Antepartum Fetal Surveillance in Gestational Diabetes Mellitus

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SUMMARY

Pregnancy in patients with gestational diabetes mellitus (GDM) is associated with increased perinatal morbidity. Whether the perinatal mortality rate, particularly the fetal death rate, is greater in these patients remains controversial. The present study was undertaken to review the role of antepartum fetal monitoring in 69 patients with GDM controlled by diet only (class A) and 28 women requiring insulin therapy (class AB). Hypertension complicated 21.6% of these pregnancies.

Antepartum fetal surveillance included outpatient nonstress testing, urinary estriol assays, maternal assessment of fetal activity, and clinical estimation of fetal weight. All insulin-requiring patients as well as fourteen class A patients with identifiable risk factors underwent testing. No perinatal deaths occurred. Only six patients required intervention for suspected fetal jeopardy and four of these women had hypertension. Macrosomia was correctly identified in only 6 of 16 infants weighing 4000 g or more.

This study suggests 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. This protocol resulted in a low rate of unnecessary intervention and good perinatal outcome. The risks for abnormal antepartum testing results appear increased in GDM with hypertension and prolonged pregnancy. DIABETES 1985; 34 (Suppl. 2):50–54.

Although Pedersen failed to demonstrate a fall in perinatal mortality in pregnancies complicated by gestational diabetes (GDM) over the 30-yr period ending in 1972,[1] most clinicians have concluded that the perinatal mortality rate in GDM is no greater than that observed in the general population if optimum care is provided.[2–5] Utilization of widespread screening programs to detect GDM has undoubtedly contributed to this improved perinatal outcome.

Antepartum fetal assessment using both biophysical and biochemical techniques can safely prolong gestation and avoid intrauterine deaths in pregnancies complicated by insulin-dependent diabetes.[6–8] The risk of intrauterine death may be increased in GDM. For this reason, fetal evaluation with antepartum heart rate testing and estriol determinations has been applied to GDM.[2,5] These studies have also employed a series of risk factors to determine which patients with GDM require more intensive antepartum fetal evaluation and hospitalization.[2,5]

The present retrospective study examines the role of antepartum fetal heart rate testing, maternal assessment of fetal activity, and estriol determinations in the management of both diet-controlled GDM who maintained normal fasting and postprandial glucose levels (class A) as well as those requiring insulin therapy to achieve normoglycemia (class AB). The presence of fetal macrosomia was primarily determined by clinical estimation of fetal weight. Whether risk factors such as pregnancy-induced hypertension, chronic hypertension, and the history of a previous stillborn influenced antepartum testing results and subsequent obstetrical intervention was considered.

MATERIALS AND METHODS

Over the 4-yr period 1979–1983, pregnant patients attending the clinic as well as the authors' private high risk practice underwent screening for glucose intolerance using the method described by O'Sullivan.[9,10] Once identified, patients were placed on an 1800–2400-cal diet and followed weekly. Fasting plasma as well as 2-h postprandial glucose values were determined at each visit. If a patient developed fasting hyperglycemia (≥105 mg/dl) or repeated postprandial values ≥120 mg/dl, insulin therapy was initiated.

Antepartum fetal surveillance in class A patients included

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TABLE 1
Antepartum fetal surveillance in GDM: HUP, 1979–1983

Class	N	PIH	CHTN	Previous SB	Twins
A	69	8	5	1	2
AB	28	4	4	0	1
Total	97	12	9	1	3

PIH, pregnancy-induced hypertension; CHTN, chronic hypertension; and SB, stillborn.

serial ultrasound examinations every 4–6 wk to assess fetal growth and, beginning at 28 wk, daily maternal assessment of fetal activity using the method of Pearson and Weaver.[11,12]

At 40 wk of gestation, class A patients were followed with a weekly nonstress test (NST) and twice weekly urinary estriol assays. This surveillance continued until the pregnancy ended. Patients with a nonreactive NST were further evaluated with a contraction stress test (CST). Elective cesarean section was performed if the estimated fetal weight was more than 4000 g.

Patients with chronic hypertension, those who had had a previous stillbirth, or who developed pregnancy-induced hypertension were followed with twice-weekly urinary estriols and a weekly NST at 34 wk. Class AB patients were monitored in a similar fashion but were admitted in late pregnancy for more intensive surveillance if poor diabetic control was documented by home glucose monitoring records.

