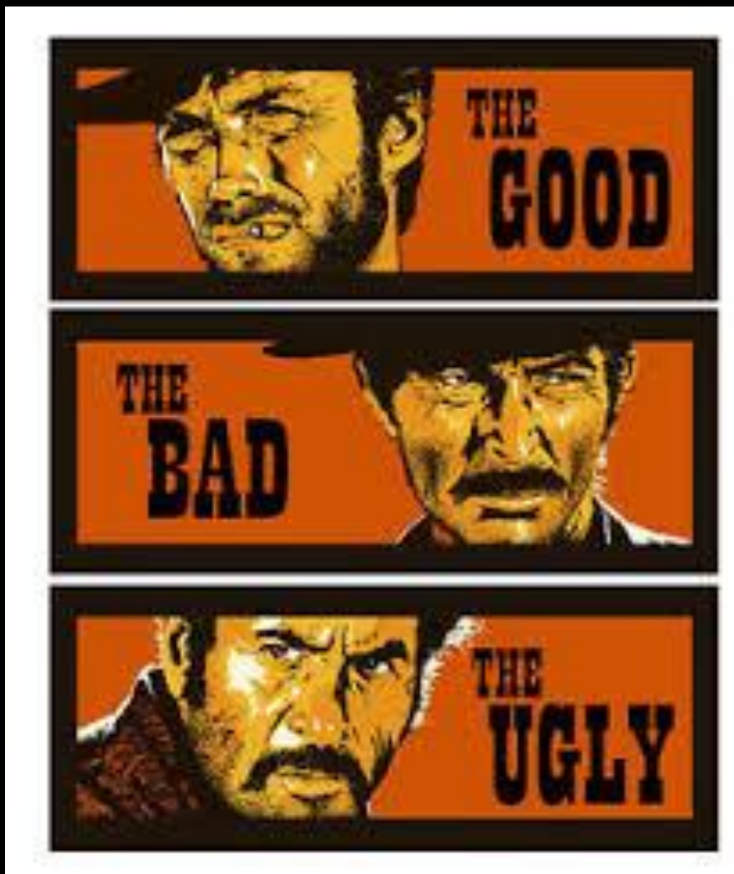
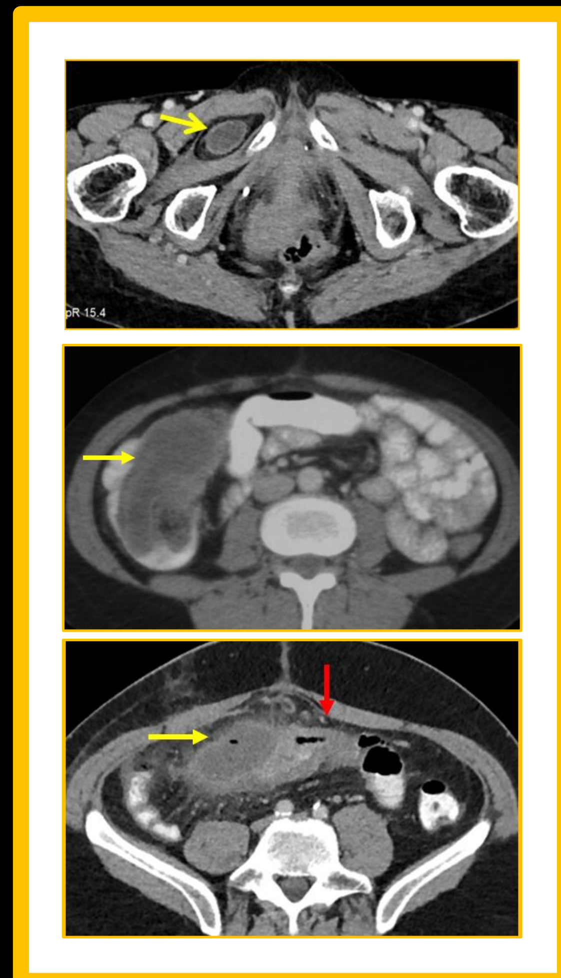
Small bowel obstruction (SBO) due to rare causes. The good, the bad and the ugly one.





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LEARNING OBJECTIVES

- To highlight the imaging features of SBO in multimodality imaging.
- To create an algorithm of the main steps in diagnosing SBO.
- To cite unusual entities of small obstruction and to classify them in intrinsic and extrinsic causes.

BACKROUND

Small bowel obstruction constitutes a rather frequent clinical entity at the emergency department that occurs secondary to mechanical or functional obstruction of the small bowel (it consists of the 80% of all mechanical intestinal obstructions), preventing normal transit of its contents.

It is a frequent cause of hospitalization and surgical consultation, representing 20% of all surgical admissions for acute abdominal pain.

Beyond usual causes, such as adhesions, hernias, inflammatory bowel disease and of course neoplasms, SBO can be the result of numerous other, more rare causes. Intussusception, vascular thrombosis, bezoars, Meckel's diverticulum consist some of infrequent causes of SBO.

- Rare causes of SBO can be categorized as intrinsic, endoluminal or extrinsic, with the latter to be the most common.
- Radiologist should bear in mind in depth the patient s age, clinical situation and personal history.
- Once the transition point is depicted , physician should try to locate the exact reason of the obstruction and of course to provide to the surgeon information about the severity of the obstruction as well as the necessity of acute intervention.

Imaging Procedures

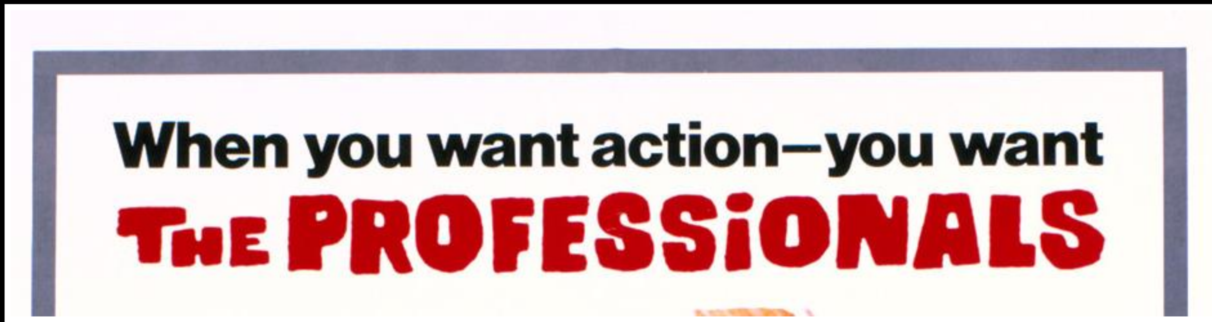
Abdominal xray

- Upright, supine and chest radiograph.
- Combination of clinical examination and abdominal xrays is diagnostic in only 50-60,% of small bowel obstruction.
- Sensitive for high grade but not for low grade obstruction.
- The presence of ≥ 2 air fluid levels
- Bowel loops greater than 3 cm, collapsed colon, differential air–fluid levels, and thickened bowel wall [1].
- Strangulation signs (rare): pneumatosis intestinalis, gas in the portal vein and thickened oedematous intestinal folds
- The cause of SBO is usually unidentified [2].

Imaging Procedures

Computed Tomography

- Gold Standard in SBO diagnosis
- Sensitivity of 82%–100% (depends on the degree of the obstruction) and accuracy of 90%–95%.
- Depicts the transition point and accurately assesses for complications which impacts on patient management, and distinguishes SBO from conditions that may mimic SBO.
- There is increased diagnostic confidence with the use of 3D and multiplanar reformats (MPR) . MPR and 3D reformative capabilities demonstrate pathological processes involving the bowel wall, bowel lumen, mesentery, mesenteric vessels, and peritoneal cavity [3].



Radiologists are recruited to answer :

- Is the small bowel obstructed?
- Severity of the Obstruction.
- Where is it located?
- Is strangulation present?
- What is the CAUSE

The Professionals is a 1966 American **western**

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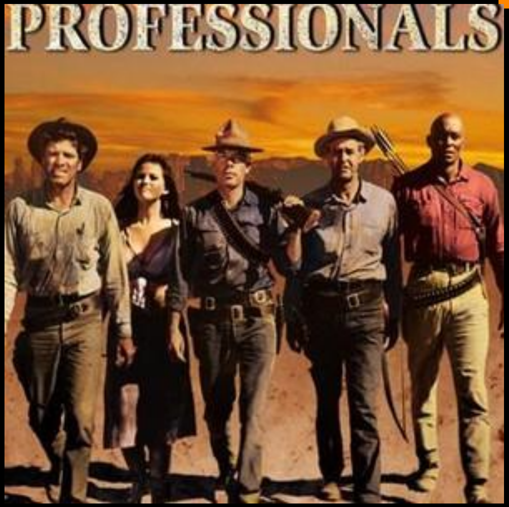

ANSWER

- Presence of dilated proximal loops (> 2.5 cm from outer wall to outer wall)
- Collapsed or normal caliber of the distal loops.

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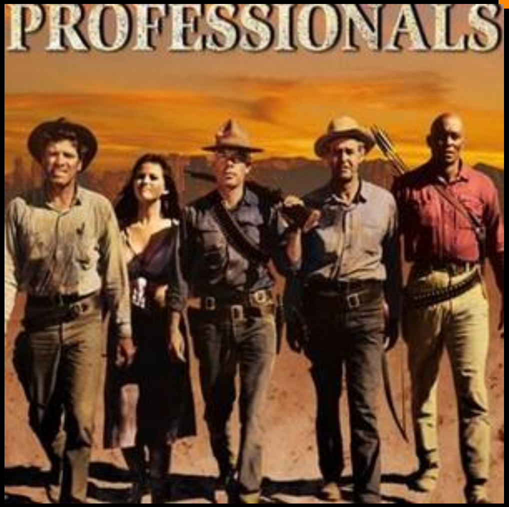

Transition Point (TP):

-Caliber change between the dilated proximal and collapsed distal SB loops.

- Gradual (degree of prestenotic dilatation)
- Abrupt (marked prestenotic dilatation)
- Absent

-Retrograde approach from the rectum and proceeding proximally to the jejenum is advised

-Presence of the “small bowel feces” sign

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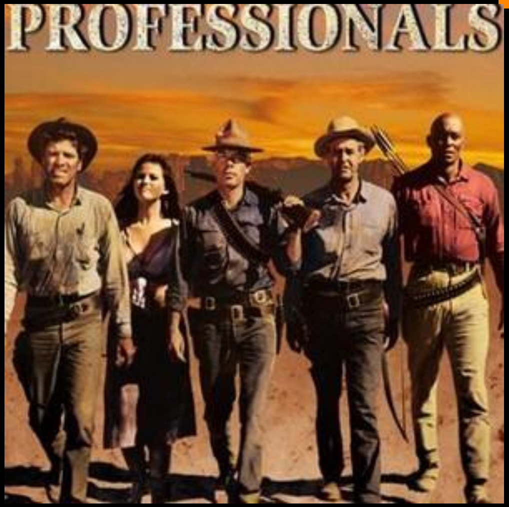

Complete versus partial SBO [3,4].

