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Case report

Step-by-step instructions for detecting whirlpool sign in adnexal torsion

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Abstract

Objective: Adnexal torsion is a common gynecological emergency whose prompt diagnosis is essential because a delay may lead to ovarian dysfunction. Although the whirlpool sign is reliable for diagnosing ovarian cyst torsion, technical difficulties hinder its use by sonographers. Here we developed a systematic approach to visualizing this sign by focusing on the fact that torsion arises from the space between the uterus and the pelvic wall. One must determine the origin of the torsion via transverse imaging of the uterus and follow the twisted ligaments to the ovarian cyst.

Patients and Methods: Two women aged 56 (Case 1) and 28 years (Case 2) visited our hospital with lower abdominal pain. Transvaginal ultrasonography showed a 7-cm right ovarian cyst in Case 1 and a 5-cm cyst in the Douglas pouch in Case 2; normal bilateral ovaries and the whirlpool sign were detected in both cases. Under laparoscopic guidance in Cases 1 and 2, an ovarian cyst and a paraovarian cyst were confirmed and removed.

Results: Our step-by-step method allowed us to identify the whirlpool sign and confirm adnexal torsion, leading to prompt surgery in both cases.

Conclusion: Using a systematic procedure helps less experienced practitioners detect the whirlpool sign.

Key words: adnexal torsion, ovarian torsion, whirlpool sign, gynecological ultrasound

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Introduction

Adnexal torsion is a common gynecological emergency in women of all ages[1)]. It accounts for up to 3% of all cases of acute abdominal pain presenting at the emergency departments[2)]. A prompt diagnosis is essential because delayed treatment can lead to ovarian dysfunction, peritonitis, and even death[1, 3)]. For diagnosing adnexal torsion, ultrasonography is the most commonly used imaging technique because of its mobility and convenience, followed by computed tomography (CT) and magnetic resonance imaging (MRI)[3, 4)]. Although ultrasonography is suitable for a quick evaluation, the visualization of key clinical signs using this technique depends on sonographer skill.

The sonographic whirlpool sign refers to the appearance of a twisted pedicle on ultrasonography in patients with adnexal torsion[5)]. Several studies have reported a markedly higher diagnostic performance of this sign versus other classical sonographic findings, such as ovarian edema or abnormal ovarian blood flow by color Doppler ultrasonography[5–7)]. Because ultrasonography is noninvasive, widely available, and less time-consuming, the detection of the sonographic whirlpool sign would be highly beneficial in settings with limited resources, especially in emergency departments in rural areas. Although detecting the whirlpool sign seems a favorable strategy, previous studies demonstrated that its identification requires expertise among trained sonographers[6, 8)]. This technical difficulty limits the utility of whirlpool sign for diagnosing adnexal torsion. To date, a method for visualizing this sign in patients with adnexal torsion has not been well documented. Here we provide step-by-step in-

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structions for detecting the whirlpool sign using transvaginal ultrasonography in adnexal torsion. We report two cases of adnexal torsion diagnosed using this method.

Patients and Methods

Following the ethical review policy of human research at the Medical and Dental School of Tokyo Medical and Dental University, this study was exempted from institutional review board approval. Written informed consent for case reports was obtained from all patients.

This ultrasonographic procedure is based on the fact that the adnexa connects to the cornu (uterine horn) and the proximal end of the infundibulopelvic ligament, and torsion arises between them (Figure 1). From this point of origin, the twisted ligaments connect to the enlarged adnexa. Evaluations perpendicular to the axis of the twisted ligament can be used to visualize the whirlpool sign. The following steps explain the process of detecting the whirlpool sign in ovarian cyst torsion; the same technique is also applicable to paraovarian cyst torsion. The step-by-step instructions are as follows.

Locate the uterus

After positioning the patient in the supine or lithotomy position, insert a transvaginal ultrasound probe into the vagina. Find the uterus in the sagittal plane (Figure 2A). In patients with ovarian torsion, the uterus may become shifted to the twisted side because the ligaments are pulled by torsion.

