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Original Article

Predictive Factors of Organ Involvement in Childhood Henoch-Schonlein Purpura

Henoch-Schönlein Purpuralı Çocuklarda Organ Tutulumunu Belirleyen Faktörler

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ABSTRACT

Objective: Henoch-Schonlein purpura (HSP) is the most common vasculitis of childhood, presenting with immunoglobulin A-dominant immune deposits. Unless there is an organ involvement, the prognosis of HSP is excellent. In this study, we aimed to evaluate clinical and laboratory risk factors for organ involvement in patients with HSP.

Method: Our study sample consisted of 95 children with HSP and 75 healthy controls. Clinical and laboratory parameters recorded at the first admission to the hospital were retrospectively evaluated. The neutrophil-to-lymphocyte ratio (NLR) and platelet-to-lymphocyte ratio (PLR) were calculated based on the complete blood counts.

Results: Leucocyte, neutrophil and lymphocyte counts, C-reactive protein, PLR, platelet distribution width, and NLR were significantly higher in the HSP group than in the control group ($p=0.008$, $p<0.001$, $p=0.003$, $p<0.001$, $p=0.002$, $p<0.001$, $p=0.002$, and $p<0.001$, respectively). In the HSP group, NLR, PLR and lymphocyte were significantly higher among the patients with renal involvement and those with gastrointestinal involvement. Neutrophil levels were correlated with renal involvement. Additionally, the older age onset of the disease and elevated antistreptolysin O (ASO) levels were associated with renal involvement.

Conclusion: NLR, PLR and lymphocyte counts may be used as inflammatory indicators of renal and gastrointestinal involvement in HSP. In addition, the neutrophil count is associated with renal involvement. The older age onset of HSP and elevated ASO levels are risk factors for renal involvement in HSP.

Keywords: Child, gastrointestinal involvement, Henoch-Schonlein purpura, renal involvement

ÖZ

Amaç: Henoch-Schönlein purpurası (HSP) çocukluk çağının en sık görülen vaskülitidir ve immünoglobulin A'nın baskın olduğu immün birikintilerle kendini gösterir. Organ tutulumu olmadıkça HSP'nin prognozu mükemmeldir. Bu çalışmada HSP'li hastalarda organ tutulumu için klinik ve laboratuvar risk faktörlerini değerlendirmeyi amaçladık.

Yöntem: Çalışma örneklemi HSP'li 95 çocuk ve 75 sağlıklı kontrolden oluştu. Hastaneye ilk başvuruda kaydedilen klinik ve laboratuvar parametreleri geriye dönük olarak değerlendirildi. Nötrofil-lenfosit oranı (NLR) ve trombosit-lenfosit oranı (PLR), tam kan sayımlarına göre hesaplandı.

Bulgular: Lökosit, nötrofil ve lenfosit sayıları, C-reaktif protein, PLR, trombosit dağılım genişliği ve NLR, HSP grubunda kontrol grubuna göre anlamlı olarak daha yüksekti ($p=0,008$, $p<0,001$, $p=0,003$, $p<0,001$, $p=0,002$, $p<0,001$, $p=0,002$ ve $p<0,001$, sırasıyla). HSP grubunda böbrek ve gastrointestinal tutulumu olan hastalarda NLR, PLR ve lenfosit anlamlı olarak daha yüksekti. Nötrofil seviyeleri böbrek tutulumu ile korele idi. Ek olarak, hastalığın ileri yaşta başlaması ve yüksek antistreptolizin O (ASO) seviyeleri böbrek tutulumu ile ilişkiliydi.

Sonuç: NLR, PLR ve lenfosit sayıları, HSP'de renal ve gastrointestinal tutulumun enflamatuvar göstergeleri olarak kullanılabilir. Ek olarak, nötrofil sayısı böbrek tutulumu ile ilişkilidir. HSP'nin daha ileri yaşta başlaması ve yüksek ASO seviyeleri, HSP'de böbrek tutulumu için risk faktörleridir.