- Degree of distal collapse
- Proximal bowel dilatation
- Passage of oral contrast through the transition point into the collapsed bowel (partial SBO)

Radiologists are recruited to answer :

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- Where is it located- Transition Point?
- Severity of the Obstruction.
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- What is the CAUSE

ANSWER

- Strangulation refers to vascular involvement along with the SBO.
- Occurs in ± 10% of patients
- Usually, it coexists with closed loop obstructions.
- Venous outflow obstruction is the commonest cause of Ischemia

CT Imaging findings include:

- Circumferential mural thickening, increased mural attenuation,
- Different degrees of mural enhancement
- Mesenteric fat stranding and rarely, pneumatosis intestinalis, and portal venous gas.
- Curved multiplanar reformats along the closed loop axis help identify the pivot point and torsion of the mesenteric vessels [4].

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- What is the ***CAUSE***

THE ANSWER IS ALMOST ALWAYS IN THE TRANSITION POINT.

- Intrinsic bowel lesions are seen at the transition point as localized mural thickening.
- Extrinsic causes are adjacent to the transition point and usually have associated extraintestinal manifestations.
- Intraluminal causes manifest as endoluminal “foreign objects” with different imaging characteristics from those of the remaining enteric content [3].

Main rare entities lead to SBO

“ Good ” Extrinsic	“ Bad” Intrinsic	“ Ugly”Endoluminal
• Hernias (Internal, obturator, Femoral) • Meckel's Diverticulum • Midgut volvulus • Sclerosing Mesenteritis	• Intussusception • Vascular thrombosis	• Bezoar • Foreign bodies • Abscesses (although extrinsic)

Imaging Findings

INTERNAL HERNIAS

- Internal hernias have a low incidence of <1% and represent a relatively small amount of presentations, of ~5%
- The small bowel herniates through:

  - A pre-existing anatomic structure, (foramina, recesses, fossae)

  - Pathologic defects of the mesentery and visceral peritoneum, due to congenital development of the   mesenteries or internal herniation orifices after surgery.

- Most common type is the the paraduodenal hernias(55%), followed by foramen of Winslow hernia, pericaecal hernia, sigmoid mesocolon (inter-, trans-, intra mesosigmoid) hernias (Figures 1A-D) and transmesenteric hernias [5].
- CT IMAGING FINDINGS [5] :

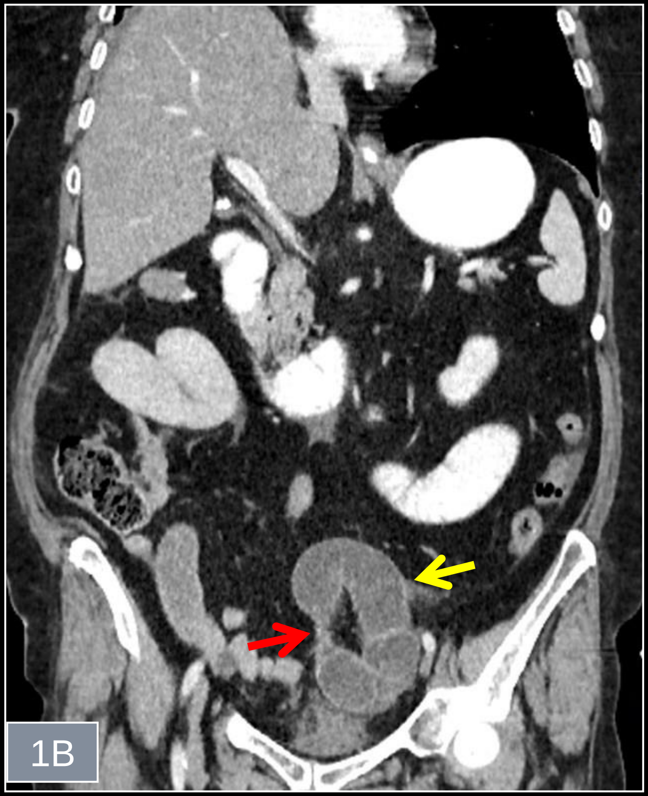
  - Evidence of obstruction with segmental dilatation and stasis, usually closed loop (C or U shape)

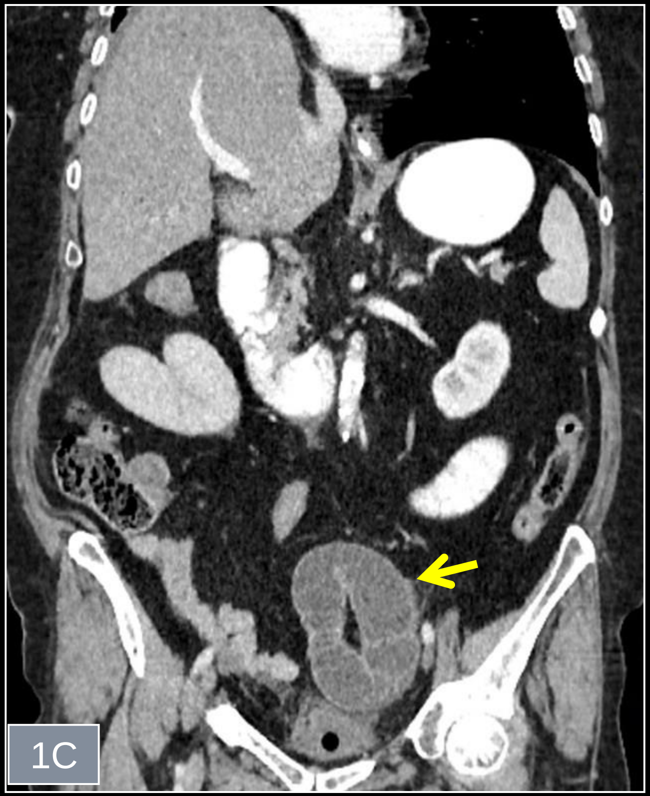
  - Encapsulation of crowded distended bowel loops within an abnormal location

  - May show signs of strangulation

  - Mesenteric vessel alteration in course (crowding, twisting, stretching) nad focal fat stranding

  - Oedematous bowel wall shows mural stratification, ‘target sign’ with congestion of the   mesentery.





Figures 1A-D : A case of SBO in a 81 years old female patient with imaging findings of close loop obstruction (yellow arrows) on axial image (fig.1A), coronal (fig.1B-C) and sagittal (fig.1D) MPR images. Red arrows point the transition zone. Surgical exploration revealed transmesosigmoid hernia, type of Sigmoid mesocolon internal hernia

Imaging Findings

FEMORAL - OBTURATOR HERNIAS

Femoral hernias [6]

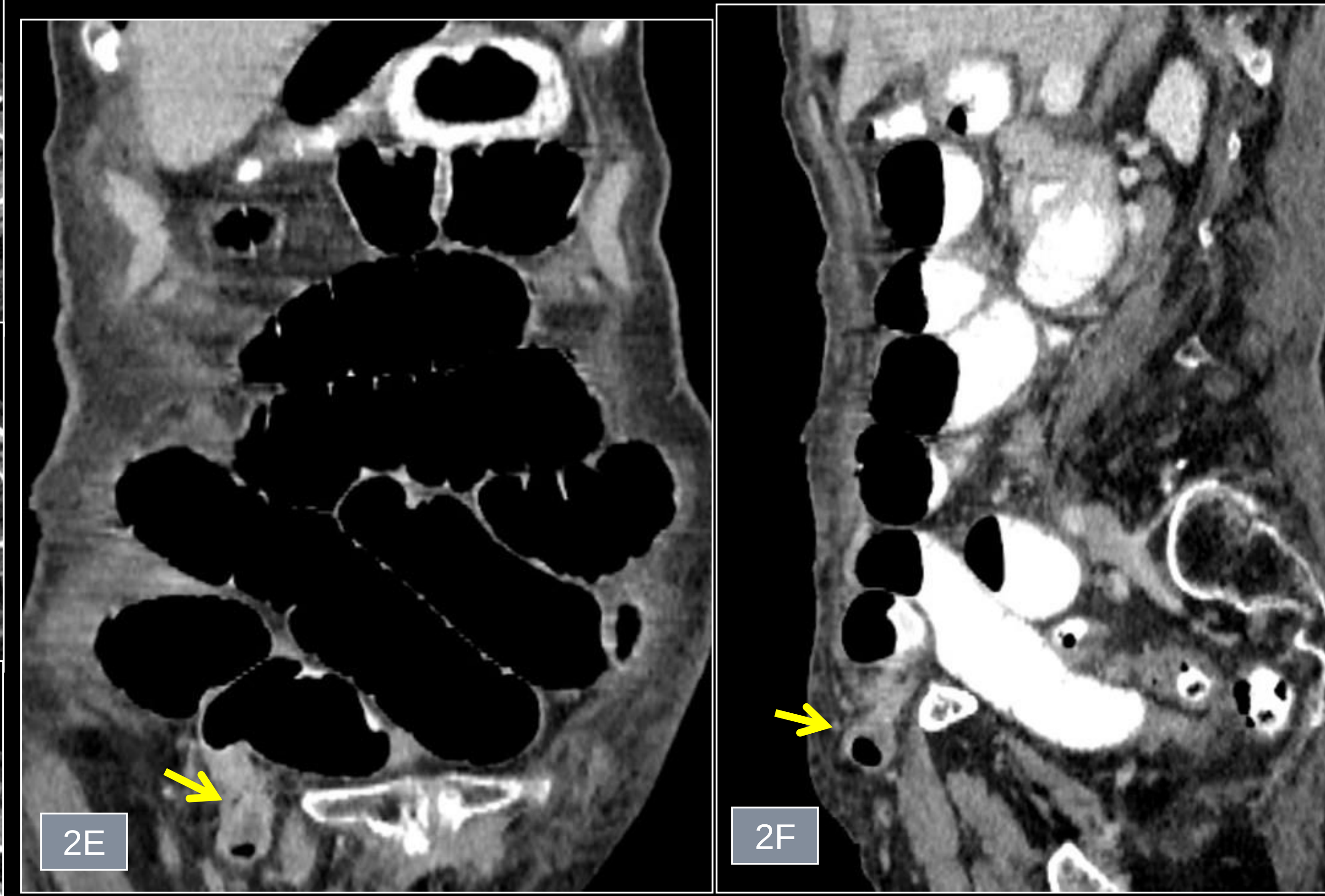
- Femoral hernias occur, unlike inguinal hernias, lateral to the pubic tubercle, medial to the femoral vein and posterior to the inguinal ligament, usually on the right side.
- More common in females.
- Femoral hernias typically have a characteristic funnel-shaped neck.

