Diagnostic Value of Laboratory Parameters in Predicting Treatment Success in Tubo-ovarian Abscess

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Abstract

Aim: Tubo-ovarian abscesses (TOA) are among the common emergency gynecological pathologies. Diagnosis remains controversial due to limitations in laboratory and imaging methods. In this study, we evaluated the demographic characteristics, laboratory parameters, and the correlation between the C-reactive protein (CRP) level at the time of diagnosis and the success of antibiotic therapy in patients treated in our hospital with a diagnosis of TOA.

Methods: A total of 71 women followed up with a diagnosis of TOA in our hospital between May 2018-May 2021 were evaluated retrospectively. The physical examination findings, laboratory parameters, and imaging methods used during the patients' initial presentation and treatment were assessed.

Results: The mean age of the 71 women was 36.2±8.0 years. Of the women, 97.3% were of reproductive age, 28.2% were using an intrauterine device (IUD), and 52.1% were smokers. The mean CRP level at presentation was 173.9 mg/L, and it was ≥100 mg/L in 73.2% of patients. On ultrasonography (USG), the abscess/mass was located on the left in 52.1%, on the right in 42.3%, and in the pouch of Douglas in 5.6%. While 50.7% of the cases recovered with antibiotics alone, 49.3% underwent surgery. Abscess diameter (63±23 vs 46±24 mm; p<0.001) and procalcitonin (PCT) (4.22±10.71 vs 1.64±3.59 ng/mL; p=0.03) were higher in the surgical group. The presence of an IUD was not associated with antibiotic therapy success (OR 1.83; p:0.300). A CRP level ≥100 mg/L predicted the need for surgery with limited accuracy (sensitivity 82.9%, specificity 36.1%; OR 2.73; p:0.107).

Conclusions: Elevated CRP, white blood cell count (WBC), and PCT are laboratory parameters that support the diagnosis of TOA. However, when a cut-off value of 100 mg/L is taken for CRP, it is not sufficient for determining the treatment option.

Keywords: *Tubo-ovarian Abscess; Pelvic Inflammatory Disease; Erythrocyte Sedimentation Rate; White Blood Cell*

1. Introduction

Tubo-ovarian abscess (TOA) is an infectious condition within the most severe spectrum of pelvic inflammatory disease (PID), potentially threatening fertility and associated with increased morbidity. Clinical presentation most commonly involves fever, lower abdominal pain, and an adnexal mass. Differential diagnosis includes pathologies that form masses, such as malignancy and endometrioma.[1] TOA can develop in a significant proportion of PID cases. Therefore, early diagnosis and appropriate treatment selection are critical.[2] In diagnosis, physical examination and laboratory markers (leukocytosis, C-reactive protein [CRP], erythrocyte sedimentation rate [ESR]) support clinical suspicion. Although transvaginal ultrasonography (TV USG) is used as the first-line imaging method, computed tomography (CT) or magnetic resonance imaging (MRI) are more successful in selected cases for assessing spread and complications.[1,3] Serum tumor markers (especially CA-125) may also be elevated in TOA due to peritoneal irritation and can lead to false positives that may be confused with malignancy; therefore, they are not specific for differential diagnosis alone.[1,4]

The main approaches in TOA management include intravenous broad-spectrum antibiotics, imaging-guided drainage, and surgical treatment. It remains controversial in which patients medical treatment will fail and when to proceed with invasive intervention. Data in the literature are increasingly suggesting that abscess size, fever, and some inflammatory biomarkers (CRP, WBC, etc.) may predict medical treatment failure.[5,6] It has been reported that CRP, in particular, may be a marker that can reflect both the presence of TOA and the treatment response; however, a single "cut-off" value may not be valid in every population in clinical practice.[6,7] Procalcitonin

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(PCT) has also been investigated as a marker with diagnostic and prognostic potential in the context of PID/TOA and has been associated with the need for surgery or treatment failure in some studies.[7,8] Furthermore, epidemiologically, it has been shown that certain factors, such as long-term intrauterine device (IUD) use, may increase the risk of TOA.[9]

Therefore, determining the diagnostic value of laboratory parameters (especially the CRP level at presentation and related indicators) in predicting treatment success could contribute to standardizing the clinical decision-making process. In this study, we aimed to describe the demographic and clinical characteristics as well as the laboratory parameters at presentation of women followed up with a diagnosis of TOA in our clinic, and to evaluate the performance of the CRP level at the time of diagnosis in predicting the success of antibiotic therapy.

