"AROUND ILEO-CECAL REGION IN 2500 WORDS"-AN ORGAN-BASED IMAGING REVIEW OF PATHOLOGIES.

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LEARNING OBJECTIVE

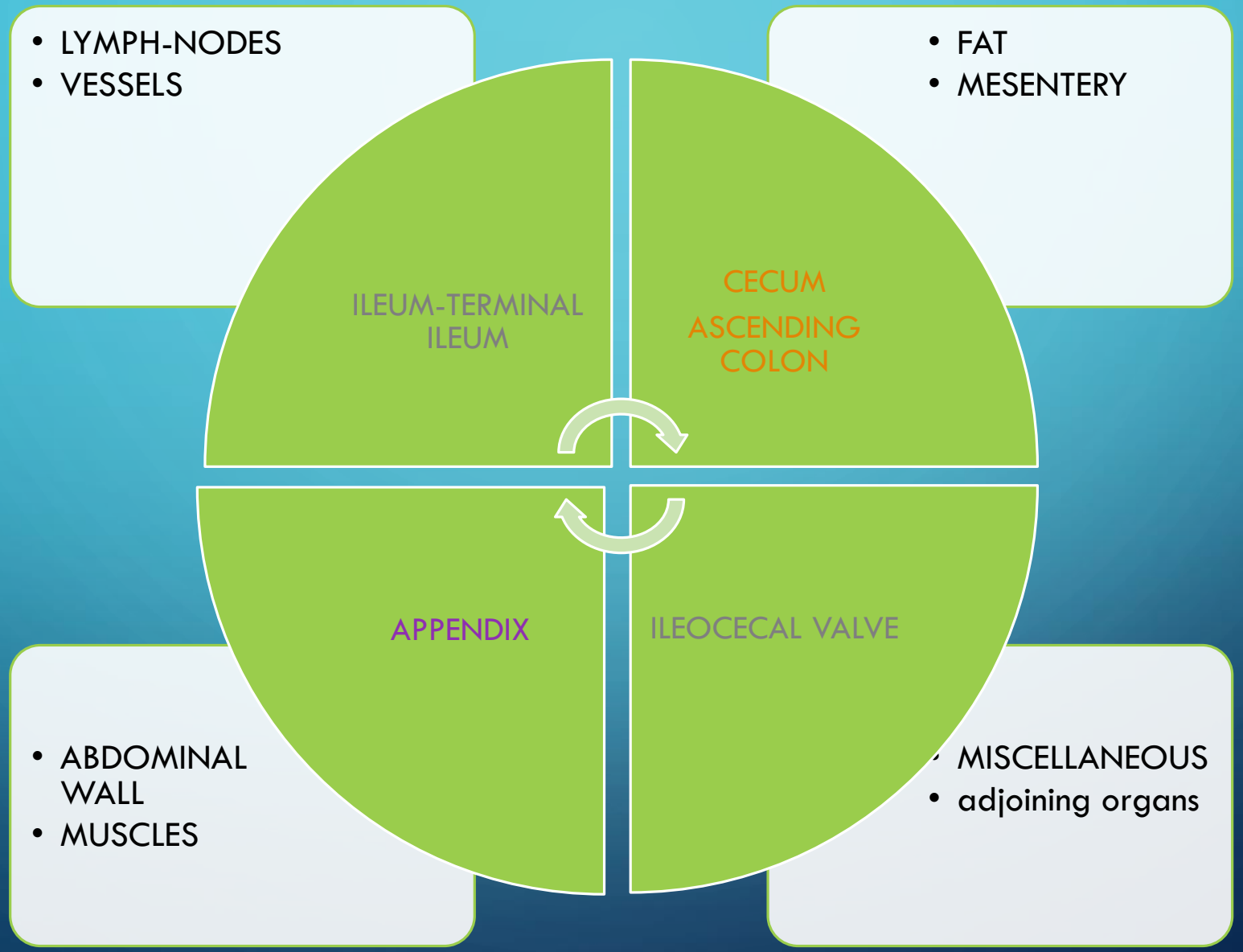
- To delineate imaging features of right lower quadrant pathologies using an organ-based approach.

BACKGROUND

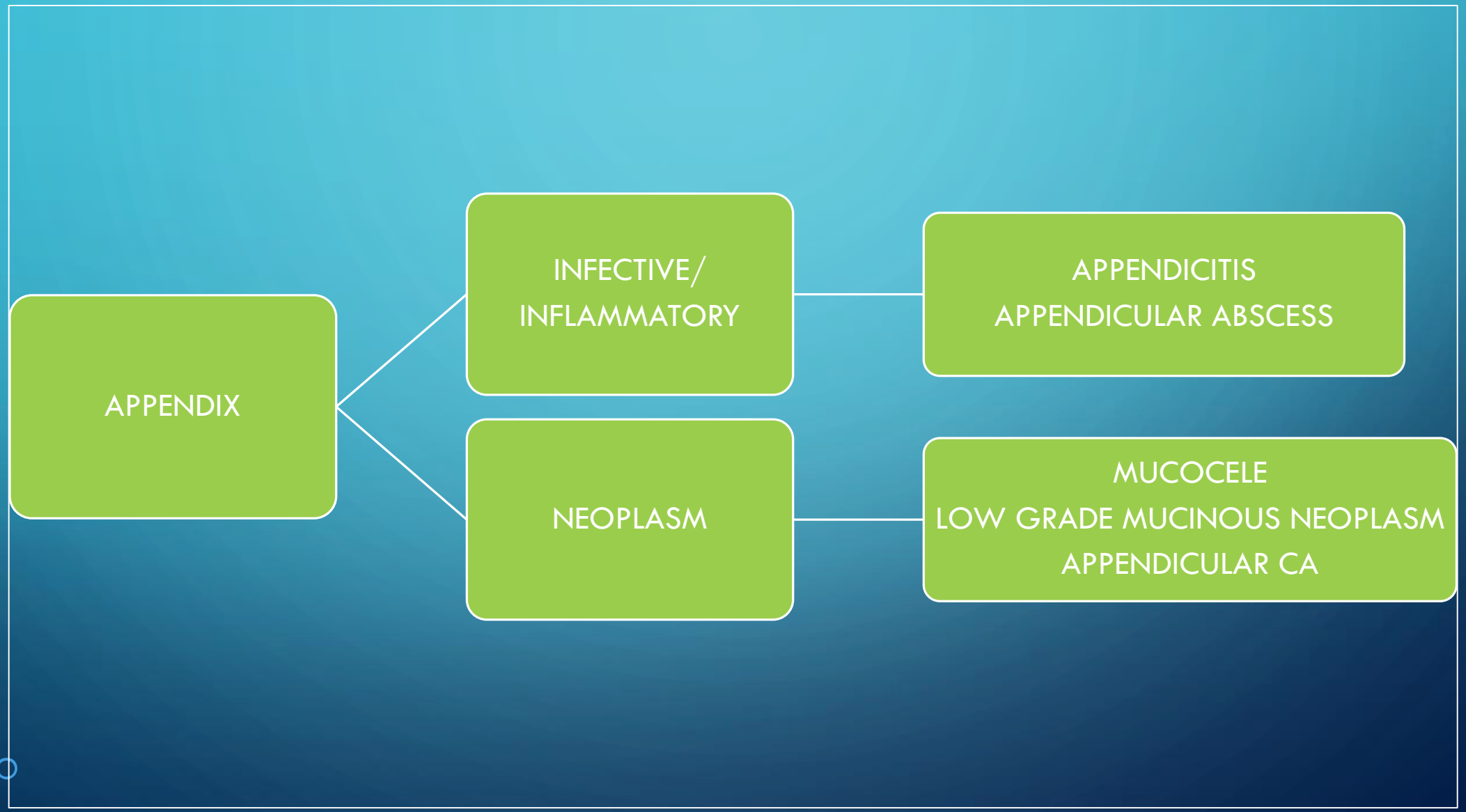
- Right iliac fossa perhaps is one of the most important abdominal quadrant from a surgeon's perspective. A broad spectrum of pathologies can arise from this potentially small space varying from commonly encountered appendicitis to Inflammatory bowel diseases to infections and neoplasms. The Radiologist can play a pivotal role not just in picking up various abnormalities but also by suggesting a meaningful differential diagnosis.

PROCEDURE DETAILS

- This educational exhibit aims at reviewing various pathologies of right lower quadrant using organ-based approach as shown in the algorithm below. Wherever possible the pathologies will be discussed under infection, inflammatory, neoplastic and miscellaneous categories. Relevant radiological anatomy and pertinent imaging findings will be discussed.


• LYMPH-NODES
• VESSELS
• FAT
• MESENTERY
ILEUM-TERMINAL ILEUM
CECUM
ASCENDING COLON
APPENDIX
ILEOCECAL VALVE
• ABDOMINAL WALL
• MUSCLES
• MISCELLANEOUS
• adjoining organs

APPENDIX


APPENDIX
INFECTIVE/
INFLAMMATORY
APPENDICITIS
APPENDICULAR ABSCESS
NEOPLASM
MUCOCELE
LOW GRADE MUCINOUS NEOPLASM
APPENDICULAR CA

APPENDICITIS-IMAGING CONSIDERATIONS

- Although CT is the gold standard, ultrasound is considered a primary imaging modality in many institutions.
- Sonography technique includes graded compression using a linear probe over the site of maximal tenderness.
- In cases with non diagnostic ultrasound and non visualization of appendix, clinical reassessment should be done. Further imaging with MRI/CT to be considered depending on clinical concern.

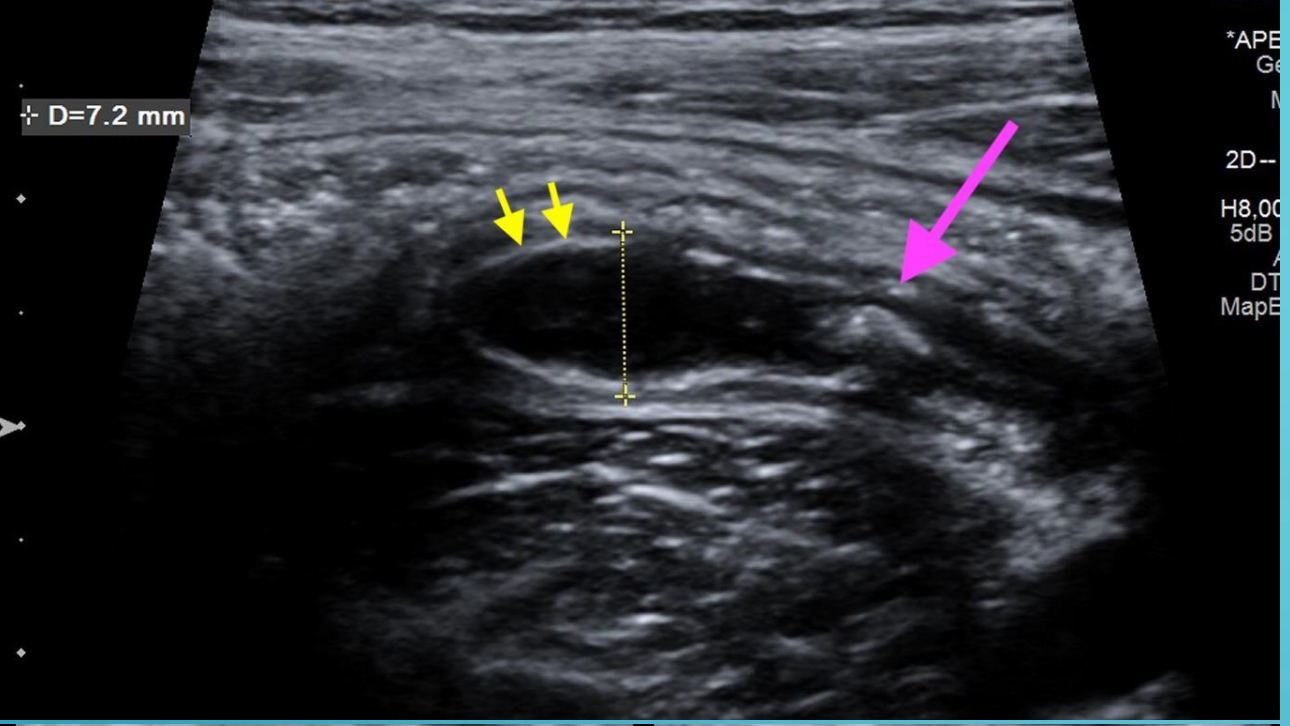
APPENDICITIS –SONOGRAPHIC FINDINGS

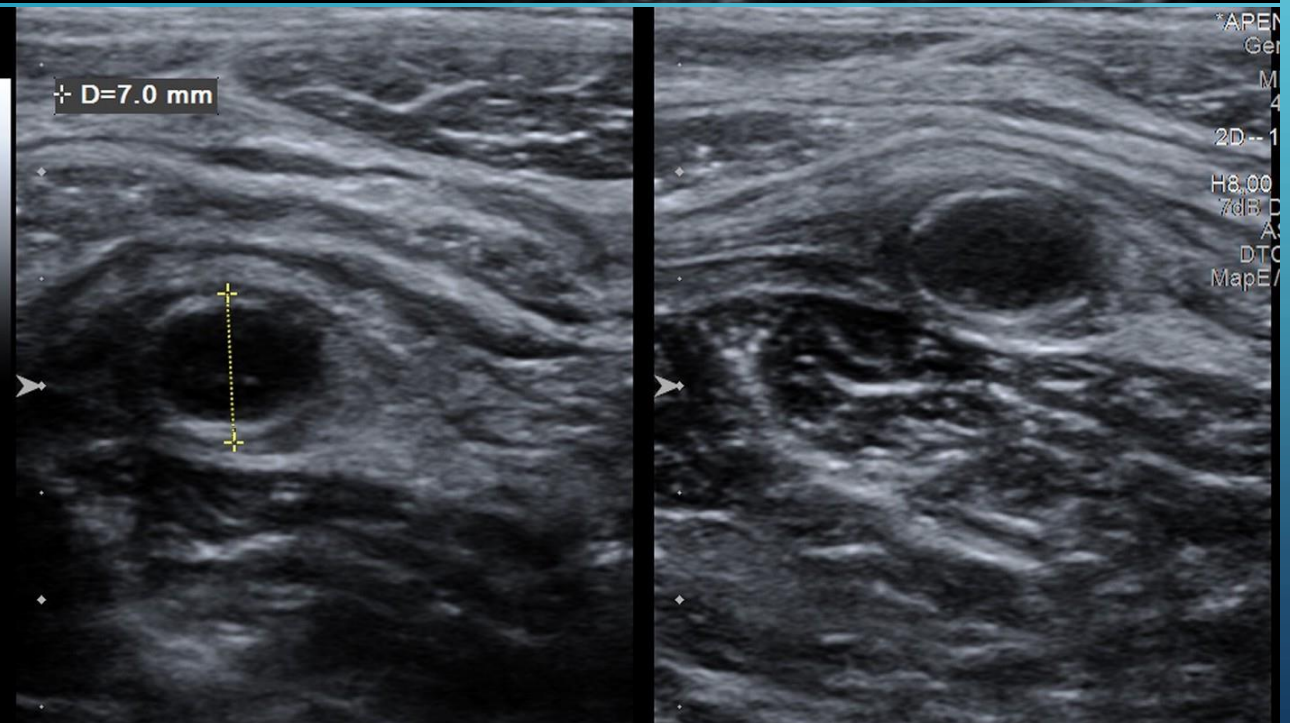
DIRECT SIGNS-

- Dilated, tubular, blind ending , aperistaltic, non compressible structure in right Iliac fossa.
- Diameter of >6mm.
- Target Sign-hypoechoic fluid filled lumen, echogenic mucosa/submucosa and hypoechoic muscularis.
- Probe tenderness may be present.

