Ovarian and Adnexal Torsion

Spectrum of Sonographic Findings With Pathologic Correlation

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Objective. To determine the spectrum of sonographic findings on gray scale and color Doppler sonography in a series of pathologically proven cases of ovarian and adnexal torsion. ***Methods.*** The study population included 15 patients with surgical confirmation of ovarian or adnexal torsion, or both, who underwent sonographic examination before surgery. All sonograms were reviewed retrospectively. ***Results.*** Gray scale abnormalities included the following: complex masses in 11 (73%) of 15 patients, cystic masses in 3 (20%), and a solid mass in 1 (7%). Cul-de-sac fluid was present in 13 (87%) of 15 patients. Adnexal neoplasms were present in 4 (27%) of 15 (1 granulosa cell tumor and 3 dermoid cysts) on pathologic examination. Doppler findings were abnormal in 14 (93%) of 15 patients and normal in 1 (7%). Abnormal Doppler findings included no arterial and no venous flow in 6 (40%) of 15, decreased venous flow with no arterial flow in 5 (33%), decreased venous flow and decreased arterial flow in 2 (13%), and decreased arterial flow with no venous flow in 1 (7%). Small amounts of cul-de-sac fluid were present in 13 (87%) of 15 patients. ***Conclusions.*** The diagnosis of ovarian and adnexal torsion remains challenging. It cannot be based solely on the absence or presence of flow on color Doppler sonography, because the presence of arterial or venous flow does not exclude the diagnosis of adnexal torsion. Comparison with the morphologic appearance and flow patterns of the contralateral ovary will aid in diagnosis. ***Key words:*** adnexal torsion; color Doppler sonography; ovarian volume.

Abbreviations
CDS, color Doppler sonography; TV-CDS, transvaginal color Doppler sonography

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Adnexal torsion is reported to be the fifth most common gynecologic emergency condition encountered, with a prevalence of 2.7%.[1] Prompt diagnosis and surgical restoration of blood flow may avoid irreversible adnexal damage. However, the diagnosis of adnexal torsion poses a difficult challenge, because the clinical symptoms are often misleading. Sonography with color Doppler flow imaging is an excellent imaging technique, which offers correlation between morphologic features and physiologic and pathophysiologic blood flow patterns. It has been shown to be of value in the evaluation of patients with acute pelvic pain. The purpose of this study was to determine the range of gray scale and color Doppler sonographic findings of ovarian or adnexal torsion, or both, in a consecutive series of 15 pathologically proven cases of torsion seen at our institution.

Materials and Methods

A computer search of the pathology files of patients admitted to our institution between 1998 and 2000 revealed 44 patients with a pathologic diagnosis of adnexal torsion. In 15 (34%) of 44 patients, sonography was performed before surgery, including gray scale sonography and color Doppler sonography (CDS). These patients constituted our study population. Excluded from this study were cases diagnosed clinically as ovarian torsion, which were not treated surgically, and cases in which incomplete or no sonographic examinations were performed.

Sonography was performed transabdominally as well as endovaginally using a variety of commercially available high-frequency curved array transducers and endocavitary probes in all patients with the exception of those who were virginal; these patients were examined transabdominally only. Color Doppler flow parameters were optimized (spatial peak temporal average intensity, ≈40–92 MW/cm^2; wall filter, 50–100 Hz; pulse repetition frequencies, between 2 and 10 kHz; velocity ranges lowered to 4 cm/s; and Doppler angle of insonation, <60°).

We retrospectively reviewed the sonograms in our 15 patients, assessing the following criteria: the size and laterality of the involved ovary and adnexa, the presence of a twisted vascular pedicle, the presence of cul-de-sac fluid, the presence or absence of an underlying mass, and gray scale characteristics (cystic, solid, or complex). The presence, decrease, or absence of arterial or venous flow on color and spectral Doppler sonography when compared with the contralateral ovary was also assessed. Ovarian volumes were measured by applying the formula for a prolate ellipse (length × width × height) × 0.523.[2]

Results

The average age of our patients was 31 years (range, 19–51 years). Pregnancy was associated in 3 (20%) of the 15 patients. Right-side involvement was present in 9 patients (60%), and left-side involvement was present in 6 (40%). Ovarian and tubal torsion together was observed in 10 patients (67%).