Find the enlarged adnexa

Identify the enlarged adnexa and recognize the position. The presence of an intact ovary on the contralateral side can confirm the side with adnexal torsion. Tenderness and midline shift of the uterus may explain this finding. A history of ovarian cysts can also help determine the side of torsion.

Obtain a transverse view of the uterus

Identify the uterus in the sagittal plane and rotate the probe 90° to obtain a transverse plane view (Figure 2B). As the twisted adnexa pulls the cornu, the uterus is straightened rather than flexed. Consequently, the uterine cavity should appear as a triangle in the ideal transverse plane.

Center the cornu and detect the origin of the torsion

By gently moving the probe to the twisted side from the midline, center the cornu on the twisted side (Figure 2C). The ovarian and infundibulopelvic ligaments become pulled together, causing the torsion. These ligaments pull the cornu and the proximal end of the infundibulopelvic ligament, and torsion arises from the narrow space between them.

Swing the probe and visualize the torsion

Starting from the previous view, swing the probe to the enlarged adnexa detected in step 2 (Figure 2D). By slowly moving the probe back and forth between the origin and the enlarged adnexa, the twisted ligaments can be visualized as a whirlpool. Slightly rotating and moving the probe in this area may be necessary to obtain an ideal perpendicular view of the axis of the twisted ligaments.

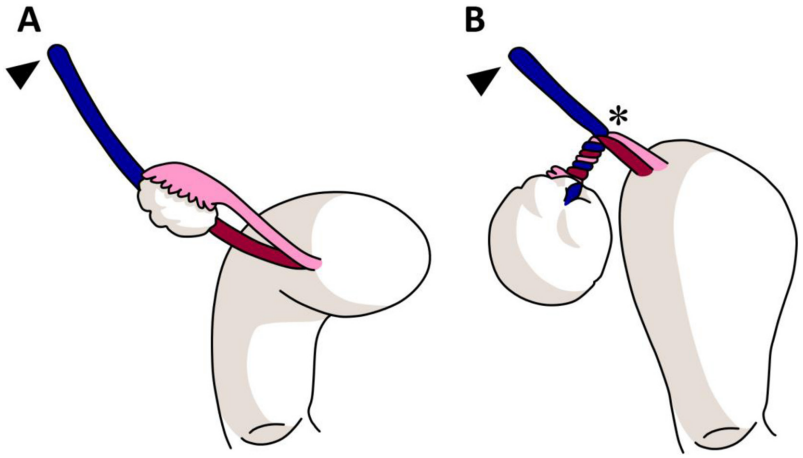

Figure 1 (A) Normal anatomical positions of the uterus, fallopian tube, ovary, and ligaments. (B) Anatomical positions of these structures in adnexal torsion. The uterus is straightened. The ligaments connected to the ovary are twisted. The cornu is pulled to the pelvic wall. The ovarian ligament, fallopian tube, infundibulopelvic ligament, and ovarian artery and vein are twisted at the origin (*). The origin is visible between the cornu and the proximal end of the infundibulopelvic ligament (arrowhead).

