

A Review of NICHD Standardized Nomenclature for Cardiotocography: The Importance of Speaking a Common Language When Describing Electronic Fetal Monitoring

Barrett Robinson, MD, MPH

Maternal Fetal Medicine, Northwest Memorial Hospital, Chicago, IL

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 standardized, quantitative nomenclature recommended to describe intrapartum cardiotocography in order to reduce miscommunication among providers caring for the laboring patient.

[Rev Obstet Gynecol. 2008;1(2):56-60]

© 2008 MedReviews, LLC

Key words: Intrapartum cardiotocography • Electronic fetal monitoring • NICHD nomenclature

In 2002, approximately 3.4 million fetuses (85% of approximately 4 million live births) in the United States were assessed with continuous cardiotocography (CTG), making it the most commonly performed obstetric procedure.¹ Although CTG, also known as *electronic fetal monitoring*, is widespread in developed nations, its ability to identify the fetus that may be becoming asphyxiated and therefore may benefit from intervention is limited, and its use has failed to lead to reduced rates of cerebral palsy and neurologic injury. There are no studies

comparing CTG with an absence of intrapartum monitoring, but trials comparing CTG with intermittent auscultation show no reduction in the overall risk of perinatal death (relative risk [RR] 0.85; 95% confidence interval [95% CI], 0.59-1.23) or cerebral palsy (RR 1.74; 95% CI, 0.97-3.11).² What studies have demonstrated is that CTG versus intermittent auscultation leads to higher operative delivery rates by cesarean section or assisted vaginal delivery (RR 1.66; 95% CI, 1.30-2.13 and RR 1.16; 95% CI, 1.01-1.32, respectively).²

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.³ In 1997, the National Institute of Child Health and Human Development (NICHD) sponsored a Research Planning Workshop that addressed this very 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

Fundamental Principles When Using NICHD Terminology

A set of overarching operational principles was outlined prior to presenting the actual definitions of terms inte-

- The 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. Tocodynamometry must be of good quality in order to assess uterine activity.
- Periodic patterns are distinguished based on waveform, defined as abrupt versus gradual onset of the deceleration.
- 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, making this a critical interpretive factor in the evaluation of a CTG pattern. Maternal medical

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.

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.³ In 1997, the National Institute of Child Health and Human Development (NICHD) sponsored a Research Planning Workshop that addressed this very 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.⁴ The intent of this article is to familiarize the reader with the resulting standardized, quantitative nomenclature that is recommended to describe intrapartum CTG in order to reduce miscommunication among providers caring for the laboring patient.

- The definitions are to be used for visual interpretation of CTG.

A full description of a cardiotocography (CTG) requires a qualitative and quantitative description of baseline rate, baseline CTG variability, presence of accelerations, periodic or episodic decelerations, and changes or trends of CTG patterns over time.

- The definitions apply to patterns produced from either an external Doppler ultrasound device or a direct transcervical fetal electrode detecting the fetal electrocardiogram.
- The paper speed parameters are 3 cm per minute for the horizontal axis and 30 beats per minute for the vertical axis. Although the appearance of CTG patterns can differ according to the scale used, the definitions still apply.

- status, prior fetal assessments, use of medications, and other factors may also require 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 baseline rate, baseline CTG variability, presence of accelerations, periodic or episodic decelerations, and

changes or trends of CTG patterns over time.

Definitions of Fetal Heart Rate Patterns⁴

Baseline fetal heart rate is the average fetal heart rate (FHR) rounded to increments of 5 beats per minute during a 10-minute segment, excluding periodic or episodic changes, periods of marked variability, or baseline segments that differ by more than 25 beats per minute.

In any given 10-minute window, the minimum baseline duration must be at least 2 minutes, or else the baseline is considered indeterminate. In cases where the baseline is indeterminate, the previous 10-minute window should be reviewed and utilized in order 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 based on visual assessment and excludes sinusoidal patterns. Variability is defined as fluctuations in the FHR baseline of 2 cycles per minute or greater, with irregular amplitude and inconstant frequency. These fluctuations are visually quantitated as the amplitude of the peak to trough in beats per minute, as shown in Table 1.

