international bowel ULTRASOUND GROUP

IBUS HYBRID module 1

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MILAN, ITALY

How to perform IUS and what to look for

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Disclosure

Consulting fees or payment for lectures, presentations, educational events from Pfizer, Abbvie, Takeda, Sandoz, Galapagos, J&J, Alfasigma.

How to perform IUS

- Probe manipulation
- How to scan the small bowel
- How to scan the colon
- How to scan the rectum
- How to scan the mesentery
- How to use Colour Doppler
- How to evaluate bowel wall thicness (BWT)

Probe manipulation

PART:

- **P**ressure
- **A**lignment
- **R**otation
- **T**ilt

By manipulating the US probe, we manipulate the direction of the beam, and, by changing the direction of the beam, slightly different US images of the same structures can be obtained.

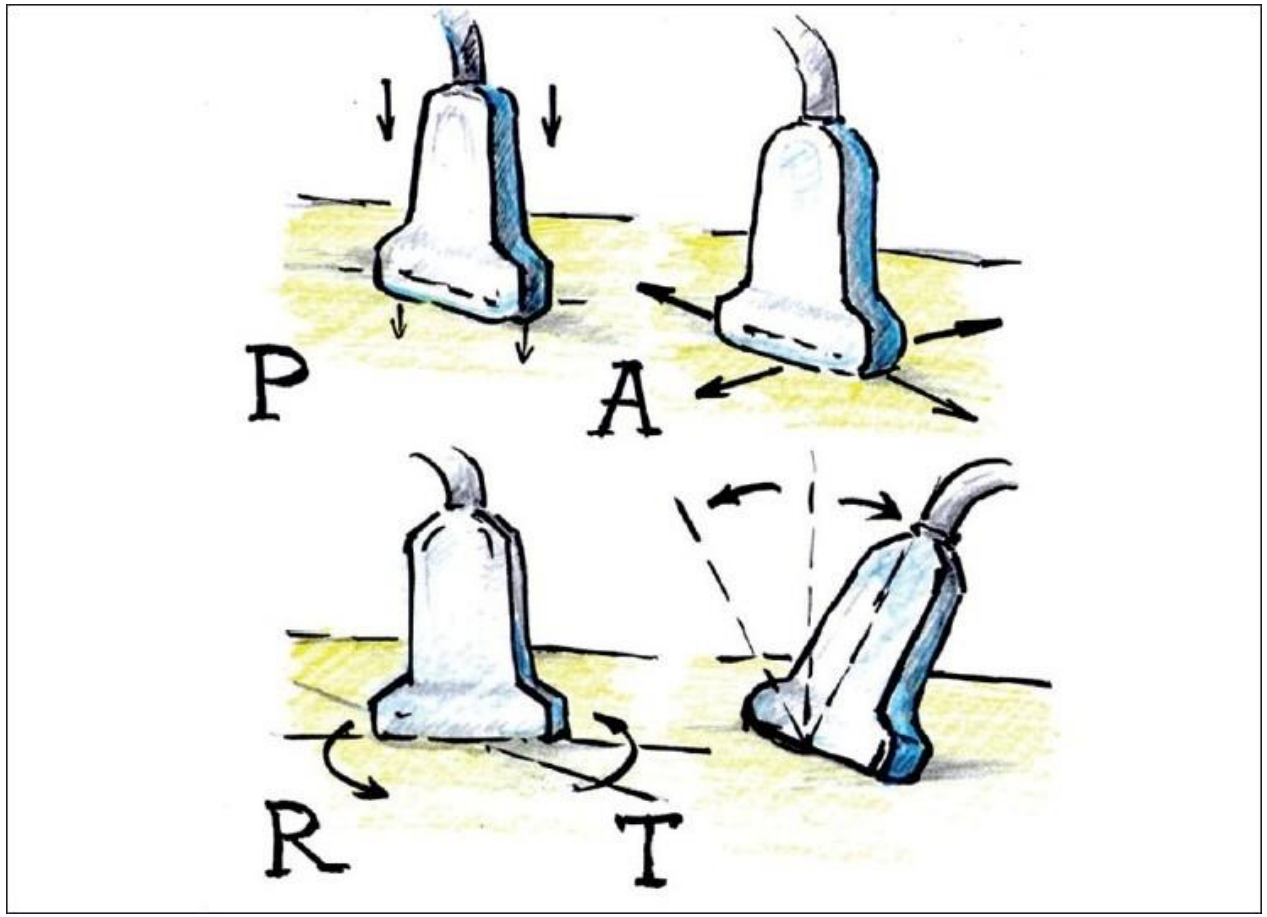


*Image from "*Ihnatsenka B, Boezaart AP. Ultrasound: Basic understanding and learning the language. I*nt J Shoulder Surg. 2010;4:55-62"*

PART: Pressure

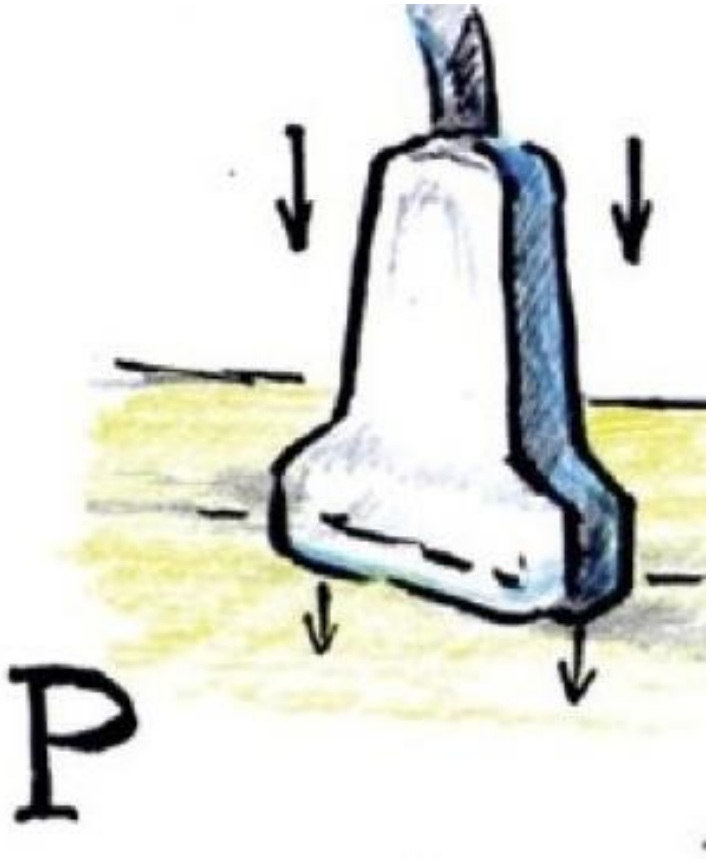


Image from "Ihnatsenka B, Boezaart AP. Ultrasound: Basic understanding and learning the language. Int J Shoulder Surg. 2010;4:55-62"

- Correct pressure application can improve the image quality as it influences the echogenicity of the tissue and shortens the distance to the structure of interest.

- An excessive pressure may be responsible for significant depth underestimation to the deep structure.