INDIRECT SIGNS-

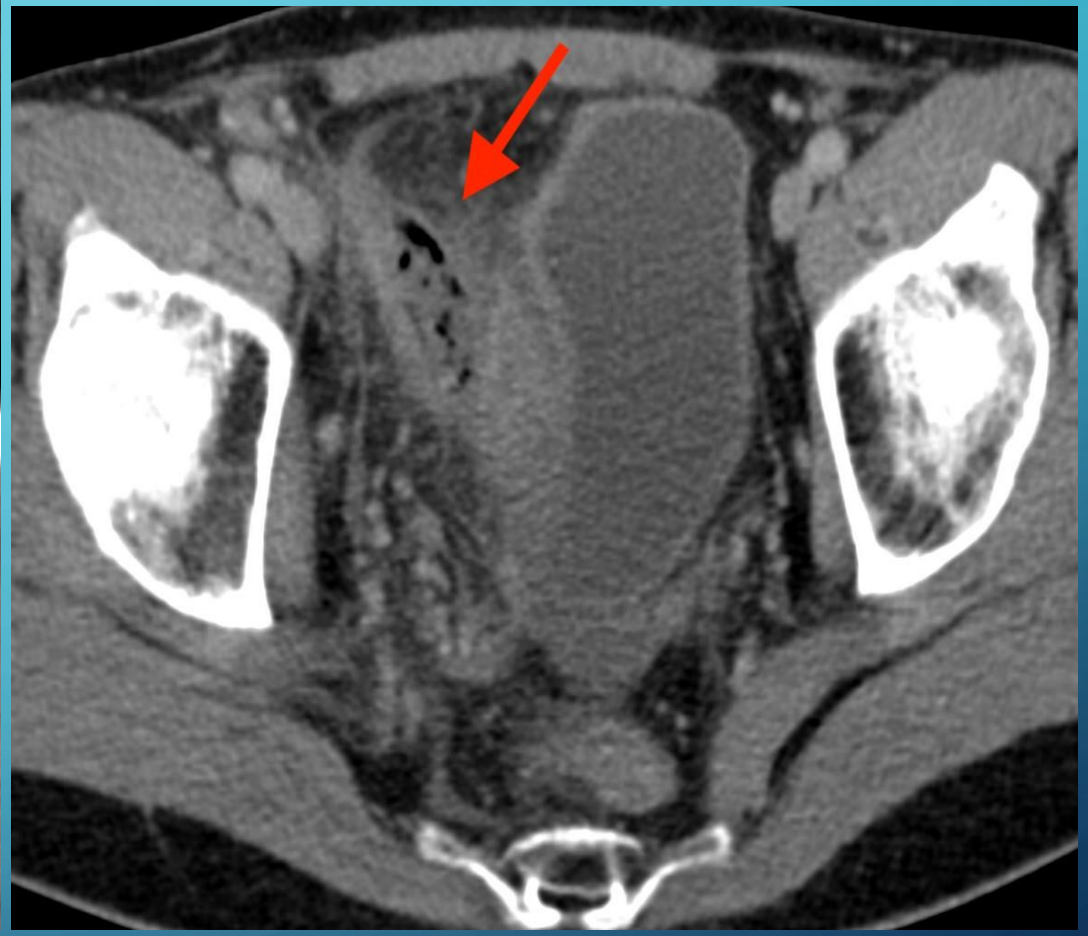
- Fluid in pelvis or right iliac fossa.
- Increased echogenicity of surrounding fat.
- Local Abscess.
- Signs of small bowel obstruction.



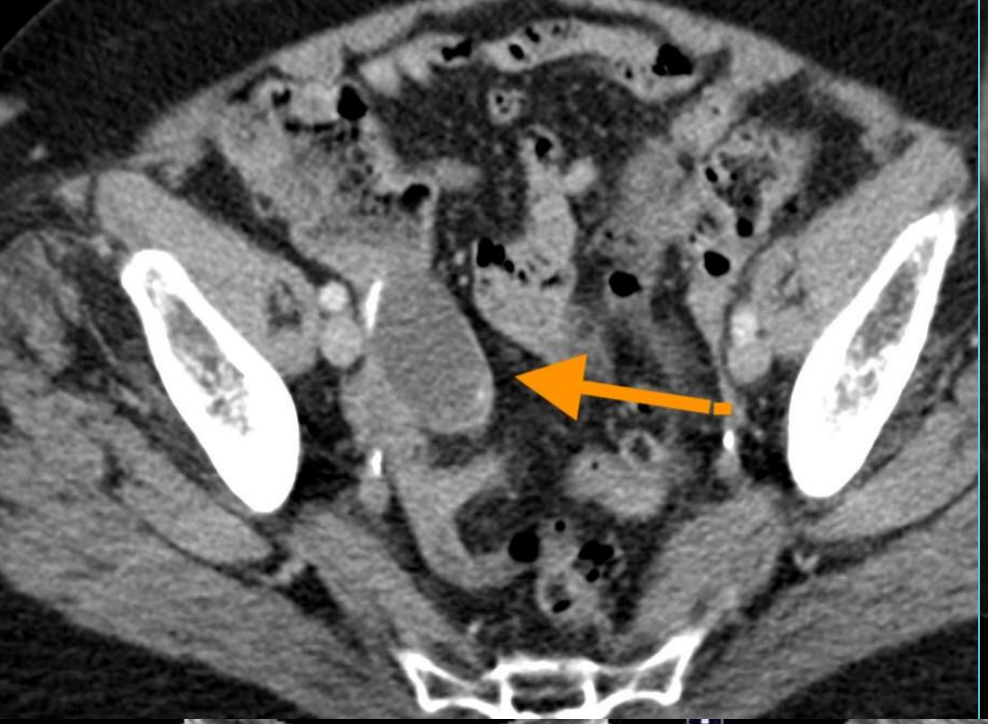


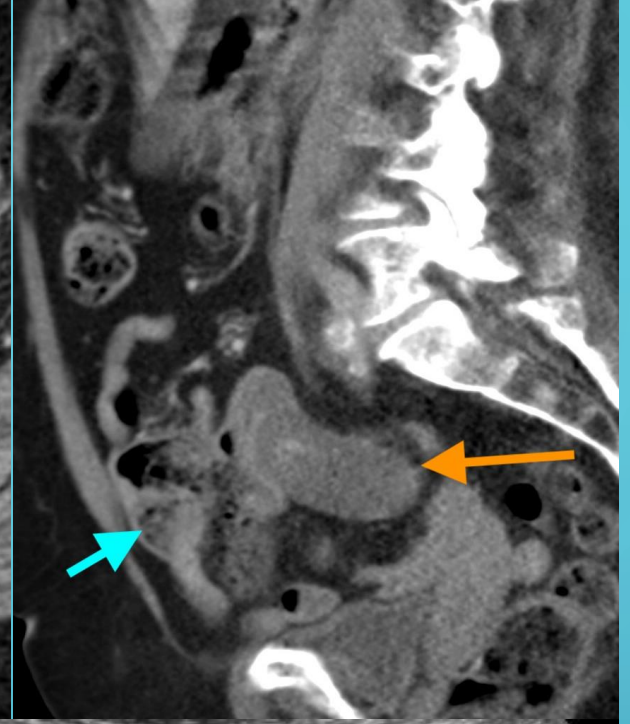
ACUTE APPENDICITIS- ULTRASOUND

- Sagittal oblique compression ultrasound image(above) and transverse images(below) in a 13 year old with right iliac fossa pain illustrating typical sonographic features of acute appendicitis characterized by dilated, fluid filled, aperistaltic, blind ending, noncompressible structure in right iliac fossa with positive probe tenderness. Pink arrow denotes appendicolith with dense acoustic shadowing.
- Note echogenic mucosal lining(yellow arrows) outlined by luminal fluid, discontinuity of which may suggest focal perforation.



A case of appendiceal perforation with pelvic abscess. On Left is a coronal CT image demonstrating dilated air filled appendix(red arrow) with obstructing appendicolith(yellow arrow) at its base. Note extensive inflammatory changes subjacent to appendiceal tip. Axial CT image(right) of lower pelvis in same patient showing walled off air containing pelvic abscess(red arrow) secondary to sealed off appendiceal perforation.



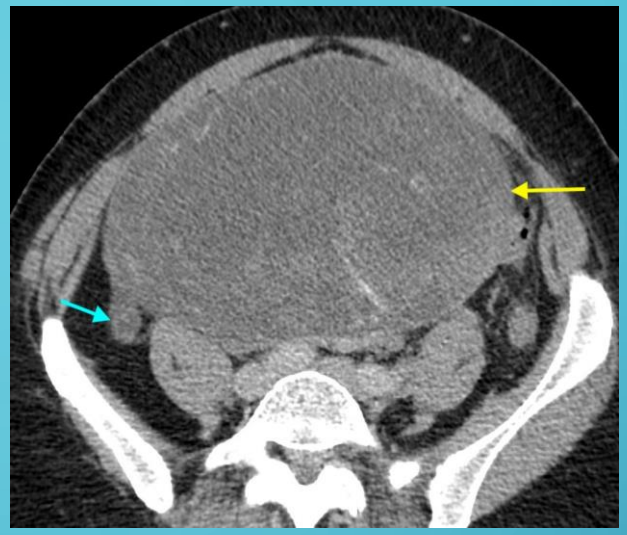


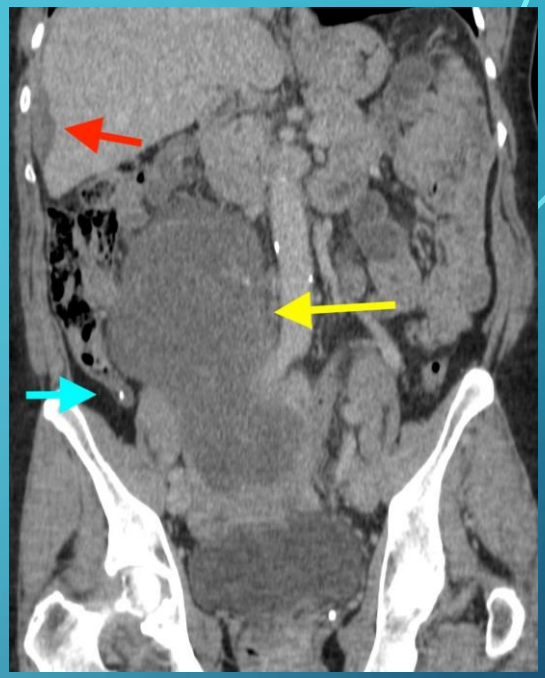
MUCOCELE OF APPENDIX

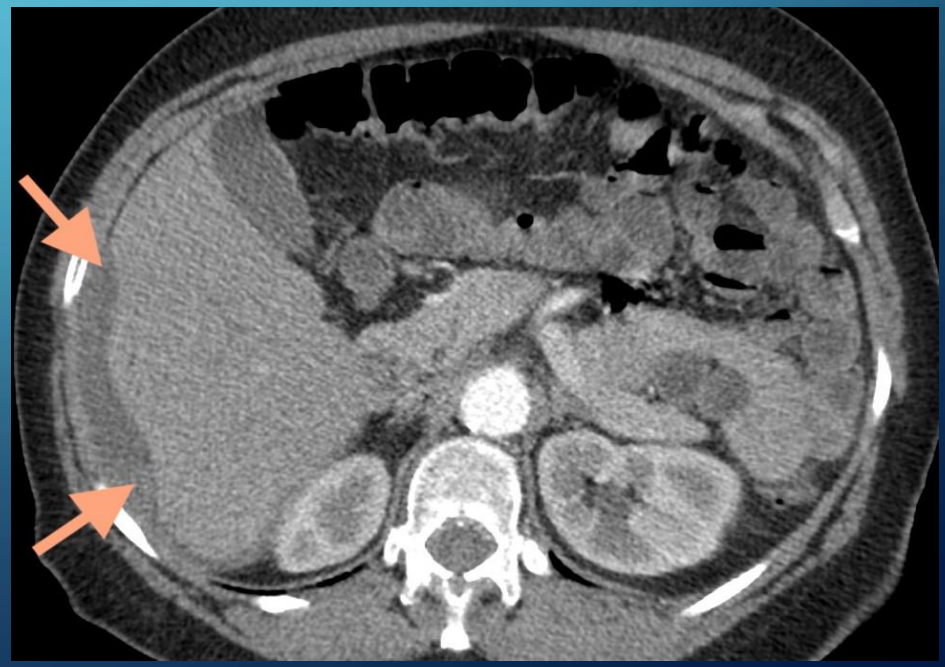
- Incidentally discovered mucocele of appendix in an elderly female patient. On right and upper left are the multi-detector row CT sagittal and axial images showing cystic mass(chicken drumstick appearance or pear shaped) with mural calcification(orange arrow) in relation to cecal pole(blue arrow). Lower left is the longitudinal oblique sonography image showing a pear shaped right iliac fossa mass with internal concentric echogenic layers(onion skin appearance)- typical of appendiceal mucocele.
- Less than 2 cms mucoceles are usually non neoplastic(mucin retention cysts) whereas neoplastic mucoceles are larger.
- Note-In larger mucoceles, always search for mural nodularity, irregular wall and low attenuation peritoneal deposits in pericecal region, pelvis, perihepatic region and along peritoneum (pseudomyxoma peritonei)-features suggesting neoplastic mucocele.

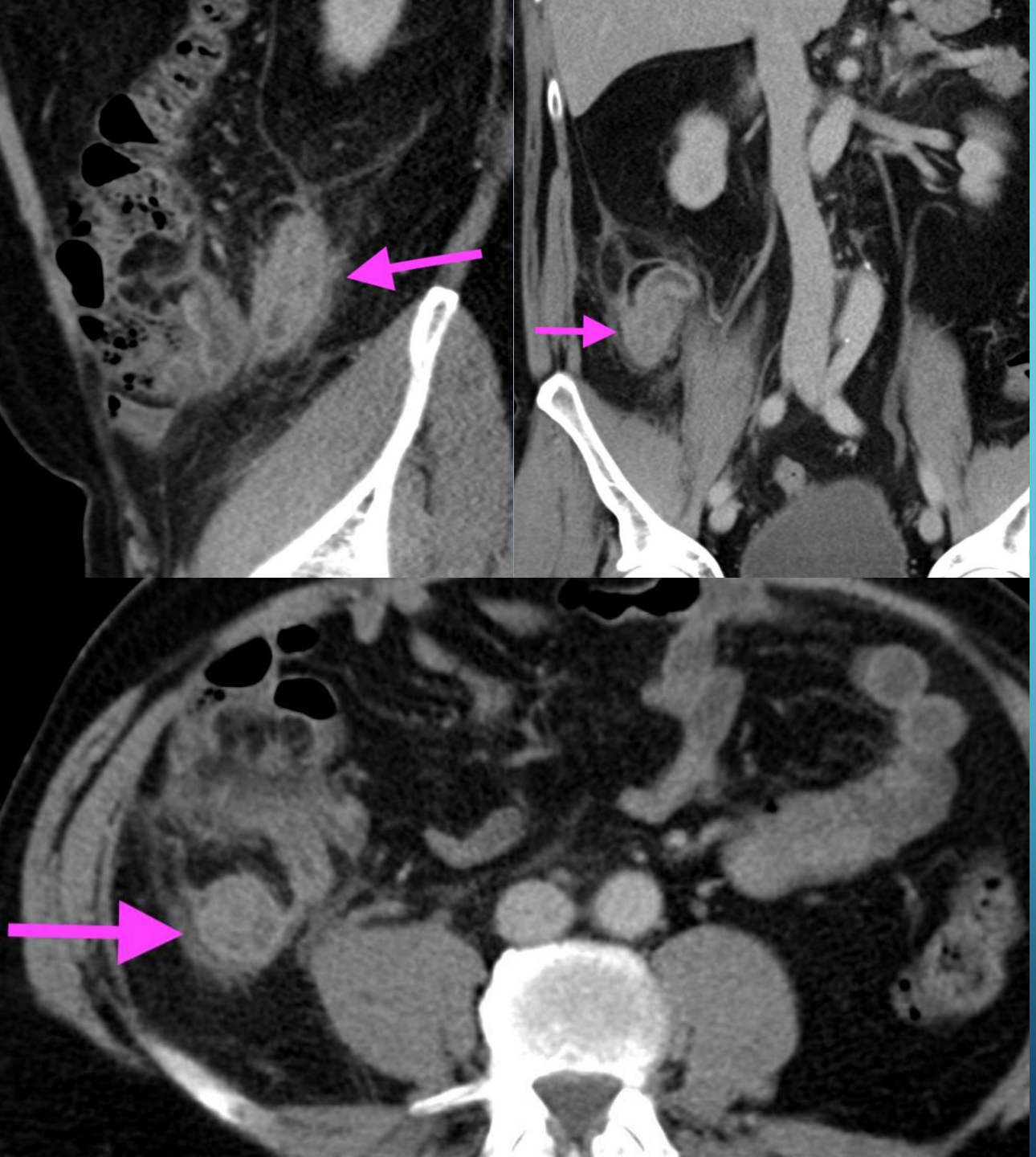
LOW GRADE APPENDICEAL MUCINOUS NEOPLASM(LAMN)

- An interesting case of LAMN of appendix in a female patient with lower abdominal pain. Axial and coronal multi-detector row CT images(Top left and right) showing a large multiloculated cystic mass in pelvis(Hounsfield units 16) with septal calcification presumed to be adenexal ?ovarian . Note subtle low attenuation mass in the appendix with calcification(blue arrows) and perihepatic implants causing scalloping of hepatic outline(red arrow in coronal and orange arrows in bottom axial CT image) typical of pseudomyxoma peritonei(PMP). CT diagnosis of primary mucinous ovarian neoplasm with PMP was given. Appendiceal lesion was overlooked on CT. Final histopathological diagnosis came as LAMN of appendix with ovarian deposit and pseudomyxoma peritonei.
- Note: Even in setting of mucinous ovarian neoplasm with PMP, always exclude appendiceal tumor which is considered the most common primary neoplasm causing PMP.









