Scientific Research

Prevalence and Risk of Anemia in Type-2 Diabetic Patients

Ayesha Sharif*, Shahnila Younus, Kanwal Baig, Nafisa Hassan Ali

Dow Institute of Medical Technology, Clinical Laboratory Sciences Department, Dow University of Health Sciences, Karachi, Pakistan
Email: *ash_aries14@hotmail.com

Abstract

Aim: To determine the prevalence and risk of anemia in type-2 diabetes mellitus. In addition, the incidence and risk of anemia in these patients were assessed according to gender and glycemic control status. Methods: The study group comprised 200 patients with type-2 diabetes. Patients were divided into groups according to glycemic control and gender. Glycated hemoglobin (HbA1c), blood glucose level, hemoglobin concentration, mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH) and mean corpuscular hemoglobin concentration (MCHC) of subjects were evaluated. The presence of anemia was defined by a hemoglobin level <13.0 g/dl for men and <12.0 g/dl for women. The patients were considered as diabetic if he/she had glycated hemoglobin >6.5%, fasting blood glucose >126 mg/dl and random blood glucose >200 mg/dl. Result: 63% of diabetic patients had anemia. There was higher incidence and risk of anemia in females (36%) as compared to males (27%) (p < 0.05) and in poorly controlled diabetes HbA1C >7.5% (49.5%) compared to those with controlled diabetes HbA1C < 7.5% (13.5%) (p < 0.05). Conclusion: This study indicated that poor glycemic control and gender difference are associated with the incidence of anemia in type II diabetes. Our findings suggest the need of screening for anemia in diabetes out-patient clinics. Routine hematological tests along with blood glucose level should be mandatory in order to make therapeutic decisions for the treatment of anemia in type II diabetes mellitus.

Keywords

1. Introduction

Diabetes mellitus is a major cause of morbidity and mortality [1], affecting approximately 6.9 million people in

*Corresponding author.

Pakistan [2]. It is a chronic disease that represents a heterogeneous group of metabolic disorders that includes hyperglycemia or hypoglycemia.

Diabetes mellitus is classified as Type-1 diabetes mellitus that results from autoimmune destruction of insulin producing beta cells of pancreas. It is also called Juvenile diabetes or insulin dependent diabetes. Type-2 diabetes mellitus that results from insulin resistance, a condition in which cells fail to properly use insulin. It is seen mostly in adults and is also called non insulin dependent diabetes. Gestational diabetes mellitus develop during pregnancy that improves or disappears after delivery but 20% - 50% cases can develop type-2 diabetes mellitus later in life [3].

Anemia is a common blood disorder [4] [5]. It is increasingly recognized entity in patients with diabetes mellitus [6]. It is a clinical condition characterized by reduction in hemoglobin concentration of blood below the normal level (as defined by WHO criteria <13 g/dl for men and <12 g/dl for women) for the age, sex, physiological problem and altitude [7]. Anemia is considered as a key indicator of chronic kidney disease, eye disease and an important cardiovascular risk factor [5] [8] [9] therefore diabetic anemic patients life span is less as compare to non anemic diabetic patients.

Complications for the earlier onset of anemia in patients with diabetes are severe symptomatic autonomic neuropathy, causing efferent sympathetic denervation of the kidney, loss of appropriate erythropoietin, damage to the renal interstitium, systemic inflammation and inhibition of erythropoietin release [5] [10]. Previous studies have shown that the incidence of anemia is mostly associated with the presence of renal insufficiency in diabetic patient because kidneys are unable to produce enough erythropoietin, hormone that controls the production of RBCs due to diabetic neuropathy which affects nerves and body fails to compensate erythropoietin level and leads to anemia [5] [11] [12].

People with diabetes also have nutritional deficiencies for example iron, folate and vitamin B12 deficiency which can result in different types of anemia. Vitamin B12 deficiency can also occur due to diabetic medication, metformin (glucophage) which interfere with Vitamin B12 absorption [13] [14].

Anemia with type-2 diabetes remains unidentified because both of them share similar symptoms such as lethargy, pale skin, chest pain, irritability, numbness/coldness in the hands and feet, tachycardia, shortness of breath and headache [14].

In the present study, we aimed at demonstrating the prevalence and risk of anemia in type-2 diabetes mellitus. In addition, the incidence and risk of anemia in these patients were assessed according to gender and glycemic control status.

