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Anemia in diabetes: Experience of a single treatment center in Kuwait

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ABSTRACT

Aims: Diabetes mellitus is the most common metabolic disorder in Kuwait. Anemia is a known outcome of diabetes and its related complications. This study examined the prevalence of anemia in diabetic subjects in Kuwait as well as any association between the presence of anemia with Hemoglobin A_{1c} and diabetes complications.

Methods: The study subjects were diabetic patients with complete records and two or more visits at Dasman Diabetes Institute. Patient's data included demographics, complications, medications and laboratory results. Descriptive statistics were applied using SPSS.

Results: Of 1580 included diabetic patients; the prevalence of anemia was 28.5% (95% CI: 26.3, 30.8). Diabetic females had a higher rate of anemia compared to males (35.8% vs. 21.3% respectively, $p < 0.001$). There was no association between diabetes control (HbA_{1c}) and anemia in both genders ($p = 0.887$). Patients with elevated serum creatinine and microalbuminuria were more likely to be anemic ($p < 0.001$). Diabetic patients with anemia had higher presence of peripheral neuropathy and diabetic foot ($p < 0.001$).

Conclusion: This study shows high prevalence of anemia in diabetic patients, particularly in those with diabetic complications. These results should prompt treatment centers to include anemia investigation and management within their diabetes treatment protocols to reduce morbidity in diabetes.

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1. Introduction

Diabetes mellitus is the most prevalent chronic metabolic disorder in Arabian Gulf countries [1]. In Kuwait, the prevalence of

diabetes in native adults has risen from 14.8% in 1995 to 25.4% in the most recent report, published in 2013 [2,3]. Anemia is a common complication of diabetes that may adversely affect the progression of diabetes-related complications resulting in poorer outcomes, particularly, in patients with nephropa-

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thy and coronary artery disease [4,5]. In addition, anemia can cause falsely low Hemoglobin A1c (HbA_{1c}) level, which may negatively affect the treatment decisions of hyperglycemia, and thus contribute to progression of both microvascular and macrovascular diabetic complications [6]. The prevalence of anemia in diabetic patients is variable as reported in studied populations. According to one study, 12% of the patients were found to have anemia in addition to 13% who developed anemia during follow up [7]. Furthermore, an increased prevalence of anemia was reported in studies on diabetic patients with chronic kidney disease (CKD) [5,7,8].

The etiology of anemia in diabetes is usually multifactorial, and includes patients with diabetic complications like albuminuria, renal failure, low testosterone, and reduced endogenous erythropoietin level [5]. Additionally, diabetic patients are at risk of anemia of chronic disease, nutritional deficiencies, autoimmune disorders and anemia related to medications [5,9,10,11]. A group of investigators found a strong positive correlation between renal function and hemoglobin level. However, no correlation was reported between hemoglobin level and metabolic control of diabetes (HbA_{1c}), proteinuria, leukocytes count, duration of diabetes and the use of angiotensin converting enzyme (ACE) inhibitors [12]. Anemia was also reported in another study to be more prevalent in chronic kidney disease, occurring earlier in patients with kidney disease from diabetes than in those with kidney disease from other causes [10].

In Kuwait, the prevalence of anemia in diabetes remains unknown. However, a general consensus exists among hematologists and diabetes specialists that mild to moderately severe anemia is observed in some diabetic patients with no evidence of kidney disease. A high prevalence of iron deficiency anemia was reported in Kuwait, especially among females of child bearing age; an issue which might increase the rate of anemia in type I diabetic patients [13]. In addition, the high prevalence of hemoglobinopathies may contribute to a higher rate of anemia in the population under study [14,15,16].

The main objective of this study is to estimate the prevalence of anemia in the Kuwaiti diabetic population, and to examine any correlation between anemia when present with HbA_{1c}, albuminuria, serum creatinine, and diabetic complications.

2. Materials and methods

2.1. Study design, data source, population and study protocol approval

In this retrospective study, de-identified data were retrieved from the Dasman Diabetes Institute (DDI) database from the date of its inauguration in June 2006 until February 2015. DDI is a specialized diabetes research center in Kuwait, with an out-patient facility, specialized in managing diabetes and related complications. Patients' medical information was gathered from the electronic health records database, which is usually updated by the treating physicians, who record each patient's visit and progress notes. The laboratory data of all registered patients were obtained from the Laboratory Infor-

mation System (LIS). The study proposal was initially reviewed and approved by the international scientific advisory board (ISAB) at DDI. The investigators were instructed to complete the online training course, "Protecting Human Research Participants", provided by National Institute of Health (NIH). The study proposal was approved by DDI ethical review committee (approval number: RA 2014-040).

2.2. Inclusion and exclusion criteria

The inclusion criteria includes all adult diabetic patients over 18 years of age, who had active files in DDI, and had been assessed at least on two occasions; one of which was within a year from the end of February, 2015. The exclusion criteria included all patients with incomplete records, and those with a record of a single visit.

2.3. Data collection

The collected data included sex, age, and laboratory test results such as: complete blood count, HbA_{1c}, renal profile and presence of proteins in urine (microalbuminuria and proteinuria). In addition, diabetic complications and presence of other co-morbid conditions were also retrieved (where possible) from the database, including presence of renal failure, peripheral neuropathy, diabetic foot, retinopathy, coronary artery and peripheral vascular disease. The medications prescribed during each patient's latest visit were also recorded.

2.4. Definitions

The World Health Organization (WHO) diagnostic criteria of anemia in adult males and females (Males <130 g/l, Females <120 g/l) was adopted, to define anemia in the study [17]. Moreover, the recommendations from the American Diabetes Association (ADA) for glycemic control in adults were adopted, where HbA_{1c} of 7% or less has been associated with reduced microvascular, and long-term macrovascular complications of diabetes [18]. Microalbuminuria is defined as excretion of 30–300 mg of albumin per 24 h (or 20–200 mcg/min or 30–300 mcg/mg creatinine) on 2 of 3 urine collections [19].

2.5. Statistical analysis

The data management, analysis and graphical presentation was carried out using the computer software 'Statistical Package for Social Sciences, (SPSS) version 22.0 (IBM Corp, Armonk, NY, USA). The descriptive statistics have been presented as frequencies and percentages for categorical variables. The quantitative or continuous variables were ascertained for normal distribution assumption, applying the Kolmogorov–Smirnov test, and presented as: mean + standard deviation (SD) and range for normally distributed variables; and median, range, interquartile (IQ) for skewed data. The prevalence of anemia was calculated as a percent with 95% confidence interval (CI). Chi-square test was applied to find any association or significant differences between categorical variables. The mean values were compared using

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