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Diagnostic value of immature granulocytes in the differential diagnosis of testicular torsion and epididymo-orchitis in acute scrotum

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ABSTRACT

Aims: This study aimed to evaluate the discriminatory performance of immature granulocyte (IG) count in differentiating testicular torsion from epididymo-orchitis.

Methods: In this retrospective observational study, 27 patients with testicular torsion, 65 patients with epididymo-orchitis and 90 control group who presented with acute scrotal pain between May 2023 and December 2025 were included. White blood cell (WBC) count, neutrophil-to-lymphocyte ratio (NLR), C-reactive protein (CRP), immature granulocyte count (IG) and IG percentage (IG%) were evaluated in all participants. The diagnostic performance of these parameters was assessed using receiver operating characteristic (ROC) curve analysis and independent predictors were determined by multivariable logistic regression analysis.

Results: WBC, NLR, CRP, IG and IG% levels were significantly higher in the epididymo-orchitis group compared to both the testicular torsion and control groups (all $p<0.001$). In differentiating epididymo-orchitis from testicular torsion, CRP demonstrated the highest diagnostic performance (AUC=0.86, 95% CI: 0.79-0.92), followed by NLR (AUC=0.83), IG (AUC=0.82), WBC (AUC=0.80) and IG% (AUC=0.79) (all $p<0.001$). In multivariable logistic regression analysis; IG (OR=2.85, 95% CI: 1.46-4.25, $p<0.05$), NLR (OR=1.75, 95% CI: 1.20-2.55, $p<0.05$) and CRP (OR=1.08, 95% CI: 1.02-1.15, $p<0.05$) were identified as independently associated with epididymo-orchitis. In a secondary model additionally adjusted for symptom duration, IG remained independently associated with epididymo-orchitis (OR=2.40, 95% CI: 1.20-5.10, $p<0.05$).

Conclusion: IG count may provide complementary information in the differential assessment of testicular torsion and epididymo-orchitis. These findings should be interpreted as supplementary to clinical assessment and imaging and should not be used to exclude testicular torsion or delay definitive management.

Keywords: Biomarkers, diagnosis, epididymitis, orchitis, spermatic cord torsion

INTRODUCTION

Acute scrotum is a urological emergency characterized by sudden scrotal pain and swelling. Testicular torsion and epididymo-orchitis are among the most common and difficult to diagnose causes of acute scrotum.[1] The primary goal in the evaluation of acute scrotum is to promptly identify or exclude testicular torsion using clinical assessment and appropriate imaging while avoiding delays in definitive management. Testicular torsion is a urological emergency requiring surgical intervention, as delay in diagnosis and treatment can lead to testicular ischemia and irreversible damage. Therefore, early diagnosis and prompt intervention are critical for testicular salvage.[2] While patient history and physical examination play a significant role in evaluating acute scrotal pain, scrotal doppler ultrasonography is commonly used to assess testicular perfusion and differentiate testicular torsion from inflammatory causes.[3] Although doppler ultrasonography has high diagnostic accuracy in the evaluation of acute scrotum, diagnostic limitations may occur particularly in early or equivocal cases.[4-5] Therefore, additional laboratory parameters may provide complementary information regarding the inflammatory profile of patients with acute scrotal pain. However, such laboratory findings should be interpreted only in conjunction with clinical assessment and appropriate imaging. Importantly, inflammatory biomarkers should be regarded only as adjunctive parameters and should not be used to exclude testicular torsion, delay surgical exploration, or override clinical or radiological indications for urgent surgical management.

Laboratory parameters such as white blood cell (WBC) count, neutrophil to lymphocyte ratio (NLR) and C-reactive protein (CRP) are commonly used biomarkers of inflammation.[6-7] Immature granulocyte count (IG) are immature myeloid cells that can be measured in peripheral blood during routine

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complete blood counts and reflect an early bone marrow response to inflammatory stimuli.[8] Previous studies have shown that IG levels increase in infectious and inflammatory conditions and may serve as indicators of systemic inflammatory response.[9]

However, the discriminatory performance of IG parameters in the differential diagnosis of acute scrotal pathologies has not been sufficiently investigated. In this study, we aimed to investigate the diagnostic performance of IG count and percentage in differentiating epididymo-orchitis from testicular torsion in patients presenting with acute scrotum, as potential adjunctive laboratory parameters alongside clinical assessment and imaging.

