ANATOMY

PATIENT PREPARATION
- 4 HOURS FASTING
- MODERATE FILLING OF THE BLADDER (cease voiding for 2 hours before the scan)
- Void if bladder is overfilled (better visualisation of the RIF)

Convex probe (3,5-5 MHz) panoramic, deeper vision

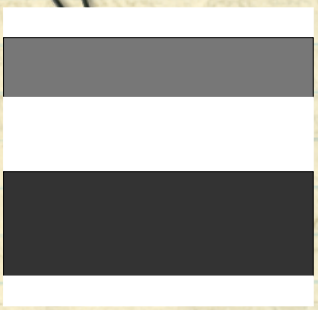
Linear probe (7-10 MHz) superficial, better resolution

Follow the course of the colon, starting from the rectum and proceeding toward the cecum. In RIF follow the terminal ileum. Then perform parallel scans over the abdominal quadrants to visualise the small bowel .

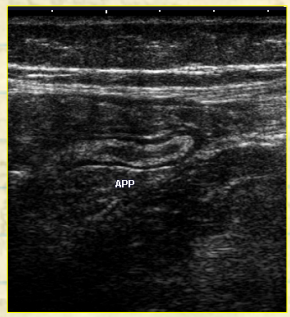
SEE THE LANDMARKS ILIOPSOAS, ILIAC VESSELS
APPLY A GRADUATED PRESSURE

BOWEL WALL STRATIFICATION

Superficial mucosa	-> hyper-echoic
Deep mucosa	-> hypo-echoic
Submucosa	-> hyper-echoic
Muscularis propria	-> hypo-/anechoic
Serosa	-> hyper-echoic



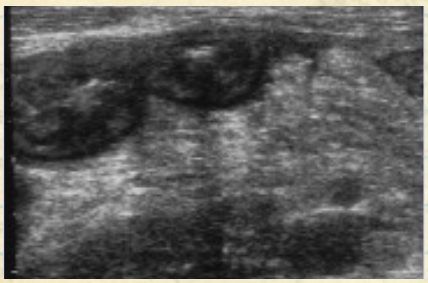
bowel wall stratification (lumen at the top)



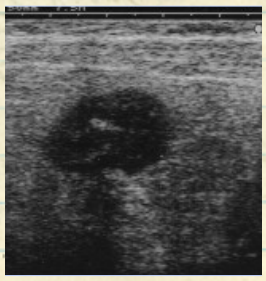
normal appendix

MESENTERIC FOLDS

Sometimes mimicking a thickened loop of bowel in longitudinal scans ("sandwich" image): transverse scans help clarify (the "target sign" typical of a thickened bowel loop is not visualised). Mesenteric **hyper-echogenicity** and **thickening** (>5mm surrounding the bowel) are signs of inflammation.



hyper-echoic mesentery



bowel surrounded by hyper-echoic mesentery

ULTRASOUND FINDINGS TO BE ASSESSED

Bowel wall thickness (small bowel up to 4mm, colon up to 5mm) must be measured in LONGITUDINAL scanning (more accurate because it evaluates the variations along the entire course of the loop and allows to detect its greater thickness). The interface and the serosa are included in the measurement. In Crohn Disease, the thickening involves mainly the submucosa. The layering can be Preserved or Lost (even focally).

- Bowel alterations
  - elasticity, compressibility
- Bowel wall alterations
  - thickening (> 4-5mm)
  - parietal stratification
  - irregular margins
- Lumen alterations
  - dilatation
  - stenosis (with > 25mm dilatation of the bowel before the stenotic tract)
- Peristalsis
- Abscess, Fistula, Lymph nodes, Free fluid, Mesenteric folds

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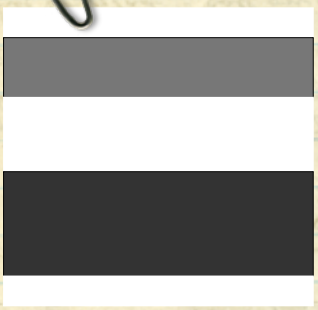
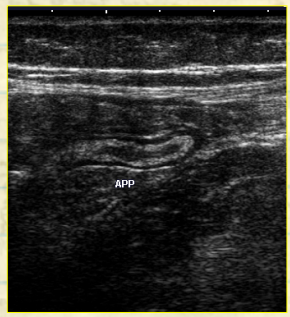


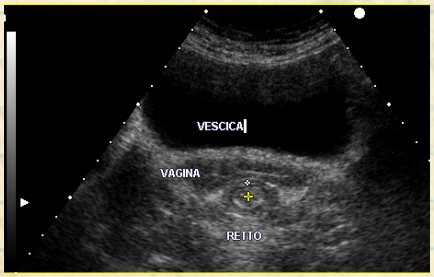
bowel wall stratification (lumen at the top)



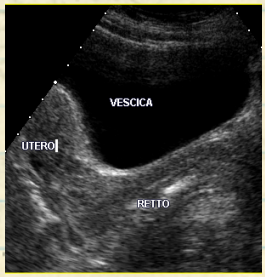
normal appendix

RECTUM

Transverse and longitudinal scans are performed. Located behind the bladder and vagina (female) or prostate (male). The accuracy on the rectum is lower than on other viscera.



Rectum, transversal scan



Rectum, longitudinal scan

ULTRASOUND FINDINGS TO BE ASSESSED

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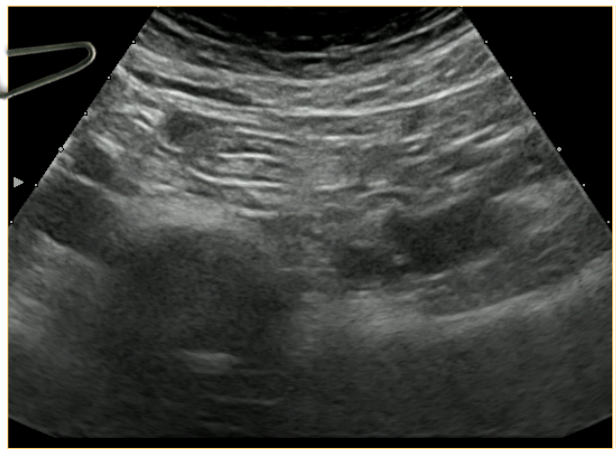
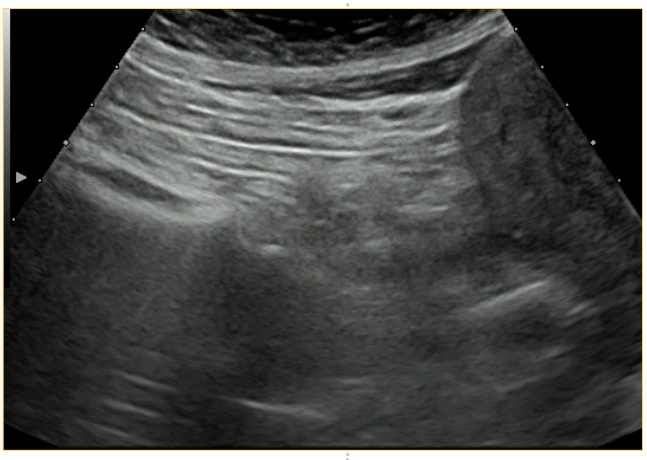


Mesi con immagine a binario



Scansione ortogonale (meso+ansa)

MESENTERIC FOLDS

APPEARANCE OF THE MESENTERIC FAT

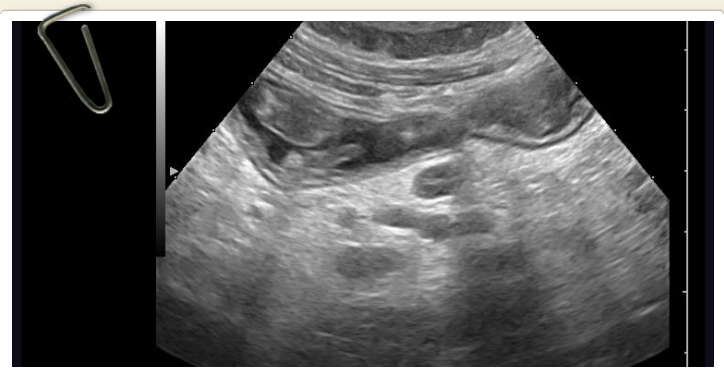
The presence of overlapping mesenteric layers can give a stratified appearance, which can sometimes be misleading by mimicking a thickened loop: this aspect is maintained by observing it in orthogonal scans (while a bowel loop turns to a target guise).

HYPERTROPHY OF THE MESENTERIC FAT

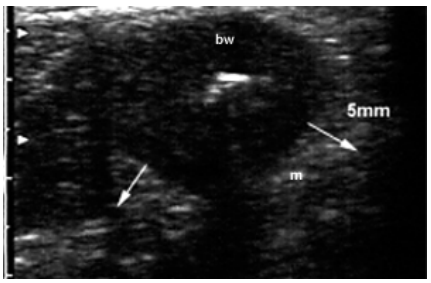
The amount of hyperechoic tissue around the loop is evaluated: the arbitrary cutoff is ≥5mm, equal to the thickness of a normal loop. The presence of hyperechoic tissue surrounding a bowel loop is a sign of hypertrophy of the mesenteric fat.

MESENTERIC INFLAMMATION

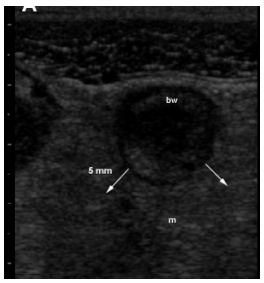
The marked hyperechogenicity of the mesenteric fat is an index of inflammation (but has no prognostic value on the activity of IBD). See the example on the side, in a case of volvulus of the small intestine.



