# The Association Between Hematological Indices and Prognosis in Crescentic Glomerulonephritis

*Asociación entre Índices Hematológicos y Pronóstico en Glomerulonefritis Semilunar*

Gamze Ergun[1], Arzu Ozdemir[2]

**RESUMEN**

**Objetivo:** La glomerulonefritis con semilunas (GNc) es una enfermedad muy agresiva que puede progresar rápidamente la enfermedad renal crónica (ERC) o enfermedad renal terminal (ERT). Debido al limitado número de estudios sobre este tema, esta trabajo tuvo como objetivo investigar la relación entre el índice neutrófilos-linfocitos (INL), el índice plaquetas-linfocitos (IPL) y el índice inmunoinflamatorio sistémico (SII) con el pronóstico de la glomerulonefritis con semilunas. **Métodos:** Este estudio retrospectivo observacional incluyó 127 pacientes diagnosticados con glomerulonefritis semilunar mediante biopsia renal. De estos casos, el 1,6 % (n = 2) se clasificaron como GN con semilunas tipo 1, el 51,2 % (n = 65) como tipo 2 y el 47,2 % (n = 60) como tipo 3. Se analizaron los valores basales de SII, INL y IPL, y el SII se calculó mediante la fórmula (recuento de plaquetas × recuento de neutrófilos) / recuento de linfocitos. Evaluamos la asociación de estos indicadores específicamente, una disminución superior al 50% en la tasa de filtración glomerular estimada (TFGe) con el desarrollo de insuficiencia renal terminal (IRT) y la mortalidad. **Resultados:** Al comparar los grupos según los cambios en la TFGe, no se encontró una diferencia estadísticamente significativa en los valores de INL, IPL y SII. Sin embargo, los pacientes con IRT mostraron valores significativamente más altos de estos índices en comparación con aquellos sin IRT. Además, no se observó asociación entre estos índices y la mortalidad. **Conclusión:** Este estudio sugiere que los niveles elevados de SII, INL y IPL pueden indicar la gravedad del daño renal en pacientes con GN semilunar. Se necesitan más investigaciones con poblaciones de pacientes más amplias para confirmar estos hallazgos.

**Palabras Clave:** Índice de inmuno-inflamación sistémica; índice neutrófilos/linfocitos; índice plaquetas/linfocitos; glomerulonefritis en semilunas.

**ABSTRACT**

**Objective:** Crescentic glomerulonephritis (cGN) is a highly aggressive condition that can quickly progress to chronic kidney disease (CKD) or end-stage renal disease (ESRD). Due to the limited number of studies on this topic, this research aimed to investigate the relationship between the neutrophil-lymphocyte ratio (NLR), platelet-lymphocyte ratio (PLR), and systemic immune-inflammatory index (SII) with the

*Correspondencia:*
Gamze Ergun
ORCID:
0000-0003-1605-7231
dgamze.ege@gmail.com

1) *Bartin State Hospital*
2) *Department of Nephrology, University of Health Sciences, Bakirkoy Dr. Sadi Konuk Education and Research Hospital, Istanbul, Turkey*

prognosis of crescentic glomerulonephritis. **Methods:** This observational retrospective study included 127 patients diagnosed with crescentic glomerulonephritis by renal biopsy. Among these cases, 1.6% (n=2) were classified as type 1 crescentic GN, 51.2% (n=65) as type 2, and 47.2% (n=60) as type 3. We analyzed baseline values for SII, NLR, and PLR, with SII calculated as (platelet count × neutrophil count) / lymphocyte count. We evaluated the association of these indicators, specifically a greater than 50% decrease in estimated glomerular filtration rate (eGFR), with the development of end-stage kidney failure (ESKD) and mortality. **Results:** When comparing groups based on changes in eGFR, we did not find a statistically significant difference in NLR, PLR, or SII. However, patients with ESKD exhibited significantly higher values of these indices compared to those without ESKD. Additionally, no association was observed between these indices and mortality. **Conclusion:** This study suggests that elevated SII, NLR, and PLR levels may indicate the severity of renal damage in patients with crescentic GN. Further research with larger patient populations is necessary to confirm these findings.