METHODS

Ethics

This study was conducted with the approval of the Osmaniye Korkut Ata University Health Sciences Researches Ethics Committee (Date: 02.03.2026, Decision No: 3). All procedures were carried out in accordance with the ethical rules and the principles of the Declaration of Helsinki.

Study Design and Population

This retrospective observational study was conducted at the Urology Department of Osmaniye Training and Research Hospital. Medical records of patients presenting with acute scrotal pain between May 2023 and December 2025 were reviewed. A total of 92 patients with acute scrotal pain and 90 males control subjects were included in the analysis. This retrospective observational study was designed and reported in accordance with the STARD (Standards for Reporting Diagnostic Accuracy Studies) guidelines, which are recommended for reporting diagnostic accuracy studies.

Patient data were retrospectively retrieved from hospital electronic medical records and archive systems using International Classification of Diseases (ICD) codes. The patient group consisted of individuals diagnosed with and treated for testicular torsion or epididymo-orchitis. Testicular torsion was diagnosed based on surgical exploration findings when surgery was performed, together with compatible clinical and Doppler ultrasonographic findings. Epididymo-orchitis was diagnosed based on compatible clinical findings, laboratory results, and Doppler ultrasonographic findings. The control group consisted of patients presenting with acute scrotal pain who were evaluated clinically and radiologically. The reference standard was based on the final clinical diagnosis, supported by scrotal Doppler ultrasonography in all groups and by surgical exploration when performed for suspected testicular torsion. Surgical exploration was not performed routinely in patients with epididymo-orchitis or non-specific scrotal pain. Inclusion criteria for the study were defined as presentation with acute scrotal pain and diagnosis confirmed by Doppler ultrasonography and/or surgical exploration. Patients with systemic inflammatory disease, scrotal trauma, known scrotal disease, hematological disorders, and incomplete clinical or laboratory data were excluded. In addition, medical records were reviewed for documented concurrent acute infectious or inflammatory conditions unrelated to the acute scrotal presentation, including urinary tract, respiratory, and gastrointestinal infections. Patients with such conditions were excluded from the study. All eligible patients were included consecutively during the planned study period. The patient selection flowchart is presented in **Figure 1**.

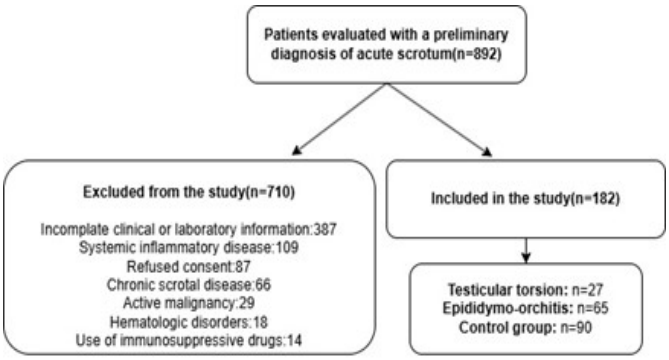


Figure 1. Patient flow diagram

Data Collection

Demographic and clinical data were recorded, including age, symptom duration (hours), presence of fever, and nausea/vomiting. The following laboratory parameters were recorded for all included participants: WBC, Neutrophil-To-Lymphocyte Ratio (NLR), IG count, immature granulocyte percentage (IG%) and CRP. Body temperature ≥38°C was defined as fever and recorded as present/absent. Symptom duration was defined as the time interval between the onset of scrotal pain and hospital admission and recorded in hours. All laboratory measurements were performed on a single standardized automated hematology analyzer subjected to routine daily calibration and quality control procedures.

