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Study of correlation between hba1c and complications of type 2 diabetes mellitus in southern odisha, India

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Abstract

Background: Diabetes mellitus is a leading cause of morbidity and mortality in India. The present study was conducted with an objective to determine the relationship between complications of type 2 diabetes mellitus and glycosylated haemoglobin (HbA1c) and

to study the effect of hyperglycemia on different organ system.

Methods: The study was carried out from January 2017 to June 2018 in the department of general medicine and department of endocrinology of MKCG Medical College and Hospital, Berhampur, Odisha, India. The study design was descriptive cross-sectional study. 100 patients were chosen for the study based on the inclusion and exclusion criteria. Detailed history, clinical evaluation, laboratory investigations were carried out. Statistical data analysis was done using SPSS 24 and Microsoft Excel. P value<0.05 was statistically significant.

Results: Out of 100 diabetic patients, 53 were males and 43 were females. All patients were in the age group of 18 to 65 years. It was observed that, higher the HbA1c value, higher were the incidence of complications (p=0.044).

Conclusions: It was concluded from the study that microvascular complications in T2DM correlates with HbA1c values. The relationship of HbA1C with macrovascular and non vascular complications like infections was not statistically significant.

Keywords : Diabetes Mellitus, glycosylated haemoglobin (HbA1c), microvascular complications, macrovascular complications.

Introduction

Diabetes mellitus is a group of metabolic diseases characterized by hyperglycemia resulting from defects in insulin secretion, action or both. It causes long-term damage and dysfunction of various organs, especially the eyes, kidneys, nerves, heart, and blood vessels**1**. Diabetes related complications can be divided into vascular and nonvascular complications . The vascular complications are further subdivided into microvascular (

retinopathy, neuropathy, nephropathy) and macrovascular complications(coronary heart disease: CHD , peripheral vascular diseases: PVD; cerebro vascular disease). Microvascular diseases are

diabetes specific where as macro vascular complications are similar to those in non diabetics but occurs at greater frequency in diabetic individuals . other factors such as dyslipidemia , hypertension , addition play important roles in macro vascular complications . non vascular complications includes gastro paresis , skin changes ,skin infections .2

Diabetes Mellitus can be defined as a fasting plasma glucose ≥126 mg/dL(7.0 mmol/L) or two-hour plasma glucose ≥ 200 mg/dL(11.1 mmol/L) during an Oral Glucose Tolerance Test. using 75g anhydrous glucose

dissolved in water or HbA1C ≥6.5% or in a patient with classic symptoms of hyperglycemia or hyperglycemic crisis, random blood glucose concentration ≥200 mg/dL(11.1 mmol/L).

In the absence of unequivocal hyperglycemia and acute metabolic decompensation, these criteria should be confirmed by repeat testing on a different day. OGTT is not recommended for routine clinical use.3,4

Acute Complications include hypoglycemia, acute metabolic complications, diabetic ketoacidosis, hyperosmolar non ketotic diabetic coma.

Chronic complications include microvascular complications like retinopathy, neuropathy and nephropathy; macrovascular like coronary heart disease, peripheral arterial disease, cerebrovascular disease.

2) Nonvascular complications include Gastrointestinal,Genitourinary (uropathy/sexual dysfunction),dermatologic, infectious, cataracts, glaucoma, cheiroarthropathy, periodontal disease, hearing loss.5,6,7

Aims and Objectives

1. To study the relationship between presenting complications of type 2 diabetes mellitus and prevailing glycemic status , reflected by value of HbA1c.

2. To study the direct effect of hyperglycemia on different organ system .

Methods

The present study design was conducted from January 2017 to june 2018 in the department of general medicine and department of endocrinology, MKCG Medical College and Hospital, Berhampur, India. Cross – sectional study was designed with a sample size of 100. The work was carried out after the study protocol was approved by the Institutional Ethics Committee. Informed consent was obtained from all participants. The study population included diabetic patients who attended outpatient department of general medicine and endocrinology and those admitted to the general medicine ward of MKCG medical college and hospital.

Inclusion Criteria

1. All type 2 diabetes mellitus patients

2. Age 18 – 65 years

Exclusion Criteria

• Type 1 diabetes mellitus

• Patient not giving consents .

• Patients with HIV and other congenital immunodeficiency diseases .

• Diabetes with uncontrolled hypertension.

• Pregnant female .

• Patient having congenital cardiac , renal , opthalmological , neurological disease that may interfere with diabetic complications or its interpretations .

• Patients with alcoholic liver diseases .

• Patients with thyroid disorder .

