Procedures in Family Practice

The Fetal Non-Stress Test

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The non-stress test has become a widely accepted method of screening for fetal distress in high-risk pregnancies. The procedure is technically simple, noninvasive, and when reactive (negative), a highly reliable predictor of fetal well-being for up to one week. This paper outlines the indications, performance, interpretation, and limits of the non-stress test as a standard evaluative tool for use by family physicians.

The use of the oxytocin challenge test as a means of predicting fetal well-being in high-risk obstetric conditions has been well established for two decades. Serious problems with this procedure, including the potential for inducing labor, relative technical complexity, expense, and a significant false-positive rate (24 to 48 percent),[1] have given impetus to the acceptance of the non-stress test.[2,3] This procedure employs continuous electronic fetal monitoring, but unlike the oxytocin challenge test, does not employ deliberate stimulation of uterine contractions with Pitocin.

The non-stress test offers significant advantages over the oxytocin challenge test as a screening tool, including time savings and applicability to the outpatient setting. When reactive (negative), it provides reliable reassurance of fetal well-being for up to one week.[4] Interpretation of the test can be easily mastered by physicians.

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Schifrin et al[5] and Trierweiler et al[6] were first to observe that during the baseline period (prior to the onset of uterine contractions), accelerations of fetal heart rate accompanying fetal movement were associated with uniformly good outcomes in the oxytocin challenge test. Subsequently, other studies[7,8] have confirmed that fetal heart rate accelerations with fetal movement are associated with good fetal tolerance of labor. However, since the test measures only one parameter of fetal health, the neurocardiac axis as it is affected by chronic hypoxia, other untoward events may occur to adversely affect the fetus that will not be predicted by this test.[9]

Indications

All pregnancies at high risk for uteroplacental insufficiency are candidates for non-stress testing. Postdatism and uncertain dates are the most common indications. For postdatism, testing normally begins at the 42nd week. Other indications are class A diabetics at term, pre-eclampsia, chronic

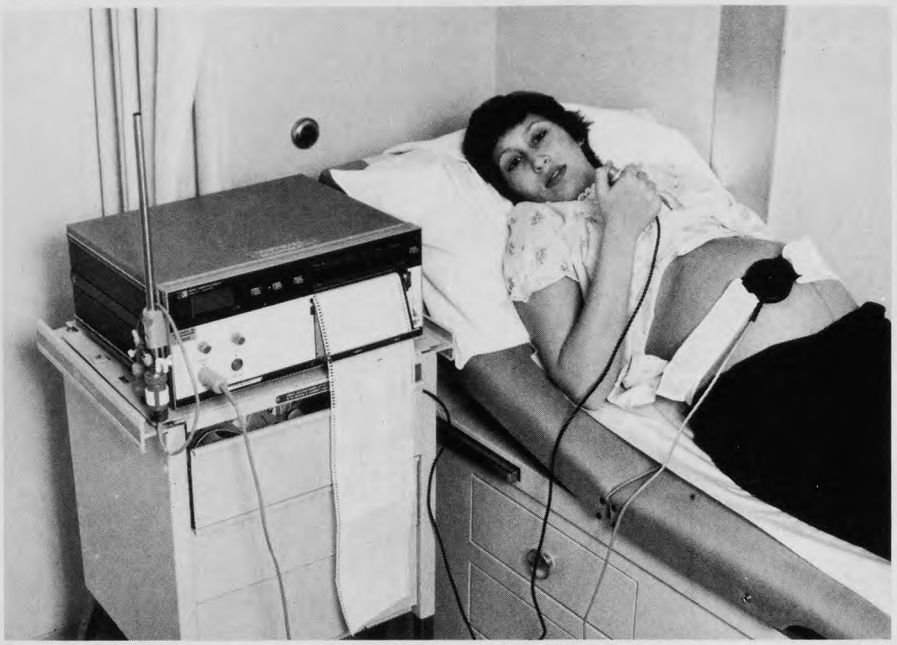

Figure 1. Monitoring equipment and patient positioning for conduct of test

hypertension, suspected intrauterine growth retardation, poor maternal weight gain, and decreased fetal movement. There are virtually no contraindications to the non-stress test.

A reactive test is in general an indication of fetal well-being, and if the pregnancy continues, the non-stress test can be repeated in one week, although twice weekly may be preferable.[10] A non-reactive test should be repeated, preferably the same day, and if reactive on repeat, the results provide reassurance of fetal well-being equal to an originally reactive test. If the results remain non-reactive, an immediate oxytocin challenge test should be scheduled and management decisions made.

Procedure

Outpatients are usually tested in specially equipped monitoring rooms adjacent to the delivery area. Tests are scheduled in advance, and a minimum of one hour is allotted per procedure. Trained nursing personnel must be present to ensure adequate technical quality of the recordings, to record blood pressure, and to note times on the recording.

The test involves a period of continuous external ultrasonic fetal monitoring. In small hospitals only a single monitor, often used for a variety of monitoring functions in addition to the non-stress testing, may be available. Cooperative lending agreements between institutions may solve bottlenecks and prevent undue delay in instituting the procedure. A monitor capable of ultrasonic beat-to-beat fetal heart rate analysis (eg, Hewlett-Packard #8040A) is desirable.

