PERINATAL JOURNAL

Original Article

Perinatal Journal 2026; 34(2):584-591

https://doi.org/10.57239/prn.26.03420058

Factors associated with treatment escalation in women hospitalized with Tubo-Ovarian abscess: A retrospective cohort study

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Abstract

To identify clinical, laboratory, and radiological predictors associated with treatment escalation in women hospitalized with tubo-ovarian abscess and to evaluate factors associated with prolonged hospitalization and antibiotic therapy. This retrospective cohort study included 75 women hospitalized with TOA between August 2021 and August 2023. Patients were categorized as medical (antibiotics alone) or surgical (invasive intervention following failure of antibiotic therapy after ≥72 hours). Baseline demographic, laboratory, and imaging data were analyzed. CRP values used in regression analysis were obtained at hospital admission. Multivariable logistic regression and Receiver Operating Characteristic (ROC) analyses were performed. Surgical intervention was required in 23 patients (30.7%). These patients had longer hospital stays and more frequent antibiotic regimen changes ($p<0.05$ for both). CRP levels showed weak but significant correlations with hospitalization duration ($\rho=0.354$, $p=0.002$) and antibiotic duration ($\rho=0.304$, $p=0.008$). In multivariable analysis, CRP was independently associated with treatment escalation (adjusted OR per 10 mg/L: 1.16; 95% CI: 1.04–1.29; $p=0.006$). ROC analysis demonstrated modest discriminatory performance (AUC=0.67), with an optimal cut-off of 205 mg/L (sensitivity 65%, specificity 63%). Among the laboratory parameters evaluated, admission CRP was independently associated with treatment escalation in women with TOA. However, its discriminatory performance was modest, suggesting that CRP may be useful as an adjunct to clinical assessment rather than as a standalone predictor.

Keywords: Antibiotic therapy, C-Reactive protein, Pelvic inflammatory disease, Surgical intervention, Tubo-Ovarian abscess

Introduction

Pelvic Inflammatory Disease (PID) is a polymicrobial infection of the upper female genital tract, most commonly resulting from ascending infection from the cervix and vagina. One of its most serious complications is the development of a Tubo-Ovarian Abscess (TOA)—a complex adnexal mass composed of purulent material within inflamed tubal and ovarian tissue—which occurs in approximately 10–15% of patients hospitalized for PID and is associated with substantial risks, including rupture, sepsis, and long-term reproductive morbidity (1).

Tubo-ovarian abscesses are typically polymicrobial, involving a combination of anaerobic and facultative organisms such as *Escherichia coli*, *Bacteroides* species, and *Peptostreptococcus* species, as well as sexually transmitted pathogens including *Chlamydia trachomatis* and *Neisseria gonorrhoe*ae (2). Recognized risk factors for TOA include a history of PID, intrauterine device use, multiple sexual partners, recent pelvic procedures, immunocompromised states, and coexisting gynecologic conditions such as endometriosis (3). Diagnosis relies on a combination of clinical findings, laboratory markers, and imaging studies, with transvaginal ultrasonography serving as the first-line modality and computed tomography or magnetic resonance imaging reserved for complex or equivocal cases (4, 5).

Current management strategies prioritize broad-spectrum intravenous antibiotic therapy, with image-guided drainage considered for large or refractory abscesses (6). Despite appropriate medical treatment, a subset of patients fails to respond and ultimately requires surgical or invasive intervention, often in the setting of persistent infection or clinical deterioration (7).

Although most women with tubo-ovarian abscess respond to broad-spectrum antibiotics, a substantial proportion require invasive intervention. Early identification of patients at high risk for treatment escalation may facilitate timely clinical decision-making, reduce morbidity, and

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optimize resource utilization. However, reliable predictors of treatment escalation remain incompletely defined. Therefore, this study aimed to identify clinical, laboratory, and imaging predictors associated with treatment escalation and adverse clinical outcomes in women hospitalized with tubo-ovarian abscess.

Methods

This retrospective cohort study was conducted at Başakşehir Çam and Sakura City Hospital, a high-volume tertiary referral center in Istanbul, Turkey. The study included women hospitalized with a diagnosis of Tubo-Ovarian Abscess (TOA) between August 2021 and August 2023. This study was approved by the Institutional Review Board of Başakşehir Çam and Sakura City Hospital (Approval No: 27.09.2023/429). Due to the retrospective nature of the study, the requirement for informed consent was waived. All procedures were conducted in accordance with the Declaration of Helsinki.