Anahtar kelimeler: Çocuk, gastrointestinal tutulum, Henoch-Schonlein purpurası, böbrek tutulumu

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INTRODUCTION

Henoch-Schonlein purpura (HSP) is the most frequently seen pediatric leukocytoclastic vasculitis characterised by the deposits of immunoglobulin A (IgA) in the small vessel walls of the skin, joint, gastrointestinal (GI) system and kidney [1]. Its incidence is 3-26.7 cases per 100,000 people [2,3]. Palpable purpura is reported in all patients, while joint involvement (JI) is observed in 60-80%, GI involvement in >50%, and renal involvement in 40-50% of patients [4,5]. Although HSP is usually self-limited, GI bleeding and HSP nephritis can be life-threatening conditions during the course of the disease [5]. It is important to assess the risk factors of organ involvement in HSP for the prediction of the disease prognosis.

HSP-GI involvement with severe GI bleeding and intestinal perforation represents the major risk in the acute period of HSP [6]. The manifestation of renal involvement in HSP varies from microscopic haematuria and intermittent proteinuria to severe nephrotic syndrome, and long-term outcome of HSP depends on the presence of renal involvement [7,8]. Approximately, 1-2% of the patients with renal involvement may progress to renal failure [8]. Therefore, it is crucial to predict organ involvement early for effective management and follow-up [9]. Thus, there is a need for reliable prognostic markers to predict organ involvement in HSP. Additionally, the predictive parameters of organ involvement in HSP should be identified.

We aimed both to determine the best prognostic markers in predicting organ involvement in children with HSP, and investigate the predictive factors for GI and renal involvement in HSP.

MATERIALS and METHODS

After obtaining the ethical approval from Manisa Celal Bayar University Ethics Committee (approval number: 20.478.486/1044, date: 01.12.2021), the study was conducted in our nephrology division with children diagnosed with HSP between December 2010 and December 2020 according to the EULAR/PRINTO/PRES diagnostic criteria [10]. The control group was consisted of healthy patients admitted to our unit without any inflammatory symptoms. Children with any inflammatory, immunologic or other chronic disorder and those taking steroids or other medication(s) were excluded.

GI involvement was defined as the presence of occult blood in stool, melena, or haematochezia. Renal involvement was identified based on the existence of one of the conditions: haematuria (>5 red cells per microscopic field under 40X magnification), proteinuria (a spot urine protein/creatinine ratios of >0.5 mg/mg and >0.2 mg/mg in children aged <2 , and ≥2 years of age, respectively), nephrotic syndrome (hypoalbuminemia, hyperlipidaemia, nephrotic range proteinuria with a protein/creatinine ratio of >2 mg/mg), and/or nephritic syndrome (haematuria, hypertension, nephritic range proteinuria with a protein/creatinine ratio of 0.2-2 mg/mg) [3].

The patients' medical history, demographic characteristics, and initial laboratory data were retrospectively obtained from patient files and the hospital records. Haemoglobin levels, leucocyte, lymphocyte, neutrophil, monocyte and platelet counts, platelet indices [mean platelet volume (MPV), plateletcrit (PCT), and platelet distribution width (PDW)], and red cell distribution width (RDW), C-reactive protein (CRP) and anti-streptolysin-O (ASO) levels were recorded at the time of the patients' first admission to the hospital. The neutrophil-to-lymphocyte ratio (NLR) and platelet-to-lymphocyte ratio (PLR) are low-cost and useful biomarkers for predicting severity and outcome of many inflammatory diseases including HSP [11-18]. NLR and PLR are calculated using the complete blood counts. Immunoglobulin levels and complement components C3 and C4 were noted. Urinalysis and faecal occult blood tests were also recorded. Renal biopsies were performed in 23 patients with nephrotic- range proteinuria or prolonged nephritis.

Statistical Analysis

Frequencies and percentages were computed for qualitative parameters. Continuous data were demonstrated as mean ± standard deviation. The distributions of data were assessed with histogram, and the Shapiro-Wilk or Kolmogorov-Smirnov test. The chi-square test was performed for testing relationships on qualitative parameters. Mann-Whitney U test or Student's t-test were utilized to measure the difference in continuous data. The Pearson and Spearman analyses were carried out to measure the correlation between the variables. The association of laboratory parameters with renal and GI involvements in HSP was measured by the receiver operating characteristic (ROC) curve analysis. Differences were determined as significant at a p-value of <0.05 in all analyses. The data was conducted with SPSS 22.0.

