



May 2010 – Knowledge to Action Evidence Summary

What is known about options and approaches to fetal surveillance and intrapartum management of women with gestational diabetes mellitus (GDM)?

This report aims to summarize the evidence around the intrapartum management of women with gestational diabetes mellitus (GDM) to help inform evidence-based guidelines and advance practice in the province of Ontario.

Key Messages

- Gestational Diabetes Mellitus (GDM) can cause serious complications in the intrapartum care of pregnant women and their fetuses. The impact and treatment differs somewhat from that of Type 1 and Type 2 diabetes.
- Fetal surveillance is a key aspect of the intrapartum care of the fetus. The most prominent methods appear to be: fetal movement counting (fetal kick counts), ultrasound/biophysical profile scoring, and the nonstress test.
- The most important aspects of fetal surveillance involve fetal monitoring in an effort to detect accelerated fetal growth, fetal compromise, and the risk of stillbirth. However there is no clear evidence or consensus on which method(s) of fetal surveillance are the most effective in detecting these risks.
- Maternal surveillance is another key aspect of intrapartum care in GDM. The focus appears to be on: maternal glycemic control, the timing of delivery, and the route of delivery.
- The most important obstetrical decisions involve choices surrounding the induction of labour vs. expectant management, and Cesarean section birth vs. vaginal delivery. However, as with fetal surveillance, there is no clear evidence or consensus on the most effective form(s) of maternal surveillance.
- Some indications are that uncomplicated GDM, well-controlled with diet, may pose minimal risks to both mother and fetus and may not require much more maternal or fetal surveillance than normal pregnancy.

Who is this summary for?

This summary was undertaken as part of the OHRI-Champlain LHIN Knowledge to Action research program and is intended for use by health systems stakeholders, policy- and decision-makers.

Information about this evidence summary.

This report covers a broad collection of literature and evidence sources **with a search emphasis on systematic reviews.**

As such, evidence summarized from systematic reviews is highlighted in blue boxes, like this one. Systematic reviews are generally favoured over other study designs, because they incorporate evidence from multiple primary studies, instead of reporting evidence from just one study.

This summary includes:

- **Key findings** from a broad collection of recent literature and evidence sources.

This summary does not include:

- **Recommendations;**
- **Additional information** not presented in the literature;
- **Detailed descriptions of the interventions** presented in the studies.

All papers summarized in this document are available by request to jgalipeau@ohri.ca.

Many sections conclude with a “Bottom line” subsection that provides a statement summarizing the studies included in this document or aims to provide some context; these statements are not meant to address all of the evidence in existence on the subject, rather, that which is featured in this document.

Background

It is estimated that gestational diabetes mellitus (GDM) affects 3.7% of Canada's non-Aboriginal pregnant population and 8% - 18% of our pregnant Aboriginal women.¹

The main complication posed by GDM is fetal macrosomia; a condition in which large-for-gestational-age fetuses are susceptible to birth trauma, including shoulder dystocia, bone fractures and brachial plexus injuries. There is also the risk of hypoglycemia and other transient metabolic disorders developing in the neonate. In addition, the risk of perinatal mortality may be increased with GDM.²

One way to manage the risks associated with a macrosomic fetus is to induce labour, usually at 38 weeks of gestation in order to avoid a potentially higher risk of Cesarean section, which may increase the risk of maternal morbidity.²

This evidence summary aims to examine options and approaches to intrapartum management of women with GDM, looking specifically at fetal and maternal surveillance methods.

Levels of Evidence (adapted from Cochrane MSK group)³

Each piece of evidence presented in this summary is assigned a level:

P **Platinum level:** Published systematic review with at least two individual controlled trials each satisfying the following: Sample sizes ≥ 50 per group. If no significant difference, adequately powered for a 20% relative difference in the relevant outcome. Blinding of patients and assessors for outcomes. Handling of withdrawals $>80\%$ follow up (imputations acceptable). Concealment of treatment allocation.

G **Gold level:** At least one RCT meets all of the following criteria: Sample sizes ≥ 50 per group. If no significant difference, adequately powered for a 20% relative difference in the relevant outcome. Blinding of patients and assessors for outcomes. Handling of withdrawals $>80\%$ follow up (imputations acceptable). Concealment of treatment allocation.

S **Silver level:** Systematic review or randomized trial not meeting the above criteria, at least one study of nonrandomized cohorts who did and did not receive the therapy or evidence from at least one case control study. A randomized trial with a "head-to-head" comparison of agents (unless a reference is provided to a comparison of one of the agents to placebo showing at least a 20% relative difference).

B **Bronze level:** At least one high quality case series without controls (including simple before/after studies in which patient acts as their own control) or if derived from expert opinion based on clinical experience without reference to any of the foregoing (e.g., argument from physiology, bench research or first principles).

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Summary of Findings

What do existing guidelines say about the intrapartum care of GDM?

•AACE Diabetes Mellitus Clinical Practice Guidelines (not GDM specific):

- Maternal hyperglycemia is the main cause of neonatal hypoglycemia; therefore, intrapartum maintenance of maternal euglycemia is essential.
- Insulin is still required before active labour and can be given subcutaneously or by intravenous infusion with a goal of maintaining blood glucose concentrations between 4.0 - 5.0 mmol/L.
- As the mother enters active labour, insulin resistance rapidly decreases because of the energy expenditure of labour as a form of strenuous exercise; as a result, exogenous insulin is often not needed.⁴

•NICE Guideline on Diabetes in Pregnancy - Intrapartum Care (not GDM specific):

Timing and Mode of Birth

- Pregnant women with diabetes who have a normally grown fetus should be offered elective birth through induction of labour, or by elective caesarean section if indicated, after 38 completed weeks.
- Pregnant women with diabetes who have an ultrasound-diagnosed macrosomic fetus should be informed of the risks and benefits of vaginal birth, induction of labour and caesarean section.