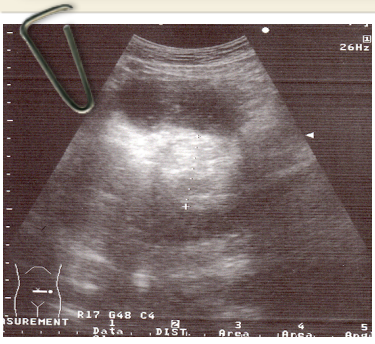
Adenomesenteritis: hyperechoic mesentery, hypoechoic lymph nodes

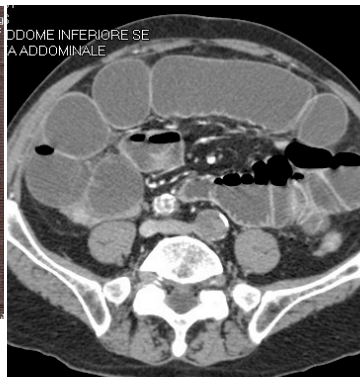


Normal mesentery

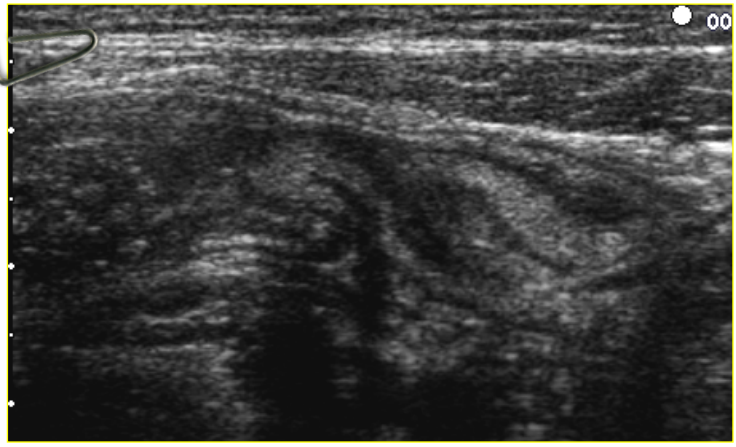


Hypertrophic mesentery

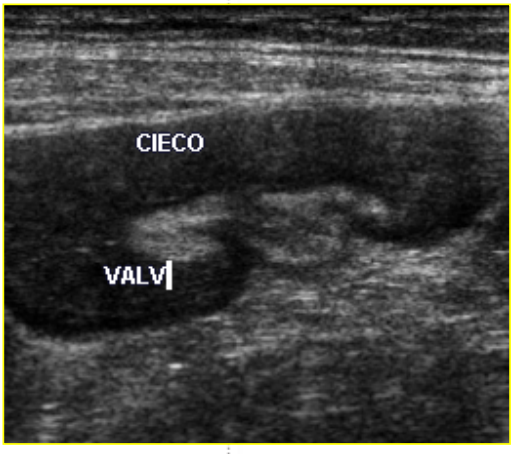




Small bowel volvulus, thickened mesentery



Ileocecal valve

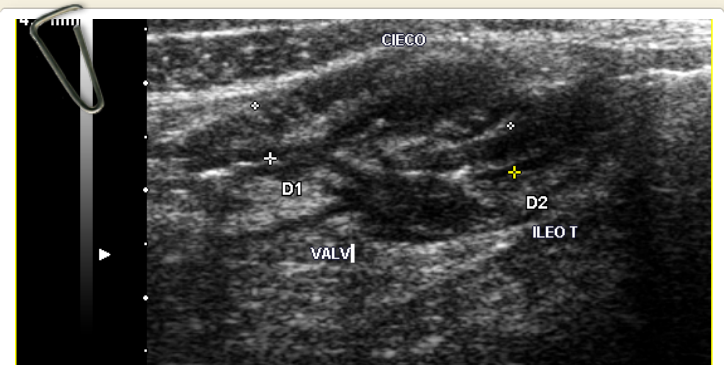


Ileocecal valve

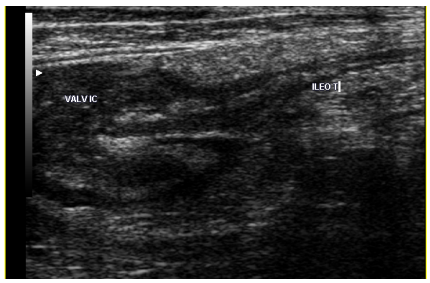
ILEOCECAL VALVE

COURSE OF THE TERMINAL ILEUM

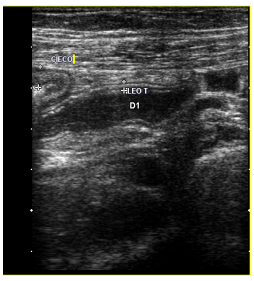
Usually found above the iliopsoas muscle and right iliac vessels. Follow it up to the cecal inlet. The ileocecal valve can be visualized by identifying the two valve flaps that open with a heart-shaped or "Y" image.



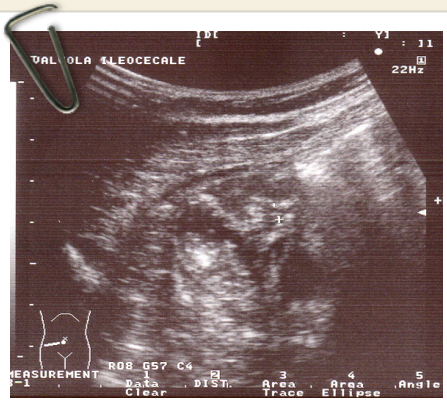
Ileocecal valve

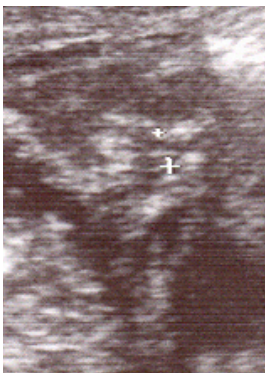


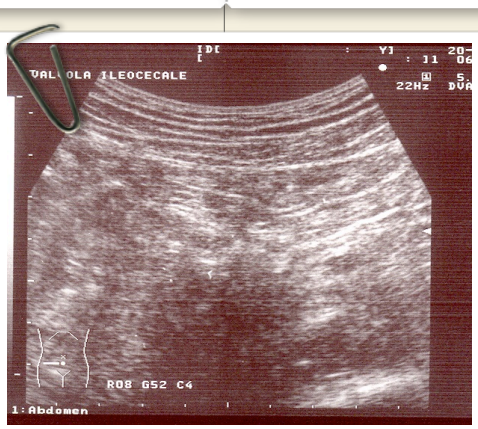
Ileocecal valve

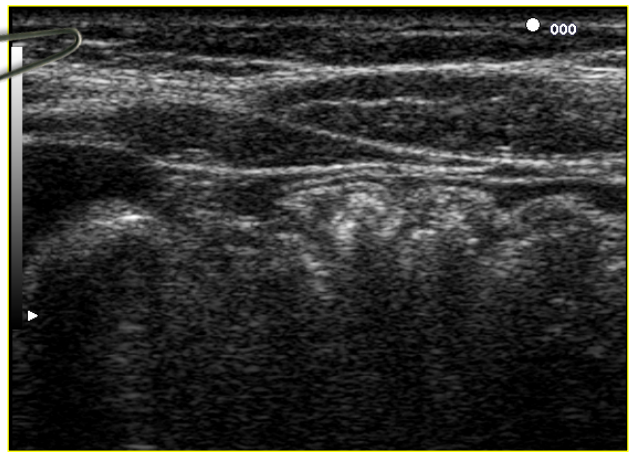


Ileocecal valve

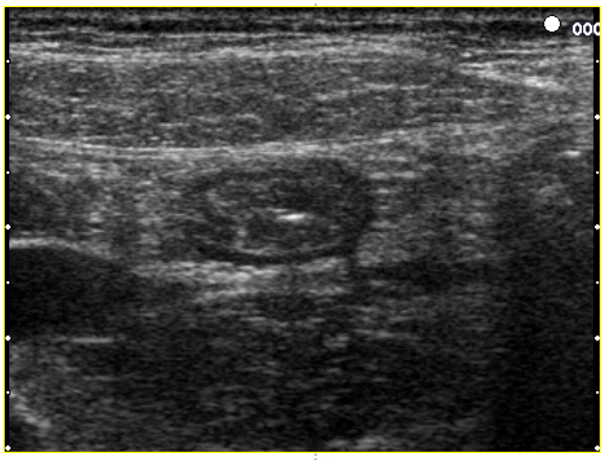






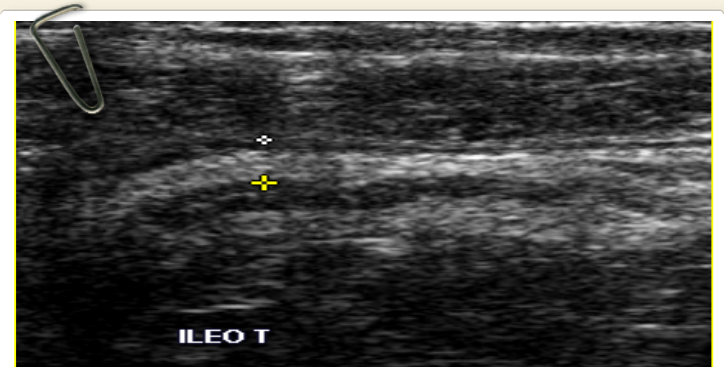


Transverse colon, longitudinal scan

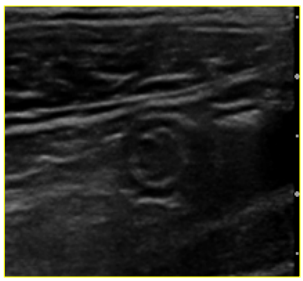


Transverse colon, transversal scan

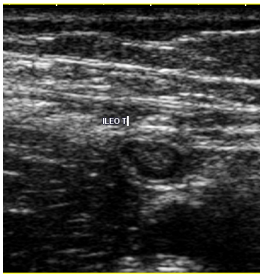
BOWEL WALL



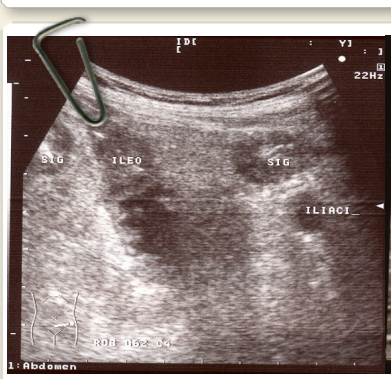
Terminal ileum, longitudinal scan



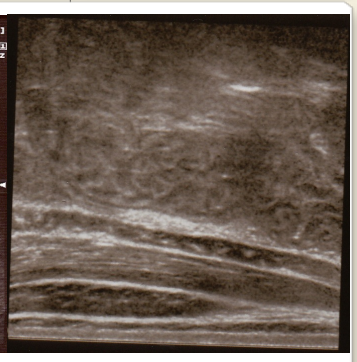
Terminal ileum, transversal scan



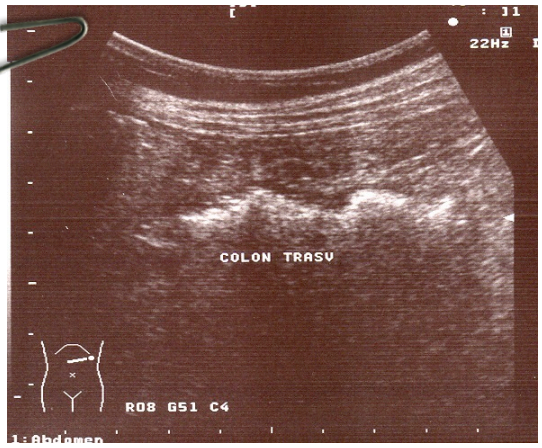
Terminal ileum, Psoas & Appendix



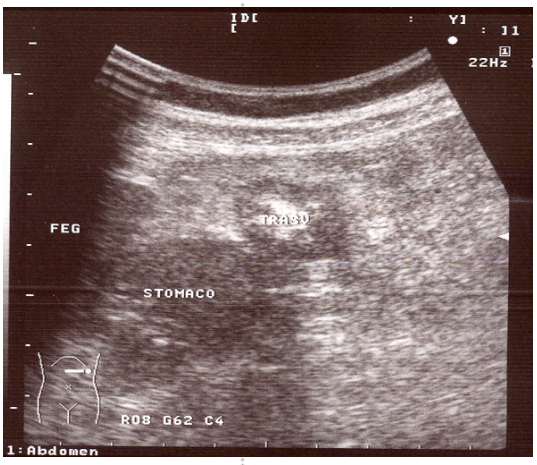
Appearance of the ileum and the sigmoid colon



Normal jejunal loop



Transverse colon, longitudinal scan



Transverse colon, transversal scan

TRANSVERSE COLON

APPEARANCE

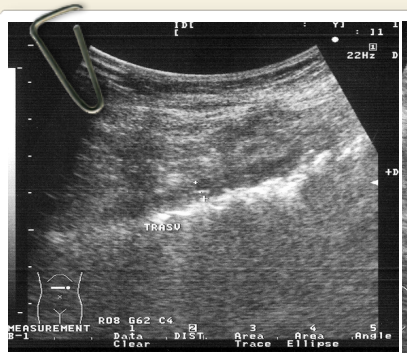
It is usually filled with gases (which mask the rear wall), with a scalloped, arched appearance. Sometimes it is possible, by shifting the luminal gas with the probe, to visualize also the rear wall.

