Mimics of Renal Colic: Alternative Diagnoses at Unenhanced Helical CT

Creed M. Rucker, MD • Christine O. Menias, MD • Sanjeev Bhalla, MD

During the past decade, unenhanced computed tomography (CT) has become the standard of reference in the detection of urinary calculi owing to its high sensitivity (>95%) and specificity (>98%) in this setting. Numerous diseases may manifest as acute flank pain and mimic urolithiasis. Up to one-third of unenhanced CT examinations performed because of flank pain may reveal unsuspected findings unrelated to stone disease, many of which can help explain the patient’s condition. Alternative diagnoses are most commonly related to gynecologic conditions (especially adnexal masses) and nonstone genitourinary disease (eg, pyelonephritis, renal neoplasm), closely followed by gastrointestinal disease (especially appendicitis and diverticulitis). Hepatobiliary, vascular, and musculoskeletal conditions may also be encountered. Vascular causes of acute flank pain must always be considered, since these constitute life-threatening emergencies that may require the intravenous administration of contrast material for diagnosis. Radiologists must be familiar with the typical findings of urinary stone disease at unenhanced CT, as well as the spectrum of alternative diagnoses that may be detected with this modality, to accurately diagnose the source of flank pain.

©RSNA, 2004

Index terms: Computed tomography (CT), helical • Gastrointestinal tract, abnormalities, 70.12115 • Genitourinary system, abnormalities, 80.12115

Ureter, calculi, 82.81

RadioGraphics 2004; 24:S11–S33 • Published online 10.1148/rg.24si045505 • Content Codes: [CT] [GU]

1From the Mallinckrodt Institute of Radiology, Washington University School of Medicine, 510 S Kingshighway Blvd, St Louis, MO 63110. Presented as an education exhibit at the 2003 RSNA scientific assembly. Received February 9, 2004; revision requested March 4 and received April 5; accepted April 14. All authors have no financial relationships to disclose. Address correspondence to S.B. (e-mail: bhallas@mir.wustl.edu).

©RSNA, 2004
Introduction
Since its introduction by Smith et al (1) in 1995, unenhanced helical computed tomography (CT) has revolutionized the imaging evaluation of acute flank pain. Unlike excretory urography, unenhanced helical CT is fast (less than 5 minutes), usually does not require the intravenous administration of contrast material, and has very low interobserver variability (2,3). It also requires no patient bowel preparation, making it particularly effective in the emergent setting.

During the past 9 years, CT has become the standard of reference in the detection of urinary calculi due to its high sensitivity (95%–98%), high specificity (98%–99%), and ability to help delineate alternative causes of flank pain (1–5). On occasion, intravenous contrast material may be administered to further characterize noncolic causes of flank pain or other asymptomatic findings.

In this article, we review causes of acute flank pain that may be identified at unenhanced helical CT. All of the cases involved patients who presented to our emergency department with acute flank pain during the past 2 years. In all cases, patients initially underwent imaging according to the standard urolithiasis protocol we use with unenhanced multi-detector row CT (2.5 detector collimation, contiguous 3-mm image reconstruction, table speed of 10–18 mm per gantry rotation, 120 kVp, and 200 effective mAs). In select cases, repeat imaging with intravenous and oral contrast material was performed. The decision to repeat CT with contrast material was based on consensus between the radiologist and referring clinician. Repeat imaging was attempted to further characterize a finding on the unenhanced study or to search for alternative diagnoses when results of follow-up clinical examination suggested a diagnosis not adequately evaluated on the unenhanced study (eg, aortic dissection).

First, we discuss urolithiasis and its secondary signs. Next, we review and categorize, according to organ system, alternative entities that may manifest as acute flank pain and may be confused with renal stone at clinical examination. Urinary tract calculi were observed in only one case; in all cases, the alternative diagnosis was believed to be responsible for the patient’s emergency department presentation. Knowledge of these conditions may allow the radiologist to know where to focus his or her attention when no stone is encountered on an unenhanced helical CT scan obtained because of flank pain, especially in an emergency department setting.