➢ CT Imaging fFindings:

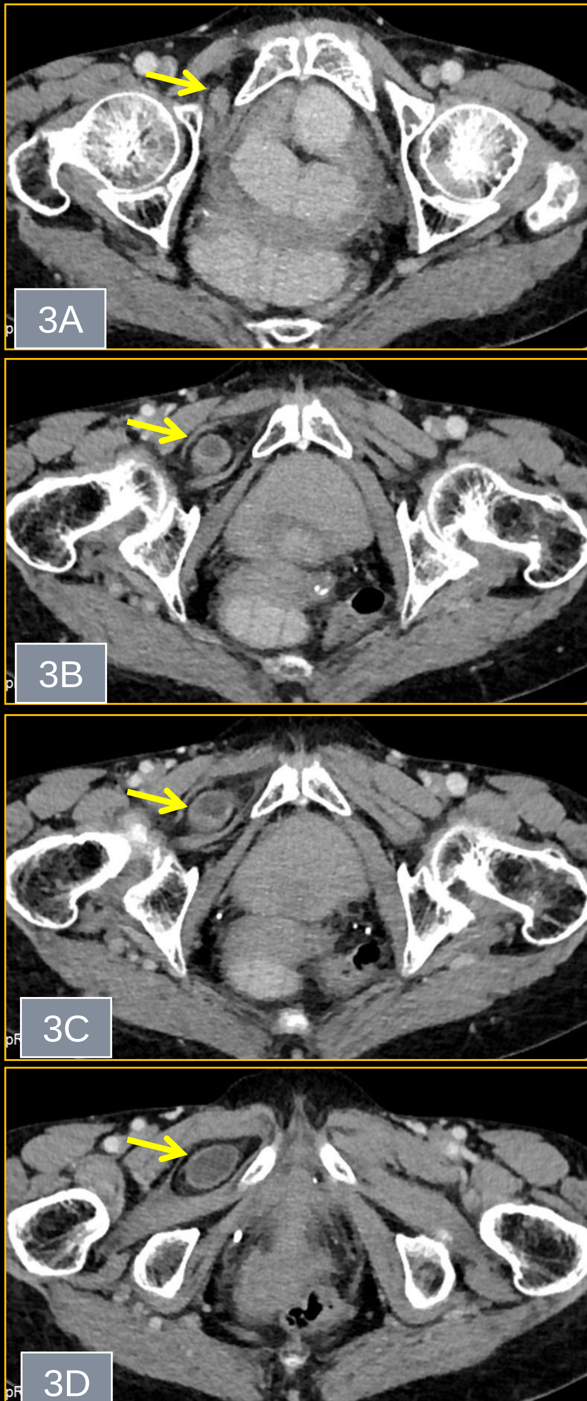
- Axial images reveal the neck of the femoral hernia sac as a narrow protrusion through the femoral ring just medial to the common femoral vein. This can often look indented and compressed by the hernia sac (Figures 2 A-F) .
- Coronal images can also be very useful and it is usually seen in the space containing the fat pad between the inguinal ligament, the common femoral vein and adductor longus. Assessment of compression of the femoral vein (in contrast to inguinal hernias) and any distal engorgement should be made.

Obturator hernias [7]

- Obturator hernias are rare and very difficult to diagnose clinically.
- Manifest as herniation of small bowel loops or a ureter through the obturator foramen which is approximately 2–3 cm long and 1 cm wide.
- Bowel herniating between the obturator and the pectineus muscle .
- Common in elderly female and post-pregnancy patients owing to the greater width of the pelvis, larger obturator canal, and increased laxity of the pelvic tissues. The condition has been nicknamed the ‘little old ladies hernia’.
- Obturator hernias contain bowel which obstructs, incarcerates or strangulates (Figures 3 A-F)



Figures 2A-F: An 80 years old lady referred for abdominal CT because of SBO. Imaging findings demonstrated the diagnosis of SBO due to right femoral hernia (yellow arrows) on axial images (fig.2A-D), coronal (fig.2E) and sagittal (fig.2F) MPR. The involved small bowel loop was necrotized during the surgery procedure

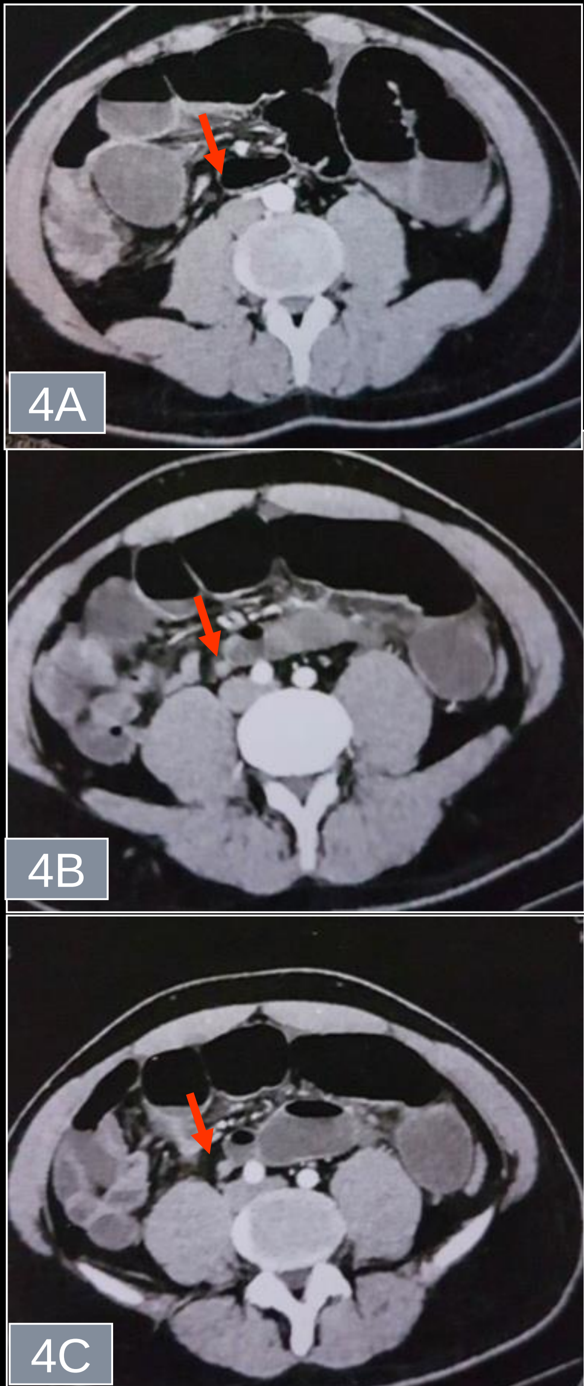


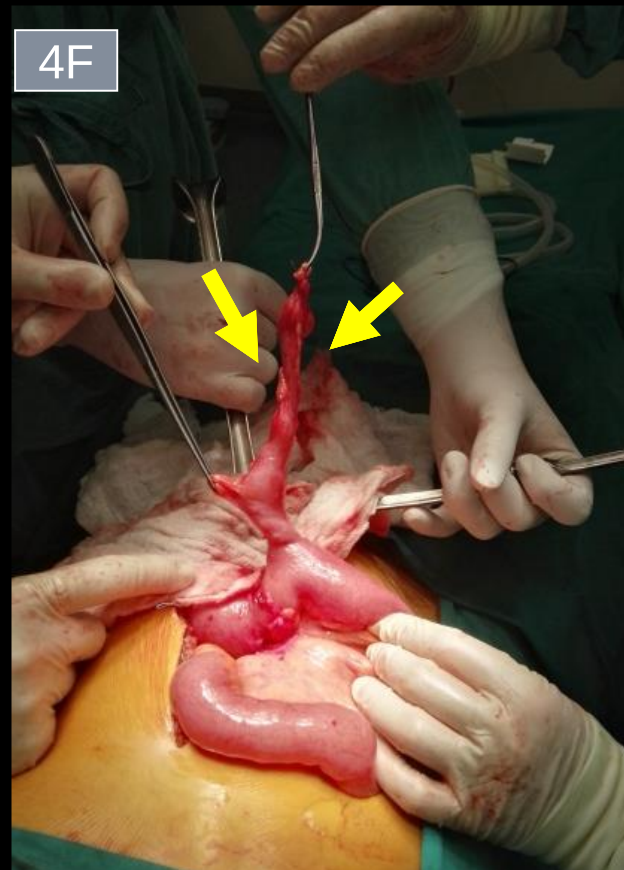
Figures 3A-F: A case of SBO due to right obturator hernia in an 80 years old lady on axial images (fig. 3A-D), coronal (fig. 3E) and sagittal (fig. 3F) MPR images, known as 'The Little **Old Lady Hernia**'.

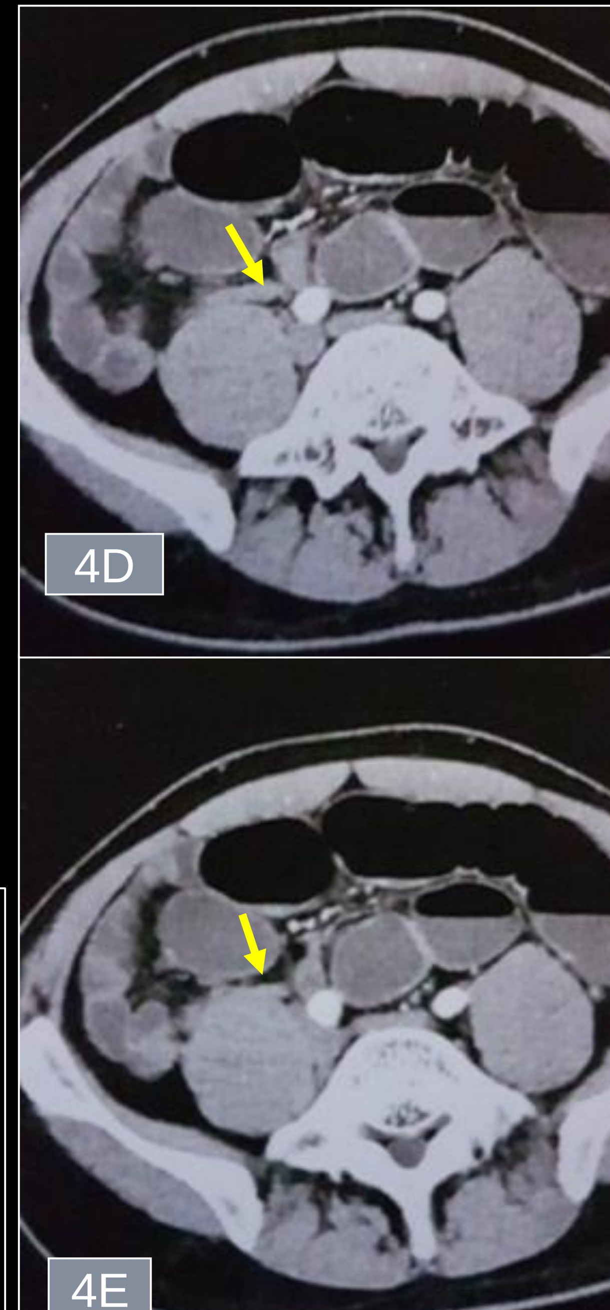
Imaging Findings

MECKELS DIVERTICULUM[8]

