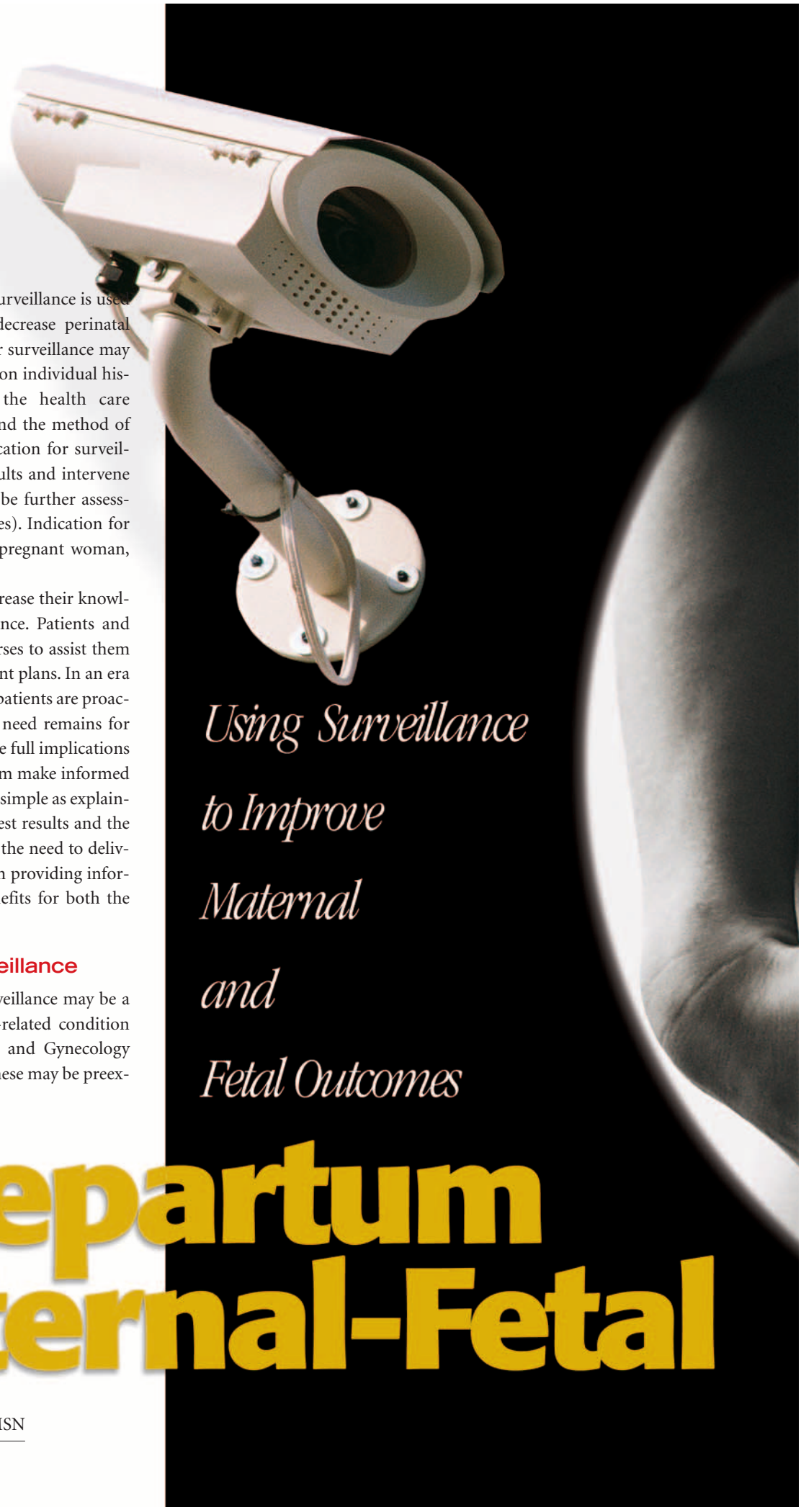


Antepartum Maternal-Fetal

Using Surveillance to Improve Maternal and Fetal Outcomes

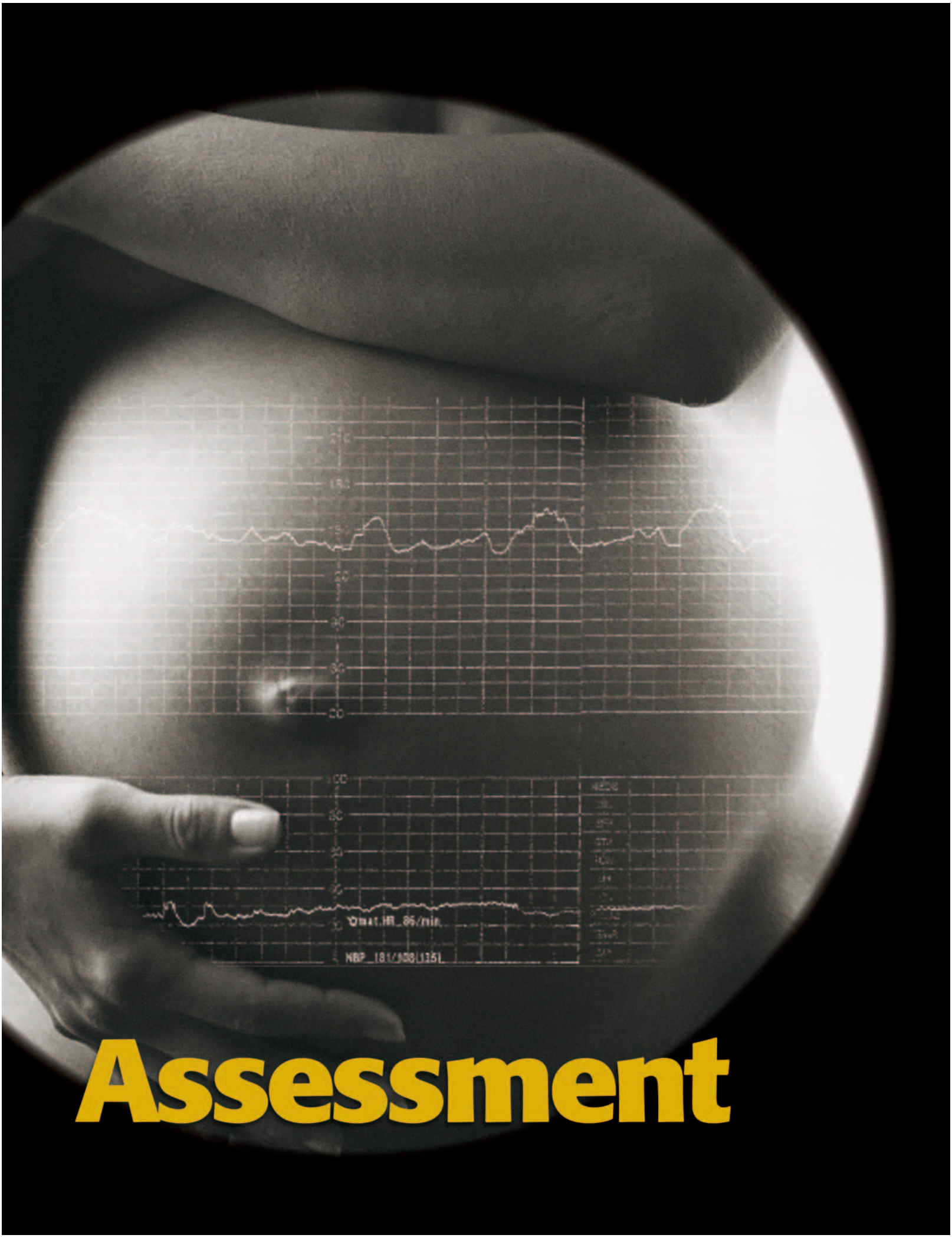
Kim Armour, CNP, APN, RDMS, MSN

Antenatal fetal assessment or surveillance is used to improve outcomes and decrease perinatal mortality. Fetal assessment or surveillance may be provided by various means based on individual history and case presentation. It's the health care provider's responsibility to understand the method of surveillance, the frequency and indication for surveillance and the ability to interpret results and intervene as necessary. Such intervention may be further assessment or actual delivery of the fetus(es). Indication for intervention may be specific to the pregnant woman, her baby or both.

The opportunity for nurses to increase their knowledge in this area has great importance. Patients and their family members depend on nurses to assist them with understanding care and treatment plans. In an era of consumer health awareness, some patients are proactive in seeking information, but the need remains for nurses to help patients understand the full implications of their health situation and help them make informed choices and decisions. This may be as simple as explaining a test or informing a patient of test results and the implications of those results, such as the need to deliver a baby early. It's often helpful when providing information to explain the risks and benefits for both the pregnant patient and her baby.

Indication for Fetal Surveillance

The primary indication for fetal surveillance may be a maternal condition or a pregnancy-related condition (American College of Obstetricians and Gynecology Compendium [ACOG], 2004a, b). These may be preex-


Assessment

isting or a new development related to the pregnancy. Common conditions include but aren't limited to maternal cardiac and pulmonary conditions, diabetes and hypertensive disorders including pregnancy-induced hypertension, intrauterine growth restriction, abnormal fluid volumes and multiple gestations.

Sometimes the indications for fetal surveillance are not as clear, such as with the 1 percent of women with unexplained elevated alpha fetal protein (AFP) serum levels. Adverse outcomes have been associated with elevated AFP levels, and although many providers do initiate antenatal surveillance, there is no published evidence to support this heightened surveillance (Fanaroff & Martin, 2002). A recent study by Huerta-Enochian, Katz, and Erfurth (2001) revealed no increased detection rate of poor outcome, but rather a risk for potential harm related to the high costs associated with heightened surveillance. The authors believe that routine obstetric care could by itself reduce the risk of adverse outcomes (Huerta-Enochian et al., 2001).

