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An evaluation of the WHO criteria for abnormal glucose tolerance test during pregnancy in Nigerian women

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Abstract

A 75g oral glucose tolerance test was performed in 127 normal Nigerian women between 24 and 28 weeks of pregnancy. The glucose response at fasting, 1, 2 and 3h were studied. At 2h, the glucose level at 2-SD and 4-SD above the mean were less than the criteria of abnormality recommended by the World Health Organisation: 6.5 mmol/l vs. 8 mmol/l for impaired glucose tolerance and 8.0 mmol/l vs. 11.0 mmol/l for gestational diabetes mellitus. The area under the glucose response curve correlated best with the glucose levels at 2h during the OGTT ($y = 4.3 + 1.8x$, $r = 0.862$). The 75-g OGTT interpreted with the WHO criteria appear not to be appropriate for use in pregnant women in Nigeria.

Résumé

Le test de tolerance de glucose s ete fait conduit chez 127 femmes enceintes entre 24 et 28 semaines de grossess. Suivant l'ingestion de 75g de glucose les responses 'apre 1, 2, et 3 heures ont ete etudiees. Deux heures suivant l'ingestion les taux de glucose etaient plus bas que celui considere comme anormal par l'OMS a 2 et 4 deviations de standards au dela de la moyenne; c'est a' dire 6.5 mmol/l contre 8 mmol/l pour une tolerance derrangee et 8.0 mmol/l contre 11.0 mmol/l en cas du diabete en grossesse. Les taux a la deuxieme heures du test etaient perfaitement reflectes par le parabole ($y = 4.3 + 1.8 x$, $r = 0.862$). Le test de tolerance de glucose oral interprete selaon les criteriums de l'OMS semble inadequat shez des Nigeriannes enceintes.

Introduction

The appropriate criteria required to make the diagnosis of impaired glucose tolerance in pregnant women has continued to generate considerable discussion in the scientific literature. Several studies indicate that there are racial differences in glucose tolerance as a result of differences in diet and body composition [1,2,3]. Our previous report [4] demonstrated that Nigerian women have better glucose tolerance during pregnancy than Caucasian women. However, in that study, we used a 50-gram oral glucose load and a 2-hour blood glucose profile. The World Health Organisation (WHO) has recommended a set of diagnostic criteria for abnormal glucose tolerance which include a 75-gram oral glucose load and blood glucose measured at fasting, 1, 2 and 3 hours after load [5].

The purpose of the study was to determine the glycemic response in unselected pregnant Nigerian women after a 75-gram glucose load, and to correlate the findings with the criteria of abnormal response recommended by the WHO for the 75-gram oral glucose tolerance test (OGTT). We hypothesize that the blood glucose levels required to make the diagnoses of impaired glucose tolerance (IGT) and gestational diabetes mellitus (GDM) in Nigerian women will be lower than those recommended by the WHO.

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Patients and methods

The study was carried out at the Obafemi Awolowo University Hospital in Nigeria over nine months, and consisted of 127 pregnant women. The women were studied when they were between 24 and 28 weeks pregnant, the gestational ages being established either by a reliable menstrual history or by an early dating ultrasound scan. Frankly diabetic women were excluded but women at risk of developing gestational diabetes mellitus: i.e., those with previous macrosomic infants, positive family history of diabetes, obese patients and those with previous unexplained stillbirths were included in the study. The major clinical characteristics of the women are as shown in table 1, where it is clear that the women were broadly divided according to age and parity. They were also from mixed socio-economic backgrounds, reflecting the profile of women who normally attend the antenatal clinic of the hospital.

A 75-g oral glucose tolerance test was performed in the women between 0800h and 1000h because of the diurnal variation that is known to exist in oral glucose tolerance tests. Venous blood was sampled at fasting, 1, 2 and 3h after the 75-g glucose drink. the blood samples were separated into plasma and stored at -20 degrees until assayed for glucose. Plasma glucose was determined by the glucose oxidase method using peroxidase as a chromogenic oxygen acceptor [6].

For statistical analysis, the mean glucose values for each hour, their standard deviations and confidence intervals were calculted. The results were then compared with the criteria of abnormality recommended by the WHO at zero and 2h. The area under the glucose response curve was determined in arbitrary area unit (AAU) by the equation [7], thus: AAU 75g = (sum of glucose concentrations) — 1/2(sum of first and last glucose concentrations).

The relationships between AAU 75g and glucose values at fasting, 1, 2 and 3 hrs were determined by linear regression analysis.

Results

The glucose response during oral glucose tolerance test in the 127 pregnant women and the values two and four standard deviations above the mean are shown in table 2. Table 3 is a comparison between the fasting and the 2-h values in the present study, with the corresponding values recommended by the WHO in diagnosing impaired glucose tolerance (IGT) and diabetes mellitus in pregnancy (GDM). It is obvious that our criteria are consistently less than those recommended by the WHO. The mean (SD) area under the glucose response curve in this study was 13.9 (2.1) AAU. When the AAU was correlated with the glucose levels at each hour during OGTT, the values at 2h gave the best correlation ($r = 0.865$, $P < 0.001$) (table 4, fig. 1) and the fasting values showed the poorest correlation.

Table 1: The clinical characteristics of the patients

Variable	Mean	SD	95% CI
Age	26.6	4.8	25.8-27.5
Parity	1.9	(0-8)*	
Prepregnancy weight	61.1	9.13	59.5-62.7
Quetelet index**	23.5	3.28	22.9-24.1
Gestational age test)	25.9	1.58	25.6-26.1

* Values refer to range; ** Quetelet index = weight (Kg)/height (m^2); SD = standard deviation; CI = confidence interval.

