

Effect of Iron Deficiency Anemia on Hba1c Levels in Controlled Plasma Glucose Levels.

Manika Khare¹, Ajit Thakur², Jyoti Batra³, Pratibha Yadav⁴, (Maj.) Murari Lal Dhanetwal¹, M Ali Sayed¹

¹Assistant Professor, Department of Pathology, Jaipur National University Institute of Medical Sciences & Research, Jaipur – 302017, Rajasthan.

²Assistant Professor, Department of Biochemistry, Jaipur National University Institute of Medical Sciences & Research, Jaipur – 302017, Rajasthan, India.

³Professor, Department of Biochemistry, Santosh Medical College, Ghaziabad, NCR, Delhi, India.

⁴Associate Professor, Department of Biochemistry, Jaipur National University Institute of Medical Sciences & Research, Jaipur – 302017, Rajasthan.

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ABSTRACT

Background: Anaemia is a major health issue that has a wide global impact involving approximately 1/3rd of patients with anaemia. HbA1C levels are not influenced by blood glucose levels alone. Studies suggest that conditions like IDA, haemolytic anaemia, alcohol ingestion, pregnancy, blood loss, and uraemia may alter HbA1C levels independent of glycaemic status. **Methods:** Totally 200 patients were included in the study. 100 patients were controlled diabetics with iron deficiency anemia and 100 were controlled diabetics without iron deficiency anemia. Comparison of levels of HbA1c was done between the two groups. **Results:** Correlation between mcv and hba1c is -0.76716. Which is strongly negative correlated. P – Value for the correlation test is 0.000001. **Conclusion:** Iron deficiency anemia has role in elevating A1C in both the groups. Iron deficiency anemia elevates HbA1c levels in diabetic individuals with controlled plasma glucose levels. The elevation is more in patients having plasma glucose levels between 100 to 126 mg/dl. Hence, before altering the treatment regimen for diabetes, iron deficiency anemia should be treated first.

Keywords: Iron Deficiency Anaemia, HbA1C, Plasma Glucose.

INTRODUCTION

Anaemia is a major health issue that has a wide global impact involving approximately 1/3rd of patients with anaemia Haemoglobin A1c (HbA1c) is a glycosylated hemoglobin that can be used as an indicator of a patient's glycemic status over the previous 3 months HbA1C levels are not influenced by blood glucose levels alone.^[1,2] Studies suggest that conditions like IDA, haemolytic anaemia, alcohol ingestion, pregnancy, blood loss, and uraemia may alter HbA1C levels independent of glycaemic status.^[3] Initial studies by Brooks et al.^[4] Sluiter et al.^[5] and Mitchell et al.^[6] showed a relationship between iron deficiency anemia and HbA1c levels. Later, Heyning et al.^[7] and Hansen et al.^[8] reported that there were no differences between the HbA1c levels of anaemic patients and controls. These observations were strikingly different from those of previous studies.

Since only limited number of studies has been carried out in Indian population, we were prompted to conduct the current study to determine the impact of IDA on HbA1C in non-diabetic population to annul the effect of glucose on HbA1C.

MATERIALS AND METHODS

This was an analytical cross-sectional study carried out in Jaipur National Institute of Medical Sciences & Research Centre, Jaipur between June 2017 to March 2018 and approved by our Institutional Ethical Committee. Totally 200 patients were included in the study. 100 patients were controlled diabetics with iron deficiency anemia and 100 were controlled diabetics without iron deficiency anemia Those having Hb<13 gm/dl in males and <12 gm/dl in females, Hct< 40% in males and <36% in females, mean corpuscular volume (MCV) <80 fl, Mean Corpuscular Haemoglobin (MCH) <26 pg/cell, Mean Corpuscular Haemoglobin Concentration (MCHC) <32 gm/dl and peripheral smear showing microcytic hypochromic picture were considered to have IDA and confirmed by their serum iron (<60 µg/dl) and ferritin levels (<15 µg/l).^[9] A total of 50 non diabetics without IDA

Name & Address of Corresponding Author

Dr. Ajit Thakur,
Assistant Professor,
Department of Biochemistry,
Jaipur National University Institute of Medical Sciences &
Research,
Jaipur – 302017, Rajasthan.

were enrolled to serve as controls. All the laboratory parameters analysed for study group and for the control group as well.

Patients with a history of acute blood loss, hemolytic anemia, hemoglobinopathies, kidney disease, pregnancy, established diabetes, impaired fasting glucose, or impaired glucose tolerance were excluded. Those with no history of glucose intolerance, but with fasting blood glucose levels greater than 100 mg/dl at the time of enrolment were also excluded.

Measurements: HbA1c was measured by HPLC method using Bio-Rad D-10 analyzer. Method of estimation and the analyser used to perform HbA1c analysis were the same throughout the study period. It was done by COBAS INTEGRA 400 plus which works on the principle of Competitive turbidimetric inhibition immunoassay (TINIA). Haemoglobin, MCV, MCH, and MCHC estimation was carried out by XP 800i automated counter, and serum ferritin estimation was performed by chemiluminescence with advanced acridinium ester technology method using SIEMENS - ADVIA Centaur CP Immunoassay System. Also, plasma glucose was estimated by GOD/PAP method by RANDOX RX imola series analyser.