DETAILS

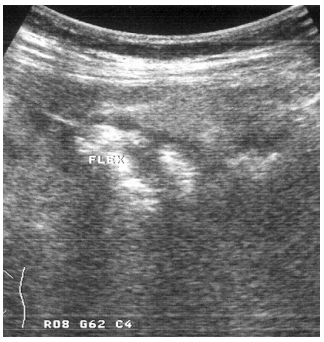
A loss of haustration, the thickening (> 4 mm) or thinning of the walls (<2 mm) associated with a dilation (> 6 cm) are elements of suspicion.

POSITION

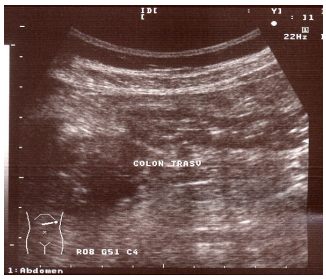
It is important not to confuse it with the stomach, with respect to which the transverse colon is located anteriorly and inferiorly.



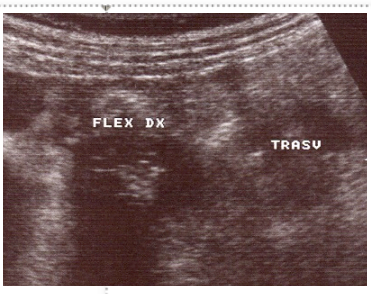
Transverse colon, longitudinal scan



Right colic flexure



Transverse colon, longitudinal scan



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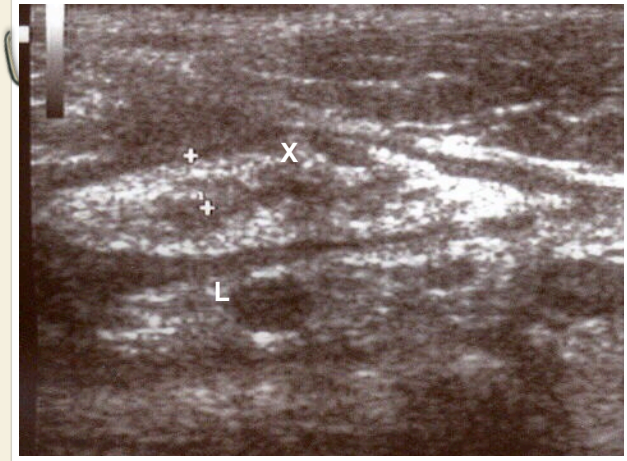
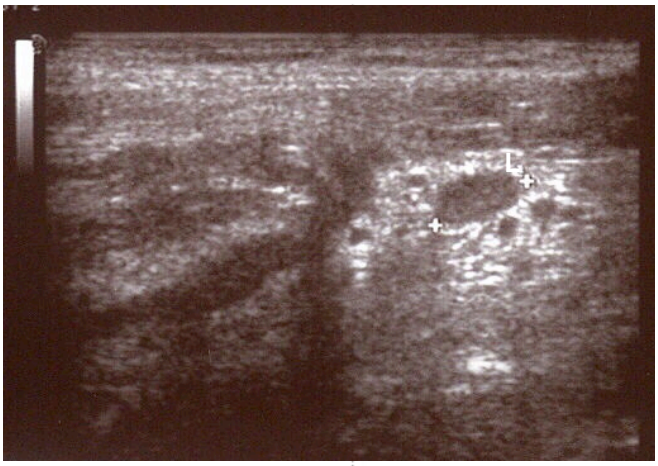


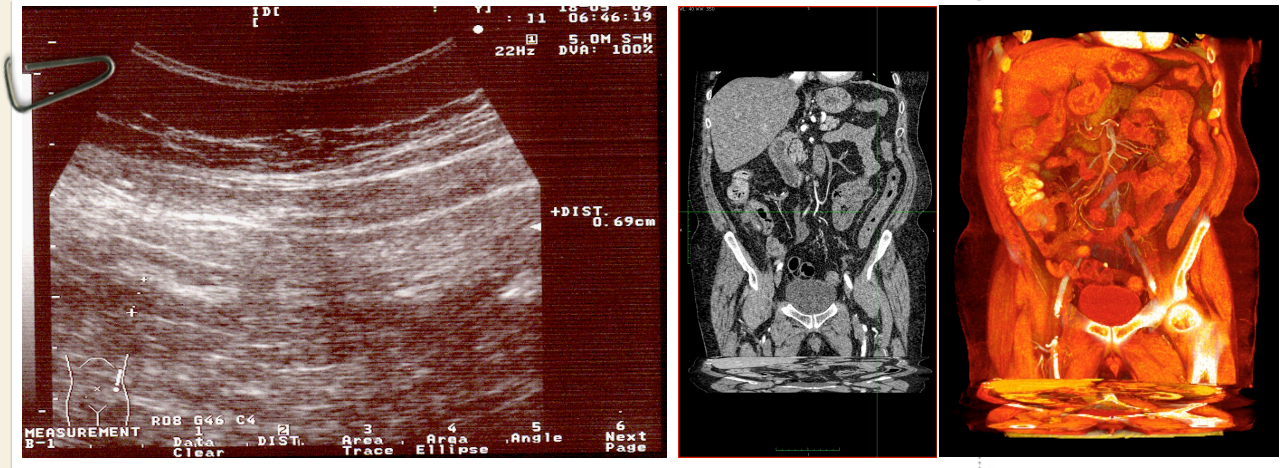


Terminal ileitis from laparoscopic post-appendectomy manipulation: focal discontinuation of the layers (X) and thickening, with reactive mesenteric lymphadenitis (L).

MESENTERIC LYMPH NODES

APPEARANCE OF INFLAMMATORY LYMPH NODES

Usually hypoechoic in the context of a hyperechoic mesentery. In the above case, after laparoscopic appendectomy on the seventh day, new hospitalization for fever and tendernes in the right iliac fossa. Sonographic evidence of a thickened ileal tract, 10 cm before the ileocecal valve, adherent to the parietal peritoneum in a focal area where the bowel wall stratification is lost. Likely consequence of damage due to manipulation. Reactive lymphadenitis in the ileal mesentery is evident.

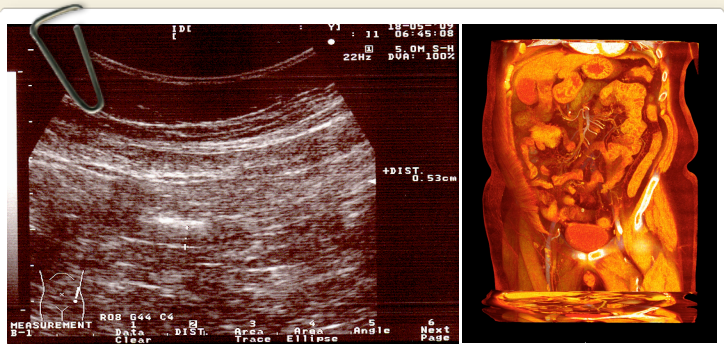


Ischemic Colitis - descending colon

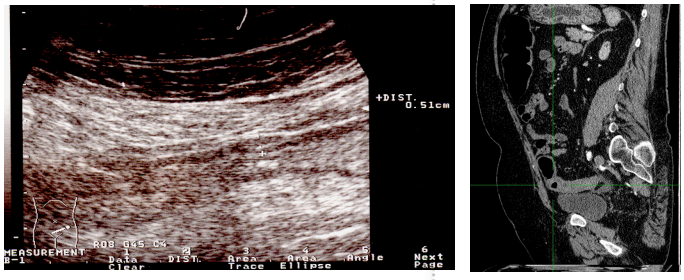
ISCHEMIC COLITIS

MORPHOLOGY

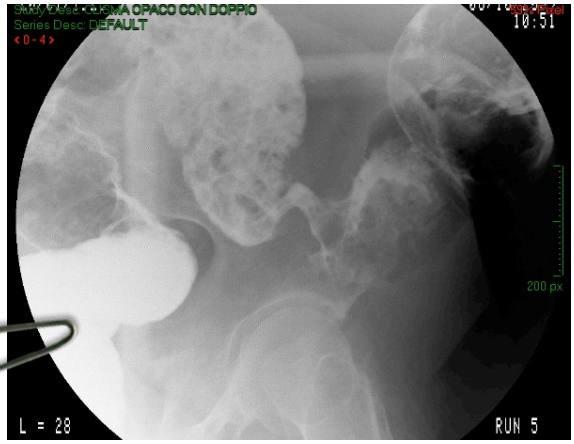
Noticeable thickening of the colon walls (> 8-9 mm). Homogeneous loss of parietal stratification (hypoechoic). Decreased transmural blood flow at Power Doppler.



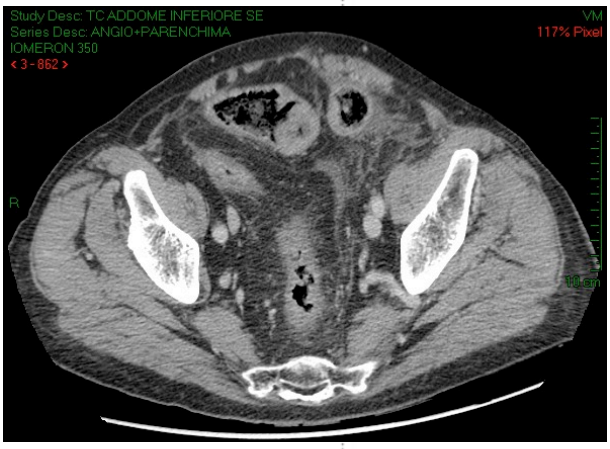
Ischemic Colitis - descending colon



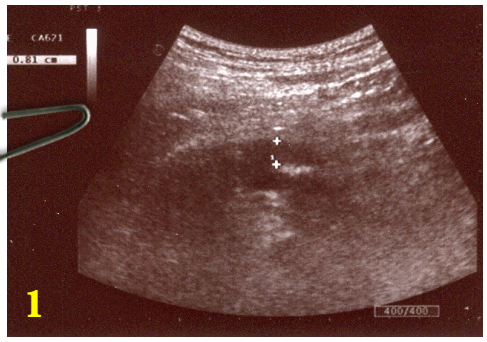
Ischemic Colitis - sigmoid colon

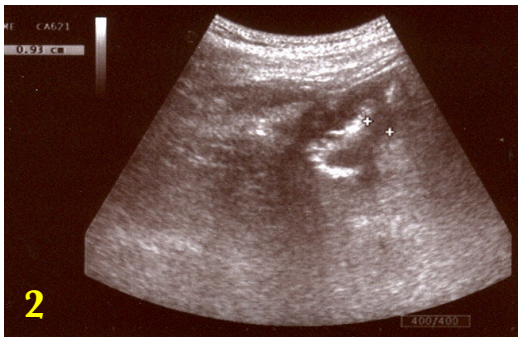


Barium Enema: caner stenosis of the middle/proximal sigmoid junction



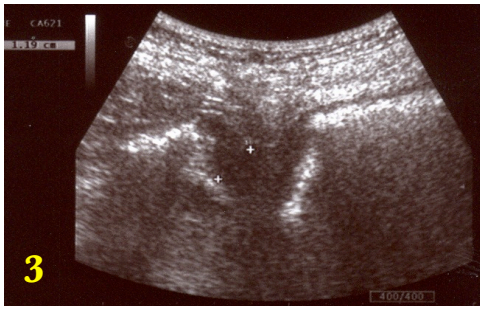
CT scan: Thickened middle/distal sigmoid j., middle/prox sigmoid j. stenosis

