

ANTENATAL Assessment

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FETAL Assessments

Available techniques employed to forecast fetal well-being focus on fetal biophysical

findings that include :

- heart rate
- movement
- Breathing
- amnionic fluid production

Fetal Assessment

- Negative predictive values—a true negative test—for most of the tests described are 99.8 percent or higher.
- positive-predictive values—a true positive test—for abnormal test results are low and range between 10 and 40 percent.

FETAL MOVEMENTS

Passive unstimulated fetal activity commences as early as 7 weeks' gestation and becomes more sophisticated and coordinated by the end of pregnancy four fetal behavioral states:

- State 1F (quiescent narrow oscillatory FHR)
- State 2F (REM)
- State 3F (eye movements absence body movements)
- State 4F (vigorous body movement with continuous eye movements and HR acceleration)

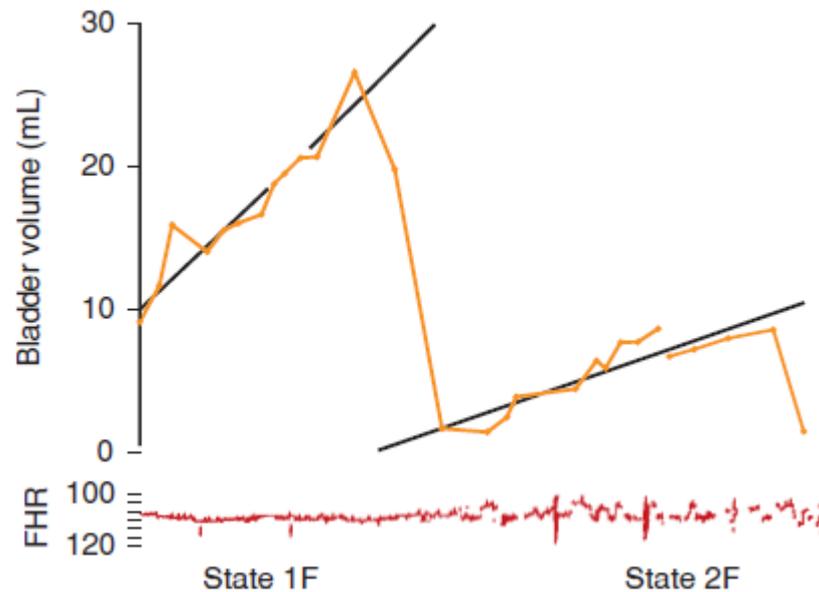
FETAL MOVEMENTS

bladder volumes increased during state 1F

During state 2F, the FHR baseline increased, and bladder volume significantly diminished.

An important determinant of fetal activity appears to be sleep-awake cycles, which are independent of the maternal sleep-awake state. (20 minutes to as much as 75 minutes)

Fetal bladder volume measurements together with fetal heart rate (FHR) variation recorded in relation to 1F or 2F behavior states. State 1F fetal heart rate has a narrow bandwidth consistent with quiet sleep. State 2F heart rate shows wide oscillation of the baseline consistent with active sleep.



FETAL MOVEMENTS

Amnionic fluid volume is important determinant of fetal activity.

three categories of fetal movements :

Weak, strong, and rolling

mean number of weekly movements (12h Daily)

recording periods increased from approximately 200 at 20 weeks to a maximum of 575 movements at 32 weeks.

FETAL MOVEMENTS

Clinical Applicationn

Diminished fetal activity may be a harbinger of impending fetal death.

various methods of fetus well being assessments

- tocodynamometer
- visualization with sonography
- maternal subjective perceptions

FETAL BREATHING

identify two types of respiratory movements :

