A ten-year gestational diabetes mellitus cohort at a university clinic of the mid-Anatolian region of Turkey

H.M. Tanir, T. Sener, H. Gürer, M. Kaya

Department of Obstetrics and Gynecology, Osmangazi University School of Medicine, Meselik Kampusu, Eskisehir (Turkey)

Summary

Objective: The study attempts to analyze a 10-year retrospective cohort of gestational diabetes mellitus (GDM) cases, elucidating the maternal complications and perinatal morbidity and mortality.

Study design: The study participants were 110 diabetic singleton pregnancies receiving obstetric care at the Department of Obstetrics and Gynecology, Osmangazi University School of Medicine in Eskisehir, Turkey from January 1995 to December 2004. In 70 of the GDM cases, mean age, diagnostic criteria used to define GDM, gestational age at delivery, presence of additional risk factors, method of clinical management, mode of delivery, fetal birthweights and newborn characteristics were assessed.

Results: The prevalence of GDM in the past ten-year period was 3.1% (110/3,548). Mean age of enrolled GDM cases was 32.6 ± 5.3 years. With regard to diagnostic criteria of GDM, 24 (37.1%) cases were diagnosed based on a 100 g, three-hour oral glucose tolerance test (OGTT), while 18 (25.7%) cases were referred to our unit without any information on the specific criteria of GDM diagnoses. In less than a third of the cases (25.7%), a one-hour 50 g glucose challenge test (GCT) resulted ≥ 185 mg/dl completing the diagnoses. More than half of the cases (57.1%) revealed controlled glucose homeostasis on diet, while 30 (42.9%) pregnant women needed insulin therapy to control blood glucose levels to within normal physiologic limits. Fetal macrosomia was present in 18 (25.7%) pregnancies. Meanwhile, most of the fetuses (62.9%) were within the normal growth percentiles throughout the pregnancy. There was no difference detected in body mass index (BMI) of women undergoing cesarean section and spontaneous vaginal births (25.1 ± 1.2 vs 26.2 ± 2.3 kg/m^2, respectively, p = 0.45). Vacuum extraction and forceps applications were indicated in 10% of all GDM groups. Fetuses born to women having cesarean section were heavier at birth compared to those of women having vaginal births (3,940 ± 320 g vs 430 ± 117 g, p = 0.08) Most frequent neonatal morbidity was hyperbilirubinemia in 25 (35.7%) newborns. Interestingly, of those women with GDM, only ten (14.3%) cases consented to follow-up evaluation of glucose intolerance between six and eight weeks postpartum.

Conclusions: Proposed risks from abnormal glucose intolerance in pregnancy are multiple. Early diagnosis, patient education, proper follow-up and postpartum testing in women with GDM will certainly decrease poor perinatal outcomes, enabling also a secondary prevention of type 2 diabetes in the long term.

Key words: Gestational Diabetes Mellitus, Screening, Diagnosis, Postpartum testing.

Introduction

Gestational diabetes mellitus (GDM) is defined as any degree of glucose intolerance with onset or first recognition during pregnancy and represents the most common metabolic complication of pregnancy [1]. Being diagnosed with GDM is coupled with the implication that the woman and her fetus are at risk [2, 3]. Perinatatal complications including fetal malformations, macrosomia, intrauterine fetal demise and associated maternal risks such as pre-eclampsia, infections, preterm labor, arrested labor, cesarean deliveries and bad neonatal outcome increase proportionally to the maternal blood sugar concentration during a glycemic continuum [4]. Therefore, a prompt diagnosis is crucial to reduce the above-mentioned maternal and fetal morbidity and to allow subsequent attempts at preventing or delaying the onset of type 2 diabetes mellitus.

Maternal and fetal monitoring is required in order to minimize maternal and fetal/neonatal morbidity and perinatal mortality. After delivery all women with GDM need to have their glucose tolerance reevaluated by a 75 g oral glucose tolerance test (OGTT) (WHO criteria).

Revised manuscript accepted for publication July 21, 2005

The present study was comducted with the aim of documenting a ten-year experience of GDM cases in a university clinic, including the diagnosis, perinatal and maternal complications, mode of delivery, and neonatal outcome.

Materials and Methods

One hundred and ten women admitted to the antenatal clinic at Osmangazi University School of Medicine from January 1995 to December 2004 constituted our study group. Of those women, 70 GDM cases with all necessary clinical information were analyzed. These women were examined, based on the age, number of parity, gravidity, mode of screening and diagnosis, mode of delivery, maternal and perinatal complications as well as neonatal outcome.

One- or two-step GDM screening approaches have been defined in the literature. The one-step approach is a 3-hour 100 g OGTT with prior plasma glucose (mg/dl) screening based on Carpenter and Coustan criteria [5]. Two-step screening is based on the sequential use of 1-hour 50-g GCT and 3-hour 100-g OGTT tests. Informed consent for the scientific use of the data was obtained from all women. The study was approved by the Local Ethical Committee.

