ACUTE RIGHT ILIAC FOSSA PAIN, BEYOND APPENDICITIS

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LEARNING OBJECTIVES

- Summarize the differential diagnosis in patients that complain of acute right iliac fossa pain.
- Analyze the role of radiologists in the management of these patients.
- Describe the spectrum of findings in the different entities responsible for this condition.

BACKGROUND

- Acute right iliac fossa pain remains one of the most frequent consultations in emergency rooms.
- Although appendicitis, due to its surgical treatment, is the most important condition to bear in mind in radiology studies, a large number of surgical and medical conditions can be responsible for pain at this site.
- Most of these patients are diagnosed with non-specific-pain and less than 30% are due to appendicitis.
- Up to one third of patients with acute appendicitis have atypical symptoms.
- Imaging before taking any decision on the management of these patients has become very important.

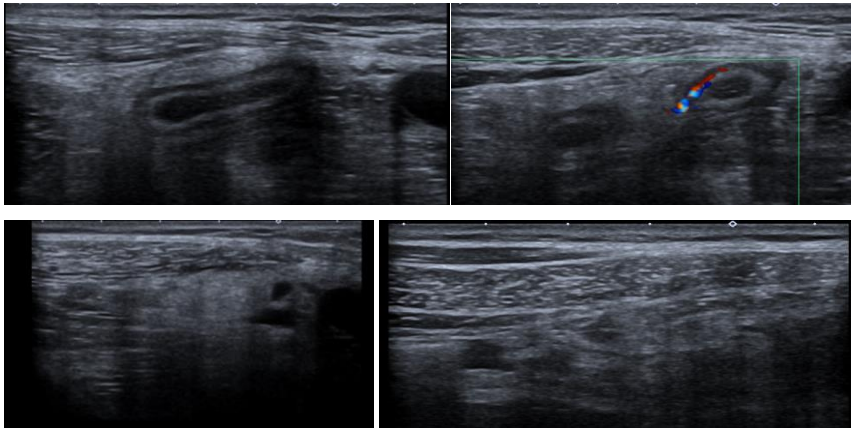
IMAGING FINDINGS

- Sonography is normally the initial imaging performed, due to its availability (and the fact that it does not involve the use of ionizing radiation, which makes it really important in pediatric and young patients, as well as in pregnant women). Nevertheless, sonography is highly operator-dependent, may be difficult in some situations (severe pain, obesity, late pregnancy and overlying gas) and may not allow the detection of normal or perforated appendixes.
- If the sonographic results are negative or inconclusive, or when ultrasound is not available, we proceed with CT, which allows the visualization of normal and abnormal appendixes and depicts the severity and extension of the inflammatory process, as well as diagnosing other causes of abdominal pain. CT should be performed with thin section scanning covering the entire abdomen and pelvis from the domes of the diaphragm to the pubic symphysis in a single breath hold and using IV contrast material (in the absence of contraindications). This will allow the identification of alternative causes of the pain in normal appendix findings. Disadvantages include the use of radiation, adverse reactions and costs.
- MRI can be practiced in pediatric patients and pregnant women when US is inconclusive.
- The differential diagnosis can be challenging, including gastrointestinal, urological and gynecological conditions. Most can be diagnosed in radiological studies, helping surgeons to decide which patients need to undergo urgent surgery. Ultrasound is the study of choice in the majority of cases but sometimes CT is necessary to reach the final diagnosis.
- In some cases, although the appendix is responsible for the symptoms, the diagnosis is not appendicitis. The appendix can be affected in other pathologies and these should also be considered.

IMAGING FINDINGS:

Appendicitis

- The normal appendix is seen as a thin-walled tubular structure originating from the posteromedial aspect of the cecum. It is approximately 2cm inferior to the ileocecal junction and surrounded by mesenteric fat.
- Appendiceal thickening is defined as a transverse diameter greater than 7mm (Fig.1). However, the upper limit of normal has been increased to 10mm and diameters of 6-10mm are indeterminate and should be evaluated in the context of clinical and other findings.
- Appendiceal wall thickening > 3mm, appendiceal wall hyperenhancement and the presence of appendicoliths and intramural gas make the diagnosis highly suggestive of appendicitis (Fig.2 and Fig.3).
- Appendicoliths are present in one third of patients with appendicitis and have prognostic importance because their presence increases the possibility of perforation Unfortunately they have low specificity due to their presence in asymptomatic patients.
- Periappendiceal inflammation can involve periappendiceal fat stranding, thickening of the lateral conal fascia and extraluminal fluid, abscesses, ileocecal lymph node enlargement and inflammatory thickening of contiguous structures such as cecum, ascending colon, terminal ileum, sigmoid and urinary bladder. If the abscess is large (> 4 cm), percutaneous drainage followed by delayed appendectomy is the preferred treatment. The presence of pericecal inflammatory changes is suggestive but not diagnostic of acute appendicitis. One needs to identify either abnormal appendix or an appendicolith to be sure. (Fig. 4 and Fig.5).
- Bacterial peritonitis is a dangerous complication and is due to appendiceal rupture. CT would show free fluid along the peritoneal reflections, sometimes far from the appendix. Gangrenous appendicitis is the result of intramural arterial thromboses. CT findings include pneumatosis and patchy areas of mural nonperfusion. (Fig. 6, Fig.7, Fig.8 and Fig.9).
- Although rare, patients with acute appendicitis may present mechanical obstruction, likely secondary to entrapment of the distal ileum in a periappendiceal inflammatory mass. More commonly, small-bowel obstruction is a late complication of appendectomy and is caused by postoperative fibrous adhesions in the peritoneal cavity.



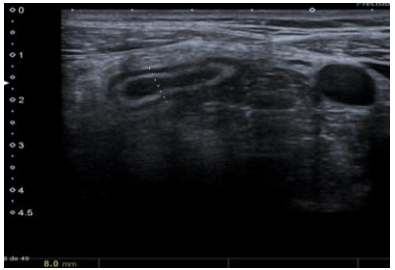
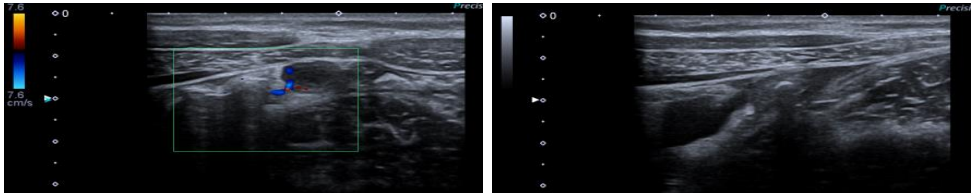


Fig.1. 50 year old man with RIF pain, fever and leukocytosis. US demonstrates dilated appendix (8mm) with wall thickening and increased Doppler sign. Hyperechogenic fat and free fluid are also seen, representing inflammatory changes.

