ACOG PRACTICE BULLETIN

CLINICAL MANAGEMENT GUIDELINES FOR OBSTETRICIAN–GYNECOLOGISTS

NUMBER 62, MAY 2005

(Replaces Educational Bulletin Number 207, July 1995)

Intrapartum Fetal Heart Rate Monitoring

In 2002, approximately 3.4 million fetuses (85% of approximately 4 million live births) in the United States were assessed with electronic fetal monitoring (EFM), making it the most common obstetric procedure (1). Despite its widespread use, there is controversy about the efficacy of EFM, interpretation of fetal heart rate (FHR) patterns, reproducibility of its interpretation, and management algorithms for abnormal or nonreassuring patterns. Moreover, there is evidence that the use of EFM increases the rate of cesarean and operative vaginal deliveries. The purpose of this document is to review nomenclature for FHR assessment, review the data on the efficacy of EFM, delineate the strengths and shortcomings of EFM, and describe the management of nonreassuring FHR patterns.

This Practice Bulletin was developed by the ACOG Committee on Practice Bulletins—Obstetrics with the assistance of Suneet P. Chauhan, MD and George A. Macones, MD. The information is designed to aid practitioners in making decisions about appropriate obstetric and gynecologic care. These guidelines should not be construed as dictating an exclusive course of treatment or procedure. Variations in practice may be warranted based on the needs of the individual patient, resources, and limitations unique to the institution or type of practice.

Background

Even though the fetus is efficient at extracting oxygen from the maternal compartment, a complex interplay of antepartum complications, suboptimal uterine perfusion, placental dysfunction, and intrapartum events may be associated with adverse outcome. Known obstetric conditions, such as hypertensive disease, fetal growth restriction, and preterm birth, predispose fetuses to poor outcomes, but they account for a fraction of asphyxial injury. In a study of term pregnancies with fetal asphyxia, 63% had no known risk factors (2).

Monitoring the FHR is a modality intended to determine if a fetus is well oxygenated because the brain modulates the heart rate. It was used among 45% of parturients in 1980, 62% in 1988, 74% in 1992 (3), and 85% in 2002 (1). Despite the frequency of its use, issues with EFM include poor interobserver and intraobserver reliability, uncertain efficacy, and a high false-positive rate.

Fetal heart rate monitoring may be performed externally or internally. Most external monitors use a Doppler device with computerized logic to interpret and count the Doppler signals. Internal FHR monitoring is accomplished with a fetal electrode, which is a spiral wire placed directly on the fetal scalp or other presenting part.

Guidelines for Interpretation of Electronic Fetal Heart Rate Monitoring

In 1997, the National Institute of Child Health and Human Development Research Planning Workshop gathered investigators with expertise in the field and proposed definitions for intrapartum FHR tracing (4). The underlying assumptions of the definitions included that the FHR patterns, obtained either from a direct fetal electrode or an external Doppler device, are for visual interpretation, and that no a priori assumptions were made about the putative etiology of patterns or their relationship to hypoxemia or metabolic acidosis. The guidelines did not differentiate between short- and long-term variability because they are visually determined as one entity; however, they did encourage clinicians to take gestational age, medications, prior fetal assessment, and obstetric and medical conditions into account when interpreting the FHR patterns during labor.

A complete clinical understanding of the FHR necessitates discussion of baseline rate, variability, presence of accelerations, periodic or episodic decelerations, and the

