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Determination of intraoperative complication rate and risk factors in patients undergoing surgery for tubo-ovarian abscess

A retrospective cohort study

Emre Erdem Tas, MD[a,*]

Abstract

This study aimed to assess intraoperative complication rates and risk factors in patients who underwent surgery for tubo-ovarian abscess. A retrospective review of the medical records of 170 patients who underwent tubo-ovarian abscess surgery between January 2014 and December 2023 was conducted. Four patients were excluded due to a histopathologic diagnosis of cancer, and 166 patients were included in the final analysis. Intraoperative complications were observed in 10 (6.0%) patients, including 8 (4.8%) and 2 (1.2%) patients with bowel and bladder injuries, respectively. The included patients were categorized into complication-positive (n = 10, 6.0%) and complication-negative (n = 156, 94.0%) groups, with between groups comparisons based on demographic, clinical, and surgical characteristics. The complication-positive group had significantly higher mean age and serum c-reactive protein (CRP) levels than the complication-negative group (46.6 ± 7.4 years vs 40.6 ± 8.5 years; $P = .03$, and 199.2 ± 89.4 mg/L vs 112.2 ± 84.2 mg/L; $P \leq .01$, respectively). Extensive surgery, such as hysterectomy with bilateral adnexectomy, was more commonly performed in the complication-positive group than in the complication-negative group (8/10 [80.0%] vs 43/156 [27.5%], $P < .01$). Receiver operating characteristic curve analysis identified a serum CRP level of 186.5 mg/L as the optimal cutoff for predicting intraoperative complications. Binary logistic regression analysis showed that elevated serum CRP levels (≥186.5 mg/L) (odds ratio: 7.9; $P < .01$) and extensive surgery (odds ratio: 11.0, $P = .01$) were independently associated with intraoperative complications. Our findings indicate that elevated serum CRP levels and extensive surgery are associated with increased intraoperative complication risks, which may have important implications in clinical practice, potentially informing preoperative assessments, and surgical planning. This study was reported in accordance with the Strengthening the Reporting of Observational Studies in Epidemiology statement.

Abbreviations: BMI = body mass index, CRP = C-reactive protein, IUD = intrauterine device, OR = odds ratio, PID = pelvic inflammatory disease, TOA = tubo-ovarian abscess.

Keywords: gynecologic surgical procedures, intraoperative complications, pelvic infection, tubo-ovarian abscess

1. Introduction

A tubo-ovarian abscess (TOA) is an inflammatory mass that involves the fallopian tubes, ovaries, and sometimes adjacent pelvic organs, such as the bladder and bowels. It is a severe and potentially life-threatening condition often seen in patients who do not receive appropriate treatment for pelvic inflammatory disease (PID).[1] Studies in the 1990s showed that approximately 15% of hospitalized patients with PID had TOA. However, with the implementation of appropriate screening and medical interventions, the prevalence of TOA decreased to 2.4% in the 2000s.[2,3]

Recently, treatment options for TOA have advanced considerably and now include various approaches, such as antibiotic therapy, image-guided drainage procedures, and surgical interventions or their combination.[1] However, no consensus exists regarding the optimal individualized treatment regimen for TOA. In many clinical settings, TOA treatment begins with empirical broad-spectrum antibiotics unless in life-threatening situations. Unfortunately, approximately 25% to 30% of patients require invasive intervention, as medical treatment alone proves ineffective.[4,5] Recently, imaging-guided needle aspiration with concomitant antibiotic therapy has attracted attention due to being highly successful success with fewer complications.[4,5] However,

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The datasets generated during and/or analyzed during the current study are not publicly available, but are available from the corresponding author on reasonable request.

Ankara City Hospital Clinical Research and Ethics Committee (E.2-24-473).

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surgical treatment remains necessary in emergencies, such as abscess rupture, sepsis, or hemodynamic instability, and when the abscess cannot be drained, or the patient does not respond to drainage and antibiotic treatment.[1,6] Surgical treatment for TOA can be performed through laparoscopy or laparotomy and may include cystectomy, unilateral or bilateral salpingo-oophorectomy, and sometimes hysterectomy.[1,2,5,7]

Surgery for TOA is typically performed out of necessity and can be distressing for both the patient and the surgeon.[1,6] Tissue and organ loss may result in hormone deficiencies or infertility in patients, whereas the presence of inflammation and intense adhesions can make surgery technically challenging, increasing the risk of complications.[1,8–11] To date, only a few studies have reported on intraoperative complications associated with TOA, and none have examined the risk factors involved.[1,2,9,10,12] This study aimed to assess intraoperative complication rates and risk factors in patients who underwent surgery for TOA.

