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The Glucose Challenge Test for Screening Gestational Diabetes in Pregnant Women with No Risk Factors

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ABSTRACT

Aim of study: To evaluate the 50g glucose challenge test as a screening tool for gestational diabetes in pregnant women with no risk factors, to determine the prevalence of gestational diabetes in this population and to determine the perinatal outcomes of pregnancy according to the glucose challenge test.

Methodology: A descriptive prospective study. A total of 146 patients with no risk factors who booked a particular obstetrician and delivered between May 1996 and April 1997 were recruited. Pregnancy outcomes were assessed by the gestation and mode of delivery, neonatal outcomes included birth weights, apgar scores and other neonatal complications.

Results: The detected incidence of gestational diabetes was 8.2%. With the threshold plasma glucose level at 7.1 mmol/l, 53 women or 36% needed to undergo the 75g oral glucose tolerance test and 12 women were found to have gestational diabetes. The diagnostic yield was 22.6%. With 7.8 mmol/l as the threshold value, 28 women or 20% needed the oral glucose tolerance test and eight women with gestational diabetes were detected. The diagnostic yield was 28.6%. Perinatal outcome for these diabetic women who were well-controlled during pregnancy was similar to the rest of the women with normal glucose challenge test.

Conclusions: The 50g glucose challenge test is a useful screening test for diabetes in Singaporean women with no risk factors. A threshold value at 7.8 mmol/l with a smaller number of women requiring the 75g oral glucose challenge test may be more acceptable.

Keywords: Glucose challenge test, gestational diabetes

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INTRODUCTION

Gestational diabetes (GDM) is defined as carbohydrate intolerance of variable severity with onset or first recognition during the current pregnancy and with glucose tolerance reverting to normal after the puerperium[1]. In Singapore the reported incidence of GDM ranges from 1.1% to 13.3% of the population[2]. The prevalence is increasing as more women are working and delaying starting a family.

GDM represents a high risk factor in pregnancy. It is associated with an increase in both diabetic and pregnancy related complications[3]. These complications include an increase incidence of ketoacidosis, progression of vasculopathy, pre-eclampsia, urinary and genital tract infections, intrauterine growth retardation, macrosomia, polyhydramnios and sudden intra-uterine death. They are also at risk for developing glucose intolerance later in life[4,5] and it has been reported that 50% of these patients will become diabetic in the 15 years following pregnancy[6]. The newborns are likely to suffer birth trauma because of macrosomia, neonatal hypoglycaemia, respiratory distress syndrome and congenital abnormalities. Thus lies the importance of screening for GDM, for this allows for early initiation of appropriate therapy which remains the cornerstone of management of GDM.

The oral glucose tolerance test (OGTT) has been the gold standard for diagnosis of diabetes mellitus. In Singapore, we have adopted the WHO definition using the 75g OGTT. Traditionally, only women with positive historical and clinical risk factors are screened for GDM and subjected to the OGTT. However, due to the relatively low sensitivity and specificity of the screening criteria, this results in almost 40% of patients with GDM left unidentified[7-9]. Furthermore, most obstetricians are not convinced that pregnant women with no risk factors require screening. Thus, this study was designed with the following aims:

1. To determine the feasibility of using the 50g GCT for all pregnant women with no risk factors.
2. To determine the proportion of women with no risk factors who would need to be subjected to the

OGTT and to determine the incidence of GDM in this population.

3. To compare the obstetric and perinatal outcome between those found to have a normal GCT result, those with an elevated GCT level and those subsequently found to have gestational diabetes.

MATERIALS AND METHODS

Between May 1996 and April 1997, all antenatal patients who booked a particular consultant obstetrician in the Singapore General Hospital and who had no risk factors were included in the study. Women with the following risk factors for GDM were excluded:

- A history of diabetes in a first-degree relative
- Bad obstetric history
- Recurrent abortions
- A previous baby weighing 4 kg or more
- A previous unexplained intrauterine death or early neonatal death
- Congenital abnormality in a previous pregnancy
- Maternal weight of greater than 80 kg at booking
- Glycosuria on two or more occasions
- Macrosomia
- Polyhydramnios
- Multiple pregnancy

These patients had the 50g GCT done between 24 and 28 weeks of gestation or at booking if they booked after 28 weeks of gestation. A 50g glucose drink was administered after the antenatal consultation and venous blood drawn for plasma glucose estimation after 60 minutes. Plasma glucose levels were determined by the glucose oxidase method.

A plasma glucose level of 7.1 mmol/l or higher was considered a positive test and these women underwent a formal 75g OGTT. Using the WHO criteria, a diagnosis of GDM was made if the second hour plasma glucose level was greater than 7.8 mmol/l.

