Original article

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Investigation of the relationship between hemogram parameters and procalcitonin levels in patients with psychiatric diseases

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Abstract

Introduction: This study aimed to evaluate the relationship between the hemogram parameters and the levels of procalcitonin, serum C-reactive protein, and inflammation in inpatients with psychiatric disorders.
Material and methods: The study population consisted of 549 inpatients treated between January 2018 and December 2020. Data were obtained retrospectively from computer records and inpatient files. Only the first hospitalization of each patient was evaluated, and 199 patients were included in the study. The researchers examined the parameters including platelet activation, neutrophil lymphocyte ratio, monocyte lymphocyte ratio, platelet count, mean platelet volume, platelet distribution width, platelet lymphocyte ratio, and procalcitonin levels in patients and compared them with findings obtained from a control group.
Results: Increased levels of C-reactive protein and decreased levels of platelets were observed in patients with schizophrenia, bipolar disorder, depressive disorder, and anxiety disorder. Increased platelet distribution width, platelet lymphocyte ratio, and neutrophil lymphocyte ratio were observed in patients with schizophrenia. The patients with bipolar disorder had increased mean platelet volume while patients with depressive disorder had an increased monocyte lymphocyte ratio. Procalcitonin levels increased in patients with anxiety disorder and depressive disorder.
Discussion: Platelet activity can be an important criterion to investigate the etiopathogenesis underlying the inflammatory process in schizophrenia, bipolar disorder, depressive disorder, and anxiety disorders. To our knowledge, this is the first study to describe a positive correlation between increased monocyte lymphocyte ratio and procalcitonin levels in depressive disorder, and a positive correlation between increased procalcitonin levels and anxiety disorder and depressive disorder.

Key words: platelet activity, procalcitonin, psychiatric disorders.

Introduction

Psychiatric diseases such as schizophrenia, bipolar disorder (BD), depressive disorder (DD), and anxiety disorder are severe mental disorders that affect millions of people worldwide. Differences in clinical characteristics and severity of the diseases, recurrence of disorders, different treatment methods, and chronic courses suggest that many factors are involved in the etiopathogenesis of these diseases (McGrath *et al*. 2008; Grande *et al*. 2016; Vandeleur *et al*. 2017; Stein *et al*. 2017). Previous studies have suggested that neurotransmitter systems, hormones, neurotrophic factors, and inflammatory and immune systems are effective in the etiopathogenesis of these disorders. Recent studies indicate that inflammatory mediators play an important role in modulating the proinflammatory process (Miller *et al*. 2011; Ng *et al*. 2018; Smaga *et al*. 2015).

The increased expression of inflammatory cytokines such as interleukin (IL)-1β, IL-6, and transforming growth factor β (TGF-β) observed during an acute relapse of a psychiatric disorder decreases after treatment with antipsychotics; however, the expression levels of some cytokines such as IL-12, interferon γ (IFN-γ), tumor necrosis factor α (TNF-α) do not change despite antipsychotic treatment. The levels of these cytokines were examined in patients with schizophrenia and their relatives (Miller *et al*. 2011). A previous study also investigated the effects of inflammatory mediators on acute phase proteins such as α1 antitrypsin, haptoglobin, and C-reactive protein (CRP) in patients with schizophrenia (Ng *et al*. 2018; Smaga *et al*. 2015). The psychopathological condition of some patients improved after treatment with nonsteroidal anti-inflammatory drugs (Moody and Miller 2018). The neutrophil, monocyte, and platelet counts may be altered in patients with schizophrenia, and patients having these counts within normal limits show a better response to treatment (Mazza *et al*. 2019). White blood cells such as leukocytes, neutrophils, and monocytes are involved in the inflammatory process underlying the etiopathogenesis of psychiatric diseases such as anxiety disorders and obsessive-compulsive disorder (OCD); thus, white blood cells have been used as biological markers in diagnosis and treatment of these diseases (Karataş *et al*. 2020; Gurok *et al*. 2019). However, the white blood cell counts obtained using a hemogram can be affected by many factors, and studies on systemic inflammation indicate that neutrophil lymphocyte ratio (NLR), platelet lymphocyte ratio (PLR), and monocyte lymphocyte ratio (MLR), which are least affected by confounding factors, are more accurate determinants of the presence of psychiatric diseases (Mazza *et al*. 2019; Balta *et al*. 2013). The NLR, PLR, and MLR increased not only in patients with schizophrenia but also in patients with BD, DD, and OCD (Mazza *et al*. 2019; Sunbul *et al*. 2016; Kirlioglu *et al*. 2019; Karatas *et al*. 2021). Some studies have reported no relationship between NLR and the severity of the psychiatric disease (Moody and Miller 2018; Semiz *et al*. 2014). Furthermore, PLR and MLR are associated with the prognosis of patients with schizophrenia (Mazza *et al*. 2019; Özdin *et al*. 2017).

