Applying NICHD Terminology and Other Factors to Electronic Fetal Monitoring Interpretation

Purpose of this Monograph

The JCAHO Sentinel Event Alert, “Preventing Infant Death and Injury During Delivery,” issued on July 21, 2004, pinpointed a need to “develop clear guidelines for fetal monitoring of potential high-risk patients including nursing protocols for the interpretation of fetal heart rate tracings” and to “educate nurses, residents, nurse midwives and physicians to use standard terminology to communicate abnormal fetal heart rate tracings.” How to address this need is now resonating among the professional medical and nursing organizations and individual hospitals and health care institutions. In recent professional publications, the use of the NICHD terminology to address these needs is being recommended and being incorporated in educational activities. The first step to address a way to standardize EFM terminology is to educate and to familiarize health care professionals with the NICHD terminology.

This monograph is an effort to address some of these educational needs. The monograph summarizes the NICHD nomenclature as identified in the articles, “Electronic Fetal Heart Rate Monitoring Research Guidelines for Interpretation” from The National Institute of Child Health and Human Development Research Planning Workshop published in the Journal of Obstetric, Gynecologic and Neonatal Nursing (JOGNN), Volume 26, Issue 6, November-December 1997 pages 635-640 and in the American Journal of Obstetrics and Gynecology, December 1997, Volume 177, No. 6, pages 1385-1390. This monograph also addresses related EFM interpretation issues as outlined in the ACOG Practice Bulletin, “Intrapartum Fetal Heart Rate Monitoring,” Number 62, May 2005, pages, 1161-1169.

NCC encourages the reader to obtain the original documents for further review and study.

Why the NICHD Terminology Was Developed

A lack of consensus was identified in the definitions and nomenclature related to fetal heart rate monitoring and the clinical interpretation of fetal heart rate patterns. Therefore, between May 1995 and November 1996, the National Institute of Child Health and Human Development sponsored a Research Planning Workshop to address this issue.

A group of investigators was convened to “propose a standardized and rigorously, unambiguously described set of definitions that can be quantitated… [and] to develop recommendations for the investigative interpretation of intrapartum FHR tracings so that the predictive value of monitoring could be assessed more meaningfully in appropriately designed observational studies and clinical trials.” It was hoped such studies would yield more evidence-based clinical management strategies to address intrapartum fetal compromise.
Operational Principles on Using NICHD Terminology

Operational principles for the basis of defining terms and their interpretive value in assessing fetal heart rate tracings were standardized. The most pertinent are listed below:

- Definitions are to be used for visual interpretation.
- Definitions would apply to patterns obtained from a direct fetal electrode or an external Doppler device.
- The paper speed parameters would be 3 cm per minute for the horizontal axis and 30 beats/min per centimeter for the vertical axis. While it was recognized that other paper speeds were currently being used and that FHR patterns might differ based on the paper scale used, the same definitions would apply.
- The focus would be on intrapartum patterns, but the definitions would be applicable to antepartum observations as well.
- The EFM patterns are defined as periodic or episodic. Periodic patterns are those that occur with contractions and episodic patterns are not related with uterine contractions. Uterine activity would be determined through the interpretation of tocodynamometer tracings of good quality.
- The components of fetal heart rate tracings do not occur in isolation and evaluation of fetal heart rate patterns should take into account all components of fetal heart rate pattern, including baseline rate, variability and presence of accelerations or decelerations. Fetal heart rate tracings should be assessed over time to identify changes and trends.
- Periodic patterns are identified based on the type of waveform defined as abrupt vs. gradual onset of the deceleration.
- No differentiation between short and long term variability was made because in practice, they are visually determined as a unit.
- EFM patterns are dependent on gestational age so this is an essential interpretative factor for evaluating an EFM pattern. Maternal medical status, prior fetal assessment results, use of medications and other factors also may need to be considered.

