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Predictive role of hematological parameters in testicular torsion and epididymo-orchitis in adolescents

Adolesanlarda testis torsiyonu ve epididimo-orşit tanısında hematolojik parametrelerin öngörücü rolü

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ABSTRACT

OBJECTIVE: This study aimed to evaluate the effects of epididymo-orchitis and testicular torsion on hematological parameters in adolescents.

MATERIAL and METHODS: The data of the patients who applied to the tertiary health care institution between 2018 and 2023 with complaints of acute scrotal pain were evaluated retrospectively. Adolescent patients diagnosed with epididymo-orchitis and testicular torsion were included in the study. Complete blood count parameters (Neutrophil, lymphocyte, monocyte, platelet counts, and mean platelet volume) and inflammation markers (LMR, NLR, PLR, SII index, SIRI index) were compared between testicular torsion and epi-didymo-orchitis groups. In addition, the data of patients with testicular torsion were compared between those with testicular fixation and those with orchiectomy.

RESULTS: Forty patients were in the testicular torsion group, and 54 were in the epididymo-orchitis group. Mean lymphocyte counts and platelet counts were statistically significantly higher in the epididymo-orchitis group (p=0.001 and p=0.008, respectively). The median neutrophil count was higher in the torsion group (p=0.001). The median LMR value was statistically higher in the epididymo-orchitis group, while median NLR and median PLR values were higher in the torsion group (p=0.003, p=0.001, and p=0.019, respectively). The median SII and SIRI values were statistically significantly higher in the torsion group. The median monocyte count was significantly higher in the orchiectomy group com-pared to the fixation group (p=0.001). The median LMR value was 4.1 in the fixation group and 2.2 in the orchiectomy group (p=0.025). The median SIRI value was 1.9 in the fixation group and 4.6 in the orchiectomy group (p=0.012).

CONCLUSION: Since testicular torsion is an ischemic process other than inflammation, it affects hematologic parame-ters more than epididymo-orchitis in the early period. In torsion patients, monocyte count, LMR value and SIRI index may predict the possibility of orchiectomy.

Keywords: adolescent, complete blood count, epididymo-orchitis, testicular torsion

ÖZ

AMAÇ: Bu çalışmanın amacı adolesanlarda epididimo-orşit ve testis torsiyonunun hematolojik parametreler üzerine etkilerini değerlendirmektir.

GEREÇ ve YÖNTEMLER: 2018–2023 yılları arasında üçüncü basamak sağlık kuruluşuna akut skrotal ağrı şikâyeti ile başvuran hastaların verileri retrospektif olarak değerlendirildi. Epididimo-orşit ve testis torsiyonu tanısı alan adolesan hastalar çalışmaya dâhil edildi. Tam kan sayımı parametreleri (Nötrofil, lenfosit, monosit, trombosit sayıları ve ortalama trombosit hacmi) ve enflamasyon belir-teçleri (LMR, NLR, PLR, SII endeksi, SIRI endeksi) testis torsiyonu ve epididimo-orşit grup-ları arasında karşılaştırıldı. Ayrıca, testis torsiyonu olan hastaların verileri testis tespiti yapılanlar ile orşiektomi yapılanlar arasında karşılaştırıldı.

BULGULAR: Kırk hasta testis torsiyonu grubunda ve 54 hasta epididimo-orşit grubundaydı. Ortalama len-fosit ve trombosit sayıları epididimo-orşit grubunda istatistiksel olarak anlamlı derecede yük-sekti (sırasıyla p=0,001 ve p=0,008). Medyan nötrofil sayısı torsiyon grubunda daha yüksekti (p=0,001). Medyan LMR değeri epididimo-orşit grubunda istatistiksel olarak daha yüksek-ken, medyan NLR ve medyan PLR değerleri torsiyon grubunda daha yüksekti (sırasıyla p=0,003, p=0,001 ve p=0,019). Ortanca SII ve SIRI değerleri torsiyon grubunda istatistiksel olarak anlamlı derecede yüksekti. Orşiektomi grubunda medyan monosit sayısı tespit grubuna kıyasla anlamlı derecede yüksekti (p=0,001). Ortanca LMR değeri tespit gru-bunda 4,1 iken orşiektomi grubunda 2,2 idi (p=0,025). Ortanca SIRI değeri tespit grubunda 1,9 iken orşiektomi grubunda 4,6 idi (p=0,012).

