ROLE OF HbA1c IN DETERMINING GLYCAEMIC CONTROL IN DIABETES MELLITUS

Sangita Choudhary[1], Rajesh Kumar[2]

[1]Assistant Professor, Department of Biochemistry, Katihar Medical College, Bihar.
[2]Associate Professor, Department of Pathology, Katihar Medical College, Bihar.

ABSTRACT

BACKGROUND

Diabetes mellitus is disorder of metabolism characterised by chronic hyperglycaemia resulting from an absolute/relative insufficiency of insulin secretion, insulin action or most commonly both.[1] Type 2 diabetes is more common and account for 90-95% of diabetic patient.[2] Severity of diabetes triggers a vast group of complications, both microvascular or macrovascular.[3]

MATERIALS AND METHODS

Glycosylated Haemoglobin (HbA1c) is a form of haemoglobin, which used primarily to identify the average plasma glucose concentration over prolonged periods of time (8 to 12 weeks).[4] The early diagnosis and glycaemic control in diabetes mellitus is important because control of blood sugar level can reduce the risk of long-term complications (Babcock Irvin C, et al; 2000)[5] and may improve treatment (Larsen ML, et al; 1990).[4]

RESULTS AND CONCLUSION

The primary aim of this work is to establish the role of HbA1c in monitoring the progression of disease and glycaemic control in diabetic patients.

KEYWORDS

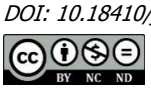
Glycosylated Haemoglobin, Diabetes Mellitus, Hyperglycaemia, Blood Glucose, Insulin.

HOW TO CITE THIS ARTICLE: Choudhary S, Kumar R. Role of HbA1c in determining glycaemic control in diabetes mellitus. J. Evid. Based Med. Healthc. 2016; 3(81), 4403-4405. DOI: 10.18410/jebmh/2016/937

BACKGROUND: Diabetes mellitus is one of the main threats to human health in twenty first century (Zimmet 2000).[6] Over the past several decades, diabetes mellitus has become a major health problem worldwide reaching epidemic proportions in many developing countries especially in India. Diabetes mellitus is a disorder of metabolism characterised by chronic hyperglycaemia resulting from absolute/relative insufficiency in insulin secretion, insulin action or most commonly both. The chronic hyperglycaemia of diabetes and attendant metabolic deregulation maybe associated with a vast group of complications with secondary damage in multiple organ systems especially the kidneys, eyes, nerves, heart and blood vessels.[1] The worldwide prevalence of diabetes has risen dramatically over past two decades. Based on current trends, more than 360 million individuals will have diabetes by the year 2030 (Harrison, 17th edition).[7] The complications of diabetes are influenced not only by the duration of diabetes, but also by the average level of chronic glycaemia.

Acute life-threatening consequences of uncontrolled diabetes are hyperglycaemia with ketoacidosis or nonketotic hyperosmolar syndrome.

Financial or Other, Competing Interest: None.
Submission 01-09-2016, Peer Review 07-09-2016,
Acceptance 25-09-2016, Published 10-10-2016.
Corresponding Author:
Dr. Rajesh Kumar,
Associate Professor, Department of Pathology,
Katihar Medical College, Katihar-854105, Bihar.
E-mail: dr.rajpmch@gmail.com
DOI: 10.18410/jebmh/2016/937



AIM AND OBJECTIVES: Long-term complications of diabetes include retinopathy, nephropathy, peripheral neuropathy and autonomic neuropathy. There is also an increased incidence of atherosclerosis, cardiovascular disease, peripheral arterial disease, cerebrovascular disease, hypertension and abnormalities of lipoprotein metabolism. (Diabetic Care, 1997).[1,8,9]

Glycosylated Haemoglobin (HbA1c): Is a form of haemoglobin, which used primarily to identify the average plasma glucose concentration over prolonged periods of time (8 to 12 weeks).[10] It is formed by a non-enzymatic glycation of haemoglobin. Diagnosing diabetes mellitus by fasting and postprandial plasma glucose are not suitable for acutely ill patients. A single fasting blood glucose measurement only gives an indication of the patient's immediate past (Last 1-2 hours) condition and may not represent the true glycaemic control. HbA1c level provides a representation of blood glucose levels over the preceding several months and does not require the patients to fast or undergo glucose challenges. The early diagnosis and glycaemic control in diabetes mellitus is important because control of blood sugar level can reduce the risk of long-term complications (Babcock Irvin C, et al; 2000) and may improve treatment (Larsen ML, et al; 1990). But, within day biological variability of plasma glucose might unveil disturbance of glucose metabolism, but HbA1c cannot.

Diabetes Control and Complication Trial (DCCT), a great extent study has demonstrated that the 10% stable reduction in HbA1c determines 35% risk reduction for retinopathy, a 25-44% risk reduction for nephropathy and

30% risk reduction for neuropathy (Lorenza Calisti et al, 2005).[11]

MATERIAL AND METHODS: The present work "Role of HbA1c in determining glycaemic control in diabetes mellitus" has been carried out in the Department of Biochemistry and Central Laboratory, Katihar Medical College, Katihar, on the clinically diagnosed cases of diabetes mellitus and control group. The patients were categorised in three groups on the basis of taking drugs regularly or not, on diet control or not, and on regular exercise or not. These cases were selected from Outdoor and Indoor Department of Medicine, Katihar Medical College and Hospital.

