Journal of Advanced Medical and Dental Sciences Research

@Society of Scientific Research and Studies

Journal home page:www.jamdsr.com doi:10.21276/jamdsr Index Copernicus value [ICV] =82.06

(e) ISSN Online: 2321-9599; (p) ISSN Print: 2348-6805

Original Research

Association of iron deficiency anemia with Hba1c levels in non-diabetics and effect of iron therapy on HbA1c levels

[1]Gopinath G, [2]Mohammed Shaheer A M, [3]R C Krishna Kumar

[1,2]Assistant Professor, [3]Medical Director, PK Das Institute of Medical Sciences, Vaniyamkulam, Ottapalam, Palakkad, Kerala, India

ABSTRACT:

Aim: Anemia is a worldwide public health issue that affects both developing and industrialized nations. The present study was conducted to find association of iron deficiency anemia with Hba1c levels in non-diabetics and effect of iron therapy on Hba1c levels. **Methodology:** 84 patients with iron deficiency anemia were assessed for haemoglobin, HbA1c, serum ferritin, serum iron, total iron binding capacity (TIBC), mean corpuscular haemoglobin (MCH), mean corpuscular volume (MCV), mean corpuscular haemoglobin concentration (MCHC), blood urea and serum creatinine. Patients received iron supplementation for three months in the form of oral ferrous sulphate (325 mg per tablet), with dosages appropriate for the severity of their anemia. The HbA1c level was evaluated before and after iron therapy. Serum iron and TIBC were measured using the ferrozine/MgCO3 technique. A method based on chemiluminescence was used to assess serum ferritin. **Results:** The age group ≤30 years had 5, 31-40 years had 18, 41-50 years had 26 and 51-60 years had 35 patients. The difference was non- significant (P> 0.05). There were 24 cases of mild, 50 cases of moderate and 10 cases of severe anemia. The difference was significant (P< 0.05). The mean hemoglobin at baseline and at 3 months was 9.26 and 11.12, serum iron was 20.4 and 60.3, TIBC was 340.1 and 348.5, serum ferritin was 8.12 and 46.2 and HbA1c was 5.27 and 5.12 respectively. The difference was significant (P< 0.05). At baseline HbA1c had negative excellent correlation with Hb (-.752) while after iron supplementation there was decrease in HbA1c levels and increase in Hb levels. HbA1c and hemoglobin at 3 months showed negative moderate correlation with Pearson's coefficient value being -0.55 (p<0.001). This signifies that as the value of Hb increases there is a moderate decrease in HbA1c. **Conclusion:** A significant correlation between iron deficiency anemia and elevated HbA1C level in non- diabetics was found. HbA1C increases with the severity of anaemia and vice versa. The decreased erythrocyte indices, decreased erythrocyte life span, and altered morphology play a significant role.

Key words: Anemia, Hemoglobin, Red blood cell

Received: 11-01- 2019 Accepted: 16-02-2019

Corresponding author: Mohammed Shaheer A M, Assistant Professor, PK Das Institute of Medical Sciences, Vaniyamkulam, Ottapalam, Palakkad, Kerala, India

This article may be cited as: Gopinath G, AM Mohammed S, Kumar RCK. Association of iron deficiency anemia with Hba1c levels in non-diabetics and effect of iron therapy on HbA1c levels. J Adv Med Dent Scie Res 2019;7(3):265-268.

INTRODUCTION

Anemia is a global public health concern that impacts both developing and developed countries. It has a major impact on social and economic advancement as well as human health. All stages of life are susceptible, but pregnant women and young children are more vulnerable.[1] About one-third of the world's population suffers from anemia, a disorder in which a person's red blood cell (RBC) count and/or hemoglobin (Hb) concentration are below normal and insufficient to meet their physiological needs. In addition to poorer birth outcomes, lower adult productivity at work, and delayed cognitive and behavioral development in children, anemia is associated with increased morbidity and death rates in both women and children.[2]

