

The value of hematological inflammatory parameters in the differential diagnosis of testicular torsion and epididymo-orchitis in children

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ABSTRACT

Aim: To investigate the value of neutrophil lymphocyte ratio (NLR) and platelet lymphocyte ratio (PLR) in differentiating acute scrotal conditions.

Methods: A total of 60 patients, including 30 epididymo-orchitis and 30 testicular torsions, diagnosed and treated in our clinic between January 1, 2010 and December 2022, were included in the study. The patients were divided into two groups; group 1 (testicular torsion = TT) and Group 2 (epididymo-orchitis = EO). The age, diagnosis, and hemogram parameters of the patients were evaluated.

Results: Both Group 1 and Group 2 consisted of 30 patients each. The mean ages of group 1 and 2 were 13.7, and 11.2 years, respectively ($p > 0.05$). When compared to the group 2, NLR was higher in the group 2 ($p < 0.05$). There was no statistically significant difference between the groups in terms of PLR value ($p > 0.05$).

ROC analysis was performed for NLR. According to the ROC analysis; at a cut-off value of 2.92, the sensitivity was 51% and the specificity was 87%, AUC (0.79; CI: 0.694 - 0.896).

Conclusion: TT and EO can be diagnosed using inflammatory markers such as NLR. However, additional prospective studies are needed.

Key words: Testicular torsion, epididymo-orchitis, children, neutrophil lymphocyte ratio (NLR), platelet lymphocyte ratio (PLR).

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Introduction

TT is a pediatric urological emergency that is characterized by the rotation of the testis and epididymis around the spermatic vessels. As a direct consequence of this rotation, the testis

experiences an abrupt interruption in its blood supply [1]. If the torsion is not immediately corrected, it has the potential to cause ischemic damage to the testis or even testicular necrosis. In patients younger than 18 years old, the incidence of TT is approximately 3.8 per 100,000 [1,2]. There is a peak between the ages of 0–12 months and 13–16 years, but it is distributed across all age groups. After TT, the hours between 4 and 8 are considered the "golden time" to save the testicle. Before further consideration of orchiopexy or orchiectomy is given to a

patient with a suspected case of TT, an early surgical exploration should be carried out on the patient in order to evaluate the viability of the testis that is twisted [3].

Research has shown that readily obtainable measures such as the neutrophil-lymphocyte ratio (NLR), platelet lymphocyte ratio (PLR), and mean platelet volume (MPV) can be beneficial in diagnosing and monitoring a range of diseases, including cancer, infections, and inflammatory events [4]. EO has been the subject of a significant number of studies, all of which have reported an increase in inflammatory markers. On the other hand, research has shown that the damage caused by hypoxia to the testicular tissue can also increase these inflammatory markers in cases of TT [3,4].

The objective of this study is to compare the NLR and PLR values, which are both obtainable from diagnostic procedures that are routinely carried out to differentiate between acute scrotal pathologies.

Materials and methods

Patients and groups: This study included 60 patients, 30 with EO and 30 with TT, who were diagnosed and treated at Dicle University's pediatric surgery clinic from January 1, 2010, to December 2022. Patient data was reviewed retrospectively. Patients were categorized into two groups: Group 1 (TT) and Group 2 (EO). Factors such as patient age, diagnosis, and hemogram results were analyzed.

Inclusion criteria: Being <18 years old, having a diagnosis of TT or EO, having been diagnosed and treated in our clinic, and having regular retrospective data were the inclusion criteria. Only patients who presented within 24 hours of symptom onset were included in our study.

Exclusion criteria: Patients aged >18 years, TT in the neonatal period, inconsistency of

retrospective data, and comorbidity were the exclusion criteria. Patients who had symptoms for more than 24 hours were excluded from the study.

Ethical approval: Ethical approval was obtained from Dicle University's non-interventional ethics committee with the number (No: 61, Date: 28.02.2023)

Statistical analysis: The analysis of patient data was conducted using statistical methods, including summarizing statistics, calculating frequency, and examining other attributes across all categories. Numerical data were presented as the mean \pm standard deviation. The Shapiro-Wilk and Kolmogorov-Smirnov tests were utilized to assess the normality of continuous variables. The Student's T-test was employed to compare normally distributed continuous variables. Non-parametric tests were selected when the data did not follow a normal distribution. The sensitivity and specificity of the data were examined using ROC analysis. The data was processed using SPSS Statistics for Windows, Version 24.0 (IBM Corp., Armonk, NY, USA). All p values were two-tailed, and a p value of ≤ 0.05 was deemed to be statistically significant.