Today, fetal surveillance allows health care providers to assess fetal perfusion, fetal oxygenation and potential for hypoxia or acidosis. Prior studies involving both fetal and animal populations have been consistent in documenting a correlation between hypoxia and acidosis with changes in fetal biophysical parameters such as heart rate, tone, movement and breathing. The central nervous system of the fetus is believed to control the fetal heart rate (FHR) via mediation of the sympathetic and parasympathetic nerve impulses. Intermittent accelerations of the FHR correlate with fetal movement and are considered to be a sign of an intact autonomic nervous and fetal well-being (Fanaroff & Martin, 2002). Fetal surveillance was developed on the premise that decreased FHR changes, long-term variability and decreased fetal movements result in lower umbilical venous blood pH values (Manning, Morrison, Lange, Harman, and Chamberlain, 1985).

So how does a practitioner know who to test, when to test, how frequent to test and what the test results mean? When do you decide to recommend delivery and when do you decide to wait? Consider the care path that might be used as follows with a high-risk obstetric patient (see Figure 1).

Types of Fetal Surveillance

There are five basic types of fetal surveillance currently used by practitioners, including:

- fetal kick counting
- nonstress testing
- contraction stress test
- biophysical profile
- doppler flow studies

The most basic and least invasive form of fetal surveillance is fetal kick counting. With fetal kick counting, fetal movements have been correlated with positive fetal well-being; lack of fetal movement is associated with poor fetal outcomes; however, only one randomized controlled study of antenatal fetal movement assessment has been able to demonstrate a decrease in the fetal mortality rate (Neldam, 1980).

Many methods of fetal movement counting have been described and studied (Neldam, 1980). A pregnant woman's perception of fetal movement has been validated via real-time ultrasonography with an 80 to 90 percent confidence rate (Neldam, 1980). Since decreased fetal activity has been linked to fetal death, the practice of counting fetal movements should be recommended for all pregnant women, regardless of risk assessment, by 28 weeks of gestation.

The Count to Ten Cardiff chart describes a process where a pregnant woman will count fetal movement during a period of 12 hours. At a minimum, the woman needs to count 10 movements during a period of 12 hours and note when the 10th movement was felt. If she feels less than 10 movements or it takes longer to account for 10 movements than the previous day, the patient is to notify her care provider. Variations of this method have been utilized including counting specifically in the evening when fetal movements have been documented to be the greatest (Moore & Piacquadiok, 1989, 1990).

Some women are advised to count a minimum of 10 movements in the two hours after each meal of the day. If the fetus is unresponsive after one hour, women are advised to stimulate the baby gently by changing position or making a noise, something similar to vibral acoustic stimulation. If they cannot obtain a total of 10 movements in a two-hour period or if there is a notable decrease in their perception of movement from one day to the next, they should be instructed to notify their care provider.

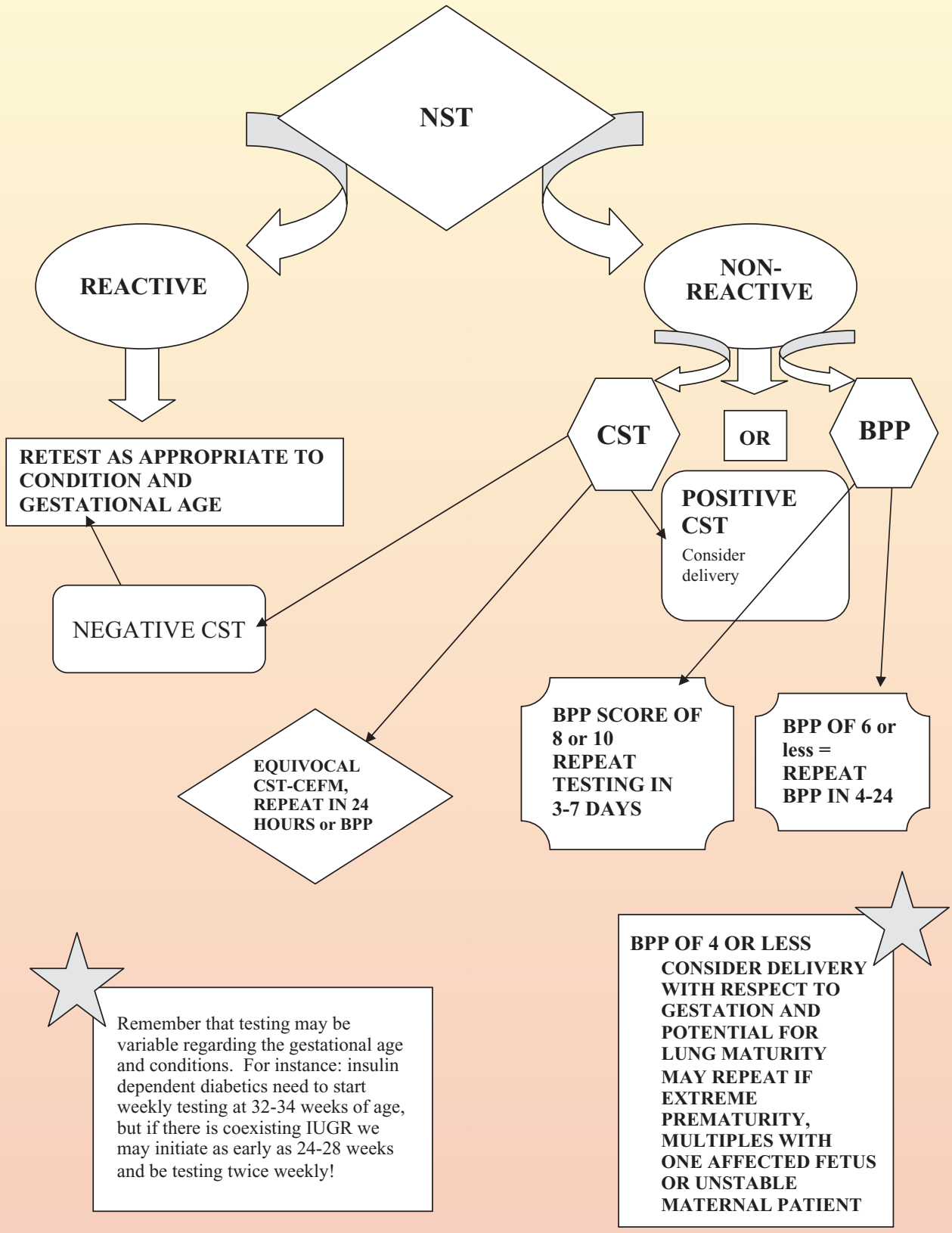
Regardless of the technique chosen for your patient population, it's extremely important that the pregnant woman receive explicit instructions and record the results of this surveillance method. She needs to fully comprehend the value of self-testing and reporting accurate results. Fetal activity can be quite varied. Although fetal activity is a reassuring sign of fetal well-being, the absence of such movement must be carefully evaluated, as fetuses do have periods of rest. Further evaluation is indicated before believing that fetal compromise is occurring (Christensen & Rayburn, 1999). It has been documented that approximately 80 percent of all pregnant mothers will be able to comply with fetal activity counting (Grant, Elbourne, Valentin, & Alexander, 1989; Neldam, 1980).