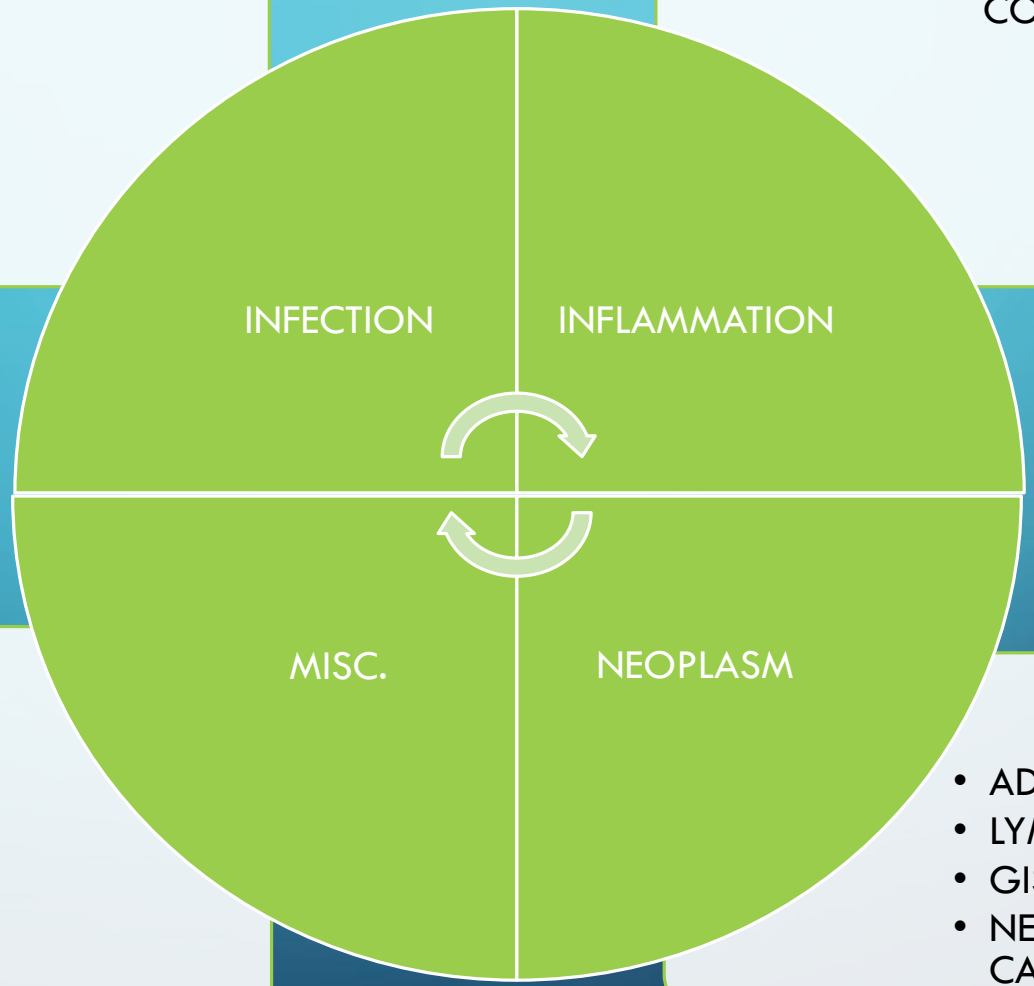
APPENDICEAL CARCINOMA

- Nonmucinous neoplasm of appendix in a middle aged male presenting with clinical features of acute appendicitis. Sagittal(top left), coronal (top right) and axial(bottom) contrast enhanced CT images illustrate features of acute appendicitis with ill defined heterogenous mass(purple arrows) most evident in distal appendix(coronal image). Final CT diagnosis in this patient was acute appendicitis, however, post-operative histopathological analysis revealed appendiceal carcinoma.
- Note- In cases of acute appendicitis, always scrutinize for focal soft tissue mass or subtle soft tissue infiltration of whole appendix which indicate underlying neoplasm. In addition, locoregional or distant lymphadenopathy.

ILEUM/TERMINAL ILEUM

- TERMINAL ILEITIS
- ILEOCECAL TUBERCULOSIS

- CROHN'S, ULCERATIVE COLITIS(BACKWASH ILEITIS)



- MECKEL'S DIVERTICULITIS
- DUPLICATION CYST
- INTUSSUSCEPTION
- LIPOMATOSIS OF ILEOCECAL VALVE

- ADENOCARCINOMA
- LYMPHOMA
- GIST
- NEUROENDOCRINE TUMORS-CARCINOID

INFECTIVE TERMINAL ILEITIS

- Causative organisms- Yersinia, Salmonella, Campylobacter, tuberculosis, Amoebiasis.
- May involve Cecum.
- Presentation is usually acute with diarrhoea, right lower quadrant pain and systemic symptoms. Stool cultures are positive for the organism.
- Characteristic CT findings –

Circumferential wall thickening of involved segment with maintained layered enhancement pattern.

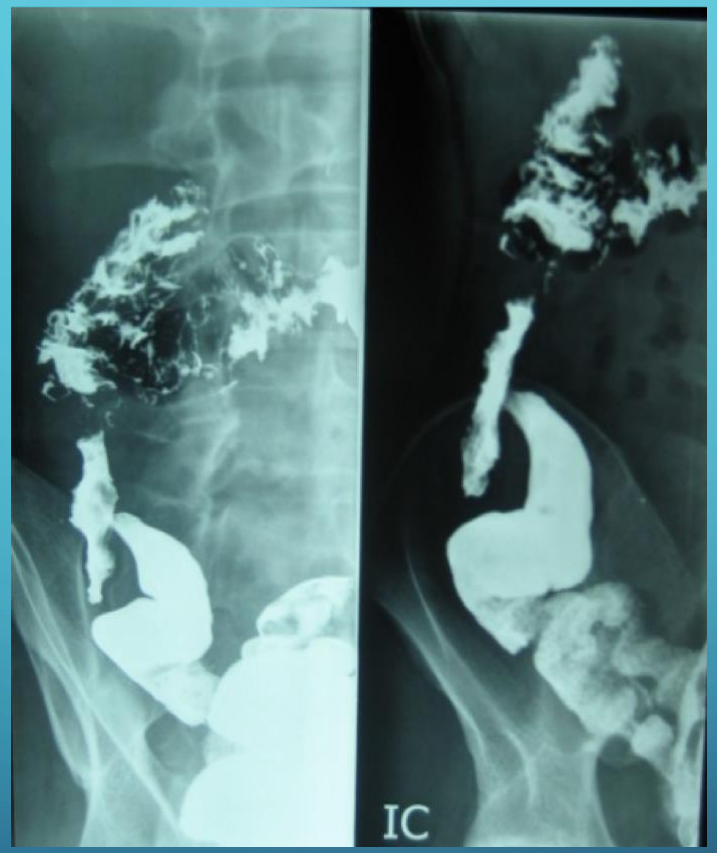
Enlargement of loco-regional mesenteric lymph nodes to varying extent-usually moderate to marked.

INFECTIVE TERMINAL ILEITIS

- A case of Campylobacter Ileitis. Axial(above) and coronal(below) multi-slice CT images in a patient with acute onset diarrhoea and fever showing diffuse wall thickening of terminal ileum(blue arrows) and ileocecal valve(red dot) without locoregional lymphadenopathy. Acute onset and circumferential (<2cms) wall thickening involving long segment suggests infective etiology over neoplasm.

INFECTIVE TERMINAL ILEITIS

- Salmonella enteritis distal ileum in a 54 year old male with recent history of diarrhoea and high fever. Coronal and axial contrast enhanced CT slices show mild diffuse circumferential wall thickening of long segment of distal ileum with stratified enhancement of bowel wall favoring infective/ inflammatory etiology.



INTESTINAL TUBERCULOSIS-GOOSE NECK DEFORMITY

- Classic Goose neck deformity on barium follow through examination in chronic intestinal tuberculosis characterised by loss of normal ileocecal angle and dilated terminal ileum, appearing suspended from a retracted, fibrosed cecum.

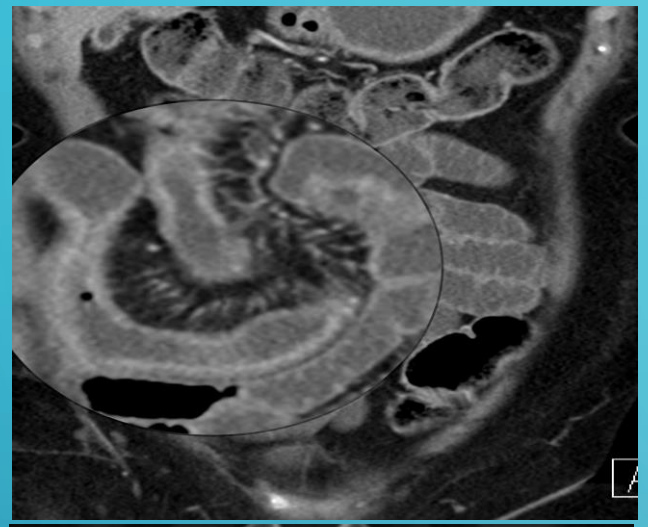
BOWEL WALL THICKENING

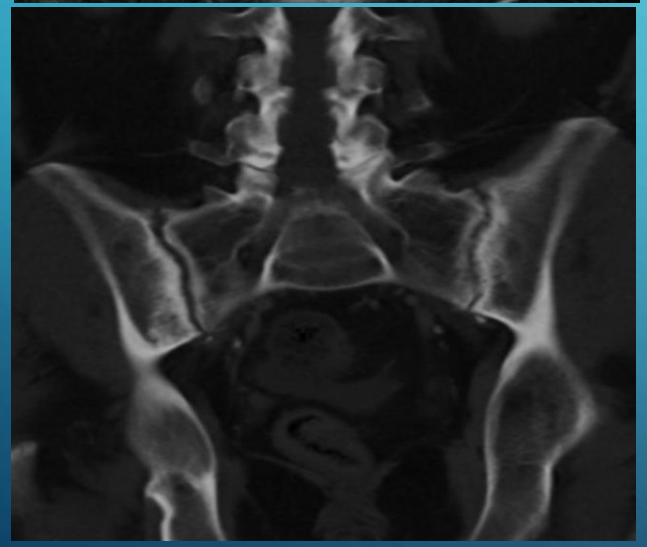
INFECTIVE/INFLAMMATORY

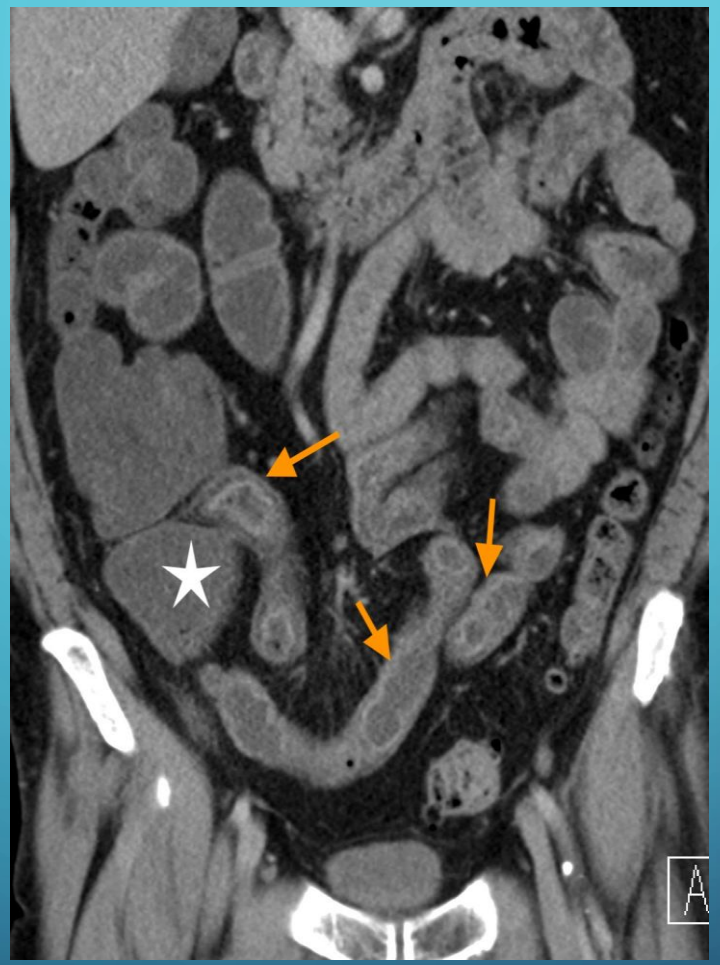
- Long segment involved.
- Symmetric/concentric wall thickening, usually <2cms.
- Stranding in adjacent fat disproportionate to the wall thickening.
- Stratified enhancement of involved segment.
- Lymphnodes+/-
- Wide/gradual zone of transition.
- Extraintestinal manifestations-e.g Sacro-ilitis in crohn's disease.

NEOPLASTIC

- Short segment.
- Focal, asymmetric, > 3cms.
- Minimal or no stranding.
- Homogenous/heterogenous enhancement.
- Locoregional lymphadenopathy.
- Narrow zone of transition.