Statistical Analysis

The data were performed using IBM SPSS Statistics for Windows, Version 27.0 (IBM Corp., Armonk, NY, USA). The distribution of continuous variables was assessed using Kolmogorov-Smirnov and Shapiro-Wilk tests, as well as skewness and kurtosis values. Categorical variables were analyzed using the Chi-square test. For continuous variables that did not conform to a normal distribution, the Mann-Whitney U test was used for comparisons between two groups, and the Kruskal-Wallis test was used for comparisons between three or more groups. Post-hoc pairwise comparisons were performed using the Dunn test with Bonferroni correction. Results were expressed as median and interquartile range (IQR).

The diagnostic performance of the variables was evaluated using receiver operating characteristic (ROC) curve analysis based on their continuous values. Area under the curve (AUC), optimal cutoff values, sensitivity, specificity, and 95% confidence intervals (CI) were calculated. The statistical significance of the AUC was assessed against the null hypothesis of an AUC of 0.50. Pairwise comparisons of AUCs were performed using DeLong's test.

Independent predictors of the differential diagnosis of testicular torsion and epididymo-orchitis were determined

using multivariable logistic regression analysis. Variables with p<0.05 in univariate analysis were considered for inclusion in the multivariable model. Age was included a priori as a covariate because of the significant baseline age difference between the study groups. In a secondary model, symptom duration was additionally included a priori because of the substantial difference in symptom duration between groups. A backward stepwise elimination method was then applied to the inflammatory predictors. Odds ratio (OR) and 95% CI were calculated. Model calibration was evaluated using the Hosmer-Lemeshow goodness-of-fit test. Model performance was evaluated using the AUC of estimated probabilities and McFadden's pseudo R^2. Statistical significance was defined as a two-sided p-value <0.05.

RESULTS

A total of 182 individuals were included in the study: 27 patients with testicular torsion, 65 patients with epididymo-orchitis and 90 in the control group. All 90 patients in the control group were ultimately classified as having non specific scrotal pain after testicular torsion and epididymo-orchitis had been excluded based on clinical evaluation, laboratory findings and scrotal doppler ultrasonography. No included patient had a documented concurrent acute infectious or inflammatory condition unrelated to the acute scrotal complaint in the reviewed medical records. A significant age difference was found between the groups (p<0.05). Post-hoc analyses showed that this difference was due to the testicular torsion group while there was no significant difference between the epididymo-orchitis and control groups. Post-hoc Dunn tests with Bonferroni correction showed that all inflammatory parameters were significantly higher in the epididymo-orchitis group than in both the testicular torsion and control groups (all adjusted p<0.001). WBC, NLR, CRP, IG and IG% were also significantly higher in the testicular torsion group than in the control group (all adjusted p<0.001). Data on the age and clinical characteristics of patients in the testicular torsion and epididymo-orchitis groups are given in **Table 1** and comparisons of laboratory parameters among the three groups are presented in **Table 2**.

When comparing the testicular torsion group with the control group, CRP showed strong diagnostic performance in distinguishing testicular torsion from the control group while NLR and WBC showed moderate performance, IG and IG% showed lower discriminatory performance with AUCs of 0.69 and 0.66, respectively (**Table 3**). A consistently significant difference was found in all inflammatory parameters between the epididymo-orchitis and control groups (p<0.001). CRP, WBC, NLR, IG% and IG parameters were observed to have high diagnostic accuracy (**Table 4**).