2. Methods

This study retrospectively reviewed the medical records of 170 patients who underwent surgery for TOA at a tertiary referral clinic in Ankara, Turkey, between January 2014 and December 2023. Approval for the study was obtained from the Ankara City Hospital Clinical Research and Ethics Committee (E.2-24-473), and all participants provided oral informed consent before their inclusion. This study was conducted in accordance with the 1964 Declaration of Helsinki and its subsequent amendments, and was reported in accordance with the Strengthening the Reporting of Observational Studies in Epidemiology statement.

Data regarding patient demographic characteristics (age and parity), medical and surgical history, smoking status, body mass index (BMI; kg/m^2), intrauterine device (IUD) use, serum laboratory indices during hospitalization, including hemoglobin, white blood cell (WBC) count, and C-reactive protein (CRP) levels, and mean abscess diameter (cm) on ultrasonography were obtained from the hospital medical database. Details of surgical procedure, including surgical approach (i.e., laparoscopy or laparotomy), type of surgery (i.e., cystectomy, unilateral adnexectomy, or hysterectomy with bilateral adnexectomy), and histopathological examination results were obtained from patients' medical records. The type of surgery was categorized into 2 groups: extensive surgery (hysterectomy with bilateral adnexectomy) and organ-preserving surgery (cystectomy or unilateral adnexectomy). Intraoperative complications were also recorded. Patients with histopathologically confirmed cancer were excluded due to their significantly higher risk of intraoperative complications compared to those with benign gynecological pathologies.[13]

This study aimed to identify complications and their rates in patients undergoing TOA surgery. To assess the risk factors associated with intraoperative complications, patients were divided into 2 groups: those with intraoperative complications (complication-positive) and those without (complication-negative).

2.1. Statistical analysis

Data were expressed as mean ± standard deviation. Univariate analysis was used to identify differences between the groups (complication-positive vs complication-negative). The relationship between serum CRP levels and intraoperative complications was determined using Spearman correlation coefficient. Receiver operating characteristic curves were used to determine the cutoff value for serum CRP levels to predict patients at elevated risk for intraoperative complications. The optimal cutoff point was selected based on the largest Youden index (sensitivity + specificity – 1). Variables with $P < .05$, including age, serum CRP level (<186.5 mg/L vs ≥186.5 mg/L), and type of surgery, were included in the binary logistic regression analysis to identify independent factors associated with intraoperative complications. Statistical analyses were performed using the Statistical Package for the Social Sciences for Windows, version 21.0 (IBM, SPSS Corp., Armonk, NY). Odds ratios (ORs) and 95.0% confidence intervals were calculated, and statistical significance was set at $P < .05$.

3. Results

After excluding 4 patients whose histopathologic examinations revealed endometrial or serous ovarian cancer, the study included 166 patients. The mean age of all patients was 40.9 ± 8.5 years, with 30 (18.1%) patients being menopausal. The mean parity was 2.4 ± 1.3, and 155 (93.4%) patients were multiparous. Twenty-five (15.1%) patients had concurrent medical conditions, and 63 (37.9%) had previous pelvic surgeries. Figures 1 and 2 show the types of concomitant medical pathologies and previous pelvic surgery. Approximately half