Results

In our study, we compared two groups each consisting of 30 patients. The mean age in Group 1 was 13.7 ± 3.9 years, while in Group 2 it was 11.2 ± 6.3 years ($p > 0.05$). The duration of symptoms was comparable between the two groups, with a mean of 16 hours (± 6) for Group 1 and 15 hours (± 6.5) for Group 2 ($p > 0.05$). There were no comorbidities reported in either group. Ultrasonography was performed on all patients in both groups ($p > 0.05$). The frequency of elevated C-reactive protein (CRP) levels was slightly higher in Group 1 (43%, $n=13$) compared to Group 2 (36%, $n=11$), but this difference was

Table 1. Comparisons between the groups.

Characteristics	Group 1 (n=30)	Group 2 (n=30)	p -value
Age (years)*	13.7±3.9	11.2±6.3	>0.05
Symptoms duration (h)*	16±6	15±6.5	>0.05
Comorbidity	0	0	>0.05
Performing ultrasonography	30(100%)	30(100%)	>0.05
High CRP	13(43%)	11(36%)	>0.05
High WBC	17(56%)	14(46%)	>0.05
High Neutrophil	13(43%)	12(40%)	>0.05
NLR#	3.41 (1.8-5.7)	2.6 (1.5-3.9)	<0.05
PLR#	127.8 (91-192)	134 (87-179)	>0.05

* mean±SD, # median (IQR)

not statistically significant ($p>0.05$). Similarly, a high white blood cell (WBC) count was observed more in Group 1 (56%, $n=17$) than in Group 2 (46%, $n=14$), but the difference was not significant ($p>0.05$). The same trend was observed for elevated neutrophil count with 43% ($n=13$) in Group 1 and 40% ($n=12$) in Group 2 ($p>0.05$). The only statistically significant difference found between the two groups was in the Neutrophil-to-Lymphocyte Ratio (NLR). Group 1 had a median NLR of 3.41 (range 1.8-5.7), while Group 2 had a median NLR of 2.6 (range 1.5-3.9) ($p<0.05$). The Platelet-to-Lymphocyte Ratio (PLR) was similar in both groups with a median of 127.8 (range 91-192) in Group 1 and 134 (range 87-179) in Group 2 ($p>0.05$). (Table 1).

A Receiver Operating Characteristic (ROC) analysis was conducted for the Neutrophil-to-Lymphocyte Ratio (NLR), as illustrated in Figure 1. The ROC analysis demonstrated that at a cut-off value of 2.92 for NLR for predicting TT, the

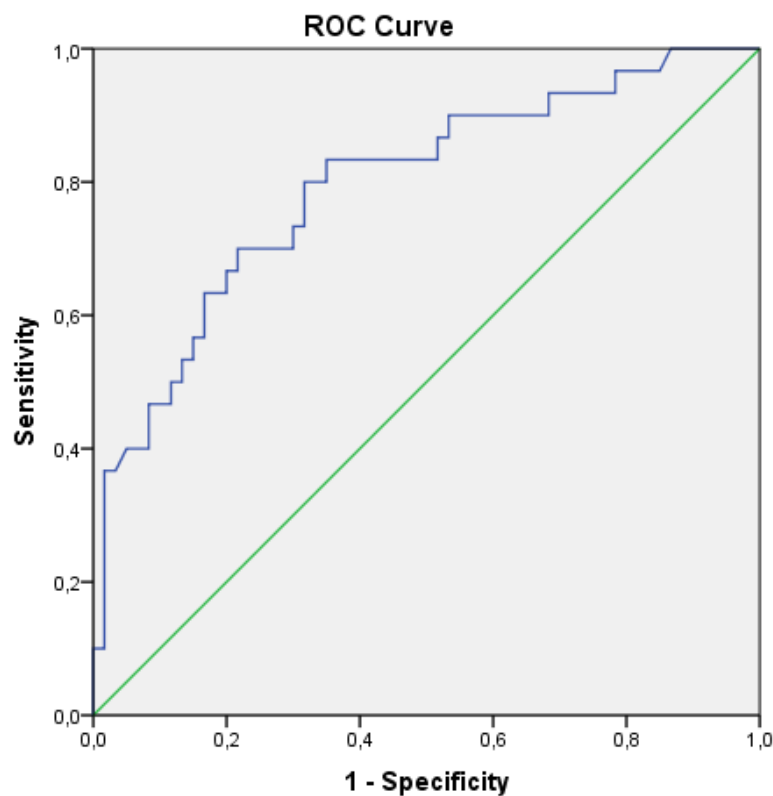
sensitivity was 51% and the specificity was 87%. The AUC was 0.79, indicating good accuracy in the test's diagnostic ability. The confidence interval for the AUC was between 0.694 and 0.896, as shown in Table 2.

