Diabetes in pregnancy

The use of home blood glucose monitoring and intensive monitoring to ensure favourable perinatal outcome

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Summary

A combined clinic for pregnant diabetic women was established at Baragwanath Hospital to assess the effects of intensive monitoring of mother and fetus and of good glycaemic control on perinatal outcome. Home blood glucose monitoring was introduced as a method for assessing glycaemic control. Standard methods of maternal and fetal monitoring were used. Sixty-two diabetic pregnancies were evaluated prospectively. Twenty women had diabetes diagnosed for the first time in the current pregnancy and the remaining 42 had established diabetes. All patients followed a diabetic diet, and 95% were treated with insulin. The technique and accurate recording of blood glucose were managed by all patients, and a mean capillary blood glucose of 6.5 mmol/l for the group was achieved. Caesarean section was performed in 52% of cases with a mean period of gestation at the time of delivery for the total study population of 37 weeks. The mean neonatal weight was 3130 g. The perinatal mortality rate of 64/1 000 was accounted for by 3 stillbirths and 1 early neonatal death. No major congenital anomalies occurred.

One of the success stories of modern medicine has been the greatly improved outlook for women suffering from diabetes in pregnancy. This has been amply chronicled in a recent review article. Perinatal mortality (PNM) has declined from 40% in the 1940s to less than 4% in most specialised centres, with a similar decline in neonatal morbidity. However, where specialised care is not available, PNM figures remain distressingly high.

The improved outlook has largely been brought about by a team approach with emphasis on early detection of diabetes, near-normalisation of blood glucose using such techniques as home blood glucose monitoring (HBGM), prophylaxis and treatment of complications, and intensive monitoring of mother and fetus.

Against this background, a combined clinic for pregnant diabetic women was established at Baragwanath Hospital in May 1983 and a study undertaken to assess the feasibility of using HBGM and the effect of good glycaemic control and intensive monitoring on perinatal outcome.

Patients and methods

A team consisting of a physician, an obstetrician, a paediatrician and diabetic nursing specialists were involved with the management of patients over a 2-year period from May 1983 to May 1985. The study population included 62 women with a diabetic pregnancy, classified as follows: (i) 20 in whom diabetes was diagnosed in pregnancy; and (ii) 42 with established diabetes (29 insulin-dependent diabetes mellitus [IDDM] and 13 non-insulin-dependent diabetes mellitus [NIDDM]). The former group was referred for assessment because of significant risk factors for diabetes, e.g. glycosuria and previous unexplained perinatal loss, and the diagnosis was confirmed on the basis of a 75 g oral glucose tolerance test: venous plasma glucose values fasting > 8 mmol/l and 2 hours post-glucose load > 11 mmol/l. Patients in the category of 'impaired glucose tolerance' were managed in the same way as those with more overt diabetes. No women in the group with established diabetes had evidence of proliferative retinopathy and only 2 had features of early nephropathy. Eight patients were in their first pregnancy (13%), 47 had 1–4 previous pregnancies (76%) and only 7 had experienced 5 or more pregnancies (11%).

Excluded from this study was a group of 5 gestational diabetics who presented too late to avail themselves of intensive management.

All the women were hospitalised initially for: (i) clinical and biochemical assessment; (ii) ultrasonographic examination; (iii) diabetes education, including instruction on HBGM; and (iv) determination of appropriate treatment.

Patients were taught HBGM by the nursing specialists. Finger-prick capillary blood samples were obtained using Autolet (Ames) or Autoclix (Boehringer Mannheim) devices and the blood glucose levels read visually using Haemo-Glukotest 20–800R strips (Boehringer Mannheim). Preprandial and 2-hour postprandial blood glucose levels were recorded while in hospital, and daily preprandial and late-night samples recorded at home.

All subjects followed a 7500–8000 kJ complex carbohydrate diabetic diet (comprising carbohydrates 60%, fat 25% and protein 15%) divided into 3 main meals and between-meal and late-night snacks.

Insulin therapy began if the fasting blood glucose level exceeded 4.4 mmol/l and/or the premeal and 2-hour postprandial glucose levels rose above 6.7 mmol/l. A regimen of twice daily combined short- and intermediate-acting insulins (monocomponent [Novo] or human [Lilly]) was used in this study.