When evaluating the performance of the inflammatory markers in differentiating epididymo-orchitis from testicular torsion, all markers demonstrated statistically significant discriminatory performance (all p<0.001). However, pairwise comparisons using DeLong's test showed no statistically

Table 1. Demographic and clinical characteristics of study groups

Variable	Testicular torsion (n=27)	Epididymo-orchitis (n=65)	Control (n=90)	p-value
Age (years), median (IQR)	18 (16-21)	27 (23-30)	29 (19-38)	<0.05
Symptom duration (hours), median (IQR)	6 (4-8)	30 (22-38)	23 (5-35)	<0.001
Fever, n (%)	3 (11.1%)	28 (43.1%)	0 (0%)	<0.001
Nausea-vomiting, n (%)	17 (63.0%)	12 (18.5%)	0 (0%)	<0.05

Continuous variables are presented as median (interquartile range, IQR), and categorical variables are presented as number (percentage). Continuous variables were compared using the Kruskal–Wallis test, and categorical variables were compared using the Chi-square test. Statistical significance was set at p<0.05. IQR: Interquartile range

Table 2. Laboratory parameters across study groups

Parameter	Torsion	Epididymo-orchitis	Control	Total	p-value
WBC ($\times10^9$/L), median (IQR)	11.3 (10.2-12.5)	14.4 (12.6-16.7)	7.0 (6.0-8.0)	10.0 (7.0-14.5)	<0.001
NLR, median (IQR)	2.9 (2.3-3.6)	5.3 (4.5-6.4)	2.0 (1.6-2.4)	3.0 (2.0-5.3)	<0.001
CRP (mg/L), median (IQR)	5.6 (4.0-7.2)	22.3 (17.5-26.5)	2.0 (1.5-2.5)	6.0 (2.0-22.3)	<0.001
IG ($\times10^9$/L), median (IQR)	0.02 (0.01-0.03)	0.06 (0.04-0.08)	0.01 (0.005-0.02)	0.03 (0.01-0.06)	<0.001
IG (%), median (IQR)	0.5 (0.3-0.7)	1.4 (0.9-1.9)	0.3 (0.2-0.4)	0.7 (0.3-1.4)	<0.001

Data are expressed as median (interquartile range, IQR). Comparisons among groups were performed using the Kruskal–Wallis test due to non-normal distribution. All inflammatory parameters were measured from routine complete blood count and biochemical analyses. WBC: White blood cell count, NLR: Neutrophil-to-lymphocyte ratio, CRP: C-reactive protein, IG: Immature granulocyte, IQR: Interquartile range

Table 3. Diagnostic performance of inflammatory markers in differentiating testicular torsion from control group

Parameter	Cut-off	Sensitivity (%)	Specificity (%)	AUC (95% CI)	p-value
WBC ($\times10^9$/L)	9.0	85(95% CI: 80-88)	88(95% CI: 85-92)	0.80(0.76-0.84)	<0.05
CRP (mg/L)	3.5	87(95% CI: 82-90)	86(95% CI: 80-90)	0.85(0.80-0.90)	<0.05
NLR	2.4	76(95% CI: 70-80)	77(95% CI: 70-82)	0.77(0.72-0.82)	<0.05
IG ($\times10^9$/L)	0.015	65(95% CI: 60-70)	68(95% CI: 60-75)	0.69(0.65-0.72)	<0.05
IG (%)	0.4	62(95% CI: 58-68)	66(95% CI: 60-70)	0.66(0.60-0.70)	0.05

AUC indicates area under the curve, CI: Confidence interval, WBC: White blood cell count, NLR: Neutrophil-to-lymphocyte ratio, CRP: C-reactive protein, IG: Immature granulocyte, AUC: Area under the curve

Table 4. Diagnostic performance of inflammatory markers in differentiating epididymo-orchitis from control group

Parameter	Cut-off	Sensitivity (%)	Specificity (%)	AUC (95%CI)	p-value
WBC (×10⁹/L)	10.0	94 (95% CI:90-96)	93 (95% CI:90-95)	0.95 (0.93-0.97)	<0.001
CRP (mg/L)	5.0	97 (95% CI:95-99)	95 (95% CI:92-97)	0.97 (0.96-0.99)	<0.001
NLR	3.5	92 (95% CI:88-94)	90 (95% CI:85-92)	0.92 (0.90-0.95)	<0.001
IG (×10⁹/L)	0.025	90 (95% CI:85-92)	89 (95% CI:85-93)	0.90 (0.88-0.94)	<0.001
IG (%)	0.6	88 (95% CI:85-93)	87 (95% CI:85-92)	0.89 (0.88-0.93)	<0.001