Previous studies have examined the relationship between changes in red blood cells observed using a hemogram and chronic psychiatric disease (Wysokiński and Szczepocka 2018; Hochman *et al*. 2014). Patients with DD showed all three types of anemia, namely, microcytic anemia, macrocytic anemia, and normocytic anemia, and the hemograms of most patients showed a decrease in red blood cells (Wysokiński and Szczepocka 2018). The mean corpuscular volume (MCV) and mean corpuscular hemoglobin (MCH) levels increased in patients with BD and decreased in patients with schizophrenia (Wysokiński and Szczepocka 2018; Hochman *et al*. 2014).

Recent studies showed that changes in platelet (PLT) activity are associated with the prognosis of chronic psychiatric diseases rather than changes in white and red blood cells (Karatas *et al*. 2021; Wysokiński and Szczepocka 2018; Hochman *et al*. 2014). Results of previous studies showed that parameters such as mean platelet volume (MPV) and platelet distribution width (PDW), which are indicators of PLT activation during inflammation, were associated with disease and disease severity in schizophrenia, BD, DD, and OCD; however, the results did not establish a clear correlation between these factors and the psychiatric disorders (Ng *et al*. 2018; Karataş *et al*. 2020; Karatas *et al*. 2021).

Recent studies have found a significant relationship between procalcitonin (PCT) levels and inflammation in patients with DD and schizophrenia (Barbosa *et al*. 2013; Varun *et al*. 2018). PCT is a hormone released from thyroid C cells, leukocytes, and neuronal cells, and almost all the PCT secreted is converted to calcitonin under normal conditions (Barbosa *et al*. 2013; Walker 2015; Matwiyoff *et al*. 2012). However, IL-1β and TNF-alpha released from macrophages and bacterial components during the inflammatory process inhibit the conversion of PCT to calcitonin, thereby increasing the levels of calcitonin in the blood (Walker 2015; Matwiyoff *et al*. 2012). PCT levels increase with an increase in CRP levels, particularly in severe systemic diseases such as inflammatory bowel diseases, respiratory system diseases, sepsis, and immunological diseases such as lupus and rheumatoid arthritis (Shehabi *et al*. 2014; Buhaescu *et al*. 2010). High levels of PCT are observed in patients with schizophrenia and bipolar mania who did not use medication (Barbosa *et al*. 2013; Varun *et al*. 2018; Miller *et al*. 2014). However, no studies have examined the levels of PCT as an inflammatory marker in other psychiatric diseases such as DD and anxiety disorder.

Thus, this study aimed to address this gap in the literature by examining the levels of various parameters using a hemogram. A limited number of studies have examined all hemo-

gram parameters, particularly NLR, PLR, MLR, PLT activation, and PCT levels simultaneously in patients with different psychiatric diseases. These values are believed to be good indicators of the disease and can be obtained easily using an inexpensive method. Thus, these parameters should be included in the evaluations of the disease and the severity of the disease. Therefore, this study evaluated the hemogram parameters and CRP values of inpatients with psychiatric disorders and compared them with those from a control group. The results of this study may provide important insights for future research on mental disorders.

