Original Research Article

Assessment of hemoglobin level in type 2 diabetes mellitus

Shanthini R [1], Abiramasundari R [2], Dharani B [3], Viji devanand [4], Lovie beneta T [5]

[1] Associate Professor, [2] Assistant Professor, [3] Post graduate, [4] Professor & Head, [5] Assistant professor, Department of Physiology, Stanley medical college, Chennai – 600 001, Tamil Nadu, India.

Abstract

Background: Type 2 diabetes mellitus is a chronic condition that occurs due to elevated blood glucose level. It was predicted that around 440 million people will be affected by type 2 diabetes mellitus by 2030. The most common clinical presentations of type 2 diabetes mellitus are fatigue and reduced work capacity. Fatigue is said to be a commonest clinical feature of anemia. Hence anemia might be the reason for fatigue and reduced work capacity in type 2 mellitus. Chronic inflammation in type 2 diabetes mellitus could be the reason for anemia. **Aim:** To assess hemoglobin level in the diabetic group and the control group. To compare the hemoglobin level in diabetic group and control group. **Materials and methods:** A cross sectional analytical study was conducted with 30 healthy volunteers as the control group and 30 type 2 diabetic individuals as the study group. The complete blood count was done and hemoglobin level was assessed. **Results:** The data obtained were analyzed using Statistical Package for Social Sciences (SPSS) version 20. The average hemoglobin level of control group was 15.3 ± 2.2 versus 10.1 ± 1.2 in type 2 diabetic group and found to be statistically significant (p-value <0.05). **Conclusion:** The present study found that the hemoglobin level was low in type 2 diabetic subjects than in non-diabetic subjects. This shows that anemia is prevalent in type 2 diabetes mellitus because of chronic systemic inflammation. Hence, during routine checkup, hemoglobin level must be assessed in type 2 diabetes mellitus to prevent cardiovascular complications and to improve the quality of life.

Key words: anemia, hemoglobin, type 2 diabetes mellitus

Corresponding Author
Dr. R. Abiramasundari, Assistant Professor, Department of Physiology, Stanley Medical College, Chennai – 600001, Tamil Nadu, India
Telephone: +91 9443724669 E-mail: abirami28051976@gmail.com

Introduction

Type 2 diabetes mellitus is a chronic condition that occurs due to elevated blood glucose level. It was predicted that around 440 million people will be affected by type 2 diabetes mellitus by 2030[1]. Urbanization, sedentary life and obesity account for increasing prevalence of type 2 diabetes mellitus. It accounts for 90% of all types of the disease worldwide.

In type 2 diabetes mellitus, the body cannot produce sufficient amount of hormone insulin and also cannot effectively use the produced hormone insulin which is referred as “insulin resistance”. The insulin resistance causes

decreased glucose tolerance especially in muscle and adipose tissue where insulin dependent glucose uptake occurs.

Diabetes is said to be a major disabling disease which can lead to amputations, blindness, kidney disease and cardiovascular complications[2]. The most common clinical presentations of type 2 diabetes mellitus are fatigue and reduced work capacity. Studies have shown that fatigue in type 2 diabetes occurs due to inability of the skeletal muscle to utilize glucose. But fatigue is said to be a commonest clinical feature of anemia. Hence anemia might be the reason for fatigue and reduced work capacity in type 2 mellitus. Type 2 diabetes mellitus is said to be associated with chronic systemic inflammation. Chronic inflammation in type 2 diabetes mellitus could lead to anemia.

Anemia is a major health problem affecting quality of life. The clinical presentations of anemia include fatigue, decreased work capacity, anorexia, cognitive dysfunction and depression. It increases the risk of cardiac diseases and thereby decreasing the quality as well as life expectancy of an individual. Hence anemia in type 2 diabetes mellitus can add on to the complications of Diabetes mellitus. Hence in this study we have assessed the level of hemoglobin in type 2 diabetic individuals.

Aim and objectives

1. To assess hemoglobin level in the diabetic group and the control group.
2. To compare hemoglobin level in the diabetic group and the control group.

Materials and Methods

A cross sectional analytical study was conducted with 30 healthy volunteers as the control group and 30 type 2 diabetic individuals as the study group at i. The duration of study was 6 months.

Inclusion criteria

Type 2 diabetic individuals diagnosed by the World Health Organization diagnostic criteria of type 2 diabetes mellitus with fasting blood sugar ≥126mg/dl or post-prandial blood sugar ≥200mg/dl or HbA1c ≥6.5% and on treatment irrespective of their glycaemic status. The study participants belong to the age group of 30-50yrs and the duration of type 2 diabetes mellitus ≤5 years.

