Unusual and Rare Presentations of Appendicitis on CT

ASER 2009

Douglas S. Katz, M.D., F.A.C.R.
Vice Chair, Department of Radiology, Winthrop-University Hospital, Mineola, NY, USA
Professor of Clinical Radiology, State University of New York at Stony Brook
Introduction

- With the increasing use of CT for imaging patients with acute abdominal and pelvic disorders, radiologists need to be familiar with the spectrum of unusual and rare presentations of appendicitis.

- The purpose of this lecture is to demonstrate this spectrum of presentations of appendicitis on CT, in conjunction with a review of the literature.

- Types of appendicitis covered will include: chronic/recurrent & resolving; foreign body; with GU tract involvement; in association with rotation anomalies; stump; diverticulitis; hernias; in association with tumors; intussusception; and secondary appendicitis.
Chronic/Relapsing Appendicitis

- Chronic appendicitis – symptoms greater than 3 weeks duration
- Recurrent/relapsing appendicitis – repeated episodes of pain
- Overlap between the two types; pain in both is usually lower grade than in classical acute appendicitis; symptoms resolve after appendectomy
- Occurs in a minority of patients – upwards of 5-10% (Barber MD et al. Br J Surg 1997)
- Pathology findings: chronic active inflammation/fibrosis

- 28-year-old man with distal appendicitis & lith; findings at pathology were consistent with chronic inflammation
Chronic/Relapsing Appendicitis

- Cause may be partial obstruction of appendiceal lumen (Checkoff JL et al. AJR 2002)
- Can also have idiopathic granulomatous appendicitis – not related to inflammatory bowel disease (Rao PM et al. AJR 1998)
- Also, there is poor correlation of symptom chronicity and the nature of the pathology findings (Rao PM et al. Am J Emerg Med 1998)
- 73-year-old man with recurrent RLQ pain due to perforated chronic tip appendicitis with abscess
Chronic/Relapsing Appendicitis

- 24-year-old woman with perforated appendicitis 3 months ago (unrelated VP shunt)
Chronic/Relapsing Appendicitis

- 66-year-old man with chronic appendicitis related to a VP shunt; CT 5 months apart
Chronic/Relapsing Appendicitis

- 19-year-old male with “dropped” appendicolith-related abscess, 5 weeks after perforated appendicitis
Chronic/Relapsing Appendicitis

- 39-year-old man with recurrent actinomycosis secondary to perforated appendicitis/dropped appendicololiths – 2004 CT on left, 2009 CT on right
Resolving Appendicitis

- Resolving appendicitis – clinical symptoms resolve without surgery, but initial CT shows acute appendicitis – cause of some “false-positive” appendicitis interpretations in the literature.
- Well known to occur based on the surgical literature, but few imaging reports.
- Non-surgical management is usually not attempted.
- Believed to occur when the inciting obstruction (e.g., soft fecalith) is relieved (Kirshenbaum M et al. Abdom Imaging 2003).

- An appendicolith is usually not present in resolving appendicitis, in contrast to chronic & recurrent appendicitis (Giuliano V et al. Emerg Radiol 2006).
- Series of 12 patients (out of 155, or 8%) with resolving appendicitis were managed non-operatively due to decreasing symptoms shortly after CT; 6 patients had an average of 2.5 years of clinical follow-up, 4 had repeat CT within a month showing resolution, and 2 were lost to follow-up (Kirshenbaum M et al. Abdom Imaging 2003).
Resolving Appendicitis

- Patient with initial CT showing appendicitis was treated non-operatively because the pain decreased shortly after the CT was performed.
- Follow-up CT 5 days later shows decreasing findings of appendicitis (case courtesy Dr. Gabriela Gayer, Assaf Harofeh Medical Center, Zerifin, Israel).
Foreign Body Appendicitis

- Foreign bodies are rarely discovered in appendectomy specimens: in 66 (0.5%) of 13,228 appendectomy specimens in one series (Balch CM et al. Arch Surg 1971)

- The first reported appendectomy, in 1735, was for perforated appendicitis due to a sewing pin (in an inguinal hernia)

- Most cases prior to the 20th century were due to accidental swallowing of needles & shotgun pellets (Fischer CD SDJ Med 2004)

- 54-year-old man (a hunter) with incidental appendiceal foreign body consistent with a shotgun pellet
Foreign Body Appendicitis

- Long, pointed, stiff, & metallic foreign bodies most likely lead to appendicitis & appendiceal perforation, but shotgun pellets and seeds can as well, & numerous other foreign bodies have been reported in association with appendicitis (Asad S et al. J Ultrasound Med 2007)

