Antenatal Evaluation of the Fetus Using Fetal Movement Monitoring

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The concept of monitoring fetal body movements has existed for more than a century. Early knowledge of fetal neurologic function was based on maternal perception of aborted fetuses and on systematic studies of newborn infants. Information on how the fetus moves and about quantitative and qualitative movement patterns during gestation has become available in the last few decades. Real-time ultrasound has allowed a quality assessment of the comprehensive motor repertoire in healthy and undisturbed fetuses in their natural environment. This information has enabled characterization of fetal movements in growth-restricted fetuses, fetuses destined to deliver prematurely, and those with either congenital malformations or chromosomal disorders.

This manuscript addresses the monitoring of fetal movements, focusing on methods to record and classify different activities. Relations between fetal movement and either simultaneous fetal heart rate (FHR) accelerations or external stimuli are described, especially in relation to a cascade of fetal testing. Limitations to fetal movement monitoring and special considerations are discussed.

Fetal Surveillance Techniques
Methods to monitor fetal movement range from charting maternally perceived movements to sophisticated methods requiring specialized equipment operated by skilled professionals, such as real-time ultrasonography, Doppler ultrasound, and electronic FHR monitoring.

MATERNAL PERCEPTION
Perceived fetal motion by a compliant gravida is the simplest and least expensive technique for monitoring fetal well-being in

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the second half of pregnancy. It requires no monitoring devices or laboratory procedures. Independent studies have reported a significant positive correlation between maternal perception of fetal movement and movements confirmed by ultrasound scanning from 28 to 43 weeks of gestation.1

Several methods for charting fetal kick counts are described in Table 1.2–9 Although several protocols have been used, neither the optimal number of movements nor the ideal duration for counting them has been defined. The definition of decreased fetal activity is therefore not universal.

An attractive method is the “count to 10” technique.3 This method is simple and can be performed at any convenient time. Table 2 shows an example of a “count to 10” chart. Patients can easily provide a “report card” for the fetus by noting whether the fetus received an A, B, C, D, or, rarely, F. An F rating should be evaluated with further testing; the woman should contact her healthcare provider for specific instructions.

### TABLE 1. Techniques for Monitoring Perceived Fetal Motion

<table>
<thead>
<tr>
<th>Study (year)</th>
<th>Definition of Decreased Fetal Activity</th>
<th>Recording Periods</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pearson and Weaver (1976)2</td>
<td>&lt;10 movements/12 h</td>
<td>12 hours (9:00 AM–9:00 PM) daily</td>
</tr>
<tr>
<td>Sadovsky and Polishuk (1977)3</td>
<td>&lt;2 movements/h</td>
<td>30 minutes to 1 hour, twice or three times daily</td>
</tr>
<tr>
<td>Neldham (1980)4</td>
<td>≤3 movements/h</td>
<td>One 2-hour period, three times weekly</td>
</tr>
<tr>
<td>O’Leary and Andrinopoulos (1981)5</td>
<td>0–5 movements/30 min for each of the three 30-min periods</td>
<td>Three 30-minute periods, daily</td>
</tr>
<tr>
<td>Harper et al (1981)6</td>
<td>Complete cessation</td>
<td>Three 1-hour periods, daily</td>
</tr>
<tr>
<td>Leader et al (1981)7</td>
<td>1 day of no movements or 2 successive days/week in which there are &lt;10 movements/h</td>
<td>30 minutes, four times daily</td>
</tr>
<tr>
<td>Rayburn (1982)8</td>
<td>&lt;3 movements/h for 2 consecutive hours</td>
<td>&gt;1 hour (when convenient)</td>
</tr>
<tr>
<td>Picquadio and Moore (1998)9</td>
<td>&lt;10 movements/h for 2 consecutive hours</td>
<td>Count to 10 movements (no time restrictions)</td>
</tr>
</tbody>
</table>