Material and methods

Study design

This was a descriptive epidemiological study.

Population, sample, and data collection

The population of this study consisted of 549 female inpatients, who were treated at the Recep Tayyip Erdoğan University Training and Research Hospital Psychiatry Clinic between January 2018 and December 2020. Male patients were not included in the study because the clinic provided services only to female patients. Only the first hospitalization of each patient was included in the evaluation. The data were obtained retrospectively from computer records and inpatient files. A total of 199 patients diagnosed with a psychiatric disease as schizophrenia (46 patients), anxiety disorders (42 patients), bipolar disorders (48 patients), or depressive disorder (63 patients) according to the diagnostic criteria specified in the Diagnostic and Statistical Manual of Mental Disorders, fifth edition (DSM-5), who had no systemic diseases such as heart, kidney, neurological, or autoimmune disease, and who had no physical or cognitive problem that prevents communication, were included in the study.

Participants who did not receive regular antipsychotic, antidepressant, anxiolytic, and mood stabilizer treatment in the last 3 months were included in the study, although the treatment was arranged earlier.

All patients with psychiatric disorders were administered the Brief Psychiatric Rating Scale at the beginning of their hospitalization. Patients with schizophrenia were followed up with the Brief Psychiatric Rating Scale.

Patients with bipolar disorder were followed up with the Young Mania Rating Scale.

Patients with anxiety disorders were followed up with the Hamilton Anxiety Rating.

Patients with depressive disorder were followed up with the Hamilton Depression Rating Scale.

Patients younger than 18 years and older than 65 years, who had any systemic disease such as heart, kidney, neurological, or autoimmune disease, and who received immunosuppressive therapy in the last 6 months, were excluded from the study.

The participants in the control group were selected among the female employees working at the hospital. Objective evaluation of these participants was performed by a psychiatrist who was not involved in the data collection and evaluation phase of the study. The participants who did not have any psychiatric illnesses detected and autoimmune, neurological, physical, or systemic disorders, and previous history of treatment with immunosuppressive or antipsychotic agents, and who agreed to participate in the study were included in the control group.

Data collection tools

The researchers examined the patient files, evaluated the sociodemographic data and the data obtained from the Brief Psychiatric Rating Scale (BPRS), the Young Mania Rating Scale (YMRS), the Hamilton Anxiety Rating Scale (HAM-A), and the Hamilton Depression Rating Scale (HAM-D) used for clinical monitoring and follow-up according to the diagnosis group. They evaluated the CRP levels and hemogram parameters to investigate the etiology of the disease and to determine the medical condition of the patients on the first day of hospitalization.

Sociodemographic form

The form was prepared by relevant experts using the patient files and information in the routinely completed inpatient follow-up files. The form included questions about the age, marital status, educational status, and employment status of the participants.

Brief Psychiatric Rating Scale

The BPRS was developed to evaluate the severity of the disease and consists of 18 questions. It provides information about anxiety, depression, thought disorder, aggression, and agitation in psychiatric diseases.

Young Mania Rating Scale

The YMRS consists of 11 items each with five degrees of severity. Cronbach's α was used to determine the internal reliability of the scale items, and two independent researchers reported the Cronbach's α as .79. The correlations of the scale items with the total score ranged from .342 to .817, except for the items of sleep, appearance, and insight. It was adapted for use in the Turkish population (Karadağ *et al*. 2001).

Hamilton Anxiety Rating (HAM-A) Scale

The HAM-A was developed by Hamilton to determine the level of anxiety and distribution of symptoms in patients. It consists of 14 items and can be used to assess both somatic and psychic symptoms. The responses on the HAM-A were similar to those obtained using a 5-point Likert-type scale. The total score on the HAM-A was the sum of the points obtained on each item. The Turkish validity and reliability study of this scale was conducted by Yazıcı *et al*. (Aydemir and Köroğlu 2012).

