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Original Research

Evaluation of Different Treatment Modalities for Tubo-Ovarian Abscess: Medical, Interventional, and Surgical Approaches

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Abstract

Background: Tubo-ovarian abscess (TOA) is a serious complication of pelvic inflammatory disease, and the optimal treatment approach remains uncertain. This study aimed to compare the effectiveness of medical, interventional, and surgical treatment modalities for tubo-ovarian abscess (TOA) and to evaluate their effects on clinical outcomes. **Methods:** A total of 62 patients diagnosed with TOA and treated at our clinic between April 2023 and April 2025 were retrospectively analyzed. Patients were divided into three groups according to treatment modality: medical therapy (n = 31), ultrasound-guided percutaneous drainage (n = 18), and surgical intervention (n = 13). Clinical findings, laboratory parameters, abscess size, antibiotic use, and length of hospital stay were compared among the groups. **Results:** The mean abscess size was 51.8 ± 18.1 mm in the medical group, 71.7 ± 30.3 mm in the interventional group, and 85.0 ± 31.4 mm in the surgical group, with a significant overall between-group difference (p = 0.001). Bonferroni-adjusted post hoc comparisons showed significant differences between the medical and interventional groups (p = 0.028) and between the medical and surgical groups (p = 0.002). The median length of hospital stay was shorter in the surgical group (6 days) than in the medical therapy group (7 days) and the interventional group (8 days) (p = 0.011). In multivariable Poisson regression analysis, higher admission C-reactive protein (CRP) levels were independently associated with a longer hospital stay (incidence rate ratio [IRR] = 1.001, 95% confidence interval [CI]: 1.000–1.002), whereas the ceftriaxone + metronidazole + doxycycline (DFM) antibiotic regimen was associated with a shorter hospital stay (IRR = 0.621, 95% CI: 0.516–0.747). Treatment modality was not independently associated with hospital stay after adjustment. Infection markers decreased significantly over time in all groups, while the magnitude of improvement did not differ significantly among treatment modalities. **Conclusion:** An individualized approach according to patient characteristics is essential in TOA management. In this cohort, surgical intervention was associated with shorter hospital stay despite larger abscess size, whereas ultrasound-guided drainage represented a minimally invasive alternative for selected patients. As the treatment allocation was not randomized, these findings should be interpreted with caution. Further prospective multicenter studies are required to establish optimal treatment algorithms.

Keywords: tubo-ovarian abscess; medical treatment; surgical treatment; percutaneous drainage

1. Introduction

Despite significant advances in healthcare, pelvic inflammatory disease (PID) remains one of the leading causes of gynecologic morbidity and mortality [1]. In the United States alone, PID accounts for more than 200,000 hospital admissions annually, with approximately half of these patients requiring surgical intervention, resulting in a considerable economic burden on the healthcare system [2].

The chronic form of PID leads to the development of tubo-ovarian abscess (TOA) in nearly one-third of cases. TOAs are most commonly observed in women with a history of PID, multiple sexual partners, and particularly in those aged 15–24 years. Clinically, TOA remains a major challenge due to its high risk of complications and potential resistance to treatment [1,3,4,5,6].

Intravenous antibiotics represent the first-line treatment for TOA. Although no standardized protocol has been established, a triple antibiotic regimen (ceftriaxone + metronidazole + doxycycline [DFM]) is frequently used and has been associated with high cure rates. However, antibiotic therapy alone has been shown to be insufficient in abscesses larger than 10 cm, in cases with recurrent symptoms, or in patients with chronic pelvic pain [7,8,9].

Among alternative treatment methods, ultrasound-guided percutaneous drainage has emerged as a minimally invasive option. Although the available evidence remains limited, this approach has demonstrated low complication rates and high success rates in appropriately selected patients. In advanced cases or in patients unresponsive to medical and interventional therapies, surgical intervention, including laparoscopy or laparotomy, becomes necessary [8,9,10,11,12,13,14,15].