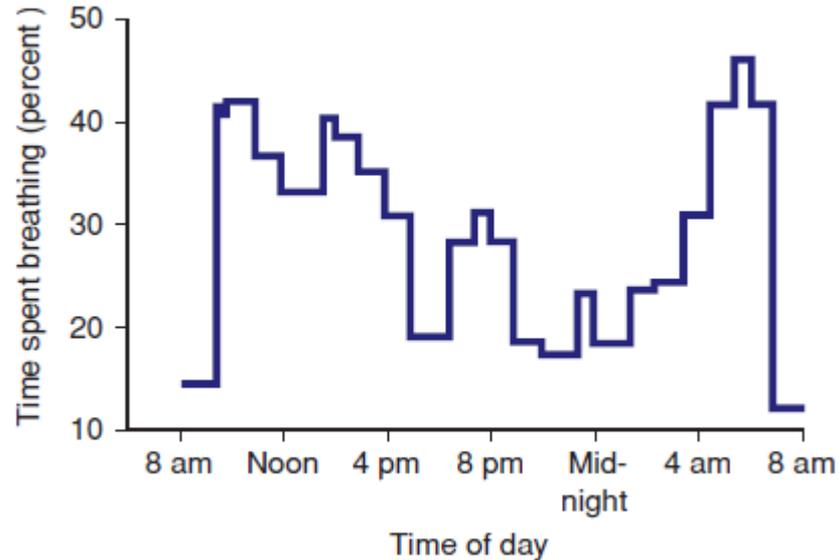
- *gasps or sighs* frequency of (1 to 4/m)
- *irregular bursts of breathing* rates up to 240 cycles /m

Several variables affect fetal respiratory movements

Hypoxia

hypoglycemia, sound stimuli, cigarette smoking, amniocentesis, impending preterm labor, GA, fetal heart rate itself, and labor—

The percentage of time spent breathing by 11 fetuses at 38 to 39 w demonstrated a significant increase in fetal breathing activity after breakfast. Breathing activity diminished during the day and reached its minimum between 8 PM and midnight hours. There was a significant increase in the percentage of time spent breathing between 4 and 7 AM, when mothers were asleep.



CONTRACTION STRESS TESTING

AF pressure increases + uterine contractions



Decreases blood flow to the intervillous space

Brief periods of impaired oxygen exchange result

CST

- positive test result or abnormal uniform repetitive late fetal FHR decelerations.
- normal results or Negative forecasted fetal health.

tests generally repeated on a weekly.

disadvantage , average CST required 90 m to complete.

Criteria for Interpretation of the CST

Negative: no late or significant variable decelerations

Positive: late decelerations following 50% or more of contractions (even if the contraction frequency is fewer than three in 10 minutes)

Equivocal-suspicious: intermittent late decelerations or significant variable decelerations

Equivocal-hyperstimulatory: fetal heart rate decelerations that occur in the presence of contractions more frequent than every 2 minutes or lasting longer than 90 seconds

Unsatisfactory: fewer than three contractions in 10 minutes or an uninterpretable tracing

CST (Nipple stimulation)

Nipple stimulation to induce uterine contractions is usually successful for contraction stress testing.

Nipple through her clothing for 2 minutes or until a contraction begins.

2-minute nipple stimulation ideally will induce a pattern of three contractions per 10 minutes.

If not, after a 5-minute interval, retry.

NONSTRESS TESTS (NST)

Freeman and Lee and colleagues (1975) introduced the *nonstress test to describe FHR acceleration in response to fetal movement* as a sign of fetal health

- NST is primarily a test of *fetal condition*.
- *CST uteroplacental function*.

NST is the most widely used primary testing method for assessment of fetal well-being and has also been incorporated into the BPP testing system

NST

Fetal Heart Rate Acceleration

There are autonomic influences mediated by sympathetic or parasympathetic impulses from brainstem centers that normally increase or decrease the FHR. *Beat-to-beat variability* is also under the control of the autonomic nervous system.

sleep cycles , central depression from medications or cigarette smoking results decreased.

NST

fetuses at or beyond 32 w, the acceleration acme is 15 bpm or more above the baseline rate, and the acceleration lasts 15 seconds or longer but less than 2 minutes.

Before 32 weeks, accelerations are defined as having an acme that is 10 bpm or more above baseline for 10 seconds or longer.