The glycation of the NH2-terminal valine residue of the globin chain produces hemoglobin A1c (HbA1c), a glycated form of hemoglobin (Hb). HbA1c and other glycated hemoglobins (HbA) make up the HbA1 percentage of adult hemoglobin. As the predominant hemoglobin, HbA1c is the major component of HbA1 fractions.[3] The American Diabetes Association has recently included HbA1c testing to its list of diagnostic criteria for diabetes diagnosis. The accepted diagnostic cutoff point for diabetes mellitus is 6.5% HbA1c. It was previously thought that blood glucose levels had the biggest impact on HbA1c.[4]

However, multiple studies have shown that, in addition to diabetes, a variety of other coexisting illnesses can also affect the HbA1c readings, such as Iron Deficiency Anemia, which is a significant public health issue in developing nations such as India.[5,6] The present study assessedthe association of iron deficiency anemia with Hba1c levels in non-diabetics and the effect of iron therapy on Hba1c levels.

METHODOLOGY

The present study comprised 84 patients with iron deficiency anemia of both genders. The ethical review committee approved the study. All were informed regarding the study and their written consent was obtained.

The demographic profile of each patient was recorded. All patients were subjected to assessment of haemoglobin, HbA1c, serum ferritin, serum iron, total iron binding capacity (TIBC), mean corpuscular haemoglobin (MCH), mean corpuscular volume (MCV), mean corpuscular haemoglobin concentration (MCHC), blood urea and serum creatinine. The serum iron <30mcg/ dl, TIBC >300mcg/dl and ferritin <15mcg/dl made the diagnosis of microcytic hypochromic anemia.

Patients received iron supplementation for three months in the form of oral ferrous sulphate (325 mg per tablet), with dosages appropriate for the severity of their anemia. The HbA1c level was evaluated before and after iron therapy. Serum iron and TIBC were measured using the ferrozine/MgCO3 technique. A method based on chemiluminescence was used to assess serum ferritin. We used the sandwich ELISA method to calculate HbA1c. The autoanalyzer PCi20+ was used to calculate the hemogram. Data thus obtained were subjected to statistical analysis. P value < 0.05 was considered significant.

RESULTS

Table I Distribution of patients

Age group (years)	Number	P value
≤30	5	0.84
31-40	18	
41-50	26	
51-60	35	

The age group ≤30 years had 5, 31-40 years had 18, 41-50 years had 26 and 51-60 years had 35 patients. The difference was non- significant(Table I).

Table II Distribution of patients based on severity of anemia

Severity of anemia	Number	P value
Mild	24	0.04
Moderate	50	
Severe	10	

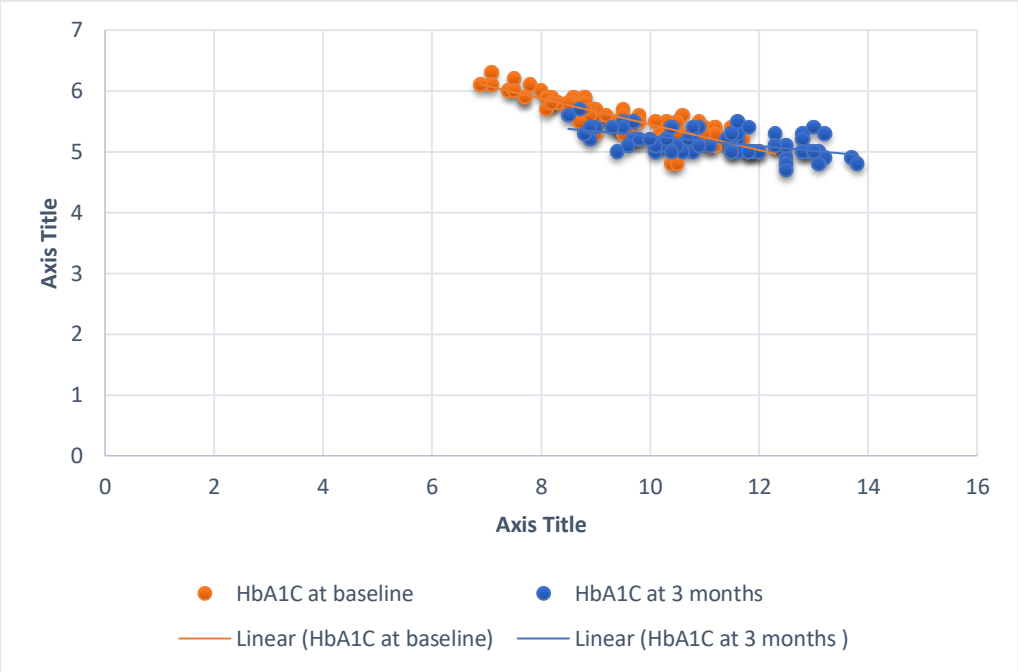
There were 24 cases of mild, 50 cases of moderate and 10 cases of severe anemia. The difference was significant (Table II).

