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ANTHROPOMETRIC AND METABOLIC CHARACTERISTICS OF PATIENTS WITH TYPE 2 DIABETES MELLITUS AND HYPOCHROMIA

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Abstract

Background and Aims. *Previous studies have shown that hypochromia is a common finding in patients with chronic diseases. The aim of our study was to estimate the anthropometric and metabolic characteristics of patients with type 2 diabetes mellitus (T2DM) and hypochromia.* ***Material and Methods.*** *30 patients with T2DM were recruited for this study. Patient demographics, relevant concomitant illnesses and medical history were recorded. Anthropometric, biochemical parameters (fasting plasma glucose - FPG, glycated hemoglobin -HbA1c, glomerular filtration rate - GFR) and morphology of blood smear were assessed. Patients diagnosed with diabetes and hypochromia constituted the study group and patients with type T2DM but without hypochromia constituted the control group.* ***Results****. The study showed no statistically significant differences on anthropometric and metabolic characteristics of patients with diabetes and hypochromia, compared with controls.* ***Conclusions.*** *We observed a high prevalence of hypochromia in diabetic patients (46.66%). Our findings suggest the need of screening for routine hematological tests in patients with T2DM.*

key words: *hypochromia, diabetes mellitus, anthropometric and metabolic characteristics.*

Background and Aims

The term of hypochromia is a generic term that indicates the red blood cells are paler than normal, their color being determined by less than normal amount of hemoglobin. There are multiple contributing factors to hypochromia described in the literature The most common causes of hypochromia are iron deficiency and thalasemia. The iron deficiency is particularly challenging in patients with acute or chronic inflammatory affections. In an issue of *BioMed Research International*, Urrechaga E et al. published in 2013 a review article entitled: "Biomarkers of Hypochromia: The Contemporary Assessment of Iron Status and Erythropoiesis" in which they report that "*It has long been known that inflammation can mimic some aspects of iron deficiency by impairing the utilization of existing iron stores for red cell*

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production and inducing an iron-sequestration syndrome and low serum iron. The molecular mechanisms that underlie the redistribution of iron during inflammation center on the cytokine-stimulated overproduction of hepcidin." [1]. Hepcidin, is an iron-regulated acute-phase protein that inhibits duodenal absorption of iron; hepcidin expression is induced by lipopolysaccharides and interleukin-6, and is inhibited by tumor necrosis factor (TNF)-α [2,3].

Relative hypochromia and anemia have been associated with a relatively poor prognosis among patients with various conditions, including chronic kidney disease, congestive heart failure and cancer [4,5].

In cross-sectional studies, markers of inflammation are associated with type 2 diabetes (T2DM) and features of the metabolic syndrome [6,7]. Additional studies in patients with T2DM have confirmed that markers of inflammation such as C-reactive protein and interleukin-6 are elevated compared with nondiabetic control subjects [8,9]. Results of studies on TNF-α concentration in diabetes are not uniform; Müller and colleagues report normal levels of TNF- α in subjects with impaired glucose tolerance [10] while other studies highlights elevated circulating TNF-α in established T2DM [10-13].

The aim of our study was to estimate the anthropometric and metabolic characteristics of patients with T2DM and hypochromia.

Materials and Method

We conducted a retrospective study that included 30 patients with type 2 diabetes mellitus (T2DM), which have been followed-up at the Clinical Centre of Diabetes, Nutrition and Metabolic Diseases, Craiova. The study was conducted over a period of three months (May-July 2014). Criteria for inclusion in the study: patients diagnosed with T2DM, successively hospitalized in the clinic of diabetes, nutrition and metabolic diseases, aged between 18 and 80 years. Exclusion criteria: patients whose data were inacesibile or incomplete, previous treatments with medication interfering or influencing the level of insulin-like growth factor 1 (IGF-1) and insulin-like growth factor binding protein-3 (IGFBP-3), exogenous glucocorticoid, oral oestrogen-replacement therapy, anti-estrogen therapy.

Patient demographics, relevant concomitant illnesses and medical history were recorded. Anthropometric, biochemical parameters (fasting plasma glucose - FPG, glycated hemoglobin - HbA1c, glomerular filtration rate - GFR) and morphology of blood smear were assessed. The anthropometric measurements included waist circumference (WC) and body mass index (BMI). BMI was computed as a ratio of weight to the square of height (kg/m^2). Waist circumference was taken at the midpoint between the lowest rib and the iliac crest. Subjects were asked to fast for 12 h before blood sampling, which was done between 8:00 and 9:00 a.m. The plasma glucose was measured enzymatically, HbA1c was determined by high performance liquid chromatography and GFR was calculated automatically using the National Kidney Foundation K/DOQI recommendations (the National Kidney Foundation has recommended that it be calculated automatically every time a creatinine test is done) [14].