Terminology and Definitions

FETAL HEART RATE BASELINE
The mean fetal heart rate is rounded to increments of 5 beats per minute during a 10-minute segment excluding periodic/episodic changes, periods of marked variability or baseline segment 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. Otherwise, it is considered indeterminate. In these instances, review of the previous 10 minute segment should be the basis on which to determine the baseline.

In determining the baseline rate, a minimum of a 10-minute period of monitoring is necessary for confirmation of the rate.

The fetal baseline rate is classified as follows:

<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal</td>
<td>110 to 160 beats per minute</td>
</tr>
<tr>
<td>Bradycardia</td>
<td>Less than 110 beats per minute</td>
</tr>
<tr>
<td>Tachycardia</td>
<td>Over 160 beats per minute</td>
</tr>
</tbody>
</table>

FETAL HEART RATE PATTERNS
Determination of baseline fetal heart rate variability is based on visual assessment and excludes sinusoidal patterns.

Variability is defined as fluctuations in the fetal heart rate baseline that are two cycles per minute or more and that are irregular in amplitude.

The visual quantification of the amplitude from peak to trough in beats per minute is as follows:

<table>
<thead>
<tr>
<th>Amplitude Range</th>
<th>Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Undetectable</td>
<td>Absent</td>
</tr>
<tr>
<td>Undetectable to equal to or less than 5 beats per minute</td>
<td>Minimal</td>
</tr>
<tr>
<td>6 to 25 beats per minute</td>
<td>Moderate</td>
</tr>
<tr>
<td>More than 25 beats per minute</td>
<td>Marked</td>
</tr>
</tbody>
</table>
Sinusoidal patterns which are excluded from the definition of variability are described as a smooth, sine wave-like pattern of regular frequency and amplitude.

ACCELERATIONS
Based on visual assessment, an acceleration is defined as an apparent abrupt increase in fetal heart rate above the baseline. Onset to peak is equal to or less than 30 seconds and duration is equal to or more than 15 seconds and less than two minutes from onset to return to baseline.

In pregnancies less than 32 weeks gestation, accelerations are defined as an increase of 10 beats per minute or more above baseline which lasts 10 seconds or more.

An acceleration is classified as prolonged if the duration is 2 minutes or more but less than 10 minutes. Accelerations that are 10 minutes or more are considered a baseline change.

LATE DECELERATIONS
Based on visual assessment, a late deceleration is defined as an apparent gradual decrease in fetal heart rate and return to baseline associated with uterine contractions. Onset to nadir is equal to or greater than 30 seconds. The nadir of the deceleration occurs after the peak of the contraction.

EARLY DECELERATIONS
Based on visual assessment, an early deceleration is defined as an apparent gradual decrease in fetal heart rate and return to baseline associated with uterine contractions. Onset to nadir is equal to or greater than 30 seconds. The nadir of the deceleration occurs at the same time of the peak of the contraction.

VARIABLE DECELERATIONS
Based on visual assessment, a variable deceleration is defined as an apparent abrupt decrease in fetal heart rate below the baseline which may or may not be associated with uterine contractions. Onset to nadir is less than 30 seconds. The decrease in fetal heart rate below the baseline is equal to or more than 15 beats per minute, lasting 15 seconds or more but less than 2 minutes in duration from onset to return to baseline. When variable decelerations occur in conjunction with uterine contractions, the onset, depth and duration vary with each succeeding uterine contraction.

PROLONGED DECELERATION
Based on visual assessment, a prolonged deceleration is defined as an apparent decrease in fetal heart rate below the baseline. The decrease in the fetal heart rate is 15 beats per minute or more and lasts for at least 2 minutes but less than 10 minutes from onset to return to baseline. A prolonged deceleration that is sustained for 10 minutes or more is a baseline change.

Quantification of the Visual Interpretation of the Fetal Heart Rate Baseline
The quantification of a deceleration is made by the depth of nadir in beats per minute below the baseline and excludes transient spikes or electronic artifact. The duration of decelerations is quantified in minutes and seconds from the beginning to end of the deceleration. The same principles apply to accelerations as well.

