**Acute Pelvic Pain in the Non-Pregnant Patient**

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**Introduction**

Pelvic pain is one of the most common complaints that we see as an indication for pelvic ultrasound in pre and postmenopausal women. One may not always be able to identify a cause but the process of establishing the diagnosis must involve more than just examining the images after the exam. The process must begin with a history focused on the many possible causes. What is the character of pain? Is it chronic or acute, stabbing or crampy, continuous or intermittent, associated with a change in bowel habits or is it associated with menstruation? All of these characteristics will help focus the exam and help make the diagnosis.

Secondly, the study must include both a transabdominal and a transvaginal exam. The transabdominal study with or without a full bladder is important to detect masses that are displaced out of the field of view of the transvaginal probe like a large cyst or masses that are obscure when viewed too close, such as a solid dermoid or a large fibroid. The density of these masses makes it difficult to appreciate transvaginally as well as difficult to judge its actual size.

Finally, the transvaginal study will allow the examiner to palpate the pelvic organs and determine exactly where the pain arises and the site of localized tenderness. This is the part of the study that is frequently omitted and one that I am sure can add the most to the overall interpretation. Remember that there are both the gynecological and non-gynecological organs that may be the source of the patient’s symptoms. The vaginal probe is used to press on all parts of the pelvic organs to elicit areas of general or focal tenderness. The uterus, tubes and the ovaries must each be examined over their entire available surface. Don’t forget to assess the non-gyn organs, the bladder, bowel and peritoneal cavity. Pelvic congestion may also be a cause with no good sonographic signs to assist in the diagnosis. Vessel size and type of flow do not appear to have any distinguishing characteristics to differentiate normal from those with chronic pain.

One of the most common causes of pain is adenomyosis that has just now begun to be recognized sonographically based on a history of heavy bleeding with clots, inhomogeneous myometrium and focal uterine tenderness.

Acute gynecologic emergencies occur mostly in women of reproductive age but can affect women of all ages. The most common and most important gynecologic conditions to be considered include ovarian or adnexal torsion, ruptured hemorrhagic cyst, pelvic inflammatory disease, and hematometrocolpos. In patients with a positive pregnancy test, diagnostic considerations should be given to the possibility of ectopic pregnancy, molar pregnancy, or threatened abortion. In the second or third trimesters of pregnancy, vaginal bleeding may be due to placenta previa or abruption. The postpartum patient with fever or excessive postpartum hemorrhage may have retained products of conception, complicated endometritis, or infected hematoma. Sonography plays a key role in patient evaluation. Computed tomography and magnetic resonance imaging may be helpful in postoperative patients or young patients who cannot tolerate transvaginal scanning. A high level of suspicion and knowledge of the sonographic features of obstetric and gynecologic conditions that may present in the acute care setting are essential for prompt diagnosis.
Clinical Features
The evaluation of the patient with acute pelvic pain begins with a clinical history and physical examination. The value of any imaging technique is enhanced by the addition of clinical information. Since multiple disease processes may present a similar clinical syndrome, the differential diagnosis is constructed from data obtained from the clinical history, including the patient’s age, known risk factors, and menopausal status. The duration and recurrence of the problem, as well as the patient’s current medications, must be considered. Important historic information about prior urinary or gynecologic problems also may guide the diagnostic evaluation. For example, if the patient has a prior history of ectopic pregnancy, the work-up must exclude recurrence of the disease.

The diagnostic evaluation is also supported by the physical examination. The location of the patient’s pain and any signs of pelvic mass limit the differential diagnosis. Signs of infection, including fever and rebound tenderness, suggest that the pain may be caused by inflammatory causes, such as appendicitis or a tuba-ovarian abscess. The differential diagnosis is also influenced by laboratory information. Hematological and blood chemistry studies are obviously important tools for determining the origin of pain. An elevated white blood cell count suggests an infection or inflammatory cause for pain. Abnormal renal or liver function tests may suggest a specific cause for pain or may point to a generalized process, such as diffuse metastatic disease. Urine or serum pregnancy tests are essential in premenopausal patients, whereas serum tumor markers may be helpful in postmenopausal women.

Causes of acute pelvic pain can be divided into gynecologic and non-gynecologic causes. Gynecologic causes have been listed above. Non-gynecologic causes of pelvic pain include appendicitis, urinary calculi, inflammatory bowel disease, bowel obstruction, metastatic disease, and diverticulitis.