Glycaemic Control during Labour and Birth

- During labour and birth, capillary blood glucose should be monitored on an hourly basis in women with diabetes and maintained at between 4 and 7 mmol/L.
- Intravenous dextrose and insulin infusion is recommended during labour and birth for women with diabetes whose blood glucose is not maintained at between 4 and 7 mmol/L.⁵

•British Columbia Reproductive Care Program: Obstetric Guideline on Gestational Diabetes

Intrapartum Care:

- Assessment of fetal lung maturity if consideration being given to early delivery (<36 weeks)
- Ideally await spontaneous onset of labour. There is no evidence to support the need for early delivery of women with well controlled GDM
- Non-stress testing or biophysical profile may be indicated

- Morning of induction do baseline blood glucose on admission and notify physician
- If Prostagandin only to be used - carry on management regimen as usual until labour is well established
- If Oxytocin is to be used - ac breakfast dose of insulin is usually withheld. Diet is at the discretion of the physician
- During the Induction, ideally, blood glucose should be monitored q1h, and minimally q2h in active labour. Approximately 20% of women with GDM will develop hyperglycemia during active labour and insulin treatment during pregnancy is not a predictor for this. Even brief episodes of maternal hyperglycemia may have adverse implications for the newborn.
- Those on diet control only often do not need IV support
- Those on insulin: Do not withhold insulin/nourishment until labour is established.
- Monitor blood glucose q2h in early labour and q1h in active labour until delivery. Administer glucose containing solution such as D5S or D5W @ 125 cc/hr.prn
- Check urine for ketones at least q2h.
- If significant ketonuria, notify physician and change IV to D10W at 125 cc/hr until clear.
- Administer insulin by sliding scale as per physicians orders. For example:
 - 8.1 - 11.0 mmol/L - Give 1 unit Regular insulin sc
 - 11.1 - 14.0 mmol/L – Give 2 units Regular insulin sc
 - > 14.0 mmol/L – Give 3 units Regular insulin sc and call physician
- NB: Some practitioners use IV insulin during labour
- Caesarean Section: Double snack at hs
- Morning of cesarean
- NPO from midnight (or allow for clear fluid diet 6 hours prior to surgery)
- If on insulin, withhold ac breakfast dose.⁶

Fetal Surveillance

Guidelines

- **SOGC - Fetal Health Surveillance: Antepartum and Intrapartum Consensus Guideline:**

-Insulin-requiring GDM is listed among the obstetrical history and current pregnancy conditions associated with increased perinatal morbidity/mortality where antenatal fetal surveillance may be beneficial. In addition, GDM is listed among the antenatal and intrapartum conditions associated with increased risk of adverse fetal outcome where intrapartum electronic fetal surveillance may be beneficial.⁷

- **Fifth International Workshop-Conference on Gestational Diabetes Mellitus in 2005:**

-Fetal ultrasound screening for congenital anomalies is recommended for women with GDM who present with A1C $\geq 7.0\%$ or fasting plasma glucose >6.7 mmol/l as an increased risk of major congenital malformations has been reported in such pregnancies. Type and frequency of surveillance for fetal well-being and its frequency should be influenced by the severity of maternal hyperglycemia or the presence of other adverse clinical factors.

-Data are not available to demonstrate the optimal application of more intensive fetal monitoring or which method is superior in women with GDM.

-No fetal surveillance method is always able to detect fetal compromise. Data are insufficient to determine whether surveillance beyond self-monitoring of fetal movements is indicated in women with GDM who continue to meet the targets of glycemic control with MNT/physical activity regimens alone and in whom fetal growth is appropriate for gestational age.⁸

- **Australasian Diabetes in Pregnancy Society - Management Guideline on GDM:**

-The timing of commencement and the frequency of fetal monitoring in pregnancies complicated by GDM depend on the presence of other pregnancy complications such as pre-eclampsia, hypertension, antepartum haemorrhage and intrauterine growth retardation. The regimen chosen should be dictated by the severity of the obstetric complication.

-Monitoring may be by either Doppler umbilical bloodflow measurement or cardiotocograph (CTG). Although CTG surveillance is commonly undertaken routinely from 36 weeks' gestation,

there is no objective evidence that fetal monitoring in uncomplicated GDM affects fetal outcome.

-Common practice in the United States is to commence CTG monitoring after 40 weeks' gestation, while awaiting spontaneous onset of labour in uncomplicated GDM pregnancies, but again there is no evidence-based medicine to support or refute this practice.

-Ultrasonography should be considered at around 34 weeks' gestation to detect abnormalities of fetal growth and polyhydramnios. It may be indicated earlier in some women, for example for women unsure of their dates, or those with morbid obesity or suspected undiagnosed non-insulin-dependent diabetes. Ultrasonography may need to be repeated if any abnormality is detected.⁹

- **International Diabetes Center 2003 Gestational Diabetes Practice Guidelines:**

-For women with GDM, monitoring fetal kick counts should begin at 28 weeks; non-stress testing should begin at 34 weeks and continue until the end of pregnancy; routine fetal monitoring should be started at 35 to 36 weeks.¹⁰

What does the literature say in general about fetal surveillance and timing of delivery in GDM?

B A 2009 review of the literature on 14 screening and monitoring interventions in pregnancy on stillbirth (including identification and management of high-risk pregnancies, advanced monitoring techniques, and monitoring of labour) found that there are numerous research gaps and large, adequately controlled trials are still needed for most of the interventions examined. Numerous studies indicated that positive tests were associated with increased perinatal mortality, but while some tests had good sensitivity in detecting distress, false-positive rates were high for most tests, and questions remain about optimal timing, frequency, and implications of testing.¹¹

A compilation of resources on fetal monitoring is available here:

http://www.gfmer.ch/Guidelines/Labour_delivery_postpartum/Fetal_monitoring.htm

Is fetal surveillance necessary in well-controlled (A-1) GDM?