Acute Flank Pain: CT Spectrum of Disease
Symptoms associated with numerous diseases can be indistinguishable from those of renal colic because receptors of many visceral organs as well as the body wall transmit sensation through pain fibers shared with the kidneys (5). Because of this overlap of the autonomic nervous system, patients have poor localization of visceral pain, and findings at physical examination are often nonspecific. Other symptoms associated with renal colic—hematuria, nausea, and, rarely, vomiting—are also seen with other, noncolic causes of flank pain (3). This clinical overlap has made imaging indispensable for diagnosing renal colic in the emergency setting. Our experience has mirrored that of other investigators (2,3,6,7), who have reported that 9%–29% of patients presenting with flank pain may have an alternative diagnosis at unenhanced helical CT, most commonly adnexal masses, pyelonephritis, appendicitis, and diverticulitis. In fact, a renal or ureteral stone will be detected at CT in only 33%–55% of patients with acute flank pain (2–4,7).
CT Findings Related to Urinary Tract Stone Disease

Even though urinary calculi are seen in fewer than one-half of patients who undergo unenhanced helical CT, they still represent the most common cause of flank pain in patients undergoing this protocol (2,3,6). Therefore, we provide a brief review of the well-documented CT findings of urolithiasis.

Regardless of composition, almost all renal and ureteral stones are detected at helical CT because the attenuation of stones is inherently higher than that of the surrounding tissues (Fig 1) (8). One notable exception is the so-called indinavir stone, which may be encountered in patients with the human immunodeficiency virus who are undergoing treatment with this protease inhibitor. This medication can crystallize in the urine and result in stones that may or may not be detected with CT (9). When the stones are not seen, findings will be similar to those of a recently passed stone, including secondary findings of obstruction.

Crystallized medication should be differentiated from matrix stones, which refer to aggregates of mucus that may form within the urinary tract of both healthy and immunosuppressed individuals (10). These matrix stones tend to have soft-tissue attenuation at unenhanced CT unless mixed with calcified impurities.

Attention should be focused on the most common locations for obstruction by a stone. Natural anatomic narrowing occurs in three areas of the ureter: the ureteropelvic junction, the pelvic brim where the ureter changes caliber as it crosses the iliac vessels, and the ureterovesical junction (Fig 2). Obviously, the most direct sign of a ureteral stone is a calcification within the ureteral lumen. At times, however, it can be difficult to differentiate a phlebolith from a stone in the ureter. In these cases, secondary signs of obstruction, including ureteral dilatation, asymmetric inflammatory change of the perinephric fat, hydronephrosis, and nephromegaly are useful (11,12). On CT scans, phleboliths virtually never demonstrate the hypoattenuating (lucent) center that is a characteristic finding on plain radiographs (13). The soft-tissue rim sign, which refers to a soft-tissue ring surrounding the calcification, is believed to represent the edematous wall of the ureter and can be helpful for differentiating a phlebolith from a ureteral stone (Fig 3) (1,2,11,13,14).

Figure 2. Obstructing stone at the right ureterovesical junction in a 26-year-old woman with right flank pain. Unenhanced helical CT scans show a tiny stone located at the right ureterovesical junction (arrow in b) and secondary right hydronephrosis and perinephric stranding (arrow in a).
times, curvilinear soft tissue can also be seen leading to a pelvic calcification. This finding has been reported in association with phleboliths and has been dubbed the comet-tail sign (15). In this case, the soft tissue is believed to represent the dilated vein leading to the phlebolith. This latter sign has been shown to have limited value in the differentiation of phlebolith from distal ureteral stone (16).

An obstructing stone at the ureteral insertion can be difficult to differentiate from a stone that has recently passed into the bladder. In this situation, it may be useful to place the patient in the prone position and obtain a repeat image of the pelvis. A stone that falls to the now-dependent anterior portion of the bladder has obviously passed, whereas a stone that remains at the ureteral insertion is obstructing the distal ureter. For stones smaller than 4 mm, prone imaging may not be worth the added radiation, since previous work has demonstrated that over 80% of stones 4 mm or smaller at the ureterovesical junction will pass spontaneously (2,17,18).

**Urinary Tract Diseases Unrelated to Calculi**

It is important to remember that any disorder that affects one kidney or causes hydronephrosis may mimic simple renal colic. One of the more common findings simulating an obstructing ureteral stone at clinical examination, as identified at unenhanced CT, is pyelonephritis, which may manifest as asymmetric perinephric stranding or mild renal enlargement when the infection is moderate to severe (6,19). Mild disease may have no unenhanced CT findings at all (19). When intravenous
contrast material is given, pyelonephritis may be seen focally as wedge-shaped areas of low attenuation or, more generally, as striated enhancement of the kidney (Fig 4) (20). More serious complications of pyelonephritis (renal or perinephric abscess) may also be depicted (Fig 5).

