DOI: 10.4149/BLL_2022_067

Bratisl Med J 2022; 123 (6)
435 – 439

CLINICAL STUDY

Evaluation of inflammatory parameters in patients who attempted suicide by taking drugs

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ABSTRACT

OBJECTIVES: Neutrophil/lymphocyte ratio (NLR), platelet/lymphocyte ratio (PLR) and mean platelet volume (MPV) are markers reflecting the inflammation process that can be easily calculated in the hemogram examination. In this study, we aimed to investigate the changes in NLR, PLR and MPV values in patients who attempted suicide by taking drugs.

METHODS: In total, 124 patients who were admitted to the emergency department after attempting suicide by taking drugs and who were followed up in the internal medicine department for observation purposes for 24–72 hours were included in the study. The study was retrospective and the data of the patients were recorded by scanning the hospital automation system. The NLR, PLR and MPV of the patients at the time of admission to the emergency department and at the time of discharge were evaluated and compared with each other.

RESULTS: The NLR and PLR values of the patients at admission were found to be significantly higher than those values at discharge. In our study, NLR and PLR values were found to be high during the period when patients attempted suicide.

CONCLUSION: The high detection of these markers of inflammation suggests that it may be a marker predictive of suicide attempt by taking medication *(Tab. 4, Ref. 28).* Text in PDF *www.elis.sk*

KEY WORDS: inflammation, MPV, neutrophil/lymphocyte ratio (NLR), platelet/lymphocyte ratio (PLR), suicide attempt by taking drugs.

Introduction

Suicide is an attempt to kill oneself, most often as a result of mental illness. Suicide is an important public health problem. According to the 2017 update of the World Health Organization, it has been reported that 800,000 people die due to suicide every year worldwide. Three important concepts related to suicide are completed suicide, attempted suicide and suicidal ideation (1). Studies show that people with suicidal ideas or attempts have inflammatory changes in their blood and cerebrospinal fluids (2–5). It has been stated that inflammatory factors may be the target of future treatments and interventions. It has also been stated that these factors may play a role as biomarkers in determining the risk of suicide and reflecting the severity of symptoms (6).

NLR and PLR are clinical biomarkers of inflammation that are both cost-effective and easily obtainable from the circulatory system (7, 8). In addition, NLR has been associated with suicidal behavior and various factors including chronic stress and impulsivity. In the study of Ekinci et al., they suggested that NLR may be a trait marker for suicidal tendency in patients diagnosed with major depressive disorder (9). It has also been stated that NLR may be useful in predicting the risk of suicide attempt in some subgroups of patients with bipolar disorder (10).

In this study, we aimed to investigate the relationship between suicide attempts and inflammation markers NLR, PLR and MPV in patients who attempted suicide by taking drugs, regardless of their psychiatric diagnosis.

Method

Procedure

Ethics committee approval was obtained from the Erzincan Binali Yildirim University Clinical Research Ethics Committee with the decision number 13/13, dated 06/12/2021. The study is retrospective, cross-sectional and descriptive. The population of the study consisted of patients aged between 18–65 years, who attempted suicide by taking drugs and applied to the Erzincan Binali Yildirim University Mengücek Gazi Training and Research Hospital emergency service and were followed up in the internal

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medicine service for 24–72 hours afterward, while excluding the patients who have taken a high dose of medication for the purpose of treatment, i.e. without suicidal ideation, patients who accidentally used a high dose of medication, patients who attempted suicide in a way other than by taking drugs, those who used alcohol and/or psychoactive substances concurrently with their suicide attempt, those who have a disease that may affect inflammation markers (acute or chronic endocrinological, inflammatory, infectious, or autoimmune diseases), those who use drugs that affect the bone marrow, patients who were evaluated by a psychiatrist at discharge and whose suicidal ideation continues, and those who did not have hemogram parameters during hospitalization/discharge. In total, 124 patients were included in the study. The data of the patients (age, gender, drug use information, sociodemographic data) were obtained from the automation system of the hospital.

