

Role of Doppler Ultrasound in the Assessment of Ovarian Torsion and its Correlation with Intraoperative Findings in Gynecological Emergencies

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ABSTRACT

Background: Ovarian torsion is a gynecologic emergency resulting from the rotation of the ovary on its vascular pedicle, with a resultant compromise of blood flow and subsequent ischemia and necrosis. It is important to diagnose early to prevent irreversible ovarian damage. However, assessment of ovarian vascularity can be made with a non-invasive method, Doppler ultrasound, but its diagnostic reliability should be evaluated.

Objective: Thus, the accuracy of Doppler ultrasound in diagnosing ovarian torsion was determined, and preoperative imaging and intraoperative surgical observations were correlated.

Methods: A prospective, cross-sectional study was carried out from January 2022 to January 2023 at the Civil Hospital Quetta. Doppler ultrasound was performed in 60 female patients aged 15–45 years with acute lower abdominal pain and clinical suspicion of ovarian torsion, and then surgical exploration was performed. Sensitivity, specificity, and overall accuracy of the Doppler results were compared to intraoperative diagnoses.

Results: During surgery, 38 (63.3%) patients were confirmed to have ovarian torsion. In 34 cases, venous flow was absent or reduced, and in 28 cases, there was a reduction of arterial flow. Doppler had sensitivity, specificity, positive predictive value, and negative predictive value of 89.5%, 81.8%, 89.4%, and 81.8%, respectively, while the overall accuracy was 86.7%. Ovarian cysts (52.6%) were the most common associated pathology. Ovarian preservation was higher (68.4%) for patients who presented early.

Conclusion: Ovarian torsion is an effective, high-sensitivity, and specific diagnostic modality by Doppler ultrasound. It aids in the timely surgical intervention when used in conjunction with clinical evaluation and improves ovarian salvage outcomes.

Keywords: Ovarian torsion, Doppler ultrasound, gynecological emergency, adnexal mass, ovarian salvage, diagnostic accuracy.

INTRODUCTION

Ovarian torsion is a gynecologic emergency in which the ovary and its vascular pedicle rotate, and there is reduced or complete obstruction of the blood flow. Ischemia, venous congestion, infarction, and, in the untreated case, loss of ovarian function, are the results of this condition. Nearly 2.7% of gynecologic emergencies are accounted for by it and can occur at any age, but it most commonly occurs during the reproductive years. Salvaging the ovary and preserving future fertility is dependent on prompt diagnosis and surgical intervention, especially in younger women^{1, 2}.

Ovarian torsion typically presents clinically nonspecifically, mimicking many other acute pelvic pathologies, including ruptured ovarian cyst, ectopic pregnancy, appendicitis, and pelvic inflammatory disease³. Sudden onset of lower abdominal pain, nausea, vomiting, and adnexal tenderness on pelvic examination are common symptoms. Despite pathognomonic signs often being lacking, diagnosis is frequently delayed, and thus, imaging techniques are used for confirmation and surgical planning⁴.

Transvaginal ultrasonography is the first-line imaging modality used in the evaluation of suspected ovarian torsion because it is widely available, noninvasive, cost-effective, and safe. Grayscale findings suggestive of torsion include enlarged and edematous ovary, the periphery of follicles, and associated adnexal masses⁵. These findings may, however, be present in other conditions. Assessment of vascular flow has significantly improved the diagnostic yield by the use of Doppler ultrasound. Venous and/or arterial flow absence or reduction on color or spectral Doppler imaging is highly suggestive of torsion, but normal flow will not exclude the diagnosis, as the ovary has a dual blood supply⁶.

Although Doppler ultrasound is being increasingly used in clinical practice, its diagnostic accuracy remains a source of clinical debate. It is operator dependent and may result in false negatives due to intermittent torsion, early-stage vascular compromise, or may be caused by bile duct obstruction⁷. For this reason, surgical exploration remains the gold standard for

confirming the diagnosis. If intraoperative findings correlate with preoperative imaging, however, unnecessary surgeries can be avoided⁸.