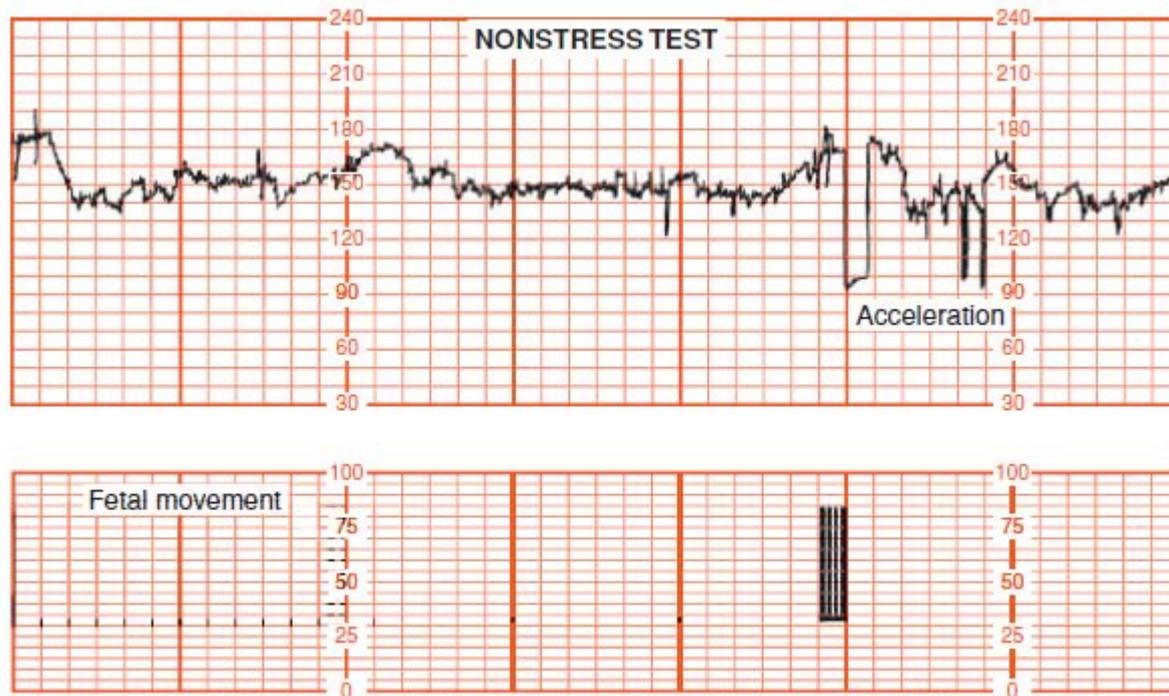
NST

definition currently recommended by the ACOG
and the American Academy Pediatrics:

two or more accelerations that peak at 15 bpm
or more above baseline, each lasting
15 seconds or more, and all occurring within
20 minutes of beginning the test.

accelerations with or without fetal movements
be accepted

Reactive nonstress test(NST)

