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Comparison Between OGTT and Glycosylated Hemoglobin (HbA1C) as a Predictor for Gestational Diabetes Mellitus

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ABSTRACT

The present study was conducted to compare OGTT and glycosylated hemoglobin (HBA1C) as a predictor for gestational diabetes mellitus. The patients for the Comparison between OGTT and glycosylated hemoglobin (HBA1C) as a predictor for gestational diabetes mellitus were selected from the cases admitted to Department of obstetrics and gynecology. Study Group included 150 pregnant female after 22 weeks gestation attending OPD were selected for the study. All participants underwent blood tests in their first trimester. Gestational age was confirmed on the basis of the self-reported date of the last menstrual period or by ultrasound. Each participant's age, number of deliveries, blood pressure, height, and weight were recorded. For these patients, simultaneous prospective assessment of HbA1c versus standard OGTT in a cohort of consecutive pregnant women were performed. Study variables i.e. age, weight, height, socioeconomic status, BMI, previous history of DM, family history of DM, HBA1C, OGTT were noted. The data was analyzed statistically using student t test, Chi-Square test. A p-value less than 0.05 was considered statistically significant. Out of 150 females, final diagnosis of GDM found in 17 subjects with deranged GTT which shows significant ($p<0.001$) relationship between GDM and GTT. In our study, result shows that HbA1C is more accurate in diagnosing GDM with accuracy of 89.04% when compared with the accuracy of OGTT OF 66.44%. OGTT being the more sensitive parameter where specificity is more with HbA1C. The area under the curves of diagnostic criteria was 0.846 for GTT, 0.836 for HBA1C. The optimal GTT level cut-off point for predicting GDM is 155, with a sensitivity of 75.0% whereas the optimal HBA1C level cut-off point for predicting GDM is 6.11%, with a sensitivity of 60.0.0% HbA1C has the highest specificity but OGTT has the highest sensitivity, from this we concluded that OGTT should be used as screening test in all the patients attending the antenatal OPD which should be further confirmed using HbA1C levels.

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Key Words
Diabetes, gestational, glycosylated hemoglobin

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INTRODUCTION

In normal pregnant females there is insulin resistance and hyperinsulinemia due to the secretion of placental diabetogenic hormones, reduced maternal activity, and increased caloric intake during pregnancy. Human placental lactogen also increases with gestational age mimicking growth hormone like action, thereby potentiating the diabetogenic state[1]. As pregnancy progresses, increased tissue resistance to insulin leads to increased insulin demand. In most pregnancies, this requirement is met and the result is a balance between insulin resistance and insulin production. In high-risk cases, the tissue resistance overcomes and patient develop hypergylcemia and diabetes, who has never had diabetes. In pregnant females, in-utero exposure to maternal hyperglycemia leads to foetal hyperinsulinemia, which in turn causes increase in foetal fat cells leading to obesity and insulin resistance in childhood. Therefore, in order to prevent complications of GDM, screening and diagnosis of this problem should be performed as soon as possible and care and treatment should be done. Despite more than 50 years of research, there is no consensus on the best way to screen for GDM. According to the guidelines of the International Diabetes Confederation (IDF), the criteria for diagnosing GDM in 24-28 gestational weeks of pregnancy with oral glucose tolerance test (OGTT) are as follows: Only one of the following three conditions is sufficient to diagnose gestational diabetes. Fasting plasma glucose = 92 mg/dL, 1-hour glucose = 180 mg/dL, or 2-hour glucose = 153 mg/dL. In 1999, for the sake of simplicity, the World Health Organization (WHO) introduced one-step screening and diagnostic test criteria for GDM. This was based on a single cut-point of 140 mg/dl, 2 hours after a 75 gm glucose load administered in the fasting state. Due to difficulties in getting women in fasting state in the OPD visiting for antenatal check-up specially in India where screening of GDM should be mandatory as the prevalence rate is high, Anjalakshi *et al*. conducted a study comparing the GTT done in the fasting and the non-fasting states. They found that the non-fasting OGTT had 100% specificity and sensitivity when compared to the fasting. Based on this study, diabetes in pregnancy study group of India (DIPSI) adopted non fasting 75 gm OGTT as “gold standard” for screening gestational diabetes mellitus. In this test, 75 gm of glucose was dissolved in 200 ml of water and asked to consume over 15 to 20 minutes. The cut off for this test is 140 mg/dl[2-4].

