Diabetes in pregnancy: lessons for the multidisciplinary team

Jean Hennings

Introduction

Pregnancy with insulin-dependent diabetes can be a challenging time, not only for the woman and her partner but also for the professionals involved. This case study posed particular challenges to the skills of all the professionals within the multidisciplinary team, highlighting the importance of effective teamwork. The situation was by no means ideal or typical, but valuable lessons were learnt regarding hyperglycaemia, ketoacidosis and their effect on the fetus.

Sarah was 25 years old at the time of referral and had no medical or surgical history of note, except that insulin-dependent diabetes had been diagnosed at 17 years of age in 1988. She had no complications associated with the disease.

Sarah had two children: a boy born at 37 weeks' gestation in 1989 by ventouse extraction, weighing 3317 g, and a girl born at 37 weeks' gestation in 1995, weighing 3710 g.

Sarah was referred to the diabetes specialist midwives (DSMs) at the end of January 1996 with a history of 8 weeks' amenorrhoea. A pregnancy test was positive.

Sarah was using Humulin M3, 30 units before breakfast and 20 units before her evening meal. She had a glycated haemoglobin (HbA_1) of 11.7% and a random blood glucose concentration of 37 mmol/litre. A review of her dietary habits, general lifestyle and treatment was made immediately.

Pre-pregnancy care

A review of the literature between 1930 and 1964 showed the incidence of congenital malformation in diabetic pregnancy to be 4.8%, compared with 1.6% in the general population (Kucera, 1971).

High blood glucose levels and ketonuria around the time of conception and in early embryonic life are now known to increase the risks of abnormalities in the fetus (Steel, 1996). The most common abnormalities are cardiac and spinal anomalies.

Philosophy of care

The DSMs work within a multidisciplinary team, offering continuous, intensive support to women to help them achieve the best possible outcome. Under normal circumstances the woman is best able to achieve optimal control of her diabetes at home, following her normal lifestyle. However, it is important that women with less than optimal control are not made to feel guilty, but are given positive encouragement to improve their diabetes control.

Sarah had received no pre-pregnancy counselling. The pregnancy was unplanned, but very much wanted. Despite this far from ideal situation, it was important that care and advice could be offered in a non-judgemental way. Sarah lived on an inner-city council estate. She had to cope with the daily stresses of a low income and motherhood, in addition to her diabetes.

Plan of care

At our first meeting, diet and lifestyle were discussed in depth. Sarah led a busy life, caring for two children and her partner. She worked as a lunchtime playground supervisor. She tended to have no lunch, and rarely tested her blood glucose level during the day.

She was aware that she should improve her diabetes control in order to reduce the risks to the baby, but she expressed fear of hypoglycaemia, particularly at night, as she had experienced loss of warning signs. Hypoglycaemia during the first trimester of pregnancy can be severe, and women often lose their warning signs, making recognition extremely difficult. Sarah was encouraged to talk about her fear of hypoglycaemia, and

ARTICLE POINTS

1 High blood glucose levels at conception increase the risks of fetal abnormalities.

2 High maternal blood glucose levels lead to acidaemia and fetal hypoxia.

3 The woman with diabetes in pregnancy should continuously self-monitor her diabetes control and fetal movement.

4 A multidisciplinary team should be available to provide advice and support.

5 Team members must be readily available and in communication with the woman and with each other.

KEY WORDS

- **Diabetes**
- **Pregnancy**
- **Diabetic ketoacidosis**
- **Multidisciplinary team**

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PAGE POINTS

1 Hypoglycaemia can be severe during the first trimester and warning signs are often lost.

2 In diabetic pregnancy it is advisable to measure blood glucose level four times a day to assess diabetes control.

3 Tighter diabetes control and greater flexibility were achieved by the use of a basal bolus regimen.

4 A detailed fetal cardiac ultrasound scan at 21 weeks' gestation can rule out major cardiac abnormalities.

5 High maternal blood glucose levels accelerate fetal insulin production and action, resulting in the overdevelopment of adipose tissue and muscle.

ways of avoiding over-reaction to the fear were discussed. As she was often awake with her youngest child, she decided to check her blood glucose level during the night. This tended to reassure her that she could safely continue to sleep. Her partner was also taught to recognise the signs of hypoglycaemia, and was instructed in the use of Hypostop and glucagon.