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

The quantification of bradycardia and tachycardia are based on the actual fetal heart rate in beats per minute.

If the fetal heart rate is not stable, it can be determined by the visual range of the fetal heart rate.

Uterine Activity
While the NICHD terminology did not address defining uterine activity, the following lists some basic principles that are well accepted in assessing uterine activity.

- Uterine activity can be assessed by palpation or external or internal fetal monitoring.
- In normal labor, contractions occur about every 2-5 minutes, with a duration of 30-60 seconds. Uterine contraction strength increases as labor progresses.
- Frequency of contractions is defined from the beginning of one contraction to the onset of next contraction described in minutes.
- Duration or length of a uterine contraction is described in seconds and is counted from beginning to the end of contraction.
• Intensity or strength of contractions can be determined by palpation or quantification of intraamniotic pressure by an internal intrauterine pressure catheter (IUPC).

• Uterine intensity is described as mild, moderate or strong when assessed by palpation and in mm Hg when assessed by an IUPC.

• Resting tone is the time between contractions and can be assessed by palpation or intraamniotic pressure by an IUPC.

• Resting tone is described as soft or rigid by palpation in mm Hg when assessed by IUPC.

**Clinical Considerations**

The primary purpose for the use of electronic fetal monitoring is to determine if the fetus is well oxygenated. The guidelines for review of electronic monitor tracing during the intrapartum period are based on the stage of labor and the status of the pregnancy and these guidelines are identified below:

<table>
<thead>
<tr>
<th></th>
<th>First Stage of Labor</th>
<th>Second Stage of Labor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pregnancy Without Complications</td>
<td>30 minutes</td>
<td>15 minutes</td>
</tr>
<tr>
<td>Pregnancy With Complications</td>
<td>15 minutes</td>
<td>5 minutes</td>
</tr>
</tbody>
</table>

**CHARACTERISTICS OF REASSURING AND NONREASSURING FETAL HEART RATE TRACINGS**

A reassuring pattern is the presence of fetal heart rate accelerations. This usually indicates there is no acidemia and is generally indicative of fetal well being. In most cases, moderate variability is also reassuring but few studies exist to support this contention.

When the fetal heart has absent or minimal variability without spontaneous accelerations and the fetal heart rate status does not change despite intervention, these findings are nonreassuring. Nonreassuring is the standard terminology to be used to describe threats to fetal well being or indicators of fetal compromise. This term replaces such terms as fetal distress or fetal stress.

**FACTORS AFFECTING FETAL HEART RATE PATTERNS**

There are many likely factors that can have an effect on the fetal heart rate. Fetal heart rate changes can occur in response to pre-existing or pregnancy-related conditions, medications given to the woman in labor and environmental influences. Below are charts that identify possible factors and the associated fetal heart rate change(s). These fetal heart rate changes may be transient and benign or require further monitoring and/or intervention. While more study may be needed to confirm some of these associations, they are included based on the prevailing consensus of information known at this time.

**The Influence of Medications on Fetal Heart Rate**

<table>
<thead>
<tr>
<th>Medication</th>
<th>Change in Fetal Heart Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Betamethasone</td>
<td>Decrease in FHR variability</td>
</tr>
<tr>
<td>Butorphanol</td>
<td>Pseudosinusoidal benign pattern</td>
</tr>
<tr>
<td>Cocaine</td>
<td>No change</td>
</tr>
<tr>
<td>Magnesium sulfate</td>
<td>Decrease in FHR baseline &amp; variability</td>
</tr>
<tr>
<td>Meperidine</td>
<td>No change</td>
</tr>
<tr>
<td>Morphine</td>
<td>Decrease in the number of accelerations that occur</td>
</tr>
<tr>
<td>Terbutaline</td>
<td>Decrease in frequency of variable declerations</td>
</tr>
<tr>
<td>Zidovudine</td>
<td>No change</td>
</tr>
</tbody>
</table>