2. Methods

2.1. Subjects

This cross-sectional and retrospective study comprised data of 200 type-2 diabetic patients recruited from Ameen Diabetic Centre, Karachi-Pakistan. Diabetes and anemia was diagnosed by patient's self report. Patients were divided into groups according to: 1) glycemic control [patients with controlled diabetes (n = 57) and those with poorly controlled diabetes (n = 143)]; 2) Gender [male (n = 100), females (n = 100)]. The controlled diabetic group comprised those whose HbA1c level was equal to or <7.5% and poorly controlled diabetic group comprised those whose HbA1c level was >7.5%. The patient were considered as diabetic if he/she had glycated hemoglobin (HbA1c > 6.5%), fasting blood glucose (FBG > 126 mg/dl), random blood glucose (RBG > 200 mg/dl) [15] while the presence of anemia as defined by World Health Organization, a hemoglobin level <13.0 g/dl for men and <12.0 g/dl for women [5] [16]. Besides hemoglobin, mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH) and mean corpuscular hemoglobin concentration (MCHC) was also calculated for diagnosing types of anemia.

Blood samples were collected from the subjects by trained phlebotomists under aseptic conditions by standard phlebotomy technique. Blood samples were collected into sodium fluoride and tri-potassium ethylenediamine tetra-acetic acid (K3 EDTA) anticoagulant tubes for fasting blood glucose (FBG), random blood glucose (RBG), glycated hemoglobin (HbA1c), hemoglobin, mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), and mean corpuscular hemoglobin concentration (MCHC) measurements respectively.

Study includes male and female patients above 40 years with type-2 diabetes and anemia. Patients with type-1 and gestational diabetes were excluded. Data for the study was provided and approved by Ameen Diabetic Association.

2.2. Statistical Analysis

Statistical analysis were done using SPSS for Windows version 16.0. Significance was set as $p < 0.05$.
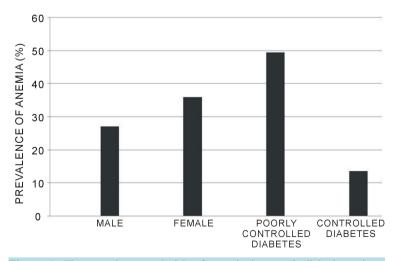
3. Results

For this current study 200 type-2 diabetic patients of both gender (males = 100, females = 100) were selected. Among these 200 diabetic patients 143 (71.5%) were poorly controlled diabetics (HbA1C > 7.5%) and 57 (28.5%) were controlled diabetics (HbA1C < 7.5%). Out of 200 patients 126 were presented with anemia representing 63% incidence of anemia. As our aim was to examine prevalence of anemia in diabetic patients it was observed that there was significantly higher risk of developing anemia. 49.5% (n = 99) of the patients with poorly controlled diabetes; 13.5% (n = 27) of those with controlled diabetes; 36% (n = 72) of the diabetic women and 27% (n = 54) of the diabetic men were found to be anemic (**Figure 1**). **Table 1** revealed that the incidence of anemia were higher in patients with poorly controlled diabetes than controlled diabetes ($p < 0.05$) and the odds of anemia were higher in diabetic females than diabetic males ($p < 0.05$).

4. Discussion

Anemia is an increasingly recognized entity in patients with type-2 diabetes mellitus [6]. Anemia along with diabetes is an alarming condition because of increased risk of developing eye disease, heart disease or a stroke therefore the life span of patients who have anemia along with diabetes is less as compare to people who have diabetes but no anemia [14].

The current study includes 200 diabetic patients selected on the basis of HbA1c level. Out of that 71.5% had poorly controlled diabetes (HbA1c > 7.5%) which is supported by previous studies that poor glycemic control was present in 65.1%, 66.7%, 46.7% and 69% of patients in Jordan, Kuwait, Pakistan and UK respectively [1] [17]-[19]. The factors which are associated with poor glycemic control among patients with type-2 diabetes are chronic diabetes, higher BMI, hypercholesterolemia, hypertriglyceridemia, elevated LDL, patients on combination of oral anti diabetic agents and insulin, patients who do not follow dietary regimens, do not practice any physical activity, who are not adherent for medications and do not regularly perform home glucose monitoring all these factors were reported in one of the previous study [1].

In the present cross-sectional study, 63% of diabetic mellitus patients were diagnosed with anemia in contrast the previous study reports 15.3% and 19.6% [5] [20]. The possible reason is due to poor nutrition, poverty, lack of awareness and illiteracy, as this study was performed in Karachi, Pakistan. It is a cosmopolitan city where most of the population consists of migrants from rural areas. It is also indicated that poorly controlled diabetics had higher incidence of anemia (49.5%), in which (26%) had normocytic normochromic anemia and it has been

Figure 1. The prevalence and risk of anemia in type-2 diabetic patients according to gender and glycemic control.