Accordingly, determining the optimal approach among medical treatment, ultrasound-guided drainage, and surgical intervention remains an important clinical challenge in TOA management. This study aimed to compare the outcomes of TOA treated with medical therapy, ultrasound-guided drainage, and surgical intervention, thereby contributing to the existing literature and guiding clinical decision-making.

2. Materials and Methods

2.1 Patients and Study Design

This retrospective, single-center study was approved by the Ethics Committee of the Kocaeli City Hospital (Approval No.: 2024-148). A total of 62 patients diagnosed with TOA and treated at our clinic between April 2023 and April 2025 were included in the final analysis. Patients with pregnancy, gynecologic malignancy, or a history of immunosuppressive therapy were excluded from the study.

2.2 Inclusion and Exclusion Critferia

The diagnosis of TOA was established based on clinical findings (fever, lower abdominal pain, and vaginal discharge), laboratory parameters (elevated leukocyte count and C-reactive protein [CRP] levels), and imaging approaches (pelvic ultrasonography or contrast-enhanced computed tomography [CT]). Patients with pregnancy, gynecologic malignancy, or a history of immunosuppressive therapy were excluded from the study.

2.3 Treatment Modalities

Patients were categorized into three groups according to the treatment received: medical treatment group (n = 31), interventional treatment group (n = 18), and surgical treatment group (n = 13).

• Medical treatment group: Patients treated with intravenous antibiotic therapy, most commonly a combination of DFM.

• Interventional treatment group: Patients who underwent ultrasound-guided percutaneous drainage in addition to antibiotic therapy.

• Surgical treatment group: Patients treated surgically by laparoscopy or laparotomy.

Ultrasound-guided drainage was performed under transvaginal or transabdominal ultrasound guidance, depending on the location and accessibility of the abscess. Following standard antiseptic preparation, an aspiration needle was introduced into the abscess cavity under real-time ultrasound guidance, and purulent material was aspirated until adequate decompression was achieved. Drainage procedures were performed by experienced gynecologists. Catheter placement was not routinely required but was considered when clinically indicated according to abscess characteristics and drainage adequacy. Intravenous antibiotic therapy was continued after the procedure in all patients.

All treatment decisions were made by the attending gynecologist based on the patient's clinical presentation, abscess characteristics, and response to treatment. Ultrasound-guided drainage was generally preferred for clinically stable patients with technically accessible abscesses. Surgical intervention was considered for patients with large abscesses, suspected rupture, hemodynamic instability, generalized peritonitis, clinical deterioration despite antibiotic therapy, or failure of medical or interventional management. Due to the retrospective nature of the study, no predefined treatment algorithm or absolute abscess-size threshold was applied. This approach is consistent with treatment algorithms previously reported in the literature [7,8].

2.4 Clinical and Laboratory Data

Patient age, gravidity, parity, intrauterine device (IUD) status, surgical history, as well as comorbidities were recorded. Body temperature was recorded at admission and at 24 hours, whereas WBC, neutrophil count, and CRP levels were recorded at admission, 24 hours, 72 hours, and at discharge. Abscess size was measured by transvaginal or abdominal ultrasonography.

2.5 Outcome Measures

Primary outcomes included duration of antibiotic therapy and length of hospital stay. Secondary outcomes were changes in infection markers, such as fever, WBC count, neutrophil count, and CRP levels, during hospitalization.