Adenomyosis
Adenomyosis is the presence of ectopic endometrial glands and stroma within the myometrium. This frequent but commonly underdiagnosed condition reportedly has been found in 19-62% of uterine specimens. Adenomyosis essentially comes in two varieties, being a diffuse and global infiltration of the endometrium or less often focal, with discrete masses scattered throughout the endometrium. Distinguishing between superficial and deep adenomyosis is useful. The definition of superficial adenomyosis is ambiguous, because the islands of ectopic glands and stroma lie within the inner myometrium (i.e., Junctional zone) within several millimeters of the endometrial basalis, a finding that may be normal. Superficial adenomyosis is unlikely to be symptomatic, and patients with superficial adenomyosis and menorrhagia respond to endometrial ablation. Deep adenomyosis is more readily diagnosed histologically, is correlated with symptoms and uterine enlargement, and is not treated effectively by endometrial ablation.

It affects premenopausal women, particularly those who are over age 30 years. Such patients frequently present with heavy periods, colicky dysmenorrhea, dyspareunia, and enlarged often-tender uterus. However, many patients (3% to 35%) are asymptomatic. Additionally, most reported series demonstrates 80% of patients were multiparous and approximately 50% had associated leiomyomas. These symptoms and signs, however, are nonspecific and can be seen in other common gynecologic disorders such as dysfunctional uterine bleeding, leiomyomas, and endometriosis.
Sonographic Features of the Adenomyosis

The classic pathologic definition includes ectopic endometrial glands that are at least one high-power field from the endomyometrial junction. Lyons et al report seeing women with distended glands that appear as one or more 2-3 mm cysts immediately adjacent to the endomyometrial junction on the transvaginal scan. Although 75% of the cysts are smaller than 4 mm in diameter, they may be as large as 4 cm in diameter and may extend across the junction, involving the endometrium. The ectopic glands and stroma may involve only a small area of myometrium or the whole uterus. The glands have functioning epithelium and therefore may fill with echo-free fluid in the secretory or latter half of the menstrual cycle and be empty in the first half or proliferative phase. The fluid in the gland may also contain blood and therefore may be more echogenic and even have a fluid-debris level.

The cyst wall may be relatively thick and echogenic or thin. The cyst is usually round but may be slightly oval or irregular, likely because of compression from the surrounding myometrium. A myometrial cyst was the most sensitive and specific transvaginal criterion in Lyons study (Bhayana D, Levi CS, Lyons EA, unpublished data, 2002) and the one reported by Bazot et al.

Cysts in the myometrium that are not due to adenomyosis include the arcuate veins in the outer third of the uterus, nabothian cysts in the cervix, and postcesarean delivery cysts, which, if present, are only in the lower uterine segment anteriorly and may be associated with the typical wedge-shaped defect in the adjacent endometrial surface. Doppler interrogation may be used to demonstrate flow in the arcuate veins, but no flow will be seen in a nabothian cyst, a postcesarean delivery defect, or an ectopic endometrial gland.

Myometrial inhomogeneity is a common feature of adenomyosis. An area of increased echogenicity is seen that varies in size, is not of uniform echogenicity, may contain cysts, and has central vascularity. The echogenic area correlates with the myometrial invasion of the glands and stroma and may show only a subtle increase in echogenicity or be as echogenic as secretory endometrium. The area may be situated in a subendometrial location or may extend out to the arcuate vascular plexus. The size of the area involved may be as small as a 2-3-mm focal hyperechoic area of an empty ectopic gland or may involve the entire uterus.

The thickness of the involved region of the uterus is increased relative to the other areas. Typically, the width of the body of the uterus anteriorly may be thicker than a similar region posteriorly when measured from the endomyometrial line to the serosal surface. The thickened area is involved with ectopic tissue and will also have increased echogenicity and cysts.

Distal to the affected area of myometrium are streaks or vertical bands of shadowing that is different from the more uniform shadowing seen behind a uterine fibroid. This streaky shadowing was seen with larger areas of involvement.