Fig.2. 18 year old male with 12 hour right iliac fossa pain. US demonstrates circumferential wall thickening of the appendix, with high colour signal Doppler, and the presence of echogenic foci with distal acoustic shadowing in relation to appendicholites. Surgery confirmed acute appendicitis.



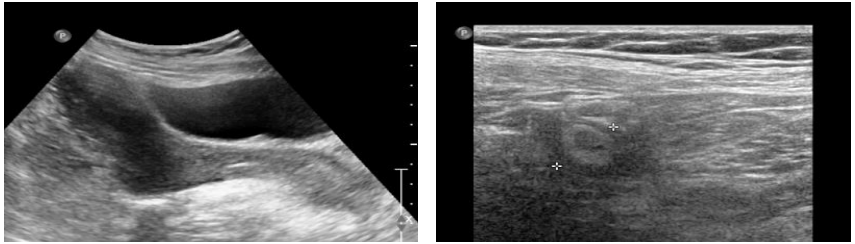


Fig.3. 44 year old female with abdominal pain focalized in right iliac fossa. US demonstrates dilated appendix, thickening of the appendix wall and fat stranding. Surgery confirmed acute appendicitis.

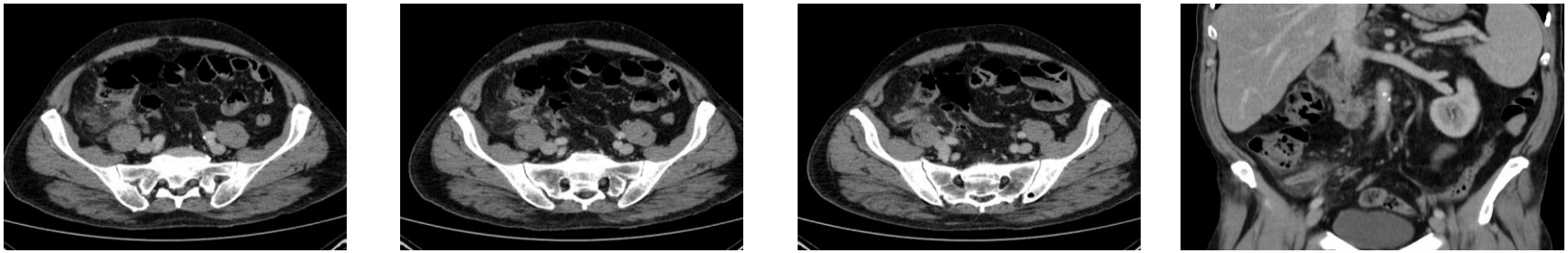


Fig.4. 71 year old patient with 48h periumbilical pain that migrates to the RIF, associated with vomiting and diarrhea. CT demonstrates retrocecal appendix increased in size with contrast enhancing walls associated with inflammatory changes in the adjacent fat and enlarged lymph nodes as well as thickening of the peritoneal layers.

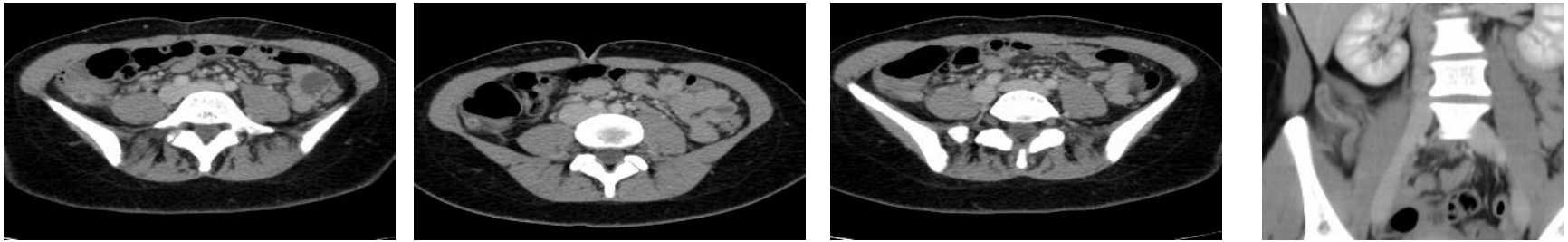
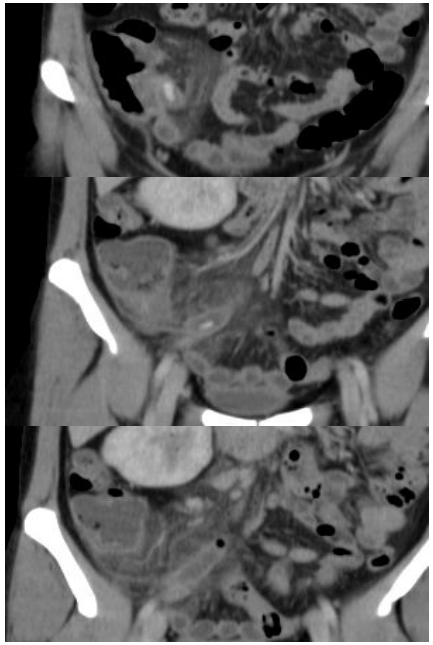


Fig. 5. 19 year old girl with 48h epigastric pain migrating to the RIF., nauseas, no vomiting and no fever, associated with 12300 leukocytes. CT scan shows an enlarged retrocecal appendix with hyperattenuating walls and fat stranding.



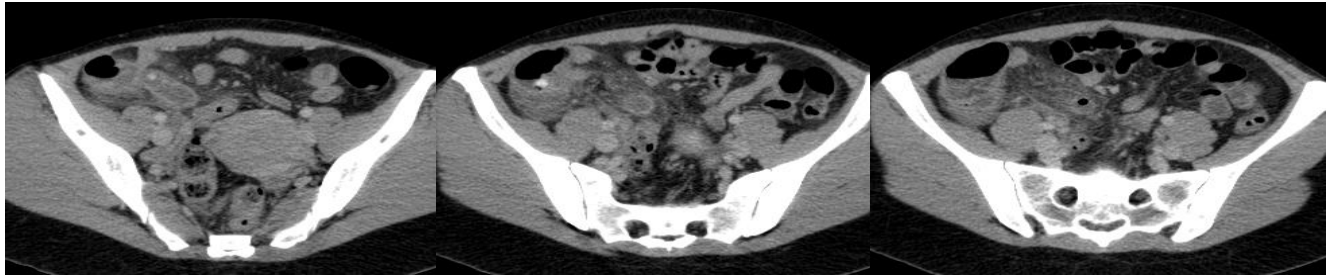


Fig.6. 41 year old woman with 3 day RIF pain, fever, nauseas and vomiting associated with 17000 leukocytes. CT shows dilated appendix with circumferencial and hyperattenuating walls . Appendicolythes are also seen associated to important inflammatory changes. Surgery confirmed microperforated acute gangrenous appendicitis.

