

STUDY OF CORRELATION BETWEEN GLYCATED HAEMOGLOBIN AND SERUM LIPID PROFILE IN OBESE TYPE 2 DIABETIC PATIENTS AND OBESE NON-DIABETIC PATIENTS IN MALWA REGION

Darshna Jain¹, Manoj Narayan Paliwa², Mohammad Khaliq Shaikh³, Shilpa Mittal⁴, Prachi Paliwa⁵, Deepasha Shahi Bagza⁶

¹Assistant Professor, Department of Biochemistry, Sri Aurobindo Medical College and P.G. Institute, Indore, Madhya Pradesh.

²Associate Professor, Department of Biochemistry, Sri Aurobindo Medical College and P.G. Institute, Indore, Madhya Pradesh.

³Professor, Department of Biochemistry, Sri Aurobindo Medical College and P.G. Institute, Indore, Madhya Pradesh.

⁴Assistant Professor, Department of Biochemistry, K.D. Medical College and Research Institute, Mathura, Uttar Pradesh.

⁵Assistant Professor, Department of Biochemistry, Sri Aurobindo Medical College and P.G. Institute, Indore, Madhya Pradesh.

⁶Demonstrator, Department of Biochemistry, Sri Aurobindo Medical College and P.G. Institute, Indore, Madhya Pradesh.

ABSTRACT

BACKGROUND

Glycated Haemoglobin (HbA1c) is the indicator of glycaemic status over long-term. Diabetes and obesity currently threaten the health, wellbeing and economic welfare of humanity. The study was designed to study the correlation between glycated hemoglobin and serum lipid profile in obese type 2 diabetic patients and obese non diabetic patients in Malwa region.

MATERIALS AND METHODS

This case control study comprised of a total of 200 obese (BMI ≥ 25 kg/m²) patients (148 males and 52 females) who visited the Outpatient Department of Sri Aurobindo Medical College and Postgraduate Institute, Indore. Out of which, those 100 obese patients with diabetes were taken as cases and 100 obese non-diabetic were taken as controls. Ethical clearance obtained for the study from the Institute Ethical Committee.

RESULTS

200 obese subjects included in the study out of which 148 (76%) were males and 52 (24%) were females. The majority (71%) of the cases had glycated haemoglobin value $>9\%$, whereas majority (84%) of the control had glycated haemoglobin value in the range of 6-9%. A significant difference ($P < 0.0001$) were found between the cases and controls. Glycated haemoglobin has a significant positive correlation with TC (total cholesterol), TG (triglycerides), LDL-C (low density lipoprotein), VLDL-C (very low density lipoprotein) whereas a significant negative correlation with HDL-C (high-density lipoprotein) and HDL-C /LDL-C ratio.

CONCLUSION

Our study ensures HbA1c status in obese diabetics and obese non-diabetics. HbA1c showed positive correlations with LDL-C cholesterol and negative correlations with HDL-C cholesterol and HDL-C/LDL-C ratio. A significant correlation exists between HbA1c and lipid profile. These findings suggest that HbA1c level can be used as good parameter for predicting the lipid profile. Glycated haemoglobin level can be used as an alarming factor for blood glucose dysregulation as well as lipid dysregulation in patients. The better the glycaemic control as reflected by HbA1c the better would be the lipidemic state. Achieving the target in HbA1c will contribute in improving the lipid state in patients.

KEYWORDS

Lipid Profile, Type-2 Diabetes Mellitus, Obesity, Glycated Haemoglobin.

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Corresponding Author:

Dr. Darshna Jain,

Department of Biochemistry,

Sri Aurobindo Medical College and P.G. Institute,

Indore, Madhya Pradesh.

E-mail: drdarshna2311@gmail.com

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BACKGROUND

Diabetes Mellitus (DM) is a group of metabolic disorders that are characterised by hyperglycaemia resulting from defects in insulin secretion, insulin action or both while obesity is accumulation of excess body fat. Diabetes is a global endemic with rapidly increasing prevalence in both developing and developed countries.¹ Diabetes and obesity currently threaten the health, wellbeing and economic welfare of humanity. DM is a disorder of multiple aetiologies characterised by chronic hyperglycaemia associated with abnormal carbohydrate, protein and lipid metabolism.²

Among the various types of diabetes, Type 2 Diabetes Mellitus (T2DM) is the most prevalent variant. The International Diabetes Federation (IDF) reported that total number of diabetic subjects in India is 41 million in 2006 and that this would raise to 70 million by the year 2025.³ Basing on current trends, the International Diabetes Federation projects that 438 million individuals will have diabetes by the year 2030.⁴ There is alarming rise in prevalence of diabetes, which has gone beyond epidemic form to a pandemic one.⁵ In India, the prevalence of diabetes is found to be 2.4% in rural and 4-11.6% in urban dwellers.⁶ Studies on migrant Indians have shown that they have a higher predisposition to insulin resistance, type 2 diabetes and coronary artery disease compared to other ethnic groups.⁷ The most characteristic lipid abnormality in diabetics is hypertriglyceridemia with or without associated increase in plasma cholesterol.^{8,9} Glycated Haemoglobin (HbA1c) is a routinely used marker for long-term glycaemic control. HbA1c expressed as the percentage of adult haemoglobin that is glycated is the most widely used measure of chronic glycaemia. Achieving near normal HbA1c levels have been shown to reduce long-term complications and HbA1c assay is recommended to determine whether treatment is adequate and to guide therapy.¹⁰ The HbA1c assay is widely accepted method to detect Mean Blood Glucose (MBG) level over the previous 8 to 12 weeks and it is the basis of treatment guidelines and is used universally to adjust therapy.¹¹ Our study was undertaken to correlate the serum lipid and glycated haemoglobin status in obese diabetics and obese non-diabetics.

