Original Article

Gestational Diabetes Mellitus: A Call for Systematic Tracing

H H Tan,*MBBS, M Med, MRCP (UK), H K Tan,**FAMS, MBBS, MRCOG (UK), H S Lim,***FAMS, MBBS, M Med, A S A Tan,****FAMS, MBBS, MRCOG (UK), S C Lim,†FAMS, M Med, MRCP (UK)

Abstract

Introduction: *Women with history of gestational diabetes mellitus (GDM) have up to 50% lifetime risk of developing frank diabetes mellitus (DM). They are an ideal group of patients to implement early interventional measures to halt the progression to diabetes. The success of any early intervention programme would depend largely on postpartum follow-up. We set out to study the response rate to postpartum oral glucose tolerance test (OGTT) and to profile the non-responders on 105 women who attended our Gestational Diabetes Joint Clinic (GDJC).* ***Materials and Methods:*** *We divided these women into 3 groups according to their response to postpartum OGTT and compared their weights, glycaemic parameters and other clinical characteristics during gestation. Group A comprised non-responders or those who did not turn up for postpartum OGTT; group B comprised responders with a normal postpartum OGTT; and group C comprised responders with an abnormal postpartum OGTT defined as 2-hour plasma glucose equal or more than 7.8 mmol/L.* ***Results:*** *The non-respondent rate to postpartum diabetes screening was 37.1%. The non-responders were found to be significantly heavier, with more severe hyperglycaemia during their pregnancy (in terms of glycosylated haemoglobin and results of antepartum OGTT) and had bigger babies compared to the responders with normal postpartum OGTT. Their features instead resembled those who had failed their postpartum OGTT.* ***Conclusion:*** *The group of non-responders was probably at similar risk of developing glucose intolerance postpartum as those who were tested abnormal. A more effective call and recall system and education programme is, therefore, needed to ensure postpartum attendance of all patients with GDM.*

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Key words: Non-responders, Postpartum OGTT, Recall

Introduction

The prevalence of diabetes is increasing worldwide. In Singapore, the prevalence of diabetes has increased dramatically from 4.7% in 1984 to 8.6% in 1998.[1] Diabetic complications lead to a significant number of patients with blindness, amputations and end-stage renal failure annually. Diabetes mellitus accounts for almost one-tenth of all deaths in Singapore.[2] Effective primary prevention programmes for type 2 diabetes are, therefore, urgently required to lessen this clinical and economic health burden.

Gestational diabetes mellitus (GDM) is a prediabetic state; it identifies premenopausal women at risk for diabetes, predominantly type 2 diabetes. Women with history of GDM have a 17% to 63% risk of non-gestational diabetes within 5 to 16 years after the index pregnancy.[3] GDM is also the most common medical complication and metabolic disorder of pregnancy. Our local incidence of GDM has been reported to be from 1.3% to 13.1%, dependent very much upon the diagnostic criteria used and the study cohort.[4] Women with GDM, therefore, form a sizeable portion of our population who could potentially benefit from well-structured primary diabetes prevention programmes.

These women are an ideal group of patients to implement early intervention measures to halt the progression to diabetes. They have received nutritional counselling and are experienced in maintaining normal blood glucose levels. They are also by selection, mothers of young families, often responsible for the shopping and the preparation of the family meals. The potential for delaying or preventing diabetes in both mothers and offspring represents an opportunity to reduce morbidity and consequent health care costs.

The evidence for the efficacy of behavioural intervention programme in delaying the onset of type 2 diabetes amongst patients with impaired glucose tolerance (IGT) has been

* *Registrar*
*** *Senior Consultant*
† *Consultant*
Department of Endocrinology, Singapore General Hospital
** *Consultant*
**** *Senior Consultant*
Department of Obstetrics and Gynaecology, Singapore General Hospital
Address for Reprints: Dr Tan Hwee Huan, Department of Endocrinology, Singapore General Hospital, Outram Road, Singapore 169608.
E-mail: gecthh@sgh.com.sg

quite encouraging so far. The DaQing Study reported a 30% 6-year reduction in the progression of IGT to type 2 diabetes in Chinese men and women adopting a low fat, high carbohydrate diet with or without the addition of exercise.[5]

However, no matter how excellent a prevention programme may be, its success depends largely upon the extent of patients' participation in the programme. With this in mind, we analysed our database of 105 GDM patients collected over 3 years to determine:

1. our patients' response to the prescription of 6-week postpartum oral glucose tolerance test (OGTT) and
2. antepartum characteristics in terms of clinical and metabolic parameters that may differentiate the non-responders from the responders.