Traditionally, the OGTT is used to diagnose GDM. But it has some practical difficulties to the pregnant women like staying in fasting state overnight, two or three pricks at short intervals, 2-3 hours of waiting period during sample collection and sometimes nauseating sensation on drinking the glucose load solution. This obviates the need for a universally accepted, easily available, simpler diagnostic method for the diagnosis of GDM. American Diabetes Association (ADA) and World Health Organization (WHO) have published the reliability of Glycated Hemoglobin (HbA1C) estimation in the diagnosis of Diabetes[5,6]. As HbA1c does not need to be fasting, consume a concentrated glucose beverage, or draw multiple blood samples[7]. Glycosylated hemoglobin (HbA1c) is an index of mean plasma glucose over the previous three months. At present, HbA1c measurement is not part of routine antenatal care, but a first-trimester HbA1c concentration = 6.5% is useful for diagnosis of overt diabetes. Some of the studies have shown that first trimester’s HbA1c level between 5.5% and 6.5% was associated with an increased risk of GDM[8,9]. Hence, this prompt us to conduct a study to compare OGTT and glycosylated hemoglobin (HBA1C) as a predictor for gestational diabetes mellitus.

MATERIALS AND METHODS

The patients for the Comparison between OGTT and glycosylated hemoglobin (HBA1C) as a predictor for gestational diabetes mellitus were selected from the cases admitted to Department of obstetrics and gynecology, People’s College of Medical Sciences and Research Center, Bhopal from Dec 2020-May 2022. Study Group included 150 pregnant female after 22 weeks gestation attending OPD were selected for the study. All participants underwent blood tests in their first trimester. Gestational age was confirmed on the basis of the self-reported date of the last menstrual period or by ultrasound. Each participant’s age, number of deliveries, blood pressure, height and weight were recorded. For these patients, simultaneous prospective assessment of HbA1c versus standard OGTT in a cohort of consecutive pregnant women were performed. Study variables i.e. age, weight, height, socioeconomic status, BMI, previous history of DM, family history of DM, HBA1C, OGTT were noted. Participants received routine antenatal care throughout their pregnancies and all participants were screened for gestational diabetes using a 75 g oral glucose tolerance test between 24 and 28 weeks of pregnancy. OGTT was performed according to the standard protocol. The patient was required to have been in good health and to be consuming a normal diet, particularly with regard to carbohydrate intake (>150 g/day). The test was performed after an overnight fast of 10 h. The test was started before 10:00 and the patient remained resting quietly for the duration of the OGTT. Blood samples were collected into Becton Dickinson 2 mL Fluoride Oxalate Vacutainer tubes. A sample was collected at baseline and then the patient consumed the 75 g glucose load. We used a commercially available product containing

75 g of dextrose in 300 mL carbonated liquid (SteriHealth Gluco Scan 75 g). The patient was required to consume the whole volume within 5 min of starting the drink. Further blood samples were collected at 1 and 2 h post-start of the dextrose drink. Glucose was measured within 3 h of collection of the sample using the Abbott glucose hexokinase method on an Architect C8000 analyzer (Abbott Australasia Pty Ltd). HbA1c samples were collected into Becton Dickinson 4 mL K2EDTA Vacutainer tubes. HbA1c was measured by immunize using the DCA 2000 (Siemens Ltd, Marburg, Germany). The DCA 2000 analyzer measures HbA1c standardized to the National Glycohemoglobin Standardization Program (NGSP), which is in turn aligned to the Diabetes Control and Complications Trial (DCCT) results with international standardization as set by the International Federation of Clinical Chemistry (IFCC)[10]. GDM was defined if fasting blood glucose was = 5.1 mmol/L or glucose tolerance test (GTT) 1 h = 10.0 mmol/L OR GTT 2 h = 8.5 mmol/L. The data was analyzed statistically using student t test, Chi-Square test. A P value less than 0.05 was considered statistically significant.

