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Intermittent Auscultation for Intrapartum Fetal Heart Rate Surveillance (replaces ACNM Clinical Bulletin #9, March 2007)

INTRODUCTION

Standard evaluation of fetal well-being during labor includes the periodic assessment of the fetal heart rate (FHR), its pattern, and response to intrapartum stimuli and events. Effective methods of evaluation and meaningful interpretation of FHR data have long been the subjects of clinical debate.[1,2] Continuous electronic fetal monitoring (EFM) is the most common method of intrapartum fetal surveillance in current use but has not been shown to be more efficacious than intermittent auscultation (IA).[3]

Most professional organization recommendations for FHR assessment during labor are based upon protocols used in randomized clinical trials that compared IA and EFM.[4–7] Guidelines based on evidence-based application of IA during labor are not available. This clinical practice bulletin reviews IA and includes recommendations for use based on the best available scientific data, the need to provide informed choice, and patient safety.

INTERMITTENT AUSCULTATION

IA is a method of fetal surveillance that utilizes listening and counting the FHR for a specified amount of time at specified intervals in relation to uterine contractions. IA may be done with a fetoscope, which uses bone conduction to assist in hearing the opening and closing of the valves of the fetal heart, or with a hand-held Doppler ultrasound, which detects fetal heart motion and converts it to sound. Newer models of the hand-held Doppler include a paper printout of the recorded heart rate.

Although consistent results have not emerged from the studies that have assessed the reliability and validity of IA,[8,9] it appears that IA using a multiple-count strategy

This Clinical Bulletin was developed under the direction of the Clinical Practice Section of the Division of Standards of the American College of Nurse-Midwives (ACNM) as an educational aid to members of the ACNM. This Clinical Bulletin is not intended to dictate an exclusive course of management nor to substitute for individual professional judgment. It presents recognized methods and techniques on clinical practice which midwives may consider incorporating into their practices. The needs of an individual patient or the resources and limitations of an institution or type of practice may appropriately lead to variations in clinical care.

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that assesses the FHR during and after a contraction detects the FHR, rhythm, accelerations, and presence of decelerations reliably,[10,11] but does not differentiate types of decelerations or determine baseline variability with accuracy (Table 1). [5,8,10–15] Despite these limitations, all of the randomized controlled trials conducted to date confirm the equivalence of IA and EFM with respect to neonatal outcomes.[3,16–18] Therefore, the inability to consistently determine the FHR variability or type of deceleration in labor using IA does not appear to be clinically significant when monitoring women who are at low risk for uteroplacental insufficiency and who have a fetus with a normal baseline heart rate.

ELECTRONIC FETAL MONITORING

EFM uses ultrasound or a fetal spiral electrode that records the fetal electrocardiogram (ECG) to produce both an auditory and visual representation of the FHR that is continuously recorded as the FHR tracing. Continuous EFM reveals baseline rate, variability, accelerations, and periodic or episodic decelerations. The presence of moderate variability, accelerations, and a normal baseline rate is highly predictive of a well-oxygenated fetus at the time they are observed.[19,20] However, the interpretation of variations in the FHR pattern and rate via EFM is dependent on the reliability and validity of interpretations of the recorded data.[2,21] Most variant FHR patterns have a low positive predictive value for identifying fetal acidemia.[22] Further, there is poor interobserver and intraobserver consistency in the interpretation of FHR patterns generated by continuous electronic fetal monitors.[2,23–27]

RESEARCH COMPARING IA AND EFM DURING LABOR

Since the adoption of EFM as the standard of care, multiple randomized clinical trials designed to determine the efficacy of EFM have been performed.[3,16–18] In 2006 the Cochrane Database of Systematic Reviews published a meta-analysis of 11 randomized controlled trials that compared maternal and neonatal outcomes after continuous EFM versus IA during labor (over 33,000 women).[3] The women in the continuous EFM group had an increase in both cesarean delivery (RR, 1.66; 95% CI, 1.30–2.13; n = 18,761; 11 trials) and operative vaginal deliveries (RR, 1.16; 95% CI, 1.01–1.32; n = 18,515; 10 trials) but no difference in perinatal mortality (RR, 0.85; 95% CI, 0.59–1.23; n = 33,513; 11 trials), rates of cerebral palsy (RR, 1.74; 95% CI, 0.97–3.11; n = 13,252; 2 trials) or rates of Apgar of < 7 at five minutes (RR, 0.97; 95% CI, 0.72–1.31; n = 4037).[3] There was a 50% decrease in the incidence of neonatal seizures in the continuous EFM group compared to the IA group (RR, 0.50; 95% CI, 0.31–0.80; n = 32,386; 9 trials).[3] However, a follow-up study of the infants who had seizures at 4 years of age found an equal number of children in each group with cerebral palsy, leading the authors to conclude that continuous EFM offers little if any benefit.[21,28] In practice, the reduction in of the incidence of neonatal seizures must be balanced against the morbidity associated with cesarean and operative vaginal deliveries which significantly increase the incidence of maternal bladder injury, thromboembolic complications, and placenta accreta in future pregnancies.[29]

