

Original Research Article

## Prevalence of Type 2 Diabetes Mellitus Patients with Anemia in a Bangladeshi Population- A Case Control Study

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### ABSTRACT

**Introduction:** Anemia is a common finding in diabetes. Number of factors contributes to an increased prevalence of anemia in diabetes. To determine the prevalence of anemia in the patients with diabetes mellitus.

**Methods:** The present study was conducted at the US Bangla Hospital, Narayanganj, Bangladesh. The subjects for the study included adult patients with age more than 30 years and having type 2 diabetes mellitus, attending the outdoor patient department (OPD) or admitted in ward as indoor patient department (IPD) of this Hospital. Blood specimens were collected and processed for determination of blood glucose, serum creatinine, and hemoglobin, HbA1C.

**Results:** Anemia was present in 18% patients of diabetes. The prevalence of anemia was almost similar between women (18.60%) and men (17.54%). 74% of anaemic patients had a serum creatinine <1.20 mg/dl and 72% of anaemic patients had a calculated creatinine clearance of >60 ml/min.

**Conclusion:** Every fifth individual in a population of diabetes mellitus could be anemic. Identifying and treating anemia would make a great impact in managing various complications of diabetes mellitus.

**Key Words:** Diabetes Mellitus, Anemia, Hemoglobin.

### INTRODUCTION

Diabetes mellitus (DM) is a metabolic disorder of great impact worldwide. Epidemiological data showed that in 2010 there were 285 million people affected with the disease in the world, and it is estimated that in the year of 2030 we will have about 440 million diabetics. [1] Its worldwide prevalence is increasing fast among developing countries. The type 2 diabetes affects about 7% of the population. [2] Anaemia is a frequent condition in patients with type 2 diabetes. [3-5] This reflects the pivotal role of the kidney in the control of hemopoiesis, in sensing changes in tissue oxygenation, and subsequently in

stimulating hemopoietic precursors in the bone marrow through the production of erythropoietin by peritubular interstitial fibroblasts of the renal cortex and outer medulla. Uremia is associated with a range of hemopoietic stressors including reduced red cell survival, occult blood losses, malnutrition, and systemic inflammation. However, the failure of the kidney to increase erythropoietin release in response to a decreasing hemoglobin (Hb) level appears to be the key contributor to the development of renal anemia. [6, 7] The prevalence of anaemia in cross-sectional studies of patients with diabetes is in the range of 14 to 23% (anaemia defined as Hb

<13g/dl for men and <12g/dl for women). [4,8,9] Anemia is associated with a more rapid decline in the GFR and is considered to be an important cardiovascular risk factor. [10-12] It is therefore important to diagnose and correct anemia. The aim of this study was to determine the prevalence of anemia in type 2 diabetics.

#### Definition of terms

Anaemia was classified according to clinical grading and red blood cell (RBC) morphology as follows:

Clinical grading based on Hb level:

- Mild (female: 11.0 – 11.9 g/dL; male: 11.0-12.9 g/dL)
- Moderate (8.0-10.9 g/dL )
- Severe (< 8.0 g/dL )

Morphology based on RBC indices [mean cell volume (MCV) and mean cell haemoglobin (MCH)]:

- Microcytic hypochromic anemia (MCV < 80fL, MCH < 27 pg)
- Normocytic normochromic anemia (MCV 80-95fL, MCH ≥ 27 pg)
- Macrocytic anemia (MCV > 95fL )

#### MATERIALS AND METHODS

This present study was carried out in the department of Laboratory, US- Bangla Medical College Hospital, Narayanganj, Bangladesh from May 2016 - July 2016. Patients were divided into groups according to: 1) glycemic control [patients with controlled diabetes (n = 33) and those with poorly controlled diabetes (n = 72)]; 2) Gender [male (n = 51), females (n = 54)]. 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%. A total 105 subjects of aged 30-60 years were selected purposively from the outpatient department of hospital. The patient were considered as diabetic if he/she had glycated hemoglobin (HbA1c > 6.0%), fasting blood glucose (FBG > 6.1 mmol/L), random blood glucose (RBG > 7.8 mmol/L) [13] 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. Diabetes and anemia was diagnosed by patients self report.

