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Sonographic findings of a gynecological cause of acute pelvic pain – a systematic review

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Keywords

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Abstract

Objective: The purpose of this study was to use ultrasonographic data to rule out and distinguish diseases that cause acute pelvic pain. **Material and method:** The literature was reviewed using a systematic search of the databases Google Scholars and PubMed, as well as through hand searching. We looked through a total of 35 articles, but only 26 were selected after preliminary screening. Furthermore, 14 articles were left out because they required a membership, copyright clearance, or featured non-English references. There were a total of 12 articles included in the final review. Among all the study-related articles, only original research studies and one systematic review that sonographically explored the gynecological etiology of acute pelvic pain were selected. **Results:** Acute pelvic pain in women might be difficult to identify between gynecologic and non-gynecologic causes based solely on patient history and examination. Advanced imaging, like ultrasound, aids in determining the reason. Pelvic inflammatory disease can be difficult to diagnose, and clinicians should use a low threshold for starting presumptive treatment in order to avoid significant long-term effects such as infertility. **Conclusions:** Pelvic pain can be acute, chronic or functional. Imaging investigations such as CT, ultrasonography, and MRI can assist in establishing a diagnosis. Particularly ultrasound scanning makes it possible to arrive at a diagnosis with a high degree of precision.

Introduction

Pelvic discomfort is a prevalent complaint among women of all ages, and it is commonly associated with morbidity and even death. Pelvic pain can be acute or chronic, and it can be influenced by a multitude of factors⁽¹⁾. Acute pelvic discomfort is described as pain that lasts shorter than three months. Most women have minor pelvic discomfort at some point during their menstrual cycle, ovulation, or sexual intercourse⁽²⁾. Acute pelvic pain may be caused by common gynecologic conditions including pelvic inflammatory disease (PID), ectopic pregnancy, ovarian cyst, adnexal torsion and adhesions. PID and ectopic pregnancy are important possibilities to consider in the

assessment of acute pelvic pain, hence a comprehensive sexual history is important. A clinical examination and laboratory testing are necessary when a gynecologic disease is suspected as the cause of acute pelvic discomfort. High-frequency endovaginal transducers offer a precise anatomic representation and pathologic characterization⁽³⁾. PID is a term used to describe a group of infections spread through sexual contact and affecting the female reproductive organs. Pelvic pain, soreness caused by cervical motion, vaginal discharge, fever, and leukocytosis are the typical clinical signs of acute PID. The intensity of the distress varies, ranging from moderate pelvic discomfort to severe bilateral lower quadrant pain. *Chlamydia trachomatis* or *Neisseria gonorrhoeae* cause the majority

of infections, though other bacteria are also known to be implicated⁽⁴⁾. Patients who present with severe pelvic pain and a positive pregnancy test should be suspected of having an ectopic pregnancy (EP). EP is the leading cause of death in the first trimester, and the second leading cause of maternal death overall, with a frequency of about 1 in every 200 diagnosed pregnancies⁽⁵⁾. The ultrasound is performed as an examination of choice, and it should be coupled with quantitative b-hCG testing for proper interpretation⁽⁶⁾. Adnexal torsion occurs when the ovary and its surrounding tissues twist on the vascular pedicle. Torsion is most often caused by a benign adnexal tumor. It can occur in normal ovaries, most commonly in prepubertal females⁽⁷⁾. Pregnancy is one of the risk factors for torsion, especially between eight and 16 weeks of gestation, as a result of fast uterine growth and shape changes⁽⁸⁾. The imaging aspects of hemorrhagic follicular and corpus luteum cysts are quite similar, and the difference is primarily determined by the patient's medical history. The pattern on the ultrasound image varies depending on the age of the bleed and the degree of clot development, cycle, or with a positive β -hCG level favors the diagnosis of hemorrhagic corpus luteum⁽⁹⁾. Although new blood may be anechoic at first, a hemorrhagic cyst is characterized by low-level echogenicity in a fine, lace-like, reticular pattern over the first 24 hours, the features being diagnostic⁽¹⁰⁾. Asherman's syndrome, or 'intrauterine adhesions', is a condition that includes amenorrhea, either with or without cyclical abdominal pain. Acute pelvic discomfort in premenopausal women can be caused by a variety of conditions, including typical physiologic changes. Understanding the common ultrasound and computed tomography features of normal and abnormal gynecologic anatomy aids in proper diagnosis and treatment.