In the present study, 50 cases of known diabetics were selected from different age groups and of both sexes, ranging from 30 to 60 years. 20 cases of non-diabetics healthy individuals has been selected as control group. Their consent was taken. In the selection of control group (Healthy Individuals), care had been taken to match the range of age with that of the test group (Diabetic patients). The diagnosis of diabetes mellitus was made on the basis of history and laboratory investigations of urine and blood. The criteria for diagnosis of diabetes mellitus were of patients having the fasting blood glucose equal or more than to 126 mg/dL and postprandial blood glucose value equal or more than 200 mg/dL and HbA1c level more than or equal to 6.5% (ADA-2010).[12,13] The patients were studied as follows:

a. Detailed history taking and clinical examination,
b. Plasma glucose and HbA1c levels were estimated in blood.

Estimation of Glucose Level in Blood is done by Glucose Oxidase Peroxidase (GOD-POD) method.

Estimation of Glycosylated Haemoglobin is done by Ion Exchange Resin Method.

RESULTS AND DISCUSSION: This work **"**Role of HbA1c in determining glycaemic control in diabetes mellitus" was done on 50 patients and 20 controls having age between 30-60 years and of both sexes in the Department of Biochemistry and Central Laboratory, Katihar Medical College, Katihar, and following observations were made. The age wise mean blood glucose and HbA1c among control group shows that the maximum mean of all the variables were found among age group 51-60 years and minimum were among 30-40 years. It shows that there is general tendency of increasing blood plasma glucose and HbA1c with increasing age.

The fasting blood glucose levels varied from 68.7-88.25 mg/dL (mean±S.E.M., 79.96±1.11), postprandial blood glucose level varied from 77-101 mg/dL (mean±S.E.M., 90.57±1.51) and glycosylated haemoglobin ranged between 4.50 to 6.11% (mean±S.E.M.; 5.30±0.05). The fasting blood glucose level is well within normal limits (<100 mg/dL) among control group that is comparable to W.H.O. expert committee report on diabetes mellitus.

A positive correlation of blood plasma glucose with age and HbA1c was found in this study among normal healthy individuals. In diabetic patients, there were 50 patients of both sexes in study group of age ranging from 30-60 years. The maximum incidence of diabetes mellitus was in 41-50 years of age groups in this study that was 49.33%. Incidence of diabetes is found more in male in comparison to female. The age and sex incidence in this work is nearly similar to that mentioned in W.H.O. expert committee report on diabetes mellitus. To assess glycaemic control and its relation to serum HbA1c, the diabetic group was divided into 3-subgroups depending upon regular medication, diet control and regular exercise.

The Entire Diabetic Patients were divided into Three Groups:

Group I: Diabetic patients on regular medication, diet control and on regular exercise (Good Glycaemic Control).

Group II: Diabetic patients on regular medication, without diet control and on irregular exercise (Poor Glycaemic Control).

Group III: Diabetic patients on irregular medication, without diet control and on irregular exercise (Bad Glycaemic Control).

Group I: Diabetic Patients on Regular Medication, Diet Control and on Regular Exercise: The fasting blood glucose levels varied from 86.5 to 111.25 mg/dL with (mean±S.E.M., 99.30±1.50), postprandial blood glucose levels varied from 102.25 to 127.5 mg/dL (mean±S.E.M., 113.10±1.6) and glycosylated haemoglobin (HbA1c) levels in diabetic, which are on regular medication, diet control and regular exercise varied from 5.90 to 7.15% (mean±S.E.M., 6.38±0.82). It was observed that HbA1c was within the range of control. The figures in this study are slightly lower than the Chandalia et al (1980)[14] and Raheja et al (1981).[15] This may be due to differences in the criteria adopted for classifying the degree of control. Chandalia et al (1980) had considered good control if fasting and postprandial blood plasma glucose were <120 mg/dL and 145 mg/dL, respectively. Raheja et al (1981) considered good control if 2-hrs. postprandial blood plasma glucose level was <140 mg/dL.

Group II: Diabetic Patients on Regular Medication, Without Diet Control and on Irregular Exercise: Fasting blood glucose levels varied from 99.7 to 117.5 mg/dL with (mean±S.E.M., 110.5±1.72), postprandial blood glucose levels varied from 121.5 to 157.75 mg/dL (mean±S.E.M., 136.36±2.75). The Glycosylated Haemoglobin (HbA1c) in this group ranged between 7.65 to 9.75% (mean±S.E.M., 8.70±0.17). The result shows that HbA1c increases more in this group in comparison to the level among good glycaemic control group (Group I).

Group III: Diabetic Patients on Irregular Medication, Without Diet Control and on Irregular Exercise: Fasting blood glucose levels varied from 111.00 to 173.75 mg/dL with (mean±S.E.M., 139.16±4.56), postprandial blood glucose levels varied from 144.75 to 247.50 mg/dL with (mean±S.E.M., 181.30±7.55) and glycosylated

haemoglobin level among this group ranged between 9.00 to 10.76% with (mean±S.E.M., 9.83±0.14).