Madaan et al.[18] randomly divided 100 women in India who were attempting a trial of labor after previous cesarean delivery into two groups, one monitored via IA and the other monitored via EFM. There were no differences in maternal or newborn outcomes between the two groups. The IA group had a non-significant increase in the number of vaginal births (70% vs 64%, respectively) and in the cohort of women who had a cesarean delivery in this study, there were more cesarean deliveries for non-reassuring FHR in the EFM group compared to the IA group (47% vs 18%, respectively).[18] Although this study was too small to generate statistically significant differences in rare maternal or newborn outcomes of interest, the results confirm previous randomized trials that suggest IA is a reliable way to monitor a fetus during labor.

Many hospitals require EFM for a specified time during the initial admission of a laboring woman. However, some investigators have noted that this requirement has not improved fetal outcome and may lead to increased intervention in labor.[30–32]

METHOD OF INTERMITTENT AUSCULTATION

Most methods of IA are based on protocols used in the randomized trials (Table 2). Both baseline rate and periodic changes are evaluated.

Procedure for Evaluation of Fetal Heart Rate Baseline

To determine a baseline, the FHR is auscultated between contractions and when the fetus is not moving. At the same time, the mother's radial pulse is felt to establish that what is being heard is the fetal, not maternal, heart rate.[6,33] After establishing the baseline rate, the FHR is auscultated for 15 to 60 seconds, at recommended intervals, between contractions and when the fetus is not moving, to monitor baseline changes.

Procedure for Evaluating Periodic Changes

Listening for accelerations and decelerations in the FHR is the second component of IA. Typically, the provider auscultates the FHR over a period of time (15 to 60 seconds) and notes any audible increase or decrease in rate. Methods have been devised to validate this information and to more accurately assess periodic changes.[9–13] These studies were done on women who were not in labor or via use of simulated data,[14] but the techniques may be utilized in the intrapartum setting. Most of the

Table 1. Fetal Heart Rate Characteristics Determined Via Auscultation vs Electronic Fetal Heart Rate Monitor

FHR Characteristic[a]	Fetoscope	Doppler Without Paper Printout	Electronic FHR Monitor
Variability	No	No	Yes
Baseline rate	Yes	Yes	Yes
Accelerations	Detects increases[b]	Detects increases[b]	Yes
Decelerations	Detects decreases	Detects decreases	Differentiates types of decelerations
Rhythm[c]	Yes	Yes	Yes
Double counting or half-counting FHR	Can clarify	May double count or half count	May double count or half count
Differentiation of maternal heart rate and FHR	Yes	May detect maternal heart rate	May detect and record maternal heart rate

FHR = fetal heart rate.

Adapted from Lyndon and Ali.[5]

[a]Definitions of each FHR characteristic per the National Institute of Child Health and Human Development 2008 criteria.[20]

[b]Per method described by Paine et al.[12,13]

[c]Determined as regular or irregular. None of these devices can diagnose the type of fetal arrhythmia.

studies done have used a multiple-count strategy whereby the observer counts the FHR during several 5 to 15 second increments.[11–15] An increase in the number obtained from each 5 or 15 second count in subsequent intervals indicates an acceleration; a decrease in the rate indicates a deceleration. These rates can be plotted on a graph for documentation as described in the work of Paine et al.[12,13,15] If there is a question as to whether accelerations or decelerations have been heard, continued auscultation may provide clarification. The multiple-count strategy is likely to be more accurate than a single-count strategy.[14]

The Timing of Auscultation in Relation to Contractions

The timing of auscultation varies among protocols, but can include auscultation during and after contractions. Although most recommend counting the FHR throughout a contraction and for a short time following, here also, protocols differ slightly in timing and method. One of the goals of listening throughout the contraction and for a brief time after the contraction resolves is to identify variable and late decelerations of the FHR. A Doppler with speaker and/or printer functions may have advantages over a fetoscope, including ease of use in several maternal positions and during water immersion. Audibility may allow collaboration with patients and other members of the caregiving team during management decisions.