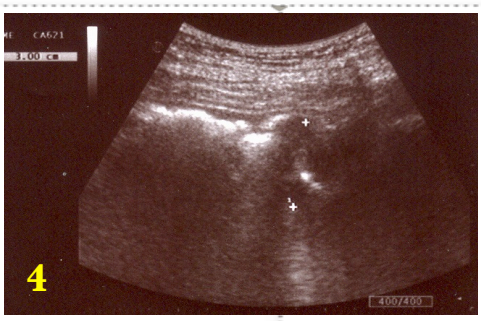


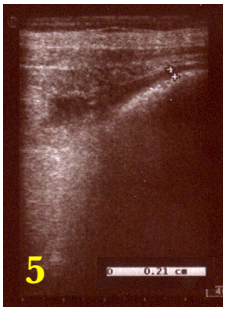


COLON SONOGRAPHY

1. *Distal sigmoid*
2. *middle to distal sigmoid junction*
3. *passage from the middle (thickened) and proximal (dilated) sigmoid colon*
4. *Luminal stenosis*
5. *Thinned and dilated descending colon, with free fluid*
6. *7. Detail of the stenosis*

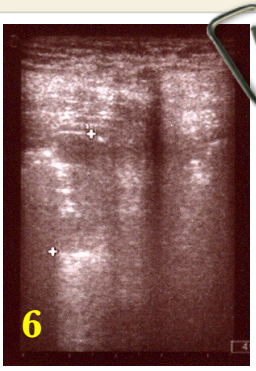


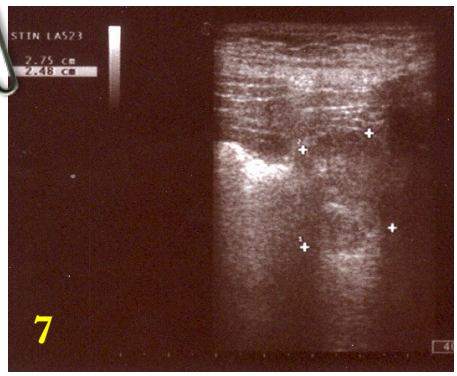




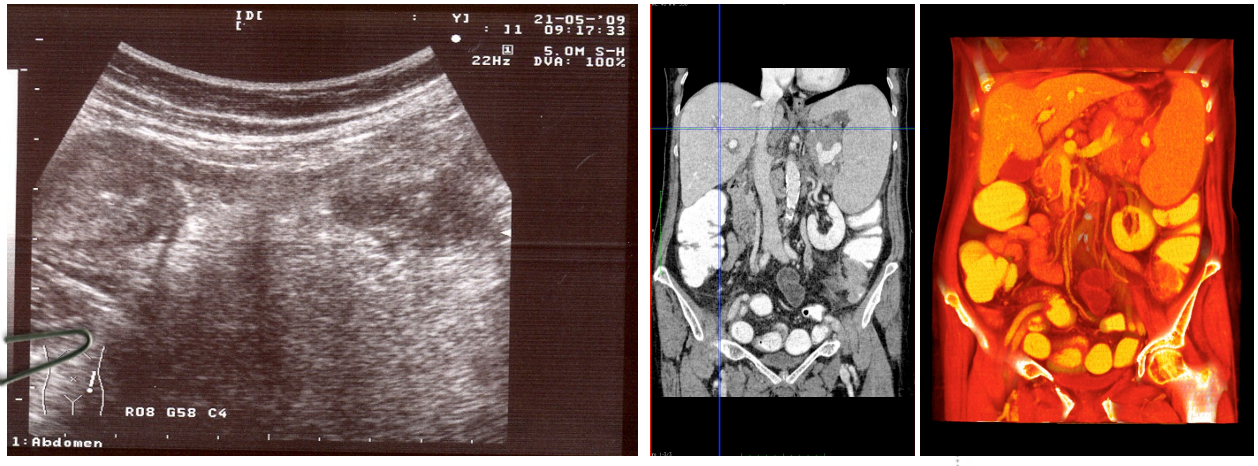
ISCHEMIC COLITIS AND CANCER

83Y OLD, ABDOMINAL PAIN AND DISTENSION.
Prior intervention for AAA with IMA ligation. Fever, leukocytosis, bowel occlusion. Thickened sigma with irregular parietal stratification (acute ischemic colitis) and stenosis due to cancer.





Cancer of the sigmoid colon

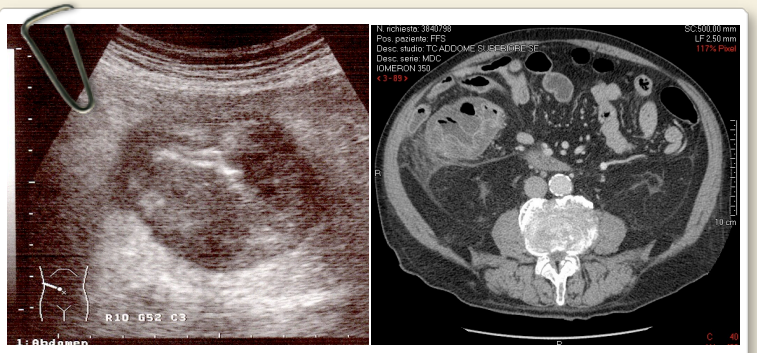


Lymphoma B - descending colon

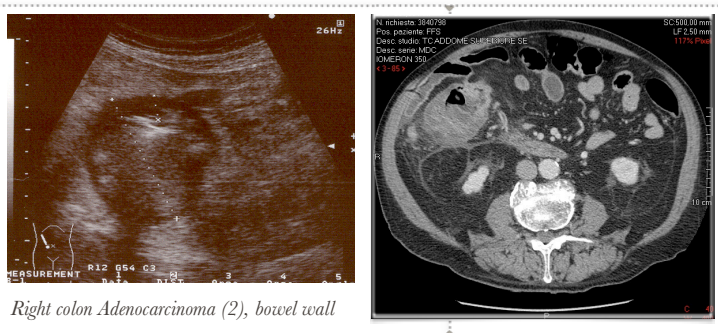
CANCER

MORPHOLOGY

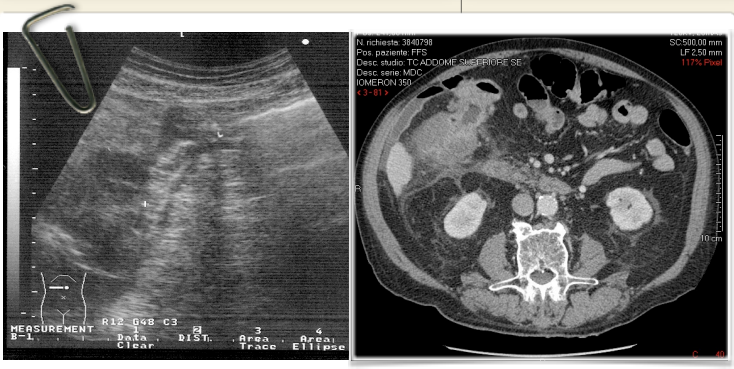
Irregular lume. Loss of parietal stratification, focal irregular appearance. The mesentery is generally not hyperechoic.



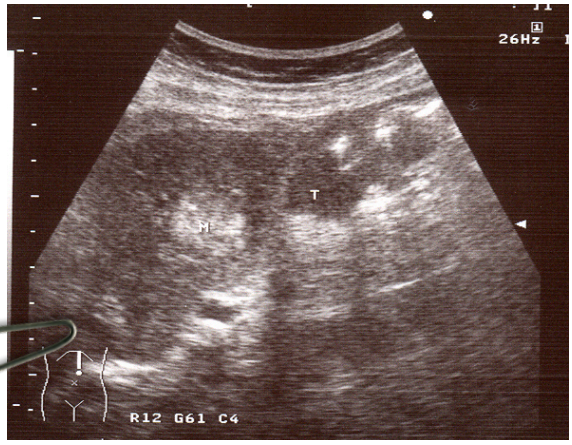
Right colon Adenocarcinoma (1), stenotic lumen



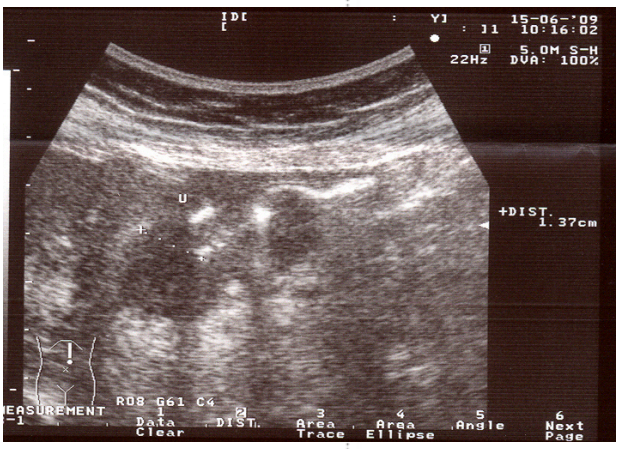
Right colon Adenocarcinoma (2), bowel wall