Discussion

In the field of pediatric urology, the acute scrotum is a disease that requires an emergency diagnosis and treatment. If the treatment is not administered as soon as possible, the patient could end up losing one or both of their testicles. EO and TT are the two conditions that are responsible for acute scrotum the majority of the time [1-4]. Both diseases are characterized by the presence of a pathological inflammatory process. Several parameters were investigated in order to arrive at an accurate diagnosis of both diseases. For example, acute phase reactants like erythrocyte sedimentation rate and C-reactive protein were found to be elevated in patients with

Table 2. ROC analysis for comparing the groups.

	Cut-off value	Sensitivity	Specificity	AUC (95%CI)
NLR	>2.92	0.51	0.87	0.79 (0.694 - 0.896)

**Figure 1:** ROC analysis for neutrophil-lymphocyte ratio (NLR).

TT. In addition, the levels of procalcitonin were analyzed in groups of rats suffering from EO and TT. The results showed that the levels of procalcitonin were significantly higher in the EO group [2-4].

Our findings regarding the levels of C-reactive protein (CRP), white blood cell (WBC) count, and neutrophil count are consistent with the literature [1,2], suggesting that these markers can rise in response to inflammation, but may not be specific or sensitive enough to differentiate between patient groups or predict outcomes.

Ovarian and testicular pathologies may share identical inflammatory markers due to the fact

that they both developed from the same embryological foundation. No statistically significant difference was found between adnexal torsion and ovarian cyst rupture when comparing adnexal pathologies in the research conducted by Soysal et al., in terms of the NLR. This was the finding of the study that compared adnexal pathologies. In addition, the group of patients with non-ruptured ovarian cysts had quantitatively higher NLR values [5].

In their study, Gunes et al [6] evaluated cut-off points and reported significances for NLR, PLR, and MPV values. There was no statistically significant difference between PLR, NLR, and

MPV values in the extensive study by Yücel et al [7] using inflammatory markers for the diagnostic differentiation of EO and TT. However, these studies are not purely pediatric studies but consist entirely of adult patients. From this point of view, our study is the first to compare TT and EO in terms of diagnostic NLR and values in children. In our study, when compared to the EO, NLR was higher in the TT group ($p < 0.05$). There was no statistically significant difference between the groups in terms of PLR value ($p > 0.05$).

Leucocyte counts had a sensitivity of 58% and a specificity of 80% in a study of patients with TT, whereas MPV had a sensitivity of 62% and a specificity of 96% [8]. In another study, leucocyte counts had a sensitivity of 80% and a specificity of 86.5% in patients with TT, compared to 76.5% and 73.1% for MPV [9]. The cut-off values for NLR and PLR for the diagnosis of TT were discovered to be 2.88 (AUC: 0.73, sensitivity 57%, specificity 87%) and 137 (AUC: 0.61, sensitivity 44%, specificity 86%), respectively. While the predictive cut-off values for NLR and PLR for the diagnosis of EO were found to be 1.62 (AUC: 0.68, sensitivity 76%, specificity 57%) and 137 (AUC: 0.67, sensitivity 48%, specificity 86%), respectively [10]. However, another limitation of our study is that we only studied NLR and PLR. We performed ROC analysis for NLR. According to the ROC analysis; at a cut-off value of 2.92, the sensitivity was 51% and the specificity was 87%, AUC (0.79; CI: 0.694 - 0.896).

The limitations of the study is based on retrospective data, which is inherently limited by the accuracy and completeness of the records reviewed. There may be missing data or inaccuracies that could potentially influence the results. The study includes a relatively small sample size of only 60 patients. This may limit the statistical power of the study and its ability to

detect significant differences between groups. The study compares two groups with different conditions, which allows for a direct comparison of the diagnostic values in different clinical situations. According to the text, this is the first study to compare TT and EO in terms of diagnostic NLR and PLR values in children, which could contribute to a better understanding of these conditions.

Conclusions

TT or/and EO can be diagnosed using inflammatory markers such as NLR. However, additional prospective studies with specifically defined inclusion/exclusion criteria are needed to clarify the contradictory data of the literature in order to determine the differential diagnostic usefulness of NLR.

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