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NONINVASIVE PREDICTORS (PLATELET-TO-LYMPHOCYTE AND NEUTROPHIL-TO-LYMPHOCYTE RATIOS) FOR RENAL INVOLVEMENT IN SYSTEMIC LUPUS ERYTHEMATOSUS IN CLINICAL PRACTICE

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Abstract

Background: Renal injury is a common complication of Systemic lupus erythematosus (SLE) and is associated with poor outcomes. However, a noninvasive method for predicting kidney dysfunction in clinical settings has not yet been established. As a result, the authors suggested that the platelet-to-lymphocyte ratio (PLR) and neutrophil-to-lymphocyte ratio (NLR) could serve as reliable noninvasive indicators of renal impairment.

Aim of the Study: To study the role of Platelet-to-lymphocyte and Neutrophil-to-lymphocyte ratios as non-invasive predictors of renal involvement in Systemic Lupus Erythematosus. To compare the PLR and NLR levels, along with other renal parameters and lupus markers.

Materials: A prospective, cross-sectional study was conducted by investigating 63 patients diagnosed with SLE; the patients being divided in to four groups. 31 patients with lupus nephritis (LN) diagnosed via renal biopsy, 12 active lupus patients without renal involvement, 10 lupus patients in remission, and 60 healthy controls. The authors measured PLR and NLR levels, along with other renal and lupus markers.

Results: The results have shown that PLR and NLR had significantly higher levels in active lupus patients as in biopsy-proven LN in comparison to inactive systemic lupus erythematosus and control groups. NLR was positively correlated with serum creatinine in patients with LN; however, they did not show significant association with other predictors of renal diseases. The study demonstrated that PLR and NLR had significant association to advanced classes of LN. Furthermore, the receiver-operating characteristic curve showed a higher sensitivity of PLR in early detection of kidney function impairment in LN patients (88.9%) while NLR showed more specificity (87.5%).

Conclusion: PLR and NLR could act as noninvasive markers for detection of renal involvement in lupus patients in health clinics as for the prediction of renal pathological class.

Keywords: Lupus nephritis, Neutrophil to lymphocyte, platelet to lymphocyte, SLE

INTRODUCTION:

Lupus erythematosus is a chronic autoimmune disorder characterized by the production of auto-antibodies against cytoplasmic and nuclear antigens. It is associated with multisystem inflammation, diverse clinical manifestations, and a relapsing-remitting course [1]. The disease can affect various systems, including the renal, pulmonary, dermatological, and musculoskeletal systems. Lupus nephritis (LN) affects more than 50% of individuals with systemic lupus erythematosus (SLE) and often leads to chronic kidney damage, eventually resulting in dialysis or kidney transplantation, which increases the risk of mortality [2,3]. Currently, renal biopsy remains the gold standard for

diagnosing LN and detecting flare-ups. While traditional markers like complement deficiencies and anti-dsDNA antibodies are commonly used to monitor lupus activity, their specificity is often limited, making them more effective in confirming a diagnosis when clinical suspicion is present [5]. In the context of systemic inflammation, white blood cell counts often show specific changes, such as decreased lymphocyte levels and increased neutrophil counts [6]. These changes in peripheral blood cell components are used by clinicians to assess immunological activity in both autoimmune and non-autoimmune conditions [7,8]. However, simple, non-invasive laboratory markers for guiding the management of LN have yet to be established in clinical practice. Current traditional methods for rapid renal impairment assessment, such as kidney biopsies, remain invasive and limited. The platelet-to-lymphocyte ratio (PLR) and neutrophil-to-lymphocyte ratio (NLR) are components of the complete blood count (CBC) that have gained attention as potential biomarkers. NLR has been proposed as a valuable biomarker in various immunological disorders, such as inflammatory bowel disease [9], psoriasis [10], and Sjögren's syndrome [11]. PLR has been used to differentiate between multiple disorders and predict conditions like inflammatory diseases and cancer [12]. Research has also shown an association between NLR and disease activity in systemic lupus erythematosus (SLE) [8]. Consequently, the present study aimed to investigate the use of these hematological ratios as non-invasive, early indicators of lupus flares and kidney involvement in lupus erythematosus.

