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# Torsion among Women with Acute Lower Abdominal Pain: A Retrospective Cross-Sectional Study

Mona Agha Majidi[1], Maliheh Arab[2]*, Robabeh Ghodssi-Ghassemabadi[3], Behnaz Nouri[4], Behnaz Ghavami[5], Kourosh Sheibani[6]

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## Abstract

**Background:** Lower abdominal or pelvic pain is a common complaint among women and one of the most challenging findings to evaluate. We performed the present study to construct a new algorithm for predicting the chance of ovarian torsion among women with acute lower abdominal pain.

**Methods:** This diagnostic retrospective cross-sectional study was performed on all female individuals who were referred to Imam Hossein Medical Center, Tehran, Iran, with the chief complaint of acute lower abdominal pain, and underwent laparotomy between 2010 and 2016. Clinical and paraclinical findings were evaluated to construct a predictive model for ovarian torsion. The variables were compared in 2 groups. The first group included individuals with a final diagnosis of ovarian torsion and the second group included those individuals with any diagnosis other than ovarian torsion. All data were compared between these 2 groups using SPSS software Version 21 to find the related findings with a predictive value for ovarian torsion.

**Results:** A total of 372 participants were evaluated, of whom 116 participants (31.2%) had ovarian torsion (case group) and 256 participants had other diagnoses for their lower abdominal pain (control group). Nausea and vomiting ($p < 0.001$), tenderness ($p < 0.001$), the size of ovarian mass ($p = 0.004$), and the percentage of polymorphonuclear ($p < 0.001$) showed significant relationships with ovarian torsion as the final diagnosis. Multiple logistic regression models were constructed to predict the factors affecting ovarian torsion, and a scoring system was designed to predict ovarian torsion, with a sensitivity of 77.59% (68.9%- 84.8%) and specificity of 74.61% (68.8% 79.8%).

**Conclusion:** The proposed model is suitable for predicting ovarian torsion and its necessary information is readily available from individuals' history, examination findings, laboratory results, and an ultrasound exam.

**Keywords:** Ovary, Torsion, Abdominal Pain, Prediction

***Conflicts of Interest:*** *None declared*
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## Introduction

Lower abdominal or pelvic pain is a common complaint among women coming to emergency departments and one of the most challenging findings to evaluate because of its wide range of underlying pathologies and symptoms and signs which are insensitive and nonspecific (1, 2). Traditionally in nonpregnant women with pelvic pain, a complete pelvic exam and imaging are performed as part of an emergency assessment (3-5). When gynecologic causes of

*Corresponding author: Dr Maliheh Arab, drmarab@sbmu.ac.ir*

1. Imam Hossein Medical Center, Shahid Beheshti University of Medical Sciences,Tehran, Iran
2. Imam Hossein Medical Center, Tehran, Iran
3. Department of Biostatistics, Faculty of Medical Sciences, Tarbiat Modares University, Tehran, Iran
4. Shohada Hospital, Shahid Beheshti University of Medical Sciences, Tehran, Iran
5. Obstetrics and Gynecilogy Department, Arash Women's Hospital, Tehrtan Univercity of Medical Sciences, Tehran, Iran
6. Basir Eye Health Research Center, Tehran, Iran

↑***What is "already known" in this topic:***
Lower abdominal or pelvic pain is a common complaint among women coming to emergency departments and one of the most challenging findings to evaluate.

→***What this article adds:***
We have devised a suitable and easy-to-perform model that uses readily available information from individuals' history, examination findings, laboratory results, and an ultrasound exam to predict the chance of ovarian torsion.

pelvic pain are considered, it is best to divide them into adnexal causes, including ovarian cysts, ovarian torsion, pelvic inflammatory disease, tubo-ovarian abscess, and uterine causes including dysmenorrhea, fibroids, and intrauterine device complications (6).

Ovarian torsion is an uncommon but serious cause of acute abdominal and pelvic pain, accounting for only about 3% of gynecologic emergencies (7-9). Individuals with ovarian torsion usually have unilateral pelvic or lower abdominal pain, nausea, and vomiting (10, 11). Risk factors for ovarian torsion include a history of the previous torsion or pelvic surgery, adnexal masses or cysts, excessive ovarian stimulation in assisted reproduction, polycystic ovary syndrome, pregnancy, previous tubal ligation, endometriosis, pelvic inflammatory disease, and malignant lesions (12). More ovarian torsions occur on the right side compared with the left side, as the placement of the sigmoid colon may help to prevent left adnexal torsion (13).