2.6 Statistical Analysis

Data were analyzed using SPSS version 26 (IBM Corp., Armonk, NY, USA). Data distribution was assessed using graphical methods and normality tests before statistical analysis. Normally distributed continuous variables are presented as mean ± standard deviation (SD), whereas non-normally distributed continuous variables are presented as median (interquartile range, IQR). Categorical variables are presented as frequencies (n) and percentages (%). Categorical variables were compared using the Pearson chi-square test or Fisher's exact/Fisher-Freeman-Halton test, as appropriate according to the expected cell frequencies. Changes over time within each treatment group were evaluated using the Friedman and Wilcoxon signed-rank tests. To compare the magnitude of improvement among treatment modalities, change values (Δ) were calculated for fever (initial–24 h), WBC count (initial–discharge), neutrophil count (initial–discharge), and CRP (initial–discharge), and compared using the Kruskal–Wallis test. Bonferroni correction was applied in post hoc analyses. Because length of hospital stay was a right-skewed count/duration variable, factors associated with hospital stay were evaluated using Poisson regression with a log-link function. Model dispersion was assessed using the Pearson chi-square-to-degrees-of-freedom ratio. No missing data were identified for the variables included in the analyses; therefore, no imputation procedure was required. A two-sided p-value < 0.05 was considered statistically significant.

Table 1. Comparison of baseline characteristics according to treatment modality.

Variable	Medical group	Interventional group	Surgical group	*p*-value
Age (mean ± SD)	36.90 ± 8.27	35.50 ± 9.18	39.38 ± 6.12	0.347[a]
Gravida [Med. (min–max)]	2 (0–7)	2 (0–4)	2 (1–5)	0.553[a]
Parity [Med. (min–max)]	2 (0–4)	2 (0–4)	2 (1–3)	0.958[a]
Presence of IUD, n (row %)	12 (46.2)	7 (26.9)	7 (26.9)	0.669[b]
Surgery in the last 12 months, n (row %)	11 (50.0)	7 (31.8)	4 (18.2)	0.940[b]
Comorbidity, n (row %)	3 (50.0)	0 (0.0)	3 (50.0)	0.081[b]

[a] Kruskal–Wallis test; [b] Pearson chi-square test, Fisher's exact test, or Fisher–Freeman–Halton test, where appropriate. SD, standard deviation; IUD, intrauterine device.

Table 2. Comparison of clinical characteristics according to treatment modality.

Variable	Medical group	Interventional group	Surgical group	*p*-value
Abscess size (mm) (mean ± SD)	51.77 ± 18.10	71.67 ± 30.29	85.00 ± 31.42	0.001[a]
Right TOA, n (row %)	14 (56.0)	7 (28.0)	4 (16.0)	0.215[b]
Left TOA, n (row %)	12 (46.2)	10 (38.5)	4 (15.4)	
Bilateral TOA, n (row %)	5 (45.5)	1 (9.1)	5 (45.5)	
DFM antibiotic regimen, n (row %)	27 (60.0)	8 (17.8)	10 (22.2)	0.006[b]
Other antibiotic regimen, n (row %)	4 (23.5)	10 (58.8)	3 (17.6)	
Length of hospital stay [Med. (min–max)]	7 (5–10)	8 (7–20)	6 (3–21)	0.011[a]
Duration of antibiotic therapy [Med. (min–max)]	7 (5–10)	8 (7–20)	5 (3–21)	0.009[a]

[a] Kruskal–Wallis test; [b] Pearson chi-square test, Fisher's exact test, or Fisher–Freeman–Halton test, where appropriate. DFM, ceftriaxone + metronidazole + doxycycline; TOA, tubo-ovarian abscess.

3. Results

The baseline demographic and clinical characteristics of the 62 patients included in the study are presented in Table 1. There were no statistically significant differences among the medical, interventional, and surgical treatment groups in terms of age, gravida, parity, IUD presence, surgical history within the past 12 months, or comorbidity distribution (all $p > 0.05$).

Mean abscess size was 51.8 ± 18.1 mm in the medical group, 71.7 ± 30.3 mm in the interventional group, and 85.0 ± 31.4 mm in the surgical group, with a significant overall between-group difference ($p = 0.001$). Post hoc pairwise comparisons showed significant differences between the medical and interventional groups ($p = 0.028$) and between the medical and surgical groups ($p = 0.002$). No significant difference was observed among the groups regarding the laterality of TOA (right, left, or bilateral) ($p = 0.215$) (Table 2).