SONUÇ: Testis torsiyonu enflamasyon dışında iskemik bir süreç olduğu için erken dönemde hemato lojik parametreleri epididimo-orşite göre daha fazla etkilemektedir. Torsiyon hastalarında monosit sayısı, LMR değeri ve SIRI endeksi orşiektomi olasılığını öngörebilir.

Anahtar Kelimeler: adolesan, tam kan sayımı, epididimo-orşit, testis torsiyonu

INTRODUCTION

Acute scrotum pain may be due to many pathologies, especially epididymo-orchitis and testicular torsion. Early diagnosis and prompt treatment are important to prevent testicular damage. Differential diagnosis based on physical examination findings alone is often challenging, and Doppler ultrasonography (USG) is frequently required

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for accurate diagnosis. Epididymo-orchitis can occur for many reasons, such as infection, trauma, inflammation, and anatomical disorders. Although the incidence of epididymo-orchitis in children is not known precisely, it is seen especially in early adolescence.[1]

Testicular torsion is a condition that requires immediate intervention caused by the rotation of the spermatic cord around itself. Incidence of testicular torsion increases in the neonatal and pubertal period in children.[2] The time from the beginning of the complaints to the surgical intervention is important for the prognosis of testicular loss.[3] The probability of orchiectomy increases to 5% in those operated on within the first 6 hours and 80% for periods longer than 24 hours.[4]

Complete blood count (CBC) is frequently used as a fast and relatively inexpensive test in clinical practice. In addition to neutrophil, lymphocyte and platelet values, mean platelet volume (MPV), lymphocyte-to-monocyte ratio (LMR), neutrophil-to-lymphocyte ratio (NLR), and platelet-to-lymphocyte ratio (PLR) values are affected by inflammation. It is also known that there is a relationship between inflammation and the Systemic Immunoinflammatory Index (SII) calculated using hemogram parameters.[5] There are many studies on the relationship between testicular pathologies and hematological parameters.[6,7] However, to our knowledge, no study exists on the relationship between the acute scrotum and hematologic parameters in adolescents.

In the present study, we aimed to evaluate the effects of epididymo-orchitis and testicular torsion on hematological parameters in adolescents. We also evaluated the relationship between the risk of testicular loss due to testicular torsion and hematological parameters.

MATERIALS and METHODS

The data of the patients who applied to the tertiary health care institution's emergency department and urology clinic between April 2018 and January 2023 with complaints of acute scrotal pain were evaluated retrospectively. Local ethics committee approval was obtained (Haseki Training and Research Hospital Local Ethics Committee, decision no: 50-2023, date: 15.03.2023), and the study was designed following the principles of the Declaration of Helsinki. Demographic data, laboratory results, USG findings, and the clinical course of the patients were noted using the hospital database.

Adolescent patients (10–18 years old) diagnosed with epididymo-orchitis and testicular torsion were included in the study. The data of the patients who had less than 24 hours between the onset of the complaint and the time of admission to the hospital were included in the study. All patients underwent physical examination and were evaluated with Doppler USG. Blood samples were taken from the patients to evaluate the CBC. The diagnosis of epididymo-orchitis was made with signs of infection on physical examination and findings such as increased blood flow and epididymal edema on Doppler USG. The diagnosis of testicular torsion was made by the twisted spermatic cord observed during emergency scrotal exploration. After the exploration, the testis was detorsioned and waited for 10 minutes by heating with saline. Fresh blood flow was examined through the tunica albuginea incision. Bilateral orchiopexy was applied to patients with fresh blood flow; other patients underwent orchiectomy.

