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Original Research

Correlation of Glycated Hemoglobin and Glucose levels after Oral Glucose Tolerance test in gestational diabetes patients: A Cross Sectional study

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Abstract

Gestational diabetes mellitus (GDM) is a prevalent and potentially serious condition which may put both mothers and neonates at risk. The current recommendation for diagnosis is the oral glucose tolerance test (OGTT). OGTT is a cumbersome test that is time consuming. So we want to test the utility of HbA_{1c} as a screening tool in pregnancy for GDM. **Aim**: This study aimed to determine the usefulness of HbA_{1c} test as a diagnostic tool for GDM as compared to the traditional criteria based on the OGTT. **Materials and Methods:** This study was done among 156 pregnant women of the age group of 20–40 years with gestational period of 24–28 weeks attending the Obstetrics and Gynecology OPD of Chettinad Hospital and Research Institute, Chengalpattu from July 2019 to December 2019. **Results:** The HbA_{1c} values will be correlated with OGTT values using Pearson's correlation analysis and there was significant correlation between HbA_{1c} and post glucose values (p value<0.05). ROC curve analysis done for HbA_{1c} showed an area under the curve of 0.569. **Conclusions:** HbA_{1c} may have a role in the diagnosis of GDM, but further studies among large populations might be required to approve the use of HbA_{1c} instead of OGTT in the diagnosis of GDM.

Keywords: Glycated Hemoglobin, HbA1C, Glucose Tolerance Test, Gestational Diabetes Mellitus

Background and Aim

Gestational diabetes mellitus (GDM) is defined as any degree of glucose intolerance with onset of first recognition during pregnancy [1]. Gestational diabetes mellitus is a prevalent and potentially serious condition that may lead to adverse effects in both mothers and neonates [2]. The prevalence of this condition has increased tremendously over the past few years [3, 4]. Studies are showing that Indian women are having 11 times more risk of developing diabetes when compared to the women in other countries [5]. The prevalence of GDM in Tamil Nadu is 22% which is higher as compared to other parts of the country [6].

There are many criteria for diagnosing GDM. American Diabetes Association had recommended a two-step approach to diagnose GDM where in first step a 50 g glucose is given as GCT and followed by 75 g or 100 g glucose test [7]. WHO recommended 75 g glucose test, with diagnostic criteria as >126 mg/dL or 200 mg/dL as diagnostic [8].

After the HAPO (Hyperglycemia and Pregnancy Outcome) study, IAPDG gave a recommendation for diagnosing GDM where single dose of 75 g of glucose is given and GDM is diagnosed if one among the following values are above the normal range. Fasting >92 mg/dL, 1 hour ≥180.0 mg/dL, or 2 hour ≥153 mg/dL [9].

In a developing country like India, where there are approximately 27 million pregnancies every year, the number of women approaching the health care facilities at early pregnancy is as low as 50–70%.

Early detection of this condition may lead to reduction of risk factors and complications during pregnancy. GDM causes macrosomia, pre-eclampsia, still birth need for cesarean section and among neonates it causes hypoglycemia and respiratory distress.

HbA_{1c} is a marker which provides an insight into the blood glucose control levels for the past 6–8 weeks, therefore HbA_{1c} can reflect the mean blood glucose levels of early pregnancy [10]. Previous studies shed light on the relationship between HbA_{1c} and adverse pregnancy outcomes [11].

Presently oral glucose tolerance test (OGTT) is accepted as a diagnostic criteria for GDM by international organizations, but it has lot of drawbacks like it requires 8 hours fasting, extensive patient preparation is required, lacks reproducibility, its time consuming, and unpalatable. When compared to OGTT, HbA_{1c} can be measured at any time of the day, has less biological variations and has high reproducibility. However the predictions of some severe events by early maternal HbA_{1c} levels is yet unclear [12].

Aim

This study aimed to determine the usefulness of HbA_{1c} test as a diagnostic tool for GDM as compared to the traditional OGTT method.

Materials and Methods

Ethical committee approval

This study was conducted after obtaining consent from Institute Ethical Committee. It was a cross-sectional study done among 156 pregnant women of the age group of 20–40 years attending the Obstetrics and Gynecology OPD of Chettinad Hospital and Research Institute, Chengalpattu from July 2019 to December 2019 for a period of 6 months. **Inclusion criteria**: All the patients who came to perform OGTT between the gestational period of 24–28 weeks were included in the study. **Exclusion criteria:** Those patients on steroid, anemic patients, patients having associated renal disease or hemoglobin variants and those who were not willing for the study were excluded from the study.

Laboratory, anthropometric and clinical data collection

Previous obstetric history and family history was taken from all patients. BMI was calculated using the formula weight in kilogram/height in meter^2. About a 5 mL of blood was drawn from all the patients in violet colored vacutainer tubes for assessing the levels of HbA_{1c} levels and complete blood count. Another 5 mL blood was drawn in red topped vacutainer to assess the levels of thyroid hormones.