MATERIALS:

63 Patients diagnosed with Systemic lupus erythematosus who attended the Department of General Medicine, Kannur Medical College, Anjarakandy between September 2017 and April 2019 to study the role of Platelet-to-lymphocyte and Neutrophil-to-lymphocyte ratios as non-invasive predictors of renal involvement in Systemic Lupus Erythematosus. To compare the PLR and NLR levels, along with other renal parameters and lupus markers. An ethics committee approval from the Institute was obtained before commencing the study. An ethics committee approved consent form was used for the study and also to collect the data. The 63 patients were divided three groups based on two parameters: 31 patients were diagnosed with lupus nephritis (LN) through renal pathological examinations, clinical findings, and laboratory results. The remaining 32 patients were further classified into two groups based on their SLE Disease Activity Index (SLEDAI) score [13]. Those with an SLEDAI score of 4 or lower were considered to have inactive disease (12 participants), while those with an SLEDAI score greater than 4 were considered to have active disease (10 participants). The LN group was further categorized into five classes according to the WHO classification [14], with the majority being in class III and IV (10 and 21 LN patients, respectively). In addition 60 healthy, matched individuals were included as the control group. The study aimed to explore the relationship between these hematological ratios and renal pathological classes in a clinical setting.

Inclusion Criteria: Patients aged between 25 years and 65 years were included. Patients of both the genders were included. Patients diagnosed with SLE and renal parameters satisfying the above criteria were included.

Exclusion Criteria: Patients aged below 25 years and above 65 years were excluded. Patients with CKD, Diabetes Mellitus and immuno-deficiency disease were excluded.

Laboratory Investigations: PLR and NLR were calculated based on the routine CBC test results. Additional tests included serum urea, serum creatinine, C-reactive protein (CRP), erythrocyte sedimentation rate (ESR), and protein levels from a 24-hour urine sample, following standard experimental protocols. Further complement activity (C3, C4) and anti-ds-DNA were evaluated using usual procedures. Statistical Analysis: SSPS version 20: IBM, Armonk New York was used for data collection and statistical analysis. Continuous data were presented as mean ± SD or median (range), while nominal variables were displayed as frequency (percentage). The $\chi 2$-test was used to compare nominal variables across different groups in the study, while the Student's t-test was applied to compare the means between two groups, and the analysis of variance (ANOVA) test was

used for comparisons involving more than two groups. The receiver operating characteristic (ROC) curve was employed to assess the diagnostic accuracy of NLR and PLR in identifying SLE and renal involvement in lupus patients. A confidence level of 95% was maintained, and a P-value of less than 0.05 was considered statistically significant.

RESULTS:

This study involved 63 SLE patients, and their demographic data are summarized in Table 1, which presents the baseline and laboratory characteristics of the participants. There were no significant differences in age or sex between the groups. Regarding renal involvement, patients with lupus nephritis (LN) showed a statistically significant increase in both proteinuria and serum creatinine levels compared to those with lupus erythematosus and healthy controls. Additionally, patients with renal involvement had significantly lower complement levels (C3 and C4) and higher CRP levels compared to healthy controls, although the CRP levels in the LN group remained lower than in the active SLE group (Table 1). PLR was significantly higher in SLE patients compared to controls (P = 0.01). Among the SLE groups, there was a statistically significant increase in PLR, with the highest ratio observed in the active SLE group, followed by the LN group, and the lowest in the SLE remission group. While NLR showed a non-significant increase (P = 0.2) in the SLE remission group compared to the control group, a significant increase in NLR was observed in the active SLE group, followed by the LN group, when compared to both the SLE remission and control groups.

Table 1 Demographic data of the study group (n-63; control group-60)