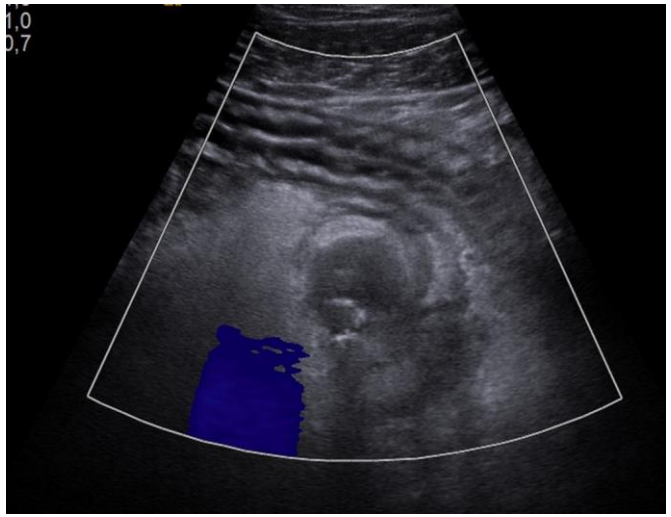


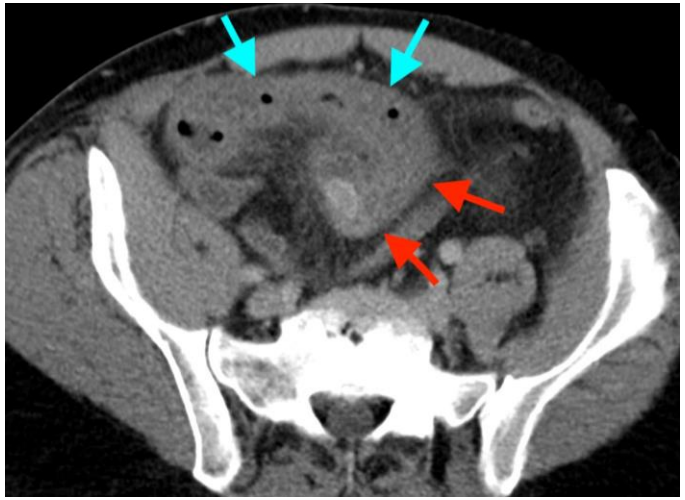


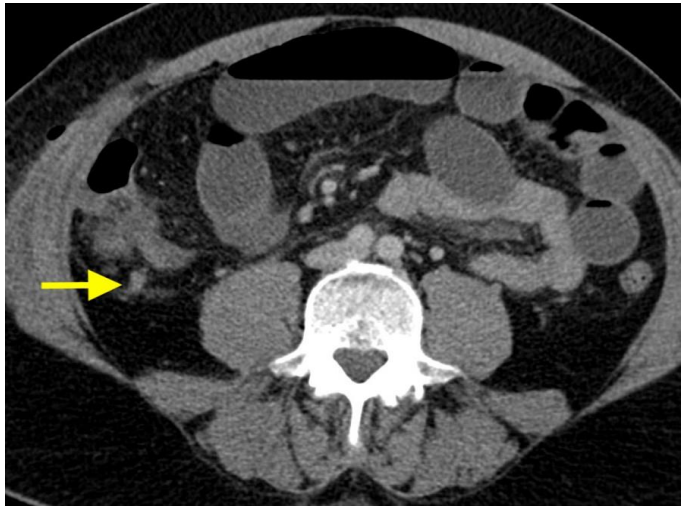
CROHN'S DISEASE

- Coronal CT slice(on right) depicting mural thickening and enhancement of terminal ileum with multisegment involvement(orange arrows). In top left image note mesenteric comb sign owing to mesenteric hypervascularity and perivascular inflammation. Bottom left image in same patient showing erosive changes with periarticular sclerosis bilateral sacroiliac joints compatible with sacroiliitis-one of the extra-intestinal manifestation of inflammatory bowel disease.
- Note-In a suspected case of infective/inflammatory bowel wall thickening, always look for extra-intestinal manifestations.

ACUTE MECKEL'S DIVERTICULITIS







- Transverse sonogram of lower abdomen (top) and CECT demonstrating a blind ending, non- compressible inflamed tubular structure in a 47 year old patient who presented with acute abdomen and clinical suspicion of appendicitis. The CT images demonstrate ileal (blue arrows) attachment in keeping with Meckel's diverticulum (red arrows). Note surrounding inflammatory changes(bottom left) and proximal bowel obstruction(image on right). A calcified enterolith can be appreciated in the diverticular lumen on both CT and ultrasound. Yellow arrow shows normal appendix in right iliac fossa.

LIPOMATOSIS OF ILEOCECAL VALVE

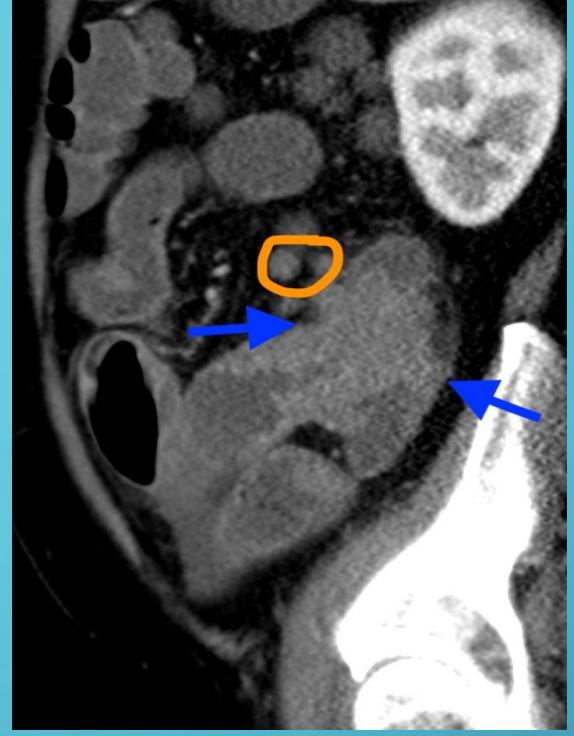
- Coronal CT image illustrating symmetric enlargement of ileocecal valve(white arrow) with fatty attenuation favoring lipomatosis over true lipoma.

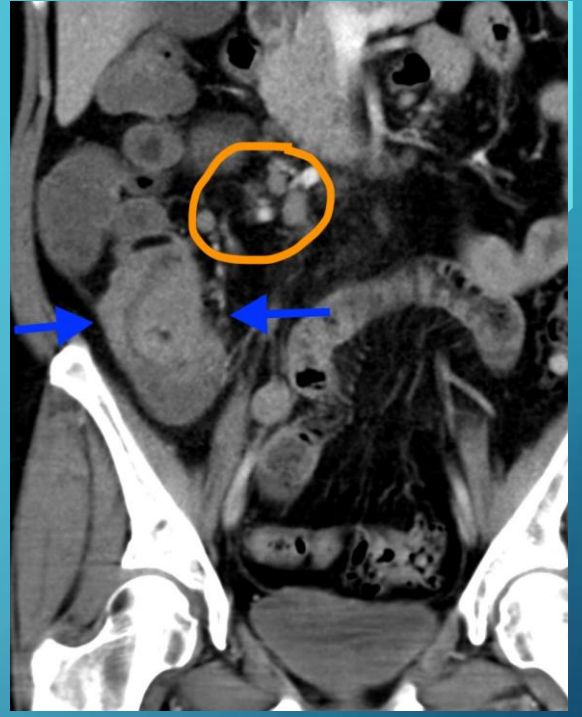
CARCINOID

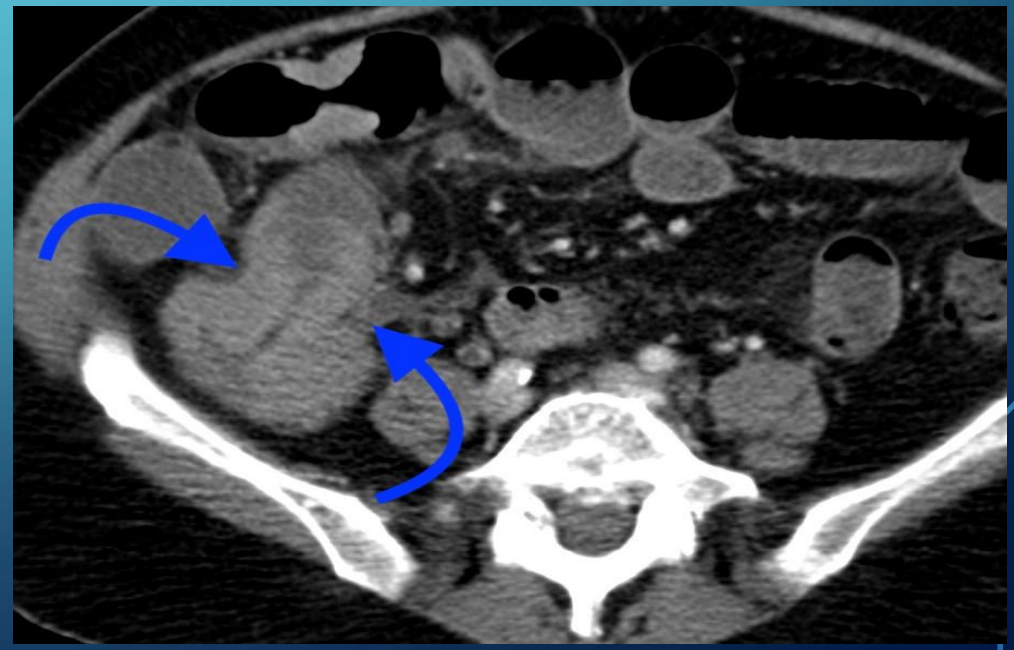
- Coronal (above) and axial(below) contrast enhanced CT showing polypoidal hyperenhancing focal lesion in terminal ileum(pink arrow) with a disproportionately large mesenteric metastasis containing calcification(green arrow). Yellow arrows denote desmoplastic reaction in mesentery seen as soft tissue spokes surrounding mesenteric deposit (considered to occur due to serotonin and other vasoactive peptides).
- Note-Carcinoids are often identified on CT due to mesenteric metastasis with desmoplastic reaction as the primary tumor can be rather small(<2cms) and may not be detected on imaging at all. Differential diagnosis include sclerosing mesenteritis.

TERMINAL ILEAL LYMPHOMA(PRIMARY LYMPHOMA)

- Sagittal(top left), coronal(top right) and axial CT images illustrating asymmetric wall thickening(blue arrows) of ileocecal region(>3cms in thickness) without stratified enhancement in an elderly female. Note lack of perilesional fat stranding and small borderline lymph nodes(orange circle) in right iliac mesentery. These features favor neoplasm over infective/inflammatory etiology. Patient was operated with histopathology consistent with lymphoma.
- Ileocecal lymphomas can mimic adenocarcinoma, crohn's disease and can present as polypoidal or cavitary mass.
- Usually multisegment involvement(d/d crohn's) and bulky lymphadenopathy favor lymphoma over other pathologies.

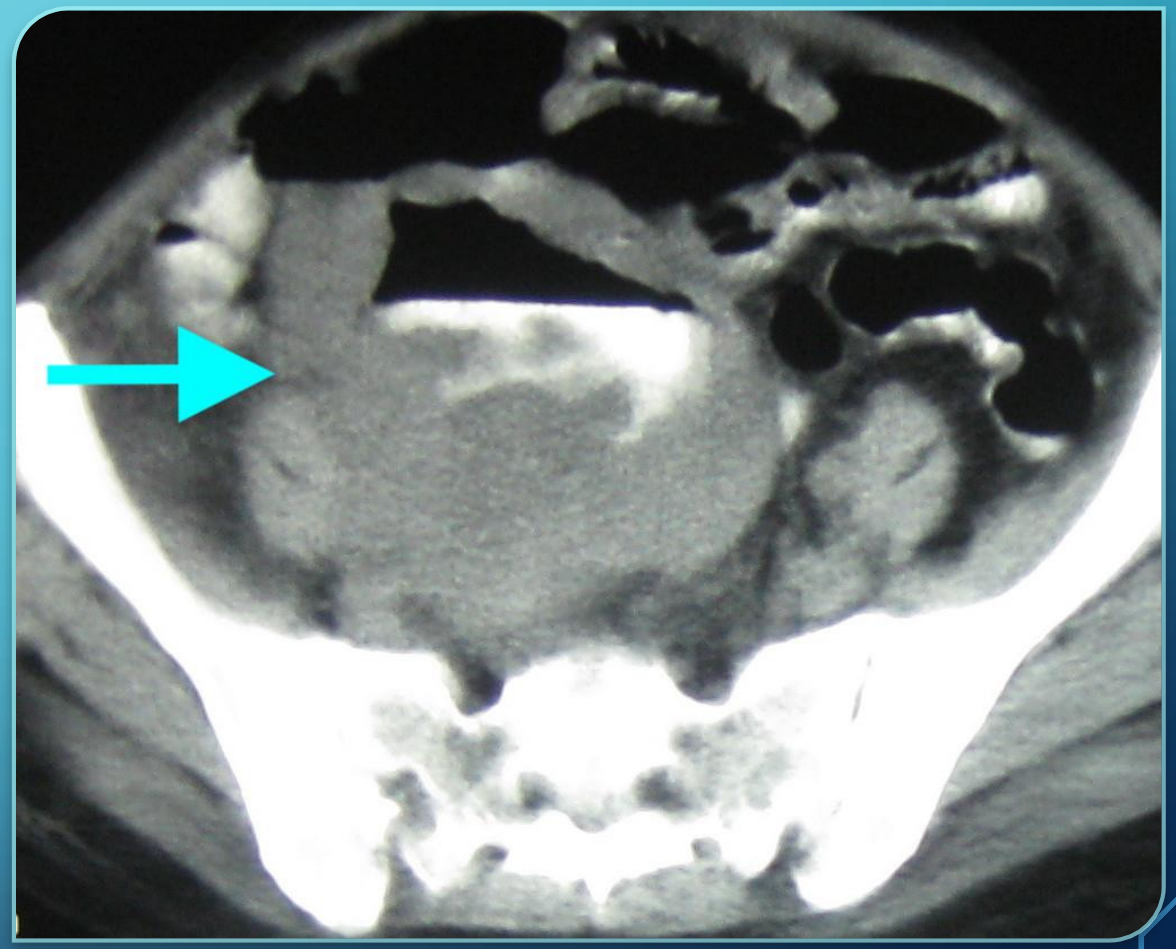






GIST

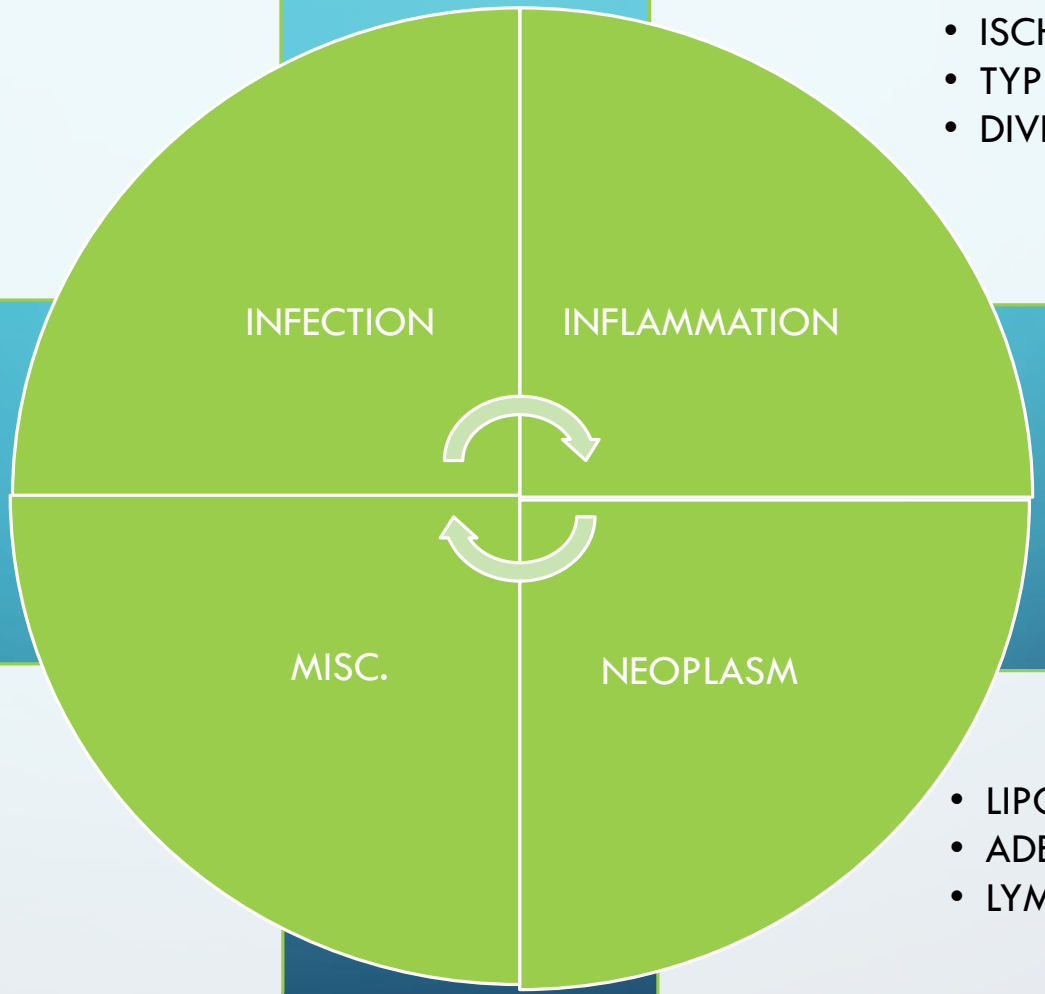
- Axial CT image in a middle aged female with abdominal pain demonstrate a large exophytic cavitating soft tissue mass in right iliac region arising from small bowel. Oral contrast-air level is seen within it owing to necrosis and ulceration representing Torricelli-Bernoulli Sign(necrosis of submucosal tumor ulcerating into intestinal lumen resulting in air fluid level within tumor).