Regarding antibiotic treatment, 60% of patients in the medical group received the standard triple protocol (DFM), whereas alternative regimens were more frequently used in the interventional group. Antibiotic selection differed significantly among the groups ($p = 0.006$).

Comparison of length of hospital stay and antibiotic duration showed that the surgical group exhibited shorter median hospital stay (6 days) and antibiotic use (5 days) compared with the medical group (7 days for both outcomes) and interventional group (8 days for both outcomes) ($p = 0.011$ and $p = 0.009$, respectively) (Table 2).

Infection markers revealed no significant differences between groups at baseline or in 24-hour fever values ($p = 0.132$ and $p = 0.222$); however, all groups demonstrated a significant decrease over time (medical group, $p < 0.001$; interventional group, $p = 0.025$; surgical group, $p = 0.021$). Similarly, WBC count, neutrophil count, and CRP levels did not differ significantly between groups (all $p > 0.05$), whereas time-series analyses within each group showed significant reductions over time (all $p < 0.001$) (Table 3).

Poisson regression analysis was performed to evaluate factors associated with length of hospital stay (Fig. 1). After adjustment for baseline CRP levels, abscess size, treatment modality, and antibiotic regimen, higher baseline CRP levels were associated with a slightly longer hospital stay (incidence rate ratio [IRR] = 1.001, 95% confidence interval [CI]: 1.000–1.002, $p = 0.013$). The DFM antibiotic protocol was associated with a shorter hospital stay compared with non-DFM regimens (IRR = 0.621, 95% CI: 0.516–0.747, $p < 0.001$). Treatment modality was not independently associated with length of hospital stay after adjustment (interventional group: IRR = 0.960, $p = 0.642$; surgical group: IRR = 0.853, $p = 0.233$). The Pearson chi-square-to-degrees-of-freedom ratio was 0.65, indicating no evidence of overdispersion (Table 4).

To further evaluate treatment response, changes (Δ) in inflammatory markers were compared between the three treatment groups. Δ body temperature was calculated between admission and 24 hours, whereas Δ WBC count, Δ neutrophil count, and Δ CRP levels were calculated between admission and discharge. Between-group compar-