Sarah was encouraged to test her blood glucose levels four times a day, to enable her to treat her diabetes adequately. Ideally, blood glucose levels should be between 4 and 6 mmol/litre pre-prandially. It was important to Sarah that the time spent monitoring her diabetes was kept to a minimum; she was given a new blood glucose meter. She also saw a dietician at this time. Close telephone contact was maintained.

She was also asked to test for ketonuria daily and to report any positive results. Sarah was also encouraged to observe fetal movements from around 26 weeks' gestation and to report any slowing or changes in the pattern of activity. In addition, the HbA_1 level was estimated on a monthly basis, giving a general picture of blood glucose control in the preceding 5–6 weeks (Scobie, 1987).

In consultation with Sarah and the consultant diabetologist, it was decided that tighter diabetes control and greater flexibility could be achieved by changing to a basal bolus regimen. Actrapid 14/16/16 units and Insulatard 28 units were prescribed.

Table 1. Intravenous regimen

10% dextrose 500 ml to run over 6 hours

50ml normal saline and 50 units Actrapid to run according to the following sliding scale:

Blood glucose level (mmol/litre)	Normal saline and Actrapid infusion rate (ml/h)
2 or below	0
2.1–3.9	0.5
4.0–6.9	1
7.0–8.9	2
9.0–10.9	4
11.0–16	6
>16.0	8

Antenatal diagnosis and screening

At 18 weeks' gestation, Sarah was offered an ultrasound scan for the detection of major structural abnormalities. She was carefully counselled and given detailed information about the test, bearing in mind that her fetus had an increased risk of spinal abnormalities.

In view of the high HbA_1 level (11.7%) at booking and the associated high risk of cardiac abnormalities, Sarah was offered a detailed fetal cardiac scan at 21 weeks' gestation. The scan would be able to rule out major structural cardiac abnormalities, such as transposition of the great vessels, atrial septal defect and ventricular septal defect. Antenatal diagnosis not only allows the woman time to prepare psychologically, but also means that the appropriate care can be readily available for the baby at delivery. There were no detectable structural abnormalities on the ultrasound scan.

High maternal blood glucose levels during pregnancy cause accelerated fetal insulin production and action. Insulin enables the fetus to utilise available glucose, resulting in the over-development of adipose tissue and muscle (Pedersen, 1977). The excess growth tends to be disproportionate; as a result the fetal abdominal circumference is relatively larger than the biparietal diameter for gestational age. However, in diabetic pregnancies complicated by vascular disease, fetal growth may be retarded. Scans were therefore performed every 2 weeks from 24 weeks' gestation to assess fetal growth and amniotic fluid volume.

Hospitalisation

At 32 weeks' gestation, Sarah reported that she had vomited several times during the night, was unable to retain fluids or food, and felt generally unwell. She was advised to attend the midwifery day unit.

On admission her vital signs were: temperature 36.2°C, pulse 104/min, and blood pressure 110/70 mmHg. She was fully conscious, but her breath smelt of ketones. Her urine contained a moderate amount of ketones and glucose. Her blood glucose level was 22.8 mmol/litre. Abdominal examination revealed polyhydramnios, and the fundal height was equivalent to term.

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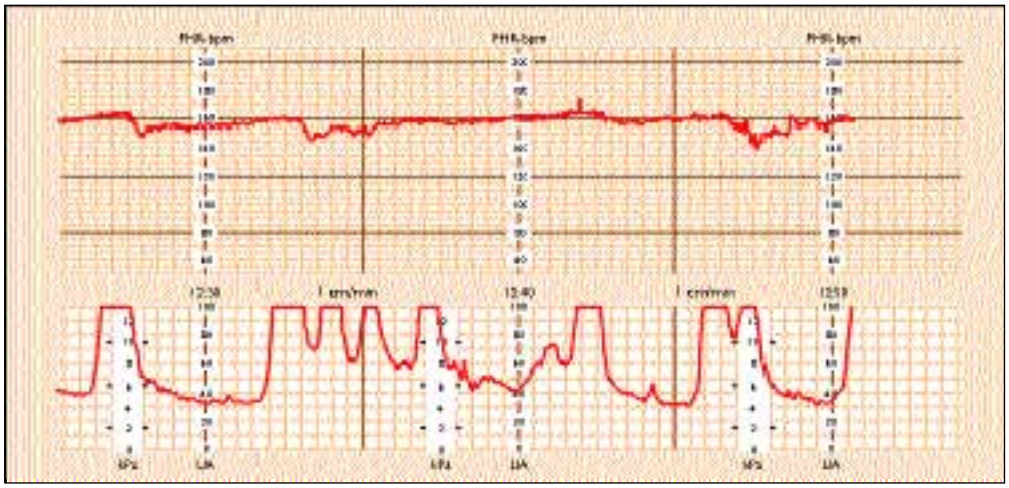

Figure 1. Cardiotocograph during diabetic ketoacidosis showing signs of fetal acidaemia and hypoxia.

