Fallopian Tube Volume May Be Associated With The Detection Rate Of The Whirlpool Sign In Ovarian Torsion

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Abstract

Objective

To determine whether the volume of the engorged fallopian tube correlates with the detection rate of the whirlpool sign in cases of ovarian torsion.

Methods

The study population included 23 patients who underwent surgical treatment for ovarian torsion. All patients had undergone computed tomography (CT) scans, which were reviewed retrospectively to detect radiologic findings. The whirlpool sign and volumetric measurement were evaluated from reconstructed CT scans. The relationship between fallopian tube volume and whirlpool sign detection was statistically analyzed.

Results

The detection rate of whirlpool sign increased with the addition of reconstructed scans compared to when using only axial CT (39.1% vs. 73.9%). Increased volume of the fallopian tube was seen to be correlated with the detection rate of whirlpool sign.

Conclusion

Presence of engorged fallopian tube and reconstructed CT scans may be helpful in the diagnosis of ovarian torsion.

INTRODUCTION

Ovarian torsion is a gynecological emergency. Ovarian torsion is usually caused by complete or partial rotation of the ovarian pedicle. Failure to conduct rapid diagnosis and surgical treatment may result in loss of potential fertility in a patient [1]. Generally, if the ovary and fallopian tube are twisted together, the term adnexal torsion is more appropriate, but the focus of treatment is concentrated on the ovaries. Of course, ovary or fallopian tube torsion may occur alone [2]. Confirmation can be obtained through direct visualization during surgery, which entails observing a vascular pedicle rotated between the ovary and the uterus. Ultrasonography (US), computed tomography (CT), and magnetic resonance imaging (MRI) can be used for diagnosis. The most important pathognomonic finding is the whirlpool sign, which shows the twisted pedicular structure on radiologic images; this sign is seen in 13 to 88% of cases [3]. Moreover, on radiological examination, a normal fallopian tube is difficult to detect, but an engorged fallopian tube is easily found in cases of adnexal torsion [4,5]. In this study, we investigated whether the detection rate of the whirlpool sign was associated with fallopian tube volume in cases of ovarian torsion.

METHODS

This study was a single institutional study, that retrospectively reviewed past medical records. We obtained IRB approval. As this was a retrospective study, obtaining informed consent was deemed impossible and the need for consent was therefore waived.

Study population

This study was performed on 42 women who were admitted to Seoul Paik Hospital from January 2006 to December 2016

and diagnosed as having ovarian torsion. Patients who did not undergo abdominal pelvic CT before surgery were excluded from the study. Patients with a history of pelvic inflammatory disease or a malignant tumor were excluded from the study. Finally, 23 women were included in the study.

CT acquisition & reconstruction

All patients underwent 3-phase contrast enhanced CT. Preoperative 3D reconstructed CT images were available in 10 (43%) cases. Otherwise, we reconstructed the sagittal and coronal plane images using OsiriX (Pixmeo SARL, Switzerland), a DICOM viewer. All CT images were analyzed independently and retrospectively for the following findings: location of ovarian tumor, presence of adnexal mass, presence of a high-density ovarian tumor & fallopian tube, lack of enhancement of ovarian tumor & fallopian tube, and whirlpool sign of adnexal mass.

Volume measurement of the ovary and fallopian tube

After setting a 2D region of interest (ROI) manually for each CT image wherein an ovarian tumor and fallopian tube lesion were observed, a 3D ROI was created and volume computing was performed.

Statistical analysis

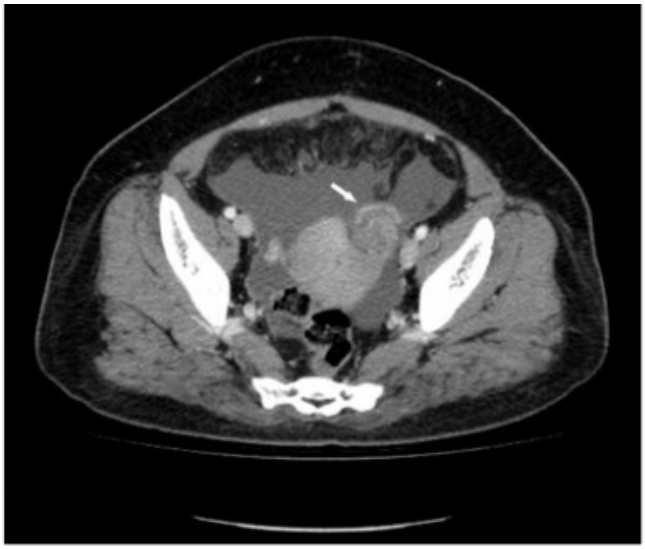
We used the ROC curve to determine the cutoff value of the fallopian tube volume. The relationship between fallopian tube volume and whirlpool sign detection was statistically analyzed using Fisher's exact test. The statistical significance was set at $p < 0.05$. The statistical analyses were performed using R studio, version 1.1.456 (R studio, Inc., Boston, MA).

