Glycoslated Haemoglobin as a Diagnostic Marker of Diabetes Mellitus in Acute Myocardial Infarction and Correlation with Dietary Pattern

Nayak Rashmi and Chauhan Vinay Singh
Department of Pathology, NSCB Medical College, Jabalpur, MP, INDIA

Abstract

This study was planned to assess the role of glycosylated hemoglobin as a diagnostic marker to diagnose and treat diabetes at earliest in acute myocardial infarction. It is meant to improve the prognosis in patients of acute myocardial infarction. Studies also assess any correlation between diabetic status and dietary pattern. This is hospital based cross-sectional study. 100 patients with acute myocardial infarction admitted to coronary care units, during October 2013 to September 2014 were studied .Patients during admission blood glucose >140mg/dl with no past history of diabetes mellitus were included in the study. Serum blood glucose and HbA1c were estimated at admission. History and examination carried out. Detailed history about their dietary pattern was taken. These patients were followed up after 15 days to assess their blood glucose. Their diabetic status was confirmed as per WHO criteria. Data were analyzed using SPSS-20 software. Out of 100 patients, 84 patients had value of HbA1c in the diabetic range (≥6.5%) and 16 patients had HbA1c in the non diabetic range (<6.5%). On follow up, out of 84 patients, 75 patients (89.28%) were confirmed to be diabetic according to the WHO criteria. Statistically study found highly significant (p<0.0001). Out of 100 patients, 34 cases were non vegetarians and 66 cases were vegetarian. In non vegetarians' 94.1% were found with increased HbA1c level. Statistically this was found significant (p<0.05). HbA1c estimation is useful tool and accurate interpretation of hyperglycemia following AMI. HbA1c estimation at the time of admission clearly differentiates stress hyperglycemia from hyperglycemia of undiagnosed diabetes mellitus. HbA1c is a more sensitive and specific diagnostic marker than blood glucose for diabetes mellitus in patients with MI and non vegetarian dietary pattern was found associated with diabetes and cardiovascular disease.

Keywords: Glycosylated hemoglobin, diabetes mellitus, myocardial infarction, hyperglycemia, diet, nonvegitarian.

Introduction

Diabetes mellitus is a disease of antiquity known to mankind since past 3500 years. Now diabetes mellitus becomes the most common non communicable, life style associated disease worldwide. India and china are converting in to hub of diabetes[1]. Most dreadful part is large number of patients remains unrecognized.

It is of great concern because of the devastating effect of its complications. Diabetes mellitus has been recognized as a risk factor for coronary heart disease since ages[2]. Hyperglycemia is associated with large infarct size[3]. Mortality due to coronary heart disease is very high in diabetics[4]. Hence early diagnosis and control of diabetes mellitus is important. It is to improve the prognosis of patients with AMI and to prevent the adverse outcome.

At the time of admission most of the patients of AMI have hyperglycemia, are associated with increased risk of morbidity and mortality[5]. This hyperglycemia could simply be a marker of preexisting, not yet diagnosed diabetes, impaired glucose tolerance or may be stress induced hyperglycemia. Blood glucose estimation alone is insufficient, unreliable tool and oral glucose tolerance test is impractical.

This differentiation is important because any attempt to lower stress induced hyperglycemia may cause hypoglycemia leading to tachycardia and cause deleterious effects[6]. HbA1c estimation provides an average blood glucose level for a period of 8-12 weeks[7]. HbA1c proves useful for diagnosis of DM in AMI. Stress induced hyperglycemia is a confounding factor. HbA1c is unlikely to rise with stress induced acute hyperglycemia[8]. HbA1c concentration can be used to distinguish stress induced hyperglycemia from diabetes mellitus for early appropriate treatment to prevent morbidity and mortality.

American diabetes association has clearly described vegetarian diet as healthful and least risk of diabetes. Red meat consumption has been associated with increased risk of diabetes[9].