Diagnostic performance of inflammatory markers in differentiating epididymo-orchitis from the control group was assessed using receiver operating characteristic (ROC) curve analysis. Cut-off values were determined using the Youden index. Sensitivity and specificity are reported as percentages with 95% confidence intervals. AUC: Area under the curve, CI: Confidence interval, WBC: White blood cell count, NLR: Neutrophil-to-lymphocyte ratio, CRP: C-reactive protein, IG: Immature granulocyte

significant differences between the AUCs (all p>0.05). CRP demonstrated the highest AUC (0.86), followed by NLR (0.83), IG (0.82), WBC (0.80), and IG% (0.79). The AUC for IG was 0.82 (95% CI: 0.75-0.88) while the AUC for IG% was 0.79 (95% CI: 0.71-0.86). The optimal cutoff value for IG, determined using the Youden index, was 0.04×10⁹/L, with a sensitivity of 81% and a specificity of 78% (**Table 5**). The ROC curve analysis of IG and IG% is presented in **Figure 2**.

Table 5. Diagnostic performance of inflammatory markers in differentiating epididymo-orchitis from testicular torsion

Parameter	Optimal cut-off	Sensitivity (%)	Specificity (%)	AUC (95% CI)	p-value
WBC (×10⁹/L)	13.0	75	78	0.80 (0.72-0.88)	<0.001
NLR	4.0	82	80	0.83 (0.72-0.88)	<0.001
CRP (mg/L)	12	85	80	0.86 (0.79-0.92)	<0.001
IG (×10⁹/L)	0.04	81	78	0.82 (0.75-0.88)	<0.001
IG (%)	1.0	78	76	0.79 (0.71-0.86)	<0.001

ROC curve analysis was performed to evaluate the diagnostic performance of inflammatory markers in differentiating epididymo-orchitis from testicular torsion. Optimal cut-off values were determined using the Youden index. Sensitivity and specificity are presented as point estimates (%). AUC values are presented with 95% confidence intervals. AUC: Area under the curve, WBC: White blood cell count, NLR: Neutrophil-to-lymphocyte ratio, CRP: C-reactive protein, IG: Immature granulocyte, CI: Confidence interval, ROC: Receiver operating characteristic

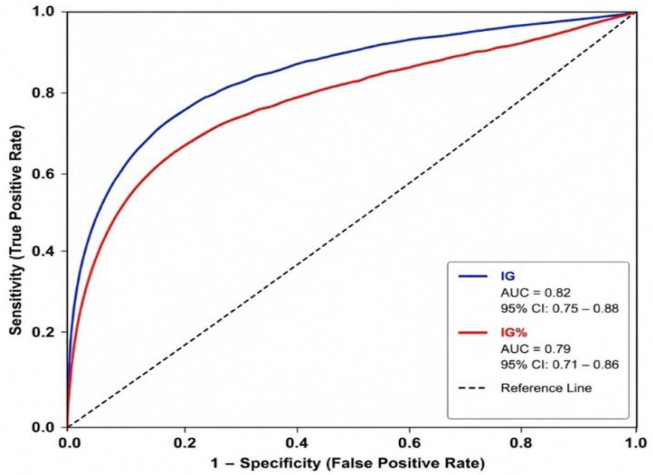


Figure 2. Receiver operating characteristic (ROC) curves of immature granulocyte count (IG) and immature granulocyte percentage (IG%) for differentiating epididymo-orchitis from testicular torsion

The ROC curves were generated using the continuous values of IG and IG%. AUC values with 95% confidence intervals are shown in the legend. IG: Immature granulocytes, AUC: Area under the curve, CI: Confidence interval, IG%: Immature granulocytes percentage, ROC: Receiver operating characteristic. The dashed line represents the reference line