The most common sonographic pattern on gray scale sonography was that of a complex mass, which was observed in 11 (73%) of the 15 patients. A solid mass was seen in 1 patient (7%), and a cystic mass was seen in 3 patients (20%). A twisted vascular pedicle was present sonographically as a rounded mass adjacent to the ovary and was seen in 2 (13%) of the 15 patients (Fig. 1). The volume of the enlarged ovaries ranged from 38 to 4308 cm^3. Small amounts of cul-de-sac fluid were observed in 13 (87%) of the 15 patients.

Necrotic adnexa with no underlying pathologic finding were present in 6 (40%) of the 15 patients (Fig. 2). Cystic lesions were present in 5 (33%) of 15; these included 2 hemorrhagic corpus luteum cysts, 1 serous cyst (Fig. 3), 1 mucinous cyst, and 1 undifferentiated cyst on pathologic examination. Four patients (27%) had an underlying neoplasm as the cause of their torsion. The most common neoplasm that caused torsion was a dermoid cyst in 3 (20%) of the 15 patients (Fig. 1). A summary of the pathologic results is given in Table 1. Of considerable interest was the fact that only 1 patient had an underlying malignant ovarian neoplasm. The patient was a 16-year-old girl with a pathologic diagnosis of granulosa cell tumor and ovarian torsion. On sonography, the involved ovary was enlarged. The volume of the adnexal mass measured 4308 cm^3. This was the largest ovarian mass in our series. Color Doppler flow findings showed decreased venous flow and absent arterial flow (Fig. 4).

Color Doppler sonographic findings showed abnormal flow in 14 (93%) of the 15 patients. One patient had intermittent torsion. During pain episodes, no arterial or venous flow was seen. With pain relief, normal flow was observed. The degree of flow was assessed in a qualitative fashion as normal, decreased, or absent when compared with the contralateral unaffected ovary. Quantification of flow with peak systolic velocities or centimeters per second was not possible in all cases because of the retrospective nature of this study. Identification of flow as arterial or venous was achieved with spectral Doppler waveforms. Six patients (40%) had absent arterial and venous flow (Fig. 2), and 5 (33%) had decreased venous flow with absent arterial flow. Two patients (13%) had decreased venous flow as well as decreased arterial flow (Fig. 1). One patient (7%) had decreased arterial flow with absent venous flow. Normal arterial and venous flow was observed in 1 patient (7%). Table 2 summarizes the CDS findings.

Discussion

Adnexal torsion is caused by complete or partial rotation of the ovarian pedicle on its long axis.[3] Clinical findings have been described, including severe pelvic pain, anorexia, nausea, and vomiting. The pain associated with adnexal torsion is usually intense and localized to either adnexal region. It may be intermittent. This can be attributed to intermittent episodes of incomplete torsion. We encountered 1 patient with intermittent torsion in our series. During pain episodes no flow could be detected, but with pain relief a normal Doppler flow pattern was seen.