Table 1. Definitions of Fetal Heart Rate Patterns

Pattern	Definition
Baseline	• The mean FHR rounded to increments of 5 beats per min during a 10 min segment, excluding: —Periodic or episodic changes —Periods of marked FHR variability —Segments of baseline that differ by more than 25 beats per min • The baseline must be for a minimum of 2 min in any 10-min segment
Baseline variability	• Fluctuations in the FHR of two cycles per min or greater • Variability is visually quantitated as the amplitude of peak-to-trough in beats per min —Absent—amplitude range undetectable —Minimal—amplitude range detectable but 5 beats per min or fewer —Moderate (normal)—amplitude range 6–25 beats per min —Marked—amplitude range greater than 25 beats per min
Acceleration	• A visually apparent increase (onset to peak in less than 30 sec) in the FHR from the most recently calculated baseline • The duration of an acceleration is defined as the time from the initial change in FHR from the baseline to the return of the FHR to the baseline • At 32 weeks of gestation and beyond, an acceleration has an acme of 15 beats per min or more above baseline, with a duration of 15 sec or more but less than 2 min • Before 32 weeks of gestation, an acceleration has an acme of 10 beats per min or more above baseline, with a duration of 10 sec or more but less than 2 min • Prolonged acceleration lasts 2 min or more but less than 10 min • If an acceleration lasts 10 min or longer, it is a baseline change
Bradycardia	• Baseline FHR less than 110 beats per min
Early deceleration	• In association with a uterine contraction, a visually apparent, gradual (onset to nadir 30 sec or more) decrease in FHR with return to baseline • Nadir of the deceleration occurs at the same time as the peak of the contraction
Late deceleration	• In association with a uterine contraction, a visually apparent, gradual (onset to nadir 30 sec or more) decrease in FHR with return to baseline • Onset, nadir, and recovery of the deceleration occur after the beginning, peak, and end of the contraction, respectively
Tachycardia	• Baseline FHR greater than 160 beats per min
Variable deceleration	• An abrupt (onset to nadir less than 30 sec), visually apparent decrease in the FHR below the baseline • The decrease in FHR is 15 beats per min or more, with a duration of 15 sec or more but less than 2 min
Prolonged deceleration	• Visually apparent decrease in the FHR below the baseline • Deceleration is 15 beats per min or more, lasting 2 min or more but less than 10 min from onset to return to baseline

Abbreviation: FHR, fetal heart rate.

changes in these characteristics over time. Table 1 provides FHR pattern definitions and descriptions based on National Institute of Child Health and Human Development Working Group findings. Decelerations are quantified by the depth of the nadir in beats per minute, as well as the duration in minutes and seconds from the beginning to the end of the deceleration. Accelerations are quantified similarly, whereas bradycardia and tachycardia are quantitated by the actual FHR. Decelerations generally are defined as recurrent if they occur with at least one half of the contractions.

Guidelines for Review of Electronic Fetal Heart Rate Monitoring

When EFM is used during labor, the nurses or physicians should review it frequently. In a patient without complications, the FHR tracing should be reviewed approximately every 30 minutes in the first stage of labor and every 15 minutes during the second stage. The corresponding frequency for patients with complications (eg, fetal growth restriction, preeclampsia) is approximately every 15 minutes in the first stage of labor and every 5 minutes during the second stage. Health care providers should periodically document that they have reviewed the tracing. The FHR tracing, as part of the medical record, should be labeled and available for review if the need arises. Computer storage of the FHR tracing that does not permit overwriting or revisions is reasonable, as is microfilm recording.

Clinical Considerations and Recommendations

▶ ***How efficacious is electronic fetal heart rate monitoring?***

The efficacy of EFM during labor is judged by its ability to decrease complications, such as neonatal seizures, cerebral palsy, or intrapartum fetal death, while minimizing the need for unnecessary obstetric interventions, such as operative vaginal or cesarean delivery. There are no randomized clinical trials to compare the benefits of EFM with no form of monitoring during labor (5). Thus, the benefits of EFM are gauged from reports comparing it with intermittent auscultation.