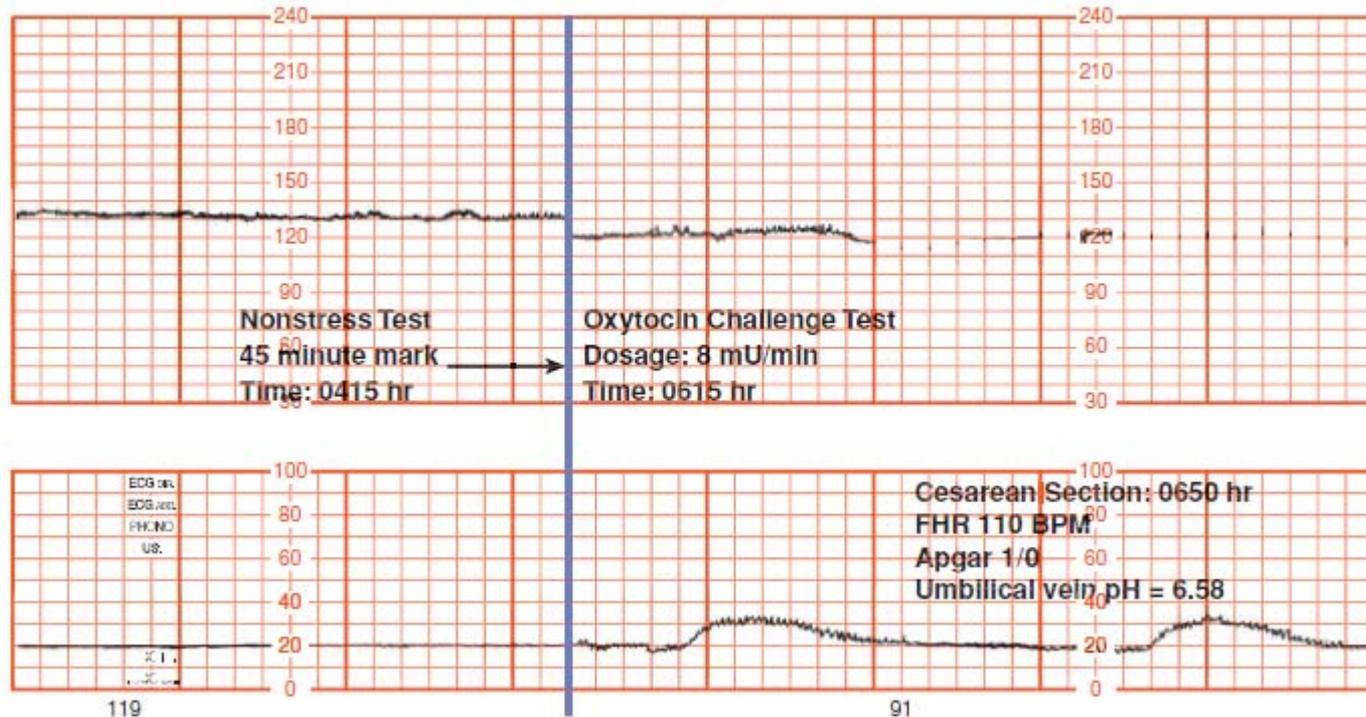


NST

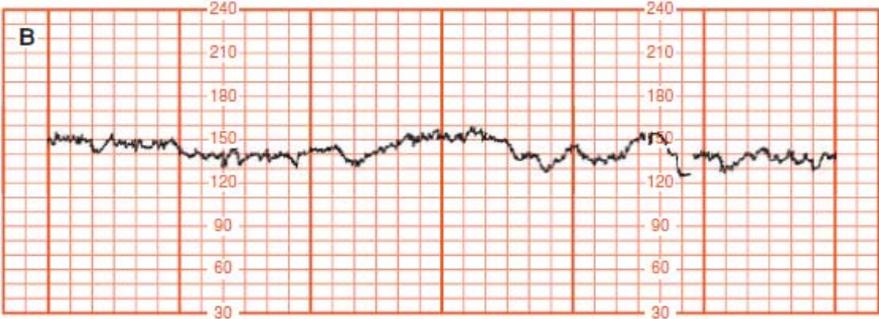
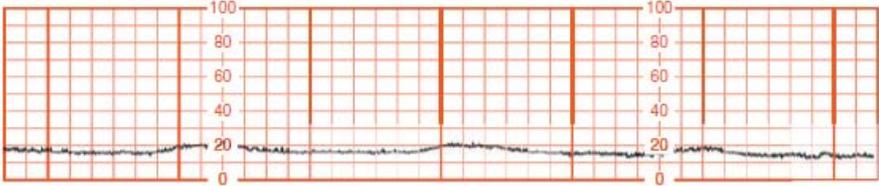
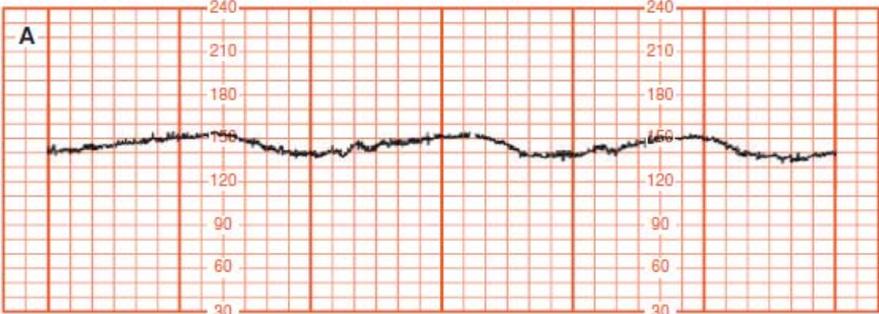
an abnormal NST is not always Malignant.
There are abnormal patterns that reliably
forecast severe fetal jeopardy.