Kim Armour, CNP, APN, RDMS, MSN, is a perinatal nurse practitioner/manager at Central DuPage Hospital in Winfield, IL.

DOI: 10.1177/1091592304267576

Figure 1.

Maternal Fetal Assessment



Nonstress Testing

Nonstress testing (NST) would be considered by many to be the next level of surveillance and is probably the most widely applied technique for fetal assessment. The premise underlying nonstress testing is that the fetal heart rate accelerates in response to fetal activity, uterine contractions or stimulation (ACOG, 2004a, b). Fetal well-being is assumed when accelerations are present (see Figure 2). However, it's important to note that the fetus may not necessarily be compromised if accelerations initially are not stimulated (ACOG, 2004a, b; Mandeville & Troiano, 1999a, 1999b). In these circumstances, further testing, such as a Contraction Stress Test (CST) or Biophysical Profile (BPP), would be indicated (ACOG, 2004a, b).

The NST should include a maternal blood pressure reading prior to testing, as well as during the test, and the woman should be positioned in a lateral tilt, avoiding supine hypotension. The test requires a minimum of 20 minutes of fetal heart rate monitoring with the uterine activity monitor (toco) in place as well as the fetal heart rate monitor transducer. The pregnant woman can utilize a marker, if available, to document fetal movement, but this is not a requirement of the nonstress test but rather an additional reassurance of fetal well-being (ACOG, 2004 a, b).

To qualify as reactive, the test must display two fetal accelerations of the fetal heart rate of 15-bpm amplitude above the baseline heart rate for a duration of 15 seconds. The acceleration duration may be measured from the increase off baseline to the return of baseline. It does not require the 15-second duration to be maintained at the peak of the 15-bpm acceleratory phase (ACOG, 2004a, b; Fanaroff & Martin, 2002; Gabbe, Niebyl, & Simpson, 2001).

The test may be extended for an additional 20 minutes if it's not reactive in the initial period. Vibroacoustic stimulation may be utilized if the NST is nonreactive in the initial 20-minute period. This stimulation is primarily provided by using an artificial larynx for a period of one to three seconds that is applied to the maternal abdomen near the fetal head. The hope is that the stimulation will awaken the fetus from a sleeping or inactive state (Mandeville & Troiano, 1999a, 1999b). The most common cause for a nonreactive tracing is fetal sleep or inactivity (ACOG, 2004a, b; Fanaroff & Martin, 2002; Gabbe et al., 2001). If after 40 minutes reactivity has not been documented, a CST or BPP should be performed.

Gestational age should be considered when providing and interpreting results of the nonstress test. Approximately 50 percent of nonstress tests are nonreactive for fetuses aged between 24 and 28 weeks. Fifteen percent remain nonreactive

Figure 2.

