SOGC CLINICAL PRACTICE GUIDELINES

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Antenatal Fetal Assessment

These guidelines have been reviewed and approved by the Maternal-Fetal Medicine Committee and the Medico-Legal Committee of the Society of Obstetricians and Gynaecologists of Canada and was approved by its Council.

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Abstract

Objective: to design national guidelines instructing obstetric care providers when, and in what populations, to consider antenatal fetal testing; which testing options are available; when to choose one testing method over another; and the expected impact on perinatal morbidity and mortality.

Options: clinical situations associated with an increased risk of fetal asphyxia.

Outcomes: perinatal morbidity and mortality.

Evidence: Medline search from 1966 to 2000 for English language articles related to: methods of antenatal testing; comparisons of antenatal testing modalities; and impact of antenatal testing methods on perinatal morbidity and mortality. A review of meta-analyses related to antenatal testing found in the Cochrane Collaboration.

Values: the evidence collected was reviewed by the Maternal-Fetal Medicine Committee of the SOGC under the leadership of the primary author and quantified using the evaluation of evidence guidelines developed by the Canadian Task Force on the Periodic Health Exam.

Benefits, harms and costs: antenatal testing in defined populations at risk for fetal asphyxia has been shown to decrease perinatal morbidity and mortality. False positive test results can be reduced by employing a hierarchy of antenatal testing methods, reducing unnecessary intervention. Cost/benefit analysis confirming the economic value of antenatal testing vs. not testing has not been performed.

Recommendations: there is fair (Class B) evidence to support the recommendation that antenatal testing strategies should be employed in specific pregnancy populations identified to be at risk for fetal asphyxia.

Validation: these guidelines have been reviewed and approved by the Maternal-Fetal Medicine and Medico-Legal Committees of the Society of Obstetricians and Gynaecologists of Canada and approved by its Council.

Sponsor: the Society of Obstetricians and Gynaecologists of Canada.

INTRODUCTION

The Canadian perinatal mortality rate of 7.7/1000 live births is one of the lowest worldwide and is a reflection of overall health, access to health care, and obstetric and paediatric practice.[1] Despite this low rate, a portion of this mortality remains potentially preventable. Specific patient populations at risk have been identified. Large randomized trials establishing the benefits of antenatal testing in the reduction of perinatal morbidity and mortality have not been performed. Due to the relatively low incidence of perinatal mortality, it is estimated that at least 10,000 patients would be required to adequately assess any benefits from antenatal fetal assessment.[2] In the absence of conclusive data and in the presence of suggestive theoretic, animal, and clinical data, these guidelines are designed to draw attention to the specific patient groups at increased risk for perinatal mortality and the antenatal fetal assessment techniques which may be used in their care. Antenatal testing strategies applied to low risk and high risk pregnancies will not prevent all perinatal morbidity and mortality. Antenatal fetal testing should only take place when the results obtained will guide future care, whether that be reassurance, more frequent testing, admission to hospital or need for delivery. Each hospital should develop their own protocol suggesting the indications, type, and frequency of antenatal testing, and the expected response to an abnormal result. These guidelines will identify specific patient populations who would be expected to benefit from antenatal testing and outline available antenatal testing techniques.

OUTCOMES

A successful antenatal fetal testing programme should be expected to impact positively on the fetal and neonatal outcomes of asphyxia listed in Table I.

PATIENTS AT RISK

Perinatal morbidity and/or mortality due to fetal asphyxia has been shown to be increased in the patient populations identified in Table II. Other, less common or untested, maternal or fetal disorders not listed may also increase the risk of fetal asphyxia.