Frequency of Intermittent Auscultation

To date there are no studies that have determined the optimal frequency of IA during labor. Current recommendations are summarized in Table 3.[4–6] In the absence of evidence-based parameters to define the optimal interval for auscultation, an interval ranging between every 15 to 30 minutes during the active phase, every 15 minutes during the second stage prior to expulsive efforts, and every 5 minutes after initiation of pushing, may be reasonable as long as the auscultated FHR is normal and there are no other labor characteristics that would suggest a need for more frequent monitoring.

The frequency of auscultation should be individualized based upon the contraction pattern, level of maternal activity, and institution of hydrotherapy or interventions that may affect the FHR. In addition to IA at regular intervals, it is recommended that the FHR be assessed before and after vaginal examinations, rupture of membranes, the administration of medication(s), or ambulation.

INTERPRETATION OF THE FETAL HEART RATE PATTERNS SEEN WITH ELECTRONIC FETAL MONITORING

In 2008, the National Institute of Child Health and Human Development (NICHD) workgroup recommended a three-tier system of categories for interpretation of FHR patterns.[20] Normal FHR characteristics detected via IA include baseline of 110-160 beats per minute, regular rhythm, presence of accelerations, and absence of decelerations. These findings are termed Category I or ''normal'' FHR. [20]

In a term fetus without risk for uteroplacental insufficiency at the start of labor, intermittent hypoxic events are usually well compensated for between contractions. If instead, the fetus deteriorates and becomes acidemic, the FHR pattern will evolve from a normal baseline with moderate variability and no decelerations to tachycardia, minimal or absent variability, and recurrent decelerations over approximately an hour as a fetus moves from well oxygenated to acidemic.[19] Alternatively, acute hypoxic events that do not resolve will be evident as an acute fetal bradycardia. Indeterminate FHR characteristics include: baseline < 110 or > 160 beats per minute, irregular rhythm, recurrent decelerations, and/or a baseline that steadily increases toward a tachycardic rate.[20] These FHR patterns are termed Category II or ''indeterminate'' because they are not predictive of abnormal fetal acid-base status and there is insufficient evidence to classify them as either Category I or Category III.[20] Abnormal FHR patterns are those with absent variability in the presence of recurrent late or variable decelerations, bradycardia, or a sinusoidal pattern.[20] Recurrent late or variable decelerations with minimal or absent variability have a 23% positive

Table 2. Technique for Performing Intermittent Auscultation

1. After performing Leopold's maneuvers to identify the fetal presentation and position, assist the laboring woman into a position that maximizes audibility and preserves comfort.
2. Assess uterine contractions by palpation.
3. Determine the maternal pulse rate.
4. Place the fetoscope or Doppler over the fetal thorax or back.
5. Determine the baseline fetal heart rate by listening between contractions and when the fetus is not moving. Verify maternal pulse rate if necessary.
6. Subsequently count the fetal heart rate after a uterine contraction for 30 to 60 seconds every 15 to 30 minutes in active labor and every 5 minutes in the second stage of labor.
7. Note increases or accelerations or decreases or decelerations from the baseline rate by counting and recording the fetal heart rate using a multiple-count strategy agreed upon by practice protocol.[a]

[a]Several multiple-count strategies have been tested in studies of auscultation, including Paine et al.,[12,13] Schifrin,[14] Daniels and Boehm,[15] and Miller et al.[11]

predictive value for identifying newborn acidemia.[19] Abnormal FHR patterns are termed Category III or ''abnormal'' and they warrant immediate evaluation and plan for delivery.[19]

INTERPRETATION OF THE AUSCULTATED FETAL HEART RATE

Interpretation of auscultated FHR patterns is summarized in Table 4. These two categories are consistent with the NICHD/American Congress of Obstetricians and Gynecologists (ACOG) three-tier system of three categories and have been adapted to reflect the FHR characteristics obtainable via IA.[5] Category I auscultated FHR characteristics are normal and reflect adequate oxygenation in the fetus. These characteristics are predictive of fetal well-being when observed.[4,5,19,20]