PART: Alignment (sliding)

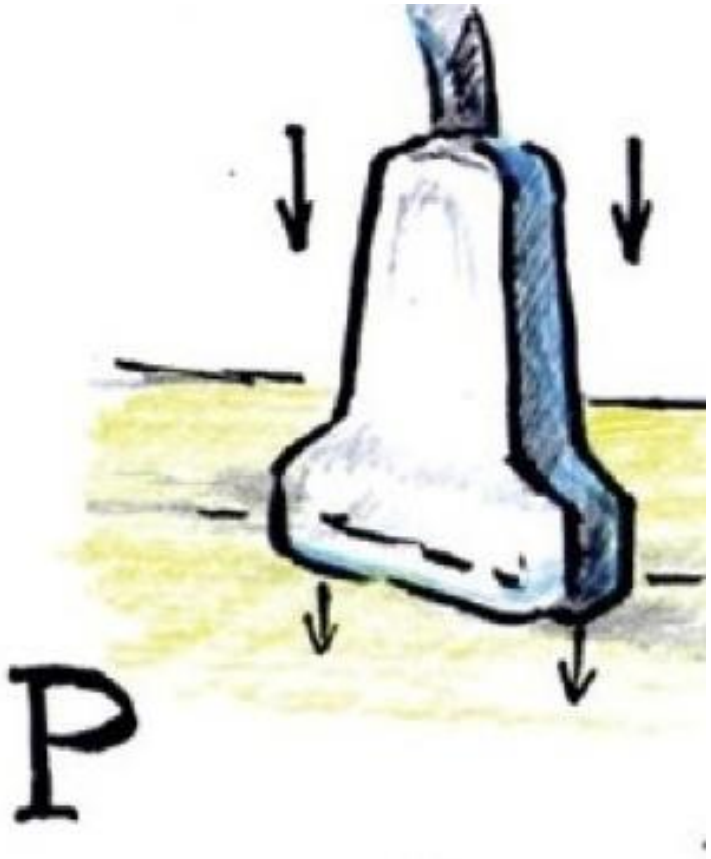


Image from “Ihnatsenka B, Boezaart AP. Ultrasound: Basic understanding and learning the language. Int J Shoulder Surg. 2010;4:55-62”

The main goal of this maneuver is to find the structure of interest and position it optimally on the screen.

PART: Rotation

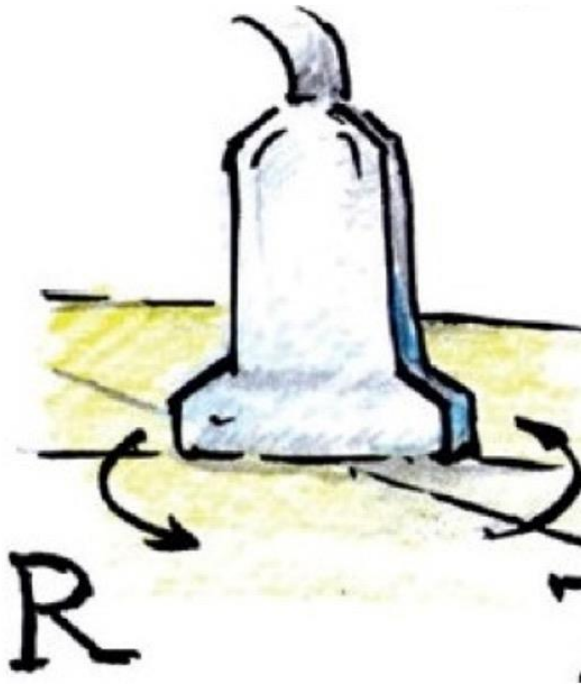


Image from "Ihnatsenka B, Boezaart AP. Ultrasound: Basic understanding and learning the language. Int J Shoulder Surg. 2010;4:55-62"

- Rotation allows a true axial view of the target with its long axis parallel to the surface.
- By rotation of the probe of 90° from the initial probe position, one can change the view of the structure from its short axis to its long axis, and vice versa.

PART: Tilting

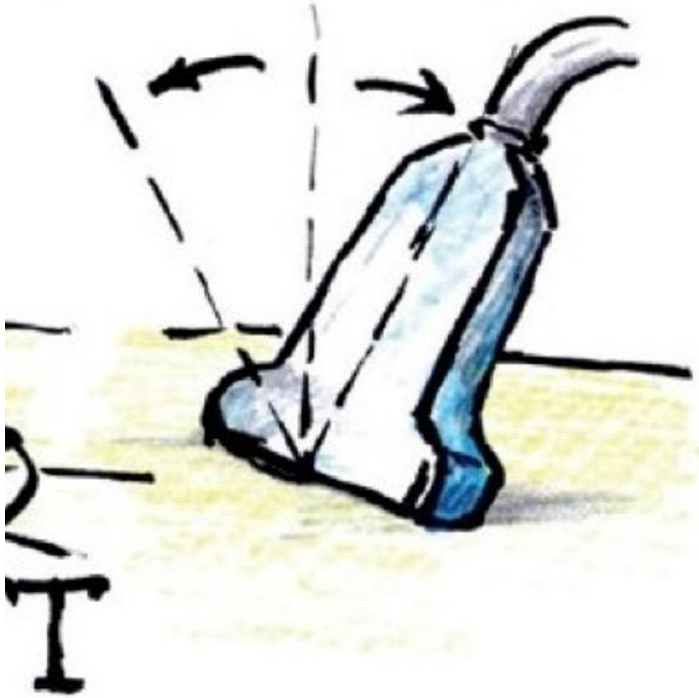


Image from “Ihnatsenka B, Boezaart AP. Ultrasound: Basic understanding and learning the language. Int J Shoulder Surg. 2010;4:55-62”

- By tilting the probe out of the true axial view of the target:
- the distance from the surface to the target increases
- the shape of the target on the screen is untrue (oval instead of round, for example).

General considerations

- First, **evaluate all four quadrants by using a curvilinear probe**. Specific attention should be focused on the region of tenderness or pain described by the patient.

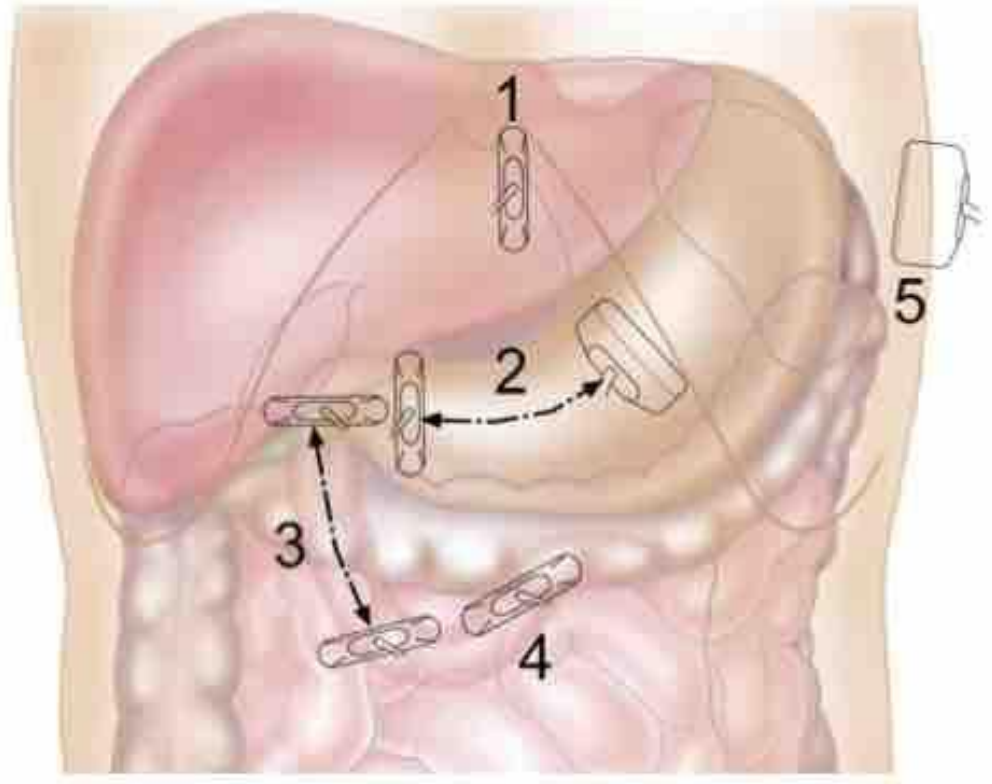
- Then, **use a high frequency probe to have better resolution** of the bowel wall layers and surrounding tissues.