	SLE on remission [*n* (%)]	Active SLE [*n* (%)]	Lupus nephritis [*n* (%)]	Control [*n* (%)]	P_1	P_2	P_3	P_4	P_5	P_6
Number	31	10	21	60						
Age (years)	38.07±7.32	39.52±3.67	37.12±5.24	37.11±4.23	0.34	0.11	0.09	0.98	0.55	0.76
Sex										
Male	21 (33.33)	8 (12.69)	14 (22.22)	45 (75)	0.06	0.10	0.21	0.87	0.11	0.87
Female	10 (15.87)	2 (03.13)	07 (11.11)	15 (25)						
ESR (mm/h)	30.11±8.11	44.56±11.56	41.76±10.76	19.09±5.89	0.03	0.01	0.01	0.01	0.01	0.01
CRP (mg/l)	6.18±0.56	13.33±5.13	11.56±3.45	2.11±0.96	0.01	0.01	0.34	0.05	0.01	0.03
ANA (%) (number of +patients)	(83.3)	(89.3)	(86.3)	0	0.11	0.46	0.01	0.49	0.01	0.01
Anti-ds DNA (%)	(50)	(91.7)	(66.3)	0	0.02	0.56	0.01	0.49	0.02	0.01
C3	102 (80.9–120)	85.50 (45–114.25)	77.6 (42.2–107)	112 (96.9–130)	0.01	0.46	0.01	0.04	0.9	0.01
C4	22.50 (15.00–35.00)	18.9 (13.6–23.2)	18.1 (8.6–24.5)	23.2 (20.0–28.4)	0.01	0.5	0.02	0.05	0.10	0.01
Hemoglobin (g/dl)	11.97±4.65	11.67±2.76	11.98±4.44	12.76±1.87	0.45	0.14	0.39	0.40	0.10	0.09
Platelets ($\times 10^6$/ml)	274.11±34.08	243.76±56.7	250.40±34.98	275.98±44.44	0.52	0.12	0.21	0.34	0.43	0.24
TLC ($\times 10^6$/ml)	6.11±2.66	7.45±2.22	7.11±3.11	7.19±2.02	0.45	0.11	0.65	0.40	0.53	0.06
Neutrophil ($\times 10^6$/ml)	3.31±1.85	6.36±3.85	5.91±3.30	4.53±1.51	0.01	0.01	0.13	0.94	0.10	0.04
Lymphocytes ($\times 10^6$/ml)	1.78±0.83	0.65±0.37	1.17±0.73	2.23±0.69	0.02	0.01	0.02	0.89	0.01	0.03
Creatinine (mg/dl)	0.71±0.18	0.71±0.20	3.41±1.31	0.82±0.15	1.00	0.01	0.98	0.01	0.99	0.01
Proteinuria (9/day)	0.17±0.06	0.15±0.06	1.77±1.20	0.16±0.07	1.00	0.01	1.00	0.01	1.00	0.01
PLR	178.92±19.85	411.57±69.41	281.98±20.18	134.22±51.67	0.01	0.01	0.05	0.01	0.01	0.01
NLR	2.02±0.93	10.54±1.81	6.88±2.90	2.14±1.77	0.01	0.01	0.2	0.05	0.01	0.01

Data were presented as mean (SD) and frequency (percentage). A P-value of less than 0.05 was considered significant. The abbreviations used are as follows: ANA, antinuclear antibody; anti-dsDNA, anti-double-stranded DNA; CRP, C-reactive protein; ESR, erythrocyte sedimentation rate; LN, lupus nephritis. The comparisons are as follows: P1 compares the active SLE group with the SLE remission group; P2 compares the active SLE group with the lupus nephritis group; P3 compares the active SLE group with the control group; P4 compares the SLE remission group with the lupus nephritis group; P5 compares the SLE remission group with the control group; P6 compares the lupus nephritis group with the control group. SLE stands for systemic lupus erythematosus.

Correlations between Platelet-to-Lymphocyte Ratio and Neutrophil-to-Lymphocyte Ratio with Renal Impairment Markers in Lupus Nephritis Patients: To assess the relationship between PLR and NLR levels and diagnostic markers in lupus nephritis (LN), Spearman's correlation coefficients (r) were calculated. A significant positive correlation between NLR and serum creatinine, urea, and CRP, with no correlation found between NLR and 24-hour urinary proteins. Additionally, PLR showed a significant positive correlation only with CRP.

Relationship Between Platelet-to-Lymphocyte Ratio, Neutrophil-to-Lymphocyte Ratio, and Pathological Classes of Lupus Nephritis: Correlations Between Platelet-to-Lymphocyte Ratio and Neutrophil-to-Lymphocyte Ratio with Renal Impairment Markers in Lupus Nephritis Patients

To assess the relationship between PLR and NLR levels and diagnostic markers in lupus nephritis (LN), Spearman's correlation coefficients (r) were calculated. The data indicates a significant positive correlation between NLR and serum creatinine, urea, and CRP, with no correlation found between NLR and 24-hour urinary proteins. Additionally, PLR showed a significant positive correlation only with CRP.

Relationship between Platelet-to-Lymphocyte Ratio, Neutrophil-to-Lymphocyte Ratio, and Pathological Classes of Lupus Nephritis: The relationship between NLR and PLR and the different pathological classes in renal biopsies. Regression analysis in revealed that PLR, NLR, and 24-hour urinary proteins were significantly associated with the more advanced renal pathology stages in SLE patients.