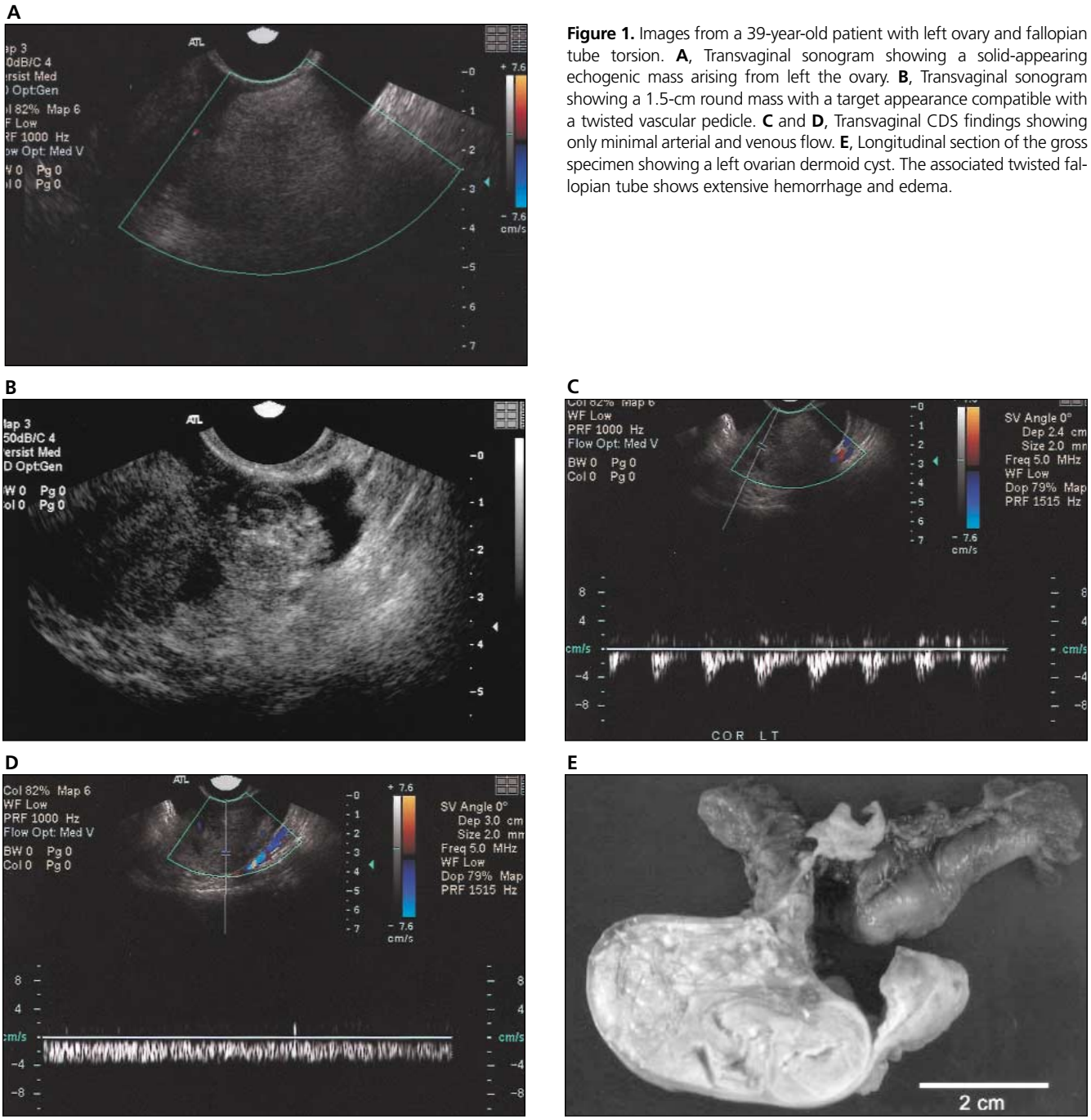