The monitoring room should be pleasant and relaxed and provide a reasonably quiet environment. The patient assumes a position compatible with placement of the external ultrasonic transducer on the abdomen (Figure 1). The semi-Fowler position is most convenient for the assistant, but the left lateral Sims' position is usually adequate and more comfortable. The transducer is attached to the monitor, and the recording equipment is calibrated and checked for proper functioning. The transducer is then moved on the abdomen until a loud, consistent fetal heart rate

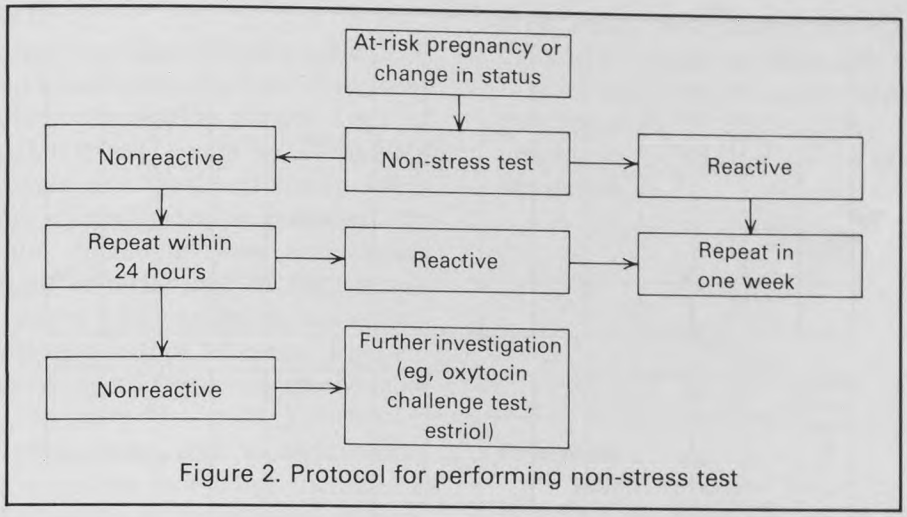

Figure 2. Protocol for performing non-stress test

is obtained. The mother is instructed in the use of the external "tocodynamometer" device to permanently mark the fetal heart rate tracing whenever she feels fetal movement. Some coaching is usually necessary the first time a patient is tested, since many women late in pregnancy may ignore many fetal movements. Once a technically satisfactory fetal heart rate baseline is established and the patient can demonstrate she can use the fetal movement indicator, the non-stress test is started and conducted for 20 minutes. A physician or technician is in attendance constantly to oversee the testing, ensuring that the fetal heart rate tracing is satisfactory and all fetal movements are noted. Fetal movement may decrease the intensity of the ultrasonic signal, requiring repositioning or supporting the transducer by hand to maintain a continuous signal.

If adequate fetal movements are noted in the first 20 minutes (defined as at least two fetal movements), the recording is terminated and interpreted. If inadequate fetal movement has occurred, it can often be elicited by various maneuvers, including giving fruit juice to raise blood sugar levels, maternal activity, fundal pressure, or loud noise. It should be realized that the fetus normally has sleep-wake cycles of up to 40 minutes, and time may be the best way to elicit fetal movement. After such maneuvers, a second 20 minutes of continuous monitoring is performed using the same protocol. Although most authors recommend stopping the test at this point, Brown and Patrick[11] have shown no increased morbidity or mortality in a large series (1,101 cases) for which a reactive pattern was obtained only after 120 minutes of monitoring. A protocol for subsequent sequencing of tests is shown in Figure 2.

Maternal obesity, methyldopa, phenobarbital, insulin, and recent amniocentesis have not been shown to affect non-stress test results.[12] Phelan[13] has demonstrated that fetal heart rate reactivity is diminished with chronic maternal smoking, although he failed to demonstrate whether this diminished reactivity was a direct function of the smoking or related to the higher rate of intrauterine growth retardation noted in the study population.

Interpretation

Several technical factors can invalidate a recording. Fetal heart rate monitoring should be continuous. Skipping is usually due to movement of the fetus and corrected by changing placement of the transducer. In addition, the mother must be attentive to fetal movement and capable of accurately noting it on the monitoring strip.

An analysis of long-term (periodic) variability has classically been used to assess the non-stress test. Inclusion of beat-to-beat variability in the