Statistical Analysis

Statistical analysis was done using Microsoft Excel, SPSS 24 and graphpad prism version 5. Data had been summarized as mean and standard deviation for numerical variables and count and percentages for categorical variables and Chi square test was used. P value of < 0.05 was considerd statistically significant.

Results

Table 1 : Distribution Of Macrovascular Complications.

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Macrovascular HbA1C	Good control	Poor control	Very poor control	Total
Absent	6	27	16	49
Row%	12 .2	55.1	32.6	100.0
Col%	42.9	50.9	48.4	49.0
Present	8	26	17	51
Row%	15.7	50.1	33.3	100.0
Col%	57.1	49.1	51.6	51.0
Total	14	53	33	100
Row%	14.0	53.0	33.0	100.0
Col%	100.0	100.0	100.0	100.0

X^2=0.295 . p= 0.863

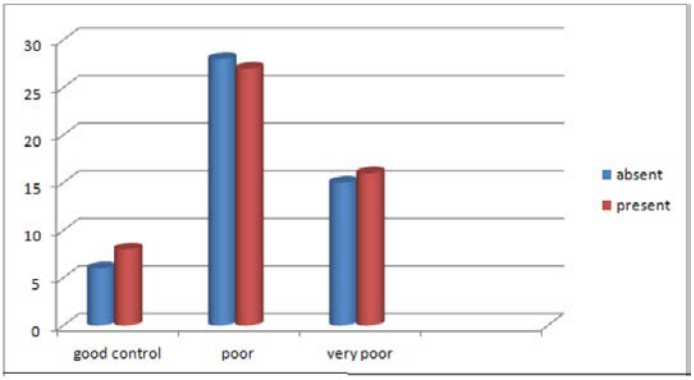

Figure 1: Association between macro vascular to HbA1C not significant (p<0.05).

Table 2: Distribution Of Micro vascular Complications

Microvascular HbA1C	Good control	Poor control	Very poor control	total
Absent	13	40	11	64
Row%	20.3	62.5	17.2	100.0
Col%	92.9	75.5	33.3	64.0
Present	1	13	22	36
Row%	2.8	36.1	61.1	100.0
Col%	7.14	24.6	66.7	36.0
Total	14	53	33	100
Row%	14.0	53.0	33.0	100.0
Col%	100.0	100.0	100.0	100.0

X^2=21.5572 . p=0 .000021

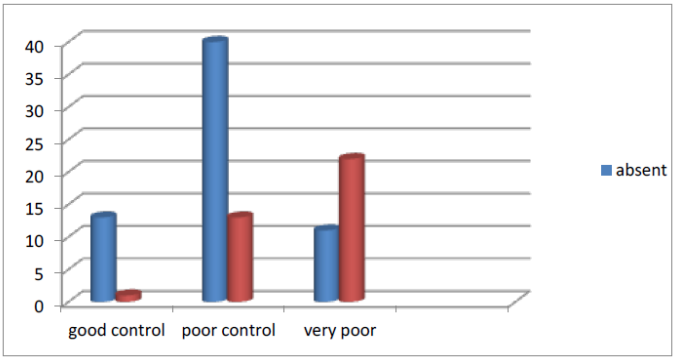

Figure 2: Association between micro vascular complications and HbA1c was statistically significant(p< 0.05) .

Table 3 : Distribution Of Cardiovascular System (CVSD) Complications

C and	Good control	Poor control	Very poor control	Row total
Normal	10	39	20	
Row%	9.66	36.57	22.77	69
Col%	0.01	0.16	0.34	
Abnormal	4	14	13	
Row%	4.34	16.43	10.23	31
Col%	0.03	0.36	0.75	
Total	14	53	33	100
Row%	14.0	53.0	33.0	100.0
Col%	100.0	100.0	100.0	100.0

X^2= 1.6465 . p= 0.439007 .

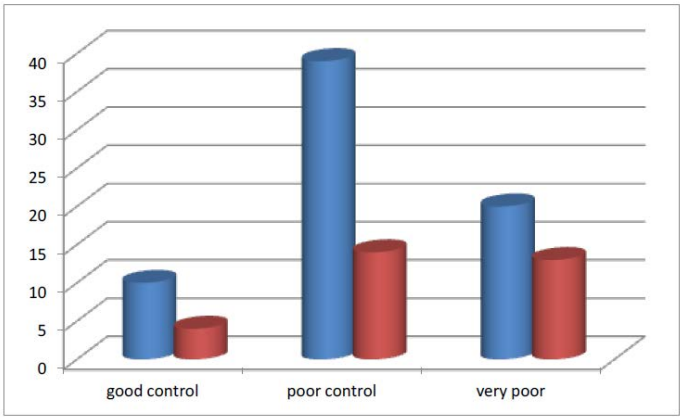

Figure 3 : Association between CVS complications and HbA1C was not significant .