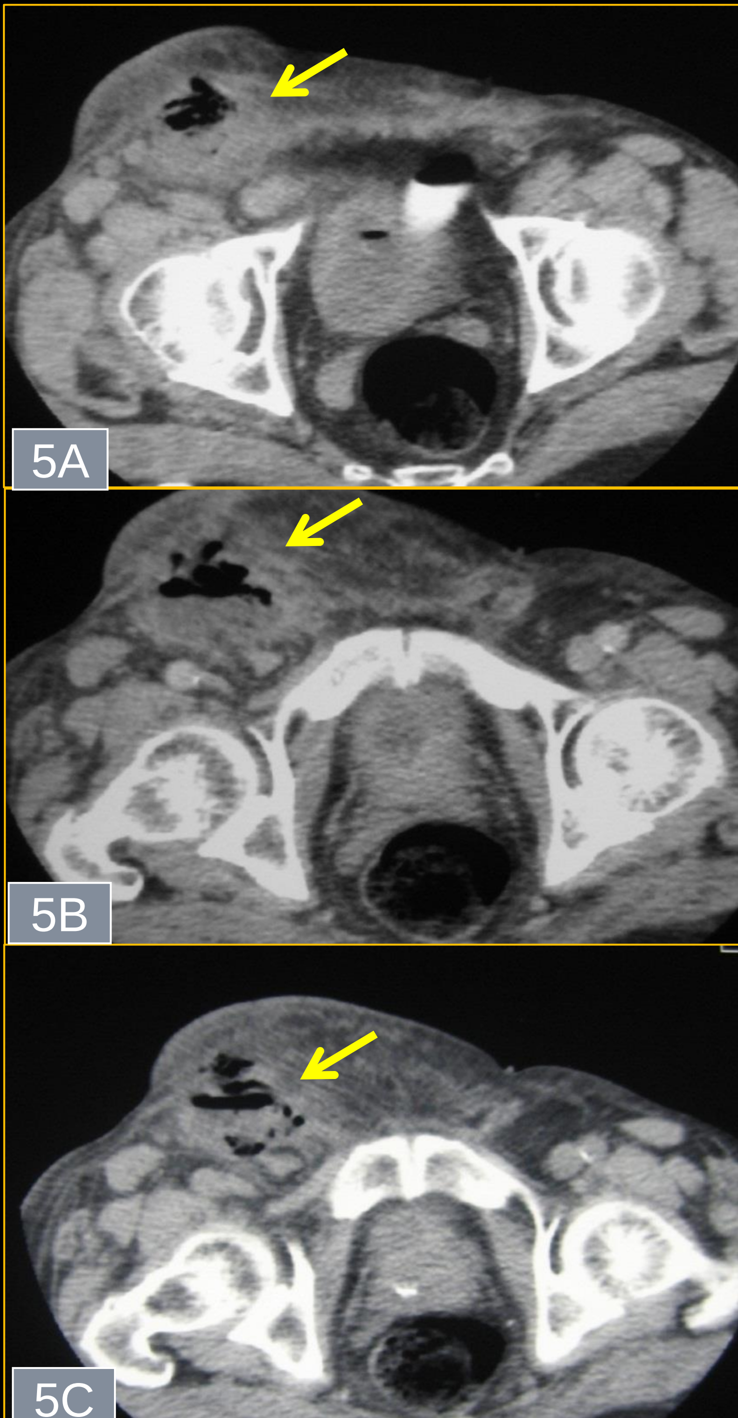
- The most common congenital anomaly of the small intestine, with a prevalence of approximately 1-3%,
- It is a true diverticulum containing all layers of the bowel wall with average length of 3 cm.
- The diverticulum is usually found within 100 cm of the ileocaecal valve on the antimesenteric border of the ileum. The mean distance from the ileocaecal valve is 67 cm.
- Most cases of Meckel’s diverticulum are asymptomatic and estimated risk of developing complications is around 4%.
- CT angiography may show the persistent omphalomesenteric artery
- Obstruction occurs due to:
  - Trapping of a bowel loop by a mesodiverticular band (Figures 4A-F)
  - A volvulus of the diverticulum around a mesodiverticular band.
  - Extension into a hernia sac, known as Littre’s hernia (Figures 5A-D)



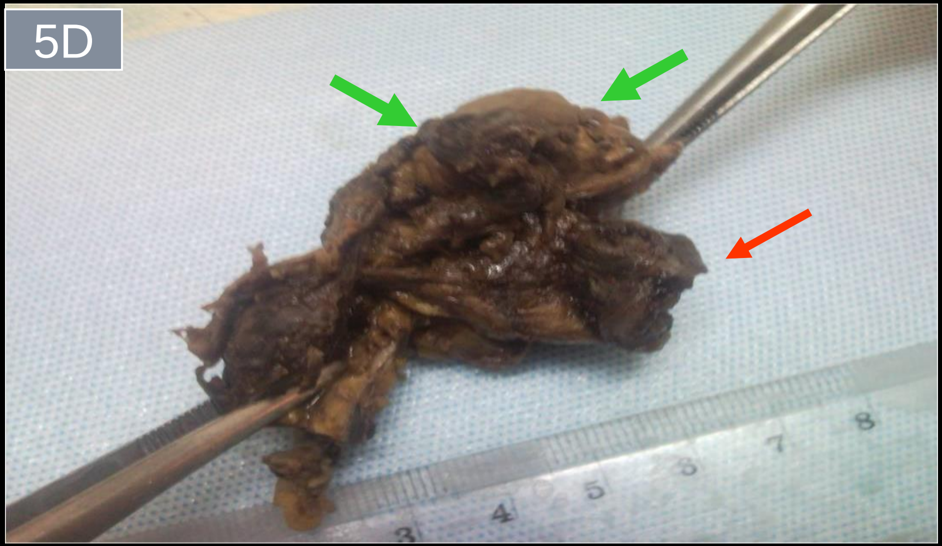




Figures 4A-F: A case of SBO in an adult young male, caused by an extremely elongated Meckel's diverticulum, acting as trapping band. The point of transition (red arrows)and part of the Meckel's diverticulum (yellow arrows) on axial images (fig. 4A-E). The surgical specimen (fig.4F)



Figures 5A-D : A 67-year old male patient presented with fever, a painful palpable mass of the right inguinal space and symptoms of SBO. Abdominal CT revealed abscess formation and perforation (yellow arrows) in a right-sided femoral hernia, on axial images (fig.5A-C). The surgical specimen (fig.5D) of inflamed Meckel's diverticulum (red arrow) in a right-sided femoral hernia and the inguinal sac with green arrows. Strangulation of Meckel's diverticulum in femoral hernias (Littre's hernia) is an extremely rare entity.



Imaging Findings

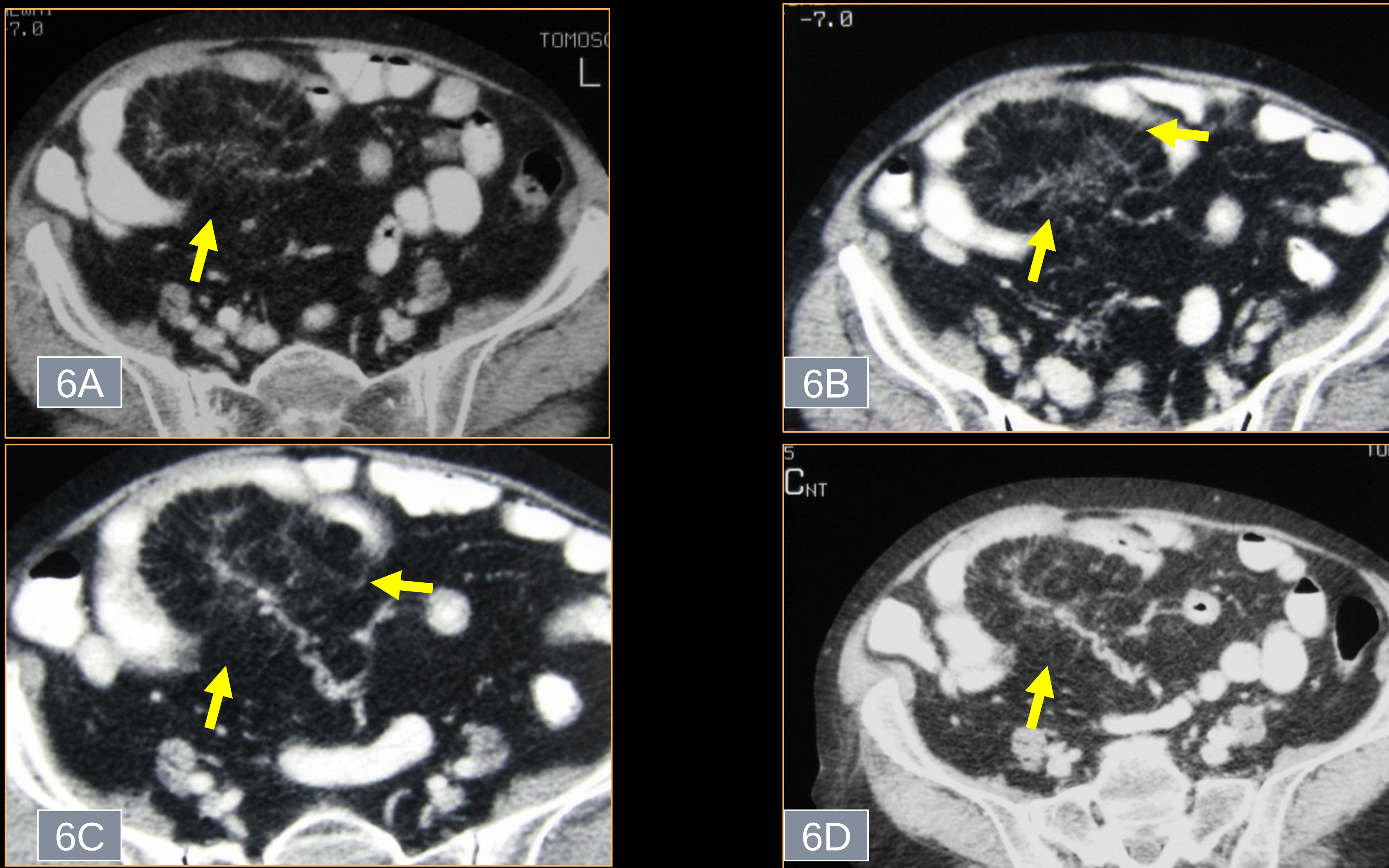
MIDGUT VOLVULUS [9]