The study did not include patients with any other infectious disease at admission. In addition, patients with hematological disease, patients who underwent surgery or used any medication in the last three months, patients with diabetes mellitus or a malignancy history, and patients with missing data were excluded from the study. The blood samples of the patients were evaluated in the same laboratory. Neutrophil, lymphocyte, monocyte, platelet counts, and mean platelet volume (MPV) were noted. LMR, NLR and PLR values were calculated and recorded. Systemic immunoinflammatory index value was calculated with the formula neutrophil × platelet/lymphocyte. SIRI was described as follows: SIRI=(neutrophil × monocyte)/lymphocyte.

Statistical Analysis

The Statistical Package for the Social Sciences (IBM Statistical Package for Social Sciences (SPSS), IBM Corp., Armonk, NY, USA) program version 26 was used. The normality of the distribution of the variables was checked by the Shapiro-Wilk test. Independent Student's t-test was used to compare the normally distributed variable between the groups, and the Mann-Whitney U test was used for non-normally distributed data. Quantitative data are given as mean ± standard deviation or median (interquartile range). Categorical variables were grouped and compared using the χ^2 or Fisher's exact test. Multivariate analysis was performed with the binary logistic analysis method with statistically significant values in the univariate analysis. The data were analyzed at a 95% confidence level, and a p-value of less than 0.05 was accepted as statistically significant.

RESULTS

The flow chart for the patients included in the study is shown in Figure 1. Data from 226 patients were evaluated,

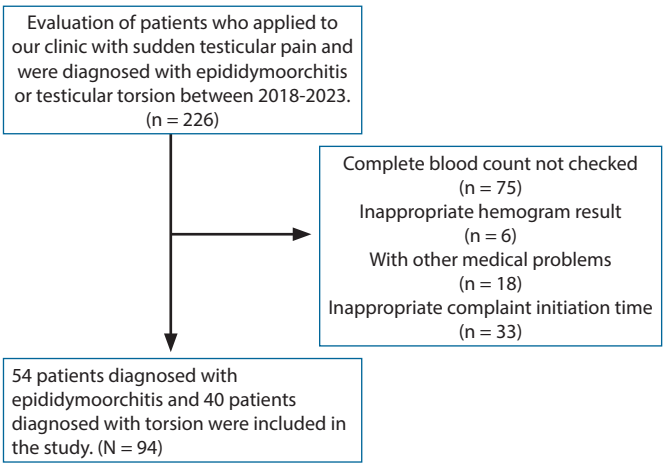

Figure 1.

and 94 patients who met the criteria were included in the study. Forty patients were in the testicular torsion group, and 54 were in the epididymo-orchitis group.

The median age was 15.0 years in the testicular torsion group and 13.0 years in the epididymo-orchitis group (p=0.108). Nine patients (22.5%) in the torsion group and 15 patients (27.8%) in the epididymo-orchitis group were admitted to the hospital within the first 6 hours after the onset of symptoms. Mean lymphocyte counts and platelet counts were statistically significantly higher in the epididymo-orchitis group (p=0.001 and p=0.008, respectively). The median neutrophil count was higher in the torsion group (8.4 and 4.8; p=0.001). Median monocyte counts and mean MPV values were similar between the groups (p=0.296 and p=0.420, respectively). The median LMR value was statistically higher in the epididymo-orchitis group, while median NLR and median PLR values were higher in the torsion group (p=0.003, p=0.001, and p=0.019, respectively). The median SII value was 1279 in the torsion group and 589 in the epididymo-orchitis group (p=0.001). Similarly, the median SIRI value was statistically significantly higher in the torsion group (2.8 and 1.2, p=0.001) (Table 1).