2. Materials and Methods

Following approval from our hospital's Ethics Committee (Reference No: 114240-35/22, Date: 23.02.2022), a total of 71 women followed up for TOA indication at Prof. Dr. Cemil Taşcıoğlu City Hospital between May 2018 and May 2021 were evaluated retrospectively. The patients' medical histories, demographic data, physical examination findings, laboratory parameters, and imaging methods at the time of presentation and during follow-up were accessed from the hospital automation system (PANATHES) and patient files.

USG examination was performed by a specialist physician in the gynecology outpatient clinic. The results of the evaluation performed with ACUSON X300 (SIEMENS®) were recorded in the patients' files and the hospital automation system. Antibiotic therapy planning for the patients was made according to CDC recommendations (10). The regimens for cases with antibiotic allergies were adjusted following consultation with an Infectious Diseases specialist. The group that did not undergo surgical intervention received antibiotic therapy for an average of 14 days. The emergence of new-onset fever during treatment, the development of defense or rebound on abdominal examination, suspicion of sepsis (such as hypotension, tachycardia, tachypnea), or an increase in abscess size on imaging methods were considered warning signs for treatment inadequacy. Surgery was performed in these cases. The decision for laparoscopy (L/S) or laparotomy (L/T) during surgical selection was made based on the characteristics of the case and the surgeon's experience.

2.1. Statistical Evaluation

SPSS (IBM SPSS Statistics, Version 22.0; Armonk, NY: IBM Corp.) software was used for statistical analyses. Descriptive statistical methods (mean, standard deviation, median, frequency, ratio, minimum, maximum) were applied when evaluating the study data. The normality of quantitative data was assessed using the Shapiro-Wilk test. The Mann-Whitney U test was used for comparisons between two groups for non-normally distributed data, and the Pearson chi-square test was used for comparing qualitative data. The Wilcoxon signed-rank test was used to evaluate follow-up measurements of non-normally distributed variables. The statistical significance level was accepted as two-tailed $p < 0.05$.

3. Results

The mean age of the 71 patients who met the inclusion criteria was 36.2±8.0 years. The median gravida was 2 (IQR 1–3), median parity was 1 (IQR 0–2), and BMI was 23.7±2.4 kg/m^2 (median 23.4; IQR 22.3–24.8). Of the cases, 97.3% were of reproductive age and 2.7% were postmenopausal; 28.2% were using an IUD, 52.1% were smokers, and 11.3% had DM (Table 1).

Table 1

Demographic and Clinical Characteristics

Variable	
Age (years)	36.2±8.0; Median 37 [30–41]
Gravida (n)	2.0±2.0; Median 2 [1–3]
Parity (n)	1.3±1.2; Median 1 [0–2]
BMI (kg/m^2)	23.7±2.4; Median 23.4 [22.3–24.8]
Reproductive Age	69/71 (97.3%)
Postmenopausal Age	2/71 (2.7%)
IUD Use	20/71 (28.2%)
Smoker	37/71 (52.1%)
Presence of DM	8/71 (11.3%)

Normality was assessed by Shapiro-Wilk; continuous variables are presented as mean ± SD and median [IQR], categorical variables as n/N (%).

Table 2

Laboratory, Imaging, and Examination Findings at Admission

Variable	
WBC (/μL)	15670±9560
CRP (mg/L)	173.9±111.3
PCT (ng/mL)	2.91±7.99
CA-125 (IU/mL)	115.4±177.9
CRP ≥100 mg/L	52/71 (73.2%)
USG Abscess Location	Left 37 (52.1%), Right 30 (42.3%), Douglas 4 (5.6%)
Largest Abscess Diameter (mm)	54±25
PE: Abdominal Tenderness	26 (36.6%)
PE: Rebound	3 (4.2%)
PE: Defense	4 (5.6%)
VE: Painful Cervical Motion	39 (54.9%)
VE: Vaginal Bleeding	20 (28.2%)
VE: Increased Temperature	17 (23.9%)

PE: Physical Examination, VE: Vaginal Examination. Descriptive statistics; categorical variables are n (%).