RESULTS

The mean age of the patients was 37.7 ± 19.9 years. There were more lesions on the right side. MCT and serous cystadenoma were the most common pathologic lesions (Table 1). The mean white blood cell (WBC) count was 10401 ± 2737.9 / mm3, suggesting inflammation in most cases. The mean ovarian tumor volume was 587.8 ± 621.2 mm3, and the mean fallopian tube volume was 24.3 ± 16.8 mm3. Among the 23 patients, ascites was found in 15 (65.2%); additionally, precontrast high-density areas were found in 11 (47.8%) cases in the ovarian tumors and 15 (65.2%) cases in the fallopian tubes. The lack of enhancement was found in 12 (52.2%) cases in the ovarian tumors and 15 (65.2%) in the fallopian tubes. Cystic wall thickening of ovarian tumors was found in 14 patients (60.9%). The whirlpool sign was found in 9 patients (39.1%) on axial CT scan, and in 8 reconstructed images (sagittal, coronal), making a total of 17 patients (73.9%) (Table 2). The cutoff value of the fallopian tube volume calculated using the ROC curve was 12.77 mm3. A significant positive correlation was found between the fallopian tube volume and detection rate of the whirlpool sign ($p = 0.021$) (Table 3).

Figure 1

(a) Whirlpool sign of ovarian torsion (arrow) (b) Ovarian tumor and engorged fallopian tube (arrow).



a.

b.

Table 1

Baseline characteristics

		All patients (n=23)
Age		37.7 ± 19.9
Ovarian tumor volume (mm³)		587.8 ± 621.2
Fallopian tube volume (mm³)		24.3 ± 16.8
Affected side	Left	8
	Right	15
Pathology	Mucinous	4
	Mature cystic Teratoma	7
	Serous	7
	Hemorrhagic cyst	3
	Massive ovarian edema	2
WBC (/mm³)		10401 ± 2737.9

Table 2

CT findings of ovarian torsion

		All patients (n=23)	%
Ascites		15	65.2
Ovary	Precontrast high density area	11	47.8
	Lack of enhancement	12	52.2
	Cystic wall thickening	14	60.9
Fallopian tube	Precontrast high density area	15	65.2
	Lack of enhancement	15	65.2
Whirlpool sign	Axial CT	9	39.1
	Coronal CT	5	21.7
	Sagittal CT	1	4.3
	Axial + Coronal CT	0	0.0
	Axial + Sagittal CT	0	0.0
	Coronal + Sagittal CT	2	8.7
	Total	17	73.9

Table 3

Detection of whirlpool sign on the basis of fallopian tube volume

		Fallopian tube volume		
		≤ 12.77mm³	> 12.77mm³	p-value
Whirlpool sign	Yes	2 (8.7%)	15 (65.2%)	0.021
	No	4 (17.4%)	2 (8.7%)	

DISCUSSION

When ovarian torsion occurs, venous and arterial flow is blocked, congestion of twisted pedicle and edema occurs, finally ischemia develops [4]. As this process progresses, imaging findings appear, which we can find on US, CT, and MRI. When congestion, edema, and hemorrhage occur, ovarian enlargement, peripheralization of the follicles, fallopian tube thickening, and cyst wall thickening are visualized [6,7]. When the position of the uterus and ovary changes, ovarian mallocation, beaking of the margin of the ovary, and uterus deviation are visualized [8].

As mentioned, the whirlpool sign is a pathognomonic finding that indicates a twisted ovarian pedicle.

These findings will appear as the disease progresses over time, but the exact sequence of their appearance is not yet known. In particular, fallopian tube engorgement is a finding that appears over time; moreover, each case presents a different volume, so we hypothesized that this would be closely related to the detection of the whirlpool sign. The cutoff of the calculated fallopian tube volume was 12.77 mm3 and the detection rate of the whirlpool sign was statistically different on this basis. The larger the fallopian tube volume, the easier it will be to find the whirlpool sign. However, this may also be due to the resolution limitations of current imaging equipment.

As previously studied, the detection rate was higher when reconstructed sagittal CT and coronal CT views were added, rather than axial CT alone [3].

The image quality of the post processing image using OsiriX was low, but the whirlpool sign was observed when the fallopian tube volume was large.

However, the planes in which the whirlpool sign appears are not the same, which seems to be related to the direction of the long axis of the adnexal pedicle. In particular, when the size of the tumor is large, the ovarian tumor is located outside the pelvic cavity. In this case, a whirlpool sign is found on the coronal CT of the pedicle.

This study is a retrospective analysis and pilot study, and a more prospective study is needed to examine the temporal and spatial relationships mentioned above.

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