**Keywords:** Systemic immune-inflammation index; neutrophil-to-lymphocyte ratio; platelet-to-lymphocyte ratio; crescentic glomerulonephritis

## INTRODUCTION

Crescentic glomerulonephritis (cGN) is a very aggressive condition that can quickly progress to chronic kidney disease (CKD) or end-stage kidney disease (ESKD) [1]. The condition is characterized by extensive, destructive cellular crescents in the glomeruli, leading to a rapid, progressive decline in renal function. The pathological definition of crescents may vary depending on the specific disease; however, cellular crescents are generally defined as having two or more layers of proliferating cells within Bowman's space. Previous research has shown that parietal epithelial cells (PECs) are the primary cell type found in these crescents [2]. These cells undergo an activation process that enhances their ability to increase, migrate, and produce extracellular matrix components [3].

Thus, three groups of patients with cGN are currently recognized: approximately 20% have anti-GBM nephritis; 40% have immune complex-induced RPGN; and the remaining 40% have RPGN without immune deposits [4].

Hematological indices have recently gained recognition as valuable biomarkers of inflammation due to their ease of availability and cost-effectiveness [5, 6, 7, 8]. The neutrophil-to-lymphocyte ratio (NLR) and platelet-to-lymphocyte ratio (PLR) are commonly used as indicators for differential diagnosis and prognostic prediction of various diseases, including cancers and inflammatory conditions [6, 7, 8, 9, 10, 11]. Additionally, the systemic immune-inflammation index (SII), which is calculated from lymphocyte, neutrophil, and platelet counts, has been included in studies as a poor prognostic indicator in various cancers, autoimmune diseases, and even coronary artery disease. [5, 12, 13, 14, 15, 16].

We aimed to investigate the relationship of NLR, PLR, and SII with prognosis in crescentic glomerulonephritis.

## METHODS

This study received approval from the local clinical research ethics committee at Bakirkoy Dr. Sadi Konuk Training and Research Hospital (approval no: 2024-08-06). Due to the study's retrospective nature, informed consent was waived.

All patients diagnosed with crescentic glomerulonephritis via biopsy at the Nephrology Department of Bakirkoy Dr. Sadi Konuk Education and Research Hospital between January 2014 and July 2024 were retrospectively analyzed. The following conditions led to patient exclusion:

-Being under 18 years of age,
-The use of drugs that could affect blood count parameters,
-Infections, autoimmune systemic diseases (including rheumatoid arthritis and autoimmune liver diseases), multiple sclerosis, malignancies, hematologic diseases,
-A history of blood transfusion within the last three months,
-Insufficient data on laboratory results.

Data on age, sex, and laboratory results at the time of kidney biopsy were collected from the hospital's electronic medical records. These

results included glucose, uric acid, total protein, albumin, urea, creatinine, neutrophils, leukocytes, platelets, hemoglobin, estimated glomerular filtration rate (eGFR), erythrocyte sedimentation rate (ESR), C-reactive protein (CRP), routine urine analysis, and the 24-hour urinary protein excretion rate.

The eGFR was calculated by the CKD-EPI equation.

The SII was calculated as platelet count divided by neutrophil count/lymphocyte count.

The NLR was calculated as neutrophil/lymphocyte count, and the PLR as platelet/lymphocyte count.

Crescentic glomerulonephritis is divided into 3 types. Type 1 crescentic glomerulonephritis is an antiglomerular basement membrane disease; type 2 crescentic glomerulonephritis is a diffuse proliferative glomerulonephritis, IgA nephritis, lupus nephritis, Immune complex related MPGN, nonlupus full-house nephropathy, and shunt nephritis; type 3 crescentic glomerulonephritis is classified as related vasculitis.

In evaluating the study's findings, the NCSS (Number Cruncher Statistical System) 2020 Statistical Software (NCSS LLC, Kaysville, Utah, USA) was utilized for statistical analysis. For the study data, quantitative variables were presented as mean ± standard deviation, median, minimum, and maximum. Qualitative variables were summarized using descriptive statistics, such as frequencies and percentages. The Shapiro-Wilk test and box plots were used to assess the normality of the data distribution.