Methodology

Data source

The literature was reviewed by performing a systematic search of the databases Google Scholars and PubMed, as well as through hand searching. The following search phrases were used to identify the articles: gynecological reasons of acute pelvic pain, sonographic evaluation of acute pelvic distress, sonographic characteristics of PID, torsion, and ruptured ovarian cyst. All types of articles published over the past 20 years, such as reviews, commentary, correspondence, journals, and original research articles, that were relevant to the topic of the review, were searched.

Study selection

We found a total of 35 articles, however, only 26 were chosen after preliminary screening. In addition, 14 items were omitted because they required a subscription, copyright clearance, or contained non-English references. The total number of articles included in the final review was 12.

Selection of relevant articles for sonographic evaluation of the gynecological cause of acute pelvic pain

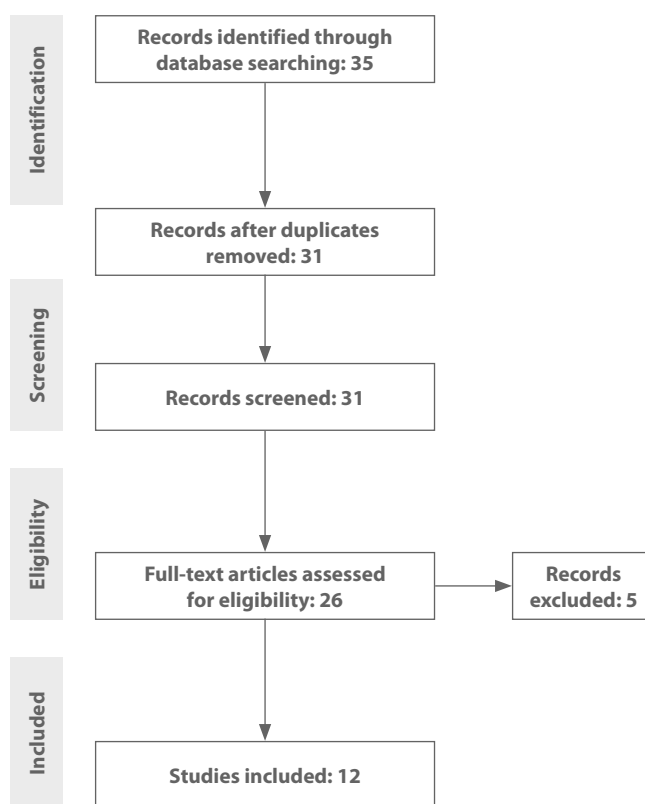


Fig. 1. Flow chart illustrating the selection of articles for the review (Preferred Reporting Items for Systematic Reviews and Meta-Analyses, PRISMA)

Data extraction

Only original research papers and one systematic review that sonographically examined the gynecological etiology of acute pelvic pain were found among all the publications related to the topic of the review. We reviewed a total of 35 publications on pelvic pain and found that 12 matched our inclusion criteria (shown in Fig. 1).

Results

We examined a total of 35 papers on pelvic pain and found that 12 of them met our inclusion criteria. According to the reviewed data, acute pelvic discomfort in women might be difficult to attribute to gynecologic or non-gynecologic causes based solely on patient history and examination findings. However, advanced imaging, such as pelvic ultrasound, aids in determining the underlying cause (Tab. 1 shows the gray-scale and Doppler ultrasound findings for acute pelvic pain causes). Determining pregnancy status is an important early step in managing individuals of reproductive age who are experiencing pelvic discomfort. Ovarian torsion causes acute pelvic pain that can be shown on Doppler ultrasound with normal vascular flow. PID can be difficult to diagnose, and doctors should maintain a low threshold for beginning presumed therapy to avoid infertility.

