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Ovarian torsion: Case–control study comparing the sensitivity and specificity of ultrasonography and computed tomography for diagnosis in the emergency department

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ABSTRACT

Objective: Evaluate the sensitivity and specificity of pelvic ultrasound (US) and abdominopelvic computed tomography (CT) for the identification of ovarian torsion in women presenting to the emergency department with acute lower abdominal or pelvic pain.

Materials and methods: This is a retrospective study of 20 cases of ovarian torsion and 20 control patients, all of whom had both US and CT performed in the emergency department. Two radiologists who were blinded to clinical data interpreted all studies as (1) demonstrating an abnormal ovary or not, and (2) suggestive of torsion or not. Sensitivity, specificity and interobserver variation were calculated for each imaging modality.

Results: Pelvic US was interpreted as demonstrating an abnormal ovary in 90.0% of ovarian torsion cases by reader 1, and in 100.0% by reader 2, whereas CT was interpreted as revealing an abnormal ovary in 100.0% of torsion cases by both readers. Pelvic US for ovarian torsion was 80.0% sensitive (95% CI, 58.4–91.9%) and 95.0% specific (95% CI, 76.4–99.1%) for reader 1, while 80.0% sensitive (95% CI, 58.4–91.9%) and 85.0% specific (95% CI, 64.0–95.0%) for reader 2. Interobserver agreement for pelvic US was fair (Kappa = 0.60). Abdominopelvic CT for ovarian torsion was 100.0% sensitive (95% CI, 83.9–100.0%) and 85.0% specific (95% CI, 64.0–94.5%) for reader 1, while 90.0% sensitive (95% CI, 69.9–97.2%) and 90.0% specific (95% CI, 69.9–97.2%) for reader 2. Interobserver agreement was excellent (Kappa = 0.85).

Conclusion: The diagnostic performance of CT is not shown to be significantly different from that of US in identifying ovarian torsion in this study. These results suggest that when CT demonstrates findings of ovarian torsion, the performance of another imaging exam (i.e. US) that delays therapy is unlikely to improve preoperative diagnostic yield.

1. Introduction

Ovarian torsion is a rare but serious cause of acute abdominal and pelvic pain in women, accounting for 2.7% of gynecologic emergencies [1]. Associated clinical signs and symptoms of torsion are nonspecific, overlapping an extensive range of gynecologic, genitourinary, and gastrointestinal etiologies of pain [2–7]. Therefore, the workup for women presenting to the emergency department (ED) with acute lower abdominal or pelvic pain often involves diagnostic imaging with either ultrasound (US) or computed tomography (CT) [4,6,8].

Pelvic US has traditionally been considered the optimal imaging modality for diagnosing ovarian torsion due to its ability to directly evaluate both ovarian anatomy and perfusion, as well as its low cost and lack of radiation. However, US can be limited by inter-operator variability, limited nighttime availability in smaller community hospitals, and limited utility for diagnosing non-gynecologic etiologies of pain. Further, the sensitivity of pelvic US for torsion is suboptimal, with false negative rates as high as 45–61% when Doppler evaluation is relied upon for evaluating blood flow [4,6,7].

Abdominopelvic CT frequently precedes pelvic US in the workup of women presenting with acute undifferentiated lower abdominal or pelvic pain [4,8–10]. While findings of ovarian torsion have been

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described on CT [4,5,10–12], numerous studies and review articles maintain that pelvic US is superior for this indication [5,10,13–15]. Nevertheless, some authors have proposed that if CT demonstrates normal morphology of the ovaries then torsion can be excluded, thus obviating the need for further imaging work-up or surgical exploration [8]. These authors still recommend that pelvic US be performed in indeterminate cases, or when the adnexae are abnormal and there is persistent clinical concern for ovarian torsion.

In light of the imperfect diagnostic performance of pelvic US, and given the suggestion that CT can exclude torsion, the primary aim of this study was to compare the diagnostic performance of pelvic US and CT in women presenting to the ED with acute lower abdominal or pelvic pain related to ovarian torsion.