A meta-analysis synthesizing the findings of nine randomized clinical trials comparing the modalities had the following conclusions (6):

- The use of EFM compared with intermittent auscultation increased the overall cesarean delivery rate (odds ratio [OR] 1.53, 95% confidence interval [CI], 1.17–2.01) and the cesarean rate for suspected fetal distress (OR 2.55, 95% CI, 1.81–3.53).
- The use of EFM increased the use of both vacuum (OR 1.23, 95% CI, 1.02–1.49) and forceps (OR 2.4, 95% CI, 1.97–3.18) operative vaginal deliveries.
- The use of EFM did not reduce overall perinatal mortality (OR 0.87, 95% CI, 0.57–1.33) although perinatal mortality caused by fetal hypoxia appeared to be reduced (OR 0.41, 95% CI, 0.17–0.98). It is important to recognize that for the comparison of perinatal mortality between EFM and intermittent auscultation, the results presented are based on a small number of events; thus, the findings are statistically unstable. For example, for perinatal deaths caused by hypoxia, there were 17 deaths out of a total of 9,163 fetuses in the intermittent auscultation group and seven out of 9,398 in the EFM group. If there had been one fewer case of perinatal death in the intermittent auscultation group, the results of the meta-analysis for this outcome would not be statistically significant.

There is an unrealistic expectation that a nonreassuring FHR tracing is predictive of cerebral palsy. The positive predictive value of a nonreassuring pattern to predict cerebral palsy among singleton newborns with birth weights of 2,500 g or more is 0.14%, meaning that out of 1,000 fetuses with a nonreassuring FHR pattern, only one or two will develop cerebral palsy (7). The false-positive rate is extremely high, at greater than 99%.

Available data, although limited in size, suggest that EFM does not result in a reduction in cerebral palsy (3). This is consistent with data that suggest that the occurrence of cerebral palsy has been stable over time, despite the widespread introduction of EFM (8). The principal explanation for why the prevalence of cerebral palsy has not diminished despite the use of EFM is that 70% of cases occur before the onset of labor; only 4% of encephalopathies can be attributed solely to intrapartum events (9, 10).

Given that the available data do not clearly support EFM over intermittent auscultation, either option is acceptable in a patient without complications. Logistically, it may not be feasible to adhere to guidelines for how frequently the heart rate should be auscultated. One prospective study noted that the protocol for intermittent auscultation was successfully completed in only 3% of the cases (11). The most common reasons for unsuccessful intermittent auscultation included the frequency of recording and the requirements for recording.

Intermittent auscultation may not be appropriate for all pregnancies. Most of the clinical trials that compare EFM with intermittent auscultation have excluded subjects at high risk for adverse outcomes, and the relative safety of intermittent auscultation in such cases is uncer-

tain. Those with high-risk conditions (eg, suspected fetal growth restriction, preeclampsia, and type 1 diabetes) should be monitored continuously.

There are no comparative data indicating the optimal frequency at which intermittent auscultation should be performed in the absence of risk factors. One method is to evaluate and record the FHR at least every 15 minutes in the active phase of the first stage of labor and at least every 5 minutes in the second stage (12).

▶ *What is the interobserver and intraobserver variability of electronic fetal heart rate monitoring assessment?*

There is a wide variation in the way obstetricians interpret and respond to EFM tracings. When four obstetricians, for example, examined 50 cardiotocograms, they agreed in only 22% of the cases (13). Two months later, during the second review of the same 50 tracings, the clinicians interpreted 21% of the tracings differently than they did during the first evaluation (14). In another study, five obstetricians independently interpreted 150 cardiotocograms (15). The obstetricians interpreted the tracings similarly in 29% of the cases, suggesting poor interobserver reliability.

An important factor that influences the interpretation of cardiotocograms is whether the tracing is normal, equivocal, or ominous, with greater agreement if the tracing is reassuring (16). With retrospective reviews, the foreknowledge of neonatal outcome may alter the reviewer's impressions of the tracing. Given the same intrapartum tracing, a reviewer is more likely to find evidence of fetal hypoxia and criticize the obstetrician's management if the outcome was supposedly poor versus good (17).