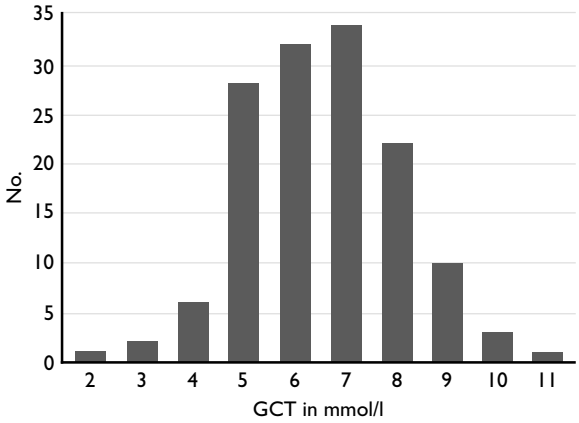
All patients who were found to have GDM were referred to a dietician and jointly managed by an endocrinologist and an obstetrician. They were put on a 1800 kilocalorie diet and started on insulin when indicated. For those women whose sugar levels were well controlled on diet, pregnancy was allowed to progress to spontaneous labour, while for those women who required insulin therapy, pregnancy was terminated at 39 weeks of gestation.

After delivery, all infants of diabetic mothers were assessed for congenital malformations, hypoglycaemia and other electrolyte and respiratory disorders. The outcome of the pregnancies was assessed by the gestation and mode of delivery and neonatal outcomes in terms of birth weights, apgar scores, congenital abnormalities, hyperbilirubinaemia, hypoglycaemia or respiratory distress syndrome. All parameters were tested for significance in the differences between the study groups by the chi-square test or the kruskal-wallis one-way anova.

Table I: Classification of patients according to GCT and OGTT results.

Group A	N = 93	GCT < 7.1 mmol/l
Group B	N = 41	GCT ≥ 7.1 mmol/l and OGTT < 7.8 mmol/l
Group C	N = 12	GCT ≥ 7.1 mmol/l and OGTT ≥ 7.8 mmol/l

Fig. 1 Result of 50g GCT.



RESULTS

A total of 146 women with no risk factors were screened antenatally with the 50g GCT. Of these, 53 women were found to have a 50g GCT value of greater or equal to 7.1 mmol/l. They were recalled for a formal OGTT and 12 women were found to have GDM.

For analytical purposes, the patients were grouped into three groups according to their GCT and OGTT results to determine if there were any significant differences with respect to their patient profiles, epidemiological characteristics, pregnancy and neonatal outcomes as shown in Table I.

The results of the 50g GCT are shown in Fig. 1.

The ages of the study group ranged from 19 to 40 years. The mean ages for the patients in groups A, B and C were 27.7 years, 28.7 years and 29.8 years respectively. The differences were not significant. ($p = 0.13$)

The second hour of the postprandial value of the 12 women in group C ranged from 7.9 to 12.1 mmol/l. In general, their diabetic control was all within the target range and their HbA_{1c} values ranged from 4.8% to 6.7%. Only two patients needed insulin therapy.

Table II: Epidemiological characteristics and obstetric outcome of groups A, B and C.

	A	B	C	P value
Median body mass index	25.8 (17-70)	25.7 (18-33)	25.8 (19-32)	0.26
Median gestation at delivery in weeks	39 (31-41)	39 (36-41)	38 (37-41)	0.19
Mode of delivery				0.08
– Normal vaginal delivery	69	24	6	
– Assisted vaginal delivery	8	9	3	
– Elective lower segment caesarean section	6	3	1	
– Emergency lower segment caesarean section	10	5	2	
Median birth weight in grams	3140 (1450-4100)	2975 (2445-4360)	3422 (2300-3810)	0.60

There were no significant differences between the three study groups with respect to body mass index, gestation at delivery, mode of delivery and birth weight and the p values were 0.26, 0.19, 0.08 and 0.60 respectively. (See Table II)

Anaemia was the most common antenatal complication encountered affecting 18 pregnancies, preterm contractions occurred in four pregnancies, three pregnancies had pre-eclampsia, two pregnancies had premature rupture of membranes and oligohydramnios was present in one pregnancy. The commonest indication for caesarean section was cephalopelvic disproportion which occurred in 10 pregnancies while breech with an inadequate pelvis accounted for eight caesarean sections.

In general, the neonatal outcome was good. The median apgar scores for all the three study groups were 8 at one minute and 9 at five minutes. None of the babies had hypoglycaemia. One baby was found to have hypophosphataemia and another developed neonatal jaundice. There was a case of congenital heart disease, ventricular septal defect associated with patent ductus arteriosus that was not detected in the antenatal period. The mother had GDM that was well controlled on diet.

All 12 women with GDM were scheduled for an OGTT at six weeks postnatal. Only seven women kept their appointments and one woman was found to be diabetic. Her second hour postprandial glucose level was 8.3 mmol/l.

DISCUSSION

GDM is a well established risk factor in pregnancy and there are clear benefits to be derived by effective screening and treatment. In our hospital GCT is not routinely done on all pregnant women. The current policy is to screen women with historical and clinical risk factors for GDM using the 75g OGTT. However, the cohort of patients referred from the polyclinics have routine GCT performed. Morever, few studies have been done locally to determine the prevalence of GDM in our local Asian population and to determine the feasibility of such a screening programme. We hope that our results will provide some useful information.