Focal uterine tenderness is a most helpful sign and correlates the sonographic and clinical findings. The transvaginal probe is used to examine the uterus by pushing on the surface of the uterus and asking the patient if this is an area of tenderness. Test the lower segment, the body, the cornua, and the fundus if possible. Remember to compare any tenderness in the uterus with tenderness in the adnexa and bowel, especially the sigmoid colon deep in the left soft tissue pelvis. Generalized tenderness may indicate a generalized process such as endometriosis or
pelvic inflammatory disease, whereas focal tenderness is most likely caused by adenomyosis. It is important to also differentiate true pain from a sensation of pressure from the transvaginal probe. Pressure is a normal sensation, but focal tenderness is abnormal.

**Leiomyoma**

Fibroids or uterine leiomyomas are the most common solid benign uterine neoplasm, occurring in 20-30% of women over age of 35, and are more prevalent in African-Americans than in whites. They are often asymptomatic and grow only during the reproductive years under the influence of estrogen. Therefore, pregnancy and birth control pills simulate their growth. In the postpartum period, fibroids shrink and may occasionally calcify. After menopause myomas tend to shrink or even disappear (except in patients who are on hormone replacement therapy). Active growth of leiomyomas in this age group should strongly indicate the possibility of malignant transformation. It has been estimated that 20-50% of women with leiomyomas present with symptoms such as abnormal uterine bleeding, pressure, urinary frequency, pain, infertility, or a palpable abdominal-pelvic mass. The clinical diagnosis of uterine myomas is usually confirmed by palpation of an enlarged, firm, irregular uterus during pelvic examination. The clinical presentation is variable, depending on the size, location, and number of tumors.

Uterine leiomyomas can exhibit a wide spectrum of sonographic features. Sonography is ideal to confirm clinically suggested uterine fibroids. The most common sonographic appearance is of a distinct, solid, well-defined hypoechoic or heterogeneous uterine mass. When multiple small leiomyomas are present, sonography may merely show globular uterine enlargement which may look identical to adenomyosis of the uterus. Submucosal leiomyoma can distort the endometrial canal whereas intramural leiomyomas are fully surrounded by myometrium, and if large, may displace the endometrial canal. Degeneration, necrosis, liquefaction, fibrosis, hemorrhage, infection and calcification cause some of the most unusual appearances of fibroids.

Clusters of high-level echoes with distal attenuation of sound or acoustic shadowing are quite common with calcific degeneration. Carneous degeneration during pregnancy may cause severe pain and appear sonographically as a heterogeneous pattern with cystic spaces within the fibroid. Fibroids located in the lower uterine segment and cervix are associated with a higher frequency of cesarean sections and retained placentas. Pedunculated subserosal leiomyomas extend laterally outward between the folds of the broad ligament, simulating an adnexal mass.

When discrete masses cannot be discerned, several secondary sonographic signs can indicate that leiomyomas are present, such as, an enlarged but normally shaped uterus, an indentation on the contour of the bladder, or an irregular lobular contour of the uterus. Diffuse heterogeneous uterine enlargement may also be caused by leiomyomas, which are too small to discretely resolve, but diffuse adenomyosis may produce a similar appearance.

Isoechoic uterine fibroids that are centrally located may be difficult to outline, especially if they have prolapsed into the endometrial canal. Saline hysterosonography is helpful because the saline fills the endometrial canal and defines the exact position of the fibroid. This information is important in treatment planning because a fibroid with 50% of the mass in the lumen is accessible to hysteroscopic resection.
Cystic areas of degeneration are uncommon, although they certainly do occur. They seem to be independent of size and are not a common feature in fibroids that have undergone embolization. The cystic areas of degeneration are usually small, about 1 cm in diameter, but may involve almost the entire mass. Multiple cystic areas in a large central fibroid may mimic a hydatidiform mole. Other pregnancy related conditions simulated by fibroids include a gestational sac inside or outside the uterus or a pseudosac within the uterus, especially when there is a surrounding echogenic rim. Severe distortion of the uterine cavity by fibroids may result in an eccentric location of a gestational sac, presumed to be an ectopic pregnancy.