S In a 2002 review of literature and opinion paper on the necessity of fetal surveillance in pregnancy complicated by diabetes, the benefit of routine fetal surveillance for GDM was deemed as more debatable than for women with pre-existing diabetes. The authors posited that women with diet-controlled (class A1) GDM who maintain normal fasting and postprandial glucose values are at low risk for an intrauterine death. Therefore, many clinicians do not initiate antepartum fetal surveillance in uncomplicated GDM until 40 weeks' gestation. There is some consensus that women who require insulin for treatment of GDM should undergo twice-weekly heart rate testing at 32 weeks' gestation. It appears that the third-trimester stillbirth rate in these patients is no higher than in the general obstetric population.¹²

B A 2006 review and opinion paper on appropriate fetal surveillance for women with diet-controlled gestational diabetes concluded that no evidence clearly supports the practice of increased fetal surveillance in these pregnancies. However, a number of guidelines recommend beginning surveillance of some kind between 32 and 40 weeks based on cumulative risk factors, including gestational diabetes.¹³

B A 1996 literature review from the US questioned whether the published data provide sufficient evidence-based support of antepartum surveillance in well-controlled diabetic pregnancies (including GDM) without evidence of microvascular disease, hypertension, or clinical fetopathy. The authors did not find sufficient data to support a specific time in gestation at which to begin testing in this specific patient population. Also, fetal surveillance did not predict the 3 fetal deaths which occurred at 36 and 37 weeks gestation among study participants.¹⁴

What are the best method and protocol for fetal testing?

B In a 2002 opinion paper from the USA on antenatal fetal testing, the authors stated that there are wide differences of opinion among providers as to the preferred protocol for such testing. The optimal method of fetal surveillance, the gestational age at which to start testing, the frequency of testing, and even whether all patients with GDM require antenatal testing are all controversial, unresolved issues.¹⁵

B A 2008 review of antenatal testing for diabetic mothers found that fetal surveillance remains the standard in pregnancies complicated with diabetes. What is unclear is the efficacy of such testing in patients with well-controlled or true GDM. Fetal heart rate monitoring as primary surveillance would appear appropriate with a testing frequency of every 3 to 4 days. Abnormal tests should have a backup test performed due to the high rate of false-positive testing.¹⁶

B In a 1996 US study of antepartum testing results for 68,869 births found 15,482 women that were identified as "high risk" (including GDM). Among them, the false-negative rate of the antepartum testing protocol (i.e., modified BPS, including NST and amniotic fluid volume index) was 0.8 per 1000 women tested. Sixty percent of those delivered because of an abnormal antepartum test had no evidence of short-term or long-term fetal compromise. False-positive test results led to preterm delivery in 1.5% of those tested before term. The false-negative rate of the modified biophysical profile was found to be lower than that of the nonstress test and compared favorably with the false-negative rates of the contraction stress test and the complete biophysical profile.¹⁷

Bottom Line: Fetal surveillance may not be as useful or necessary in uncomplicated, diet-controlled GDM.

B A 2002 review of literature on nonstress tests in high-risk pregnancies (including GDM) found that the best evidence to date showed that antepartum surveillance may use the NST but should not rely on it as a sole screening tool. The same can be said for vibroacoustic stimulation (VAS). Few clinical, nonrandomized trials of actocardiography (ACTG) have been reported. A recent large survey of ACTG found that the predictive values of Doppler movement detection were as reliable as those provided by standard NST parameters.¹⁸

B A 1996 US study was conducted to determine which test (i.e., nonstress test, biophysical profile, or umbilical artery velocimetry), is best for predicting adverse outcomes in pregnancies complicated by diabetes (abstract only – type unclear). Researchers evaluated 207 pregnancies complicated by diabetes within 1 week of delivery using the afore-mentioned pregnancy surveillance tests. Umbilical artery Doppler velocimetry was superior to either the nonstress test or the biophysical profile in identifying the subgroup of pregnancies complicated by diabetes that resulted in an adverse outcome.¹⁹

Bottom Line: There appears to be no consensus on which form of fetal surveillance is most effective. The main concern with most of the tests appears to be the rates of false-positive and false negative results.

Fetal Kick Counts

Is there a need to revisit the research on fetal movement counting?

B In a 2004 revisiting of 24 studies on fetal movement counting (which included studies of GDM), the authors state that interest for maternal fetal movement counting as a method of screening for fetal well-being boomed during the 1970's and 1980's. Several reports demonstrated that the introduction of counting charts significantly reduced stillbirth rates. However, in 1989, a large study appeared in *The Lancet* that annihilated research in this field by deeming charts ineffective. In retrospect, it seems evidence was lacking. Available data demonstrate that reduced fetal movements are associated with adverse pregnancy outcome, both in high and low risk

pregnancies. Increased vigilance towards maternal perception of movements (e.g. by performing movement counting studies) reduces stillbirth rates, in particular stillbirths deemed avoidable. The authors concluded that, while screening for fetal well-being by maternal fetal movement counting can reduce fetal mortality rates, a resurrection in research activity is urgently needed to optimize its benefits.²⁰

Ultrasound / Biophysical Profile Scores (BPS)

Is fetal ultrasound useful for monitoring fetal wellbeing?

