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Influence of anaemia on glycosylated haemoglobin levels in diabetic individuals

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Background: Glycosylated hemoglobin level sis diagnostic test used for diabetes and to determine the developing diabetic complications. The level of HbA1 CIS affected by factors such as the Hemoglobin, RBC count and the Hb glycation rate. The aim of this retrospective cross-sectional study is to assess the relationship of HbA 1c levels with Hb count and RBC indices

Material and Method: A total of 70 diabetic individuals confirmed by previous records, their sugar, Hba1c level and CBC were noted for the study.35 diabetic cases with Hb less than13 gm% in males and less than12 gm % in females and 35 controls with hemoglobin more than13 gm % for males and more than12 gm % females were considered as cases and control respectively with HbA 1c levels more than 6.5%. Hemoglobin concentration and RBC indices were calculated on ADVIA analyzer. Sugar and Hba1c levels were measured by VITROS 5600 analyzer

Observation: Present case- control retrospective descriptive study was performed on 70 diabetic subjects of both genders. HbA1c, Hb, RBS and RBC count were performed in all. Hb ≤ 10 gm % were taken as cases (N=35) and Hb > 10 gm % were taken as controls (N=35). Result so btained consist of female cases with mean age (49±12.8) years had Hb levels of 9.2±1.1 gm %, HbA1c levels of 7.9±1.9 % and female controls with age (52±14) years had Hb levels of 12.3± 0.5 gm % and HbA1c levels of 8.2±1.2%. Male cases with age (55±14.2) years with HbA1c levels of 7.2±2.5% and Hb levels of 7.3±1.2 gm %. Male controls of age (40±20) years had HbA1c levels of 6.7±1.3% and Hb 14.2±1.1 gm %. Mean RBC count in cases 3.2±0.7 and controls are 4.8±0.5. Female cases under the age of 50 showed

Hba1c levels of 7.3±1 and above 50 showed 8.5 ±2.1%. Female controls below 50 years of age showed Hba1c levels of 7.5±0.7 and above 50 showed Hba1c levels of 8.2 ±1.3%. Male cases below 50 years showed Hba1c levels 7.9±1.7 and above 50 showed Hba1c levels 9.7±2.6. Male controls below 50 years showed Hba1c levels 6.7 ± 0.6 % and above 50 showed Hba1c levels 7.3 ± 1.6

Conclusion

1.Hba1c levels are increase din male anaemic diabetic patients

2.Anemic diabetic females and males more than 50 years of age have raised Hba1c levels.

3.Hba1c levels are increased in patients with low RBC count.

4.While interoperating Hba1c levels anaemia should be taken in to consideration.

Keywords: Anaemia, diabetes, HbA1c-Glycosylated haemoglobin, Hb - hemoglobin, RBC count.

Introduction

Glycated haemoglobin sincluding HbA1cas well as other haemo globins constitute the fraction of adult haemoglobin (HbA). HbA1c is the predominant haemoglobin found in HbA1 fractions.

Glycosylated haemoglobin level is diagnostic test used for diabetes and to determine the developing diabetic complications[1].

According to the American Diabetes Association Guide lines published (2007) HbA1c levels should be maintained below 7% in all diabetic patients in or der to prevent development of micro vascular complications[2].

HbA1c is syn the sized from glycation of terminal unit of the β – chain of haemoglobin. Its percentage is determined by plasma glucose level in last six to eight weeks[3].It is also used to evaluate level of meta bolic control and especially measuring the quality of diabetes care[4]. Iron deficiency anaemia is the most common form of anaemia in India[5].Anaemia is one of the common elements that affect HbA1c values where decreased Red Blood Cells count (RBCs)

Increases glycation rate of the Hb which contributes to the high value of HbA1cfoundin splenectomy or iron deficiency anaemia[6] whereas increase RBC count decreases HbA1c levels found in blood loss, haemolysis, haemoglobin o pathies, red cell disorders, myelo dys plastic disease and haemolytic anaemia. These suggests HbA1 casa poor marker for diabetic patient with haemolytic anaemia[7,8,9,10]. Previous studies on same topic suggests hat iron deficiency anaemia causes an increase of HbA1c levels and reduced after iron therapy[11,12].

