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The Application Value of Ultrasound in the Diagnosis of Ovarian Torsion

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Abstract: In a study of 80 patients suspected of ovarian torsion and necrosis admitted to our hospital between January and December 2023, we analyzed the results of abdominal and vaginal ultrasounds with surgical diagnoses as the reference. Of the 80 cases, 74 were confirmed as ovarian torsion, accounting for 92.50%, while the remaining diagnoses included ruptured corpus luteum cysts, periapendiceal abscesses, and ruptured ectopic pregnancies, each with 2 cases. Abdominal ultrasound identified 63 cases of ovarian torsion and 17 cases of non-ovarian torsion, whereas vaginal ultrasound identified 73 cases of ovarian torsion and 7 cases of non-ovarian torsion. The sensitivity, specificity, and accuracy of abdominal ultrasound were 82.43%, 66.67%, and 78.75%, respectively, while those of vaginal ultrasound were 94.59%, 50.00%, and 91.25%. Although there was no statistical difference in specificity between the two methods ($P > 0.05$), vaginal ultrasound demonstrated significantly higher sensitivity and accuracy compared to abdominal ultrasound ($P < 0.05$). Thus, vaginal ultrasound is a more reliable diagnostic tool for ovarian torsion, providing valuable information for clinicians and improving diagnostic accuracy.

Keywords: Ovarian Torsion; Abdominal Ultrasound; Vaginal Ultrasound; Gynecological Diseases; Imaging Examination.

1. Introduction

Ovarian torsion is a highly prevalent acute abdominal condition in gynecology and ranks fifth among acute lower abdominal pain disorders in women. It can occur in females of any age, with a variety of complex causes including dysmenorrhea, ovarian developmental abnormalities, abdominal trauma, inflammation, jolting, and excessively long mesosalpinx. These internal and external factors can all potentially lead to ovarian torsion. Clinically, ovarian torsion is classified into three types: partial, tubal, and complete. When ovarian torsion occurs, it can obstruct venous blood circulation, leading to severe pain, nausea, and vomiting. As the condition progresses, patients may experience vaginal bleeding and menstrual irregularities. [1] If arterial blood flow is compromised, it can result in ischemic necrosis of the affected adnexa. Early detection and prompt treatment are crucial to preserving ovarian function. Ultrasound is commonly recommended for diagnosing ovarian torsion due to its ease of use and ability to dynamically monitor changes in the echoes and blood flow of the adnexa, allowing for timely evaluation of the patient's condition. This study collected data from 80 patients with suspected ovarian torsion and necrosis at our hospital and analyzed the ultrasound findings. The results are reported as follows:

2. Materials and Methodology

2.1. General Information

Eighty patients with suspected ovarian torsion and necrosis admitted to our hospital from January 2023 to December 2023 were selected. Their ages ranged from 21 to 38 years, with an average age of 29.32 ± 4.30 years. The time from onset of abdominal pain to medical consultation ranged from 1 to 13 hours, with an average of 5.92 ± 1.24 hours. Among them, 38 were married and 42 were unmarried. Pain location included 52 cases with right lower abdominal pain and 28 with left lower abdominal pain. Pain types were 42 cases of intermittent pain and 38 cases of continuous pain. The study received approval from the hospital ethics committee.

2.2. Inclusion and Exclusion Criteria

Inclusion criteria: 1) Clear ultrasound images with varying degrees of pain; 2) Age 18 years or older, with complete medical records; 3) Informed consent and agreement to participate in the study.

Exclusion criteria: 1) Other gynecological diseases or abdominal masses; 2) [2] Previous abdominal surgery; 3) Severe organ diseases; 4) Inability to undergo ultrasound examination; 5) Mental disorders, cognitive impairments, or lack of independent communication abilities; 6) Extremely poor cooperation.

2.3. Procedures

All patients underwent ultrasound examination using the GE VOLUSON E8 color Doppler ultrasound system.

Abdominal ultrasound: Patients were instructed to drink water before the examination to ensure a full bladder. They were positioned supine, with the probe set at a frequency of 3-5 MHz, and placed on the abdomen to examine the ovaries' size, position, shape, internal structure, and blood flow. Blood flow imaging was used to observe blood flow signals, measure ovarian size, and check for twisted vascular pedicles, low echogenicity masses, and pelvic effusion. After abdominal examination, the bladder was emptied for a vaginal ultrasound.