RESULTS

This study involved ninety-five patients with HSP and 75 healthy children. The demographic factors and laboratory variables are shown in Table 1. The HSP group contained 39 female and 56 male children with a mean age of 14.9±4.1 years. The control group comprised 40 female and 35 male children with a mean age of 13.6±2.5 years. No significant difference was detected among the groups in terms of age and gender (p=0.07 and p=0.11, respectively). The leucocyte, lymphocyte and neutrophil counts and the CRP, PLR, PDW and NLR levels were significantly higher in the HSP group (p=0.008, p=0.003, p<0.001, p<0.001, p=0.002, p<0.001, and p<0.001, respectively). No significant difference among the groups were found in terms of haemoglobin MPV, PCT and RDW values, monocyte, and platelet counts, (Table 2). Upper respiratory tract infection (URTI) was present in 39 (41%) children.

In the HSP group, there were 57 (60%) patients with renal involvement. In five (8.8%) of these patients, renal involvement was identified at the time of diagnosis. Among the remaining patients, renal involvement was found within the first month in 43 (75.4%), first to third months in five (8.8%), fourth to sixth months in three (5.3%), and the first year in one (1.8%) case. Patients presented with isolated haematuria (n=15), isolated proteinuria (n=10), nephritic syndrome (n=10), and nephrotic syndrome (n=23). Table 2 presents the comparison of the demographic characteristics and laboratory data between the patients with and without renal involvement in the patients with HSP. The mean age at the onset of the disease, neutrophil and lymphocyte counts, and PDW, PLR, NLR and ASO levels were significantly higher among the patients with renal involvement compared to those without (p=0.001, p=0.011, p=0.003, p=0.028, p=0.015, p<0.001, and p=0.036, respectively). However, no statistically significant difference was detected between these two subgroups in terms of gender and, leucocyte, monocyte, platelet counts; CRP, haemoglobin, MPV, PCT and RDW levels (p=0.15, p=0.27, p=0.43, p=0.64, p=0.6, p=0.86, p=0.93, p=0.54, and p=0.36, respectively). There was also no significant difference among the patients with and without renal involvement in terms of presenting signs, such as abdominal pain, joint, and GI or scrotal involvement (p=0.49, p=0.25, p=0.7, and p=0.2, respectively). We determined positive correlations between the presence of renal involvement and neutrophil, lymphocyte counts, PDW, PLR, NLR and C3 values (r=0.24, p=0.017; r=0.32, p=0.02; r=0.22, p=0.03; r=0.25, p=0.015; r=0.36, p<0.001; and r=0.23, p=0.025, respectively). Leucocyte counts was negatively associated with renal involvement (r=-0.084 and p=0.4).

Twenty-two (23%) patients with HSP had GI involvement. The data of the children with and without

Table 1. Demographic characteristics and laboratory parameters of the HSP and control groups

Characteristics	HSP group (n=95)	Control group (n=75)	p-value
Age at onset (years) (mean ± SD)	14.9±4.1	13.6±2.5	0.07
Gender (F/M)	39/56	40/35	0.11
CRP (mg/dL)	2.3±6.3	0.24±0.2	**<0.001**
Haemoglobin (g/dL) (mean ± SD)	12.3±1.4	12.6±1.4	0.35
Leukocytes (10^3/μL) (mean ± SD)	11.5±10	8.9±3.9	**0.008**
Neutrophils (10^3/μL) (mean ± SD)	6.7±3.1	4.4±2.4	**<0.001**
Lymphocytes (10^3/μL) (mean ± SD)	2.9±1.2	3.7±2.2	**0.003**
Monocytes (10^3/μL) (mean ± SD)	0.6±0.3	0.6±0.2	0.57
Platelets (10^3/μL) (mean ± SD)	355±110	340±80	0.3
MPV (fL) (mean ± SD)	8.3±1.1	8.6±0.95	0.09
PCT (mean ± SD)	0.29±0.1	0.29±0.06	0.9
PDW (mean ± SD)	15.9±0.7	15.6±0.43	**<0.001**
PLR (mean ± SD)	139±65	110±47	**0.002**
NLR (mean ± SD)	2.8±2.4	1.56±1	**<0.001**
RDW (%) (mean ± SD)	13.6±1.4	15.1±1.3	0.18