Right colon Adenocarcinoma (3), distal to the right colic flexure

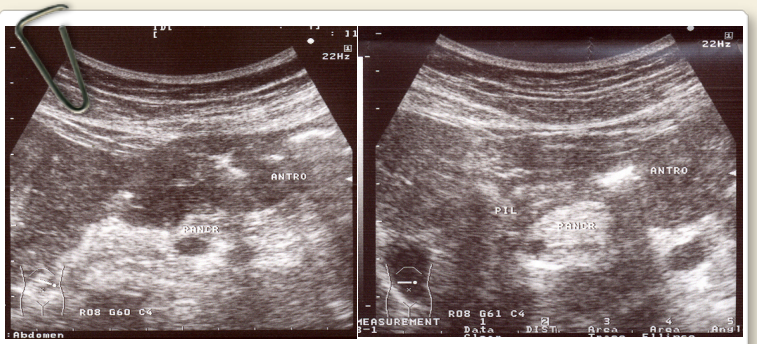


Antral gastric adenocarcinoma (T), liver metastasis (M) - Case 1

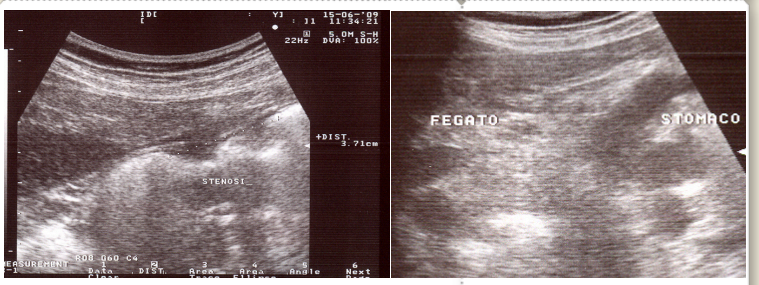


Antral gastric adenocarcinoma (T), parietal ulceration (U) - Case 1

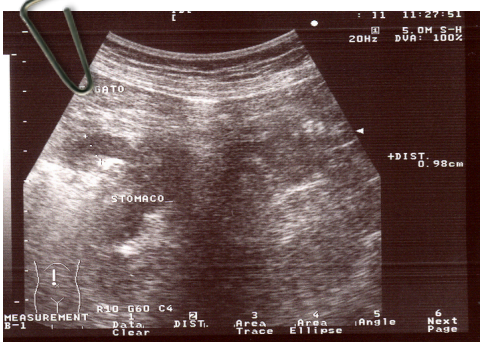
CANCER/2



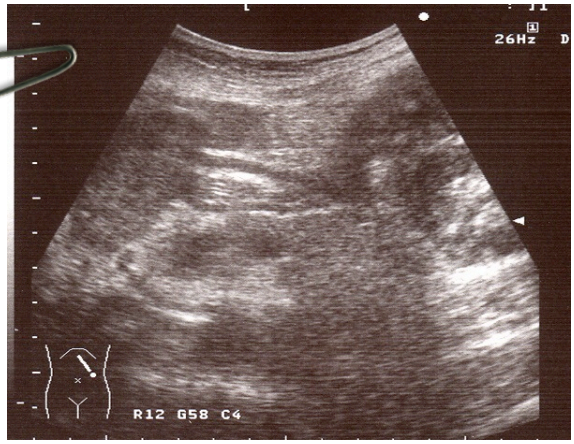
Antral gastric adenocarcinoma - Case 1



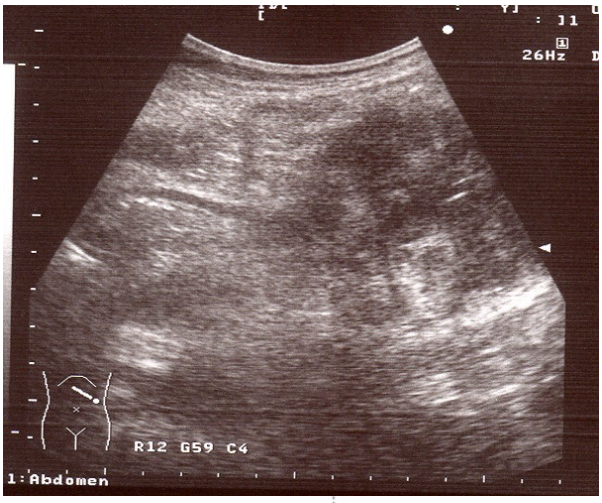
Antral gastric adenocarcinoma (stenotic tract) - Case 2



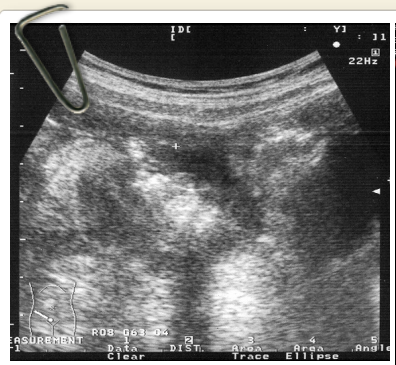
Antral gastric adenocarcinoma (sagittal scan) - Case 2

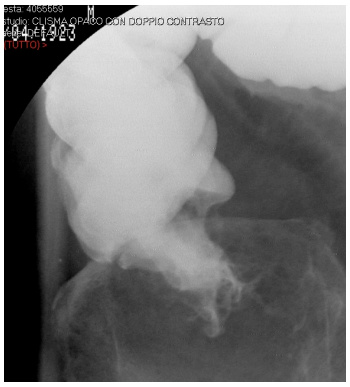


Transverse colon adenocarcinoma infiltrating the gastric wall

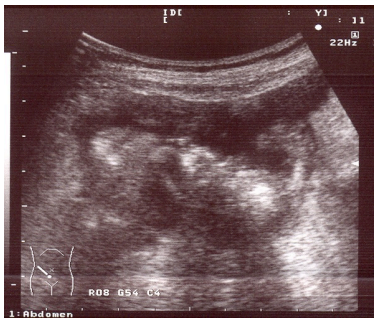


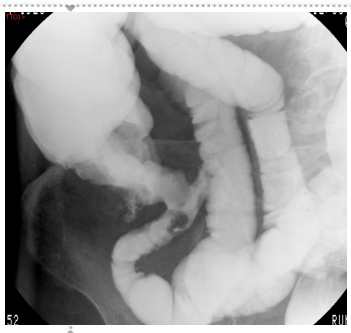
CANCER/3

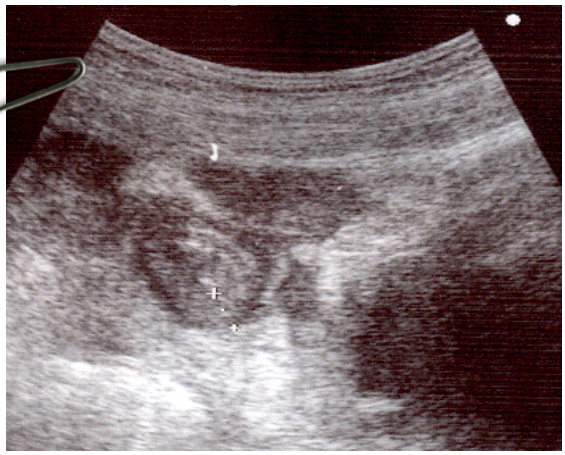




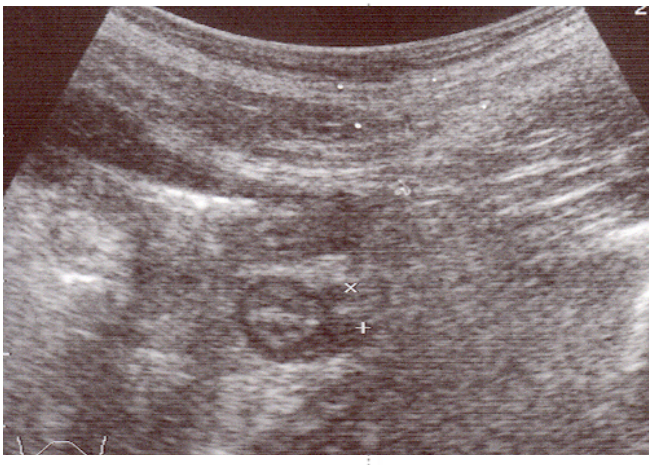
Adenocarcinoma of the cecum







Sigmoid diverticulitis, thickened wall and fluid collections

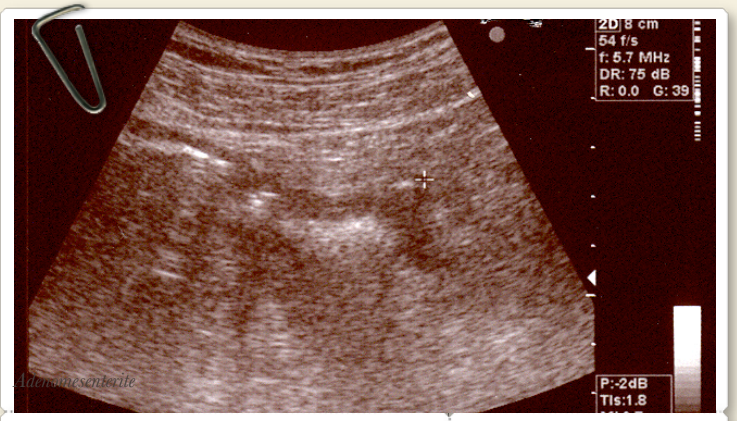


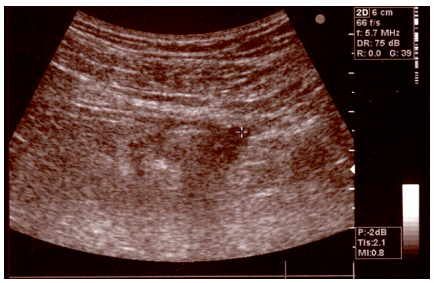
Diverticula

DIVERTICULITIS

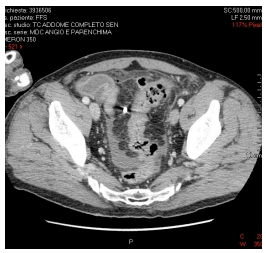
MORPHOLOGY

Localized thickening of the colon walls. Presence of diverticula or their complications. Hyperechogenicity of pericolic fat. Power Doppler: transmural flow increased.

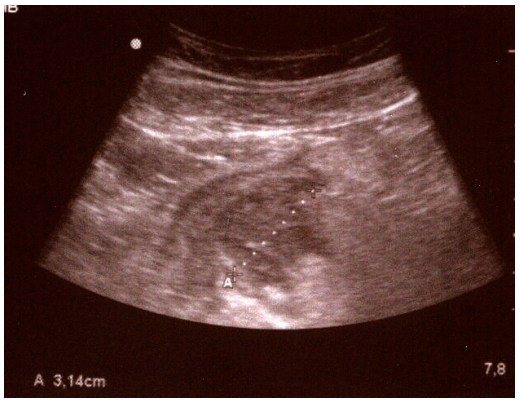


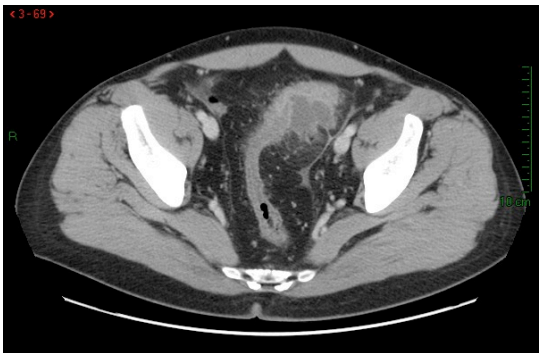


Sigmoid diverticulitis

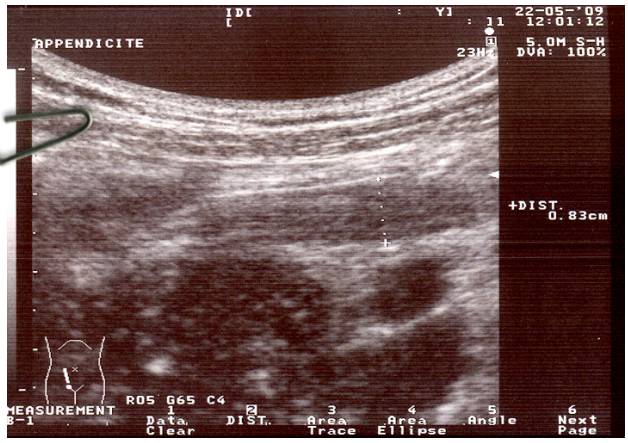


CT scan

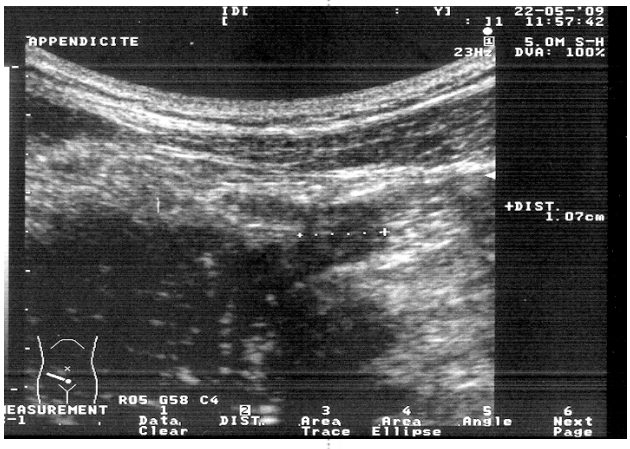




Perforated diverticulum with mesosigmoid abscess (US/CT)

