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Original Research Article

Blood Glucose Levels and Glycosylated Hemoglobin in Patients with Non-Insulin Dependent Diabetes Mellitus (Niddm)

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Abstract

Diabetes mellitus has become a major health problem worldwide reaching epidemic proportions in many developing countries as well as in minority groups in many developed countries. (HbA1c) glycosylated hemoglobin is a valuable adjunct to blood glucose determinations in the assessment of glycemia control in individuals with diabetes mellitus. Present study was undertaken in 52 subjects. It consists of 26 control subjects with no present history of Diabetes mellitus and 26 diabetic subjects of type 2 diabetes mellitus (NIDDM).In the present study, glycosylated hemoglobin (HbA1c) and blood glucose levels were estimated in both control and diabetic group. It was concluded that glycosylated hemoglobin was raised in patients with diabetes mellitus which is highly significant (p<.0.001).Percentage of glycosylation of hemoglobin depends on mean blood glucose concentration.HbA1c assay allows clinicians to identify patients with relatively poor glycemia control and in conjugation with glucose monitoring,dietery instruction and adjustment of deug or insulin regimens can lead to improvement in glycemia control.

INTRODUCTION

Diabetes mellitus is a clinical syndrome featured by hyperglycemia due to absolute or relative deficiency of insulin. Long lasting metabolic derangement is associated with permanent and irreversible functional and structural changes in the cells of the body particularly vascular system .These changes lead to development of well-defined clinical entilities called complications of diabetes. Glycosylated hemoglobin assay is a powerful research tool that is unique as a retrospective index of glucose control over time in patients with diabetes. The glycosylated hemoglobin assay co-relates with mean plasma glucose levels and other index of metabolic control determined over preceding two to three months .Control of blood glucose levels is a major objective in managing patients with diabetes mellitus. Glycosylated hemoglobin assay reflects blood glucose control over previous 2-3 months; it should not be obtained in general, more than four times a year. The present study was carried out with a aim to make aware the patients with diabetes of the degree of blood glucose control by getting themselves investigated of HbA1c in order to minimise the risk of long term complications.

MATERIAL AND METHODS

Present study was conducted in the Department of Biochemistry and Guru Nanak, Dev Hospital Govt.Medical College, Amritsar. It comprises estimation of glycosylated hemoglobin and blood glucose (fasting).Total subjects were divided into two groups:

Control group: it consists of 26 apparently normal and healthy men and women in the age group 40-70 years .They were either the attendants of patients or employees of Guru Nanak Dev hospital with no history of diabetes

Diabetic group: Patients selected in the present study were of type 2

Diabetes of either sex (male or female) age 40-70 years.

A standard proforma was employed in every case where a detailed history regarding the onset and duration of the disease was properly recorded.

COLLECTION OF BLOOD SPECIMEN

5ml of blood was taken from the anterior cubital vein with a dry autoclaved syringe from each of the patient for present study and carried to the department of biochemistry for biochemical analysis .In every case precautions were

taken to prevent hemolysis of RBC.The entire procedure was carried out under aseptic conditions. The needle from the syringe was removed and 2 ml of sample was put in a properly cleaned vial containing a mixture of potassium oxalate and sodium fluoride in ratio of 3:1. From this vial 50 micro litre sample was taken separately in a test tube for analysis of HbA1c .Rest of the sample is centrifuged at 3000rpm for 10 minutes and plasma is seperated for investigation of blood glucose.

ESTIMATION OF GLYCOSYLATED HEMOGLOBIN (HbA1c)

Glycosylated hemoglobin was estimated by chromatographic method (ion -exchange temperature independent) with analytical kits.

PRINCIPLE: After preparing the hemolysate where the labile fraction is eliminated, hemoglobins are retained by cationic exchange resin.Hemoglobin A1C is specifically eluted after washing away HbAia and HbA1b fraction and is quantified by semi autoanalyser reading at 410 nm.

ESTIMATION OF BLOOD GLUCOSE

Blood glucose levels were estimated by the method using o-toluidine (hyvaria and nikkila, 1962)

PRINCIPLE: The o-toluidine reacts quantitatively with aldehyde group of aldohexoses to form glycosylamine which rearranges to form a Schiff z base, the intensity of which was measured colorimetrically at 650 nm (red filter).