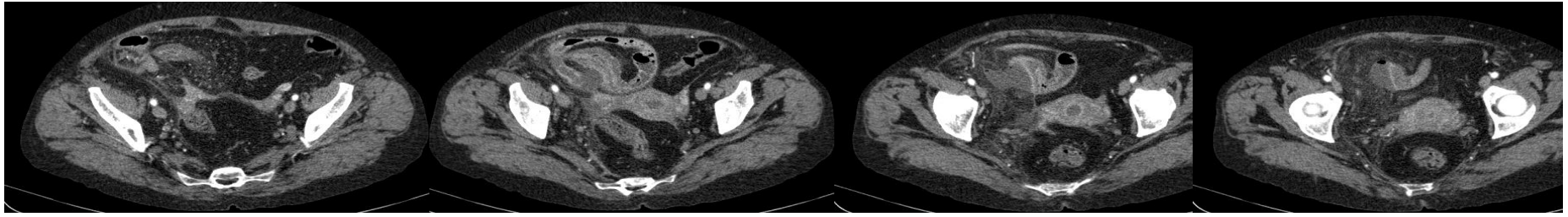


Fig.7. 64 year old woman with RIF pain. CT shows a retrocecal appendix with dilated base and bad definition of the walls in the distal segment. Free fluid and gas are also seen in relation to perforated appendicitis. Reactive wall thickening of the ileum is also seen. Gangrenous appendicitis was found at surgery.

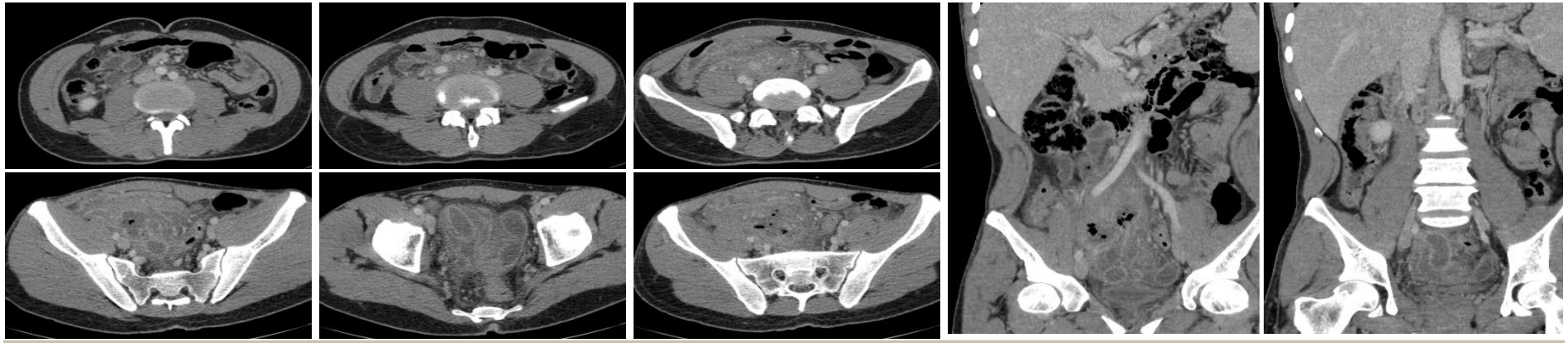


Fig.8. CT scan practised in a 37 year old man with suspected appendicitis who was diagnosed with an acute gastroenteritis 5 days before and came to the emergency room with increased pain and leukocytosis. Important inflammatory changes extending from the RIF to the mesentery with enlarged lymph nodes, free fluid and gas formation in relation to perforated appendix. Thickening of the ileum is also seen as a reactive change.

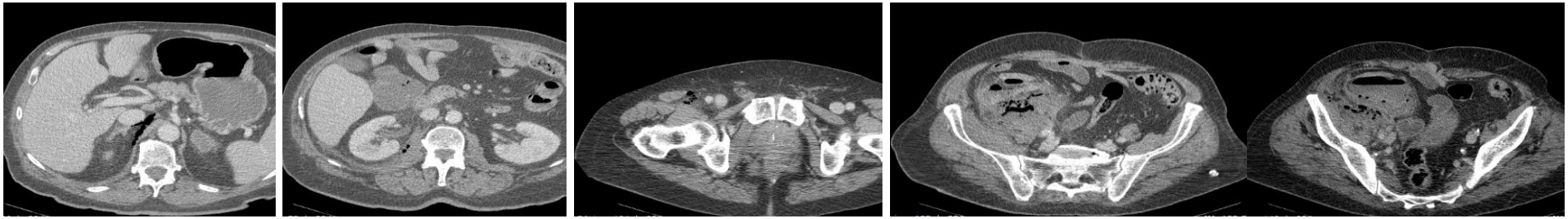


Fig.9. 73 year old man with 3 day right iliac fossa pain, fever and vomiting. CT demonstrates free gas extending from the RIF to the right retroperitoneal space and the right groin associated with important inflammatory changes surrounding the appendix. End of the appendix is normal but the base has interrupted walls which suggests perforation from its joint to the cecum. Surgery confirmed perforated appendicitis.

IMAGING FINDINGS:
Differential Diagnosis

- ILEITIS:
  - Small-bowel inflammatory conditions affecting the distal or terminal ileum can mimic appendicitis.
  - Crohn's disease is the most frequent cause. It is a chronic granulomatous inflammatory condition than can involve any segment of the gastrointestinal tract but most commonly involves the terminal ileum and right colon. Imaging features include ileocolic circumferential wall thickening which can show mural stratification on contrast CT scans (target sign). Local proliferation of mesenteric fat, prominent vessels, fistulas and abscesses are often found. Crohn's disease may involve the appendix. It is important to differentiate it from a real appendicitis as it is treated conservatively. (Fig.10 and Fig.11).
  - Other ileitis include ulcerative colitis, which involves the ileum in 25% of cases, and intestinal infections such as Yersinia.
- CECAL OR RIGHT COLONIC DIVERTICULITIS
  - Diverticulitis of the colon is one of the most common causes of acute abdominal pain in elderly patients, typically manifested as left-side lower abdominal pain because the left and sigmoid colon are predominantly affected.
  - If the normal appendix cannot be seen the differential diagnosis can be challenging. CT findings include pericecal inflammatory changes, cecal or right colon mural thickening and visualization of one or more diverticula. The inflamed diverticulum may contain gas, fluid, contrast material, or calcified material. (Fig.12, Fig.13 and Fig.14).
  - Differentiation from malignancy can be difficult or in some cases impossible.
- ILEAL DIVERTICULITIS:
  - Much less frequent than colonic diverticula.(Fig.15).
  - Normally multiple and usually aymptomatic.
  - When they become inflamed, the clinical presentation is indistinguishable from acute appendicitis.