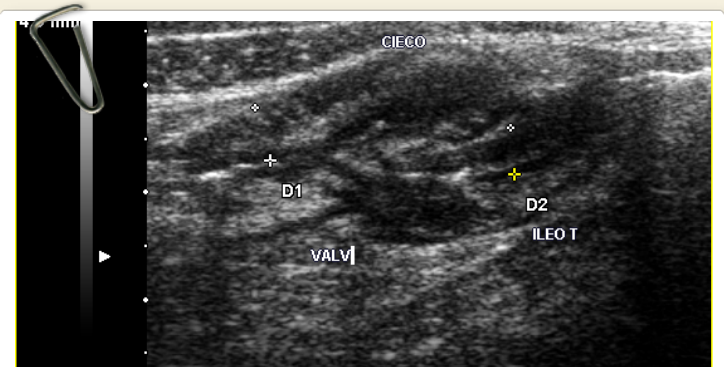


Phlegmonous appendicitis, longitudinal scan

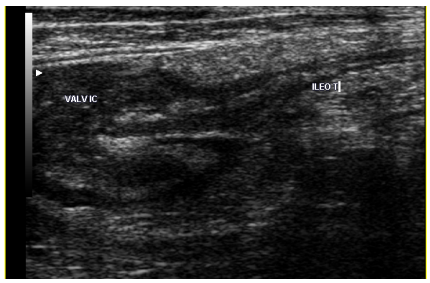


Transversal scan

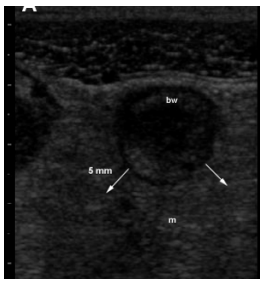
ACUTE APPENDICITIS



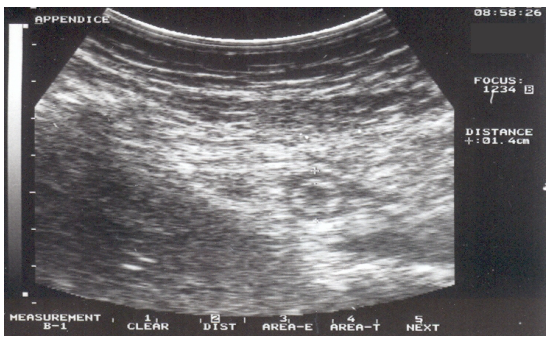
Adenomesenteritis



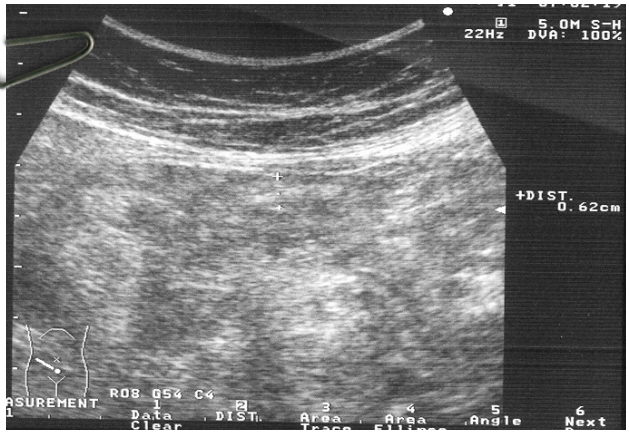
Normal mesenteric fat

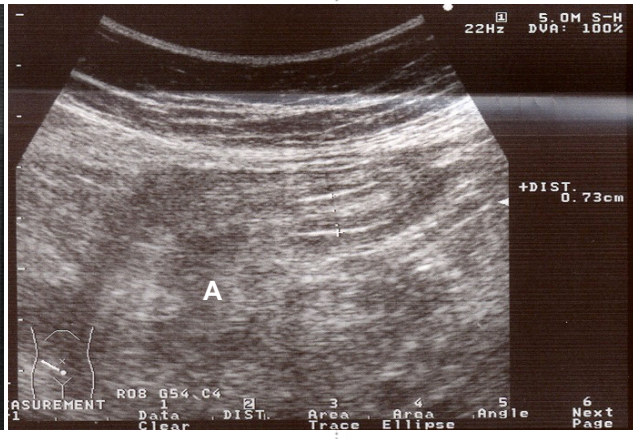


Hypertrophic mesentery



Target sign





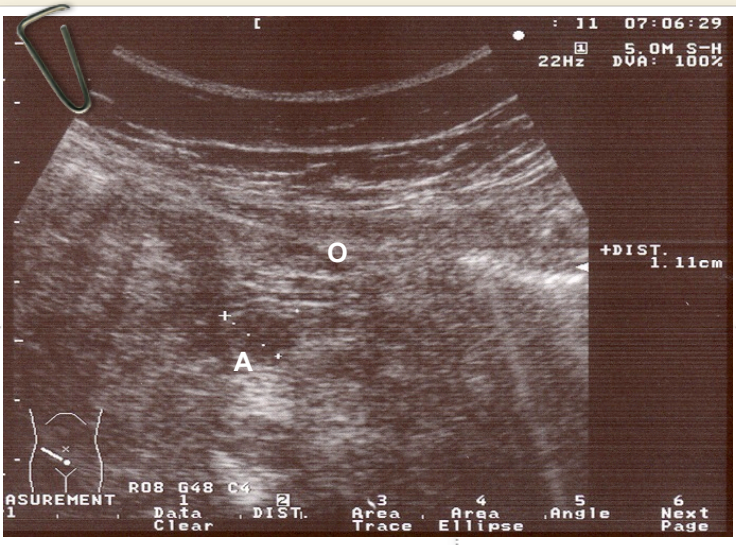
False image of the appendix: rotating the probe for an orthogonal scan, it reveals itself as a bundle of mesenteric fat (greater omentum) covering the appendix (A).

ACUTE APPENDICITIS

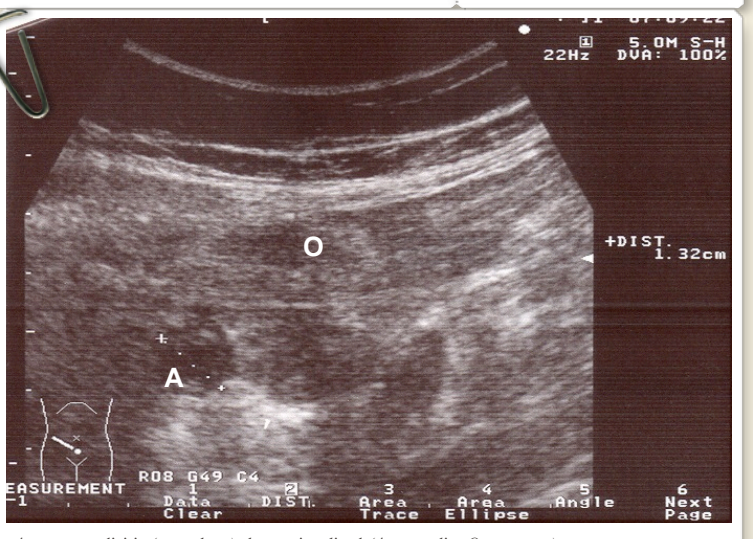
FALSE IMAGES

It may happen that the omentum or the mesenteric folds, especially when thickened or adherent, mimic the image of a thickened loop or an oedematous appendix: in this case, an orthogonal scan obtained by rotating the probe 90 ° shows an almost identical image, instead of the typical target image of a transversely cut bowel loop.

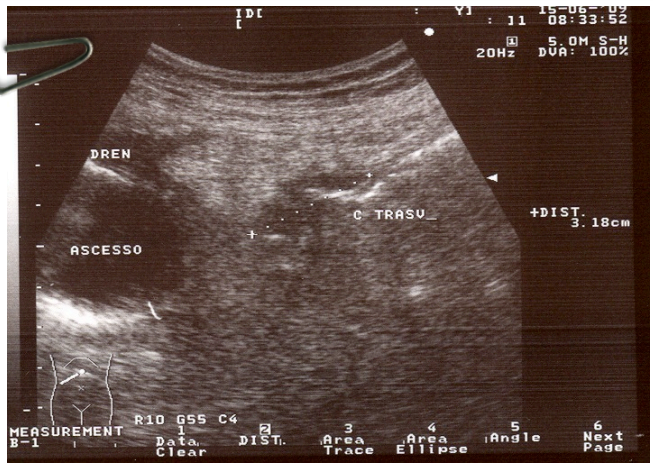
In the case illustrated here, the greater omentum (O) has migrated and adhered to the right iliac fossa, to cover a phlegmonous appendicitis: the appendix (A) is found more deeply, close to the cecum. The interpretation is all the more deceptive the more the appendix is masked by meteorism and not immediately identifiable: in this case it is useful to stay close to the right iliac fossa, performing several orthogonal scans, without being immediately attracted by the stratified image that first catches your eye.



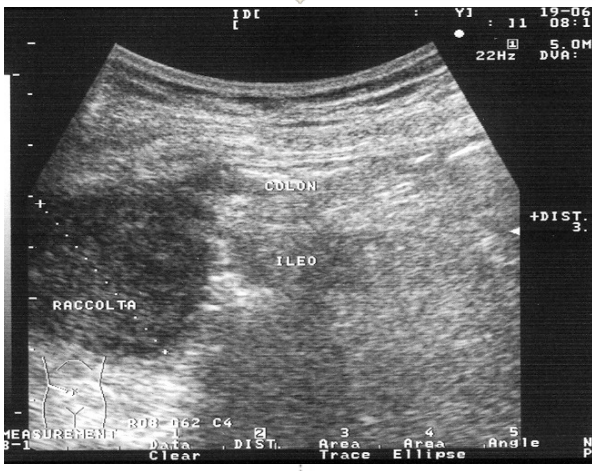
Acute appendicitis (case above), better visualized (A appendix, O omentum).



Acute appendicitis (case above), better visualized (A appendix, O omentum).