All patients diagnosed with TOA at our institution are routinely hospitalized for inpatient management and clinical monitoring in accordance with current clinical guidelines. Diagnosis was established based on a combination of clinical findings and imaging studies, including transvaginal ultrasonography, Computed Tomography (CT), or magnetic resonance imaging (MRI).

Patients with histopathologically confirmed endometriomas, gynecologic malignancies, or non-infectious adnexal masses were excluded. Additionally, patients with known immunodeficiency or receiving immunosuppressive therapy were excluded. After applying these criteria, 75 patients with confirmed TOA were included in the final analysis.

All patients initially received intravenous antibiotic therapy consisting of clindamycin (900 mg every 8 hours) and gentamicin (2 mg/kg loading dose followed by 1.5 mg/kg every 8 hours), in accordance with institutional protocols and guideline-based recommendations.

Patients were categorized into two groups based on their clinical course: the medical group, comprising patients successfully treated with antibiotic therapy alone, and the surgical group, including those who required invasive intervention following failure of medical treatment.

Antibiotic non-response was defined as the absence of clinical improvement after 72 hours of treatment, based on a combination of persistent fever, ongoing abdominal or pelvic pain, lack of improvement or worsening in inflammatory markers (particularly CRP and WBC), and no reduction in abscess size on follow-up imaging.

Treatment decisions were made according to institutional practice by the attending gynecologic team based on patients' clinical status, laboratory findings, imaging results, and response to antibiotic therapy.

Clinical and laboratory data were retrospectively extracted from electronic medical records. Collected variables included:

- Demographic and obstetric characteristics (age, gravida, parity, mode of delivery)
- Clinical history (intrauterine device use, prior abdominal surgery)
- Laboratory parameters (white blood cell count, neutrophil count, C-reactive protein, procalcitonin)
- Imaging findings (abscess size and bilaterality)
- Treatment-related variables (length of hospital stay, duration of antibiotic therapy, need for intervention)

CRP values used in all analyses corresponded to baseline measurements obtained at the time of hospital admission, and serial measurements were not included in regression models.

Abscess size was assessed using transvaginal ultrasonography following hospital admission. All measurements were performed by the responsible attending gynecologist in the inpatient unit, each with substantial experience in gynecologic imaging.

Measurements were obtained in two perpendicular planes, and the largest diameter (in millimeters) was recorded for analysis.

Serial ultrasonographic evaluations were performed during hospitalization to monitor treatment response. Follow-up measurements were conducted using the same two-dimensional approach; however, strict operator standardization

could not be ensured due to the retrospective design.

For all statistical analyses, including group comparisons and regression models, baseline abscess size at hospital admission was used.

The primary outcome was treatment escalation, defined as the requirement for surgical or image-guided intervention after failure of initial intravenous antibiotic therapy.

Secondary outcomes were length of hospital stay, duration of antibiotic therapy, and antibiotic regimen modification.

Statistical analysis

All statistical analyses were performed using IBM SPSS Statistics for Windows, version 26.0 (IBM Corp., Armonk, NY, USA).

The normality of continuous variables was assessed using the Shapiro–Wilk test. Normally distributed variables were presented as mean ± standard deviation, while non-normally distributed variables were expressed as median (25th–75th percentile).

Between-group comparisons were performed using the independent samples t-test or Mann–Whitney U test, as appropriate. Categorical variables were compared using the chi-square test or Fisher's exact test. Correlations between continuous variables were evaluated using Spearman's rank correlation coefficient.

Multivariable logistic regression analysis was performed to identify factors independently associated with treatment escalation. Given the limited number of treatment escalation events, a parsimonious multivariable model was prespecified and restricted to three clinically relevant variables (age, admission CRP level, and baseline abscess size) to minimize the risk of model overfitting.

Although neutrophil count was associated with treatment escalation in the univariable comparisons, it was not included in the multivariable model because of the limited number of events and the prespecified modeling strategy.