The level of HbA1c is affected by factors such as the Hemoglobin, RBC count and the Hb glycation rate[13,14]. The aim of this retro spective study is to assess the relationship of HbA1c levels with Hb count and RBC indices

Material and Method

Present retrospective case-control descriptive study was performed between the duration February 2022 to may 2022. Institutional ethics committee permission was taken prior to commencement of study. A total of 70 diabetic individuals confirmed by previous records, their sugar levels, Hba1c level and CBC were noted for the study. 35 diabetic cases with Hb less than 13 gm % in males and less than 12 gm % in females and 35 controls with hemoglobin more than 13 gm % males and more than 12 gm % females were considered as cases and control respectively with hba1c more than 6.5. For calculation of sample size, G. Power software was used.

Alphaα = 0.05, Power = 0.95, large effect size was considered = 0.8. using G* power sample sized of each group was found to be 35 samples/ cases. Hemoglobin concentration and RBC in dices were calculated on ADVIA analyzer. Sugar and hba1c levels were measured by VITROS 5600 analyzer Statistical analysis was performed using SPSS software. Data are expressed as mean ± SD. Unpaired t-test' were used for comparing the two groups. Statistical sign if I cance was assumed if P value less than 0.05.

Result

Table 1 shows females cases with mean age (49± 12.8) years had Hb levels of 9.2±1.1 gm %, HbA1c levels of 7.9 ± 1.9 % and females controls with age (52±14) years had Hb levels of 12.3 ± 0.5 gm % and HbA1c levels of 8.2±1.2%. Males cases with age (55 ±14.2) years with HbA1c levels of 7.2±2.5 % and Hb levels of 7.3±1.2 gm %. Male controls of age (40±20) years had HbA1c levels of 6.7±1.3 % and Hb 14.2±1.1 gm %. Mean RBC count in cases 3.2±0.7 and control sare 4.8±0.5. Table 2 shows female cases under the age of 50 showed Hba1c levels of 7.3±1 and above 50 showed 8.5±2.1%. Female controls below 50 years of age showed hba1c levels of 7.5±0.7 and above 50 showed hba1c levels of 8.2 ±1.3 %. Male cases below 50 years showed Hba1c levels 7.9±1.7 and above 50 showed Hba1c levels 9.7±2.6. Male controls below 50 years showed Hba1c levels 6.7 ± 0.6 % and above 50 showed Hba1c levels 7.3± 1.6.

Table 1: Distribution of Haemoglobin profile.

Sr No.	Variable	Cases35(50%)		Controls35(50%)		T Value	P. Value
		Male14(20%)	Female21(30%)	Male14 (30%)	Female21(20%)		
1	Age (Mean±SD)	55± 14.2	49±12.8	40±20	52± 14	Male -1.846 Female 0.47	Male 0.08 Female 0.63
2	Hb (gm%)	7.3±1.2	9.2+1.1	14.2±1.1	12.3±0.5	Male13.49 Female6.983	Male<0.0001 Female<0.0001
3	HbA1c (%)	8.785±2.24		7.845±1.42		-1.585	0.121
		7.2+2.5	9	3	2	Male-0.606 Female 0.374	Male 0.55 Female0.71
4	RBC Count (Million/ mm^3)	3.2±0.7		4.8±0.5		8.318	<0.0001

Graph 1: Distribution of HbA1c as per RBC.