HSP: Henoch-Schonlein purpura, SD: Standard deviation, F: Female, M: Male, CRP: C-reactive protein, MPV: Mean platelet volume, PCT: Plateletcrit, PDW: Platelet distribution width, PLR: Platelet-to-lymphocyte ratio, NLR: Neutrophil-to-lymphocyte ratio, RDW: Red cell width distribution

GI involvement are presented in Table 3. The PLR and NLR values were found to be higher in the HSP subgroup of patients with GI involvement (p=0.003 and p=0.036, respectively). No significant difference was detected between the patients with and without GI involvement in terms of age, gender, and leukocyte, lymphocyte, neutrophil, monocyte, and platelet counts; CRP, haemoglobin, MPV, PCT, PWD and RDW values (p=0.5, p=0.6, p=0.42, p=0.41, p=0.88, p=0.92, p=0.72, p=0.63, p=0.86, p=0.14, p=0.82, p=0.2, and p=0.12, respectively). The presence of GI involvement was found positively associated with PLR and NLR (r=0.310, p=0.002 and r=0.217, p=0.035, respectively) and negatively associated with leucocyte counts (r=-0.229, p=0.007).

JI was detected in 34 (36%) of patients with HSP mostly involving ankles. Twenty-three (68%) patients with JI had renal, 9 (26%) of them had GI involvement. When the patients with and without JI evaluated, no statistically significant difference was determined between presenting symptoms of HSP, such as abdominal pain, renal, GI or scrotal involvement (p=0.07, p=0.26, p=0.6, p=0.3, respectively). Also, no statistically significant difference was assessed between these two subgroups in terms of age, gender and leucocyte, neutrophil, lymphocyte, monocyte, platelet counts, and CRP, haemoglobin, MPV, PCT, PWD, PLR, NLR and RDW levels (p=0.66, p=0.68, p=0.68, p=0.25, p=0.78, p=0.47, p=0.67, p=0.56, p=0.16, p=0.67, p=0.66, p=0.16, p=0.17, p=0.29, and p=0.66, respectively).

Figure 1 and Table 4 present the area under the curve (AUC) values acquired from the ROC analyses of the patients with RI in the HSP group. According to this analysis, NLR, lymphocyte count, PLR, and neutrophil counts had AUC values of 0.725, 0.679, 0.658, and 0.634, respectively (p<0.001, p=0.003, p=0.009 and p=0.028, respectively).

Figure 2 and Table 4 show the AUC values obtained from the ROC analysis of the cases with GI involvement in the HSP group. The results revealed that PLR, lymphocyte count, and NLR had AUC values of 0.709,

Table 2. Demographic characteristics and laboratory parameters of the patients with and without RI in the HSP group

Characteristics	RI subgroup (n=57)	Non-RI subgroup (n=38)	p-value
Age at onset (years) (mean ± SD)	10.3±3.4	7.8±3.5	**0.001**
Gender (F/M)	20/37	19/19	0.15
CRP (mg/dL) (mean ± SD)	2±2.4	3.3±9.6	0.6
Haemoglobin (g/dL) (mean ± SD)	12.4±1.5	12.3±1.3	0.86
Leukocytes (10^3/μL) (mean ± SD)	12.4±13	10±3.4	0.27
Neutrophils (10^3/μL) mean ± SD)	7.3±3.4	5.7±2.3	**0.011**
Lymphocytes (10^3/μL) mean ± SD)	2.6±0.9	3.3±1.3	**0.003**
Monocytes (10^3/μL) (mean ± SD)	0.63±0.3	0.67±0.3	0.43
Platelet counts (10^3/μL) (mean ± SD)	350±109	361±113	0.64
MPV (fL) (mean ± SD)	8.3±1.16	8.3±0.96	0.93
PCT (mean ± SD)	0.28±0.1	0.29±0.08	0.54
PDW (mean ± SD)	16.1±0.6	15.8±0.7	**0.028**
PLR (mean ± SD)	151±72	120±49	**0.015**
NLR (mean ± SD)	3.4±2.9	1.9±0.9	**<0.001**
RDW (%) (mean ± SD)	13.6±1.6	13.7±1.1	0.36
Elevated IgA	8/49	2/36	0.2
Decreased C3	6/54	5/33	0.7
Elevated ASO	22/36	7/31	0.036
Abdominal pain	20/37	16/22	0.49
Joint involvement	23/34	11/27	0.25
GI involvement	14/43	8/30	0.7
Scrotal involvement	5/52	3/38	0.2