1. **To determine the feasibility of using the 50g GCT to all pregnant women with no risk factors.**
   The 50g GCT is a simple, cheap and convenient test. It does not require a patient to be fasted and can be easily organised after the consultation. Apart from the occasional nausea, it does not bother the patient very much. Most of our pregnant women did not object to the test when the protocol was explained. None complained about nausea or vomiting.

2. **To determine the proportion of women with no risk factors who would need to be subjected to the OGTT and to determine the incidence of GDM in this population.**
   Of the 146 women who underwent the 50g GCT, 53 women were found to have an elevated level greater or equal to 7.1 mmol/l and 12 women were found to have GDM. The incidence of GDM was 8.2% and the diagnostic yield was 22.6%.

   Approximately one in five women with an elevated GCT and no risk factors were found to have GDM. As the threshold values were gradually increased, the proportion that needed to undergo the OGTT and the diagnostic yield is as shown in Table III.

   The pioneering studies of O'Sullivan and Mahan first started in 1964[10]. In 1973, O'Sullivan et al[11], proposed that a single sample of glucose tolerance done without dietary preparation could provide an acceptable screening compromise. Thus came about the 50g GCT. Based on their study involving a total of 19,798 women, O'Sullivan reported a sensitivity of 79% and specificity of 87% using a threshold value of 130 mg/dl whole

blood (or 7.9 mmol/l plasma). Based on his study, OGTT done for positive historical or obstetrical risk factors yielded poor results with a sensitivity rate of 63% and specificity rate of 56%.

Our results are similar to two studies that were also conducted in Singapore by Chua[12] and Ray[13]. It can be realised that the incidence of GDM among Singaporean women with no risk factors is not small and cannot be ignored.

There is disagreement on the most appropriate threshold value for the 50g GCT. Cousins[14], favoured a cut-off of 130 mg/dl (7.2 mmol/l) while Carpenter[7], suggested the threshold value be set at 135 mg/dl (7.5 mmol/l).

When the threshold was set at 7.1 mmol/l, we discovered that one third of the population would need to be further tested with the OGTT and the diagnostic yield was 22.6%. For economic reasons, we recommend that the threshold be taken at 7.8 mmol/l. At this threshold value, only one fifth of the screened population needs to undergo the OGTT. The diagnostic yield is high at 28.8%, with one in three being found to have GDM.

3. To compare the obstetric and perinatal outcome.

We sought to compare the epidemiological data between the three groups A, B and C to determine if there were any epidemiological risk factors significantly associated with a raised GCT or OGTT result. Some local studies[13], have suggested that older age, Chinese ethnic group and maternal obesity were factors that were significantly and independently associated with raised GCT levels. Our results however showed that there were no statistical differences with respect to age, race and body mass index between the three groups.

Comparison of the pregnancy outcomes among the three groups A, B and C and analysis of the respective gestations at delivery, mode of delivery, birth weights and apgar scores did not show any statistical differences among the three groups. Thus, the pregnancy outcome for group C, the group with GDM was comparable to the other two groups which were apparently normal pregnancies.

Similarly, the neonatal outcome was comparable to that of the general population except for one isolated case of congenital heart disease. The mother of that infant had mild GDM which was well controlled on diet. The cause for the congenital heart disease is probably multifactorial in origin.

In general, the excellent perinatal outcome could partly be attributed to the vigilant monitoring and maintenance of euglycaemia instituted upon diagnosis of GDM.

Table III: The diagnostic yield and proportion of women that would need to undergo the OGTT depending on the different threshold value of the GCT.

Threshold value (mmol/l)	Proportion that would be subjected to the OGTT	Diagnostic yield
7.1	36% (53/146)	22.6% (12/53)
7.3	32% (47/146)	25.5% (12/47)
7.5	27% (39/146)	25.6% (10/39)
7.8	19% (28/146)	28.6% (8/28)

CONCLUSIONS

The 50g GCT when performed on a low risk population appeared to be a feasible and acceptable screening test. It is simple, convenient, cheap and easy to organise in the outpatient setting. It was well tolerated by all the patients. Screening with the GCT was helpful in overcoming the low sensitivity rates associated with historical or obstetrical risk factor screening.

The detected incidence of GDM in our study population was 8.2%. A suitable threshold value needs to be established taking into consideration the economic and cost implications of such a screening programme. We recommend that the threshold value be set at 7.8 mmol/l because only one-fifth of the population would need to undergo the OGTT and the diagnostic yield was 28.8%.

There were no statistical differences found among the three groups in terms of the perinatal and obstetric outcome. Today, the strict blood glucose control and closer antenatal supervision have resulted in obstetric outcome and perinatal morbidity and mortality to be similar to that of the general population. In view of these excellent results, the prime emphasis in the management of GDM should be focused on the early detection of GDM.

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