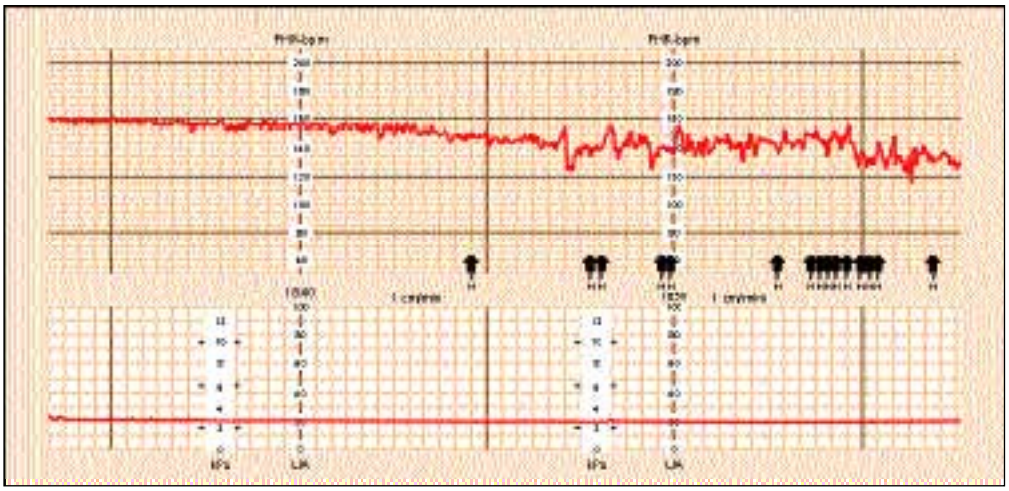

Figure 2. The cardiotocograph returned to normal as the maternal blood glucose level came under control.

PAGE POINTS

1 The smell of ketones, the presence of ketones and glucose in the urine, and a high blood glucose suggested diabetic ketoacidosis.

2 A low venous bicarbonate level confirmed the diagnosis.

3 Increased HbA_1 levels have been associated with reduced oxygen release from the placenta.

4 There was a marked lack of fetal movement.

5 Once the maternal blood glucose returned to normal, the fetus became active and reactive again.

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Venous blood samples were taken for urea and electrolytes, blood glucose and bicarbonate levels. A full infection screen was also carried out. The results were all within normal limits, except the bicarbonate level which was 11 mmol/litre (normal 24–30), confirming the initial diagnosis of diabetic ketoacidosis.

Before the results were known, an intravenous infusion of 10% dextrose 500 ml to run over 6 hours and 50 ml normal saline containing 50 units Actrapid via a syringe driver were commenced and run according to a sliding scale (*Table 1*). A stat dose of 20 units Actrapid was given intramuscularly. The vomiting quickly subsided, and within a few hours Sarah was able to tolerate fluids and a light diet.

On admission the fetal heart trace pattern was extremely poor. Cardiotocography showed an unreactive trace with reduced baseline variability; the baseline fetal heart rate (FHR) was 160 beats/min and there were some shallow decelerations. There was marked lack of fetal movement (*Figure 1*).

Increased HbA_1 levels have been associated with reduced oxygen release from the placenta. The macrosomic fetus with enlarged organs demands greater supplies of oxygen than the fetus whose growth is appropriate for gestational age (Maresh and Beard, 1995). The cardiotocograph appeared to support the theory that high maternal blood glucose levels lead to acidaemia and fetal hypoxia (Teramo et al, 1983; Maresh and Beard, 1995). Once the maternal blood glucose level returned to normal (8.5 mmol/litre), the fetus became active and reactive and the baseline FHR returned to 140 beats/min (*Figure 2*).

