

Assessment of Haemoglobin A1c in the Prediction of Risk of Development of Diabetes

Meenakshi Puri¹, Waseem²

ABSTRACT

Introduction: Diabetes comprises of a group of metabolic diseases manifested by hyperglycemia resulting from defects in insulin secretion, insulin action, or both. For the prevention of diabetic complications, good glycemic control is necessary. The level of glycosylated hemoglobin provides a measure of the glycemic control of diabetes patients during the previous 2–3 months. Hence; we planned the present cohort study to evaluate the applicability of HbA1c baseline levels as predictor of new onset diabetes.

Material and methods: The present study included assessment of all the patients reporting the department from last one year. All the patients between age group of 40 to 65 years were included for the present study. Questionnaire was given to the patients in which patient was asked about their diagnosis of diabetes and telephone number to contact them. Only those patients were selected for the study, in which diabetes was not diagnosed and gave telephone number to contact them for the study. All subjects with HbA1c $\geq 6.0\%$ were invited back for follow-up Fasting plasma glucose (FPG) to complete the baseline diabetes assessment. Demographic details of the patients were also recorded. All the results were analyzed by SPSS software.

Results: 56.2 years was the mean age of the subjects included in the present study. 93.5 percent of the subjects in the present study were males while 6.5 were females. 40 percent of subjects in the present study were overweight while 36 percent were obese. 57 percent of the subjects were affected by hypertension. 0.9 and 2.7 were the incidence of normal and high normal per 100 subjects per year respectively while 7.9 was the incidence of the elevated HbA1c category.

Conclusion: By identification of the high risk populations with increase in the efficacy of screening protocol of these systemic diseases.

Keywords: Diabetes, HbA1c, Screening

INTRODUCTION

Diabetes is referred to as a group of metabolic diseases manifested by hyperglycemia resulting from defects in insulin secretion, insulin action, or both. The chronic hyperglycemia occurring in diabetes causes a substantial loss of the visceral organs including damage and dysfunction of the eyes, renal tissues, nerves, cardiac tissues and micro-vasculature of the body.¹ Pathogenesis for the development of diabetes is multifactorial and varies from autoimmune basis leading to the damage of β -cells of the pancreatic tissue further resulting in the deficiency of the insulin leading to the resistance to insulin. Decrease in the activity of insulin on target tissues is the main effect in diabetes which leads to the basic abnormality in carbohydrate, fat, and protein metabolism.² decrease in action of insulin is experienced because of insufficient secretion of insulin and reduced response of tissues to the insulin at some points in hormonal pathways. primary etiology of the hyperglycemia

is very difficult to diagnose because same patient has both abnormality in insulin secretion and defect in action of insulin.³ Clinical manifestation of diabetes includes polyuria, polydipsia, weight loss, sometimes with polyphagia, and blurred vision.⁴ For the prevention of diabetic complications, good glycemic control is necessary.⁵ During the past two three months the measure of glycemic control of the patients with diabetes is done by the amount of glycosylated hemoglobin (HbA1c). For the study regarding relation between HbA1c and diabetic complications and the clinician, different inferences can be possible due to some changes observed in levels of HbA1c in addition to its average level. In the present scenario, the term HbA1c-variable is used to describe how diabetic complications are related to different combinations and weighting of HbA1c-values relate to diabetic complications.⁷ Hence; we planned the present cohort study to evaluate the applicability of HbA1c baseline levels as predictor of new onset diabetes.

MATERIAL AND METHODS

Planning of the present study was done in the department of Biochemistry of the medical institute and included assessment of all the patients reporting the for department last two years. All the patients between age group of 40 to 65 years were included for the present study. Questionnaire was given to the patients in which patient was asked about their diagnosis of diabetes and telephone number to contact them. Only those patients were selected for the study, in which diabetes was not diagnosed and gave telephone number to contact them for the study. A written informed consent was obtained from the patient after educating them about the study's procedure. For the present study, ethical approval was obtained from the ethical committee of the institute before commencing the study.

Screening protocol for diabetes

Measurement of HbA1c by HPLC was done on all subjects; initially by one machine and later by chromatograph. Calibrations of the both the machines were done to a physiologic range of 4 percent to 6 percent. Fasting plasma glucose (FPG) was measured to complete the baseline diabetes assessment. For two years, subjects were interviewed annually by phonic conversation to assess whether diagnosis of diabetes was given to them or not. Definition of diabetes was given as the subjects

¹Senior Resident, Department of Biochemistry, PIMS Jalandhar, Punjab, ²Consultant, Department of Medicine, CYGNUS Hospital, Delhi, India

Corresponding author: Dr. Meenakshi Puri, Senior Resident, Department of Biochemistry, PIMS Jalandhar Punjab, India

How to cite this article: Meenakshi Puri, Waseem. Assessment of haemoglobin A1 c in the prediction of risk of development of diabetes. International Journal of Contemporary Medical Research 2017;4(1):301-303.

with HbA1c \geq 7.0% or FPG \geq 7.0 mmol/L (126 mg/dl).