Materials and Methods

The Singapore General Hospital is a 1600-bedded tertiary acute hospital with a weekly Gestational Diabetes Joint Clinic (GDJC). Women with pregestational and GDM are routinely referred to the GDJC for management. In this hospital, only high-risk patients would be screened routinely for diabetes during the 24th to 28th week of gestation. These include patients who are obese [body mass index (BMI) $\geq$30kg/m^2], with a past history of unexplained intrauterine death, big babies (with birth weight $\geq$4 kg), GDM, a family history of diabetes and mothers older than 35 years of age. Antepartum OGTT may be done even earlier if the patient presents with significant glycosuria on routine screening.

We performed a retrospective analysis on the GDJC database for data collected between 1996 and 1998. Of a total of 178 names on the database, only the casenotes of 135 patients were retrievable. The reasons for the missing casenotes included wrong identification numbers and casenotes culled by the medical records office. Of these, patients who were diabetic prior to pregnancy and those who eventually delivered elsewhere were excluded. The final analysis was performed on the data available from 105 patients. The demographic characteristics (age and ethnic distribution) of the excluded cohort were similar to the final study cohort.

These patients were divided into 3 groups according to the outcome of their postpartum OGTT:

Group A: women who defaulted their postpartum OGTT (non-responders);

Group B: those who responded and had a normal post-partum OGTT; and

Group C: those who responded but had an abnormal OGTT (defined as 2-hour plasma glucose equal or more than 7.8 mmol/L).

Both clinical and metabolic parameters that included age, body mass index (BMI), parity, glycaemic status during pregnancy and infant outcome were analysed. Data were analysed using SPSS program version 7.5 (Chicago IL). A one-way analysis of variance (ANOVA) or analysis of covariance (ANCOVA) was used to compare the means of continuous data and a post-hoc pair-wise comparison was done with Tukey's test. χ^2 analysis was used for categorical data. *P* values less than 0.05 were considered significant and data were expressed as means ± SE.

Results

Table I shows the characteristics of the 3 groups of GDM patients seen at our GDJC.

The mean age of our study cohort was 33.5 ± 4.8 years and there was no statistical difference in mean age amongst the 3 groups. The racial distribution of the study cohort was 55.2% Chinese, 35.2% Malays and 9.5% Indians. There were 39 non-responders (group A), 49 responders with normal postpartum OGTT (group B) and 17 responders with abnormal OGTT (group C). Of the patients from group C, only 5 were diabetic (29%); the rest had IGT. Of those 5 diagnosed of DM, 4 required insulin during pregnancy. All the patients from group C were continued on dietary management alone after delivery. The non-respondent rate was 37.1%; the majority of the non-responders were Malays. The number of previous live births (parity) of group A was not significantly different from group B but the patients from group A had significantly more children compared to group C.

The BMI at the time of OGTT of the patients in group A was similar to that of group C, although there was a statistically significant difference between groups A and B. The patients in group A were clearly heavier than those in group B.

The difference in the mean gestation at booking for all the 3 groups of patients did not reach statistical significance; with a median of 14 weeks, ranging from the 5th to 34th week of gestation. The difference in the timing of OGTT done during gestation between groups A and C was found to be statistically significant. Eighteen patients were booked in after the 24th week of gestation; of these, 44% belonged to group A.