Pelvic ultrasonography is the most useful diagnostic tool for the diagnosis of ovarian torsion (14). Transvaginal ultrasound and color Doppler imaging should be used whenever necessary to increase the accuracy of diagnosis (15). Previous studies have shown diagnostic accuracy ranging (16, 17) from 74.6 to 87%.

In many emergency settings, using these imaging modalities to diagnose ovarian torsion has some limitations either caused by the limited availability of imaging modalities or the lack of experience in performing and translating the results of these modalities.

The purpose of the present study was to construct a simple algorithm for predicting the chance of ovarian torsion among women with acute lower abdominal pain based on history and physical examination findings to substitute the imaging methods in absence of imaging modalities or to assist in diagnosis when the imaging results are inconclusive.

## Methods

This was a retrospective diagnostic cross-sectional study. The study included individuals referred to Imam Hossein Medical Center, Tehran, Iran, between 2010 and 2016. The inclusion criteria were being a female patient with the chief complaint of acute lower abdominal pain and undergoing laparotomy due to their complaint. The exclusion criteria were incomplete medical files or incomplete treatment. Relevant data were collected from participants' medical records using a questionnaire designed for the present study.

Clinical information and paraclinical findings collected included demographic characteristics, clinical complaints, and symptoms, and previous medical history—including previous surgical history, history of gynecological and obstetric diseases, contraceptive methods, features related to abdominal pain and tenderness, nausea and vomiting, bleeding patterns, and vital signs; laboratory results—including complete blood count, differential blood count, C-reactive protein, Alpha-Fetoprotein, cancer antigen 125 levels, ultrasound findings, findings during surgery, and pathology results of participants after surgery. Then, the variables were compared between the 2 groups based on the final diagnosis and laparotomy results. The first group included individuals with a final diagnosis of ovarian torsion (case group) based on their laparotomy results and the second group included those participants with any diagnosis other than ovarian torsion (control group). Those involved in constructing the model and the practitioners who confirmed the final diagnosis based on laparotomy results had no contact with each other to eliminate probable bios in the final diagnosis.

### *Statistical Analysis*

All data were compared between these 2 groups using SPSS software Version 21 (IBM Corp.) to find the related findings with a predictive value for ovarian torsion.

Quantitative data were displayed using mean and standard deviation and qualitative data using frequency and percentage. Univariate analysis was performed using an independent t-test, a Man-Whitney test, and a chi-squared test. The significance level of all statistical tests was considered to be 0.05.

To find the factors determining the torsion event, variables that showed a $P < 0.1$ in univariate analysis were included in the backward logistic regression model. The criterion for selecting the variables of the final model in the logistic regression model was the likelihood ratio test. Based on the results of the final logistic regression model, the score related to the event was determined so that the score of each variable was obtained by dividing the coefficient of that variable by the smallest coefficient in the model and its approximation with the nearest integer. Finally, a predictive model was constructed and the area under the receiver operating characteristic (ROC) curve was calculated to determine the accuracy of this model.

## Results

In the present study, the data from 372 women who referred to Imam Hossein Medical Center, Tehran, Iran, with lower abdominal pain between 2010 and 2016 and underwent laparotomy were examined. No cases were dropped due to missing data. A total of 116 patients (31.2%) had ovarian torsion (case group), and 256 had other final diagnoses (control group) for their lower abdominal pain. Table 1 shows the demographic findings of these 2 groups. The mean age of the participants was 30.08 ± 8.71 years.

The oldest and youngest patients were 62 and 11 years old, respectively. The participants with ovarian torsion had a mean age of 28.08 ± 8.16 years compared to the other participants' mean age of 30.99 ± 8.18 years, showing a statistically significant difference in age ($p = 0.003$) (Table 1). Also, the number of pregnant women was significantly higher in the torsion group compared with the control group ($p < 0.001$). No statistically significant difference regarding the gravid number or body mass index was observed between the 2 groups.