The Mann-Whitney U test was applied to evaluate variables that did not follow a normal distribution across two groups. Additionally, Fisher's exact test was used for comparing qualitative data.

Kaplan-Meier survival analysis was conducted, and the results were assessed at a 95% confidence interval, with statistical significance set at $p < 0.05$.

**RESULTS**

Demographic data and histopathological diagnoses for 127 patients with crescentic GN are presented in Table 1. It was observed that 1.6 % (n=2) of the cases were crescentic GN type 1, 51.2 % (n=65) type 2 crescentic GN, and 47.2 % (n=60) were type 3.

Of the cases, 29.1% (n=37) had biopsies due to nephrotic syndrome/nephrotic proteinuria, 29.9% (n=38) had nephritic syndrome/persistent proteinuria, 7.1% (n=9) had rapidly progressive glomerular diseases, 14.2% (n=18) had unexplained acute kidney injury, and 19.7% (n=25) had systemic diseases with renal involvement.(**Table 1**)

**Table 1:** Demographic data and Histopathological Diagnosis of crescentic GN patients

|  |  | n (%) |
|---|---|---|
| Gender | Female | 54 (42.5) |
|  | Male | 73 (57.5) |
| Age | Mean ±SD | 49.43±16.90 |
|  | Median (Min-Max) | 48 (19-89) |
| Biopsy indication | Nephrotic syndrome/nephrotic proteinuria | 37 (29.1) |
|  | Nephritic syndrome/persistent proteinuria | 38 (29.9) |
|  | Rapidly progressive glomerular diseases | 9 (7.1) |
|  | Unexplained acute kidney injury | 18 (14.2) |
|  | Systemic diseases with renal involvement | 25 (19.7) |
| Follow-up period (month) | Mean ±SD | 18.74±16.61 |
|  | Median (Min-Max) | 15 (0 -72) |
| Crescentic GN subtype | Type 1 | 2 (1.6) |
|  | Type 2 | 65 (51.2) |
|  | Type 3 | 60 (47.2) |

**GN** glomerulonephritis

Of the cases, 22.8% (n=29) had IgA nephropathy, 48.1% (n=61) had AAV (Antineutrophil cytoplasmic antibody associated vasculitis), 9.4% (n=12) had lupus nephritis, 9.4% (n=12) had IgA vasculitis, 6.3% (n=8) had immune complex related MPGN, 0.8% (n=1) had Anti-GBM, 0.8% (n=1) had anti-glomerular basement membrane antibodies with pulmonary involvement, 0.8% (n=1) had diffuse proliferative glomerulonephritis due to hepatitis C, 0.8% (n=1) had nonlupus fullhouse nephropathy ,and 0.8% (n=1) shunt nephritis were detected. **(Table 2)**

Changes in laboratory values over time during patients' follow-up are shown in **Table 3**. eGFR values ranged from 3 to 144, with an average eGFR of 46.25±38.21.

**Table 2:** GN subtypes

| GN | n (%) |
| --- | --- |
| AAV | 61(48.1) |
| Anti-GBM | 1 (0.8) |
| Anti-glomerular basement membrane antibodies with pulmonary involvement | 1 (0.8) |
| Diffuse proliferative GN due to hepatitis C | 1 (0.8) |
| IgA nephritis | 29 (22.8) |
| IgA vasculitis | 12 (9.4) |
| Lupus nephritis | 12 (9.4) |
| Immune complex related MPGN | 8 (6.3) |
| Non lupus fullhouse nephropathy | 1 (0.8) |
| Shunt nephritis | 1 (0.8) |

**GN** Glomerulonephritis, **AAV** Antineutrophil cytoplasmic antibody associated vasculitis, **IgA** Immunoglobulin A, **MPGN** membranoproliferative glomerulonephritis