Table 4: Distribution Of Peripheral Vascular Disease (PVD) HbA1C

PVD	Good Control	Poor Control	Very Poor Control	Row Total
NORMAL	13 12.74 0.01	51 48 .23 0.16	27 30 .03 0.31	91
ABNORMAL	1 1.26 0.05	2 4.77 1.61	6 2.97 3.09	9
COLUMN TOTAL	14	53	33	100

X^2= 5.2236 . p= 0.073404 .

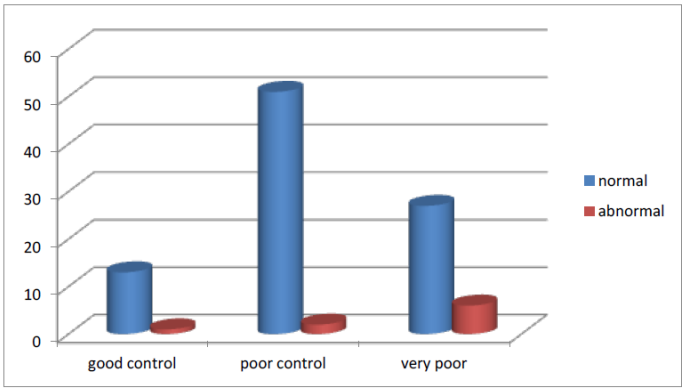

Figure4:A ssociation between PVD and HbA1C was not statistically significant .

Table 5: Distribution Of Peripheral Nervous System(PNS) Complications.

PNS (HbA1c)	Good control	Poor control	Very poor control	Row total
Normal	13 11.20 0.29	47 42.20 0.50	20 26.40 1.55	82
abnormal	1 2.80 1.16	6 10.60 2.00	13 6.60 6.21	18
Col total	14	53	33	100

X^2=11.6993 . p= 0.002881 .

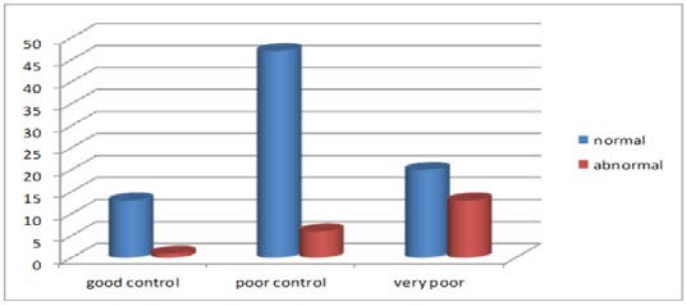

Figure 5: Association between PNS and HbA1c was statically significant .

Table 6: Distribution Of Ocular Complications HbA1C.

EYE	Good control	Poor control	Very poor control	Row total
normal	13 10.08 0.85	44 38.16 0.89	15 23.76 3.23	72
abnormal	1 3.92 2.18	9 14.84 2.30	18 9.24 8.30	28
total	14	53	33	100

X^2=17.7476 . p= 0.00014 .

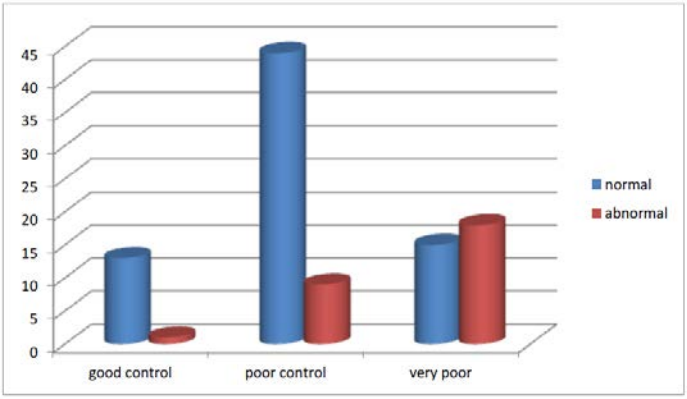

Figure 6:Association between ocular complications and HbA1c was statistically significant .