MATERIALS AND METHODS

This case control study comprised of a total of 200 obese (BMI ≥ 25 kg/m²)¹² patients (148 males and 52 females) who visited the Outpatient Department of Sri Aurobindo Medical College and Postgraduate Institute, Indore, out of which those 100 patients with diabetes were taken as cases and 100 non-diabetic were taken as controls. Ethical clearance obtained for the study from the Institute Ethical Committee. Diabetes was defined as per American Diabetes Association (ADA) criteria¹³ for serum lipid reference level, National Cholesterol Education Programme (NCEP) Adult Treatment Panel III (ATP III) guideline was referred.¹⁴

Inclusion Criteria

1. Patients of age ≥ 30 years of both genders.
2. Patients with BMI ≥ 25 kg/m².
3. Type 2 diabetic patients.

Exclusion Criteria

1. Patients with known diagnosis of type 1 DM.
2. Patients with BMI ≤ 25 kg/m².
3. Patients already on drugs like lipid lowering drugs, beta blockers, thiazide, diuretics, steroids and oral contraceptives.
4. Diabetic patients with complications like neuropathy, nephropathy, retinopathy, ischaemic heart disease, diabetic ketoacidosis, non-ketosis hyperosmolar coma and hypoglycaemia.

5. Patients with any illness like chronic renal disease, chronic liver disease, hypothyroidism, familial hypercholesterolaemic syndromes.

After obtaining informed consent from patients, detailed history was taken followed by thorough physical examination and laboratory investigations. Venous blood samples collected from all the patients after at least 10 hours fasting. 2 mL whole blood was used for estimation of HbA1c and 3 mL serum was used for measurement of lipid profile. Glucose was estimated by enzymatic reaction glucose oxidase and peroxidase (GOD-POD).¹⁵ Serum total cholesterol as estimated by an enzymatic (CHOD-PAP) colorimetric method.¹⁶ Triglycerides were estimated by an enzymatic (GPO-PAP) method.¹⁷ HDL-cholesterol was estimated by a precipitant method.¹⁸ LDL-cholesterol was estimated by using Friedewald formula.¹⁹ LDL-cholesterol = total cholesterol - (HDL cholesterol + triglycerides/5).

Serum total cholesterol, HDL-C, LDL-C, VLDL-C and triglyceride levels were estimated by VITROS 5, 1 FS (dry chemistry analyser). Hb1Ac was estimated by following turbidimetric inhibition immunoassay method.²⁰ Glycated haemoglobin estimated by VITROS 5, 1 FS (dry chemistry analyser). Values of HbA1c were given as % of total haemoglobin and values of all other parameters were given in mg/dL. Statistical analysis was done using SPSS v 20. Independent sample t test were performed. Pearson's correlation coefficient was calculated to find the correlation between HbA1c and lipid parameters analysis was observed.

RESULTS

200 obese subjects included in the study out of which 148 (76%) were males and 52 (24%) were females. The mean glycated haemoglobin level of cases was found to be $10.17 \pm 1.40\%$, which was much higher than the mean glycated haemoglobin level of controls. Mean glycated haemoglobin level of controls is $6.55 \pm 0.67\%$. The majority (71%) of the cases had glycated haemoglobin value $>9\%$ whereas majority (84%) of the control had glycated haemoglobin value in the range of 6-9%. A significant difference ($P < 0.0001$) were found between the cases and controls. Glycated haemoglobin has a significant positive correlation with TC (total cholesterol), TG (triglycerides), LDL-C (low-density lipoprotein), VLDL-C (very low density lipoprotein) whereas a significant negative correlation with HDL-C (high-density lipoprotein) and HDL-C/LDL-C ratio. HbA1c can provide valuable supplementary information about the extent of circulating lipids besides its primary role in monitoring long-term glycaemic control.