Mean laboratory values at presentation were: WBC 15670±9560/μL, CRP 173.9±111.3 mg/L, PCT 2.91±7.99 ng/mL, CA-125 115.4±177.9 IU/mL; CRP ≥100 mg/L was detected in 73.2% of patients. On USG, 37 (52.1%) had left adnexal abscess/mass, 30 (42.3%) had right adnexal abscess/mass, and 4 (5.6%) had a mass located in the pouch of Douglas. The largest abscess diameter was 54±25 mm. On physical examination, 26 (36.6%) had tenderness, 3 (4.2%) had rebound, 4 (5.6%) had defense; on vaginal examination, 39 (54.9%) had painful cervical motion, 20 (28.2%) had vaginal bleeding, and 17 (23.9%) had increased temperature were recorded (Table 2).

While 36 patients (50.7%) recovered with antibiotic therapy alone, 35 (49.3%) received surgical treatment (9 L/S; 26 L/T). Demographic variables were similar between the treatment groups (Table 3).

In pre- and post-treatment laboratory comparisons, pre-treatment PCT and abscess diameter were significantly higher in the surgical group; although the pre-treatment WBC difference was statistically significant, the effect size was small. Post-treatment WBC and CRP values were similar between the groups (Table 4).

No significant relationship was found between the presence of an IUD and the need for surgery: OR=1.83 (95% CI 0.64–5.22), p=0.300 (Table 5).

The CRP ≥100 mg/L threshold for predicting the need for surgery yielded a sensitivity of 82.9%, specificity of 36.1%, PPV of 55.8%, NPV of 68.4%, and accuracy of 59.2%; OR 2.73 (95% CI 0.90–8.30), p=0.107 (Table 6a-b).

Table 3

Demographic Variables by Treatment Groups

Variable	Medical (n:36) Mean±SD	Surgical (n:35) Mean±SD	p-value
Age (years)	35.0±8.0	37.4±7.8	0.11
Gravida (n)	2.3±2.4	1.8±1.4	0.60
Parity (n)	1.4±1.4	1.3±1.0	0.85
BMI (kg/m^2)	23.8±2.1	23.7±2.7	0.36

Test: Student t/Mann-Whitney U; effect size Cohen's d was suggested.

Table 4

Pre-/Post-Treatment Laboratories and Abscess Size (by Treatment Group)

Variable	Medical Mean± SD	Surgical Mean± SD	p (between groups)
WBC (pretreatment) (/µL)	14.97± 12.52	16.40± 5.08	0.01 (d≈0.15)
WBC (posttreatment) (/µL)	9.20± 3.01	9.31± 3.29	0.96
CRP (pretreatment) (mg/L)	162.7± 110.6	185.4± 112.3	0.62
CRP (posttreatment) (mg/L)	35.3± 49.2	24.6± 28.6	0.35
PCT (pretreatment) (ng/mL)	1.64± 3.59	4.22± 10.71	0.03 (d≈0.32)
PCT (posttreatment) (ng/mL)	0.23± 0.55	0.10± 0.08	0.12
CA-125 (IU/mL)	119.4± 161.3	111.3± 195.8	0.77
Abscess Diameter (mm)	46±24	63±23	<0.001 (d≈0.72)

Test: Between groups Student t / Mann-Whitney; within group pre-post paired t / Wilcoxon. Effect size (Cohen's d) in parentheses.

Table 5

Treatment Outcome by IUD Presence

	Medical n (%)	Surgical n (%)	Total
IUD Present	8 (22.2)	12 (34.3)	20
IUD Absent	28 (77.8)	23 (65.7)	51
Total	36	35	71
OR (95% CI)		1.83 (0.64–5.22)	
p (Fisher)		0.3	

Test: Chi-square/Fisher's exact; OR and 95% CI.

