HbA_{1C} status in iron deficiency anemia

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Abstract

Introduction: Iron deficiency anemia (IDA) is a major public health problem in world and India too. It has been found that HbA1c level rise in patients of IDA without raised blood glucose level.

Materials and Methods: Study consists of 30 cases of Iron deficiency anemia and 30 controls of age and sex match between the ages of 18 to 60 years. This is a prospective case controlled study done over a period of two years. Blood samples were collected from subjects and $HbA_{1C,}$ Serum iron, TIBC, Serum ferritin, Blood glucose level and Hematological parameters were measured.

Observations and Result: Serum iron and Ferritin levels were highly significantly decreased ($p<0.001$) in IDA group patients compared to controls. TIBC levels were highly significantly increased ($p<0.001$) in IDA group patients compared to control. HbA1c levels were also highly significantly increased ($p<0.001$) in IDA group patients compared to control. Mean BSL-F and BSL-PP showed no significant difference in glycemic status of both case and control groups.

Conclusion: Apart from blood glucose, iron deficiency anaemia also affects HbA1c level.

Keywords: HbA1c, Iron deficiency anemia, Serum iron, Serum ferritin, TIBC.

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Introduction

Protein glycation is a spontaneous reaction that is believed to play a key role in the pathogenesis of many clinical disorders. The glycation of proteins is enhanced by elevated blood glucose concentrations. The major form of protein glycation with a clinical consideration is glycated haemoglobin (HbA1c).[1] HbA1c is majorly affected by the blood glucose levels alone. However, certain studies have proven that the HbA1c levels are altered by various other coexisting factors, along with diabetes, especially that of iron deficiency anaemia which is a major public health problem in developing countries like India. Therefore, this study have been planned to assess the level of HbA1c in IDA patients.

Aims and Objectives

To assess the status of HbA1C in patients of iron deficiency anaemia & compare with age and sex matched controls.

Materials and Methods

It is a cross sectional comparative study conducted in 2 yrs of duration. A total number of 60 subjects between the ages of 18 to 60 years were enrolled for the present study. Detailed medical history and relevant clinical examination data and written consent were obtained from all subjects by explaining the study procedure.

Considering the average of HbA1c value of 4.5 and allowable error of 1 at $p<0.05$ and power of the test 80%, estimated sample size is 60 which include 30 cases (clinically diagnosed patients of iron deficiency anaemia) & 30 age and sex matched controls belonging to age group of 18 to 60 years were selected.

The cases included in present study were selected from patients attending outpatient department (OPD) and indoor patient department (IPD) of internal medicine. Samples were assessed at the Central Clinical Laboratory (CCL), Department of Biochemistry.

Inclusion criteria

Cases: Clinically diagnosed cases of IDA

Exclusion criteria

Patients having history of Impaired glucose tolerance, Diabetes Mellitus, Haemoglobinopathy, Hemolytic anaemia, Chronic renal diseases, Chronic alcoholism, Pregnancy, Blood transfusion within a period of 6 months.

The following parameters were evaluated

i. Haematological parameters: HiCN and Electrical impedance method[2]
ii. Serum iron: Ferrozin method[3]
iii. TIBC: Ferrozin method[3,4]
iv. Serum ferritin: ELISA Method[5]
v. Blood glucose: GOD-POD Method[6]
vi. HbA1C: immunoturbidometric method[7]

Haematological parameters were analysed on Sysmex kx-21 autoanalyzer. All biochemical investigations were carried out on 'Erba 360 Fully automated biochemistry analyzer'.

Observations and Results

Serum iron and Ferritin levels were highly significantly decreased (p<0.001) in IDA group patients compared to controls. TIBC levels were highly significantly increased (p<0.001) in IDA compared to control. HbA1c levels were also highly significantly increased (p<0.001) in IDA compared to control.

Table I: **Mean serum iron, TIBC, and serum ferritin level of case and control groups**

Parameters	Case	Control	P value
Serum Iron	31.9 ± 10.3	98.98 ± 21.25	0.0001
TIBC (µg/dl)	399 ± 27.2	302.1 ± 33.47	0.0001
Ferritin (µg/dl)	6.17 ± 3.34	62.96 ± 18.33	0.0001

P<0.001 Indicate highly significant.