In a 2010 Cochrane Review to assess the effects of Doppler ultrasound used to assess fetal well-being in high-risk pregnancies on obstetric care and fetal outcomes, 18 studies were identified involving just over 10,000 women. These studies compared the use of Doppler ultrasound of the babies' vessels in utero with no Doppler or with cardiotocography (CTG). There was a reduction in the number of babies who died, fewer caesarean sections and operative deliveries. The quality of the studies was not high.²¹

B A 2004 study from China found that using Doppler to study the umbilical artery pulsatility index (UA-PI), middle cerebral artery pulsatility index (MCA-PI), and the middle cerebral artery peak systolic velocity (MCA-Vmax) was not useful in the prediction of abnormal pregnancy outcome in GDM.²²

B In a 2008 review of antenatal testing methods for diabetic mothers, it was suggested that mild to moderate fetal acidosis may not be detected by umbilical artery Doppler.²³

S A 1995 double-blind study of 92 diabetic pregnant women (53 GDM) was conducted in Israel to evaluate a random single Doppler test of the systolic to diastolic ratio of the umbilical artery as a predictor of perinatal outcome in diabetic pregnancies. The results suggest that the systolic to diastolic ratio of the umbilical artery offers no advantage over other well-established tests in the management of diabetic pregnancies.²⁴

Is fetal ultrasound useful for monitoring fetal size and maternal metabolic control?

B In a 1994 study in the US on the use of fetal ultrasound to select metabolic therapy for pregnancies of 303 women complicated by mild gestational diabetes, fetal ultrasound early in the third trimester identified mothers whose infants were at high risk for fetal macrosomia in the absence of standard glycemic criteria for insulin therapy. Insulin treatment reduced the macrosomia, indicating that fetal ultrasound can be used to guide metabolic therapy in pregnancies complicated by mild GDM.²⁵

B In a 2004 study of 226 women with GDM in Italy, researchers evaluated a therapeutic strategy for GDM based on ultrasound measurement of fetal insulin-sensitive tissues. The authors concluded that this modified approach was associated with better neonatal outcomes in a population of women with GDM with various degrees of metabolic alteration. The percentage of LGA newborns was significantly lower than that obtained with a standard conventional protocol, where therapeutic decisions were based only on maternal glycemic concentrations.²⁶

B A Swedish study of 146 women with GDM in 2006 sought to evaluate if maternal glucose level and growth of the fetus were related to placental vascular impedance in pregnancy complicated by GDM. Uterine and umbilical artery vascular impedance in pregnancies complicated by gestational diabetes was related to birth weight and placental weight, but not to maternal HbA1c levels. Placental Doppler ultrasound did not seem to be of clinical value for fetal surveillance in these pregnancies unless the pregnancy was complicated by pre-eclampsia and/or intrauterine fetal growth restriction.²⁷

Bottom Line: Ultrasound for fetal monitoring is useful for monitoring fetal wellbeing (e.g. lowering the number of fetal deaths, c-sections, and operative deliveries) and for guiding metabolic control, but it may not be useful in detecting all complications associated with GDM..

When is the best time for a fetal ultrasound?

S A 2000 randomized trial of 140 women with mild GDM in Italy was designed to investigate the adequate timing of fetal ultrasound to guide metabolic therapy. 29 women whose fetal abdominal circumference exceeded the 75th percentile were considered eligible for insulin therapy. In this group, there was a statistically significant increase in the percentage of macrosomic infants born from women whose ultrasound abdominal circumference assessment was performed only at 32 weeks gestation when compared to women evaluated at both 28 and 32 weeks gestation. The results support the need for fetal ultrasound at 28 weeks gestation to direct metabolic therapy since insulin administration introduced after 32 weeks gestation has a limited effect on fetal growth.²⁸

Is the Biophysical Profile Score (BPS) useful?

In a 2008 Cochrane Review to assess the effects of the BPP when compared with conventional monitoring (Cardiotocograph only or Modified BPP) on pregnancy outcome in high-risk pregnancies (including diabetes, but does not mention GDM in particular), five trials were included, involving 2,974 women. Most trials were not of high quality. Although the overall incidence of adverse outcomes was low, available evidence from randomized controlled trials did not support the use of BPP as a test of fetal wellbeing in high-risk pregnancies.²⁹

B In a 2008 review of antenatal testing methods for diabetic mothers, the biophysical profile (BPP) was described as having been used for fetal surveillance in insulin-dependent patients with reportedly excellent negative-predictive value. More specifically, the BPP used twice weekly appears to be an adequate test with few unnecessary interventions.³⁰

B In a 1988 study of 238 well-controlled diabetic pregnancies (188 GDM) researchers attempted to evaluate the ability of BPS to facilitate conservative management when the fetus was healthy and to indicate accurately the compromised fetus for whom intervention was needed. Intervention was not pursued unless there were maternal or fetal complications. The incidence of abnormal BPS was 3.3% overall, with no significant difference between types of diabetics. Of the fetuses with a normal BPS, 87% were delivered at term with minimal maternal or neonatal morbidity. The authors concluded that using the BPS permitted safe expectant management in the diabetic pregnancy, yielding significant clinical advantages to both mother and fetus.³¹

Vibroacoustic stimulation

S A 2007 study involving 214 high-risk pregnancies (including diabetics but does not specify how many GDM) was conducted in India to evaluate vibroacoustic stimulated modified fetal biophysical profile in antepartum monitoring of high risk pregnancy. Results indicated that vibroacoustic stimulated modified fetal biophysical profile (VAS/mFBP) as a primary means of surveillance in high risk pregnancy is a reliable diagnostic approach.³²

Bottom Line: There is a lack of evidence on the utility of the biophysical profile for fetal surveillance in the intrapartum care of GDM pregnancies.

Nonstress Testing

Is the nonstress test useful?

