ORIGINAL ARTICLE

Procalcitonin and inflammatory biomarkers in tubo-ovarian abscess: Predicting surgical intervention

Simten Genc,[1] Murat İbrahim Toplu,[2] Tuğba Salman,[2] Enes Halk,[2] Mirac Ozalp,[3] Neçirvan Çağdaş Çaltek,[4] Veli Mihmanli[2]

[1]Private Practice, İstanbul-*Türkiye*
[2]Obstetrics and Gynecology Department of Prof. Dr. Cemil Tascıoglu City Hospital İstanbul-*Türkiye*
[3]Liv Hospital Ulus, Department of Perinatology, İstanbul-*Türkiye*
[4]Başakşehir Çam ve Sakura City Hospital, Gynecologic Oncology Surgery Clinic, İstanbul-*Türkiye*

ABSTRACT

BACKGROUND: Pelvic inflammatory disease (PID) and tubo-ovarian abscess (TOA) are significant gynecological infections that can lead to serious complications such as infertility and chronic pelvic pain. This study aimed to evaluate the diagnostic and prognostic value of procalcitonin (PCT) and other inflammatory biomarkers (C-reactive protein [CRP], white blood cell count [WBC], and neutrophil-to-lymphocyte ratio [NLR]) in patients with PID and TOA, and to identify predictors of treatment failure.

METHODS: A retrospective cohort study was conducted on 136 patients diagnosed with PID or TOA at Prof. Dr. Cemil Taşçıoğlu City Hospital between January 2021 and December 2023. Demographic data, clinical findings, and laboratory results (PCT, CRP, WBC, NLR) were collected. Statistical analyses were performed using the Number Cruncher Statistical System (NCSS) 2007 software.

RESULTS: Of the 136 patients, 103 (75.73%) were diagnosed with TOA and 33 (24.26%) with PID without TOA. The TOA group had significantly longer hospital stays and higher levels of PCT, CRP, WBC, and NLR compared to the PID group ($p<0.05$). Multivariate analysis identified CRP as the most significant predictor of TOA ($p=0.03$). Among TOA patients, 53.3% required surgical intervention. Patients who underwent surgery had significantly higher PCT and NLR levels ($p<0.05$). Receiver operating characteristic (ROC) analysis showed that a PCT cut-off value of 0.21 ng/mL predicted the need for surgical treatment with a sensitivity of 69.09% and specificity of 64.58%.

CONCLUSION: Procalcitonin and neutrophil-to-lymphocyte ratio are valuable biomarkers in the diagnosis and management of TOA. Elevated PCT and NLR levels are associated with an increased likelihood of surgical intervention. Together with abscess size, these biomarkers can help predict treatment failure and support clinical decision-making. However, further prospective multicenter studies are necessary to validate these findings.

Keywords: Tubo-ovarian abscess; procalcitonin; neutrophil-to-lymphocyte ratio; surgical intervention; treatment failure; diagnostic biomarkers.

INTRODUCTION

Pelvic inflammatory disease (PID) affects the upper genital tract, including the peritoneum, fallopian tubes, endometrium, and ovaries.[1] Delayed diagnosis increases the risk of infertility, ectopic pregnancy, and chronic pelvic pain. Additionally, antibiotic resistance and emerging pathogens may reduce treatment efficacy.[2]

Tubo-ovarian abscess (TOA) is a severe complication of PID,

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Address for correspondence: Simten Genc
Private Practice, İstanbul, Türkiye
E-mail: simtengenc@yahoo.com.tr

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typically diagnosed clinically by identifying an inflammatory adnexal mass on pelvic imaging in patients who meet PID diagnostic criteria.[3] While definitive diagnosis requires direct visualization through invasive procedures such as laparoscopy or laparotomy, transvaginal ultrasound (USG) and contrast-enhanced computed tomography (CT) are widely used to support diagnosis and exclude alternative conditions such as diverticulitis or appendicitis.[4] On ultrasound, TOAs usually appear as multiloculated adnexal masses with thick walls, internal septations, and echogenic fluid content. CT imaging offers greater sensitivity and specificity in distinguishing TOA from other pathologies.[5]