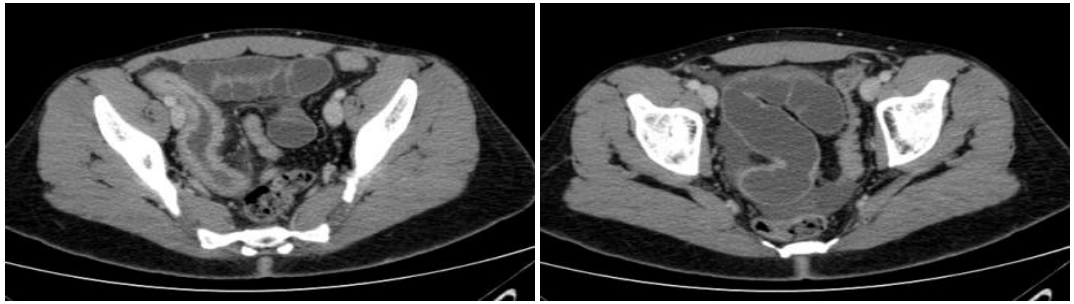


Fig.10. 27 year old male with epigastric pain that migrates to right iliac fossa, nauseas and leukocytosis (16000). US is practised, visualizing normal appendix and dilated small bowel. CT shows terminal ileum wall thickening with retrograde dilation of small bowel, and free fluid in abdominal cavity, making the diagnosis of intestinal inflammatory disease.

Fig.11. 63 year old man with abdominal RIF pain and leukocytosis. CT demonstrates enlarged distal ileum with hyperattenuating thickened walls. Important contact with urinary bladder and fistula formation is also seen (gas was seen in the interior of the urinary bladder). Normal appendix is also seen. The patient was diagnosed with Crohn's disease.

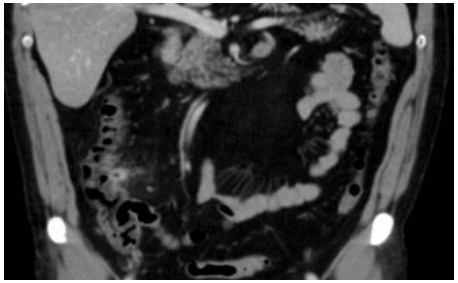
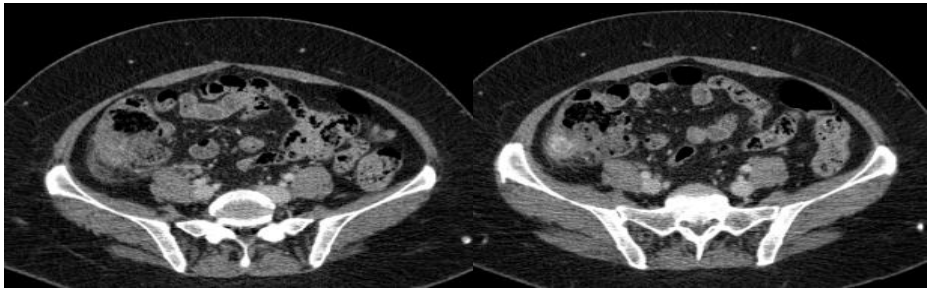
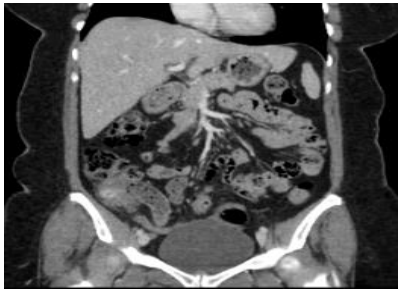
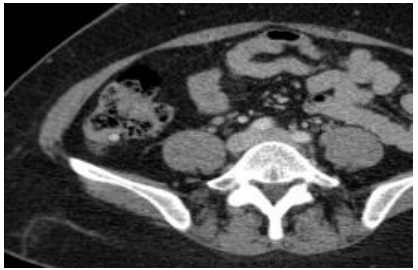


Fig.12. 59 year old man with one day of right iliac fossa pain and fever. CT demonstrates a right colon diverticulum with enhancing wall and inflammatory changes in the surrounding fat. Imaging findings point to right colon diverticulitis.

Fig.13. 52 year old woman with 24h epigastric pain that migrates to RIF and leukocytosis. CT shows Inflammatory changes in the RIF with cecum wall thickening and nodular hyperdense image suggestive of diverticulum. Normal appendix is seen.







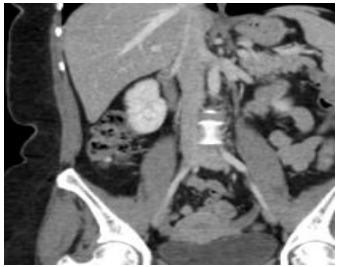
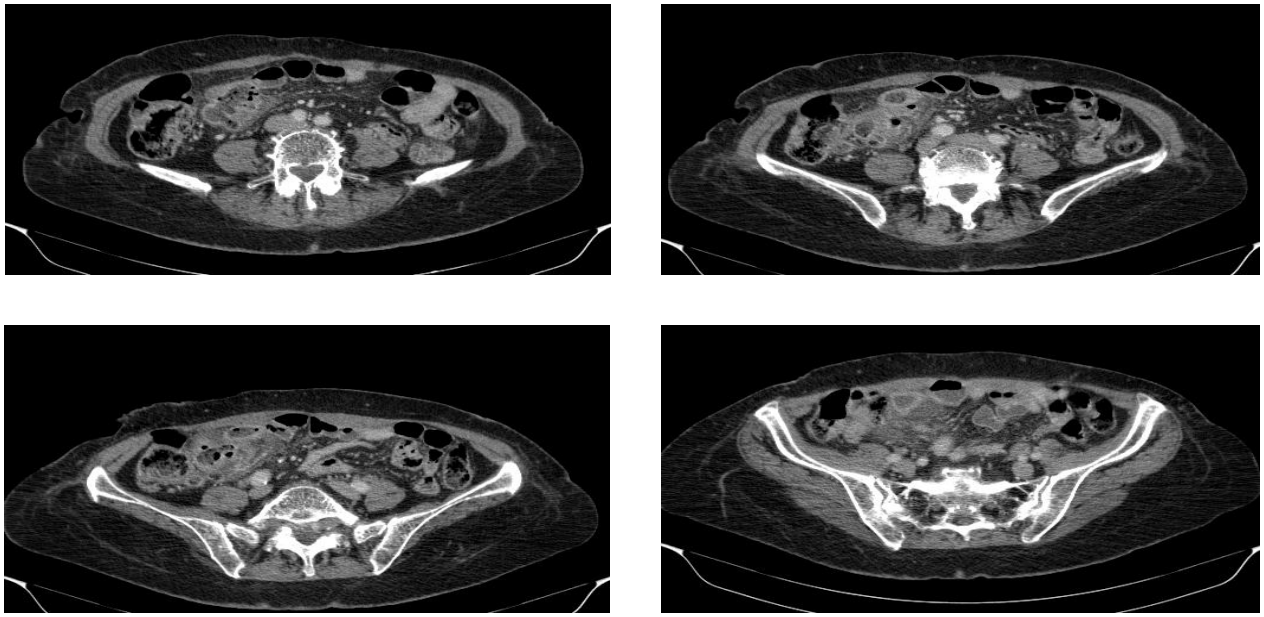