Exclusion criteria

- H/O hypertension.
- H/O bleeding disorder.
- H/O Chronic renal failure or decrease in Glomerular Filtration Rate.
- H/O acute or chronic cardio-respiratory disease.
- H/O smoking or tobacco chewing.
- BMI > 30.
- Pregnancy.

Data collection was done after obtaining Institutional Ethical Committee clearance. After giving complete information about the study, informed and written consent was obtained from the participants who were selected from diabetology Out Patient Department. The participants were assured of the confidentiality. Using a validated semi structured proforma, a detailed history was obtained. A detailed clinical examination was done.

Under sterile precautions, 2ml of venous blood sample was collected for complete blood count assessment using SYSMEX automated complete blood count analyzer in the central lab of diabetology department. This analyzer uses cyanide free sodium lauryl sulphate (SLS) hemoglobin detection method.

Statistical analysis

The data obtained were analyzed by using Statistical Package for Social Sciences (SPSS) version 20. Mean and standard deviation was calculated for parameters like age, BMI, biochemical parameters and hemoglobin levels for the control group and type 2 diabetic group. Comparison of the parameters among the study groups was done using student t-test.

Results

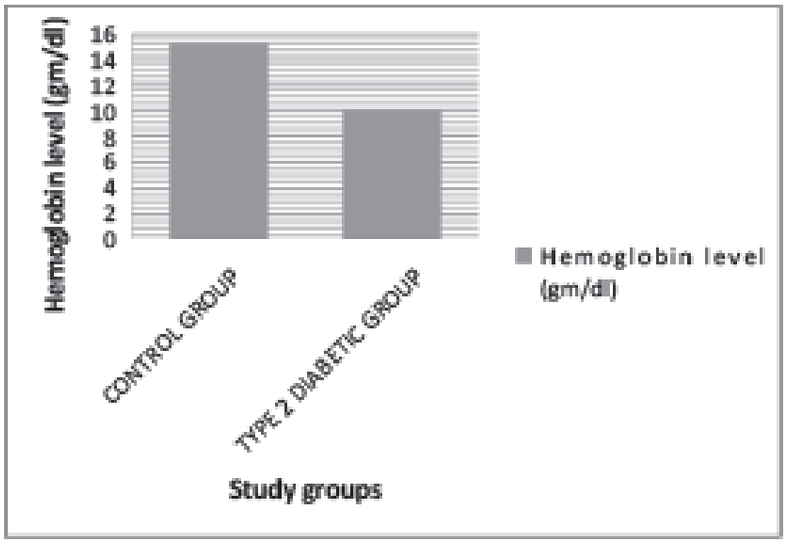
Table 1 depicts the comparison of age, BMI, biochemical parameters and hemoglobin level among the study groups. The mean age in the control group was 42 ± 4.6564 years versus 42 ± 4.3638 years in type 2 diabetic group. The mean BMI in the control group was 22±2.6848 versus 22±2.3652 in type 2 diabetic group. The p-value of age and BMI was found to be statistically not significant. This shows that the study groups were age and BMI matched.

Table 1: Comparison of age, BMI, biochemical parameters and hemoglobin levels among the study groups

Variables	Control group (Mean ± SD) (n=30)	Type 2 diabetes mellitus group (Mean ± SD) (n=30)	p-value
AGE (yrs)	42±4.6564	42±4.3638	0.1235
HEIGHT (cm)	154±3.6466	156±4.6686	0.1667
WEIGHT (Kg)	64±5.9624	64±6.6894	0.2456
BMI	22±2.6848	22±2.3652	0.3457
HbA1C (%)	4.4±0.6787	6.1±0.1565	0.0458*
FBS (mg/dl)	94±9.6754	178±39.8668	0.0008**
PPBS (mg/dl)	114±8.7754	218±82.8654	0.0006**
RBS (mg/dl)	117±7.3565	206±62.9944	0.0005**
S.Urea (mg/dl)	26±7.5762	27±6.6862	0.2451
S.Creatinine (mg/dl)	0.9±0.1	0.9±0.1264	0.1258
Hemoglobin level (gm/dl)	15.3 ± 2.2	10.1 ± 1.2	0.0401*

***-Significant **-Highly significant**

Figure 1: Comparison of hemoglobin level between control group and type 2 diabetic group



The mean HbA1C in the control group was 4.4 ± 0.6787% versus 6.1 ± 0.1565% in type 2 diabetic group and was found to be statistically significant ($p < 0.05$). The mean fasting blood sugar and postprandial blood sugar in the control group was 94 ± 9.6754 mg/dl and 114 ± 8.7754 mg/dl versus 178 ± 39.8668 mg/dl and 218 ± 82.8654 mg/dl in type 2 diabetic group and was found to be statistically highly significant ($p < 0.001$). This shows that blood glucose level was significantly higher in type 2 diabetic group.

