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A Crossectional Study of Glycosylated Haemoglobin ($HbA1_c$) Values in Type II Diabetes Mellitus & its Relationship with Lipid Profile and Diabetes Complications

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Research Article

Abstract: The present study was carried out with an objective to find out the correlation of glycosylated haemoglobin with blood sugar, serum cholesterol and triglyceride levels in patients having type II diabetes with and without complications. In this study 30 diabetic patients without any complication and 40 diabetic patients with microangiopathies, in which 20 were having diabetic retinopathy and 20 having diabetic nephropathy with retinopathy were compared with 30 normal subjects of same age group acting as a control group. Blood glucose levels (Fasting & Post meal), glycosylated haemoglobin, serum cholesterol and triglyceride were estimated in these three groups. In diabetes with microangiopathy the fasting blood glucose level was 232.92 ± 20.03, post-meal blood glucose level was 267.96 ± 25.68, HbA1c % was 10.48 ± 1.22, serum cholesterol 262.0 ± 11.30 and triglyceride 174.60 ± 7.87. In diabetes without any complications the fasting blood glucose level was 163.07 ± 20.31, post-meal blood glucose level was 208.33 ± 18.50, HbA1c % was 7.62 ± 0.69, serum cholesterol 213.66 ± 11.51 and triglyceride 151.08 ± 10.86. And in non-diabetic control subjects the fasting, post-meal blood glucose levels, HbA1c% serum cholesterol and triglyceride were 95.12 ± 9.31, 140.15 ± 9.43, 4.99 ± 0.98, 164.75 ± 13.39 and 120.0 ± 9.21 respectively. It was observed that the glycosylated haemoglobin % is more in diabetics and much more in diabetics with complications, and this increase in glycosylated haemoglobin % has a positive correlation with fasting, post-meal blood glucose, serum cholesterol and triglyceride levels.

Key words: Type II Diabetes, Glycosylated Haemoglobin (HbA1c), Retinopathy, Nephropathy.

Introduction:

Diabetes is a global epidemic with rapidly increasing prevalence in both developing and developed countries [1]. Diabetes mellitus is associated with devastating consequences when vascular complications are present. Vascular diseases are the cornerstone of long term complications in diabetes.

A recent study called the United Kingdom Prospective Diabetes Trial (UKPDT)[2], however, found that keeping blood sugar levels as close to normal as possible significantly reduced the damage to eyes, kidneys, and nerves caused by high blood sugar.

Assessment of blood sugar levels do not provide information about average blood sugar levels over long term which are necessary for initiating appropriate treatment.

In normoglycemic subjects a small proportion of haemoglobin A is attached to a carbohydrate moiety, thus creating what is called glycated or glycosylated haemoglobin. In conditions of sustained hyperglycemia such as in diabetes mellitus, the proportion of haemoglobin that is glycosylated is increased substantially.

Glycosylation of haemoglobin is a slow non-enzymatic, post-transitional event taking place over 120 days life-span of the RBC in which there is attachment of glucose with amino terminal valine of B chain of HbA. When properly assessed the percent of glycosylated haemoglobin gives an estimate of diabetic control for preceding 3 months period. On an average the non diabetic subjects have HbA1c values around 6 percent and the levels in poorly controlled diabetes may reach 10 – 12 percent [3].

Material & Methods:

The study was carried out in three groups:
Group I- Non-diabetic and acting as control group,
Group II- diabetes without any complication and
Group III- having diabetes with microangiopathies.

Following parameters were estimated.

1) Blood glucose levels
    a) Fasting
    b) Post meal
2) Glycosylated haemoglobin
3) Serum Cholesterol
4) Serum Triglyceride

The present study was carried out in diabetic clinic and medical wards in Govt. Medical College, Aurangabad.

Group I & II were having 30 subjects each, and group III was comprised of 40 subjects. Care was taken in selecting normal subjects of same age group as control group.

Diagnosis of diabetes was based on WHO criteria [4]. The duration of diabetes was recorded as period between the diagnosis and the date of examination.

Diagnosis of diabetic nephropathy was based on persistent proteinurea (>300mg/24hrs) in a diabetic patient with retinopathy and elevated blood pressure, but without urinary tract infection, other disease or heart failure.

The subjects were asked to report after overnight fasting for estimation of blood sugar, serum cholesterol and triglyceride. The venous sample was collected in plain and fluoride bulb. The blood was collected in EDTA bulb for estimation of glycosylated haemoglobin for which subject doesn't need to fast.

Parameters were measured with following methods:

1) Blood Sugar: Enzymatic GOD-POD end point calorimetry, single reagent chemistry[5].
2) Glycosylated haemoglobin: High performance liquid chromatography.
3) Serum cholesterol: Roeschlau COD/POD method [6]
4) Serum Triglyceride: Trinder's GPO / POD method [7]

The statistical treatment of the data was done using SPSS software which included calculation of the mean, standard deviation and Correlation of HbA1c levels with various parameters by Pearson's correlation co-efficient 'r'.