After initial assessment in hospital, patients returned fortnightly for follow-up until 32 weeks' gestation and then weekly until 34–36 weeks when they were re-admitted. A full clinical assessment was made at each clinic visit, the results of HBGM were recorded, and adjustments in treatment made accordingly.
Predelivery management in hospital consisted of frequent clinical assessments and corrections of deviations from glycaemic control. Fetal well-being was monitored using non-stress testing and fetal-obstetrical kick charts. The timing and mode of delivery were dictated by obstetric factors, especially the previous obstetric history, and by the degree of glycaemic control achieved. Our policy was to deliver most patients at between 36 and 38 weeks' gestation providing fetal lung maturity had been confirmed by measurement of amniotic fluid lecithin/sphingomyelin levels. During labour or caesarean section diabetes was controlled by dextrose-insulin infusions with frequent monitoring of capillary blood glucose samples. Insulin therapy was terminated in the immediate postpartum period and blood glucose monitoring recommended. Usually, insulin was restarted in patients with IDDM on day 2–3 postpartum at the pre-pregnancy doses. The treatment of the remaining group of patients was dictated by the results of the blood glucose profiles. The diagnosis of gestational diabetes was confirmed by finding a normal OGTT 6 weeks post partum.

Neonates were assessed by the paediatric staff for the presence of clinical and/or biochemical complications and appropriate treatment was instituted if required.

Results

The mean age of the 62 women in the study was 32 ± 6 years (range 19–42 years). The mean gestational age at the time of entering the study was 25 ± 8 weeks, only 6 patients presenting in the first trimester. Of the 20 women in whom diabetes was first diagnosed during pregnancy 80% had glycosuria, 50% had a strong family history of diabetes and a history of 'large' babies was elicited in 43%. Previous perinatal loss was noted in 30%. Other risk factors were also present, although to a lesser extent.

Hypoglycaemia (8 cases), hypertension (4), hydramnios (6) and urinary tract infection (6) accounted for the majority of maternal complications in the study group. Of the 4 patients with pregnancy-induced hypertension (blood pressure >130/80 mmHg), 2 developed pre-eclampsia in the third trimester with diastolic blood pressure >85 mmHg in association with proteinuria and oedema. One patient presented for the first time at 26 weeks' gestation in severe keto-acidosis associated with pulmonary tuberculosis. She was successfully treated and delivered a normal baby at 35 weeks' gestation. A second woman was not as fortunate and intra-uterine death occurred at 30 weeks' gestation after an episode of keto-acidosis precipitated by domestic upheaval.

Fifty-nine women (95%) were treated with insulin and the mean daily dose just before delivery was 64 U (range 8–182 U). Twenty-four patients received less than 50 U, 29 received between 101 and 150 U, and 3 more than 151 U of insulin per day. One woman refused insulin therapy and was treated with glibenclamide 10 mg daily. Dietary therapy alone was successful in 2 patients.

All but seven monitored blood glucose levels satisfactorily. The mean capillary blood glucose of the group was 6.5 ± 1.2 mmol/l. The mode of delivery was almost equally divided among the women: 32% underwent caesarean section and 48% vaginal delivery. The mean period of gestation at the time of delivery was 37 ± 1.6 weeks. The mean of the neonatal weights of the 58 successful pregnancies was 3 130 ± 590 g.

The PNM rate for this study was 64/1000 live and stillbirths, which included 3 stillbirths and 1 early neonatal death. The overall PNM at Baragwanath Hospital over the same period was 52/1000. Hyperbilirubinaemia was the commonest neonatal complication, occurring in 30 of the babies (50%). Hypoglycaemia occurred in 2 neonates and severe respiratory distress syndrome in a single neonate. Only 1 minor congenital abnormality was noted: radial aplasia of the right forearm (Table I).

Patients in whom diabetes was diagnosed during pregnancy were reviewed several months after parturition and after an oral glucose tolerance test: 5 were reclassified as NIDDM, 1 as IDDM and 2 as having impaired glucose tolerance. Therefore, only 12 women (19% of the total population) were left for whom the term 'gestational diabetes' was appropriate.

Discussion

Near-normalisation of blood glucose is a desired objective in the management of diabetes in general and more particularly in pregnancy-related diabetes. The degree of control, however, remains controversial. HBGM has become a useful tool in assessing glycaemic control and has been shown to be effective and advantageous in pregnancy. We found this method particularly useful, even though many of our patients have a poor educational and social background. Every patient in this study managed HBGM effectively. Using this method, a mean capillary blood glucose for the group of 6.5 mmol/l was achieved. Most mothers were able to remain at home for the greater part of pregnancy and hospitalisation was less frequent, resulting in significant cost reduction. The disadvantage of 'tight' metabolic control is the development of maternal hypoglycaemia which, fortunately, does not appear to harm the fetus. Eight women (13%) in the present study developed severe hypoglycaemic reactions without apparent untoward complications.