B A 2008 review of antenatal testing for diabetic mothers described the NST as the preferred antepartum HR test for women with diabetes. While testing is initiated generally at 32 wks GA, it is started as early as 28 wks GA in diabetic women with renal disease, vascular disease, or suspected intrauterine growth restriction.³⁰

B In a 1994 study from Greece, a series of 180 cases of high-risk pregnancies (14 diabetics, no mention of how many were GDM) were studied in order to assess if a nonstress test taken 24 h before delivery is of any prognostic significance. Results indicated that the nonreactive test could identify a population at risk but it was not helpful as a 'stand alone' modality in decision making, because of the low sensitivity and positive predictive value rates (40.9% and 28.1 %, respectively).³³

B In a 1995 study of 2134 women with diabetes (1388 GDM), an antepartum fetal surveillance program using twice-weekly NST and fluid index assessment was successful in preventing stillbirth. The absence of fetal heart rate reactivity and the presence of decelerations were predictive of the diagnosis of fetal distress in labour requiring cesarean delivery. Ultrasonographic assessment of amniotic fluid volume was not a significant predictor of fetal distress in labour in diabetic pregnancy.³⁴

B A 1985 study was conducted to review the role of antepartum fetal monitoring in 69 patients with GDM controlled by diet only and 28 women requiring insulin therapy. Antepartum fetal surveillance included outpatient NST, urinary estriol assays, maternal assessment of fetal activity, and clinical estimation of fetal weight. The results suggested that, in GDM, an outpatient program of fetal testing, using primarily the nonstress test and maternal assessment of fetal activity, can be employed in patients requiring insulin as well as class A patients with identifiable risk factors. The protocol resulted in a low rate of unnecessary intervention and good perinatal outcome. The risks for abnormal antepartum testing results appeared to be increased in GDM with hypertension and prolonged pregnancy.³⁵

S A 1999 randomized controlled trial in the US tested whether the number of fetal surveillance tests and perinatal outcomes would differ statistically between pregnancies randomized to visual or computerized interpretation of antepartum NST results. Results indicated that computerized interpretation of NST test results was associated with fewer additional fetal surveillance exams, less time spent in testing, and a similar length of stay in the neonatal ICU compared with standard visual interpretation.³⁶

B In a 1986 Swedish study of 99 diabetic women (22 GDM) to examine the predictive value of the NST, results indicated that in diabetic pregnancy the frequently performed NST is a good predictor of normality and thus is highly reliable in fetal surveillance.³⁷

B In a 2002 review of the literature on NST in high-risk pregnancies (including diabetes, but GDM is not specifically mentioned), the authors state that the best evidence to date shows that antepartum surveillance may use the NST but should not rely on it as a sole screening tool. It should be clear that the NST can only be intended as a single rather than the sole part of the comprehensive evaluation of high risk pregnancies. Clinical management, including obstetric interventions, should be based on a composite picture that incorporates as much patient information as possible and that includes adequate determination of fetal age and maturity.¹⁸

Nonstress test vs. biophysical profile

B In a 1984 Canadian randomized study of 735 patients with high-risk pregnancies (64 GDM), fetal BPP scoring resulted in a significantly higher positive predictive value in regards to low Apgar scores. Sensitivity, specificity, and accuracy, although higher with fetal BPP scoring, did not demonstrate significant differences when compared to the nonstress test. The negative predictive value between the two methods was similar.³⁸

Nonstress test vs. contraction stress test

B A 2008 review of antenatal testing for diabetic mothers emphasized that there are significant problems with the contraction stress test (CST). While there are very rarely false-negative results, the false-positive rates approach 50 to 60%. Further, the frequency of such positive testing led to delivery for an abnormal test in upwards of 10% of tested diabetic women. Thus, the CST is overall less efficient, more costly, and more inconvenient than the nonstress test (NST). Consequently, few perinatal centers continue to use the CST as their primary means of antepartum fetal surveillance.³⁰

Bottom Line: The nonstress test appears to be useful for fetal surveillance in GDM, however its value as a “stand alone” test is limited.

Maternal Surveillance

Guidelines

Australasian Diabetes in Pregnancy Society - Management guideline on GDM:

-During labour, good glycemic control needs to be maintained while avoiding hypoglycemia. Lower insulin requirements are common during labour (often no insulin is necessary). Fetal surveillance is needed, as it is for any high risk pregnancy. A pediatrician should be present at the delivery if significant neonatal morbidity is suspected. The maternal blood glucose level should be monitored for 24 hours postpartum and, if indicated, continued for longer.⁹

Glycemic control in labour

B A 2006 clinical trial examined rotating fluids versus insulin drip for intrapartum maternal glycemic control in women with insulin requiring diabetes (pre-gestational and gestational diabetes). The study found that there was no difference in mean maternal intrapartum CBG whether patients with insulin requiring diabetes (who were well-controlled during the antepartum period) were placed on maintenance dextrose intravenous fluids and a concurrent adjusted insulin drip or their fluids were rotated between glucose containing and non-glucose containing intravenous fluids. Either method seems adequate to control maternal blood sugar in labour. In addition, there was no difference in neonatal outcomes between the 2 study groups.³⁹

B In a 2010 observational study, 86% of maternal intrapartum CBG values fell within target range (3.3-7.2 mmol/L) without need for insulin use. Intrapartum maternal glucose levels were related with third-trimester glycated hemoglobin and higher in those with no endocrinologic follow-up.⁴⁰

B In a 2007 opinion paper, the authors recommend that women with diabetes should not take long-acting insulin on the day of labour induction or elective cesarean delivery. Regular insulin may be used during labour as part of an infusion adjusted according to a capillary blood glucose monitoring-based protocol. Tight regulation of maternal glucose levels during labour can reduce the incidence of neonatal hypoglycemia, even among women with poor antepartum glycemic control. Women with diet-treated gestational diabetes generally do not require such intense monitoring and insulin therapy during labour.⁴¹

that insulin requirements during labour are unrelated to therapy during pregnancy and that high CBG during labour increases the risk of neonatal hypoglycemia.⁴⁴

Bottom Line: High CBG during labour in women with GDM increases the risk of neonatal hypoglycemia. However, uncomplicated GDM, well-controlled with diet, does not appear to require any additional intensive monitoring or insulin therapy during labour.