2. Materials and methods

This multicenter, retrospective, case–control study was approved by our institutional review board, and the need for informed consent was waived. It was conducted in accordance with the Health Insurance Portability and Accountability Act. Subjects were identified through query of the electronic medical record (EMR) at two urban hospitals from 3/1/2005 through 7/31/2010. The start date corresponds to the introduction of electronic medical records. The first site is a large urban academic level I trauma center with an annual ED census of approximately 100,000 patient visits. The second is an academic hospital specializing in obstetric and gynecologic care, with an annual ED census of 29,000 patient visits.

2.1. Study population

Potential subjects included all adult females (age 18–100 years) with acute lower abdominal or pelvic pain who were evaluated in the ED and underwent both pelvic US and abdominopelvic CT within 48 h of presentation. Ninety patients with surgical and/or pathologic reports confirming ovarian torsion were initially identified. Twenty patients had pelvic US and abdominopelvic CT studies available for review, and these comprised the cohort of ovarian torsion cases. In all cases, surgery was performed within 48 h of presentation. Twenty randomly selected, age-matched control patients were identified who similarly underwent both US and CT within 48 h of presentation to the ED for lower abdominal or pelvic pain, but who were not diagnosed with ovarian torsion.

The electronic medical record was reviewed for each subject, and the following data were recorded: (1) patient age, (2) location of abdominal or pelvic pain, (3) white blood cell count, (4) presence or absence of nausea and vomiting, (5) surgical and pathologic findings (when applicable), (6) discharge diagnosis, (7) length of available follow-up documented within the EMR, and (8) the incidence of delayed adnexal torsion or other abdominopelvic surgery within the control population during available follow-up within the EMR.

2.2. Image acquisition

CT examinations were obtained on one of the multi-detector scanners: GE BrightSpeed Elite 16 slice (GE Corporation, Waukesha, Wisconsin), GE Lightspeed VCT 64 (GE Corporation, Waukesha, Wisconsin), Siemens Sensation 16 (Siemens Corporation, Munich, Germany). Patients are not routinely given oral contrast in either ED. Of the cases, 16/20 (80.0%) had CT performed with intravenous (IV) contrast, while 4 (20%) had no IV contrast. Nineteen (95.0%) of the cases had coronal reformat images created from the axial dataset, while one had axial images only. Of the controls, 19/20 (95.0%) underwent CT with IV contrast, and only 1 (5.0%) had no IV contrast. Fifteen (75.0%) of the controls had coronal reformat images available, while 5 (25.0%) had only axial images.

Ultrasound examinations were obtained on one of two high resolution ultrasound units (Philips IU22 [Philips Corporation, Amsterdam, The Netherlands] or GE Logiq 9 [GE Corporation, Waukesha, Wisconsin]). 15/20 (75.%) of the cases had Doppler waveform interrogation of ovarian blood flow included in their US exam. 18/20 (90.0%) of the controls had Doppler waveform interrogation included.

2.3. Image analysis

Two radiologists independently reviewed each US and CT study. These radiologists were aware that the purpose of the study was to evaluate imaging findings of ovarian torsion in patients with lower abdominal or pelvic pain. However, they were blinded to all clinical data. All studies were de-identified and transferred onto separate blank CDs, which were then presented to each radiologist in random order. Therefore, the radiologists were also blinded as to which US corresponded to which CT for individual patients. One radiologist was an attending with fellowship specialization in women's imaging and 3 years of additional experience (A.P.L.). The other was a third year radiology resident (D.W.S.).

Prior to the study, the radiologists met to standardize their approach to interpretation of ovarian torsion on US and CT using these previously described signs of torsion: (1) enlarged ovary with single greatest measurement over 5 cm, (2) estimated ovarian volume greater than 15 cm^3 (using the standard formula for a prolate ellipse), with or without evidence of underlying ovarian mass, (3) presence of a discrete solid or cystic ovarian mass, (4) ovarian stromal heterogeneity suggestive of edema or hemorrhage, (5) presence of multiple peripheral follicles in a unilaterally enlarged ovary, (6) displacement of the uterus toward the side of abnormal ovary, (7) presence of a twisted vascular pedicle, or "whirlpool sign", (8) presence of free fluid in the pelvis, and (9) for CT only, the presence of inflammatory fatty stranding adjacent to the abnormal ovary (Fig. 1) [4,5,10,16,17]. Color and spectral Doppler waveform interrogation of ovarian vascular flow was reviewed as part of the pelvic US exam when available, and was considered suspicious for torsion when either arterial or venous flow was absent. Recorded data were entered into a spreadsheet with categorical (yes or no) responses to the following questions: (1) Are the ovaries normal? (2) Does study suggest torsion? The first question was intended to as an initial step in evaluation of the ovaries, as demonstration of normal ovaries makes torsion extremely unlikely. The second question was intended to allow the radiologists to differentiate between abnormal ovaries that were suspicious for torsion from those that might contain a large hemorrhagic cyst or neoplasm, but which demonstrated no imaging signs to suggest superimposed torsion. Finally, three plane, orthogonal size measurements for each ovary were recorded by each radiologist.