The first-line treatment for TOA is broad-spectrum intravenous antibiotic therapy.[6] However, patients who do not respond to this approach may require radiologic drainage or surgical intervention. The choice between surgical intervention and image-guided percutaneous catheter drainage depends on the patient's clinical status, abscess characteristics, and individual risk factors. Image-guided drainage is preferred for hemodynamically stable patients with smaller, localized, and non-multiloculated abscesses, while CT-guided drainage is reserved for deep-seated or difficult-to-access abscesses. In contrast, surgical intervention is indicated in cases involving large abscesses (greater than 5 cm), ruptured TOA, generalized peritonitis, or hemodynamic instability. Laparotomy is often preferred in such cases due to extensive adhesions and anatomical distortion, whereas laparoscopy may be considered for hemodynamically stable patients with localized abscesses and minimal adhesions.[7]

Risk factors associated with failure of medical treatment include advanced age, bilateral abscesses, comorbidities such as diabetes or immunosuppression, and larger abscess size.[8]

Hospitalization is necessary for patients with high fever, pregnancy, TOA, or an inability to tolerate oral therapy. Management is guided by clinical status and infection markers, which help determine the need for medical versus surgical intervention.[9]

Procalcitonin (PCT) is a serum biomarker for bacterial infections and sepsis and is useful in assessing the response to antibiotic therapy. Unlike C-reactive protein (CRP), PCT levels remain unchanged in viral or non-bacterial inflammation. However, its role in pelvic infections is not yet well established.[10,11]

This study evaluates the clinical significance of PCT in patients with PID and TOA, comparing it with white blood cell count (WBC), CRP, and neutrophil-to-lymphocyte ratio (NLR), while also identifying factors contributing to medical treatment failure in TOA patients.

MATERIALS AND METHODS

This retrospective cohort study reviewed records of patients aged 18 to 60 diagnosed with PID or TOA who presented to Prof. Dr. Cemil Taşçıoğlu City Hospital's emergency gynecology service between January 1, 2021 and December 31, 2023. All included patients were hospitalized due to severe infection and the need for close monitoring. Patients with a history of prior surgery, malignancy, pregnancy, postpartum status, age under 18, trauma, previous PID treatment, or other surgical emergencies were excluded. Ethical approval was obtained prior to the initiation of the study.

Each patient underwent a comprehensive gynecological evaluation, diagnostic workup, and pelvic ultrasound. TOA diagnosis was primarily based on the Centers for Disease Control and Prevention (CDC) criteria for PID, supported by imaging findings. According to CDC guidelines, a diagnosis of PID requires the presence of at least one of the following clinical criteria: cervical motion tenderness, uterine tenderness, or adnexal tenderness. Additional supportive criteria were used to strengthen the diagnosis, including: oral temperature >38.3°C, abnormal cervical or vaginal discharge, presence of abundant white blood cells on saline microscopy of vaginal fluid, elevated erythrocyte sedimentation rate (ESR) or CRP, and laboratory confirmation of Neisseria gonorrhoeae or Chlamydia trachomatis infection.[6] TOA was diagnosed when clinical PID criteria were met in conjunction with the presence of an inflammatory adnexal mass detected by USG. In our clinical practice, USG was the primary imaging modality used to diagnose TOA, providing essential information about abscess characteristics such as multiloculated structures, thick walls, internal septations, and echogenic fluid content. Imaging findings consistent with TOA supported the clinical diagnosis and guided subsequent management.

Hospitalization criteria included the presence of TOA, inability to tolerate oral outpatient therapy, high fever (>39°C), severe peritonitis, or failure of antibiotic treatment within 72 hours. Surgical intervention was considered in cases where the abscess diameter exceeded 5 cm, clinical deterioration occurred despite medical therapy, or if patients showed signs of rupture, peritonitis, or hemodynamic instability.

Venous blood samples were collected for analysis of PCT, CRP, and complete blood count (CBC). Procalcitonin levels were measured using the Access PCT Assay (Beckman Coulter, Dxl 600), with values below 0.05 ng/mL considered normal. CBC was performed using the Mindray BC 6800 analyzer, and CRP levels were assessed with the Beckman Coulter AU5800 analyzer.

