

# Nurse-Based Management in Patients With Gestational Diabetes

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**OBJECTIVE** — To compare the rate of insulin treatment and perinatal outcome in women with gestational diabetes mellitus (GDM) under endocrinologist-based versus diabetes nurse-based metabolic management.

**RESEARCH DESIGN AND METHODS** — In a retrospective analysis, maternal characteristics, rate of insulin treatment, and perinatal outcome of patients with GDM delivering between 1 January 1995 and 30 June 1997 ( $n = 244$ ) receiving endocrinologist-based care were compared with those delivering between 1 July 1997 and 31 December 1999 ( $n = 283$ ) who received diabetes nurse-based care. The diabetes nurse's role was similar to that of an advanced practice nurse in the U.S. There were no changes in the metabolic goals and instruments or in obstetric and neonatal management. Quantitative data were compared with the Mann-Whitney *U* test and categorical data, with Fisher's exact test.

**RESULTS** — Maternal characteristics (age, BMI, family history of diabetes, prior glucose intolerance, gestational age, and blood glucose at diagnosis of GDM) did not differ between groups treated during the two periods. Rates of insulin treatment and perinatal outcome (hypertension, preterm delivery, cesarean section, low Apgar score, macrosomia, small- and large-for-gestational-age newborns, obstetric trauma, major malformations, hypoglycemia, hypocalcemia, polycythemia, jaundice, respiratory distress, and mortality) were also similar in both groups.

**CONCLUSIONS** — Comparison of periods of endocrinologist-based and diabetes nurse-based metabolic management of women with GDM showed no differences in the rate of insulin treatment and perinatal outcome. This supports a more active role of nurses in the management of women with GDM.

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Gestational diabetes mellitus (GDM) is defined as any degree of carbohydrate intolerance with onset or first recognition during pregnancy (1). Appropriate management contributes to improving perinatal outcome for both mother and newborn (2), but such care is particularly time consuming. The role of the diabetes nurse in the care of women with GDM has either not been specified

(1,3–5) or been defined as educational (6–10). Furthermore, in a review of the literature, only one study was found suggesting a more active role for the diabetes nurse (11). The aim of the present study was to compare the rate of insulin treatment and perinatal outcome in women with GDM under endocrinologist-based versus diabetes nurse-based metabolic management.

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**Abbreviations:** GDM, gestational diabetes mellitus; OGTT, oral glucose tolerance test.

A table elsewhere in this issue shows conventional and Système International (SI) units and conversion factors for many substances.

## RESEARCH DESIGN AND METHODS

On 1 July 1997, the metabolic management of women with GDM was switched from endocrinologist-based to diabetes nurse-based care without any other modification in the previously described management protocol (metabolic goals and methods, obstetric and neonatal management) (12) (Table 1). The diabetes nurse's role in the present study was similar to that of an advanced practice nurse in the U.S. The diabetes nurses providing care to women with GDM in our center were highly trained registered nurses, with long-term specialization in diabetes (meeting qualifications for the accredited program of the Federation of European Nurses on Diabetes, as well as being employed full-time as diabetes nurses, with their tasks including structured individual and group diabetes education, diet and insulin therapy modification in patients with type 1 and type 2 diabetes, and care of patients with metabolic emergencies). Their participation in diabetes and pregnancy management began as an educational role in the care of women with prepregnancy and gestational diabetes (Table 1; "Endocrinologist-based management") as well as participating with the obstetrician in the weekly discussion sessions. When a modification in the management protocol of women with GDM was decided in 1997, diabetes nurses were already well familiar with the metabolic goals and instruments of GDM management. The nurses visited the patients in a room adjacent to where the endocrinologist was attending women with thyroid disorders and/or prepregnancy diabetes before, during, and after pregnancy. This allowed the nurses to discuss issues related to management whenever required. Specifically, nurses consulted the endocrinologist whenever diet and/or insulin modification was not straightforward, always before initiating insulin therapy, and whenever any medically relevant issue arose.

In 2000, we undertook an evaluation of the equivalence of the two care programs. We retrospectively analyzed the equivalent-length periods of diabetes nurse-based management and endocri-

nologist-based management using the database that is prospectively and continuously collected. Chart review, data entry, and analysis were performed regularly by the endocrinologists shortly after delivery as part of a continuous quality improvement strategy. Three forms (one each for pregnancy, delivery, and neonatal outcome) were used for data collection and later entered in an Access (Microsoft) database. Internal validation rules and double checking of each entered record were used to ensure data accuracy.

The diagnosis of GDM was established by universal screening and oral glucose tolerance test (OGTT) in accordance with the first three Workshop Conferences on Gestational Diabetes Mellitus (13), as described in reference 12. We previously reported a GDM prevalence of 12% with this screening protocol (14).