Results

Among the 75 women included in the analysis, 23 (30.7%) required treatment escalation with surgical or image-guided intervention after failure of initial antibiotic therapy, whereas 52 (69.3%) responded successfully to medical management alone.

The mean age was comparable between the surgical and medical groups (38.2 ± 6.6 vs. 37.8 ± 8.3 years, respectively; p = 0.851). Gravidity and parity did not differ significantly between groups (p = 0.309 and p = 0.558, respectively). Similarly, mode of delivery was comparable between groups (p = 0.860).

Median abscess size was higher in the surgical group (70 mm [60–80]) compared with the medical group (61.5 mm [50–172]); however, this difference did not reach statistical significance (p = 0.074). Bilaterality of the abscess was also comparable between groups (4.3% vs. 15.4%; p = 0.260) (Table 1).

Table 1. Baseline demographic and clinical characteristics of the patients with tubo-ovarian abscess according to treatment modality

	Surgical	Medical	p
N	23	52	
Age	38.2±6.6	37.8±8.3	0.851
Gravidity	2 (0-3)	2 (1-4)	0.309
Parity	2 (0-3)	2 (0-3)	0.558
Mode of delivery			0.860
Cesarean section	7 (43.7)	19 (46.3)	
Vaginal delivery	9 (56.3)	22 (53.7)	
History of abdominal surgery	10 (43.4)	28 (53.8)	0.509
Intrauterine device	4 (17.4)	18 (34.6)	0.131
Ovarian cyst	10 (43.4)	17 (32.7)	0.370

Abscess size (mm)	70 (60-80)	61.5 (50-172)	0.074
Bilaterality of abscess	1 (4.3)	8 (15.4)	0.260

Data are presented as mean ± standard deviation (SD), number (percentage), or median (25th–75th percentile), as appropriate. Comparisons between groups were performed using the independent samples t-test for normally distributed continuous variables, the Mann–Whitney U test for non-normally distributed continuous variables, and the chi-square test for categorical variables

Clinical course and laboratory parameters during hospitalization differed between the treatment groups. Patients who required surgical intervention had a significantly longer median length of hospital stay compared with those managed medically (16 days [10–21] vs. 9.5 days [7–14]; p = 0.001). Similarly, the duration of antibiotic therapy was significantly longer in the surgical group (15 days [10–21] vs. 9 days [7–13]; p = 0.001). Antibiotic regimen change was more frequent among surgically treated patients (52.1% vs. 23.1%; p = 0.013). However, the time to antibiotic escalation did not differ significantly between groups (2.5 days [1.2–6] vs. 2 days [2–4.5]; p = 0.835).

Among laboratory parameters, neutrophil count was significantly higher in the surgical group (14.9 ± 5.4 vs. 12.4 ± 4.6 $\times 10^3/\mu L$; p = 0.048), whereas CRP levels, WBC count, and procalcitonin levels were comparable between groups (p > 0.05 for all).

Table 2. Clinical course, laboratory parameters and outcomes during hospitalization in patients with tubo-ovarian abscess according to treatment modality

	Surgical	**Medical**	**p**
N	23	52	
Length of hospital stay	16 (10-21)	9.5 (7-14)	0.001
Duration of antibiotic therapy	15 (10-21)	9 (7-13)	0.001
Antibiotic regimen change	12 (52.1)	12 (23.1)	0.013
Time to antibiotic escalation	2.5 (1.2-6)	2 (2-4.5)	0.835
Neutrophil count ($\times 10^3/\mu L$)	14.9±5.4	12.4±4.6	0.048
CRP	221±86	198±99	0.323
WBC count	17.4±5.4	15.4±4.6	0.093
Procalcitonin level	0.21 (0.1-0.85)	0.14 (0.06-0.67)	0.175

Data are presented as mean ± standard deviation (SD), number (percentage), or median (25th–75th percentile), as appropriate. Abbreviations: CRP: C-reactive protein, WBC: White blood cell

Spearman correlation analysis demonstrated weak but statistically significant positive correlations between CRP levels and duration of antibiotic therapy (ρ = 0.304, p = 0.008), as well as length of hospital stay (ρ = 0.354, p = 0.002). Abscess size was also weakly correlated with antibiotic duration (ρ = 0.305, p = 0.008) and hospitalization duration (ρ = 0.293, p = 0.011). No significant correlations were observed between WBC count, neutrophil count, or procalcitonin levels and either antibiotic duration or length of hospital stay (Table 3).