First-line antimicrobial therapy for PID was administered in accordance with CDC guidelines.[6]

Statistical Evaluation

Statistical analyses were performed using the Number Cruncher Statistical System (NCSS) 2007 software (NCSS, LLC; Kaysville, Utah, USA). The Shapiro-Wilk normality test was applied, along with descriptive statistics (mean, standard

Table 1. Baseline demographic characteristics and outcomes

	Group 1 Non-TOA (n=33)		Group 2 TOA (n=103)		p
Age (years)					
Mean (±SD)	35.70±9.26		39.04±8.82		0.063*
Gravida					
Mean (±SD)	1.91±1.65		1.78±1.55		0.728†
Median (IQR)	1 (1-3)		2 (0-3)		
Parity					
Mean (±SD)	1.27±1.15		1.37±1.33		0.899†
Median (IQR)	1 (0-2)		1 (0-2)		
Abortus					
Mean (±SD)	0.64±0.93		0.39±0.63		0.151†
Median (IQR)	0 (0-1)		0 (0-1)		
Previous cesarean section	13	39.39%	27	26.21%	0.148+
Previous pelvic surgery	13	39.39%	33	32.04%	0.437+
Previous tubal ligation	0	0.00%	1	0.97%	0.570‡
Intrauterine device	4	12.12%	14	13.59%	0.828+
Hospital length of stay					
Mean (±SD)	6.61±2.57		10.89±4.1		0.0001†
Median (IQR)	6 (5-7.5)		10 (8-13)		
Blood transfusion	0	0.00%	10	9.71%	0.063‡
Intensive care unit admission	0	0.00%	3	2.91%	0.321‡
Procalcitonin					
Mean (±SD)	0.35±0.79		2.51±7.50		0.029†
Median (IQR)	0.08 (0.05-0.36)		0.23 (0.06-1.06)		
CRP					
Mean (±SD)	127.5±75.42		193.72±103.55		0.002†
Median (IQR)	137 (62-171.5)		186 (116-271)		
WBC					
Mean (±SD)	12,766.36±6,902.06		16,181.26±5,775.74		0.006*
NLR					
Mean (±SD)	6.91±5.00		9.51±6.12		0.022†
Median (IQR)	5.76 (3.04-9.56)		7.52 (5.17-12.57)		
Hemoglobin					
Mean (±SD)	11.39±1.24		11.29±1.78		0.766*
Hematocrit					
Mean (±SD)	33.86±3.24		33.77±4.54		0.917*

*Unpaired t-test; †Mann-Whitney U test; +Chi-square test; ‡Fisher's exact test. TOA: Tubo-ovarian abscess; CRP: C-reactive protein; WBC: White blood cell count, NLR: Neutrophil-to-lymphocyte ratio.

deviation, median, and interquartile range), to assess the distribution of the data. Group comparisons were conducted using the independent t-test for normally distributed variables and the Mann-Whitney U test for non-normally distributed variables. The chi-square test was applied for categorical variables. Logistic regression analysis was used to identify factors associated with TOA and the need for surgical intervention. For differential diagnosis, Receiver operating characteristic (ROC) curve analysis was employed to evaluate sensitivity, specificity, positive predictive value, negative predictive value, and positive likelihood ratio (LR+). Cut-off values were determined, with statistical significance set at $p<0.05$.

Table 2. Multivariate logistic regression for inflammatory markers

	OR (95% CI)	p
Procalcitonin	1.29 (0.89-1.85)	0.172
CRP	1.01 (1.00-1.03)	0.03
WBC	1.00 (0.99-1.11)	0.058
NLR	0.99 (0.89-1.09)	0.832

CRP: C-reactive protein; WBC: White blood cell count; NLR: Neutrophil-to-lymphocyte ratio.

Ethics Approval

This study was conducted in accordance with the principles of the Declaration of Helsinki. Ethical approval was obtained from the Ethics Committee of the University of Health Sciences, Prof. Cemil Taşçıoğlu Training and Research Hospital (Date: 28/05/2024, No: 48670771-514.99-244890518).