B A 2000 study on intrapartum screening for diabetes in patients without prenatal care sought to determine whether a labour admission serum glucose is of predictive value in the diagnosis of gestational diabetes. The study found that in labouring patients without insulin-requiring diabetes, labour admission glucose did not predict an abnormal 1 degree PG and thus does not aid in labour management of patients with suboptimal prenatal care.⁴²

B A 2009 retrospective review was conducted in Australia on 137 singleton, term deliveries of women with diabetes (114 GDM) using a more conservative approach than traditional tight glycemic control. Regardless of planned delivery method, maternal blood sugar level (BSL) was monitored during delivery and only if outside 4–7 mmol/L was action taken. The results suggested that the practice of a more conservative approach, particularly in women with GDM, may offer an alternative to more aggressive regimes.⁴³

B A 2000 Spanish observational study of 85 women with GDM (54 insulin-treated) was performed to assess metabolic control during labour using a standardized protocol, the influence of therapy during pregnancy in intrapartum metabolic control and insulin requirements, and the impact of maternal glycemia during labour on neonatal hypoglycemia. Intrapartum metabolic management included i.v. glucose and insulin infusions, urinary ketone measurement and hourly capillary blood glucose (CBG) monitoring. The authors concluded that in women with GDM, the use of a standardized intrapartum management protocol is associated to fair metabolic control,

Timing of Delivery

Guidelines

Fifth International Workshop-Conference on Gestational Diabetes Mellitus:

-There are no data supporting delivery of women with GDM before 38 weeks' gestation in the absence of objective evidence of maternal or fetal compromise. Data are not available to indicate whether or not there is greater risk of perinatal morbidity/mortality in the infants of women with well-controlled GDM if pregnancy is allowed to proceed past 40 weeks' gestation. Nevertheless, it is reasonable to intensify fetal surveillance when pregnancy is allowed to continue beyond 40 weeks' gestation. Some evidence indicates that delivery past 38 weeks can lead to an increase in the rate of large-for-gestational-age infants without reducing the rate of cesarean deliveries.

-Amniocentesis for assessment of fetal lung maturity is not indicated in well-controlled patients who have indications for induction of labour or cesarean section as long as there is reasonable certainty about the estimation of gestational age. When delivery is necessary at an earlier gestational age for the well-being of mother or fetus, delivery should be effected without regard to lung maturity testing.⁸

Australasian Diabetes in Pregnancy Society - Management guideline on GDM:

-The possibility that diagnosis of GDM may lead to increased obstetric intervention, including induction of labour and caesarean section, is a concern. Delivery before full term is not indicated unless there is evidence of macrosomia, polyhydramnios, poor metabolic control or other obstetric indications (e.g., pre-eclampsia or intrauterine growth retardation). Continuation of the pregnancy in uncomplicated GDM to full term is acceptable provided that indications from fetal monitoring are reassuring.⁹

Guideline on Induction of Labour from (ACOG)

-Indications for induction of labour are not absolute but should take into account maternal and fetal conditions, gestational age, cervical status, and other factors. Diabetes Mellitus (no mention of what type(s)) is listed as an example of a maternal or fetal condition that may be an indication for induction of labour.⁴⁵

Is there an optimal time of delivery for GDM?

B A 2006 study to estimate the gestational age ranges that result in optimal birth outcomes (measured by rates of cesarean delivery, major perineal trauma, low 5-min APGAR score, and neonatal ICU admission) for four risk-defined groups (low-risk, advanced maternal age, hypertension, and any type of diabetes mellitus) found that for the DM group optimal time of delivery was 40 weeks 3 days to 41 weeks 1 day.⁴⁶

S A 1993 randomized trial found that in women with uncomplicated insulin-requiring gestational or class B pregestational diabetes, expectant management of pregnancy after 38 weeks' gestation did not reduce the incidence of cesarean delivery. Moreover, there was an increased prevalence of large-for-gestational-age infants (23% vs 10%) and shoulder dystocia (3% vs 0%). Because of these risks, delivery should be contemplated at 38 weeks and, if not pursued, careful monitoring of fetal growth must be performed.⁴⁷

B A 1992 review of the charts of 125 women with GDM who delivered beyond 40 weeks of gestation was compared to two control groups. Results indicated that by allowing the pregnancies of gestational diabetic patients class A1 and class A2 to proceed beyond 40 weeks of gestation, the incidence of perinatal mortality and morbidity rate did not increase. The cesarean section rate was low (10.76% in class A1 and 22.03% in class A2). The authors suggested that not only is elective intervention prior to 40 weeks of gestation to be avoided, but an attempt should be made to allow the gestational diabetics class A1 and class A2 to proceed to spontaneous labour.⁴⁸

Compilation of evidence-based resources on induced labours:

http://www.gfmer.ch/Guidelines/Labour_delivery_postpartum/Induced_labour.htm

Bottom Line: Delivery before full term is not indicated in GDM unless there are other complicating factors (e.g. macrosomia, poor metabolic control).

Does induction of labour improve/worsen outcomes?