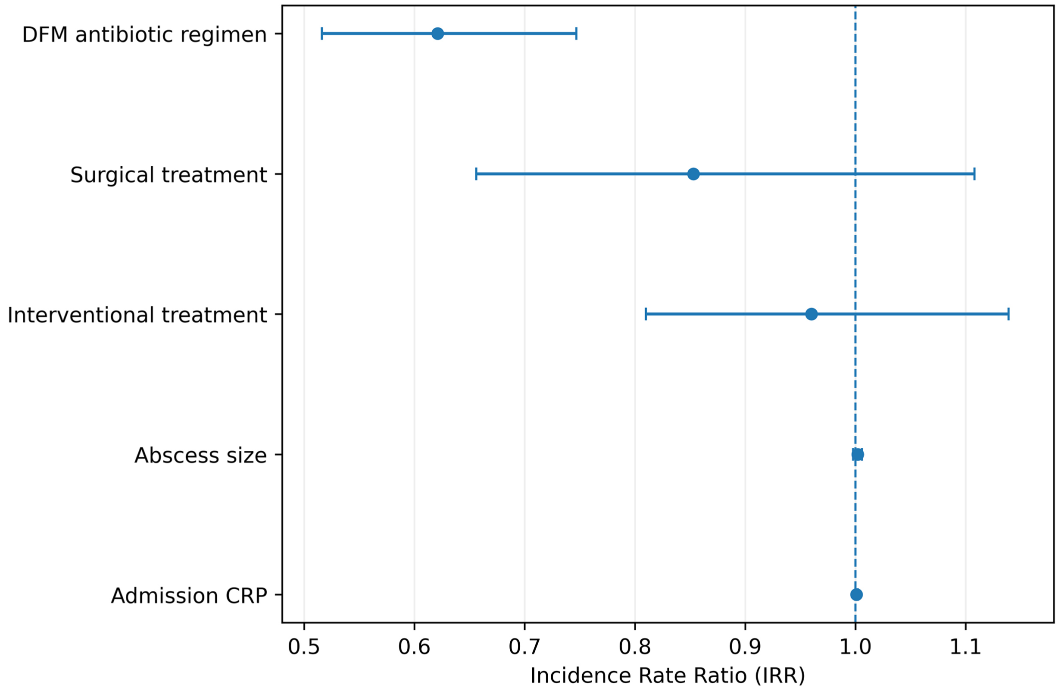

Fig. 1. Forest plot of the multivariable Poisson regression model for factors associated with length of hospital stay. DFM, ceftriaxone + metronidazole + doxycycline; CRP, C-reactive protein; IRR, incidence rate ratio.

Table 3. Changes in fever and laboratory infection markers according to treatment modality.

Parameter	Medical mean	Medical SD	Interventional mean	Interventional SD	Surgery mean	Surgery SD	p value[a]
Initial fever (°C)	37.59	0.99	38.11	1.05	38.15	0.88	0.132
Fever_24h (°C)	36.91	1.95	37.55	0.75	37.67	0.82	0.222
Within-group p-value[c]	<0.001		0.025		0.021		
WBC_initial ($\times 10^3/\mu L$)	15.72	5.60	16.16	4.53	16.22	4.81	0.884
WBC_24h ($\times 10^3/\mu L$)	15.26	6.54	13.21	5.02	17.03	8.22	0.300
WBC_72h ($\times 10^3/\mu L$)	13.28	5.36	10.86	4.49	11.48	4.05	0.323
WBC_discharge ($\times 10^3/\mu L$)	8.47	2.01	8.59	2.63	8.51	2.66	0.999
Within-group p-value[d]	<0.001		<0.001		<0.001		
Neutrophils_initial ($\times 10^3/\mu L$)	12.62	5.52	13.29	4.91	12.81	5.20	0.864
Neutrophils_24h ($\times 10^3/\mu L$)	12.27	6.30	10.19	4.15	14.10	8.30	0.266
Neutrophils_72h ($\times 10^3/\mu L$)	10.15	5.19	7.71	3.98	8.30	3.55	0.285
Neutrophils_discharge ($\times 10^3/\mu L$)	5.23	1.78	5.42	2.25	5.37	2.50	0.953
Within-group p-value[d]	<0.001		<0.001		<0.001		
CRP_initial (mg/L)	119.91	85.29	166.40	106.34	150.88	81.00	0.184
CRP_24h (mg/L)	140.35	92.42	172.76	143.09	174.74	134.57	0.858
CRP_72h (mg/L)	114.73	85.81	122.83	130.69	95.59	69.34	0.936
CRP_discharge (mg/L)	19.30	17.98	17.33	15.02	32.06	45.09	0.889
Within-group p-value[d]	<0.001		<0.001		<0.001		

[a] Kruskal–Wallis test; [c] Friedman test for fever; [d] Friedman test for WBC, neutrophil count, and CRP across repeated time points. SD, standard deviation; WBC, white blood cell; CRP, C-reactive protein.

isons were performed using the Kruskal–Wallis test. No statistically significant differences were observed among the medical group, interventional group, and surgical treatment group regarding Δ body temperature (p = 0.889), Δ WBC count (p = 0.756), Δ neutrophil count (p = 0.890), or Δ CRP levels (p = 0.270) (Table 5, Fig. 2). These findings indicate that all three treatment modalities were associated with comparable improvements in inflammatory markers during hospitalization, despite differences in length of hospital stay and antibiotic duration.