Table 3. Demographic, laboratory, and clinical characteristics of the patients based on the need for antibiotic regimen change

	First line	**Changed**	**p**
N	51	24	
Age	38.7±7.7	36.3±7.8	0.218
Gravidity	2 (1-4)	2 (0-3)	0.201
Parity	2 (1-3)	2 (0-3)	0.361
Route of delivery			0.442
Cesarean section	20 (48.8)	6 (37.5)	
Vaginal delivery	21 (51.2)	10 (62.5)	
History of abdominal surgery	25 (49.0)	13 (54.2)	0.807
IUD	14 (27.5)	8 (33.3)	0.602
Ovarian cyst	21 (41.2)	6 (25.0)	0.173

Length of hospital stay	9 (7-13)	15.5 (12-21)	**<0.001**
Duration of antibiotic therapy	8 (7-12)	15 (10.5-21)	**<0.001**
Abscess size (mm)	63 (50-74)	67.5 (49.5-80)	0.561
Bilaterality of abscess	5 (9.8)	4 (16.7)	0.455
Neutrophil count (×10^3/μL)	12.2±4.9	15.1±4.7	0.020
CRP	185±98	246±74	0.010
WBC count	15.1±4.9	17.9±4.3	0.020
Procalcitonin level	0.16 (0.06-0.98)	0.2 (0.09-0.37)	0.699

Data are presented as mean ± standard deviation (SD), number (percentage), or median (25th–75th percentile), as appropriate. Comparisons were performed using the independent samples t-test, Mann–Whitney U test, or chi-square test, as appropriate.

In multivariable logistic regression analysis including age, admission CRP level, and abscess size, admission CRP was the only variable independently associated with treatment escalation, whereas age and abscess size were not significantly associated with the outcome (adjusted OR per 10 mg/L increase: 1.16; 95% CI: 1.04–1.29; p = 0.006) (Table 4).

Table 4. Multivariable logistic regression analysis of factors associated with treatment escalation in women with tubo-ovarian abscess

Predictor	Adjusted OR	95% CI	p-value
Age (years)	1.02	0.96–1.08	0.52
CRP (per 10 mg/L increase)	1.16	1.04–1.29	0.006
Abscess size (mm)	1.01	0.99–1.04	0.18

Multivariable logistic regression analysis was performed including age, CRP, and abscess size. Odds Ratios (ORs) are presented with 95% Confidence Intervals (CIs). A parsimonious modeling approach was adopted due to the limited number of events

ROC analysis demonstrated modest discriminatory performance of CRP (AUC = 0.67, 95% CI 0.54–0.80). The optimal cut-off value was 205 mg/L, yielding a sensitivity of 65% and specificity of 63% (Figure 1).

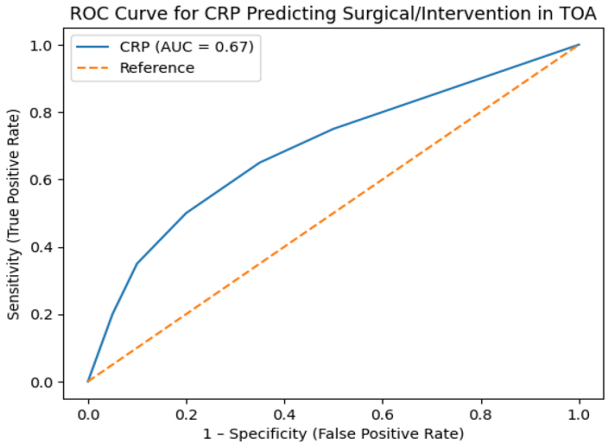

Figure 1. Receiver operating characteristic (ROC) curve of C-reactive protein (CRP) for predicting surgical or invasive intervention in patients with tubo-ovarian abscess. The area under the curve (AUC) was 0.67. The optimal cut-off value was 205 mg/L, with a sensitivity of 65% and specificity of 63%.