Table 2 shows a comparison of findings in history, physical exams, and laboratory results between participants with a final result of ovarian torsion and those with other outcomes.



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*Table 1.* Demographic characteristics of participants

| Variable | Total (N = 372) | Torsion ( n = 116) | Other (n = 256) | *P* |
|---|---|---|---|---|
| Age* | 30.08±8.71 | 28.08 ±8.16 | 30.99± 8.18 | 0.003[a] |
| BMI* | 27.31±7.00 | 28.62 ± 4.45 | 26.78 ± 7.72 | 0.492[a] |
| Gravid number** | | | | 0.633[b] |
| 0 | 155 (41.7) | 49 (42.2) | 106 (41.4) | |
| 1-3 | 180 (48.4) | 58 (50) | 122 (47.7) | |
| > 3 | 37 (9.9) | 9 (7.8) | 28 (10.9) | |
| Pregnancy ** | 14 (3.8) | 12 (10.3) | 2 (0.8) | <0.001[c] |

BMI, body mass index
* Data are presented as mean ± SD.
** Data are presented as N (%).
a, independent sample t-test; b, Kendall's tau-b correlation; c, Fisher-exact test.

*Table 2.* Comparison of Findings in History, Physical Examinations, and Laboratory Results Between Patients With a Final Result of Ovarian Torsion and Those With Other Outcomes

| Variable | Total (N = 372) | Torsion (n =116) | Other (n = 256) | P (A) |
|---|---|---|---|---|
| History of section * | 97 (26.1) | 24 (20.7) | 73 (28.5) | 0.111 |
| History of infertility * | 16 (4.3) | 8 (6.9) | 8 (3.1) | 0.233 |
| History of EP * | 3 (0.8) | 1 (0.9) | 2 (0.8) | 0.999 |
| History of endometriosis * | 3 (0.8) | 0 (0) | 3 (1.2) | 0.555 |
| History of reanastomosis * | 3 (0.8) | 0 (0) | 3 (1.2) | 0.555 |
| History of AUB * | 107 (28.8) | 33 (28.4) | 74 (28.9) | 0.928 |
| History of surgery * | 150 (40.3) | 34 (29.3) | 116 (45.3) | 0. 04 |
| History of ovarian cyst * | 118 (31.7) | 35 (30.2) | 83 (32.4) | 0.666 |
| History of chronic pelvic pain * | 1 (0.3) | 1 (0.9) | 0 (0) | 0.312 |
| History of vaginal discharge* | 37 (9.9) | 14 (12.1) | 23 (9) | 0.357 |
| Current vaginal discharge * | 54 (14.5) | 19 (16.4) | 35 (13.7) | 0.492 |
| Weight loss * | 4 (1.1) | 1 (0.9) | 3 (1.2) | 0.510 |
| Appetite loss * | 111 (29.8) | 44 (37.9) | 67 (26.2) | 0.022 |
| PMN>65% * | 189 (50.8) | 102 (87.9) | 87 (34) | <0.001 |
| Ovarian mass size ≥ 6 cm * | 199 (53.5) | 75 (64.7) | 124 (48.4) | 0.004 |
| Leukocyte>8500 * | 184 (49.5) | 75 (64.7) | 109 (42.6) | <0.001 |
| Sudden start of pain * | 274 (73.7) | 96 (82.8) | 178 (69.5) | 0.007 |
| Unilateral pain * | 238 (64) | 85 (73.3) | 153 (59.8) | 0.012 |
| Nausea and vomiting * | 225 (60.5) | 96 (82.8) | 129 (50.4) | <0.001 |
| Chronic dyspareunia * | 48 (12.9) | 7 (6) | 41 (16) | 0.025 |
| Free fluid * | 166 (44.6) | 56 (48.3) | 110 (43) | 0.340 |
| Tenderness * | 266 (71.5) | 99 (85.3) | 167 (65.2) | <0.001 |
| RLQ tenderness * | 124 (33.3) | 54 (46.6) | 70 (27.3) | <0.001 |
| Hypogastric tenderness * | 57 (15.3) | 12 (10.3) | 45 (17.6) | 0.073 |
| Pain interval ** | 26 (16) | 25 (16) | 28 (10.75) | 0.001 |
| Temperature *** | 37.04 ± 0.33 | 37.04 ± 0.395 | 37.04 ± 0.293 | 0.842 |
| Pulse rate *** | 89.59 ± 40.56 | 87.16 ± 11.94 | 90.69 ± 48.23 | 0.437 |
| Respiratory rate *** | 18.83 ± 2.34 | 19.26 ± 3.12 | 18.67 ± 1.98 | 0.232 |
| SBP *** | 108.59 ± 11.29 | 108.58 ± 11.74 | 108.6 ± 11.11 | 0.985 |
| DBP *** | 70.99 ± 8.31 | 70.39 ± 7.86 | 71.26 ± 8.51 | 0.351 |