WHEN TO INITIATE TESTING

The initiation of antenatal fetal testing should be individualized and reflect the risk factor(s) associated with that pregnancy. Antenatal testing in insulin dependent or insulin requiring pregnancies, which are otherwise uncomplicated, should begin at 32-36 weeks gestation.[12] (III B) Perinatal morbidity and mortality is increased further in patients with poorly controlled diabetes, and the gestational age at initiation of antenatal fetal assessment should reflect the clinical perception of increased risk, once the fetus has reached viability. (II-2 B) Antenatal testing in postdates pregnancies should begin between 287 and 294 days (41 and 42 weeks).[5] The severity and gestational age of onset in other maternal and fetal disorders will dictate the appropriate time for initiation of antenatal fetal testing. Antenatal fetal testing should be performed, without delay, when patients present with decreased fetal movement. (III B)

FREQUENCY OF TESTING

The frequency of antenatal testing should correspond to the perceived risk of fetal asphyxia and the practical implications for the patient. For example, only a single normal assessment is required for the patient experiencing decreased fetal movement, which subsequently resolves. Once reassured, and without other risk factors, the patient can return to routine prenatal care. Antenatal testing frequency should reflect the degree of risk in cases where the perceived risk persists, usually once to twice weekly. (II-3 B) However, antenatal testing may be required on a daily, or even more frequent, basis to aid in timing delivery to maximize gestational age, while avoiding significant intrauterine morbidity in the premature fetus.[13] (III C)

ANTENATAL TESTING TECHNIQUES

Antenatal testing techniques fall into four categories and may be used simultaneously or in a hierarchical fashion. These categories are:

1. Maternal assessment of fetal activity.
2. Cardiotocographic assessment with or without induced contractions.

TABLE I

FETAL AND NEONATAL COMPLICATIONS OF ANTEPARTUM ASPHYXIA

Fetal Outcomes	Neonatal Outcomes
Stillbirth	Mortality
Metabolic acidosis at birth	Metabolic acidosis
	Hypoxic renal damage
	Necrotizing enterocolitis
	Intracranial haemorrhage
	Seizures
	Cerebral palsy

TABLE II

CONDITIONS ASSOCIATED WITH INCREASED PERINATAL MORBIDITY/MORTALITY WHERE ANTENATAL FETAL TESTING MAY HAVE AN IMPACT

Small for gestational age fetus[3]
Decreased fetal movement[4]
Postdates pregnancy (>294 days)[5,6]
Pre-eclampsia/chronic hypertension[7]
Pre-pregnancy diabetes[8]
Insulin requiring gestational diabetes[9]
Preterm premature rupture of membranes[10]
Chronic (stable) abruption[11]

3. Sonographic assessment of fetal behaviour and/or amniotic fluid volume.
4. Fetal umbilical Doppler velocimetry.

The antenatal testing technique of choice will vary depending on the perceived risk to the fetus, the expertise, and equipment available. There are few randomized trials to date comparing techniques.[14-17] These trials, with sample sizes ranging from several hundred to several thousand, have compared the biophysical profile to non-stress or contraction stress testing, with or without the added assessment of amniotic fluid. Except for a statistically significant increase in the ability to predict neonates with 5-minute Apgar scores <7, the biophysical profile testing technique does not appear to offer significant benefits as compared to fetal heart rate monitoring with or without the added assessment of amniotic fluid volume. (I B) Of note, patients with expected oligohydramnios based on the diagnosis of intrauterine growth restriction have been excluded from studies where they could have been randomized to cardiotocography alone.[16] The antenatal fetal testing technique should be tailored to the underlying etiology and perceived risk. Therefore, in cases where oligohydramnios is suspected, assessment of the amniotic fluid volume should be considered a necessary adjunct to the planned testing technique, if other than biophysical profile. Umbilical artery Doppler velocimetry is not an appropriate screening tool for low risk pregnancies.[3] (III B) However, it may play a role in high risk pregnancy management, specifically in fetuses identified as being small for gestational age or in pregnancies complicated by hypertension.[18] Meta-analysis of randomized trials assessing the addition of umbilical artery Doppler testing to other forms of antenatal testing on perinatal mortality in high risk pregnancies have shown a reduction in mortality of 29 percent with confidence limits of 0-50 percent.[18] (I A) No single antenatal testing technique appears superior. As several of the techniques available test differing components of fetal well-being, consideration should be given to combining testing techniques when abnormal findings are identified in an effort to reduce the false positive rate associated with a single test technique.