Most of the antepartum OGTT of patients from groups A and B were done between the 23rd and 24th week of gestation. Patients in group C were mostly diagnosed before the 23rd week of gestation. The most common indication for an OGTT for the patients from group A was having a past history of GDM. This was followed closely by having a family history of diabetes and glycosuria. The most common indication for OGTT for the other 2 groups was glycosuria. The patients from group C were screened earlier because of the detection of glycosuria early on in their pregnancy. The mean fasting blood glucose (G0) of group A was higher than that of groups B and C, although

TABLE I: COMPARISON OF THE CLINICAL CHARACTERISTICS OF THE 3 GROUPS OF PATIENTS

Clinical characteristic	A	B	C	A vs B	A vs C	B vs C
No.	39	49	17			
*Ethnicity (%)						
Chinese	31	65	82			
Malay	51	29	18			
Indian	18	6	0			
Mean age at delivery (y)	32.8 ± 1.4	33.8 ± 1.4	34.0 ± 1.0	ns	ns	ns
Body mass index at OGTT (kg/m^2)	29.3 ± 1.6	25.8 ± 1.7	27.0 ± 1.3	0.015	ns	ns
Mean parity	1.7 ± 0.3	1.1 ± 0.4	0.8 ± 0.3	0.091	ns	ns
Mean gestation at booking (weeks)	16.7 ± 2.2	16.1 ± 2.3	12.0 ± 1.7	ns	ns	ns
Mean gestation at OGTT (weeks)	23.4 ± 2.0	23.8 ± 2.0	17.5 ± 1.5	ns	0.014	0.006
Antepartum OGTT						
Mean blood glucose at 0 hour (G0)	6.1 ± 0.4	5.1 ± 0.5	5.5 ± 0.3	0.010	ns	ns
1 hour (G1)	11.7 ± 0.8	10.1 ± 0.8	11.0 ± 0.6	0.024	ns	ns
2 hour (G2)	10.7 ± 0.8	9.3 ± 0.8	10.3 ± 0.6	0.049	ns	ns
HBA1c at presentation (%)	5.73 ± 0.2	5.26 ± 0.3	5.59 ± 0.2	0.030	ns	ns
Mean gestation at first visit to GDJC (weeks)	27.5 ± 2.1	30.0 ± 2.1	23.1 ± 1.5	ns	ns	0.004
Mean maximum insulin used (U/kg)	0.52 ± 0.1	0.46 ± 0.2	0.52 ± 0.1	ns	ns	ns
Mean gestation at delivery (weeks)	38.1 ± 0.7	38.5 ± 0.7	35.8 ± 0.5	ns	0.003	0.001
*Infant birth weight (kg)	3.32 ± 0.2	3.21 ± 0.2	2.67 ± 0.1	ns	0.004	0.020
†Infant birth weight ≥4 kg (%)	50	37.5	12.5			

NS: not significant; OGTT: oral glucose tolerance test;
Data presented as mean ± standard error
*Analysis done with adjustment for gestation age via ANCOVA; †Analysis done by χ^2 test was statistically significant

the difference only reached statistical significance when compared with group B. This was also the trend seen for the mean blood glucose measured at the first hour (G1) and at the second hour (G2) of the antepartum OGTT. The mean HbA1c of group A was also statistically higher than that of group B but comparable to that of group C. Majority of the patients were managed on diet alone; only a quarter of the cohort required insulin during their pregnancy. The daily dose of insulin used during the pregnancy ranged from 0.19 U/kg to 1.21 U/kg; there was no statistical difference found amongst the 3 groups. The rates of insulin usage for the 3 groups (A, B and C) were 21%, 24% and 35%, respectively. None of the patients required continued use of insulin after delivery.

Referrals to our GDJC were more often made towards the last trimester of the pregnancy, with a median of 30 weeks, ranging from the 9th to the 39th week of gestation. Patients from group C were seen earlier at the GDJC compared to the other 2 groups.

Ninety-nine per cent of the patients delivered before the 40th week of gestation. There were only 9 deliveries before the 35th week of gestation; of which 5 were from group C. There were 3 twin pregnancies in this cohort; 2 from group B and 1 from group C. Most of the infants were delivered vaginally. Assisted instrumental delivery was found in 26% in group A, 49% in group B and 53% in group C. Infant complications at delivery recorded in this study included intrauterine growth retardation, prematurity, babies weighing more than 4 kg, renal abnormalities and shoulder dystocia. Information on the incidence of neonatal jaundice was not available from our database. The infant complication rates in the 3 groups were 18%, 6% and 50%, respectively. There were only 8 big babies (i.e. babies with birth weight ≥4 kg); of these, half of them were infants from group A.