Table 7 : Distribution Of Renal Complications HbA1C

RENAL	Good control	Poor control	Very poor control	Row total
normal	13 8.26 2.72	38 31.27 1.45	8 19.47 6.76	59
abnormal	1 5.74 3.91	15 21.73 2.08	25 13.53 9.72	41
Colum total	14	53	33	100

X2=26.6478 .p< 0.00001 . p<0.05

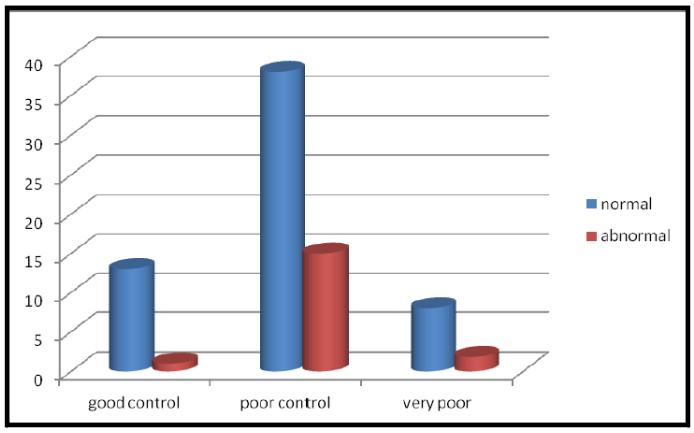

Figure 7: Association between renal complications and HbA1c is statically significant .

Table 8 : Distribution Of Nonvascular Complications HbA1C

Non vascular	Good control	Poor complications	Very poor complications	Row total
Absent	9 8.40 0.04	31 31.80 0.02	20 19.80 0.00	60
present	5 5.60 0.06	22 21.20 0.03	13 13.20 0.00	40
Col total	14	53	33	100

X^2=0 .1625 . p= 0.92196 .

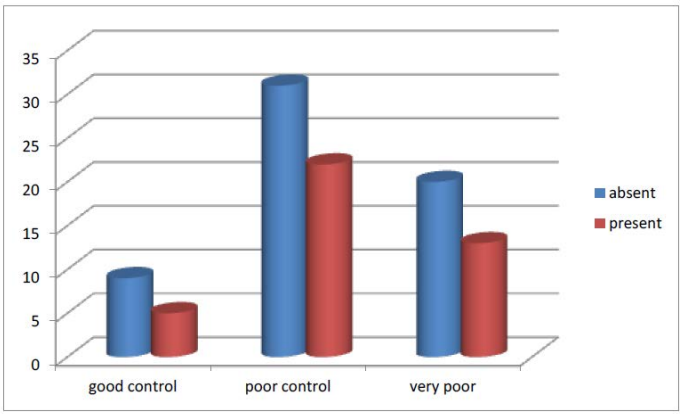

Figure 8 : Association between non vascular complications and HbA1c was non-significant .

Table 9 : Distribution Of Peripheral Nervous System Abnormality HbA1C

PNS	Good control	Poor control	Very poor control	total
normal	13	40	15	68
abnormal	1	6	8	15
total	14	46	23	83

X^2= 6.25 ,p=0.044

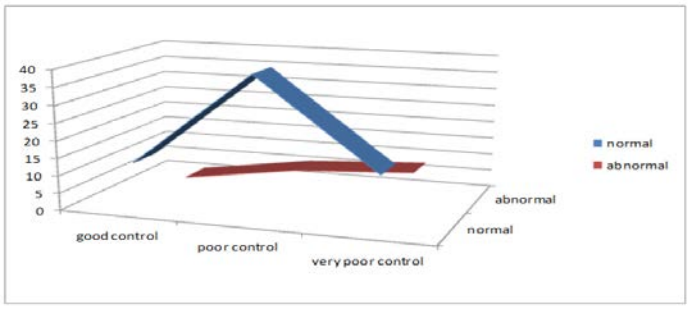

Figure 9 :Association PNS abnormality and HbA1c was statistically significant .

Table 10 : Distribution Of micro albuminuria HbA1C.

Micro albuminuria	Good control	Poor control	Very poor control	total
absent	10	31	5	46
present	4	22	28	54
total	14	53	33	100

X^2=19.6 p= 0.0001

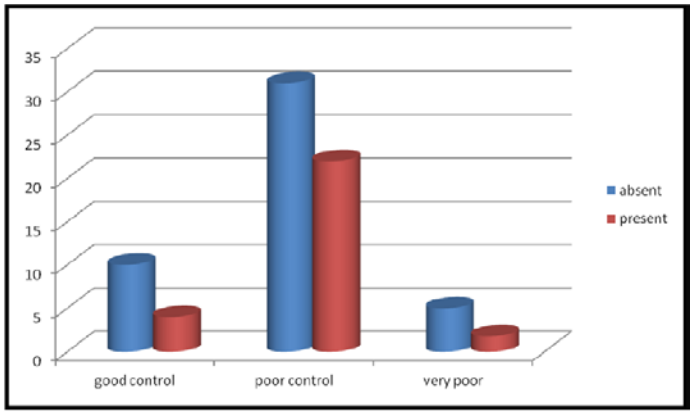

Figure 10 : Association between microalbuminuria and HbA1c was statistically significant .

