Sultan Qaboos University Med J, November 2015, Vol. 15, Iss. 4, pp. e496–500, Epub. 23 Nov 15
Submitted 15 Dec 14
Revision Req. 5 Apr 15; Revision Recd. 6 Apr 15
Accepted 19 May 15
doi: 10.18295/squmj.2015.15.04.009

CLINICAL & BASIC RESEARCH

Gestational and Pregestational Diabetes Mellitus in Omani Women

Comparison of obstetric and perinatal outcomes

*Adel T. Abu-Heija,[1] Majeda Al-Bash,[2] Mariam Mathew[2]

مرض السكري خلال الحمل وما قبل الحمل عندالنساء العمانيات

مقارنة النتائج عند الولادة وفترة ما قبل الولادة

عادل أبوالهيجاء، ماجدة الباش، مريم ماثيو

abstract: ***Objectives:*** The aim of this study was to assess the prevalence of gestational diabetes mellitus (GDM) and pregestational diabetes mellitus (PGDM) among pregnant women in Oman and compare their obstetric and perinatal outcomes. ***Methods:*** This retrospective study assessed the obstetric and perinatal outcomes of pregnant Omani women with GDM or PGDM who delivered at the Sultan Qaboos University Hospital in Muscat, Oman, between January 2009 and December 2010. ***Results:*** There were a total of 5,811 deliveries during the study period. Of the 5,811 women who gave birth, 639 women were found to have diabetes mellitus (11.0%). A total of 581 of the diabetic women had GDM (90.9%) and only 58 (9.1%) had PGDM. Women with PGDM had a significantly higher incidence of pre-eclampsia (P = 0.022), preterm deliveries (P <0.001) and Caesarean sections (P <0.001). Neonatal complications, such as respiratory distress syndrome (RDS), neonatal hypoglycaemia, neonatal jaundice and subsequent admission to a neonatal intensive care unit (NICU) were significantly higher for neonates born to mothers with PGDM compared to those born to mothers with GDM (P <0.001). The corrected perinatal mortality rates for women with PGDM and GDM were 34.5 and 13.7 per 1,000 live births, respectively. ***Conclusion:*** In this Omani cohort, women with PGDM were at higher risk of developing obstetric and perinatal complications such as pre-eclampsia, preterm delivery and Caesarean delivery compared to women with GDM. In addition, neonates who had mothers with PGDM had higher rates of RDS, neonatal hypoglycaemia, neonatal jaundice and admission to the NICU.

Keywords: Diabetes Mellitus; Gestational Diabetes; Perinatal Care; Obstetrics; Complications; Oman.

الملخص: الهدف: الهدف من هذه الدراسة هو تقييم مدى انتشار سكري الحمل (GDM) وسكري ما قبل الحمل بين النساء الحوامل في عمان ومقارنة النتائج عند الولادة وفترة ما قبلالولادة. **الطريقة:** هذه دراسة استعادية لتقييم نتائج الولادة وفترة ما قبل الولادة للنساء العمانيات الحوامل ممن لديهن سكري الحمل أو سكري ماقبل الحمل في مستشفى جامعة السلطان قابوس في مسقط، عمان، بين يناير 2009 وديسمبر 2010. **النتائج:** كانت هناك 5,811 ولادة في تلك الفترة. من 5,811 امرأه ولدت في المستشفى وجدت 639 امرأة لديها داء السكري (11.0%). منهن 581 كان لديها سكري الحمل (90.9%)، و 58 فقط (9.1%) لديهن سكري ماقبل الولادة. في النساء اللاتي لديهن سكري ماقبل الولادة حصل تسمم الحمل بنسبة أكبر إحصائيا (P = 0.022)، وكذلك الولادة المبكرة (P <0.001) والولادة القيصرية (P <0.001). وكذلك كانت المضاعفات لحديثي الولادة، مثل متلازمة الضائقة التنفسية (RDS)، نقص سكر الدم عندالأطفال حديثي الولادة، واليرقان الوليدي والدخول لاحقا في وحدة العناية المركزة لحديثي الولادة (NICU) أعلى بكثير للرضع الذين كانت أمهاتهم لديهن سكري ما قبل الحمل مقارنة مع الذين أمهاتهم لديهن سكري الحمل. (P <0.001). كانت معدلات الوفيات للرضع ما حول الولادة للنساء اللاتي لديهن سكري ما قبل الحمل 34.5 وللنساء اللاتي لديهن سكري الحمل 13.7 لكل 1,000 ولادة حية، على التوالي. **الخلاصة:** في هذه المجموعة من النساء العمانيات، كانت النساء اللاتي اللاتي سكري ما قبل الحمل أكثر عرضة لمضاعفات الولادة مثل تسمم الحمل، الولادة المبكرة والولادة القيصرية مقارنة مع النساء اللواتي لديهن سكري الحمل. بالإضافة إلى ذلك، فقد كان لدى الرضع للأمهات اللاتي لديهن سكري الحمل ارتفاع في معدلات متلازمة الضائقة التنفسية، ونقص سكر الدم في لأطفال حديثي الولادة، واليرقان الوليدي ومعدل الدخول الى وحدة العناية المركزة لحديثي الولادة.