Tab. 1. Gray-scale and Doppler ultrasound findings for the causes of acute pelvic pain

Causes of acute pelvic pain	Gray-scale findings	Doppler findings
Pelvic inflammatory disease	<ul style="list-style-type: none"> • Endometrial thickening or fluid as a result of endometritis • Internal echoes or fluid levels in a complicated purulent fluid in the pelvis • Pyosalpinx causes dilated fluid-filled fallopian tubes with internal echoes and elevated fluid levels due to purulent debris • A multiloculated, septated mass with poorly defined irregular boundaries, internal echoes, and difficulties distinguishing the ovary from the fallopian tube due to tissue degradation is seen on sonography of a tubo-ovarian abscess • Air from gas-producing organisms can be detected in TOA as echogenic foci with posterior dirty shadowing. 	<ul style="list-style-type: none"> • On color Doppler, blood flow may be detected in the tissues between the tubo-ovarian abscess loculations
Ectopic pregnancy	<ul style="list-style-type: none"> • Enlargement of the uterus or a decidual response in the endometrium in the absence of a gestational sac • A diagnostic finding is a gestational sac in the adnexa containing a fetal pole with heart tones and a yolk sac. • Within the uterus, a cystic formation resembling a gestational sac may be observed. This decidual reaction has a single shape, but an early gestational sac has a twofold decidual reaction, though with a thin outer layer. Echogenic fluid due to blood often occurs within the pseudogestational sac. • The endometrial cavity echoes may also be exceptionally thick due to a decidual reaction without a pseudo sac. 	<ul style="list-style-type: none"> • Color Doppler may be helpful because a rim of vessels surrounds and supplies an ectopic pregnancy. • A low-resistance pattern at the center of a nonspecific extraovarian mass is typical of an ectopic pregnancy.
Adnexal torsion	<ul style="list-style-type: none"> • A big hemorrhagic cyst in an edematous ovary, an enlarged ovary with follicles scattered peripherally: • Heterogeneous ovarian echotexture • Whirlpool sign indicating the twisted pedicle appearing as a hypoechoic band • The cut-section of a twisted pedicle may resemble a snail shell or massive echogenic or hypoechoic masses 	<ul style="list-style-type: none"> • Lack of vascularity • No flow on duplex Doppler • Whirlpool sign indicating the vessels looping around the center axis
Ovarian cysts	<ul style="list-style-type: none"> • A follicular cyst has a thin wall, posterior acoustic enhancement, and increased echogenicity posterior to the cyst. • The corpus luteum is usually unilocular, with a diameter of less than 3 cm and a thin wall. The cysts have internal echoes at low levels. • Cyst whose walls are thick or the fluid within the cyst is more echogenic than it is in a solid cyst. 	<ul style="list-style-type: none"> • A follicular cyst on pulsed Doppler reveals no internal vascularity • The core echogenic solid-looking regions of a corpus luteum cyst have considerable peripheral blood flow ("ring of fire" on Doppler) but little internal vascularity. • Duplex Doppler reveals prominent diastolic flow with low-velocity waveform throughout the luteal phase of the cycle.
Adhesions	<p>2D transvaginal ultrasound (suggestive features):</p> <ul style="list-style-type: none"> • In the sagittal plane, there is an interrupted endometrial line. • Endometrium with punctate echogenic foci • Endo-myometrial junction is indistinct. • Endometrium indistinct or thin (6 mm), and failing to improve with hormone treatment instead of normal ovaries and hormonal profile • In the endometrium, there is a small amount of loculated fluid appearing as multiple small cystic areas. • Fibrosis is considered if there is a hyperechoic lesion with no posterior shadowing, while calcification is considered if there is posterior shadowing. <p>3D transvaginal ultrasound shows:</p> <ul style="list-style-type: none"> • In the coronal plane, there is an irregular endometrial cavity outline. • Decreased endometrial thickness (<2 mm) • Narrowing of the endometrial cavity is considered when the trans-cornual diameter is <20 mm and the mid-cavity diameter <10 mm. 	

Discussion

Pelvic inflammatory disease is an infection and inflammation of the upper genital tract caused mostly by *N. gonorrhoeae* or *C. trachomatis*, however other aerobic and anaerobic organisms may also be causative agents in upper genital tract infections⁽¹¹⁾. Fever and purulent vaginal discharge are common symptoms, and a pelvic ultrasound is recommended in such cases⁽¹²⁾. Early therapy with antibiotics effective against *N. gonorrhoeae* and *C. trachomatis*, as well as anaerobic organisms, is important to avoid long-term effects of PID, such as chronic pelvic discomfort, infertility, and an increased risk of ectopic pregnancy⁽¹³⁾.