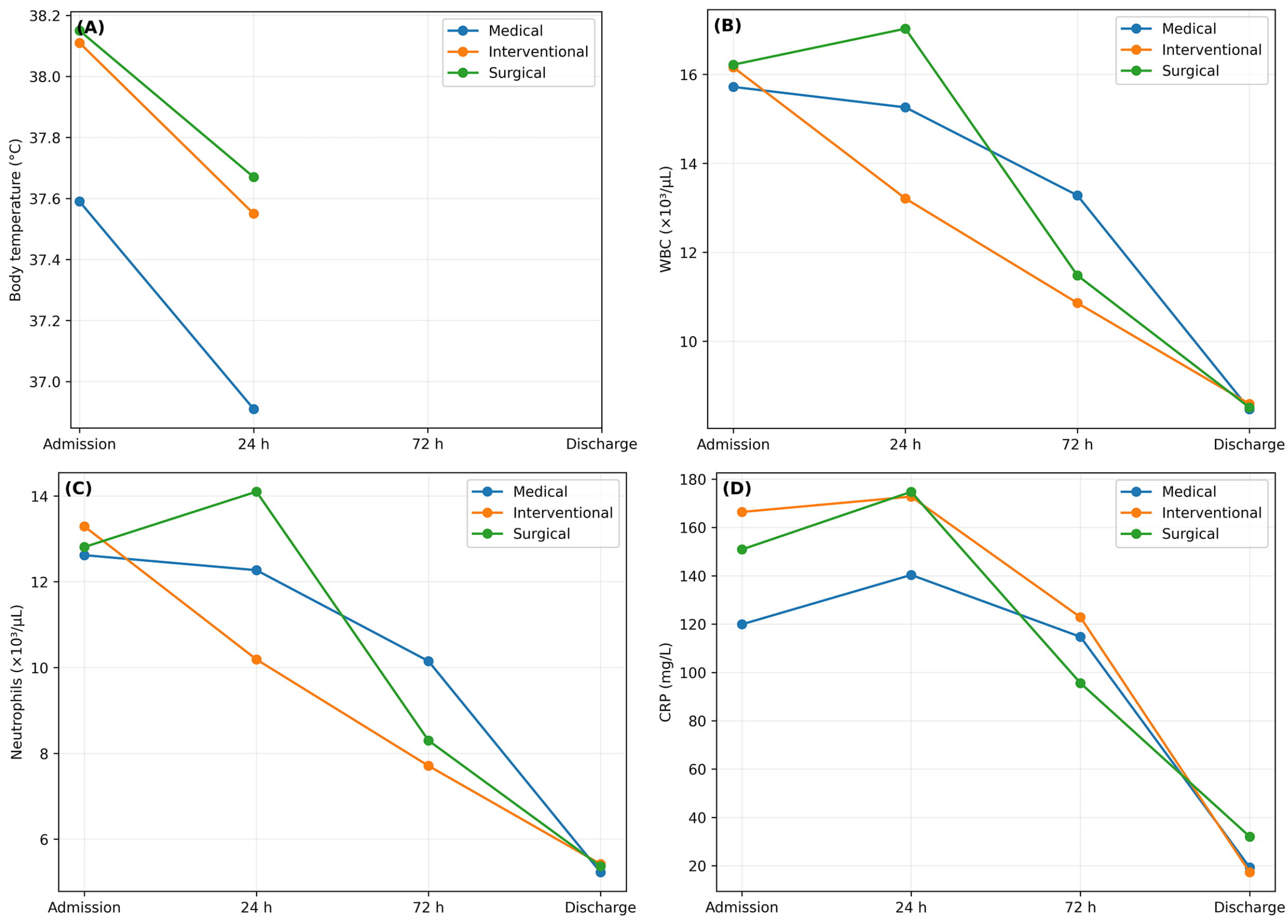

Fig. 2. Longitudinal changes in inflammatory parameters according to treatment modality. (A) Body temperature. (B) WBC count. (C) Neutrophil count. (D) CRP levels during length of hospital stay in the medical group, interventional group, and surgical treatment group. WBC, white blood cell; CRP, C-reactive protein.

Table 4. Poisson regression analysis of factors associated with length of hospital stay.