Analysis of blood cytology: the staining technique used was May-Grunwald-Giemsa. The microscopic examination was performed initially with the objective of 10x/20x, subsequently, the smear was evaluated with an immersion objective of 100x. Each cell type was evaluated for quantitative and qualitative abnormalities. Image acquisition was done after the examination of the preparations obtained with a 40X objective, using Image Pro Plus 6.0 software.

Patients diagnosed with diabetes and hypochromia constituted the study group and patients with type T2DM but without hypochromia constituted the control group. All patients signed an informed consent. The study protocol and informed consent were approved by the Institutional Ethics Committee.

Statistical analysis

Data are presented as mean±SD. Clinical characteristics were compared using the t Student Test. Pearson's moment-product correlation coefficients were calculated to evaluate correlations between variables. Significance was defined at the 0.05 level of confidence. Calculations were performed using the Statistical Package for Social Sciences Software (SPSS) version 15.

Results

The patients in the study group (14 patients - 7 women and 7 men) were aged between 45 and 72 years, median age 59.93±8.74 years, and had an evolution of diabetes between 4 months and 15 years. 7 patients were from urban and 7 patients from rural areas. The patients in the control group (16 patients - 8 women and 8 men) were aged between 49 and 77 years, median age 61.81±7.91 years. 11 patients of control group were from urban areas and 5 patients from rural areas. and had an evolution of diabetes between 6 years and 30 years. The prevalence of the hypochromia in diabetic patients in our whole dataset was 46.66%.

Regarding the study of anthropometric measurement, BMI in the study group had an average of 28.28±5.70 kg/m^2 compared with controls that had a value of 31.32±5.17 kg/m^2. According to the World Health Organization cut-offs [15], five patients (35.71%) of the study group were obese (BMI greater than or equal to 30) and 5 patients (35.71%) were overweight (BMI greater than or equal to 25 and less than 30). In the control group the prevalence of obesity was 62.50% (10 patients) while the prevalence of overweight was 25.00% (4 patients). In the study group WC ranged between 75 and 116 cm; for the control group, WC values were between 89-127 cm. The abdominal obesity is defined by a value of WC>102 cm in men and>88 cm in women [16]. Abdominal obesity was present in 10 patients of the study group (71.42%) and 10 patients of the control group (62.50%). The prevalence of obesity and overweight in the study and control group is shown in Figures 1 and 2.