CECUM/ASCENDING COLON

- COLITIS-INFECTIVE

- ULCERATIVE COLITIS
- ISCHAEMIC
- TYPHILITIS
- DIVERTICULITIS

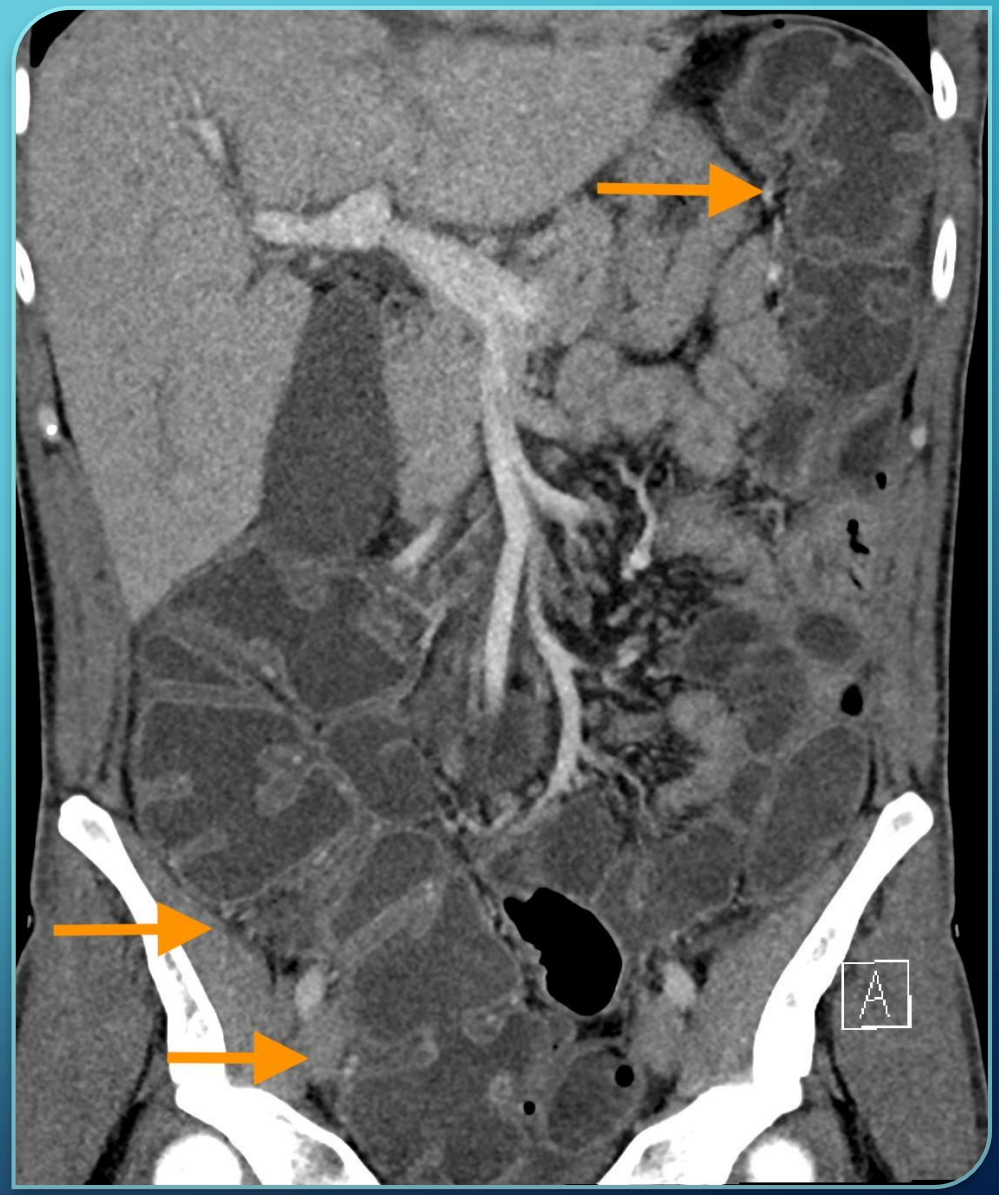


- CECAL VOLVOLUS
- EPIPLOIC APPENDAGITIS
- INTUSSUSCEPTION

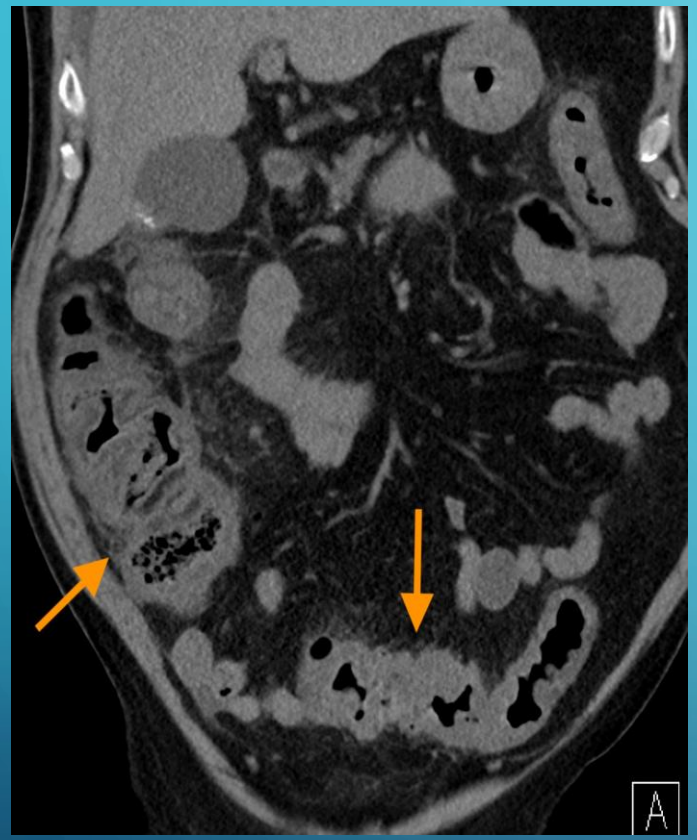
- LIPOMA
- ADENOCARCINOMA
- LYMPHOMA

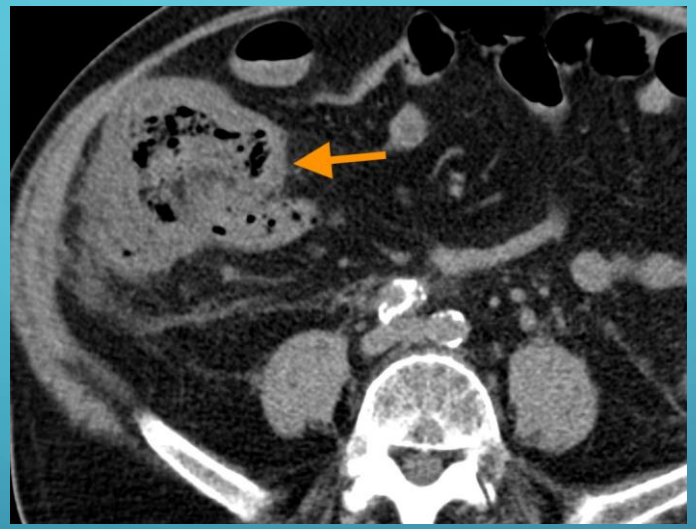
PANCOLITIS

- Pancolitis in a 35 year old male with recent onset diarrhoea and right iliac pain. Contrast enhanced coronal CT image demonstrating pancolitis(ascending colon and splenic flexure marked by orange arrows) characterized by edematous thickened bowel wall and haustra with mucosal hyperenhacement and pericolic stranding. Note mainly fluid filled colon with no formed faeces, a sign of inflammation.



PANCOLITIS

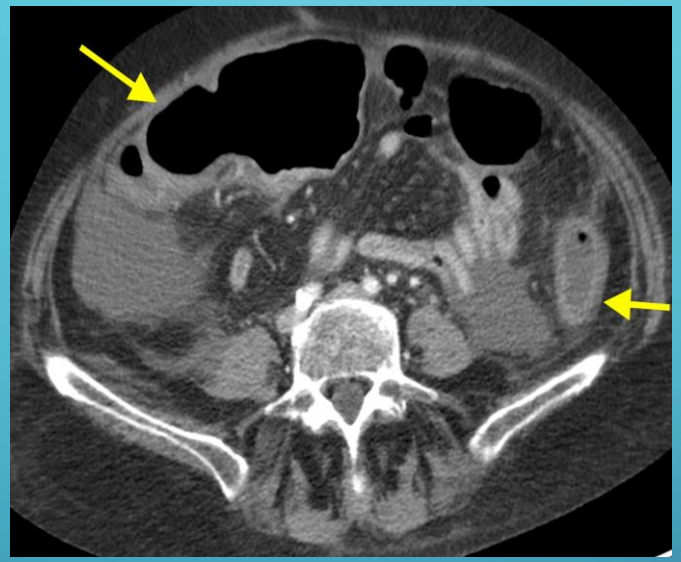




- Companion case. 72 year male presenting with 3 days history of diarrhoea, increased c-reactive protein and pain bilateral iliac fossae. Coronal and axial CT(left and right) images showing thickened, edematous colon with extensive pericolic stranding . Long segment of involvement, disproportionate pericolic stranding and lack of lymphadenopathy favors infective etiology over neoplasm.

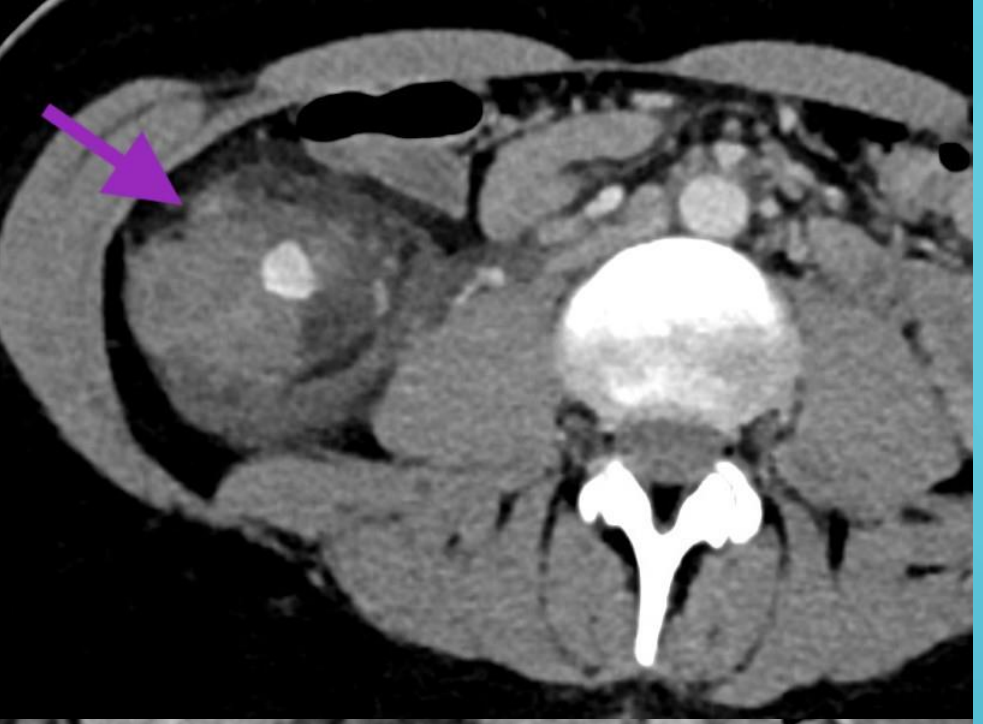
TYPHLITIS (NEUTROPENIC COLITIS)

- Rare Inflammatory condition of right colon commonly involving cecum, though appendix and terminal ileum involvement can also occur.
- Seen in immunocompromised patients with neutropenia.
- Associated with infection with gram positive organisms.
- Needs urgent management due to increased risk of necrosis and perforation leading to high mortality rate of 50%.
- Imaging findings –bowel wall thickening, intramural air, inflammatory fat stranding/fluid in pericecal location.



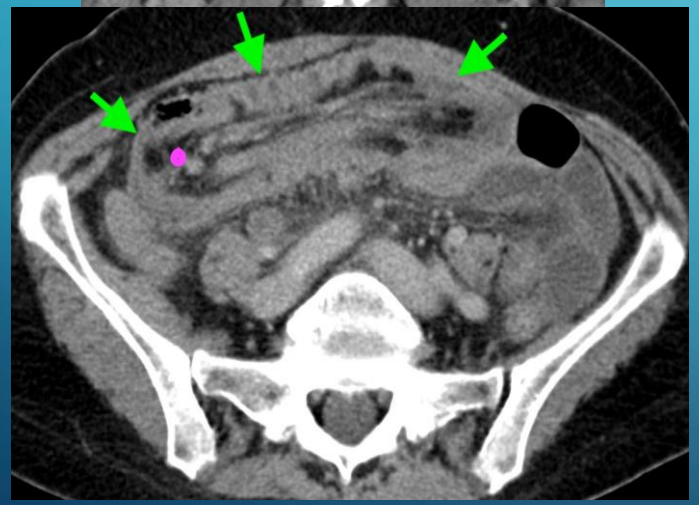
TYPHLITIS

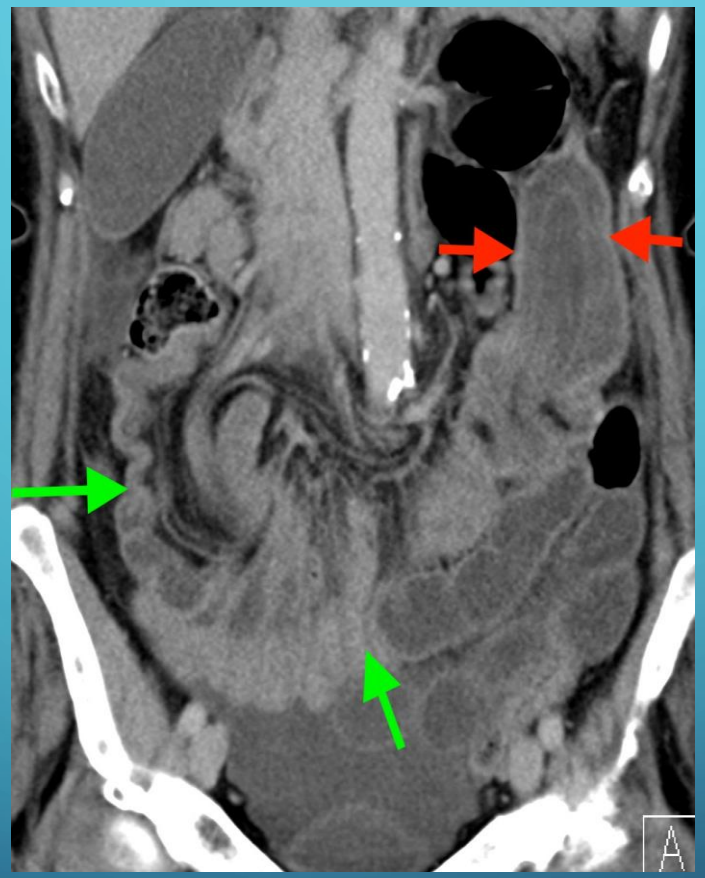
- Typhlitis in a 62 year old female patient with acute myeloid leukemia and neutropenia with sudden right abdominal pain and diarrhoea. Multidetector row CT slices in axial and coronal plane show thickened colon with submucosal edema(yellow arrows) along with ascites. PCR and ELISA positive for Clostridium difficile.