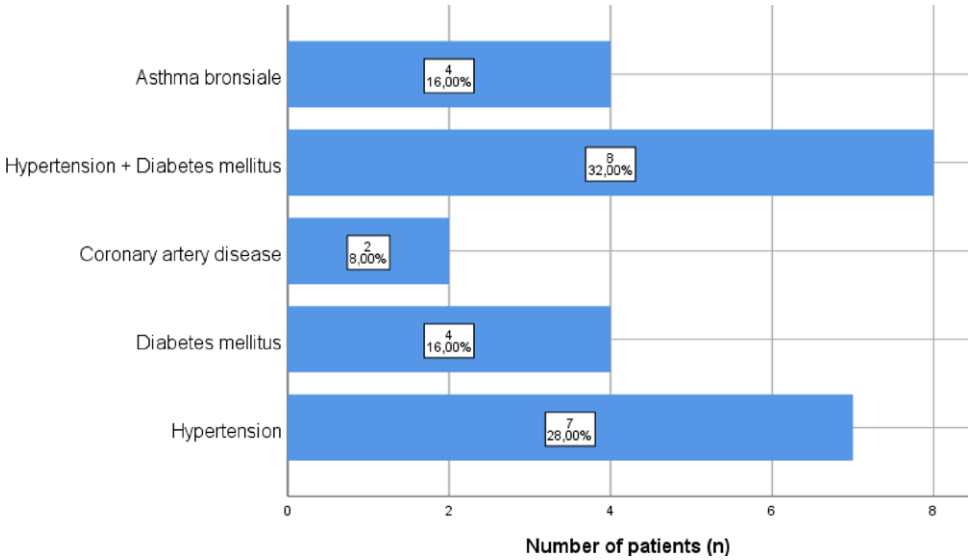

Figure 1. Concomitant medical diseases of patients with tubo-ovarian abscess.

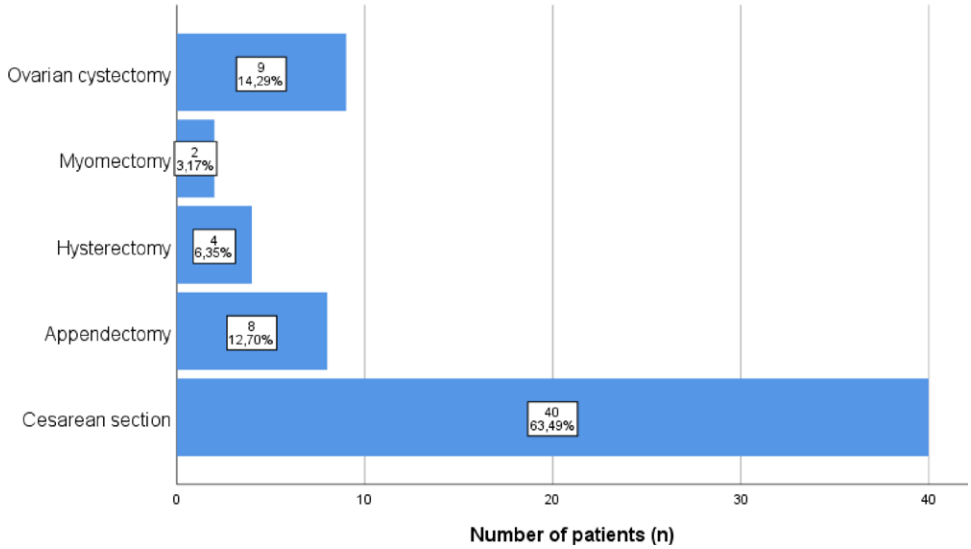

Figure 2. Previous pelvic surgery types of patients with tubo-ovarian abscess.

of the patients (n = 80, 48.2%) were smokers. The mean BMI was 25.7 ± 4.1 kg/m^2 and 25 (15.1%) patients were classified as obese (BMI > 30 kg/m^2). Of the 166 patients, 71 (42.8%) used an IUD for contraception, with a mean IUD use duration of 8.3 ± 5.1 years.

The mean serum hemoglobin, WBC count, and CRP levels during hospitalization were 11.4 ± 1.5 g/dL, 14.5 ± 5.9 (×10^3/μL), and 117.5 ± 86.7 mg/L, respectively. The mean abscess diameter on ultrasonography was 6.4 ± 2.3 cm.

Of 166 patients, 123 (74.1%) underwent laparotomic surgery, whereas the remaining 43 (25.9%) underwent laparoscopic surgery. Extensive surgery was performed in 51 (30.7%) patients, while 115 (69.3%) patients underwent organ-preserving surgery. Figure 3 shows the surgical approaches and types of surgeries performed in the study population.

Histopathological examination revealed that all patients had chronic inflammation; however, 33 (19.9%) patients had concurrent endometriosis, and 2 (1.2%) patients had concurrent teratomas. Intraoperative complications occurred in 10 (6.0%) patients, including bowel injuries in 8 (4.8%) and bladder injuries in 2 (1.2%). No cases of excessive hemorrhage or anesthetic complications were reported. Of the patients with bowel injury, half had damage limited to the serosal layer, while the other half had a full-thickness injury. All bladder and bowel injuries were repaired intraoperatively.