### TABLE 2. Example of a “Count to 10” Fetal Kick Count Chart

<table>
<thead>
<tr>
<th>Week</th>
<th>Sunday</th>
<th>Monday</th>
<th>Tuesday</th>
<th>Wednesday</th>
<th>Thursday</th>
<th>Friday</th>
<th>Saturday</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>A</td>
<td>A</td>
<td>A</td>
<td>A</td>
<td>A</td>
<td>A</td>
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<tr>
<td>F</td>
<td>F</td>
<td>F</td>
<td>F</td>
<td>F</td>
<td>F</td>
<td>F</td>
<td>F</td>
</tr>
</tbody>
</table>

To know more about your baby, we ask you to count how many minutes it takes you to feel 10 distinct movements (kick, stretches, or rollovers—not hiccups). Do this anytime while lying on your side. Circle the letter corresponding to the number of minutes.

A = 0–15 minutes; B = 16–30 minutes; C = 31–45 minutes; D = 46–60 minutes; F = >60 minutes.
The patient should be encouraged to lie on her side and to concentrate on fetal movement. For many women, evening hours are most convenient for movement charting. Despite a commonly held belief, a recent meal or juice intake is not necessary, because gross fetal body movements are unaffected by maternal glucose levels. Fetal limb and body movements, breathing movements, heart rate, and Doppler velocity waveforms are not affected by maternal glucose levels as low as 45 mg/dL.

The patient should be clearly instructed about the specific technique of recording perceived fetal movement. The importance of recognizing decreased fetal activity must be stressed. Most women are compliant when they understand the rationale for fetal monitoring and are informed that the procedure usually requires no more than 1 or 2 hours per day. Continued encouragement by a consistent healthcare professional yields the most complete findings.

Fetal movement charting may enhance maternal–fetal bonding. Having the father periodically help with charting may also prove useful in the family attachment process and in some cases may reinforce compliance. The small number of women who are incapable of recording perceived fetal movement often improve their perceptive ability when viewing activity during real-time ultrasound examinations.

**REAL-TIME ULTRASOUND IMAGING**

Direct observation of fetal movement over extended periods is permitted using real-time ultrasound imaging without disturbing the fetus. Two-dimensional images are produced by placing an ultrasound transducer, usually 3.5 MHz, on the maternal abdomen along the axis of the fetal thorax and abdomen. Two transducers used simultaneously to visualize the whole fetus have been used for research purposes. A 5- to 30-minute observation period is commonly considered to be adequate. The frequency, intensity, and duration of fetal movements are correlated with maternal perception of the movements.

Certain movements of lesser duration or intensity, observed during an ultrasound examination, are not usually perceived.

Although ultrasound assessment of gross body movements is important as a diagnostic index of fetal well-being, the underlying morphologic substrate of these movements and their functional significance during prenatal life are less clearly understood. This lack of knowledge is related in part to limited information about the ultrastructure of the central nervous system and muscles in the fetus, particularly synapse and motor end plate formation. Shortcomings of ultrasound investigations of fetal movement patterns and their developmental course relate to the relatively short duration of observation (usually only a few minutes) and the lack of repeated observations.

Comparisons of longitudinal observations of fetal behavior with the well-established patterns of postnatal behavior in low-risk premature infants have revealed striking similarities between fetal and preterm infant behaviors at the same conceptual age. Identical movement patterns in the fetus may be observed after birth, along with certain specific movements such as the Moro reflex that represent an apparent adaptation to the extraterine environment. Terminology used to describe movement patterns in the newborn applies before birth. The reduced effect of gravity in utero may cause a more gradual drop of an elevated limb. Similarly, flexion of the head or rotation of the body, which is normally seen in infants, is observed in utero because of the buoyancy effect of amniotic fluid.

**DOPPLER ULTRASOUND**

Fetal movement may be documented by Doppler ultrasound. Faterni et al found pulsed Doppler and B-modes to be associated with fetal stimulation. When this modality is used, the fetus is observed in a disturbed state.

Limb and trunk movements can be recorded with very low-frequency signals by passing the Doppler signal through a band.
filter. In contrast, unprocessed raw signals may impede the analysis of movement. Electronic monitoring systems are commonly used for the continuous automatic, time-synchronous recordings of gross fetal body movements and heart rate. The Hewlett-Packard M-1350-A (Boeblingen, Germany) Doppler device is reported to record 94% of isolated limb movements, 95% of spinal flexion and extension movements, 97% of rolling movements, and 100% of complex combined movements observed by ultrasound. Prolonged fetal movements are usually recorded as many movements of shorter duration, whereas brief discrete movements of lower intensity are inefficiently detected.