Characteristics	Mean \pm SD
Mean Glycated Haemoglobin Level of Cases	$10.17 \pm 1.40\%$
Mean Glycated Haemoglobin Level of Controls	$6.55 \pm 0.67\%$

Table 1. Mean Glycated Haemoglobin Levels of Study Population

Characteristics	Categories	Case N (%)	Control N (%)	P value
HbA1c	<6%	0 (0.0%)	16 (16.0%)	<0.0001*
	6-9%	29 (29.0%)	84 (84.0%)	
	>9%	71 (71.0%)	0 (0.0%)	

Table 2. Distribution of Study Population Based Upon Glycated Haemoglobin Levels

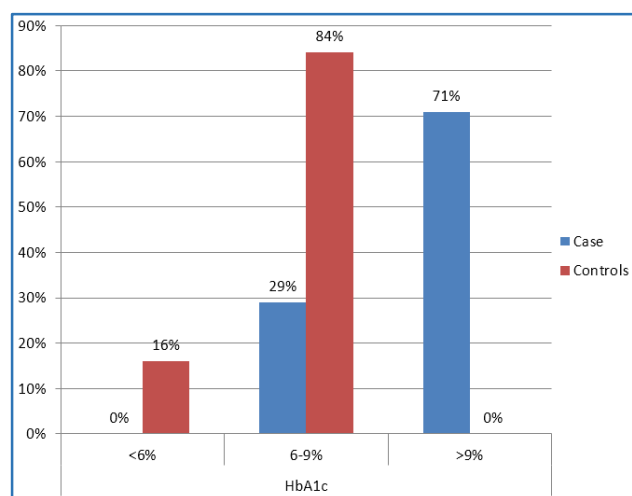
*p value<0.05: Statistically Significant Difference

	HbA1c r value (sig.)	TC r value (sig.)	TG r value (sig.)	HDLc r value (sig.)	LDLc r value (sig.)	VLDLc r value (sig.)	HDLc/LDLc r value (sig.)
HbA1c	1	0.551**	0.347**	-0.542**	0.641**	0.208**	-0.509**
TC	0.551**	1	0.560**	-0.458**	0.920**	0.329**	-0.780**
TG	0.347**	0.560**	1	-0.238**	0.557**	0.832**	-0.433**
HDL-C	-0.542**	-0.458**	-0.238**	1	-0.671**	-0.014	0.796**
LDL-C	0.641**	0.920**	0.557**	-0.671**	1	0.320**	-0.883**
VLDL-C	0.208**	0.329**	0.832**	-0.014	0.320**	1	-0.170*
HDL-C/LDL-C	0.208**	0.329**	0.832**	-0.014	0.320**	-0.170*	1

Table 3. Correlation of Glycated Haemoglobin Content with Serum Lipid Profiles

** . Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).



Graph 1. Distribution of Study Population Based Upon Glycated Haemoglobin Content

DISCUSSION

This present study is a further step towards understanding the correlation between glycated haemoglobin and serum lipid profile in obese type 2 diabetic individuals compared to obese non-diabetic individuals. Dyslipidaemia is very common in type 2 diabetes and it is characterised by hypertriglyceridemia and low levels of HDL-C.²¹ A significant difference (P<0.0001) was found between cases and controls when the TC, TG, HDL-C values, LDL-C values, VLDL-C values, HDL-C/LDL-C ratio where compared between them.

The studies of Santen et al and Peret et al observed mean serum triglyceride levels higher in obese diabetics in comparison to obese control subject.^{22,23} D Sharma and A Jain observed increase in the levels of serum total lipids, total cholesterol, serum triglycerides and serum phospholipids in diabetic subjects as compared to normal

controls.^{24,25} Bijlani et al found HDL-C to be significantly lower in obese diabetics when compared to normal weight diabetics.²⁶

While Yadav NK et al observed serum HDL-cholesterol levels did not differ significantly (P>0.05) in the two study groups, but level were low in obese diabetic compared to obese controls.²⁷ As expected obese diabetic had significantly higher fasting as well as postprandial blood sugar levels as compared to controls in present study. Also, the glycated haemoglobin level was significantly higher in obese diabetic patients. This indicates that the obese diabetic subjects had impaired blood sugar control indicating poorly-controlled diabetes.

In our study, Glycated Haemoglobin (HbA1c) had significant positive correlation with TC, TG, LDL-C, VLDL-C were as a significant negative correlation was observed with HDL-C and HDL-C/LDL-C ratio. Similarly, Arivarasan et al observed a direct and significant correlation between HbA1c with TC, TG and LDL and reverse correlation with HDL.²⁸ Thus, our study findings suggest that HbA1c level can be used as good parameter for predicting the lipid profile of diabetic patient's. Similar result was observed by Meenu et al.²⁹ So, as suggested by our study HbA1c can be used as a potential biomarker for predicting dyslipidaemia in diabetic patients that is also observed by Singh and Kumar.³⁰ HbA1c can provide valuable supplementary information about the extent of circulating lipids besides its primary role in monitoring long-term glycaemic control. Similar suggestion was given by Khan et al study.³¹

CONCLUSION

Our study ensures HbA1c status in obese diabetics and obese non-diabetics. HbA1c showed positive correlations with LDL-C cholesterol and negative correlations with HDL-C cholesterol and HDL-C/LDL-C ratio. A significant

correlation exists between HbA1c and lipid profile. These findings suggest that HbA1c level can be used as good parameter for predicting the lipid profile. Glycated haemoglobin level can be used as an alarming factor for blood glucose dysregulation as well as lipid dysregulation in all diseased patients. The better the glycaemic control as reflected by HbA1c, the better would be the lipidemic state. Achieving the target in HbA1c will contribute in improving the lipid state.

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