- Midgut volvulus is rare in adults.
- Is the result of the abnormal fixation of the small bowel mesentery, which leads to an abnormally short mesenteric root, allowing the small bowel to twist around its mesentery, causing obstruction and possibly ischemia of the bowel.
- CT Imaging Findings :
  - Malrotated bowel configuration findings
  - Inverted SMA/SMV relationship
  - Small bowel obstruction
  - Whirlpool sign of twisted mesentery
  - Free fluid/free gas in advanced cases

Imaging Findings

SCLEROSING MESENTERITIS(SM) [10]

- Rare inflammatory disorder of the mesentery, with a prevalence of 0.16% to 7.80%.
- Affects older adults in their 60s and 70s, twice male predilection.
- There is a reported association of SM with malignancies such as lymphomas, colorectal and prostate cancers.
- CT Imaging Findings :
  - Fat tissue mass
  - Hyperattenuation of the mass in comparison to other fatty tissues
  - “Halo sign”
  - Pseudocapsule
  - Absence of lymphadenopathy
  - Distended small bowel loops are centered on a stellate mesenteric soft tissue density (Figures 6A-D)



Figures 6 A-D : A case of a female patient presented with abdominal pain and sign and symptoms of SBO. Axial CT images (fig. 6A-D) demonstrate that the distended small bowel loops were centered on a stellate mesenteric soft tissue density, without evidence of internal calcifcation, compatible with Sclerosing Mesenteritis (yellow arrows), resulting in retraction of the small bowel. Patient was managed with conservative therapy.

Imaging Findings

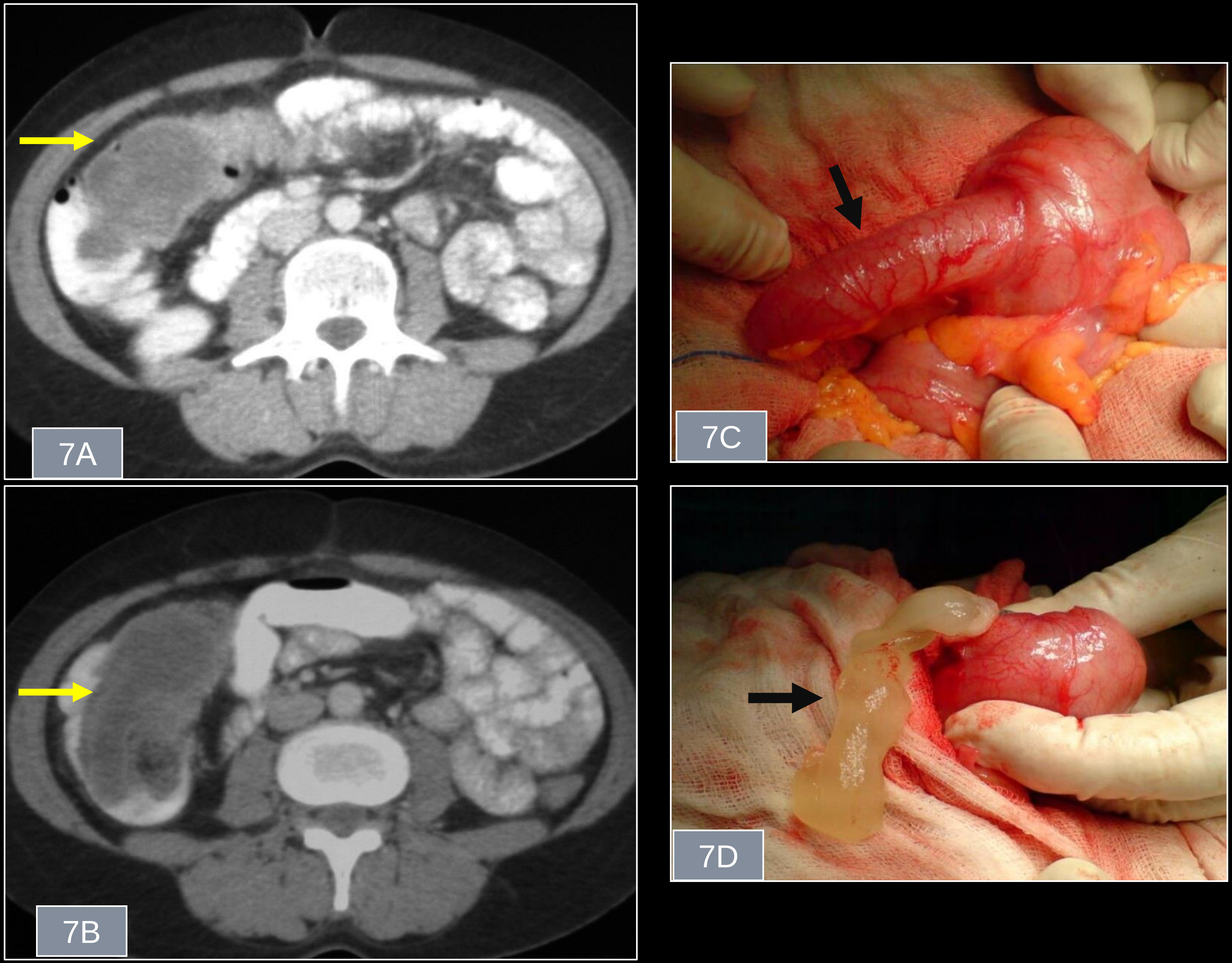
INTUSSUSCEPTION [3]

- Accounting for less than 5% of SBOs.
- Intussusceptions secondary to neoplasms, adhesions, or foreign bodies are associated with SBO.
- Common in HIV.
- A leading mass usually constitutes the cause of the intussusception and carefully must be differentiated from the soft-tissue pseudotumor that represents the intussusception itself.
- **CT Imaging Findings:**

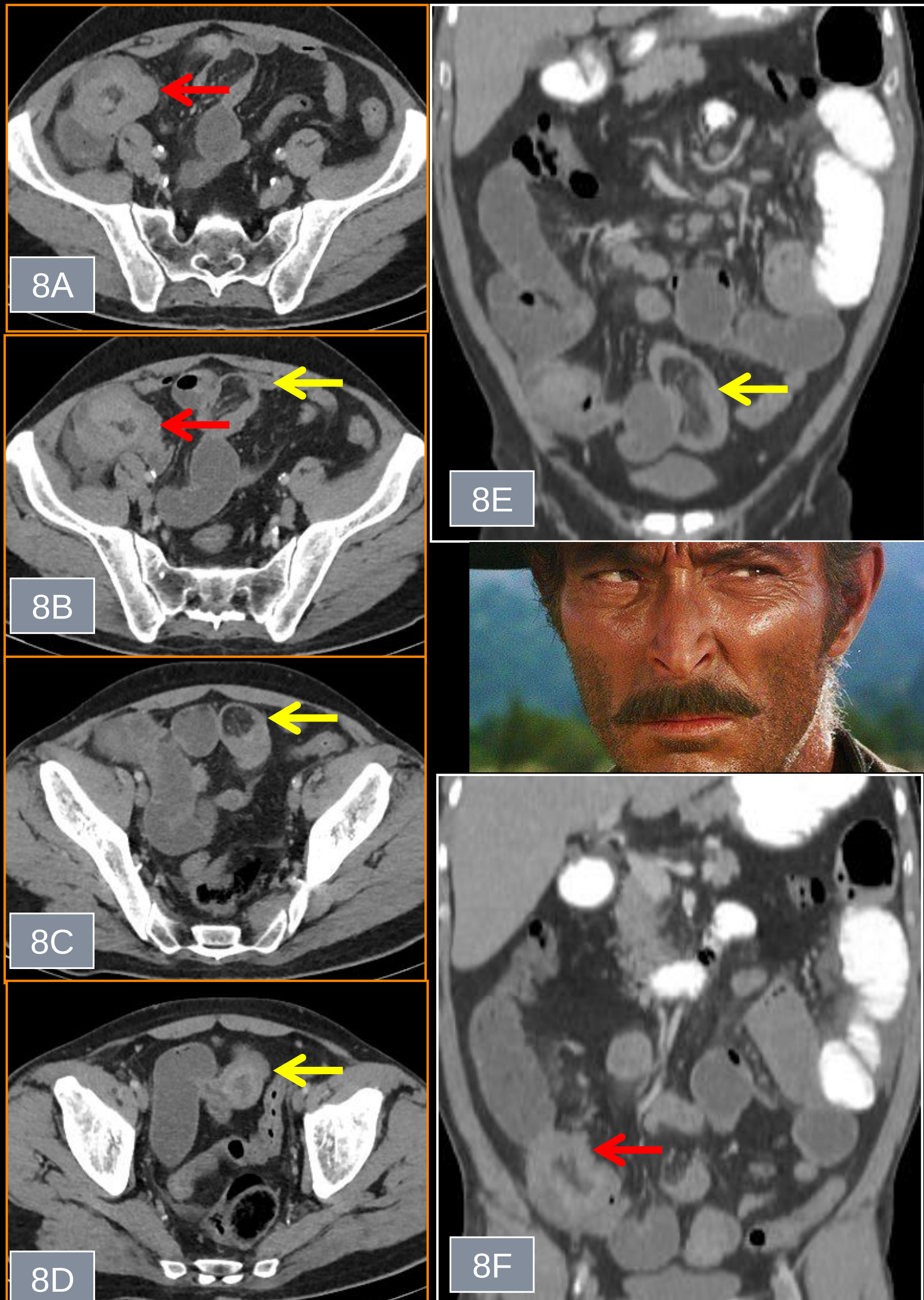
– The gold point of a bowel-within-bowel configuration . It represents the collapsed intussuscepted proximal bowel (intussusceptum) into the distal bowel lumen (intussuscepiens).

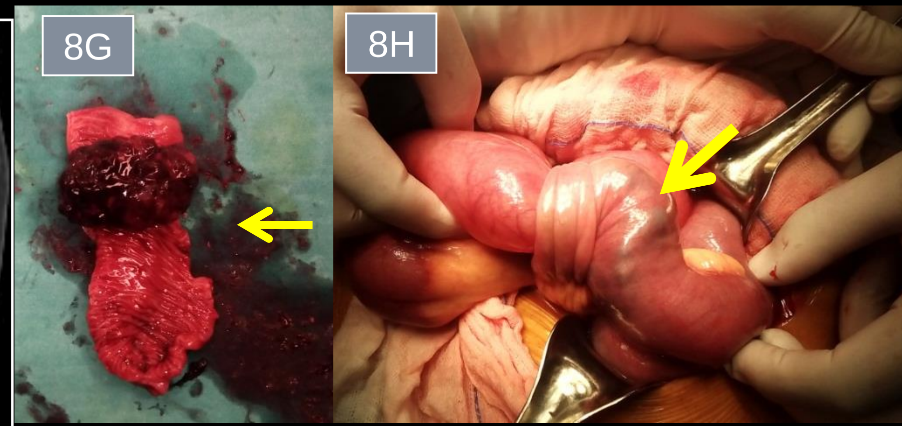
– It may contains mesenteric fat and vessels

– In advance stage CT shows a sausage (Figures 7 A-D) or reniform (pseudorenal forming) mass with alternating layers of low (mesenteric fat) and high attenuation (bowel wall) (Figures 8A-J) .