2.4. Data analysis

Descriptive continuous variables were represented as means and standard deviation. Comparison of clinical symptoms on presentation between cases and controls was compared using Fisher's exact test. Statistical significance was defined as $\alpha < 0.05$.

Sensitivity and specificity were calculated for each radiologist's interpretations of US (including Doppler studies when available) and CT studies for the diagnosis of ovarian torsion. Interobserver agreement between radiologists was assessed using Fleiss's kappa Statistic. The guidelines of Landis and Koch were followed for the interpretation of these values: 0.00–0.20 indicating slight agreement; 0.21–0.40, fair agreement; 0.41–0.60, moderate agreement; 0.61–0.80, substantial agreement; 0.81–1.00, almost perfect

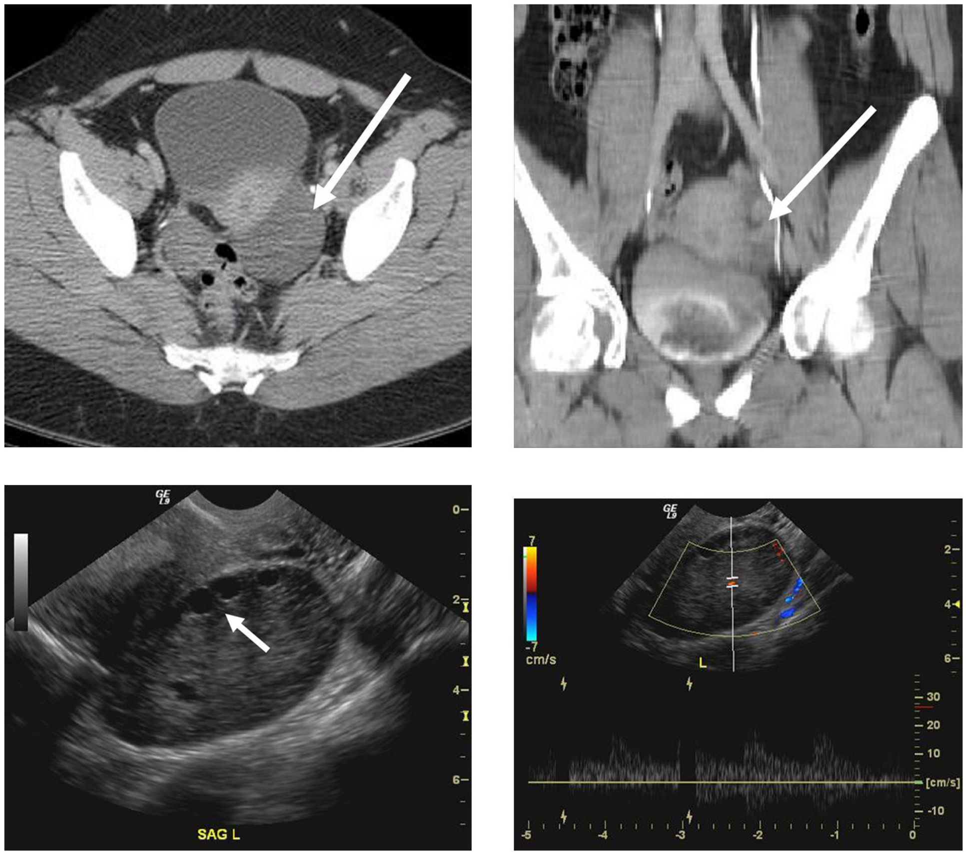

Fig. 1. 41 year old female presented with 5 days of intermittent but progressive left lower quadrant pain. A torsed left ovary without underlying mass was identified at surgery and detorsed. Axial contrast enhanced CT demonstrated asymmetric left ovarian enlargement (a), while a coronal reformat image demonstrates the twisted vascular pedicle (arrow) (b). Transvaginal grayscale ultrasound demonstrates an enlarged ovary with multiple small, peripheral follicles (c), and spectral Doppler interrogation reveals arterial waveforms centrally within the torsed ovary (d).