The sinusoidal pattern differs from variability in that it demonstrates a smooth, sine wave-like pattern of regular frequency and amplitude and is incompatible with the definition of variability.

By visual assessment, *acceleration* is defined as an apparent abrupt increase in FHR above baseline, with the time from the onset of the acceleration to the acme of less than 30 seconds. The increase is measured from the most recently determined portion

Table 1
Baseline Fetal Heart Rate
Variability Fluctuation
Classification

Amplitude Range	Classification
Undetectable	Absent
Undetectable to ≤ 5 beats/min	Minimal
6 to 25 beats/min	Moderate
> 25 beats/min	Marked

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 lasting 10 minutes or longer constituting a change in baseline.

By visual assessment, *late deceleration* is defined as an apparent gradual decrease and return to 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 measured from the most recently determined portion of the baseline. 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 measured from the most recently determined portion of the baseline. 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.

By 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 less than 30 seconds. The decrease is measured from the most recently determined portion of the baseline. Variable decelerations may or may not be associated with uterine contractions. The decrease from baseline is 15 beats per minute or higher and 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.

Finally, *prolonged deceleration* is defined as an apparent decrease in FHR below the baseline, measured from the most recently determined portion of the baseline. The decrease in the FHR is 15 beats per minute or more and lasts at least 2 minutes but less than 10 minutes from onset to return to baseline. A prolonged deceleration that is sustained for 10 minutes constitutes a change in baseline.

Quantification Guidelines⁴

The quantification of a deceleration is based on the depth of the deceleration's nadir in beats per minute below the baseline, excluding any transient

spikes or electronic artifact. The duration of the deceleration is quantitated in minutes and seconds from the start of the deceleration to the deceleration's end. Accelerations are likewise quantitated.

Decelerations are classified as *recurrent* if they occur with 50% or more of uterine contractions in any 20-minute segment.

Bradycardia and tachycardia are quantitated by the actual FHR in

of 110 to 160 beats per minute, (2) moderate variability, (3) gestational age-appropriate FHR accelerations, and (4) absence of FHR decelerations. When all 4 of these criteria are present, the provider can be reassured that no fetal acidemia is present.^{8,9}

Individual components of the CTG should never be interpreted in isolation, but the presence of FHR accelerations generally assures the provider that no fetal acidemia is present.¹⁰ If

blood pressure measurement, examination of uterus for tetanic contraction, oxygen administration, and fluid bolus should be performed in order to generate a more reassuring CTG. If these or additional efforts are unsuccessful in either reassuring the provider or resolving the concerning aspects of the tracing, consideration should be made to move in a more expedited fashion towards delivery.

Conclusions

Though most studies do not demonstrate clear neonatal benefits from continuous cardiotocography, CTG can be a useful modality when assessing fetal status during labor. Nurses, residents, midwives, and attending physicians caring for women in labor can most effectively utilize CTG if they speak a common language when describing the FHR patterns. The value of a common language is that

Although the NICHD workshop did not address interpretation of fetal heart rate (FHR) patterns, clinicians must determine whether the FHR pattern on the CTG is reassuring or nonreassuring.

beats per minute. Alternately, if the FHR is unstable without a single identifiable rate, visual assessment of the FHR range can be used to quantitate the bradycardia or tachycardia.

Characteristics of Reassuring and Nonreassuring FHR Tracings

Although the NICHD workshop did not address interpretation of FHR patterns, clinicians must determine whether the FHR pattern on the CTG is reassuring or nonreassuring. With a high degree of certainty, a reassuring pattern indicates that there is no fetal acidemia at the time of testing. On the other hand, the nonreassuring pattern is suggestive of potential fetal acidemia, worsening fetal status, and the need for further measures to be taken to reassure the provider of the fetus's health. Due to the low prevalence of intrapartum fetal asphyxia, a nonreassuring tracing has a well-recognized false-positive rate of greater than 90%.⁵