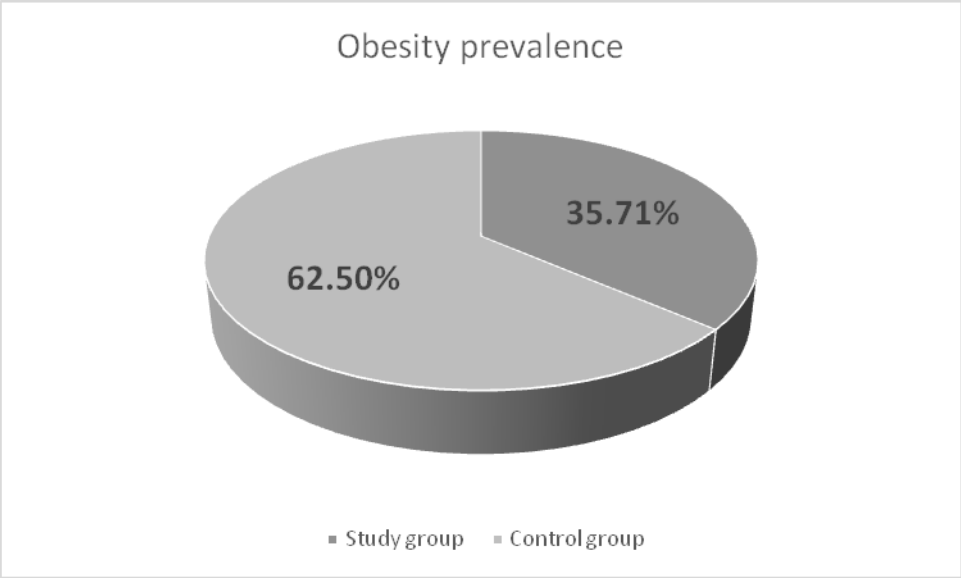

Figure 1. *The prevalence of obesity in study and control group.*

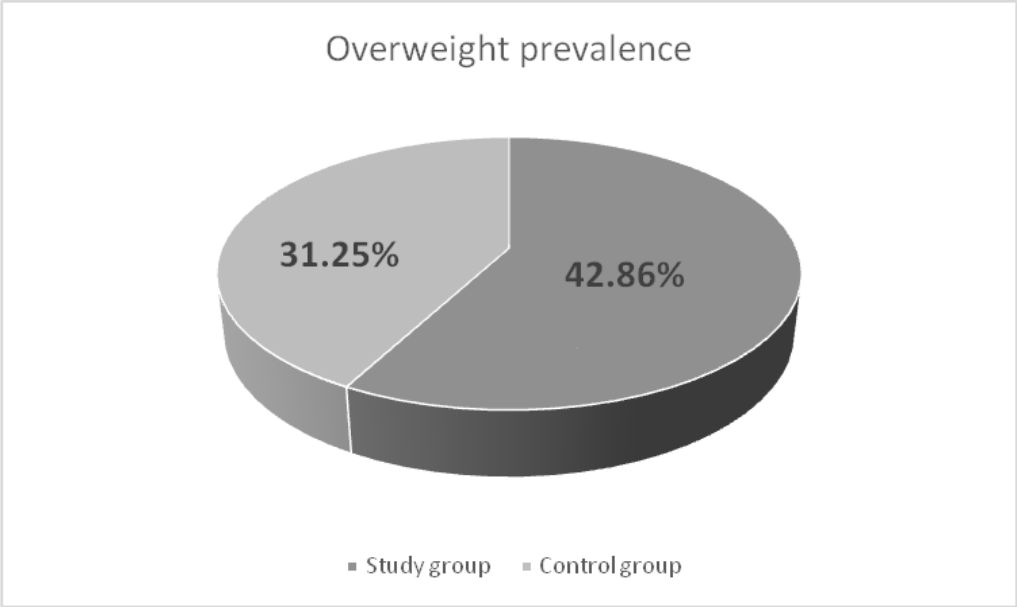

Figure 2. *The prevalence of overweight in study and control group.*

In the study group FPG ranged between 113-351 mg/dl,, HbA1c between 6.2-12.9%, and GFR between 53.01-105.95 ml/min/1.73 m^2. According to National Kidney Foundation definition, only 1 patient of the study group (7.14 %) presented chronic kidney disease (CKD). The condition is defined by "*Glomerular Filtration Rate (GFR) less than≤60ml/min/1.73m^2 that is present for≥3 months with or without evidence of kidney damage or evidence of kidney damage with or without decreased GFR that is present for≥3 months as evidence by microalbuminuria, proteinuria, glomerular haematuria, pathological abnormalities, anatomical abnormalities*" [14].

For the control group, FPG ranged between 106-346 mg/dl, HbA1c between 5.1-12.9% and GFR between 49.2-102.9 ml/min/1.73 m2. According to the National Kidney Foundation definition, 2 patients of the study group (12.50 %) presented CKD.

In the analysis of blood cytology for the study group, red cell/ cellular changes are presented in Figures 3, 4, 5, 6.