* Data are presented as n (%).**Data are presented as median (interquartile range).*** Data are presented as mean ± SD.
EP, ectopic pregnancy; AUB, abnormal uterine bleeding; RLQ, right lower quadrant; SBP, systolic blood pressures; DBP, diastolic blood pressures; PMN, polymorphonuclear.
A, to compare percentages, P values were calculated based on the chi-squared test; to compare means, an independent samples t-test was used; and to compare medians, the Mann-Whitney test was used.

Table 3 shows those variables used in the construction of the logistic regression model for predicting ovarian torsion as the outcome. The primary variables included in the model were age, pain interval, PMN, ovarian mass size, leukocyte count, appetite loss, sudden start of pain, unilateral pain location, nausea and vomiting, chronic dyspareunia, and tenderness. The final variables used to construct the model included PMN count, ovarian mass size, presence of nausea and vomiting, and unilateral pain.

Based on these variables, the predictive model was constructed as follows:

Torsion Score = 3 (PMN>65%) + 1 (Ovarian mass size over 6 centimeter) + 2 (Presence of nausea and vomiting) + 1 (Presence of unilateral pain).

The risk score ranged from 0 to 7, with 0 indicating the participants with none of the risk factors, and 7 indicating those with the presence of all risk factors. The increment in the risk score significantly increased the probability of torsion ($p < 0.001$ for trend).

Figure 1 shows the ROC curve diagram, displaying the accuracy of the prediction model devised to predict ovarian torsion. The cutoff point for this model is a cumulating score of 5 or higher, which will indicate ovarian torsion with a sensitivity of 77.59% (95% CI, 68.9%-84.8%) and specificity of 74.61% (95% CI, 68.8% 79.8%).

## Discussion

The present study was conducted to evaluate the risk

*Table 3.* Variables used in the construction of the model for predicting ovarian torsion using the results of a backward stepwise logistic regression method

| Variables | Beta | S.E. | P * | OR (95% CI) |
|---|---|---|---|---|
| PMN > 65% | 2.50 | 0.329 | <0.001 | 12.16 (6.38 – 23.18) |
| Ovarian mass size ≥6 cm | 0.956 | 0.283 | <0.001 | 2.60 (1.50 – 4.53) |
| Nausea and vomiting | 1.28 | 0.318 | <0.001 | 3.60 (1.93 – 6.72) |
| Unilateral pain | 0.777 | 0.294 | 0.008 | 2.17 (1.22 – 3.87) |

*P values are calculated based on Wald statistics tests for logistic regression coefficients.
SE, standard error; OR, odds ratio; PMN, polymorphonuclear.

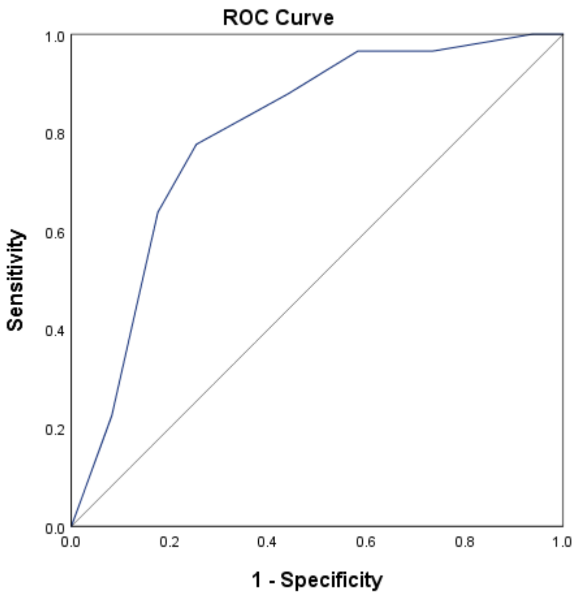


*Fig. 1.* The receiver operating characteristic curve diagram showing the accuracy of the prediction model devised to predict the ovarian torsion

factors related to ovarian torsion in women with the chief complaint of acute lower abdominal pain and to construct a new algorithm for predicting the chance of ovarian torsion among them.