Discussion

Value of HbA1c < 7% was categorized as good control of diabetes, 7-9 as poor control and value of > 9% very poor control.Out of 100 patients, 40 patients belonged to age group of 40- 65 years. This could be due to long temporal relationship of complications of type 2 diabetes mellitus, making the aged patients vulnerable to complications. Also, for older peoples high HbA1C were significantly associated with increased risk of mortality.Sex predilection was not evident in the incidence of complications.Majority attended medical care due to infection and/ sepsis. 15 patients had CNS involvement in from of cerebrovascular events. 21 patient's acute myocardial infarction or symptomatic IHD, 14 patients due to renal complications, 5 patents had visual complications.Out of 26 patients with CNS complications ,14 patient (53%) had poor glycemic control showing insignificant p value (0.259232) .Among 31 patients CAND symptoms ,27 patients

had HbA1C > 7 % again p-value 0.439007 was not significant . ARIS STUDY revealed HbA1C beings a significant predictor for cardiovascular disease (CVA, IHD , even death), even in patients having a normal value of HbA1C .8Peripheral vascular disease did not have a significant relation with level of HbA1C . (p-0.073404) .DM is associated with several types of polyneuropathy. 9Risk factors for the development of neuropathy include long-standing, poorly controlled DM and the presence of retinopathy and nephropathy.10,11Out of 18 patients with problems affecting peripheral nervous system , only 1 had good control, while rather 13 patient (72%) had very poor control ,and 6 (33.3%) had poor diabetic control having significant p – value(0.002881) .Correlation of ophthalmic complications with HbA1c levels showed a significant p value of 0.00014 .Renal involvement also demonstrated highly significant correlation with HbA1C (p value: 0.00001), supporting the previous studies.UKPDS also has shown that for each percentage point reduction in HbA1C was associated with a 35% reduction in micro vascular complications .12Nonvascular complications like infections failed to show a significant p value, indicating that infections are not related to chronic glycemic status of the patient .The prevalence of macrovascular complications are markedly increasing among individuals with diabetes mellitus.13,14 Overall we can see that high HbA1C is related linearly mainly to micro vascular complications and not macro vascular or other complications – corroborating with other large trials .Smoking and alcohol abuse are independent confounding factors mainly responsible for macrovascular complications . patients with proven alcoholic liver disease were not included in the study .Patients with long history of diabetes mellitus showed a increased risk of developing diabetic complications .Anemia along with declining renal function accounted for increased risk of

mortality)Another important observation is that autonomic system involvement was not significantly related to HbA1C . (P –value 0.8272) .Microalbuminuria and macroalbuminuria has shown a significant relation with HbA1C . (p value 0.0018 and 0.0001 respectively). Echocardiography was performed mainly to diagnose the findings of ischemic heart disease and dilated cardiomypathy . When individual parameters were considered , reduced ejection fraction and DCM showed significant relation in term of p value . but the RWMA and diastolic dysfunction did not – again reminding that these mainly reflect macro vascular complications .Color Doppler study was performed to specially diagnose peripheral vascular disease and failed to show significant p value changes . Out of 8 patients with PVD , 5 patient were in category of very poor control of glycemic status (62.5%) .While interpreting the results , it is evident that HbA1C only reflects the glycemic status for last 3 months . while microvascular complications has a much longer temporal relationship with diabetes .determining glycemic status of the patient before that time is largely history and document based and so cannot be assessed accurately in this hospital due to poor awareness of patients and relatives . The finding of the current study appear to be consistent with those found in large trials i.e UKPDS and ACCORD studies . This present study has clearly established that high hbA1c level can be associated with increased risk of all cause of mortality .Analysis of the results showed that the HbA1c value at the time of presentation is matched with the presenting complications . It can be concluded that complications of diabetes is mainly due to long term glycemic status reinforcing good glycemic control from the very beginning to prevent and to treat complications . Again to reduce macrovascular and other complications , it is important to look for the other co-morbidities , like addiction, lipid profile ,

LFT ,diet , hypertension as these are the other instrumentals for the complications that need further large trials to be established properly.

Conclusion

From the above discussion, it can be concluded that complications of type 2 diabetes mellitus is dependent on prevailing glycemic status of patient as indicated by HbA1c levels. Relation of Microvascular complications with HbA1C is statistically significant. Correlation between macro vascular complications and HbA1C are statistically insignificant . Nonvascular complications including infections have no statistically significant correlation with HbA1C .

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