Sonographic findings

Ultrasound is the most often used imaging modality for evaluating PID. Healthy women can have fluid both in the endometrium and the cul-de-sac, but individuals with pelvic inflammatory illness may have little or no free fluid⁽¹⁴⁾, as illustrated in Fig. 2. PID may have a sonographic spectrum ranging from moderate acute salpingitis to tubo-ovarian abscess. Ultrasound findings include endometrial thickening and discharge caused by endometritis⁽¹⁵⁾. Pyosalpinx is characterized by dilated fluid-filled fallopian tubes, internal echoes, and elevated fluid levels caused by purulent material.

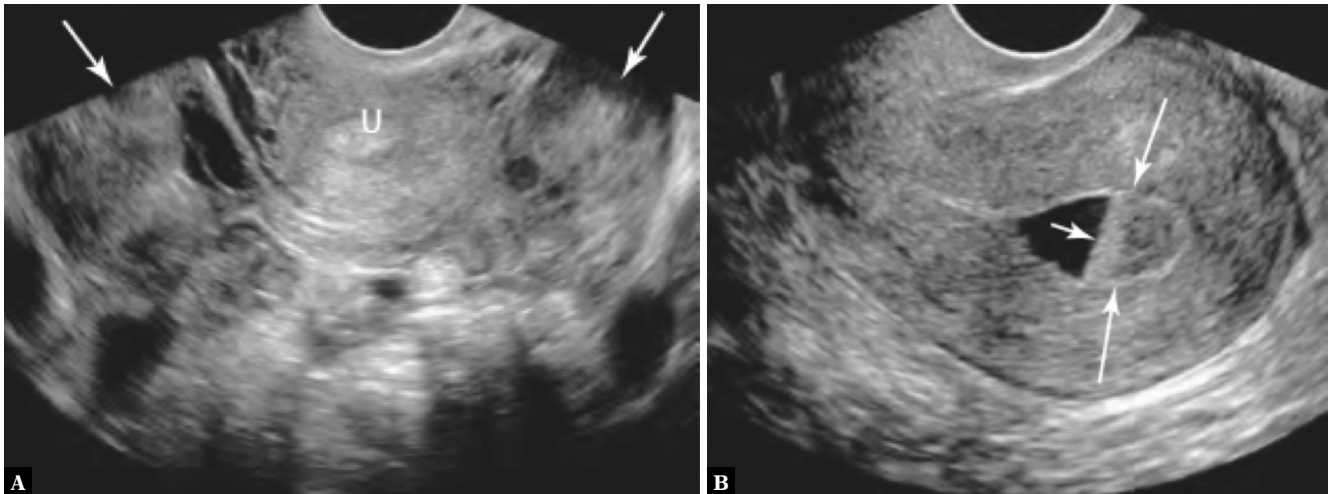


Fig. 2. PID in various individuals. **A.** A transverse transvaginal pelvic scan reveals bilateral adnexal masses caused by PID (arrows). Because of the inflammatory material around the ovaries, the ovarian borders are not visible. **B.** A retroverted uterus demonstrates a dilated uterine cavity (long arrows) with a fluid-fluid level (short arrow) caused by layered purulent material^(17,18)

Inadequate delineation of pelvic structural borders is caused by inflammatory tissue in the periovarian and peritubular areas. Unless accompanied by ascites, normal fallopian tubes are rarely visualized. When the tube is inflamed, it becomes edematous, and the walls thicken, permitting ultrasound imaging⁽¹⁶⁾.

Ectopic pregnancy

Ectopic pregnancy (EP), or extrauterine pregnancy, refers to the implantation of a blastocyst outside the uterine cavity's lining, with approximately 95.5% of blastocysts implanting in the fallopian tube⁽¹⁹⁾, where the baby or embryo frequently goes missing or stops developing. Other most common implantation sites are the ovaries (3.2 %) and the abdominal cavity (1.3 %)⁽²⁰⁾. EP represents a major cause of morbidity and death in women, with risks of tubal rupture and intra-abdominal hemorrhage, and it can result in significant future reproductive morbidity, including ectopic pregnancy and infertility⁽²¹⁾. As a result, it is

a medical emergency that needs to be addressed urgently⁽²²⁾. A serum-hCG pregnancy test and a transvaginal ultrasound are suggested in a patient who has the classic triad of ectopic pregnancy symptoms: pelvic discomfort, vaginal bleeding, and an adnexal mass⁽²³⁾.