▶ *Should the very preterm fetus be monitored?*

The decision of whether to monitor the very preterm fetus is complicated. It requires a discussion between the obstetrician, pediatrician, and patient concerning the likelihood of survival or severe morbidity of the preterm child (based on gestational age, estimated fetal weight, and other factors) and issues related to mode of delivery.

If a patient would undergo a cesarean delivery for fetal indications for a very preterm fetus, monitoring should be achieved continuously rather than intermittently auscultated. The earliest gestational age that this will occur may vary by the institution. Nonreassuring FHR patterns may occur with up to 60% of preterm parturients, with the most common abnormality being deceleration and bradycardia, followed by tachycardia and a flat tracing (18). Variable decelerations are more common among preterm (55–70%) than term (20–30%) deliveries (19). Because preterm fetuses may be more susceptible to intrapartum hypoxemia, they should be monitored. If FHR abnormalities are persistent, intrauterine resuscitation, ancillary tests to ensure fetal well-being, and possibly delivery should be undertaken (20).

▶ *What medications affect the fetal heart rate?*

Fetal heart rate patterns can be influenced by the medications administered in the intrapartum period. Most often, these changes are transient, although they sometimes lead to obstetric interventions.

Epidural analgesia with local anesthetic agents (lidocaine, bupivacaine) can lead to sympathetic blockade, maternal hypotension, transient uteroplacental insufficiency, and alterations in the FHR. Parenteral narcotics also may affect the FHR. A randomized trial comparing epidural anesthesia with 0.25% of bupivacaine and intravenous meperidine reported that the beat-to-beat variability was decreased, and FHR accelerations were significantly less common with parenteral analgesia compared with regional analgesia (21). The rates of decelerations and cesarean delivery for nonreassuring FHR tracings were similar for the two groups. A systematic review of five randomized trials and seven observational studies also noted that the rate of cesarean delivery for nonreassuring FHR was similar between those who did and those who did not receive epidural analgesia during labor (22).

Concern has been raised about combined spinal–epidural anesthesia during labor. An intent-to-treat analysis of 1,223 parturients randomized to combined spinal–epidural anesthesia (10 μg intrathecal sufentanil, followed by epidural bupivacaine and fentanyl at the next request for analgesia) or intravenous meperidine (50 mg on demand, maximum 200 mg in 4 hours) noted a significantly higher rate of bradycardia and emergent cesarean delivery for nonreassuring abnormal FHR in the group randomized to combined spinal–epidural anesthesia (23). Neonatal outcome, however, was not significantly different between the two groups. There are methodologic concerns with this study, and additional trials are necessary to determine the potential safety and efficacy of the combined spinal–epidural technique (22).

The effect of corticosteroids, to enhance pulmonary maturity of fetuses during preterm labor, on FHR has been studied (Table 2). Among twins (24) and singletons (25, 26), the use of betamethasone transiently decreased the FHR variability, which returned to pretreatment status by the fourth (25) to seventh (26) day. There also may be a decrease in the rate of accelerations with the use of betamethasone. These changes, however, were not associated with increased obstetric interventions or with adverse outcomes (24). The biologic mechanism of this is

Table 2. Effects of Medications on Fetal Heart Rate Patterns

Medications	Reference	Study Design	Effect on Fetal Heart Rate
Butorphanol	Hatjis 1986[1]	Case–control	Transient sinusoidal FHR pattern
Cocaine	Chazotte 1991[2]	Case–control	No characteristic changes in FHR pattern
Corticosteroid	Senat 1998[3]	Randomized clinical trial	Decrease in FHR variability with betamethasone but not dexamethasone
Magnesium sulfate	Hallak 1999[4] and Wright 1996[5]	Randomized clinical trial and retrospective	A significant decrease in the FHR baseline and variability; inhibits the increase in accelerations with advancing gestational age
Meperidine	Giannina 1995[6]	Randomized clinical trial	No characteristic changes in FHR pattern
Morphine	Kopecky 2000[7]	Case–control	Decreased number of accelerations
Nalbuphine	Giannina 1995[6]	Randomized clinical trial	Decreased the number of accelerations, long- and short-term variation
Terbutaline	Tejani 1983[8]	Retrospective	Abolishment or decrease in frequency of late and variable decelerations
Zidovudine	Blackwell 2001[9]	Case–control	No difference in the FHR baseline, variability, number of accelerations or decelerations

Abbreviation: FHR, fetal heart rate.