Reactive Nonstress Testing

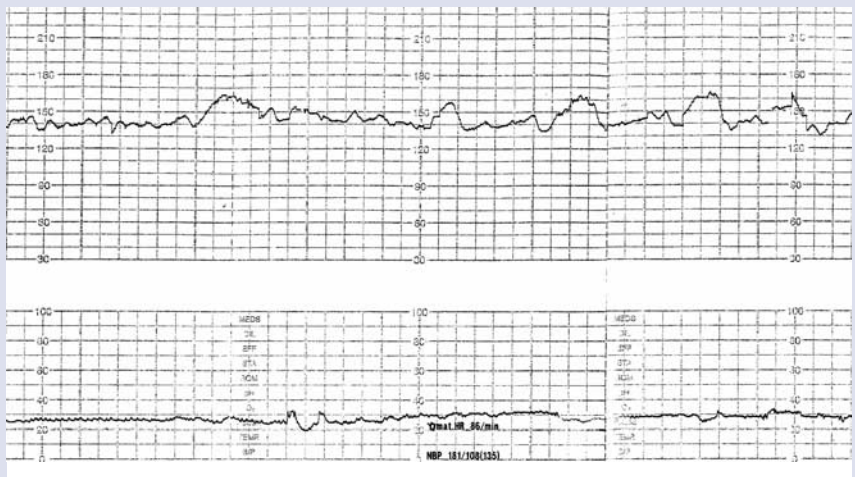
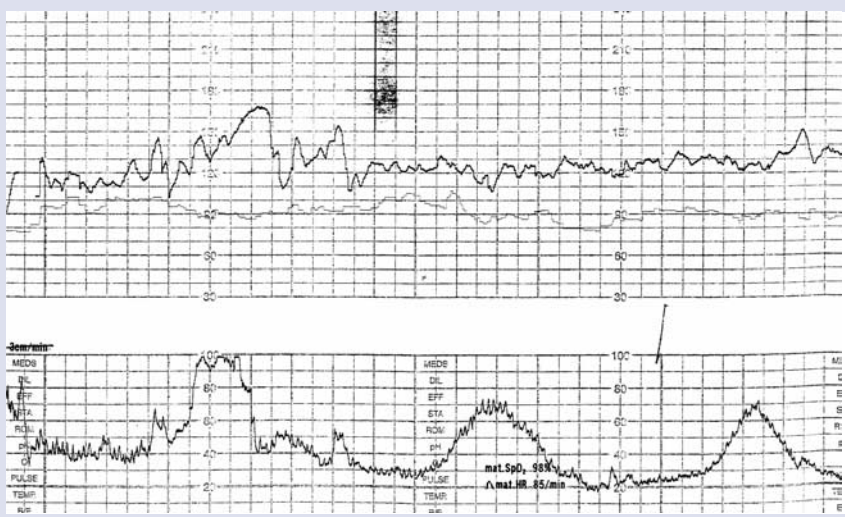


Figure 3.

Negative Contraction Stress Test



in the 28- to 32-week period, and after 32 weeks the occurrence rate for reactive and nonreactive testing is the same as a term fetus (ACOG, 2004a, b).

Nonreactive nonstress tests produce a high false positive rate of 75 to 90 percent (Lavery, 1982). Most fetuses that have a nonreactive response over 40 minutes may not be compromised, yet they fail to provide reassuring reactivity. Fetuses with malformations or chromosome abnormalities have been shown to be more at risk for nonreactive testing. Research has noted that if nonreactivity is noted for a period of 80 minutes or longer, there is due cause for concern of true fetal jeopardy (Gabbe et al., 2001). When an NST does not prove to provide reassuring information, the care provider should order either a contraction stress test or biophysical profile.

Contraction Stress Test (CST)

A contraction stress test (CST) is an NST with the addition of uterine contractions. The fetal response to the uterine contractions is then observed and evaluated. The hypoxemic fetus will display concerning fetal heart rate changes including late decelerations (ACOG, 2004a, b). These signs have been linked to a worsening state of fetal well-being (ACOG, 2004a, b; Gabbe et al., 2001).

The CST is evaluated similarly to the NST but includes the interpretation of the fetal heart rate in response to maternal uterine contractions. Positioning and application of the external monitors is identical to that of an NST. The added dimension is the need to have three contractions lasting 40 seconds or longer in a 10-minute period during the test. If spontaneous contractions are not present, the patient may provide nipple stimulation or an IV of oxytocin may be initiated to stimulate contractions. The CST is interpreted as follows:

- A negative CST is considered normal and has no late decelerations
- A positive CST would be considered abnormal and displays late decelerations being present with 50 percent or more of the uterine contractions

This would still hold true even if there were less than three noted contractions in a 10-minute period. A suspicious or equivocal CST will display intermittent late decelerations or significant variable decelerations, and an unsatisfactory CST will have less than three contractions in a 10-minute period or the fetal heart rate tracing is considered inadequate for interpretation (ACOG, 2004a, b).

Contraindications to performing a CST include cases where labor would be undesirable such as a history of classical uterine incision or a known placental previa. A negative (normal) CST is associated with a low incidence of fetal death within one week of testing (see Figure 3), and, as with all antepartum testing, the entire clinical picture should be taken into consideration. A positive (nonreactive) test requires further evaluation or delivery (ACOG, 2004a, b).

Biophysical Profile

A biophysical profile (BPP) may be an alternative to the CST in some cases. It's commonly used with multiple gestations or intrauterine growth–restricted fetuses. The BPP can provide valuable information related to growth and fluid volumes, which are important with these patients. Manning and associates (1985) developed the BPP as another tool to provide information regarding fetal well-being. The BPP is a combined screening test that utilizes four components of ultrasound, with a maximum of 30 minutes to observe, in addition to the NST. The ultrasound components include:

Figure 4.