Mean BSL-F and BSL-PP showed no significant difference in glycemic status of both case and control groups.

Table II: Mean BSL-F and BSL-PP in case and control groups

BSL (mg/dl)	Case	Control	P value
BSL-F	88.9 ± 9.03	84.70 ± 7.6	P>0.05
BSL- PP	120.00 ± 10.53	124.00± 9.08	P> 0.05

P< 0.05 Indicates statically significant.

Mean HbA1c showed highly significant difference in both case and control groups (P <0.001). **Table II**: Mean HbA1c level of case and control groups.

Parameters	Case	Control	P value
HbA1c	6.55 ± 0.77	5.27± 0.83	0.0001

P<0.001 Indicates statically significant.

Unpaired 'T' test is applied for statistical analysis of Mean Hb, HCT, MCV, MCH, MCHC levels. All levels were highly significantly decreased (p<0.001) in IDA group patients compared to controls. RDW levels was highly significantly increased (p<0.001) in IDA compared to control.

Table III: Mean Haemoglobin (Hb), MCV, MCH, MCHC, and RDW in case and control groups

Parameters	Case	Control	P value
Hb (g/dl)	8.9 ± 1.5	13.83± 1.04	0.0001
HCT (%)	26.64 ± 5.2	40.97 ± 3.4	0.0001
MCV (fl)	70.03 ±5.1	91.44 ± 3.87	0.0001
MCH (pg)	23.51 ± 2.6	30.88 ± 1.59	0.0001
MCHC (g/dl)	28.03 ± 1.74	33.86 ± 1.86	0.0001
RDW (%)	19.14 ± 3.92	13.42 ± 0.64	0.0001

P <0.001 indicate highly significant.

Discussion

HbA1c is majorly affected by the blood glucose levels. However, certain studies showed that the HbA1c levels are altered by various other coexisting factors, along with diabetes, especially that of iron deficiency anaemia, which is a major public health problem in developing countries like India. Present study was conducted to assess the status of HbA1c in iron deficiency anaemia.

Present study was conducted on 60 subjects with IDA (n=30) and age and sex matched healthy controls (n=30) groups. Diagnosis of iron deficiency anaemia requires laboratory-confirmed evidence of anaemia, as well as low iron stores.[8] Complete blood count was assessed to recognize the indices of iron deficiency anaemia (reduced Hb, Hct, MCV, MCH, MCHC and raised RDW) along with peripheral smear blood smear examination. Iron study was carried

out to confirm iron deficiency (reduced Serum iron, ferritin, and increase TIBC in IDA.).[9,10]

Several mechanisms have been advocated for this increase in the level of glycated haemoglobin in anaemic patients. It has been proposed that in iron deficiency, the quaternary structure of the haemoglobin molecule may be altered and the glycation of the beta globin chains occurs more readily.[11]

According to the explanation provided by Sluiter et al[12] the formation of glycosylated haemoglobin is almost irreversible, the concentration of HbA1 in erythrocyte will increase linearly with the cell's age. Younger population of red blood cells have lower HbA1 level as after treatment of iron deficiency anaemia but if iron deficiency has been worsening in the previous months, red cell production will fall causing not only anaemia but also increasing average age of circulating erythrocytes and thus an increase in HbA1 level.

Above discussion underline the effect of iron deficiency anaemia on HbA1C concentration. Increased level of HbA1C was observed in iron deficiency anaemia. This study has got significant relevance because IDA is highly prevalent in a tropical country like India. Recently HbA1c has been recommended as one of the diagnostic criteria of DM. Thus iron status must be considered during the interpretation of the HbA1C. Further similar study on a large sample size is needed to substantiate the results of this study.

Conclusion

Apart from blood glucose, iron deficiency anaemia also affects HbA1c level. As IDA and Diabetes mellitus both being frequent in India, IDA is to be taken in consideration while interpreting HbA1c in diagnosis and monitoring of Diabetes mellitus. IDA can be suspected in raised HbA1c level with euglycemia

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