agreement. Stats 10.0 software (StataCorp LP, College Station, Texas) was used to analyze the data.

3. Results

Patient clinical characteristics are presented in Table 1. The cases and controls were age-matched, with mean age of 40.1 years (range, 18.0–59.0). The distribution of pain was similar between cohorts, as were rates of fever, leukocytosis, and nausea. The only statistically significant difference was the presence of vomiting in patients with ovarian torsion, which nevertheless is unlikely to be of clinical significance in differentiating torsion from other causes of acute pain in women. In 75.0% (15/20) of cases and 65.0% (13/20) of controls, CT was performed prior to US.

All surgeries for ovarian torsion cases in this study were performed within 48 h of presentation. The mean volume of torsed ovaries was 332.7 mL (range, 40.8–1612.4 mL) compared to 12.3 mL (range, 2.9–57.0 mL) in non-torsed ovaries. Among torsion cases, 11 (55.0%) involved the right ovary, and 9 (45.0%) involved the left. In 13 cases (65.0%) an underlying ovarian mass was identified by surgical pathology: 5 mature cystic teratomas, 3 serous cystadenomas, 2 mucinous cystadenomas, 2 fibromas, and 1 cystadenofibroma. In 7 cases (35.0%) no discrete underlying mass was identified within the torsed ovary. Two of these ovaries were detorsed and pexed during laparoscopy, while 6 were removed due to necrosis.

Diagnoses for the control patients were established according to available data in the electronic medical record, including discharge summaries from the ED, as well as subsequent clinical notes. Three patients had no available clinical follow-up after discharge from the ED. Two of these three patients had normal US and CT exams, and both were diagnosed with gastroenteritis in their discharge paperwork. One of these patients was diagnosed with a 3 cm simple cyst in her left ovary, which was reported in her discharge note as a likely source of pain. This cyst was described in the initial US and CT reports, as well as by both radiologists during their independent review for the patient's imaging studies; however, there were no other findings to suggest ovarian torsion. The average length of follow-up for the other 17 control patients was 968 days (range, 63–2467 days). Ten of these controls were described as having abnormal adnexa on either US or CT by at least one radiologist. Only two control patients underwent surgery for ovarian pathology during the course of the study. One was diagnosed with an ovarian serous cystadenoma, and the other with a ruptured hemorrhagic cyst. One control was diagnosed with a tubo-ovarian abscess and treated with antibiotics. Two were diagnosed with hydrosalpinx, one of which received treatment for pelvic inflammatory disease. Three controls were diagnosed with hemorrhagic ovarian cysts.

3.1. Independent blinded review of CT and US studies

Blinded, independent, retrospective review of all pelvic US and abdominopelvic CT studies was performed in random order by each radiologist. Full results are presented in Tables 2 and 3.

Pelvic US demonstrated an abnormal ovary in 90.0% of torsion cases for reader 1, and 100.0% for reader 2. Ultrasound interpretation by reader 1 had a sensitivity of 80.0% and specificity of 95.0% for ovarian torsion while for reader 2, US had a sensitivity of 80.0% and specificity of 85.0%. Interobserver agreement for grayscale US was

Table 1
Clinical characteristics of the 20 cases with ovarian torsion and 20 controls.