RESULTS AND DISCUSSIONS

Out of 150 females, 19 (12.08%) patients belong to age group of 18-22 years and about 53 (35.57%) patients each are in 23-27 and 28-32 years age group, where as it was found that 22 (14.77%) patients were in 33-37 year group and remaining 3 (2.01%) patients were in 38-42 years age group. In present study, it was observed that there were 29 subjects with 22-25 weeks of gestation period, 70 subjects in 26-30 weeks, 33 subjects in 31-35 weeks and 17 subjects are found in 36-40 weeks of gestation period. Maximum patients were found in 26-30 weeks gestation being 47%. In our study it was observed that out of 30 patients in high risk group, 12 were diagnosed with GDM which counts for 40% of the total whereas in normal 120 patients without any risk, only 9 had GDM which counts 7.55% only. High risk groups develops GDM more when compared with normal group patients. Out of 150 patients, final diagnosis of GDM found in 21 subjects of which 8 had raised HbA1C levels with significant ($p<0.001$) relationship between GDM and HbA1C groups. Final diagnosis of GDM found in 17 subjects with deranged GTT which shows significant ($p<0.001$) relationship between GDM and GTT. In our study, result shows that HbA1C is more accurate in diagnosing GDM with accuracy of 89.04% when compared with the accuracy of OGTT OF 66.44%. OGTT being the more sensitive parameter where specificity is more with HbA1C. The area under the curves of diagnostic criteria was 0.846 for GTT, 0.836 for HBA1C. The optimal GTT level cut-off point for predicting GDM is 155, with a sensitivity of 75.0% whereas the optimal HBA1C level cut-off point for predicting GDM is 6.11%, with a sensitivity of 60.0.0%.

Table 1: Distribution of subjects according to risk factors

	Normal group (n = 120)		High risk group (n = 30)	
	GDM	Normal	GDM	Normal
OGTT	5	36	7	15
HbA1C	4	1	5	1
Total	9	111	12	18

Table 2: Diagnosis of GDM by HbA1C value

HbA1C	GDM	Normal
3.5-4.5	0	24
4.6-5.5	5	66
5.6-6.5	8	33
>6.5	8	3
Total	21	129
Chi square value	38.29	
p-value	0.001*	

Table 3: Diagnosis of GDM by GTT

GTT	GDM	Normal
Normal	4	82
Derranged	17	46
Total	21	128
Chi square value	14.97	
P-value	0.001*	

Table 4: Distribution of Subjects according to risk factor

Study group	Normal group n = 120		High risk group n = 30	
	GDM	Normal	GDM	Normal
GTT	5	36	7	15
HbA1C	4	1	5	1
Total	9	111	12	18

Table 5: Test Characteristics for HbA1c and GTT as a Predictor of GDM

Statistic	HbA1C	GTT
Sensitivity	38.10%	80.95%
Specificity	97.60%	64.06%
Positive Predictive Value (*)	72.73%	26.98%
Negative Predictive Value (*)	90.37%	95.35%
Accuracy (*)	89.04%	66.44%

Pregnant mothers with GDM are at high risk of future incidence of diabetes predominantly type-2 diabetes. Thus GDM women are an optimal group for the primary prevention of diabetes[11]. Thus, a universal screening procedure, which is simple and satisfactory, for detection of women with GDM may be considered. Out of 147 subjects who had abortion 0-2 times, 21 had GDM in which 9 subjects were diagnosed by OGTT and 11 were diagnosed by HBA1C. Cross tabulation of various HbA1C groups with final diagnosis of GDM found in 21 subjects which showing significant ($p<0.001$) relationship between GDM and HbA1C groups with final diagnosis of GDM in subjects with and without GDM. Cross tabulation of OGTT results groups with final diagnosis of GDM found in 17 subjects shows significant ($p<0.001$) relationship between GDM and GIT result groups with final diagnosis of GDM in subjects with and without GDM. Rivers KL *et al.* of the initial pool, 861 adolescents (98.6%) completed the study. The OGTT demonstrated that 89.4% of these students had normal fasting glucose levels and 98.8% had normal 2-hour OGTT glucose levels. Eighty seven students (37 boys and 50 girls) had elevated fasting plasma glucose, however, 2 hours after the oral glucose load, only 9 students (2 boys and 7 girls) had

blood glucose concentrations indicative of IGR. For the HbA1c test, 82.6% of the students had normal results, and 1.3% had diabetes. The HbA1c test revealed a higher percentage of students with IGR (16.1%) than the OGTT (1%)[12].

The area under the curves of diagnostic criteria was 0.846 for GTT, 0.836 for HBA1C. The optimal GTT level cut-off point for predicting GDM is 155, with a sensitivity of 75.0% whereas the optimal HBA1C level cut-off point for predicting GDM is 6.11%, with a sensitivity of 60.0.0%. GINIS, *et al*. investigated the value of HbA1c as a screening and diagnostic test for diabetes mellitus (DM) in high risk Turkish individuals. With a cut-off value for the diagnosis of DM of 6.1%, HbA1c had a sensitivity of 81.8% and a specificity of 80%, with positive and negative predictive values of 80.2% and 81.05%, respectively. A sensitivity of 56.8% and a specificity of 89.2% were calculated for a cut-off value of 6.5%. Both fasting plasma glucose and 2-h plasma glucose levels were found to correlate moderately with HbA1c levels (r = 0.47, P = 0.001 and r = 0.52, P = 0.000, respectively)[13].