RESULTS

Among the 136 patients diagnosed with pelvic infection, 103 (75.73%) were classified in the TOA group, while 33 (24.26%) belonged to the PID (non-TOA) group. Baseline characteristics and clinical outcomes are summarized in Table 1. In the TOA group, hospital length of stay, PCT, CRP, WBC, and NLR levels at admission were significantly higher than in the PID group. However, there were no significant differences between the groups in terms of age, parity, gravidity, abortion history, prior pelvic surgery, cesarean section, tubal ligation, intrauterine device (IUD) use, blood transfusion, or intensive care unit (ICU) admission.

Multivariate analysis identified CRP as the most significant inflammatory parameter [p=0.03, odds ratio (OR): 1.01 (1.00-1.03)] (Table 2). Logistic regression confirmed CRP as a statistically significant predictor.

Clinical and demographic factors were analyzed in patients with TOA, comparing those who underwent surgical intervention with those who did not (Table 3). Pelvic USG was the primary imaging modality used for diagnosing TOA in all patients. In the surgically treated group, the mean diameter of the TOA was 6.62±2.43 cm, compared to 5.85±1.86 cm in the medically managed group (p=0.047). The median abscess diameter was also larger in the surgical group (6 cm, interquartile range [IQR]: 5-7 cm) than in the non-surgical group (5.75 cm, IQR: 5-7 cm), indicating a significant difference in abscess size between the two groups.

Among the 103 patients with TOA, 48 (46.6%) received medical treatment, while 55 (53.3%) underwent surgical intervention. In the surgical group, 33 patients (60%) underwent laparotomy, which included 10 salpingectomies (six unilateral and four bilateral), four total abdominal hysterectomies with bilateral salpingo-oophorectomy, 10 unilateral salpingo-oophorectomies, and nine drainage procedures. Additionally, 13 patients (23.64%) underwent laparoscopic procedures, which included five laparoscopic drainages, four salpingo-oophorectomies (one unilateral and three bilateral), two salpingectomies (one unilateral and one bilateral), and two total laparoscopic hysterectomies with bilateral salpingo-oophorectomy. Lastly, nine patients (16.36%) underwent image-guided drainage, with seven cases (77.8%) performed under ultrasound guidance and two cases (22.2%) under CT guidance. Compared to the non-surgical group, the surgical group had significantly longer hospital stays, higher rates of intrauterine device usage, elevated PCT levels, and increased NLR values (p=0.023). Additionally, TOA diameter was significantly larger in surgically treated patients (p=0.047).

Logistic regression analysis was conducted to identify factors influencing TOA and the likelihood of surgical intervention (Table 4). However, TOA diameter, PCT, and NLR did not reach statistical significance as predictive markers.

The area under the curve (AUC) for PCT was 0.695, with a cutoff value of 0.21 ng/mL, yielding a sensitivity of 69.09% and specificity of 64.58%. The positive predictive value (PPV) was 69.1%, the negative predictive value (NPV) was 64.6%, and the likelihood ratio was 1.95. For NLR, the AUC was 0.630, with a cutoff value of 8.24, resulting in a sensitivity of 54.55% and specificity of 72.92%. The PPV and NPV were 69.8% and 58.3%, respectively, with a likelihood ratio 2.01.

ROC curve analysis demonstrated that higher levels of PCT and NLR were associated with an increased likelihood of surgical or procedural intervention (Table 5). These markers showed moderate discriminative ability for predicting the need for surgery, as reflected in their respective AUC values.