Fig.14. Same patient as Fig.13. after antibiotic treatment shows resolution of the inflammatory changes and normal diverticulum in the cecum wall, confirming the previous diagnosis of cecum diverticulitis.



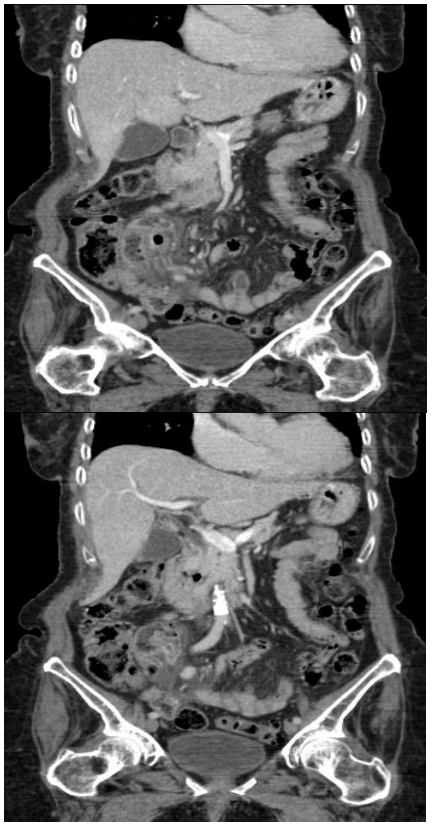


Fig.15. 90 year old woman with RIF pain and fever. Abdominal CT shows distal ileum enhancing wall thickening and multiple diverticula, associated with inflammatory changes in the surrounding fat, findings of acute distal ileum diverticulitis. Medical treatment was given with clinical improvement.

IMAGING FINDINGS:
Differential Diagnosis

- GYNOCOLOGICAL CAUSES:
  - Pelvic inflammatory disease: although typically vaginal discharge is present, the differential diagnosis is sometimes difficult. More common if there are multiple sexual partners, a history of PID and if an intrauterine device is in place. (Fig.16).
  - Ovarian pathology: patients with ovarian torsion, ectopic pregnancy and complicated tumours can present a severe RIF pain that simulates appendicitis. (Fig.17).
- URETERIC COLIC:
  - Stones in the ureter cause severe flank pain that migrates to the inguinal region in 60-95% of cases.
  - Imaging modalities demonstrate the presence of lithiasis in the urological tract with or without associated hydronephrosis and inflammatory changes in the surrounding fat and kidney. (Fig.18).

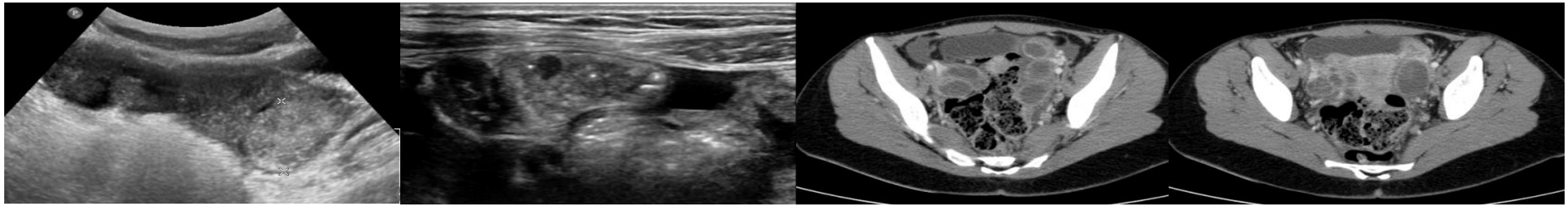


Fig.16. 24 year old woman with right iliac fossa pain. US demonstrates dilated tubular bilateral images in the pelvis and free pelvis fluid. CT confirms the diagnosis of bilateral tuboovarian abscess.

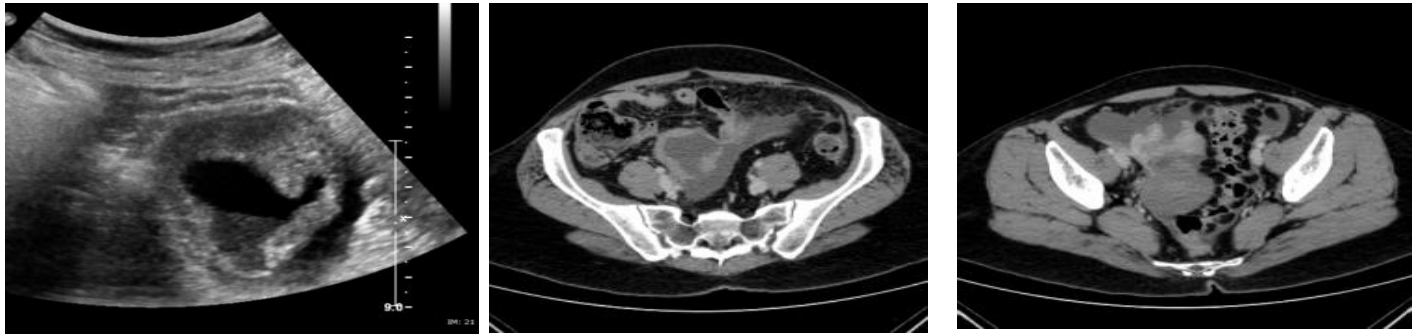


Fig.17. 39 year old female with right iliac fossa pain. US shows a parautherine lesion with wall thickening and free fluid. CT is practised showing an ovarian heterogeneous mass with a thick capsule that appears broken, communicating with peritoneal cavity. Ovarian adenocarcinoma with peritoneal carcinomatosis was confirmed.