Figure 4. Acute pyelonephritis in a 19-year-old woman with acute left flank pain. (a) Initial unenhanced helical CT scan shows an enlarged left kidney with perinephric stranding and urothelial thickening, but no obstructing stone. (b) Contrast-enhanced CT scan shows striated enhancement of the kidney (arrow). Results of urinalysis helped confirm the presence of urinary tract infection.

Figure 5. Renal abscess in a 26-year-old man with acquired immunodeficiency syndrome who presented with right flank pain. (a) Initial unenhanced helical CT scan shows no obstructing stone but demonstrates a hypoattenuating mass in the right upper pole. (b) Delayed contrast-enhanced CT scan helps confirm the presence of a cystic lesion with adjacent renal parenchymal edema (arrows). Staphylococcus aureus was seen in cultures of the aspirated specimen.

When unenhanced CT demonstrates unilateral perinephric stranding or nephromegaly but no stones, the use of intravenous contrast material should strongly be considered. Although contrast-
enhanced CT may show findings of pyelonephritis, which is usually diagnosed at clinical examination, it may occasionally reveal more serious vascular conditions such as renal infarction, renal vein thrombosis, or renal artery aneurysm, which can also manifest with acute flank pain and hematuria (Fig 6) (19,21).

Renal and transitional cell carcinoma must be excluded in any middle-aged to elderly patient with flank pain and hematuria as well. On unenhanced images, urinary tract cancers may appear as subtle, focal contour abnormalities of the kidney, complex renal cysts, focal ureteral or bladder wall thickening, and soft-tissue masses in the bladder (Fig 7). If any of these signs are encountered, intravenous contrast material will usually be useful for further characterization. Sometimes, previously occult malignancies may result in spontaneous hemorrhage and concomitant flank pain (Fig 8). When an isolated subcapsular or
perinephric hemorrhage is seen, close attention should be paid to exclude an underlying neoplasm. Intravenous contrast material may enable the detection of the cause of the hemorrhage and help guide management (Fig 9) (22). Intravenous contrast material may also enable exclusion of soft-tissue masses that may mimic subcapsular hemorrhages on unenhanced scans (Fig 10).

Figures 7–9. (7) Transitional cell carcinoma in a 56-year-old man who presented with gross hematuria. (a) Unenhanced helical CT scan shows a vague soft-tissue mass within the urinary bladder (arrow). (b) Delayed contrast-enhanced CT scan enables better characterization of the mass. Results of biopsy helped confirm the presence of transitional cell carcinoma. (8) Hemorrhagic renal cell carcinoma in a 58-year-old man who presented with acute flank pain and hematuria. Unenhanced helical CT scan shows a large hemorrhagic mass within the left kidney (arrows). No obstructing stone was seen. Surgical findings helped confirm the presence of hemorrhagic renal cell carcinoma. (9) Spontaneous subcapsular hematoma in a patient with left renal colic who was receiving anticoagulants. Unenhanced helical CT scan shows a subcapsular collection with high attenuation (arrows). Contrast-enhanced CT scans (not shown) helped confirm the presence of subcapsular hematoma without a distinct underlying mass.
Other causes of flank pain that may be encountered on unenhanced helical CT scans include congenital ureteropelvic junction obstruction, ureteral obstruction from compressive lymphadenopathy, and cystitis (Fig 11) (2,6).

**Extraurinary Tract Diseases**

**Gynecologic Conditions**

Gynecologic conditions frequently manifest as abdominal and flank pain and represent one the most common nonstone findings (about 10% of alternative diagnoses) at unenhanced CT performed for urolithiasis (2,6). In this group, adnexal masses make up most cases. Most of these masses tend to be ovarian cysts, usually hemorrhagic (Fig 12), but tubo-ovarian abscesses, dermoid cysts, endometriomas, and ovarian neoplasms may also be seen (Fig 13). In addition to hemorrhage, large adnexal masses may be painful owing to the mass effect on the distal ureter, with resultant hydroureteronephrosis or adnexal torsion. Hemorrhagic masses may have high attenuation on unenhanced images and may be surrounded by free peritoneal fluid. Complex-appearing masses can be further evaluated with ultrasonography (US) or magnetic resonance (MR) imaging. Although contrast-enhanced CT

**Figure 10.** Renal lymphoma in a 75-year-old woman who presented with left renal colic. (a) Initial unenhanced helical CT scan shows an enlarged left kidney with subcapsular soft-tissue attenuation (arrows) and an ill-defined lesion posteriorly. No obstructing stone was seen. (b) Contrast-enhanced CT scan helps confirm the presence of both subcapsular and parenchymal masses (arrows). Results of biopsy helped confirm the diagnosis of non-Hodgkin lymphoma.