We found that an ovarian size of over 6 cm in sonography has a strong correlation with the chance of ovarian torsion. Similar to our findings, several other studies have indicated ovarian mass as a risk factor for torsion. For example, a previous review article studying ovarian torsion has indicated that more than 80% of those with ovarian torsion had ovarian masses of 5 cm or larger, showing that ovarian mass is a primary risk factor for ovarian torsion (10). Similarly, another study reported that an enlarged ovary (>5 cm) was found in 89% of women with ovarian torsion (13). Also, it has been reported that a preexisting ovarian mass of size >5 cm is a strong risk factor for ovarian torsion.

We found that the presence of nausea and vomiting has a strong correlation with the chance of ovarian torsion. Similar to our findings, a previous study has reported nausea and vomiting as the most common finding in women with ovarian torsion. Also, the most common symptom of ovarian torsion has been reported to be the acute onset of pelvic pain, followed by nausea and vomiting, with up to 60% of cases with ovarian torsion complaining from nausea and vomiting (10, 18, 19).

We found a strong correlation between polymorphonuclear cell count of over 65% and ovarian torsion. Similar to our finding, in a previous study evaluating complete blood count parameters to predict ovarian torsion, the authors found a strong relationship between neutrophil count and ovarian torsion (20).

We also found a correlation between unilateral pain and ovarian torsion, which is similar to what has been previously reported (21).

Based on these findings, we constructed a model for predicting ovarian torsion among women with acute lower abdominal pain. This model uses only 4 parameters, which are easily available through history taking (nausea and vomiting, unilateral pain), laboratory results (PMN count), and simple sonographic study (ovarian mass size). This model could predict ovarian torsion, with a sensitivity of 77.59% (68.9% - 84.8%), which is better than what has been reported for Doppler sonography alone. For example, in a study conducted in 2000, a sensitivity of only 40% for Doppler sonography in the diagnosis of ovarian torsion has been reported,[22] and in a more recent study in 2018, the sensitivity of Doppler ultrasound was 70%. Nevertheless, the specificity of our model was only 74.61% (68.8% 79.8%), which was much lower than what has been reported (22, 23) for Doppler sonography (87%-100%). This suggests that our model can be used for primary screening of individuals to find those with a high chance of ovarian torsion, particularly in centers with no


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access to advanced sonographic equipment like Doppler sonography, or when trained personnel are not available for interpreting the Doppler results. The purpose of the present study was not to substitute the clinical judgment of the practitioner with a diagnostic algorithm. We only suggest our algorithm be used in conjunction with clinical judgment and also imaging modalities available to help the practitioner in reaching the final diagnostic decision.

This study has some limitations which should be noted. We had 372 patients entering the present study, with 116 cases diagnosed with ovarian torsion. Having a higher number of participants would probably result in constructing a better and more accurate diagnostic algorithm; however, it took us about 6 years to reach the present number of participants. Also, a more refined and elaborate method for conducting the present study would be dividing the patients into training and confirmatory groups. We decided not to do this because of our relatively limited number of participants in 6 years of conducting the present study and our limited resources for continuing the study to reach a higher number of participants. To overcome this shortcoming, we propose larger sample sizes in future studies.

## Conclusion

The proposed model is suitable for predicting ovarian torsion and its necessary information is readily available from patient history, examination findings, laboratory results, and an ultrasound exam.

## Acknowledgment

No financial support was obtained for performing the present study.

### *Ethical Considerations*

The study was approved by the ethics committee of Shahid Beheshti University of Medical Sciences (approval code IR.SBMU.MSP.REC.1398.253), Tehran, Iran.

### *Conflict of Interests*

The authors declare that they have no competing interests.

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