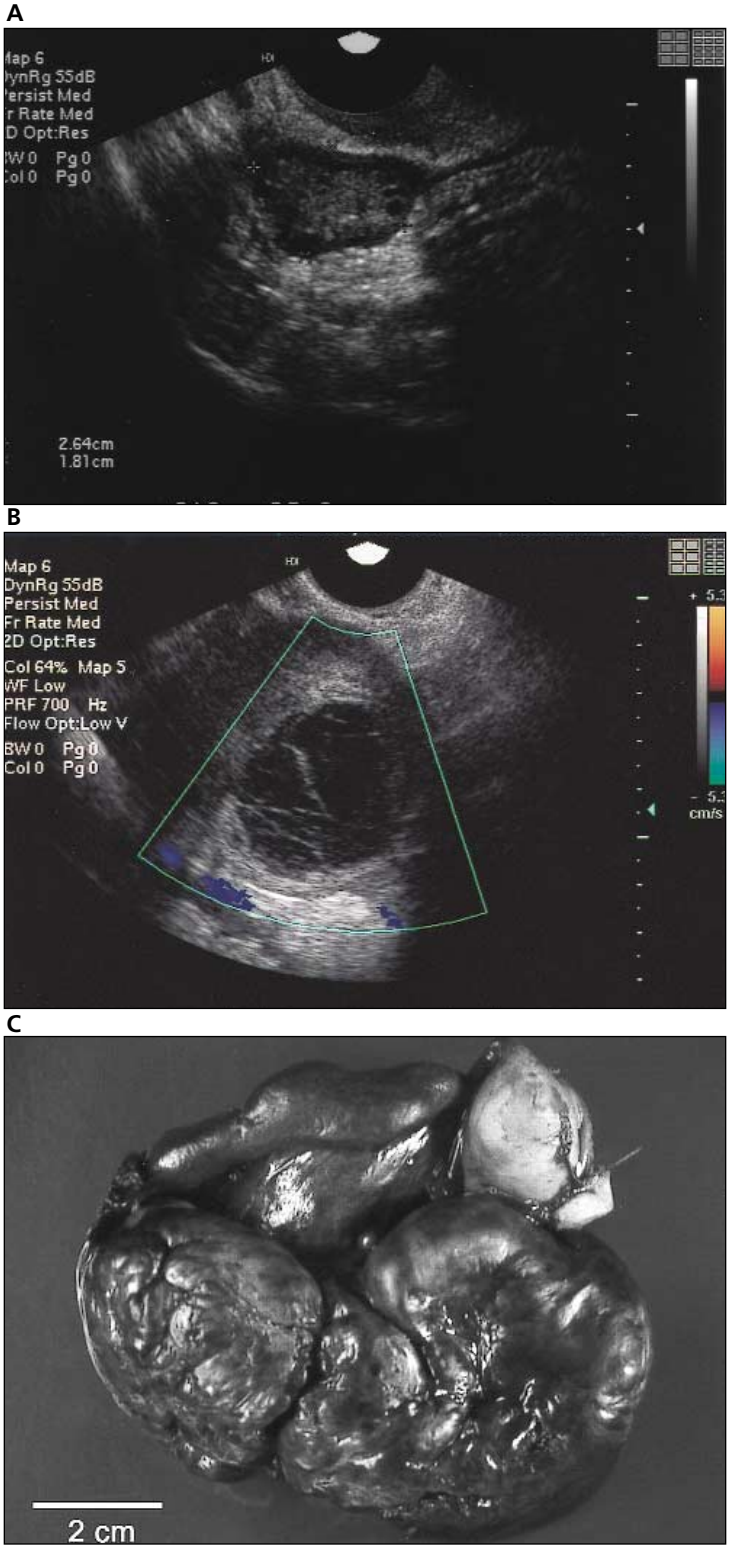