Ultrasound findings

The presence of an intrauterine pregnancy almost always rules out the possibility of a coexisting ectopic pregnancy. The double decidual sac sign indicates the existence of an early intrauterine pregnancy⁽²⁴⁾. The early gestational sac's thick-walled echogenic ring-like appearance should be differentiated from the thin-walled pseudogestational sac observed in ectopic pregnancy. This pseudogestational sac, which is seen in 5% to 10% of ectopic pregnancy patients, is fluid in the endometrial cavity surrounded by the decidual lining of the endometrial cavity as shown in Fig. 3⁽²⁵⁾.

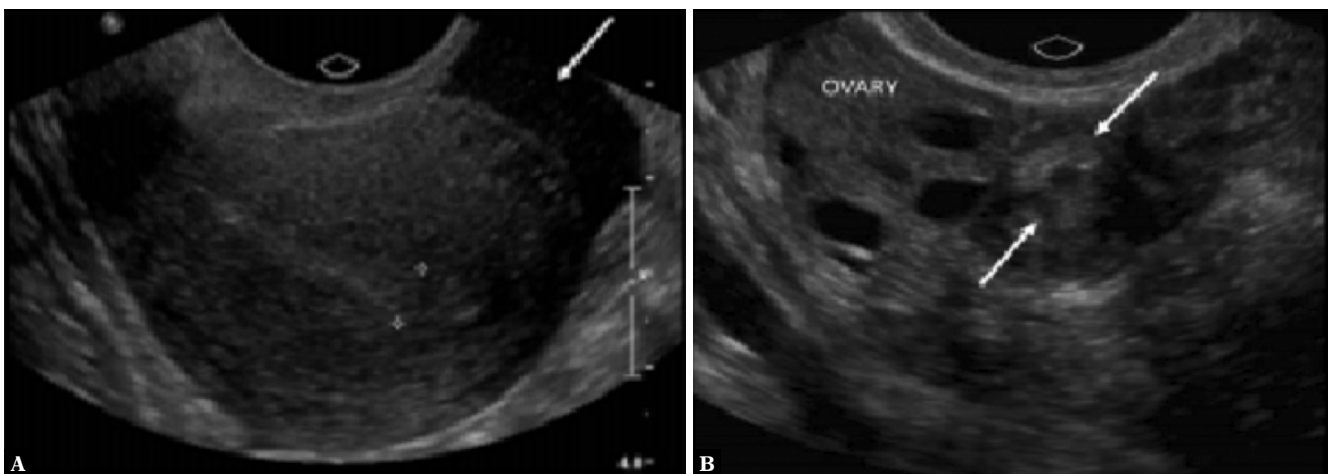


Fig. 3. True ectopic pregnancy that was not ruptured, diagnosed in a patient with right adnexal pain. **A.** Transvaginal ultrasonography reveals a retroflexed uterus surrounded with minimally complicated pelvic fluid (arrow) and a thin endometrium (calipers⁽²⁶⁾). **B.** An echogenic ring (arrows) next to the right ovary, the TEP (this shows the so-called sliding sign separate from the ovary)⁽²⁷⁾

Adnexal torsion

Acute pelvic discomfort can also be caused by ovarian masses, whether benign or malignant. Adnexal torsion is the seventh most common emergency condition, with a prevalence of 2.7%⁽²⁸⁾. Ovarian torsion is typically the first diagnostic consideration in the case of severe pelvic distress, and Doppler ultrasonography is the preferred imaging method. Although ovarian torsion can cause severe pelvic pain, the clinical picture is not always clear. Due to a lack of distinct clinical symptoms, ovarian torsion is commonly misdiagnosed, lowering the chances of ovarian salvage^(29,30).