Despite numerous studies having demonstrated that inter- and intraobserver variability is high when CTG tracings are reviewed,^{6,7} there is a common consensus that reassuring FHR patterns include each of the following: (1) a baseline fetal heart rate

accelerations cannot be elicited, then variability should be critically evaluated. Moderate FHR variability is strongly associated (98%) with an umbilical pH higher than 7.15.¹¹ Therefore, in most cases, normal FHR

Interventions such as maternal position change, discontinuation of labor stimulating agents, vaginal examination to assess cervical dilation and possible presence of cord, blood pressure measurement, examination of uterus for tetanic contraction, oxygen administration, and fluid bolus should be performed in order to generate a more reassuring CTG.

variability provides reassurance about fetal status.¹⁰

In the absence of accelerations, either spontaneous or elicited (ie, by techniques such as scalp stimulation, vibroacoustic stimulation, or fetal scalp sampling), a combination of minimal or absent variability with late or variable decelerations typically constitutes a nonreassuring CTG and is the FHR most predictive of acidemia. Acidemia may be present in up to 1 of 4 fetuses with such FHR patterns.¹¹ Interventions such as maternal position change, discontinuation of labor stimulating agents, vaginal examination to assess cervical dilation and possible presence of cord,

everyone involved has the same understanding of the FHR, thereby increasing patient safety by decreasing the risk of miscommunication.

Standardization of terminology when attempting to determine whether FHR patterns are reassuring or nonreassuring aids providers deciding whether the patterns are suggestive of a lack of fetal acidemia or, alternately, require intervention. This article familiarizes the reader with NICHD language in an effort to propagate the utilization of common terminology among providers who use continuous cardiotocography in their clinical practice. Personal review of the original NICHD workshop document (cited

below) and any or all of the additional sources for this article is strongly encouraged. ■

References

1. Martin JA, Hamilton BE, Sutton PD, et al. Births: final data for 2002. *Natl Vital Stat Rep.* 2003; 52(10):1-113.
2. Alfirevic Z, Devane D, Gyte GM. Continuous tocography (CTG) as a form of electronic fetal monitoring (EFM) for fetal assessment during labour. *Cochrane Database Syst Rev.* 2006;3: CD006066.
3. National Certification Corporation. *Applying NICHHD Terminology and Other Factors to Electronic Fetal Monitoring Interpretation.* Chicago: National Certification Corporation; 2006.
4. Electronic fetal heart rate monitoring: research guidelines for interpretation. National Institute of Child Health and Human Development Research Planning Workshop. *Am J Obstet Gynecol.* 1997;177:1385-1390.
5. Acker D. Clinical pearls in application of electronic fetal heart rate monitoring. UpToDate Web site. <http://www.uptodate.com/patients/content/topic.do?print=true&topicKey=labor/14250&view=print>. Accessed June 11, 2008.
6. Helfand M, Marton K, Ueland K. Factors involved in the interpretation of fetal heart monitor tracings. *Am J Obstet Gynecol.* 1985;151:737-744.
7. Nielson PV, Stigsby B, Nickelsen C, Nim J. Intra- and inter-observer variability in the assessment of intrapartum cardiotocograms. *Acta Obstet Gynecol Scand.* 1987;66:421-424.
8. Krebs HB, Petres RE, Dunn LJ, et al. Intrapartum fetal heart rate monitoring. I. Classification and prognosis of fetal heart rate patterns. *Am J Obstet Gynecol.* 1979;133:762.
9. Young BK. Intrapartum fetal heart rate assessment. UpToDate Web site. <http://www.uptodate.com/patients/content/topic.do?print=true&topicKey=antenat/13808&view=print>. Accessed June 11, 2008.
10. American College of Obstetricians and Gynecologists. *Intrapartum Fetal Heart Rate Monitoring.* Washington, DC: American College of Obstetricians and Gynecologists; 2005:1-9. ACOG Practice Bulletin No. 70.
11. Parer JT, King T, Flanders S, et al. Fetal acidemia and electronic fetal heart rate patterns: is there evidence of an association? *J Matern Fetal Neonatal Med.* 2006;19:289-294.

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.
- Standardized terminology also helps determine whether fetal heart rate patterns are reassuring or nonreassuring and aids providers in deciding whether intervention is required.
- Personal review of the original NICHD document is strongly encouraged.