Nonreactive for 90 minutes almost invariably
(93 %) associated with significant perinatal
pathology.

Nonreactive nonstress test



Two antepartum fetal heart rate (FHR) tracings in a 28-week pregnant woman with diabetic ketoacidosis



NST

Silent oscillatory pattern :

FHR baseline that oscillated less than 5 bpm and presumably indicated absent acceleration and beat-to-beat variability.

terminal cardiotocogram included :

- (1) baseline oscillation of less than 5 bpm
- (2) absent accelerations, and
- (3) late decelerations with spontaneous uterine contractions.

evidence of uteroplacental pathology

NST

Interval between Testing (originally rather arbitrarily at 7 days)

According to the ACOG more frequent testing is advocated by some investigators for women with postterm pregnancy, multifetal gestation, type 1 diabetes mellitus, fetal-growth restriction, or gestational hypertension

NST

Fetal movements commonly produce heart rate deceleration (in $\frac{1}{2}$ to $\frac{2}{3}$ of tracings)

ACOG has concluded that variable decelerations, if nonrepetitive and brief (less than 30 seconds) do not indicate fetal compromise or the need for obstetrical intervention.

repetitive variable decelerations at least three in 20 minutes even if mild, have been associated with an increased risk of c/s for fetal distress.

NST

Decelerations lasting 1 minute or longer results worse prognosis.

Severe variable decelerations during a NST plus an amnionic fluid index of ≤ 5 cm resulted in a 75% C/S.

NST is not inadequate to preclude such an acute asphyxial event and that other biophysical Characteristics might be beneficial

ACOUSTIC STIMULATION TESTS

Loud external sounds have been used to startle the fetus and thereby provoke heart rate acceleration an *acoustic stimulation nonstress test*.

A commercially available acoustic stimulator

is positioned on the maternal abdomen, and a stimulus of 1 to 2 seconds is applied.

may be repeated may be repeated up to 3 times

for up to 3 seconds. (shortened the average time from 24 to 15m)

BIOPHYSICAL PROFILE

- combined use of five fetal biophysical variables as a more accurate means of assessing fetal health than a single element.
- require 30 to 60 minutes of examiner time.
- Maternal medications such as morphine can significantly decrease the score.
- BP score of 0 = fetal acidemia
- high incidence of false-positive and -negative results is seen in very preterm fetuses

Components and Scores for the Biophysical Profile

Component	Score 2	Score 0
Nonstress test ^a	≥ 2 accelerations of ≥ 15 beats/min for ≥ 15 sec within 20-40 min	0 or 1 acceleration within 20-40 min
Fetal breathing	≥ 1 episode of rhythmic breathing lasting ≥ 30 sec within 30 min	< 30 sec of breathing within 30 min
Fetal movement	≥ 3 discrete body or limb movements within 30 min	< 3 discrete movements
Fetal tone	≥ 1 episode of extremity extension and subsequent return to flexion	0 extension/flexion events
Amnionic fluid volume ^b	A pocket of amnionic fluid that measures at least 2 cm in two planes perpendicular to each other (2 × 2 cm pocket)	Largest single vertical pocket ≤ 2 cm

^aMay be omitted if all four sonographic components are normal.

^bFurther evaluation warranted, regardless of biophysical composite score, if largest vertical amnionic fluid pocket ≤ 2 cm.