Figure 1. Images from a 39-year-old patient with left ovary and fallopian tube torsion. **A**, Transvaginal sonogram showing a solid-appearing echogenic mass arising from left the ovary. **B**, Transvaginal sonogram showing a 1.5-cm round mass with a target appearance compatible with a twisted vascular pedicle. **C** and **D**, Transvaginal CDS findings showing only minimal arterial and venous flow. **E**, Longitudinal section of the gross specimen showing a left ovarian dermoid cyst. The associated twisted fallopian tube shows extensive hemorrhage and edema.

Figure 2. Images from a 19-year-old patient with left ovary and fallopian tube torsion. **A**, Transvaginal sonogram showing a morphologically normal right ovary. **B**, Transvaginal sonogram showing a cystic ovarian mass with internal reticular echoes suggesting hemorrhage. No flow was seen on CDS. **C**, Pathologic specimen showing a gangrenous appearance of markedly enlarged torsed adnexa.



Many varied gynecologic conditions can clinically mimic adnexal torsion. These include tuboovarian abscesses, endometriomas, appendicitis, and ruptured ovarian cysts.[4] The pathophysiologic characteristics of torsion vary according to its cause. Broad ligament ovarian cysts and neoplasms can act as fulcrums to facilitate torsion. Torsion of both the fallopian tube and ovary occurs more often than that of either structure alone, because the broad ligament acts as the fulcrum.[5] In our study we observed involvement of both the ovary and tube in 10 (67%) of the 15 patients. The right side has been reported to be the most commonly involved side in ovarian torsion.[1] We showed classic right-sided predominance in 9 (60%) of our patients. The propensity of right-side involvement has been thought to be due to the decrease in space on the left side of the lower abdomen and pelvis, which is occupied by the sigmoid colon.[5] Pregnancy poses a greater risk for adnexal torsion when compared with the risk in nonpregnant women.[6,7] Three (20%) of the 15 patients in our series were pregnant.

Another predisposing factor for adnexal torsion is a hypermobile adnexa. This may be due to a mobile hydrosalpinx, an elongated fallopian tube, or previous tubal ligation, allowing torsion at the mesosalpinx.[6] Malignant neoplasms rarely cause torsion. A possible cause may be that tumor invasion or a fibrous response fixes the ovary in position.[4,8,9] In our study, malignancy was found as the underlying cause of adnexal torsion in only 1 patient. The most common neoplasm reported to cause torsion is a dermoid cyst.[1] In our study, dermoid cysts were observed in 3 (20%) of the 15 patients. Massive edema or hemorrhage within the ovary without any underlying pathologic manifestations was seen in 6 patients (40%).

The spectrum of reported sonographic findings of ovarian or adnexal torsion has varied in part because of the degree and the duration of adnexal torsion.[5] If the torsion is incomplete, an entity known as a massive ovarian edema may result. This develops when the torsion is insufficient to cause ischemic necrosis but sufficient enough to elevate capillary hydrostatic pressure and to interfere with lymphatic drainage.[5]

Small amounts of cul-de-sac fluid were found in 13 (87%) of our patients. The fluid is possibly a transudate from the ovarian capsule secondary to obstructed veins and lymphatic vessels.[5]