Patients operated on with the diagnosis of testicular torsion were grouped as those with testicular fixation and those with orchiectomy, and the comparison of the data is shown in Table 2. Twenty-four patients underwent testicular fixation, and 16 patients underwent orchiectomy. The mean age of the patients was similar between the groups (p=0.939). While 9 (37.5%) patients in the testicular fixation group presented in the first 6 hours, this number was 0 in the orchiectomy group (p=0.005). Median lymphocyte counts, mean neutrophil counts, mean platelet counts, and mean MPV were similar between the groups (p=0.066, p=0.090, p=0.100, and p=0.786, respectively). The median monocyte count was significantly higher in

Table 1. Comparison of demographic data and hematologic parameters between patients with testicular torsion and epididymoorchitis

	Testicular Torsion (n=40)	*Epididymo-orchitis (n=54)*	*P value*
Age (years)**	15.0 (13.0–16.0)	13.0 (11.8–16.3)	0.108
Duration of complaint (hours) <6 hr >6 hr	 9 (22.5%) 31 (77.5%)	 15 (27.8%) 39 (72.2%)	0.562
Side Right Left	 22 (55.0%) 18 (45.0%)	 30 (55.6%) 24 (44.4%)	0.957
Lymphocytes (n×10^9/L)*	1.9±0.8	2.7±0.9	0.001
Monocytes (n×10^9/L)**	0.5 (0.4–0.8)	0.6 (0.5–0.8)	0.296
Neutrophils (n×10^9/L)**	8.4 (5.9–11.4)	4.8 (3.7–7.2)	0.001
Platelets (n×10^9/L)*	270.8±73.8	315.4±83.1	0.008
MPV (fL)*	9.8±0.8	9.6±1.1	0.420
LMR**	2.6 (2.0–4.2)	4.2 (3.3–5.2)	0.003
NLR**	4.6 (3.1–7.7)	1.8 (1.3–3.1)	0.001
PLR**	152.0 (108.2–187.0)	125.1 (93.3–149.7)	0.019
SII (×10^9/L)**	1279.0 (807.0–1965.0)	589.0 (349.0–1024.0)	0.001
SIRI (×10^9/L)**	2.8 (1.5–5.2)	1.2 (0.7–1.8)	0.001

***mean:** standard deviation; ****mean:** interquartile range
WBC: white blood cells; **LMR:** lymphocyte-to-monocyte ratio; **NLR:** neutrophil-to-lymphocytes ratio; **PLR:** platelet-to-lymphocyte ratio; **PDW:** platelet distribution width; **MPV:** mean platelet volume; **CRP:** C-reactive protein; **SII:** systemic immune-inflammation index; **SIRI:** systemic inflammation response index.

Table 2. Comparison of demographic data and hematologic parameters of testicular fixation and orchiectomy in patients with testicular torsion

	Testicular Fixation (n=24)	*Orchiectomy (n=16)*	*P value*
Age (years)**	14.7±1.9	14.6±1.3	0.939
Duration of complaint (hours) <6 >6	 9 (37.5%) 15 (62.5%)	 – 16 (100%)	0.005
Side Right Left	 15 (62.5%) 9 (37.5%)	 7 (43.8%) 9 (56.2%)	0.243
Lymphocytes (n×10^9/L)**	1.5 (1.0–2.4)	2.4 (1.5–2.6)	0.066
Monocytes (n×10^9/L)**	0.5 (0.3–0.6)	0.9 (0.6–1.2)	0.001
Neutrophils (n×10^9/L)*	7.9±2.9	9.6±3.2	0.090
Platelets (n×10^9/L)*	255.2±74.0	294.4±69.2	0.100
MPV (fL)*	9.8±0.9	9.7±0.8	0.786
LMR**	4.1 (2.2–4.9)	2.2 (1.7–3.2)	0.025
NLR**	4.6 (2.7–9.5)	4.6 (3.3–6.8)	0.720
PLR**	159.1 (104.3–231.3)	149.0 (109.2–166.3)	0.456
SII (×10^9/L)**	1626.4 (685.0–2183.3)	1240.9 (854.1–1648.0)	1.000
SIRI (×10^9/L)**	1.9 (1.2–4.4)	4.6 (2.3–6.2)	0.012

***mean:** standard deviation; ****mean:** interquartile range
WBC: white blood cells; **LMR:** lymphocyte-to-monocyte ratio; **NLR:** neutrophil-to-lymphocytes ratio; **PLR:** platelet-to-lymphocyte ratio; **PDW:** platelet distribution width; **MPV:** mean platelet volume; **CRP:** C-reactive protein; **SII:** systemic immune-inflammation index; **SIRI:** systemic inflammation response index.