Discussion

There were several observations made in this study. Firstly, less than 70% of the GDM patients actually returned for postpartum OGTT. This would be considered a moderate rate, keeping in mind that some studies have reported no show rates of up to 50%.[6,7] There was a previous local study that reported a default rate of 24%; there was no mention of attempts at recall in this study.[8]

Secondly, group C, the group of patients whose postpartum OGTT remained abnormal, as may be expected, faired the worst in terms of glycaemic status during pregnancy and foetal outcome. Only 5 remained diabetic and they were placed on diet control alone. Some antepartum risk factors for predicting postpartum glucose intolerance have been well established in a number of studies; these

include ethnicity, pre-pregnancy weight, age, parity, degree of hyperglycaemia during the pregnancy and a diagnosis of GDM before 22nd week of gestation.[7, 9-11] The risk factors that were present in our patients were higher BMI, poorer glycaemic profile and an earlier diagnosis of GDM.

Thirdly, most of the non-responders to postpartum OGTT (patients from group A) shared similar features to group C and were distinctly different from those of group B. Compared to group B, they were heavier, were more severely hyperglycaemic during pregnancy and had bigger babies at birth. These features would probably place them at similar if not higher risk of developing postpartum hyperglycaemia. These patients were mostly multiparous with a previous history of GDM and booked late in pregnancy. It would be useful to know if socio-economic status play a part in the aforementioned observations.

There was a surprisingly high percentage of Malays in group A. It may be too presumptive to assume that cultural difference is the key factor to the high incidence of no-show amongst the Malays. The prevalence of diabetes in Malay women has been found to be significantly higher than that of Chinese women but similar to that of Indian women.[1] With the increasing prevalence of diabetes in our population, it is only prudent that this group of women, in particular, be counselled during their pregnancy on the importance of postpartum diabetes screening.

Finally, although uncomplicated GDM has not been associated with increased perinatal mortality, GDM increases the risk of foetal macrosomia and other neonatal morbidities.[12] With the mean infant complication rate of almost 18% in this study, one would wonder if this rate could be reduced had the diagnosis of GDM been made earlier and appropriate management instituted thereafter. It is quite worrying to observe that the infant complication rate of the non-responders was almost 3 times that of those who had normal postpartum OGTT.

Most health policy makers probably realise that women with history of GDM are an ideal group of patients to implement early preventive measures. Unfortunately, once these women deliver and leave the hospital, the opportunity to potentially prevent subsequent development of DM may have been missed. This study is probably the first ever to be written on with its focus on non-responders to postpartum OGTT. The observations made from this study that the non-respondents had many similarities with those who failed the postpartum OGTT and were quite distinct from those who passed, impel one to wonder if the group of non-responders would be the ones to benefit the most from any screening programme.

Diabetes mellitus is a major health and economic issue worldwide including Singapore. It has been calculated that if one were to delay type 2 diabetes by 6 years and then initiate treatment at its onset, the lifetime risk of sight-threatening retinopathy would be reduced by 65%.[13] For a nation like the United States of America, it has also been estimated that US$179 million would be saved over a 10-year period if it would embark on a plan of primary prevention targeted at reducing the conversion to diabetes by 5% annually.[14] The observations made in this study serve to render strong support for antepartum counselling and an effective postpartum recall system, especially in places where no-response rate is high. Given the high metabolic risk profile of our non-responders, such a proactive system would most likely be cost-effective.

Conclusion

Our no-response rate to postpartum diabetes screening was 37.1%. Our group of defaulters of postpartum OGTT is probably at similar, if not higher, risk of developing glucose intolerance postpartum as those who were tested abnormal. A more effective call and recall system and education programme is, therefore, needed to ensure postpartum attendance of all patients with GDM.

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