Receiver-Operating Characteristic Analyses: The ROC analysis showed that an NLR cutoff value of greater than 3.8, with 98% sensitivity and 58% specificity, was optimal for predicting lupus activity. The typical PLR cutoff value was 190.5, showing 90% sensitivity and 58% specificity. For predicting renal involvement in SLE patients, the ROC/AUC analysis indicated a sensitivity of 88.9% for PLR and a specificity of 87.5% for NLR when a cutoff value of more than 2.83 was used for NLR. However, when the PLR cutoff value was set at 0.72, the sensitivity was 88.9%, with a specificity of 50%. **ROC Analysis for NLR and PLR in Predicting SLE Activity:** The optimal NLR cutoff value of more than 3.8 exhibited 98% sensitivity and 58% specificity [95% confidence interval (CI): 0.542–0.875, P = 0.024]. The ideal PLR cutoff value of more than 190.5 showed 90% sensitivity and 58% specificity (CI: 0.614–0.911, P = 0.005). **ROC Analysis of PLR and NLR for Predicting Renal Involvement in Lupus Patients:** The ROC/AUC analysis demonstrated 83.3% sensitivity and 87.5% specificity when a cutoff value of more than 2.83 was applied for NLR (95% CI: 0.594–0.901, P = 0.007). In contrast, when the cutoff value for PLR was more than 111.3, the sensitivity was 88.9% and the specificity was 50%.

DISCUSSION:

Our study found that both PLR and NLR were significantly higher in SLE patients with renal involvement compared to healthy controls and, unexpectedly, also compared to SLE patients in remission without renal involvement. Notably, both ratios were significantly elevated in active lupus patients compared to those in remission. Additionally, we observed that NLR correlated with kidney

function markers (serum creatinine and urea) and CRP (an acute-phase reactant). Another interesting finding was the negative correlation between PLR and C4 levels. Moreover, our study revealed a statistically significant association between both ratios and the WHO renal pathological classes of lupus nephritis (LN), which are crucial for diagnosing LN and evaluating the degree of kidney damage. Importantly, both ratios were notably elevated in advanced pathological stages. Based on ROC analysis and the correlations between PLR, NLR, and renal markers, we concluded that PLR and NLR are promising non-invasive biomarkers for assessing renal involvement in SLE. Specifically, an NLR cutoff value of more than 3.8 and a PLR cutoff of more than 190.5 were found to predict SLE activity, with the highest accuracy for predicting LN at an NLR value of 2.83, showing 83.3% sensitivity and 87.5% specificity. As is well known, CBC is a routine, simple, and cost-effective laboratory test that includes blood cell counts, primarily platelets, red blood cells, and white blood cells. Neutrophils, which play key roles in inflammation and immune disorders, are the most abundant white blood cells in healthy individuals. Systemic inflammation often results in changes in the blood composition, including neutrophilia, lymphopenia, and anemia. In recent years, levels of neutrophils, lymphocytes, and platelets have been identified as important markers of inflammation in a variety of conditions. NLR has been used alongside other inflammatory markers to predict systemic inflammation in both autoimmune and non-autoimmune diseases. PLR has been assessed in patients with various medical conditions, including chronic inflammatory disorders, cardiovascular diseases, myeloproliferative disorders, malignancies, and infections. Lupus, an ongoing autoimmune disorder, is characterized by relapsing-remitting patterns, and its associated comorbidities can be better managed with early detection of flare-ups. Given that renal involvement is a major determinant of poor outcomes in SLE, timely prediction and management of LN are crucial for SLE patients. Therefore, the goal of our study was to evaluate the potential role of both hematological ratios (NLR and PLR) as indicators of SLE activity and renal involvement in clinical settings. Our findings suggest that PLR and NLR can serve as reliable and easily measurable markers for renal involvement in SLE. These results align with those of Qin et al. [8], who also observed elevated levels of PLR and NLR in SLE patients. In contrast to healthy controls, patients with lupus exhibited higher NLR levels, which were positively correlated with CRP, ESR, and the SLEDAI score. PLR, on the other hand, showed a positive correlation with the SLEDAI score. Additionally, an NLR cutoff of 2.06 was identified as predictive for diagnosing SLE, while an NLR cutoff of 2.66 was found to predict lupus nephritis (LN). However, no cutoff value for PLR was determined for predicting LN, as the AUC values were below 0.7. This differs from our findings, where we demonstrated that PLR could predict LN, with a cutoff value of 111.3, achieving a sensitivity of 88.9% and specificity of 50%. This discrepancy may be explained by the elevated serum creatinine levels observed in the advanced stages of LN, which are associated with higher PLR and NLR levels [18]. Wu et al. [19] also reported increased PLR and NLR levels in SLE patients compared to healthy controls. Both ratios were significantly associated with the SLEDAI-2K, and NLR alone was notably elevated in LN. The best NLR cutoff for predicting severe disease in SLE patients was found to be 2.26, with 75% sensitivity and 50% specificity. Meanwhile, the optimal PLR cutoff for severe disease was 203.85, with 42.3% sensitivity and 83.9% specificity. Similarly, Ayna et al. [20] observed a significant increase in NLR in LN patients compared to SLE patients without renal involvement. These findings align with our results. Furthermore, we documented a positive correlation between CRP and NLR in the LN group. Ayna et al. [20] also found that an NLR cutoff of 1.93 had 83% sensitivity and 54% specificity for distinguishing lupus patients with nephritis from those without. In other studies, Oehadian et al. [21] reported that an NLR cutoff of ≥1.93 had 70% sensitivity and 67% specificity for identifying lupus patients versus healthy controls. Hematological abnormalities are common in lupus patients, including reductions in red blood cells, white blood cells, and platelets, which may result from bone marrow suppression or increased peripheral cell destruction. Decreased white blood cell counts in lupus are often due to a drop in lymphocytes and/or neutrophils. Neutropenia is frequently observed in lupus and is mediated by antineutrophil antibodies. Other factors contributing to hematological abnormalities in