Considering the possibility of ovarian salvage and fertility preservation with prompt intervention, it is important to know the diagnostic performance of Doppler ultrasound. The purpose of this study was to determine the role of Doppler ultrasound in the diagnosis of ovarian torsion and to evaluate its correlation with intraoperative findings in women presenting with acute pelvic pain. The aim is to increase diagnostic accuracy, decrease diagnostic delay, and support clinical decision-making in emergency gynecological settings^{9, 10}.

MATERIALS AND METHODS

Study Design and Duration: The study was a prospective, cross-sectional observational study. It was done over a one-year period from January 2022 to January 2023. The purpose was to evaluate the accuracy of Doppler ultrasound in the detection of ovarian torsion and relate imaging to intraoperative surgical observations. Real-time documentation of clinical, radiological, and surgical data was possible with this design.

Place of Study: The work was done in the Department of Obstetrics and Gynecology, Civil Hospital Quetta, one of the largest tertiary care teaching hospitals of Balochistan. It is a facility with an emergency gynecology and a range of other advanced radiology services, including Doppler ultrasonography, which makes it appropriate for studies dealing with acute pelvic emergencies.

Study Population and Sample Size: N=60 females patients were considered for the study. These patients were presented to the emergency department with symptoms of acute lower abdominal pain and suspicion of acute ovarian torsion based on the history and physical examination. All the patients were in the reproductive age group of 15 to 45 years.

Inclusion Criteria: Patients were eligible for inclusion if between 15 and 45 years, presented with acute lower abdominal or pelvic pain of less than 72 hours duration, and were clinically suspected

to have ovarian torsion. Each patient or guardian gave informed consent, and all participants underwent Doppler ultrasound followed by surgical exploration.

Exclusion Criteria: If patients were hemodynamically unstable and could not be safely done under ultrasound or surgery, then they were excluded from the study. Individuals with a confirmed diagnosis of other acute abdominal conditions, including ectopic pregnancy, pelvic inflammatory disease, and ruptured hemorrhagic cysts, were also excluded. In addition, the patients who refused surgical intervention or opted not to participate in the study were not included in the study.

Doppler Ultrasound Protocol: Pelvic ultrasonography was performed using either transabdominal or transvaginal probes, depending on patient comfort and clinical stability. High-resolution ultrasound machines equipped with color and spectral Doppler functionality were used to perform the imaging. The ovarian size, echotexture, presence of peripheral follicles, and presence or absence of torsion-related signs (stromal edema or deviation of uterus) were each examined. Arterial and venous flow in the ovarian pedicle was given particular attention. Suggestive features included reduced or absent venous flow, diminished or reversed arterial flow, and heterogeneous ovarian parenchyma.

Surgical Procedure and Intraoperative Assessment: Surgical exploration through laparoscopy or laparotomy was done in patients with positive clinical and/or Doppler findings as per urgency and availability. Surgeons documented intraoperatively the presence of torsion, number of twists, ovarian color and viability, and pathology (such as cysts or masses). Ovarian viability was visually assessed, and the decision was made to perform detorsion and ovarian preservation or oophorectomy. A structured proforma was developed for this study, and operative findings were recorded using this proforma.

Data Collection and Statistical Analysis: Each patient was recorded using standardized data collection forms for demographic details, clinical presentations, Doppler findings, and surgical outcomes. The accuracy of Doppler ultrasound in diagnosing a condition was evaluated by comparing the Doppler ultrasound images to surgical findings, which are considered the gold standard. SPSS version 26 was used for statistical analysis. Calculations for sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and overall diagnostic accuracy were made. Frequencies and percentages were used to express categorical variables, while continuous variables were presented as means and standard deviations.