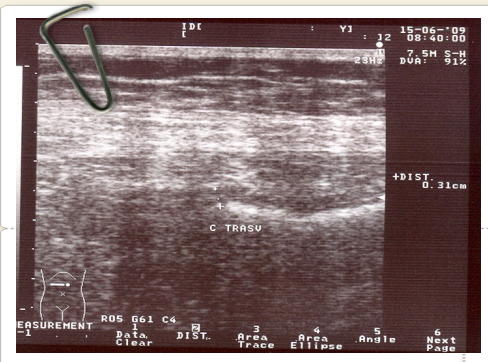


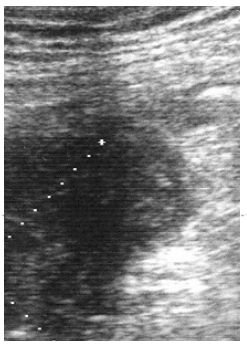
Ileal-transverse LL anastomotic fistula, perianastomotic collection + abscess



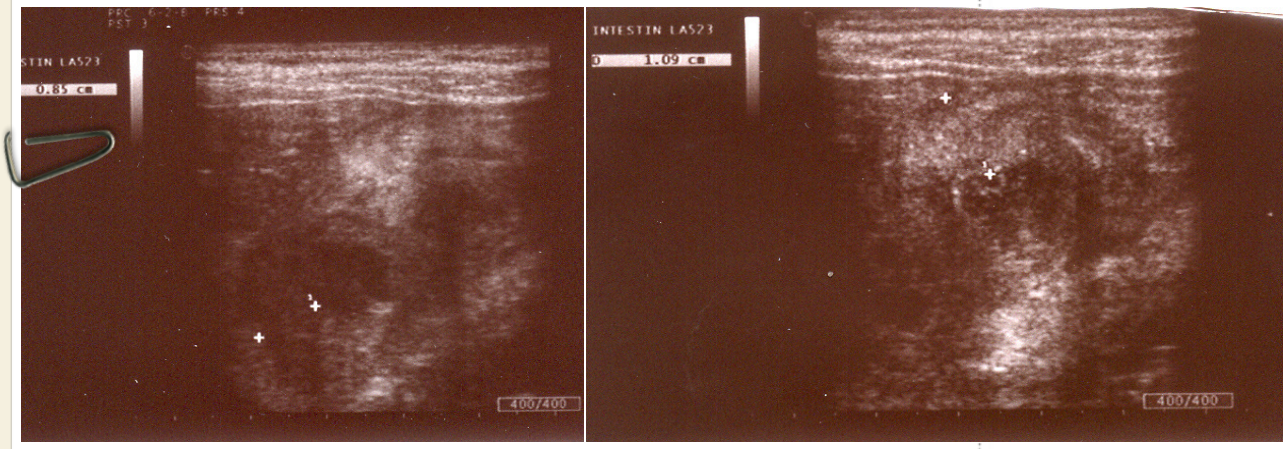
Ileal-transverse LL anastomotic fistula, detail of the anastomosis and abscess

BOWEL ANASTOMOTIC FISTULAS





Ileal-transverse LL anastomotic fistula (case above), dettail of the wall of the trasverse colon



Thickening of the duodenal wall

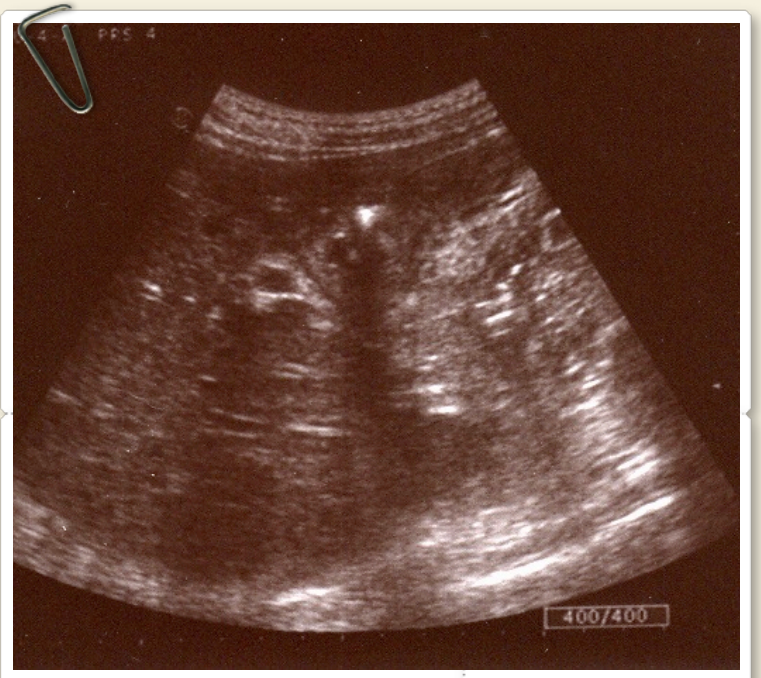
DUODENAL ULCER

DUODENAL WALL

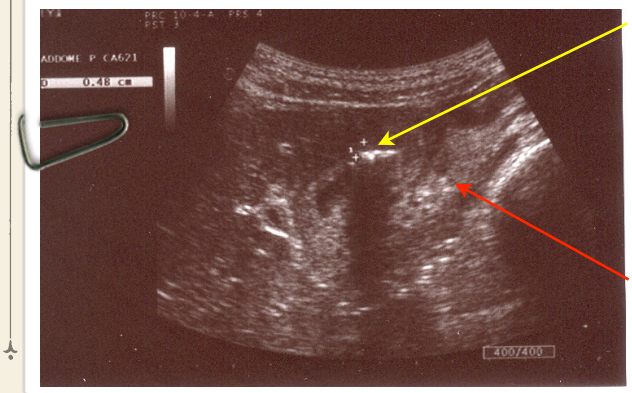
In the case on the side the wall of the duodenum, immediately after the pylorus, is thickened and hyperechoic, as in chronic fibrosis. Posteriorly there is hypoechogenicity of the wall and hyperechogenicity of the retroperitoneum (signs of acute inflammation).

GAS WITHIN THE WALL OF THE DUODENUM

It is a sign of discontinuation of the wall, which allows the air (hyperechoic with rear acoustic barrier) to penetrate its thickness.

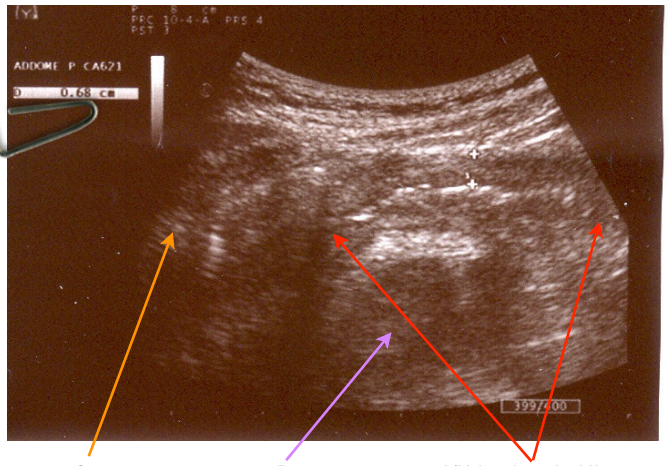


Ulcer with gas infiltrating the wall of the duodenum

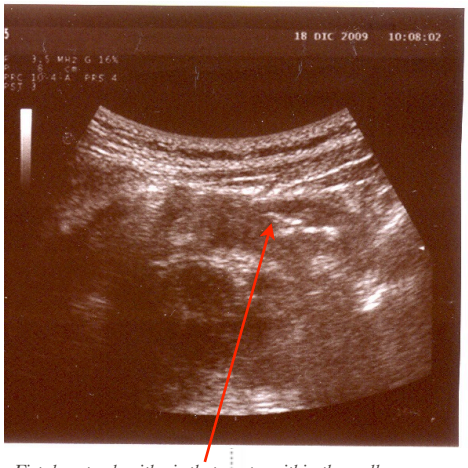


Gas infiltrating the wall of the duodenum (ulceration)

Pylorus



Cecum *Psoas* *Thickened terminal ileum*

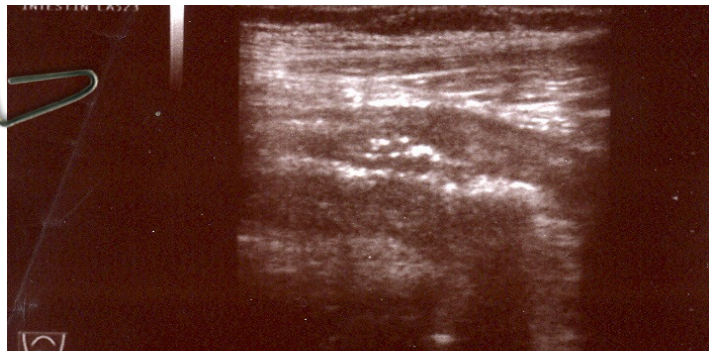


Fistulous track with air that creeps within the wall

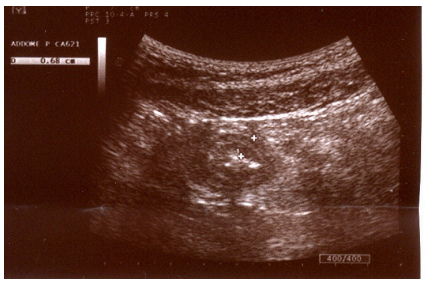
CROHN
FIRST DIAGNOSIS

FEMALE, 23Y OLD, RIGHT ILIAC FOSSA PAIN

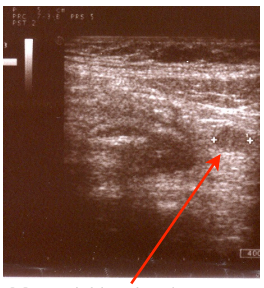
In this case, the thickened terminal ileum with hypertrophy of the mesentery and lymphadenopathy is visualized. In the context of the wall, air infiltration is visible, as if for a threat of fistula.