The hemogram parameters of the patients at the time of admission and at the time of discharge after 24–72 hours were compared with each other by calculating the NLR and PLR values. NLR was obtained by dividing the neutrophil count by lymphocyte count. PLR was obtained by dividing the platelet count by lymphocyte count.

Statistical analysis

For statistical analysis, SPSS Statistics 23 (IBM Corporation, NY, US) was used. Kolmogorov-Smirnov and Shapiro-Wilks tests were used to determine the suitability of parameters for normal distribution. Descriptive statistical methods including percentage and mean ± standard deviation (±SD) or median (interquartile range (IQR)) were used to provide the basic characteristics of the data according to the evaluation of the normality distribution. For the purpose of comparing the two groups, Student's t test was used to evaluate the data showing normal distribution, and Mann-Whitney U test was used to evaluate the data not showing normal distribution. When comparing hematological parameters at the time of admission to the emergency department and discharge, the data with normal distribution were evaluated by means of the paired samples T-test, and data without normal distribution were evaluated with the use of the Wilcoxon signed-ranked test. The correlation analysis of NLR, PLR, and MPV values was performed with Spearman's correlation test. The statistical significance level was accepted at the level of $p < 0.05$.

Results

In total, 124 patients (42 male (33.8 %), 82 female (66.2 %)) were included in the study. The mean age of the patients was 29.26 ± 10.48 years. Analysis showed that 48.3 % of the patients were married and 51.7 % were single. The proportion of those who had a history of suicide attempts before was 9.6 % (n = 12) (Tab. 1).

Out of those who attempted suicide by taking drugs, 20.1 % had a previous psychiatric diagnosis. These psychiatric diagnoses were seen as anxiety disorder, major depressive disorder, bipolar disorder, schizophrenia and obsessive compulsive disorder. The majority of the patients (79.9 %) had no previous psychiatric diagnosis. Drug groups taken for suicidal purposes were listed as psychotropic drugs (antipsychotics, antidepressants, benzodiazepines, or mood stabilizers; 37.9 %), analgesic drugs (24.2 %), antibiotics (11.3 %) and other drugs (26.6 %) (Tab. 2).

Tab. 1. Sociodemographic characteristics of the patients.

		All patients (n=124)
Age		29.26±10.48*
Sex	Man (n,%)	42 (33.8%)
	Woman (n,%)	82 (66.2%)
Marital status	Married (n,%)	64 (51.7%)
	Single (n,%)	60 (48.3%)
History of suicide attempts	Yes (n,%)	12 (9.6%)
	No (n,%)	112 (90.4%)

* Data are presented as mean ± standard deviation (SD)

Tab. 2. Psychiatric diagnostic characteristics and suicidal drug groups.

Psychiatric diagnosis status	Number of patients
With previous psychiatric diagnosis	25 (20.1%)
Anxiety disorder	12
Major depressive disorder	9
Bipolar disorder	2
Schizophrenia	1
Obsessive compulsive disorder	1
Without previous psychiatric diagnosis	101 (79.9%)
Drug groups taken for suicidal purposes	**Number of patients**
Psychotropic drugs (antipsychotics, antidepressants, benzodiazepines, mood stabilizers)	47 (37.9%)
Analgesic drugs	30 (24.2%)
Antibiotics	14 (11.3%)
Other drugs	33 (26.6%)

The leukocyte, erythrocyte, platelet, and neutrophil counts, NLR, PLR, hemoglobin and hematocrit levels, as well as MCHC and PCT values that were taken at admission were found to be statistically significantly higher as compared to the those taken at the discharge of the patients who attempted suicide ($p < 0.05$). MCV, MPV, and RDW values and eosinophil counts at admission were statistically significantly lower than those taken at at the time of discharge ($p < 0.05$). There was no significant difference between admission and discharge values of MCH, RDW, lymphocyte, monocyte and basophil values of the patients (Tab. 3).

