

# Ovarian Torsion Surgery in a Tertiary Referral Center: Clinical, Laboratory, and Operative Associations

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## Abstract

**Aim:** Ovarian torsion is a gynecological emergency that can lead to adnexal ischemia and tissue loss if not promptly treated. This study aimed to describe the clinical, laboratory, imaging, and surgical characteristics of patients undergoing surgery for ovarian torsion in a tertiary care center and to explore associations between selected laboratory and sonographic findings and histopathologic necrosis and surgical outcomes.

**Methods:** This retrospective study included 40 patients who underwent surgical treatment for ovarian torsion between November 2023 and February 2025 at a tertiary referral center. Demographic characteristics, presenting symptoms, laboratory parameters, ultrasonographic findings, operative details, and histopathological results were reviewed. Doppler ultrasonography was used to assess ovarian blood flow. Associations between torsion degree, inflammatory markers, Doppler findings, and surgical outcomes were evaluated using univariate and correlation analyses.

**Results:** Most patients were of reproductive age (90%), and adnexal masses were present in 55% of cases. Absent Doppler flow was observed in 60% of patients. Histopathological evaluation, available in half of the cohort, demonstrated necrotic ovarian tissue in 40%. Higher torsion degree was associated with increased CRP levels, higher necrosis rates, and a greater frequency of laparotomy ( $p < 0.05$ ). Elevated CRP levels and the presence of necrosis were moderately correlated with longer hospital stay.

**Conclusions:** In this tertiary center experience, torsion severity, elevated inflammatory markers, and absent Doppler flow were associated with adnexal necrosis and more extensive surgical management. These parameters may reflect disease severity in ovarian torsion. Further prospective studies are needed to confirm these findings.

**Keywords:** Adnexal mass; doppler ultrasonography; laparoscopic surgery; ovarian torsion; ultrasonography

## 1. Introduction

Ovarian torsion (OT) is a common gynecological surgical emergency that predominantly affects women of reproductive age.<sup>1</sup> It occurs when the ovary and/or fallopian tube rotates partially or completely around its supporting ligaments, leading to venous congestion and potential compromise of arterial blood flow.<sup>2</sup> If not promptly treated, this process may progress to ischemia and adnexal necrosis. Although most cases occur in reproductive-aged women, OT can also be observed in pediatric and postmenopausal populations.<sup>3</sup> The typical presentation includes acute pelvic pain with nausea or vomiting; however, atypical symptoms may delay diagnosis, making timely recognition challenging.<sup>4,5</sup>

Ultrasonography (USG) with Doppler evaluation is the primary imaging modality in suspected OT. Common findings include ovarian enlargement, peripheral follicular displacement, heterogeneous stromal appearance, the “whirlpool sign,” and pelvic free fluid.<sup>6</sup> Nevertheless, normal or preserved Doppler flow does not exclude torsion, and false-negative results may occur. Magnetic resonance imaging (MRI) can be helpful in selected cases with inconclusive ultra-

sonographic findings.<sup>7</sup>

Several predisposing factors have been identified, including adnexal masses larger than 5 cm, polycystic ovarian morphology, prior pelvic surgery and ovulation induction.<sup>8-10</sup> Surgical intervention remains the definitive treatment. Laparoscopic detorsion is generally preferred to preserve ovarian function, whereas salpingo-oophorectomy may be necessary when the adnexa appear nonviable intraoperatively.<sup>11-13</sup>

Despite advances in imaging, operative decisions often depend on intraoperative findings. Therefore, interest has grown in identifying clinical, laboratory, and imaging parameters that may reflect disease severity. Inflammatory markers such as C-reactive protein (CRP) and white blood cell (WBC) count, as well as Doppler flow status and torsion degree, have been suggested as potential indicators of adnexal compromise, although their clinical relevance remains uncertain.<sup>1,6</sup>

The aim of this study was to describe the clinical, laboratory, imaging, and surgical characteristics of patients undergoing surgery

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for OT in a tertiary care center and to explore associations between selected laboratory and sonographic findings and histopathologic necrosis, surgical approach, and length of hospital stay.

## 2. Materials and Methods

This retrospective study was conducted at the Department of Obstetrics and Gynecology, Izmir City Hospital, after approval by the Institutional Ethics Committee (Approval No: **2025/125**). Medical records of patients who underwent surgical treatment for OT between November 1, 2023, and February 1, 2025, were reviewed. Among 44 identified patients, four were excluded due to incomplete medical data, resulting in a final study population of 40 patients.