METHODS OF ANTENATAL TESTING

FETAL MOVEMENT COUNTING

Several different techniques for maternal assessment of fetal movement have been suggested.[19] There is no evidence to date that one technique is superior; however, there is a wide range of required time by the patient in monitoring fetal movement. Two suggested techniques are presented.[20]

CARDIFF TECHNIQUE

Starting at 9:00 a.m., women should lie or sit and concentrate on fetal movements. They should record how long it takes to count 10 fetal movements. This record should be presented at antenatal visits. If the fetus has not moved 10 times by 9:00 p.m., then she should present herself for further assessment.

SADOVSKY TECHNIQUE

For one hour after meals women should lie down, if possible, and concentrate on fetal movement. Four movements should be felt within one hour. If four movements have not been felt within one hour, then patients should monitor movement for a second hour. If, after two hours, four movements have not been felt, the patient should report for further assessment. Fetal testing times and movement should be recorded and presented at antenatal visits.

Routine daily counting, followed by appropriate action when movements are reduced, does not reduce fetal/neonatal mortality over informal inquiry about movements during standard antenatal care, and selective use of formal counting in high-risk cases.[21] (I B)

NON-STRESS TEST

The non-stress test is performed using cardiotocography with the patient in the left lateral recumbent position. The recording should last at least 20 minutes. The baseline fetal heart rate should be within the normal range of 120-160 bpm. A "reactive" non-stress test includes at least two accelerations from the baseline of at least 15 bpm for at least 15 seconds within the 20 minute testing period. If the fetal heart rate is "non-reactive" after 20 minutes of testing, the recording should continue for another 20 minutes to account for the average length of periods of non-rapid eye movement sleep when fetal movement and subsequently heart rate variability are reduced. If the fetal heart tracing remains non-reactive after 40 minutes of testing, the clinician may proceed with either a contraction stress test or a biophysical profile. The positive predictive value of the non-stress test in detecting metabolic acidosis at birth is only 44 percent; however, no abnormal test should be ignored and appropriate follow-up is required.[22] In particular, caution should be used in applying the usual "reactive" criteria in the interpretation of the non-stress test in the premature fetus. Fetal well-being can be interpreted when a "reactive" non-stress test is seen in the premature fetus. However, it should be acknowledged that approximately 50 percent of normal fetuses between 24 and 28 weeks gestation will have a non-reactive non-stress test due to the relative immaturity of the fetal sympathetic innervation.[23] (II-2 B) In some centres, the non-stress test is used as an adjunct to all biophysical profiles, and in others, only when the ultrasound component is non-reassuring.

CONTRACTION STRESS TEST

Although not commonly used in Canada, the contraction stress test remains an alternative for antenatal fetal assessment in centres that do not have access to the use of biophysical profiles. The contraction stress test is designed to assess fetal response to the induced stress of uterine contractions and relative uteroplacental insufficiency. The contraction stress test should not be used in

any patient when vaginal delivery is contraindicated (i.e. placenta praevia). Caution should be used when using the contraction stress test prior to 37 weeks gestation in patients at risk for preterm labour. A twenty minute non-stress test is performed first. Uterine contractions are then induced using exogenous intravenous oxytocin or nipple stimulation while the cardiotocography continues. The objective is to induce three contractions lasting one minute within a ten minute period. Nipple stimulation can be performed through the clothing, brushing the nipple with the palmar surface of the hand or rolling the nipple between the thumb and first finger for two minutes or until a contraction is stimulated. If there is less than the desired number of contractions, the other nipple is stimulated after a two to five minute rest. If this does not result in adequate contractions, then bilateral stimulation is used. Once adequate contractions are achieved, the nipple stimulation can be stopped.[24,25] Dilute exogenous oxytocin intravenous infusion may also be used to induce uterine contractions. An infusion pump should be used starting at a dose of 0.5-1.0 mlU/ min, increasing every 15 minutes by 1.0 mlU/ min, until adequate contractions are achieved. It is unusual to require an infusion rate of more than 10 mlU/min.[26]