While there was a significant positive correlation ($r = 0.577$; $p < 0.001$) between NLR and PLR at admission, no significant correlation was found between NLR and MPV ($r = 0.097$; $p > 0.05$) with PLO and MPV ($r = -0.118$; $p > 0.05$) (Tab. 4).

Discussion

The leukocyte, erythrocyte, platelet, and neutrophil counts, NLR, PLR, hemoglobin and hematocrit levels, MCHC,and PCT values were found to be significantly higher at the time of admission as compared to those taken at discharge of the patients who attempted suicide. The MCV, MPV, RDW values and eosinophil counts of the patients at admission were significantly lower than

Tab. 3. Comparison of hemogram parameters taken at emergency admission and in the discharge period.

Hemogram parameters	Admission	Discharge	p
Leukocyte (10^3/uL)	8.75 (7.02–11.27)†	7.10 (6.10–8.60)†	**<0.001**[a]
Erythrocyte (10^6/uL)	4.91±0.54*	4.53±0.54*	**<0.001** [b]
Hematocrit (%)	42.17±4.79*	39.35±4.71*	**<0.001** [b]
Hemoglobin (g/dL)	14.00 (12.60–15.60)†	12.80 (11.70–14.57)†	**<0.001**[a]
MCV (fL)	85.85 (83.27–89.50)†	86.98±5.69*	**<0.001**[a]
MCH (pg)	29.25 (27.40–30.40)†	29.25 (27.50–30.40)†	0.603[a]
MCHC (g/dL)	33.30 (32.60–34.50)†	33.17±1.39*	**<0.001**[a]
RDW (%)	13.15 (12.40–14.27)†	13.00 (12.40–14.17)†	0.660[a]
Platelet (10^3/uL)	264.50 (214.00–309.75)†	234.71±57.32*	**<0.001**[a]
MPV (fL)	9.80 (9.00–10.30)†	9.80±1.15*	**<0.001**[a]
PCT (%)	0.26 (0.20–0.30)†	0.23 (0.18–0.26)†	**0.001**[a]
PDW (%)	11.60 (10.72–13.77)†	12.00 (10.60–13.80)†	**0.017**[a]
Neutrophil (10^3/uL)	5.47 (4.15–7.84)†	3.91 (3.06–5.28)†	**<0.001**[a]
Lymphocyte (10^3/uL)	2.42±0.94*	2.36±0.69*	0.467[b]
NLR	2.23 (1.58–3.72)†	1.84 (1.25–2.52)†	**<0.001**[a]
PLR	106.86 (84.64–153.72)†	99.57 (81.24–122.76)†	**0.006**[a]
Monocytes (10^3/uL)	0.58±0.21*	0.57 (0.45–0.68)†	0.696[a]
Eosinophil (10^3/uL)	0.09 (0.04–0.16)†	0.17 (0.09–0.25)†	**<0.001**[a]
Bazophil (10^3/uL)	0.03 (0.02–0.05)†	0.03 (0.02–0.04)†	0.104[a]

[a]Wilcoxon Signed-Ranked Test, [b]Paired samples t-test, † Data are presented as median (interquartile range (IQR))
* Data are presented as mean ± standard deviation (SD)

Tab. 4. Correlation analysis between NLR, PLR and MPV.

	Inflammation markers	Correlation coefficient(r)	p*
Correlation	NLR-PLR	0.577	**<0.001**
	NLR-MPV	0.097	0.283
	PLR-MPV	–0.118	0.194

* Spearman correlation test used

those at discharge. There was no significant difference between the admission and discharge values of MCH, RDW, lymphocyte, monocytes and basophils.

NLR and PLR parameters are useful and inexpensive inflammatory markers that can be easily measured from peripheral blood (11). It has been shown that changes in NLR are associated with factors that may increase the risk of suicide (12). It has been shown that there is a relationship between suicidal tendency and NLR in patients with major depression (9). Gundogdu Meydaneri et al showed that NLR values were significantly higher in patients with major depression who had attempted suicide than those who did not (13). It has been shown that NLR value is significantly associated with suicidal behavior (14). Orum et al found that the relationship between severe suicide attempt and NLR was higher than the relationship between non-severe suicide attempt and NLR (15). The fact that in our study, we found a significantly higher NLR value in the suicidal period of people who attempted suicide by taking drugs regardless of their diagnosis, seems to be very important both in a more specific group and in terms of comparing different periods of the same patients.