Hamilton Depression Rating Scale

The HAM-D administered by clinicians measures the level of depression and the change in the severity of disease in patients. It consists of structured questions, and the responses are scored between 0 and 4. The scores are evaluated as follows: 0-13 as no depression; 14-27 as mild depression; 28-41 as moderate depression; and 42-53 as severe depression. It was developed by Hamilton and Williams and was adapted for use in the Turkish population by Akdemir *et al*. (1996) (Aydemir and Köroğlu 2012).

Statistical analysis

The frequencies of continuous data were expressed as median and interquartile range. The distribution characteristics of continuous variables were determined using Shapiro-Wilk and Kolmogorov-Smirnov tests. The Mann-Whitney *U* test and Kruskal-Wallis test were used to evaluate the relationships between variables. The inflammatory parameters were compared among groups by the generalized linear model. The sensitivity and specificity values were determined for variables showing statistical significance. The statistical significance level was accepted as $p < 0.05$ for all analyses.

Ethics committee approval

Local ethics committee approval was obtained from the Recep Tayyip Erdogan University Faculty of Medicine Non-Interventional Clinical Research Ethics Committee with the number 2020/207 and dated October 16, 2020. All applications in this study were made following the ethical standards of the institutional and/or national research committee and the 1964 Declaration of Helsinki and its subsequent revisions, or comparable ethical standards.

Results

No significant difference was observed in the sociodemographic data between the control and patient groups (Table 1).

The levels of CRP and PLT were significantly different in all disease groups in the comparison of the blood values of patients with schizophrenia, anxiety disorder, BD, and DD with the control group ($p \leq 0.000$, $p \leq 0.000$, $p \leq 0.000$, and $p \leq 0.000$ vs. $p \leq 0.002$, $p \leq 0.000$,

Table 1. Sociodemographic data of the participants

Variable	Control (*n* = 113)		Schizophrenia (*n* = 46)		Anxiety disorders (*n* = 42)		Bipolar disorder (*n* = 48)		Depressive disorder (*n* = 63)		*p*
	n	%	*n*	%	*n*	%	*n*	%	*n*	%	
Age*	32.9	9.2	44.8	12.8	41.4	14.8	41.6	13.5	44.5	14.8	0.141**
Marital status											0.102
Married	61	54.0	21	45.7	30	71.4	31	64.6	38	60.3	
Single	52	46.0	25	54.3	12	28.6	17	35.4	25	39.7	
Employment status											0.121
Employed	66	58.4	6	13.0	11	26.2	16	33.3	13	20.6	
Unemployed	47	41.6	40	87.0	31	73.8	32	66.7	50	79.4	

**Means and standard deviations*
***Analyzed using the Kruskal-Wallis test; χ^2 test was used in other analyses*

$p \leq 0.007$, $p \leq 0.003$). A significant difference was observed in the MPV ($p \leq 0.025$) between the control and the BD group. Moreover, significant differences were observed in the PDW, PLR, and NLR ($p \leq 0.044$, $p \leq 0.008$, and $p \leq 0.003$) in the schizophrenia group while a significant difference was observed in the MLR ($p \leq 0.023$) in the DD group. A significant difference was observed in the hemoglobin (Hb) and hematocrit (Hct) levels in patients in all disease groups compared to the control group. Similarly, a significant difference was observed in the MCV and MCH levels in patients in the schizophrenia ($p \leq 0.001$ and $p \leq 0.002$) and BD groups ($p \leq 0.000$ and $p \leq 0.001$) compared to the control group. A significant difference was observed in the PCT levels between the control group and the anxiety disorder and DD groups ($p \leq 0.005$ and $p \leq 0.035$ (Table 2).

Discussion

The results of this study showed that CRP levels increased and PLT levels decreased in patients with schizophrenia, BD, DD, and anxiety disorder.