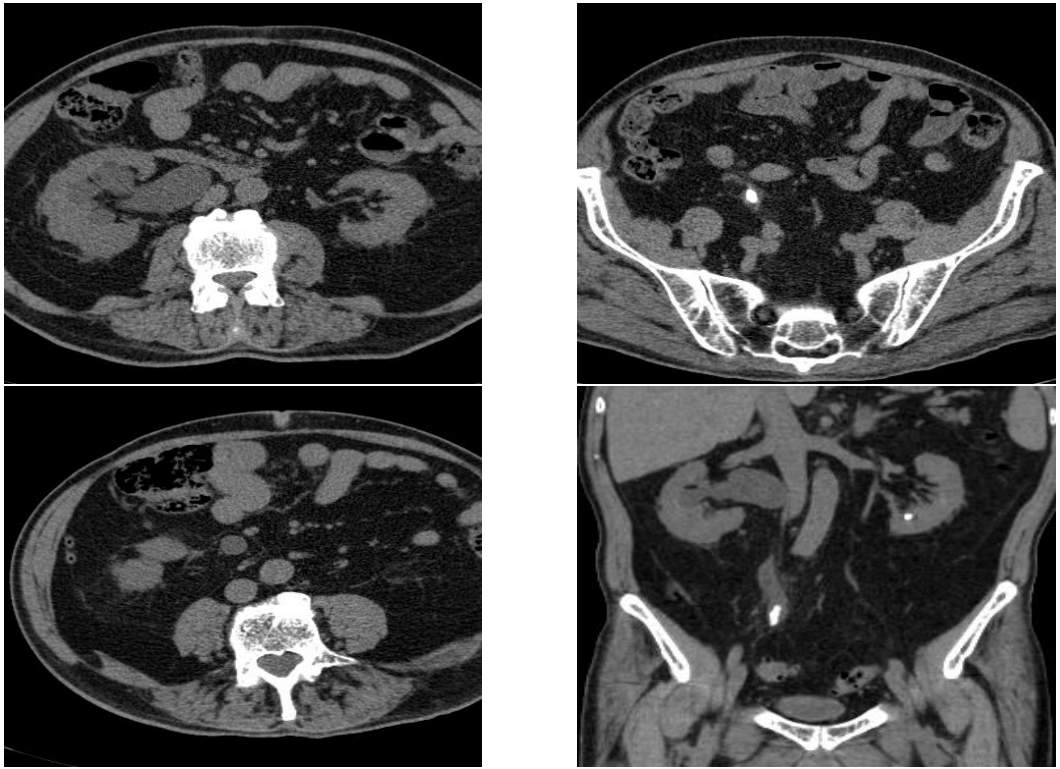


Fig.18. 67 year old man. Non-contrast CT scan shows right hydronephrosis due to lithiasis in the mid ureter. Normal appendix is also seen.

IMAGING FINDINGS:
Differential Diagnosis

- MESENTERIC ADENITIS:
  - This is the most common alternative condition identified at negative appendectomy, frequently in children and young adults.
  - It is a benign inflammation of the ileocolic lymph nodes usually caused by a viral infection of the gastrointestinal tract.
  - Imaging studies will show enlargement of mesenteric lymph nodes (>5mm), thickening of the adjacent cecum and ileum, and a normal appendix.
- EPIPLOIC APPENDAGITIS:
  - An uncommon condition caused by inflammation, torsion, or ischemia of an epiploic appendage.
  - The most common finding on CT is a fat density oval lesion with surrounding inflammation adjacent to the colon.
  - A round or linear hyperdense focus in the centre of the lesion is characteristic but not always present, and represents a thrombosed central vein.
- OMENTAL INFARCTION:
  - Rare condition in which there is a segmental infarction of some portion of the omentum.
  - CT findings include a well circumscribed region of fat with surrounding inflammatory fat stranding (Fig.19).

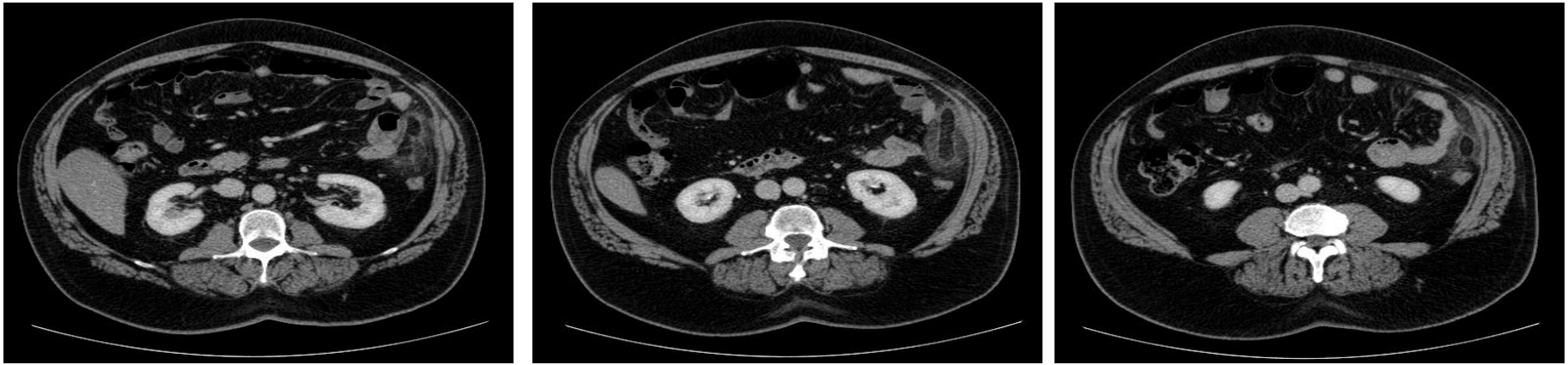
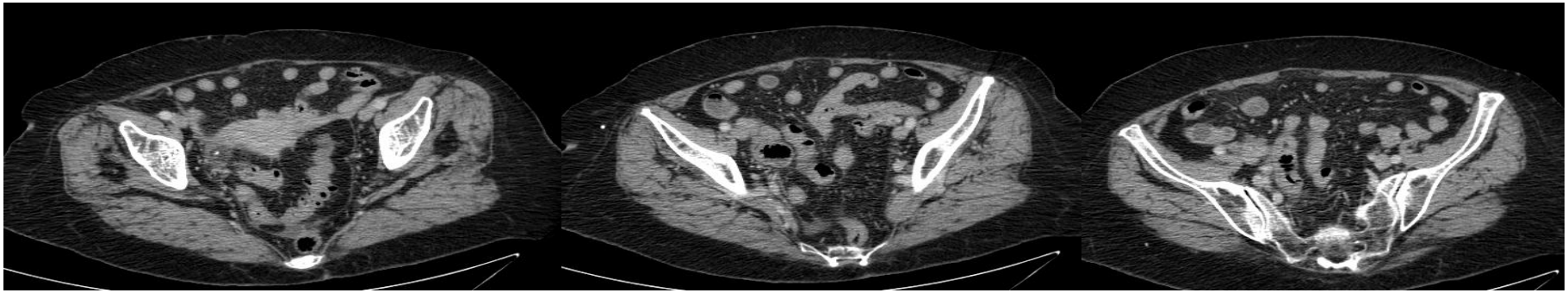