A 2009 Cochrane Review on elective delivery in pregnant diabetic women found only one trial of labour induction for 200 women with diabetes treated with insulin (187 had gestational diabetes). The risk of macrosomia, defined as birthweight above 4000 g, was reduced in the active induction group, while two infants in the expectant group had a birthweight of more than 4500 g. Mean birthweight and proportion of large-for-gestational age infants (at or above 90th percentile) were higher in the expectant management group. Perinatal morbidity was rare. Three cases of mild shoulder dystocia (without brachial plexus injury or bone fracture and with Apgar scores at 5 minutes higher than 7) were observed in the expectant management group, while none were reported in the induction group. No other perinatal morbidity was reported.²

In a 2008 AHRQ Evidence Report on therapeutic management, delivery, and postpartum risk assessment and screening in GDM, two low-quality observational studies suggested a potential reduction in macrosomia and shoulder dystocia with elective labor induction and elective cesarean delivery for macrosomia or LGA infants.⁴⁹

In a 2009 systematic review (5 studies) to estimate benefits and harms of the choice of timing of induction or elective cesarean delivery based on estimated fetal weight or gestational age in women with GDM, the proportion of newborns with birth weight greater than the 90th percentile was significantly greater in the expectant-management group (23% compared with 10% with active induction). There were no significant differences in rates of cesarean delivery, shoulder dystocia, neonatal hypoglycemia, or perinatal deaths. Four observational studies suggested a potential reduction in macrosomia and shoulder dystocia with labor induction and cesarean delivery for estimated fetal weight indications.⁵⁰

B In a 2007 opinion paper, the authors state that the risk of stillbirth is not elevated in women with diet-treated GDM, thus incentive for elective labour induction in women with GDMs should be related to estimates of fetal weight. Also, the obstetric provider is often tempted to consider early elective delivery in women with GDM to avoid the increased risk of fetal overgrowth and difficult delivery, however the evidence to justify such an intervention is also lacking. Available literature suggests that, while elective labour induction for women who have mild GDM may not result in a significant increase in maternal or fetal risk, the benefit of this practice is unclear.⁵¹

Early induction of labour and strict glycemic control

B A 1998 study on antepartum management protocols sought to determine whether strict glycemic control during diabetic pregnancy combined with elective early induction of labour reduced the rate of cesarean delivery and fetal birth trauma. The results indicated that maintaining strict control of maternal diabetes and adhering to an active management protocol for early elective delivery based on the estimated fetal weight had a significant effect on reducing the rate of macrosomia, thereby affecting the incidence of both traumatic births and cesarean deliveries.⁵²

B A 1998 US study was conducted among 2604 patients (91.35% GDM) to test the hypothesis that elective delivery of infants diagnosed with macrosomia by ultrasonographic studies in diabetic women will significantly reduce the rate of shoulder dystocia without significantly increasing cesarean section rate. The results showed that an ultrasonographically estimated weight threshold as an indication for elective delivery in diabetic women reduced the rate of shoulder dystocia without a clinically meaningful increase in cesarean section rate. This practice, in conjunction with an intensified management approach to diabetes, is believed to improve the outcome of these high-risk women and their infants.⁵³

B A 1996 study of 96 women with GDM from Israel was conducted to test the hypothesis that the incidence of shoulder dystocia could be reduced in insulin-requiring diabetic women by elective induction of labour at 38 to 39 weeks of gestation. The incidence of shoulder dystocia in patients in whom labour was electively induced at 38 to 39 weeks of gestation was 1.4% as compared to 10.2% in patients who delivered beyond 40 weeks' gestation ($p < 0.05$). No increase in cesarean section rate was demonstrated. The authors concluded that elective induction of labour is suggested for insulin-requiring diabetic women in order to reduce the incidence of shoulder dystocia.⁵⁴

B A 2002 review of literature on induction of labour versus conservative management of pregnant diabetic women (including GDM) found that there is no evidence that the incidence of shoulder dystocia is affected by either induction of labour or expectant management. The authors stated that currently available evidence suggests that, while induction of labour for women who have diabetes may not carry much maternal or fetal risk, the benefit of this procedure is unclear.⁵⁵

B In a 2009 Israeli study of 184,256 deliveries (10,227 GDM A1) to examine pregnancy outcomes associated with diet-controlled GDM, the stillbirth rate before 40 weeks of gestation was identical among all participants. However after 40 weeks it was significantly higher in women without GDM A1, leading to the conclusion that induction of women with GDM A1 at 40 weeks may play a role in lowering perinatal mortality to below that of the general population.⁵⁶

B A 2001 study on vaginally administered misoprostol for outpatient cervical ripening in pregnancies complicated by diabetes mellitus (most had GDM) found that vaginally administered misoprostol was no more effective than placebo in reducing the need for inpatient labour induction or the induction-delivery interval. Outpatient cervical ripening with use of vaginally administered misoprostol was well tolerated.⁵⁷

Are women with GDM more likely to be induced by providers?

In a 2009 Cochrane Review to compare the effect of alternative treatment policies for GDM on both maternal and infant outcomes, women who received specific treatment were more likely to have their labour induced compared to women who received routine antenatal care only (two trials, 1068 women).⁵⁸

B A 2004 study of 2,060 women with GDM to assess the impact of different management approaches to GDM on perinatal outcome over 4 time periods found that the periods from 1993-1996 and 1996-1999 were characterized by lower mean glucose level, lower mean gestational age at delivery, and a decline in macrosomia, shoulder dystocia and perinatal mortality rates, but also by high rates of labour induction and cesarean delivery. A significant difference was found between the GDM and normal control groups in rates of labour induction (38.6% vs. 10.8%) and cesarean delivery (34% vs. 20%) for the last period. The researchers concluded that perinatal complications are preventable with good glycemic control and early induction of labour, but at a cost of a higher cesarean section rate.⁵⁹

B A 2001 study of perinatal complications in 327 women with GDM vs 295 non-diabetic women reported that induction of labour took place significantly more often in the group with GDM. The indications for induction were not registered but the frequency of pregnancy complications did not differ between the groups. Thus, the increased induction rate might have been due to the management scheme for GDM in the department where the study took place. The researchers did not find a significantly increased rate of cesarean section in women with GDM, despite the higher rates of induction and of macrosomia, which were found in the GDM group.⁶⁰

Bottom Line: Induction of labour for GDM appears to lower the risk of morbidity and possibly mortality in the fetus, often without increasing the rate of Cesarean sections. It also appears that women with GDM are more likely to have their labour induced than non-diabetic women.