Category II auscultated FHR characteristics include all FHR characteristics that are not normal or Category I. These FHR characteristics may be either indeterminate or abnormal depending on the FHR variability that is present, which cannot be determined via IA. EFM may be used to verify or clarify an indeterminate or abnormal FHR pattern, and guide management. Management of indeterminate FHR patterns depends on multiple factors present. Intrapartum resuscitation techniques such as position change, hydration, and correction of hypotension or hyperstimulation are instituted as necessary.

Continuous EFM is recommended for women who have maternal or fetal risk factors for adverse outcomes or acidemia. Individual practice guidelines should address these conditions.

DOCUMENTATION

Characteristics of the auscultated FHR that should be documented include the uterine activity pattern, the counted FHR, the rhythm, and the presence or absence of accelerations or decelerations. Terms used for each characteristic should be consistent with the terminology defined by the NICHD Research Planning Group guidelines (Appendix A) where applicable to auscultated findings.[20] If decelerations are detected, documentation should include the nadir rate, whether the decelerations are recurrent or non-recurrent, and any interventions instituted. If accelerations are documented, they can be detected using the criteria for identifying acceleration via auscultation that has been validated by Paine et al.[12,13] In addition, information about the labor course or maternal status that may assist in the interpretation of data by independent observers should be noted in the record. For example, the FHR response to rupture of membranes, maternal position changes, scalp stimulation, medication, or change in labor stage.

Table 3. Frequency of Fetal Heart Rate Auscultation for Women Who Are Low Risk[a] During Labor

Organization	Latent Phase	Active Phase Minutes	Second Stage Minutes
AWHONN	At time of assessment and approximately every hour	15–30	5–15
ACOG[b]		15	5
SOGC[c]		15–30	5[d]
RCOG		15[e]	5[e]
ACNM		15–30	5

ACNM = American College of Nurse-Midwives; ACOG = American Congress of Obstetricians and Gynecologists; AWHONN = Association of Women's Health, Obstetric and Neonatal Nurses; FHR = fetal heart rate; RCOG = Royal College of Obstetricians and Gynecologists; SOGC = The Society of Obstetricians and Gynaecologists of Canada.

Adapted from the American College of Obstetricians and Gynecologists,[4] Lyndon and Ali,[5] Liston et al.,[6] the National Collaborating Centre for Women's and Children's Health,[7] and previous versions of this ACNM Clinical Bulletin.

[a]None of the professional organization guidelines specifically define "low risk." For the purpose of this bulletin, "low risk" refers to women who have no medical or obstetric conditions that are associated with uteroplacental insufficiency, and/or conditions that are associated with an increased incidence of umbilical artery pH of less than 7.1 at birth.

[b]There is, at the time of this writing, a discrepancy in ACOG publications about the frequency that intermittent auscultation (IA) is recommended. The ACOG Practice Bulletin on FHR monitoring[4] suggests that IA be conducted every 15 minutes in active labor and every 5 minutes in the second stage of labor based on research by Vintzileos et al.[17] In contrast, the Joint American Academy of Pediatrics (AAP)/ACOG Guidelines for Perinatal Care 6th edition recommend every 30 minutes in the active phase and every 5 minutes in the second stage for IA.

[c]IA should only be used by experienced practitioners with experience in the technique of auscultation, palpation of contractions, and auditory recognition of pertinent FHR changes.

[d]When pushing initiated.

[e]For a minimum of 60 seconds after a contraction.

PATIENT SATISFACTION AND CHOICE

In a systematic review of factors contributing to women's satisfaction with the experience of childbirth (n = 45,000),

Table 4. Interpretation of Auscultation Findings

Category I

Category I FHR characteristics by auscultation include all of the following:

- Normal FHR baseline between 110 and 160 bpm
- Regular rhythm
- Presence of FHR increases or accelerations from the baseline
- Absence of FHR decreases or decelerations from the baseline

Category II

Category II FHR characteristics by auscultation include any of the following:

- Irregular rhythm
- Presence of FHR decreases or decelerations from the baseline
- Tachycardia (baseline >160 bpm, >10 minutes in duration)
- Bradycardia (baseline <110 bpm, >10 minutes in duration)

FHR = fetal heart rate

Reprinted with permission from Lyndon and Ali.[5]

personal expectations, amount of caregiver support, quality of caregiver support, and involvement in decision making were identified as the four factors most associated with childbirth satisfaction.[34] Offering low-risk laboring women an informed choice about mode of fetal monitoring may further add to satisfaction with the experience of labor and birth.[35] Since IA requires 1:1 caregiving and near constant presence in order to perform auscultation at the recommended frequency, it may contribute to increased patient satisfaction.