The level of blood glucose and HbA1c among this group was increased significantly when compared to other groups. Scobie et al (1981) observed that a rise in blood plasma glucose concentration of 2.5 mmol/L (45 mg/dL) could produce a significant increase in HbA1c concentration of almost (1%) of total haemoglobin and this increase appeared 10 days after the hyperglycaemia and remained high until 30 days.[16]

Similarly, Svendsen et al (1979) reported that HbA1c increased in diabetic patients within hours after blood glucose concentration was raised by means of an intravenous infusion of glucose. They showed that HbA1c value returned to pre-infusion levels after incubation of blood samples for 17 hrs. in glucose free solution.[17]

CONCLUSION: The entire work may be summarised as follows:

1. The glycosylated haemoglobin was in normal range among the control group, but there was a positive correlation of blood glucose and HbA1c with age.
2. Among the diabetic patients with good glycaemic control, the HbA1c levels was also within normal range with positive correlation with blood sugar control.
3. It was observed that among the poor and bad glycaemic control groups, the HbA1c levels was increased with the increase in their blood glucose level indicating the glycation increases with the persistent increase in blood glucose level.
4. It was observed that lifestyle changes can dramatically reduce the incidence of diabetes and slow the HbA1c increase in both non-diabetic and diabetic individuals. Broadly adopted lifestyle changes should therefore reduce diabetes-related complications.

As we know that lifestyle changes can dramatically reduce the incidence of diabetes and slow the HbA1c increase in both non-diabetic and diabetic individuals. Broadly adopted lifestyle changes should therefore reduce diabetes-related complications. So, on the basis of entire work, finally, it maybe concluded that the HbA1c test provides crucial information about glycaemic control and progression of disease (Complications) in patients with diabetes. It seems to be considered the most significant parameters for monitoring diabetic control and institution of appropriate drugs for the management of the diabetes and prevention of its complications.

REFERENCES

1. Expert committee on the diagnosis & classification of diabetes mellitus. Report of the expert committee on the diagnosis and classification of diabetes mellitus. Diabetes Care 2002;25(Suppl 1):S5-S20.
2. Mitchell RN, Kumar V, Abbas AK. Robbins & Cotran pathologic basis of disease. 8th edn. Saunders 2012.
3. Fajans SS, Cloutier MC, Crowther R. Clinical & etiological heterogeneity of idiopathic diabetes mellitus (Banting memorial lecture). Diabetes 1987;27:1112-1125.
4. Larsen ML, Horder M, Mogen FF. Effect of long-term monitoring of glycosylated haemoglobin levels in insulin dependent diabetes mellitus. N Engl J Med 1990;323:1021-1025.
5. Babcock IC, Wyer PC, Gerson LW. Preventive care in the emergency department, part II: clinical preventive services-an emergency medicine evidence based review. Society for academic emergency medicine public health and education task force preventive services work group. Acad Emerg Med 2000;7(9):1042-1054.
6. Zimmet P. Globalization, coca-colonization & the chronic disease epidemic; can the doomsday scenario be averted? J Intern Med 2000;247(3):301-310.
7. Fauci AS, Kasper DL, Longo DL. Harrison's principles of internal medicine. Vol. 2. 17th edn. McGraw-Hill 2008.
8. Diabetes Control and Complications Trial (DCCT) research group. The relationship of glycaemic exposure (HbA1c) to the risk of development and progression of retinopathy in the diabetes control and complications trial. Diabetes 1995;44(8):968-983.
9. Diabetes control and complications trial research group. The effect of intensive diabetes treatment on the development and progression of long-term complications in insulin dependent diabetes mellitus. N Engl J Med 1993;329:977-986.
10. Bunn HF, Gabbay KH, Gallop PM. The glycosylation of hemoglobin: relevance to diabetes mellitus. Science 1978;200(4337):21-27.
11. Calisti L, Tognetti S. Measure of glycosylated hemoglobin. Acta Biomed 2005;76(Suppl 3):59-62.
12. American Diabetes Association. Summary of revisions for the 2008 clinical practice recommendations. Diabetes care 2008;31(Suppl 1):S3-S4.
13. American Diabetes Association. Standards of medical care of diabetes. Diabetes Care 2010;33(Suppl 1):S11-S61.
14. Chandalia HB, Sadikot S, Bhargava DK, et al. Estimation of glycosylated haemoglobins by a simple chemical method and it was monitoring control of diabetes mellitus. J Assoc Phys Ind 1980;28(9):285-6.
15. Raheja BS, Lyer PD, Bhargava D, et al. GHb: its value in the management of diabetes mellitus. J Assoc Phys Ind 1981;29:609-12.
16. Scobie IN, Thomson P, Jonstone F, et al. GHb after oral glucose load. Por Med Jour 1981;283:877-8.
17. Svendsen PA, Christiansen JS, Andersen AR, et al. Fast glycosylation of haemoglobin. Lancet 1979; 1(8116):1142-1143.