If late decelerations occur in more than 50 percent of the induced contractions, this is deemed a positive contraction stress test. A negative contraction stress test has a normal baseline fetal heart rate tracing without late decelerations. A suspicious result is the presence of intermittent late decelerations, variable decelerations or an abnormal baseline heart rate (<110 or >160 bpm). A contraction stress test is deemed unsatisfactory if the desired number and length of contractions is not achieved or if the quality of the cardiotocography tracing is poor. Finally, if hyperstimulation occurs (contractions more frequent than every 2 minutes or longer than 90 seconds), an abnormal fetal response may be the result of the testing technique alone and should be repeated or another form of testing employed. The corrected perinatal

TABLE III **SCORING CRITERIA FOR THE BIOPHYSICAL PROFILE**
From Manning FA, Dynamic ultrasound-based fetal assessment: The fetal biophysical score (Clin Obstet Gynecol)[27]

Biophysical Variable	Normal (score = 2)	Abnormal (score = 0)
Fetal breathing movements	1 episode FBM of at least 30 s duration in 30 min	Absent FBM or no episode >30 s in 30 min
Fetal movements	3 discrete body/limb movements in 30 min	2 or fewer body/limb movements in 30 min
Fetal tone	1 episode of active extension with return to flexion of fetal limb(s) or trunk. Opening and closing of the hand considered normal tone.	Either slow extension with return to partial flexion or movement of limb in full extension Absent fetal movement
Amniotic fluid volume	1 pocket of AF that measures at least 2 cm in 2 perpendicular planes	Either no AF pockets or a pocket <2 cm in 2 perpendicular planes

FBM = fetal breathing movement; AF = amniotic fluid.

TABLE IV **PERINATAL MORTALITY WITHIN ONE WEEK OF BIOPHYSICAL PROILE BY BPP SCORE**
Modified from Manning FA, Dynamic ultrasound-based fetal assessment: The fetal biophysical score (Clin Obstet Gynecol)[27]

Test Score Result	Interpretation	PNM within 1 week without intervention	Management
10 of 10 8 of 10 (normal fluid) 8 of 8 (NST not done)	Risk of fetal asphyxia extremely rare	1/1,000	Intervention for obstetric and maternal factors
8 of 10 (abnormal fluid)	Probable chronic fetal compromise	89/1,000	Determine that there is functioning renal tissue and intact membranes. If so, delivery of the term fetus is indicated. In the preterm fetus less than 34 weeks, intensive surveillance may be preferred to maximize fetal maturity.[30]
6 of 10 (normal fluid)	Equivocal test, possible fetal asphyxia	Variable	Repeat test within 24 hr
6 of 10 (abnormal fluid)	Probable fetal asphyxia	89/1,000	Delivery of the term fetus. In the preterm fetus less than 34 weeks, intensive surveillance may be preferred to maximize fetal maturity.[30]
4 of 10	High probability of fetal asphyxia	91/1,000	Deliver for fetal indications
2 of 10	Fetal asphyxia almost certain	125/1,000	Deliver for fetal indications
0 of 10	Fetal asphyxia certain	600/1,000	Deliver for fetal indications

PNM = perinatal mortality NST = non-stress test

mortality within one week of a negative contraction stress test is 1.2/1,000 births.[24] (II-2 B)

SONOGRAPHIC ASSESSMENT OF FETAL BEHAVIOUR AND/OR AMNIOTIC FLUID VOLUME

Sonography allows the simultaneous assessment of several fetal behavioural and physiologic characteristics. The biophysical profile is a scored test performed over 30 minutes which assesses fetal behaviour by monitoring fetal body movements, breathing movements, tone, and amniotic fluid volume. Decreased amniotic fluid is an indirect marker of decreased glomerular filtration, due to shunting of cardiac output away from the fetal kidneys in response to chronic hypoxia.

