ORIGINAL RESEARCH PAPER

Volume-8 | Issue-1 | January-2019 | PRINT ISSN No 2277 - 8179

INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

EFFECT OF DYSGLYCEMIA AND DYSLIPIDEMIA ON HEMATOLOGICAL INDICES

Biochemistry

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ABSTRACT

Introduction: Dysglycemia mostly manifests as hyperglycemia characterized as diabetes mellitus and dyslipidemia is frequently associated with type 2 diabetes mellitus. Blood viscosity and hematocrit are the emerging risk factors for insulin resistance and type 2 diabetes mellitus. Therefore the objective of this study was to test the association of dysglycemia and dyslipidemia with hematological parameters.

Materials and Methods: It was a cross-sectional study. A total of 81 subjects both males and females were randomly selected. Biochemical parameters, blood glucose and lipids were compared with the haematological indices.

Results: Groups with dysglycemia and dyslypidemia has shown statistical significant differences in the hematocrit, WBC, MCV and the levels of platelets.

Discussion and conclusion: Elevated levels of hematocrit, total counts and platelets indicate that dysglycemia and dyslipidemia affect some of the hematological parameters.

KEYWORDS

Dysglycemia, Dyslypidemia, Diabetes Mellitus

INTRODUCTION:

Dysglycemia is a qualitative term used to describe blood glucose that is abnormal, without defining a threshold. Dysglycemia mostly manifests as hyperglycemia characterized as diabetes mellitus [1]. Dyslipidemia is elevation of plasma cholesterol, triglycerides (TGs), high LDL or a low HDL cholesterol level that contributes to the development of atherosclerosis [2,5]. The most important cause of dyslipidemia in developed countries is a sedentary lifestyle, diet and diabetes mellitus. Blood viscosity and hematocrit are the emerging risk factors for insulin resistance and type 2 diabetes mellitus. About 80% of diabetics die from thrombotic events with 75% to 80% of these deaths resulting from cardiovascular events [2]. The objective of this study was to measure blood glucose and lipid variables with haematological indices and to test the association of dysglycemia and dyslipidemia with hematological parameters.

MATERIALS AND METHODS:

It was a cross-sectional study. A total of 81 subjects both males and females were randomly (every second patient) selected from subjects, who had come for a general health checkup at Alluri Sitarama Raju Academy of Medical Sciences, Eluru, Andhra Pradesh. Approval by the institutional ethical committee and informed consent from all the subjects enrolled in the study was obtained. Venous blood sample was collected from the antecubital vein and analyzed for fasting plasma glucose (FPG), 2hr PG, total cholesterol, serum triglycerides, low density lipoprotein cholesterol (LDL-C) high density lipoprotein cholesterol (HDL-C), and hematological parameters including Hemoglobin (Hb), hematocrit, RBC, WBC, Platelet Count (PLT), Mean Corpuscular Volume (MCV), Mean corpuscular hemoglobin (MCH), and Mean corpuscular hemoglobin concentration (MCHC). Fasting plasma glucose was measured by hexokinase method, total serum cholesterol and high density lipoprotein cholesterol (HDL-C) by CHOD-POD method and Triacylglycerol with the GPO-POD-method on fully automated Beckman Coulter AU480 analyzer. The level of low- density lipoprotein cholesterol (LDL-C) was determined using the formula: LDL= Total Cholesterol – (TG/5 + HDL). Haematological parameters were measured on Sysmex-XL 1000. Subjects in the age group of 30-70 years were included in the study. Biochemical parameters, fasting and post prandial blood glucose, total cholesterol, triglycerides, HDL and LDL cholesterol were compared with the haematological indices.

OPERATIONAL DEFINITIONS AND CRITERIA :

Subjects were defined as having dysglycemia if there FPG and 2hr PG was >100mg/dl and >140mg/dl respectively.