OBSERVATIONS AND RESULTS

Table 1 shows the values of mean blood sugar and mean HbA1c in Control and diabetic subjects .So in normal individuals levels of mean blood glucose is 81.3 mg% and in diabetic it is between 163.5 mg%. So in diabetic blood glucose rises considerably. Table 2 shows the comparison of glycosylated hemoglobin (HbA1c) of, control and dibetic subjects. It is found that in dibetic individuals HbA1c levels fall between 6 and 10%. In some cases values above 10 were also. In control subjects values between 4 and 6 shows that (controls) healthy individuals also show glycosylation of hemoglobin to some extent. T value comes out tobe 16.4 with $p<0.001$ which is highly significant.

TABLE - 1

Mean glucose in control and diabetic groups.

Sr. no	Subject	No. of individuals	Mean HbA1c (in %)	Mean blood glucose (in mg%)
1	Control	26	4.305	81.3
2	Diabetic	26	7.93	163.5

TABLE -2

Glycated hemoglobin in control and diabetic group.

Sr. no	Subject	No. of individuals	Glycated hemoglobin (in %)	Mean +_ SD	S.E
1	Control	26	4-6	4.305+_ 0.94	0.184
2	Diabetic	26	6-10	7.93+_ 1.83	0.359

t= 16.4

p< 0.001

DISCUSSION

Diabetes mellitus has become a major health problem worldwide, reaching epidemic proportions in many developing countries , as well as in minority groups in developed countries .Health care costs due to diabetes are approximately 14 percent of total health care budget ,with half in direct costs ,and they too are projected to rise considerably .Type 1 diabetes is accompanied by long term microvascular and macrovascular complications, primary cause of morbidity and

mortality in these patients .Epidemiological data suggest that classic cardiovascular risk factors like hypercholestrolemia , hypertension and smoking do not account for the excess risk of cardiovascular morbidity and mortality in type diabetes mellitus .Regular monitoring of glycaemic status of a diabetic patient is considered a cornerstone of diabetes care .Results of monitoring are used to assess the efficacy of therapy and do guide adjustments in lifestyle to achieve best possible glucose control.The t tests used in monitoring the glycaemic status of people with diabetes are blood glucose and glycated hemoglobin.Of the several pathogenic mechanism by which hyperglycemia may lead to an altered tissue structure and function ,non -enzymatic glycosylation causes altered structure and function of several soluble and insoluble proteins . Non -enzymatic glycosylation is the attachement of free aldehyde groups of glucose or other sugars of the unprotonated free amino groups of proteins. It changes also the structure and function of isolated basement membrane components.

The accumulation of glycation products and the accompanying structural modifications correlate with the developement of functional complications of diabetes. These changes in tissue structures and function are slow and cumulative, resulting in a long time lag between the diagnosis of diabetes and the onset and progression of the complications of diabetes mellitus. Following table shows the mean values of glycosylated hemoglobin and blood glucose concentration in both control and diabetic group. It is evident that HbA1c is directly proportional to the mean blood glucose concentration (MBG) for extended period of time (6-8)weeks.As the glucose concentration in the blood rises glycosylation of hemoglobin also rises and glucose remains attached to erythrocytes for whole of its life (120 days) .the results of the present study has been verified by DCCT which gives following relationship between mean blood glucose concentration and glycosylated hemoglobin :

MBG(mg %)= 31.7* %HbA1c- 66.1

Hemoglobin is one among many proteins that undergo non-enzymatic glycosylation and glycated hemoglobin is a general term for hemoglobin non-enzymatically glycated by glucose. Rahbar first described glycohemoglobins in 1968 as diabetic hemoglobins .The human erythrocyte is freely permeable to glucose and within each erythrocyte glycohemoglobin is formed at a rate dependent on the ambient concentration of glucose .Concentration of glycosylated hemoglobin is raised in diabetics as compared to normal healthy individuals .It was observed that HbAic values reached upto 10 or above in diabetics while in controls it remained between 4 and 6.