CHALLENGES AND FUTURE RESEARCH

IA requires 1:1 care, which may be difficult to achieve in settings where the volume of women needing attention exceeds provider capacity. More research is necessary to determine the most effective frequency of auscultation, interobserver and intraobserver reliability, and barriers to the use of IA in labor. Investigations should also evaluate practical methods of incorporating IA into educational programs and busy intrapartum units. Providers and students need opportunities to learn and develop comfort with the skill of IA.[36]

RECOMMENDATIONS FOR PRACTICE

In both Canada and the United Kingdom, IA is the preferred method of fetal surveillance in women who enter labor at term with no medical or obstetric conditions that are associated with uteroplacental insufficiency and/or conditions that are associated with an increased risk for fetal acidemia.[6,7] ACOG recommendations for monitoring women in labor state that IA is ''acceptable in a patient without complications.''[20] The frequency of observations required to monitor labor with IA facilitates other evidence-based labor support practices, and this method of monitoring the FHR should be the preferred method. IA is associated with fewer cesarean and operative vaginal deliveries when compared to EFM, procedures which have additional attendant risks for the mother and newborn. In addition, IA and EFM have equivalent neonatal outcomes.[3,16–18] Finally, IA allows women more mobility, which in turn increases comfort and progress of labor.

SUMMARY OF RECOMMENDATIONS

- IA is the preferred method for monitoring the FHR during labor for women at term who at the onset of labor are low risk for developing fetal acidemia.
- IA should be conducted according to practice guidelines that include criteria for use of IA, criteria for converting to EFM, and protocols for frequency of observation and documentation.
- Multiple-count methods are more accurate and reliable than single-count methods for evaluation of periodic changes.
- Listening through a contraction versus listening between contractions will likely improve detection of periodic or episodic changes that might suggest conversion to EFM.
- Documentation of auscultated FHR characteristics should use approved terminology and needed descriptive notations.
- Further research is needed to determine the reliability and validity of different IA protocols.

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A literature search was conducted and articles published in English between 1986 and 2006 were reviewed. Studies were evaluated for quality using the guidelines recommended by the US Preventative Health Services Task Force in their document titled:

Guidelines for Rating Strength and Quality of Evidence from Research Findings

Strength of Recommendation

- **A:** There is good evidence to support that the intervention be adopted.
- **B:** There is fair evidence to support that the intervention be adopted.
- **C:** There is insufficient evidence to recommend for or against the intervention, but recommendations may be made on other grounds.
- **D:** There is fair evidence to support that the intervention be excluded.
- **E:** There is good evidence to support that the intervention be excluded.

Quality of Evidence

- **I:** Evidence obtained from at least one properly randomized controlled trial.
- **II-1:** Evidence obtained from well-designed controlled trials without randomization.
- **II-2:** Evidence obtained from well-designed cohort or case-control analytic studies, preferably from more than one center or research group.
- **II-3:** Evidence obtained from multiple time series studies with or without the intervention. Dramatic results in uncontrolled experiments (such as the results of the introduction of penicillin treatment in the 1940s) could also be regarded as this type of evidence.
- **III:** Opinions of respected authorities, based on clinical experience; descriptive studies and case reports; or reports of expert committees.

REFERENCES

1. Parer JTP, King T. Whither fetal heart rate monitoring? Obstet Gynecol Fertil 1999;22:149–92.

2. Parer JTP, King T. Fetal heart rate monitoring: Is it salvageable? Am J Obstet Gynecol 2000;182:982–7.

3. Alvrevic Z, Devane D, Gyte GML. Continuous cardiotocography (CTG) as a form of electronic fetal monitoring (EFM) for fetal assessment during labour. Cochrane Database Syst Rev 2006;3. CD006066.