**Figure 11.** Emphysematous cystitis in a 62-year-old diabetic man who presented with groin pain and hematuria. Unenhanced helical CT scan shows a thick-walled urinary bladder with intraluminal and intramural air, a finding that is consistent with emphysematous cystitis. *Escherichia coli* was seen in a culture of the urine specimen.

may show signs of malignancy, including wall enhancement and nodular septa, it is usually reserved for staging, not lesion characterization (22–24). Other gynecologic conditions that may be encountered at unenhanced CT include cervical cancer (which may involve the distal ureters), degenerating or twisted fibroids, and ectopic pregnancy (Fig 14) (2,6).
Along with gynecologic conditions, gastrointestinal disease represents one of the most common clinical mimics of renal colic. Appendicitis and diverticulitis are two of the most common conditions detected on stone-negative unenhanced helical CT scans in our emergency department and were frequently encountered in previously published series as well, representing 10%–12% of alternative diagnoses (2,3,6). Appendicitis should always be considered in any patient presenting to the emergency department with abdominal pain, since it is a very common cause of an acute abdomen, especially in younger patients (Fig 15). For this reason, every attempt should be made to identify the normal appendix on all CT scans obtained with a renal stone protocol. The normal appendix is usually less than 6 mm wide, is thin

**Gastrointestinal Diseases**

Along with gynecologic conditions, gastrointestinal disease represents one of the most common clinical mimics of renal colic. Appendicitis and diverticulitis are two of the most common conditions detected on stone-negative unenhanced helical CT scans in our emergency department and were frequently encountered in previously published series as well, representing 10%–12% of alternative diagnoses (2,3,6). Appendicitis should always be considered in any patient presenting to the emergency department with abdominal pain, since it is a very common cause of an acute abdomen, especially in younger patients (Fig 15). For this reason, every attempt should be made to identify the normal appendix on all CT scans obtained with a renal stone protocol. The normal appendix is usually less than 6 mm wide, is thin

**Figure 12.** Hemorrhagic cyst in a 24-year-old woman who presented with right-sided groin pain. Unenhanced helical CT scan shows a right adnexal cyst with high attenuation and a hematocrit level (arrow). No obstructing stone was seen. The presence of a hemorrhagic ovarian cyst was later confirmed with transvaginal US.

**Figure 13.** Complex ovarian mass in a 38-year-old woman who presented with right-sided groin pain. Unenhanced helical CT scan shows a cystic adnexal mass with internal septa (arrow). Analysis of the surgical specimen confirmed the diagnosis of cystadenofibroma.

**Figure 14.** Ruptured ectopic pregnancy in a 42-year-old woman who presented with acute right flank pain. Unenhanced helical CT scan shows a hemorrhagic mass in the right adnexa (arrow), a finding that is associated with hemoperitoneum. No obstructing stone was seen. Imaging was performed before results of a urine pregnancy test were known. The beta subunit of human chorionic gonadotropin was later found to be positive. Surgical findings helped confirm the diagnosis of ruptured ectopic pregnancy.

**Figure 15.** Acute appendicitis in a 30-year-old woman who presented with right flank pain. Unenhanced helical CT scan shows an enlarged thick-walled appendix with periappendiceal stranding (arrow). No obstructing stone was seen. Surgical findings helped confirm the diagnosis of acute appendicitis.
walled, and may contain an appendicolith. Gas within the appendiceal lumen can be helpful for finding a normal appendix. When seen in the context of wall thickening or stranding, however, the presence of intraluminal gas does not exclude appendicitis.

Several studies have reported that the sensitivity and specificity of unenhanced helical CT are sufficiently high to exclude both ureterolithiasis and appendicitis (25–27). The proper protocol for evaluating appendicitis, however, remains controversial (28). At our institution, we prefer to administer both oral and intravenous contrast material. The use of intravenous contrast material can be beneficial in thin patients with only a small
amount of intraperitoneal fat and allows better characterization of complications of appendicitis, such as perforation and abscess formation (28,29).