Reduced consumption of animal fat and increased consumption of fruit, vegetables and food with low level of glycemic index such as legumes, nuts, cereals, and whole grain reduce the risk of chronic disease and may have protective effect.

Material and Methods

This study is carried out in Government NSCB Medical

College, Jabalpur. Department of Pathology and ICCU. 100 M.I. patients admitted in ICCU during October 2013 to September 2014 fulfilling the inclusion criteria.

Inclusion criteria: Patients diagnosed AMI confirmed by electrocardiogram or cardiac marker (CPK-MB). Patients not known or diagnosed as diabetic. Patients whose admission glucose level found >140mg/dl.

Exclusion criteria: Patients died of AMI and its complications during hospital stay. Patients unavailable for follow up after 15 days.

Venous blood was taken at the time of admission for estimation of blood sugar and HbA1c before starting treatment. These patients were further followed up after 15 days .Their fasting blood sugar was estimated. Patients with HbA1c ≥6.5% as cut off were analyzed for diabetes as per WHO criteria.

The majority of studies conducted included HbA1c ≥6.5% as cut off for diabetic diagnosis as per American Diabetic Association and WHO.

Specimen collection and preparation: We need preferentially venous blood using EDTA anticoagulant. Reagents should be at room temperature. Dilute the sample with lysing reagent in the 1:100 ratios. Wait for minimum 3 minutes; take care to avoid the formation of foam. Erythrocytes are lysed by low osmotic pressure. Greenish-brown color develops as per the hemoglobin concentration of sample.

HbA1c is determined immunoturbidometrically. The final result is expressed as percent HbA1c.

Method and Test principle: Test is based on immunoturbidometry performed by auto analyser. It is based on interaction between antigen molecule (HbA1c) and HbA1c specific monoclonal antibodies coated on latex bead. This cross link reaction results in change in the solution turbidity. HbA1c was estimated by auto analyser Biosystem S.A. COD 22044.

Advantages: HbA1c is stable after collection of sample. Their levels do not fall on storage prior to test. Sample can be obtained at any time. It requires no patient's preparation. Their levels do not vary between meals like blood sugar.

Statistical test applied: Statistical analyses were carried out by using SPSS 20 software. The results obtained are statistically analyzed.

Results and Discussion

100 patient admitted in ICCU with acute myocardial infarction without past history of diabetes mellitus during October 2013 to September 2014 was included in the study. All 100 patients had admission blood glucose >140mg/dl. Table-1 shows that out of

100 cases 84 patients had value of HbA1c in the diabetic range (>6.5%) and 16 patients had HbA1c in the non-diabetic range (<6.5%). On follow up after 15 days, out of 84 patients with HbA1c>6.5%, 75 patients (89.28%) were confirmed to be diabetic and only 9 patients (10.72%) were found to be non diabetic according to WHO criteria. Statistically this was highly significant (p<0.0001). Rest 16 patients with HbA1c<6.5%, only 1case (1.3%) was diagnosed as diabetes on blood glucose estimation. Sensitivity of the test (HbA1c) in diagnosing diabetes in acute myocardial infarction patients was 98.6, specificity was 62.5, and positive predictive value 89.28, negative predictive value was 93.75. Therefore in the present study 75% of patients had previously unrecognized diabetes mellitus that had come to light after HbA1c estimation and rest 25% of patients had admission hyperglycemia that was secondary to stress of AMI.

Table-1
Diabetic status and HbA1c

-	HbA1c <6.5%	HbA1c >6.5%
DM (76)	1(1.3%)	75(98.7%)
ND (24)	15(62.5%)	9(37.5%)
Total (100)	16	84

In the present study (table-2) <40yr cohort only 25% case were found with increased HbA1c level while in 40-59 yr age group 85.1% cases and in >60yr age group 87.8% cases were found with increased HbA1c level. Statistically a significant association of increased age and increased HbA1c level was found (p<0.01). This finding is comparable with studies done by J. D. Kesqvadev et al[10] and others[11-13].