lupus patients include infections and medications [22, 23]. Interestingly, NLR was found to increase progressively with the progression of renal disease [24, 25]. A key takeaway from our study is that both PLR and NLR can be easily measured from routine CBC tests in health clinics. These ratios are cost-effective and simple compared to other inflammatory biomarkers. Additionally, they are relatively stable, as changes in leukocyte counts due to dehydration, rehydration, or diluted blood samples can be accounted for, making them suitable for predicting renal involvement and assessing renal pathological classes in LN. However, there are some limitations to our study, including the relatively small sample size, which may affect the generalizability of our findings. Additionally, the impact of drug therapy on PLR and NLR was not explored. In conclusion, our study provides statistical evidence supporting the use of PLR and NLR as inflammatory biomarkers for estimating lupus flare, as both ratios correlate with the SLEDAI score. Most importantly, the simplicity and feasibility of using these hematological ratios make them valuable tools for early prediction of renal involvement in lupus patients in clinical settings, as they correlate with renal markers in SLE and are linked to various histological stages of LN.

REFERENCES

1. Putterman C, Caricchio R, Davidson A, Perlman H. Systemic lupus erythematosus. Clin Dev Immunol 2012; 12:437282.
2. Gaballah NM, El-Najjar AR. Clinical characteristics and health related quality of life (HRQoL) in Egyptian patients with systemic lupus erythematosus. Egypt Rheumatol 2019; 41:117–21.
3. Bertsias GK, Tektonidou M, Amoura Z, Aringer M, Bajema I, Berden JH, *et al.* Joint European League Against Rheumatism and European Renal Association European Dialysis and Transplant Association (EULAR/ ERA-EDTA)recommendations for the management of adult and pediatric lupus nephritis. Ann Rheum Dis 2012; 71:1771–82. 5.
4. Giannico G, Fogo AB. Lupus nephritis: is the kidney biopsy currently necessaryin the management of lupus nephritis?. Clin J Am Soc Nephrol 2013; 8:138–45.
5. Donnelly S, Roake W, Brown S, Young P, Naik H, Wordsworth P, *et al.* Impairedrecognition of apoptotic neutrophils by the C1q/ calreticulin and CD91 pathwayin systemic lupus erythematosus. Arthritis Rheum 2006; 54:1543–56.
6. Soliman W, Sherif N, Ghanima IM, El-Badawy MA. Neutrophil to lymphocyte and platelet to lymphocyte ratios in systemic lupus erythematosus: relation with disease activity and lupus nephritis. Reumatol Clin 2018; 27: S1699.
7. Mercan R, Bitik B, Tufan A, Bozbulut UB, Atas N, Ozturk MA, *et al.* The association between neutrophil / lymphocyte ratio and disease activity in rheumatoidarthritis and ankylosing spondylitis. J Clin Lab Anal 2016; 30:597–601. 13
8. Qin B, Ma N, Tang Q, Wei T, Yang M, Fu H, *et al.* Neutrophil to lymphocyte ratio (NLR) and platelet to lymphocyte ratio (PLR) were useful markers in assessmentof inflammatory response and disease activity in SLE patients. Mod Rheumatol 2016; 26:372–6.
9. Celikbilek M, Dogan S, Ozbakır O, Zararsız G, Kücük H, Gürsoy S, *et al.* Neutrophil–lymphocyte ratio as a predictor of disease severity in ulcerativecolitis. J Clin Lab Anal 2013; 27:72–6.
10. Sen BB, Rifaioglu EN, Ekiz O, Inan MU, Sen T, Sen N. Neutrophil to lymphocyteratio as a measure of systemic inflammation in psoriasis. Cutan Ocul Toxicol 2014; 33:223–7.
11. Hu ZD, Sun Y, Guo J, Huang YL, Qin BD, Gao Q, *et al.* Red blood cell distribution width and neutrophil/lymphocyte ratio are positively correlated with diseaseactivity in primary Sjögren's syndrome. Clin Biochem 2014; 47:287–90.
12. Feng JF, Huang Y, Chen QX. Preoperative platelet lymphocyte ratio (PLR) is superior to neutrophil lymphocyte ratio (NLR) as a predictive factor in patientswith esophageal squamous cell carcinoma. World J Surg Oncol 2014; 12:1.
13. Bonaventura A, Montecucco F, Dallegri F, Carbone F, Lüscher TF, Camici GG, *et al.* Novel findings in neutrophil biology and their impact on cardiovascular disease. Cardiovasc Res 2019;