DISCUSSION

Pelvic inflammatory disease (PID) is diagnosed through physical examination, clinical history, imaging, and laboratory findings. TOA, a potential complication of PID, can progress to peritonitis and must be differentiated from conditions such as appendicitis, diverticulitis, or malignancies that may require urgent surgical intervention. Transvaginal ultrasound and CT are commonly used for diagnostic purposes; however, CT provides superior sensitivity and helps distinguish TOA from gastrointestinal pathologies. In this study, all patients admitted with a preliminary diagnosis of PID or TOA underwent both CT and ultrasound imaging to ensure accurate differentiation from other surgical conditions. While TOA is typically observed in approximately 15% of PID cases, our study identified a markedly higher rate of 75.73%. This is likely attributable to the selective hospitalization of patients with more severe presentations, while milder infections were managed on an outpatient basis.[12]

Several biomarkers, including PCT, CRP, and WBC, play a role in assessing the severity of PID. Erenel et al.[9] investigated the

Table 3. Baseline demographic characteristics and outcomes in patients with tubo-ovarian abscess (TOA)

	Surgical Treatment (-) (n=48)		Surgical Treatment (+) (n=55)		p
Age (years)					
Mean (±SD)	37.48±9.25		40.4±8.27		0.094*
Gravida					
Mean (±SD)	1.56±1.5		1.96±1.58		
Median (IQR)	1 (0-2.75)		2 (0-3)		0.167†
Parity					
Mean (±SD)	1.17±1.34		1.55±1.3		
Median (IQR)	1 (0-2)		2 (0-3)		0.081†
Abortus					
Mean (±SD)	0.4±0.68		0.38±0.59		
Median (IQR)	0 (0-1)		0 (0-1)		0.913†
Previous pelvic surgery	18	37.50%	15	27.27%	0.267+
Previous cesarean section	15	31.25%	12	21.82%	0.278+
Previous tubal ligation	1	2.08%	0	0.00%	0.282‡
Intrauterine device	1	2.08%	13	23.64%	0.001‡
TOA diameter (cm)					
Mean (±SD)	5.85±1.86		6.62±2.43		0.047†
Median (IQR)	5.75 (5-7)		6 (5-7)		
Hospital length of stay					
Mean (±SD)	9.21±3.85		12.36±3.76		0.0001†
Median (IQR)	9 (7-11)		12 (9-15)		
Blood transfusion	2	4.17%	8	14.55%	0.076+
Intensive care unit admission	0	0.00%	3	5.45%	0.101‡
Bilateral TOA	2	4.17%	3	5.45%	0.762‡
Procalcitonin					
Mean (±SD)	0.79±2.07		4.01±9.87		0.001†
Median (IQR)	0.1 (0.04-0.41)		0.44 (0.08-2.30)		
CRP					
Mean (±SD)	178.14±97.41		207.33±107.65		0.166†
Median (IQR)	167.5 (106-265.5)		202.9 (129-272)		
WBC					
Mean (±SD)	15,606.46±5,957.77		16,682.91±5,618.53		0.348*
NLR					
Mean (±SD)	8.29±5.93		10.57±6.14		
Median (IQR)	6.68 (4.48-10.77)		9.05 (6.14-13.89)		0.023†
Hemoglobin					
Mean (±SD)	11.56±1.81		11.05±1.73		0.142*
Hematocrit					
Mean (±SD)	34.65±4.7		33±4.3		0.067*

*Unpaired t-test; †Mann-Whitney U test; +Chi-square test; ‡Fisher's exact test. TOA: Tubo-ovarian abscess; CRP: C-reactive protein; WBC: White blood cell count, NLR: Neutrophil-to-lymphocyte ratio.

diagnostic utility of PCT in TOA and found that both PCT levels and hospital stay duration were significantly elevated in TOA cases. A PCT cutoff value of 0.330 ng/mL demonstrated 62% sensitivity and 75% specificity for TOA. However, no

Table 4. Logistic regression analysis of predictors of surgical intervention

	OR (95% CI)	p
TOA diameter (cm)	1.17 (0.94-1.46)	0.153
Procalcitonin	1.16 (0.98-1.38)	0.092
NLR	1.04 (0.96-1.11)	0.360

TOA: Tubo-ovarian abscess; NLR: Neutrophil-to-lymphocyte ratio.

significant differences were observed in other infection markers, and mean CRP levels did not differ significantly between groups. Hong IK et al.[13] examined serum PCT levels in relation to antibiotic therapy for PID. Their findings indicated that CRP was the most accurate predictor of antibiotic response, whereas PCT had limited diagnostic value. No significant variation was observed in serum PCT levels between admission and treatment response.