Fig.19. 64 year old man with intense LIF pain and leukocytosis. CT demonstrates an omental infarct. A solitary well circumscribed oval heterogeneous fatty mass is seen on the left flank, situated between the anterior abdominal wall and the left colon. When located on the right, clinical findings may point to appendicitis.

IMAGING FINDINGS:
Differential Diagnosis

- OTHER RARE CONDITIONS:
  - Typhlitis: severe condition that affects patients with a weakened immune system, mostly patients under intensive chemotherapy treatment. CT shows a marked low-attenuation cecal wall thickening with pericolonic inflammatory stranding. (Fig.20).
  - Meckel's diverticulum: a congenital abnormality of the gastrointestinal tract present in approximately 2% of the population. It is a slight bulge in the small intestine 50-100cm from the ileocecal junction located on the antimesenteric border. Normally asymptomatic, if symptoms occur due to complications such as intussusception, perforation and inflammation they can mimic an acute appendicitis on intestinal obstruction. The CT appearance is a blind ending pouch of variable size containing fluid and air, with mural thickening, hyperenhancement and surrounding mesenteric inflammation. (Fig.21).
  - Internal hernia: although uncommon, they may cause intestinal obstruction, especially in the abscence of a history of abdominal surgery or trauma. CT findings include small-bowel obstruction, saclike mass or cluster of dilated small bowel loops at an abnormal anatomical location and an engorged and displaced mesenteric vascular pedicle with vessels converging at the hernial orifice. (Fig.22 and Fig.23).

Fig.20. 50 year old man in chemotherapy treatment for advanced pancreatic cancer with RIF pain. CT shows a diffuse ascendant colon wall thickening, with inflammatory changes in the surrounding fat. These findings in this clinical context suggest the diagnosis of Typhlitis. Biliary prosthesis is also seen.



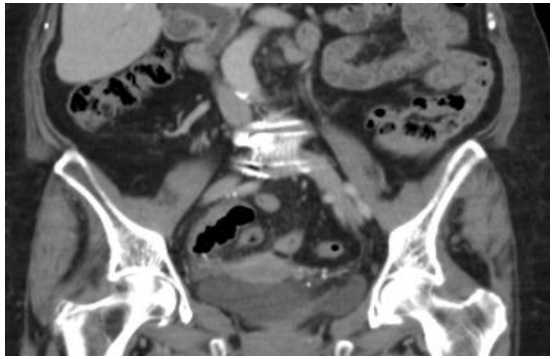


Fig.21. 76 year old woman with abdominal pain and leukocytosis. CT shows parietal addition imaging of 4cm adjacent to distal ileon, with a dense lineal imaging inside and fat straining. The diagnosis was diverticulitis caused by a fish bone in a Meckel diverticulum.

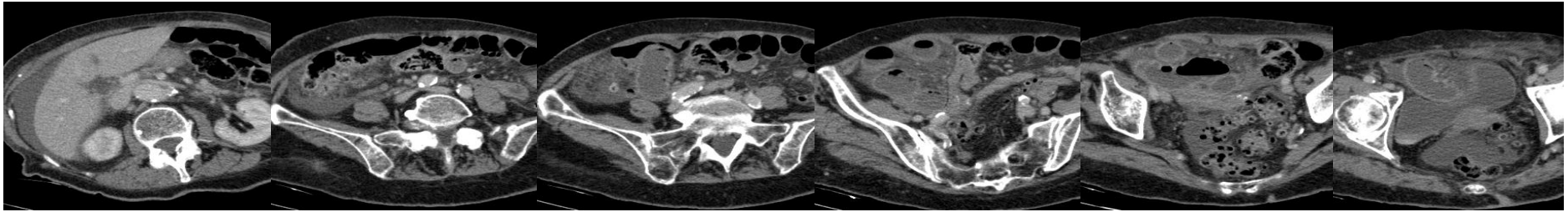


Fig.22. 97 year old woman with clinical suspicion of appendicitis. CT demonstrates dilated ileum with change of calibre in the pelvis, associated with free fluid in the abdomen. Normal appendix is seen. CT confirmed internal hernia.

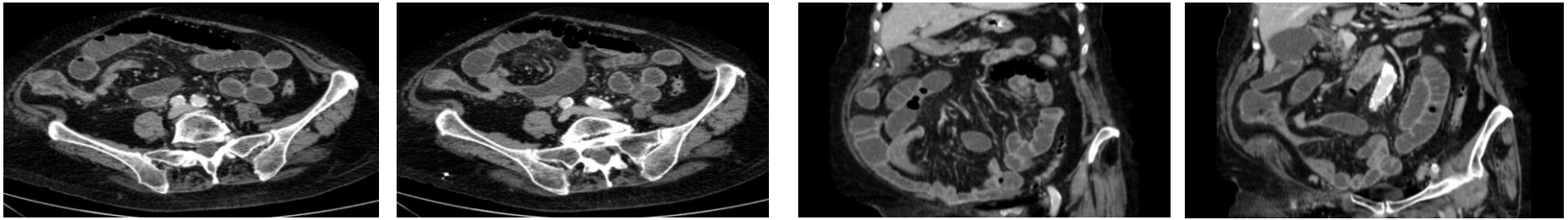


Fig.23. 96 year old woman with abdominal pain that focalizes in the right iliac fossa and 16000 leukocytes. CT shows small-bowel obstruction, observing whirlpool sign in the adjacent fat and retraction of the appendix. Free fluid is also seen. Internal hernia with appendix involved was diagnosed.