- Visualization of the gut in the pelvis and lower quadrants is frequently limited by the deep position of the bowel, which can be obscured by luminal gas of more superficial loops of gut. **Use a graded compression** to better assess the bowel.

General considerations

- Placing the probe in the epigastric region in sagittal orientation demonstrates the liver and **stomach**.

- The stomach and the duodenum can be scanned by standardized longitudinal and transverse sections through the upper abdomen.



- Image from "Hollerweger A, Dirks K, Szopinski K, Dietrich CF. EFSUMB – European Course Book. Transabdominal ultrasound of the gastrointestinal tract."

General considerations

Begin at the right anterior superior iliac crest and move medially to the edge of the rectus muscles in a sagittal plane, to identify the common iliac vessels. Then rotate anticlockwise to a transverse plane and move cranially, to identify the **terminal ileum**.

This is followed to the **ileocaecal valve** and **caecum**.

The base of the **appendix** can be identified at the deep margin of the caecum where the colonic taenia meet.

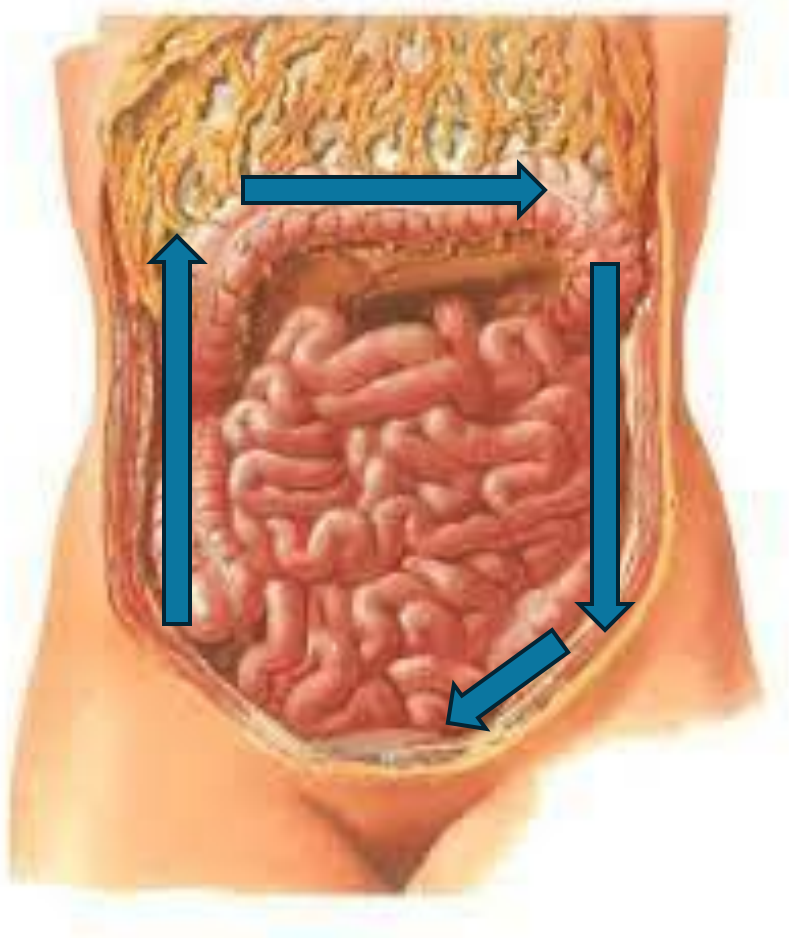


Image from "Netter Atlas of Human Anatomy."

How to scan the small bowel

- **"Lawn Mowing" strategy**: sweep up and down the abdomen to provide an overview of the small bowel, by using the probe in horizontal, sagittal and oblique (parallel to the mesenteric attachment) orientations and applying sufficient probe pressure to identify the dorsal wall of the abdominal cavity.

- Look carefully at the small bowel segments in the pelvic region: a well filled urinary bladder may help as it push the small bowel loops in the hypogastric region up towards the umbilical region.

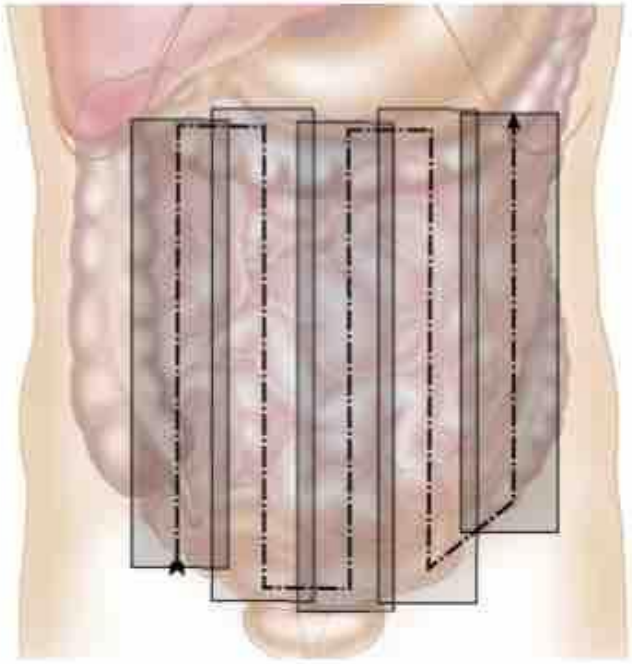


Image from "Hollerweger A, Dirks K, Szopinski K, Dietrich CF. *EFSUMB – European Course Book*. Transabdominal ultrasound of the gastrointestinal tract."

General considerations

The same technique can be used on the left side identifying the sigmoid colon as the first loop of bowel crossing the left iliac vessels.

The iliopsoas muscle can be used as an alternative landmark for identification of the terminal ileum and sigmoid colonic segments in the right and left iliac fossae, respectively.