Ultrasound findings

An enlarged ovary with peripherally dispersed follicles, a massive hemorrhagic cyst in an edematous ovary, and a lack of vascularity are all ultrasonography findings associated with ovarian torsion, as seen in Fig. 4⁽³¹⁾. The length and degree of ovarian torsion, as well as the presence or absence of an ovarian mass, affect the sonographic appearance of ovarian torsion. Mahajan⁽³²⁾ described the twisted pedicle by a whirlpool sign that appears as a hypoechoic band indicating the vessels looping around the center axis, on gray-scale sonography. A cut section of a twisted pedicle cut-section may resemble a target, a snail shell, or large echogenic or hypoechoic masses⁽³³⁾.

Ovarian cysts

During the reproductive years, benign adnexal masses are prevalent, as are physiologic cysts. In the differential diagnosis of acute pelvic discomfort, ovarian cysts and ovarian torsion are two conditions to consider⁽³⁵⁾. Follicular cysts, corpus luteum cysts, and theca lutein cysts are examples of functional

or physiologic cysts. Large follicular cysts may give rise to pelvic discomfort and dyspareunia. The majority of follicular cysts resolve on their own⁽³⁶⁾. Following regular ovulation, blood collects in the central cavity and is reabsorbed, resulting in the formation of a corpus luteum cyst. Pain or discomfort may be caused by a chronic corpus luteum cyst⁽³⁷⁾. High levels of hCG, which can arise as a result of molar pregnancy, choriocarcinoma, or clomiphene therapy, cause theca lutein cysts. They are naturally eliminated when the underlying illness is treated or when clomiphene is stopped^(38,39).

Ultrasound findings

An anechoic follicular cyst has a thin wall and posterior acoustic enhancement, which is apparent as a zone of enhanced echogenicity posterior to the cyst⁽⁴⁰⁾, as illustrated in Fig. 5. After ovulation, a corpus luteum forms, which is generally unilocular, smaller than 3 cm in diameter, and diffusely thick-walled, with considerable peripheral blood flow ("ring of fire" on Doppler)⁽⁴¹⁾.

The cyst may appear solid if the cyst wall is unusually thick or the fluid within the cyst is echogenic. Color Doppler correlation is extremely useful in such situations. Figure 6 shows a corpus luteum cyst with substantial peripheral vascularity and a typical absence of internal vascularity in the core echogenic solid-looking parts of the lesion.

Adhesions

Asherman's syndrome refers to a set of signs and symptoms (such as discomfort and menstrual irregularities) that occur in the presence of intrauterine adhesions. Even though it falls outside of the original description, Asherman syndrome