Modified Biophysical Profile

nonstress test + amnionic fluid index
required approximately 10 minutes to perform
AFI \leq 5 cm to be abnormal

ACOG and AAP have concluded that the
modified BP test is as predictive of fetal
well-being as other approaches to biophysical
fetal surveillance

AMNIONIC FLUID VOLUME

The importance of AFV estimation is indicated by its inclusion into virtually all schemes by which fetal health is assessed.

decreased uteroplacental perfusion may lead to diminished fetal renal BF decreased urine production, and ultimately, oligohydramnios.

ACOG has concluded that either an AFI index < 5 cm or a maximum deepest vertical pocket < 2 cm are acceptable criteria for diagnosis of oligohydramnios

Interpretation of Biophysical Profile Score

Biophysical Profile Score	Interpretation	Recommended Management
10	Normal, nonasphyxiated fetus	No fetal indication for intervention; repeat test weekly except in diabetic patients and postterm pregnancy (twice weekly)
8/10 (Normal AFV) 8/8 (NST not done)	Normal, nonasphyxiated fetus	No fetal indication for intervention; repeat testing per protocol
8/10 (Decreased AFV) 6	Chronic fetal asphyxia suspected Possible fetal asphyxia	Deliver If amniotic fluid volume abnormal, deliver If normal fluid at > 36 weeks with favorable cervix, deliver If repeat test \leq 6, deliver If repeat test > 6, observe and repeat per protocol
4 0 to 2	Probable fetal asphyxia Almost certain fetal asphyxia	Repeat testing same day; if biophysical profile score \leq 6, deliver Deliver

AFV = amniotic fluid volume; NST = nonstress test.

From Manning, 1987, with permission.

UpTo Dated: Jan 12, 2016

The goal of antepartum fetal assessment is to both identify fetuses at risk of intrauterine death or other complications of intrauterine asphyxia and intervene to prevent these adverse outcomes, if possible.

The main techniques for fetal assessment are:

NST, BPP, mBPP, CST, and FM acount

Assessment of amniotic fluid volume and Doppler velocimetry provide additional information about fetal status.

UpTo Dated: Jan 12, 2016

- Despite widespread use of these techniques, there is limited evidence to guide their optimal use or to demonstrate their effectiveness for improving perinatal outcomes.
- Antepartum testing is based on the premise that the fetus responds to hypoxemia with a detectable sequence of biophysical changes, beginning with signs of physiological adaptation and potentially ending with signs of physiological decompensation

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fetal biophysical parameters can be affected by factors unrelated to hypoxemia, such as gestational age, maternal medication/smoking, fetal sleep-wake cycles, and fetal disease/anomalies.

Periodic fetal antepartum testing rarely identifies fetuses at risk of death from a sudden insult, such as complete placental abruption

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INDICATIONS FOR FETAL SURVEILLANCE

It is not possible to list every clinical setting

The more common clinical settings in which antepartum fetal testing is typically performed are :

Diabetes (Pregestational diabetes, gestational diabetes treated with anti-hyperglycemic drugs, or gestational diabetes poorly controlled with nutritional therapy alone).

INDICATIONS FOR FETAL SURVEILLANCE

- **Diabetes**
- **Hypertensive disorders**
- **Fetal growth restriction**
- **Twin pregnancy**
- **Postterm pregnancy**
- **Decreased fetal activity**
- **Systemic lupus erythematosus**
- **Antiphospholipid syndrome**
- **Oligohydramnios or polyhydramnios**
- **Sickle cell disease**

INDICATIONS FOR FETAL SURVEILLANCE

- **Isoimmunization**
- **Prior fetal demise**
- **Preterm premature rupture of membranes**
- **Other** – Nonimmune hydrops, maternal cyanotic heart disease, poorly controlled maternal hyperthyroidism, and maternal vascular diseases are associated with an increased risk of fetal demise and generally considered appropriate indications for antenatal fetal testing.

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Possible indications for antenatal testing — Epidemiologic data suggest a small increased risk of fetal demise associated with a number of additional conditions, including advanced maternal age, obesity, abnormalities in first and second trimester, and major fetal structural anomalies.

Whether a policy of antenatal testing in pregnancies with these risk factors can reduce the incidence of fetal demise or fetal injury is unknown. The use of fetal testing in these pregnancies is decided on a case-by-case basis.