A multivariable logistic regression analysis was performed with age included a priori as a covariate. NLR, CRP and IG were included in the initial model followed by backward stepwise elimination of non significant variables. IG, NLR and CRP remained independently associated with epididymo-orchitis (**Table 6**). IG remained independently associated with epididymo-orchitis after adjustment for age and the other inflammatory markers included in the model. The model showed acceptable explanatory performance with McFadden's pseudo R^2 values ranging from 0.18 to 0.24 depending on the inclusion or exclusion of covariates. To further assess the potential confounding effect of symptom duration, a second multivariable logistic regression model was constructed with age and symptom duration included as a priori covariates. In the multivariable logistic regression analysis, IG remained independently associated with epididymo-orchitis after adjustment for age, symptom duration, and the other inflammatory markers included in the model (OR=2.40, 95% CI: 1.20–5.10, p<0.05) (**Table 7**).

Table 6. Multivariable logistic regression analysis of factors independently associated with epididymo-orchitis

Variable	OR	95% CI	Regression coefficient (β)	p-value
Age (years)	1.06	1.01-1.11	0.06	<0.05
IG (×10⁹/L)	2.85	1.46-4.25	1.05	<0.05
NLR	1.75	1.20-2.55	0.56	<0.05
CRP (mg/L)	1.08	1.02-1.15	0.08	<0.05

Multivariable logistic regression analysis was performed using an age-adjusted model. Variables with p<0.05 in univariate analysis were included in the initial model. OR with 95% CI are reported. β values represent regression coefficients. Model performance was assessed using McFadden's pseudo R^2 (0.18–0.24). OR: Odds ratio, CI: Confidence interval, NLR: Neutrophil-to-lymphocyte ratio, CRP: C-reactive protein, IG: Immature granulocyte

Table 7. Multivariable logistic regression analysis of factors independently associated with epididymo-orchitis after adjustment for symptom duration

Variable	OR	95% CI	Regression coefficient (β)	p-value
Age (years)	1.04	0.99-1.10	0.04	0.095
Symptom duration (hours)	1.08	1.04-1.13	0.08	<0.001
IG (×10⁹/L)	2.40	1.20-5.10	0.88	<0.05
NLR	1.52	1.05-2.21	0.42	<0.05
CRP (mg/L)	1.05	1.01-1.10	0.05	<0.05

Multivariable logistic regression analysis was performed with age and symptom duration included as a priori covariates. NLR, CRP and IG were included as inflammatory predictors, followed by backward stepwise elimination of non-significant variables. OR, 95% confidence interval (CI), regression coefficient (β) and p-values are reported. OR: Odds ratio, CI: Confidence interval, NLR: Neutrophil-to-lymphocyte ratio, CRP: C-reactive protein, IG: Immature granulocyte

DISCUSSION

This study investigated the usefulness of IG parameters in differentiating testicular torsion from epididymo-orchitis. Additionally, the diagnostic roles of WBC, NLR and CRP were

evaluated comparatively. The main finding of our study is that IG count and percentage were significantly higher in patients with epididymo-orchitis than in those with testicular torsion and demonstrated moderate discriminatory performance in distinguishing these two conditions. These findings suggest that IG parameters may provide complementary information regarding the inflammatory response in patients presenting with acute scrotum. Previous studies have shown that IG parameters can increase in various inflammatory conditions and may be an early indicator of systemic inflammatory response.[10] However, evidence regarding the diagnostic role of IG parameters specifically in acute scrotal pathologies remains limited. Recent studies have investigated inflammatory and hematological parameters in testicular torsion and epididymo-orchitis but the role of IG parameters in this clinical setting has not been sufficiently characterized.