Patients suffering from type 1 diabetes mellitus, hemoglobinopathies, iron deficiency anemia, hemolytic anemia and pregnancy were excluded from the study. Data were collected including demographic characteristics and clinical history by utilizing a pre-designed questionnaire and were collected by direct interview from participants. Relevant physical examinations were performed on all participants. With all aseptic precaution about 5 ml blood and spot urine was collected from all of the subjects. Serum was separated after centrifuging at 3000 rpm for 10 minutes. The sera obtained and were separated. Blood glucose-both fasting and OGTT, HbA1C, CBC, Total cholesterol, Triglyceride, High density lipoprotein (HDL) cholesterol, Low density lipoprotein (LDL) cholesterol, creatinine, eGFR, urea, microalbumin level were obtained in all participants. HbA1C was estimated in whole blood by a BIO-RAD variant which was modified ion exchange high performance liquid chromatography (HPLC) method. Hemoglobin was estimated by cell counter-SYSMEX through cyanmethemoglobin method. Diabetes was diagnosed by HbA1C >6.5%. Serum creatinine values were considered abnormal if values were >1.50 mg/dl and considered as chronic kidney disease. Definition for anemia is hemoglobin values <13.0 g/dl for men and <12.0 g/dl for women. [14] Data for the study was provided and approved by the above mentioned hospital. Statistical analyses were performed with the SPSS version 20.0. Data expressed as mean (±SD) or median (range) if the variables were continuous and as percentage, if categorical.

## RESULTS

For this current study 105 type-2 diabetic patients of both gender (males = 51, females = 54) were selected. Among these 105 diabetic patients 72 (68.6%) were poorly controlled diabetics (HbA1C > 7.5%) and 33 (31.4%) were controlled diabetics (HbA1C < 7.5%).

In the present study, total 105 patients with diabetes type 2 had mean age

50 years ( $\pm 16$ ) and 44 years ( $\pm 12$ ) in males and females respectively. 84% of patients (83% of males and 80% of females) had a normal serum creatinine (<1.20 mg/dl). 75% of patients (74% of males and 77% of females) had a normal urinary albumin/creatinine ratio (<24 mg/g). Mean Hb levels were  $13.3 \pm 1.8$  g/dl in males and  $11.3 \pm 1.68$  g/dl in females (Table - 1).

**Table - 1: Findings among males, females and total group of type 2 diabetes patients with anemia.**

Parameter	Males (N=51)	Females (N=54)	Total group (N=105)
Age (years) (Mean $\pm$ SD)	50 $\pm$ 16	44 $\pm$ 12	43 $\pm$ 11
Hb (g/dl) (Mean $\pm$ SD)	13.3 $\pm$ 1.8 (9.5-17.8)	11.3 $\pm$ 1.6 (8.5-14.3)	12.3 $\pm$ 2.0(8.5-17.8)
HbA1C (%)	8.1 $\pm$ 1.6(6.5-15.3)	8.4 $\pm$ 1.8(6.5-15.3)	8.2 $\pm$ 1.7(6.5-15.3)
Serum Creatinine (mg/dl)	1.29 $\pm$ 0.41(0.85-3.27)	1.27 $\pm$ 0.44(0.75-3.15)	1.28 $\pm$ 0.42(0.75-3.27)

51 patients (53%) were anemic by the WHO criteria including 21 males (41.2%) and 30 females (58.8%) with a median Hb level of 11.5 g/dl (range 9.5 to 13.0) and 10.1 g/dl (range 8.5 to 11.9) in males and females respectively. The average mean cell volume (MCV) for the 21 anemic males was  $86.1 \text{ fl} \pm 8.1$ , with only two patients with MCV <78 and two patients with MCV >90. The average MCV for the 30 anemic females was  $86.6 \text{ fl} \pm 11.8$  with seven (23%) of 30 patients had MCV <78 and one patient being macrocytic (MCV>90). Therefore the majority (81.6%) of patients had a normocytic anemia.