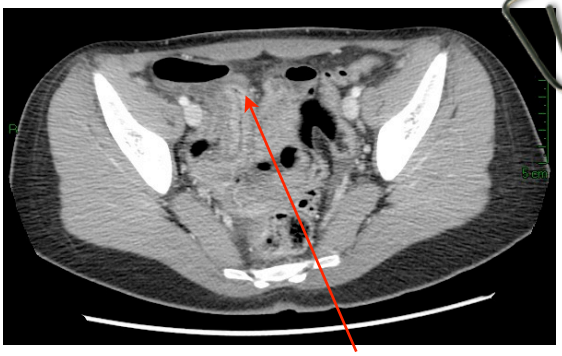
Fistulous route with air that creeps into the wall



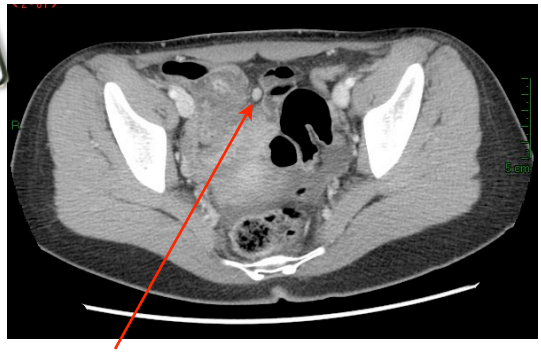
Mesenteric fat hypertrophy/hyperechogenicity



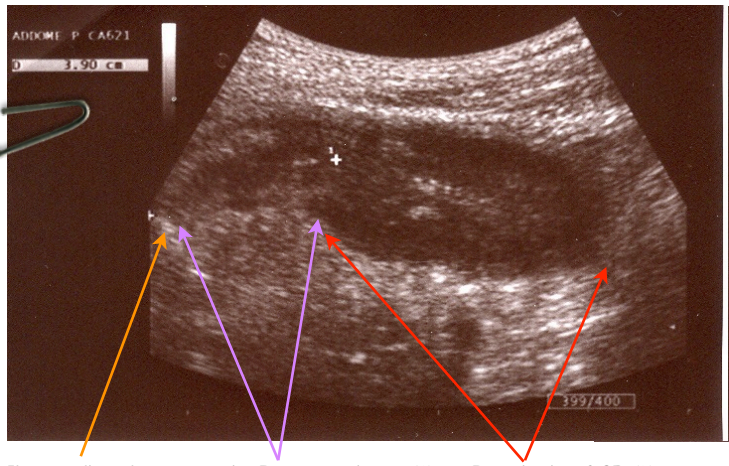
Mesenterial lymph node

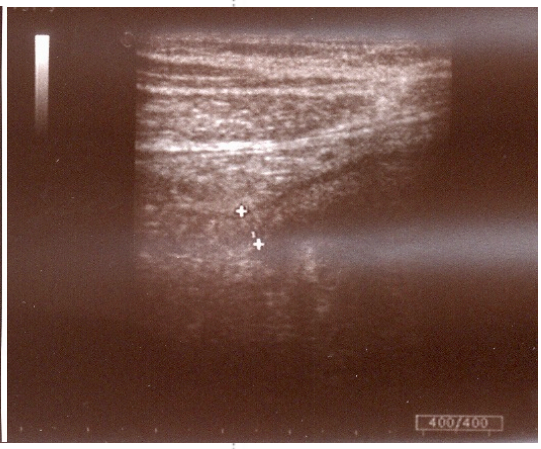


Thickened terminal ileum with intraparietal fistolous track



Mesenterial lymph node



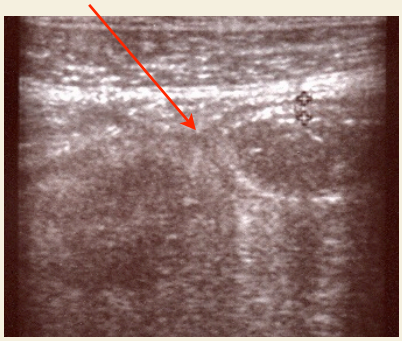


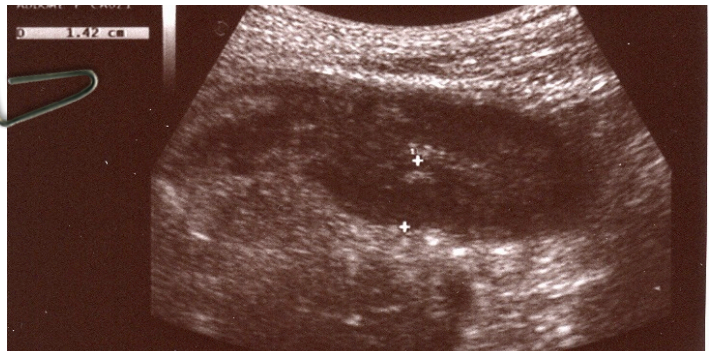
Ileo-ascending colon anastomosis *Preanastomotic tract (1)* *Reacutization of CD (2)* *Preanastomotic ileum thickness: 5.6 mm*

CROHN
REACUTIZATION

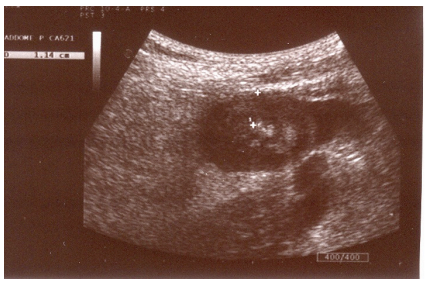
PREVIOUS ILEOCECAL RESECTION FOR CD

In this case, the ileo-ascending colon anastomosis is visualized, above which the ileum is moderately thickened for a 3-4 cm tract, with preserved parietal stratification and submucosal fibrosis, as in chronic disease. Then, the ileum continues abruptly with a markedly thickened segment of about 10-12 cm, with an echoic structure that alternates diffuse hypoechogenicity (acute inflammation) and tracts with marked submucosal fibrosis, with evident hyperechogenicity of the mesenteric fat (as for acute inflammation) and adjacent free fluid (right iliac fossa). The lumen is narrow here and there is dilation of the loops above, in the context of intestinal obstruction secondary to stenosis of the terminal ileum due to reacutization of CD.

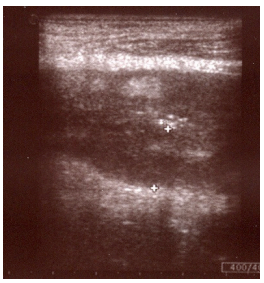




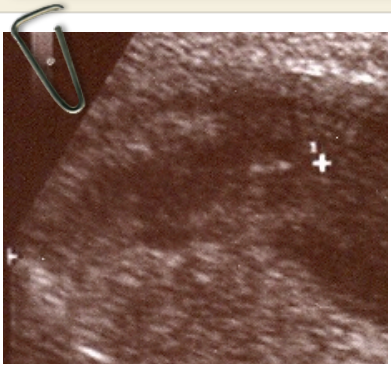
Reacutization of CD (2): uneven loss of stratification, hyperechoic mesenteric fat



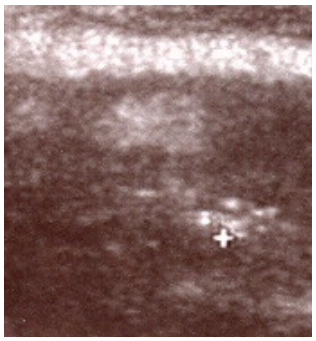
Fluid close to the inflamed bowel loop



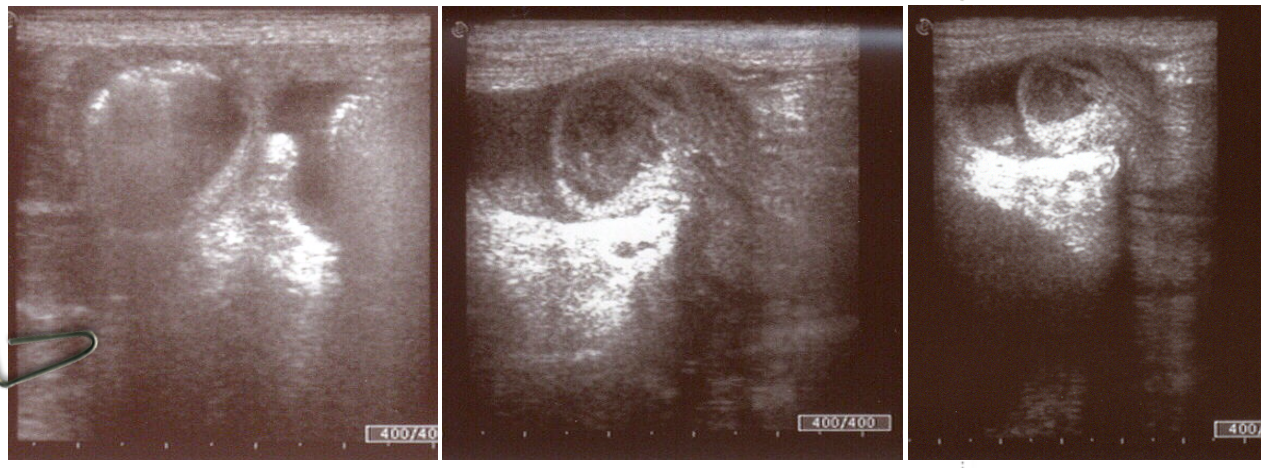
uneven hypoechogenicity



Submucosal fibrosis, a sign of chronic disease (tract 1)



Tract 2: severe fibrosis (+)

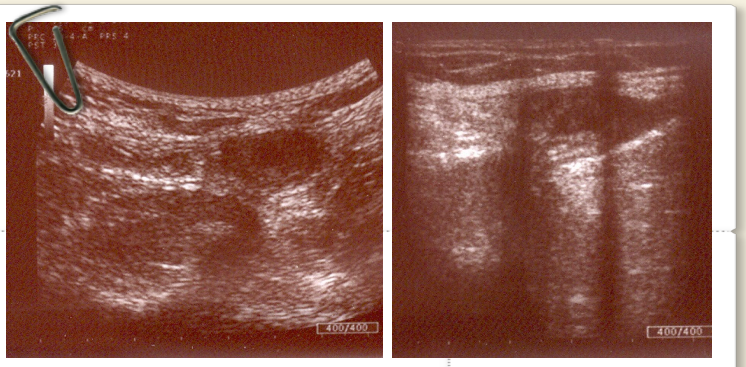


Incarcerated inguinal hernia, containing small bowel; fluid within the sac; hyperechogenicity of the surrounding soft tissues, due to flogosis.

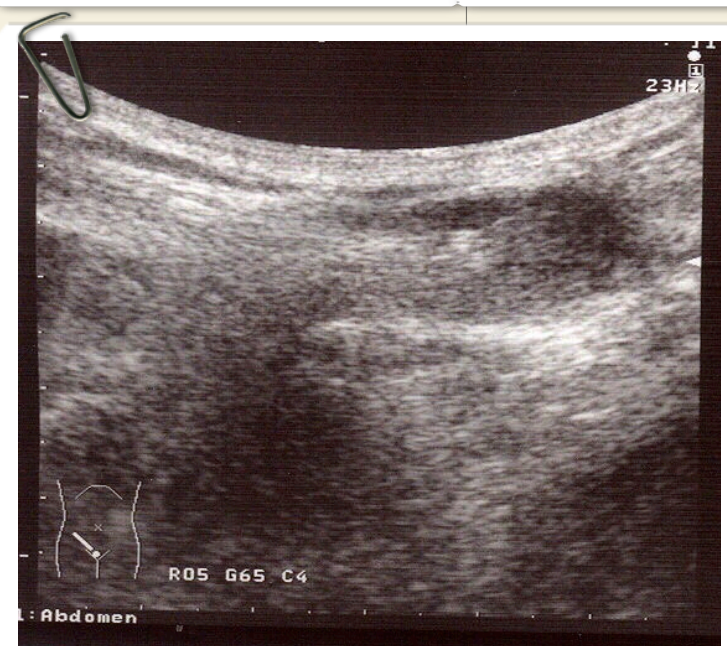
INGUINAL HERNIA

MORPHOLOGY

Evidence of the hernial sac in the context of the anterior abdominal wall. The sac is occupied by fluid and may contain intestinal loops, of which the peristalsis, any thickening of the wall and possibly the vascularity of the wall can be noted by power doppler.
The adjacent soft tissues can be hyperechoic in case of inflammation.



Inguinal hernia containing a small bowel tract



Inguinal hernia, fluid within the sac, bulging from the external inguinal ring