The biophysical profile is performed using real time B-mode ultrasound. A score of 0 (absent) or 2 (present) is given for each of the four observed variables as described in Table III. The maximal score is 8 without the non-stress test and 10 with it. Management response to the biophysical profile is determined by the score result as demonstrated in Table IV.

Reassessment of the patient with an equivocal result, 6 of 10 (normal fluid), will be reassuring in 75 percent. Should the equivocal result persist, delivery for fetal indications is suggested.[27] (II-3 B) The biophysical profile identifies less than a 2 cm by 2 cm pocket of amniotic fluid as evidence for oligohydramnios. There are two other commonly used techniques. The first is the maximal vertical pocket depth. This technique identifies a pocket depth of 2-8 cm as normal, 1-2 cm as marginal, < 1 cm as decreased, and > 8 cm as increased. The second technique is the amniotic fluid index. The amniotic fluid index attempts to quantify the total amount of amniotic fluid by summing the deepest vertical pocket of fluid in the four quadrants of the uterus with the centre point being the umbilicus. This technique uses the 5th and 95th percentiles for gestational age to identify oligohydramnios and hydramnios respectively. Dye dilution techniques at amniocentesis have not shown one method of sonographic prediction of amniotic fluid volume to be better at determining the true amniotic fluid volume.[28] (II-2 B) Although no large randomized trials have compared biophysical testing to no testing, the biophysical profile has been the most extensively studied antenatal testing technique. These II-2, II-3 B, and III data indicate that biophysical testing reduces perinatal mortality and morbidity. A recent large cohort study identified a significant reduction in the cerebral palsy rate from 4.74/1,000 in a "low risk" untested group to 1.33/1,000 in a "high risk" tested group.[29] (II-3 B) In the patient with 8 of 10 or 6 of 10 (abnormal fluid), delivery of the term fetus is indicated. In the preterm fetus less than 34 weeks, intensive surveillance may be preferred to maximize fetal maturity.[30] (III C)

Fetal breathing movements are reduced in the preterm fetus <34 weeks compared to the term fetus.[31] This should be taken into consideration when interpreting the biophysical profile in the preterm fetus.

UMBILICAL DOPPLER VELOCIMETRY

Umbilical artery Doppler studies should not be used as a screening tool in the general population. At present there appears to be a role for umbilical artery Doppler assessment in pregnancies complicated by growth restriction or pregnancy associated hypertension/pre-eclampsia. (I A) Other "high risk" pregnancies may also benefit; however, more research is required to identify specific patient populations.[18]

Umbilical artery flow can be documented using Doppler real time sonography. A free floating loop of umbilical cord is identified using real time B-mode sonography when there is absence of fetal breathing motion. Once a suitable segment of umbilical cord has been determined, either continuous or pulsed wave Doppler can be used to identify arterial flow. The waveform pattern is then recorded and analyzed. The most commonly used method of analysis of umbilical artery Doppler waveforms is the systolic/diastolic ratio (S/D). The presence of diastolic flow, however, has greater clinical relevance than the absolute value of the S/D ratio as seen in Table V.

Intervention based on the identification of abnormal umbilical artery waveform patterns has reduced the incidence of perinatal death by 38% in pregnancies at risk (confidence limits 15-55%).[33] (I A)

RESPONSE TO ABNORMAL TESTING

Antenatal testing should be performed by nursing, sonography or physician staff with knowledge of antenatal testing techniques and experience using these techniques in the identification of the fetus suspected of asphyxia. Antenatal testing units should be supervised by appropriately experienced physician(s). Protocols must be in place for immediate notification of abnormal results to the responsible physician(s) and for the appropriate response. This response includes increasing the frequency of antenatal testing, hospital admission or delivery.