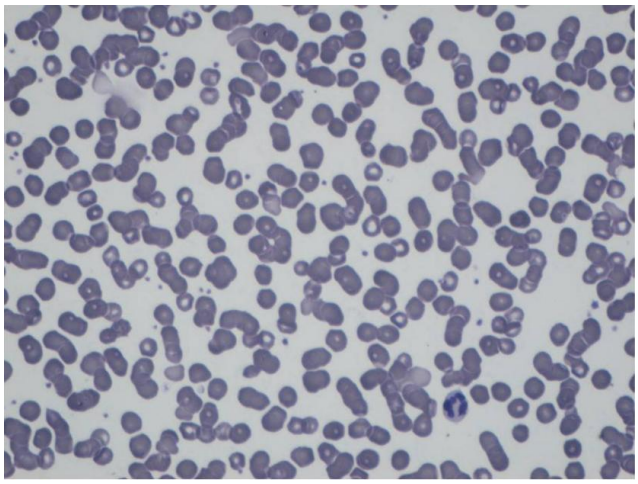

Figure 3. *Hypochromia and poikilocyosis.*

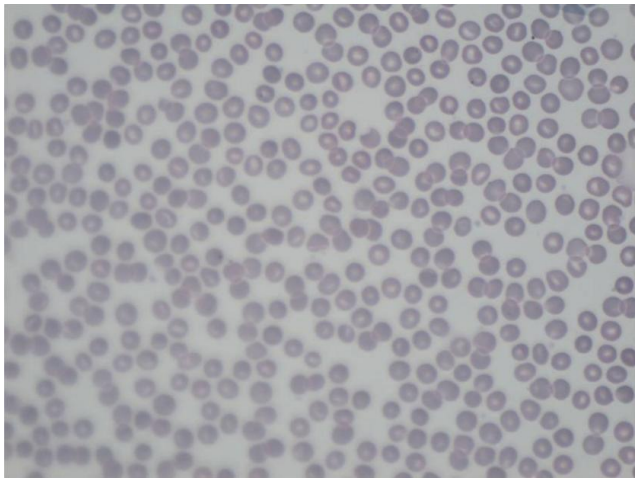

Figure 4. *Hypochromia and anisocytosis.*

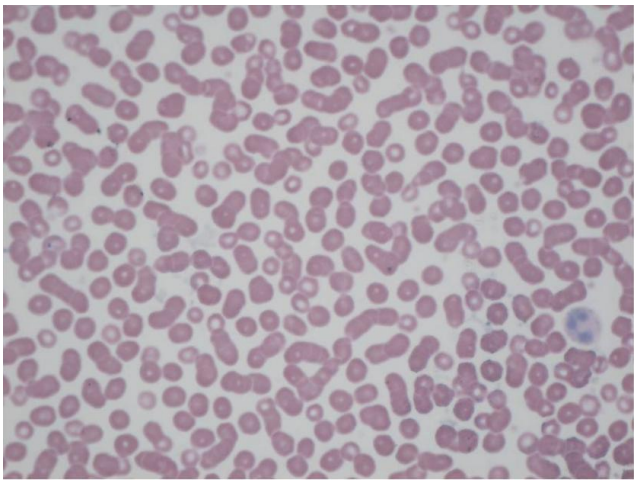

Figure 5. *Hypochromia and anisocytosis.*

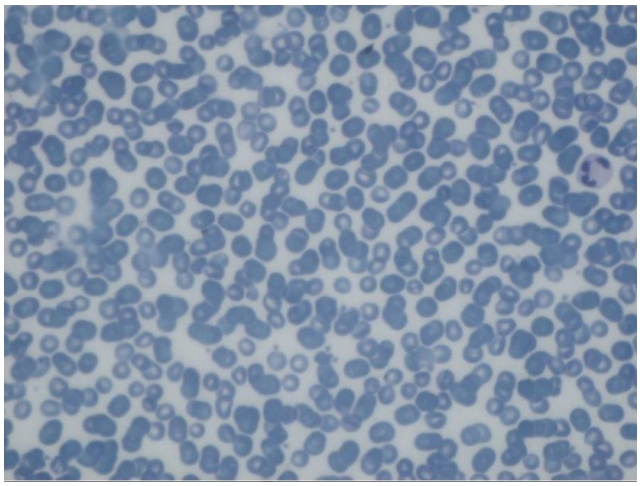

Figure 6. *Hypochromia and anisocytosis.*

The study showed no statistically significant differences in anthropometric and metabolic characteristics of patients with diabetes and hypochromia, compared with controls. The main characteristics of patients of study and control group are shown in Table 1.

Table 1. Characteristics of patients recruited in the study.

Recorded parameters	Characteristics of study group (n=14)	Characteristics of control group (n=16)	P
Age (years)	59.93±8.74	61.81±7.91	NS
BMI (kg/m2)	28.28±5.70	31.32±5.17	NS
WC (cm)	101.57±12.93	109.06±12.89	NS
FPG (mg/dl)	199.00±65.18	234.06±73.63	NS
HbA1c (%)	8.17±1.81	7.81±2.07	NS
GFR (ml/min/1.73m2)	90.22±13.00	86.86±18.53	NS

NS–non-significant

Discussions

Our retrospective study revealed a high prevalence of hypochromia in diabetic patients (46.66%). David O *et al* reported in a retrospective analysis of data from 943 patients, an overall anemia prevalence of 25.2% (238 subjects). Among the 238 anemic subjects, the prevalence of hypochromia and microcytosis was 19.3%, respectively 5.9%. Among the 705 non-anemic subjects the prevalence of hypochromia was 3.8%, and prevalence of microcytosis was 1.9% [17].

A limitation of our study is represented by the relatively small number of patients enrolled and that the prevalence of anemia was not evaluated. Future clinical and experimental studies should explore potential causal mechanisms linking hematological alterations and diabetes mellitus. As strengths of the study it should be mentioned that it is an evidence based observational study, analyzing the correlation between the hematological dynamics and T2DM.

Conclusions

We observed a high prevalence of hypochromia in diabetic patients (46.66%). Our findings suggest the need of routine screening for hematological tests in patients with T2DM.

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