Aguglia et al found the PLR value to be significantly higher in the highly severe suicide attempt group than in other two groups, namely in the group with cases of less severe suicide attempt and in the psychiatric control group, but they observed no significant difference between the less severe suicide attempt group and the psychiatric control group (16). In our study, it was found that PLR values were significantly higher in the suicidal periods compared to the nonsuicidal period of the same individuals. This suggests that PLR may be effective in determining the risk of suicide in individuals with a less severe suicidal behavior such as suicide by taking drugs. In a very recent study, it was found that the PLR value is high in relation to the risk of suicide (17).

MPV is considered a marker of platelet activity. This marker was found to be significantly higher in highly lethal suicide attempts and significantly lower in non-severe suicide attempts, and this low was shown to be inversely proportional to the platelet count (12). In another study by Orum et al, the MPV value was found to be significantly higher in the group with severe suicide attempts as compared to the group with non-severe suicide attempts and control group (15). In another study, it was shown that the MPV values in patients who attempted suicide were significantly higher than in the healthy control group (18). In our study, we found that the MPV value of the patients in the suicidal period was significantly lower than in their non-suicidal periods. This situation can be explained by the fact that the attempt to commit suicide by taking drugs in our study was a non-severe suicide attempt.

In our study, we found a significantly positive correlation between NLR and PLR markers. In previous studies, it has been shown that high levels of these two values are frequently present together as inflammation markers (11, 14, 16). However, we could not find any study that looked into the correlation between the two. In this aspect, it may be very meaningful to consider these two markers together in studies.

It is seen in the literature that most of the patients who attempt suicide by taking drugs are young. In a study investigating the characteristics of people who attempted suicide by taking drugs, the mean age was shown to be 22 ± 4.6 years (19) In our study, the mean age of those who attempted suicide by taking drugs was 29.26 ± 10.48 years and mostly consisted of young patients, which was consistent with the literature. In our study, male and female ratios were 33.8 % and 66.2 %, respectively. Previous studies have shown that the overall rate of suicide is higher in males than in females, yet there are a few countries where it is higher in women. At the same time it has also been shown that suicide attempts specifically by means of taking drugs are more common in women (20–22). Marriage generally appears to be a protective factor for suicide. It has been stated that the rate of suicide is higher in single people (23). In our study, 48.3 % (n = 60) of the patients were married and 51.7 % (n = 66) were single. In our study, the rate of those who had a previous suicide attempt was 9.6 % (n = 12). Different rates of results are seen in the literature. It is known that having a history of suicide attempt in

the past increases the risk of suicide. In a study, it was reported that those who attempted suicide with drugs had a higher history of suicide attempts than those who attempted suicide with other methods, and this rate was high (about 70 %) (21). In another study, it was shown that 23 % of the people who attempted suicide by taking drugs had a history of suicide attempts (19).

Out of these people who attempted suicide, 20.1 % (n = 25) had a previous psychiatric diagnosis. These psychiatric diagnoses were seen as anxiety disorder (n = 12), major depressive disorder (n = 9), bipolar disorder (n = 2), schizophrenia (n = 1) and obsessive-compulsive disorder (n = 1). The study showed that 79.9 % (n = 101) of the patients had no previous psychiatric diagnosis. Mood disorders (especially major depression) are stated in literature as the main mental disorder among those who attempt suicide (24). In another study, it was shown that 32.3 % of those who attempted suicide had at least one psychiatric diagnosis, while major depressive disorder (18.6 %) was found to be the most common diagnostic group (25). It is noteworthy that in our study, the most frequent diagnosis group among those who attempted suicide was anxiety disorder. This can be explained by the fact that in our study there were only patients who attempted suicide by taking drugs, and there was no group of subjects who attempted a more severe suicide.