FETAL ASSESSMENT TECHNIQUES

Fetal movement counting

- Objective maternal assessment of fetal movements is based on evidence that fetal movement decreases in response to hypoxemia. Although there is universal consensus that women with decreased fetal movement should undergo further fetal assessment, available evidence does not support a clear fetal movement threshold or "alarm limit" indicating when the risk of fetal death or injury is increased.

FETAL ASSESSMENT TECHNIQUES

Contraction stress test — (CST) is based on the fetal response to a transient reduction in fetal oxygen delivery during uterine contractions. If the fetus becomes hypoxemic (fetal arterial pO_2 below 20 mm Hg fetal chemoreceptors and baroreceptors, as well as sympathetic and parasympathetic influences, respond by reflex slowing of the (FHR), which may manifest clinically as late decelerations separately.

Contraction stress test

Major drawbacks related to use of the CST include the need to stimulate contractions with intravenous oxytocin, the contraindication to inducing contractions in some conditions (placenta previa), and the high false-positive rate (fetus goes on to tolerate labor without FHR changes necessitating intervention). In contrast, the false-negative rate (ie, rate of antepartum stillbirth within one week of a negative test) is very low, thus providing reassurance of adequate fetal oxygenation after a normal test result

Nonstress test

The main advantage of the NST over the CST is that it does not require an intravenous line, oxytocin, or contractions. Disadvantages are that the false-negative and false-positive rates are higher than for the CST. (a false-negative NST is when an antepartum stillbirth occurs within one week of a reactive test; a false-positive NST is a nonreactive test that is followed by a normal back-up test, such as a negative CST or high biophysical profile score)

Biophysical profile

The biophysical profile (BPP) combines the NST with ultrasonographic fetal assessment by assigning points:

amniotic fluid volume (AFV), fetal breathing movements, fetal body movements, and reflex/tone/flexion-extension movements. this test assesses indicators of both acute hypoxia (NST, breathing, body movement, tone) and chronic hypoxia (AFV). The BPP score has a direct linear correlation with fetal pH.

Biophysical profile

The modified biophysical profile (mBPP) consists of the NST as a measure of acute oxygenation and assessment of AFV as a measure of longer-term oxygenation.

The false-negative rates for the BPP and mBPP are very low, but the false-positive rates are high (a false-negative BPP or mBPP is when an antepartum stillbirth occurs within one week of a high score; a false positive is a low score that is followed by a normal back-up test).

Amniotic fluid volume

In the hypoxemic fetus, cardiac output is redirected to the brain, heart, and adrenals and away from less vital organs, such as the kidney; the reduction in renal perfusion leads to decreased fetal urine production, which may result in decreased amniotic fluid volume (oligohydramnios) over time. This is the rationale for amniotic fluid evaluation as part of fetal assessment.

Amniotic fluid volume

Sonographic determination of the single deepest amniotic fluid pocket (SDP) is the preferred method of AFV assessment. The SDP and the amniotic fluid index (AFI) method are equivalent in their prediction of adverse outcome in singleton pregnancies, but use of the AFI increases the number of labor inductions and cesarean deliveries without any improvement in perinatal outcome.

Doppler velocimetry

Doppler velocimetry — Measurement of blood flow velocities in the maternal and fetal vessels provides information about uteroplacental blood flow and fetal responses to physiologic challenges. Abnormal vascular development of the placenta, such as in preeclampsia, results in progressive hemodynamic changes in the fetoplacental circulation

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CHOICE OF TEST — Although observational studies have described the use of the NST, CST, and BPP for monitoring high-risk pregnancies, no method has been evaluated in well-designed randomized trials and it is not clear which method, if any, is superior. The choice depends on multiple factors, including gestational age (up to 50 percent of NSTs are not reactive in healthy 24 to 28 weeks fetuses), availability, desire for fetal biometry or follow-up of a congenital anomaly, ability to monitor the fetal heart rate (eg, the NST and CST may not be interpretable in a fetus with an arrhythmia), and cost.