4. American College of Obstetricians and Gynecologists. ACOG Practice Bulletin No. 106: Intrapartum fetal heart rate monitoring: Nomenclature, interpretation, and general management principles. Obstet Gynecol 2009;114:192–202.

5. Lyndon A, Ali LU. Fetal heart monitoring principles and practices, 4th ed. Dubuque, IA: Kendall-Hunt Publishing, 2009.

6. Liston R, Sawchuck D, Young D. Society of Obstetrics and Gynaecologists of Canada, British Columbia Perinatal Health Program. Fetal health surveillance: Antepartum and intrapartum consensus guideline. J Obstet Gynaecol Can 2007;29(9 Suppl. 4). S3–56.

7. National Collaborating Centre for Women's and Children's Health Web site. Intrapartum care of healthy women and their babies during childbirth. Clinical guideline September 2007. Revised reprint 2008. Available from: *www.nice.org.uk/guidance/index.jsp?action=byID&o=11837* [Accessed May 15, 2010].

8. Harrison J. Auscultation: The art of listening. Midwives 2004; 7:64–9.

9. Feinstein NF. Fetal heart rate auscultation: Current and future practice. J Obstet Gynecol Neonatal Nurs 2000;29:306–15.

10. Strong TH, Jarles DL. Intrapartum auscultation of the fetal heart rate. Am J Obstet Gynecol 1993;168:935–6.

11. Miller FC, Pearse K, Paul RH. Fetal heart rate pattern recognition by the method of auscultation. Obstet Gynecol 1984;64:332–6.

12. Paine LL, Payton RG, Johnson TR. Auscultated fetal heart rate accelerations. Part I. Accuracy and documentation. J Nurse Midwifery 1986;31:68–72.

13. Paine LL, Johnson TR, Turner MH, Payton RG. Auscultated fetal heart rate accelerations. Part II. An alternative to the nonstress test. J Nurse Midwifery 1986;31:73–7.

14. Schifrin BS, Amsel J, Burdorf G. The accuracy of auscultatory detection of fetal cardiac decelerations: A computer simulation. Am J Obstet Gynecol 1992;166:566–76.

15. Daniels SM, Boehm N. Auscultated fetal heart rate accelerations. J Nurse Midwifery 1991;36:88–94.

16. 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.

17. Vintzileos AM, Nochimson DJ, Antsaklis A, Varvarigos I, Guzman ER, Knuppel RA. Comparison of intrapartum electronic fetal heart rate monitoring versus intermittent auscultation in detecting fetal acidemia at birth. Am J Obstet Gynecol 1995;173:1021–4.

18. Madaan M, Trivedi SS. Intrapartum electronic fetal monitoring vs intermittent auscultation in postcesarean pregnancies. Int J Gyencol Obstet 2006;94:123–5.

19. 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.

20. 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 heart rate monitoring: Update on definitions, interpretation, and research guidelines. J Obstet Gynecol Neonatal Nurs 2008;37:510–5.

21. Paneth N, Bommarito M, Stricker J. Electronic fetal monitoring and later outcome. Clin Invest Med 1993;16:159–65.

22. Williams KP, Galerneau F. Intrapartum fetal heart rate patterns in the prediction of neonatal acidemia. Am J Obstet Gynecol 2003;188:820–3.

23. Nielsen PV, Stigsby B, Nickelsen C, Nim J. Intra- and interobserver variability in the assessment of intrapartum cardiotocograms. Acta Obstet Gynecol Scand 1987;66:421–4.

24. Beckmann CA, Mullem CV, Becamann CRB, Broekhuizen F. Interpreting fetal heart rate tracings. Is there a difference between labor and delivery nurses and obstetricians? J Reprod Med 1997; 42:647–50.

25. Devane D, Lalor J. Midwives' visual interpretation of intrapartum cardiotocographs: Intra- and inter-observer agreement. J Adv Nurs 2005;52:133–41.

26. Bernardes J, Ayres-de-Campos D, Costa-Pereira A. Further concerns about the National Institute of Child Health and Human Development guidelines for interpretation of electronic fetal heart rate monitoring. Am J Obstet Gynecol 2001; 184:1587–8.