Drug groups taken for suicidal purposes are as follows: psychiatric drugs (antidepressants, antipsychotics, mood stabilizers, benzodiazepines; 37.9 %), analgesic drugs (24.2 %), antibiotics (11.3 %) and other drugs (26.6 %) (Tab. 2). The rates of drugs taken for suicidal purposes differ in studies. In a study on completed suicide with high-dose drug intake, it was shown that approximately 30 % of subjects used analgesics, 15 % used antidepressants, and 15 % used sedative-hypnotic drugs (26). In a study conducted in Switzerland with completed suicide cases, the rate of suicide with psychotropic drugs was 78.7 % among all drugs, and it was reported that benzodiazepines were the most common ones (27). In a study conducted in Ireland, high-dose drug groups were listed as analgesics (32.4 %), antidepressants (21.9 %), anxiolytics (21.2 %), and sedative-hypnotic drugs (21.0 %) (28). These studies show us that there are great similarities in the drug groups taken.

In addition to being the first study in the literatüre in terms of comparing the suicidal and non-suicidal periods data of the same patient group and examining the group who attempted suicide only by taking drugs, our study has some limitations. These include the fact that the potential effect of taken drugs on hemogram parameters has not been fully isolated, the possible effect of the diseases of a group of people with a previous psychiatric illness on inflammation, and the absence of a healthy control group in the study.

In conclusion, the study suggests that NLR, PLR and MPV values can be used as predictive markers for the risk of attempting suicide by taking drugs, regardless of the diagnosis. If it is supported with other studies that will be done in the future, it is possible that it can guide the clinician in the follow-up of patients for suicide.

References

1. Cullberg J, Wasserman D, Stefansson CG. Who commits suicide after a suicide attempt? An 8 to 10 year follow up in a suburban catchment area. Acta Psychiatr Scand 1988; 77 (5): 598–603.

2. Black C, Miller BJ. Meta-analysis of cytokines and chemokines in suicidality: distinguishing suicidal versus nonsuicidal patients. Biol Psychiatry 2015; 78 (1): 28–37.

3. Janelidze S, Mattei D, Westrin Å, Träskman-Bendz L, Brundin L. Cytokine levels in the blood may distinguish suicide attempters from depressed patients. Brain Behav Immun 2011; 25 (2): 335–339.

4. Lindqvist D, Janelidze S, Hagell P et al. Interleukin-6 is elevated in the cerebrospinal fluid of suicide attempters and related to symptom severity. Biol Psychiatry 2009; 66 (3): 287–292.

5. O'Donovan A, Rush G, Hoatam G et al. Suicidal ideation is associated with elevated inflammation in patients with major depressive disorder. Depress Anxiety 2013; 30 (4): 307–314.

6. Falcone T, Fazio V, Lee C et al. Serum S100B: a potential biomarker for suicidality in adolescents? PloS One 2010; 5 (6): e11089.

7. Balta S, Ozturk C. The platelet-lymphocyte ratio: a simple, inexpensive and rapid prognostic marker for cardiovascular events. Platelets 2015; 26 (7): 680–681.

8. Zahorec R. Ratio of neutrophil to lymphocyte counts-rapid and simple parameter of systemic inflammation and stress in critically ill. Bratisl Med J 2001; 102 (1): 5–14.

9. Ekinci O, Ekinci A. The connections among suicidal behavior, lipid profile and low-grade inflammation in patients with major depressive disorder: a specific relationship with the neutrophil-to-lymphocyte ratio. Nord J Psychiatry 2017; 71 (8): 574–580.

10. Ivković M, Pantović-Stefanović M, Dunjić-Kostić B et al. Neutrophil-to-lymphocyte ratio predicting suicide risk in euthymic patients with bipolar disorder: Moderatory effect of family history. Compr Psychiatry 2016; 66: 87–95.