Elective induction of labor at term was considered when the patient's cervix was found to be favorable. Intervention was also undertaken after 37 wk of gestation if antepartum fetal testing suggested fetal compromise. Delivery of patients before term was accomplished only when a positive CST followed a nonreactive NST and the estriol pattern also suggested fetal compromise. If the results of these tests were equivocal, an amniocentesis was often performed to assess fetal lung maturity before deciding on delivery.

Data was evaluated using Chi-square analysis.

RESULTS

A total of 97 patients were studied, representing approximately 1% of deliveries at the Hospital of the University of Pennsylvania (HUP) (Table 1). Clinic patients accounted for 53 cases, while 44 were private patients. Of the 53 clinic patients, 22 (or 41%) required insulin therapy during pregnancy. This finding was markedly different in the 44 private patients of whom 6 (or 14%) were treated with insulin ($P < 0.01$). In previous studies, 10–15% of GDM have been found to require insulin.[2,3] In total, 28 patients, 29% of the total study group, were designated as class AB. The mean ages in the two groups were 30.0 yr for class A and 28.5 yr for class AB. Eleven patients (39% of AB women) requiring insulin were under age 25 yr, a group that has previously been described as being at low risk.[10]

The mean parity for both groups was similar. There was an average of 1.30 previous deliveries in the class A group and 1.39 in the class AB population. Overall, 31 patients or approximately one-third of the women were nulliparous.

Of the 69 class A patients, eight developed pregnancy-induced hypertension (PIH) and five had a history of chronic hypertension (CHTN). Only one patient had a history of a previous stillborn. In total, 14 of class A patients or 20% of this group were managed identically to class AB patients with respect to antepartum testing.

Pregnancy-induced hypertension occurred in 12% of all patients studied. There was no difference in the incidence of PIH between class A (12%) and AB women (14%).

Timing of delivery. Class A patients were delivered at a mean gestational age of 38.4 wk, and class AB at 37.3 wk. The five preterm deliveries in the class A group included four cases of advanced premature labor, and one woman delivered at 35 wk for moderately severe Rh sensitization. Four cases of spontaneous preterm labor leading to delivery were found in the AB group. The only two cases of preterm intervention for abnormal fetal heart rate testing occurred in class AB patients.

Mode of delivery. The primary cesarean section rate was 30% in class A patients and 23% in the class AB group (Table 2). The primary cesarean section rate for the general population at our institution is approximately 11%. Five primary cesarean sections were performed for macrosomia in class A women, and four of the infants delivered weighed 4000 g or more. Two class A patients with a cervix unfavorable for induction underwent primary cesarean section after abnormal fetal testing as did two patients in the insulin-treated group.

Perinatal morbidity and mortality. No stillbirths or neonatal deaths occurred among the 100 infants delivered. Thirty-six percent of class A infants experienced some form of morbidity, while 39% of infants of class AB mothers had at least one problem (Table 3). These figures are considerably lower than the 62% reported previously for White classes B–F.[6] Hyperbilirubinemia, defined as a serum value >12 mg/dl, was found in 12 class A and 2 class AB neonates. Hypoglycemia was the single most common problem encountered. Thirteen class A and 5 class AB infants, 19 and 17%, respectively, were found to have glucose values ≤40 mg/dl.

TABLE 2
Mode of delivery in GDM: HUP, 1979–1983

	Class A	Class AB
Vaginal	43 (62%)	20 (72%)
Spontaneous labor	31	11
Induction	12	9
Cesarean section	26 (38%)	8 (28%)
Repeat	7	2
Primary	19	6

TABLE 3
Perinatal morbidity in GDM: HUP, 1979–1983

	Class A	Class AB
Hypoglycemia	13 (19%)	5 (17%)
Hyperbilirubinemia	12 (17%)	2 (7%)
Macrosomia	11 (16%)	5 (17%)
Trauma	1	0
RDS	0	3
IUGR	3	2
Polycythemia	0	1
Congenital malformations	1	0

RDS, respiratory distress syndrome; and IUGR, intrauterine growth retardation.

TABLE 4
Indications for intervention in GDM: HUP, 1979–1983

	Class A	Class AB
None	44 (64%)	10 (35%)
Elective	6 (8.7%)	10 (35%)
Macrosomia	5	2
Abnormal tests	4 (5.7%)	2 (6.3%)
Susp. IUGR	3	2
Other*	7	2

IUGR, intrauterine growth retardation.
* Includes twins, post dates, and breech presentation.

There was one infant with an atrial septal defect in the class A group, but no anomalies were noted in the offspring of insulin-requiring GDM patients.