- Foreign bodies are supposedly more likely to lodge in retrocrural & superiorly extending appendices (Fischer CD SDJ Med 2004)

- Perforated appendicitis related to a shotgun pellet; note extensive peri-appendiceal inflammation
Foreign Body Appendicitis

- Foreign bodies may cause appendicitis days to years following ingestion, or may be incidentally discovered (Larsen AR et al. Am Surg 2000)
- One study followed 62 Eskimos for 2 to 13 years after initial incidental discovery of shotgun pellets in the presumed location of the appendix based on abdominal radiographs; none developed appendicitis on follow-up (Reddy ER J Can Assoc Radiol 1985)
- 44-year-old man with right lower quadrant pain and perforated appendicitis due to chicken bone fragments
Barium Appendicitis

- Inspissated barium in the appendix ("barolith") has been reported to result in appendicitis, both shortly after barium administration as well as with delayed presentations.
- Appendicitis related to both upper and lower GI barium administrations have been reported (Nagata H et al. Acta Paediatr 2006).
- A controversial entity – rare and possibly coincidental.
- Only one report on CT to our knowledge (but no images shown) (Nagata H).
- I have never seen barium appendicitis on CT.

- 24-year-old woman with incidental retained barium in the appendix several days following an initial CT (for continued abdominal pain).
The ureter and bladder can occasionally become secondarily involved in perforated appendicitis.


A fistula between perforated appendicitis and the bladder is rare.

This patient had chronic right lower quadrant pain due to perforated appendicitis; note the lith embedded in the thickened bladder wall (case courtesy Dr. Philip Beuchert).
This 27-year-old presented with right flank pain and a non-enhanced CT was performed.

There is perforated tip appendicitis with a phlegmon along the right ureter and associated hydronephrosis and hydroureter.
GU Tract Involvement

- 77-year-old woman with perforated appendicitis
Appendicitis and Rotation Anomalies

- Intestinal malrotation is a congenital anomaly that refers to either non- or incomplete rotation of the primitive intestinal loop around the axis of the superior mesenteric artery during fetal development (Lee MR et al. World J Gastroenterol 2006)

- Appendicitis in such patients often presents with atypical clinical symptoms because of the altered anatomy (Lin CJ et al. Emerg Radiol 2004)

- Acute appendicitis in a patient with situs inversus (case courtesy Dr. Michael Sadler, St. Vincent’s Catholic Medical Center, New York, NY)
Left-sided appendicitis occurs in association with two types of congenital anomalies: situs inversus and intestinal malrotation (Kamiyama T et al. Radiat Med 2005); situs inversus has an incidence between 1 in 6,000 and 1 in 35,000.

CT findings of non-rotation: right-sided small bowel, left-sided colon, and an abnormal relationship of the superior mesenteric vessels, as well as aplasia of the uncinate process of the pancreas (Lee MR et al. World J Gastroenterol 2006).

19-year-old man with non-rotation and acute appendicitis (note SMV/SMA inversion) (case courtesy Dr. Brian Weber, Nassau University Medical Center)
Appendicitis and Rotation Anomalies

- CT is very useful for prospectively diagnosing intestinal non-rotation in conjunction with left-sided appendicitis

- The CT findings of left-sided appendicitis are very similar to those of right-sided appendicitis except for the opposite location (Kamiyama T et al. Radiat Med 2005)

- 32-year-old man with intestinal non-rotation, distal left-sided appendicitis, and secondary small bowel obstruction on non-enhanced CT; again note the SMA (small arrow)/SMV (large arrow) relationship
Appendicitis and Rotation Anomalies

- Two recent cases of non-rotation and appendicitis
Appendicitis and Rotation Anomalies

Corresponding coronal reformations
Stump Appendicitis

- Stump appendicitis is interval or continued inflammation or obstruction of any residual appendix following appendectomy.
- A rare complication although likely underreported; the increased use of laparoscopy may be increasing the frequency of residual appendiceal stumps (Liang MK et al. Am Surg 2006).
- Believed to be related to the decreased field-of-view, the lack of 3D perspective, and the absence of tactile feedback at laparoscopy (Shin LK et al. AJR 2005).