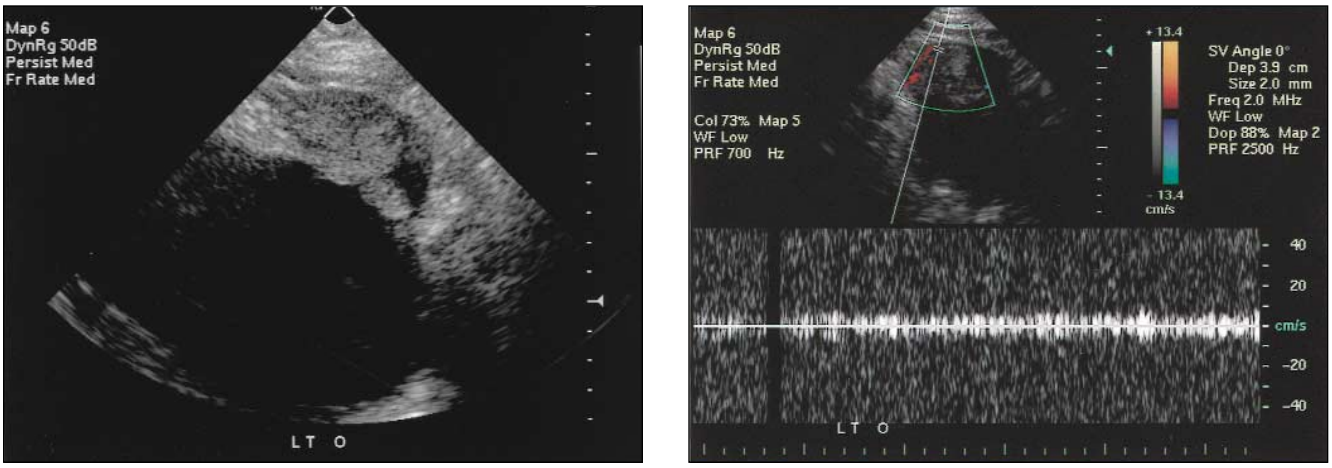


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Figure 3. Images from a 38-year-old patient with left ovarian torsion due to an underlying serous cyst. **A**, Gray scale sonogram showing a large simple cyst originating from the left ovary. **B**, Color Doppler sonogram showing only minimal venous and no arterial flow.

The most consistent sonographic finding in ovarian torsion is ovarian enlargement.[4] In 2 prior studies, ovarian volumes ranged from 26 to 441 cm^3. This represents an average of 28 times that of a normal ovary.[2,10] In our study, the size of the enlarged ovary or adnexa ranged from 38 to 4308 cm^3. Other reported sonographic findings of ovarian torsion such as hyperechoic central areas of edema and peripherally placed follicles were not encountered in this series.[2] It is possible that those findings are early signs of torsion and may have been obscured by the significant necrosis of the adnexa in several of our cases in which no underlying mass was identified.

Normally the vascular pedicle of the ovary, which connects the ovary with the uterus, has either a straight or a tortuous course on sonography.[11] Twisted vascular pedicles appear as round, anechoic structures with multiple concentric echoic stripes (target appearance). In one study, the twisted vascular pedicle was identified by sonography in 88% of all cases of adnexal torsion.[11] In our series, a twisted vascular pedicle was observed in only 2 patients (13%). Isolated tubal torsion has been described in the literature as showing absent flow or reversed diastolic flow within the tubal wall with preserved peripheral and central flow to the ovaries.[12] We did not encounter cases of isolated tubal torsion in our series.

Color Doppler sonography would appear to be an excellent tool for evaluation of ovarian torsion. However, variation in the completeness of the obstruction of the vascular supply may explain the variety and discrepancy of CDS findings that have been reported in ovarian torsion.[6] The ovary has a dual arterial supply and is supplied by 5 to 10 branches, which penetrate the capsule. The venous system roughly parallels the arterial system.[13] Color Doppler sonography may have a role in establishing the viability of the ovary preoperatively in cases of torsion. Fleischer et al[12] showed an absence of central intraovarian venous flow in all cases of torsion with nonviable ovaries as opposed to none of the cases of torsion with ovarian viability. However, this was not confirmed in other series.[14,15] We could not evaluate the viability of the ovaries in our study, because surgery was not always performed immediately after the sonographic examination.

Table 1. Pathologic Results of Adnexa With Torsion

Pathologic Result	No. of Cases (%)* (n = 15)
Necrotic adnexa	6 (40)
Cysts	
Hemorrhagic corpus luteum	2 (13)
Mucinous	1 (7)
Serous	1 (7)
Undifferentiated	1 (7)
Neoplasms	
Dermoid cyst	3 (20)
Granulosa cell tumor	1 (7)

*Percentages do not total 100 because of rounding.