**FHR MONITORING**

Fetal movement and the onset of FHR accelerations are synchronized and coordinated functions. DePietro et al showed that coupling of fetal movement and FHR occurs as sympathetic and parasympathetic innervations develop. A heart-rate acceleration lagged 5 seconds behind the body movement at 32 weeks. Doppler and real-time ultrasound studies have shown an association between fetal trunk movement and the FHR pattern. Adequate accelerations (≥15 bpm and lasting >15 seconds) are associated with 79% of fetal movements perceived by pregnant women and 99% of fetal movements seen sonographically. Smaller accelerations are correlated with 53% of perceived movements and 82% of those recorded by ultrasound. A nonreactive nonstress test (NST) pattern is associated with either few or no Doppler-detected fetal movements.

Vibration is a potent stimulus to elicit fetal movements and heart rate changes. An electrolarynx firmly applied against the maternal abdomen, having an output of approximately 110 dB in a frequency range of 250 to 850 Hz, can produce a vibroacoustic stimulus. When the stimulus is applied for at least 3 seconds to a normal fetus during behavioral state 1F (when the FHR variability, body movements, and eye movements are the least), an abrupt increase in fetal movements is observed that may last for an hour. The typical fetal response consists of a startle reaction characterized by a head aversion, arm movement, and leg extension. Vibroacoustic stimulation is used often as a test for fetal well-being during periods of low FHR reactivity owing presumably to reduced motor activity. Fetal movement in response to this stimulation correlates with umbilical blood pH values of 7.20 or greater in situations in which initial FHR monitoring is neither reassuring or nonreassuring.

Evidence that the near-term fetus can hear has been offered for many years. Several systematic and well-controlled studies have shown a state of dependence similar to that in the newborn infant. In a randomized controlled trial using acoustic stimulation, Marden et al reported that 89% of fetuses had increased body movement, and stimulation was associated with a reactive NST result in 99% of cases. The effect of external light stimulation on fetal behavior was examined by Kiuchi et al. A positive response to a flashlight was observed by FHR acceleration and body movement when the fetus was in an awake rather than in a sleep cycle. This response was less than with vibroacoustic stimulation, which occurred during any behavior state.

**Characterization of Fetal Movements**

A distinction between fetal movements can be based on strength and speed (e.g., weak vs. strong, short vs. sustained) of the whole body or limb-only movements. Table 3 describes different types of observed fetal movement using this distinction. Although this type of characterization has been used...
since Reinold’s pioneering work, the complexity of movements exceeds the limited discrimination power of such categories. A systematic approach has been described by DeVries et al.\textsuperscript{24} within the conceptual context of developmental neurology. Their investigations were preceded by a longitudinal study by Prechtl and Nolte of strictly selected, low-risk preterm infants.\textsuperscript{12} These infants were chosen “because they are the only group whose behavior can be compared, with any meaning, with the recorded behavior of the intrauterine fetus during undisturbed pregnancies.” Repeated observations of fetuses by DeVries were videotaped on a longitudinal basis for 1 hour during the second trimester and for 2 hours during the third trimester.\textsuperscript{24} The fetal movements were characterized as follows:

**Startles** are quick generalized movements that always begin in the limbs and often spread to the trunk and neck. The duration of a startle is 1 second or less. Usually, these movements occur singly but sometimes may be repetitive. Startles can be superimposed on a general body movement.

**General body movements** are slower movements that involve the whole body. They last from a few seconds to a minute. A peculiarity of these movements is the indeterminate sequence of arm, leg, neck, and trunk movements (stretches, rollovers). The movements wax and wane in intensity, force, and speed. Despite this variability, these patterns are distinct and easy to recognize.