Table 1. Demographic characteristics of patients.

Variables	Total	No of patients (%)
Gender		
Male	200	100
Female		100
Family history		
With family history	200	130 (65)
Without family history		70 (35)
Glycemic status		57 (28.5)
Controlled diabetes	200	
Uncontrolled diabetes		143 (71.5)
Incidence of anemia according to gender	200	126 (63)
Anemic male		54 (27)
Anemic female		72 (36)
Incidence of anemia according to glycemic control	200	126 (63)
Controlled diabetics		99 (49.5)
Uncontrolled diabetics		27 (13.5)

reported that longstanding poorly controlled diabetes is associated with normocytic normochromic anemia [5] [11] while (15.5%) had microcytic hypochromic anemia.

It has been established that diabetic autonomic neuropathy is a major complication of poor glycemic control [12] [21]. Since erythropoietin production and release is regulated by autonomic nervous system therefore higher incidence of anemia in poorly controlled diabetic patients is due to impaired erythropoietin production [5].

In past study, Craig *et al.* [20] [22], reported higher prevalence of anemia in diabetic males(17.8%) than diabetic females (11.8%) in contrast our result indicates higher incidence of anemia in diabetic females (36%) than diabetic males (27%). The possible reason for higher incidence of anemia in females is that the current study was performed in Pakistan where women' health needs are determined by gender disparities, illiteracy, lack of empowerment to make decisions related to health, poor nutrition and giving more importance to their men. Therefore, in order to be relevant and appropriate to women's health needs the Pakistan Health Policy should use gender equity in health and health related sectors, strengthen health systems through creation of gender equity among all cadres of health provider, tailoring health interventions to counter gender-based obstacles, dissemination interventions for behavior change and expand the focus from reproductive health to life cycle approach to address all issues around women's life [23].

Thus our findings suggest that a reduction of blood glucose levels and the targeting of acceptable glycated hemoglobin levels would help reduce the risk of anemia in the diabetic population. There is an urgent need for proper diabetic care and management for diabetic senior citizens, who have limited food choices and are more vulnerable to iron deficiency anemia. Therefore, physicians should recommend them to take iron and vitamin supplement and take nutritious iron-rich diet. Foods rich in iron include seafood, beans, whole-grain products and nuts. Many processed foods and milk are also reinforced with iron.

As high incidence of anemia was observed in diabetes mellitus we recommend that routine hematological tests along with blood glucose level should be mandatory in diabetic outpatient clinics in order to make optimal therapeutic decisions for treatment of anemia in type-2 diabetes mellitus.

Besides patients should be motivated to use the medications as prescribed, continuous education should be recommended to encourage physical activity and diet regimen adherence. Correction of anemia may have a significant role in prevention of other diabetic complications.

Acknowledgements

Conflict of Interest

No conflict of interest is declared.

References

[1] Khattab, M., Khader, Y.S., Al-Khawaldeh, A. and Ajlouni, K. (2010) Factors Associated with Poor Glycemic Control among Patients with Type 2 Diabetes. *Journal of Diabetes and Its Complication*, **24**, 84-89.

[2] World Health Organization (2008) WHO Ranks Pakistan 7th on Diabetes Prevalence List. The Nation, Karachi. http://www.nation.com.pk/karachi/15-Nov-2008/WHO-ranks-Pakistan-7th-on-diabetes-prevalence-list

[3] Johnson, L.J., Gregory, L.C., Christenson, R.H. and Harmening, D.M. (2001) Appleton and Lange Series Outline Review Clinical Chemistry. McGraw-Hill, New York, 10-15.

[4] Thomas, M.C., Maclsaac, R.J., Tsalamandris, C., Moly-neaux, L., Goubina, I., Fulcher, G., Yue, D. and Jerums, G. (2004) The Burden of Anaemia in Type 2 Diabetes and the Role of Nephropathy: A Cross-Sectional Audit. *Nephrology Dialysis Transplantation*, **19**, 1792-1797. http://dx.doi.org/10.1093/ndt/gfh248

[5] Adejumo, B.I., Dimkpa, U., Ewenighi, C.O., Onifade, A.A., Mokogwu, A.T., Erhabor, T.A., Ukatu, E. and Nnatuanya, I.N. (2012) Incidence and Risk of Anemia in Type-2 Diabetic Patients in the Absence of Renal Impairment. *Health Journal*, **4**, 204-308.