By column chromatography of adult hemoglobin are detected certain minor components designated A1a,A1b,A1c which have an isoelectric point lower than that of main HbA. Making upto about 5% of total hemoglobin in normal adult red cells HbA1C has structure differing from that of HbA as the N-terminal amino group of each beta chain is covalently bonded to glucose by a Schiff s base .This glycoprotein is increased in patients with diabetes mellitus .Assay adopted for the glycosylated hemoglobin fo present study is based on column chromatography. Glycohemoglobin reflects the mean blood glucose concentration over the previous 8-10 weeks .Measurement of glycosylated hemoglobin is recommended by organisation like the American Diabetes Association and is widely used in clinical practice to monitor glycemia in diabetic patients .It serves as a key predictor of the risk to develope diabetic complications.Most important , the measurement of glycated hemoglobin served as a primary parameter of glycaemia control in major clinical trials(DCCT and UKPDS) which addressed the efficacy of intensive diabetic therapy in preventing or delaying long term diabetic complications. In addition knowledge of glycated hemoglobin levels appears to alter the behaviour of health care providers or patients, in turn improving glycaemia and lowering glycosylated hemoglobin levels .If HbA1c is between4 -6% person is said to be non-diabetic. If it is between 6-7% it is on the verge of developing diabetes, if it is between 7-8% after taking treatment it is considered as Good Control and if it is above 8% with treatment going on than the treatment regimen must be changed so as to have control over the disease .HbA1c value is not modified by eating or fasting. This is very important practical advantage of HbA1c, measurement in a mass diabetes detection programme, since in this type of survey, it impossible to ascertain fasting, especially when children are included.

The results of present study indicate that the hemoglobin A1C assay provides a measurement of metabolic control over time that is not otherwise obtainable in the usual clinical setting. Although refinement of indexes of short term glucose control may lead to a better appreciation of long term control, no currently available single assessment is an informative about long term control as the glycosylated hemoglobin assay.

SUMMARY AND CONCLUSIONS

Long lasting diabetes of either type results in complications in the form of microangiopathy ,retinopathy ,nephropathy and neuropathy .Complications of diabetes results mainly from hyperglycemia and mechanism linking hyperglycemia to complications of long standing diabetes are also known. One important mechanism is non-enzymatic glycosylation in which glucose chemically attaches amino groups of proteins without aid of enzymes .In the present study, glycosylated hemoglobin and blood glucose were estimated in both normal subjects and patients suffering from diabetes mellitus. In conclusion both glycosylated hemoglobin and blood glucose increased in diabetes mellitus.

Glycosylated hemoglobin measurements provide accurate information regarding mean blood glucose control integrated during the preceding six to eight weeks.

Current need of the day is not only to diagnose the disease at the earliest but to cure it so as to have a better life free out of disease.

REFERENCES

1. American Diabetes Association. (2001). American Diabetes Association clinical practice recommendations 2001. Diabetes Care, 24(1), 1-133.
2. Baynes, J. W., Bunn, H. F., Goldstein, D., Harris, M., Martin, D. B., Peterson, C., & Winterhalter, K. (1984). National Diabetes Data Group: report of the expert committee on glucosylated hemoglobin. Diabetes Care, 7(6), 602-606.
3. Bell, E. T. (1952). Hyalinization of the islets of Langerhans in diabetes mellitus. Diabetes, 1(5), 341-344.
4. BrowleeM; Vlassar Hand Cerami A. Ann Int med 1984;101:527-37
5. Franklin Bunn, H. (1981). Evaluation of glycosylated hemoglobin in diabetic patients. Diabetes, 30(7), 613-617.
6. Diabetes Control and Complications Trial Research Group. (1986). The Diabetes Control and Complications Trial (DCCT), design and methodologic considerations for the feasibility phase. Diabetes, 35, 530-545.
7. Gabbay, K. H. (1976). Glycosylated hemoglobin and diabetic control. New England Journal of Medicine, 295(8), 443-444.
8. Boucher, B. J., Burrin, J. M., Gould, B., John, P. N., Lewis, G., Owens, C., ... & White, J. M. (1983). A collaborative study of the measurement of glycosylated haemoglobin by several methods in seven laboratories in the United Kingdom. Diabetologia, 24(4), 265-271.
9. Hofmann, M., & Klinkenberg, R. (Eds.). (2016). RapidMiner: Data mining use cases and business analytics applications. CRC Press.
10. Endocrine and metabolic disorders – oxfords textbook of public health ,3rd ed 1997:5-1124
11. King, H., Taylor, R., Zimmet, P., Pargeter, K., Raper, L. R., Beriki, T., & Tekanene, J. (1984). Non-insulin-dependent diabetes (NIDDM) in a newly independent Pacific nation: the Republic of Kiribati. Diabetes care, 7(5), 409-415.
12. Koji et al .Immediate elimination of labile HbA1c with allosteric effectors of hemoglobin .Diabetes 1990 ;39 .
13. Larsen, M. L., Hørder, M., & Mogensen, E. F. (1990). Effect of long-term monitoring of glycosylated hemoglobin levels in insulin-dependent diabetes mellitus. New England Journal of Medicine, 323(15), 1021-1025.