RI: Renal involvement, HSP: Henoch-Schonlein purpura, SD: Standard deviation, F: Female, M: Male, CRP: C-reactive protein, MPV: Mean platelet volume, PCT: Plateletcrit, PDW: Platelet distribution width, PLR: Platelet-to-lymphocyte ratio, NLR: Neutrophil-to-lymphocyte ratio, RDW: Red cell width distribution, IgA: Immunoglobulin A, ASO: Anti-streptolysin O, GI: Gastrointestinal involvement

Table 3. Demographic characteristics and laboratory parameters of the HSP-GI and HSP-non-GI groups

Characteristics	HSP-GI patients (n=22)	HSP-non-GI (n=73)	p-value
Age at onset (years)	9.7±3.5	9.2±3.7	0.5
Gender (F/M)	8/14	31/42	0.6
CRP (mg/dL) (mean ± SD)	2.3±3.4	2.3±7	0.63
Hemoglobin (g/dL) (mean ± SD)	12.5±1.8	12.3±1.3	0.86
Leukocytes (10^3/μL) (mean ± SD)	9±3.8	12±11	0.42
Neutrophils (10^3/μL) (mean ± SD)	6.6±3	6.7±3.1	0.88
Lymphocytes (10^3/μL) (mean ± SD)	2.4±1.3	3±1.1	0.41
Monocytes (mean ± SD) (10^3/μL)	0.64±0.4	0.65±0.31	0.92
Platelets (10^3/μL) (mean ± SD)	363±139	352±100	0.72
MPV (fL) (mean ± SD)	8.6±1.3	8.2±1	0.14
PCT (mean ± SD)	0.29±0.1	0.29±0.07	0.82
PWD (mean ± SD)	15.8±0.8	16±0.6	0.2
PLR (mean ± SD)	172±65	129±62	**0.003**
NLR (mean ± SD)	3.2±1.8	2.65±2.6	**0.036**
RDW (%) (mean ± SD)	13.3±0.9	13.7±1.5	0.12
Elevated IgA	2/20	10/63	0.08
Decreased C3	4/18	9/66	0.7
Elevated ASO	8/14	21/52	0.5
Abdominal pain	14/8	22/51	**0.049**
Joint involvement	9/13	25/48	0.57
Renal involvement	14/8	43/30	0.7
Scrotal involvement	2/20	6/67	0.3

HSP-GI: Henoch-Schonlein purpura-gastrointestinal involvement, HSP-non-GI: Henoch-Schonlein purpura without gastrointestinal involvement, SD: Standard deviation, F: Female, M: Male, CRP: C-reactive protein, MPV: Mean platelet volume, PCT: Platecrit, PWD: Platelet width distribution, PLR: Platelet/lymphocyte ratio, NLR: Neutrophil/lymphocyte ratio, RDW: Red cell width distribution, IgA: Immunoglobulin A, ASO: Anti-streptolysin O

Table 4. Receiver operating characteristic analysis for HSP-RI and HSP-GI

Test result variable (s)	Area under the curve	p-value	95% Confidence interval	
			Lower bound	Upper bound
HSP-RI				
NLR	0.725	**<0.001**	0.624	0.827
Lymphocyte	0.679	**0.003**	0.575	0.771
PLR	0.658	**0.009**	0.545	0.771
Neutrophil	0.634	**0.028**	0.522	0.746
PWD	0.605	0.086	0.489	0.721
HSP-GI				
PLR	0.709	**0.003**	0.562	0.856
Lymphocyte	0.691	**0.004**	0.587	0.781
NLR	0.644	**0.042**	0.512	0.776

HSP-RI: Henoch-Schonlein Purpura-Renal Involvement, HSP-GI: Henoch-Schonlein Purpura-Gastrointestinal Involvement, PWD: Platelet width distribution, PLR: Platelet/lymphocyte ratio, NLR: Neutrophil/lymphocyte ratio