ASCENDING COLON DIVERTICULITIS

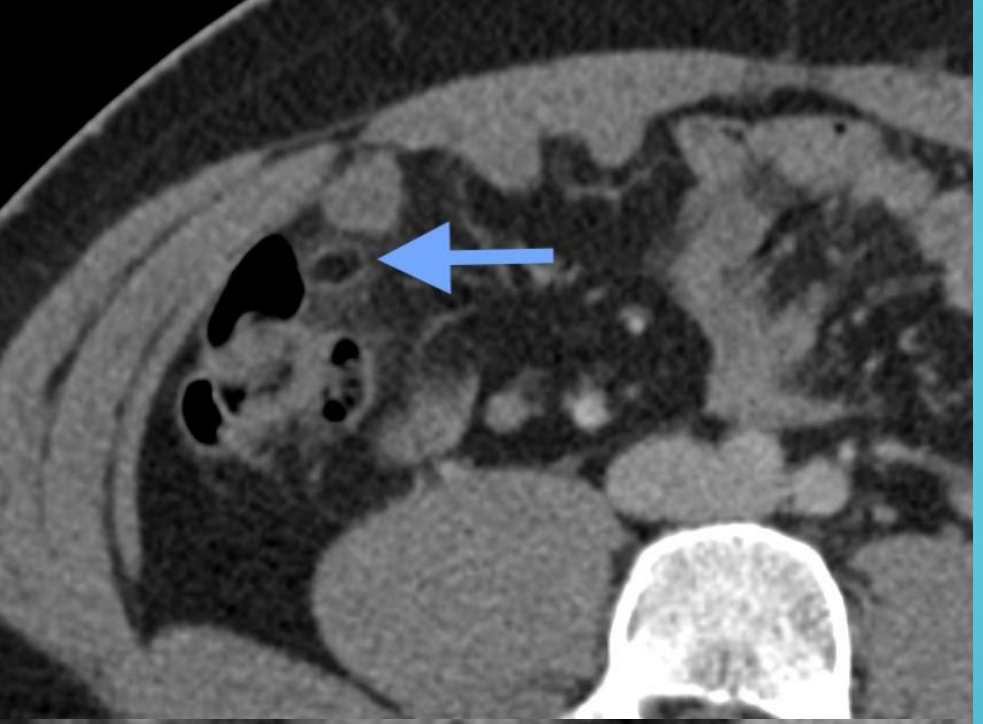
- Acute uncomplicated diverticulitis in a young girl with acute onset right iliac fossa pain. Contrast enhanced CT – axial(above) and coronal(below) slices reveal a relatively long segment of thickened, edematous ascending colon(purple arrow) with sentinel (inflamed)diverticulum containing fecalith (yellow arrow) medially. Note disproportionate stranding in subjacent fat favoring inflammatory over neoplastic etiology. No complications in form of perforation or abscess are evident.





INTUSSUSCEPTION

- Large colocolic intussusception in a 66 year old female with acute onset of abdominal pain and diarrhoea. Green arrows in the coronal (top left and right) and axial(bottom left) CT images outlining the extent of intussusception(from right iliac fossa to left lumbar region) with a low attenuation intraluminal mass in left lumbar region(red arrows) presumed to be the lead point. Pink dot represents mesentery accompanying intussusceptum. Patient underwent laparotomy confirming the CT findings with edematous, necrosed mucosa giving appearance of a mass/lead point. No mass was identified on histopathological examination.

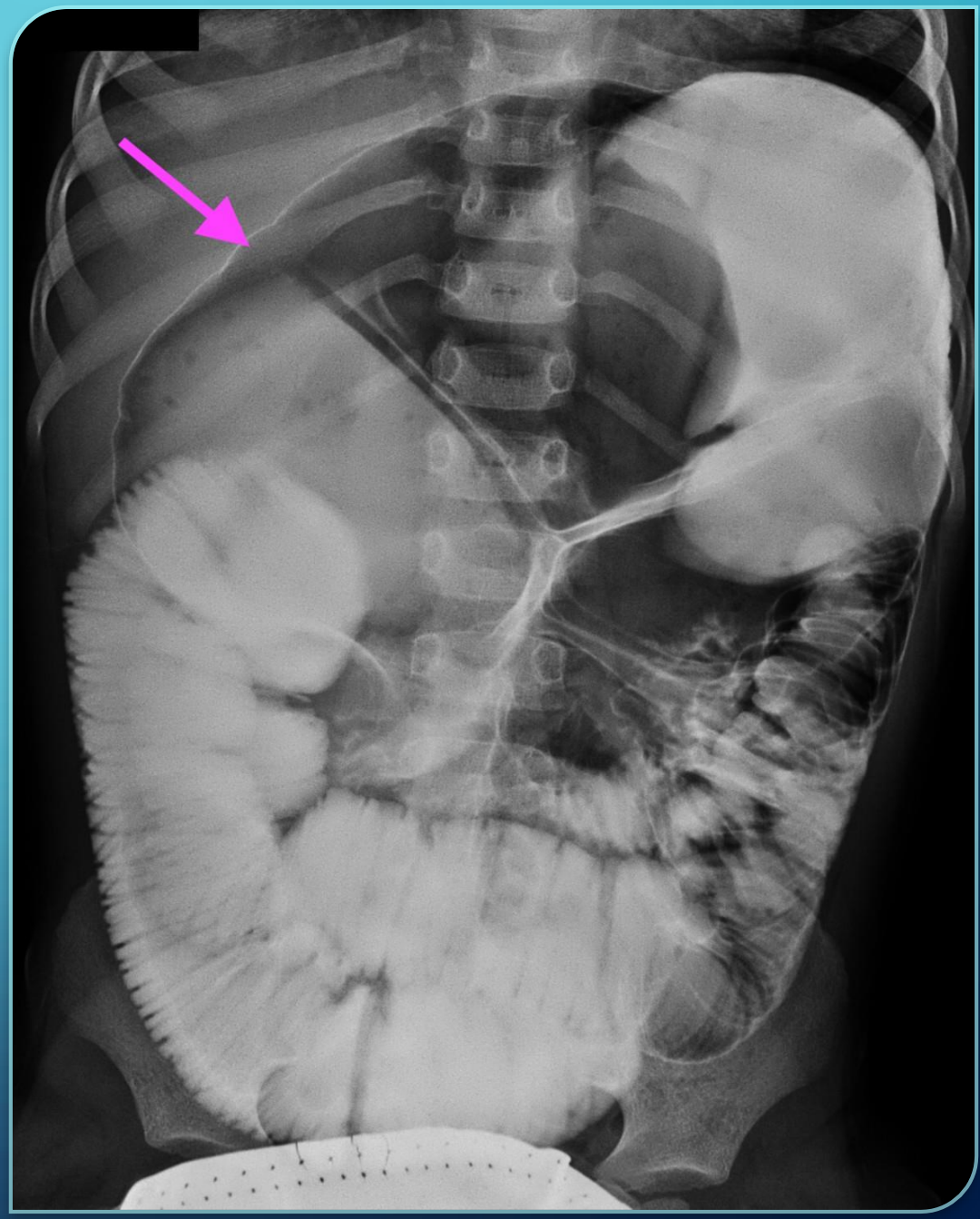


EPIPLOIC APPENDAGITIS

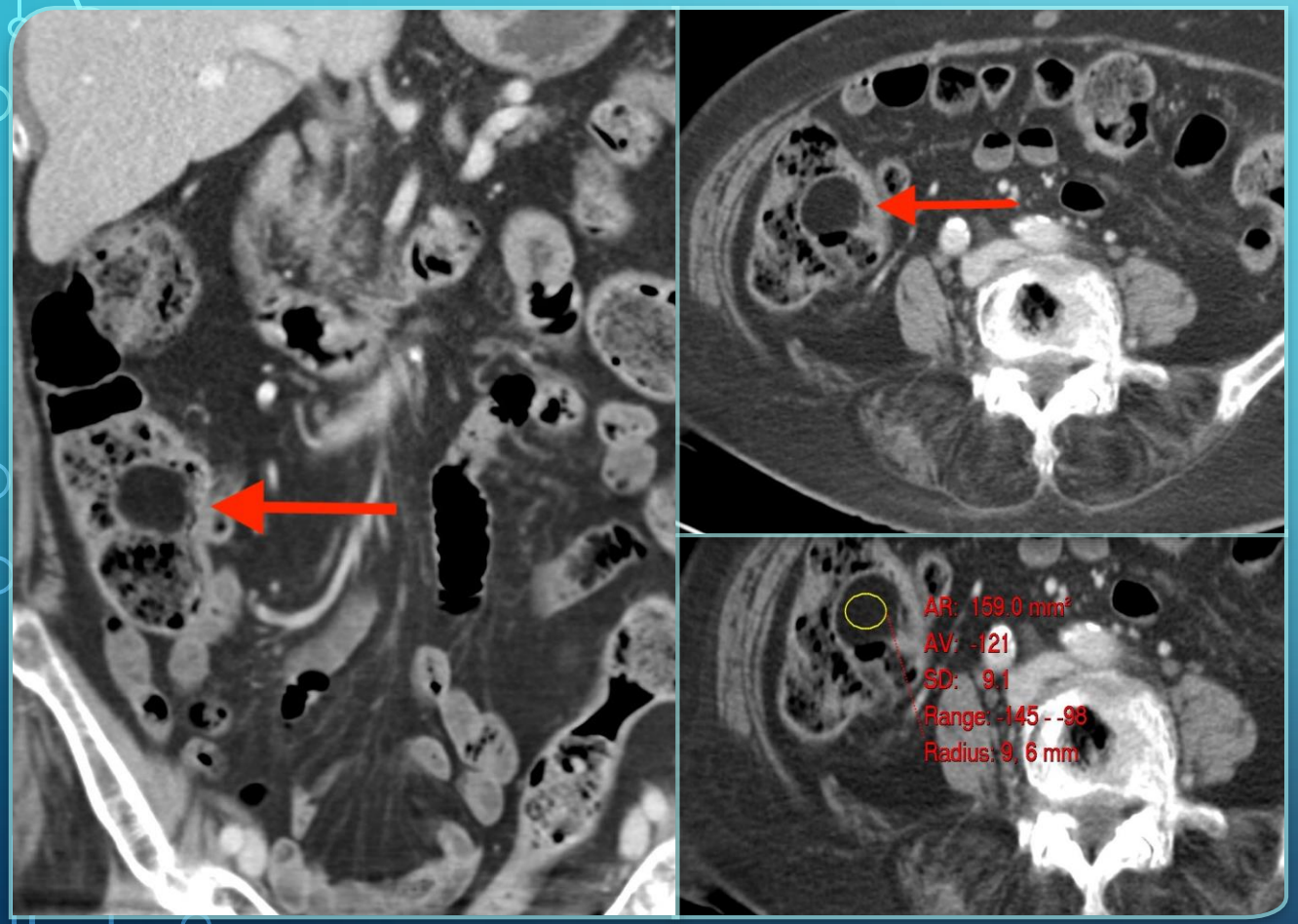
- Axial(above) and sagittal(below) CT images in a case of acute epiploic appendagitis (blue arrows) subjacent to ascending colon. Note the typical CT findings:
- Oval, fat attenuating lesion with rim of increased attenuation abutting anterior colonic wall, <5 cms in size and surrounding inflammatory changes. Sometimes, central increased attenuation can be observed(not in the case shown) due to venous occlusion (underlying cause being torsion of these peritoneal pouches leading to venous occlusion and ischemia).
- Differential diagnosis includes omental infarction.
- It is a self limiting condition.

CECAL VOLVULUS

- Cecal Volvulus in a 3 year old male child with previous history of gastroschisis and stomach wall atresia. Contrast study of GIT with water soluble contrast demonstrating a markedly dilated haustrated bowel in right, left hypochondrium and epigastrium consistent with cecal volvulus. Note significant proximal bowel dilatation.



CECAL LIPOMA



- Coronal (left) and axial(right) CT images in an elderly female patient showing a well defined eccentric lipomatous lesion(-121 HU) in cecum(red arrows).
- Cecum is the most common location for GI lipomas(45%).
- These lesions are almost always submucosal, well circumscribed, showing typical fat attenuation on MDCT.
- Usually asymptomatic, lesions more than 2 cm may be associated with symptoms due to obstruction etc.
- Malignant transformation is not seen in these tumors.

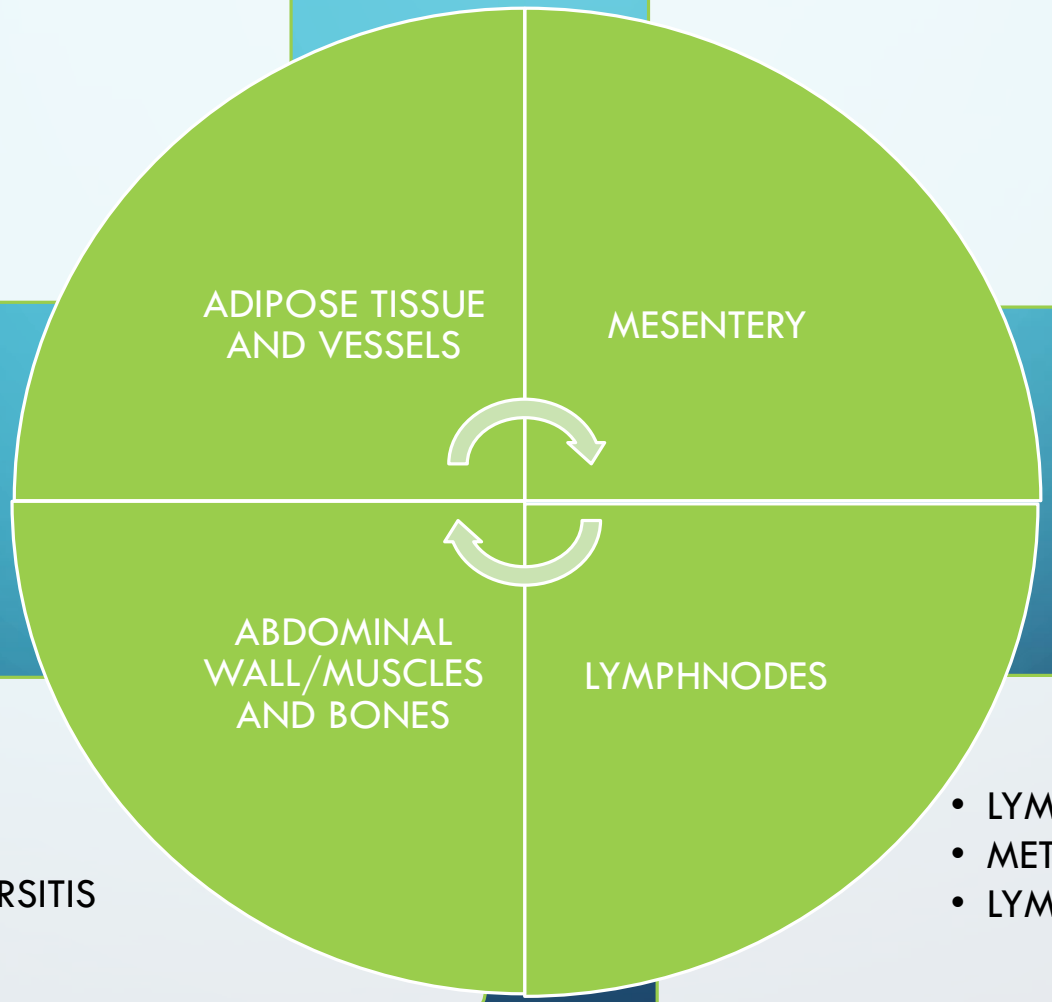
ADENOCARCINOMA COLON

- Proven case of Adenocarcinoma colon in a male patient with anemia and pain abdomen. Axial and coronal contrast enhanced CT images showing asymmetric, stenosing mass involving terminal ileum and cecal pole with minimal subjacent fat stranding. Resultant small bowel obstruction. Pink curved arrow denotes secondary appendiceal obstruction with the abnormality centered around ileocecal region.