Vaginal ultrasound: Patients remained supine, with the probe set at 5-8 MHz. A disposable condom was placed on the probe and coupling gel was applied. The probe was inserted into the vagina and placed against the vaginal posterior fornix. [3-5] The probe was moved and tilted to scan the adnexa, pelvis, and uterus in longitudinal, transverse, and oblique sections. Observations included ovarian position and size, pelvic effusion, abnormal masses, mass location, size,

internal echogenicity, ovarian blood flow dynamics, and surrounding vascularity. Ovarian torsion was diagnosed if the ultrasound showed enlarged ovaries, absent blood flow signals, uneven echogenicity, and twisted vascular pedicles.

2.4. Observation Indicators

Based on surgical diagnoses, the sensitivity, specificity, and accuracy of abdominal and vaginal ultrasound in diagnosing ovarian torsion were analyzed. Sensitivity = (True Positive Cases) / (True Positive Cases + False Negative Cases) × 100%; Specificity = (True Negative Cases) / (True Negative Cases + False Positive Cases) × 100%; Accuracy = (True Positive Cases + True Negative Cases) / Total Cases × 100%.

2.5. Statistical Analysis

Data were processed using SPSS 26.0 software. Count data were presented as (n) and analyzed with chi-square tests; measurement data were presented as (±s) and analyzed with t-tests; $P < 0.05$ was considered statistically significant [6].

3. Results

3.1. Surgical Diagnosis Analysis

Out of 80 patients with suspected ovarian torsion and necrosis, surgical diagnoses confirmed 74 cases of ovarian torsion, representing 92.50%. The remaining diagnoses included 2 cases each of ruptured corpus luteum cyst, periapendiceal abscess, and ruptured ectopic pregnancy [7-8].

3.2. Analysis of Different Ultrasound Examination Methods

Among the 80 patients, abdominal ultrasound identified ovarian torsion in 63 cases and non-ovarian torsion in 17 cases. Vaginal ultrasound identified ovarian torsion in 73 cases and non-ovarian torsion in 7 cases. The sensitivity, specificity, and accuracy of abdominal ultrasound were 82.43%, 66.67%, and 78.75%, respectively. [9] For vaginal ultrasound, these values were 94.59%, 50.00%, and 91.25%, respectively. There was no significant difference in specificity between abdominal and vaginal ultrasound ($P > 0.05$), but vaginal ultrasound had higher sensitivity and accuracy compared to abdominal ultrasound ($P < 0.05$). Detailed results are shown in Tables 1-3.

Table 1. Analysis of Abdominal Ultrasound Results

Abdominal Ultrasound	Surgical Diagnosis		Total
	Adnexal Torsion	Non-Adnexal Torsion	
Adnexal Torsion	61	2	63
Non-Adnexal Torsion	13	4	17
Total	74	6	80

Table 2. Analysis of Vaginal Ultrasound Examination Results

Vaginal Ultrasound	Surgical Diagnosis		Total
	Adnexal Torsion	Non-Adnexal Torsion	
Adnexal Torsion	70	3	73
Non-Adnexal Torsion	4	3	7
Total	74	6	80

Table 3. Diagnostic Performance Analysis of Abdominal Ultrasound and Vaginal Ultrasound

Examination Method	**Number of Cases**	**Sensitivity**	**Specificity**	**Accuracy**
Abdominal Ultrasound	80	82.43(61/74)	66.67(4/6)	78.75(63/80)
Vaginal Ultrasound	80	94.59(70/74)	50.00(3/6)	91.25(73/80)
χ^2		4.253	0.017	3.971
P		$P<0.05$	0.897	0.046

4. Discussion

Ovarian torsion encompasses partial or complete ovary and fallopian tube rotation around their vascular pedicle, including the pelvic suspensory ligament, fallopian tube, and ovarian ligament. [10-11] Such torsion can lead to partial or complete obstruction of the ovarian artery and vein, lymphatic circulation disturbances, and severe ischemia and necrosis of the adnexa, ultimately affecting fertility. Epidemiological data indicate that ovarian torsion ranks fifth among gynecological acute abdominal conditions, with an incidence of 3% among surgical patients. While ovarian torsion can occur at any age, it is more common in women of reproductive age and adolescents. [12] Ovarian torsion frequently involves the ovary, with fallopian tube torsion being less common. For women of reproductive age and adolescents, preserving the adnexa is crucial, underscoring the importance of preoperative diagnosis.