115:1266–1285.
14. Yu H, Jiang L, Yao L, Gan C, Han X, Liu R, Su N. Predictive value of the neutrophil to lymphocyte ratio and hemoglobin in systemic lupus erythematosus. Experiment Ther Med. 2018; 16:1547–1553.
15. Alan S, Tuna S, Türkoğlu EB. The relation of neutrophil-to-lymphocyte ratio, platelet-to-lymphocyte ratio, and mean platelet volume with the pres-ence and severity of Behcet's syndrome. Kaohsiung J Med Sci 2015; 31:626–31.
16. Kim DS, Shin D, Lee MS, Kim HJ, Kim DY, Kim SM, *et al.* Assessments of neutrophilto lymphocyte ratio and platelet to lymphocyte ratio in Korean patients with psoriasis vulgaris and psoriatic arthritis. J Dermatol. 2016; 43:305–10.
17. Grande JP. Experimental models of lupus nephritis. Exp Models Renal Dis 2011; 169:183–97.
18. Toraman A, Aras F, Hekimsoy Z, Kursat S. Is There a relationship between parathyroid hormone and neutrophil lymphocyte ratio or platelet lymphocyte ratio? Acta Endocrinologica (Buc) 2019; 5:96–101. doi: 10.4183/aeb.2019.96.
19. Wu Y, Chen Y, Yang X, Chen L, Yang Y. Neutrophil-to-lymphocyte ratio (NLR) and platelet-to-lymphocyte ratio (PLR) were associated with disease activity in patients with systemic lupus erythematosus. Int Immunopharmacol 2016; 36:94–9.
20. Ayna AB, Ermurat S, Cos kun BN, Harman H, Pehlivan Y. Neutrophil to lymphocyte ratio and mean platelet volume as inflammatory indicators in systemic lupus erythematosus nephritis. Arch Rheumatol 2017; 32:021–5.
21. Oehadian A, Suryadinata H, Dewi S, Pramudyo R, Alisjahbana B. The role of neu-trophil lymphocyte count ratio as an inflammatory marker in systemic lupus erythematosus. Acta Med Indones 2013; 45: 170–4.
22. Hepburn AL, Narat S, Mason JC. The management of peripheral bloodcytopenia in systemic lupus erythematosus. Rheumatology 2010; 49:2243–54.
23. Kocyigit I, Eroglu E, Unal A, Sipahioglu MH, Tokgoz B, Oymak O, Utas C. Role of neutrophil/lymphocyte ratio in prediction of disease progression in patients with stage-4 chronic kidney disease. J Nephrol 2013; 26:358–365.
24. Xuejing Z, Jiazhen T, Jun L, Xiangqing X, Shuguang Y, Fuyou L. Urinary TWEAK level as a marker of lupus nephritis activity in 46 cases. J Biomed Biotechnol 2012; 2012:359647.
25. Markowitz GS, D'Agati VD. The ISN/RPS 2003 classification of lupus nephritis: An assessment at 3 years. 2007; 71:491–495.