Calcification in myomas is common and is used as a helpful distinguishing feature from other pelvic masses. Some patterns of calcification result in erroneous diagnosis. Rim like or peripheral calcification may create the appearance of a fetal calvarium, which to the inexperienced observer may appear to be a fetal demise or a twin head. Such errors can be avoided by recognizing the intramural location and by searching for normal intracranial and fetal anatomy. Popcorn like calcification, being coarse and clumpy, may mimic an ovarian dermoid. Calcification on the surface of a fibroid may cause distal shadowing and obscure underlying pelvic organs, resulting in the appearance of a tip of the iceberg, suggestive of a dermoid cyst. Actually some of the unusual appearances of dermoids overlap with those of unusual fibroids. One example of this is a pedunculated fibroid with degeneration and gas formation causing multiple scattered bright reflectors that mimic an ovarian dermoid. Misdiagnosis of fibroids as solid ovarian tumors, such as fibromas, is understandable, but this has also been the case even for endometriomas.

Transvaginal sonography provides detail that surpasses that of transabdominal sonography. Transvaginal imaging can detect very small lesions and provides better differentiation of a submucous from a mural lesion, as both may produce distortion of the endometrial echo. However, because of a limited field of view, subserosal or pedunculated fibroids may be missed, and the transvaginal approach should be used in conjunction with transabdominal sonography. A uterine fibroid may occasionally prolapse out of the cervix into the vaginal vault. The mass is most easily seen during the transvaginal examination while compressing the uterus with the transvaginal probe. The fibroid is firm and noncompressible compared with normal myometrium. Uterine fibroids seldom tender. At palpation with the transvaginal probe, fibroids are rarely tender. To detect tenderness, you must ask the patient if it hurts when you are compressing the fibroid with the probe.

**Ovarian Torsion**

Ovarian torsion accounts for approximately 3% of all gynecologic emergencies. Torsion usually occurs in premenopausal patients and is often associated with an ovarian mass. The mass serves as the focal point for the torsion, which involves both the ovary and fallopian tube. Ovarian or adnexal torsion is an uncommon cause of pelvic pain during pregnancy. However, women undergoing ovulation induction may develop numerous theca lutein cysts, which can massively enlarge the ovaries and predispose to torsion. Ovarian torsion most often occurs in an ovary > 5-6cm usually by a mass (commonly a dermoid in a premenopausal patient). Ovarian torsion rarely occurs in the presence of ovarian carcinoma or endometriosis due to fixation by adhesions to adjacent structures. Torsion can also occur in postmenopausal patients and may be associated with an ovarian neoplasm.
Patients with ovarian torsion present with acute, severe onset of unilateral pelvic pain. The right ovary is more commonly involved than the left. This pain may be accompanied by nausea and vomiting and may mimic other conditions, such as appendicitis or small bowel obstruction. Recurrent, intermittent bouts of pain may have preceded the current episode by days or weeks.

Sonography is the primary noninvasive examination for the diagnosis of ovarian torsion. Sonographic findings in ovarian torsion are variable. Most patients with torsion present with an enlarged ovary or mass. The sonographic appearance of the mass can vary from cystic to complex to complex solid. The torsed ovary may contain hypoechoic areas resulting from hemorrhage or infarction. Multiple immature follicles may be present along the periphery of the ovary the result of central ovarian edema. Venous and lymphatic obstruction may produce edema and free intraperitoneal fluid. With partial torsion, the ovary can attain a massive size due to edema from lymphatic obstruction. In pediatric patients, two sonographic patterns have emerged. In pre-pubertal girls, torsion tends to occur in enlarged, complex cystic masses, whereas in pubertal girls torsion tends to occur in predominantly solid, enlarged adnexal masses.

It is important to remember that early in the process there may be obstruction of lymphatic and venous flow with preservation of arterial perfusion. Therefore in a patient with an ovarian mass and real time findings consistent with ovarian torsion, who presents with an acute pain, the diagnosis should be suggested even in the presence of documented arterial blood flow. The diagnosis of ovarian torsion is likely if color Doppler flow imaging and pulsed Doppler flow sampling do not show any arterial or venous flow within the ovarian parenchyma.

The absence of flow within the torsed ovary during color Doppler flow, power Doppler, and pulsed Doppler sampling is diagnostic. All color flow parameters must be optimized to ensure that the absence of flow is not related to technical factors, such as high pulse repetition frequency or high wall filter or low color gain settings. With chronic torsion, arterial flow may be seen only around the periphery of the ovary due to reactive inflammation. In chronic torsion, there may be arterial collaterization of flow but in acute torsion, the first and only finding may be lack of venous flow within the ovary. Decreased vascularity may be seen within the ovary with partial torsion. Several authors have described the presence of venous and arterial signals within ovaries surgically proved to be torsed. Thus, in difficult cases, it is necessary to incorporate clinical and sonographic information when considering a diagnosis of ovarian torsion.