	20 cases	20 controls	*P* value
Lower abdominal/pelvic pain	20(100.0%)	(100.0%)	1.000
Right lower quadrant	7(35.0%)	(50.0%)	0.523
Left lower quadrant	(35.0%)	(40.0%)	1.000
Nonfocal	(30.0%)	(10.0%)	0.235
Fever	(10.0%)	(20.0%)	0.661
Leukocytosis (WBC count > 12)	(20.0%)	(20.0%)	1.000
Nausea	(70.0%)	(35.0%)	0.056
Vomiting	(65.0%)	(25.0%)	0.025*

Table 2
Image analysis: diagnostic performance of CT, grayscale US, and Doppler US at (1) characterizing the adnexa as abnormal in patients with torsion, and (2) demonstrating suspicious findings for adnexal torsion.

	Radiologist 1	Radiologist 2	Both
Pelvic US: Abnormal Ovary? (Abnormal/Total)	90.0% (18/20)	100.0% (20/20)	0.67
95% confidence interval	(69.9–97.2%)	(83.9–100.0%)	
CT: Abnormal ovary? (Abnormal/Total)	100.0% (20/20)	100.0% (20/20)	0.75
95% confidence interval	(83.9–100.0%)	(83.9–100.0%)	

fair (Kappa = 0.60). Fifteen ovarian torsion cases and 18 controls had color and spectral Doppler waveform interrogation of the ovaries performed as part of their pelvic US studies. While the Doppler findings were interpreted in conjunction with review of grayscale US of ovarian morphology, the sensitivity and specificity of absent arterial or venous flow by Doppler examination for identifying ovarian torsion was 60.0% and 88.9% respectively for reader 1, and 60.0% and 94.4% for reader 2. Interobserver agreement was fair (Kappa = 0.51).

Each radiologist interpreted 4 US studies as falsely negative; however, 3 of 4 were different patients. The false negative shared by both radiologists proved to be a serous cystadenoma which both readers described as a likely ovarian neoplasm, but neither suspected torsion. Reader 1's other false negative interpretations were based on attributing ovarian enlargement to multiple ovarian cysts rather than torsion. At surgery, these cases showed torsion with cysts and hemorrhagic necrosis but no underlying mass. Reader 2's false negative interpretations were due to attributing ovarian enlargement to underlying masses, but without suspicion of torsion. At surgery, these cases showed torsion with an ovarian mass (serous cystadenoma, mucinous cystadenoma, and mature cystic teratoma).

The readers had 1 false positive case in common. This patient had a complex left adnexal mass with cystic components, which was clinically treated as a tubo-ovarian abscess. Reader 2 had two additional US false positives, one of which had a hemorrhagic cyst and the other had and an ill-defined left adnexal mass that was not identified by reader1 nor on the initial report. This was never definitively characterized by follow-up imaging or surgery.

The CT studies of all torsion cases were interpreted as demonstrating an abnormal ovary by both readers. Conversely, a CT demonstrating normal ovaries effectively excluded ovarian torsion as a consideration for both readers. The sensitivity and specificity of CT for ovarian torsion was 100.0% and 85.0% respectively for reader 1, and 90.0% and 90.0% for reader 2. Interobserver agreement was excellent (Kappa = 0.85).

Reader 1 had no CT false negatives. Reader 2 had 2 CT false negatives, one of which had an enlarged ovary thought to be due to physiologic cysts. The other involved an underlying serous cystadenoma which was described as likely neoplastic, however torsion was not suspected. Subsequent image review by both readers demonstrated a subtle twisting of the vascular pedicle, which was not clearly seen on any single image, but could be appreciated during active scrolling through multiple slices at the level of the abnormal ovary. There were 2 CT false positives shared by both readers. The first was a patient with an ovarian serous cystadenoma; pelvic US did not exclude torsion for either reader in this case. The second was a patient with a ruptured corpus luteum cyst; pelvic US was interpreted as suspicious for torsion with hemorrhage by reader 1, while reader 2 described a likely ruptured cyst without suspicion of torsion. Reader 1 had a third false positive CT, involving an enlarged ovary by volume (19 mL) but not by single greatest diameter (3.4 cm).

4. Discussion

Ovarian torsion is a rare but serious gynecologic emergency. Urgent surgical detorsion successfully preserves ovarian function in over 90% of cases [18], whereas delayed diagnosis may lead to necrosis, rupture, infection, peritonitis, and possibly death [2,12,15,18,19]. Currently, laparoscopic surgical evaluation of the ovaries remains the gold standard for diagnosis because diagnostic imaging has been considered unreliable [1,3,4,6,10,20]. To our

Table 3
Sensitivity and specificity of US and CT for diagnosing ovarian torsion in 20 cases with ovarian torsion and 20 controls.