Using the WHO criteria for anemia, 70% of anemic patients had a serum creatinine <1.20 mg/dl and 72% of anemic patients had a calculated creatinine

clearance of >60ml/min. Of those with normal serum creatinine (<1.20 mg/dl), 9% of male and 19% of female were anaemic compared to 31% of male and 39% of female of those with an elevated creatinine (>1.20 mg/dl).

Regarding duration of diabetes mellitus, 80.4% of males and 63% of females had the disease for more than 5 years. Out of the 51 patients of anemia with diabetes mellitus, 21 (58.3%) patients had diabetes mellitus for more than 5 years duration. Hemoglobin levels were not associated with glycaemic control as measured by HbA1C or urinary albumin excretion in either sex as measured by urinary albumin/creatinine ratios, when the sexes were considered individually.

**Table - 2: Duration of Diabetes Mellitus along with anemic patients**

Duration of diabetes mellitus	Males (N=51)	Females (N=54)	Total group (N=105)
<5 years	22 (43.1%)	29 (56.9%)	51 (48.6%)
>5years	29 (53.7%)	25 (46.3%)	54 (51.4%)
Urinary albumin/ Creatinine ratio (mg/g)	9.0 (0.8 -> 1000)	9.9 (1.0->1000)	9.6 (0.8 ->1000)

## DISCUSSION

The results of the present epidemiological study estimated the prevalence of anemia to be 18% in individuals with type 2 diabetes mellitus. Despite the finding that the factor with the strongest correlation with the presence of anaemia was calculated creatinine clearance, approximately 53% of anaemic

patients had normal serum creatinine levels (<1.20 mg/dl) and normal calculated creatinine clearance (>60 ml/min). The measured prevalence of anemia varies depending on both the population studied and the definitions used. One of the largest studies that are most comparable to our study population is the Third National Health and Nutrition Examination Survey

(NHANES) in which population based sample of 15,419 participants from the general public in the USA was included. [15] This study defined anemia as Hb level <12.0 g/dl in men and <11.0 g/dl in women and found that at the age of 60 years and with maintained renal function (estimated GFR of 60 ml/min per 1.73 m<sup>2</sup>) the prevalence of anemia is 1%. [15] The degree of anemia in patients with diabetes has been associated with a number of factors including glomerular filtration rate, urinary albumin excretion rate and HbA1C levels. [4] In addition, the prevalence of anemia in patients with diabetes is two to three times higher than in patients with comparable renal impairment and iron stores in the general population. [4,15] Our study is in accordance with these findings, although only associations with age, serum creatinine and calculated creatinine clearance were found, and these were only significant in males. The lack of further associations may be due to the relatively small sample size.

Another salient finding was the association between the duration of diabetes and the prevalence of anemia. Individuals with duration of diabetes of more than 5 years have 1.05 times higher risk of developing anemia than those with diabetes for less than 5 years. These observations suggest that anemia evaluation should be considered in the routine management of persons with diabetes and should be treated to minimize the risk of microvascular complications such as nephropathy and retinopathy. There is evidence that the erythropoietin (EPO) levels in patients with diabetes and anemia are inappropriately low compared to patients with iron deficiency anemia. [16] It has been suggested that erythropoietin deficiency occurs earlier in diabetic nephropathy compared to other causes of nephropathy, and this may in part be due to autonomic nephropathy leading to sympathetic denervation of the kidney, [17-19] Whilst anemia related to renal impairment can be corrected by using erythropoietin, it is still not clear what effect this may have on morbidity and mortality. Studies such as

the ACORD study (Anaemia CORrection in Diabetes) [19] may begin to answer these questions.

## CONCLUSION

The relatively high prevalence of anemia in our population of patients with diabetes suggests the need for consideration of screening for anemia in the diabetes out-patient clinic. Furthermore, the relatively high prevalence of anemia amongst those with apparently normal renal function as measured by serum creatinine, suggests that such screening should not be limited to those with overt nephropathy.

**Conflict of Interest:** No conflict of interest is declared.

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