[1]Hatjis CG, Meis PJ. Sinusoidal fetal heart rate pattern associated with butorphanol administration. Obstet Gynecol 1986;67:377–80.

[2]Chazotte C, Forman L, Gandhi J. Heart rate patterns in fetuses exposed to cocaine. Obstet Gynecol 1991;78:323–5.

[3]Senat MV, Minoui S, Multon O, Fernandez H, Frydman R, Ville Y. Effect of dexamethasone and betamethasone on the fetal heart rate variability in preterm labour: a randomised study. Br J Obstet Gynaecol 1998;105:749–55.

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[5]Wright JW, Ridgway LE, Wright BD, Covington DL, Bobitt JR. Effect of MgSO4 on heart rate monitoring in the preterm fetus. J Reprod Med 1996;41:605–8.

[6]Giannina G, Guzman ER, Lai YL, Lake MF, Cernadas M, Vintzileos AM. Comparison of the effects of meperidine and nalbuphine on intrapartum fetal heart rate tracings. Obstet Gynecol 1995;86:441–5.

[7]Kopecky EA, Ryan ML, Barrett JF, Seaward PG, Ryan G, Koren G, et al. Fetal response to maternally administered morphine. Am J Obstet Gynecol 2000;183:424–30.

[8]Tejani NA, Verma UL, Chatterjee S, Mittelmann S. Terbutaline in the management of acute intrapartum fetal acidosis. J Reprod Med 1983;28:857–61.

[9]Blackwell SC, Sahai A, Hassan SS, Treadwell MC, Tomlinson MW, Jones TB, et al. Effects of intrapartum zidovudine therapy on fetal heart rate parameters in women with human immunodeficiency virus infection. Fetal Diagn Ther 2001;16:413–6.

unknown. Computerized analysis of the cardiotocograms indicates that use of dexamethasone is not associated with a decrease in the FHR variability (26).

Other medications that influence FHR tracing have been studied (see Table 2). Pseudosinusoidal FHR patterns occurred in 75% of patients who received butorphanol during labor, but this was not associated with adverse outcomes (27). Fetuses exposed to cocaine did not exhibit any characteristic changes in the heart rate pattern, although they did have frequent contractions even when labor was unstimulated (28). Multiple regression analysis indicated that decreased variability associated with the use of magnesium sulfate was related to early gestational age but not the serum magnesium level (29). As determined by computer analysis of cardiotocograms, a randomized trial reported that compared with meperidine, nalbuphine used for intrapartum analgesia decreased the likelihood of two 15-second decelerations over 20 minutes (30). In antepartum patients, administration of morphine decreased not only the fetal breathing movement but also the number of accelerations (31).

▶ *What findings on EFM reassure fetal status?*

The presence of FHR accelerations generally ensures that the fetus is not acidemic and provides reassurance of fetal status. The data relating FHR variability to clinical outcomes, however, are sparse. One study reported that in the presence of late or variable decelerations, the umbilical arterial pH was higher than 7 in 97% of the cases if the FHR tracing had normal variability (32). In another retrospective study, most cases of adverse neonatal outcome demonstrated normal FHR variability (33). This study is limited because it did not consider other characteristics of the FHR tracing, such as the presence of accelerations or decelerations. Thus, in most cases, normal FHR variability provides reassurance about fetal status.