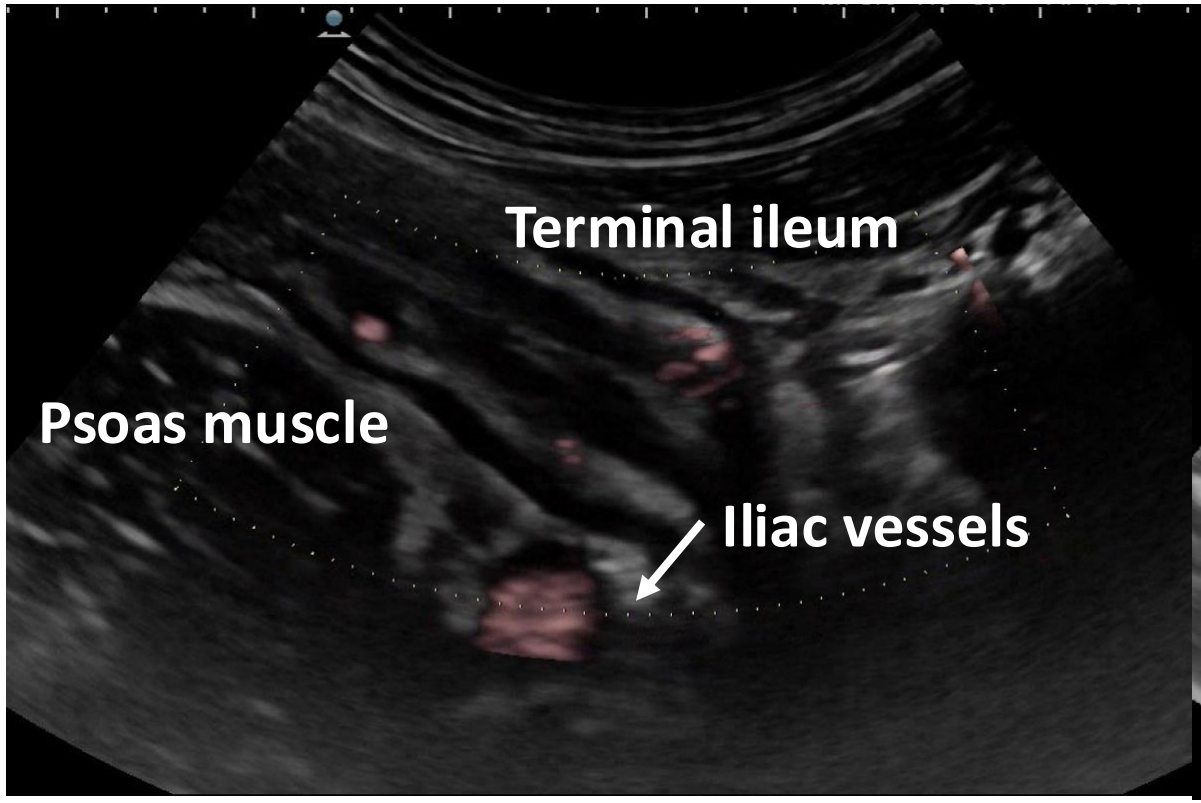
Image from "Netter Atlas of Human Anatomy."

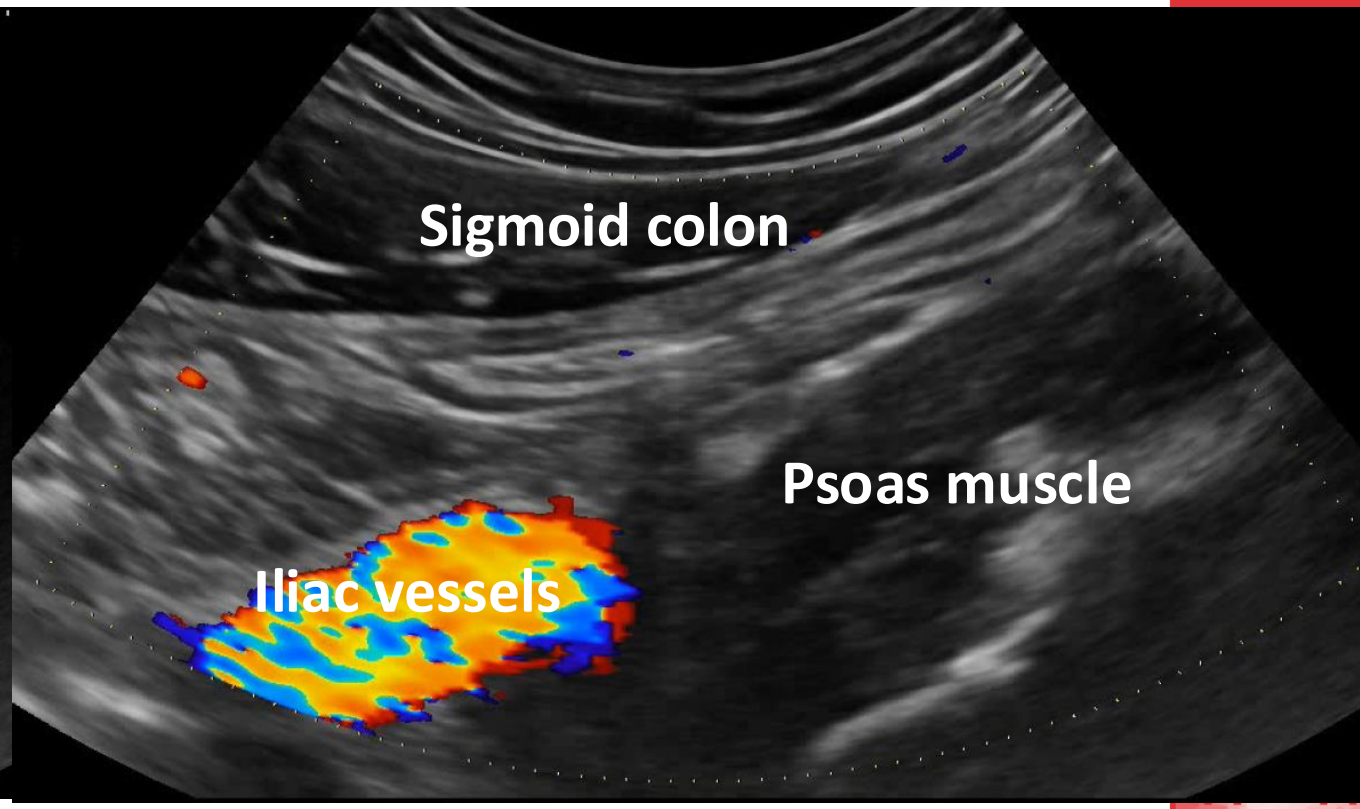
Anatomical Landmarks: Psoas muscle, iliac vessels

IBUS HYBRID module 1

right iliac fossa

left iliac fossa





How to scan the colon

The rest of the **colon** can be followed via the transverse segment distally towards the rectum.