All three cases of respiratory distress syndrome (RDS) occurred in class AB babies. Two of these patients were allowed to deliver at 35 wk of gestation after amniotic fluid analysis demonstrated fetal lung maturity. An L/S ratio of 3.4 without phosphatidylglycerol (PG) present was found in one case, while the other had an L/S ratio of 2.5 and a small amount of PG. The third patient was in advanced labor at 35 wk and did not undergo an amniocentesis. These infants had mild RDS with uneventful nursery courses.

The average birthweights for class A and AB offspring were 3217 and 3295 g, respectively. Sixteen percent of class A neonates and 17% of class AB babies weighed >4000 g. Traumatic delivery due to shoulder dystocia occurred in one case: a 4000-g infant suffered a fractured clavicle and was depressed at birth after vaginal delivery. Resuscitative efforts were successful, and the baby suffered no immediate sequelae.

Antepartum fetal evaluation and intervention. Sixty-four percent of class A patients went into spontaneous labor, while the remaining 25 patients required some form of intervention (Table 4). Nearly 25% of these interventions were elective. Only four patients in the class A group were delivered because of specific fetal indications, representing 16% of the total interventions in this group.

Among the six cases of intervention based on suspected fetal jeopardy, four patients were being tested because they had a hypertensive disorder (Tables 5 and 6). Two class A patients had a nonreactive NST. One patient with chronic hypertension was induced at 40 wk of gestation. Fetal distress occurred during labor and she underwent an emergency cesarean section. The other nonreactive pattern was found in a patient with suspected macrosomia at 39 wk. A primary cesarean section was performed in this case.

Class AB patients were managed more aggressively. Only 35% of this group went into spontaneous labor, while an equal number underwent elective delivery (Table 4). There were only two cases of suspected fetal jeopardy based on antepartum testing (Table 6). One patient, who reported decreased fetal movement, was delivered at 30 wk by primary cesarean section after a nonreactive NST and positive CST. This baby was vigorous at birth and did well subsequently. A second class AB patient was delivered at 34 wk of a 1300-g, growth-retarded infant in response to a nonreactive NST, positive CST, and low estriol values.

Five class A patients underwent primary cesarean section for suspected macrosomia (Table 7), and four of the infants delivered weighed at least 4000 g. While patients in this study routinely underwent serial ultrasound examinations, the diagnosis of macrosomia was made primarily on clinical examination. Only 6 of 16 macrosomic infants, a sensitivity of 37.5%, were correctly identified before delivery. Eight macrosomic infants were delivered vaginally with one case of traumatic delivery involving shoulder dystocia.

DISCUSSION

Remarkable advancement has been made toward improving perinatal outcome for the offspring of diabetic mothers. In most series, infants of mothers with GDM have a perinatal mortality rate no greater than that of the general obstetrical population.[2–5] Despite these excellent statistics, significant mobidity may still occur. Our observed incidence of neonatal hypoglycemia, hyperbilirubinemia, and RDS are similar to those previously reported.[2,5]

Recent interest has centered on the problem of the macrosomic infant. In our study, 16–17% of the infants weighed >4000 g, a figure consistent with previous studies in GDM.[2,3,5] We did not observe a difference in the frequency of macrosomia in class A and class AB patients. Antepartum recognition of this problem may serve to reduce traumatic morbidity associated with vaginal delivery. Our clinical ability to detect macrosomia was poor. Several investigators have employed ultrasonographic criteria to aid in making this diagnosis before delivery. Elliott, using measurements of biparietal and chest diameters, and Bracero, utilizing femur length and ab-

TABLE 5
Perinatal outcome with abnormal testing, class A: HUP, 1979–1983

History	Wk	Abnormal test	Outcome
27 yo* G_1P_0 Suspected macrosomia, CHTN	39	Decreased FM NR NST	Primary cesarean 4500 g, Apgar 6/8
34 yo G_3P_2 CHTN	40	NR NST	Failed induction: primary cesarean, fetal distress 3700 g, Apgar 1/4
21 yo G_1P_0 PIH	38	Falling estriol	Induction: vaginal delivery 3100 g, Apgar 7/8
28 yo G_1P_0	42	Falling estriol	Induction: vaginal delivery 2900 g, Apgar 7/8

PIH, pregnancy-induced hypertension; CHTN, chronic hypertension; NR NST, nonreactive nonstress test; and FM, fetal movement.
*yo, years old.

dominal circumference determinations, report sensitivities of 87 and 79% respectively.[13,14] Further investigation will be necessary to define more specific methods of antepartum detection of macrosomia.