**Table 3:** Course of laboratory parameters of patients during follow-up

| Test | | n (%) |
| --- | --- | --- |
| Urea | Mean±Sd | 87.15±56.24 |
| | Median (Min-Max) | 68 (19.7-291) |
| Last urea | Mean±Sd | 73,.2±51.72 |
| | Median (Min-Max) | 59 (17-260) |
| Creatinine | Mean±Sd | 2.76±2.29 |
| | Median (Min-Max) | 2.1 (0.4-12.3) |
| Last creatinine | Mean±Sd | 2.07±1.2 |
| | Median (Min-Max) | 1.5 (0-11) |
| Albumin | Mean±Sd | 3.21±0.66 |
| | Median (Min-Max) | 3.2 (1.4-4.5) |
| Last albumin | Mean±Sd | 3.78±0.73 |
| | Median (Min-Max) | 3.9 (1.5-5.1) |
| Proteinuria | Mean±Sd | 3019.64±2804.45 |
| | Median (Min-Max) | 2105.5 (196-15810) |
| Last proteinuria | Mean±Sd | 1251.8±1624.23 |
| | Median (Min-Max) | 650 (50-8906) |
| eGFR | Mean±Sd | 46.25±38.21 |
| | Median (Min-Max) | 30 (3-144) |
| Last eGFR | Mean±Sd | 57.76±39.22 |
| | Median (Min-Max) | 49 (6-143) |
| GFR % change | Mean±Sd | 1.71±1.35 |
| | Median (Min-Max) | 1.3 (0.2-7.8) |

**eGFR** estimated glomerular filtration rate. Last **eGFR** values ranged from 6 to 143, with an average last **eGFR** of 57.76±39.22. **GFR** % change rate ranged from 0.2 to 7.8, with an average **eGFR** % change of 1.71±1.35

NLR, PLR, and SII do not show statistically significant differences according to eGFR change groups (p>0.05).(**Table 4, 5, 6**)

**Table 4:** Comparison of NLR, PLR, SII and LMR according to eGFR Groups

| | | eGFR change | | p |
|---|---|---|---|---|
| | | <%50 decrease (n=6) | >%50 decrease (n=121) | |
| NLR | Mean±Sd | 4.94±3.74 | 5.26±5.15 | 0.955 |
| | Median (Min-Max) | 3.6 (1.5-12.1) | 4,1 (1,1-36,7) | |
| PLR | Mean±Sd | 222.85±89.41 | 182,63±117,81 | 0.187 |
| | Median (Min-Max) | 218.3 (122.1-344.8) | 157,8 (45,3-824,3) | |
| SII | Mean±Sd | 1615.37±1256.51 | 1441,2±1635,72 | 0.400 |
| | Median (Min-Max) | 1388.9 (377.8-4006.5) | 987 (186,5-13974,4) | |

**NLR**, **PLR**, and **SII** values do not show statistically significant differences according to mortality (p>0.05).

**Table 5:** Comparison of NLR, PLR, and SII Values According to Renal Replacement Therapy Groups

| | | Renal Replacement Therapy | | p |
|---|---|---|---|---|
| | | Yes (n=109) | No(n=18) | |
| NLR | Mean±Sd | 4,74±4,23 | 8,29±8,14 | 0,003** |
| | Median (Min-Max) | 3,5 (1,1-35,2) | 5,5 (2,2-36,7) | |
| PLR | Mean±Sd | 178,7±119,15 | 219,82±95,58 | 0,044* |
| | Median (Min-Max) | 156,7 (45,3-824,3) | 173,7 (87,1-389,7) | |
| SII | Mean±Sd | 1348,67±1578,44 | 2059,55±1753,21 | 0,026* |
| | Median (Min-Max) | 966,2 (186,5-13974,4) | 1573,2 (379,2-6893,3) | |

Mann Whitney U Test, **p<0,01, *p<0,05, **NLR** neutrophil-to-lymphocyte ratio, **PLR** platelet-to-lymphocyte ratio, **SII** systemic immune-inflammation index