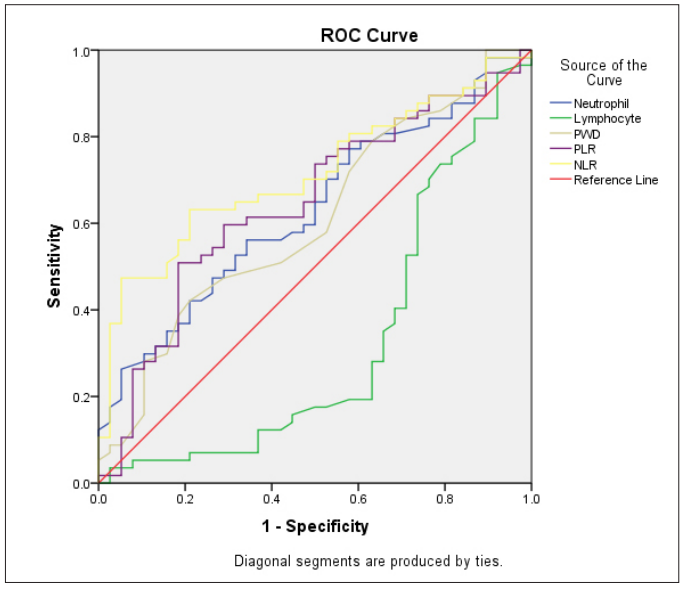

Figure 1. Area under the curve values of the ROC analysis of the patients with renal involvement in the HSP group

ROC: Receiver operating characteristic, HSP: Henoch-Schonlein purpura, PWD: Platelet distribution width, PLR: Platelet-to-lymphocyte ratio, NLR: Neutrophil-to-lymphocyte ratio

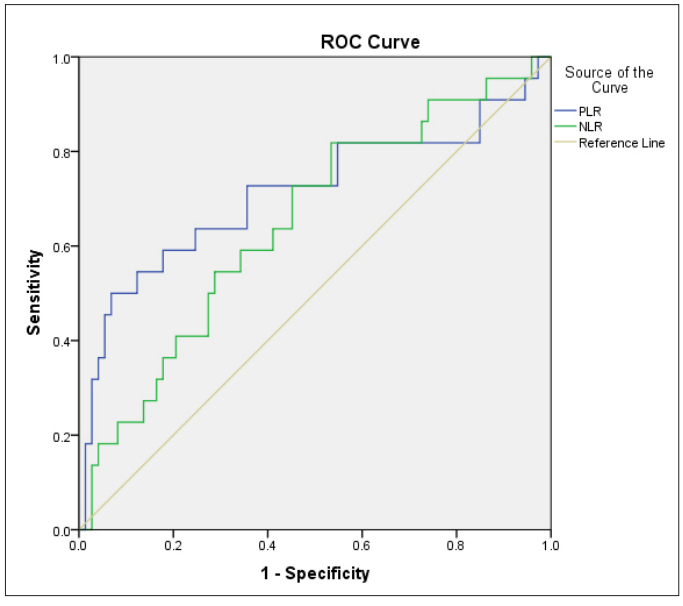

Figure 2. Area under the curve values of the ROC analysis of the patients with gastrointestinal involvement in the HSP group

ROC: Receiver operating characteristic, HSP: Henoch-Schonlein purpura, PLR: Platelet-to-lymphocyte ratio, NLR: Neutrophil-to-lymphocyte ratio

0.691, and 0.644, respectively (p=0.003, p=0.004, and p=0.042, respectively).