We followed DIPSI (Diabetes in pregnancy study group of India) guidelines for diagnosing GDM in our hospital. All the pregnant women were given 75 g of anhydrous glucose mixed in 300 mL of water to drink over 5–10 minutes irrespective of their previous meal status. After 2 hours they were advised to come again and give their blood sample for taking post prandial blood sugar (PPBS) levels. If the PPBS values were ≥140 mg/dL, they will be worked up for GDM. HbA_{1c} was measured using chromatographic method using D-10 machine in Biochemistry laboratory. Thyroid hormones like free T3, free T4 and TSH (thyroid stimulating hormones) were measured using CLIA (Chemiluminescence immune assay) method in UNICEL DXI machine in Biochemistry laboratory. Complete blood count was measured in pathology laboratory in Beckman Coulter LH 780 machine, total count, platelet count, RBC count and PCV (packed cell volume) were measured using Impedance method. Neutrophils, lymphocytes, eosinophils, basophils, lymphocytes, and monocytes were measured using colorimetric method. MCV, MCHC, MCH and RDW were calculated using formulas. MCV values were calculated using the formula PCV/RBC × 10, MCH using Hb/RBC × 10, MCHC using Hb/PCV × 100. Hemoglobin was measured using cyanmethemoglobin method.

Statistical analysis

The mean±SD of all the variables were taken. The sample was divided based on the post

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glucose values into two groups as those with values above and >140 mg/dL. Independent sample t test was done between the two groups. Correlation analysis was done between HbA_{1c} and OGTT values.

Results

Mean±SD of all the variables were taken (Table 1). The 156 samples were divided into two groups based on the non-fasting OGTT values as those above and below the levels of 140 mg/dL. Independent sample t test was done to find out between the two groups. There was significant difference in the height, non-fasting glucose levels and HbA_{1c} between the two groups (p value < 0.05) (Table 2).

Correlation analysis between HbA_{1c} and non-fasting OGTT values showed significant correlation values (r value –0.28) (p value = 0.0003) (Figure 1).

Table 1: Shows the mean±SD of all the variables.

Variables	Mean	SD
Height (m)	157.08	4.38
Weight (kg)	62.1	10.3
BMI (kg/m^2)	25.18	4.2
Hemoglobin (g/dL)	11.156	1.3596
Post glucose	120.017	23.0700
HbA_{1c}	5.075	0.4115

ROC curve was done for HbA_{1c} and the area under the curve was found out to be 0.569 (Figure 2).

Discussion

Gestational diabetes mellitus (GDM) is a condition associated with many obstetric and other complications like macrosomia and pre-eclampsia. Women having GDM during pregnancy have a greater chance of developing type 2 diabetes mellitus in the future. So accurate diagnosis is required to correctly identify subjects with GDM. This study will be a unique one where the criteria under DIPSI guidelines for diagnosing GDM is being compared with HbA_{1c}.

DIPSI guideline used for diagnosing GDM among pregnant women has been approved by the Ministry of Health AND Family Welfare [13]. It follows a procedure which is more economical and more feasible for the women in India where in rural areas the hospitals will be far away from the villages and pregnant women will have to travel long distances and do the OGTT test in fasting will be difficult. So a non-fasting tolerance test would be more acceptable for a country like India.

HbA_{1c} is a marker used for the diagnosis of diabetes mellitus. Its use in the diagnosis of GDM is still under debate.

Studies done by Shobha et al. has a shown a relationship between HbA_{1c} and unfavorable pregnancy outcomes [14]. Another study done by

Table 2: Independent sample t test to compare the variables between pregnant women with post glucose levels less than and more than 140 mg/dL.

	Pregnant women with post glucose values <140 mg/dL		Pregnant women with post glucose values >140 mg/dL		p value
Variables	Mean	SD	Mean	SD	
Age (years)	25.1	3.66	25.7	4.14	0.345
Height (cm)	156.9	4.42	155.45	3.4	0.03
Weight (kg)	61.57	10.48	61.95	10.1	0.84
BMI	24.7	4	25.27	4.04	0.39
Hemoglobin (%)	11.12	1.37	11.34	1.32	0.0001
Non-fasting glucose (mg/dL)	112.3	16.19	156.9	13.2	0.0001
HbA_{1c} (%)	5.05	0.39	5.12	0.5	0.334