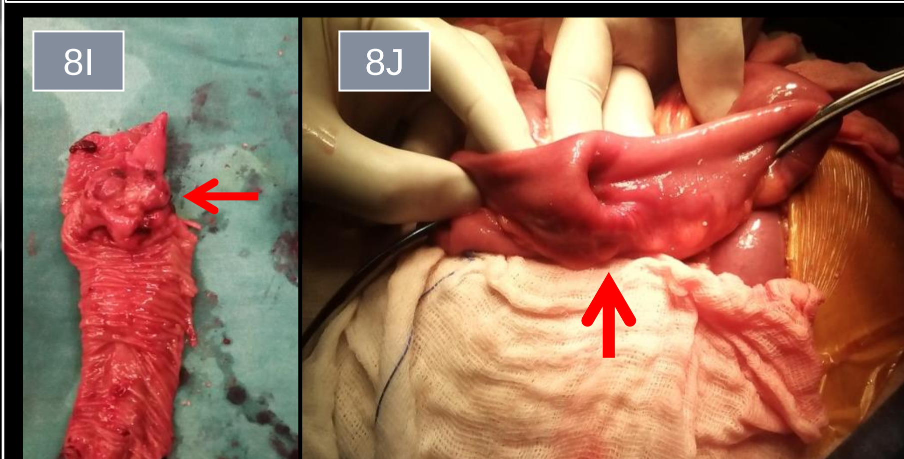


Figures 7 A-D : A case of a 45 years old male presented with RLQ pain, SBO and a palpable mass in this region. Spiral CT (fig. 7A-B) revealed ileocecal intussusception due to a low attenuation sausage -like mass (yellow arrows). During surgical exploration the sausage -like mass proved to be an appendix mucocele, containing mucus (black arrows, fig. 7C-D). The histological diagnosis was mucinous cystadenoma of the appendix.





Figures 8A-J:A 43-years old patient with SBO because of double location intussusception (yellow arrows to the former point and red arrows to the latter-reniform) on axial images (fig.8A-D) and coronal MPR (fig.8E-F). Images of the intussusceptions in the operation room (fig.8H,J). Surgical specimens (fig.8G,I) were compatible with tumors. The histopathological diagnosis was bifocal adenocarcinomas of the small bowel

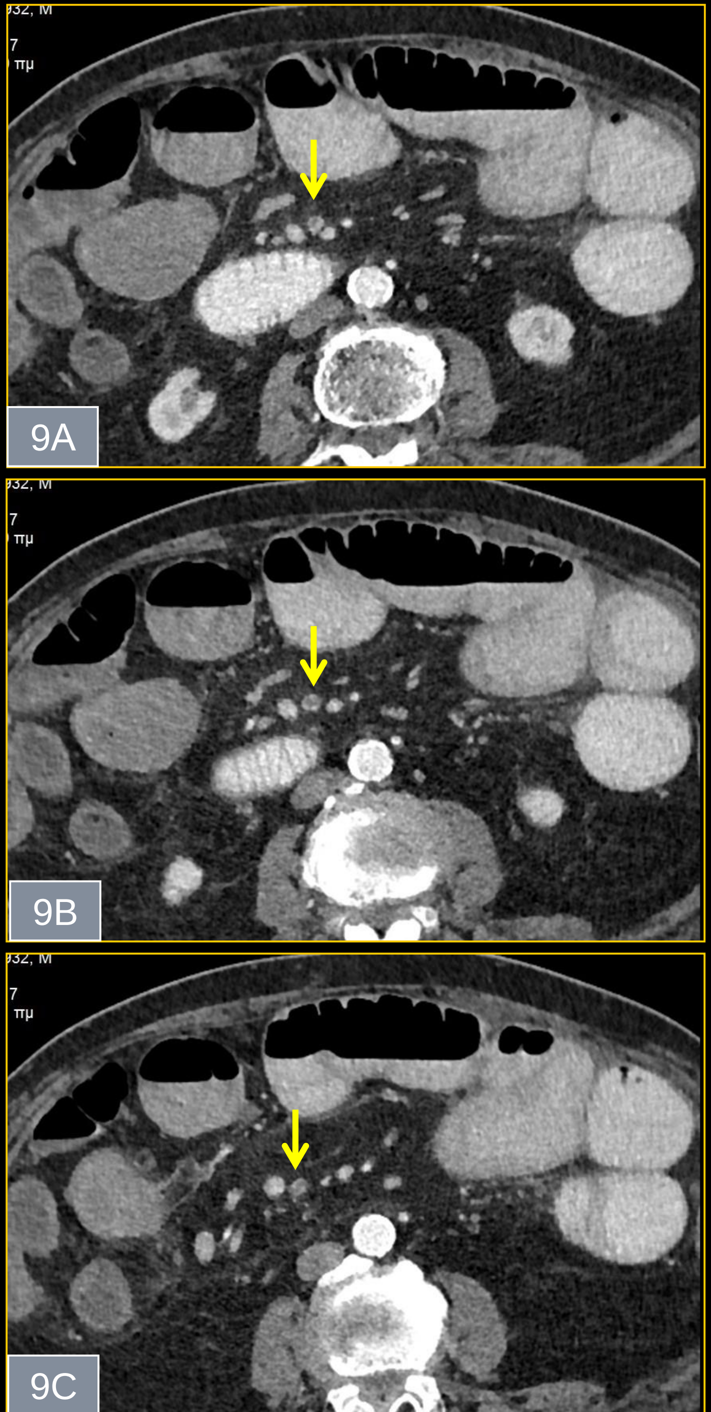


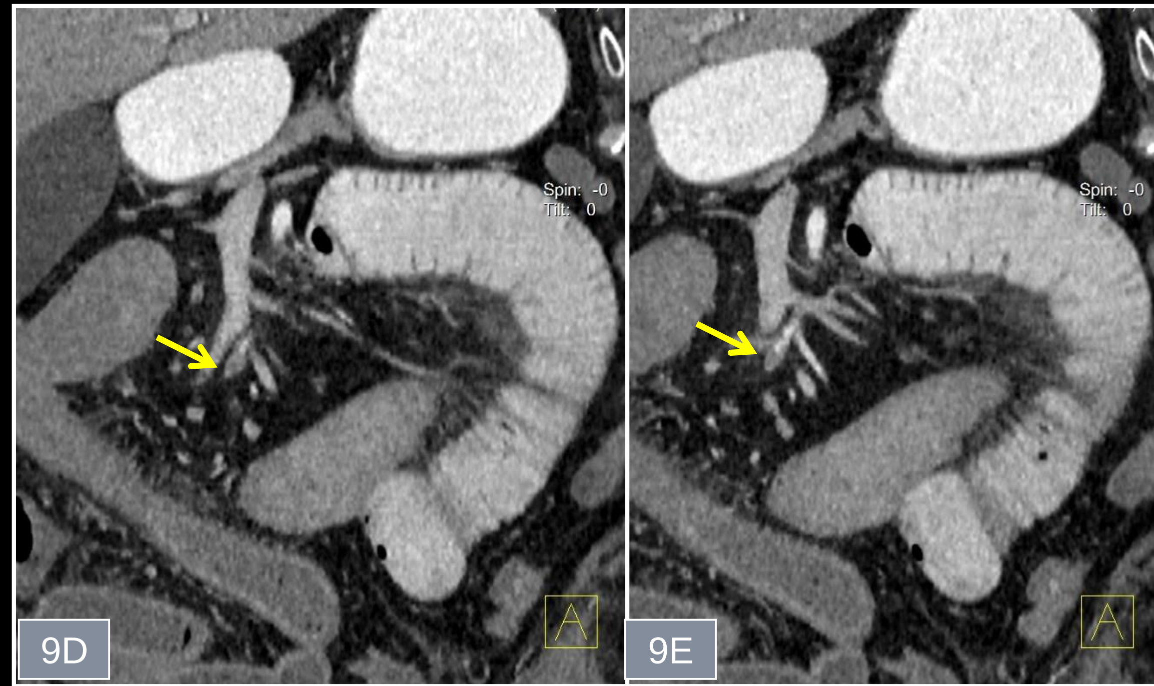
Imaging Findings

VASCULAR THROMBOSIS [3]

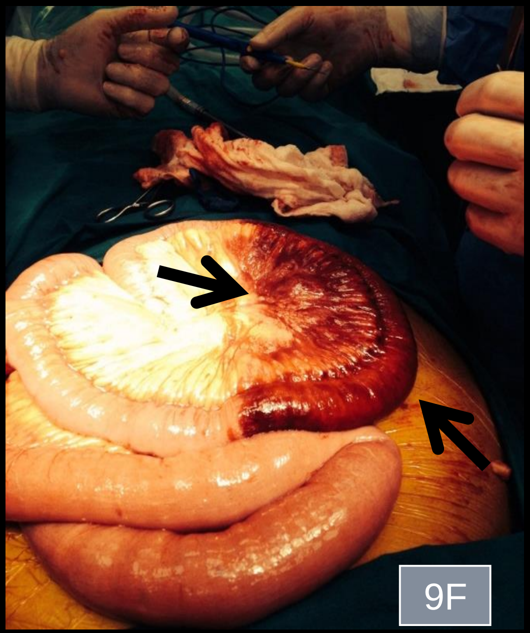
- Occlusion or stenosis of the mesenteric vascular supply (arterial or venous) leads to bowel ischemia, resulting to SBO (Figures 9A-F).

- **CT Imaging Findings**
  - Thrombosis or occlusion of the mesenteric vessels.
  - Thickening of the bowel wall in the affected loops.
  - Different degree of asymmetric wall enhancement.
  - In advanced underdiagnosed cases, a bowel infarct may be present, which manifests as pneumatosis intestinalis and air in the portal venous system.





Figures 9A-F : A case of SBO in a 83 years old male patient with acute abdominal pain and history of atrial fibrillation. Axial CT images (fig.9A-C) and coronal (fig.9D-E) MPR images revealed a thrombus in the ileocolic branch of superior mesenteric artery (yellow arrows) and dilated small bowel loop. The image of the necrotized small bowel loop (black arrows) during the operation (fig.9F) .



