A Review of the Proceedings from the 2008 NICHD Workshop on Standardized Nomenclature for Cardiotocography

Update on Definitions, Interpretative Systems With Management Strategies, and Research Priorities in Relation to Intrapartum Electronic Fetal Monitoring

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Despite evidence demonstrating no neonatal benefit, the medicolegal climate in the United States requires obstetricians to integrate continuous intrapartum surveillance into their care of the pregnant laboring patient. The intent of this article is to familiarize the reader with the most recent, standardized, quantitative nomenclature recommended to describe intrapartum CTG in order to reduce miscommunication among providers caring for the laboring patient, propagate consistent, evidence-based responses to CTG patterns, and systematize the terminology used by researchers investigating intrapartum CTG.


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Key words: Intrapartum cardiotocography • Electronic fetal monitoring • NICHD nomenclature
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1.30–2.13 and RR 1.16; 95% CI, 1.01–1.32, respectively).

Despite compelling evidence demonstrating no neonatal benefit, the medicolegal climate in the United States requires obstetricians to integrate continuous intrapartum surveillance into their care of the pregnant laboring patient. Due to the setup of labor and delivery units and the team-oriented approach that exists in most facilities, nurses, residents, nurse midwives, and physicians may all be regularly involved in assessing the CTG. To communicate effectively in the event that an abnormal CTG exists and invoke an appropriate level of concern, standardized terminology is necessary.14

In 1997, the National Institutes of Child Health and Human Development (NICHD) sponsored a Research Planning Workshop that addressed this issue. The workshop’s express purpose was to develop “a standardized and rigorously, unambiguously described set of definitions that can be quantitated” for electronic fetal heart monitoring, with the ultimate goal of producing a common language that would facilitate further investigational research examining the predictive value of electronic fetal monitoring and management strategies to recognize and reduce intrapartum fetal compromise.5 The American College of Obstetricians and Gynecologists (ACOG); the Association of Women’s Health, Obstetric and Neonatal Nurses; the Royal College of Obstetricians and Gynaecologists; and the Society of Obstetricians and Gynaecologists of Canada not only endorsed the definitions, but recommended new interpretations, definitive systems, and recommended management strategies, as set forth by the recent 2008 joint workshop, is also included and reviewed in detail.

Fundamental Principles When Using NICHD Terminology

A set of overarching operational principles was outlined prior to presenting the actual definitions of terms integral to the interpretation of cardiotocography. The most germane principles are:

• Although the development of computerized interpretation programs is underway, the definitions are to be used for visual interpretation of CTG.
• The definitions apply to patterns produced from either an external Doppler ultrasound device or a direct transcervical fetal electrocardiogram.
• The documentation of both CTG and tocodynamometry should be of adequate quality for visual interpretation.
• The chief emphasis is on intrapartum patterns, although the definitions are applicable to antepartum observations.
• The patterns to be defined are categorized as either baseline, periodic, or episodic. Periodic patterns are associated with contractions, whereas episodic patterns are independent of uterine contractions.
• Periodic patterns are distinguished based on waveform, with accelerations or decelerations defined as abrupt versus gradual onset in relation to the adjacent baseline CTG.
• No differentiation is made between short-term variability (or beat-to-beat variability or R-R wave period differences in the electrocardiogram) and long-term variability because in practice, they are visually determined as a unit. The definition of variability is based visually on
the amplitude of the complexes, with exclusion of the regular, smooth sinusoidal pattern.

- CTG patterns are gestational age-dependent and can differ based on fetal physiologic status and maternal physiologic status, making each of these critical interpretive factors in the evaluation of a CTG pattern. Maternal medical status, prior fetal assessments, use of medications, and other factors also warrant consideration.

- The individual components of CTG that are defined do not occur in isolation and generally evolve over time. A full description of a CTG requires a qualitative and quantitative description of uterine contractions, baseline fetal heart rate, baseline CTG variability, presence of accelerations, periodic or episodic decelerations, and changes or trends of CTG patterns over time.