Diagnostic laparoscopy is usually performed for ovarian torsion after sonographic evaluation. If the ovary appears viable, it is detorsed, and any ovarian mass is removed. The ovary may be secured to prevent recurrent torsion. If the ovary is found to be non-viable or gangrenous, it is removed.

**Pelvic Inflammatory Disease**

Pelvic inflammatory disease develops in one in eight sexually active female adolescents. Most cases of pelvic inflammatory disease are caused by an ascending infection from the cervix to the endometrium. Most patients are premenopausal, with a typical history of multiple sexual partners and gonococcal or chlamydial infection. It is a leading cause of infertility and is associated with a higher incidence of ectopic pregnancy. In general, sonography is not indicated in patients with a clinical diagnosis of pelvic inflammatory disease, and the sonographic findings with mild or early salpingitis are limited. Sonography is helpful in evaluating patients with more advanced disease or refractory disease and for excluding other pathology that may mimic pelvic inflammatory disease. Uterine and periuterine abnormalities, such as subtle, ill-defined margins,
mild enlargement, and indistinctness of the central endometrial stripe, are difficult to diagnose sonographically and are nonspecific findings. More common findings on sonography are abnormal tubal and periovarian/ovarian structures and enlarged, ill-defined ovaries. Abnormally distended fallopian tubes and thick-walled; echogenic or redundant tubes can be diagnosed sonographically and can be distinguished from bowel loops by the lack of peristalsis. Dilated fallopian tubes can be differentiated from pelvic veins by a lack of moving low level echoes or an absence of color flow. Free fluid may be present and may be echogenic. More severe infection can result in tubo-ovarian abscess. Most commonly, these abscesses appear as complex adnexal masses with variable septations, internal echoes, and fluid levels. However, because of their variable sonographic appearance, tubo-ovarian abscesses may be difficult to distinguish from hemorrhagic cysts or other cystic ovarian masses. Cervical and adnexal tenderness are useful clinical signs. Transvaginal sonography is more sensitive and specific than the transabdominal approach but may be compromised in patients with extreme pain.

Treatment of pelvic inflammatory disease requires antibiotic therapy. Patients with severe disease and tubo-ovarian abscesses require hospitalization and intravenous administration of broad-spectrum antibiotics. Surgical exploration should be considered for those patients who do not respond to medical therapy within 72-96 hours. Surgical drainage or a total abdominal hysterectomy-bilateral salpingo-oophorectomy may be performed to prevent impending rupture of the abscess or to treat overwhelming sepsis.

**Hemorrhagic Ovarian Cyst**

Hemorrhage into an ovarian cyst is most commonly associated with ovulation and complicates the corpus luteal cyst. Hemorrhagic ovarian cysts can present with a variety of sonographic findings depending on the amount and age of clot. Characteristically, acute hemorrhagic cysts appear as echogenic masses, whereas resolving hemorrhagic cysts appear as complex cystic masses. The presence of a fluid-fluid level is helpful in diagnosis, but hemorrhagic cysts can mimic other ovarian masses. A positive history of ovarian cysts and the presence of through sound transmission suggest a cystic process. The differential diagnosis, however, may be extensive including dermoid, endometriomas, abscesses, torsion, cystadenoma and ectopic pregnancy. Doppler confirms absent internal blood flow, although peripheral flow with a low RI may be observed. Color Doppler can help support the diagnosis by demonstrating peripheral vascularity. Hemoperitoneum may occur and can be confused with hemoperitoneum in association with an ectopic pregnancy. In the absence of acute torsion, most patients can be followed clinically. Most hemorrhagic ovarian cysts resolve spontaneously after one or two menstrual cycles. Such resolution can be seen on follow-up sonography and can help to confirm the diagnosis retrospectively.