Table 6a-b

CRP ≥100 mg/L and Need for Surgery: 2×2 Table and Diagnostic Performance

a *Contingency Table*

	Medical	Surgical	Total
CRP <100 mg/L	13	6	19
CRP ≥100 mg/L	23	29	52
Total	36	35	71

p (Fisher's exact): 0.107

b *Diagnostic Performance (Outcome: Need for Surgery, Index Test: CRP ≥100 mg/L)*

Criterion	Value
Sensitivity	82.9% (29/35)
Specificity	36.1% (13/36)
Positive Predictive Value (PPV)	55.8% (29/52)
Negative Predictive Value (NPV)	68.4% (13/19)
Accuracy	59.2% (42/71)
LR+ / LR–	1.30 / 0.47
OR (95% CI)	2.73 (0.90–8.30)
p (Fisher)	0.107

Note: 2×2 diagnostic statistics were used; OR and 95% CI are based on Fisher's exact test.

4. Discussion

In our single-center retrospective cohort study, approximately half of the cases presenting with a diagnosis of TOA recovered with antibiotics alone (50.7%), while nearly half required surgery (49.3%). Pre-treatment PCT level and abscess diameter were significantly higher in women who required surgical treatment. Although the pre-treatment WBC difference was statistically significant, the effect size was small. The CRP ≥100 mg/L threshold showed limited discriminative power in predicting the need for surgery, exhibiting high sensitivity (82.9%) but low specificity (36.1%). These findings suggest that abscess size based on initial imaging and PCT contribute significantly to the decision-making process, while high thresholds for CRP alone are not sufficient for clinical guidance.

The mean age of the cases included in our study was 36.2±8.0 years, which is consistent with studies reporting that TOA is mostly seen in the reproductive age.[11-13] Demirtaş et al., in their series comparing PID and TOA, showed that the TOA group was younger.[11] In data from Western Anatolia, the mean age of women successfully treated with antibiotics was 33.9 years, and those requiring surgery was 36.4 years[12]; our distribution (medical 35.0; surgical 37.4 years) is similar to this study. Our proportion of postmenopausal patients was low at 2.7% compared to other studies. The deviation from rates reported as 14–18% in different centers may be explained by differences in referral chains and study scope.[14-16]

Although IUD has long been emphasized as a risk factor for TOA development[9,14,17], in our study, the presence of an IUD was not associated with the need for surgery (OR 1.83; p:0.300). In series published from Turkey, IUD prevalence has been reported in a wide range (18–62%).[11-13,17] Tahaoğlu et al. showed that IUD significantly increases the risk of TOA development.[18] However, this association may not automatically translate into the choice of treatment type at presentation. Our finding is consistent with data indicating that IUD is a risk indicator for development, but does not solely determine the need for surgery.[12,15,17]

The median gravida was 2 and median parity was 1, consistent

with comparable distributions in the literature.[13,19] Our mean BMI (23.7±2.4 kg/m^2) is lower than values reported in domestic series.[13,19] However, no BMI difference was observed between the groups. Whether BMI is an independent marker in TOA management is not clear in the literature, and in most series, abscess size and clinical response more strongly guide the surgical decision.[12,13,19]

The rate of DM in the cases included in the study was 11.3%. This is similar to Haqverdiyev's retrospective series[20] and did not show a significant association with the need for surgery. Clinical examination findings (tenderness, rebound/defense, painful cervical motion, vaginal bleeding/increased temperature) did not show significant differences between the groups. Similarly, previous studies have reported that fever and general examination parameters alone have limited discriminatory value.[11,13,14] It is generally accepted that clinical findings should be interpreted holistically with laboratory and imaging in the management of severe cases.[21,22]

The mean WBC (15,670/μL) is similar to domestic series.[12,13,19] Demirtaş et al. reported that WBC has limited value in distinguishing PID from TOA.[11] Although pre-treatment WBC was higher in the surgical group in our study, the effect size was small and it is not decisive alone. This observation is consistent with data showing that WBC is supportive but insufficient in predicting failure.[13,19] CRP is a practical indicator of disease severity. However, threshold selection is critical.[11,23,24] Güngördük et al. reported sufficient sensitivity/specificity for a 21 mg/L cut-off for the need for surgery.[12] In our study, a high threshold like 100 mg/L limited clinical benefit by reducing specificity (36.1%). Therefore, center-specific ROC-based thresholds are recommended.[23-25] PCT is reported to be able to differentiate the need for invasive intervention due to its sensitivity to bacterial load and systemic response.[26] In our study, PCT was significantly higher in the surgical group (4.22 vs 1.64 ng/mL; p:0.03). This supports that PCT may provide additional value over CRP/WBC in predicting the need for surgery.[26] Mean CA-125 did not differ between groups. CA-125 may be elevated in PID/TOA due to peritoneal irritation, but its specificity is low.[27,28] Levin et al. reported that CA-125 may contribute to management when combined with clinical and imaging findings, but is not decisive alone.[29] Our finding supports this approach.