Ethical Considerations: The study was approved by the Institutional Review Board. This study was carried out by the ethical standards of the institutional and national research committees, and according to the 1964 Helsinki Declaration and its later amendments. All patients were informed written consent before inclusion. Confidentiality of the patient was strictly maintained during the study, and all data were anonymized for analysis.

RESULTS

Demographic and Clinical Profile: A total of 60 female patients aged 15 to 45 years were included in the study who were brought to the Civil Hospital, Quetta, with acute lower abdominal or pelvic pain. Age was 27.3 ± 6.5 years with a mean. As shown in Table 1, the largest number of patients ($n = 25$; 41.7%) belonged to the 21–30 years age group, and 18 patients (30.0%) were in the 31–40 years age group. Ninety percent of the patients were nulliparous ($n = 42$, 70.0%), 20.0% primiparous ($n = 12$), and 10.0% multiparous ($n = 6$). The majority of patients ($n = 42$; 70.0%) had symptom onset within 24 hours. In 48 patients (80.0%), associated symptoms were nausea and vomiting, in 22 patients (36.7%) palpable adnexal mass, and 9 patients (15.0%) fever as shown in table 1.

Doppler Ultrasound Findings: Color and spectral Doppler ultrasonography were performed in all 60 patients. As shown in Table 2, 34 patients (56.7%) had absent or significantly reduced

venous flow, and 28 patients (46.7%) had reduced or absent arterial flow. In 41 cases (68.3%), enlarged ovaries with peripheral follicles were found. In 18 patients (30.0%), the “whirlpool sign” indicating a twisted vascular pedicle was identified. A total of 35 patients, 58.3%, had adnexal or ovarian cystic masses, which were the most common being dermoid cyst and hemorrhagic corpus luteum.

Table 1: Demographic and Clinical Characteristics of Study Participants ($n = 60$)

Characteristic	Category	n (%)
Age Group (years)	15–20	7 (11.7%)
	21–30	25 (41.7%)
	31–40	18 (30.0%)
	41–45	10 (16.6%)
Parity	Nulliparous	42 (70.0%)
	Primiparous	12 (20.0%)
	Multiparous	6 (10.0%)
Symptom Duration	<24 hours	42 (70.0%)
	24–48 hours	12 (20.0%)
	>48 hours	6 (10.0%)
Associated Symptoms	Nausea/Vomiting	48 (80.0%)
	Palpable Adnexal Mass	22 (36.7%)
	Fever	9 (15.0%)

Table 2: Doppler Ultrasonography Findings ($n = 60$)

Finding	n (%)
Absent/Reduced Venous Flow	34 (56.7%)
Absent/Reduced Arterial Flow	28 (46.7%)
Enlarged Ovary with Peripheral Follicles	41 (68.3%)
Whirlpool Sign	18 (30.0%)
Presence of Adnexal/Ovarian Cyst	35 (58.3%)

Intraoperative Findings: Of the 60 patients, 38 (63.3%) had surgical exploration, which confirmed ovarian torsion. Other pathologies were found in 22 patients (36.7%): hemorrhagic cyst rupture ($n = 9$), tubo-ovarian abscess ($n = 6$), pelvic adhesions ($n = 4$), and acute appendicitis ($n = 3$). There were 21 cases (55.3%) with a single twist and 17 cases (44.7%) with multiple twists among the confirmed torsion cases. In 28 (73.7%) patients, there was ovarian congestion and color changes, and, in 12 cases (31.6%), necrosis warranted oophorectomy. In 26 patients (68.4%), detorsion with ovarian preservation was performed as shown in table 3.