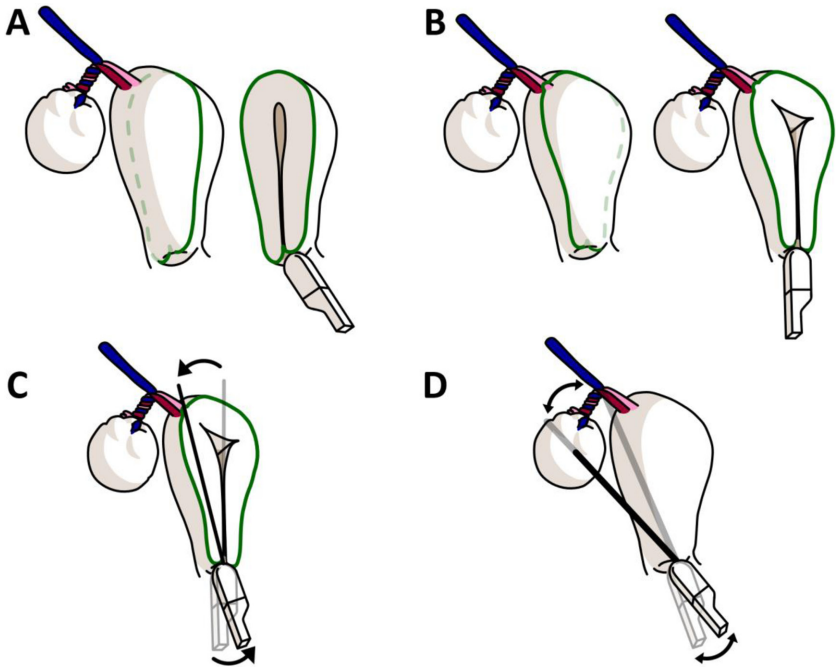

Figure 2 (A) The sagittal plane of the uterus. (B) The probe is rotated 90° and a transverse plane of the uterus is identified. (C) The probe is moved from the midline to the twisted side and the center of the cornu. (D) The probe is moved back and forth from the point of origin to the enlarged ovary. The whirlpool sign is visible when adnexal torsion is present.

Results

Case 1: Ovarian torsion

A 56-year-old multiparous woman visited our hospital complaining of a 1-week history of right lower quadrant pain. Laboratory findings revealed a slight elevation in white blood cell count and C-reactive protein level, but other findings were normal. Transvaginal ultrasonography (Sonovista, Konica Minolta Inc., Tokyo, Japan) with a center frequency of 9.0 MHz showed a 7-cm multilocular right ovarian cyst. The whirlpool sign was found between the right cornu and the pelvic wall (Figure 3A). MRI findings also supported the diagnosis of ovarian cyst torsion, and the patient was admitted for laparoscopic surgery. During surgery, a 7-cm right ovary tumor was found twisted 900° around its ligament axis (Figure 3B). A bilateral salpingo-oophorectomy was performed, and the postoperative pathological diagnosis was torsion of a serous cystadenoma.

Case 2: Paraovarian cyst torsion

A 28-year-old multiparous woman presented to our hospital reporting a 4-hour history of left lower quadrant pain. She complained of tenderness in the left lower abdomen but showed no signs of peritoneal irritation. The blood test results were normal except for a slightly elevated white blood cell count. Transvaginal ultrasonography, which was performed using the same equipment as in Case 1, revealed a 5-cm cyst in the Douglas pouch and normal bilateral ovaries. The whirlpool sign was detected extending from the left cornu to the cyst (Figure 4A). Laparoscopic surgery revealed a paraovarian cyst connected to the left fallopian tube twisted 1440° (Figure 4B). A cystectomy was performed, and postoperative pathology confirmed its identity as a paraovarian cyst.

Discussion

Based on the anatomical features of ovarian torsion, we developed a simple method for detecting the whirlpool sign. Despite its high diagnostic capability, the whirlpool sign has not been recognized as an essential diagnostic method for adnexal torsion because it is difficult to visualize. Our method can help clinicians detect the whirlpool sign and thereby consider it a viable finding for diagnosing adnexal torsion.

The whirlpool sign, first described by Vijayaraghavan in 2004[5], represents torsion itself and is, therefore, directly linked to the diagnosis of adnexal torsion. Previous studies have reported that the whirlpool sign has a higher specificity for adnexal torsion than other sonographic findings, such as ovarian stromal edema, follicular ring sign, and the absence of vascularization on color Doppler[7]. Valsky *et al.*[6] reported a true-positive diagnosis rate of 90% for the whirl-