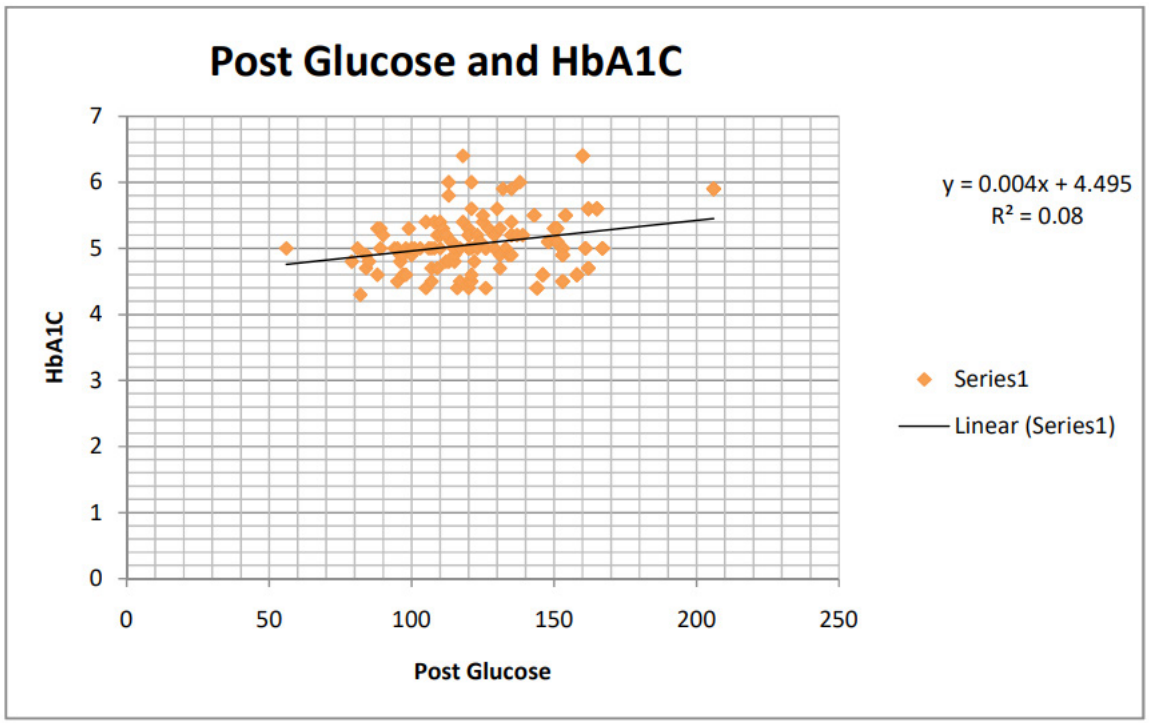

Figure 1: Pearson's correlation analysis between post glucose and HbA_{1c}.

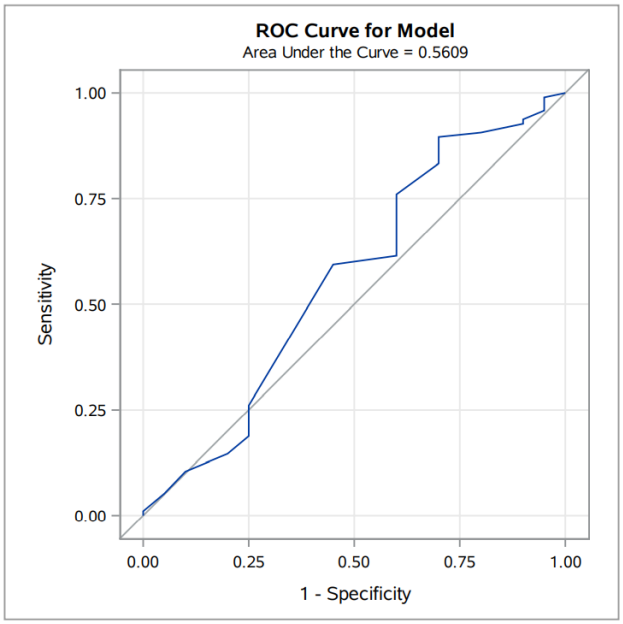

Figure 2: Showing the ROC curve for HbA_{1c}.

Bhavadharaini et al. showed that HbA_{1c} levels are associated with the incidence of macrosomia [15].

There was no significant difference in the values of HbA_{1c} between women whose post glucose values were more or less than 140 mg/dL. In our study HbA_{1c} has shown a significant positive correlation between non-fasting glucose values (r value –0.28) (p value = 0.0003). HbA_{1c} levels changes throughout pregnancy due to the changes in the hemoglobin levels due to dilution. In this study the ROC curve analysis for HbA_{1c} has shown an area under the curve of 0.569 which is on par with the study done by Agarwal et al. comparing HbA_{1c} with screening GDM by WHO criteria showed an area under the curve of 0.54 (95% CI 0.48–0.61) [16].

Rajput et al. and Sevket et al. compared HbA_{1c} levels with screening GDM by IADPG criteria showed an area under the curve of 0.683, when they screened 607 Indian women and 0.697 (95% CI 0.645–0.745) among 339 Turkish women done respectively [17, 18].

In the present study we did not find any differences in the levels of HbA_{1c} between GDM subjects and normal women, even though there was a significant correlation between HbA_{1c} levels and non-fasting glucose taken as a whole.

So the role of HbA_{1c} in the diagnosis of GDM remains unclear and invites further research in this area.

Conclusion

HbA_{1c} has shown a significant role in the diagnosis of GDM, but still requires studies on a

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large population to establish its use instead of OGTT in the diagnosis of GDM.

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Conflict of Interest

The authors declare no conflict of interest.

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