STATISTICAL ANALYSIS

Demographic details of the patients were also recorded. All the results were analyzed by SPSS software. Chi-square test, student t test and multi-variate analysis were used for the assessment of level of significance. P-value of less than 0.05 was considered as significant.

RESULTS

Demographic details of the patients is highlighted in Table 1. Mean age of the subjects included in the present study was 56.2 years. 93.5 percent of the subjects in the present study were males while 6.5 were females. 40 percent of subjects in the present study were overweight while 36 percent were obese. 57 percent of the subjects were affected by hypertension. Table 2 and Figure 1 shows the incidence of diabetes in subjects on the basis of baseline HbA1c characteristic. 0.9 and 2.7 were the incidence of normal and high normal per 100 subjects per year respectively while 7.9 was the incidence of the elevated HbA1c category.

DISCUSSION

One of the potential useful interventions is the systematic screening for diabetes because diabetes is one of the prevalence and frequently affecting disease with high morbidity.⁸ Still conflicts exists regarding the recommendations from professional organizations regarding diabetes screening, with some organizations failing to support diabetes screening, and others recommending screening all patients 45 and over every 3 years.⁹ The significance of the HbA1c as a risk factor can be underestimated due to the fact that most of the studies used the baseline values of HbA1c¹⁰ Equal weightage is given to all the historic HbA1c measurements by the updated mean value of HbA1c due to which considerable underestimation is given to the importance of glycaemic control.¹¹ Hence; we planned the present cohort study to evaluate the applicability of HbA1c baseline levels as predictor of new onset diabetes.

In the present study, we observed that HbA1c strongly predicts the development of diabetes among the subjects undergoing screening. Our results were in correlation with the results obtained by Edelman et al who observed similar findings in their study.¹² Edelman et al assessed the frequency of occurrence of new cases of diabetes among the patients visiting the health care centre. They planned the study to evaluate the haemoglobin A1c (HbA1c) values and to assess whether over the three years of observation period, the levels of HbA1c would allow risk stratification for development of diabetes in the patients. The three year follow-up study was conducted by them which was a prospective cohort in nature and was conducted at Department of Veterans Affairs Medical Center (VAMC). A total of 1253 subjects were rolled in their study which ages between 45 to 64 years and were scheduled to visit at the VAMC. Screening was carried for the presence of diabetes by measuring the HbA1c values. For the measurement of fasting plasma glucose (FPG), invitation was given to all the subjects with HbA1c \geq 6.0% (normal, 4.0% to 6.0%) The only significant predictors found in the present study of multivariate regression model, which were found to be associated with onset of diabetes, were

Parameter	Value (%)	
Mean age (years)	56.2	
Gender (% of individual)	Male	93.5
	Female	6.5
BMI (% of individuals)	Normal	24
	Overweight	40
	Obese	36
Hypertension (% of individuals)	57	

Table-1: Demographic details of the patients

Hb A1c category	Incidence per 100 persons / year
Normal	0.9
High normal	2.7
Elevated	7.9

Table-2: Incidence of diabetes in subjects on the basis of baseline HbA1c characteristic

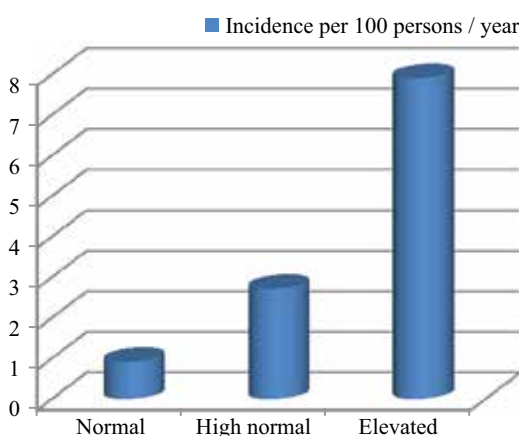


Figure-2: Incidence of diabetes in subjects on the basis of baseline HbA1c characteristic