Results:

HbA1c% is positively correlated with fasting blood sugar (r = +0.46), post meal blood sugar (r = +0.43), serum cholesterol (r = +0.42), and serum triglyceride (r = +0.37) as shown in Table II, III, IV and V respectively.

Discussion:

American Diabetes Association (ADA) proposed the use of HbA1c in the definition of diabetes and the category of increased diabetes risk (which also includes impaired fasting glucose and impaired glucose tolerance) in 2010 [8]

Retrospective studies using measurements of glycosylated haemoglobin to evaluate relatively long-term glycemic control have suggested that, chronic hyperglycemia is closely related to the development of diabetic retinopathy. Diabetes Control and Complication Trial (DCCT 1993) proved that the strict blood glucose control reduces the risk of development and progression of diabetic retinopathy [9].

Javier Anglo et al have postulated that glycosylated haemoglobin may participate in the endothelial dysfunction described in diabetes, contributing to the development of vascular complications. Thus glycosylated haemoglobin could be useful, not only as a measure of glycemic control but also as a contributor to the pathophysiological mechanisms producing the diabetic vascular complications [10].

Nitric oxide (an endothelial derived relaxing factor) induces smooth muscle relaxation and is an important mediator in the regulation of vascular tone. Advanced glycosylation end products, the glucose derived moiety that are formed non-enzymatically and accumulate on long-lived tissue proteins, have been implicated in many of complications of diabetes and normal aging. Bucala R, Tracey KJ, Cerami A have demonstrated that the advanced glycosylation end products quench nitric oxide in vitro and in vivo, and inhibition of advanced glycosylation with aminoguanidine prevents nitric oxide quenching and ameliorates the vasodilatory impairment [11].

The American Diabetes Association (ADA) recommends glycosylated haemoglobin testing at least twice a year in patients who have stable glycemic control and more frequently (quarterly assessment) in patients whose therapy has changed or who are not meeting glycemic goals. The ADA recommends that the goal of therapy should be a glycosylated haemoglobin concentration <7 % and that the treatment regimes should be re-evaluated if glycosylated haemoglobin levels are consistently >8 % [12].

Conclusion:

In this study HbA1c is found to be correlated positively with fasting & post meal blood sugar, serum cholesterol and triglyceride levels. The products of glycation including HbA1c not only have the importance clinically in monitoring the cases of diabetes but also are found to produce adverse effects on vascular endothelium and thus contribute for the complications of diabetes such as diabetic retinopathy and nephropathy. It was concluded from the results of this study that HbA1c can be used as a predictor of dyslipidaemia in type II diabetics in addition to being used as a glycemic control parameter. It is also found that diabetic patients with incidence of complications have higher values of HbA_1c as compared to the controls and the diabetic patients without complications.

Therefore, in all cases of diabetes mellitus under treatment not only the HbA1c should be monitored but also its level should be maintained as per recommended values so as to avoid various microvascular and other complications of Diabetes.

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Table I showing age and sex distribution amongst control and diabetics:

Group	Type of subject	No. of cases	Sex M	Sex F	Age mean±SD
I	Normal control	30	17	13	54.20 ± 7043
II	Diabetic without complication	30	14	16	49.13 ± 4.63
III	Diabetic with Complication	40	20	20	57.77 ± 5.62

Table II showing correlation of fasting blood sugar & HbA1c%:

Group	Fasting blood sugar Mean±SD	HbA1c % mean±SD	Correlation of coefficient
I	95.12 ± 9.31	4.99 ± 0.98	r = +0.46
II	163.07 ± 20.31	7.62 ± 0.69	
III	235.92 ± 20.03	10.84 ± 1.22	

Table III showing correlation of post meal blood sugar & HbA1c%:

Group	Postmeal blood sugar Mean±SD	HbA1c % mean±SD	Correlation coefficient
I	140.15 ± 9.43	4.99 ± 0.98	r = +0.43
II	208.33 ± 18.50	7.62 ± 0.69	
III	267.96 ± 25.68	10.84 ± 1.22	

Table IV showing Correlation of serum cholesterol and HbA_{1c}%

Group	Serum cholesterol mg/dl Mean ± SD	HbA_{1C}% Mean ± SD	Correlation of co-efficient
I	164.75 ± 13.39	4.99 ± 0.98	r = +0.42
II	213.66 ± 11.51	7.62 ± 0.69	
III	262.0 ± 11.30	10.48 ± 1.22	

Table V showing Correlation of serum triglycerides and HbA_{1c}%

Group	Serum triglycerides mg/dl Mean ± SD	HbA_{1C}% Mean ± SD	Correlation of co-efficient
I	120.0 ± 9.21	4.99 ± 0.98	r = +0.37
II	151.08 ± 10.86	7.62 ± 0.69	
III	174.60 ± 7.87	10.48 ± 1.22	