Uterine Contractions

The number of contractions present in a 10-minute window, averaged over 30 minutes, is the manner by which uterine contractions are quantified. When assessing uterine activity, equal importance should be given to contraction frequency, duration, intensity, and relaxation time between contractions. Normal uterine contractions are 5 contractions or less in 10 minutes, averaged over a 30-minute window. Tachysystole is defined as more than 5 contractions in 10 minutes, averaged over a 30-minute window. When using the term tachysystole, several key points should be kept in mind, including: (1) the presence or absence of associated CTG decelerations and decelerations and periods of marked variability (> 25 beats/min).

In any given 10-minute window, the minimum baseline duration must be at least 2 minutes (not necessarily contiguous), or else the baseline is considered indeterminate. In cases where the baseline is indeterminate, the previous 10-minute window should be reviewed and utilized to determine the baseline.

A normal FHR baseline rate ranges from 110 to 160 beats per minute. If the baseline FHR is less than 110 beats per minute, it is termed bradycardia. If the baseline FHR is more than 160 beats per minute, it is termed tachycardia.

Baseline FHR variability is determined in a 10-minute window and excludes accelerations and decelerations. A sinusoidal fetal heart rate pattern is defined as a visually apparent, smooth, sine-wave-like undulating pattern in FHR baseline with a cycle frequency of 3 to 5 per minute that persists for 20 minutes or more. A sinusoidal fetal heart rate pattern is incompatible with the definition of variability.

Variability is defined as fluctuations in the FHR baseline with irregular amplitude and inconstant frequency. These fluctuations are visually quantitated as the amplitude of the peak to trough in beats per minute, shown in Table 1.

Based on visual assessment, an acceleration is defined as an apparent abrupt increase in FHR above baseline, with the time from the onset of the acceleration to its acme less than 30 seconds. The increase is measured from the most recently determined portion of the baseline. The peak is 15 beats per minute or more above the baseline, and the acceleration lasts 15 seconds or more, but less than 2 minutes from the onset to the return to the previously determined baseline. In pregnancies of fewer than 32 weeks of gestation, accelerations are defined as having a peak 10 beats per minute or more above the baseline and duration of 10 seconds or longer.

Prolonged acceleration is 2 minutes or longer and less than 10 minutes in duration, with any acceleration...
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last 10 minutes or longer constituting a change in baseline.

FHR decelerations are classified as late, early, or variable. The characteristics of each type of deceleration are described in the following paragraphs.

Based on visual assessment, late deceleration is defined as an apparent gradual decrease and return to the baseline FHR in association with a uterine contraction, with the time from onset of the deceleration to its nadir as 30 seconds or longer. The decrease is typically symmetrical in shape and is measured from the most recently determined portion of the baseline to the nadir of the deceleration. The deceleration’s timing is delayed, with the nadir of the deceleration occurring after the peak of the uterine contraction. In general, the onset, nadir, and recovery of a late deceleration occur after the beginning, acme, and end of the associated contraction, respectively.

Based on visual assessment, early deceleration is defined as an apparent gradual decrease and return to the baseline FHR in association with a uterine contraction, with the time from onset of the deceleration to its nadir as 30 seconds or longer. The decrease is typically symmetrical in shape and is measured from the most recently determined portion of the baseline to the nadir of the deceleration. Early decelerations are coincident in timing with uterine contractions, with the nadir of the deceleration occurring simultaneously with the peak of the uterine contraction. In general, the onset, nadir, and recovery of a late deceleration occur in a coincident fashion with the beginning, acme, and end of the associated contraction, respectively.

Based on visual assessment, variable deceleration is defined as an apparent abrupt decrease in FHR below the baseline, with the time from the onset of the deceleration to the nadir of the deceleration as fewer than 30 seconds. The decrease is measured from the most recently determined portion of the baseline to the nadir of the deceleration. Variable decelerations may or may not be associated with uterine contractions. The decrease from baseline is 15 beats per minute or greater and lasts 15 seconds or longer, but lasts less than 2 minutes from onset to return to baseline. When variable decelerations occur in conjunction with uterine contractions, their onset, depth, and duration may vary with each successive uterine contraction. Variable decelerations may occur in conjunction with other findings, the clinical significance of which requires further investigational research. Some examples include a slow return of the FHR to the baseline, with the time from the most recently determined portion of the baseline to the nadir of the deceleration as fewer than 30 seconds. The decrease is measured from the most recently determined portion of the baseline to the nadir of the deceleration. Variable decelerations are likewise quantitated.