Doppler assessment of the umbilical artery should be used to monitor the growth-restricted fetus.

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TIMING — Testing should begin as soon as an increased risk of fetal demise is identified and delivery for perinatal benefit would be considered if test results are abnormal. Observational data show that rates of stillbirth in nongrowth-restricted fetuses significantly rise between about 32 weeks and term

DURATION AND FREQUENCY

- Fetal testing should be performed periodically until delivery if the clinical condition that prompted fetal surveillance continues to exist. A single normal test result is adequate if performed for a nonrecurring indication in an otherwise low-risk pregnancy.

Testing is typically performed weekly, but the frequency is generally increased if there is a change in pregnancy status (eg, fetal growth percentile falls from 10th percentile to 3rd percentile, worsening preeclampsia) or in clinical settings considered to be very high risk (eg, fetal growth restriction with absent or reversed diastolic flow)

DURATION AND FREQUENCY

There are no data from randomized trials on which to base recommendations for the optimum frequency of fetal monitoring (daily, every other day, twice per week, once per week). These decisions are based on expert opinion, clinical experience with similar high-risk pregnancies, and community standards.

MANAGEMENT OF ABNORMAL TEST RESULTS

- Given the high rate of false-positive tests, an abnormal test result is generally followed by additional testing with a different test (eg, CST or BPP after a nonreactive NST) to provide more information about fetal status.

The clinical setting also needs to be considered. If a temporary maternal condition, such as diabetic ketoacidosis or acute bronchospasm, may account for the abnormal test result, prompt treatment of the maternal condition may also improve fetal oxygenation and lead to a normal test result on subsequent testing.

MANAGEMENT OF ABNORMAL TEST RESULTS

In chronic conditions, clinical judgment guides management, taking into account factors such as gestational age (low threshold for delivery for an abnormal test result at term), severity of disease (eg, diabetes with poor glycemic control versus good glycemic control), progression of disease (eg, fetal growth falls from the 10th percentile to the 3rd percentile), and other available information (eg, decelerations, absent variability, or bradycardia on a nonreactive NST; BPP score 0 versus 4 or 6; absence of accelerations on a positive CST).

MANAGEMENT OF ABNORMAL TEST RESULTS

If delivery is indicated by the specific clinical setting and test results, induction of labor is not contraindicated. After a positive CST, up to 40 percent of fetuses have been reported to tolerate labor without FHR changes necessitating intervention

COSTS AND BENEFITS

The gaps in the evidence regarding the efficacy of antepartum testing in preventing fetal neurologic injury or death preclude a definite conclusion about the benefits of antepartum testing. One concern is that cerebral palsy and stillbirth may share a common etiologic pathway since they have many common risk factors

SUMMARY AND RECOMMENDATIONS

- The main goal of antepartum fetal surveillance is to identify the fetus that will benefit from early intervention, such as in utero resuscitation or delivery, and thereby prevent fetal death or neurologic injury.
- Antepartum testing is based on the premise that the fetus responds to hypoxemia with a detectable sequence of biophysical changes.
- Antepartum fetal surveillance has had an established role in obstetrical practice since the 1970s, although its ability to improve pregnancy outcome has not been evaluated by large, well-designed randomized trials.

SUMMARY AND RECOMMENDATIONS

- Antepartum fetal testing is indicated in "pregnancies in which the risk of antepartum fetal demise is increased.
- Techniques for assessment of fetal well-being: NST, CST, BPP, mBPP
- The optimal choice of technique(s) for fetal assessment has not been determined and depends on multiple factors, including gestational age, availability, desire for fetal biometry or follow-up of a congenital anomaly, ability to monitor the fetal heart rate, and cost.

SUMMARY AND RECOMMENDATIONS

- Antepartum fetal surveillance is initiated when an increased risk of fetal demise is identified and delivery for perinatal benefit would be considered if test results are abnormal.
- Testing is typically performed weekly, but the frequency is generally increased if there is a change in pregnancy status or in clinical settings considered to be very high risk.
- An abnormal test result is generally followed by additional testing with a different test, given the high rate of false-positive results