Imaging Findings

BEZOARS [3,11]

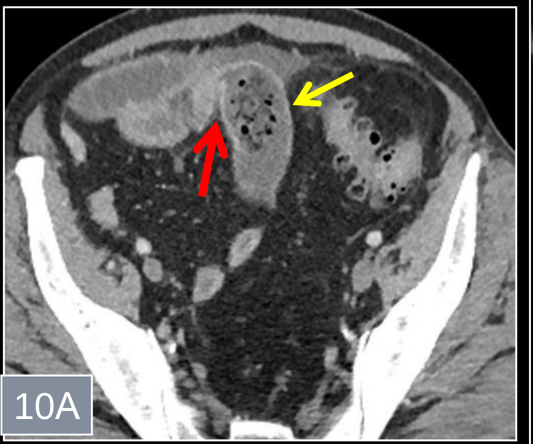
- Bezoar consists of indigestible material found in the gastrointestinal tract.
- Phytobezoar consists of the 55% of all bezoars and it derives from poorly digested vegetable fibers.
- Other types include trichobezoars , pharmakobezoars and lactobezoars.
- Bezoar-leads to small bowel obstruction that rarely improves with conservative treatment, so surgery is the choice of therapy.
- **CT Imaging Findings**

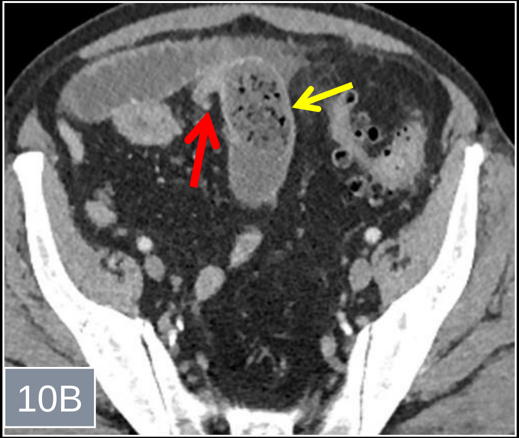
– Similar to that of SBO Dilated small-bowel lumen filled with mottled gas-patterned, feces-like material just proximal to the transitional zone; In contrast to small faeces sign, phytobezoars appear well-defined in shape, shorter in length than small-bowel feces and fat density debris floating in the dilated bowel loops proximal to the obstruction (Figures 10A-E)

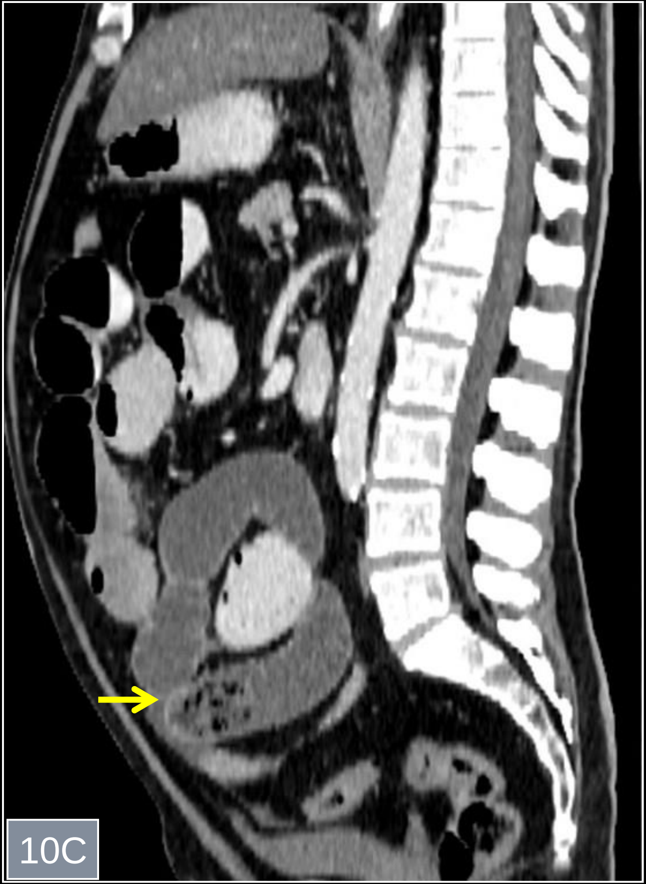
– No evidence of mural thickening or mass lesion at the transitional zone

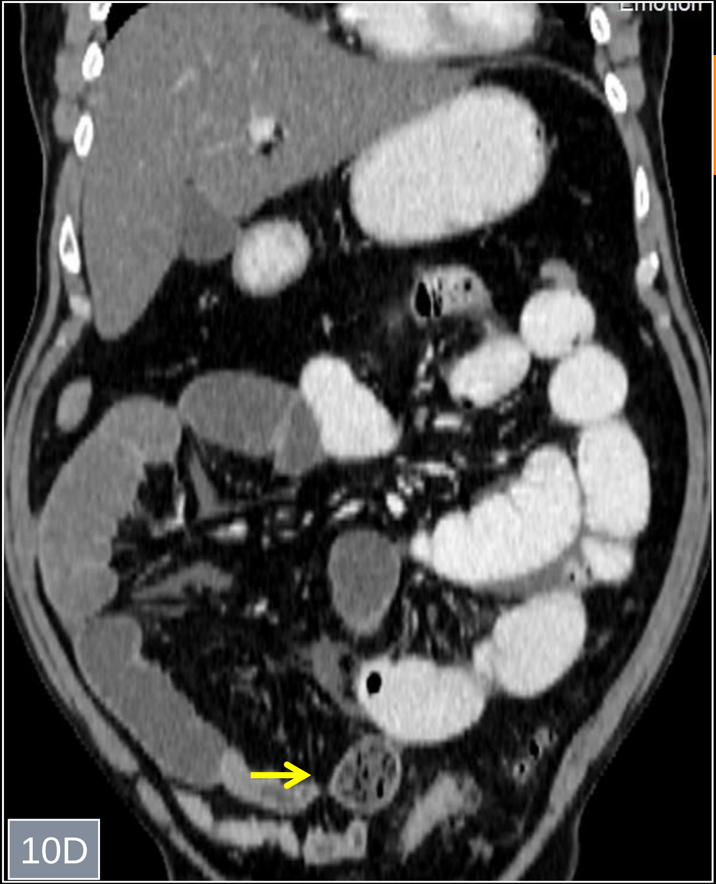
– Collapsed bowel loop, distal to the transitional zone and

– Presence or absence of evidence of ascites

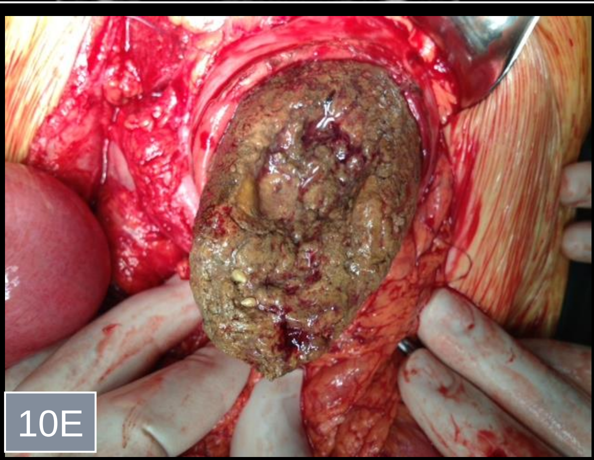








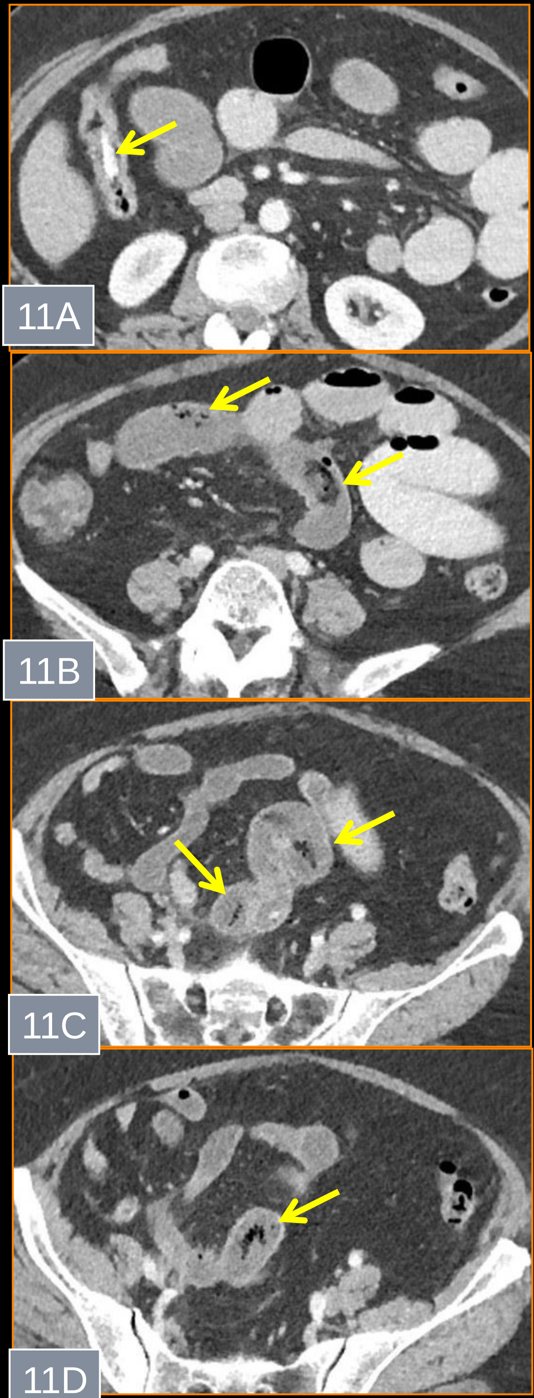
Figures10A-E : A case of SBO in a 57 years old male patient. Axial CT images (fig.10A-B), sagittal (fig.10C) and coronal (fig.10D) MPR images revealed an air-containing mass in an ileum loop (yellow arrows) before the point of the obstruction (red arrows). Surgical exploration revealed a phytobezoar (fig.10E).