Table 3. Multivariate analysis of systemic inflammatory markers for testicular torsion and orchitis diagnoses

	Odds ratio	*%95 CI*	*P value*
LMR	0.632	0.419 – 0.953	0.028
NLR	2.240	1.323–3.790	0.003
PLR	0.980	0.965–0.995	0.010
SII (×10^9/L)	1.001	1.000–1.003	0.106
SIRI (×10^9/L)	0.466	0.296–0.735	0.001

CI: confidence interval; **LMR:** lymphocyte-to-monocyte ratio; **NLR:** neutrophil-to-lymphocytes ratio; **PLR:** platelet-to-lymphocyte ratio; **SII:** systemic immune-inflammation index; **SIRI:** systemic inflammation response index.

the orchiectomy group compared to the fixation group (p=0.001). The median LMR value was 4.1 in the fixation group and 2.2 in the orchiectomy group (p=0.025). Median NLR, median PLR, and median SII values were similar between the groups (p=0.720, p=0.456, and p=1.000, respectively). The median SIRI value was 1.9 in the fixation group and 4.6 in the orchiectomy group (p=0.012).

Statistically significant values in univariate analysis between testicular torsion and orchitis diagnoses and multivariate analysis results are shown in Table 3. LMR, NLR, PLR, and SIRI values were calculated as statistically significant in multivariate analysis for differential diagnosis (p=0.028, p=0.003, p=0.010, and p=0.001; respectively). The SII value was not statistically significant in terms of differential diagnosis in multivariate analysis (p=0.106).

DISCUSSION

Testicular torsion and epididymo-orchitis are the two most important causes of acute scrotal pain in childhood. Both diseases are more common, especially in adolescence. It is very important to quickly reveal the differential diagnosis of these two diseases to protect testicular health. Complete blood count parameters and inflammation values calculated with these parameters have been evaluated for the diagnosis and follow-up of many diseases. There are not enough studies on acute scrotal pain and hematological parameters in adolescence.

Inflammation occurs to preserve tissue integrity and provide hemostasis after acute infection or ischemia.[8] With the onset of this process, serum levels of inflammation markers change rapidly.[9] In recent years, the frequency of

studies on hematological parameters showing the state of inflammation has been increasing.[10,11] NLR is an important parameter that changes in the early phase of inflammation. Lee HY. et al. evaluated acute testicular pathologies in pediatric and adult patients and found a higher NLR value in patients with testicular torsion than those with epididymo-orchitis.[7] Gunes et al. evaluated the patients operated on for testicular torsion and found higher NLR levels in the testicular torsion group compared to the control group.[12] We found that the NLR value was higher in the torsion group than in the epididymo-orchitis group. However, NLR value was not a predictive factor regarding orchiectomy risk in patients operated on for testicular torsion.

Platelet-to-lymphocyte ratio is another parameter used as an inflammation marker. He M. et al. evaluated the hematological parameters of a patient operated on for testicular torsion. The PLR value of the patients who underwent orchiectomy was lower than those who underwent orchiopexy.[6] Imamoglu et al. showed that patients with 2nd and 3rd-stage testicular tumors had higher PLR values compared to low-stage patients.[13] Our study found that the patients with epididymo-orchitis had lower PLR levels than those with testicular torsion. This may be attributed to the fact that epididymo-orchitis is primarily an infectious process rather than an acute ischemic event like testicular torsion. In infections, lymphocyte levels tend to increase due to immune response activation, which may lead to a lower PLR value in comparison to the torsion group. Lymphocyte-to-monocyte ratio value is another parameter associated with inflammation. Li T. et al. showed that a low LMR value indicates poor prognosis in patients with upper urinary tract tumors.[14] Imamoglu et al. showed the association of low LMR value with advanced-stage in testicular tumor patients.[13] Our study found lower LMR values in the testicular torsion group compared to the epididymo-orchitis group. This finding is likely due to the distinct inflammatory responses triggered by these two conditions. Testicular torsion is an acute ischemic event that leads to a rapid and severe inflammatory response dominated by neutrophils, which play a key role in tissue damage and ischemia-reperfusion injury. In contrast, epididymo-orchitis is primarily an infectious-inflammatory process, where lymphocytes and monocytes are more actively involved in the immune response to bacterial or viral pathogens. The higher LMR values observed in epididymo-orchitis may be attributed to a relatively greater increase in lymphocyte levels compared to neutrophil levels, reflecting a more prolonged and regulated immune response rather than the abrupt and severe neutrophilic infiltration seen in torsion cases.