In another study, researchers reported that elevated CRP was an independent predictor of acute PID.[14] In our study, patients in the TOA group had significantly higher PCT levels and longer hospital stays. Additionally, infection markers such as CRP, WBC, and NLR were also significantly elevated in the TOA group. We found that mean initial CRP levels were 127.5±75.42 mg/L and 193.72±103.55 mg/L in patients without TOA. In patients with TOA, CRP was the most significant inflammatory parameter identified in logistic regression analysis (p=0.03).

In a retrospective study by Akopuz et al.,[15] it was suggested that NLR can be used to monitor clinical improvement in PID. Compared to healthy women, the pre-treatment NLR value was significantly higher in the PID group (6.9±6.4 vs. 1.9±0.5, p<0.001). In our study, the mean NLR in PID patients prior to treatment was 6.91±5.00, consistent with the literature. In another study comparing healthy women with patients with TOA, an NLR cut-off value of ≥4.15 was proposed. The study reported that a higher preoperative NLR improved the predictive value of serum markers for the presence of TOA.[16]

Tubo-ovarian abscess and severe PID are pelvic infections that require hospitalization, and treatment options vary depending on the clinical condition of each patient. The first-line treatment for TOA is antibiotic therapy, with a success rate of approximately 70%. However, as abscess size increases, patients are more likely to require surgical intervention.[17] Surgery is typically indicated for patients who do not respond to medical treatment, especially those with bilateral abscesses, larger abscesses, or advanced age.[18]

In the study by Karaca K et al.,[12] variables, such as age, parity, and abscess diameter did not have significant predictive value in determining which TOA patients would require surgery. In our study, 46.6% of patients recovered with medical treatment. However, consistent with previous literature, abscess size was significantly larger in the surgically treated group. No significant differences were observed between the groups in terms of age or bilaterality.

In the study by Tugrul Ersak et al.,[19] factors such as elevated WBC, larger TOA size, older age, longer duration of IUD use, multigravidity, and higher parity were associated with medical treatment failure. The identified abscess diameter cut-off value was 4.5 cm. In a retrospective analysis, Dewitt et al.[20] reported that the average abscess size was 6.3 cm in medically managed patients and 7.7 cm in those who required surgery. Larger abscess size was also associated with longer hospital stays, increased complication rates, and higher likelihood of surgical intervention. Greenstein Y et al.[21] evaluated whether TOA size and other clinical features were associated with the need for surgery. They found that the mean TOA diameter was 4.4 cm in the medical treatment group and 7.3 cm in the surgical group. Parity, maximum leukocyte count, and older age have been associated with a significantly higher risk of surgical intervention. However, in our study, no significant differences were observed in mean age, gravidity, or parity between the surgical and non-surgical TOA groups. On the other hand, IUD use and abscess size were significantly higher in the surgical group, with a cut-off value 5 cm identified for abscess diameter. We found that the mean abscess size was significantly larger in TOA patients who underwent surgery. In a study by Kose et al.,[22] mass size was identified as a significant prognostic factor for surgical intervention (OR:

Table 5. Cut-off values of parameters for predicting the need for surgical treatment

	AUC	95% CI	Criterion	Sensitivity	Specificity	PPV	NPV	LR (+)
TOA diameter (cm)	0.606	0.505-0.701	>5	69.09	47.92	60.3	57.5	1.33
Procalcitonin	0.695	0.596-0.782	>0.21	69.09	64.58	69.1	64.6	1.95
CRP	0.579	0.478-0.676	>129	74.55	41.67	59.4	58.8	1.28
WBC	0.573	0.472-0.670	>13,520	72.73	47.92	61.5	60.5	1.40
NLR	0.630	0.529-0.723	>8.24	54.55	72.92	69.8	58.3	2.01

TOA: Tubo-ovarian abscess; CRP: C-reactive protein; WBC: White blood cell count, NLR: Neutrophil-to-lymphocyte ratio.

1.018 (1.010-1.027), p<0.001), with the AUC reported as 0.670 (p<0.001). In contrast, our study did not find TOA size to be a predictor of surgical intervention (OR: 1.17 (0.94-1.46), p=0.153).