Variable	B	SE	Wald z	*p*-value	IRR	95% CI for IRR
Admission CRP (mg/L)	0.0010	0.0004	2.496	0.013	1.001	1.000–1.002
Abscess size	0.0017	0.0020	0.847	0.397	1.002	0.998–1.006
Interventional treatment	–0.0404	0.0869	–0.465	0.642	0.960	0.810–1.139
Surgical treatment	–0.1591	0.1335	–1.192	0.233	0.853	0.656–1.108
Antibiotic regimen (DFM)	–0.4770	0.0944	–5.055	<0.001	0.621	0.516–0.747

Poisson regression with log-link function and robust standard errors. Reference categories: medical treatment and non-DFM antibiotic regimens. Pearson chi-square/degrees of freedom = 0.65. DFM, ceftriaxone + metronidazole + doxycycline; CRP, C-reactive protein; IRR, incidence rate ratio; CI, confidence interval.

Table 5. Comparison of changes (Δ) in inflammatory markers among treatment groups.

Variable	Medical (n = 31) median (IQR)	Interventional (n = 18) median (IQR)	Surgical (n = 13) median (IQR)	*p*-value
Δ Body temperature (°C)	0.50 (0.23–0.77)	0.50 (0.23–1.30)	0.60 (0.20–0.70)	0.889
Δ WBC ($\times 10^3/\mu$L)	5.87 (3.75–9.25)	8.23 (4.93–10.60)	6.98 (6.25–8.57)	0.756
Δ Neutrophil ($\times 10^3/\mu$L)	6.04 (4.48–9.04)	7.02 (4.90–11.48)	8.06 (4.00–9.51)	0.890
Δ CRP (mg/L)	85.75 (40.50–164.19)	129.06 (75.93–166.04)	106.00 (90.22–171.60)	0.270

IQR, interquartile range; WBC, white blood cell; CRP, C-reactive protein.

4. Discussion

In this retrospective study, the efficacy and outcomes of the medical, interventional, and surgical treatments for TOA management were compared. Our findings demonstrated that, despite having larger abscesses, patients in the surgical group presented shorter hospital stays and shorter durations of antibiotic therapy compared with the medical and interventional groups. However, these findings should be interpreted with caution. Treatment allocation was not randomized and was based on clinical decision-making. Patients who underwent surgery generally had larger abscesses and may have differed from those in the other groups in ways that were not fully captured by the available data. Therefore, the observed differences in hospitalization duration should not be interpreted as evidence of treatment superiority.

These findings are largely consistent with the existing literature. Dewitt et al. [16] and Gjelland et al. [17] reported that antibiotic therapy is successful in 60–70% of TOA cases, but failure rates increase significantly in abscesses larger than 9–10 cm or in multiloculated abscesses. In our study, the larger mean abscess size among patients requiring surgical intervention supports this observation. Similarly, Goje et al. [8] demonstrated that when abscess diameter exceeds 10 cm, antibiotic therapy alone is usually insufficient, thereby increasing the need for additional interventions.

Another notable finding was the shorter hospital stay and shorter duration of antibiotic therapy observed in the surgical group. Previous studies have reported favorable outcomes following surgical management in selected patients with TOA [18,19,20].

4.1 Clinical Implications of the Findings

Our findings suggest that treatment selection for TOA should be individualized according to clinical presentation, abscess characteristics, and patient stability rather than relying on a single therapeutic approach. Despite surgically treated patients experienced shorter hospitalization, this finding should not be interpreted as evidence of treatment superiority because treatment allocation was based on clinical judgment. Instead, it may reflect earlier definitive source control combined with a more standardized institutional postoperative care pathway. Ultrasound-guided drainage remains a valuable minimally invasive option for carefully selected patients, whereas medical treatment continues to be appropriate for clinically stable women with favorable disease characteristics.

Ultrasound-guided drainage emerged as a minimally invasive option in appropriate cases. Reported success rates in the literature range between 70% and 100% [17,21]. However, success rates decrease significantly in multiloculated abscesses or those with risk of rupture. Herein, patients treated with drainage exhibited longer hospital stays and antibiotic requirements compared with the surgical group. These findings suggest that ultrasound-guided drainage may be considered a minimally invasive treatment option in carefully selected patients. However, further comparative studies are warranted to determine its optimal role in TOA management.