The mean urea level was 26 ± 7.5762 mg/dl and creatinine level were 0.9 ± 0.1 mg/dl in control group versus urea level was 27 ± 6.6862 mg/dl and creatinine level were 0.9±0.1264 mg/dl in type 2 diabetic group and was found to be statistically not significant. This shows that type 2 diabetic group had normal renal function.

Figure 1 depicts the comparison of hemoglobin level between control group and type 2 diabetic group.The average hemoglobin level of control group was 15.3 ± 2.2 gm/dl versus 10.1 ± 1.2 gm/dl in type 2 diabetic group and found to be statistically significant (p-value <0.05). It shows that hemoglobin level was low in type 2 diabetic subjects than in non-diabetic subjects

There were 10 males and 20 females in control group. There were 10 males and 20 females in study group. But there was no significant statistical difference in their hemoglobin and blood sugar levels, thereby showing no gender difference in hemoglobin levels.

Discussion

Our present study found that hemoglobin level was decreased in type 2 diabetic individuals when compared to normal healthy volunteers. Andrews et al in their study found that expression of inflammatory genes is associated with prevalence of anemia in type 2 diabetes mellitus[3]. Similar findings were seen in Jessica et al study[4].

Craig et al in their study found that overt inflammation due to type 2 diabetes mellitus leads to anemia because of erythropoietin unresponsiveness. Similar findings were seen in our present study[5]. Similar findings were found in chagai et study. It was found that type 2 diabetes mellitus was associated with normal renal function[6].

Babatundunde et al in their study found that poor glycemic control and old age are associated with high incidence of anemia in type 2 diabetes mellitus despite of normal renal function[7].

Insulin resistance in type 2 diabetes mellitus has affected the glucose tolerance leading to accumulation of excess glucose in the circulation[8]. This leads to a state of chronic hyperglycemia creating a homeostatic imbalance[4]. Insulin is required for maturation of erythroid progenitors. Reduced Insulin action might lead to reduced production of mature erythrocytes[9,10].

Type 2 diabetes mellitus is now regarded as a chronic inflammatory disease. Many previous studies have showed that level of inflammatory markers like CRP, TNF alpha and IL-6 was increased in type 2 diabetes mellitus[11,12]. The level of inflammation was found to be associated with glycemic control and the duration of disease in type 2 diabetes mellitus[13,14]. The increased level of inflammation in type 2 diabetes mellitus leads to complications like anemia. Anemia is defined as hemoglobin level <13.5gm/dl in men and <12gm/dl in women[15].

The increased inflammatory cytokines have an apoptotic effect on erythroid progenitor cells. Insulin resistance in type 2 diabetes mellitus leads to increased production of adipokines from adipocytes. IL-6 is an important adipokine which was found to be associated with insulin resistance[16]. Increasing level of IL-6 in type 2 diabetes mellitus has an anti-erythropoietic effect. This alters the sensitivity of erythroid progenitors to erythropoietin and further leads to apoptosis of matured erythrocytes. This causes decrease in circulating erythrocytes leading to decrease in hemoglobin level[17]. Andrews et al in their study found that diabetic patients were found to have high CRP and Ferritin level which indicated the chronic underlying inflammation[18].

It was found that anemia in type 2 diabetes mellitus arising out of chronic systemic inflammation gets aggravated by the developing diabetic nephropathy[19]. The diminished erythropoietin production by the failing kidneys in turn causes anemia.

Escorcio et al in their study found that inflammation and decreasing renal function are the two important factors determining reduced hemoglobin level in type 2 diabetes mellitus[20]. Cohen et al in their study found that hyperglycemic environment and increased formation of advanced end glycation products also reduces the life span of erythrocytes[21].

Anemia decreases the quality of life by causing symptoms like decreased appetite, lethargy, depression, insomnia and loss of concentration. Fatigue in type 2 diabetes due to inability of the skeletal muscle to utilize glucose is still more worsened by anaemia.Hence anemia in type 2 diabetes mellitus must be screened routinely. Early diagnosis and treatment can prevent progression to cardiovascular complications and also improves the quality of life in type 2 diabetes mellitus patients.

Conclusion

The present study found that hemoglobin level in type 2 diabetes mellitus was reduced in diabetic group when compared to normal group which is statistically significant (p-value <0.05). This shows that anemia is prevalent in type 2 diabetes mellitus because of chronic systemic inflammation. Hence, during routine checkup, hemoglobin level must be assessed in type 2 diabetes mellitus to prevent cardiovascular complications and to improve the quality of life.

Limitations

Sample size is small in the present study, other markers of anemia like iron profile, Vitamin B12 level and peripheral smear were not assessed.