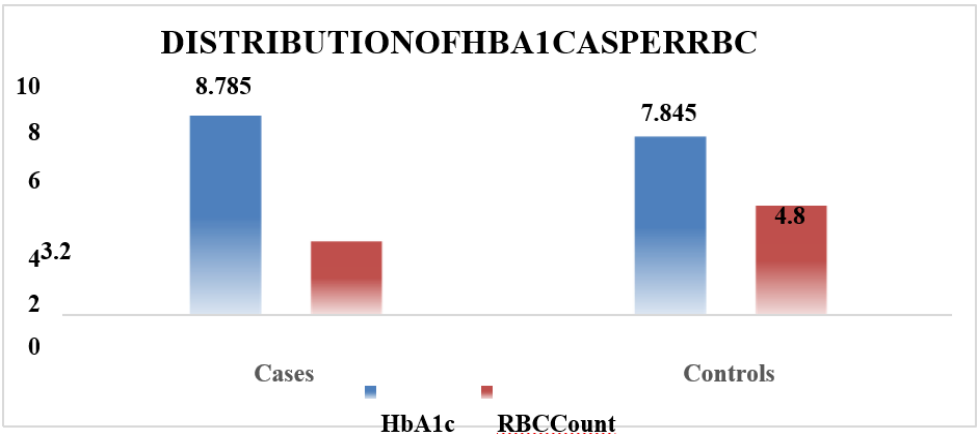
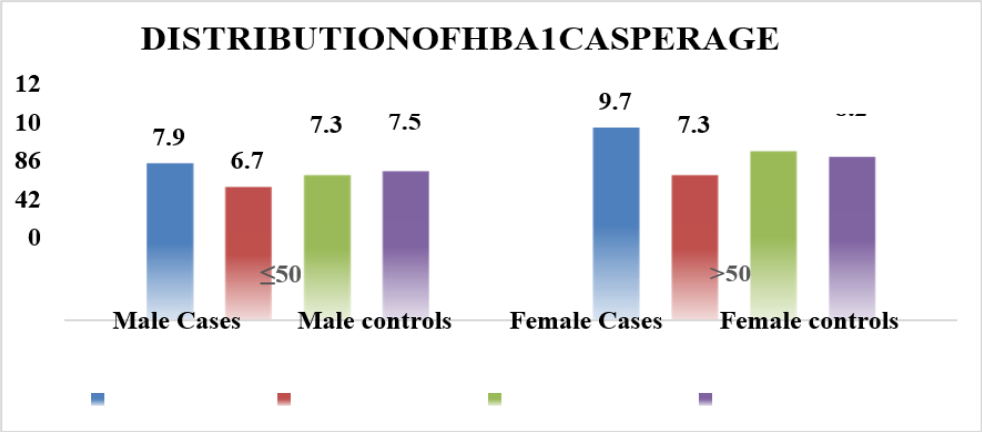


Table 2: Distribution of HbA1c as per age.

Sr. No	Age group (Years)	Cases 35 (50%)		Controls 35 (50%)		T Value	P Value
		Male14(20%)	Female21(30%)	Male21(30%)	Female14(20%)		
1	≤50	7.9±1.7	7.3±1	6.7±0.6	7.5±0.7	Male-2.349 Female0.464	Male0.02 Female0.64
2	>50	9.7±2.6	8.5±2.1	7.3±1.6	8.2±1.3	Male-2.635 Female-0.340	Male0.01 Female0.73

Graph 2: Distribution of HbA1c as per age.



Discussion

Present cross sectional retrospective descriptive study was performed on 70 diabetic subjects of both genders. HbA1c, Hb, RBS and RBC count were performed in all. Hb ≤ 10 gm % were taken as cases (N=35) and Hb > 10 gm % were taken as controls (N=35). Results obtained consist of female cases with mean age (49±12.8) years had Hb levels of 9.2±1.1 gm %, HbA1c levels of 7.9±1.9 % and female controls with age (52±14) years had Hb levels of 12.3 ± 0.5 gm % and HbA1c levels of 8.2±1.2%. Male cases with age (55±14.2) years with HbA1c levels of 7.2±2.5 % and Hb levels of 7.3±1.2 gm %. Male controls of age (40±20) years had HbA1c levels of 6.7±1.3 % and Hb 14.2±1.1 gm %. Mean RBC count in cases 3.2±0.7 and control sare 4.8±0.5.