For serum lipid reference level, National Cholesterol Education Programme (NCEP) Adult Treatment Panel III (ATP III) guideline was referred. According to NCEP - ATP III guideline, hyper-cholesterolemia is defined as TC >200 mg/dl, high LDL-C when value >100 mg/dl, hypertriglyceridemia as TAG >150 mg/dl and low HDL-C when value <40 mg/dl. Dyslipidemia was defined by presence of one or more than one abnormal serum lipid concentration [5].

Data was analyzed using SPSS software version 19. The statistical analysis was done by the unpaired two tailed 't' test,. The statistical significance was kept as a p value of < 0.05.

RESULTS:

Comparison of all biochemical parameters – FPG, 2hr PG, TC, TG, HDL-C and LDL-C between the control groups and the groups with dysglycemia and dyslypidemia group has shown statistical significant differences [Tables1-6]. Comparison of glycemic parameters – FPG, 2hr PG, with the hematological indices- hematocrit and WBC count, has shown statistical significant differences between the control groups and the groups with dysglycemia [Tables-1,2]. Statistical significant differences between the control groups and the groups with dylipidemia was seen with MCV in relation to total cholesterol and LDL-C levels [Tables-3,6], MCH in relation to LDL-C levels [Tables-6], with WBC count in relation to TG levels [Tables4], and with platelets in relation to HDL-C [Tables-5].

Table 1- Comparison of haematological indices based on FBS

Variables	Controls	Dysglycemics
FBS(mg/dl)	92.4±5.1	153.2+57.2*
Hb(gm/dl)	14.1±2.27	13.3±1.76
Hematocrit (%)	42.8±5.81	40.07±4.9*
WBC (103/µl)	7.5±2.33	8.3±1.06*
RBC (mil/cmm)	5.06±0.71	4.7±0.6
PLT (lakhs/cumm)	2.78±0.81	2.57±0.6
MCV (Fl)	85±6	84.75±5.8
MCH (pg)	28.3±2.9	28.0±2.67
MCHC (g/dl)	33±1.7	33.7±3.2
*Significant – p<0.05		

Table 2- Comparison of haematological indices based on 2hr PG

Variables	Controls	Dysglycemics
2hr PG (mg/dl)	105±16.8	238.8±82.8*
Hb (gm/dl)	13.5±2.2	13.5±1.7
Hematocrit (%)	41.7±5.8	40.7±5.09*
WBC (103/µl)	7.2±1.76	8.7±2.23*
RBC (mil/cmm)	4.9±0.75	4.78±0.59
PLT(lakhs/cumm)	2.7±0.6	2.6±0.7
MCV (Fl)	84.7±7.1	84.9±4.4
MCH (pg)	28.1±3.2	28.3±2.1
MCHC (g/dl)	60.3±7.9	33.3±1.2
*Significant – p<0.05		

Table 3- Comparison of haematological indices based on total cholesterol		
Variables	**Controls**	**Dyslipidemics**
Total Cholesterol (mg/dl)	236±34.7	156±30.2*
Hb(gm/dl)	13.1±2	13.8±1.9
Hematocrit (%)	40.3±5.7	41.4±5.3
WBC (103/µl)	8.6±2.01	7.7±2.16
RBC(mil/cmm)	4.84±0.71	4.85±0.6
PLT(lakhs/cumm)	2.86±0.58	2.58±0.7
MCV (Fl)	82±6.3	85.8±5.4*
MCH (pg)	26.9±2.9	28.7±2.5
MCHC (g/dl)	33.5±4.6	33.3±1.4
*Significant – p<0.05		

Table 4- Comparison of haematological indices based on triglycerides		
Variables	Controls	Dyslipidemics
TG(mg/dl)	238.3±92.7	106.3±22.4*
Hb(gm/dl)	13.7±2.2	13.5±1.8
Hematocrit (%)	41.23±6	41.1±4.9
WBC (103/µl)	8.4±2.27	7.5±1.94*
RBC (mil/cmm)	4.8±0.7	4.87±0.6
PLT(lakhs/cumm)	2.6±0.6	2.73±0.7
MCV (Fl)	84.9±6.3	84.7±5.4
MCH (pg)	28.3±3	28.1±2.48
MCHC (g/dl)	33.7±3.57	33.3±1.4
*Significant – p<0.05		