The study found that the PDW, PLR, and NLR increased in the schizophrenia group, MPV increased in the BD group, and MLR increased in the DD group. While a decrease in Hb and Hct levels was observed in all disease groups, the schizophrenia and BD groups had increased MCV and MCH levels. Additionally, an increase in PCT levels was observed in the patients with anxiety disorder and DD.

CRP levels were examined in previous studies on the inflammatory etiopathogenesis underlying chronic psychiatric diseases; however, consistent results were not obtained in these studies (Sunbul *et al*. 2016; Karataş *et al*. 2020;Karatas *et al*. 2021; Danner *et al*. 2003; Kalia and Silva 2015; Wium-Andersen *et al*. 2013). Increased CRP levels are observed in patients with schizophrenia, DD, BD, generalized anxiety disorder, and OCD (Karataş *et al*. 2020; Kalia and Silva 2015; Frasure-Smith *et al*. 2007). Some studies indicate that CRP levels increased independently, especially in patients with DD (Sunbul *et al*. 2016; Kalia and Silva 2015; Pasko *et al*. 2010), whereas other studies indicate that there is no change in CRP levels (Bankier *et al*. 2008). The results of this study showed that the CRP levels of patients with psychiatric diseases increased, which indicates the importance of measuring

Table 2. Comparison of the values obtained using a hemogram between the disease group and the control group

	Control (n = 113)	Schizophrenia (n = 46)	p	Anxiety disorders (n = 42)	p	Bipolar disorder (n = 48)	p	Depressive disorder (n = 63)	p
CRP	0.1 (0.3)	2.48 (3.93)	0.000	1.85 (4.5)	0.000	1.92 (4.08)	0.000	2.31 (5.09)	0.000
WBC	7770 (1355)	7790 (2982.5)	0.455	7295 (3247.5)	0.062	7215 (3187.5)	0.224	7080 (2925)	0.217
HCT	39.3 (2.35)	39.45 (4.53)	0.018	37.95 (5.53)	0.001	38.45 (3.58)	0.001	38.95 (5.48)	0.012
HB	13 (0.75)	12.85 (1.35)	0.021	12.8 (1.78)	0.021	12.65 (1.45)	0.001	12.95 (1.90)	0.001
MCV	86.8 (8)	89.85 (7.03)	0.001	88.55 (6.27)	0.131	90.55 (6.7)	0.000	86.90 (7.55)	0.630
MCH	28.8 (3.3)	29.7 (2.65)	0.001	29.55 (3.33)	0.258	29.75 (2.65)	0.001	29.20 (3.05)	0.188
MCHC	32.7 (1.4)	33 (1.2)	0.816	33.1 (1.6)	0.601	32.9 (0.98)	0.853	33.10 (1.33)	0.276
PLT	294 (123)	308.5 (102.5)	0.002	247.5 (79.25)	0.000	258.5 (96.75)	0.005	260.00 (78.75)	0.003
MPV	9.4 (0.8)	9.6 (1.33)	0.553	9.7 (1.65)	0.170	9.85 (1.58)	0.037	9.55 (1.30)	0.152
PCT	0.26 (0.1)	0.3 (0.12)	0.231	0.24 (0.06)	0.003	0.26 (0.09)	0.227	0.25 (0.07)	0.028
PDW	16 (0.6)	15.8 (0.5)	0.036	16 (0.53)	0.962	16.05 (0.58)	0.386	16.00 (0.42)	0.784
RDW-SD	41.3 (6.35)	43.25 (4.58)	0.650	42.6 (3.28)	0.475	43.9 (5.45)	0.193	41.75 (5.15)	0.659
RDW-CV	13.2 (5.3)	13.3 (1.68)	0.490	13.15 (1.53)	0.296	13.4 (1.05)	0.559	13.35 (1.65)	0.916
NLR	2.05 (1.56)	2.58 (2.04)	0.002	2.12 (2)	0.123	2.16 (1.33)	0.145	1.94 (1.03)	0.745
PLR	123.4 (90.19)	152.64 (74.87)	0.007	124.97 (80.29)	0.473	132.03 (68.3)	0.760	121.32 (71.26)	0.218
MLR	0.22 (0.15)	0.22 (0.14)	0.155	0.19 (0.1)	0.444	0.22 (0.11)	0.741	0.18 (0.07)	0.019