مفتاح الكلمات: مرض السكري؛ سكري الحمل؛ العناية ما قبل الولادة؛ التوليد؛ مضاعفات؛ عمان.

Advances in Knowledge

- *From the results of this study, Omani women with pregestational diabetes mellitus (PGDM) are at higher risk of developing certain obstetric and perinatal complications in comparison to women with gestational diabetes mellitus (GDM).*
- *Neonates born to Omani mothers with PGDM had higher rates of respiratory distress syndrome, neonatal hypoglycaemia, neonatal jaundice and subsequent admission to a neonatal intensive care unit compared to those with GDM mothers.*

[1]*Department of Obstetrics & Gynaecology, College of Medicine & Health Sciences, Sultan Qaboos University;* [2]*Department of Obstetrics & Gynaecology, Sultan Qaboos University Hospital, Muscat, Oman*

**Corresponding Author e-mail: abuheija2008@hotmail.com*

Application to Patient Care

- *Pregnant diabetic women, particularly women with PGDM, should be monitored closely for obstetric complications. Any complications should be recognised and managed effectively so that they do not adversely affect perinatal outcomes.*

Gestational diabetes mellitus (GDM) is defined as a carbohydrate intolerance which occurs for the first time during pregnancy and disappears by the end of the puerperium.[1] If diabetes mellitus is diagnosed before pregnancy, it is classified as pregestational diabetes mellitus (PGDM). The reported prevalence of diabetes in Oman is approximately 12.0%, with the disease affecting males and females equally.[2] Approximately 3.0% of pregnant women in Oman develop GDM before delivery.[3] In the United Arab Emirates, GDM has been reported to occur in 5.0% of pregnancies.[4]

A mild increase in glucose levels during pregnancy can adversely affect both the mother and fetus. Increased incidences of pre-eclampsia, preterm delivery, miscarriage, fetal malformation and perinatal mortality and morbidity have been reported in diabetic pregnancies in comparison to the general population.[5] Hyperglycaemia during pregnancy is associated with macrosomia, which may subsequently lead to shoulder dystocia and birth trauma in addition to an increase in the rate of Caesarean sections.[6] Additionally, research has shown that hyperglycaemia is associated with an increased risk of perinatal mortality and neonatal complications such as respiratory distress syndrome (RDS), neonatal hypoglycaemia and jaundice.[7–9]

The majority of studies in the literature on this topic have compared the obstetric and perinatal outcomes of women with uncomplicated pregnancies to either PGDM or GDM cohorts. This study aimed to retrospectively review the obstetric and perinatal outcomes of women with PGDM or GDM who were cared for and delivered at the Sultan Qaboos University Hospital (SQUH), a tertiary hospital in Muscat, Oman.

Methods

This retrospective study investigated the obstetric and perinatal outcomes of pregnant Omani women between 15–49 years old with GDM and PGDM who delivered at SQUH between January 2009 and December 2010. Patient records were retrospectively reviewed for maternal data (age, parity, gestational age, labour induction and mode of delivery), antenatal or obstetric complications (e.g. pre-eclampsia, preterm delivery, polyhydramnios or oligohydramnios) and perinatal outcomes (birth weight, five minute Apgar scores, admission to the neonatal intensive care unit [NICU], fetal anomalies, stillbirths and early neonatal deaths). Neonatal complications, such as RDS, neonatal hypoglycaemia and jaundice, were also reviewed. Women were considered diabetic (positive oral glucose tolerance test [OGTT]) if either their fasting or two-hour blood glucose levels (venous plasma glucose) exceeded 5.5 or 9 mmol/L (99 or 162 mg/dL), respectively.

During the study period, standard SQUH protocol for the diagnosis and management of diabetes during pregnancy required that all healthy pregnant Omani women who were not known to be diabetic or at high-risk of developing diabetes undergo random blood sugar tests during their first official antenatal appointment (at between eight and 12 gestational weeks). If their blood sugar level was >7 mmol/L (126 mg/dL), then a two-hour 75 g OGTT was performed in order to diagnose PGDM. Pregnant women who were not known to be diabetic but were classified as having a relatively high risk of developing diabetes also underwent a two-hour 75 g OGTT during their first official antenatal appointment. Women were considered high-risk if they had a history of recurrent miscarriages, macrosomia, fetal malformation or unexplained intrauterine fetal death (IUFD) or a family history of diabetes, previous GDM or glycosuria on at least two occasions. For pregnant women who were not at an increased risk of developing diabetes, a 50 g oral glucose challenge test was performed between 24 and 28 gestational weeks. If their blood sugar level was ≥7.8 mmol/L (140 mg/dL), a two-hour 75 g OGTT was performed.

