

Response to fifty grams oral glucose challenge test and pattern of preceding fasting plasma glucose in normal pregnant Nigerians

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Abstract

Background: Diabetes mellitus in pregnancy has profound implications for the baby and mother and thus active screening for this is desirable.

Method: Fifty grams oral glucose challenge test was administered after obtaining consent to 222 women in good health with singleton pregnancies without diabetes mellitus at 24 to 28 weeks gestation after an overnight fast. Venous blood sample was obtained before and 1 hour after the glucose load. A diagnostic 3-hour 100 g oral glucose tolerance test was subsequently performed in all.

Results: Two hundred and ten women had a normal response to oral glucose tolerance test i.e. venous plasma glucose below these cut-off levels: fasting 95 mg/dl (5.3 mmol/l), 1 hour 180 mg/dl (10.0 mmol/l), 2 hours 155 mg/dl (8.6 mmol/l) and 3 hours 140 mg/dl (7.8 mmol/l), while 12 were found to have gestational diabetes mellitus and were subsequently excluded from the study. They were appropriately managed. The mean maternal age was 30.9 ± 4.1 years (range 19 to 45 years) and the mean parity was 1.2 ± 1.1 (range 0 to 5). The mean fasting plasma glucose was 74.5 ± 11.5 mg/dl (range 42 to 117 mg/dl), while the mean plasma glucose 1 hour after 50 g glucose challenge test was 115.3 ± 19.1 mg/dl (range 56 to 180 mg/dl).

Conclusions: The mean fasting plasma glucose in normal pregnant Nigerians was 74.5 ± 11.5 mg/dl (range 42 to 117 mg/dl). There is a need to re-appraise and possibly review downwards the World Health Organization fasting plasma glucose diagnostic criteria in pregnant Nigerians for better detection of gestational diabetes mellitus. Pregnant women with venous plasma glucose greater than 153.5 mg/dl (8.5 mmol/l) 1 hour after 50 g glucose challenge test are strongly recommended for diagnostic test of gestational diabetes mellitus.

Keywords

Fifty grams oral glucose challenge test, fasting plasma glucose, normal pregnant Nigerians

Introduction

Gestational diabetes mellitus (GDM) defined as glucose intolerance with onset or first recognition during pregnancy occurs in 2% to 5% of all pregnancies.¹ Diagnosis of GDM is either by the two-step 100 g 3-hour oral glucose tolerance test (OGTT) endorsed by the National Diabetes Data Group (NDDG) or the one-step 75 g 2-hour OGTT endorsed by the World Health Organization (WHO).² In either of the two, fasting plasma glucose plays a crucial role in the diagnosis. In the WHO (1999) criteria,³ venous plasma glucose of ≥ 7 mmol/l (126 mg/dl) fasting and 2 hour value after OGTT of ≥ 11 mmol/l (200 mg/dl) is diagnostic. The NDDG criteria require at least two venous plasma to meet or exceed the following: 105 mg/dl (5.8 mmol/l) fasting, 190 mg/dl (10.6 mmol/l) at 1 hour, 165 mg/dl (9.2 mmol/l) at 2 hours and 145 mg/dl (8.1 mmol/l) at 3 hours, while the Carpenter and Coustan's modification requires fasting 95 mg/dl (5.3 mmol/l), 1 hour 180 mg/dl (10.0 mmol/l), 2 hours 155 mg/dl (8.6 mmol/l) and 3 hours 140 mg/dl (7.8 mmol/l).⁴ This modification has been noted to result in the identification of 68.9% more patients with GDM when compared with the NDDG criteria.⁵

Fasting hyperglycemia (>105 mg/dl or >5.8 mmol/l) may be associated with an increase in the risk of intrauterine death especially during the last 4 to 8 weeks of gestation.⁶ It is therefore necessary to ensure normoglycemia to forestall this dreaded perinatal outcome. Screening for GDM based on 50 g 1 hour glucose challenge test (GCT) is usually performed at 24 to 28 weeks gestation. A glucose threshold value ≥ 140 mg/dl (7.8 mmol/l) identified about 80% of women with GDM and the yield is further increased to 90% by using a cut off of ≥ 130 mg/dl (7.2 mmol/l).⁷ With either of these thresholds for an abnormal screen, diagnostic criteria is by the 100 g OGTT derived from the original work of O'Sullivan and Mahan adopted by the NDDG or the modification by Carpenter and Coustan.^{4,6} Alternatively, the diagnosis can be made using the 75 g OGTT,³ however, this test is not as well validated for detection of at-risk infants or mothers as the 100 g OGTT.⁶