Female cases under the age of 50 showed Hba1c levels of 7.3±1 and above 50 showed 8.5 ±2.1%. Female controls below 50 years of age showed Hba1c levels of 7.5±0.7 and above 50 showed Hba1c levels of 8.2 ±1.3%. Male cases below 50 years showed Hba1c levels 7.9±1.7 and above 50 showed Hba1c levels 9.7±2.6. Male controls below 50 years showed Hba1c levels 6.7 ±0.6 % and above 50 showed Hba1c levels 7.3±1.6 (Table1&2). In similar study by Rashed E Retal (2020)[15] they found that correlation of HbA1c and blood sugar levels with RBC parameter indicates positive correlation with RBC count and negative correlation with MCV and MCH. Comparison among diabetic, pre - diabetic and non-diabetic patients showed significantly higher mean of RBC count, Hb concentration and Hct in diabetic patients, and the mean MCV and MCH were significantly higher in non – diabetic compared with pre-diabetic and diabetic. They concluded that the low level of HbA1c has been found to shorten RBCs life span, which is affected by RBC parameters and decrease of RBC life span in hyper glycaemia patients. Nitin Sin

haetal (2012)[16] in their study found mean base line HbA1c level in anemic patients (4.6%) was significantly lower than that in the control group (5.5%, P < 0.01). There was a significant difference between the base line values of patients and controls. HbA1c levels and absolute HbA1c levels increased with treatment of iron deficiency anemia which could beattribu tablet on utritional deficiency and/ or certain unknown variables.

Sree dev Narayanan etal (2020)[17] in their study observed that HbA1c value correlated significantly only with FBS level and total Hemoglobin level was not found to have any effect on the HbA1c value in Type 2 Diabetes Mellitus patients.

The factor significantly affecting the HbA1c value is Fasting Blood Sugar level. Hemoglobin level doesn't seem to be affecting the HbA1c indicating that Hemoglobin is not asignifi cant predictor of HbA1c.They concluded that asignifi cant positive relationship found between FBS and HbA1c level only. No correlation was found between total Hemoglobin level and HbA1c. Patients with mild to moderate anemia revealed a high HbA1c value correlating only with the blood sugar status. Shaoying Yeet

Al (2016)[18] in their study explores the impact of HbA1c levels on the structure of hemoglobin (Hb) in patients with type 2 diabetes.

They concluded that high HbA1c levels might be a factor contributing to Hb structural modifications in diabetic patients.

FTIR spectr al analysis can provide a novel way to investigate the pathogens is of type 2 diabetes mellitus.

Renuka Petal (2020)[19] in their study found a negative correlation between HbA1c and MCV, MCH and MCHC and positive correlation with RDW.

Hematological parameters like MCH, MCV and MCHC should be taken in to account in interpreting HbA1c level sin diagnosis and management of prediabetes and diabetes.

Increased HbA1c level indicating levated hyper glycaemia may increase the β- sheet structure content of Hb, causing it to aggregate. These consequently decrease solubility of Hb in RBC which increases viscosity of the contents of RBC.

These changes may reduce the deformability of the erythrocytes India be tic patients and impair erythrocyte flexibility, which further adversely affect the micro circulation and lead to diabetic complications by impeding their flow through capillaries[20].

Inadditi on to these structural changes in Hb might be induced by persistent hyper glycaemia due to decrease in peroxidase activity of Hb[20].

In view of changes in RBC & Hb alternating HbA1c values, diagnostic or management purpose India be tics will require further in vestigatione specially RBC indices which reflect the RBC life span.

Al so nutritional in fluence of iron, vitaminB12 and folic acid on HbA1c needs to be evaluated.

Conclusion

1. Hba1c level sare increased in male anemic diabetic patients.

2. Anemic diabetic females and males more than 50 years of age have raised Hba1c levels.

3.Hba1c levels are increased in patients with low RBC count

4.While interpretating Hba1c level stype of anemia and RBC count should be taken in to consideration.

Abbreviations

Hba1c- Glycosylated hemoglobin, Hb- Hemoglobin, CBC- Complete blood count, RBC- Red blood cells.

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