MISCELLANEOUS

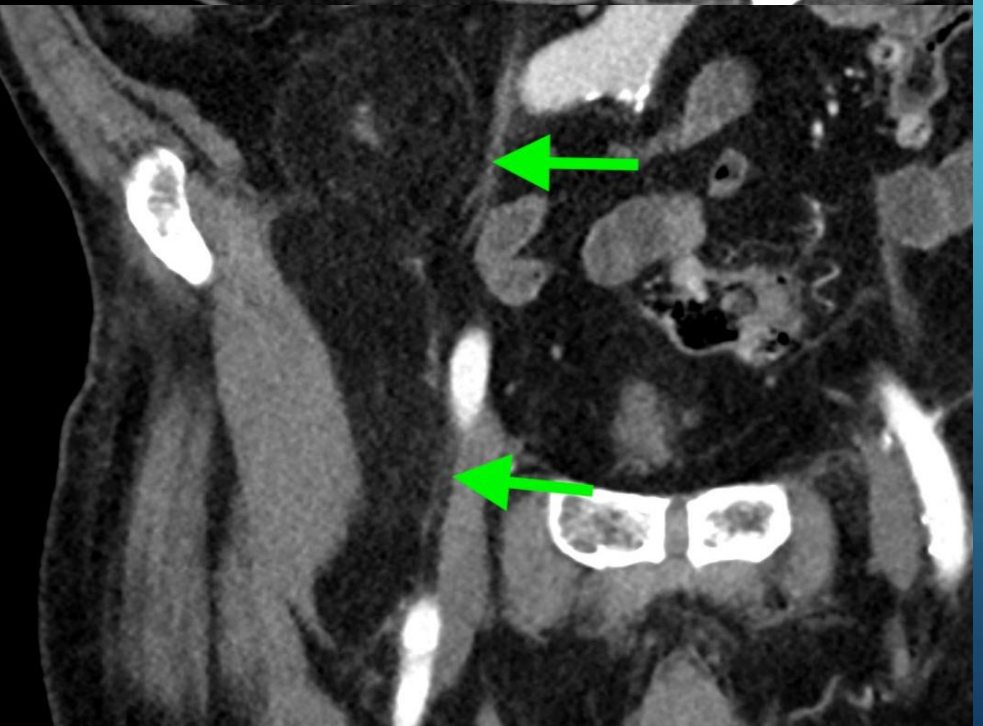
- LIPOMA/LIPOSARCOMA
- ANEURYSM

- METASTATIC DEPOSITS



- HERNIA
- ILIOPSOAS HEMATOMA/ABSCESS/BURSITIS
- BONE TUMORS-PRIMARY/ METASTATIC

- LYMPHOMA
- METASTASIS
- LYMPHADENITIS

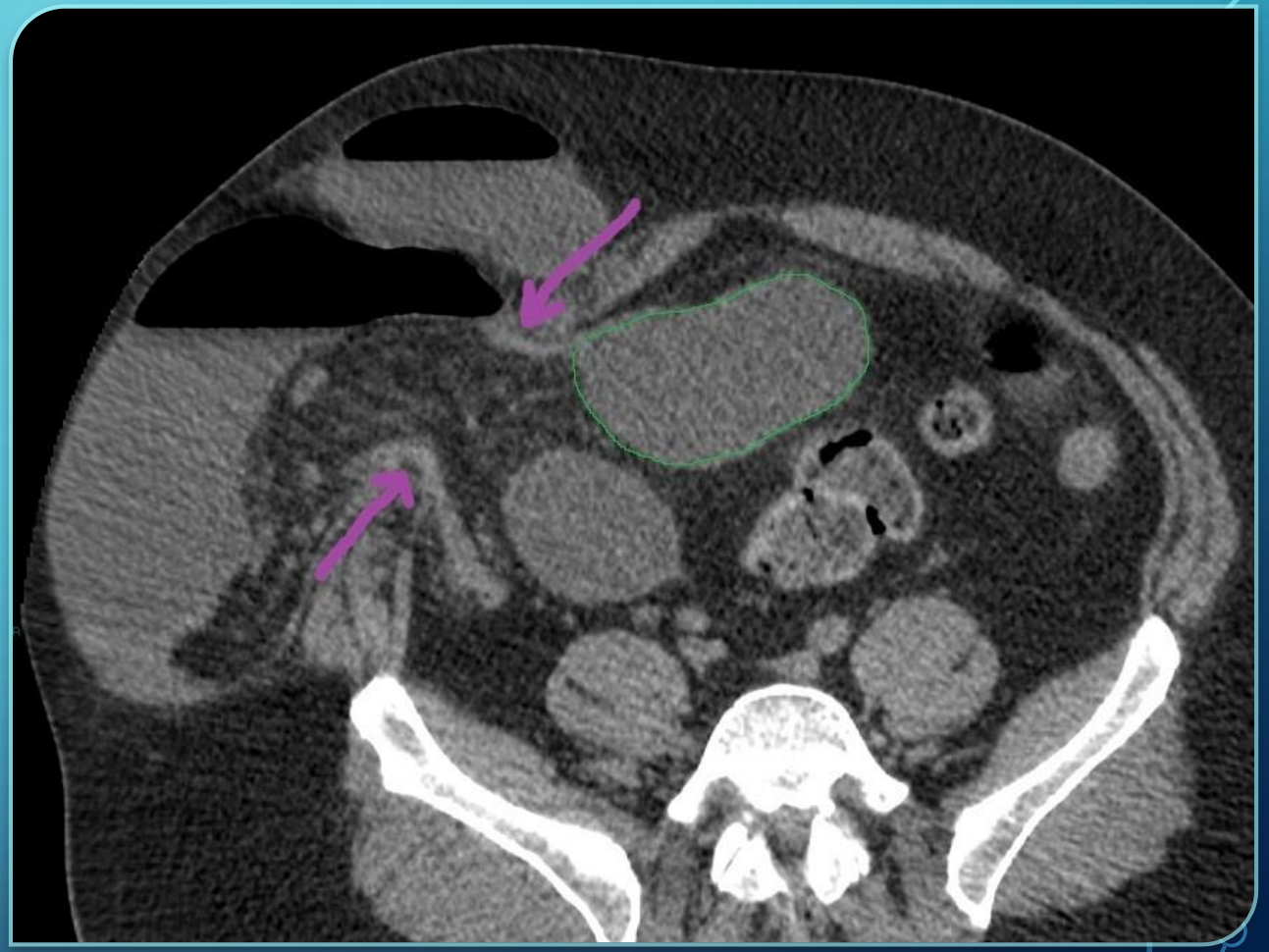


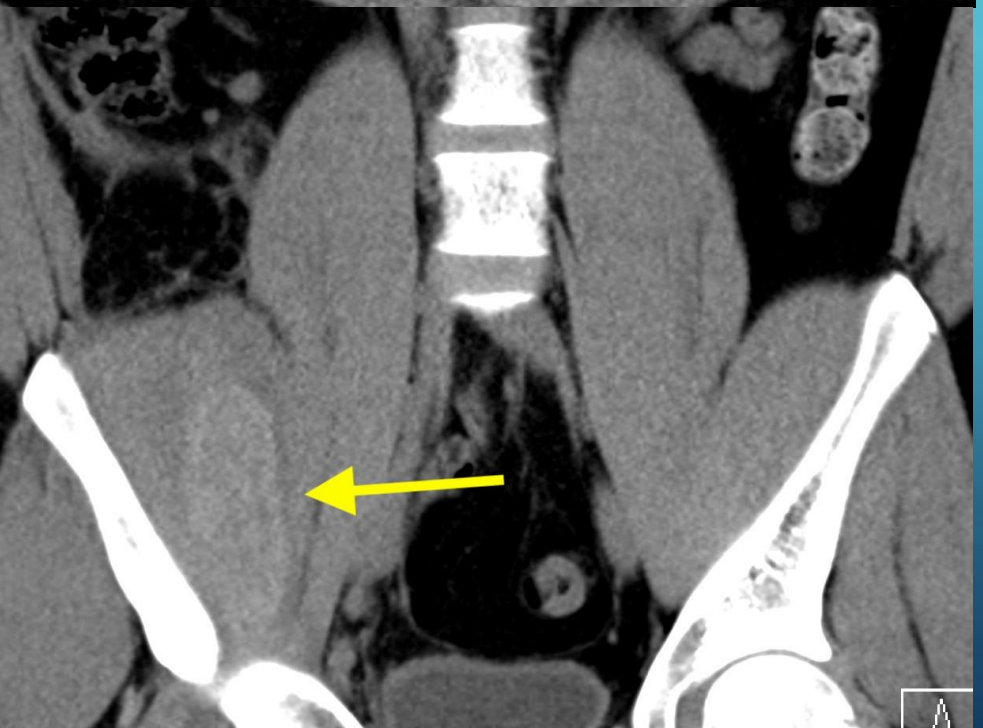
ATYPICAL LIPOMA/WELL DIFFERENTIATED LIPOSARCOMA

- Incidentally detected lipomatous tumor(green arrows) separating anterior and posterior bellies of right iliacus muscle in a 90 year old male patient. Concerning features for sarcomatous change include retroperitoneal(deep) location, large size and focal soft tissue attenuation.

INCISIONAL TYPE SPIGELIAN HERNIA

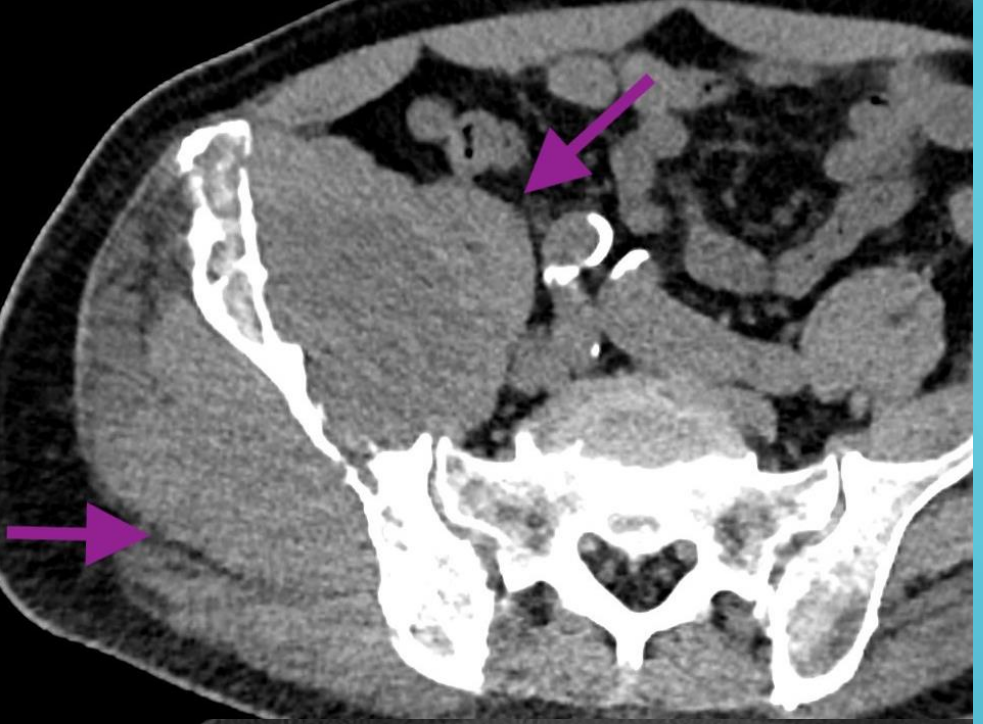
- Noncontrast axial CT section showing a large obstructed post appendicectomy incisional hernia containing dilated fluid filled small bowel. Zone of transition is at the hernial neck (purple arrows). Note dilated proximal bowel outlined in green.





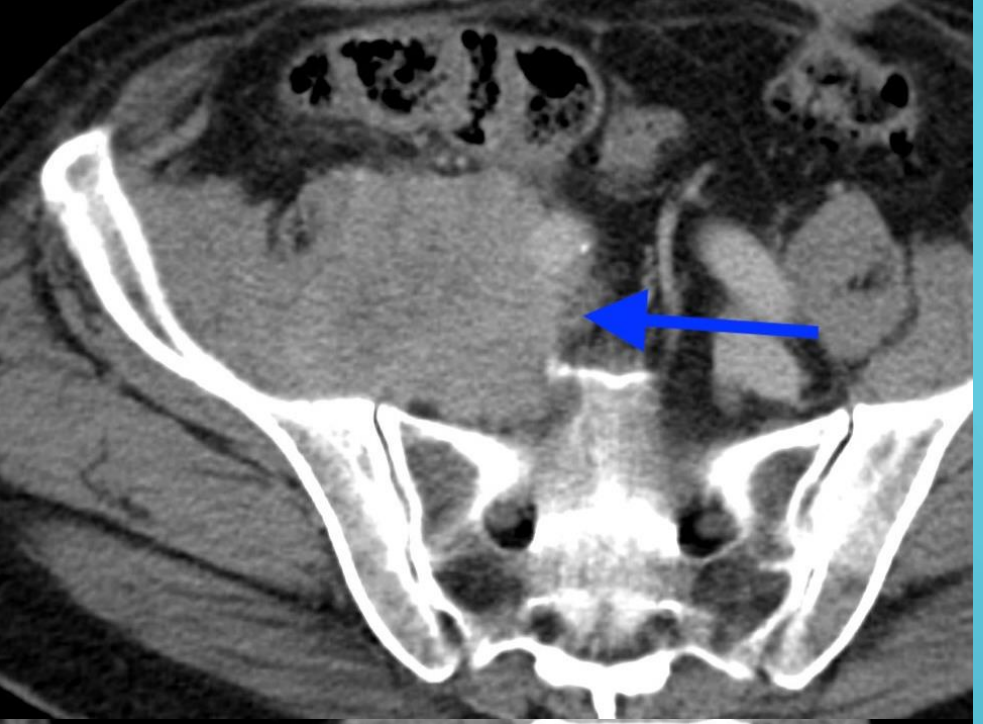
ILIOPSOAS HEMATOMA

- Axial and coronal(above and below) without contrast multidetector CT images illustrating hyperdense acute hematoma(yellow arrows) in a patient with Hemophilia A presenting with right iliac fossa pain.
- Can be spontaneous or traumatic, occur in patients with coagulopathy or Hemophilia.
- CT is the modality of choice and reveals enlargement of the involved musculature with heterogenous/hyperdense attenuation and/or fluid fluid levels.



ILIAC BLADE(BONE) LYMPHOMA

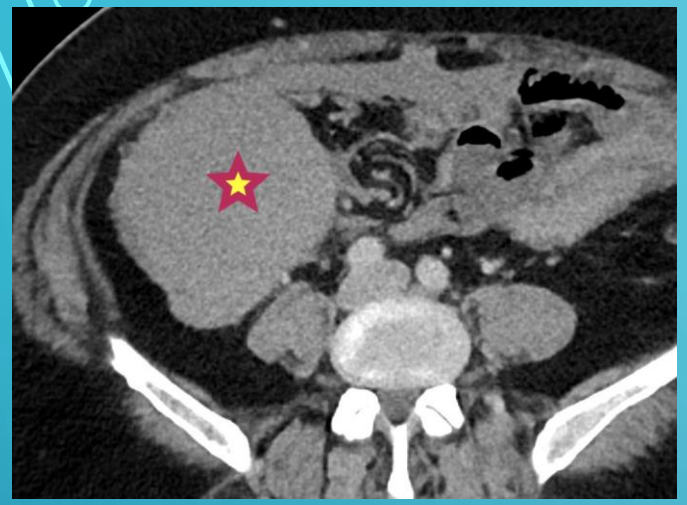
- Don't forget to look for osseous pathology as a cause for right iliac fossa pain. Axial CT images(soft tissue and bone window) in an elderly male with right iliac fossa and hip pain reveal permeative destruction of right iliac bone with associated large soft tissue mass(purple arrows) extending into iliacus and gluteal muscles. The radiological differential diagnosis include sarcoma, metastasis, lymphoma, plasmacytoma etc. The lesion was biopsied confirming this to be Large B-cell Lymphoma.