Fasting plasma glucose is lower in pregnant women than non-pregnant women, possibly as a result of haemodilution.⁸ In a Caucasian population in Austria, fasting plasma glucose of 78 ± 1.7 mg/dl was found in pregnant women without GDM as compared to 84 ± 1.9 mg/dl in those with GDM.² Also, a Dutch multi-ethnic cohort study found fasting plasma glucose of 3.6 ± 0.4 mmol/l for normal pregnant women and 4.7 ± 0.7 mmol/l for women with GDM.⁹ While the values for the fasting plasma glucose were similar for women with GDM in both studies, it was lower for normal pregnant women in the Dutch study. In another study in North America,¹⁰ the fasting plasma glucose was similar in normal pregnant women in the different racial and ethnic groups with Asian 83.2 ± 0.1 mg/dl, Hispanic 83.7 ± 0.1 mg/dl, Whites 83.6 ± 0.1 mg/dl and Blacks 82.8 ± 0.1 mg/dl despite the fact that a racial-ethnic gradient of maternal glucose level occurred after 75 g OGTT (Asian > Hispanic and Whites > Blacks).¹⁰ This is not surprising as certain ethnic groups have been identified as being at increased risk for GDM such as Hispanics, African American, American Indian and South or East Asian.⁷

In light of this, it becomes necessary to determine the normal fasting plasma glucose in pregnant Nigerians as well as the pattern of response to 50 g oral GCT in our institution in a predominantly black African Nation. This was the aim of this study.

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Table 1. Venous plasma glucose levels in milligrams per deciliters (mg/dl).

	Mean	Standard deviation (SD)	Mean \pm 2 SD
Fasting	74.5	11.5	51.5 to 97.5
One hour after 50 g glucose load	115.3	19.1	77.1 to 153.5

Subjects and method

Two hundred and twenty two consenting women with singleton pregnancies and in good health attending the antenatal clinic of the Lagos University Teaching Hospital (LUTH) were recruited into the study at 24 to 28 weeks gestation between the years 2002 and 2003. Women with pre-GDM, hypertension, pre-pregnant obesity, those on drugs that may affect glucose tolerance (like steroids, beta adrenoceptor agonist like salbutamol) were excluded from the study. They were given appointments and were required to have fasted overnight for about 10 hours. A baseline venous blood sample was taken to ascertain the fasting plasma glucose before they were given 50 g of anhydrous glucose in 250 ml of water to drink within 5 minutes and subsequently; venous blood samples were taken 1 hour after. A diagnostic 3-hour 100 g OGTT was performed in all either within 1 week for those with GCT \geq 130 mg/dl (7.2 mmol/l) and if normal, it was repeated at 30 to 32 weeks gestation. For those with GCT of less than 130 mg/dl, the OGTT was done at 30 to 32 weeks gestation. This is because two to three percent of women expected to receive a diagnosis of GDM are not identified until 30 to 32 weeks gestation⁴ and this will not be detected if the tests were restricted to 24 to 28 weeks. The diagnosis of GDM was based on the criteria established by Carpenter and Coustan.⁴ The plasma glucose was determined by the glucose oxidase method. The ethics committee of the Lagos University Teaching Hospital approved the study. The mean and standard deviation of the fasting plasma glucose, plasma glucose 1 hour after 50 g GCT and other related parameters were computed using Epi-info for those women with normal response to 100 g OGTT.

