauterine resuscitation: a systematic review and meta-analysis. JAMA Pediatr 2021;175:368–76. doi: 10.1001/jamapediatrics.2020.5351

43. Simpson KR, James DC. Effects of oxytocin-induced uterine hyperstimulation during labor on fetal oxygen status and fetal heart rate patterns. Am J Obstet Gynecol 2008;199:34.e1–5. doi: 10.1016/j.ajog.2007.12.015

44. Xodo S, de Heus R, Berghella V, Londero AP. Acute tocolysis for intrapartum nonreassuring fetal status: how often does it prevent cesarean delivery? A systematic review and meta-analysis of randomized controlled trials. Am J Obstet Gynecol MFM 2022;4:100639. doi: 10.1016/j.ajogmf.2022.100639

45. Westgate J, Harris M, Curnow JS, Greene KR. Plymouth randomized trial of cardiotocogram only versus ST waveform plus cardiotocogram for intrapartum monitoring in 2400 cases. Am J Obstet Gynecol 1993;169:1151–60. doi: 10.1016/0002-9378(93)90273-I

46. Amer-Wåhlin I, Hellsten C, Norén H, Hagberg H, Herbst A, Kjellmer I, et al. Cardiotocography only versus cardiotocography plus ST analysis of fetal electrocardiogram for intrapartum fetal monitoring: a Swedish randomised controlled trial. Lancet 2001;358:534–8. doi: 10.1016/s0140-6736(01)05703-8

47. Neilson JP. Fetal electrocardiogram (ECG) for fetal monitoring during labour. The Cochrane Database of Systematic Reviews 2003;2:CD000116. doi: 10.1002/14651858.CD000116

48. Belfort MA, Saade GR, Thom E, Blackwell SC, Reddy UM, Thorp JM Jr, et al. A randomized trial of intrapartum fetal ECG ST-segment analysis. *Eunice Kennedy Shriver* National Institute of Child Health and Human Development Maternal–Fetal Medicine Units Network. N Engl J Med 2015;373:632–41. doi: 10.1056/NEJMoa1500600

49. Neilson JP. Fetal electrocardiogram (ECG) for fetal monitoring during labour. The Cochrane Database of Systematic Reviews 2015;12:CD000116. doi: 10.1002/14651858.CD000116.pub5

50. Saccone G, Schuit E, Amer-Wåhlin I, Xodo S, Berghella V. Electrocardiogram ST analysis during labor: a systematic review and meta-analysis of randomized controlled trials. Obstet Gynecol 2016;127:127–35. doi: 10.1097/AOG.0000000000001198

51. Dildy GA, Clark SL, Loucks CA. Intrapartum fetal pulse oximetry: past, present, and future. Am J Obstet Gynecol 1996;175:1–9. doi: 10.1016/s0002-9378(96)70242-9

52. Johnson N, Johnson VA. Continuous fetal monitoring with a pulse oximeter: a case of cord compression. Am J Obstet Gynecol 1989;161:1295–6. doi: 10.1016/0002-9378(89)90686-8

53. Seelbach-Göbel B, Heupel M, Kühnert M, Butterwegge M. The prediction of fetal acidosis by means of intrapartum fetal pulse oximetry. Am J Obstet Gynecol 1999;180:73–81. doi: 10.1016/s0002-9378(99)70153-5

54. Bloom SL, Swindle RG, McIntire DD, Leveno KJ. Fetal pulse oximetry: duration of desaturation and intrapartum outcome. Obstet Gynecol 1999;93:1036–40. doi: 10.1016/s0029-7844(98)00565-1

55. Gorenberg DM, Pattillo C, Hendi P, Rumney PJ, Garite TJ. Fetal pulse oximetry: correlation between oxygen desaturation, duration, and frequency and neonatal outcomes. Am J Obstet Gynecol 2003;189:136–8. doi: 10.1067/mob.2003.307

56. Garite TJ, Dildy GA, McNamara H, Nageotte MP, Boehm FH, Dellinger EH, et al. A multicenter controlled trial of fetal pulse oximetry in the intrapartum management of nonreassuring fetal heart rate patterns. Am J Obstet Gynecol 2000;183:1049–58. doi: 10.1067/mob.2000.110632

57. Porreco RP, Boehm FH, Dildy GA, Miller HS, Wickstrom EA, Garite TJ, et al. Dystocia in nulliparous patients monitored with fetal pulse oximetry. Am J Obstet Gynecol 2004;190:113–7. doi: 10.1016/s0002-9378(03)00855-x

58. Bloom SL, Spong CY, Thom E, Varner MW, Rouse DJ, Weininger S, et al. Fetal pulse oximetry and cesarean delivery. National Institute of Child Health and Human Development Maternal-Fetal Medicine Units Network. N Engl J Med 2006; 355:2195–202. doi: 10.1056/NEJMoa061170

59. East CE, Begg L, Colditz PB, Lau R. Fetal pulse oximetry for fetal assessment in labour. The Cochrane Database of Systematic Reviews 2014, Issue 10. Art. No.: CD004075. doi: 10.1002/14651858.CD004075.pub4

60. Mitchell JM, Walsh S, O'Byrne LJ, Conrick V, Burke R, Khashan AS, et al. Association between intrapartum fetal pulse oximetry and adverse perinatal and long-term outcomes: a systematic review and meta-analysis. Int J Gynaecol Obstet 2025:1-10. doi: 10.1002/ijgo.70242

61. MacDonald D, Grant A, Sheridan-Pereira M, Boylan P, Chalmers I. The Dublin randomized controlled trial of intrapartum fetal heart rate monitoring. Am J Obstet Gynecol 1985;152:524–39. doi: 10.1016/0002-9378(85)90619-2

62. Grant A, O'Brien N, Joy MT, Hennessy E, MacDonald D. Cerebral palsy among children born during the Dublin randomised trial of intrapartum monitoring. Lancet 1989;2:1233–6. doi: 10.1016/s0140-6736(89)91848-5

63. McCoy JA, Levine LD, Wan G, Chivers C, Teel J, La Cava WG. Intrapartum electronic fetal heart rate monitoring to predict acidemia at birth with the use of deep learning. Am J Obstet Gynecol 2025;232:116.e1–9. doi: 10.1016/j.ajog.2024.04.022

64. Balayla J, Shrem G. Use of artificial intelligence (AI) in the interpretation of intrapartum fetal heart rate (FHR) tracings: a systematic review and meta-analysis. Arch Gynecol Obstet 2019;300:7–14. doi: 10.1007/s00404-019-05151-7

65. Computerised interpretation of fetal heart rate during labour (INFANT): a randomised controlled trial. INFANT Collaborative Group. Lancet 2017;389:1719–29. doi: 10.1016/S0140-6736(17)30568-8

Appendices

Supplemental Digital Content

A. Literature search strategy: available online at http://links.lww.com/AOG/E272

B. PRISMA diagram: available online at http://links.lww.com/AOG/E273

C. Evidence tables: available online at http://links.lww.com/AOG/E274

D. Five-tier FHR interpretation system: available online at http://links.lww.com/AOG/E275

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