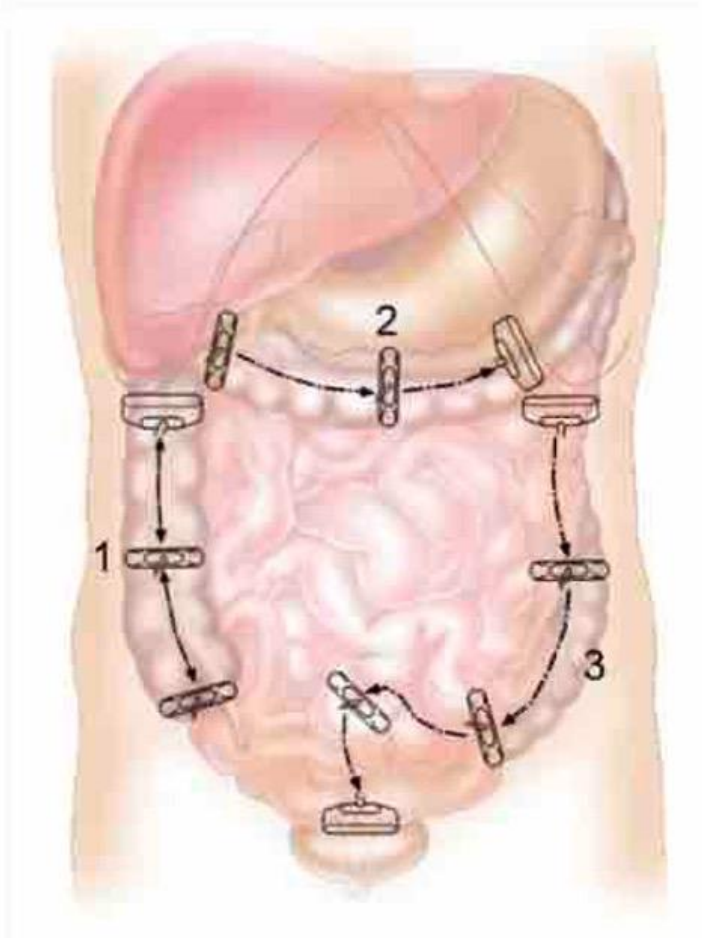
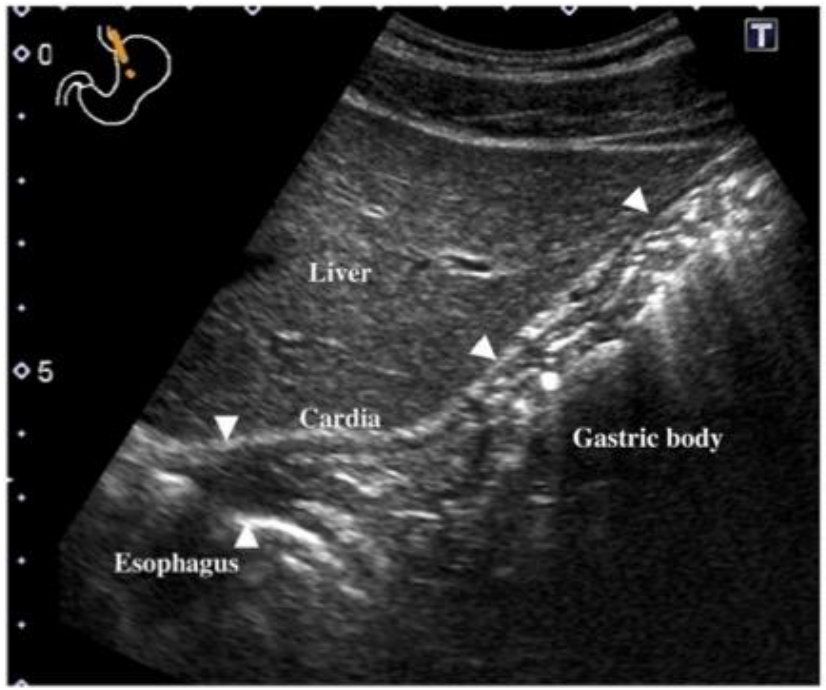
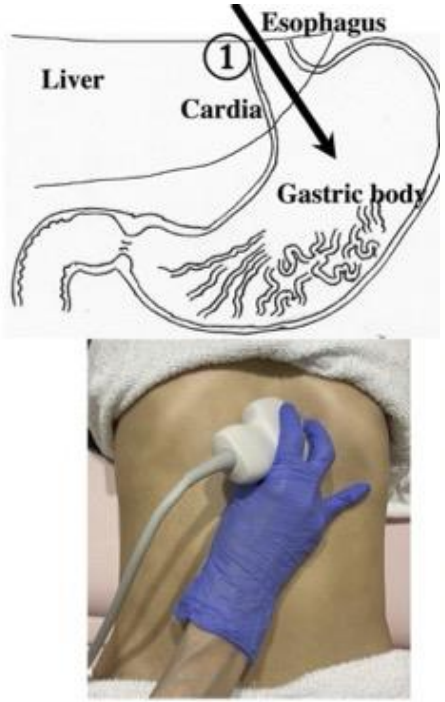
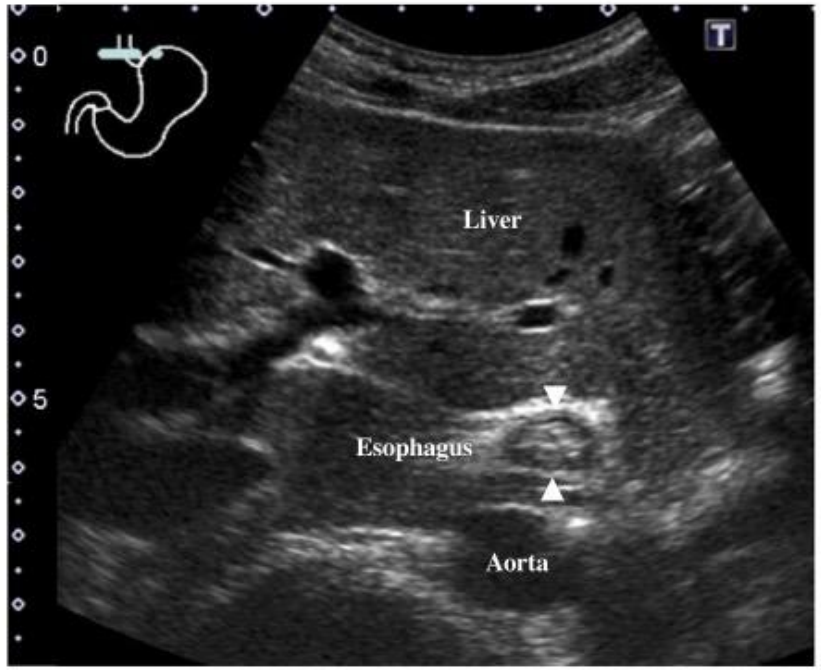


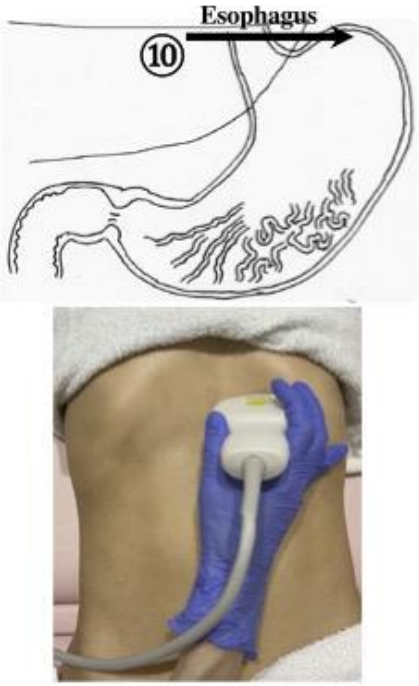
Image from "Hollerweger A, Dirks K, Szopinski K, Dietrich CF. EFSUMB – European Course Book. Transabdominal ultrasound of the gastrointestinal tract."

