Screening for gestational diabetes by measuring fasting plasma glucose levels

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ABSTRACT. Objectives: (a) To test the sensitivity and specificity of measuring fasting plasma glucose levels (FPG) as a screening test for gestational diabetes mellitus (GDM). (b) To compare predicting levels of FPG levels with the one-hour, oral 50g non-fasting glucose challenge test (GCT) for predicting GDM. Methods: One thousand and six hundred pregnant women from the Health Centres, antenatal clinics and Salmaniya Medical Complex were screened by the GCT after 50g of oral glucose during 26–32 weeks gestation, giving a 13.5% incidence of GDM (using the Third International Workshop cutoff values of 7.8 mmol/l). All patients also had an FPG estimation followed by the three-hour oral glucose tolerance test (oGTT). Seventy eight percent of the patients were Bahraini, 19% Asian and 3% other nationalities. Their mean age was 27.2±0.2 years. Receiver-operating curves (ROC) were used to test the ability of the FPG and the oGTT to differentiate patients of GDM (using the Third International Workshop cutoff values of 7.8 mmol/l). All patients also had an FPG estimation followed by the three-hour oral glucose tolerance test (oGTT) in cases of a positive screen which includes fasting plasma glucose levels (FPG). Because of the complexity of this test (which requires prior appointments, ingestion of oral glucose, prolonged waiting time and ever increasing costs and pressure on an already over-stretched laboratory service), a search for an easier and less expensive method has been studied.

In 1997, the American Diabetic Association⁵,⁶ announced new criteria for screening diabetes in non-pregnant patients by measuring a fasting plasma glucose
level (FPG) instead of the oral glucose tolerance test (oGTT). Between 1999 and 2001, progressive population studies by Peruccini et al in Switzerland, Agarwal from the UAE and Aguiar from Brazil have reported successes in the screening of pregnant women for GDM using the measurement of lower FPG levels.

Our study aimed at evaluating the sensitivity and specificity of using FPG as a screening test for GDM compared to the 50g non-fasting glucose challenge test (GCT).

**METHODS**

With the purpose of determining a FPG value with good sensitivity and specificity that could identify pregnant women with GDM, we conducted a study between 1st January and 31st May 2002 in which 1,600 pregnant women were screened by GCT followed by oGTT. These women were drawn from outpatients and inpatients in Salmaniya Medical Complex, the major referral hospital in Bahrain. All patients who were diagnosed to have GDM (by GCT testing) had undergone the 75g oGTT which includes the FPG. The major ethnic distribution of the study was 78% Bahrainis, 19% Asians and 3% from other nationalities. The mean age distribution was 27.2 ± 0.2 years, ranging from 17–48.

We analysed the data using the Med/Calc statistical package. A receiver-operating characteristics (ROC) curve was constructed in order to compare the ability of the FPG against the GCT in discriminating patients with a diagnosis of GDM, and to determine the best cut-off value for FPG levels, which would have the best predictive value for need of oGTT.

**RESULTS**

The incidence of GDM among the cohort of pregnant women in this study who had undergone the GCT followed by oGTT during 26–32 weeks of gestational age was 217 (13.5%) [Figure 1]. Analysis of the results of the GCT group was carried out and is reported in Table 1. Table 2 shows the analysis of the results of those tested with the FPG.

Figures 2 and 3 show the FPG level sensitivities and specificities of 94% and 93% respectively, along with the false positives encountered. The area under the curve in Figure 3 is 0.962 for FPG. The true positive rates (sensitivity) versus false positive rates (specificity) are plotted for determination of the cut-off value.

**DISCUSSION**

Gestational diabetes mellitus (GDM) is defined as any degree of glucose intolerance with onset or first recogni-
the use of the 50g GCT resulted in a higher yield of a 13.5% rate for GDM. Currently, approximately 900–1200 pregnant women are diagnosed annually to have GDM. The prevalence may range from 7% to 14% of all pregnancies based on the ethnic group studied and the diagnostic criteria employed.

In Bahrain’s Government antenatal clinics, the screening test currently used is the 50g GCT, performed between 26–32 weeks of gestation. This test involves a prior appointment, ingestion of glucose, nausea after the drink, a waiting time of one hour, and an ever increasing number of patients. More than 30% of those tested would eventually require a full oGTT. To explore new ways for reducing this burden on the laboratory, we should consider a test that is less expensive, more efficient, and more specific. The other option would be the return to clinically selective criteria for patient screening. Obviously, the first choice is more attractive.

In 1997, the American Diabetic Association announced new diagnostic criteria for diabetic screening, abolishing the use of oGTT, and shifting diagnosis exclusively to the use of fasting glucose. In 1998, Ramachandran et al published a paper on using the new diagnostic criteria in an Asian population, suggesting the use of fasting glucose level as a screening technique.

**Table 2. Analysis of the results of the glucose challenge test group using a receiver operating characteristics curve**

<table>
<thead>
<tr>
<th></th>
<th>Group</th>
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<tbody>
<tr>
<td>Positive Group</td>
<td>217</td>
<td></td>
</tr>
<tr>
<td>Negative Group</td>
<td>1383</td>
<td></td>
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<tr>
<td>Area under ROC Curve</td>
<td>0.964–0.988</td>
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<tr>
<td>Sensitivity at 5.4</td>
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<tr>
<td>Specificity</td>
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<tr>
<td>Positive likelihood ratio</td>
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<tr>
<td>Negative likelihood ratio</td>
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**Figure 2. Sensitivity and specificity of fasting plasma glucose in detecting gestational diabetes mellitus**

**Figure 3. Receiver operating characteristics (ROC) curve of fasting plasma glucose concentration.**
test for diabetes. There was some criticism to the use of fasting glucose instead of oGTT, based on observational studies of long term morbidity of GDM, showing that the glucose level is more accurate than fasting glucose levels in predicting future morbidity.14,15

The use of fasting blood sugar does not carry the same disadvantages, and will not obviate the need for a full GFT if this should be deemed necessary. A few studies on the use of fasting glucose levels in pregnancy have since been published, pointing to the favourable use of FPG as a screening test in obstetrics.16–19

In our series we utilized the receiver-operating curve to test the ability of the fasting plasma sugar and oGTT to identify patients with GDM and find out the cut off value which predicts a GDM diagnosis. Fasting plasma glucose levels at 5.6 mmol/l yielded sensitivity and specificity of 94% and 93% respectively. When fasting plasma glucose was used, 13% of the positives required further testing while 32% needed this when the glucose challenge test was used.

FPG at a value of 5.5 mmol/l is an easier, more acceptable test for patients compared with the 50g glucose challenge test. Using the FPG is more cost effective and allows 70% of women to avoid the challenge test. Future collaborative studies, pregnancy outcomes, and meta-analysis will answer all the questions related to the validity of this test.

CONCLUSION

Using fasting plasma glucose levels at cut off values of \( \geq 5.5 \text{ mmol/l (99 mg/dl)} \) as the higher FPG threshold to rule out GDM with a specificity of 95% is an easier, more acceptable test for patients than the 50g glucose challenge test. The fasting blood level test is more cost effective and allows 70% of women to avoid the challenge test. Furthermore, 13% more cases of GDM were diagnosed using the FPG criteria compared to the glucose challenge test.

REFERENCES