Although HBGM figures in more sophisticated and specialised centres have shown an even more dramatic decline than in this study, the same cannot be said for areas where these facilities are not readily available. For example, a study conducted in South Carolina in 1978 showed an overall diabetic PNM rate of 102/1000 with a notable excess for non-whites of 153/1000. It should be pointed out that the PNM figure of 64/1000 in this study reflects a combined figure for the different diabetic groups. Separation of these groups for comparative analysis would reduce the numbers too much for valid conclusions to be drawn.

An analysis of fetal and neonatal deaths in this study is as follows: 1 mother developed diabetic keto-acidosis at 30 weeks' gestation following a serious domestic upheaval, and by the time she arrived at hospital the fetus was dead. A second woman presented with gestational diabetes at 29 weeks and despite showing improved glycaemic control while on insulin, the fetus died at 33 weeks. A third patient, who had NIDDM, presented at 30 weeks with hydramnios. Despite good blood glucose control achieved using insulin therapy, the fetus died at 37 weeks at home where she had gone to spend a weekend with her family. The remaining patient had poorly controlled IDDM of 14 years' duration. She went into premature labour at 36 weeks and delivered a 2850 g baby who was hypoglycaemic and developed fatal respiratory distress syndrome. An absent right radius was noted in this baby.

We feel that the prospects for successful diabetic pregnancy at our centre can still be improved upon. Pre-pregnancy counselling of women with established diabetes, earlier referral of patients who develop gestational diabetes, and the increasing experience of the diabetic team should all contribute to this end. This study has shown that HBGM is a useful and practical tool in the management of patients with diabetes in pregnancy. Good glycaemic control and close maternal and
fetal monitoring ensured a favourable outcome in the majority of pregnancies, notwithstanding the poor obstetrical histories of many patients and the rather overloaded obstetric services at this hospital.

REFERENCES

Meconium during labour — self-medication and other associations

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Summary
Prior to artificial rupture of membranes, 498 women were questioned about obstetric and social factors including self-medication during pregnancy. Caesarean section ($P < 0.01$) and low Apgar scores ($P < 0.001$) were significantly more common in pregnancies complicated by fetal meconium passage. Meconium passage was more common in women who had recently taken castor oil ($P < 0.01$) and possibly herbal substances called 'sihlambezo' (trend $P < 0.2$). Use of laxatives or enemas and other obstetric risk factors were not associated with meconium passage.

The risk to the neonate of inhaled meconium has been clearly established. However, the importance of the passage of meconium as an indicator of fetal distress remains controversial and its mechanism obscure. An increased incidence of meconium passage in fetuses of drug-dependent women has been ascribed to the intestinal hyperperistaltic effect of drug withdrawal. Other mechanisms suggested include arginine vasopressin release during hypoxia, cord compression, vasoconstriction in the fetal gastro-intestinal tract precipitated by hypoxia, and occurrence as a normal physiological event. An association of fetal meconium passage with maternal ingestion of certain drugs, particularly purgatives, has been suggested but not to our knowledge formally investigated. We have therefore undertaken a prospective study of the association of meconium passage with various obstetric factors, including maternal self-medication.

Patients and methods
The study was conducted at Baragwanath Hospital, which serves a high-risk, predominantly urban, black population. Women in labour for whom the decision to rupture the membranes artificially had been taken were enrolled in the study. They were interviewed by a member of the nursing staff who completed a questionnaire on 13 items relating to their medical and social history, including a careful enquiry into self-medication during the pregnancy. Baseline obstetric variables were also recorded. Artificial rupture of the membranes was then performed, and the appearance of the amniotic fluid recorded as being clear, lightly or heavily meconium-stained, or not visualised. Details of the outcome of the labours were obtained subsequently from the hospital records. Statistical comparisons between the groups were made by means of the $t$-test for continuous variables and the chi-square test for proportions.

Results
The amniotic fluid was examined at the time of rupture of membranes in 478 of the 498 subjects and was meconium-stained in 174 (36%) of these and clear in the remaining 304. Caesarean section, low Apgar score, and the recent ingestion of castor oil were significantly more common in those with meconium-stained amniotic fluid (Table I). There was also a trend towards increased ingestion of 'sihlambezo'. No significant association of meconium passage was found with age, parity, gestational age, previous...