Esophagus


Liver
Cardia
Gastric body
Esophagus


Esophagus
1
Liver
Cardia
Gastric body

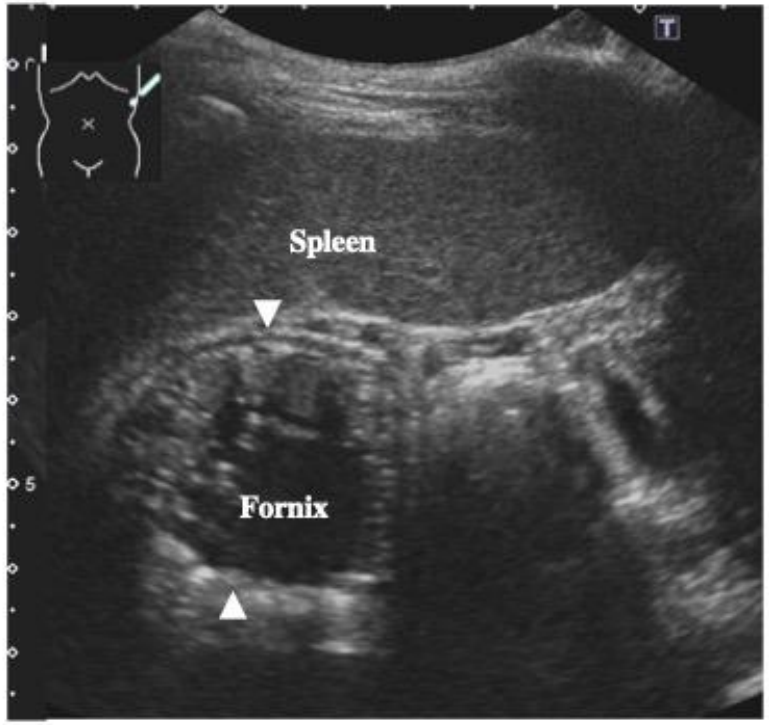

Liver
Esophagus
Aorta

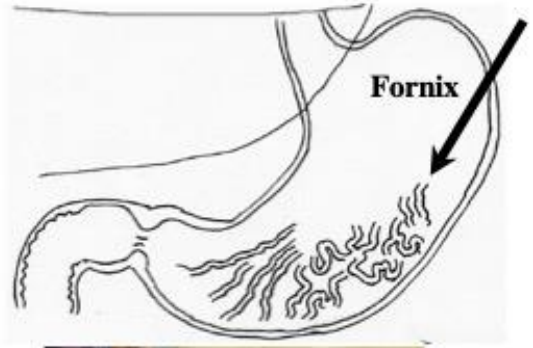

Esophagus
10

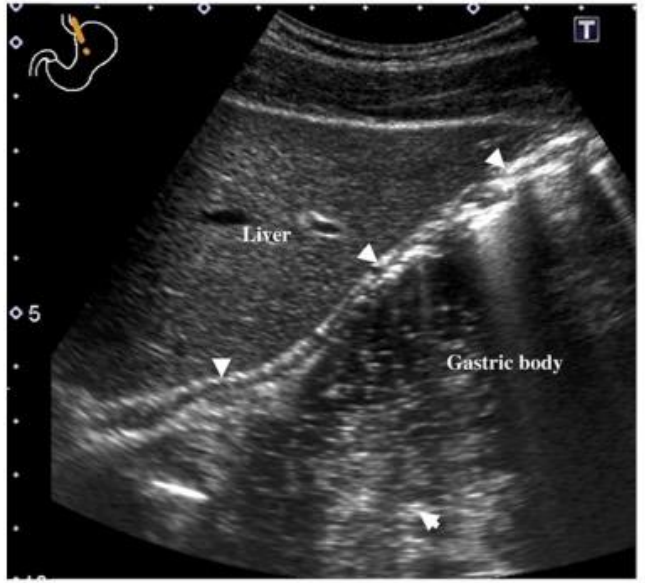
Stomach

- The muscular layer of the stomach, especially of the antrum, is more pronounced than in other parts of the bowel.
- In a non-distended condition the mucosal folds of the gastric corpus and fundus are well demonstrable.
- Thick pyloric muscle

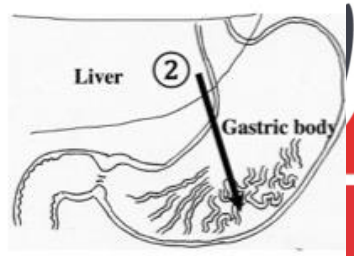
Stomach


Spleen
Fornix

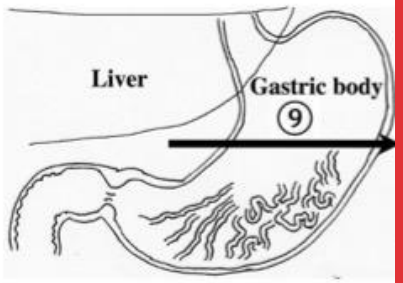

Fornix

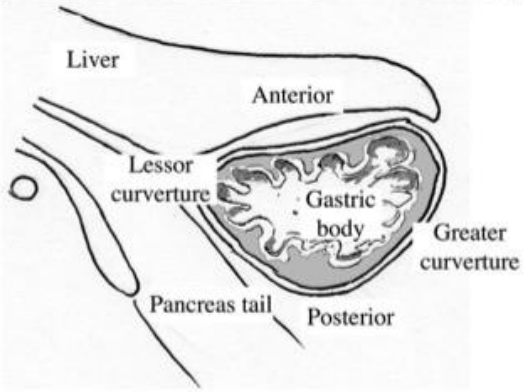

Liver
Gastric body

(a)