Karaca K et al.[12] reported that serum CRP and PCT levels did not have significant predictive value in identifying TOA patients requiring surgical intervention. They also concluded that PCT was not a reliable marker for predicting treatment failure with medical management. In another study, elevated CRP and ESR levels were associated with longer hospital stays and greater disease severity, and were significantly correlated with TOA sizes larger than 5 cm. However, PCT levels were not assessed in that study.[23] A study involving patients who presented to the general surgery clinic with acute abdomen found that plasma PCT values exceeding 5 ng/mL could indicate the need for surgical intervention.[24] In our study, PCT and NLR levels were significantly higher in the surgical group.

Recently, attention has turned to markers such as NLR, which can be easily obtained from routine CBC tests and reflect systemic inflammation. In a study comparing patients who received medical treatment for TOA with those who required surgery due to treatment failure, NLR values were significantly higher in the surgical group. The mean NLR was 7.4±5.8 in the conservative management group and 10.3±5.8 in the surgical group (p=0.004), with a threshold value of ≥6.97 (95% confidence interval). (21) In our study, the mean NLR was 8.29±5.93 in the medical treatment group and 10.57±6.14 in the surgical group (p=0.023), with a cut-off value of ≥8.24.[25]

Minimally invasive techniques are also employed in the treatment of TOA, including laparoscopy, ultrasound-guided drainage, and CT-guided drainage. In the study by Greenstein Y et al.,[21] 65.6% of patients responded to antibiotic treatment, while 34.4% required surgical intervention or ultrasound-guided drainage. In contrast to the literature, a greater proportion of patients in our study were treated surgically compared to those who received only medical treatment (53.3% vs. 46.6%). Among those in the surgical group, 40% were managed with laparoscopy or drainage. In a study by Silva et al.,[26] a five-year descriptive analysis of patients with TOA was conducted, including 26 patients. They stated that transvaginal ultrasound-guided drainage is a safe and effective approach. In the study by Goje O et al.,[17] the highest success rates were observed for image-guided TOA drainage. This method was associated with shorter hospital stays and fewer complications. While conservative treatment of TOA with antibiotics remains the first-line approach, improved outcomes have been noted with minimally invasive techniques.

Some studies have demonstrated the therapeutic superiority of laparoscopy, reporting lower complication and greater treatment efficacy with this method.[27,28]

High serum inflammatory marker levels have been associated with prolonged hospitalization. In a study examining TOA patients postoperatively, all inflammatory markers increased within the first 48 hours following surgery. WBC levels returned to normal within 2.5 days, NLR within 7.1 days, and CRP in more than 14 days. These findings suggest that WBC and NLR may be useful in predicting the need for surgical versus medical intervention.[29] Our study did not assess the time required for inflammatory markers to return to baseline in the postoperative period. However, we found that elevated NLR levels may effectively predict the need for surgical treatment.

Hospital stay duration varies depending on the type of abscess management. Doğanay et al.[30] reported an average hospitalization of two days for laparoscopic procedures, 7.4 days for laparotomy, and 11 days for patients receiving only medical therapy. In contrast, TO et al.[31] found that patients treated with antibiotics had a mean hospital stay of 7.4 days, while those undergoing image-guided drainage stayed an average of 13.3 days. This extended stay may be due to delays in the decision to perform drainage and prolonged hospitalization prior to the procedure. In our study, similar to the literature, the duration of hospital stay was statistically significantly longer for patients who underwent surgical treatment.

We acknowledge certain limitations in this study. It was a retrospective, single-center study. Pelvic inflammatory disease was diagnosed clinically without histological confirmation, and the study did not include analysis of outpatient follow-up or patients treated in an outpatient setting. Additionally, it should be noted that PCT levels may not increase during the early stages of the disease; therefore, this marker may not always accurately reflect clinical severity.