Fetal Flexion & Extension of the Hand & Fingers (tone) May Be Observed

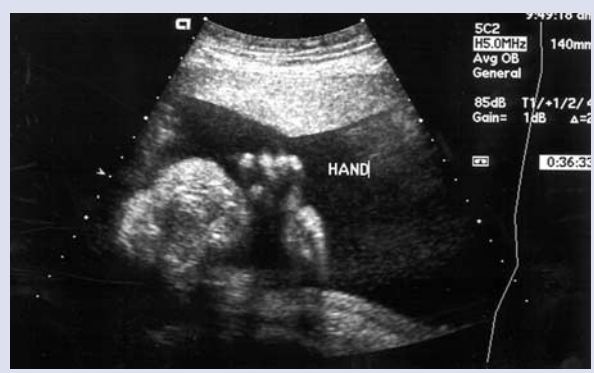


Figure 5.

Fetal Profile May Demonstrate Flexion or Extension of the Neck (tone) May Be Observed

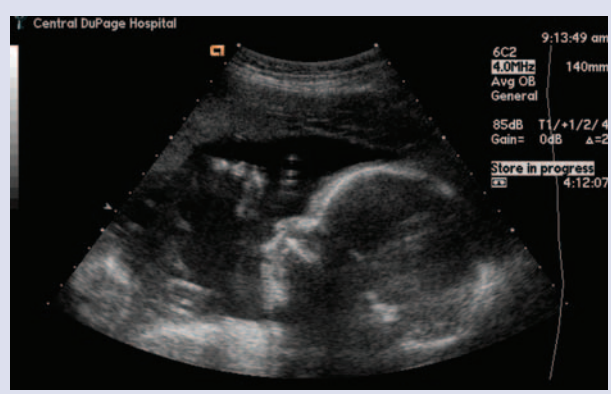
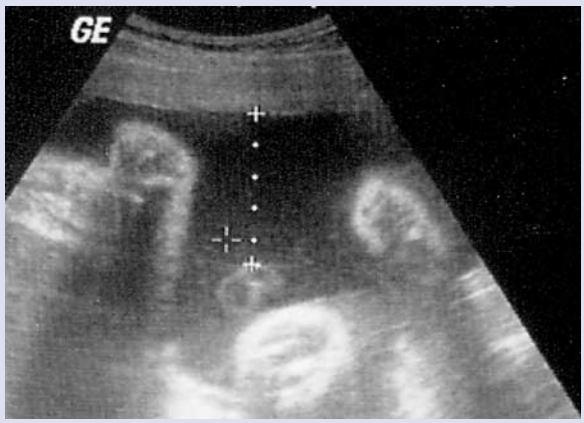


Figure 6.

Measuring Amniotic Fluid Pocket for an AFI or BPP



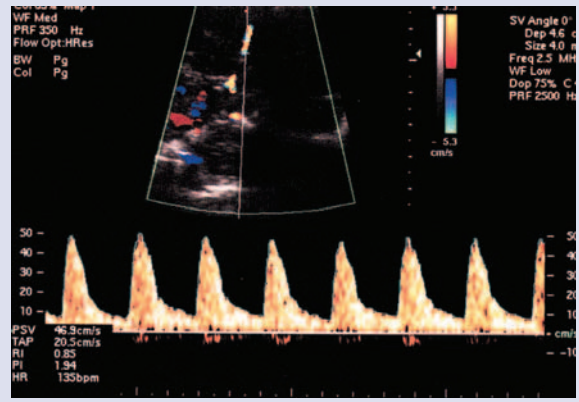
- fetal breathing movements, observed by ultrasound, with a minimum of 30 continuous seconds (some institutions do accept diaphragm movement such as hiccoughs for 30 continuous seconds)
- fetal movement with a minimum of three or more limb or body movements
- fetal tone with one or more episode(s) of active extension of a limb returning to the fetal trunk or the opening and closing of the hand (see Figures 4 & 5)
- amniotic fluid volume with a single vertical pocket of more than 2 centimeters (see Figure 6)
- NST-reactive

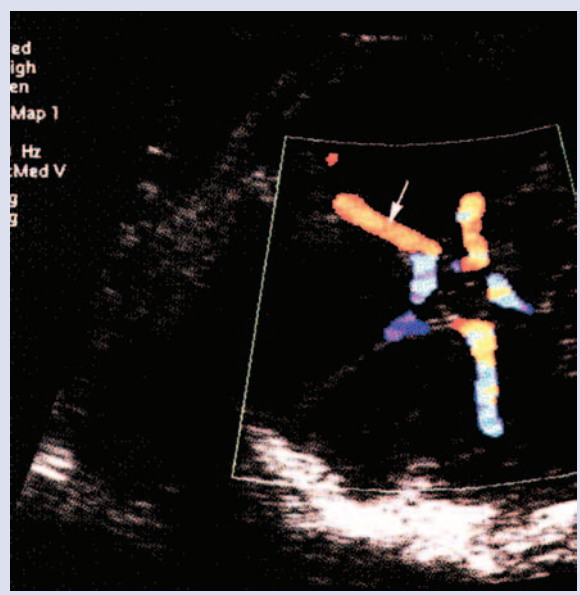
Each component is worth two points if all criteria are met, for a total possible of 10 points. If the minimum criteria are not met within the maximum 30 minutes, no points will be awarded. When the combined score is 8 or 10, fetal well-being is considered to be present. A score of 6 is considered equivocal, and a repeat BPP should be performed in the next 6 to 24 hours. The woman may need to be admitted for a short-term observation period or the screening may be performed in outpatient services. A score of 4 or 2 is considered abnormal, and management should be directed toward imminent delivery (ACOG, 2004a, b; Fanaroff & Martin, 2002).