IMAGING FINDINGS:
Differential Diagnosis

- In some cases, although the appendix is responsible for the symptoms, the diagnosis is not appendicitis. The appendix can be affected in other pathologies and these should also be considered.
- Appendix tumours are unusual, accounting for 0.4% of all gastrointestinal tract malignancies.
  - Mucocele is a well capsulated cystic mass in the pericecal region representing the distended appendiceal lumen caused by abnormal mucus accumulation, usually without periappendiceal inflammation or abscess. Curvilinear or punctuate calcifications may be seen on non contrast CT scans. Focal nodular thickening in the wall suggests mucinous cystadenocarcinoma. Peritoneal carcinomatosis may be present, frequently in cases of peritoneal pseudomixoma.(Fig.24 and Fig.25).
  - Adenocarcinoma: solid mass in the appendix that obstructs the lumen. Metastases may be present at diagnosis.(Fig.26).
  - Other tumours: other tumours such as lymphoma and adenoma can affect the appendix.(Fig. 27 and Fig.28).

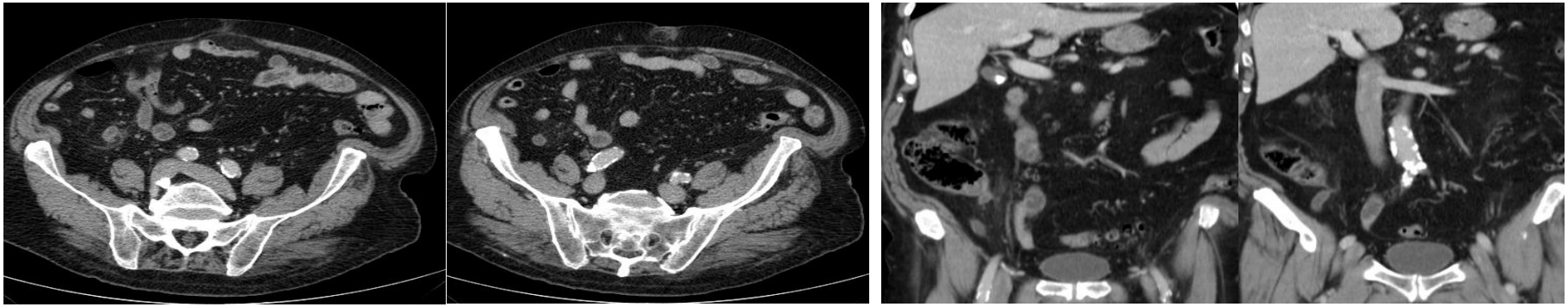


Fig.24. 84 year old man with RIF pain and abdominal defense. CT scan shows a dilated appendix with minimum fat stranding. Surgery was performed and an appendicitis underlying a mucinous appendicular neoplasm was found.

Fig.25. 72 year old female with right iliac fossa pain and weight loss. US does not visualize the appendix. CT shows retrocecal appendix with thin walls, dilated in its distal third (14mm) with minimum fat stranding suggesting appendicular mucocele. Surgery confirms low grade mucinous appendix neoplasm.

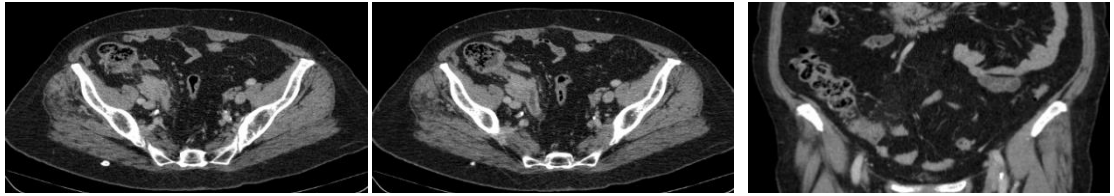
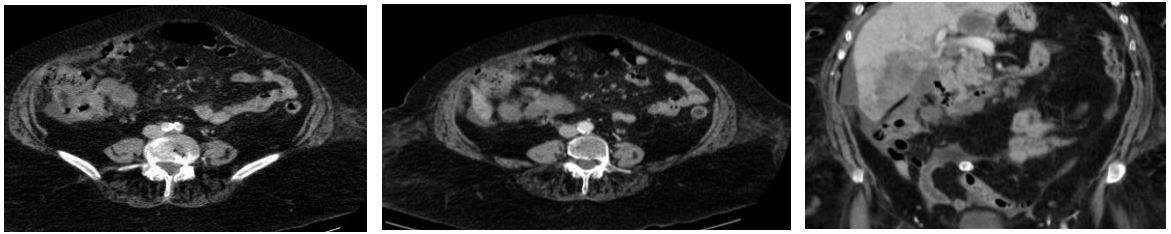


Fig.26. 85 year old female with right abdominal pain and toxic syndrome. CT shows imaging findings suggestive of appendicular tumour extending from the base to the end, with subhepatic location, in contact with duodenum and hepatic segment VI as well as multiple focal hepatic lesions (metastases) and micronodular peritoneal fat suggesting peritoneal carcinomatosis. Hepatic biopsy confirmed appendicular adenocarcinoma.

Fig.27. 79 year old female with right iliac fossa pain, leukocytosis and toxic syndrome. CT demonstrates imaging findings of probable appendicular neoformation in contact with right ovary and terminal ileum, with no signs of peritoneal carcinomatosis. Surgery confirms 35mm tubulovillous adenoma localized in the appendicular base.



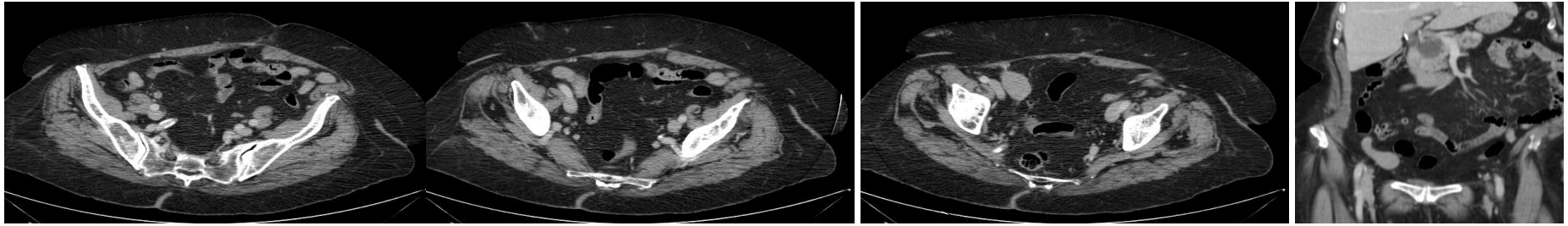


Fig.28. 89 year old woman with RIF pain. CT shows a pseudonodular tubular image in the RIF originating in the cecum and an enlarged external iliac lymph node. A cystic pancreatic mass is also seen. Lymphoma was found in the surgical piece.

CONCLUSIONS

- Radiologists need to be aware of the differential diagnosis in patients with right acute iliac fossa pain in order to avoid unnecessary appendectomies.
- US and CT are the imaging modalities that can help us to achieve the correct diagnosis.