CONCLUSION

Pelvic inflammatory disease, particularly when complicated by abscess formation, poses a serious health risk that requires timely and appropriate management. In such cases, specific biomarkers such as NLR and PCT are valuable tools in guiding surgical decision-making. Among patients who underwent surgical treatment for TOA, NLR, and PCT levels were significantly higher compared to those managed with medical therapy alone. Additionally, the TOA diameter was significantly larger in the surgical group (6.62±2.43 cm) compared to the medically treated group (5.85±1.86 cm) (p=0.047).

In the surgical group, 60% of patients underwent laparotomy, 23.64% underwent laparoscopic procedures, and 16.36% received ultrasound- or CT-guided drainage. Although TOA-related surgeries carry potential complications, including abscess recurrence, bowel or urinary tract injury, hemorrhage, and postoperative infections, no such complications were observed in our study cohort.

In summary, elevated NLR and PCT levels may serve as effective predictors of medical treatment failure in TOA and assist in identifying patients who would benefit from early surgical intervention. However, further prospective studies

are needed to validate these findings.

Ethics Committee Approval: This study was approved by the Ethics Committee of the University of Health Sciences, Prof. Cemil Taşçıoğlu Training and Research Hospital (Date: 28.05.2024, Decision No: 48670771-514.99-244890518).

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ORİJİNAL ÇALIŞMA - *ÖZ*

Tubo-ovaryan apsede prokalsitonin ve enflamatuvar biyobelirteçlerin rolü: Cerrahi müdahale gereksiniminin öngörülmesi

AMAÇ: Pelvik enflamatuvar hastalık (PID) ve tubo-ovaryan apse (TOA), infertilite ve kronik pelvik ağrı gibi ciddi komplikasyonlara yol açabilen önemli jinekolojik enfeksiyonlardır. Bu çalışmanın amacı, PID ve TOA tanılı hastalarda prokalsitonin (PCT) ve diğer enflamatuvar biyobelirteçlerin (C-reaktif protein [CRP], lökosit sayısı [WBC] ve nötrofil-lenfosit oranı [NLR]) tanısal ve prognostik değerini değerlendirmek ve tedavi başarısızlığını öngören faktörleri belirlemektir.

GEREÇ VE YÖNTEM: Ocak 2021-Aralık 2023 tarihleri arasında Prof. Dr. Cemil Taşcıoğlu Şehir Hastanesi'nde PID ve TOA tanısı alan 136 hastanın verileri geriye dönük olarak incelendi. Hastaların demografik verileri, klinik bulguları ve laboratuvar sonuçları (PCT, CRP, WBC, NLR) kaydedildi. İstatistiksel analizler NCSS 2007 yazılımı kullanılarak yapıldı.

BULGULAR: Çalışmaya dahil edilen 136 hastanın 103'ü (%75.73) TOA, 33'ü (%24.26) ise PİH (TOA dışı) tanısı aldı. TOA grubunda hastanede yatış süresi, PCT, CRP, WBC ve NLR düzeyleri PID grubuna kıyasla anlamlı olarak daha yüksek bulundu ($p<0.05$). Multivaryant analizde, TOA için en güçlü prediktörün CRP olduğu belirlendi ($p=0.03$). TOA tanılı hastaların %53.3'ü cerrahi müdahale geçirdi. Cerrahi uygulanan grupta PCT ve NLR düzeyleri anlamlı derecede daha yüksekti ($p<0.05$). ROC analizine göre, PCT'nin 0.21 ng/ml eşik değeri ile cerrahi tedavi gereksinimini öngörmede %69.09 duyarlılık ve %64.58 özgüllük gösterdi.

SONUÇ: PCT ve NLR, TOA'nın tanı ve yönetiminde değerli biyobelirteçlerdir. Yüksek PCT ve NLR düzeyleri, cerrahi müdahale gereksinimi ile ilişkilidir. Bu biyobelirteçler ve apse boyutu, tedavi başarısızlığını öngörmede yol gösterici olabilir ve klinik karar alma sürecini destekleyebilir. Ancak, bu bulguların doğrulanması için ileriye dönük çok merkezli çalışmalara ihtiyaç vardır.

Anahtar sözcükler: Cerrahi müdahale; tubo-ovaryan apse; prokalsitonin; nötrofil-lenfosit oranı; tedavi başarısızlığı; tanısal biyobelirteçler.

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