Often, tone is the last criterion for the fetus to lose, so if tone cannot be documented, this is an ominous sign. The entire clinical situation should be included in the evaluation of fetal surveillance and management decisions made in this context. The BPP without the NST component has been shown to provide the same false-negative rate as the full BPP. The BPP has a lower false-positive rate than both the NST and CST, and as such, it's also considered a more valid predictor of fetal jeopardy (Fanaroff & Martin, 2002).

Figure 7.

Doppler Flow Study of the Mid Cerebral Artery



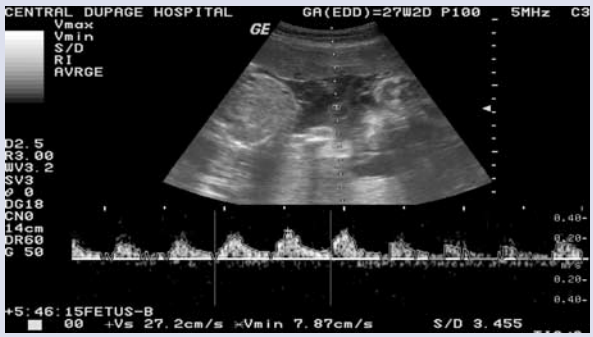


Modified BPPs are also being utilized more frequently. This test format offers an NST with an amniotic fluid index (AFI) (Miller, Rabello, & Paul, 1996). An AFI is obtained by imaging the uterus in four quadrants and measuring the largest vertical drop pocket of amniotic fluid that does not contain a fetal part or umbilical cord. The total of the four quadrants is then totaled for an index or volume. There is potential for increased fetal compromise when oligohydramnios is detected. The definition of oligohydramnios is variable, but most providers use a total volume less than 5 cm or the inability to document at least one vertical pocket more than 2 cm (ACOG, 2004a, b; Fanaroff & Martin, 2002; Gabbe et al., 2001).

When measuring an AFI, many sonographers will add color flow to the screen to document cord presence and increase

Figure 8.

Umbilical Artery Doppler Flow Study



the accuracy of the indices. If oligohydramnios or intrauterine growth restriction is suspected, the sonographer or sonologist may add a Doppler flow study to the examination.

Doppler Flow Studies

Doppler flow studies measure the pulsatile blood flow of the umbilical arteries, which represents maternal-fetal circulation. It's believed that progressive impairment of placental perfusion will yield increasing resistance in umbilical flow. This is evidenced by the diastolic flow decreasing, which results in absent end or reverse flow. The evaluation of these parameters is influenced by gestational age. Higher indices are not uncommon in gestations just at viability, at viability (24 weeks), and the further toward term the fetus is, the lower the indices will be with regard to normal (ACOG, 2004a, b). Doppler flow studies have been shown to be valuable in the assessment of the intrauterine growth–restricted fetus (Lees, Albaiges, Deane, Parra, & Nicolaides, 1999). Mid-cerebral and uterine artery flow patterns are now also being used for fetal assessment (Figures 7 & 8).

Some practitioners evaluate arterial Doppler flow patterns on all growth-restricted fetuses. No value has been shown for using this testing in the low-risk population. Typical common indices measured include:

- Systolic/diastolic ratios (S/D)
- Resistance index (S-D/S)
- Pulsatility index (S-D/A)

Doppler flow studies have primarily used arterial flow patterns, but a recent study looked at umbilical vein blood flow in the growth-restricted fetus. This longitudinal study suggests that reduction in blood flow is an early finding in the IUGR fetus and may persist for several weeks until delivery. The reduction is secondary to decreased vein velocity (Rigano et al., 2001). In the past, absent end diastolic arterial flow or reverse flow measures would have been used to make management and delivery decisions; it's now thought that any one of these Doppler studies may assist in making management decisions.

Validity of Antepartal Screening

Although there are many types of antepartal surveillance currently available and used, research is lacking to fully support their use. Obstetric care in the U.S. and other developed countries has used fetal surveillance widely in the clinical management of patients with risk factors, prior history of an adverse outcome or current condition that places them at risk (ACOG, 2004a, b; Gabbe et al., 2001). There has been a longstanding correlation between this testing and decreased fetal morbidity in comparison to those women with similar conditions that did not receive testing. However, it should be noted that this might be a misinterpretation of the data based on the low incidence of complication in the general population and the lack of adverse fetal outcomes (ACOG, 2004a, b).

Box 1.