Discussion

The present study evaluated clinical and laboratory factors associated with treatment escalation and clinical outcomes in women hospitalized with tubo-ovarian abscess. Patients requiring treatment escalation experienced longer hospitalization and prolonged antibiotic therapy. Among the laboratory variables evaluated, only admission CRP remained independently associated with treatment escalation after adjustment for age and abscess size.

The observed correlations between CRP levels and both treatment duration and length of hospital stay are consistent with previous studies suggesting that CRP reflects disease severity in TOA. Aktoz et al. reported that CRP levels above 144 mg/L were associated with medical treatment failure, with moderate discriminatory performance (AUC = 0.71), and also demonstrated a correlation with hospitalization duration (8). Similarly, in our study, CRP showed weak but significant correlations with both antibiotic duration and length of hospital stay, supporting its role as a marker of clinical burden rather than a definitive predictor (9). Likewise, a recent study including 305 patients reported that

higher pre-treatment CRP and WBC levels were associated with the need for invasive treatment, whereas patients successfully managed medically had significantly lower inflammatory markers and shorter hospital stays (10).

Although neutrophil count and WBC were elevated in patients requiring treatment escalation, these parameters were not independently associated with surgical intervention after adjustment. This may reflect shared inflammatory pathways and collinearity among hematologic markers, limiting their independent predictive contribution. Previous studies in pelvic infections have also suggested that leukocytosis alone has limited discriminatory value when considered independently (11).

In contrast, procalcitonin did not demonstrate a significant association with treatment outcomes in this cohort. While some studies have suggested a potential role for procalcitonin in distinguishing TOA from less severe pelvic inflammatory disease (12), others have reported limited utility in predicting the need for intervention (13). Our findings are consistent with the latter, suggesting that procalcitonin may have limited value in guiding management decisions in TOA.

Abscess size has traditionally been considered an important factor in clinical decision-making, with larger abscesses associated with higher rates of intervention in previous reports (14, 15). Although a similar trend was observed in our study, the lack of statistical significance may be related to sample size limitations or the influence of additional clinical factors. This finding supports the notion that abscess size should not be used in isolation but rather interpreted within the broader clinical context.

Although CRP was identified as an independent predictor in multivariable analysis, its discriminatory performance in ROC analysis was modest. This highlights that statistical association does not necessarily translate into strong predictive ability. Similarly, a recent large retrospective study developed and validated a multivariable nomogram for predicting invasive intervention in women with tubo-ovarian abscess (16). Consistent with our findings, admission CRP contributed to risk stratification; however, combining laboratory, clinical, and imaging variables resulted in superior predictive performance compared with individual biomarkers alone. Together, these findings support the interpretation of CRP as an adjunctive marker that should be considered within an integrated clinical assessment rather than as a standalone predictor.

This study has several limitations. First, its retrospective design and single-center setting may limit the generalizability of the findings. Second, the moderate sample size and the relatively small number of treatment escalation events limited the complexity of the multivariable model and may have reduced statistical power. In addition, procalcitonin measurements were not available for all patients, and the timing of these measurements was not standardized because of the retrospective study design. Finally, treatment decisions were based on routine clinical practice and may have been influenced by unmeasured clinical factors.

Despite these limitations, our findings provide clinically relevant insights into factors associated with treatment escalation in women with tubo-ovarian abscess. Future prospective, multicenter studies are warranted to validate these findings and to develop robust prediction models integrating clinical, laboratory, and imaging parameters.

Conclusion

Treatment escalation in women with tubo-ovarian abscess is likely multifactorial and cannot be explained by inflammatory biomarkers alone. In this cohort, admission CRP was independently associated with treatment escalation and correlated with indicators of a more severe clinical course. However, because of its modest discriminatory performance, CRP should be considered an adjunctive laboratory marker rather than an isolated determinant of clinical decision-making.

Funding

The authors declare that no financial support was received for this study.

Conflicts of interest

The authors declare that they have no conflicts of interest.

Acknowledgements

None.

Availability of data and materials

Data is available and can be shared by editors and reviewers if necessary.

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Ethics approval and consent to participate

Ethical approval for this retrospective study was obtained from the Institutional Review Board of Başakşehir Çam and Sakura City Hospital (Approval No. 27.09.2023/429). The requirement for informed consent was waived because of the retrospective study design. The study was conducted in accordance with the Declaration of Helsinki.

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