Women with diabetes were treated with a diet plan and/or administration of metformin or subcutaneous insulin. Glycaemic control was considered satisfactory for patients with preprandial glucose levels of <5.5 mmol/L (99 mg/dL) and two-hour postprandial levels of <8 mmol/L (144 mg/dL). Long-term glycaemic control was assessed by estimating glycosylated haemoglobin levels; women with levels of <6.0% were considered to have satisfactory glycaemic control. The major indication for a Caesarean delivery included cephalopelvic disproportion (CPD) or 1–2 previous Caesarean section deliveries performed due to CPD.

Statistical analyses were performed using Chi-squared, Mann-Whitney U and Fisher's exact tests, as appropriate. Differences between values were

Table 1: Demographic characteristics and obstetric outcomes of women with gestational diabetes and pregestational diabetes among a pregnant Omani cohort (N = 5,811)

Characteristic	n (%)		*P* value
	GDM (n = 581)	PGDM (n = 58)	
Mean age in years ± SD	31.6 ± 13.6	32.6 ± 5.9	0.579
Parity			
0	134 (23.1)	14 (24.1)	0.871
1–4	265 (45.6)	21 (36.3)	0.212
≥4	182 (31.3)	23 (39.6)	0.237
Mean gestational age in weeks ± SD	38.3 ± 2.1	38.6 ± 5.9	0.415
Obstetric outcome			
Pre-eclampsia	44 (7.8)	10 (17.2)	0.022
Preterm delivery at <37 gestational weeks	55 (9.5)	15 (25.9)	<0.001
Caesarean section	162 (27.9)	35 (60.3)	<0.001
Shoulder dystocia	10 (1.7)	1 (1.7)	>0.999
Polyhydramnios	29 (4.9)	4 (6.8)	0.529
Oligohydramnios	4 (0.7)	1 (1.7)	0.380
Induction of labour	139 (23.9)	9 (15.5)	0.191

GDM = gestational diabetes mellitus; PGDM = pregestational diabetes mellitus; SD = standard deviation.

considered significant at $P \leq 0.0500$.

Ethical approval for this study was granted by the Medical Research & Ethics Committee of the College of Medicine & Health Sciences at Sultan Qaboos University (MREC #397).

Results

During the study period, there were 5,811 deliveries. Of the 5,811 women who gave birth, 639 were diabetic (11.0%). Of these, 581 had GDM (90.9%) while only 58 had PGDM (9.1%). All women with PGDM received insulin therapy. In the diabetic cohort, 42.0% of the women had had 1–2 previous Caesarean section deliveries performed due to CPD.

Table 1 compares the demographic characteristics and obstetric outcomes of women with GDM to those with PGDM. There were no significant differences in mean maternal or gestational age between the two groups. Parity was also not significant between the two groups. However, women with PGDM had a significantly higher incidence of pre-eclampsia compared to those with GDM (17.2% versus 7.8%; $P = 0.022$). The incidence of preterm deliveries (25.9% versus 9.5%; $P < 0.001$) and Caesarean sections (60.3% versus 27.9%; $P < 0.001$) were also significantly higher in women with PGDM compared to those with GDM. There were no differences between the groups with regards to the incidence of other obstetric complications such as polyhydramnios, oligohydramnios or labour induction. The incidence of shoulder dystocia was the same in both groups.

Table 2: Perinatal outcomes of women with gestational diabetes and pregestational diabetes among a pregnant Omani cohort (N = 5,811)

Perinatal outcome	n (%)		*P* value
	GDM (n = 581)	PGDM (n = 58)	
Mean birth weight in g ± SD	3,166 ± 597	3,135 ± 793	0.715
Macrosomia >4,000 g	29 (4.9)	6 (10.3)	0.120
IUGR	5 (0.8)	1 (1.7)	0.436
Birth weight <2,500 g	51 (8.8)	8 (13.6)	0.231
NICU admissions	75 (12.9)	18 (31.0)	<0.001
RDS	15 (2.6)	5 (8.5)	0.028
Neonatal hypoglycaemia	9 (1.5)	4 (6.8)	0.024
Neonatal jaundice requiring phototherapy	14 (2.4)	5 (8.5)	0.022
Apgar scores <7 at five minutes	25 (4.3)	5 (8.5)	0.179
Fetal anomalies	11 (1.8)	2 (3.4)	0.333
Intrapartum IUFD	1 (0.2)	1 (1.7)	0.173
Unexplained IUFD	7 (1.2)	1 (1.7)	0.535
IUFD with malformations	3 (0.5)	1 (1.7)	0.317
Early neonatal death	1 (0.2)	1 (1.7)	0.173

GDM = gestational diabetes mellitus; PGDM = pregestational diabetes mellitus; SD = standard deviation; IUGR = intrauterine growth restriction; NICU = neonatal intensive care unit; RDS = respiratory distress syndrome; IUFD = intrauterine fetal death.