Table 2: Plasma glucose levels in mmol/l after 75g oral glucose load

Test Period	Mean	SD	95% CI	2SD	4SD
Fasting	3.6	0.6	3.5-3.7	4.8	6.0
1 hour	5.4	0.9	5.2-5.6	7.2	9.0
2 hour	4.8	0.8	4.7-4.8	6.4	8.0
3 hour	3.9	0.8	3.8-4.04	5.5	7.1

SD = standard deviation; CI = confidence interval.

Table 3: Comparison of WHO criteria with our present study

Criteria	WHO		This study	
	IGT	GDM	2SD	4SD
Fasting	6.0	8.0	4.8	6.0
2 Hour	8.0	11.0	6.4	8.0

Values are in mmol/l

Table 4: Linear correlation of AAU 75g with glucose level at each hour during OGTT ($y = ax + b$).

	a	b	c
Fasting	2.4	5.2	0.7578*
1 Hour	1.8	5.3	0.804*
2 Hour	2.2	3.3	0.862*
3 Hour	1.9	6.5	0.760**

*$P < 0.001$; ** $P < 0.01$

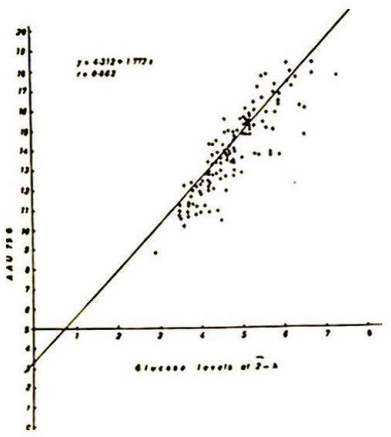

Fig. 1: Correction of AAU 75g with glucose levels at 2-h

Discussion

The findings in this study support the major tenet of the research hypothesis. The fasting and the two hour blood glucose criteria for impaired glucose tolerance and diabetes mellitus were consistently less than the values recommended by the WHO for pregnant women. To our knowledge, this is the first study that has evaluated the WHO criteria in African women, although both Fraser [2] and Famuyiwa *et al* [8] also found lower OGTT blood glucose values in two non-identical groups of pregnant African women. However, in the above studies, oral glucose tolerance tests were not performed according to the WHO standardisation protocol, and therefore, the tests could not usefully be compared with the WHO criteria.

Other investigators have evaluated the WHO criteria in different populations of women. Li *et al* [9] compared the WHO criteria with the National Diabetes Data Group (NDDG)-100g glucose test [10] and found that the NDDG was more discriminative in differentiating those with normal glucose tolerance, impaired glucose tolerance and gestational diabetes mellitus. A second study by the same group [3] showed that the blood glucose criteria in Chinese women were lower than those recommended by the WHO although they concluded that the WHO criteria was appropriate for Chinese women. In contrast, Nasrat [11] found that more stringent criteria were needed for the diagnosis of gestational diabetes mellitus in Saudi Arabian women and Samanta [12] concluded that the WHO criteria tended to over-diagnose abnormal glucose tolerance in Asian women.

The WHO criteria has been criticised on the grounds that the glucose tests were performed in non-pregnant women and the results were then extrapolated to pregnant women [3]. Thus, it has been argued that the criteria did not take into consideration the physiological hypoglycemia that exists in pregnancy and ignored the possibility that significant changes occur in glucose tolerance in pregnancy.

Wide ethnic differences have been reported in the incidence of gestational diabetes mellitus [13] and Nigerian women are thought to have low rates of the disorder [1,8]. The explanation for this observation is presently unclear but the low glucose values in this study suggests an insulin mediated mechanism. Fraser [2] also reported low glucose values following OGTT in pregnant women in Kenya and attributed it to prolonged habituation of the women to high fibre diet. He conducted a second series of experiments in Caucasian women [14] and was able to show that feeding the women with high fibre diet improved their sensitivity to insulin and reduced their blood glucose during OGTT. Thus, it is possible that the traditional high fibre African diet may protect Nigerian women from gestational diabetes mellitus and improve their response to oral glucose load. Other factors that may be important include the low incidence of obesity in the population, excessive activity by women, cultural dietary restrictions during pregnancy and the high prevalence of subclinical adult malnutrition in the population. Specific studies such as an investigation into insulin sensitivity in the women and a dietary survey are required to outline the exact mechanisms involved.

Another important observation in this study was the better correlation of the area under the glucose response curve with the 2h plasma glucose values than with the fasting plasma glucose. It confirms previous observations [3] which indicate that the 2h plasma glucose is the best predictor of abnormal glucose tolerance during OGTT. Fasting plasma glucose had the poorest correlation with AAU 75g, implying that fasting glucose cannot be relied upon as a predictor of IGT and GDM in pregnant women at least in this population and would be less useful as a screening test.

We conclude that the glucose criteria as proposed by the WHO for establishing the diagnoses of

impaired glucose tolerance test and diabetes mellitus during oral glucose tolerance tests may not be appropriate for pregnant women in Nigeria. Lower glucose criteria as enumerated in this report may be required. However, before widespread use of this recommendation, we believe that further studies are warranted that will compare the clinical outcome of pregnancies in which the two criteria have been used independently to allocate normal and abnormal glucose tolerance in the pregnant Nigerian women.

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