CRP – C-reactive protein; WBC – white blood cells; HCT – hematocrit; HB – hemoglobin; MCV – mean corpuscular volume; MCH – mean corpuscular hemoglobin; PLT – platelets; MPV – mean platelet volume; PCT – procalcitonin; PDW – platelet distribution width; RDW-SD – red cell distribution width – standard deviation; RDW-CV – red cell distribution width – coefficient of variation; NLR – neutrophil lymphocyte ratio; PLR – platelet lymphocyte ratio; MLR – monocyte lymphocyte ratio
Generalized linear model was used for comparison and age was included as a covariate.

CRP levels for investigating the etiopathogenesis of inflammation in psychiatric diseases.

Previous studies indicate that stress induces a release of cytokines and enzymes from PLT, which decreases the PLT count. Moreover, the MPV, PDW, and apoptosis may increase, thereby contributing to inflammation (Camacho and Dimsdale 2000; Tzura *et al*. 2019; Asoglu *et al*. 2016). The change in PLT activity in psychiatric diseases can be used as a peripheral marker and may be associated with mortality in these patients (Karatas *et al*. 2021; Camacho and Dimsdale 2000; Asoglu *et al*. 2016). PLT count decreases in patients with schizophrenia (37). Some studies reported that there were changes in PLT serotonin levels in patients with mood disorders, and these levels may be used as a marker for increased cardiovascular mortality, especially in patients with DD (Camacho and Dimsdale 2000). The PLT count decreases and PDW increases in patients with OCD (Karatas *et al*. 2021). Increased MPV in patients with BD has been associated with inflammation (Mert and Terzi 2016). The results of this study showed that the changes in the levels of various markers showing PLT activity in all disease groups support the inflammatory etiopathogenesis and that PLT activity may be a useful marker of prognosis; thus, it should be monitored in patients with psychiatric diseases.

Recent studies have investigated the PLR (Mazza *et al*. 2019; Balta *et al*. 2013), which is affected least by external factors, and have evaluated it together with NLR as another inflammatory and prognostic marker (39). NLR and PLR levels are associated with the severity of disease in patients with schizophrenia, BD, DD, and OCD (Mazza *et al*. 2019; Karatas *et al*. 2021; Kulaksizoglu and Kulaksizoglu 2016). The NLR and PLR were high in patients with schizophrenia (Moody and Miller 2018; Kulaksizoglu and Kulaksizoglu 2016). In addition, recent studies show that monocyte counts and MLR obtained using a hemogram are prominent markers of inflammation in psychiatric diseases (Karatas *et al*. 2021). Monocyte activation may be a marker of inflammation in patients with DD (Sunbul *et al*. 2016). Furthermore, monocyte count increased in patients with BP, DD, and schizophrenia (Mazza *et al*. 2019). It had been reported that the MLR increased in patients diagnosed with OCD for the first time, which supports the inflammatory etiopathogenesis of this disease and may be used in determining the disease severity (Karatas *et al*. 2021). The results of this study indicate that increased MLR levels in patients with DD may be an important marker in studies on the etiopathogenesis of psychiatric diseases. The study results showed that parameters such as NLR, PLR, and MLR are associated with schizophrenia and DD. These parameters can be easily determined during a routine examination and can be obtained using an inexpensive method such as a hemogram.