27. Chauhan SP, Klauser CK, Woodring TC, Sanderson M, Magann EF, Morrison JC. Intrapartum nonreassuring fetal heart rate tracing and prediction of adverse outcomes: Interobserver variability. Am J Obstet Gynecol 2008;199:623. e1–5.

28. Grant S, O'Brien N, Joy MT, Hennessy E, MacDonald D. Cerebral palsy among children born during the Dublin randomized trial of intrapartum monitoring. Lancet 1989;2:1233–5.

29. Silver RM, Landon MB, Rouse DJ, Leveno KJ, Spong CY, Thom EA, et al. Maternal morbidity associated with multiple repeat cesarean deliveries. Obstet Gynecol 2006; 107:1226–32.

30. Mires G, Williams F, Howie P. Randomised controlled trial of cartography versus Doppler auscultation of fetal heart at admission in low risk obstetric population. Br Med J 2001; 322:1457–62.

31. Impey L, Reynolds M, MacQuillan K, Gates S, Murphy J, Sheil O. Admission cardiotocography: A randomised controlled trial. Lancet 2003;361:465–70.

32. Cheyne H, Dunlop A, Shields N, Mathers AM. A randomized controlled trial of admission electronic fetal monitoring in normal labour. Midwifery 2003;19:221–9.

33. Harmon KM. Techniques for Fetal Heart Assessment. In: Lyndon A, Ali LU, editors. Fetal heart monitoring principles and practices, 4th ed. Dubuque, IA: Kendall-Hunt Publishing, 2009:65–97.

34. Hodnett ED. Pain and women's satisfaction with the experience of childbirth: A systematic review. Am J Obstet Gynecol 2002;186:S160–72.

35. Hodnett ED, Gates S, Hofmeyr GJ, Sakala C. Continuous support for women during childbirth. Cochrane Database Syst Rev 2003;3. CD003766.

36. Walker DS, Shunkwiler S, Supanich J, Williamsen J, Yensch A. Labor and delivery nurses attitudes toward intermittent fetal monitoring. J Midwifery Womens Health 2001;46:374–80.

Appendix A. National Institute of Child Health and Human Development Terminology for Fetal Heart Rate Characteristics Determined By Electronic Fetal Heart Rate Monitoring

Term	Definition
Baseline rate	Mean FHR rounded to increments of 5 bpm during a 10-min segment excluding periodic or episodic changes, periods of marked variability, and segments of baseline that differ by >25 bpm; duration must be ≥2 min
Bradycardia	Baseline rate of <110 bpm for ≥10 minutes
Tachycardia	Baseline rate of >160 bpm for ≥10 minutes
Variability	Fluctuations in the baseline FHR of 2 cycles/min or greater; visually quantitated as the amplitude of the peak-to-trough in beats per minute
Absent	Amplitude from peak to trough undetectable
Minimal	Amplitude from peak to trough > undetectable and ≤5 bpm
Moderate	Amplitude from peak to trough 6–25 bpm.
Marked	Amplitude from peak to trough >25 bpm
Acceleration	Visually apparent abrupt increase (onset to peak is <30 sec) of FHR above baseline; peak is ≥15 bpm; duration is ≥15 bpm and <2 min. In gestations <32 wks, peak of 10 bpm and duration of 10 sec is acceleration
Prolonged acceleration	Acceleration >2 min and <10 min in duration
Early deceleration	Visually apparent gradual decrease (onset to nadir is ≥30 sec) of FHR below baseline, return to baseline associated with a uterine contraction. Nadir of deceleration occurs at the same time as the peak of the contraction; generally, the onset, nadir, and recovery of the deceleration occur at the same time as the onset, peak, and recovery of the contraction
Late deceleration	Visually apparent gradual decrease (onset to nadir is ≥30 sec) of FHR below baseline, return to baseline associated with a uterine contraction. Nadir of deceleration occurs after the peak of the contraction; generally, the onset, nadir, and recovery of the deceleration occur after same time as the onset, peak, and recovery of the contraction
Variable deceleration	Visually apparent abrupt decrease (onset to nadir is <30 sec) in FHR below baseline; decrease is ≥15 bpm; duration is ≥15 sec and <2 min
Prolonged deceleration	Visually apparent abrupt decrease (onset to nadir is <30 sec) in FHR below baseline; decrease is ≥15 bpm; duration is ≥2 min but <10 min

bpm = beats per minute; FHR = fetal heart rate.