**Hiccups** are phasic contractions of the diaphragm, often repetitive at regular intervals. A bout of hiccups may last as long as several minutes. In contrast to the startle, the movement always starts in the trunk but may be followed by involvement of the limbs. **Fetal breathing movements** are usually paradoxical. Every contraction of the diaphragm (which after birth leads to an inspiration) causes an inward movement of the thorax and a simultaneous movement of the abdomen outward. The sequence of “breaths” is either regular or irregular. No amniotic fluid enters into the collapsed lungs during inspiration. Isolated breaths may resemble a sigh.

**Isolated arm or leg movements** (weak kick or jab) may occur without other body parts moving. The speed and amplitude of these movements vary.

**Twitches** are quick extensions or flexions of a limb or the neck. They are neither generalized nor repetitive.

**Clonic movements** are repetitive tremulous movements of one or more limbs at a rate of approximately three per second. More than three or four beats are rare in normal fetuses.

The total repertoire of these fetal movements involves motor patterns observed after birth. Although the newborn’s behavior matures rapidly, the striking similarity between fetal movements and postnatal motor patterns facilitates a consistent and comprehensive descriptive classification and terminology.

If monitoring fetal motion is useful in predicting fetal compromise, then one must be aware of movement patterns as they change with gestational age. Fetuses studied

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**TABLE 3. Characterization of Fetal Body Motion During the Second Half of Gestation**

<table>
<thead>
<tr>
<th>Maternal Perception</th>
<th>Visualized Movement</th>
<th>Types of Motion</th>
<th>Duration/Strength</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rollover, stretch</td>
<td>Whole fetal body</td>
<td>Rolling and stretching</td>
<td>Sustained/strong (3–30 sec)</td>
</tr>
<tr>
<td>Kick, jab, startle</td>
<td>Trunk and extremity</td>
<td>Simple or isolated</td>
<td>Short/strong (1–15 sec)</td>
</tr>
<tr>
<td>Flutter, weak kick</td>
<td>Lower extremity</td>
<td>Simple</td>
<td>Short/weak (&lt;1 sec)</td>
</tr>
<tr>
<td>Hiccup</td>
<td>Chest wall and isolated extremity</td>
<td>High frequency</td>
<td>Rapid/weak (&lt;1 sec)</td>
</tr>
</tbody>
</table>

From Rayburn.\textsuperscript{8}
longitudinally by DiPietro et al from 20 weeks’ gestation to term display these biophysical changes: progressively slower heart rate, increased beat-to-beat variability, reduced but more vigorous motor behavior, coalescence of heart rate and movement patterns into distinct behavioral states, and increased cardiac responsivity to stimulation with advancing gestation. Qualitative and quantitative measures of fetal activity do not decrease appreciably during the week before delivery.1 This observation dispels the common belief that a sudden loss or decrease in movement is predictive of impending labor.

Role in Fetal Surveillance
The compromised fetus presumably reduces its activity to decrease oxygen requirements. Documented cessation of activity warns of impending death.3,8,9 A gradual reduction in activity is more often associated with chronic rather than acute fetal compromise. Approximately of inactive fetuses are stillborn, tolerate labor poorly, or require resuscitation at birth.8

Fetal movement charting has become a useful adjunctive test for fetal assessment in high-risk pregnancies. Although such applications may be beneficial, questions regarding patient acceptability, the need for further fetal testing, and the perinatal implications of unwarranted intervention must be answered before the universal application of fetal movement charting protocols can be recommended.

If a patient reports fetal inactivity lasting more than 1 hour, then her perception should be confirmed. Any underlying complication must be sought. Fetal surveillance should be assessed more precisely either by electronic FHR monitoring or by ultrasound visualization (the biophysical profile). Although there is no evidence as to how promptly these women should be examined, we recommend evaluation within 12 hours of the woman’s perception of fetal inactivity. The findings must be carefully conveyed to the patient so that she does not experience undue anxiety.