Anemia is very common in patients with chronic psychiatric diseases (Wysokinski and Szczepocka 2018). Previous studies reported that anemia was more common in patients with schizophrenia than patients with other psychiatric diseases, which was associated with increased mortality (Wysokiński and Szczepocka 2018; Barshtein *et al*. 2004). Some studies have emphasized the relationship between disease severity and the degree of anemia in patients with DD (Karataş *et al*. 2020; Alves de Rezende *et al*. 2019). Macrocytic anemia is frequently reported in patients with BD (Wysokiński and Szczepocka 2018); however, some studies reported a decrease in the Hb and Hct levels during the bipolar manic period and an increase in these levels during the depressive period (Hochman *et al*. 2014). Similarly, the results of this study showed that there was a decrease in Hb and Hct levels in all disease groups, and an increase in MCV and MCH levels in the patients with schizophrenia and BD. An advantage of this study is that it was conducted on patients with different psychiatric diseases; thus, hematological data from these patients could be compared. However, whether the changes in blood parameters play a role in the etiopathogenesis or whether chronic psychiatric diseases cause anemia has yet to be clearly explained.

Studies on the etiopathogenesis underlying the inflammatory process in psychiatric diseases showed that PCT levels increased in schizophrenia patients and that PCT is a more sensitive marker than CRP (Buhaescu *et al*. 2010; Miller *et al*. 2014). Barbosa *et al*. reported that there was an increase in PCT levels in two out of 10 (14%) patients with BD who were in the manic period, but no change was reported in patients in the euthymic period, which was interpreted as the inability of low-grade inflammation to significantly affect PCT levels in patients with BD (Aydemir and Köroğlu 2012). Another study reported that PCT levels of patients with BD increased (Mert and Terzi 2016).

A previous study found that PCT levels did not increase in patients with schizophrenia who were taking any antipsychotic medication and treatment doses were equaled with mean (stan-

dard deviation) 383.1 mg cholorpromazine. The study's explanation for the absence of increased levels of PCT levels in chronic schizophrenia is that most cytokines capable of modulating the transcription process of PCT tend to normalize according to the chronicity of the disease and the use of antipsychotics (de Campos *et al*. 2015).

Another inflammatory etiopathogenesis study showed that the PCT levels were significantly higher in patients with schizophrenia who did not take medication than in those in the control group (Buhaescu *et al*. 2010).

In our study, it is important to note that PCT is affected in patients with chronic psychiatric disease who have not received regular treatment for the last 3 months.

As stated in the previous study, although PCT is thought to be affected in schizophrenia patients with regular antipsychotic use and duration of illness, the larger sample size indicates that controlled and prospective studies are needed in patients diagnosed for the first time.

We found that increased PCT levels were associated with the disease in patients with anxiety disorder and DD, which supports the inflammatory etiopathogenesis of the diseases. Another advantage of this study is that increased PCT levels were reported in patients with different psychiatric diseases such as anxiety disorder and DD for the first time besides schizophrenia and BD.

Limitations

This study had certain limitations: 1. The most important limitation was that it did not include any male patients because only female patients were followed up in the inpatient service. 2. A smaller number of patients met the inclusion criteria; therefore, this study had a small sample size. 3. Since this was a retrospective, clinical follow-up study, only the available tests in patient follow-ups were evaluated. 4. Also, only BPRS was used in the clinical follow-up of patients with schizophrenia, and the Positive and Negative Syndrome Scale was not used. 5. The duration of illness was not recorded in the file scans.

Conclusions

A positive correlation was observed between decreasing PLT counts and schizophrenia, BD, DD, and anxiety disorder. Significant differences in PLR of schizophrenia patients and MPV of BD patients were found, and this result suggests that PLT activity can be used as a parameter in schizophrenia, BD, DD, and anxiety disorder. There is a relationship between the increase in MLR and PCT values in patients with DD, and the increase in PCT levels in anxiety disorder and the diseases. To our knowledge, this is the first study to report these observations in patients with psychiatric diseases.

Disclosure

The authors declare no conflict of interest.

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