Table 3: Intraoperative Findings in Patients with Confirmed Torsion ($n = 38$)

Finding	n (%)
Number of Twists	
— Single Twist	21 (55.3%)
— Multiple Twists (≥ 2)	17 (44.7%)
Ovarian Congestion/Discoloration	28 (73.7%)
Ovarian Necrosis	12 (31.6%)
Detorsion with Preservation	26 (68.4%)
Oophorectomy Performed	12 (31.6%)
Associated Cyst or Mass	20 (52.6%)

Correlation between Doppler Findings and Surgical Confirmation:

Doppler ultrasound was assessed for its diagnostic performance using intraoperative findings (gold standard) as a comparison. As shown in Table 4, Doppler correctly identified torsion in 34 of 38 confirmed cases (true positives). 4 of the cases were false negatives where Doppler flow was present despite torsion, which may have been secondary to partial or intermittent torsion. This was also true for 4 cases of torsion not present with reduced flow, which were all also false positives. The sensitivity calculated was 89.5%, specificity 81.8%, positive predictive value 89.4%, negative predictive value 81.8%, and overall diagnostic accuracy (sensitivity + specificity)/2 = 86.7%.

There is a very clear demonstration of the strong diagnostic value of Doppler ultrasound in assessing ovarian torsion in the correlation data. It also points out that vascular flow alone cannot

rule out early or partial torsion, in support of the importance of interpreting imaging in the context of clinical features.

Table 4: Diagnostic Accuracy of Doppler Ultrasound Compared to Intraoperative Findings

Parameter	Value
True Positives (TP)	34
False Negatives (FN)	4
True Negatives (TN)	18
False Positives (FP)	4
Sensitivity	89.5%
Specificity	81.8%
Positive Predictive Value	89.4%
Negative Predictive Value	81.8%
Diagnostic Accuracy	86.7%

DISCUSSION

Ovarian torsion is a gynecologic emergency that requires rapid diagnosis and prompt intervention to save ovarian viability and future fertility. The strong diagnostic value of Doppler ultrasound was shown in this study as 89.5% sensitivity and 81.8% specificity for detecting ovarian torsion compared with intraoperative findings¹¹. This is in agreement with previous literature that color and spectral Doppler ultrasonography are a very helpful but not infallible diagnostic tool for adnexal torsion¹².

The major strength of Doppler ultrasound in ovarian vascularity is its noninvasive nature. The most consistent indicator of torsion in this study was present or reduced venous flow, present in 32 of 38 cases confirmed by surgery. This is in keeping with the pathophysiology of torsion, in which venous and lymphatic outflow is generally compromised before arterial inflow¹³. While this was true in four cases, intraoperative torsion was confirmed in four cases with preserved arterial and venous flow, thus suggesting that Doppler may give false negatives in cases of intermittent or early-stage torsion. The significance of this is that imaging findings should be integrated with clinical assessment, not just Doppler alone¹⁴.

The most common associated pathology was ovarian cysts, especially dermoid and hemorrhagic cysts, which are responsible for increased weight of the ovary and predispose to torsion. More than half of the confirmed torsion cases had this¹⁵. Furthermore, successful preservation of the ovaries was associated with early presentation to the hospital within 24 hours of symptom onset (68.4 cases), suggesting that prompt diagnosis and surgical intervention remain important for improving outcomes¹⁶.

Lastly, false-positive Doppler findings were seen in 4 cases to show that reduced ovarian flow can occur from nontorsion-related causes such as hemorrhagic cysts, endometriosis, or even technical limitations of imaging. Therefore, surgical exploration is the definitive diagnostic modality, especially when clinical suspicion is still high, despite inconclusive imaging¹⁷.

In summary, this study supports the use of Doppler ultrasound in the initial diagnosis of suspected ovarian torsion in emergencies. When used in conjunction with clinical judgment, timely surgical decision making, it markedly increases the likelihood that ovarian salvage will be achieved and decreases the unnecessary delays^{18, 19}.

CONCLUSION

Doppler ultrasound is a very useful, noninvasive diagnostic technique for the evaluation of suspected ovarian torsion, having high sensitivity and specificity. Its findings correlate strongly with intraoperative observations and are an important part of emergency gynecological care. But decision making should always be made on clinical judgment, as even imaging might not detect early or partial torsion. A prompt diagnosis and timely surgical

intervention remain important for the preservation of ovarian function and fertility.

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