Getting all the Facts

Ultrasound information and perinatal education regarding fetal assessment can be found at the following Internet sites:

- **GE Healthcare:** www.gehealthcare.com
- **Institute for Advanced Medical Education:** www.iame.com
- **Siemens:** www.siemensmedicalacademy.com
- **Association of Women's Health, Obstetric and Neonatal Nurses:** www.awhonn.org

Further reading may include:

1. *Obstetrics: Normal and Problem Pregnancies* (2001). Gabbe, S., Niebyl, J., & Simpson, J.; Churchill Livingstone, Philadelphia, PA
2. *Diagnostic Imaging of Fetal Anomalies* (2002). Nyberg, D., McGahan, Pretorius, D., Pilu, G., & Eisenber, R.; Lippincott Williams & Wilkins, Hagerstown, MD
3. *The Unborn Patient: The Art and Science of Fetal Therapy* (2001). Harrison, M., Evans, M., Adzick, S., & Holzgreve, W.; W. B. Saunders, Philadelphia, PA
4. *Ultrasonography in Obstetrics and Gynecology* (2000). Callen, P.; W. B. Saunders, Philadelphia, PA
5. *Fetology: Diagnosis and Management of the Fetal Patient* (2000). Bianchi, D., Crombleholme, T., & D'Alton, M.; McGraw-Hill Professional, New York, NY
6. *Clinical Competencies and Education Guide: Limited Ultrasound Education in Obstetric and Gynecologic/Infertility Settings* (1998). Association of Women's Health, Obstetric and Neonatal Nurses, Washington, DC

References

American College of Obstetricians and Gynecology Compendium. (2004a). Clinical management guidelines for obstetrician-gynecologists. *Antepartum Fetal Surveillance* (Number 9, October 1999).

American College of Obstetricians and Gynecology Compendium. (2004b). *Committee opinion* (October 1997). *Utility of antepartum umbilical artery Doppler velocimetry in intrauterine growth restriction* (Number 188, 1997).

Christensen, F. C., & Rayburn, W. F. (1999). Fetal movement counts. *Obstetrics & Gynecology of North America 26*(4), 607-621.

Fanaroff, A. A., & Martin, R. J. (2002). *Neonatal-perinatal medicine: Disease of the fetus and infant* (7th ed., Vol. 1 & 2, pp. 109-129 & 131-143, 251). St. Louis, MO: Mosby.

Gabbe, S., Niebyl, J., & Simpson J. (2001). Antepartum fetal assessment. In *Obstetrics: Normal and problem pregnancies* (4th ed., pp. 313-349). Philadelphia, PA: Livingstone Churchill.

Grant, A., Elbourne, D., Valentin, L., and Alexander, S. (1989). Routine formal fetal movement counting and risk of antepartum late death in normally formed singletons. *Lancet*, 12(2), 345-349.

Huerta-Enochian, G., Katz, V., & Erfurth, S. (2001). The association of abnormal alpha-fetoprotein and adverse pregnancy outcome: Does increased fetal surveillance affect pregnancy outcome? *American Journal of Obstetrics and Gynecology*, *184*(7), 1549-1555.

Lavery, J. P. (1982). Nonstress fetal heart rate testing. *Clinical Obstetrics and Gynecology, 25*(4), 689-705.

Lees, C., Albaiges, G., Deane, C., Parra, M., & Nicolaides, K. H. (1999). Assessment of umbilical arterial and venous flow using color Doppler. *Ultrasound Obstetrics and Gynecology*, *14*, 250-255.

Mandeville, L., & Troiano, N. (1999a). Guidelines for fetal heart rate monitoring. In *Association of Women's Health, Obstetric and Neonatal Nurses high-risk & critical care intrapartum nursing* (2nd ed., pp. 414-418). Philadelphia, PA: Lippincott.

Mandeville, L., & Troiano, N. (1999b). Guidelines for use of fetal acoustic stimulation. In *Association of Women's Health, Obstetric and Neonatal Nurses high-risk & critical care intrapartum nursing* (2nd ed., p. 419). Philadelphia, PA: Lippincott.

Manning, F. A., Morrison, I., Lange, I. R., Harman, C. R., & Chamberlain, P. F. (1985). Fetal assessment based on fetal biophysical profile scoring. *American Journal of Obstetrics and Gynecology*, *162*, 703.

Miller, D. A., Rabello, Y. A., & Paul, R. H. (1996). The modified BPP: Antepartum testing in the 1990's. *American Journal of Obstetrics and Gynecology*, *174*, 812.

Moore, T. R., & Piacquadiok, K. (1989). A prospective evaluation of fetal movement screening to reduce the incidence of antepartum fetal death. *American Journal of Obstetrics and Gynecology*, *160*, 1075-1080.

Moore, T. R., & Piacquadiok, K. (1990). Study results vary in counting to 10 method of fetal movement screening. *American Journal of Obstetrics and Gynecology*, *163*, 264.

Neldam, S. (1980). Movements as an indicator of fetal well-being. *Lancet*, *1*, 1222.

Rigano, S., Bozzo, M., Ferrazzi, E., Bellotti, M., Battaglia, F., & Galan, H. (2001). Early and persistent reduction in umbilical vein blood flow in the growth-restricted fetus: A longitudinal study. *American Journal of Obstetrics and Gynecology*, *185*(4), 834-838.