A recent study involving 301 patients, all of whom presented with acute scrotal pain of less than 12 hours' duration, reported an AUC of 0.73 for IG in differentiating epididymo-orchitis from testicular torsion, with IG remaining independently associated with epididymo-orchitis after adjustment for age. In the present study, IG demonstrated a higher AUC of 0.82; however, differences in study populations, particularly symptom duration, as well as study design, should be considered when comparing these findings.[11]

Although doppler ultrasonography, the most commonly used imaging method for evaluating testicular blood flow is known to have high diagnostic accuracy, it can yield false negative results, especially in early stage torsion cases.[12] Therefore, additional laboratory parameters may provide complementary information regarding the inflammatory response in patients with acute scrotal pain. However, IG and other inflammatory biomarkers should be considered adjunctive findings only and should not be used to exclude testicular torsion, delay surgical exploration, or override clinical or radiological indications for urgent surgical management. In patients with persistent clinical suspicion of torsion or equivocal imaging findings, definitive clinical management should remain guided by the overall clinical assessment and established urological emergency protocols.

In our study, both the number and percentage of immature granulocytes were significantly higher in patients with epididymo-orchitis compared to those with testicular torsion ($p<0.001$). Furthermore, ROC curve analysis demonstrated moderate discriminatory performance for IG and IG% in differentiating epididymo-orchitis from testicular torsion, with AUC values of 0.82 and 0.79, respectively. These findings suggest that IG parameters may have potential value as adjunctive inflammatory markers in the differential assessment of acute scrotum; however, their diagnostic performance should be interpreted in conjunction with clinical findings and imaging rather than as an independent basis for excluding testicular torsion. In multivariable logistic regression analysis, IG remained independently associated with epididymo-orchitis after adjustment for age and the other inflammatory parameters included in the multivariable model (OR=2.85, 95% CI: 1.46-4.25, $p<0.05$). This finding indicates an independent association between higher IG levels and epididymo-orchitis within the study population. However, this association should not be interpreted as evidence that IG can independently establish the diagnosis or exclude testicular torsion. Rather, IG may be considered a complementary laboratory parameter that could contribute to the overall clinical assessment. NLR was also independently associated with epididymo-orchitis (OR=1.75, 95% CI: 1.20-2.55, $p<0.05$) while CRP showed a statistically significant association (OR=1.08, 95% CI: 1.02-1.15, $p<0.05$).

The higher IG levels observed in the epididymo-orchitis group may be consistent to the inflammatory response associated with infectious processes. However, this interpretation should be made cautiously because symptom duration differed substantially between the study groups. The median symptom duration was 6 hours in the testicular torsion group and 30 hours in the epididymo-orchitis group. Because inflammatory biomarkers may increase with time following the onset of an inflammatory process, the observed differences in IG and other inflammatory markers may be partly attributable to the longer symptom duration in the epididymo-orchitis group rather than solely to disease specific pathophysiological differences. Importantly after adjustment for symptom duration IG remained independently associated with epididymo-orchitis (OR=2.40, 95% CI: 1.20-5.10, $p<0.05$). This finding suggests that the association between IG and epididymo-orchitis was not entirely explained by the longer symptom duration observed in the epididymo-orchitis group. However, findings from studies evaluating hematological markers in acute scrotum are not entirely consistent. While the current literature generally reports higher inflammatory markers in epididymo-orchitis, it has also been shown that ischemia-reperfusion injury in testicular torsion can increase some inflammatory parameters.[13-14]

Taken together, our findings indicate that IG parameters may provide additional information when differentiating epididymo-orchitis from testicular torsion. Nevertheless, these markers are non-specific inflammatory parameters and should not be regarded as stand-alone diagnostic tests. In particular a low IG level cannot be used to exclude testicular torsion, and an elevated IG level cannot independently establish epididymo-orchitis. Clinical examination and appropriate imaging remain central to the evaluation of the acute scrotum, and laboratory findings should not delay surgical exploration when testicular torsion remains clinically suspected.