	Radiologist 1		Radiologist 2		Both
	Sensitivity	Specificity	Sensitivity	Specificity	Kappa
Pelvic US: Suggestive of torsion? (Suspected torsion/total)	80.0% (16/20)	95.0% (19/20)	80.0% (16/20)	85.0% (17/20)	0.60
95% confidence interval	(58.4–91.9%)	(76.4–99.1%)	(58.4–91.9%)	(64.0–95.0%)	
Doppler US: Absent ovarian arterial or venous flow? (Absent flow/total with Doppler available)	60.0% (9/15)	88.9% (16/18)	60.0% (9/15)	94.4% (17/18)	0.51
95% confidence interval	(35.8–80.2%)	(67.2–96.9%)	(35.8–80.2%)	(74.2–99.0%)	
CT: suggestive of torsion? (Suspected torsion/total)	100.0% (20/20)	85.0% (17/20)	90.0% (18/20)	90.0% (18/20)	0.85
95% confidence interval	(83.9–100.0%)	(64.0–94.5%)	(69.9–97.2%)	(69.9–97.2%)	

knowledge, this is the first case-controlled study to directly compare the diagnostic performance of pelvic US and CT for identifying ovarian torsion in women presenting with acute lower abdominal or pelvic pain.

Pelvic US is generally described as the preferred imaging modality for evaluating ovarian torsion. However, the most consistently reported grayscale US abnormality is a nonspecific and variably described, including a unilaterally enlarged ovary, commonly with an underlying cystic or solid mass [3,4,6,10,12,16,21]. Lee et al. found ovarian enlargement in 100% of 32 torsion cases, with single largest diameter ranging from 5 cm to 33 cm [21]. Houry et al. describe a mean ovarian size of 9.5 cm in a series of 87 torsion cases, with 89% measuring greater than 5 cm [3]. Chiou et al. describe an underlying mass in 65% of 34 adnexal torsion cases, and a large ovary without underlying mass in 32% of cases. They report a mean ovarian volume of 112 mL, with range of 26–410 mL [10].

Other previously described US findings of torsion are less reproducible. Graif described the "characteristic" grayscale appearance of a torsed ovary as unilaterally enlarged with multiple peripheral follicles [22]. In a recent review article, Chang et al. state that this characteristic finding of a unilaterally enlarged ovary with peripheral follicles can be seen in up to 72% of ovarian torsion cases [5]. However, Rouseau et al. reported this appearance in just 45% of 11 torsion cases [23], and Chiou et al. reported the finding in only 12% of 18 torsion cases [10].

Lee et al. described a twisted vascular pedicle sign on pelvic US with reported sensitivity of 88% and specificity of 88% [21]. This study included a review of US imaging performed preoperatively, with particular attention to this previously described sign. Unfortunately their results have yet to be replicated by other groups, which may be due to the operator dependence of pelvic US.

Clinically, radiologists may rely (or over rely) on detecting abnormal color and spectral Doppler waveforms for diagnosing ovarian torsion. While Doppler can be relatively specific for torsion, it remains disappointingly insensitive. Bar-On et al. recently reported abnormal ovarian flow on Doppler US in only 43.8% of ovarian torsion cases, although the specificity was 91.7% [20]. Prior reports have similarly demonstrated that Doppler findings can be normal in 45–61% of ovarian torsion cases [2,4,7,10] (Fig. 1).

In cases of suspected torsion, US is typically the first-line imaging modality. However, given that the signs and symptoms of torsion or non-specific, CT is often performed, particularly when other etiologies for pain are suspected. As with pelvic US, the most reproducible CT finding of ovarian torsion is an enlarged ovary, often with an underlying solid or cystic mass. Hiller et al. describe adnexal enlargement in all 32 patients with torsion in their series [4]. Rha et al. found enlarged ovaries in all 25 of their patients with torsion [12]. There is some evidence that CT may even be more sensitive than ultrasound for detecting underlying adnexal masses. For example, Chiou et al. described a series of 58 patients with adnexal torsion in which an adnexal mass was identified in 13/15 (87%) cases that had preoperative CT, but in only 22/34 (65%) cases that had a pelvic US [10] (Fig. 1).