The patient reporting fetal inactivity according to the charting technique should be queried as to whether she rested and concentrated on counting. If the patient remains uncertain regarding the inactivity, she should be instructed to count for another hour and to notify the provider again if few movements are felt. When cessation of movements is perceived, confirmation and further fetal evaluation should be initiated. An NST is an appropriate first step in evaluating these patients. In women with low-risk pregnancies, a reactive FHR pattern is reflective of an active fetus and is predictive of a favorable outcome in approximately 93% of cases.26 If the NST result is nonreactive, then either a contraction stress test or a biophysical profile is necessary. Unlike Doppler ultrasound, real-time ultrasonography permits an improved recognition of specific movement patterns. Direct visualization with ultrasonography provides an opportunity to localize fetal cardiac motion, search for major malformations, and semiquantify amniotic fluid volume.

If a vigorous fetus is confirmed, movement charting should still be encouraged unless the patient feels uncomfortable in relying on this screening method. A lack of body movement during sonographic observation may warrant transabdominal vibroacoustic stimulation. A vibroacoustic stimulus-evoked fetal startle response, observed during ultrasonography, is a good predictor of a reassuring biophysical profile score (8–10) in almost all cases.27 Subsequent biophysical profile testing or delivery may be indicated depending on the clinical situation or if the score is lower.1

Limitations to Movement Monitoring
Every fetal movement monitoring technique is fallible. Examples of limitations include expense and equipment needs, and failure to
anticipate certain fetal deaths, malformations, or growth abnormalities.

EXPENSE AND PATIENT INCONVENIENCE
Optimal assessment of fetal well-being requires continuous rather than intermittent monitoring of movement. Monitoring often requires evaluation for 30-minute periods or longer with costly equipment (ultrasonography, electronic FHR monitor, Doppler ultrasound) operated by skilled professionals. Consequently, monitoring is usually performed only weekly or semiweekly. Evaluation is to begin when the pregnancy has reached a critical stage (usually >32 weeks) when extrauterine survival is very probable and delivery is an acceptable option.

The daily perception of fetal activity has the distinct advantages of no cost and the ability to monitor at any time and place. However, expecting the pregnant woman to monitor her fetus for more than 1 hour daily for long periods can lead to compliance problems.

PREDICTING FETAL GROWTH
Perceived fetal movement patterns are inaccurate for detecting most growth abnormalities. Growth-restricted fetuses exhibit significantly lower activity rates than normally grown fetuses at all gestational ages when evaluated consistently by ultrasound, even though fetal activity may be perceived as being normal by the gravida. Diminished activity can be anticipated in only the most severe cases, such as fetuses in the lower fifth percentile for estimated weight. When sonography confirms that a fetus is small for gestational age, an underlying medical, genetic, metabolic, or chronic inflammatory process should be considered. Activity patterns of fetuses large for gestational age are thought to be indistinguishable from activity patterns of appropriately sized fetuses. An exception would be a severely hydropic fetus with polyhydramnios in whom activity is perceived to be significantly less.

DETECTING MALFORMATIONS AND THEIR OUTCOMES
Only a few malformations or fetal conditions affect movement. Excess activity, defined clinically as an average of more than 40 perceived motions per hour for at least 14 days, may represent a fetal anomaly such as anencephaly. Rapid seizure-like movement has been described among brain-dead fetuses who are decerebrate with hypertonicity. A lack of vigorous motion may relate to abnormalities of central nervous system pathways or, less commonly, to muscular dysfunction, skeletal abnormalities, or mechanical restriction of the lower extremities. Inactivity has been documented in fetuses with major malformations such as hydrocephalus, bilateral renal agenesis, and bilateral hip dislocation. A malformation should be considered when activity is not perceived in the presence of oligohydramnios or polyhydramnios.