Although the leukocyte count alone indicates inflammation, it alone is insufficient due to the different kinetics of its subsets.[15] For this reason, one of the developed inflammatory markers is the SII index. Studies examine the relationship between the SII index value and many conditions, such as infective, inflammatory and oncological diseases.[16,17] Studies on testicular pathologies with the SII index are limited. Imamoglu et al. evaluated the SII index values of testicular tumor patients. They showed that high-grade cancer progresses with higher SII values in seminoma patients.[13] Our study showed that testicular torsion was associated with higher SII levels than epididymo-orchitis. Testicular torsion is an acute ischemic event that triggers a rapid and intense inflammatory response characterized by neutrophil activation and platelet aggregation due to vascular occlusion and subsequent ischemia-reperfusion injury. The surge in neutrophil and platelet levels during this process likely contributes to the elevated SII index in torsion cases. Conversely, epididymo-orchitis is primarily an infectious-inflammatory condition in which the immune response is more regulated and involves a gradual increase in lymphocytes and monocytes rather than an overwhelming neutrophilic reaction. This may explain why SII levels are lower in epididymo-orchitis compared to testicular torsion.

Another systemic inflammation index is SIRI. Studies on the importance of SIRI value regarding diagnosis, follow-up and prognosis of some diseases have been increasing in recent years. Lv Z et al. showed that the SIRI value is associated with the prognosis of the disease in patients with renal cell carcinoma with a vena cava thrombus.[18] Yek et al. showed that the SIRI value could predict the prognostic effect of intravesical Bacillus Calmette-Guerin treatment in non-muscle invasive bladder cancer patients.[19] Studies on the SIRI index relationship of testicular pathologies are limited in the literature. In our study, the SIRI value was higher in testicular torsion patients than in epididymo-orchitis patients. In addition, the probability of orchiectomy due to testicular torsion increases in patients with a high SIRI value.

Testicular torsion is an ischemic process that causes rapid inflammation.[20] Epididymo-orchitis is a pathology characterized by inflammation only. The more severe change in inflammation markers in testicular torsion compared to epididymo-orchitis is considered secondary to this condition. The acute inflammation process starts with neutrophil dominance in the first hours and increases monocyte levels as the 24th-hour approaches.[21] The most important parameter related to testicular loss in patients with testicular torsion is the time elapsed after the complaint. The risk of orchiectomy increases after the critical first 6-hour period. Our study showed that monocyte count and monocyte-containing formulas, LMR, and SIRI values could predict the possibility of orchiectomy.

The retrospective design of the study can be cited as a limitation. In addition, the duration of symptoms of the patients was noted according to their reports. Ultrasonographic findings were considered in evaluating the patients, and the results may vary depending on the radiologist's interpretation. The results should be supported by studies to be planned prospectively with higher patient numbers.

CONCLUSION

Our study revealed the importance of hematologic parameters in adolescents diagnosed with acute scrotum. Since testicular torsion is not only an inflammatory process but also a severe ischemic event, it triggers a much more pronounced and rapid hematologic response compared to epididymo-orchitis, particularly in the early period. This leads to a significant increase in neutrophil count, platelet activation, and systemic inflammatory markers, distinguishing it from the more gradual immune response observed in epididymo-orchitis. In torsion patients, monocyte count, LMR value and SIRI index may predict the possibility of orchiectomy.

Ethics Committee Approval
The study was approved by Haseki Training and Research Hospital Local Ethics Committee. (date and number of approval: 15.03.2023/50-2023).

Peer-review
Externally peer-reviewed.

Conflict of Interest
No conflict of interest was declared by the authors.

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