- 41-year-old man with RLQ pain and history of laparoscopic appendectomy 2 months earlier; stump appendicitis was diagnosed on CT and then pathologically proven.
Stump Appendicitis

- Mean time between initial appendectomy and recurrent symptoms is 10 years; range is 2 months to 50 years (Liang MK et al. Am Surg 2006)
- Usually perforated at surgery
- Signs & symptoms are similar to acute appendicitis, but the diagnosis often is not considered due to the prior appendectomy history
- 36 cases reported as of 2006; first report in 1945 (Uludag M et al. World J Gastroenterol 2006)
- Debate exists regarding decreased risk with simple ligation versus stump inversion (Shin LK et al. AJR 2005)
- 74-year-old man with ruptured appendicitis several years earlier, with asymptomatic stump and mild fascial thickening on CT 2 (bottom) and 5 (top) years later
Stump Appendicitis

- A few case reports on CT: findings may be specific in some cases – inflamed stump adjacent to cecum, residual appendicolith, with associated findings of cecal thickening, inflammatory changes, fluid, & abscess

- 35-year-old man with incidental asymptomatic appendiceal stump
Appendiceal Diverticulitis

- Appendiceal diverticula are discovered on 0.004% to 2.8% of appendiceal specimens at surgery/autopsy.
- Few reports of prospective CT diagnosis of appendiceal diverticulitis (Friedlich M et al. J Can Med Assoc 2004); series of 20 patients – up to 4 small distal wall outpouchings with wall enhancement (Lee KH et al. JCAT 2007).
- Associated with chronic appendicitis, which is presumably the most common cause; also associated with cystic fibrosis, and age >30; more common in males (Barc RM et al. J Radiol 2005).
- Increased risk of perforation; usually no lith.
- Virtually all are acquired pseudodiverticula.
- Appendiceal diverticulae are most frequently discovered in the distal appendix; more common on the mesenteric border; usually small (0.2 - 0.75 mm) (Chiou YY et al. JCAT 2003; Barc RM et al. J Radiol 2005; Lee KH et al. JCAT 2007).
- When multiple, appendix has a beaded appearance (Chiou YY et al. JCAT 2003).
- Occasionally discovered incidentally.
Appendiceal Diverticulitis

- Initial CT showed subtle lobulation of appendiceal contour without definite appendicitis although patient had RLQ pain.

- Follow-up CT several days later for worsening pain shows swollen appendix consistent with appendicitis & appendiceal diverticulosis; findings confirmed at surgery.
Appendic平itis & Pylephlebitis

- Septic thrombophlebitis of the portal venous system (pylephlebitis) secondary to complicated appendicitis was previously relatively common, but is now rarely found on cross-sectional imaging.

- Blood cultures are usually positive for bacterial infection.

- The role for anticoagulation is controversial (Balthazar EJ et al. JCAT 2000).

- Appendiceal abscess, mesenteric/portal venous thrombosis, & hepatic abscess (case courtesy Dr. Erik Paulson, Duke University).
Appendicitis & Pylephlebitis

- 36-year-old man with RUQ pain, after surgery for perforated appendix (left, several weeks later; f/u CT 2 weeks after that, right)
Appendicitis & Pylephlebitis

- 54-year-old woman with perforated appendicitis & subtle SMV/portal venous gas
Appendicitis in Hernias

- Appendicitis very infrequently occurs within a hernia – may be inguinal ("Amyand’s hernia", after Claudius Amyand, surgeon to King George II of England, who did the first appendectomy for this entity in 1735), femoral, umbilical, incisional, or Spigelian (D’Ambrosio N et al. AJR 2006)

- Prior to several recent CT reports, the diagnosis was almost always established at surgery; these patients were all believed to have incarcerated hernias

- 75-year-old man with incidental appendix in a right inguinal hernia
Appendicitis in Hernias

- The appendix is found in up to 1% of external hernia sacs, but appendicitis is found in only 0.13% of such sacs (Ash L et al. Emerg Radiol 2005)
- Debate as to whether the hernia is incidental, or if appendicitis is caused by compression from the hernia (Gupta S et al. Sing Med J 2005)
- CT is valuable for prospective diagnosis, although the findings may be confusing if the appendix has perforated, which is often the case (Luchs JS et al. JCAT 2000; Ash L et al.; Maizlin ZV et al. Emerg Radiol 2007)
- 79-year-old man with Amyand’s hernia on CT
Appendicitis in Hernias

- Femoral hernias are more common in women and rarely may be the site of appendicitis; first reported in 1731 by DeGarengot (D’Ambrosio N et al. AJR 2006; Fukukura Y et al. Abdom Imaging 2005; Maizlin ZV et al. Emerg Radiol 2007)

- Left-sided appendicitis in a hernia occurs rarely, in combination with malrotation, situs inversus, or a mobile cecum (Gupta S et al. Singapore Med J 2005)

- 74-year-old woman with perforated appendicitis in a large left abdominal wall hernia; note lith...
Appendicitis in Hernias

- 71-year-old woman with 2 weeks of a growing upper anterior right thigh mass; CT findings and surgical findings of perforated appendicitis in a femoral hernia
Appendicitis and Neoplasm