**Table 6: Comparison of NLR, PLR, and SII Values According to Mortality**

| | | Mortality | | p |
|---|---|---|---|---|
| | | Alive (n=103) | Ex (n=24) | |
| NLR | Mean±Sd | 5,33±5,50 | 4,86±2,63 | 0,427 |
| | Median (Min-Max) | 3,7 (1,1-36,7) | 4,2 (1,5-12) | |
| PLR | Mean±Sd | 182,58±108,66 | 192,87±148,65 | 0,956 |
| | Median (Min-Max) | 162,7 (45,3-794) | 146,5 (65,8-824,3) | |
| SII | Mean±Sd | 1465,76±1719,21 | 1379,31±1093,72 | 0,534 |
| | Median (Min-Max) | 977,5 (186,5-13974,4) | 1038,7 (377,8-5605,1) | |

**NLR** neutrophil-to-lymphocyte ratio, **PLR** platelet-to-lymphocyte ratio, **SII** systemic immune-inflammation index

NLR, PLR, and SII values in those receiving renal replacement therapy were statistically significantly higher than in those not receiving (p=0.003; p<0.01; p=0.044; p<0.05; and p=0.026; p<0.05, respectively)

Among the risk factors whose effects on ESKD were to be investigated, NLR, PLR, and SII, which were significant in the univariate comparison (p<0.200), were evaluated using Backward Logistic regression analysis. The model resulting from the 4th step for the risk factors affecting ESKD is shown in **Table 7**.

**Table 7: Logistic Regression Analysis of Risk Factors Affecting ESKD**

| | p | ODDS | %95 CI | |
| --- | --- | --- | --- | --- |
| | | | Lower | Upper |
| Constant | 0,001** | 0,093 | | |
| NLR | 0,025* | 1,100 | 1,012 | 1,197 |
| PLR | 0,551 | 1,000 | 0,995 | 1,009 |
| SII | 0,302 | 1,000 | 0,999 | 1,000 |

Of the 126 cases, 102 survived (81.0%), and 11 died. The mean survival time was 50.659±3.599 months. The last death occurred in the 65th month; the cumulative survival rate in this month was 29.6%, with a standard error of 21.4%.

The variables included in the study were evaluated using backward stepwise logistic regression. At the end of the 4th step in the study; It is seen that NLR, PLR, and SII values, which are risk factors affecting ESKD, form a significant model (p=0.019; p<0.05). The model's explanatory coefficient is 7.6%. According to the model, a unit increase in NLR increases the risk of ESKD by 1.100 times (95% CI: 1.012-1.197). NLR values are independent risk factors for ESKD.

.

## DISCUSSION

To our knowledge, few studies have investigated the impact of NLR, PLR, and SII on the prognosis of crescentic glomerulonephritis and its progression to ESKD. Our findings indicate that these hematologic indices do not affect changes in the eGFR. However, they were found to be directly associated with ESKD, especially NLR values, which were also associated with ESKD. No statistically significant differences in mortality rates were observed.

Crescentic GN is a severe form of kidney disease characterized by glomerular and systemic inflammation. This condition involves the activation of systemic inflammatory markers and shows inflammatory findings on renal biopsy [17, 18]. Factors such as immune complexes, anti-GBM antibodies, and ANCA can trigger glomerular inflammation, leading to crescentic glomerular injury [19].

Both the innate and adaptive immune systems play roles in the development of crescentic GN. Proinflammatory cytokines and chemokines increase neutrophil numbers and activity and induce lymphocyte apoptosis. Consequently, neutrophils and lymphocytes are involved in type 1, type 2, and type 3 crescentic GN. In cases of lupus nephritis, the deposition of subendothelial immune complexes triggers neutrophil infiltration, leading to glomerular damage. In contrast, IgA vasculitis predominantly features neutrophils in the inflammatory infiltrate. ANCA antibodies are produced against the granules of neutrophils and the lysosomes of monocytes, primarily in the IgG structure.

Additionally, platelets actively participate in inflammation by regulating immune system cells. As a result, parameters derived from complete blood cell counts have become useful and cost-effective tools for diagnosing, assessing current disease activity, and predicting prognosis in various inflammatory diseases [19]. NLR, PLR, and SII have been studied in many diseases recently.