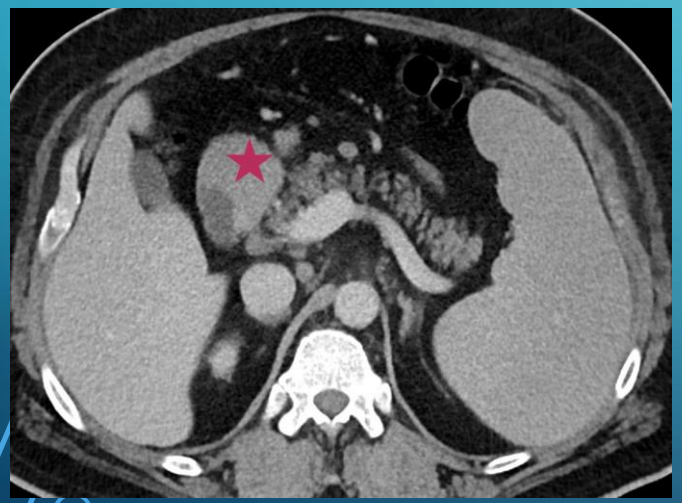


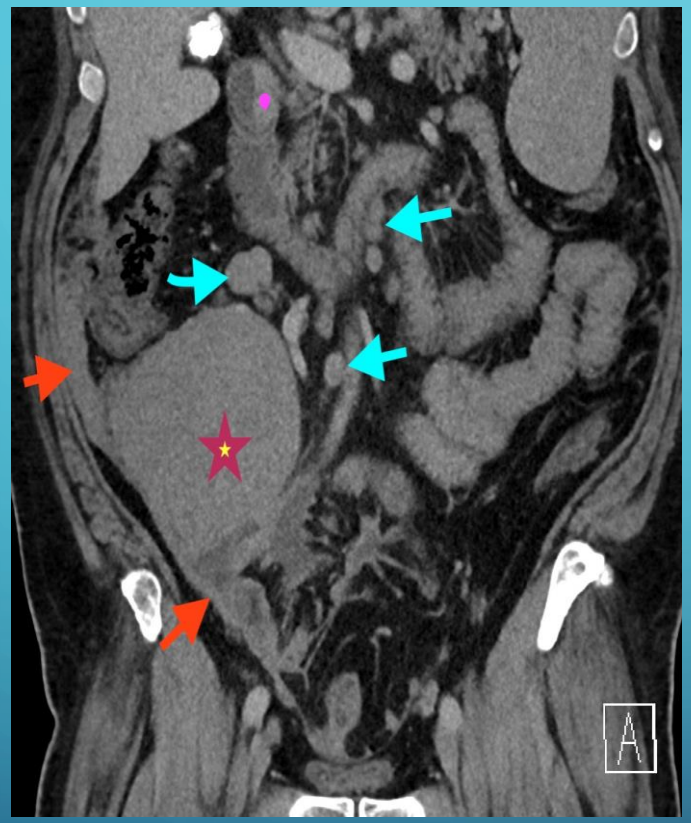
MULTIPLE MYELOMA

- Extra-osseous Multiple Myeloma deposit in right iliac fossa in a 68 year old male with previously known multiple myeloma. Axial(above) and coronal(below) CT images illustrating a heterogeneously enhancing mass(blue arrows) involving right iliopsoas muscles and encasing the right common and external iliac vessels. No calcification within the lesion. No bone destruction. Patient was treated on lines of multiple myeloma. Follow up CT after 3 months showed marked decrease in size of this mass (not shown).
- On Imaging, these are bulky heterogenous enhancing masses mimicking lymphoma.

SECONDARY LYMPHOMA (LYMPH NODAL DEPOSITS)



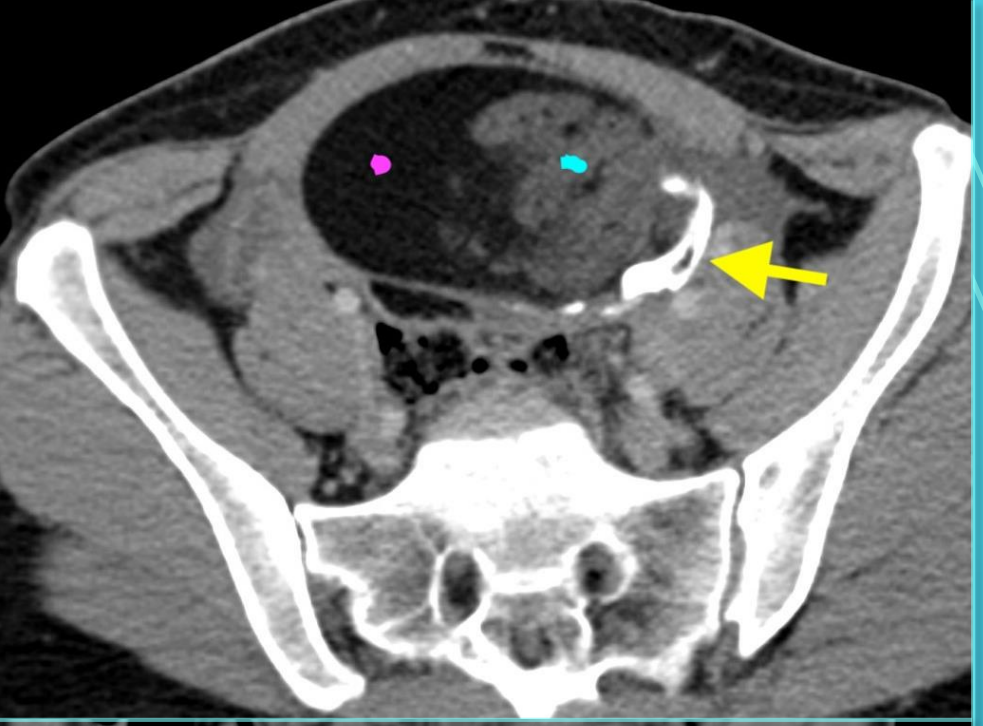


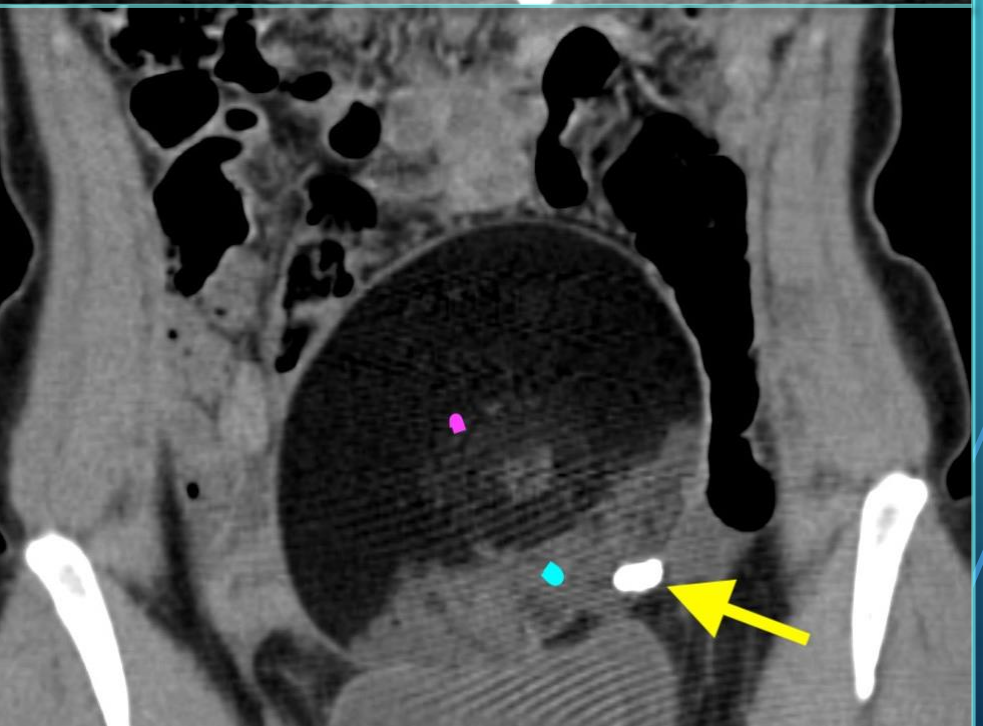


- A 52 year old male with previous history of Mantle cell lymphoma pharynx, presenting with right iliac pain. Top left(axial) and right(coronal) contrast enhanced CT images illustrating large homogenous soft tissue mass in right iliac fossa(asterix) without calcification or necrosis. Discrete enlarged lymphnodes in adjacent mesentery(blue arrows), sheet like omental/ peritoneal deposits(orange arrows) , splenomegaly and similar appearing nonobstructive duodenal mass(Asterix in lower left axial CT image and pink dot in coronal image) favor this to be secondary lymphomatous deposits rather than a second primary(confirmed by lymphnodal excision biopsy). Note that lymphoma is not a common cause for peritoneal carcinomatosis.

LAST BUT NOT LEAST- ADJOINING ORGANS/MASSES ENCROACHING RIGHT ILIAC FOSSA

- OVARIAN/RIGHT ADENEXAL MASSES
- TRANSPLANT KIDNEY



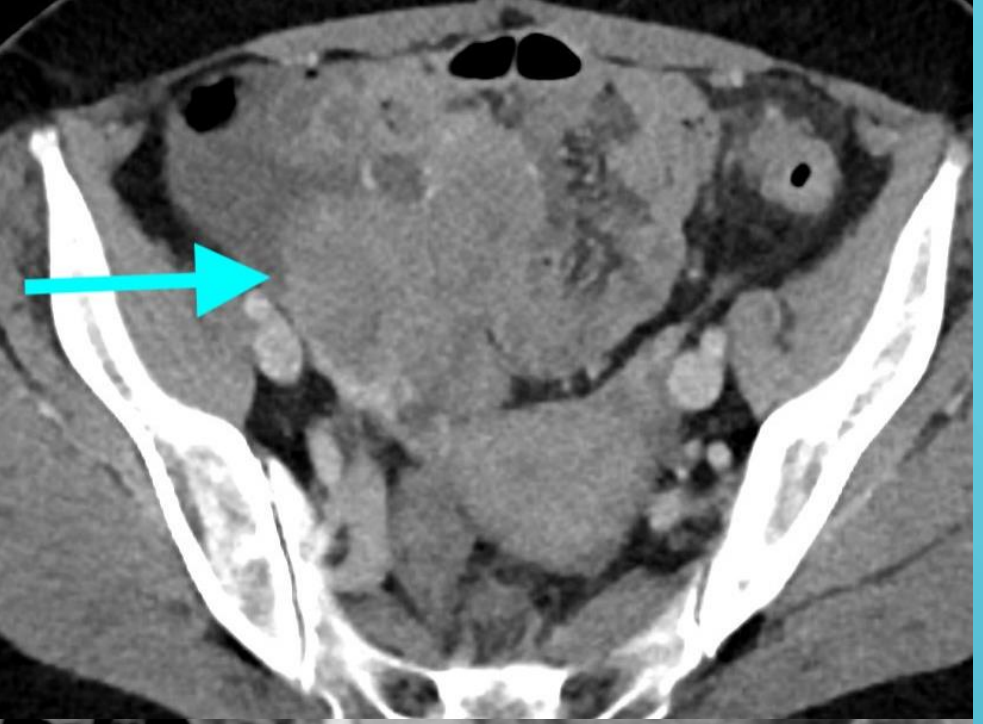


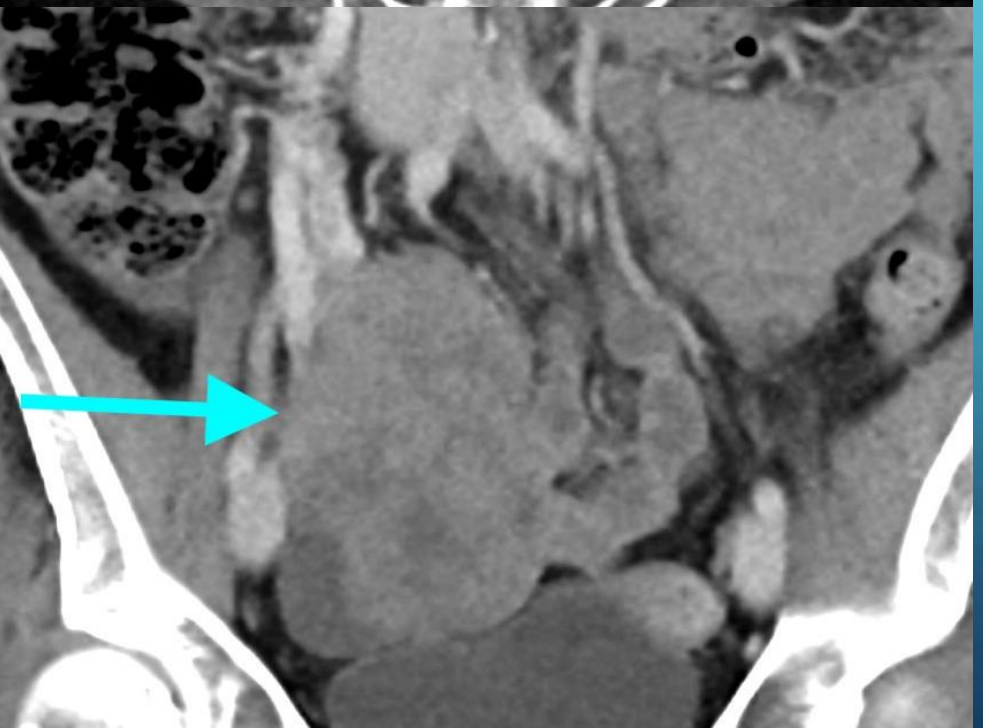
DERMOID CYST(MATURE CYSTIC TERATOMA OF OVARY)

- Incidentally detected ovarian dermoid in a 29 year old female who underwent CT abdomen for Motor Vehicle Accident. Axial (above) and coronal CT images showing a well circumscribed pelvic mass with large fatty component(pink dots), irregular solid component- blue dots (representing sebaceous material, hairs) and eccentric curvilinear calcification with tooth like structure(yellow arrows). Large ovarian mass can be a cause for right iliac fossa pain and should be thought of in a female patient.
- Eccentric solid component(Rokitansky protruberance or dermoid plug), fat-fluid levels are other CT features(not seen in this case).
- Occasionally, dermoids can be lead to ovarian torsion (see next case), can rupture or rarely can undergo malignant transformation.

OVARIAN TORSION DUE TO DERMOID

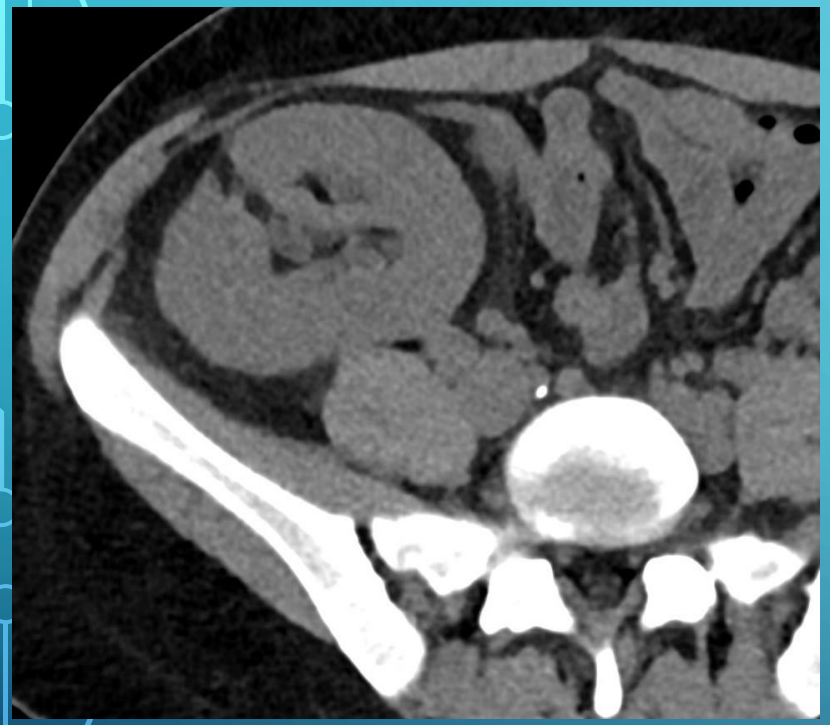
Ovarian torsion in a young female presenting with acute onset right iliac pain . Coronal CT slice on left showing thickened ovarian pedicle with enlarged , heterogenous right ovary (red arrow) containing peripherally arranged hemorrhagic foci(follicles) and stranding in surrounding soft tissues. Coronal CT image on left demonstrating the cause for torsion in form of mature cystic teratoma(yellow arrows).





SEROUS CARCINOMA RIGHT FALLOPIAN TUBE

- Contrast enhanced CT(axial-above and coronal-below) images showing a solid heterogeneously enhancing adnexal mass(blue arrows). No perilesional fat stranding or lymphadenopathy. The imaging appearance is consistent with adnexal neoplasm-proven to be serous carcinoma in right fallopian tube with normal right ovarian tissue on histopathology.



TRANSPLANTED KIDNEY

- Transplanted kidney in right iliac fossa in a 37 year old male with IgA glomerulonephritis. Transplanted kidney can be mistaken for an iliac fossa mass.

CONCLUSION

- There is more to the pathologies in the ileo-cecal region than just appendicitis and Crohn's disease. Evaluation of right iliac fossa structures should be included in the check list of every radiologist reporting CT abdomen irrespective of its indication as many a times these abnormalities are incidentally noticed.

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