

**INVESTIGATION OF THE INFLAMMATORY AND PROTHROMBOTIC
HEMATOLOGICAL INDICES IN THE PATIENTS WITH METABOLIC SYNDROME**

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ABSTRACT

Background: Metabolic syndrome is the most important health problem in the world in recent years and is closely related to the development of diabetes mellitus, hypertension, hyperlipidemia, cardiovascular diseases, cerebrovascular diseases, chronic renal failure and some types of cancer. Therefore it thought to be an inflammatory and prothrombotic condition. Increased Mean Platelet Volume (MPV) has recently been claimed to initiate thrombotic processes by activating platelets in a number of studies. Also Neutrophil to Lymphocyte Ratio (NLR) has been associated with inflammatory processes in many studies. Herein our aim was to evaluate the value of MPV and NLR values in metabolic syndrome. **Methods:** 236 patients admitted to the department of internal medicine were included into this present study. Demographic and laboratory data of the patients were retrospectively evaluated. Metabolic syndrome was diagnosed according to NCEP ATP III criteria. Patients were divided into two groups according to presence of the metabolic syndrome; metabolic syndrome positive group and negative group. The recorded data were compared between these groups. Data were analyzed by SPSS for Windows (version 21.0; SPSS / IBM, Chicago, IL). **Results:** Metabolic syndrome was diagnosed in 125 patients (52,9%). There was no statistically significant difference between MPV and NLR values between the groups (p value > 0.05). **Conclusion:** According to the results of this present study, we can say that there was no significant correlation between metabolic syndrome and indicators of the subclinical inflammation (NLR) and platelet activation (MPV).

KEYWORDS: Metabolic syndrome, Mean Platelet Volume, Neutrophil to Lymphocyte Ratio.**INTRODUCTION**

Glucose metabolism disorder, dyslipidemia, hypertension, and cardiovascular risk factors of abdominal obesity were defined as the syndrome X in 1988 and latter was defined by the WHO as the metabolic syndrome in 1999. The criteria known as Syndrome X were impaired glucose tolerance, hyperinsulinemia, high triglyceride levels and low HDL levels. WHO criteria consisted of impaired fasting glucose or tolerance or presence of diabetes mellitus, hypertension, high triglyceride level, low HDL level, central obesity and microalbuminuria.^[1] Today, the metabolic syndrome criteria defined by the National Cholesterol Education Program (NCEP) are accepted all over the world.^[2] Five criteria are defined here and at least three of these criteria must be positive for the diagnosis.

Metabolic syndrome is a very serious cardiovascular risk factor. In addition to cardiovascular diseases, it is a serious risk factor for the development of diabetes mellitus, hypertension, hyperlipidemia, cerebrovascular disease, chronic renal failure and some types of cancer.^[3]

We thought that metabolic syndrome might be an inflammatory disease and prothrombotic condition. Hence we investigated indicators of the inflammatory and prothrombotic hematological indices in metabolic syndrome patients.

MATERIALS AND METHODS**Patients selection**

236 patients aged > 18 were included into the study. Patients were retrospectively analyzed for age, gender, height, weight, waist circumference, systolic and diastolic blood pressure, fasting blood glucose, HDL, triglyceride, neutrophil, lymphocyte, MPV, WBC, Platelet count and hemoglobin. NLR values was found by dividing of the neutrophil to lymphocyte.

Metabolic Syndrome Definition

The metabolic syndrome was diagnosed according to the NCEP ATP III guideline with a positive detection of at least three of the following 5 criteria.

1. Fasting glucose ≥ 100 mg/dl or pharmacological treatment
2. Blood pressure $\geq 130/80$ mmHg or pharmacological treatment

3. Triglyceride ≥ 150 mg/dl or pharmacological treatment
4. Waist circumference ≥ 88 cm in women ≥ 102 cm in men
5. HDL > 40 mg/dl in men < 50 mg/dl in women or pharmacological treatment

Patients were divided into two groups as patients with and without metabolic syndrome. The recorded data were compared between the two groups. In patients diagnosed with diabetes mellitus, regardless of blood glucose, the first criterion was accepted as positive. In patients diagnosed with hypertension, the second criterion was accepted as positive regardless of blood pressure. Patients using hypolipidemic drugs due to hypertriglyceridemia and / or low HDL were also considered to be positive criteria.

Statistical Analysis

All the analyses were done using the SPSS for Windows (version 21.0; SPSS / IBM, Chicago, IL). Descriptive statistics, independent sample T test, Mann-Whitney U and Binary logistic regression tests were used when appropriate. Normality was tested with Kolmogorov Smirnov test. Normal distributed data was tested with independent sample T test and the others were tested with Mann-Whitney U test. The statistical significance level was accepted as a P value of less than 0.05.