Table-2
Age and HbA1c

Age	HbA1c <6.5%	HbA1c >6.5%	Total
<40yr	3(75.0%)	1(25%)	4
40-59yr	7(14.9%)	40(85.1%)	47
>60yr	6(12.2%)	43(87.8%)	49

In the present study (table-3) rural population cohort (46), 76.1% were having raised HaA1c while in urban population (54), 90.7% was having raised HbA1c. This association between urban population and HbA1c level was found significant (χ^2 =3.969; p<0.05). Study by Baizayanti baur et al[14] also showed similar result.

Table-3
Habitate and HbA1c

Habitate	HbA1c <6.5%	HbA1c >6.5%	Total
Rural	11(23.9%)	35(76.1%)	46
Urban	5(9.3%)	49(90.7%)	54
Total	16	84	100

Both rural and urban area in India are currently experiencing a great increase in lifestyle oriented diseases. Urban population

have more number of diabetic patients but rural population is also at risk for development of diabetes mellitus.

Table-4 shows about the dietary pattern of the subjects. Among 34 cases with non vegetarian diet, 94.1% case were found with increased levels of HbA1c while in vegetarian category (66 cases) only 78.8% cases were found with raised level of HbA1c. Statistically this was significant, showing that cases with non-vegetarian diet were having higher chances of raised HbA1c level ($\chi^2_{=3.92}$; p<0.05). The results are consistent with studies of Shishir nigam[15]. Most vegetarian diets are not only nutritionally adequate but also associated with lower risk of diabetes and cardio vascular disease. Diet rich in fiber and complex carbohydrate and restricted in fat improve control of blood glucose concentration and aid in good control of diabetes[16]. Non vegetarian diets like red meat were associated with increased risk of diabetes[17].

Table-4
Dietary habit and HbA1c

Dietary pattern	HbA1c <6.5%	HbA1c >6.5%	Total
Non veg	2(5.9%)	32(94.1%)	34
Veg	14(21.2%)	52(78.8%)	66
Total	16	84	100

In the present study modifiable risk factors like smoking, tobacco, alcohol intake were found more common in diabetic patients than non diabetic patients (table-5). Similar observations were found in other studies[18,19].

Conclusion

Glycosylated hemoglobin estimation is useful for early and accurate interpretation of hyperglycemia following acute myocardial infarction. HbA1c estimation at the time of admission to ICCU clearly and quickly differentiates stress induced hyperglycemia in M.I. patients from hyperglycemia in undiagnosed diabetic patients with AMI.

HbA1c is more sensitive and specific diagnostic test for diabetes mellitus in patients with AMI than serum blood glucose Prognosis in cases of AMI improves by early identification of diabetic and nondiabetic cases by HbA1c evaluation and effective management.

Smoking, alcohol and tobacco consumption predisposes to diabetes and acute myocardial infarction.

Non vegetarian dietary pattern was associated with increased risk of diabetes and cardio vascular disease.

References

1. Frank B.Hu, M.D., Ph.D., Globalisation of diabetes, The role of diet, lifestyle and gene, *American Diabetes Association, Diabetes care June*, **34**, 61249-1257 **(2011)**

2. Rev Port Cardiol, Coronary Heart Disease in diabetes mellitus risk factor and epidemiology, **23(10)** 1359-66 **(2004)**

3. Timmer Jr, Vander Horst ICC, Ottervanger JP, Henriqves JPS, Hoornlje JCA and Boer MJ et al, Prognostic value of admission glucose in non diabetic patients with myocardial infarction, *A M Heart J.*, **148,** 399-03 **(2004)**

4. Foo K, Cooper J, Deaner A, Knight C, Suliman A and Ranjadayalan K et al, A single serum glucose measurement predicts adverse outcomes across the whole range of acute coronary syndrome, *A J Heart*, **89**, 512-6 **(2003)**

5. Umpierrez GE, Isaacs SD, Bazargan N, Youx, Thaler LM and Kitachi A E et al, Hyperglycemia: An independent marker of in hospital mortality in patients with undiagnosed diabetes, *J Clin Endocrinal Metab.*, **87**, 978-82 **(2002)**