[6] Cawood, T.J., Buckley, U., Murray, A., Corbett, M., Dillon, D., Goodwin, B. and Sreenan, S. (2006) Prevalance of Anemia in Patients with Diabetes Mellitus. *Irish Journal of Medical Science*, **175**, 25-27. http://dx.doi.org/10.1007/BF03167944

[7] Viteri, F.E. (1998) A New Concept in the Control of Iron Deficiency: Community Based Preventive Supplementation of at Risk Groups by Weakly Intake of Iron Supplements. *Biomedical and Environmental Sciences*, **11**, 46-60.

[8] Bosman, D.R., Winkler, A.S., Marsden, J.T., Macdougall, I.C. and Watkins, P.J. (2001) Anaemia with Erythropoietin Deficiency Occurs Early in Diabetic Nephropathy. *Diabetes Care*, **24**, 495-499. http://dx.doi.org/10.2337/diacare.24.3.495

[9] Dikow, R., Schwenger, V., Schomig, M. and Ritz, E. (2002) How Should We Manage Anaemia in Patients with Diabetes? *Nephrology Dialysis Transplantation*, **17**, 67-72. http://dx.doi.org/10.1093/ndt/17.suppl_1.67

[10] Craig, K.J., Williams, J.D., Riley, S.G., Smith, H., Owens, D.R., Worthing, D., Cavill, I. and Phillips, A.O. (2005) Anemia and Diabetes in the Absence of Nephropathy. *Diabetes*, *Care*, **28**, 1118-1123. http://dx.doi.org/10.2337/diacare.28.5.1118

[11] Kojima, K. and Totsuka, Y. (1995) Anemia Due to Reduce Serum Erythropoietin Concentration in Non Uremic Diabetic Patients. *Diabetes Research and Clinical Practice*, **27**, 229-233.

[12] Ahmed, A.M., Hussein, A. and Ahmed, N.H. (2000) Diabetic Autonomic Neuropathy. *Saudi Medical Journal*, **21**, 1034-1037.

[13] Bolen, S., Wilson, L., Vassy, J., *et al.* (2011) Agency for Healthcare Research and Quality (US). Comparative Effectiveness and Safety of Oral Diabetes Medications for Adults with Type 2 Diabetes.

[14] Bev Betcher, Association Manager—Anemia.org (2009) Recognizing Anemia in People with Diabetes. www.anemia.org

[15] American Diabetes Association (2012) Executive Summary: Standards of Medical Care in Diabetes. *Diabetes Care*, **35**, S4.

[16] World Health Organization (1968) Nutritional Anemia. Report of a WHO Scientific Group, WHO, Geneva.

[17] Al-Sultan, F.A. and Al-Zanki, N. (2005) Clinical Epidemiology of Type 2 Diabetes Mellitus in Kuwait. *Kuwait Medical Journal*, **37**, 98-104.

[18] Habib, S.S. and Aslam, M. (2003) Risk Factors, Knowledge and Health Status in Diabetic Patients. *Saudi Medical Journal*, **24**, 1219-1224.

[19] Fox, K.M., Gerber, R.A., Bolinder, B., Chen, J. and Kumar, S. (2006) Prevalence of Inadequate Glycemic Control among Patients with Type 2 Diabetes in the United Kingdom General Practice Research Data Base: A Series of Retrospective Analysis of Data from 1998 through 2002. *Clinical Therapeutics*, **28**, 388-395. http://dx.doi.org/10.1016/j.clinthera.2006.03.005

[20] Bonakdaran, S., Gharebaghi, M. and Vahedian, M. (2011) Prevalence of Anemia in Type-2 Diabetes and Role of Renal Involvement. *Saudi Journal of Kidney Diseases and Transplantation*, **22**, 286-290.

[21] Toyry, J.P., Niskanen, L.K., Mantyseari, M.J., Lansimies, E.A. and Uusitupa, M.I. (1996) Occurrence, Predictors and Clinical Significance of Autonomic Neuropathy in NIDDM. Ten-Year Follow-Up from the Diagnosis. *Diabetes*, **45**, 308-315. http://dx.doi.org/10.2337/diabetes.45.3.308

[22] Griac, K., Williams, J.D., Riley, S.G., *et al.* (2005) Anemia and Diabetes in the Absence of Nephropathy. *Diabetes Care*, **28**, 18-23.

[23] Narjis, R. and Sania, N. (2008) Pakistan's Health Policy: Appropriateness and Relevance to Women's Health Needs. *Health Policy*, **88**, 269-281.

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