Table III Assessment of laboratories parameters

Parameters	Baseline	3 months	P value
Hb (gm/dl)	9.26	11.12	0.03
Serum iron (mcg/dl)	20.4	60.3	0.01
TIBC (mcg/dl)	340.1	348.5	0.19
Serum ferritin (ng/ml)	8.12	46.2	0.01
HbA1c	5.27	5.12	0.05

The mean hemoglobin at baseline and at 3 months was 9.26 and 11.12, serum iron was 20.4 and 60.3, TIBC was 340.1 and 348.5, serum ferritin was 8.12 and 46.2 and HbA1c was 5.27 and 5.12 respectively. The difference was significant (Table III).

Graph I Correlation between haemoglobin and hba1c at baseline and 3 months



At baseline, HbA1c had a negative excellent correlation with Hb (-.752) while after iron supplementation there was a decrease in HbA1c levels and an increase in Hb levels. HbA1c and hemoglobin at 3 months showed a moderate negative correlation with Pearson's coefficient value being -0.55($p<0.001$). This signifies that as the value of Hb increases there is a moderate decrease in HbA1c (Graph I).

DISCUSSION

One of the most prevalent diseases in the world and one that is spreading quickly is diabetes mellitus. It is also a leading contributor to morbidity and mortality. Diabetes control has been linked to complications from the illness.[7] Glycated hemoglobin, or hemoglobin A1C, continues to be the primary indicator of disease control even with the introduction of newer objectives that indicate diabetes control, such as the time in range. The hemoglobin A1C (HbA1c) test determines a person's glycemic index for the last three months. The most common hemoglobin A1 fraction is called HbA1c.[8] The N-terminal valine of both beta chains joins forces with red blood cell glucose during the glycation process to form an aldimine linkage, which then experiences rearrangement to form a more stable ketoamine bond.[9] Not only is it considered the primary objective of glycemic control, but it is also listed as a diagnostic criterion in recommendations made by the American Diabetes Association. Once believed to be exclusively influenced by blood glucose levels, HbA1c may also be raised in conditions other than diabetes, such as haemoglobinopathies, pregnancy, chronic renal illnesses, and nutritional anemias, according to several studies.[10,11]

We found that the age group ≤30 years had 5, 31-40 years had 18, 41-50 years had 26 and 51-60 years had 35 patients. There were 24 cases of mild, 50 cases of moderate and 10 cases of severe anemia. Alzahrani et al[12] assessed the effect of different types of anemia including iron deficiency anemia, sickle cell anemia, β -thalassemia trait, and megaloblastic anemia on HbA1c levels. The mean HbA1c levels were significantly higher in sickle cell anemia at 5.83% and in iron deficiency anemia at 5.75% when compared to the control group at 5.32%. However, the mean HbA1c levels in megaloblastic anemia were 5.38% and 5.45% in beta thalassemia trait, which were not significantly different when compared to the control group. HbA1c significantly decreased from 5.75 to 5.44% after treatment in the iron-deficient group. Moreover, lower hemoglobin and higher red cell distribution width correlated with higher HbA1c levels in patients with sickle cell anemia.

We found that the mean hemoglobin at baseline and at 3 months was 9.26 and 11.12, serum iron was 20.4 and 60.3, TIBC was 340.1 and 348.5, serum ferritin was 8.12 and 46.2 and HbA1c was 5.27 and 5.12 respectively. Hansen et al[13] anticipated normal levels of glycated hemoglobin and found that HbA1c levels decreased in response to anemia treatment, which was likely due to increased bone marrow erythropoiesis resulting in the production of new immature erythrocytes. They also demonstrated that there were no statistically significant differences between the HbA1c concentrations of iron-deficient patients, vitamin B12-deficient patients, and healthy controls.