The low perinatal mortality rates and improved neonatal outcomes for infants of GDM have undoubtedly occurred because of increased awareness resulting in greater screening for this diagnosis during pregnancy. Several studies have contrasted poor previous obstetrical history with subsequent improved outcomes in large groups of both insulin- and diet-controlled patients with GDM.[3,4,15]

Once identified, a program of optimum fetal surveillance should be instituted. Gabbe employed the CST and estriol assays in a series of 262 class A patients in which only 9% of the total interventions were performed for suspected fetal compromise.[2] In the present study, the NST was employed primarily to assess fetal wellbeing. This test has been associated with a perinatal mortality of 10/1000 within 1 wk of a reactive pattern.[16] In our series, only two patients, or 4.4% of those tested, had a nonreactive NST followed by a positive OCT necessitating preterm delivery. One of these cases involved a severely growth-retarded infant, who did well in the nursery. The second case appeared to be a false positive, with delivery of a vigorous 1080-g infant at 30 wk of gestation.

Urinary 24-h estriol collections were used as an adjunct to heart rate testing. Because urinary estriol assays have a significant false-positive rate, intervention based solely on abnormal estriol test results was limited to patients at term.[17,18] Two cases with significant (≥35%) falls in estriol excretion led to induction of labor at 38 and 42 wk of gestation. Neither fetus demonstrated fetal distress in labor.

The low rate of intervention based on antepartum testing seems acceptable in view of the good neonatal outcomes observed. Only two of six interventions for suspected fetal jeopardy were associated with perinatal morbidity. Fetal compromise was uncommon in class A patients managed expectantly. Two cases of birth asphyxia did occur. One patient with an unrecognized postdates pregnancy was delivered of a growth-retarded infant. The second case involved a poorly compliant alcoholic patient also with a growth-retarded baby. Thus, it appears that the truly low-risk class A patients did well without intensive antepartum surveillance. It should be noted that the rates of elective delivery were 25 and 35%, respectively, in class A and class AB patients. Elective induction did lead to five cesarean sections in 26 cases, although three of the infants delivered were macrosomic. It is possible that without such aggressive intervention more abnormal antepartum tests would have been observed.

Hypertension did appear to be a risk factor for fetal compromise. The frequency of abnormal antepartum tests was not increased in patients with hypertension. However, four of six interventions for suspected fetal jeopardy did occur in cases with maternal hypertension.

It is not clear whether class AB patients are at greater risk for fetal compromise. Patients with overt diabetes clearly have a greater frequency of abnormal heart rate tests and estriol values.[6] Little data has been reported giving the results of antepartum testing programs in patients with GDM who require insulin. However, it has been assumed that the risk of perinatal mortality increases if insulin therapy is needed. Our rate of intervention based on abnormal testing in class AB patients was only 7%, considerably lower than previously reported rates for overt diabetic women.[6] Certainly, the quality of maternal control achieved must be an important determinant in the need for rigorous antepartum surveillance.

In summary, our data suggests that an outpatient program of fetal testing, using primarily the nonstress test and maternal assessment of fetal activity, may be utilized in pregnancies complicated by gestational diabetes with a good perinatal outcome. This approach resulted in few unnecessary premature interventions. Abnormal antepartum test results were more often observed in GDM with hypertension and prolonged pregnancies. Our study confirms that class A patients without identifiable risk factors may be safely followed to term before instituting a program of fetal surveillance. A large prospective study will be required to determine if all insulin-requiring gestational diabetic subjects benefit from more rigorous antepartum evaluation.

TABLE 6
Perinatal outcome with abnormal testing, class AB: HUP, 1979–1983

History	Wk	Abnormal test	Outcome
24 yo* G_1P_0	30	Decreased FM NR NST, Pos. CST	Primary cesarean 1080 g, Apgar 6/9
30 yo G_2P_1 CHTN, Susp. IUGR	34	Low estriol NR NST, Pos. CST	Primary cesarean 1300 g, Apgar 8/9

CHTN, chronic hypertension; NR NST, nonreactive nonstress test; CST, contraction stress test; and FM, fetal movement.
*yo, years old.

TABLE 7
Cesarean section in GDM: HUP, 1979–1983

Macrosomia	7*
Other	6
Breech 2	
Twins 2	
Cephalopelvic disproportion 2	
Failed induction	5†
Abnormal fetal monitoring test	4
Fetal distress	3
Repeat	9

* Six of seven infants ≥4000 g.
† Two of five infants ≥4000 g.

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