Although some authors have suggested grading decelerations based on such factors as the depth or absolute nadir in beats per minutes and duration, the predictive value of these grading systems has not been sufficiently established and requires further investigation.

Decelerations are classified as recurrent if they occur with 50% or more of uterine contractions in any 20-minute segment. Decelerations occurring with less than 50% of uterine contractions in any 20-minute segment are defined as intermittent.

Interpretative Systems for Classification of Fetal Heart Rate Patterns

Although many interpretative systems exist for FHR tracings, the selected system must be evidence based, simple, and applicable to clinical practice. As the FHR response is a dynamic process that requires frequent reassessment, categorization of a tracing is limited to the time period being assessed. Over time it is not uncommon for FHR tracings to migrate from one category to another. FHR tracing patterns provide information on the current acid-base status of the fetus and cannot predict the development of cerebral palsy.

Two FHR findings reliably predict the absence of acidaemia: (1) the presence of FHR accelerations, either spontaneous or stimulated, or (2) moderate FHR variability. It must be emphasized, however, that although either fetal accelerations or moderate FHR variability reliably predict the absence of acidaemia, the absence of accelerations, the presence of minimal variability, or the presence of absent variability does not reliably predict the presence of fetal hypoxemia or metabolic acidaemia. The significance
of marked variability (formerly described as saltatory) remains unclear. Although the entire associated clinical circumstances must always be taken into account, the 2008 NICHD workshop has simplified categorization and interpretation of FHR tracings into a 3-tier system, described in Table 2.

### Table 2

#### 3-Tier Fetal Heart Rate Interpretation System

<table>
<thead>
<tr>
<th>Category I</th>
<th>Normal tracings, which are strongly predictive of normal fetal acid-base status at the time of observation and can be followed in a routine manner without any specific action required, include all of the following:</th>
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<tbody>
<tr>
<td>• Baseline rate: 110-160 beats/min</td>
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<tr>
<td>• Moderate variability</td>
<td></td>
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<tr>
<td>• Absence of any late or variable decelerations</td>
<td></td>
</tr>
<tr>
<td>• Early decelerations may or may not be present</td>
<td></td>
</tr>
<tr>
<td>• Accelerations may or may not be present</td>
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</tbody>
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<tr>
<th>Category II</th>
<th>Indeterminate tracings, although not predictive of abnormal fetal acid-base status, cannot be classified as Category I or III and thus require evaluation and continued surveillance and reevaluation. These tracings are not infrequently encountered in clinical care, and include any of the following:</th>
</tr>
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<tbody>
<tr>
<td>• Baseline rate</td>
<td></td>
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<tr>
<td>○ Tachycardia</td>
<td></td>
</tr>
<tr>
<td>○ Bradycardia not accompanied by absent baseline variability</td>
<td></td>
</tr>
<tr>
<td>• Baseline FHR variability</td>
<td></td>
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<tr>
<td>○ Minimal baseline variability</td>
<td></td>
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<tr>
<td>○ Absent baseline variability not accompanied by recurrent decelerations</td>
<td></td>
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<tr>
<td>○ Marked baseline variability</td>
<td></td>
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<tr>
<td>• Absence of induced accelerations after fetal stimulation (eg, scalp stimulation, vibroacoustic stimulation, direct fetal scalp sampling, transabdominal halogen light)</td>
<td></td>
</tr>
<tr>
<td>• Periodic or episodic decelerations</td>
<td></td>
</tr>
<tr>
<td>○ Recurrent variable decelerations accompanied by minimal or moderate baseline variability</td>
<td></td>
</tr>
<tr>
<td>○ Prolonged deceleration ≥2 min but &lt;10 min</td>
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<tr>
<td>○ Recurrent late decelerations with moderate baseline variability</td>
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<tr>
<td>○ Variable decelerations with other characteristics, such as slow return to baseline, “overshoots,” or “shoulders”</td>
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<tr>
<th>Category III</th>
<th>Abnormal tracings, which are predictive of abnormal fetal acid-base status at the time of observation, require prompt evaluation and initiation of expeditious attempts to resolve the abnormal FHR pattern, such as provision of maternal oxygen, change in maternal position, discontinuation of labor stimulation, treatment of maternal hypotension, or additional efforts. These tracings include either:</th>
</tr>
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<tbody>
<tr>
<td>• Absent baseline FHR variability along with any of the following:</td>
<td></td>
</tr>
<tr>
<td>○ Recurrent late decelerations</td>
<td></td>
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<tr>
<td>○ Recurrent variable decelerations</td>
<td></td>
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<tr>
<td>○ Bradycardia</td>
<td></td>
</tr>
<tr>
<td>• Sinusoidal pattern</td>
<td></td>
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FHR, fetal heart rate.
Research Recommendations