Results

Of the 222 women, 210 had a normal response to 100 g OGTT i.e. venous plasma glucose below these cut-off levels: fasting 95 mg/dl (5.3 mmol/l), 1 hour 180 mg/dl (10.0 mmol/l), 2 hours 155 mg/dl (8.6 mmol/l) and 3 hours 140 mg/dl (7.8 mmol/l), while 12 were found to have GDM and were subsequently excluded from the study. They were appropriately managed. The mean maternal age was 30.9 ± 4.1 years (range 19 to 45 years) and the mean parity was 1.2 ± 1.1 (range 0 to 5). The mean fasting plasma glucose was 74.5 ± 11.5 mg/dl (range 42 to 117 mg/dl) while the mean plasma glucose 1 hour after 50 g GCT was 115.3 ± 19.1 mg/dl (range 56 to 180 mg/dl) as shown in Table 1. Most of the women (93.8%) delivered at term, the mean gestational age at delivery was 38.3 ± 1.4 weeks (range 31 to 41 weeks).

The mean birth weight of the babies was 3.26 ± 0.45 kg (range 1.6 to 4.5 kg). Eleven babies (5.2%) weighed <2.5 kg; 193 (91.9%) had weight from 2.5 to 4 kg, amongst this group two babies actually weighed 4 kg. Six babies (2.9%) weighed more than 4 kg and in this group two babies actually weighed 4.5 kg (0.95%).

Discussion

The mean fasting plasma glucose of 74.5 mg/dl in this study was lower than Asian, Hispanic, White and Black Americans with normal pregnancies without GDM in an earlier study,¹⁰ it is also much lower than

the WHO (1999), NDDG and Carpenter and Coustan's diagnostic fasting criteria for GDM.^{3,4} The value was however similar to the multi-ethnic Dutch study and the Caucasian population in Austria for normal pregnant women without GDM.^{2,9} Though the upper limit of normal for the mean fasting plasma glucose \pm 2 standard deviation (mean FPG \pm 2 SD) of 97.5 mg/dl is comparable to both NDDG and Carpenter and Coustan's diagnostic fasting limit for GDM, this is far lower than that of WHO (1999) diagnostic fasting criteria. This finding may form the basis for a call for a downward review of the WHO (1999) diagnostic fasting limit for GDM at least in the Black African population of Nigeria if the detection of GDM using the one-step 75 g OGTT endorsed by WHO is to be adopted. Consequently, the 2-hour value may also need to be stepped down by similar ratio. It can also reasonably be implied that fasting plasma glucose below 51.5 mg/dl (the lower limit for the mean FPG \pm 2 SD) in this study could be suggestive of fasting hypoglycemia in our normal pregnant women population.

Two standard deviations from the mean plasma glucose level 1 hour after 50 g GCT was 77.1 mg/dl to 153.5 mg/dl (Table 1). The upper limit of normal of 153.5 mg/dl (8.5 mmol/l) has significant implication in a financially challenged African Nation like ours where there are many competing needs for scarce resources. It can be suggested that women with a venous plasma glucose of greater than 153.5 mg/dl (8.5 mmol/l) 1 hour after 50 g GCT are the ones strongly recommended for diagnostic 100 g 3-hour OGTT or the alternative 75 g 2-hour OGTT, which can be a cost-effective measure without necessarily compromising the detection of GDM in a developing nation like Nigeria.

Also six (2.9%) of the women with normal response to 100 gms OGTT had babies weighing above 4 kg with two babies (0.95%) weighing 4.5 kg. This implies that there are other factors that account for fetal macrosomia other than GDM.

Conclusion

We found the mean fasting plasma glucose in normal pregnant Nigerians to be 74.5 ± 11.5 mg/dl. There is a need to re-appraise and possibly review downwards the World Health Organization (WHO 1999) fasting plasma glucose diagnostic criteria in pregnant Nigerians for better detection of GDM. Also, we strongly recommend that pregnant women with venous plasma glucose greater than 153.5 mg/dl (8.5 mmol/dl) 1 hour after a 50 g GCT should undergo a diagnostic test for GDM. This may be a cost-effective measure in a developing nation like ours.

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Conflicts of interest

The authors declare that there is no conflict of interest.

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Guarantor

Dr Omololu Adegbola

Contributorship

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Research ethics

The Health Research and Ethics Committee of the Lagos University Teaching Hospital approved the study. The patients gave their consents for the study and the investigations were carried out to a high ethical standard.

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