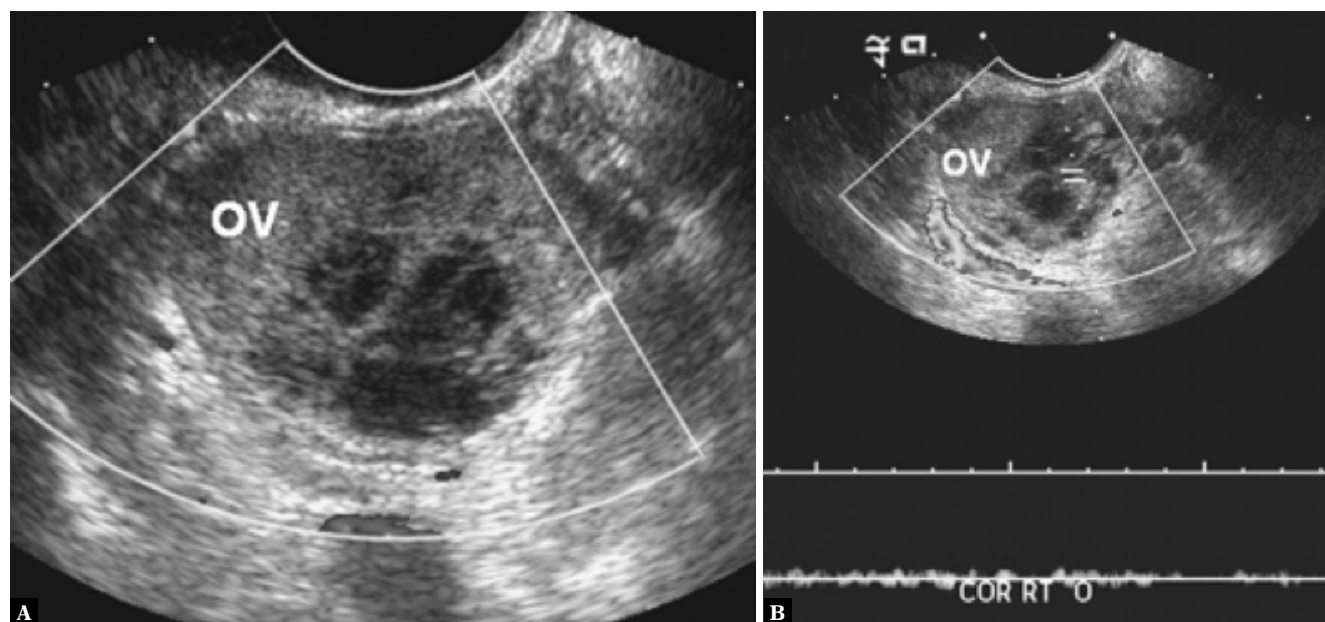


Fig. 4. Torsion of the ovaries. Due to ovarian torsion, coronary transvaginal ultrasonography indicates an enlarged ovary with a hemorrhagic cyst and (A) no color flow and (B) no flow on duplex Doppler⁽³⁴⁾

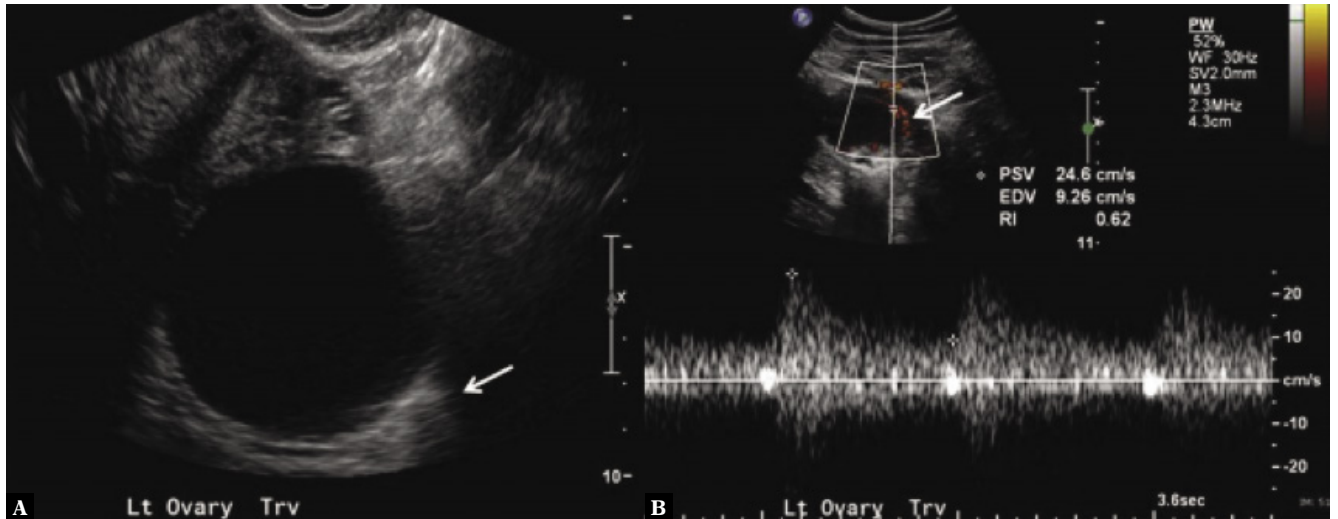


Fig. 5. Ovarian cyst, simple/follicular. APP is brought in by a 31-year-old lady. **A.** A 6.0-cm anechoic cyst with a thin wall and posterior acoustic enhancement is revealed by TVS (arrow). **B.** Internal vascularity is not found on a pulsed Doppler examination. Normal low-velocity, low-resistance waveforms can be identified in the squeezed and thin margin of ovarian tissue (arrow). A one-year follow-up US examination was advised due to its significance⁽⁴²⁾

should be considered when the signs and symptoms are present in women who do not have pregnancy-related intrauterine adhesions⁽⁴³⁾. It is important to distinguish between intrauterine adhesions that are formed for a specific reason, such as endometrial ablation in any of its forms as a treatment for dysfunctional uterine bleeding, and intrauterine adhesions that are brought to clinical attention owing to symptoms⁽⁴⁴⁾.