DISCUSSION

HSP is the commonest pediatric vasculitis of presenting with the accumulation of IgA within the walls of small vessels [1,2]. GI, and renal involvement indicate acute and chronic course of the disease, respectively [4,19]. The etiopathogenesis of HSP has not yet been well defined; however, the abnormal expression of inflammatory cytokines is the most associated factor [11]. Neutrophils, lymphocytes and platelets are key mediators in the inflammatory pathways of HSP [11,12]. PLR and NLR are low-cost and simple methods used to estimate the severity and prognosis of several inflammatory diseases [13-15] and chronic diseases, such as prostate, breast, colon and renal cancers [16]. NLR and PLR have also been described to reflect the activity of rheumatoid arthritis and lupus erythematosus [13]. In addition, NLR is considered as a useful marker to evaluate Behçet's disease activity [14]. Platelets are likely to contribute to inflammation, and therefore platelet indices are used in various diseases, such as cardiovascular disease, Crohn disease, diabetic nephropathy, rheumatoid arthritis, and ankylosing spondylitis [17,18]. Recently, neutrophil-, lymphocyte- and platelet-associated markers; e.g., NLR, PLR, MPV and PDW have been increasingly reported to serve as the predictors of GI and renal involvement in HSP [9,12,20-23]. In the current study, we planned to determine the predictive factors for organ involvement in HSP and define possible biomarkers correlated with the presence of GI, and renal involvement.

Renal involvement is reported in a wide range (20-80%) of patients with HSP [3]. Consistent with the literature, renal involvement was detected in 57 (60%) of the patients with HSP in this study. It has been suggested that renal involvement is associated with the more severe form of HSP and more frequently seen among older children [20,21]. We also found a significantly higher age at the time of diagnosis among the children in the HSP group with renal involvement compared to those without. Kim et al. [20] and Karadağ et al. [24] reported NLR to be higher in patients with renal involvement. Ekinci et al.[25] reported elevated neutrophil and NLR in biopsy-proven nephritis. Yakut et al. [26] observed significantly elevated MPV in HSP cases presenting with renal involvement. We have shown that lymphocyte, and neutrophil counts, NLR, and PLR were significantly higher in the HSP subgroup with renal involvement. In the ROC analysis, the AUC values indicated that NLR was the parameter that was

most related to renal involvement. ASO, an indicator of streptococcal infection, is a specific streptolysin antibody. Most patients with HSP are reported to have a history of URTI, especially streptococcal infection with high levels of ASO [27]. Chan et al. [21] determined that relatively higher ASO levels were related with renal involvement in HSP. We also reported elevated ASO levels in children with renal involvement in our HSP group. However, the mechanism causing the relationship between streptococcal infection and renal involvement in HSP is still debated [28].

GI involvement is the most severe acute complication of HSP. In this study, 22 (23%) patients with GI involvement had HSP. Ekinci et al. [25], Yakut et al. [26], and Makay et al. [29] evaluated that NLR was associated with GI bleeding. Karadağ et al. [24] observed that NLR, PLR, neutrophil and platelet levels were elevated in HSP cases with GI involvement. Gayret et al. [30] found that both PLR and NLR were significantly higher in children with HSP presenting with GI involvement. We also observed that PLR and NLR were with GI involvement in our HSP group.

JI was detected in 34 (36%) patients with HSP. This ratio was lower than those reported in other studies [4,19]. NLR and PLR were not found to be associated with JI in this research.

Study Limitations

The limitations of the current study are that its single-centre and retrospective nature and small sample size.

CONCLUSION

In conclusion, NLR, PLR and lymphocyte count may be useful parameters in predicting renal and GI involvement in HSP. In addition, neutrophil counts are related to renal involvement. Its onset at a relatively older age and elevated ASO levels are risk factors for renal involvement. When we evaluated platelet indices, we found that PDW was significantly higher in the HSP group compared to the control group and in the subgroup with renal involvement compared to the patients without. However, PDW was not correlated with GI involvement. We also determined that MPV was not related to organ involvement in HSP. Further prospective, large-scale and multicentre studies are needed to corroborate our findings.

Ethics

Ethics Committee Approval: The study was approved by the Manisa Celal Bayar University Ethics Committee (approval number: 20.478.486/1044, date: 01.12.2021).

Informed Consent: Retrospective study.

Peer-review: Externally and internally peer-reviewed.

Author Contributions

Surgical and Medical Practices: E.N.A.Ö., P.E., Concept: E.N.A.Ö., P.E., Design: E.N.A.Ö., P.E., Data Collection and/or Processing: E.N.A.Ö., Analysis and/or Interpretation: E.N.A.Ö., P.E., Literature Search: E.N.A.Ö., P.E., Writing: E.N.A.Ö.

Conflict of Interest: The authors have no conflict of interest to declare.

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