The perinatal outcomes of women with PGDM and those with GDM are compared in Table 2. There were no significant differences in mean birth weight or the incidence of macrosomia or intrauterine growth restriction between the two groups. Neonatal complications such as RDS (8.5% versus 2.6%; $P = 0.028$), hypoglycaemia (6.8% versus 1.5%; $P = 0.024$) and jaundice requiring phototherapy (8.5% versus 2.4%; $P = 0.022$) were significantly higher in babies born to PGDM women compared to their GDM counterparts. There was no significant difference in the incidence of fetal anomalies, intrapartum or unexplained IUFD, stillbirths with malformations or early neonatal deaths between the groups. More babies

born to mothers with PGDM were admitted to the NICU compared to those with GDM mothers (31.0% versus 12.9%; P <0.001). In women with GDM, obstetric and perinatal outcomes were not affected by treatment method.

The uncorrected perinatal mortality rate was significantly higher in women with PGDM compared to women with GDM (68.9 and 20.6 per 1,000 live births, respectively; P = 0.041). However, when this rate was corrected for lethal fetal malformations, the difference in perinatal mortality rates between the two groups was not significant (13.7 and 34.5 per 1,000 live births; P = 0.222).

Discussion

Pregnant diabetic women have an increased risk of developing obstetric complications such as pre-eclampsia and preterm delivery and perinatal complications such as miscarriages and fetal malformations. These complications are observed more frequently in women with PGDM compared to women with GDM; this may be due to the prolonged and severe fetal exposure to hyperglycaemia.[10,11] In the current study, the incidence of pre-eclampsia was higher among women with PGDM compared to women with GDM. These findings are in agreement with those from a recent Japanese study which reported an incidence of 10.1% and 6.1% for PGDM and GDM women, respectively (P <0.05).[11]

Cetković *et al*. noted that adverse neonatal outcomes were common among women with PGDM; macrosomia occurred in 29.6% of infants born to PGDM women in their study.[12] In contrast, the incidence of macrosomia was much lower in the current cohort of women with PGDM (10.3%) and those with GDM (4.9%). This may be due to early diagnosis, strict glycaemic control and labour induction (providing that there was no contraindication for vaginal delivery) between 38 and 40 gestational weeks.

In the current study, women with PGDM had a considerably higher occurrence of Caesarean sections and an increased risk of developing pre-eclampsia when compared to those with GDM. This may also have contributed to the higher rate of Caesarean sections among the PGDM women. Infants born to women with PGDM also had an increased rate of premature delivery (<37 gestational weeks) when compared to those born to GDM women. This may have been due to the relatively higher, but not statistically significant, incidence of polyhydramnios and fetal malformation in the PGDM group. Additionally, infants born to women with PGDM were admitted more frequently to the NICU, mainly because of RDS, neonatal hypoglycaemia and neonatal jaundice requiring phototherapy. In women with GDM, obstetric and perinatal outcomes were not affected by treatment methods. This may indicate sufficient control of blood sugar levels during treatment.

The corrected perinatal mortality rate found in the current study did not differ significantly between women with PGDM and those with GDM. However, the PGDM mortality rate was lower than that reported by other studies, with perinatal mortality rates of 111.1 and 66.2 per 1,000 live births in women with PGDM, respectively.[12,13] In comparison, a Saudi Arabian study reported a similar perinatal mortality rate for women with GDM (13.6 per 1,000 live births).[14] The relatively low GDM perinatal mortality rate observed in the current study may be due to strict glycaemic control and careful follow-up during pregnancy.

Conclusion

In the studied Omani cohort, women with PGDM had a higher risk of developing obstetric complications such as pre-eclampsia or experiencing preterm or Caesarean deliveries in comparison to those with GDM. Although the incidence of fetal complications such as RDS, neonatal hypoglycaemia and neonatal jaundice was significantly higher in women with PGDM, corrected perinatal mortality rates did not differ significantly between the two diabetic groups.

CONFLICT OF INTEREST

The authors declare no conflicts of interest.

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