- Underlying neoplasm in appendicitis is found in 0.5 – 1.0% of appendectomy specimens, and 30-50% of appendiceal neoplasms present with signs and symptoms consistent with appendicitis (Pickhardt PJ et al. Radiology 2002)
- Appendicitis is related to luminal obstruction and/or secondary infection
- Carcinoid is the most common appendiceal neoplasm – usually distal, small, low-grade, and incidentally discovered (Pickhardt PJ et al. RadioGraphics 2003)

- 46-year-old woman with acute RLQ pain due to mucinous tumor at the cecal base involving the appendix
Appendicitis and Neoplasm

- 73-year-old woman with abdominal pain – new diagnosis of colon CA with metastases with secondary appendiceal involvement (& right common iliac vein DVT)
Appendicitis and Neoplasm

Case continued
Appendicitis and Neoplasm

- Need a relatively high radiographic index of suspicion to diagnose prospectively.
- Suspect if the appendiceal diameter on CT is > 15 mm, especially in an older patient (Pickhardt PJ et al. Radiology 2002).
- Important to diagnose as the surgical procedure often changes if a neoplasm is present; the surgeon also wants to avoid perforating or spilling tumor (particularly if related to a mucocele), if the tumor has not yet perforated (Bittle MM et al. AJR 2005).
- Lymphoma of the appendix is rare, but can present as acute appendicitis or lower GI bleeding.
- CT findings of appendiceal involvement by lymphoma include appendiceal enlargement which may be marked; pay careful attention to any associated adenopathy (Pickhardt PJ et al. AJR 2002; Katz DS AJR 2002).

Lymphoma of the appendix is rare, but can present as acute appendicitis or lower GI bleeding. CT findings of appendiceal involvement by lymphoma include appendiceal enlargement which may be marked; pay careful attention to any associated adenopathy (Pickhardt PJ et al. AJR 2002; Katz DS AJR 2002).
Primary non-mucinous adenocarcinoma of the appendix is very rare – few reports on the CT appearance.

A much more likely scenario is cecal adenocarcinoma with secondary appendicitis due to luminal obstruction/spread of tumor (Chiou YY et al. JCAT 2003).


45-year-old man with appendicitis and adenocarcinoid of the appendix - 2004.
Appendicitis and Neoplasm

- Same patient in 2008 - carcinomatosis
Appendicitis and Neoplasm

- Mucocele – condition of chronic obstruction of the appendiceal lumen leading to mucus accumulation; variety of underlying benign and malignant processes – up to 1/3 related to cystadenocarcinoma (Francica G et al. J Ultrasound Med 2006)

- Very variable clinical presentation – from an incidental finding to acute appendicitis; found in up to 0.3% of appendectomy specimens (Bittle MM et al. AJR 2005)

- 32-year-old woman with a mucocele, a 2 cm lith, and appendicitis
Appendicitis and Neoplasm

- Mucoceles are more common in women and in individuals > 50 years (Ruiz-Tovar J et al. World J Surg 2007)
- When large, it may be difficult to differentiate from ovarian cystic lesions
- CT: hypodense cystic oval mass, +/- mural calcification; if irregular wall with enhancing nodules suspect cystadenocarcinoma, but difficult to diagnose underlying etiology in most cases (Zhou M et al. Chin J Med 2006; Lim HK et al. AJR 1999)
- Pseudomyxoma peritonei may result from rupture

- 38-year-old man with acute RLQ pain secondary to a ruptured mucocele (note curvilinear calcification)
Appendicitis and Neoplasms

- 80-year-old man with acute RLQ pain – appendicitis related to mucocele
Intussusception

- Appendiceal intussusception is rare, especially in acute appendicitis; symptoms are usually more subacute
- May be due to appendicitis alone, but more often due to underlying mass or foreign body
- CT appearance is similar to that of other bowel intussusceptions; multiplanar reformations may be helpful
- Only a handful of cases have been diagnosed prospectively on imaging; one relatively recent case on CT (Luzier J et al. AJR 2006)

Example of intussusception of the appendix presenting as acute appendicitis
Intussusception

- 54-year-old woman with RLQ pain
Secondary Appendicitis

- 28-year-old woman with mild appendiceal inflammation secondary to ulcerative colitis
- 13-year-old boy with mild appendiceal inflammation secondary to an infectious pancolitis
Secondary Appendicitis

- 73-year-old woman with RLQ pain – mild appendicitis secondary to colitis
Secondary Appendicitis

- 64-year-old woman with pseudomembranous colitis; mild secondary appendiceal involvement
Conclusions

Radiologists need to be familiar with the broad spectrum of unusual and rare presentations of appendicitis as may be identified on CT, and the implications for appropriate patient management.