Demographic characteristics (age, gravida, parity, abortion history, prior cesarean section), presenting symptoms (pelvic pain, nausea, vomiting), and physical examination findings (abdominal tenderness, guarding, rebound) were obtained from electronic medical records. Laboratory parameters included hemoglobin, WBC count, platelet (PLT) count, and CRP levels. A CRP value  $\geq 0.5$  mg/dL was considered elevated.

Pelvic USG was performed using a suprapubic approach in virginal patients and transvaginal USG in sexually active patients. All examinations were conducted using the same ultrasound system (Voluson E8, GE Healthcare) and were independently performed by at least two board-certified obstetricians and gynecologists with experience in gynecologic emergency imaging. Doppler evaluation was used to assess ovarian blood flow and was categorized qualitatively as normal, decreased, or absent based on visual assessment of arterial and venous signals. Ovarian size, laterality of torsion, and the presence of pelvic free fluid were also recorded.

Operative reports were reviewed to determine the surgical approach (laparoscopy or laparotomy), number of torsion rotations, presence of adnexal masses, and type of surgical procedure performed (detorsion, cystectomy, or salpingo-oophorectomy). Histopathological findings were evaluated when tissue sampling was available. Postoperative hospital stay was recorded in days.

Statistical analyses were performed using IBM SPSS Statistics for Windows, Version 29.0 (IBM Corp., Armonk, NY, USA). Continuous variables were expressed as mean  $\pm$  standard deviation or median (minimum–maximum), depending on data distribution, while categorical variables were presented as frequencies and percentages. Group comparisons were conducted using the independent samples t-test or Mann–Whitney U test for continuous variables, and Chi-square or Fisher's exact test for categorical variables. Comparisons involving more than two groups were performed using the Kruskal–Wallis test. Correlations were assessed using Spearman's rank correlation coefficient. Given the exploratory nature of the study and limited sample size, no adjustment for multiple comparisons was applied. A p-value  $< 0.05$  was considered statistically significant.

## 3. Results

A total of 40 patients who underwent surgical management for ovarian torsion were included in the final analysis after exclusion of four patients due to incomplete medical records. Most patients (90%) were between 18 and 40 years of age, and 40% were nulliparous. Reported risk factors included a history of prior abdominal surgery (45%), the presence of an adnexal mass (55%), polycystic ovary syndrome (PCOS) (10%), and pregnancy (5%). The most common presenting complaint was isolated pelvic pain (40%), followed by pelvic pain accompanied by nausea or vomiting (30%). On physical examination, generalized abdominal tenderness (40%) and

guarding (25%) were the most frequently documented findings.

Laboratory evaluation revealed a mean WBC count of  $11.41 \pm 4.10 \times 10^3/\mu\text{L}$  and a mean CRP level of  $17.37 \pm 31.21$  mg/dL. Doppler ultrasonography demonstrated absent ovarian blood flow in 60% of patients. Free pelvic fluid was observed in 50% of cases, and the mean size of the torsioned ovary was  $65.75 \pm 32.53 \times 52.35 \pm 29.23$  mm (Table 1).