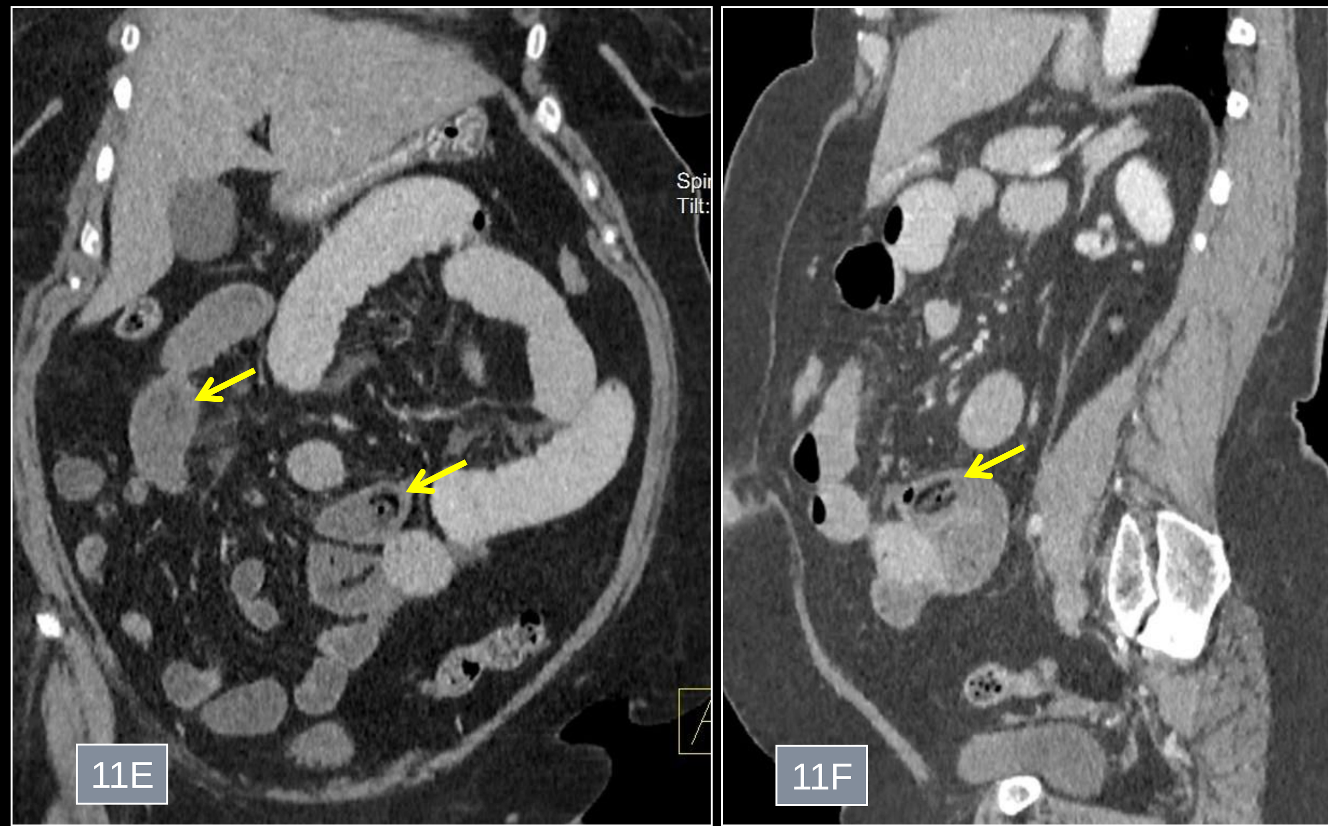


Imaging Findings

FOREIGN BODIES [12]

- Foreign body ingestions are common in children and mentally handicapped adults, accidental or intentional.
- Foreign bodies ingestion consists of a rare cause of SBO.
- The most common sites of bowel obstruction include the less mobile segments of bowel or those with acute angulations such as ileum.
- Symptoms vary depending on site of impaction, type of ingested foreign object and presence of complications. Patients with impaction in small intestine present with symptoms of vomiting, abdominal distension, and constipation.
- **CT Imaging Findings reveal:**
  - SBO signs,
  - the endoluminal foreign object at the transition point and
  - often signs of other possible complications, such as perforation (Figures 11A-J)



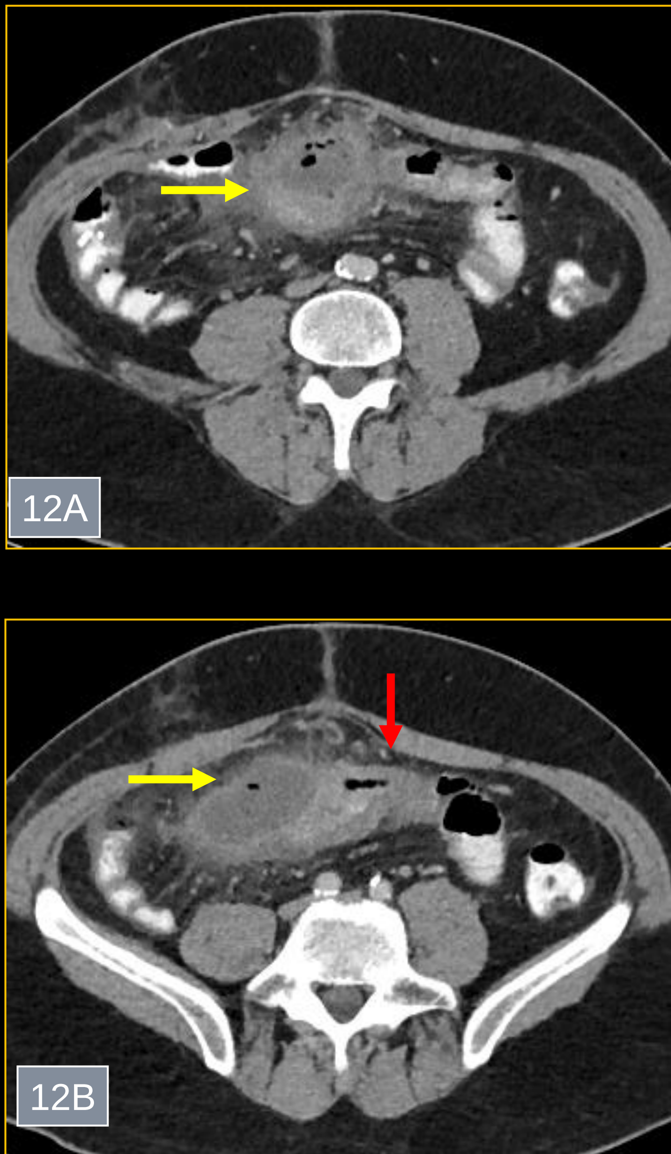


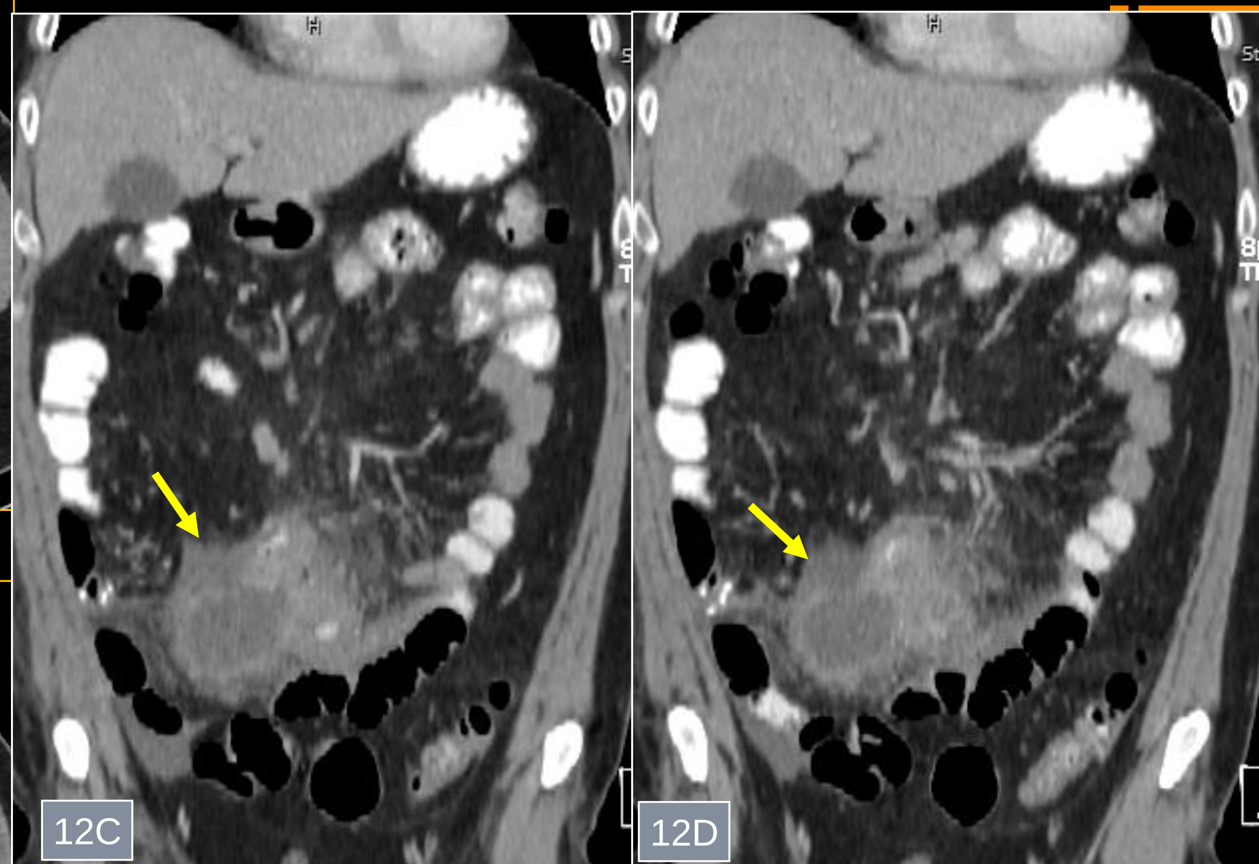
Figures 11A-J : A case of SBO in a 61-years old female Muslim patient. Imaging findings of multiple bezoar-like foreign bodies (yellow arrows) in axial images (fig.11A-D), coronal (fig.11E) and sagittal MPR images (fig.11F). The patient confessed that she had been eaten **multiple unchewed dates from Mekka** (fig.11J), according to a religious custom**.**

Imaging Findings

INFLAMMATORY(intrinsic though) [3]

- A variety of abdominal conditions can cause inflammatory processes.
- Develop by extension of infection or inflammation resulting from conditions such as appendicitis, diverticulitis, Crohn's disease (Figures 12A-D), pancreatitis, pelvic inflammatory disease, or indeed any condition causing generalized peritonitis.





Figures 12A-D : Abdominal axial CT images (fig.12A-B) with coronal MPR images (fig.12C-D) in a 40-years old male patient with acute abdominal pain, symptoms of SBO and a known history of Crohn’s disease with previous surgical resection. SBO due to abscess formation (yellow arrows) in touch with a remain inflamed small bowel loop (red arrows).

CONCLUSION

- CT remains the main gold standard in diagnosis of SBO.
- The pivotal role of the radiologist in SBO management is crucial; firstly, to establish the primary clinical suspicion and secondly to consult the surgeon whether it’s an urgent to operative versus conservative management.
- Radiologist must keep in mind that there are more scarce causes of SBO and it is crucial to be able to identify these entities, in order to consult the clinicians, whether there is a necessity for immediate intervention.

“Never let the sun set or rise on an obstructed Bowel”… [13]

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