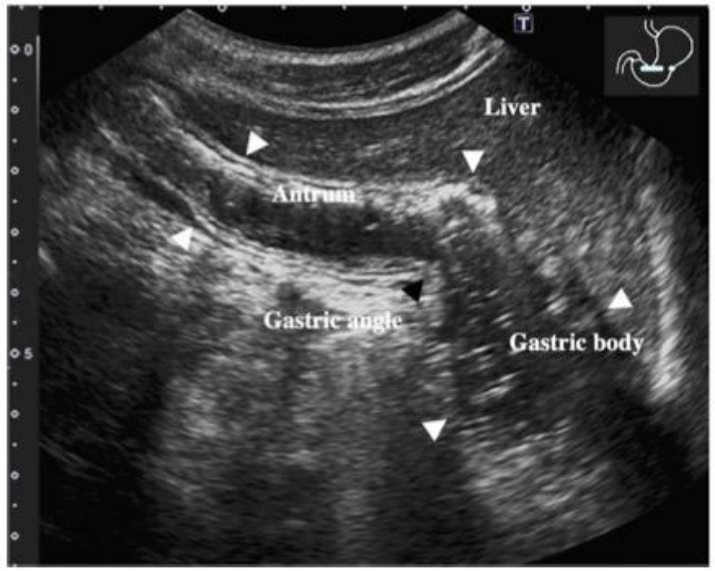

Liver
2
Gastric body

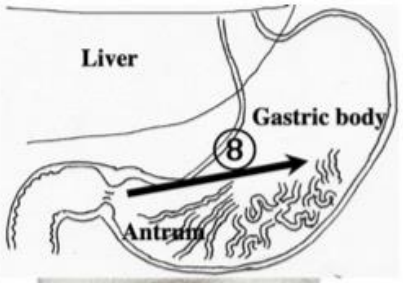

LIVER
A
L
G
PANCREAS
P
Gastric body

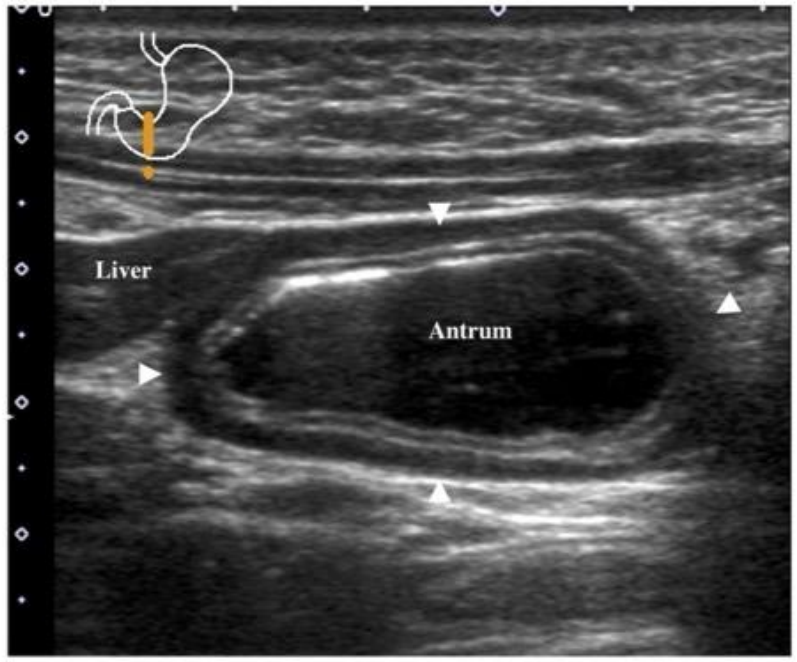

Liver
Gastric body
9


Liver
Anterior
Lessor curverture
Gastric body
Greater curverture
Pancreas tail
Posterior

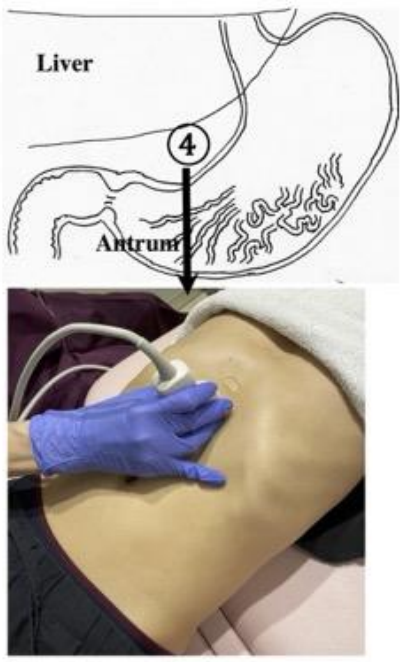
Stomach


Liver
Antrum
Gastric angle
Gastric body

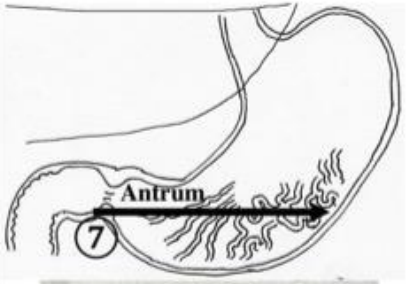

Liver
Gastric body
8
Antrum


Liver
Antrum

(a)

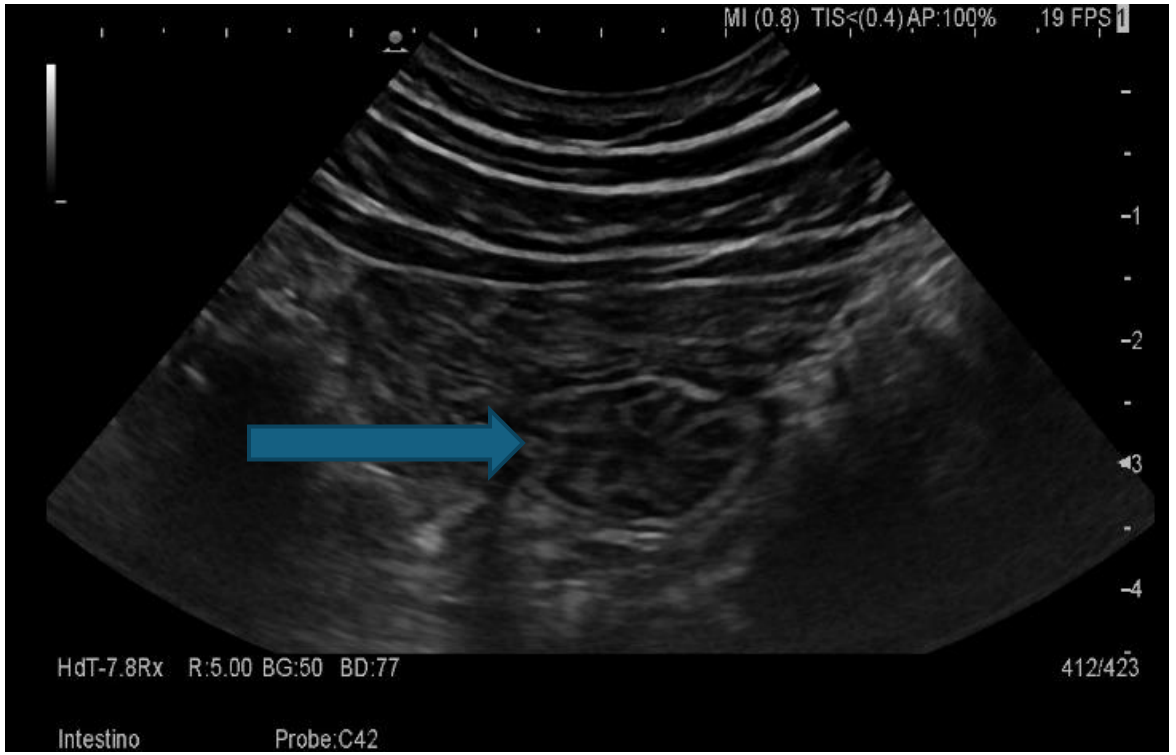

Liver
4
Antrum


Antrum


Antrum
7

Jejunum

- Thick folds
- Fill lumen
- Herringbone pattern
- The valvulae conniventes are typical of the small intestine. They decrease in number and height from the proximal jejunum to the distal ileum and are best visible when bowel loops are fluid filled
- Peristalsis active (diminishes in fasting condition)