RESULTS

Metabolic syndrome was detected in 125 of the studied patients. The mean age of the patients diagnosed with metabolic syndrome was 57.7 ± 13.5 years, whereas the mean age of the patients without metabolic syndrome was 38 ± 16.7 (p value < 0.01). Of the patients diagnosed with metabolic syndrome, 35 were males and 90 were females, whereas 37 of the patients without metabolic syndrome were males and 74 were females (p value = 0,37). Of the patients diagnosed with the metabolic syndrome, 27 were living in the rural residence, 98 of them living in non-rural residence, while 2 of the patients without metabolic syndrome were living rural residence, 87 of them in the non-rural residence (p value = 0,99). Diabetes mellitus was detected in 66 of the patients diagnosed with metabolic syndrome, whereas 5 of the patients without metabolic syndrome had diabetes mellitus (p value < 0.01). Of the patients diagnosed with metabolic syndrome, 51 had hypertension and 2 of the patients without metabolic syndrome had hypertension (p value < 0.01). The mean waist circumference of patients diagnosed with metabolic syndrome was $108,8 \pm 11,2$, and the mean waist circumference of patients without metabolic syndrome was $95,6 \pm 12,4$ (p < 0.01). The

mean triglyceride values of the patients diagnosed with metabolic syndrome were 189 ± 92 , and the mean triglyceride values of the patients without metabolic syndrome were 114.5 ± 72.3 (p value < 0.01). The mean HDL values of the patients diagnosed with metabolic syndrome was $39,4 \pm 9,6$ and the mean HDL values of the patients without metabolic syndrome was $46,7 \pm 11,7$ (p < 0.01). The mean fasting blood glucose levels of patients diagnosed with metabolic syndrome were 141.6 ± 66.8 and the mean fasting blood glucose level of patients without metabolic syndrome was found to be 96.8 ± 30.8 (p value < 0.01). The mean systolic blood pressure of the patients diagnosed with metabolic syndrome was 132.8 ± 22.3 , while the mean systolic blood pressure of patients without metabolic syndrome was determined as 108.7 ± 13.8 (p value < 0.01). The mean diastolic blood pressure of the patients diagnosed with metabolic syndrome was 74.3 ± 14.3 , and the mean diastolic blood pressure of the patients without metabolic syndrome was $67,8 \pm 8,9$ (p < 0.01). The mean WBC values of the patients diagnosed with metabolic syndrome was $8,42 \pm 2,3$, while the mean WBC values of the patients without metabolic syndrome was found to be $7,7 \pm 2$ (p value < 0.01). Hemoglobin averages of patients with metabolic syndrome were 14.03 ± 1.9 , and hemoglobin averages of patients without metabolic syndrome were found to be 14.06 ± 2.02 (p value = 0,89). The mean platelet counts of patients with metabolic syndrome were 264990 ± 72600 and the mean platelet count of patients without metabolic syndrome was 256200 ± 61400 (p value = 0,32). The mean MPV values of patients diagnosed with metabolic syndrome was $8,24 \pm 1,3$. Mean MPV values of patients without metabolic syndrome was found to be $8,47 \pm 1,4$ (p value = 0,21). Neutrophil averages of patients diagnosed with metabolic syndrome were $4,97 \pm 1,9$, while neutrophil averages of patients without metabolic syndrome were $4,59 \pm 1,8$ (p value = 0,03). The mean lymphocyte values of the patients diagnosed with metabolic syndrome were $2,67 \pm 0,8$ and the mean lymphocyte values of the patients without metabolic syndrome was found to be $2,39 \pm 0,5$ (p value < 0.01). NLR averages of patients with metabolic syndrome were found to be $2,07 \pm 1,3$. NLR averages of patients without metabolic syndrome were found to be $2,08 \pm 1,35$ (p value = 0,74). These results are summarized in **Table 1**.

According to the results of binary logistic regression test, the metabolic syndrome and MPV (P value: 0,21 exp B: 0,99 (95% 0,81-1,2)) and NLR (P value: 0,95 exp B: 0,89 95% 0,74-1,07)) were not found to be significant difference (**Table 2**).