Parameters such as neutrophil-lymphocyte ratio (NLR), platelet-lymphocyte ratio (PLR) and mean platelet volume (MPV) have been investigated as potential diagnostic markers in the differential diagnosis of acute scrotum.[6,7,15] It was found that WBC, NLR and CRP levels were higher in patients with epididymo-orchitis compared to those with testicular torsion, suggesting that inflammatory markers may reflect underlying infectious processes.[16] While classic inflammatory markers such as WBC, NLR and CRP reflect systemic inflammation, they are non-specific and may be elevated in various clinical situations. Similarly, IG values may be influenced by the timing and intensity of the inflammatory response. In addition, IG and CRP may be affected by concurrent

infections or inflammatory conditions unrelated to the acute scrotal pathology. Although medical records were reviewed for documented concurrent acute infectious or inflammatory conditions, the retrospective design does not allow complete exclusion of subclinical or incompletely documented conditions. Therefore, residual confounding by concomitant inflammatory processes cannot be excluded and may have influenced the observed differences between the study groups. Therefore, the observed diagnostic performance of IG in the present study should be interpreted as complementary rather than definitive. Further prospective studies with symptom duration matching or appropriate adjustment for time from symptom onset are needed to determine whether IG provides disease specific diagnostic information beyond the effect of symptom duration.

Limitations

This study has several limitations that should be considered when interpreting the findings. First, its retrospective, single-center design and relatively small sample size may limit the generalizability of the results and introduce selection and information bias. In particular, the testicular torsion group consisted of only 27 patients, which limits the precision of the ROC estimates and multivariable regression results, as reflected by the relatively wide CI of the OR for IG. Second, there was a substantial difference in symptom duration between the study groups, with a median duration of 6 hours in the testicular torsion group and 30 hours in the epididymo-orchitis group. Because inflammatory biomarkers may increase with time after the onset of an inflammatory process, this temporal imbalance represents an important potential confounder and may have contributed to the observed differences in IG and other inflammatory parameters. Although symptom duration was additionally adjusted for in a secondary multivariable model, residual confounding cannot be excluded because of the retrospective nature of the study and the substantial difference in symptom duration between groups. Prospective studies with symptom duration matching or standardized assessment of time from symptom onset would provide a more robust evaluation of the disease specific discriminatory performance of IG. Third, the testicular torsion group was significantly younger than the epididymo-orchitis and control groups. Although age was included as a covariate in the multivariable analysis to account for this baseline imbalance, residual confounding cannot be excluded. Differences in age related inflammatory responses may have influenced the observed laboratory values. Fourth, the retrospective design limited the availability and standardization of clinical and diagnostic information. In addition, no specific final diagnosis was documented for the control patients and this heterogeneous, non specific reference group may have introduced variability in the baseline inflammatory marker levels and may limit the interpretability and generalizability of comparisons involving the control group. Medical records were also reviewed for documented concurrent acute infectious or inflammatory conditions at initial evaluation and no such conditions were identified among the included patients. Nevertheless, the retrospective nature of the study means that subclinical or incompletely documented conditions cannot be completely excluded. Finally, the findings should be considered hypothesis generating rather than definitive evidence of clinical utility. Future prospective, multicenter studies with larger, age and symptom duration matched cohorts, standardized diagnostic reference standards and systematic assessment of potential inflammatory confounders are needed to validate these findings.

CONCLUSION

When evaluated together with clinical findings, imaging findings and other laboratory parameters, IG measurements may provide supplementary information in the differential diagnosis of acute scrotal conditions. However, these parameters should be considered adjunctive findings and should not be used to exclude testicular torsion or delay urgent surgical management when clinical suspicion persists. Further large scale, prospective and appropriately time matched studies are needed to determine whether IG parameters provide diagnostic information beyond the effects of symptom duration and to validate their diagnostic performance in acute scrotal conditions.

ETHICAL DECLARATIONS

Ethics Committee Approval

This study was conducted with the approval of the Osmaniye Korkut Ata University Health Sciences Researches Ethics Committee (Date: 02.03.2026, Decision No: 3).

Informed Consent

As this was a retrospective study, formal written informed consent was not required and was therefore not obtained. This retrospective study used pre-existing anonymized patient data. No additional intervention was performed, and there was no direct patient contact. The study was approved by the Ethics Committee, and the requirement for written informed consent was waived by the ethics committee.

Peer Review Process

This manuscript was subject to external peer review.

Conflict of Interest

The authors declare no conflicts of interest related to this study.

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