### Subjects

All women diagnosed with GDM attending the Diabetes and Pregnancy Clinic from 1 January 1995 to 31 December 1999 were included in the study. Until 30 June 1997, women with GDM received endocrinologist-based metabolic management ( $n = 244$ : 232 singleton, 11 twin, 1 triplet), whereas from 1 July 1997 to 31 December 1999, they received diabetes nurse-based metabolic management ( $n = 283$ : 272 singleton, 9 twin, 2 triplets).

### Diabetes control

Therapy was initiated with normocaloric diet and self-monitoring of blood glucose, with insulin therapy being added when necessary (12) to achieve glycemic target values (90 mg/dl fasting/preprandial and 120 mg/dl postprandial) (15,16).

### Outcome definitions

Hypertension was defined as blood pressure  $\geq 140/90$  mm/Hg, recorded on two occasions at least 6 h apart (17), as well as all variables of perinatal outcome previously described (12).

### Statistical analysis

Baseline characteristics, insulin treatment, and perinatal outcome of women with GDM in the two periods were compared. A  $\chi^2$  test, with Fisher's correction, was used to analyze categorical data. As quantitative data did not adjust to a normal distribution (Kolmogorov-Smirnov test), they were expressed as median

**Table 1—Sketch of the program of care for women with GDM in the periods of endocrinologist-based and diabetes nurse-based management**

	Endocrinologist-based management		Diabetes nurse-based management	
	Endocrinologist	Diabetes nurse	Endocrinologist	Diabetes nurse
<b>First appointment</b>				
Information about the disorder	X	—	—	X
Diet calculation	X	—	—	X
Blood test request	X	—	X	—
<b>Instruction</b>				
Diet (timing and nutrient exchange)	—	X	—	X
Self-monitoring of blood glucose and urine ketones	—	X	—	X
<b>Second appointment</b>				
Medical visit to identify health background	X	—	X	—
<b>Follow-up visits during pregnancy*</b>				
Glycemic profile revision	X	—	—	X
Blood test request (HbA <sub>1c</sub> and fructosamine) every 4 weeks	X	—	X	—
Diet revision	—	X	—	X
Decision on initiation of insulin Tx	X	—	X	—
Instruction on insulin administration	—	X	—	X
Instruction on treatment of hypoglycemia	—	X	—	X
Modification of diet and insulin	X	—	Backup	X
<b>After delivery follow-up</b>				
Blood test request including thyroid Ab and if negative, OGTT and lipid profile	X	—	X	—
Blood test checkup, weight, blood pressure	X	—	X	—
Information about type 2 diabetes prevention and cardiovascular risk factors	X	—	—	X

The diabetes nurse role in this report would be similar to that of an advanced practice nurse in the U.S. \*For follow-up visits during pregnancy, frequency was weekly or biweekly, and targets of blood glucose control were  $<90$  mg/dl fasting and  $<120$  mg/dl 1 h postprandial.

(range); the Mann-Whitney  $U$  test was used for analysis. Significance was set at  $P < 0.05$ , with Bonferroni correction for 9 variables in the case of maternal characteristics ( $P < 0.006$ ) and 15 variables in the case of outcome ( $P < 0.0033$ ).

**RESULTS**— Maternal characteristics included the following (percent or median [range]): age, 33 years (19–44); BMI, 22.95 kg/m<sup>2</sup> (15.4–43.9); family history of diabetes, 57.7%; prior history of hyperglycemia, 17.2%; gestational age at diagnosis, 32 weeks (3–40); fasting blood glucose in diagnostic OGTT, 4.5 mmol/l (3.3–10.9); 1-h blood glucose in diagnostic OGTT, 11.5 mmol/l (5.5–18.7); 2-h blood glucose in diagnostic OGTT, 10.2 mmol/l (4.8–18.7); and 3-h blood glucose in diagnostic OGTT, 7.5 mmol/l (1.8–23.7). Characteristics did not differ for mothers in the two study periods (Table 2).

The rate of insulin treatment was 38.2%; maternal hypertension, 6.4%; preterm delivery, 10.0%; cesarean section, 29.4%; 1-min Apgar  $<7$ , 5.0%; macrosomia, 4.0%; small-for-gestational-age newborns, 8.3%; large-for-gestational-age newborns, 7.0%; obstetric trauma, 2.4%; major malformations, 4.5%; hypoglycemia, 1.5%; hypocalcemia, 0.5%; polycythemia, 2.8%; jaundice, 4.5%; respiratory distress, 3.2%; and mortality, 1.5%. No differences were seen between mothers treated in the two periods (Table 3).