Fetal movement charting has not been useful in predicting outcomes in the presence of malformations. Sonographic studies can improve our understanding about central nervous system development and the formation of fetal movement patterns. Weekly recordings comparing a normal with an anencephalic fetus in a twin pregnancy have provided insight into the development of the central nervous system. Cerebral matter above the medulla oblongata plays an important role in the elimination of fetal movements, such as startle and writhing, and in the commencement of breathing movements. In the fetus with an open neural tube defect, kicks may be perceived as being normal by the pregnant woman. Leg movements below these lesions seem to be of normal quality when assessed with real-time ultrasound. Longitudinal follow-up of these fetuses reveals that fetal and early neonatal leg movements are not predictive of postnatal motor function. Early sensory function is strongly related to the level of open spinal defect, however, and accurately predicts final motor outcome in most cases.
REDUCING ANTEPARTUM STILLBIRTHS

The value of fetal movement charting to reduce antepartum stillbirth has not been proven. Its application to low-risk pregnancies is attractive because approximately half of stillbirths occur without obvious cause.\(^8,9\) The diagnosis of fetal death, especially when unexplained, necessitates prompt delivery for meticulous gross and microscopic examination of the stillborn infant, umbilical cord, and placenta. Most clinical trials of fetal movement monitoring involve too few cases to predict the risk of stillbirth. In a large study of more than 68,000 pregnancies, Grant et al.\(^{34}\) randomized these patients, regardless of risk category, either to routinely perform movement charting or to do no charting. Women in the charting arm were instructed to record the time needed to feel 10 movements each day. Women in the control group were informally asked about movements during prenatal visits. Antepartum death rates for normally formed singletons were similar in the two study groups, regardless of risk status. Most stillborn fetuses were dead by the time the mothers received medical attention. The investigation concluded that maternal perceptions were thought to be as good as routinely charted fetal movements.

No technique of fetal surveillance can predict all stillbirths. When movement patterns are reassuring, the low proportion of unfavorable outcomes is usually related to acute hypoxic events, presumably from an umbilical cord compression or a placental abruption.\(^8,34\) An autopsy often shows no obvious abnormalities. On careful questioning, the patient frequently describes a sudden loss of perceived movement shortly before fetal death is confirmed.

LIMITATIONS OF DOPPLER ULTRASOUND

Doppler ultrasound can neither distinguish between types of body movements nor detect very subtle movements. Single or cluster recordings of movements reflect isolated kicks or more coordinated trunk and extremity movements such as stretches or roll-overs.\(^{16}\) As is true for maternal perception, Doppler ultrasound cannot detect fetal activity such as rapid eye, breathing, and hand movements. In addition to missing certain forms of movement, Doppler ultrasound can record unwanted signal artifacts, usually caused as the woman moves or when the Doppler beam is repositioned. Experience in recognizing such artifacts and in reducing such extraneous movement helps the clinician determine which recordings more accurately indicate fetal body movement.

Special Considerations

FETAL SLEEP–WAKE CYCLES

An appreciation of fetal sleep–wake cycles is important when evaluating fetal movement. Being independent of the maternal sleep–awake state, fetal “sleep cyclicity” has been described to vary considerably. Timor-Tritsch et al.\(^{35}\) reported that the mean length of the quiet or inactive state for term fetuses was about 23 minutes. Patrick et al.\(^{36}\) measured gross fetal body movements with real-time ultrasound for 24-hour periods in 31 normal pregnancies and found the longest period of inactivity to be 75 minutes.

In the third trimester, when fetal movement monitoring is more clinically applicable, behavioral states are established in nearly all fetuses. Nijhuis et al.\(^{37}\) studied the combination of FHR patterns, eye movements, and whole body movements to describe four distinct fetal behavioral states:

- **State 1F** is a quiescent state (quiet sleep), with a narrow oscillatory bandwidth of the FHR.
- **State 2F** includes frequent whole body movements, continuous eye movements, and wider FHR oscillation. This state (active sleep) is analogous to rapid eye movement (REM) in the neonate.
- **State 3F** includes continuous eye movements in the absence of body movements and no FHR accelerations.
State 4F is one of vigorous body movements with continuous eye movements and FHR accelerations. This state corresponds to the awake state in infants.

Fetuses spend most of their time in the two sleeping states, 1F and 2F. The state 3F has been disputed.38

MATERNAL EXERCISE
One ultrasonographic study of the effects of maternal exercise (20 minutes of aerobic dance) on fetal behavior in late gestation showed a significant decrease in fetal breathing but no significant change in shoulder movement or kick response.39 Effects of low-impact exercise on the fetus are mild and transitory, and fetal movement charting immediately after this activity is not necessary.