Clinical studies reveal that ovarian torsion often presents without clear clinical symptoms initially. Some patients may experience sudden abdominal pain, with severe, persistent, or intermittent lower abdominal pain or unilateral pelvic pain emerging in the early stages. [13-15] As the condition progresses, the pain intensifies. Physical examination often reveals lower abdominal tenderness, muscle rigidity, rebound tenderness, and the presence of masses. [16]During bimanual and three-dimensional pelvic examinations, significant enlargement of the adnexa with marked tenderness can be observed. Laboratory tests may show elevated white blood cell counts in 20% to 62% of patients, with increased levels of C-reactive protein, interleukins, and erythrocyte sedimentation rates, although these markers lack specificity. Elevated serum inflammatory markers, particularly IL-6 and D-dimer (with a critical value of 0.65 mg/mL), can aid in diagnosis. The sensitivity and specificity of D-dimer in diagnosing torsion are 71.4% and 85%, respectively. [17]However, due to the lack of specific diagnostic markers

in laboratory tests, they are mainly used for differential diagnosis. Diagnosing ovarian torsion remains challenging when typical clinical manifestations and specific laboratory findings are absent.

Imaging plays a vital role in diagnosing ovarian torsion. Ultrasound is a preferred method due to its ability to clearly visualize ultrasound images and surrounding structures. It is non-invasive, convenient, and does not cause physical harm to the patient. [18]Ultrasound findings of ovarian torsion typically include asymmetrical enlargement of the ovary, edema, and the presence of "string of beads" sign or "follicular peripheralization" where follicular cysts form peripheral rings. Other indicators include echogenic rings around the ovarian mass, ovarian parenchyma thickening, and free fluid around the ovary. Doppler ultrasound may reveal the "whirlpool sign" with one or multiple concentric ring structures near the ovary. Normally, the adult ovary is oval, with a volume of approximately 40 mm × 30 mm × 20 mm, displaying homogeneous low echogenicity with a clear boundary. Blood supply comes from the ovarian arteries and uterine artery branches. [19]Ovarian torsion can cause venous obstruction, leading to increased intra-ovarian pressure, edema, congestion, and necrosis. If fluid from immature follicles transfers, it may obscure blood flow detection on ultrasound, leading to heterogeneous echogenicity and an increased ovarian volume with low echogenic areas. However, since Doppler flow is not entirely absent in torsion cases, arterial flow may be intermittent. Given the dual blood supply of the ovary, the presence of blood flow signals does not completely exclude torsion. [10]Clinical studies show that ovarian torsion is often misdiagnosed as other acute abdominal conditions such as hydrosalpinx, appendicitis, corpus luteum cyst rupture, or ectopic pregnancy, due to similar symptoms and imaging findings. For instance, appendicitis often presents with right lower abdominal pain and tubular low echogenicity on ultrasound, while hydrosalpinx torsion may show cystic masses in the adnexal region on imaging.

5. Conclusion

This study found that among 80 patients with suspected ovarian torsion, 74 were confirmed to have ovarian torsion by surgery. Abdominal ultrasound identified 63 cases of ovarian torsion and 17 non-torsion cases, while vaginal ultrasound identified 73 cases of ovarian torsion and 7 non-torsion cases. The sensitivity, specificity, and accuracy for abdominal ultrasound were 82.43%, 66.67%, and 78.75%, respectively. For vaginal ultrasound, these values were 94.59%, 50.00%, and 91.25%, respectively. Vaginal ultrasound demonstrated higher sensitivity and accuracy compared to abdominal ultrasound ($P < 0.05$), although specificity did not differ significantly ($P > 0.05$). These results indicate that vaginal ultrasound is superior to abdominal ultrasound in diagnosing ovarian torsion, with higher sensitivity and accuracy. This advantage is due to the proximity of the vaginal probe to the adnexa, providing clearer images without interference from abdominal fat, intestinal gas, or fascial tissues. Additionally, the higher resolution of the vaginal probe allows for more detailed visualization of the adnexa, improving diagnostic accuracy. Doppler techniques used in vaginal ultrasound further enhance the ability to assess blood flow, aiding in more accurate diagnosis.

In summary, ultrasound is a convenient, non-invasive, and cost-effective method for diagnosing ovarian torsion. Vaginal ultrasound offers superior image quality and resolution, allowing for more accurate identification of adnexal abnormalities and facilitating timely treatment, which can improve patient outcomes. Future research should consider expanding sample sizes to enhance the accuracy and reliability of findings, providing more comprehensive reference data for the clinical diagnosis of ovarian torsion.

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