With respect to antibiotic protocols, our study highlighted significant clinical heterogeneity. While the triple combination (DFM) was most frequently used in the medical group, alternative regimens were more commonly administered in the interventional group. A standardized antibiotic protocol has not yet been established, and various combinations are used across different centers [7,8], reflecting a lack of standardization in clinical practice. Our findings support the need for greater standardization of antibiotic protocols for TOA management. Future prospective studies should evaluate whether standardized antibiotic regimens can improve treatment consistency and clinical outcomes.

Regarding infection markers, our findings demonstrated significant reductions in fever, leukocyte count, neutrophil count, and CRP levels across all treatment groups, regardless of modality. In addition to the within-group analyses, Δ analyses showed that the magnitude of reduction in infection markers did not differ significantly between the three treatment groups. This finding suggests that, although hospital stay duration and antibiotic use differed among groups, short-term biochemical improvement was broadly comparable. Ribak et al. [22] similarly reported that baseline CRP levels are valuable in predicting length of hospital stay and treatment success. Our Poisson regression analysis also identified baseline CRP levels as a factor associated with length of hospital stay, underscoring its potential clinical relevance. Nevertheless, given the retrospective design and limited sample size, these findings should be interpreted with caution and considered exploratory rather than causal.

An additional important consideration in TOA management is long-term fertility outcome. The literature reports variable fertility rates following surgical treatment; however, early and effective management may help prevent permanent tubal damage [23,24]. Fertility outcomes were not assessed in our study, which represents a major limitation. In addition, recurrence and chronic pelvic pain are clinically important long-term outcomes that may affect quality of life and future reproductive potential. Unfortunately, these data were not consistently available in the retrospective records and therefore could not be evaluated.

4.2 Limitations

Strengths of our study include its single-center design, which allowed for relatively homogeneous patient management, and the comparative evaluation of medical, interventional, and surgical treatment approaches. However, several limitations should also be acknowledged. First, the retrospective design introduces the possibility of selection bias and confounding by indication because treatment allocation was based on clinical judgment rather than randomization. Second, the relatively small sample size may have limited statistical power and increased the risk of type II error. Third, data on recurrence rates, readmissions, and long-term fertility outcomes were not available. Finally, the single-center design may limit the generalizability of the findings.

5. Conclusion

This retrospective analysis demonstrated that medical, interventional, and surgical approaches were associated with different clinical outcomes in patients with TOA. Surgical treatment was associated with shorter hospitalization despite larger abscess size, whereas ultrasound-guided drainage represented a minimally invasive alternative for selected patients. Given the nonrandomized nature of treatment allocation, these findings should not be interpreted as evidence of superiority of any treatment modality. Prospective multicenter studies are warranted to define optimal management strategies.

Availability of Data and Materials

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

Author Contributions

ES: Project administration, methodology, investigation, data curation, formal analysis, writing and editing. GK: investigation, writing, review and editing. MD: contributed to the conception and design of the study, data acquisition and interpretation, drafting and critical revision of the manuscript. All authors read and approved the final manuscript. All authors have participated sufficiently in the work and agreed to be accountable for all aspects of the work.

Ethics Approval and Consent to Participate

This study was conducted in accordance with the principles of the Declaration of Helsinki. The current study collected data from the gynecology and obstetrics department of Kocaeli City Hospital. A retrospective study was conducted by obtaining data from the Hospital Management System (KEYDATA). It was approved by the Kocaeli City Hospital Ethics Committee with the approval number 2024-148. Due to the retrospective nature of the data collection, the Ethics Committee exempted the authors from obtaining individual informed consent.

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Conflicts of Interest

The authors declare no conflicts of interest.

Supplementary Material

Supplementary material associated with this article can be found, in the online version, at https://doi.org/10.31083/CEOG54129.

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