Statistical analysis: Data was analyzed using IBM SPSS statistics 20. The data were presented as mean ± SD. A student's t-test was applied for comparison of group means. Pearson's coefficient of correlation was calculated to determine the correlation between the two variables. Categorical data was analyzed by χ^2 test. Odds ratio and 95% confidence intervals were obtained by the use of logistic regression analyses. P value less than 0.05 was considered significant.

RESULTS

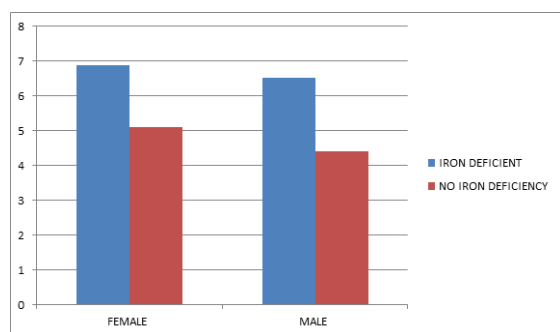


Figure 1: Distribution of HbA1c (%) gender wise in subjects with iron deficiency anemia and no Anemia.

In 100 cases of this study, mean HbA1c value was found to be 6.69 ± 1.04 . Haemoglobin levels in male and female cases were 9.9 ± 1.54 and 8.44 ± 1.23 g/dl, respectively. The mean MCV was 68.72 ± 6.3 . The mean HbA1c was higher in the females compared to the males (6.89 for females and 6.53 for males) [Figure 1]. Mean fasting glucose

levels in cases was found to be 100.72 ± 15.02 . Subjects were divided into two groups according to their FPG levels. The subjects with controlled diabetes with normal fasting glucose (FPG levels <100 mg/dl) had HbA1c of 6.4 ± 1.54 while subjects who had FPG between 100-126 mg/dl had a significantly higher mean A1C value of 7.2 ± 1.76 . Correlation between mcv and hba1c is -0.76716 . Which is strongly negative correlated. P – Value for the correlation test is 0.000001. Significance level or Alpha value 0.05. It is statistically significant.

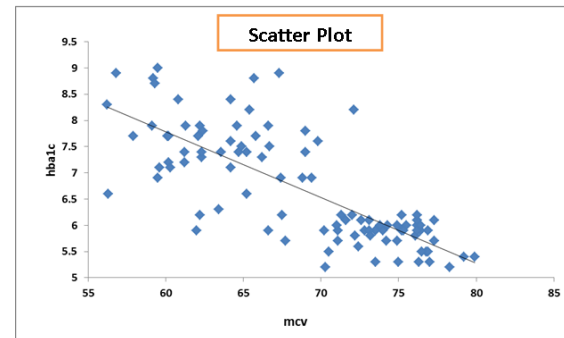


Figure 2: Scatter plot showing significant negative relation between HbA1c and MCV

DISCUSSION

Iron deficiency anemia is most common form of anemia observed in our country. Haemoglobin A1c (HbA1c), a glycosylated hemoglobin is formed by an irreversible, slow non-enzymatic catalysis of the β chain of globin in mature haemoglobin (Hb).^[9,10] It is used as a gold standard for monitoring glycemic status for the previous three months (the life span of a red blood cell) in patients with diabetes.^[11] HbA1c is less susceptible to short-term modulation than blood glucose levels and hence provide the integrated measure for diabetes. In the process of glycation, glucose in the red cells reacts with N-terminal valine of both beta chains to form an aldimine linkage which undergoes rearrangement forming a more stable ketoamine link.^[12,13]

This study showed that HbA1c was significantly raised in uncontrolled diabetic females with significant odd ratio. Raised HbA1c levels were raised in males too but odd ratio was not significant. Similar results were seen in the study by Christy L et al.^[3]

In this study the levels of HbA1c were found to be raised in the patient with iron deficiency patient who was statistically significant. Similar results were seen in the study done by Coban et al and sluiyer et al. sluter et al gave the explanation that haemoglobin glycation is the irreversible process so HbA1c levels in the erythrocytes will increase with age. In iron deficiency, red cell production decreases, consequently an increased average age of circulating red cells ultimately leads to elevated HbA1 levels.^[5]

Hashimoto et al.^[14] A1C levels were elevated in pregnant diabetic women. Pregnancy is mostly associated with iron deficiency anemia and do cause spurious raise in HbA1c levels.. The study showed that it was iron deficiency anemia which caused elevated A1C, and not pregnancy itself. Hence, Hashimoto and co-workers concluded that it should not be used as a marker of glycemic control, especially in later half of pregnancy.^[14] Jen et al,^[15] in their study showed that in chronic kidney disease patient having diabetes but a good glycemic control, had a spuriously high HbA1c levels due to iron deficiency associated with the disease. Therefore, iron deficiency anemia not only increases A1C levels in non-diabetic individuals but also it can interfere with its ability to determine glycemic status of diabetic individuals. This study showed significantly higher value of A1C in anaemic patients who had FGP between 100-126 mg/dl as anemia exaggerated the picture of glycemic status in this group of patients. In this study mean A1C is 6.4% for the patient with FGP levels <100mg/dl which were higher than those of controls. Thus iron deficiency anemia has role in elevating A1C in both the groups.

CONCLUSION

Iron deficiency anemia elevates HbA1c levels in diabetic individuals with controlled plasma glucose levels. The elevation is more in patients having plasma glucose levels between 100 to 126 mg/dl. Hence, before altering the treatment regimen for diabetes, iron deficiency anemia should be treated first.

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