Because appendicitis is frequently encountered at unenhanced helical CT performed because of urolithiasis (about 5% of alternative diagnoses), all radiologists must be familiar with the unenhanced CT findings, which include dilatation of the appendix to more than 6 mm, inflammatory stranding of the periappendiceal and pericecal fat, and surrounding phlegmon or abscess. Although an appendicolith can be seen to advantage at unenhanced CT, as an isolated finding it is not diagnostic for appendicitis (Fig 16) (25,26,30,31). The presence of a fecalith within a fluid collection in the right lower quadrant is very helpful for making the diagnosis of perforated appendicitis.

Diverticulitis is also easily visualized at unenhanced CT. Characteristic findings include inflammation of the pericolonic fat in association with nearby diverticula, focal colonic wall thickening, thickening of adjacent fascia, thickening of the root of the sigmoid mesentery, and intraabdominal abscess (Fig 17) (25,26,32). Although the inflamed diverticula are usually within the sigmoid or descending colon, they may be present within the transverse or ascending colon, especially in younger people (Fig 18) (33). Small bowel diverticulitis and Meckel diverticulitis may mimic nephroureterolithiasis as well, which emphasizes the importance of careful bowel inspection with unenhanced CT (34). Although less common, abdominal hernias, small bowel obstruction (Fig 19), intussusception (Fig 20), colon carcinomas, and inflammatory bowel disease may also be discovered (Fig 21) (2,6,7).
Pancreatic and Hepatobiliary Disorders

Hepatobiliary findings at unenhanced helical CT are usually related to stones within the gallbladder or bile duct. Gallstones are commonly an incidental finding in patients with true renal colic. Although US remains the imaging modality of choice for the screening for cholelithiasis and choledocholithiasis, gallstones are a frequent incidental finding at unenhanced CT performed because of renal stones and, occasionally, may help explain the patient’s symptoms (2,6,35,36). Unlike US, which may depict more than 95% of gallstones, unenhanced helical CT has been shown to depict only 65%–88% of them (37,38). Cholecystitis can sometimes mimic renal colic at clinical examination and should be detected on CT scans obtained with a renal stone protocol (Fig 22). CT, which has a reported sensitivity of 92% when intravenous contrast material is administered, may demonstrate gallbladder wall thickening, pericholecystic fluid, gallstones, gallbladder distention, and, possibly, gas within the gallbladder wall (39). These findings may be more difficult to visualize with unenhanced CT.

Choledocholithiasis should be suspected when biliary ductal dilatation is present and no other source for flank pain is found; occasionally, the intraductal stone may be seen (Fig 23). In such instances, further imaging with US or MR imaging may be warranted.

Pancreatitis may manifest as left flank pain, thus mimicking renal colic (Fig 24). Although intravenous contrast material is not required to make the diagnosis of pancreatitis, it may be helpful in the evaluation of related complications (40).

Vascular Diseases

Vascular diseases represent the most difficult category of disease to diagnose at unenhanced CT, and they are potentially the most life threatening. The clinical findings of acute aortic and splanchnic arterial conditions as well as venous conditions may overlap with those of renal colic (41).
Acute aortic conditions that may be detected at unenhanced helical CT include ruptured abdominal aortic aneurysm and aortic dissection (Figs 25, 26). The former may manifest as a crescent-shaped area of high attenuation (higher than that of intraluminal blood) in the wall of an abdominal aortic aneurysm. Figure 23. Choledocholithiasis in a 46-year-old man who presented with right flank pain. (a) Initial unenhanced helical CT scan shows mild intrahepatic biliary ductal dilatation (arrow). No obstructing ureteral stone was found. (b) Unenhanced CT scan obtained slightly caudad to a shows high attenuation within the duct (arrow). Findings at endoscopic retrograde cholangiopancreatography helped confirm the presence of choledocholithiasis.

Figure 24. Acute alcoholic pancreatitis in a 46-year-old man with known renal stones who presented with left flank pain. Unenhanced helical CT scan shows bilateral renal calculi as well as an edematous pancreas with peripancreatic inflammation and fluid collections (arrowheads), findings that are consistent with acute pancreatitis.

Figure 25. Ruptured abdominal aortic aneurysm in a 66-year-old man who presented with acute left flank pain. Unenhanced helical CT scan shows a ruptured 8-cm abdominal aortic aneurysm with an associated large retroperitoneal hematoma (arrows).
aortic aneurysm, which is believed to represent a sign of impending rupture, or as periaortic stranding or hemorrhage (>60 HU), which is indicative of active bleeding (42). Although the use of intravenous contrast material is not required to make the diagnosis, it may be helpful if endoluminal treatment is planned (43). Conversely, intravenous contrast material is almost always required to exclude an aortic dissection. Findings at unenhanced CT include high attenuation in the wall of the aorta, which is indicative of an intramural hematoma, or displacement of intimal calcification into the aortic lumen (Fig 27). Other findings include unilateral perinephric stranding, which is suggestive of renal infarction from a dissection flap into the renal artery, and actual visualization of the flap, which can become more conspicuous if the patient is anemic (44).