11. Kalelioglu T, Akkus M, Karamustafalioglu N et al. Neutrophil-lymphocyte and platelet-lymphocyte ratios as inflammation markers for bipolar disorder. Psychiatry Res 2015; 228 (3): 925–927.

12. Mazza MG, Lucchi S, Rossetti A, Clerici M. Neutrophil-lymphocyte ratio, monocyte-lymphocyte ratio and platelet-lymphocyte ratio in non-affective psychosis: A meta-analysis and systematic review. World J Biol Psychiatry 2020; 21 (5): 326–338.

13. Gundogdu Meydaneri G, Meydaneri S. Can Neutrophil Lymphocyte Ratio Predict the Likelihood of Suicide in Patients with Major Depression? Cureus 2018; 10 (4): e2510.

14. Velasco Á, Rodríguez-Revuelta J, Olié E et al. Neutrophil-to-lymphocyte ratio: A potential new peripheral biomarker of suicidal behavior. Eur Psychiatry 2020; 63 (1): e14.

15. Orum MH, Kara MZ, Egilmez OB. Mean platelet volume and neutrophil to lymphocyte ratio as parameters to indicate the severity of suicide attempt. J Immunoassay Immunochem 2018; 39 (6): 647–659.

16. Aguglia A, Amerio A, Asaro P et al. High-lethality of suicide attempts associated with platelet to lymphocyte ratio and mean platelet volume in psychiatric inpatient setting. World J Biol Psychiatry 2021; 22 (2): 119–127.

17. Puangsri P, Ninla-Aesong P. Potential usefulness of complete blood count parameters and inflammatory ratios as simple biomarkers of depression and suicide risk in drug-naive, adolescents with major depressive disorder. Psychiatry Res 2021; 305: 114216.

18. Yagci I, Avci S. Biochemical predictors in presentations to the emergency department after a suicide attemp. Bratisl Lek Listy 2021; 122 (3): 224–229.

19. Al-Jahdali H, Al-Johani A, Al-Hakawi A et al. Pattern and risk factors for intentional drug overdose in Saudi Arabia. Can J Psychiatry 2004; 49 (5): 331–334.

20. Bachmann S. Epidemiology of Suicide and the Psychiatric Perspective. Int J Environ Res Public Health 2018; 15 (7).

21. Mak KK, Ho CS, Zhang MW, Day JR, Ho RC. Characteristics of overdose and non-overdose suicide attempts in a multi-ethnic Asian society. Asian J Psychiatr 2013; 6 (5): 373–379.

22. Yasuda M, Kobayashi T. Suicide attempts by drug overdose at Jichi Medical University Hospital emergency centre: A study of patient characteristics and quantity of drug overdose. Asian J Psychiatr 2019; 41: 34–37.

23. Masocco M, Pompili M, Vichi M, Vanacore N, Lester D, Tatarelli R. Suicide and marital status in Italy. Psychiatr Q 2008; 79 (4): 275–285.

24. Bi B, Tong J, Liu L et al. Comparison of patients with and without mental disorders treated for suicide attempts in the emergency departments of four general hospitals in Shenyang, China. Gen Hosp Psychiatry 2010; 32 (5): 549–555.

25. Liu BP, Qin P, Liu YY, Yuan L, Gu LX, Jia CX. Mental disorders and suicide attempt in rural China. Psychiatry Res 2018; 261: 190–196.

26. Crome P. The toxicity of drugs used for suicide. Acta Psychiatr Scand Suppl 1993; 371: 33–37.

27. Michel K, Arestegui G, Spuhler T. Suicide with psychotropic drugs in Switzerland. Pharmacopsychiatry 1994; 27 (3): 114–118.

28. Daly C, Griffin E, Ashcroft DM, Webb RT, Perry IJ, Arensman E. Frequently used drug types and alcohol involvement in intentional drug overdoses in Ireland: a national registry study. Eur J Public Health 2018; 28 (4): 681–686.

Received December 31, 2021.
Accepted January 18, 2022.