**Ovarian Hyperstimulation Syndrome**

Ovarian hyperstimulation syndrome (OHSS) occur when there is an excessively high circulating BHCG level and is the most serious complication of ovulation induction in women undergoing treatment for infertility. It is essential that mild OHSS may occur in as many as 65% of women undergoing ovulation induction. Patients with ovarian hyperstimulation may present with symptoms ranging from mild abdominal discomfort to life threatening electrolyte imbalance associated with third spacing of fluid. The presence of numerous large ovarian follicles, enlarged ovaries > 6-10cm in diameter, elevated estradiol levels, young age, and underlying PCOD increase the risk for developing clinically significant OHSS. OHSS is more severe in
patients who become pregnant. Pain may be due to rupture of or hemorrhage into the enlarged
cysts or ovarian torsion. On ultrasound examination markedly enlarged ovaries, often over 10-
20 cm in diameter, with multiple, large, thin walled cysts will be noted. Careful examination of
the abdomen, pelvis, and pleural space should be made to check for and to quantitate ascites and
pleural effusions since these are important indicators of the hemodynamic stability of the patient.
As an increased risk of ovarian torsion accompanies ovarian enlargement, ovarian perfusion
should be documented by Doppler ultrasound examination. Pain, however, is more often caused
by hemorrhage into or leakage from one of these cysts. Hence, debris or low level echoes within
the cysts or an irregularly shaped cyst with adjacent free fluid are often identified.

Non-Gynecological Causes

There are many non-gynecologic causes of acute pain whose presentation may mimic ectopic
pregnancy or other adnexal pathology. Appendicitis is one of the most common causes of acute
abdominal and pelvic pain and is the most common indication for emergency laparotomy.
Patients present with right lower quadrant or paraumbilical pain, which may be accompanied by
fever, leukocytosis, and tenderness. Of all patients, 30% will have an atypical presentation;
unfortunately, the clinical features are not specific, which results in a high negative
appendectomy rate. The differential diagnosis includes all the gynecologic problems discussed
earlier as well as urolithiasis, diverticulitis, bowel obstruction, and other inflammatory
conditions. Since appendicitis can mimic other clinical entities, the diagnostic evaluation should
include examination of the abdomen and pelvis. The examination is performed using a high
frequency linear transducer. Graded compression is employed to displace overlying bowel at the
point of maximum tenderness. The inflamed appendix will appear as a non-compressible,
aperistaltic blind loop on sagittal and transverse views. On the transverse view, the inflamed
appendix has a “target” appearance, with a diameter greater than 6 mm. Loss of the echogenic
submucosal ring is associated with advanced infection and perforation. An appendicolith is
occasionally seen within the appendix. The surrounding area should also be carefully evaluated
to exclude loculated periappendiceal fluid, or gas which suggest abscess formation. Landmarks
helpful in locating the appendix include the pelvic sidewall and cecum. A common pitfall is to
confuse the terminal ileum with the appendix. Hence, false positive examinations have been
reported in the presence of small bowel pathology. CT examinations are recommended for
patients with suspected appendiceal perforation based on clinical or sonographic findings. CT
imaging can define the extent of inflammation better than ultrasound imaging and can help guide
percutaneous drainage procedures.

Patients with urinary obstruction related to ureteral calculus will also present with acute lower
quadrant or pelvic pain. The pain is unilateral and may radiate to the back, flank, or pelvis. It
may be associated with hematuria, fever, and leukocytosis. When renal colic is suspected, a
search for the level of obstruction should be performed. The kidneys should be evaluated both
on real-time and with pulse Doppler to assess for hydronephrosis and elevation of the resistive
index, remembering that with early obstruction, there may be minimal or no hydronephrosis and
little increase in RI. Careful ultrasound examination of the pelvis, including the region of the
ureterovesical junction (UVJ) may reveal the obstructing calculus. Transvaginal sonography may
be helpful in the identification of the distal ureteral stone. The transducer is directed toward the
posteroinferior aspect of the bladder at the level of the UVJ. A dilated distal ureter can be
followed to the level of obstruction. An obstructing calculus appears as an echogenic structure
with acoustic shadowing. In patients without obstruction, documentation with color Doppler of
the ureteral jet into the bladder eliminates complete obstruction of the ipsilateral ureter.
Diverticulitis is uncommon in young women but should be considered in older patients presenting with lower quadrant (usually left) pain. Ultrasound examination may identify an abnormal loop of bowel in the region of the patient’s pain with an irregular lumen and thickening of the bowel wall. A surrounding fluid collection or extraluminal shadowing air suggests perforation and abscess formation.