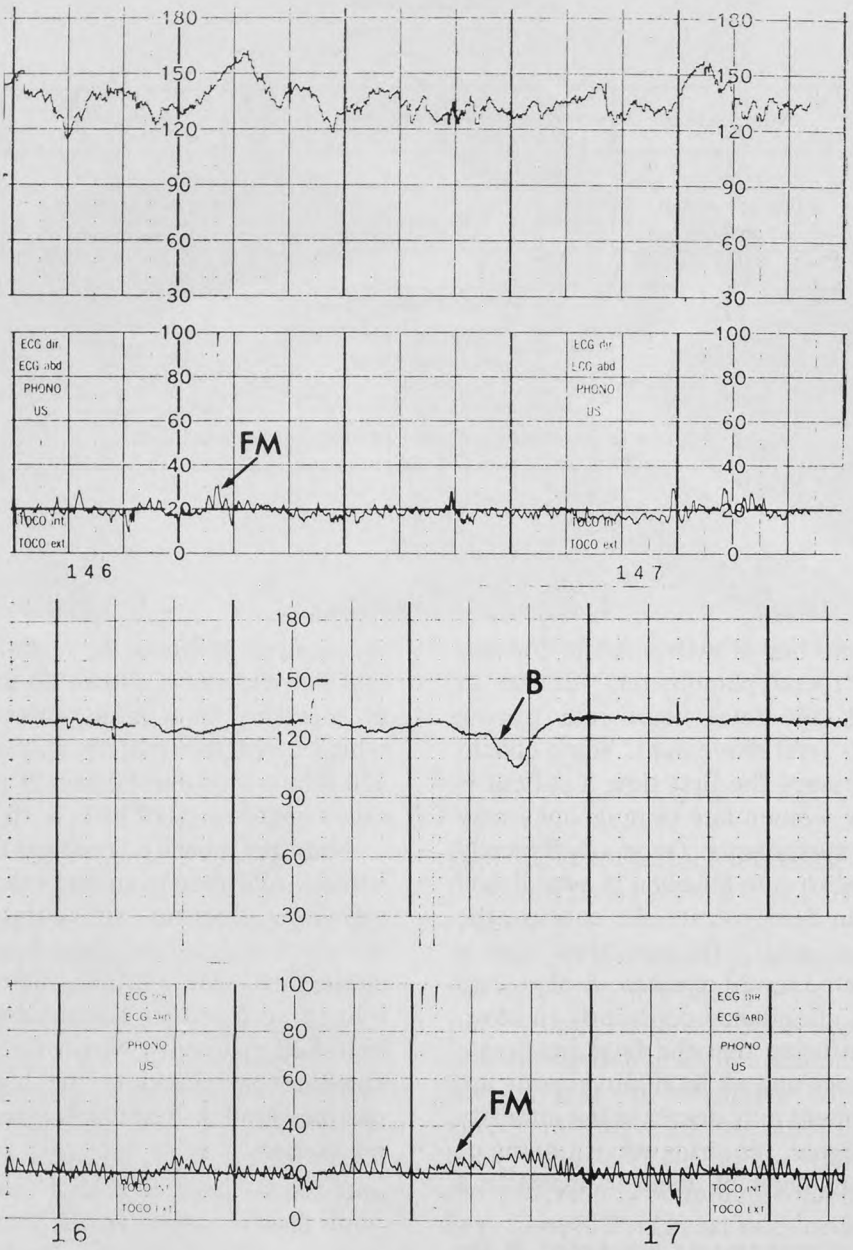

Figure 3. Interpretation of reactive and nonreactive non-stress tests. (Top) Acceleration of fetal heart rate shown by arrows. (Bottom) Lack of reactivity and decelerations. FM shows fetal movement

analysis of the test has also been suggested[13-16] but is not yet widely accepted.

A variety of criteria have been used to interpret periodic variability, including number of accelerations, time period of test, amplitude of the acceleration, and duration of accelerations.[4] A reactive test is generally accepted to be one with two to

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three accelerations (of at least 15 beats per minute over 15 seconds) associated with fetal movement within a 40-minute observation period. Lack of accelerations with fetal movement or deceleration constitutes a nonreactive (positive) test in which case an oxytocin challenge test is indicated. Intermediate results, including some acceleration not meeting cutoff criteria, lack of fetal movement, or poor beat-to-beat variability, are indicators for repeat testing within 24 hours. Figure 3 shows examples of reactive and nonreactive non-stress tests.

In high-risk pregnancies with a reactive non-stress test, fetal morbidity should be anticipated in the range of 2 to 3 percent.[7] Nonreacting patterns are predictive of morbidity in the range of 40 to 60 percent.[8,17] Because a nonreactive test may be a false positive, further testing is warranted, usually with an oxytocin challenge test.

Limitations

If the non-stress test is considered in isolation from other clinical data and improperly interpreted, unnecessary intervention may result.[18] The non-stress test cannot predict morbidity from congenital malformations, abruptio placentae, and umbilical cord accidents.[19] The non-stress test does have advantages over the oxytocin challenge test, but one large prospective trial favors the oxytocin challenge test for primary surveillance.[10] Because the ease of application and economy of the non-stress test allow its use in greater numbers of patients, the non-stress test may provide the possibility for a more significant impact on fetal death prevention that the oxytocin challenge test. Maternal counting of daily fetal movements may also prove to be an acceptable alternative to the non-stress test in some patients.[20] Physicians and institutions may differ in their utilization of those means of surveillance.

Summary

The non-stress test is a safe, comfortable, and reliable tool for identifying in otherwise high-risk pregnancies those fetuses that have a good probability of favorable outcome with vaginal delivery. It has great utility, being less expensive and safer than the oxytocin challenge test. The use and interpretation of this test can be easily mastered by physicians.

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