**Table 1**

Demographic, Clinical, Laboratory, and Imaging Characteristics of Patients

| Characteristic                         | n                                        | Percentage (%) |
|----------------------------------------|------------------------------------------|----------------|
| <b>Age (years)</b>                     |                                          |                |
| 18–40                                  | 36                                       | 90             |
| 41–43                                  | 4                                        | 10             |
| <b>Parity</b>                          |                                          |                |
| Virgin                                 | 6                                        | 15             |
| 0                                      | 16                                       | 40             |
| 1                                      | 10                                       | 25             |
| $\geq 2$                               | 8                                        | 20             |
| <b>Menopausal Status</b>               |                                          |                |
| Yes                                    | 2                                        | 5              |
| No                                     | 38                                       | 95             |
| <b>Smoking Status</b>                  |                                          |                |
| Yes                                    | 18                                       | 45             |
| No                                     | 22                                       | 55             |
| <b>Risk Factors</b>                    |                                          |                |
| Adnexal mass                           | 22                                       | 55             |
| PCOS                                   | 4                                        | 10             |
| Pregnancy                              | 2                                        | 5              |
| Prior abdominal surgery                | 16                                       | 40             |
| <b>Presenting Symptoms</b>             |                                          |                |
| Isolated pelvic pain                   | 16                                       | 40             |
| Nausea/vomiting only                   | 4                                        | 10             |
| Pelvic pain + nausea/vomiting          | 12                                       | 30             |
| Pelvic pain + fever                    | 6                                        | 15             |
| Nausea/vomiting + fever                | 2                                        | 5              |
| <b>Physical Examination Findings</b>   |                                          |                |
| Generalized tenderness                 | 16                                       | 40             |
| Guarding                               | 10                                       | 25             |
| Rebound                                | 4                                        | 10             |
| Guarding + rebound                     | 10                                       | 25             |
| <b>Laboratory Findings</b>             | <b>Mean <math>\pm</math> SD / Range</b>  |                |
| WBC ( $\times 10^3/\mu\text{L}$ )      | $11.41 \pm 4.10$ (5.62–19.84)            |                |
| CRP (mg/dL)                            | $17.37 \pm 31.21$ (0.5–109)              |                |
| Hemoglobin (g/dL)                      | $11.47 \pm 1.41$ (9.4–14.0)              |                |
| Platelet ( $\times 10^3/\mu\text{L}$ ) | $280.05 \pm 43.68$ (217–368)             |                |
| <b>Ultrasonographic Findings</b>       |                                          |                |
| Torsioned ovary size (mm)              | $65.75 \pm 32.53 \times 52.35 \pm 29.23$ |                |
| Adnexal mass                           | 22                                       | 55             |
| Right-sided torsion                    | 22                                       | 55             |
| Left-sided torsion                     | 18                                       | 45             |
| Absent Doppler flow                    | 24                                       | 60             |
| Decreased Doppler flow                 | 6                                        | 15             |
| Normal Doppler flow                    | 10                                       | 25             |
| Free pelvic fluid                      | 20                                       | 50             |

WBC: white blood cell; CRP: C-reactive protein; PCOS: polycystic ovary syndrome; SD: standard deviation

Laparoscopy was performed in 55% of patients, while 45% underwent laparotomy. Regarding torsion severity, 25% had semitorsion, 20% had one rotation, 15% had two rotations, and 40% had three or more rotations. Detorsion with or without additional procedures was the most commonly performed intervention (65%), followed by salpingo-oophorectomy (20%). The mean length of hospital stay was 3.15±1.56 days. Histopathological evaluation was available in 20 patients, revealing necrotic ovarian tissue in 40%, whereas benign ovarian pathologies were identified in the remaining cases (Table 2).

**Table 2**

Surgical Approach, Intraoperative Findings, and Histopathological Results

| Characteristic                          | Number of Patients       | Percentage (%) |
|-----------------------------------------|--------------------------|----------------|
| <b>Surgical Approach</b>                |                          |                |
| Laparoscopy                             | 22                       | 55             |
| Laparotomy                              | 18                       | 45             |
| <b>Torsion Degree</b>                   |                          |                |
| Semitorsion                             | 10                       | 25             |
| 1 rotation                              | 8                        | 20             |
| 2 rotations                             | 6                        | 15             |
| ≥3 rotations                            | 16                       | 40             |
| <b>Surgical Procedure Performed</b>     |                          |                |
| Detorsion ± additional procedures*      | 26                       | 65             |
| Cystectomy                              | 6                        | 15             |
| Salpingo-oophorectomy                   | 8                        | 20             |
| <b>Histopathological Evaluation</b>     |                          |                |
| Not performed                           | 20                       | 50             |
| Performed                               | 20                       | 50             |
| Necrotic ovarian tissue                 | 8                        | 40†            |
| Benign lesions (teratoma, cystadenomas) | 12                       | 60†            |
| <b>Length of Hospital Stay (days)</b>   | <b>Mean ± SD / Range</b> |                |
|                                         | 3.15±1.56 (2–9)          |                |

SD: standard deviation. \* Additional procedures included cystectomy or adhesiolysis at the discretion of the operating surgeon.

† Percentages calculated among patients with available histopathological evaluation.

When patients were stratified according to torsion degree, increasing torsion severity was associated with higher CRP levels, increased rates of histopathologic necrosis, and a greater frequency of laparotomy (**all p<0.05**) (Table 3).