Abscess diameter emerged as the strongest and most consistent indicator for the need for surgery: 63±23 mm in the surgical group vs. 46±24 mm in the medical group ($p<0.001$; $d\approx0.72$). The literature repeatedly shows that the likelihood of surgery increases significantly above the 6–7 cm band.[13,19,25] Güngördük et al. reported acceptable diagnostic performance for a 6.5 cm threshold.[25] Our data indicate that the threshold for surgery should be kept low in the ≥6 cm band. The lack of a significant difference between location (right/left/Douglas) and treatment pathway suggests that management is shaped around size and systemic response.[13,19,25]

The convergence of post-treatment WBC and CRP in both groups in our patients indicates that systemic inflammation regresses rapidly under appropriate antibiotic therapy; however, the initial burden (large abscess, high PCT) determines the likelihood of surgery. For CRP ≥100 mg/L, sensitivity was 82.9%, specificity 36.1%, and accuracy 59.2%; the relatively high LR− (below 0.47) indicates that low CRP alone is not reliable for ruling out surgery; the low LR+ (1.30) indicates its limitation in confirming surgery.[23,24] Therefore, in the initial evaluation, a combination of abscess size + PCT (+/− CRP) should replace an approach based on a single marker.[23,24,26]

In clinical practice, it seems appropriate to lower the threshold for surgery and make early multidisciplinary decisions in cases with an abscess size ≥6–7 cm.[13,19,25] Since procalcitonin (PCT) can provide additional discriminatory power in predicting the need for surgery compared to leukocyte/CRP, it is recommended that centers define their own local thresholds with their ROC analyses.[26] Instead of fixed "high" cut-offs for CRP, center-specific ROC-based optimization should be preferred; it should be kept in mind that the ~20–30 mg/L band may be more functional in some series.[23-25] Although the presence of an IUD is associated with development risk[9], it should not solely determine the surgical decision at presentation and should be evaluated together with other clinical parameters.[12,15,17] Finally, since clinical findings alone can be insufficient, adopting a composite decision framework that integrates clinical, laboratory, and imaging data is the most rational approach.[21,22]

The limitations of our study include its retrospective design, small sample size, lack of microbiological/culture data, and limited measurement of potential confounders such as symptom duration and sepsis scores. Future studies should investigate the clinical utility of multivariate models, internally/externally validated ROC analyses, and multi-marker scores such as CA-125 + PCT + abscess size.

5. Conclusion

TOA will remain on the agenda of all physicians, especially gynecologists and obstetricians, due to its incidence and the challenges in its diagnosis and treatment. The relationship between laboratory parameters and imaging methods at the time of diagnosis and treatment options will always remain current. Although the CRP values of the cases in our study were elevated, no relationship was found between the treatment options and the CRP value at the time of diagnosis.

Statement of ethics

The study was carried out in accordance with the guidelines of the Declaration of Helsinki, and the protocol was approved by the Ethics Committee of Prof.Dr. Cemil Taşçıoğlu City Hospital (Reference No: 114240-35/22, Date: 23.02.2022). As this was a retrospective chart review, the requirement for informed consent was waived.

genAI

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Conflict of interest statement

The authors declare that they have no conflict of interest.

Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author upon reasonable request.

Author contributions

Concept – MAÇ, HAŞ; Design – HAŞ; Supervision – EA, BGB; Resource – MAÇ, EA; Materials – BGB; Data collection and/or processing – MAÇ, EA; Analysis and/or interpretation – BGB, MAÇ; Literature review – MAÇ, HAŞ; Writing – EA, BGB; Critical review –HAÇ. Both authors read and approved the final manuscript.

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