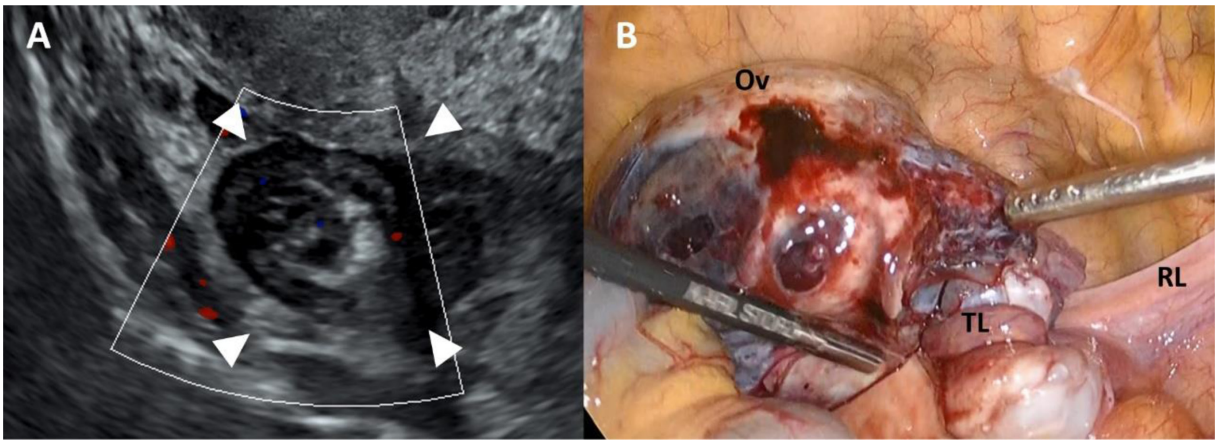

Figure 3 (A) The whirlpool sign (arrowhead) identified on transvaginal ultrasonography in Case 1. (B) Intraoperative image of Case 1. The 7-cm right ovarian tumor was twisted 900°. Ov, ovarian tumor; RL, round ligament; TL, twisted ligaments.

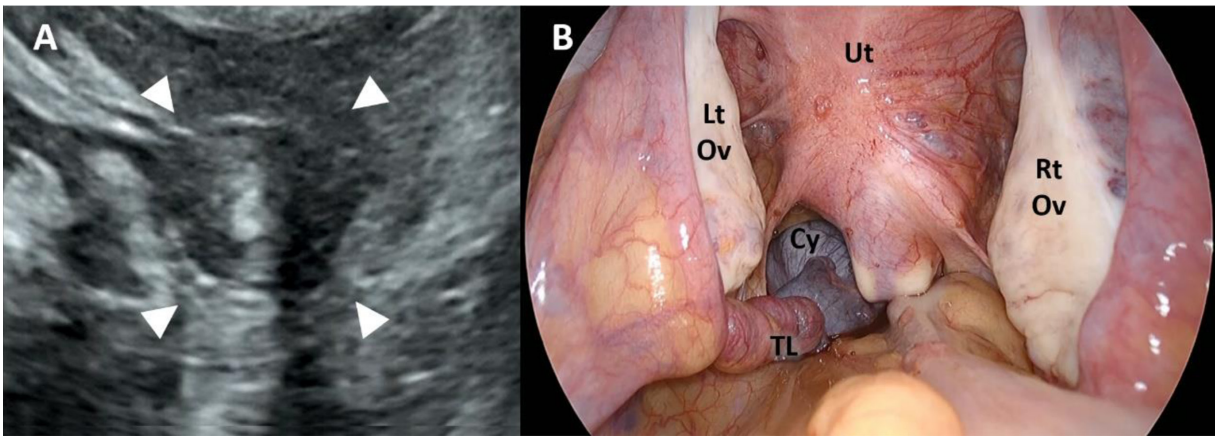

Figure 4 (A) Whirlpool sign (arrowhead) identified on transvaginal ultrasonography in Case 2. (B) Intraoperative image in Case 2. The 5-cm paraovarian cyst in the Douglas pouch was twisted 1440° from the left fallopian tube. A uterine manipulator is inserted and the uterus is anteverted. Cy: paraovarian cyst; Ov: ovary; TL: twisted ligament; Ut: uterus.

pool sign in adnexal torsion. Since ultrasound examinations are noninvasive and more widely available than CT and MRI, especially in emergency departments, detection of the whirlpool sign is highly beneficial for patients with adnexal torsion, among whom a prompt diagnosis facilitates earlier operations and improves patient prognosis.