**Table 3**

Associations Between Torsion Degree and Selected Clinical Outcomes

| Torsion Degree | Median CRP (mg/dL) | Necrosis (%)  | Laparotomy (%) |
|----------------|--------------------|---------------|----------------|
| Semitorsion    | 1.0 (0.5–9.6)      | 0             | 0              |
| 1 rotation     | 6.0 (0.5–15.0)     | 0             | 0              |
| 2 rotations    | 10.9 (1.0–57.6)    | 25            | 25             |
| ≥3 rotations   | 18.2 (3.6–109.0)   | 42            | 53             |
| <b>p-value</b> | <b>0.007†</b>      | <b>0.041‡</b> | <b>0.030‡</b>  |

Values are presented as median (minimum–maximum) or percentage, as appropriate. † Kruskal–Wallis test. ‡ Chi-square test. CRP: C-reactive protein.

In univariate comparisons, patients with histopathologically confirmed necrosis demonstrated higher torsion degrees, higher CRP levels, and a greater proportion of absent Doppler flow compared with those without necrosis (**p<0.05 for all**). No significant associations were observed between necrosis and surgical approach or the presence of an adnexal mass (Table 4).

**Table 4**

Univariate Associations Between Selected Variables and Histopathologic Necrosis

| Variable                       | Necrosis (+) | Necrosis (–) | p-value |
|--------------------------------|--------------|--------------|---------|
| <b>Torsion degree (mean)</b>   | 2.9          | 2.1          | 0.04    |
| <b>CRP (median, mg/dL)</b>     | 21.4         | 7.8          | 0.016   |
| <b>Absent Doppler flow (%)</b> | 90           | 55           | 0.03    |
| <b>Laparotomy (%)</b>          | 70           | 42           | 0.18    |
| <b>Adnexal mass (%)</b>        | 60           | 53           | 0.68    |

Values are presented as mean, median, or percentage, as appropriate.

CRP: C-reactive protein. All analyses represent univariate comparisons; no multivariable adjustment was performed due to sample size limitations.

Statistical significance was defined as  $p < 0.05$ .

Subgroup analyses showed that the presence of an adnexal mass was associated with a higher oophorectomy rate. CRP levels, presence of necrosis, and performance of oophorectomy each demonstrated a moderate positive correlation with length of hospital stay (**p<0.05**) (Table 5).

Among patients with PCOS, the prevalence of adnexal cysts was higher compared with non-PCOS patients; however, PCOS status was not associated with necrosis, oophorectomy rates, or choice of surgical approach (Table 5).

**Table 5**

Exploratory Associations and Correlations with Surgical Outcomes

| Variable / Group Comparison                                | Outcome                           | p-value |
|------------------------------------------------------------|-----------------------------------|---------|
| Presence of adnexal mass                                   | Oophorectomy rate: 60.8% vs 23.5% | 0.018   |
| Length of hospital stay vs CRP (Spearman $\rho$ )          | p:0.48                            | 0.002   |
| Length of hospital stay vs necrosis (Spearman $\rho$ )     | p:0.41                            | 0.008   |
| Length of hospital stay vs oophorectomy (Spearman $\rho$ ) | p:0.39                            | 0.010   |
| PCOS vs non-PCOS                                           | Adnexal cyst rate: 100% vs 59%    | 0.018   |
|                                                            | Necrosis: 25% vs 31%              | 0.72    |
|                                                            | Oophorectomy: 25% vs 53%          | 0.15    |

All p-values refer to two-tailed tests.

Correlations were assessed using Spearman's rank correlation coefficient ( $\rho$ ). CRP: C-reactive protein; PCOS: polycystic ovary syndrome.

## 4. Discussion

In this retrospective study, we evaluated the clinical presentation, laboratory findings, imaging characteristics, and surgical outcomes of patients who underwent operative management for OT at a tertiary care center. Adnexal torsion remains a diagnostic chal-

lenge despite advances in imaging modalities.<sup>14</sup> In line with previous reports, OT predominantly affected women of reproductive age and was frequently associated with known risk factors such as adnexal masses, PCOS, and a history of abdominal surgery.<sup>8,9</sup> Adnexal masses were present in more than half of the cohort and were associated with a higher rate of salpingo-oophorectomy, suggesting that underlying adnexal pathology may influence intraoperative decision-making. Ovarian torsion may also occur during pregnancy due to increased ovarian mobility and the presence of corpus luteum cysts.<sup>15</sup>