IMPACT OF ANTENATAL FETAL TESTING ON MORBIDITY AND MORTALITY

Quality outcome studies are lacking in the field of antenatal testing. Table VI lists the indication for antenatal testing and

TABLE V

FETAL AND NEONATAL OUTCOME WITH AND WITHOUT UMBILICAL ARTERY END DIASTOLIC FLOW[32]

Outcome	Positive EDV	Absent EDV	Reversed EDV
Fetal death	6 (3%)	25 (14%)	16 (24%)
Neonatal death	2 (1%)	48 (27%)	34 (51%)
Alive	206 (96%)	105 (59%)	17 (25%)
Total	214 (100%)	178 (100%)	67 (100%)

EDV = end diastolic velocity

TABLE VI

POPULATIONS WHERE ANTEPARTUM FETAL ASSESSMENT HAS BEEN SHOWN TO REDUCE NEONATAL MORBIDITY AND/OR MORTALITY

Antepartum risks for asphyxia	Quality of evidence	Classification of recommendations
Small for gestational age fetus[3]	I , II-2	A
Pre-eclampsia/chronic hypertension[7, 34]	I	A
Postdates pregnancy (>294 days)[6]	II-2	B
Preterm premature rupture of membranes[10]	II-3	B
Decreased fetal movement[21]	I	A
Pre-pregnancy diabetes[8]	III	B
Insulin requiring gestational diabetes[9]	III	B

the impact of the response to antenatal testing on neonatal morbidity and mortality.

Other, less common or untested, maternal or fetal disorders at risk for fetal asphyxia may also benefit from antenatal fetal testing.

SUMMARY OF RECOMMENDATIONS

These guidelines are classified, based on the Canadian Periodic Health Exam Classification of Recommendations, as class B recommendations. This implies that there is fair evidence to support the recommendation that antenatal testing strategies should be employed in specific pregnancy populations identified to be at risk for fetal asphyxia.

Intervention based on the described antenatal testing techniques is expected to reduce the perinatal mortality rate. However, no strategy of antenatal testing will guarantee prevention of fetal or neonatal death or morbidity. Caution is advised in the interpretation of antenatal testing methods in the preterm fetus.

QUALITY OF EVIDENCE ASSESSMENT

The quality of evidence reported in these guidelines has been described using the Evaluation of Evidence criteria outlined in the Report of the Canadian Task Force on the Periodic Health Exam.[35]

I: Evidence obtained from at least one properly randomized controlled trial.

II-1: Evidence obtained from well-designed controlled trials without randomization.

II-2: Evidence obtained from well-designed cohort or case-control analytic studies, preferably from more than one centre or research group.

II-3: Evidence obtained from comparisons between times or places with or without the intervention. Dramatic results in uncontrolled experiments (such as the results of treatment with penicillin in the 1940's) could also be included in this category.

III: Opinions of respected authorities, based on clinical experience, descriptive studies or reports of expert committees.

CLASSIFICATION OF RECOMMENDATIONS

Recommendations included in these guidelines have been adapted from the ranking method described in the Classification of Recommendations found in the Report of the Canadian Task Force on the Periodic Health Exam.[35]

A: There is good evidence to support the recommendation that antenatal testing strategies be employed in specific pregnancy populations identified to be at risk for fetal asphyxia.

B: There is fair evidence to support the recommendation that antenatal testing strategies be employed in specific pregnancy populations identified to be at risk for fetal asphyxia.

C: There is poor evidence to support the recommendation that antenatal testing strategies be employed in specific pregnancy populations identified to be at risk for fetal asphyxia, but recommendations may be made on other grounds.

D: There is fair evidence to support the recommendation that antenatal testing not be employed in specific pregnancy populations identified to be at risk for fetal asphyxia.

E: There is good evidence to support the recommendation that antenatal testing not be employed in specific pregnancy populations identified to be at risk for fetal asphyxia.

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