CTG is nearly ubiquitous in obstetric practice in the United States, and well-designed studies are needed to fill gaps in knowledge. Areas of highest priority include observational studies focused on indeterminate CTG patterns, including descriptive epidemiology, frequency of specific patterns, changes over time, relationships to clinically relevant outcomes, and the effect of the patterns’ durations (eg, recurrent late decelerations with minimal variability) on clinical outcomes. Additional areas with a paucity of research include the effect of uterine contractile characteristics on clinical outcomes, the effectiveness of CTG educational programs that include all relevant stakeholders, potential comparisons between computerized interpretation and provider interpretation, digitally addressable formatted comprehensive data sets that integrate CTG outcomes, and techniques that may serve to supplement CTG, such as ST segment analysis.

Commentary and Conclusions

Cardiotocography has become an accepted component of most intrapartum monitoring in the United States, despite the lack of demonstrated fetal or neonatal benefit in the literature. In order to continue to safely and consistently apply this technology to the care of obstetrical patients, agreed-upon guidelines for description of CTG patterns, interpretation and categorization of CTG patterns, and appropriate provider responses to CTG patterns must be systematically introduced into practice and adhered to by all members of the obstetrical team. The recent joint workshop on continuous fetal CTG sponsored by the NICHD, ACOG, and SMFM in April 2008 and the resulting update published by Macones and colleagues substantially advanced the cause of clarifying the current, recommended nomenclature and establishing a simple, evidence-based, clinically applicable interpretative system.

Standardization of terminology and subsequent categorization into 1 of 3 tiers should aid providers who are deciding whether the patterns are suggestive of a lack of fetal acidemia or alternately require intervention. Despite numerous studies demonstrating that inter- and intraobserver variability is high when CTG tracings are reviewed, there is consensus that normal tracings classified as Category I indicate an absence of fetal acidemia. On the other hand, acidemia may be present in up to 1 of 4 fetuses with abnormal or Category III CTG tracings. Although expeditious action is indicated to either resolve the concerning aspects of the abnormal tracing or to move towards delivery, due to the low prevalence of intrapartum fetal asphyxia, even abnormal tracings have a well-recognized false-positive rate that in some instances can be greater than 90%. Patients with indeterminate tracings, classified as Category II, may ultimately be the most difficult to manage in clinical practice. A mainstay of the recommended strategy is close, continuous evaluation and assessment. These tracings may ultimately fit criteria for normal, Category I tracings as time passes or after subsequent evaluative strategies, at which point confidence in the nonacademic status of the fetus may be gained. Alternately, indeterminate tracings may ultimately meet the criteria for abnormal, Category III tracings, in which case the imperative to resolve concerning aspects or move expeditiously towards delivery will become clear. Due to the potential uncertainty inherent in these nonpredictive tracings, a call has been issued for investigational research focusing on the relationship between such tracings and clinical outcomes.

This document attempts to familiarize the reader with recently proposed NICHD language in an effort to further advance the cause of utilizing common terminology and employing consistent, evidence-based, and simple interpretative systems among providers who use continuous CTG in their clinical practice. Personal review of the original NICHD workshop document cited below, along with any or all of the additional sources for this article, is strongly encouraged.

Main Points

- Continuous cardiotocography (CTG) is the most commonly performed obstetric procedure in the United States.
- Usage of the standardized terminology developed by the National Institute of Child Health and Human Development (NICHD) to describe intrapartum CTG can help reduce miscommunication among providers caring for the laboring patient and systematize the terminology used by researchers investigating intrapartum CTG.
- Utilization of the recent interpretative systems and corresponding management strategies result in consistent, evidence-based responses to CTG patterns that are normal (Category I), abnormal (Category III), or indeterminate (Category II).
- Personal review of the original NICHD document is strongly encouraged.

References

monitoring (EFM) for fetal assessment during labor.