Univariate analysis showed statistically significant differences between the complication-positive and complication-negative groups regarding age, serum CRP levels, and type of surgery (Table 1). The complication-positive group had significantly higher mean age and serum CRP levels than the complication-negative group (46.6 ± 7.4 years vs 40.6 ± 8.5 years; $P = .03$, and 199.2 ± 89.4 mg/L vs 112.2 ± 84.2 mg/L; $P \leq .01$, respectively). Additionally, extensive surgery was more commonly performed in the complication-positive group than in the complication-negative group (8/10 [80.0%] vs 43/156 [27.5%]; $P < .01$). A weak positive linear correlation was found between intraoperative complications and serum CRP levels ($P < .01$, Spearman correlation coefficient = .21). Receiver operating characteristic curve analysis revealed that the optimal cutoff value of serum CRP level to predict intraoperative complication was 186.5 mg/L with 70.0% sensitivity and 74.8% specificity (Fig. 4).

Binary logistic regression analysis revealed that elevated serum CRP levels (≥186.5 mg/L) (OR: 7.9; $P < .01$) and extensive surgery (OR: 11.0, $P = .01$) were independently associated with intraoperative complications (Table 2).

4. Discussion

Although the etiology and risk factors for TOA and PID are similar, the factors that initiate abscess formation remain unclear. Previous studies have shown that TOA is more common in parous, sexually active, and reproductive-aged women, particularly in those aged 20 to 40 years.[5,6,14,15] The demographic characteristics of patients in our study aligned with those reported in previous studies. The mean age of patients was 40.9 years; 18.1% of the patients were menopausal, and 93.4% were multiparous. The complication-positive and complication-negative groups did not differ regarding demographic characteristics, except for mean age. Although mean age was significantly higher in the complication-positive group than in the complication-negative group (46.6 years vs 40.6 years; $P = .03$), age was not an independent risk factor for intraoperative complications.

The immune system is critical in preventing and controlling infections.[16] In PID and TOA, in addition to the virulence of the causative organisms, the host's systemic and local immune responses are compromised.[17] Factors such as obesity, smoking, and additional systemic diseases like diabetes mellitus and hypertension weaken systemic immunity.[5,10,18] Similarly, previous pelvic surgeries and conditions such as endometriosis impair local immunity.[19,20] In our study, approximately half of the patients (48.2%) were smokers. The prevalence of obesity, concomitant medical diseases, previous pelvic surgery, and endometriosis were 15.1%, 15.1%, 37.9%, and 19.9%, respectively. However, none of these factors significantly differed between the complication-positive and complication-negative groups.

TOA is commonly associated with IUD use. Furthermore, clinicians should be alert to other IUD-related complications in patients with prolonged use of IUDs.[21] Previous retrospective cohort studies have reported that almost half of the patients with TOA used IUDs.[5,6,18] In their study, Charonis et al suggested that the risk of TOA increased with prolonged IUD use, particularly beyond 5 years.[22] Similarly, in our study, 42.8% of patients with TOA used IUDs, with a mean IUD use of 8.3 years, which is considerably longer than 5 years. However, IUD use did not differ significantly between the complication-positive and complication-negative groups.

Failure of antibiotic treatment is an unfavorable outcome for patients with TOA. Elevated levels of inflammatory markers commonly indicate severe inflammation, the need for surgery, and prolonged posttreatment follow-up.[23–25] In previous studies, leukocytosis (>14.0 × 10^3/μL or > 16.0 × 10^3/μL), elevated serum CRP levels (>143.5 mg/L), and large abscess