SII has emerged as a significant novel inflammatory marker lately. This index is calculated using three blood components: neutrophils, platelets, and lymphocytes. Its relevance has increased due to demonstrated correlations with the prognosis of various diseases [12, 13, 14].

A 2024 study involving 374 patients with IgA nephropathy (IgAN) found that a high SII was associated with more severe clinical and pathological features at baseline. Additionally, the SII was identified as an independent risk factor for progression to ESKD in these patients [20]. Similarly, in our study, SII were significantly higher in individuals receiving renal replacement therapy compared to those who were not. Furthermore, NLR values were associated with progression to ESKD.

Kim et al. conducted a study involving 160 AAV patients and found that the SII is directly proportional to disease severity. Additionally, SII can predict poor outcomes in these patients

[15]. However, Chen et al. suggested that AAV patients with high SII values have a lower risk of developing end-stage renal disease (ESRD). This discrepancy may arise from several factors, including the relatively short follow-up period in their study and the non-standardized immunosuppressive treatments administered to patients, given the research's retrospective design [21].

A 2024 study involving 88 patients with crescentic glomerulonephritis found that a high SII may reflect the severity of kidney injury [22]. This correlation was determined based on baseline values; a limitation of this study is that prognosis was not analysed, unlike in our study.

As seen in many studies of glomerulonephritis, high SII indicates poor renal prognosis. Our study also supports this.

In a study involving 196 patients with IgA nephritis and 138 with membranous glomerulonephritis, NLR was a significant predictor of ESKD in IgAN, whereas PLR was associated with increased mortality. In MN, NLR and PLR are predictors of mortality but not kidney survival [23]. Qianqian Li et al. showed that NLR levels were associated with clinical and pathological phenotypes, and that NLR may serve as an independent risk factor for poor renal outcome in adult IgAV-N patients, as in our study [24].

In contrast to our work, a study of 44 patients with rapidly progressive glomerulonephritis examined the effects of NLR and PLR on renal survival, finding that renal survival was better in patients with high NLR and PLR [25]. When we examined the reasons for the contradiction, we observed that the study population was smaller than ours and the follow-up period was shorter. A common limitation of our study and this study is that they are retrospective.

54 patients with RPGN were followed for at least 6 months, and NLR and PLR were found to be positively correlated with mortality [26]. Although the mortality rate of this study was similar to ours, we did not observe any correlation between hematological indices and mortality.

We aimed to investigate the association between NLR, PLR, and SII and the prognosis of crescentic glomerulonephritis. We followed 127 patients with biopsy-proven crescentic glomerulonephritis for an average of 18 months,

with a maximum follow-up period of 72 months. When analyzing the changes in estimated glomerular filtration rate (eGFR) among the patients, we found that 95.3% (n=121) experienced a decrease of more than 50%. This suggests that crescentic glomerulonephritis generally has a poor prognosis. However, we did not find any correlation between these eGFR changes and our hematological indices. On the other hand, we did observe a positive correlation between end-stage kidney disease (ESKD) and all three hematological indices.

At the conclusion of Backward Stepwise Logistic Regression, it was found that the NLR, PLR, and SII values, which are risk factors impacting ESKD, create a significant predictive model (p=0.019; p<0.05). According to this model, a one-unit increase in NLR raises the risk of renal replacement by 1.100 times (95% Confidence Interval: 1.012-1.197). NLR values have been identified as associated with ESKD.

The limitations of this study include the retrospective design and the single-center setting. Another limitation is that we did not assess systemic involvement in the diseases studied. Conditions such as ANCA vasculitis, lupus nephritis, and crescentic IgA nephropathy can all present with systemic manifestations that may influence inflammatory markers, including hematological indices. Another issue is that the inclusion of various pathologies, ranging from nephrotic proteinuria to pulmonary involvement with anti-glomerular basement membrane antibodies, can confound the analysis of results. Despite these limitations, this study provides valuable information regarding the use of hematological indices in clinical practice for prognostic purposes in glomerulonephritis.