Because of the nonsignificant increase in mortality in the period of diabetes nurse-based management (2.0 vs. 0.8%; NS), the causes of mortality in both periods were analyzed. The two cases of neonatal mortality in the period of endocrinologist-based management were attributed to hyaline membrane in a preterm twin (1) and a Fallot tetralogy (1); the six cases in the period of diabetes

**Table 2—Characteristics of women with GDM delivering in the periods of endocrinologist-based and diabetes nurse-based management**

	Endocrinologist-based management	Diabetes nurse-based management	P
Age (years)	33 (23–42)	33 (19–44)	NS
BMI (kg/m <sup>2</sup> )	22.9 (16.7–40.8)	22.9 (15.4–43.9)	NS
Family history of diabetes (%)	58.6	57.9	NS
History of hyperglycemia (%)	13.2	20.9	NS
Gestational age at diagnosis (weeks)	32 (10–39)	31 (3–40)	NS
Diagnostic OGTT (mmol/l)			
Fasting blood glucose	4.5 (3.5–8.7)	4.5 (3.3–10.9)	NS
1-h blood glucose	11.6 (5.5–17.2)	11.4 (7.3–18.7)	NS
2-h blood glucose	10.2 (4.8–18.0)	10.2 (6.8–18.7)	NS
3-h blood glucose	7.3 (1.8–14.8)	7.7 (3.2–23.7)	NS

Data are median (range) or %. The diabetes nurse role in this report would be similar to that of an advanced practice nurse in the U.S.

nurse-based management were attributed to stillbirth in a twin fetus (2), preterm birth before 24 weeks (2), respiratory distress secondary to meconium aspiration (1), and cardiac malformation in a baby with chromosome 13 trisomy (1).

**CONCLUSIONS**— Most guidelines and original studies on the care of women with GDM do not describe the role of the diabetes nurse as an active one, whereas it is clearly stated that diet instruction should be carried out by dietitians (6,9). Nurse practitioners today are increasingly furthering their training, developing specialized skills, and making autonomous

diagnoses and treatment decisions, with outcomes that do not differ from those of physicians (18,19). Their wider role is becoming increasingly recognized not only in diabetes management but in many fields (20,21), such as in emergency units (22), primary care (18,19,23), and pediatrics (24), and has been the subject of several recent systematic reviews (19,21). However, to the best of our knowledge, there has been no study testing the performance of nurse practitioners or advanced practice nurses in the care of women with GDM.

The present study was not a controlled clinical trial, as it was conceived

retrospectively. However, as data had been collected prospectively before the research question arose, the study should be considered nonbiased. The only change in the management protocol was the difference in the distribution of health professionals' time: in the period of endocrinologist-based management, the endocrinologist spent more time with the woman and the diabetes nurse provided backup, whereas the reverse was true in the period of diabetes nurse-based management. The study and historical control groups displayed similar baseline characteristics and no differences either in the rate of insulin treatment or in perinatal outcome. The trend toward increased mortality in the period of nurse-based management was further analyzed, and most underlying causes (stillbirth in twin pregnancy, extreme preterm birth, and cardiac malformation in an infant with trisomy) were not related to metabolic control after GDM diagnosis. Subsequently, they cannot be attributed to diabetes nurse-based management. Treatment satisfaction was not evaluated, but we believe that endocrinologist backup in diabetes nurse-based management provides reassurance to patients, nurses, and the physicians themselves. In addition, although available for backup whenever required, the endocrinologist remained able to attend his patients.

A prospective controlled trial is necessary to give definitive proof that care provided to women with GDM by diabetes nurses and endocrinologists is equivalent. However, in the meantime, the present study supports a more active role of the diabetes nurse in the management of women with GDM.

**Table 3—Insulin treatment and perinatal outcome in women with GDM delivering in the periods of endocrinologist-based and diabetes nurse-based management**

	Endocrinologist-based management	Diabetes nurse-based management	P
Insulin treatment	33.7	42.0	NS
Hypertension	6.4	6.4	NS
Preterm delivery	9.2	10.8	NS
Cesarean delivery	28.8	30.0	NS
Apgar <7 (1 min)	6.0	4.1	NS
Macrosomia	3.2	4.7	NS
Small for gestational age	6.8	9.6	NS
Large for gestational age	6.4	7.5	NS
Obstetric trauma	1.6	3.1	NS
Major malformation	3.6	5.2	NS
Hypoglycemia	1.6	1.4	NS
Hypocalcemia	0	1.0	NS
Polycythemia	3.2	2.4	NS
Jaundice	3.6	5.2	NS
Respiratory distress	3.6	2.8	NS
Mortality	0.8	2.0	NS

Data are %. The diabetes nurse role in this report would be similar to that of an advanced practice nurse in the U.S.

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