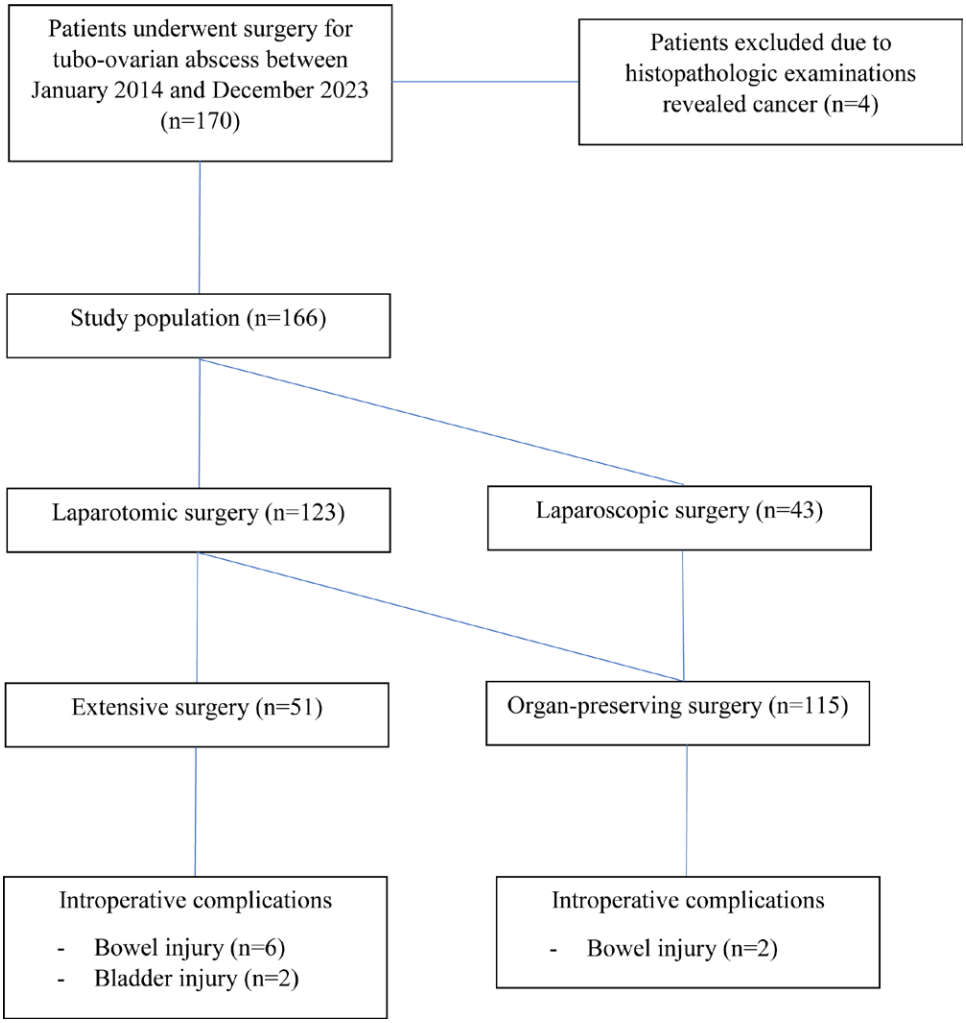

Figure 3. The flow-chart of the study population.

Table 1

Univariate analysis of tubo-ovarian abscess patients with and without intraoperative complications.

Characteristics	Complication-positive (n = 10, 6.0%)	Complication-negative (n = 156, 94.0%)	*P*
Age (years)	46.6 ± 7.4	40.6 ± 8.5	.03
Serum CRP level (mg/L)	199.2 ± 89.4	112.2 ± 84.2	<.01
Type of surgery			
Extensive surgery	8 (4.8)	43 (25.9)	<.01
Organ-preserving surgery	2 (1.2)	113 (68.1)	

Data are presented as mean ± standard deviation or n (%).
CRP = c-reactive protein.

diameters (>6.2 or >7.0 cm) were found to be risk factors for antibiotic treatment failure, the need for surgery.[26–28] In our study, the mean serum WBC count, CRP level, and abscess diameter in patients with TOA were 14.5 × 10^3/μL, 117.5 mg/L, and 6.4 cm, respectively, which is consistent with the results of 2 previous studies.[26,27] Our results showed no significant differences in serum WBC count and abscess diameter between the complication-positive and complication-negative groups. In contrast, serum CRP levels were significantly higher in the complication-positive group than in the complication-negative group (199.2 mg/L vs 112.2 mg/L, $P < .01$). Moreover, using 186.5 mg/L as a cutoff value for serum CRP level, elevated serum CRP levels (≥186.5 mg/L) were associated with a 7.9-fold increased risk of intraoperative complications.