Statistical analysis included the Student's t-test for parametric data analysis with a statistical package program (SPPS 10.0, Chicago, IL, USA) was used. A p value of < 0.05 was considered statistically significant.

Results

During this time period, a total number of 3,548 deliveries were observed in our unit, of whom 110 pregnant women were diagnosed with GDM. Hence, the prevalence was nearly 3.1%.

The mean age of the 70 GDM cases was 32.6 ± 5.3 years. The mean body mass index (BMI) of the cases was 26.1 ± 3.2 kg/m^2. The majority of the cases (n = 40) were multiparous (57.1%). A previous history of GDM was present in 23 (32.9%) of the pregnant diabetic women. Furthermore, women with a history of macrosomic infant and intrauterine fetal demise constituted 12.9% (n = 9) and 5.7% (n = 4) of the study population, respectively. Clinical characteristics including mode of screening and diagnosis (one-stage vs two-stage screening), insulin or drug use, maternal complications, and fetal biometry are summarized in Table 2.

As shown in Table 1, nearly a third of the cases were older than 35 years of age and most had preterm labor complicating the ongoing pregnancy. Preterm premature rupture of membranes (pPROM) and pre-eclampsia complicated 4.2% and 2.8% of all GDM cases, respectively. Interestingly, there was no consensus regarding GDM diagnoses. Almost half of the cases were screened and diagnosed based on the two-stage screening method. However, one-stage screening based on a 1-hour 100 g glucose tolerance test was applied in 28.5% of cases. As the mode of treatment there was an even distribution between cases on insulin plus diet and cases on diet only. Fetal macrosomia based on estimated fetal birthweight measurement was present in 25.7% of cases. Amniotic fluid assessment was normal in 59 (84.3%) of the enrolled study group.

Mode of delivery, cesarean indications, neonatal birthweight, presence of fetal anomalies and, one and five minute Apgar scores are shown in Table 2. As clearly shown in Table 2, the majority of deliveries were by cesarean section (57.1%), of which arrested second-stage labor constituted the most common (40%) cesarean indication. In addition, there was no difference detected in the BMI of women undergoing cesarean section and spontaneous vaginal birth (25.1 ± 1.2 vs 26.2 ± 2.3 kg/m^2, respectively, p = 0.45). Vacuum extraction and forceps aplications were indicated in 10% of all the GDM group. Newborns of women with cesarean section were heavier at birth, compared to those of women delivering vaginally (3,940 ± 320 g vs 3,430 ± 117 g, p = 0.08).

Three (4.3%) fetal anomalies were detected (2 neural tube defects and 1 ventricular septal defect). Percentages of low birthweight (< 2,500 g) and macrosomic neonates were 24.3% and 14.3%, respectively. In none of the fetal macrosomia cases was shoulder dystocia encountered. Hyperbilirubinemia was the most common fetal morbidity observed among neonates of diabetic women (35.7%).

Interestingly, of the 70 GDM cases during the postpartum period only ten (14.3%) cases underwent a 75 g oral gluce tolerance test six to eight weeks following the delivery. None of the cases exhibited impaired glucose tolerance (IGT) or fasting hyperglycemia.

Table 1. — *Maternal clinical characteristics of 70 GDM cases.*

	No.	%
Maternal complications		
Age ≥ 35 yeras	26	37.1
Preterm labor	20	28.5
pPROM**	3	4.2
Pre-eclampsia	2	2.8
Hyperemesis gravidarum	2	2.8
Urinary infection	7	10
Mode of screening and diagnosis		
One-step (100 g 3-hr oGTT)	18	25.7
Two-step (one-hour 50 g GCT)	34	48.6
Non-specified	18	25.7
Mode of treatment		
Insulin+diet	30	42.8
Diet only	40	57.2
Ultrasound finding		
Polyhydramnios	6	8.6
Oligohydramnios	5	7.1
Macrosomia	18	25.7
IUGR*	8	11.4
Within normal growth percentiles	44	62.9

* Intrauterine growth restriction; ** preterm premature rupture of membranes.