Table 5- Comparison of haematological indices based on HDL-C		
Variables	Controls	Dyslipidemics
HDL- C (mg/dl)	49.7±7.4	33±4.4*
Hb (gm/dl)	13.5±1.6	14±2.2
Hematocrit (%)	39.9±4.4	42±5.9
WBC (103/µl)	8.1±2.68	7.8±1.71
RBC(mil/cmm)	4.7±0.5	4.9±07
PLT(lakhs/cumm)	2.84±0.7	2.5±0.6*
MCV (Fl)	84.9±5.1	84.7±6.3
MCH (pg)	28.1±2.2	28.3±3
MCHC (g/dl)	33.4±3.6	33.3±1.6
*Significant – p<0.05		

Table 6- Comparison of haematological indices based on LDL-C		
Variables	Controls	Dyslipidemics
LDL- C (mg/dl)	128±22.9	69.6±20.5*
Hb (gm/dl)	13.6±2.	13.6±2.
Hematocrit (%)	41.6±4.9	40.5±6
WBC (103/µl)	7.9±1.87	8.0±2.50
RBC(mil/cmm)	4.9±0.5	4.7±0.7
PLT (lakhs/cumm)	2.5±0.7	2.5±0.6
MCV (Fl)	83.4±6.2	86.2±4.4*
MCH (pg)	27.7±3.1	29±1.8*
MCHC (g/dl)	33.1±3.3	33.6±1
*Significant – p<0.05		

DISCUSSION:

Diabetes is said to be a hypercoagulable state causing platelet hyperactivity. Insulin is a natural antagonist of platelet hyperactivity and a low-grade inflammation is a key factor in the pathogenesis of type 2 diabetes [2]. The number of circulating platelets in diabetic patients is normal, i.e. there is no quantitative change compared to the non-diabetic population [2,6,8] which was also observed in this study in subjects with dysglycemia. It is also known that hematocrit is a determining factor of blood thickness and if it is increased it could develop insulin resistance. In patients having type-2 diabetes, hematocrit levels were found to be higher than normal [6,8]. This study also showed elevated levels of hematocrit in association with dysglycemia.

This study has shown significant increase in WBC count in subjects with dysglycemia and previous studies have indicated that WBC count is elevated in the diabetic patients and may contribute to the micro- and macro-vascular complication [7,8]. The white blood cells are activated by the AGE products in response to the hyperglycemic states. It is also possible that immune system activation caused by inflammation, might increase WBC [9]. Dyslipidemia is associated with procoagulant changes [10]. This study has shown a significant increase in WBC count in dysglycemic subjects with hypertriglyceridemia, MCV in diabetics with hypercholesterolemia (total cholesterol and LDL cholesterol) and significant difference in platelet count based on HDL-C levels in diabetics. This is in contrast to other studies by M. Mahmoudi et al [11] and H. Hosseini et al [12] who had shown that both hyperlipidemia and hyperglycemia caused increase in mean cell volume (MCV) and also hyperlipidemia can cause increase in mean cell hemoglobin concentration (MCHC), hemoglobin and hematocrit (Hct), while in a study by Mohammad H etal [13], hypertriglyceridemia significantly increased MCHC but they did not detect any correlation between hyper-cholesterolemia and erythrocytes indices.

CONCLUSION:

Hyperglycemia and hyperlipidemia appear to alter not all but some haematological parameters. HbA1c measurement to know the mean glycemic status and demographic characteristics might further help to define the hypercoagulable state seen in subjects with dysglycemia and dyslipidemia.

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