In conclusion, high NLR, PLR, and SII are associated with the severity of kidney injury in patients with crescentic GN, as these hematologic indices are readily available and can be assessed non-invasively. Further studies with large series are needed to confirm the above results.

## BIBLIOGRAPHY

1) Wong MN, Tharaux PL, Grahammer F, Puelles VG. Parietal epithelial cell dysfunction in crescentic glomerulonephritis. Cell Tissue Res. 2021 Aug; 385(2):345-354. doi: 10.1007/s00441-021-03513-9.

Epub 2021 Aug 28. PMID: 34453566; PMCID: PMC8523405.

2) Smeets B, Uhlig S, Fuss A, Mooren F, Wetzels JF, Floege J, et al. Tracing the origin of glomerular extracapillary lesions from parietal epithelial cells. J Am Soc Nephrol. 2009;20(12):2604–2615. doi: 10.1681/ASN.2009010122.

3) Ohse T, Chang AM, Pippin JW, Jarad G, Hudkins KL, et al. A new function for parietal epithelial cells: a second glomerular barrier. Am J Physiol Renal Physiol. 2009;297(6):F1566–F1574. doi: 10.1152/ajprenal.00214.2009.

4) Couser WG. Rapidly progressive glomerulonephritis: classification, pathogenetic mechanisms, and therapy. Am J Kidney Dis. 1988 Jun;11(6):449-64. doi: 10.1016/s0272-6386(88)80079-9.

5) Hu B, Yang XR, Xu Y, et al. Systemic immune-inflammation index predicts prognosis of patients after curative resection for hepatocellular carcinoma. Clin Cancer Res. 2014; 20:6212–6222. https://doi.org/10.1158/1078-0432.CCR-14-0442.

6) Motomura T, Shirabe K, Mano Y, et al. Neutrophil-to-lymphocyte ratio reflects hepatocellular carcinoma recurrence after liver transplantation via an inflammatory microenvironment. J Hepatol. 2013; 58:58-64. https://doi.org/10. 1016/j.jhep.2012.08.017.

7) Feng JF, Huang Y, Chen QX. Preoperative platelet-to-lymphocyte ratio (PLR) is superior to neutrophil-to-lymphocyte ratio (NLR) as a predictive factor in patients with esophageal squamous cell carcinoma. World J Surg Oncol. 2014; 12.https://doi.org/10.1186/1477- 7819-12-58.

8) Hu ZD, Sun Y, Guo J, et al. Red blood cell distribution width and neutrophil/lymphocyte ratio are positively correlated with disease activity in primary Sjogren's syndrome. Clin Biochem. 2014. https://doi.org/10.

9) Sen BB, Rifaioglu EN, Ekiz O, et al. Neutrophil to lymphocyte ratio as a measure of systemic inflammation in psoriasis. CutanOculToxicol. 2014; 33:223-227. https://doi.org/10.3109/15569527 .2013.834498.

10) Hu G, Liu G, Ma JY, Hu RJ. Lymphocyte-to-monocyte ratio in esophageal squamous cell carcinoma prognosis. Clin Chim Acta. 2018 Nov;486:44-48. doi: 10.1016/j.cca.2018.07.029. Epub 2018 Jul 17.

11) Hu RJ, Ma JY, Hu G. Lymphocyte-to-monocyte ratio in pancreatic cancer: Prognostic significance and meta-analysis. Clin Chim Acta. 2018 Jun;481:142-146. doi: 10.1016/j.cca.2018.03.008. Epub 2018 Mar 12.

12) Ruonan Y, Qian C, Xianchun M, et al. Prognostic value of Systemic immune-inflammation index in cancer: A meta-analysis. J Cancer. 2018; 9(18):3295- 3302.

13) Jian-Hui C, Er-Tao Z, Yu-Jie Y, et al. Systemic immune-inflammation index for predicting prognosis of colorectal cancer. World J Gastroenterol. 2017 September 14; 23(34):6261-6272.