**The Influence of Environmental or Fetal Factors on the Fetal Heart Rate**

<table>
<thead>
<tr>
<th>Environmental Factor</th>
<th>Change in Fetal Heart Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scalp or vibroacoustic stimulation</td>
<td>Accelerations</td>
</tr>
<tr>
<td>Spontaneous fetal movement</td>
<td>Accelerations</td>
</tr>
<tr>
<td>Uterine contractions</td>
<td>Accelerations or early decelerations</td>
</tr>
<tr>
<td>Vaginal or pelvic examination</td>
<td>Accelerations</td>
</tr>
</tbody>
</table>

The Influence of Maternal or Fetal Conditions on the Fetal Heart Rate

<table>
<thead>
<tr>
<th>Maternal or Fetal Factors</th>
<th>Change in Fetal Heart Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Congenital heart block</td>
<td>Bradycardia</td>
</tr>
<tr>
<td>Maternal fever or fetal infection</td>
<td>Tachycardia</td>
</tr>
<tr>
<td>Maternal hyperthyroidism</td>
<td>Tachycardia</td>
</tr>
<tr>
<td>Maternal hypotension</td>
<td>Prolonged decelerations/bradycardia and late decelerations</td>
</tr>
<tr>
<td>Maternal supine hypotension</td>
<td>Late decelerations, bradycardia</td>
</tr>
<tr>
<td>Oligohydramnios</td>
<td>Variable decelerations</td>
</tr>
<tr>
<td>Placenta previa/abruption</td>
<td>Late decelerations</td>
</tr>
<tr>
<td>Profound fetal hypoxia</td>
<td>Bradycardia</td>
</tr>
<tr>
<td>Prolonged cord compression</td>
<td>Prolonged decelerations/bradycardia</td>
</tr>
<tr>
<td>Regional anesthetics</td>
<td>Late decelerations</td>
</tr>
<tr>
<td>Tetanic contractions</td>
<td>Prolonged decelerations</td>
</tr>
<tr>
<td>Umbilical cord compression</td>
<td>Variable decelerations</td>
</tr>
<tr>
<td>Uterine hyperstimulation</td>
<td>Late decelerations</td>
</tr>
</tbody>
</table>


GENERAL CONSIDERATIONS

In consideration of the clinical applicability of electronic fetal monitoring and its efficacy, consistent scientific evidence supports the following:

• Electronic fetal monitoring has a high false positive rate for predicting adverse outcomes.

• With the use of electronic fetal monitoring, there is an increased rate of operative interventions: cesarean delivery, forceps delivery and use of vacuum extraction.

• Electronic fetal monitoring is not useful in reducing the incidence of cerebral palsy.

• Amnioinfusion is useful in avoiding emergent cesarean delivery in the presence of recurrent variable decelerations.

Conclusion

Electronic fetal monitoring can be useful in assessing the fetal status during labor. It has limitations and benefits but it will be most beneficial when all health care personnel providing care to women in labor use consistent language in describing the fetal heart rate patterns and other information elicited from the fetal monitor. No one terminology is inherently better than another. The value of a common language is that everyone has the same understanding and hence patient safety is increased by decreasing the risk of miscommunication. Agreement on a common language and its use is one the best safeguards in preventing errors and avoiding miscommunication. This monograph focuses on the NICHD language as a way of sharing information.
APPENDIX
Representative tracings demonstrating NICHD terminology are listed below:

VARIABILITY

Absent Variability

Minimal Variability

Moderate variability
Marked Variability

Sinusoidal pattern
BASELINE RATE

1916-22

Normal

Tachycardia
Bradycardia
PERIODIC PATTERNS

Early Decelerations

Variable Decelerations
Prolonged Deceleration

Late Decelerations
REFERENCES


7 Fetal Monitoring and Assessment, Tucker, Susan, Mosby, St. Louis, 2004, pages page 159

8 Fetal Monitoring and Assessment, Tucker, Susan, Mosby, St. Louis, 2004, pages page 159

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