Heavy maternal exercise affects the fetus with signs of transient impairment. In 12 healthy women, Manders et al40 reported that the number of fetal body movements inversely correlated with the percentage of maximal increase in maternal heart rate. The FHR and breathing movements decreased significantly when the maximal increase in maternal pulse exceeded 90%. At this level of cardiac stress, two cases of fetal bradycardia were reported, followed by reduced FHR variability and the absence of body and breathing movements for 20 minutes.

SUBJECTIVELY LESS FETAL MOVEMENT
A bothersome clinical situation occurs when women present in late gestation with a concern about feeling less fetal movement. Harrington et al41 reported that 7% of pregnant women at a London hospital presented for this reason. FHR monitoring was undertaken if ultrasound scans for fetal growth or Doppler velocimetry were abnormal. Pregnancy outcomes for these women were not significantly different than a control group of women without this complaint. This condition among women who did no charting may have been reduced if instructions to chart had been given.

EFFECTS OF MEDICATIONS
Sedating drugs such as alcohol, barbiturates, narcotics, methadone, or benzodiazepines are known to cross the placenta easily. Significantly more NST results are nonreactive or take longer to become reactive in the methadone-maintained gravid. Biophysical profile scores are reported to be the same before and after methadone dosing in 75% of women.42 Kopecyk et al43 noted that morphine administered to the mother may significantly decrease the biophysical profile score by reducing fetal breathing (80%) and by an NST being nonreactive (60%). Neither movement nor tone was affected. Altered behavior is expected to reverse after clearance of the drug.

Possible effects of maternal antiepileptic medication on fetal movement have been examined between 32 and 38 weeks’ gestation.44 No marked differences in patterns of fetal motion and FHR were observed, and no obvious effect on fetal neuromuscular development could be found.

Changes in fetal activity have been observed in patients receiving the corticosteroids betamethasone and dexamethasone. Mulder et al45 reported that on the second day after betamethasone administration, FHR variability was reduced by 20% and body and breathing movements were reduced by 49% and 85%, respectively. All values returned to normal by the fourth day after dosing, indicating a transient effect from the corticosteroid. Mushkat et al46 found that betamethasone led to decreased fetal movement as perceived by the mother and as observed by ultrasound. It was also associated with decreased fetal breathing. Administration of dexamethasone did not influence fetal whole body movement, although breathing was diminished after 24 hours postdosing.46 Neither drug affected the basal heart rate, beat-to-beat variability, or number of accelerations.
DISTINGUISHING BETWEEN MULTIPLE FETUSES

Only direct visualization with ultrasonography can distinguish between multifetal pregnancies. Videotaped recordings of twin pregnancies by Arabin et al.47 showed that contacts between fetuses that produce movement by the other twin may begin by 11 weeks’ gestation, or even earlier if twinning is monochorionic rather than dichorionic. Ultrasound imaging often shows “boxing matches” that last a few minutes and that are separated by rest periods. This type of activity may explain why the whole body movements of twins are thought to be more frequent than those of singletons.48 The patient’s perception that both fetuses are active is reassuring; however, the patient frequently reports that one fetus is more active than the other. The mother’s ability to distinguish between fetuses from day to day is unreliable with most multifetal gestations.

Summary

Monitoring fetal movement serves as an indirect measure of central nervous system integrity and function. The gradual coordination of whole body movement in the fetus, which requires complex neurologic control, is similar to the coordination of movement in the preterm newborn infant. Monitoring has its greatest value when placental insufficiency is long-standing; its routine role in low-risk pregnancies requires further clinical investigation. The presence of a vigorous fetus is reassuring. Perceived inactivity is a screening method that requires a reassessment of any underlying antepartum complication and a more precise evaluation by FHR testing or real-time ultrasonography. Evidence is lacking that monitoring fetal movement is an effective independent surveillance technique for predicting fetal growth, malformation, and stillbirth.

Acknowledgments:

Certain portions of material presented here were also published in Obstetrics and Gynecology Clinics of North America, Volume 26, December 1999. Permission was obtained from the publisher.

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