

OBSTETRICS

Graded classification of fetal heart rate tracings: association with neonatal metabolic acidosis and neurologic morbidity

Colm Elliott, MEng; Philip A. Warrick, MEng; Ernest Graham, MD; Emily F. Hamilton, MD

OBJECTIVE: The objective of the study was to measure the performance of a 5-tier, color-coded graded classification of electronic fetal monitoring (EFM).

STUDY DESIGN: We used specialized software to analyze and categorize 7416 hours of EFM from term pregnancies. We measured how often and for how long each of the color-coded levels appeared in 3 groups of babies: (A) 60 babies with neonatal encephalopathy (NE) and umbilical artery base deficit (BD) levels were greater than 12 mmol/L; (I) 280 babies without NE but with BD greater than 12 mmol/L; and (N) 2132 babies with normal gases.

RESULTS: The frequency and duration of EFM abnormalities considered more severe in the classification method were highest in group A and lowest in group N. Detecting an equivalent percentage of cases with adverse outcomes required only minutes spent with marked EFM abnormalities compared with much longer periods with lesser abnormalities.

CONCLUSION: Both degree and duration of tracing abnormality are related to outcome. We present empirical data quantifying that relationship in a systematic fashion.

Key words: computer analysis, electronic fetal monitoring, hypoxic ischemic encephalopathy, risk classification

Cite this article as: Elliott C, Warrick PA, Graham E, et al. Graded classification of fetal heart rate tracings: association with neonatal metabolic acidosis and neurologic morbidity. *Am J Obstet Gynecol* 2010;202:258.e1-8.

The general goal of electronic fetal monitoring (EFM) is to identify fetuses with increased risk of hypoxic injury so that intervention can avoid adverse outcome without also causing excessive numbers of unnecessary interventions. Currently clinicians visually assess EFM tracings to infer what physiological conditions are present and how well the fetus is compensating. Inconsistency in tracing evaluation is well rec-

ognized, especially when assessments are carried out over long periods of time or in the presence of fatigue or distractions.¹⁻⁵

Written definitions for graded classifications of tracings are designed to reduce assessment inconsistency and help clinicians communicate more precisely the level of abnormality and hence the urgency and nature of clinical interventions required. Several recent publications define graded classification schema, but none have reported how often the various levels occur in labors with normal or abnormal outcomes.²⁻⁵ The objective of this study was to measure the performance of a 5 level classification system of EFM in 3 groups of term babies, defined by functional and biochemical markers of perinatal abnormality.

MATERIALS AND METHODS

We studied the last 3 hours of EFM traces from 2472 babies greater than 35 weeks' gestation that were born without apparent congenital malformations or inborn errors of metabolism. All babies had umbilical artery blood gas measurements and tracings that met preestablished criteria for recording quality.

The abnormal (A) or index group included 60 babies with umbilical artery

base deficit levels greater than 12 mmol/L who developed neurological signs of encephalopathy in the early neonatal period. Encephalopathy was defined clinically requiring the presence of at least 2 of the following criteria lasting longer than 24 hours: altered level of consciousness, hypotonia, hypotonia, feeding difficulty of central origin, or respiratory difficulty of central origin.⁶

The very low natural incidence of this condition necessitated collecting cases from a number of hospital series (n = 40) and medicolegal files (n = 20).

The reference groups were convenience samples of consecutive vaginal births from an urban university teaching hospital, which used EFM extensively and routinely measured umbilical artery blood gases at birth. The normal (N) group included 2132 babies with normal umbilical artery gases and no neurological signs of encephalopathy. The intermediate (I) group comprised 280 babies with base deficit values greater than 12 mmol/L but without encephalopathy. This base deficit level corresponds to the second percentile and hence is a reasonable way to define a group with increased risk of evolution to a more adverse state.^{7,8} All data were provided in compliance with institutional regulations.

From PeriGen (Mr Elliott and Dr Hamilton), Princeton, NJ; the Department of Biomedical Engineering (Mr Warrick) and the Department of Obstetrics and Gynecology, Faculty of Medicine (Dr Hamilton), McGill University, Montreal, QC, Canada; and the Department of Obstetrics and Gynecology (Dr Graham), Johns Hopkins School of Medicine, Baltimore, MD.

Received Jan. 29, 2009; revised April 15, 2009; accepted June 4, 2009.

Reprints not available from the authors.

This study was supported in part by LMS Medical Systems, Montreal, QC, Canada with PeriGen, Princeton, NJ.

0002-9378/\$36.00

© 2010 Published by Mosby, Inc.

doi: 10.1016/j.ajog.2009.06.026



See Journal Club, page 317

TABLE 1

Summary of the 5 level classification

	Decelerations		Recurrent variable			Recurrent late			Prolonged		
	None	Early	Mild	Mod	Severe	Mild	Mod	Severe	Mild	Mod	Severe
MODERATE (NORMAL) VARIABILITY											
Baseline											
Tachycardia	B	B	B	Y	O	Y	Y	O	Y	Y	O
Normal	G	G	G	B	Y	B	Y	Y	Y	Y	O
Mild bradycardia	Y	Y	Y	Y	O	Y	Y	O	Y	Y	O
Moderate bradycardia	Y	Y			O		O	O			O
Severe bradycardia	O	O			O			O			O
MINIMAL VARIABILITY											
Baseline											
Tachycardia	B	Y	Y	O	O	O	O	R	O	O	O
Normal	B	O	Y	O	O	O	O	R	O	O	R
Mild bradycardia	O	O	R	R	R	R	R	R	R	R	R
Moderate bradycardia	O	O			R		R	R			R
Severe bradycardia	R	R			R			R			R
ABSENT VARIABILITY											
Baseline											
Tachycardia	R	R	R	R	R	R	R	R	R	R	R
Normal	O	R	R	R	R	R	R	R	R	R	R
Mild bradycardia	R	R	R	R	R	R	R	R	R	R	R
Moderate bradycardia	R	R			R		R	R			R
Severe bradycardia	R	R			R			R			R
Sinusoidal	R										
Marked variability	Y										

B, blue; G, green; O, orange; R, red; Y, yellow.

Elliott. Graded classification of fetal heart rate tracings. *Am J Obstet Gynecol* 2010.

The digital version of the 7416 hours of tracings were analyzed using CALM Patterns (LMS Medical Systems, Montreal, Canada with PeriGen, Princeton, NJ), a software that identifies and measures fetal heart rate (FHR) baseline, baseline variability, accelerations, and decelerations according to the National Institute of Child Health and Human Development (NICHD) definitions. The

software uses a variety of proprietary digital signal processing techniques and pattern recognition algorithms to identify and measure the FHR features.

In brief, baseline was determined by a polynomial best-fit line in flat portions of the FHR that excluded accelerations and decelerations. Variability was the range enclosed by 2 SD of FHR values around the baseline segments. Internal

neural networks classified deceleration segments as either gradual or variable decelerations using a number of criteria including slope of the onset and end of the deceleration, deceleration depth, and duration as well as ambient variability and baseline levels. Gradual decelerations were further classified as late or early, depending on their timing in relation to associated contractions.

Download English Version:

<https://daneshyari.com/en/article/3435394>

Download Persian Version:

<https://daneshyari.com/article/3435394>

[Daneshyari.com](https://daneshyari.com)