6. Sandeep Chopra and Aditya Kewal, Does hypoglycemia cause cardiovascular events?, *Indian Journal of endocrinology and metabolism,* **16(1),** 102-104 **(2012)**

7. American Diabetes Association, Standards of medical care in diabetes (position statement) Diabetes care, **27(1)**, 515-35 **(2004)**

8. Michael Cd' Emden, the role of HbA1c in the diagnosis of diabetes mellitus in Australia, *Med J Aust,* **197(4)**, 220-221 **(2012)**

Table-5
Association between HbA1c, and smoking, alcohol and tobacco consumption

Characteristics		HbA1c Value		χ2 value	P value	95%confidence interval	
		<6.5%	>6.5%				
Tobacco chewing	Present	5	49	3.37	<0.05	-.521227	-.020438
	Absent	11	35				
Smoking	Present	6	54	4.02	<0.05	-.526258	-.009456
	Absent	10	30				
Alcohol intake	Present	2	35	4.90	<0.05	-.484993	-.098339
	Absent	14	49				

9. American Dietetic Association; Dietitians of Canada: Position of the American dietetic association and dietitians of Canada: vegetarian diets, *J Am Diet Assoc*, **103(6),** 748-765 **(2003)**

10. Kesqvadev J.D., Short K.R., Review Article, Diabetes in old age: An Emerging Epidemic, *JAPI.,* **51**, **(2003)**

11. Swapna S. Kadam, Payghan B.S., Mayuri Reddy R. and Kumara Swamy R.C., Role of social determinant in Glycemic Control of Type-2 Diabetic Subjects, *Int. Res. J. Medical Sci.,* **2(4),** 2-6 **(2014)**

12. Kaleemullah M. Khan and Mohd Nasir Mohiuddin, A Controlled Study on Predictors of Type 2 Diabetes in Nodular Diabetic Glomerulosclerosis, *Int. Res. J. Medical Sci.,* **2(9)**, 9-15 **(2014)**

13. Thakur Abhimanyu and Sushmitha Kondru, Role of Non-HDL Cholesterol and LDLC/HDLc Ratio to Assess cardio vascular risk in Type- II Diabetic Patients, *Int. Res. J. Medical Sci.,* **3(1),** 23-28 **(2015)**

14. Baijayanti Bour, Nirmala Manna and Jhuma Sarkar, Global Journal of Medicine and Public Health, An epidemiological study on risk factors of diabetes mellitus attending a tertiary care hospital of West Bengal, India, *GJMEDPH*, **2(4), (2013)**

15. Shishir Nigam, Shyamal Koley and Sandhu J.S., A study on Body Composition components in vegetarian and non vegetarian patients with diabetes mellitus, *J.Hum. Ecol.,* **22(1)**, 53-56 **(2007)**

16. Kaur Bhagyapreet, Verma R.K. and Mishra Ravi, Recent Trend of Diagnosis Criteria, Goal and Dietary Recommendation for Type II Diabetes and an Assessment of the Role of Recommended Dietary intake for Good Control(DMII), *Int. Res. J. Medical Sci.,* **2(6),** 14-18 **(2014)**

17. Sutapa Agrawal and Christopher j Millett, Type of vegetarian diet, obesity and diabetes in adult Indian population, *Nutrtion Journal,* **13,** 89 **(2014)**

18. Iqbal MJ, Azhar M, Javed MT and Tahira I, Study on ST-Segment Elevation Acute Myocardial Infarction (STEMI) in diabetic and non diabetic patients, *Pak J Med Sci,* **24(6),** 786-91 **(2008)**

19. Linda W.H. Kao and Ian B Puddey, Alcohol consumption and the risk of type 2 diabetes mellitus: Atherosclerosis risk in community study, *Ammerican Journal of epidemiology,* **154(8)**, 748-57 **(2001)**