Table 1: Clinical and biochemical characteristics of the patients according to the presence of metabolic syndrome

Parameters	With MS (N = 125)	Without MS (N = 111)	P value
Age	57,7 \pm 13,5	38 \pm 16,7	<0,01
Gender (Male/Female)	35/90	37/74	0,37
Residence (rural/non-rural)	27/98	24/87	0,99
Diabetes mellitus	66 (%52,8)	5 (%4,5)	<0,01

<i>Hypertension</i>	51 (%40,8)	2 (%1,8)	< 0,01
<i>Waist circumference</i>	108,8±11,2	95,6±12,4	< 0,01
<i>Triglyceride</i>	189±92,2	114,5±72,3	< 0,01
<i>HDL</i>	39,4±9,6	46,7±11,7	< 0,01
<i>Glucose</i>	141,6±66,8	96,8±30,8	< 0,01
<i>Systolic blood pressure</i>	132,8±22,3	108,7±13,8	< 0,01
<i>Diastolic blood pressure</i>	74,3±14,3	67,8±8,9	< 0,01
<i>WBC</i>	8,42±2,3	7,7±2	< 0,01
<i>Hemoglobin</i>	14,03±1,9	14,06±2,02	0,89
<i>Platelet count</i>	264990±72600	256200±61400	0,32
<i>Neutrophil</i>	4,97±1,9	4,59±1,8	0,03
<i>Lymphocyte</i>	2,67±0,8	2,39±0,5	< 0,01
<i>NLR</i>	2,07±1,3	2,08±1,35	0,74
<i>MPV</i>	8,24±1,3	8,47±1,4	0,21

Table 2: Binary Logistic Regression test results for metabolic syndrome positive and negative groups

Parameters	B	S.E	Exp(B)	95% CL	P value
<i>NLR</i>	-,006	,099	,994	0,81-1,2	0,95
<i>MPV</i>	-,116	,094	,890	0,74-1,07	0,21

B, regression coefficient; CI, confidence interval of Exp (B); Exp (B), adjusted regression coefficient; SE, standard error

DISCUSSION

Metabolic syndrome is a metabolic disorder associated with insulin resistance and abdominal obesity.^[4] In animal studies, high-fat diets have been shown to increase insulin resistance, which is the most important step in metabolic syndrome.^[5] This metabolic disorder increases the risk of developing diabetes mellitus, hypertension, hyperlipidemia, cardiovascular diseases, polycystic over syndrome, obstructive sleep apnea syndrome, nonalcoholic fatty liver disease, sexual dysfunction, cerebrovascular disease, chronic renal failure and some types of cancer.^[6-11] The worldwide incidence of metabolic syndrome has increased and this increase is thought to be triggered by technological progress and increasing sedanter life.

In this present study metabolic syndrome was detected in 52,9% of the patients. This high rates will explain the importance of this health problem. This condition can be reversible with lifestyle changes involving diet and exercise.^[12]

Metabolic syndrome is known to cause thrombotic diseases because it accelerates the process of atherosclerosis.^[13] Mean Platelet Volume (MPV) is a hemogram parameter that displays mean platelet volume and platelet activity. MPV elevation has recently been claimed to initiate thrombotic processes by activating platelets in many studies, and a statistically significant association has been found in these studies.^[14-16] It is known that increased insulin resistance is central to the pathogenesis of complications of metabolic syndrome. Some studies have found a significant association between insulin resistance and MPV.^[17] There are also a number of studies showing the association of MPV value with inflammatory processes.^[18-19]

In a study by Shah B et al., A significant association was found with MPV values and diabetes mellitus, although no significant association was found between MPV values and the metabolic syndrome.^[20] In a study of the Husband-Wrist, there was no significant association between MPV values and the metabolic syndrome.^[21] In a study by ByoungJin Park et al., A significant association was found between low MPV values and the metabolic syndrome.^[22]

In this present study, there was no statistically significant relationship between the metabolic syndrome and MPV values (p value> 0.05).

Numerous studies have shown that NLR values increases in inflammatory conditions.^[23-26] Metabolic syndrome is thought to be chronic subclinical inflammation in the human body. Another study showed that obesity increases the macrophage infiltration in fat tissue, thus producing a pro-inflammatory process.^[27] In another study, CRP and IL-6 levels were found to be significantly higher in patients with metabolic syndrome compared to the control group^[28]

In a study conducted by Büyükkaya E et al., A significant association was found between high NLR and CRP levels and metabolic syndrome.^[29] In a study conducted by Bahadira et al., there was a significant relationship between CPR values and the metabolic syndrome, while there was no relationship between NLR values and the metabolic syndrome.^[30]

In this present study, there was no statistically significant relationship between NLR values and Metabolic syndrome (p value> 0.05).

CONCLUSION

In conclusion, according to the results of this present study, there was no significant correlation between metabolic syndrome and subclinical inflammation or platelet activation indicators.

Our work had some limitations. These were, respectively, the small number of patients and the retrospective nature of the study. This issue will be better illuminated in the future by prospective studies with a large number of patients.

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