Within a few days, Sarah was discharged home. Intensive antenatal care continued, with twice-weekly antenatal clinic

PAGE POINTS

1 From 35 weeks' gestation, Sarah's condition was monitored closely with twice-weekly antenatal clinic visits with the diabetologist, obstetrician and DSMs.

2 Telephone support was continuous and ongoing.

3 Anaesthesia and delivery cannot be safely contemplated until acidosis has been corrected.

4 Maternal acidosis improved with a stat dose of Actrapid and intravenous regimen, although signs of fetal asphyxia continued.

5 The long-term neurological consequences of repeated fetal hypoxia cannot be assessed fully until several months after delivery.

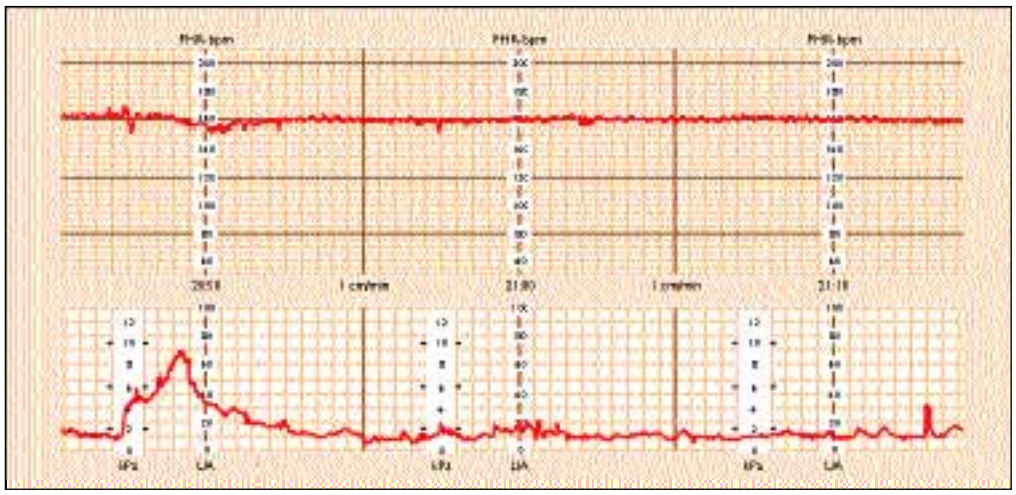

Figure 3. Cardiotocograph while maternal blood glucose level was 14.1 mmol/l showing some uterine activity, a late deceleration of the fetal heart rate, baseline tachycardia, reduced variability and no fetal movement.

appointments to see both the consultant diabetologist and consultant obstetrician as well as the DSMs. Ongoing continuous support by telephone was also provided.

At 35 weeks' gestation, Sarah was seen in the antenatal clinic and was found to have a blood glucose level of 14.1 mmol/litre and a moderate degree of ketonuria. A cardiotocograph of the fetus was abnormal (*Figure 3*). As with the previous admission, blood was taken for urea and electrolyte levels, blood gases and a full blood count. An infection screen was also performed.

Sarah was found to be acidotic (bicarbonate 21 mmol/litre). She was given a stat dose of 20 units Actrapid intramuscularly and an intravenous regimen was commenced (*Table 1*). It was essential to correct the acidosis before the administration of anaesthesia and delivery of the baby could be safely contemplated.

Once Sarah's condition had stabilised, the cardiotocograph was reassessed. The baseline FHR remained at 160 beats/min; there was reduced baseline variability and lack of fetal movement. Despite the improved maternal condition, signs of fetal asphyxia continued.

A baby girl was delivered by caesarean section under spinal anaesthesia. She required suction, oxygen and a short period of assisted ventilation. She weighed 2950 g. Both mother and baby made good progress, and were discharged after 10 days. Although the baby appeared to be making good progress, the long-term neurological consequences of repeated episodes of hypoxia cannot be fully assessed for some months to come.

Discussion

This case study illustrates several important management issues. The woman with diabetes in pregnancy should continuously self-monitor her diabetes control and fetal movement. She should be able to access advice and support from the multidisciplinary team when deviations from the normal are noticed. The team must be readily available and in communication with the woman and each other. In this case the fetus was at particular risk, but the consultant obstetrician, consultant diabetologist and the DSMs were able to act quickly and effectively to achieve a positive outcome for both mother and baby. ■

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