We observed that at baseline HbA1c had negative excellent correlation with Hb (-.752) while after iron supplementation there was decrease in HbA1c levels and increase in Hb levels. HbA1c and hemoglobin at

3 months showed negative moderate correlation with Pearson's coefficient value being -0.55. This signifies that as the value of Hb increases there is a moderate decrease in HbA1c. Sluiter et al's[14] theory postulated that since the production of glycated haemoglobin is an irreversible process, the amount of HbA1c in a single erythrocyte would increase proportionately with the age of the cell. For example, they discovered that, as would be the case following treatment for iron deficiency anemia, those with very young red blood cells and normal blood glucose levels had reduced HbA1c concentrations. On the other hand, if iron shortage has continued for a long time, the rate at which red blood cells are produced will drop. This will lead to anemia, a greater average age of circulating erythrocytes than is typical, and rising HbA1c values.

CONCLUSION

Authors found a significant correlation between iron deficiency anemia and elevated HbA1C level in non-diabetics. HbA1C increases with the severity of anaemia and vice versa. The decreased erythrocyte indices, decreased erythrocyte life span, and altered morphology play a significant role.

REFERENCES

1. Mortensen HB, Christophersen C. Glucosylation of human haemoglobin A in red blood cells studied in vitro. Kinetics of the formation and dissociation of haemoglobin A1c. Clin Chim Acta. 1983 Nov;134(3):317–26.
2. Mortensen HB, Vølund A, Christophersen C. Glucosylation of human haemoglobin A. Dynamic variation in HbA1c described by a biokinetic model. Clin Chim Acta. 1984 Jan;136(1):75–81.
3. Rahbar S. An abnormal hemoglobin in red cells of diabetes. Clin Chim Acta. 1968 Oct;22(2):296–8.
4. Bindayel IA. Influence of iron deficiency anemia on glycated hemoglobin levels in non-diabetic Saudi women. Journal of International Medical Research 49(2) 1–10.
5. Aydın B, Özçelik S, Kilit TP, Eraslan S, Çelik M, Onbaşı K. Relationship between glycosylated hemoglobin and iron deficiency anemia: A common but overlooked problem. Prim Care Diabetes. 2022 Apr;16(2):312-317.
6. Rahbar S, Blumenfeld O, Ranney HM. Studies of an unusual hemoglobin in patients with diabetes mellitus. Biochem Biophys Res Commun. 1969 Aug;36(5):838–43.
7. Mohamed AS, Mohamed EN, Abd El Halim AF, Metwally ES. Effect of Iron Deficiency Anemia on HbA1c Levels in Non-Diabetic Individuals. Egypt J Hosp Med. 2021 Jan 1;82(1):74-9.
8. Trivelli LA, Ranney HM, Lai HT. Hemoglobin components in patients with diabetes mellitus. N Engl J Med. 1971 Feb;284(7):353–7.
9. Ng JM, Cooke M, Bhandari S, Atkin SL, Kilpatrick ES. The effect of iron and erythropoietin treatment on the A1C of patients with diabetes and chronic kidney disease. Diabetes Care. 2010 Nov;33(11):2310–3.
10. Van Heyningen C, Dalton RG. Glycosylated haemoglobin in iron-deficiency anaemia. Lancet. 1985 Apr 13;1(8433):874.
11. Kim C, Bullard K, Herman W, Beckles G. Association between iron deficiency and A1C Levels among adults without diabetes in the National Health and Nutrition Examination Survey, 1999-2006. Diabetes Care. 2010;33(4):780-785.
12. Alzahrani BA, Salamatullah HK, Alsharm FS, Baljoon JM, Abukhodair AO, Ahmed ME, Malaikah H, Radi S. The effect of different types of anemia on HbA1c levels in non-diabetics. BMC Endocrine Disorders. 2023 Jan 28;23(1):24.
13. Gram-Hansen P, Eriksen J, Mourits-Andersen T, Olesen L. Glycosylated haemoglobin (HbA1c) in iron- and vitamin B12 deficiency. J Intern Med. 1990 Feb;227(2):133-6.
14. Sluiter WJ, van Essen LH, Reitsma WD, Doorenbos H. Glycosylated haemoglobin and iron deficiency. Lancet. 1980 Sep 6;2(8193):531-2.