Most patients presented with acute pelvic pain, often accompanied by gastrointestinal symptoms, whereas a smaller proportion exhibited atypical features such as fever, which may contribute to diagnostic delay, as previously described.<sup>16</sup> Similar clinical presentations have also been reported in retrospective case series evaluating emergency department admissions for ovarian torsion.<sup>17</sup> Laboratory evaluation demonstrated higher CRP levels in patients with histopathologically confirmed necrosis, and CRP values showed a moderate positive correlation with length of hospital stay. Rather than indicating causality, these findings suggest that elevated inflammatory markers may reflect greater disease severity and tissue compromise in ovarian torsion. Previous long-term clinical reviews have also emphasized the diagnostic difficulty and variable presentation of ovarian torsion.<sup>18</sup>

Doppler USG demonstrated absent ovarian blood flow in a substantial proportion of cases and was more frequently observed among patients with necrosis, consistent with prior studies emphasizing its role in the assessment of adnexal viability.<sup>19</sup> However, Doppler findings alone were not uniformly associated with torsion degree or surgical approach, underscoring the limitations of relying on a single imaging parameter and highlighting the importance of integrated clinical, laboratory, and imaging assessment. Recent studies have also evaluated novel inflammatory markers as potential adjuncts in the diagnosis of ovarian torsion.<sup>20</sup>

An important observation of this study was the association between increasing torsion degree and higher CRP levels, necrosis rates, and laparotomy frequency. Patients with higher numbers of torsion rotations demonstrated more severe inflammatory responses and required more extensive surgical intervention. These findings support the concept that torsion severity is closely related to adnexal ischemia and surgical complexity, reinforcing the clinical importance of early diagnosis and prompt intervention.

Histopathological examination, available in half of the cohort, revealed necrotic ovarian tissue in 40% of cases, while the remaining specimens demonstrated benign ovarian lesions, including mature cystic teratoma and serous or mucinous cystadenomas. This is consistent with existing literature indicating that ovarian torsion is most commonly associated with benign pathology<sup>21</sup>, although delayed presentation and prolonged ischemia may lead to irreversible tissue damage and adnexal loss.

Although laparoscopy was the preferred surgical approach in more than half of the patients, it was not independently associated with necrosis or prolonged hospitalization. Instead, torsion degree, inflammatory burden, and the presence of necrosis appeared to be more closely related to postoperative recovery, suggesting that disease severity rather than surgical modality primarily determines short-term outcomes. Meta-analyses have demonstrated that conservative laparoscopic management can be safe and effective in many patients with ovarian torsion, particularly in pediatric and adolescent populations.<sup>22</sup>

PCOS was associated with a higher prevalence of adnexal cysts but was not linked to increased rates of necrosis, oophorectomy, or choice of surgical approach. This finding suggests that while PCOS may predispose patients to torsion through ovarian enlargement, it

does not necessarily confer a worse clinical prognosis once torsion occurs.

This study has several limitations. Its retrospective design and relatively small sample size precluded multivariable analysis and adjustment for potential confounders such as symptom duration, cyst size, body mass index, and menstrual cycle phase. In addition, laboratory markers such as CRP may vary depending on the interval between symptom onset and hospital admission, which could not be standardized. Histopathological evaluation was not available for all patients, further limiting definitive conclusions. Therefore, the results should be interpreted as exploratory and hypothesis-generating. Larger, prospective, and multicenter studies are needed to validate these associations and clarify their clinical implications.

## 5. Conclusion

OT remains a gynecological emergency that requires prompt recognition and timely surgical management. In this tertiary center experience, higher torsion degree, elevated inflammatory markers, and absence of Doppler flow were associated with adnexal necrosis and more extensive surgical procedures. These findings suggest that clinical, laboratory, and imaging parameters may reflect disease severity rather than serve as independent predictors of outcome. Laparoscopic surgery remains a feasible and fertility-preserving option in appropriately selected patients; however, operative decisions should be individualized based on the overall clinical context. Future prospective studies are warranted to develop standardized, risk-adapted approaches for the management of OT.

## Statement of ethics

This study was approved by the Ethics Committee for Non-Interventional Studies of İzmir City Hospital (Approval No: 2025/125). Due to the retrospective design of the study, the requirement for informed consent was waived in accordance with institutional regulations.

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## 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

E.G.Ö. contributed to the study design and drafted the initial version of the manuscript. S.Ö. and M.B.B. contributed to data collection and clinical data acquisition. E.K.İ. and P.A. performed the statistical analysis and contributed to data interpretation. H.S.S. and B.O.D. were involved in patient follow-up and clinical documentation. Y.K.A. supervised the study and critically revised the manuscript for

important intellectual content. All authors reviewed and approved the final version of the manuscript.

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