Swift BE, *et al*. examined the adequacy of glycated hemoglobin (A1C) and waist circumference (WC) measurements to detect impaired glucose metabolism among women with prior GDM. Combining A1C = 5.7% and WC = 88 cm to detect pre-diabetes had a sensitivity of 76% and specificity of 62%, and to detect type 2 diabetes it had a sensitivity of 91% and specificity of 34%. Compared with women who had A1C and WC within the normal range, women with A1C = 5.7% and WC = 88 cm were more likely to have type 2 diabetes (OR 4.4; 95% CI 2.0 to 9.9)[14]. In our study all patients underwent OGTT and ones with abnormal OGTT underwent HbA1c as well for the further confirmation of the diagnosis. In all high risk patients HbA1C was done and it was found that high risk group are more prone to get GDM. In our study we concluded that maximum subjects belong to 23-27 and 28-32 years age group and most of them reside in rural area. The mean age of mother was 28.15 year. Mean BMI of study subjects was 23.86 (kg/m²). Most of the subjects belongs to 26-30 weeks of gestation period. Maximum mothers were multigravida and those with previous history of abortions most of them developed GDM. There was a significant relationship between HbA1C and GDM. HbA1C has the highest specificity but OGTT has the highest sensitivity, from this we concluded that OGTT should be used as screening test in all the patients attending the antenatal OPD which should be further confirmed using HbA1C levels.

CONCLUSION

HbA1C has the highest specificity but OGTT has the highest sensitivity, from this we concluded that OGTT should be used as screening test in all the patients attending the antenatal OPD which should be further confirmed using HbA1C levels.

REFERENCES

1. Shrivastava, N., K. Durugkar, P. Viswanadh and H. Bal, 2019. The study of role of hba1c as a predictor of gestational diabetes mellitus. Int. J. Rep. Cont. Obstet. Gynecol., 8: 4525-4530.
2. WHO., 1999. World health organization..
3. Anjalakshi, C., V. Balaji, M.S. Balaji, S. Ashalata and S. Suganthi *et al*. 2008. A single test procedure to diagnose gestational diabetes mellitus. Acta. Diabetol., 46: 51-54.
4. Seshiah, V.,A.K. Das, V. Balaji, S.R. and Joshi, 2006. Diabetes in pregnancy study group. gestational diabetes mellitus-guidelines. J. Assoc. Phys. India., 54: 622-628.
5. WHO., 2011. Use of glycated hemoglobin (HbA1c) in diagnosis of diabetes mellitus.
6. ADA., 2010. Diagnosis and classification of diabetes mellitus. Diabet. Care., 33: 2-9.
7. Selvin, E., 2007. Short-term variability in measures of glycemia and implications for the classification of diabetes. Arch. Internal Med., 167: 1545-0.
8. Balaji, V., B.S. Madhuri, S. Ashalatha, S. Sheela, S. S and V. Seshiah, 2007. A1c in gestational diabetes mellitus in asian Indian women. Diabet. Care, 30: 1865-1867.
9. Sujithra, D.,S. Mukherjee and S. Sudha, 2018. Glycated hemoglobin in early pregnancy as a predictor of gestational diabetes mellitus. Ind. J Obstet. Gynecol. Res., 5: 327-330.
10. 2024. Certified methods and laboratories., https://ngsp.org/certified.asp
11. 2007. Diabetes mellitus statistics.
12. Rivers, K.L. and C.H. Mahase, 2016. Comparison between the oral glucose tolerance test and the hba1c assay for detecting impaired glucose regulation in bahamian adolescents. J. Diabet. Metab., Vol. 6 .10.4172/2155-6156.1000511.
13. Ginis, Z., G. Özturk, R. Sirmali, A. Yalcindag, Y. Dulgeroglu, T. Delibasi and N. Delibas, 2012. The role of hba1c as a screening and diagnostic test for diabetes mellitus in ankara. Turk. J. Med. Sci., 42: 1430-1436.
14. Swift, B.E. and K.E. Liu, 2014. The effect of age, ethnicity and level of education on fertility awareness and duration of infertility. J. Obstet. Gynaecol. Canada., 36: 990-996.