Conditions affecting the mesenteric arteries and veins can also mimic renal colic and may be easily overlooked if clinical suspicion is not high. Occasionally, an aortic dissection may extend into the superior mesenteric artery; rarely, an isolated superior mesenteric artery dissection may be present. Unenhanced CT findings of arterial dissection include perivascular fat stranding, vessel enlargement, irregular contour, and displacement of intimal calcification. Secondary signs of vascular compromise of bowel may be present, including bowel wall thickening, pneumatosis, and bowel distention (44). The sensitivity and specificity of these signs have not been well studied, so a low threshold for intravenous contrast material administration should be maintained if mesenteric artery dissection is suspected. Superior mesenteric artery embolism or thrombosis and venous thrombosis may also manifest as pain radiating to one side. As with dissection, intravenous contrast material is needed for their diagnosis. Findings at unenhanced CT include an enlarged vessel, perivascular stranding, and, rarely, high-attenuation material within the vessel representing the clotted blood (Fig 28) (45).

Intraperitoneal and retroperitoneal hemorrhage represent another category of vascular disease that may appear on unenhanced helical CT scans. Although procedure- or trauma-related hemorrhages may be suspected at clinical examination, spontaneous hemorrhage may not. Spontaneous hemorrhage, which is usually related to the use of anticoagulants, may also be seen in the setting of bleeding diatheses, vasculitis (eg, polyarteritis nodosa), splenic rupture, and certain

Figure 26. Ruptured common iliac artery aneurysm in a 68-year-old man with acute left flank pain. Unenhanced helical CT scans show a ruptured left common iliac artery aneurysm with disruption of intimal calcification (arrow in b) and a large left retroperitoneal hematoma (arrow in a).
neoplasms (Fig 29) (46). If no history of trauma or antecedent procedure is elicited, the use of intravenous contrast material should be strongly considered. Intravenous contrast material may also provide information about the presence and rate of active bleeding.

Musculoskeletal Pain

Body wall or musculoskeletal pain is commonly mistaken for renal colic in the emergency department because of its nonspecific clinical presentation. Low mechanical back pain is a common example. When reading unenhanced helical CT scans, however, the radiologist should keep in mind...
mind the potentially more clinically important musculoskeletal causes of flank pain (47), including a missed fracture in elderly patients or in those with osteopenia who experience complications from seemingly minor injuries. In this patient population, careful analysis of the thoracolumbar junction is warranted because of the relative frequency of nontraumatic vertebral fractures in this region (48). Metastases to the bones, multiple myeloma, and psoas hematomas can also be detected at unenhanced CT performed for flank or costovertebral angle tenderness (Fig 30) (6).

**Miscellaneous Conditions**

Rarely, focal intraperitoneal fatty infarctions (ie, epiploic appendagitis and focal omental infarctions) may be confused with other causes of acute flank pain (49). Their detection on unenhanced CT scans is dependent on careful inspection of the fat surrounding the colon. CT findings suggestive of this condition include pericolonic fat stranding without visualization of bowel wall thickening and a well-circumscribed fatty mass with a center of high attenuation (50). The differentiation between epiploic appendagitis and focal omental infarction is not always possible and is less important, since both tend to be treated conservatively and are usually self-limiting (51).

**Conclusions**

Numerous diseases may manifest as acute flank pain and mimic urolithiasis. The ability to diagnose these conditions with CT, in addition to the speed and high accuracy in stone detection, has resulted in the near-universal acceptance of unenhanced helical CT for the initial imaging of patients suspected of having renal colic. Up to one-third of unenhanced CT scans obtained because of acute flank pain, however, may reveal unsuspected or additional findings unrelated to stone disease, which may help explain the patient's flank pain and presentation. Most of these findings are related to gynecologic conditions, in particular adnexal masses, and gastrointestinal diseases, especially appendicitis and diverticulitis. The radiologist should be aware that more serious diseases involving the genitourinary tract (eg, neoplasm) and abdominal vessels may have clinical findings similar to those of stone disease. Vascular causes of acute flank pain must always be considered, since these constitute life-threatening emergencies that may require the administration of intravenous contrast material for their exclusion.

**References**