Considering the absence of an established method to visualize the whirlpool sign, our step-by-step instructions will help examiners easily detect adnexal torsion, enabling a prompt diagnosis. Although previous reports provided instructions to move the probe back and forth along the twisted ligament axis, pivotal instructions for detecting the torsion axis have not been specifically documented[6]. Moro *et al.*[7] reported a study of adnexal torsion in which all ultrasound examiners had >10 years of experience performing gynecological ultrasonography. Despite the high diagnostic performance of this sign, the technical difficulty with its detection has hindered its use as an indispensable technique for diagnosing adnexal torsion. We focused on the fact that twisted ligaments arise between the cornu and the proximal end of the infundibulopelvic ligament and the link between the origin and the enlarged adnexa. When the adnexa is twisted, it pulls on the ovarian and infundibulopelvic ligaments. The cornu is pulled to the pelvic wall, and the uterus undergoes a midline shift. Torsion arises between the pulled cornu and the proximal end of the infundibulopelvic ligament. Additionally, the twisted ligaments pull the enlarged adnexa, allowing the connected points of the ligaments to face the origin. Torsion was identified between the origin and the enlarged adnexa, and the main focus of our procedure was to use a view perpendicular to this torsion axis. With slow scanning using the probe from the narrow space between the cornu and the proximal end of the infundibulopelvic ligament to the enlarged adnexa, the origin can be

identified and twisted ligaments can be visualized, leading to the whirlpool sign. Positioning the probe to obtain a transverse plane view of the uterus can aid detection of the whirlpool sign as torsion is often observed in the dorsoventral axis.

This method is applicable to ovarian and paraovarian cyst torsion. We performed the same step-by-step procedure in Case 2 and identified torsion between the enlarged adnexa and the origin located between the cornu and the proximal end of the infundibulopelvic ligament. In paraovarian cyst torsion, the uterus might not be pulled to the twisted side as in ovarian cyst torsion because the torsion does not pull the ligaments together. Hence, the space between the cornu and proximal end of the infundibulopelvic ligament is wider in paraovarian cyst torsion. Although the twisted object differs, the same technique can be applied to detect the whirlpool sign.

Depending on the position of the twisted adnexa, transvaginal ultrasonography may not reveal a perpendicular view of the twisted axis. For instance, if the enlarged ovary lies cranial to the uterus, the axis of torsion lies on the extension line of the transvaginal probe, and a perpendicular view would be difficult to achieve. In such cases, transabdominal ultrasound may be an alternative because it is best suited for obtaining a perpendicular view of the craniocaudal axis. By positioning a transabdominal ultrasound probe in the lower abdomen and creating a transverse plane, a perpendicular view of the twisted axis could be detected.

Adnexal torsion has various clinical presentations and lacks specific serum markers for its diagnosis[4]. Previously reported sonographic features, such as an enlarged ovary, ascites, follicular ring sign, and absence of vascularization on color Doppler imaging, are indirect signs of torsion and do not have a high positive predictive value. The whirlpool sign has high positive predictive value, although its sensitivity depends substantially on sonographer ability. Therefore, even in the absence of the whirlpool sign, if the clinical picture is highly suggestive of adnexal torsion, an operative approach is recommended[6]. However, if there is a chance of detecting this noninvasive high-specificity sign, its identification should be considered when adnexal torsion is suspected. Our method will familiarize gynecologists with the whirlpool sign and provide a powerful diagnostic tool for detecting adnexal torsion, leading to a prompt diagnosis and improved prognosis.

Conclusion

The whirlpool sign, if easily detected, is highly useful for diagnosing adnexal torsion. Our step-by-step method will help gynecologists and other medical professionals overcome technical obstacles in detecting this sonographic finding. Detecting the whirlpool sign is a practical technique that we hope will be widely used for diagnosing torsion.

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