Ultrasound findings

Adhesions are seen on ultrasound as bands of myometrial tissue spanning the endometrial cavity and joining the opposing uterine walls. The thickness of the bands varies, but their echogenicity is generally the same as that of the surrounding myometrium⁽⁴⁵⁾.

Conclusion

Pelvic pain can be acute, chronic, or recurring, and it can be functional. Pelvic pain can originate in many organ systems, all of which must be treated in patients experiencing this symptom. Physical examination aids in the confirmation of prior assumptions. Clinically, diagnosing the etiology of acute pelvic discomfort in female patients can be difficult. Diagnostic imaging can be quite useful in patients with such a presentation. Imaging modalities such as CT, ultrasonography, and MRI can assist in establishing the diagnosis, but imaging methods, particularly ultrasound, can help arrive at the diagnosis with a high degree of precision, allowing therapy to be explicitly adapted to the disease process. Clinicians who understand the value of various imaging modalities, as well as being familiar with the signs of potential diseases,

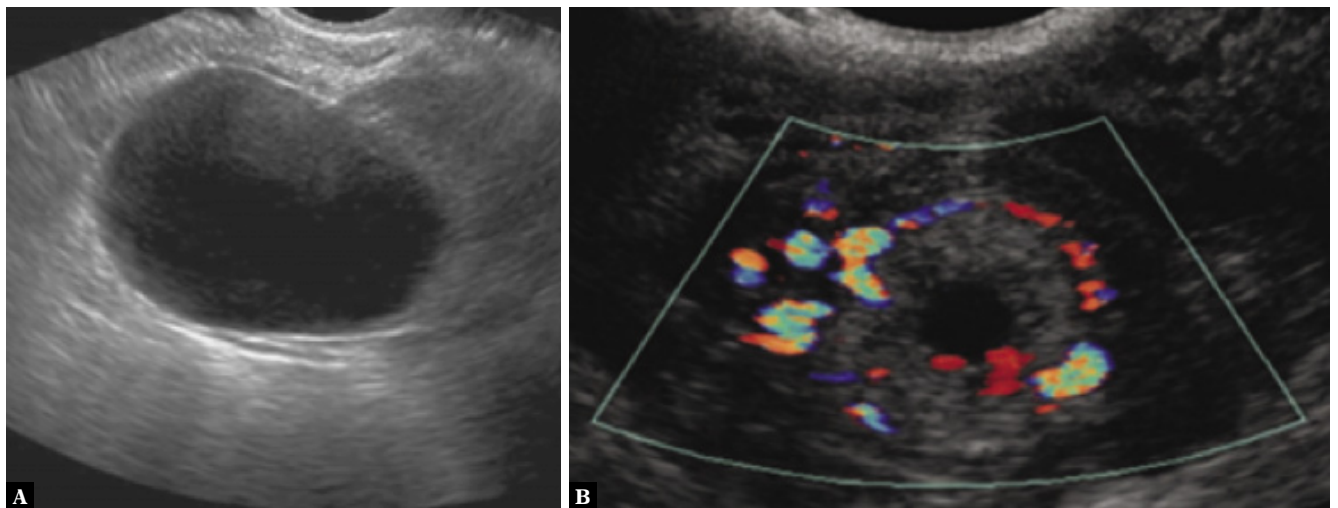


Fig. 6. A simple ovarian cyst on the left side. A transverse transvaginal US image (**A**) shows a well-defined anechoic and hypoattenuating adnexal fluid accumulation. **B.** The corpus luteum is a Latin term that means “corpus of the luteum”. Color Doppler US shows the thick walls and improved peripheral vascularity of a newly established corpus luteum⁽¹⁸⁾

will be best equipped to meet this challenge. The use of sonographic data in conjunction with clinical history aids in the determination of a definitive diagnosis. In instances when ultrasound data are inconclusive, MRI should be explored to make a precise diagnosis.

Conflict of interest

There is no conflict of interest.

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Author contributions

Original concept of study: SKM. Writing of manuscript: HT. Analysis and interpretation of data: GHZ. Final acceptance of manuscript: TS. Collection, recording and/or compilation of data: ET, SJHS. Critical review of manuscript: FN, SJHS.

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