Table 2. — *Mode of delivery, cesarean indications, neonatal birthweight, 1- and 5-min Apgar scores of 70 GDM cases in a 10-year retrospective cohort.*

	No.	%
Mode of delivery		
Spontaneous vaginal birth	22	31.4
Cesarean delivery	41	58.6
Vacuum extraction	5	7.1
Outlet/low forceps	2	2.9
Cesarean indication		
Previous cesarean section	16	22.9
Acute fetal distress on CTG*	5	7.1
Primiparous breech presentation	4	5.7
Placenta previa	1	1.4
Elective primary	7	10
Fetal macrosomia	3	4.3
Arrest of second stage of labor	28	40
Failure of labor induction	6	8.6
Fetal and neonatal outcome		
Fetal anomaly	3	4.3
– neural tube defect	2	
– ventricular septal defect	1	
Intrauterine fetal demise	3	4.3
Birthweight		
< 2,500 g	17	24.3
2,501-3,999 g	43	61.4
≥ 4,000 g	10	14.3
1-min Apgar < 7	24	34.3
5-min Apgar < 7	13	18.6
Hyperbilirubinemia	25	35.7
Polycythemia	13	18.6
RDS**	14	20

* Cardiotocography (CTG) findings (repetitive late and various decelerations, fetal bradycardia); ** Respiratory distress syndrome.

Discussion

In the present study the prevalence of GDM in the 10-year cohort was 3.1%. In general the prevalence of GDM all over the world has been estimated to be 3-5% of all

pregnancies [6]. As shown in Table 1, a substantial percentage of cases were complicated by preterm labor, advanced maternal age and related medical conditions such as pre-eclampsia and infection.

With regard to GDM screening, we encountered different screening approaches for GDM, the majority of which were based on two-step screening (48.6%). All cases in our series underwent some form of screening test.

Various screening and diagnostic tests are used for GDM screening, none of which offer the combination of qualities to be expected from a test: simplicity of use, reproducibility, specificity and sensitivity. Recently, based on certain factors (age, ethnicity, previous history of GDM or adverse perinatal outcome) that have been shown to place women at low risk for the development of GDM, the Fourth International Workshop/Conference on Gestational Diabetes modified the screening policy [7]. Given the high prevalence of this metabolic disorder and some concerns regarding the efficacy of selective screening, our strategy was also based on the fact that universal screening is probably the most reliable policy to identify GDM. However, as observed in many countries, this study had a widespread variation in the practice of screening for GDM [8]. It can be argued that an OGTT should be considered in all pregnant women with high-or low-risk, irrespective of a negative GCT (one-step screening approach). This latter approach is said to be reserved for patients with previously impaired glucose intolerance or multiple risk factors for GDM [9].

There also reports in the literature implicating that early (20 weeks of gestation) GDM surveillance is essential among a subset of women with advanced maternal age, pre-pregnancy overweight, family history of diabetes and previous GDM history [10]. However, it has also been reported that a repeat test of glucose tolerance late in pregnancy enables a diagnosis of GDM in women with negative test results earlier in pregnancy [11].

GDM is associated with fetal macrosomia as well as risk of neonatal respiratory distress syndrome (RDS), hyperbilirubinemia, polycytemia and obesity later in life [12]. In our study, the most prevalent neonatal complication was hyperbilirubinemia followed by RDS and polycytemia.

Evidence demonstrated that women with diabetes mellitus (DM) have a greater risk of abortion and congenital malformations. Presence of fetal congenital malformations have been observed in 4.3% of cases, a rate similar to that recorded in women with normal glucose tolerance [13]. Morover, all of those malformations belonged to women with early onset GDM. Late-onset DM in pregnancy is not associated with an increased incidence of congenital malformations [14].

Diabetes mellitus in pregnancy confers a high risk for operative delivery [14]. Moreover, other studies have attempted to discern the relative contribution of obesity, an important confounding factor determining the mode of delivery [15, 16]. In the present study, the mean BMI of the cases was 26.1 ± 3.2 kg/m^2. In addition there was no difference detected in the BMI of women undergoing cesarean section vs spontaneous vaginal birth (25.1 ± 1.2 vs 26.2 ± 2.3 kg/m^2, respectively, p = 0.45). Bo *et al.* [15] showed that obesity had a greater influence on the risk of macrosomia and hypertension than hyperglycemia, and increased the operative delivery rates.

Another interesting finding came from a study from Salim *et al.* [17] suggesting that anthropometric measurements of infants of mothers with well-controlled gestational diabetes did not differ from infants of nondiabetic mothers when they were matched for gender, gestational age, ethnicity and birthweight. According to our study, infants born to women with cesarean section were heavier than their vaginal birth counterparts, although no statistically significant difference was observed.

Interestingly, only 14.3% of the pregnant women were enrolled in postpartum 75 g OGTT following six weeks postpartum. Nevertheless, all of them had normal glucose tolerance test values. Several studies have reported that the incidence of postpartum diabetes mellitus rates beyond six to eight weeks postpartum vary from 3 to 38% [18, 19]. In the present study, the small percentage of women undergoing postpartum glucose tolerance testing made us reorganize our ongoing counseling and education services regarding postpartum evaluation, since, in the majority of GDM cases postpartum glucose testing was lacking. Hence, this result supports the importance of postpartum testing in women with GDM for the primary and/or secondary prevention of type 2 diabetes.