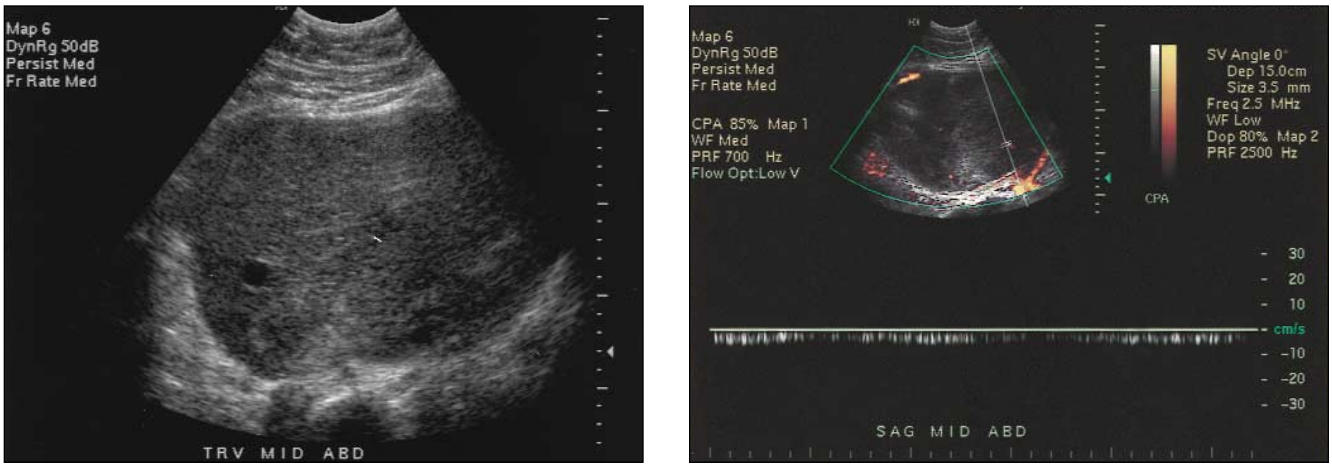

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Figure 4. Images from a 16-year-old patient with right ovary and fallopian tube torsion due to an underlying granulosa cell tumor. **A**, Transabdominal sonogram showing a large, heterogeneous, circumscribed mass with a 23 × 23 × 15-cm diameter and a volume of 4308 cm^3. Pathologic examination revealed a granulosa cell tumor. **B**, Color Doppler sonogram showing absent arterial flow and decreased venous flow in the mass.

We observed abnormal flow on CDS in 14 (93%) of 15 patients. The most common abnormal flow pattern was a complete absence of flow, with no arterial and no venous waveforms detectable in 6 (40%) of 15 patients. The second most common abnormal flow pattern was decreased venous flow with absent arterial flow, seen in 5 patients (33%). Decreased venous and arterial flow was seen in 2 patients (13%), and decreased arterial flow with absent venous flow was seen in 1 patient (7%). Normal flow was present in 1 patient. As previously mentioned, flow to the torsed ovary or adnexa could only be assessed qualitatively in comparison with the flow to the contralateral ovary. A true quantitative assessment was not possible because of the retrospective nature of this study.

In conclusion, diagnosis of adnexal torsion remains a challenging task. It cannot be based solely on the absence or presence of flow on Doppler sonography, because the presence of arterial or venous flow, or both, does not exclude the diagnosis of adnexal torsion. A common finding in our series was the absence of arterial and venous flow patterns or a decrease in venous flow. Comparison with the morphologic appearance and flow patterns of the contralateral ovary aided in the diagnosis. The presence of an adnexal mass or an abnormal appearance of the torsed ovary on gray scale sonography and the presence of cul-de-sac fluid were also common findings. The observation of a gray scale abnormality in combination with an abnormal color Doppler flow pattern and the presence of cul-de-sac fluid offers the highest predictive value for the presence of ovarian or adnexal torsion in a patient with acute pelvic pain.

Table 2. Transvaginal CDS Findings in Adnexal Torsion

Finding	No. of Cases (%) (n = 15)
Absent arterial and absent venous flow	6 (40)
Decreased venous and absent arterial flow	5 (33)
Decreased venous and decreased arterial flow	2 (13)
Decreased arterial and absent venous flow	1 (7)
Normal arterial and venous flow	1 (7)

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