Planned Cesarean Section

Guidelines

Fifth International Workshop-Conference on Gestational Diabetes Mellitus:

-Delivery of a large-for-gestational-age fetus in the setting of GDM is associated with an increased risk of birth injury compared with the nondiabetic population. Strategies to reduce the risk of birth injury include a liberal policy toward cesarean delivery when fetal overgrowth is suspected. However, no controlled trials are available to support this approach. In planning the timing and route of delivery, consideration of fetal size using clinical and ultrasound estimation of fetal weight, despite inherent inaccuracies, is frequently used.

-Using ultrasound estimated fetal weight or abdominal circumference to make decisions regarding timing and route of delivery may be associated with a lower rate of shoulder dystocia, but larger studies are needed to determine if this approach affects the rate of neonatal injury.⁸

What does the literature say about cesarean section delivery in GDM?

A 2009 Cochrane Review on elective delivery in pregnant diabetic women found only one trial of labour induction for 200 women with diabetes treated with insulin (187 had gestational diabetes). The risk of caesarean section (elective or in labor) was not statistically different between groups. More women in the expectant management group had a previous cesarean section as compared to the induction group (20% and 11%, respectively). Elective caesarean section was performed in 8% of women in the induction group, and 7% in the expectant group.²

In a 2009 Cochrane Review to compare the effect of alternative treatment policies for GDM on both maternal and infant outcomes, Caesarean section rate was not significantly different when comparing any specific treatment with routine antenatal care (ANC) (including data from five trials with 1255 participants). There was a significantly lower rate of caesarean sections in women receiving oral hypoglycaemics compared to insulin (two trials, 90 women).⁵⁸

B In a 2007 opinion paper, the authors suggest that for a woman whose pregnancy is complicated by diabetes and whose fetus is estimated to be at least 4500 g, a policy of primary cesarean section seems justified. A woman with diabetes whose fetus is estimated to be less than 4000 g should not be considered a candidate for cesarean delivery based solely on fetal size. Importantly, in women with diabetes and a history of shoulder dystocia, primary cesarean delivery should be seriously considered. In women with diabetes and an estimated fetal weight between 4000 and 4500 g, routine elective cesarean delivery remains an area of controversy. Prior delivery history, clinical assessments of the maternal pelvis, and labour progress should be considered before proceeding with a cesarean delivery in these women.⁵⁰

B In a study of data from 329,988 births in New York City stratified by race/ethnicity, chronic and GDM were significant risks for a primary cesarean section and for preterm birth in all women.⁶¹

B In a 1997 study, 220 deliveries of diabetic pregnant women (186 GDM), occurring from 1990-1994 were studied in comparison with 3615 women who delivered during the year of 1994. The data indicate that in our diabetic population there is a high rate of cesarean sections and planned deliveries, as well as macrosomia, LGA and shoulder dystocia. Obstetric decision to allow the delivery to term or near term was not enough to bring the rate of macrosomia and LGA close to the normal, which can be a consequence of the diabetic control in pregnancy, in spite of intensive care intervention.⁶²

B A 2002 review of literature on cesarean section versus vaginal delivery of macrosomic infants found the following conclusions:

- Shoulder dystocia and brachial plexus injury risk increase with increasing birth weight in infants of diabetic mothers
- Cesarean delivery essentially eliminates the risk of brachial plexus injury;
- Use of a fetal weight threshold for recommending cesarean delivery, when fetal weight is determined by ultrasonography, can result in a decrease in the occurrence of shoulder dystocia in diabetic women;
- The benefit of reducing the shoulder dystocia rate in diabetic women (and thereby reducing the rate of permanent brachial plexus injuries) must be weighed carefully against the maternal cost of increased cesarean deliveries with their associated short- and long-term morbidities;
- Fetal overgrowth is best detected ultrasonographically by employing fetal weight formulas in common clinical use.¹⁸

B A 1992 review of the charts of 125 women with GDM who delivered beyond 40 weeks of gestation was compared to two control groups. Results indicated that by allowing the pregnancies of gestational diabetic patients class A1 and class A2 to proceed beyond 40 weeks of gestation, the incidence of perinatal mortality and morbidity rate did not increase. The cesarean section rate was low (10.76% in class A1 and 22.03% in class A2). The authors suggested that not only is elective intervention prior to 40 weeks of gestation to be avoided, but an attempt should be made to allow the gestational diabetics class A1 and class A2 to proceed to spontaneous labour.⁶³

B A 2005 study of 143 women with GDM in the U.S. found that routine delivery at 38 weeks in an A-2 diabetic population was not associated with additional intrapartum morbidity or a greater need for cesarean delivery.⁶⁴

B In a 2007 study in the US, analyzing the data from 3,218 women with GDM, women with suboptimal blood glucose control had a higher incidence of cesarean deliveries (and a number of other complications). Results suggest that careful monitoring of blood glucose levels and initiation of appropriate treatment are essential in the care of women with GDM.⁶⁵

B A 1991 US 5-year study was conducted, involving 210 patients with gestational diabetes mellitus who delivered offspring weighing greater than or equal to 3500gm. Only three primary cesarean sections were performed electively because of suspected macrosomia while 120 were delivered vaginally. The authors concluded that a policy to deliver by cesarean section all fetuses estimated to weigh greater than 4000 gm would considerably increase the number of cesarean sections with minimal fetal benefit.⁶⁶

Bottom Line: Despite a lack of conclusive evidence, it appears that cesarean section may be beneficial when fetal overgrowth is suspected. However any benefits must be carefully weighed against the maternal risks/costs associated with cesarean section deliveries

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None declared

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