▶ *How is a nonreassuring EFM tracing initially assessed?*

A persistently nonreassuring FHR tracing requires evaluation of the possible causes. Initial evaluation and treatment may include:

- Discontinuation of any labor stimulating agent
- Cervical examination to assess for umbilical cord prolapse or rapid cervical dilation or descent of the fetal head
- Changing maternal position to left or right lateral recumbent position, reducing compression of the vena cava and improving uteroplacental blood flow
- Monitoring maternal blood pressure level for evidence of hypotension, especially in those with regional anesthesia (if present, treatment with ephedrine or phenylephrine may be warranted)
- Assessment of patient for uterine hyperstimulation by evaluating uterine contraction frequency and duration

▶ *Are there ancillary tests that reassure fetal status?*

The false-positive rate of EFM is high. There are some ancillary tests available that help to ensure fetal well-being in the face of a nonreassuring FHR tracing, thereby reducing the false-positive rate of EFM.

In the case of an EFM tracing with decreased or absent variability without spontaneous accelerations, an effort should be made to elicit one. A meta-analysis of 11 studies of intrapartum fetal stimulation noted that four techniques are available to stimulate the fetus: 1) fetal scalp sampling, 2) Allis clamp scalp stimulation, 3) vibroacoustic stimulation, and 4) digital scalp stimulation (34). Each of these tests is a reliable method to exclude acidosis if accelerations are noted after stimulation. Because vibroacoustic stimulation and scalp stimulation are less invasive than the other two methods, they are the preferred methods. When there is an acceleration following stimulation, acidosis is unlikely and labor can continue.

When a nonreassuring FHR tracing persists and neither spontaneous nor stimulated accelerations are present, a scalp blood sample for the determination of pH or lactate can be considered. However, the use of scalp pH has decreased (35), and it may not even be available at some tertiary hospitals (36). The sensitivity and positive predictive value of a low scalp pH (defined in the study as less than 7.21 because it is the 75th percentile) to predict umbilical arterial pH less than 7 were 36% and 9%, respectively. More importantly, the sensitivity and positive predictive value of a low scalp pH to identify a newborn with hypoxic–ischemic encephalopathy were 50% and 3%, respectively (37).

The use of pulse oximetry has been suggested as a modality to reduce the false-positive rate of a nonreassuring FHR tracing. A multicenter randomized clinical trial reported that among term singleton fetuses with nonreassuring FHR patterns, the use of fetal pulse oximetry along with electronic tracing was associated with a significantly lower rate (4.5%) of cesarean delivery for presumed nonreassuring tracing than the controls (10%), who were managed with FHR monitoring alone (38). However, before proceeding with emergent cesarean delivery, most of the patients had not undergone ancillary tests to assess fetal well-being or intrauterine resuscitation, both of which could have decreased the need to proceed with cesarean delivery. Moreover, the randomized trial decreased neither the overall rate of cesarean delivery nor the rate of umbilical arterial pH less than 7. Because of the uncertain benefit of pulse oximetry and concerns about falsely reassuring fetal oxygenation, use of the fetal pulse oximeter in clinical practice cannot be supported at this time. Additional studies to test the efficacy and safety of fetal pulse oximetry are underway.

▶ *Are there methods of intrauterine resuscitation that can be used for persistently nonreassuring patterns?*

Maternal oxygen commonly is used in cases of a persistently nonreassuring pattern. Unfortunately, there are no data on the efficacy or safety of this therapy. Often, the nonreassuring FHR patterns persist and do not respond to change in position or oxygenation. In such cases, the use of tocolytic agents has been suggested to abolish uterine contractions and perhaps avoid umbilical cord compression. A meta-analysis reported the pooled results of three randomized clinical trials that compared tocolytic therapy (terbutaline, hexoprenaline, or magnesium sulfate) with untreated controls in the management of a suspected nonreassuring FHR tracing (39). Compared with no treatment, tocolytic therapy more commonly improved the FHR tracing. However, there were no differences in rates of perinatal mortality, low 5-minute Apgar score, or admission to the neonatal intensive care unit between the groups (possibly because of the small sample size). Thus, although tocolytic therapy appears to reduce the number of FHR abnormalities, there is insufficient evidence to recommend it.