14) Ya LY, Cheng HW, Pai FH, et al. The systemic immune-inflammation index (SII) predicted clinical outcomes in patients with coronary artery disease. Wiley Apr. 2020 9-11. https://doi.org/: 10.1111/eci.13230.

15) Kim Y, Choi H, Jung SM, et al. Systemic immune-inflammation index could estimate the cross-sectional high activity and the poor outcomes in immunosuppressive drug-naïve patients with antineutrophil cytoplasmic antibody-associated vasculitis. Nephrology (Carlton). 2019. Epub 2019Apr29.Jul; 24 (7):711-717.https://doi.org/:10.1111/ nep.13491.

16) Tanacan E, Dincer D, Erdogan FG, et al. A cutoff value for the systemic immune-inflammation index in determining activity of Behçet disease. Clin Exp Dermatol. 2021; 46(2):286-291. https://doi.org/: 10.1111/ced.14432.

17) Jennette JC. Rapidly progressive crescentic glomerulonephritis. Kidney Int 2003; 63: 1164. https://doi.org/10. 1046/j.1523-1755.2003.00843.

18) Jennette JC, Thomas DB, Falk RJ. Microscopic polyangiitis (microscopic polyarteritis). Seminars in Diagnostic Pathology. 2001 Feb; 18(1):3-13. PMID: 11296991.

19) Imig JD, Ryan MJ. Immune and inflammatory role in renal disease. Compr Physiol. 2013 Apr. 3(2):957-76. doi: 10.1002/cphy.c120028.

20) Zhai Y, Sun S, Zhang W, Tian H. The prognostic value of the systemic immune inflammation index in patients with IgA nephropathy. Ren Fail. 2024 Dec; 46(2):2381613. doi: 10.1080/0886022X.2024.2381613. Epub 2024 Jul 22. PMID: 39039867.

21) Chen JB, Tang R, Zhong Y, et al. Systemic immune-inflammation index predicts a reduced risk of end-stage renal disease in Chinese patients with myeloperoxidase-anti-neutrophil cytoplasmic antibody-associated vasculitis: A retrospective observational study. Exp Ther Med. 2021 Sep; 22(3):989.

22) Sezer GE, Ozdemir A, Kansu AD, Yilmaz, M (2024). La utilidad diagnóstica del índice de

inflamación inmune sistémica para diferenciar los subtipos de glomerulonefritis con semilunas. Revista de Nefrología, Diálisis y Trasplante, 44(3), 142-150.

23) Pană N, Ştefan G, Popa T, Ciurea O, Stancu SH, Căpuşă C. Prognostic Value of Inflammation Scores and Hematological Indices in IgA and Membranous Nephropathies: An Exploratory Study. Medicina (Kaunas). 2024 Jul 23;60(8):1191. doi: 10.3390/medicina60081191. PMID: 39202473; PMCID: PMC11356348.

24) Li Q, Shi S, Liu L, Lv J, Zhu L, Zhang H. Neutrophil-to-lymphocyte ratio as an independent inflammatory indicator for poor renal prognosis in adult IgA vasculitis with nephritis. Int Immunopharmacol. 2022 Oct;111:109178. doi: 10.1016/j.intimp.2022.109178. Epub 2022 Aug 24. PMID: 36027850.

25) Mae Y, Takata T, Ida A, Ogawa M, Taniguchi S, Yamamoto M, et al. Prognostic Value of Neutrophil-To-Lymphocyte Ratio and Platelet-To-Lymphocyte Ratio for Renal Outcomes in Patients with Rapidly Progressive Glomerulonephritis. J Clin Med. 2020 Apr 15;9(4):1128. doi: 10.3390/jcm9041128. PMID: 32326552; PMCID: PMC7230792.

26) Toraman A, Neşe N, Özyurt BC, Kürşat S. Association between neutrophil-lymphocyte & platelet lymphocyte ratios with prognosis & mortality in rapidly progressive glomerulonephritis. Indian J Med Res. 2019 Oct;150(4):399-406. doi: 10.4103/ijmr.IJMR_1234_17. PMID: 31823922; PM.CID: PMC6902366.