Intraoperative complications are unexpected adverse events that can significantly affect patient outcomes.[29] Studies have reported complication rates in benign gynecological procedures ranging from 4.6% to 5.9%.[30–32] Factors such as prior pelvic surgery, emergency or laparotomic surgery, extensive procedures (i.e., cancer staging), endometriosis, and the presence of peritoneal adhesions (e.g., TOA) are known to increase these risks.[6,11,13,20,32,33] Complication rate in TOA surgeries ranges from 2.8% to 20.0%.[1,2,9,10,12] Granberg et al recommended an organ-preserving surgical approach for women with TOA to minimize complications irrespective of fertility intentions.[1]

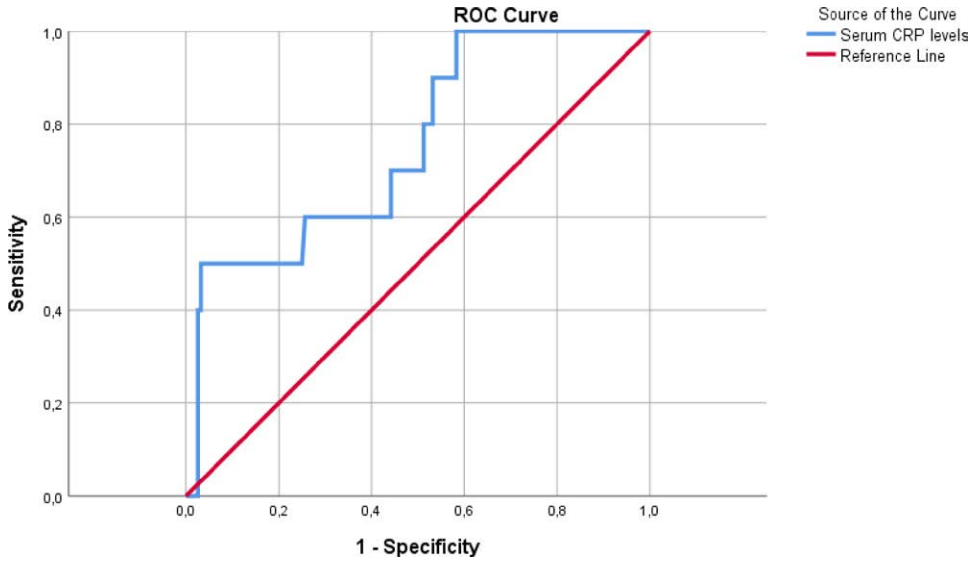

Figure 4. Receiver operating characteristic curve analysis of serum c-reactive protein levels for predicting patients with intraoperative complication (area under the curve = .75, standard error = .07, $P < .01$). CRP = C-reactive protein, ROC = receiver operating characteristic.

Table 2

Binary logistic regression analysis of risk factors associated with intraoperative complications.

	P-value	95% CI	OR
Age (years)	.46	0.85–1.08	–
High serum CRP level (≥186.5 mg/L)	<.01	1.76–35.22	7.9
Type of surgery (extensive surgery)	.01	1.714–71.3	11.0

Data are presented as the mean ± standard deviation or n (%).
CI = confidence interval, CRP = C-reactive protein, OR = odds ratio.

Our study found an intraoperative complication rate of 6.0%, which aligns with previous findings. Furthermore, our findings supported Granberg et al's recommendation. Although the surgical approach (laparoscopy vs laparotomy) did not affect intraoperative complications, extensive surgery was associated with an 11.0-fold increased risk of intraoperative complications.

5. Conclusions

This research evaluates the adverse effects associated with TOA from a novel perspective, focusing specifically on intraoperative complications. Our findings indicate that intraoperative complication risks increase with elevated serum CRP levels and extensive surgery. These findings may have important implications in clinical practice, potentially informing preoperative assessments and surgical planning.

The major limitations of this study were its retrospective design, selection bias due to the exclusion of certain patient groups, and the lack of long-term follow-up. For instance, we could not evaluate the effects of intraoperative complications on postoperative recovery processes, including the surgical incision site and the length of hospital stay. Further research is needed to determine the potential risk factors for intra- and postoperative complications in TOA cases. Multicenter and prospective research could help surgeons refine risk stratification strategies and improve patient outcomes in TOA cases.

Author contributions

Conceptualization: Emre Erdem Tas.
Data curation: Emre Erdem Tas.
Formal analysis: Emre Erdem Tas.
Funding acquisition: Emre Erdem Tas.
Investigation: Emre Erdem Tas.
Methodology: Emre Erdem Tas.
Project administration: Emre Erdem Tas.
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Supervision: Emre Erdem Tas.
Validation: Emre Erdem Tas.
Visualization: Emre Erdem Tas.
Writing – original draft: Emre Erdem Tas.
Writing – review & editing: Emre Erdem Tas.

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