Hyperstimulation (six or more contractions in 10 minutes) or hypertonus (single contraction lasting more than 2 minutes) in conjunction with a nonreassuring FHR pattern can be successfully treated with β_2-adrenergic drugs (hexoprenaline or terbutaline). A retrospective study

suggested that 98% of cases of uterine hyperstimulation respond to treatment with a β-agonist (40).

When the FHR abnormality is recurrent variable decelerations, amnioinfusion to relieve umbilical cord compression should be considered (41). A meta-analysis of 12 randomized trials that allocated patients to no treatment or transcervical amnioinfusion noted that placement of fluid in the uterine cavity significantly reduced the rate of decelerations (relative risk 0.54, 95% CI, 0.43–0.68) and cesarean delivery for suspected fetal distress (relative risk 0.35, 95% CI, 0.24–0.52) (42). Because of the lower rate of cesarean delivery, amnioinfusion also decreased the likelihood that either the patient or the newborn will stay in the hospital more than 3 days (42). Amnioinfusion can be done by bolus or continuous infusion technique. A randomized trial compared the two techniques of amnioinfusion and concluded that both have a similar ability to relieve recurrent variable decelerations (43).

Another common cause of nonreassuring FHR patterns is maternal hypotension secondary to regional anesthesia. If maternal hypotension is identified and suspected to be secondary to regional anesthesia, treatment with intravenous ephedrine is warranted.

Summary of Recommendations and Conclusions

The following recommendations are based on good and consistent scientific evidence (Level A):

- The false-positive rate of EFM for predicting adverse outcomes is high.
- The use of EFM is associated with an increase in the rate of operative interventions (vacuum, forceps, and cesarean delivery).
- The use of EFM does not result in a reduction of cerebral palsy rates.
- With persistent variable decelerations, amnioinfusion reduces the need to proceed with emergent cesarean delivery and should be considered.

The following recommendations are based on limited or inconsistent scientific evidence (Level B):

- The labor of parturients with high-risk conditions should be monitored continuously.
- Reinterpretation of the FHR tracing, especially knowing the neonatal outcome, is not reliable.
- The use of fetal pulse oximetry in clinical practice cannot be supported at this time.

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The MEDLINE database, the Cochrane Library, and ACOG's own internal resources and documents were used to conduct a literature search to locate relevant articles published between January 1985 and December 2004. The search was restricted to articles published in the English language. Priority was given to articles reporting results of original research, although review articles and commentaries also were consulted. Abstracts of research presented at symposia and scientific conferences were not considered adequate for inclusion in this document. Guidelines published by organizations or institutions such as the National Institutes of Health and the American College of Obstetricians and Gynecologists were reviewed, and additional studies were located by reviewing bibliographies of identified articles. When reliable research was not available, expert opinions from obstetrician–gynecologists were used.

Studies were reviewed and evaluated for quality according to the method outlined by the U.S. Preventive Services Task Force:

- I Evidence obtained from at least one properly designed 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 with or without the intervention. Dramatic results in uncontrolled experiments also could be regarded as this type of evidence.
- III Opinions of respected authorities, based on clinical experience, descriptive studies, or reports of expert committees.

Based on the highest level of evidence found in the data, recommendations are provided and graded according to the following categories:

Level A—Recommendations are based on good and consistent scientific evidence.

Level B—Recommendations are based on limited or inconsistent scientific evidence.

Level C—Recommendations are based primarily on consensus and expert opinion.

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Intrapartum fetal heart rate monitoring. ACOG Practice Bulletin No. 62. American College of Obstetricians and Gynecologists. Obstet Gynecol 2005;105:1161–69.