Other described CT signs of torsion include ovarian stromal heterogeneity or edema, numerous small peripheral follicles, inflammatory stranding of the para-ovarian fat, a twisted vascular pedicle, pelvic free fluid, and deviation of the uterus toward the side of torsion [4,10,12]. Using these signs, Chiou et al. report a correct preoperative diagnosis of torsion was made in 5/15 (33%) CT studies, compared to 22/34 (65%) pelvic US studies performed on patients with adnexal torsion [10]. Hiller et al. found only 14/35 (40%) patients were diagnosed with torsion pre-operatively by imaging. In their review, CT correctly diagnosed torsion in 12/35 (34%) patients, while 9/35 (26%) patients were diagnosed by pelvic US. Interestingly, the CT and US reports agreed about suspicion for torsion in only 50% of cases [4].

In our study, we sought to compare the diagnostic performance of pelvic US and abdominopelvic CT in a blinded, case-controlled setting. Similar to other studies, we did note ovarian enlargement in all 20 cases of torsion, with mean volume of 332.7 mL (range, 40.8–1612.4 mL). In our study, pelvic US was 80% sensitive, and 85–95% specific for ovarian torsion. Spectral Doppler interrogation alone was 60% sensitive, and 89–94% specific for torsion, with fair to moderate interobserver agreement. Thus, pelvic US is highly specific for torsion, but is not adequate to exclude the diagnosis if the ovary is enlarged.

Abdominopelvic CT demonstrated a sensitivity of 90–100% and specificity of 85–90%. Importantly, a CT demonstrating normal ovaries effectively excluded ovarian torsion for both readers. This supports the previous assertion by Moore et al. that a negative CT is adequate to exclude torsion as an etiology of lower abdominal or pelvic pain in women [8] and is particularly relevant given the extensive and growing utilization of CT in emergency departments. For example, CT was performed prior to pelvic US in 28/40 (70%) of our patients.

While a CT demonstrating bilateral normal ovaries may effectively exclude torsion as an etiology for acute pain, the presence of an abnormal ovary on CT must be considered suspicious for torsion in the acute setting. Interestingly, there were more false negative pelvic US studies in our series than false negative CT studies: 3 for reader 1, and 3 different cases for reader 2. At the same time, each radiologist interpreted several of the corresponding CT studies as suspicious for torsion: 3 of 3 for reader 1, and 2 of 3 for reader 2. In this small series, these results contradict the common thinking that pelvic US is superior to CT for evaluating ovaries in the acute setting.

Of note, however, our retrospective review of pelvic US studies is inherently limited by the inability of the interpreting radiologists to directly perform real-time scanning. Additionally, while our control population was matched for age and symptomatology, the incidence of adnexal pathology in the controls (as defined by imaging and available clinical follow-up in the EMR) was low, including 10/20 (50%) described as having any adnexal abnormality on either US or CT, and only 2/20 (10%) with reported surgical intervention to provide definitive pathology. Given that the most common imaging finding in cases of torsion is an abnormally enlarged ovary, further study with a control group consisting of patients with an enlarged ovary that is surgically confirmed to be non-torsed would be interesting. Such a control population would be expected to decrease the specificity of both US and CT imaging for torsion, although sensitivity would likely remain high, allowing torsion to be excluded in the acute setting. In addition, given the relative rarity of ovarian torsion, a control group with larger numbers of controls would more closely mimic actual clinical practice.

In conclusion, the sensitivity and specificity of CT are not shown to be significantly different from that of US in diagnosing ovarian torsion. Radiologist familiarity with the findings of ovarian torsion on CT may expedite accurate diagnosis and urgent surgical intervention. Conversely, appreciation of the high sensitivity of CT for identifying an abnormal ovary in the setting of torsion may allow clinicians to avoid unnecessary additional imaging with pelvic US when a CT demonstrates normal bilateral ovaries. This is increasingly relevant as CT is often the first imaging modality performed for acute undifferentiated lower abdominal or pelvic pain in women.

Conflict of interest statement

None of the authors has any conflict of interest.

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