Based on the findings from the current study, future studies could assess all the other investigations of anemia in type 2 diabetes mellitus in a larger study population.

Acknowledgements: Nil

Conflict of interest: Nil

References

1. J.E. Shaw, R.A. Sicree and P.Z.Zimmet. Global estimates of the prevalence of diabetes for 2010 and 2030. Diabetes Research and Clinical Practice. 2010; 87(1): 4-14.
2. P.M.S.B.Francisco, A.P.Belon, M.B.A. Barros, L.Carandina, M.C.G.P.Alves et al. Self – reported diabetes in the elderly: prevalence, associated factors and control practices. Cadernos de Saude Publica. 2010; 26(1): 175-184.
3. M. Andrews and M. Arredondo. Ferritin levels and hepcidin mRNAexpression in peripheral mononuclear cells from anemic type 2 diabetic patients. Biological Trace Element Research. 2012; 149(1): 1–4.
4. Jessica B, Paula C F, Eliane R W, Carine Eloise P Z, Yana P S. Anemia in patients with type 2 diabetes mellitus. Anemia. 2015; 1: 1-7.
5. Craig KJ, Williams JD, Riley SG, et al. Anemia and diabetes in the absence of nephropathy. Diabetes Care 2005; 28(5): 1118–1123.
6. Chagai Grossman, Zamir Dovrish, NiraKoren-Morag, Gil Bornstein, Avshalom Leibowitz. Diabetes with normal renal function is associated with anemia. Diabetes Metab Res Rev. 2014; 30: 291-296.
7. Babatunde et al. Incidence and risk of anemia in type 2 diabetic patients in the absence of renal impairment. Health. 2012; 4(6): 304-308.
8. P. L. Hooper and P. L. Hooper. Inflammation, heat shock proteins, and type 2 diabetes. Cell Stress and Chaperones. 2009; 14(2): 113-115.
9. McCarty MF. Hyperinsulinemia may boost both hematocrit and ironabsorption by up-regulating activity of hypoxia-inducible factor-1alpha.Med Hypotheses 2003;61:567–73.
10. Masuda S, Chikuma M, Sasaki R. Insulin-like growth factors and insulinstimulate erythropoietin production in primary cultured astrocytes. BrainRes1997;746:63–70.
11. De Rooij SR, Nijpels G, Nilsson PM, et al. Low-grade chronic inflammation in the relationship between insulin sensitivity and cardiovascular disease (RISC) population: associations with insulin resistance and cardiometabolic risk profile. Diabetes Care. 2009 ;32(7) :1295–1301.
12. Garcia C, Feve B, Ferré P, et al. Diabetes and inflammation: fundamental aspects and clinical implications. Diabetes Metab. 2010 ;36(5) :327–338.
13. A. Angelousi and E. Larger. Anaemia, a common but often unrecognized risk in diabetic patients: a review. Diabetes & Metabolism. 2015; 41(1): 18–27.
14. B. Mart´ınez-P´erez, I. De La Torre-D´ıez, and M. L´opez-Coronado. Mobile health applications for the most prevalent conditions by the World Health Organization: review and analysis. Journal of Medical Internet Research. 2013; 15(6) :120
15. I.C.Macdougall, K.U.Eckardt and F.Locatelli. Latest US KDOQI Anaemia Guidelines update – what are the implications for Europe?. Nephrology dialysis Transplantation. 2007; 22 (10): 2738-2742.
16. C.Ruster and G.Wolf. Adipokines promote chronic kidney disease. Nephrology Dialysis Transplantation. 2013; 28(4): 2013.
17. S.Fava, J.Azzopardi, S.Ellard and A.T.Hattersley. ACE gene polymorphism as a prognostic indicator in patients with type 2 diabetes and established renal disease. Diabetes Care. 2001; 24(12): 2115-2120.
18. M. Andrews and M. Arredondo. Ferritin levels and hepcidin mRNAexpression in peripheral mononuclear cells from anemic type 2 diabetic patients. Biological Trace Element Research. 2012; 149(1): 1–4.

19. V. Jha, G. Garcia-Garcia, K. Iseki et al. Chronic kidney disease: global dimension and perspectives. The Lancet. 2013; 382(9888): 260–272.
20. C. S. M. Escorcio, H. F. Silva, G. B. S. Junior, M. P.Monteiro, and R. P. Gonc¸alves. Evaluation of anemia treatment with EPO and oral and iv iron in patients with chronic kidney disease under hemodialysis. RBSA. 2010; 42(2) : 87–90.
21. Cohen RM, Franco RS, Khera PK, Smith EP, Lindsell CJ, CiraoloPJ,et al. Red cell life span heterogeneity in hematologically normal people is sufficient to alter HbA1c. Blood 2008;112:4284–91.