To conclude, clinical recognition of this most common endocrinopathy in pregnancy is important because medical interventions and perinatal surveillance can reduce the perinatal morbidity and mortality associated with GDM. Every effort should be given in counseling and patient education for postpartum identification of those cases associated with disturbed glucose tolerance, in order to confront type 2 diabetes development later in life.

References

[1] Metzger B.E.: "Summary and recommendations of the third international workshop-conference on gestational diabetes mellitus". *Diabetes,* 1991, *40* (suppl. 2), 197.

[2] Walkinshaw S.A.: "Gestational diabetes mellitus". *Curr. Obstet. Gynecol.*, 2002, *12,* 346.

[3] Kjos S.L., Buchanan T.A.: "Gestational diabetes mellitus". *New Engl. J. Med.,* 1999, *341*, 1749.

[4] Yang X., Hsu-Hage B., Zhang H., Zhang C., Zhang Y., Zhang C.: "Women with impaired glucose tolerance during pregnancy have significantly poor pregnancy outcomes". *Diabetes Care,* 2002, *25,* 1619.

[5] Carpenter M.W., Coustan D.R.: "Criteria for screening tests for gestational diabetes". *Am. J. Obstet. Gynecol.*, 1982, *144*, 768.

[6] King H.: "Epidemiology of glucose tolerance and gestational diabetes in women with childbearing age". *Diabetes Care*, 1998, *21* (suppl. 2), B9.

[7] Alberico S., Strazzanti C., De Santo D., De Seta F., Lenardon P., Bernardon M. *et al.*: "Gestational diabetes: universal or selective screening?". *J. Mat. Fetal. Neonatal. Med.,* 2004, *16,* 331.

[8] Aldrich P.J., Moran M.D., Gillmer C.G.: "Screening for gestational diabetes in the United Kingdom: a national survey". J. *Obstet. Gynaecol.* 1999, *19*, 575.

[9] Di Cianni G., Volpe L., Lencioni C., Miccoli R., Cuccuro I., Ghio A., Chatzianagnostou K. *et al.*: "Prevalence and risk factors for gestational diabetes assessed by universal screening". *Diabetes Res. Clin. Pract.*, 2003, *62,* 131.

[10] Boriboonhirunsarn S., Sunsaneevithayakul P., Nuchangrid M.: "Incidence of gestational diabetes mellitus diagnosed before 20 weeks of gestation". *J. Med. Assoc. Thai.,* 2004, *87,* 101.

[11] Jovanovic L., Peterson C.M.: "Screening for gestational diabetes mellitus: optimum timing and criteria for retesting". *Diabetes,* 1985, *34* (suppl. 2), 21.

[12] Pettit D.J., Benet P.H.: "Long term outcome of infants of diabetic mothers". In: E.A. Reece (ed.), Diabetes Mellitus in Pregnancy, Principles and Practice, New York, Churchill Livingstone, 1998, 559.

[13] Ventura S.C., Gatt M.: "Embryonal risks in gestational diabetes mellitus". *Early Hum. Dev.,* 2004, *79,* 59.

[14] Zargar A.H., Sheikh M.I., Bashir M.I., Masoodi S.R., Laway A.B., Wani I.A. *et al.*: "Prevalence of gestational diabets mellitus in Kasmiri women from the Indian subcontinent". *Diabetes Res. Clin. Pract.*, *66,* 139.

[15] Bo S., Menato G., Signorile A., Bardelli C., Lezo A., Gallo M.L. *et al.*: "Obesity or diabetes: what is worse for the mother and for the baby". *Diabetes Metab.*, 2003, *29,* 175.

[16] Ehrenberg H.M., Durnwald C.P., Catalano P., Mercer B.M.: "The influence of obesity and diabetes on the risk of cesarean delivery". *Am. J. Obstet. Gynecol.,* 2004, *191*, 969.

[17] Salim R., Hasanein J., Nachum Z., Shalev E.: "Anthropometric parameters in infants of gestational diabetic women with strict glycemic control". *Obstet. Gynecol.,* 2004, *105,* 1021.

[18] Dacus J.V., Meyer N.L., Muram D., Stislon R., Phipps P., Sibai B.M.: "Gestational diabetes: postpartum glucose tolerance testing". *Am. J. Obstet.,* 1994, *171,* 927.

[19] Jang H.C., Yim C.H., Han K.O., Yoon H.K., Han I.K., Kim M.Y. et al.: "Gestational diabetes mellitus in Korea: prevalence and prediction of glucose intolerance at early postpartum". *Diabetes Res. Clin. Pract.,* 2003, *61,* 117.

Address reprint requests to:
H.M. TANIR, M.D.
Osmangazi University School of Medicine
Department of Obstetrics and Gynecology
Meselik Kampusu,
26480 Eskisehir (Turkey)