baseline HbA1c and baseline body mass index (BMI). From the results, they concluded that development of diabetes in subjects can be predicted by HbA1c.¹² Analysis of data from the Juvenile Diabetes Research Foundation continuous glucose monitoring (CGM) was done by Thomas et al. they extracted all the information regarding various parameters which were integrated in the GPM and analysed. They assessed a total of 108 subjects and observed a significant reduction in the values of HbA1c from 7.4% to 7.0% which was also accompanied by a downfall in the values of glycemia from 164 to 156 mg/dl. This was followed a significant decline in the GRP from 3.3 to 2.7; this decrease by 18.2% was significantly larger than that in HbA1c by 8.6%. This observation was supported by the change in the individual's GPMs/ GRPs. Also, the showed and demonstrated the effect of high glycaemic variability on GPM/ GRP. From the results, they concluded that a long term study is required for validation of such models.¹³ In a study conducted by Lind et al, assessment of the risk of development of diabetes was done along with its association with mean HbA1c. They tested several different HbA1c variables along with profiles to assess their long term effect. They compared the updated mean HbA1c values of predicate variables. In comparison with the updated mean HbA1c values, the predicative values of HbA1c differed considerably. From the results, they concluded that in prevention of diabetic complications, good glycaemic control plays a crucial role.¹⁴

CONCLUSION

From the above results, the authors concluded that by identification of the high risk populations with increase the efficacy of screening protocol of these systemic diseases. However, future studies are recommended.

Source of Support: Nil; **Conflict of Interest:** None

Submitted: 06-01-2017; **Published online:** 19-02-2017

REFERNECES

1. Genuth S, Alberti KG, Bennett P, Buse J, Defronzo R, Kahn R et al. Expert Committee on the Diagnosis and Classification of Diabetes Mellitus², the Expert Committee on the Diagnosis and Classification of Diabetes Mellitus. Follow-up report on the diagnosis of diabetes mellitus. *Diabetes Care*. 2003;26:3160–3167.
2. International Expert Committee International Expert Committee report on the role of the A1C assay in the diagnosis of diabetes. *Diabetes Care*. 2009;32:1327–1334.
3. Edelman D, Olsen MK, Dudley TK, Harris AC, Oddone EZ. Utility of hemoglobin A1c in predicting diabetes risk. *J Gen Intern Med*. 2004;19:1175–1180.
4. Pradhan AD, Rifai N, Buring JE, Ridker PM. Hemoglobin A1c predicts diabetes but not cardiovascular disease in nondiabetic women. *Am J Med*. 2007;120:720–72.
5. DCCT Study Group. The Effect of intensive treatment of diabetes on the development and progression of long-term complications in insulin-dependent diabetes mellitus. *N Engl J Med*. 1993;329:977–986.
6. Jeffcoate SL. Diabetes control and complications: the role of glycated haemoglobin, 25 years on. *Diabet Med*. 2004;21:657–665.
7. Lind M, Odén A, Fahlén M, Eliasson B. A Systematic Review of HbA1c Variables Used in the Study of Diabetic Complications, Diabetes and Metabolic Syndrome: Clinical Research and Reviews. 2008:282–293.
8. de Vegt F, Dekker JM, Jager A, et al. Relation of impaired fasting and postload glucose with incident type 2 diabetes in a Dutch population: the Hoorn Study. *JAMA*. 2001;285:2109–13.
9. Edelstein SL, Knowler WC, Bain RP, et al. Predictors of progression from impaired glucose tolerance to NIDDM: an analysis of six prospective studies. *Diabetes*. 1997;46:701–10.
10. Stern MP, Williams K, Haffner SM. Identification of persons at high risk for type 2 diabetes mellitus: do we need the oral glucose tolerance test? *Ann Intern Med*. 2002;136:575–81.
11. Khaw KT, Wareham N, Luben R, et al. Glycated haemoglobin, diabetes, and mortality in men in Norfolk cohort of European Prospective Investigation of Cancer and Nutrition (EPIC-Norfolk) *BMJ*. 2001;322:1–6.
12. Edelman D, Olsen MK, Dudley TK, Harris AC, Oddone EZ. Utility of Hemoglobin A1c in Predicting Diabetes Risk. *Journal of General Internal Medicine*. 2004;19:1175–1180.
13. Thomas A, Heinemann L. Prediction of the Risk to Develop Diabetes-Related Late Complications by Means of the Glucose Pentagon Model: Analysis of Data from the Juvenile Diabetes Research Foundation Continuous Glucose Monitoring Study. *Journal of Diabetes Science and Technology*. 2012;6:572–580.
14. Lind M, Odén A, Fahlén M, Eliasson B. The True Value of HbA1c as a Predictor of Diabetic Complications: Simulations of HbA1c Variables. Zhang C, ed. *PLoS ONE*. 2009;4:e4412.