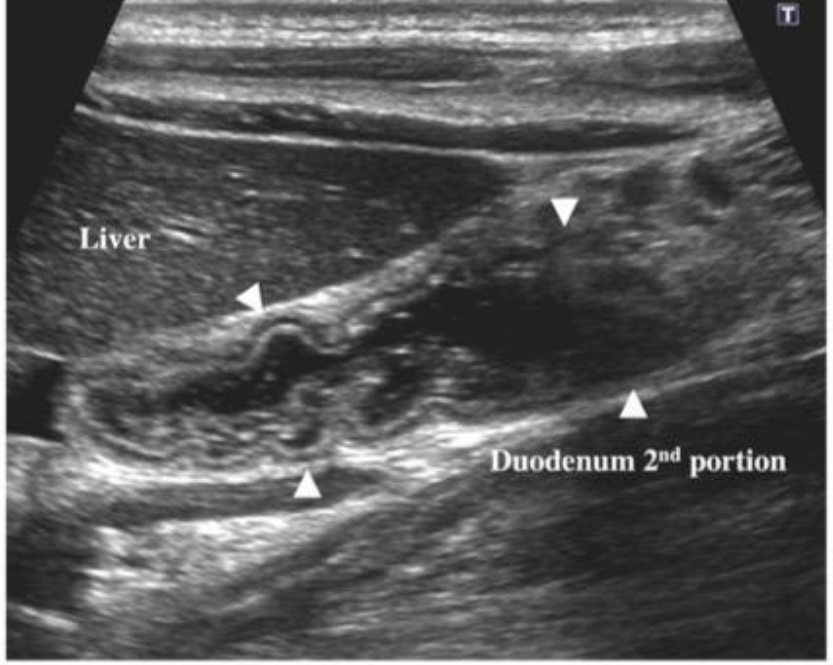



MI (0.8) TIS (0.4) AP:100% 19 FPS
JEJUNUM
HdT-7.8Rx R:5.00 BG:54 BD:77
193/194

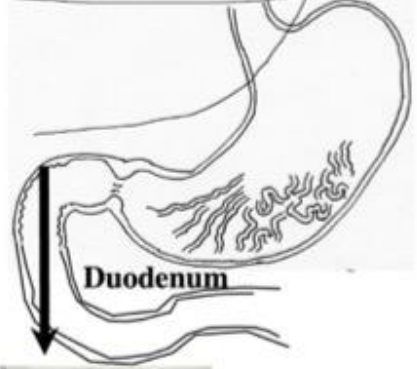
Jejunum

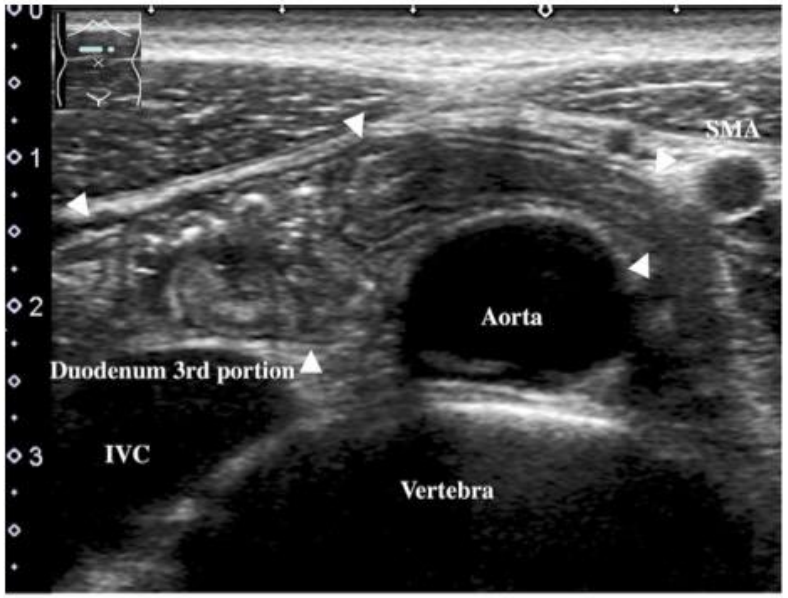

Pyloric ring
Antrum
Liver
Duodenal bulb

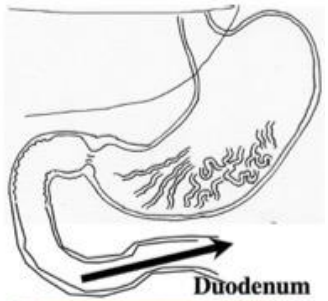

Liver
Pyloric ring
5
Antrum
Duodenum

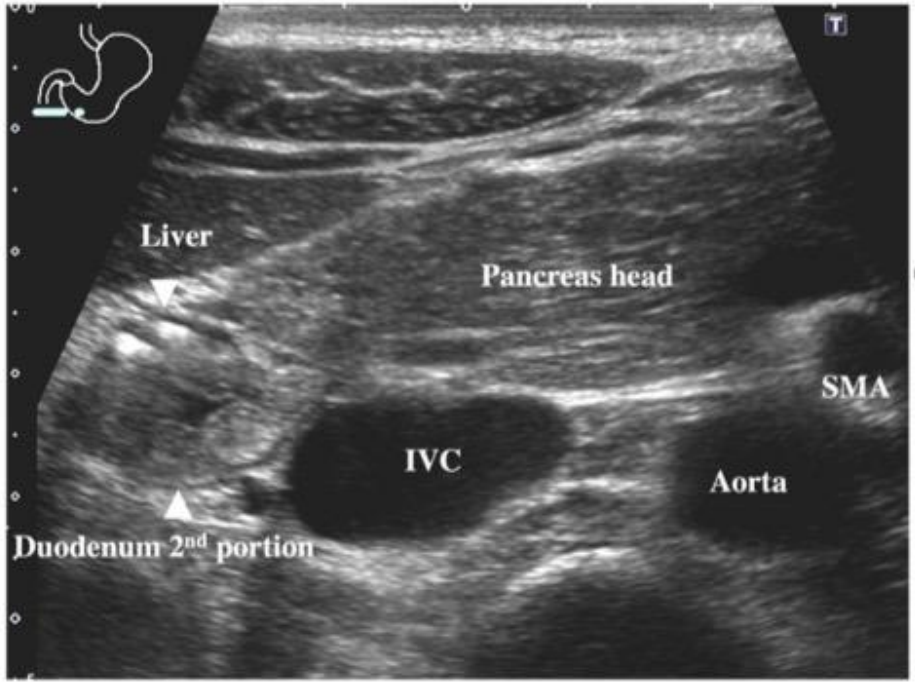

Liver
Duodenum 2nd portion

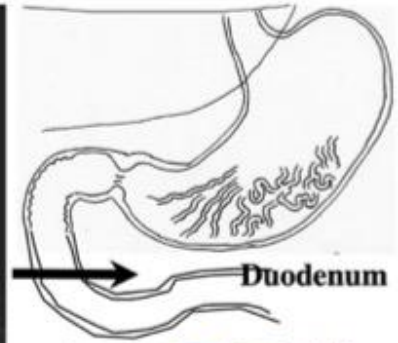
(a)

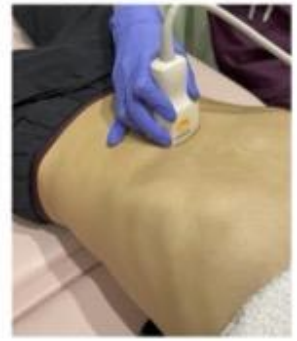

Duodenum


SMA
Aorta
Duodenum 3rd portion
IVC
Vertebra


Duodenum

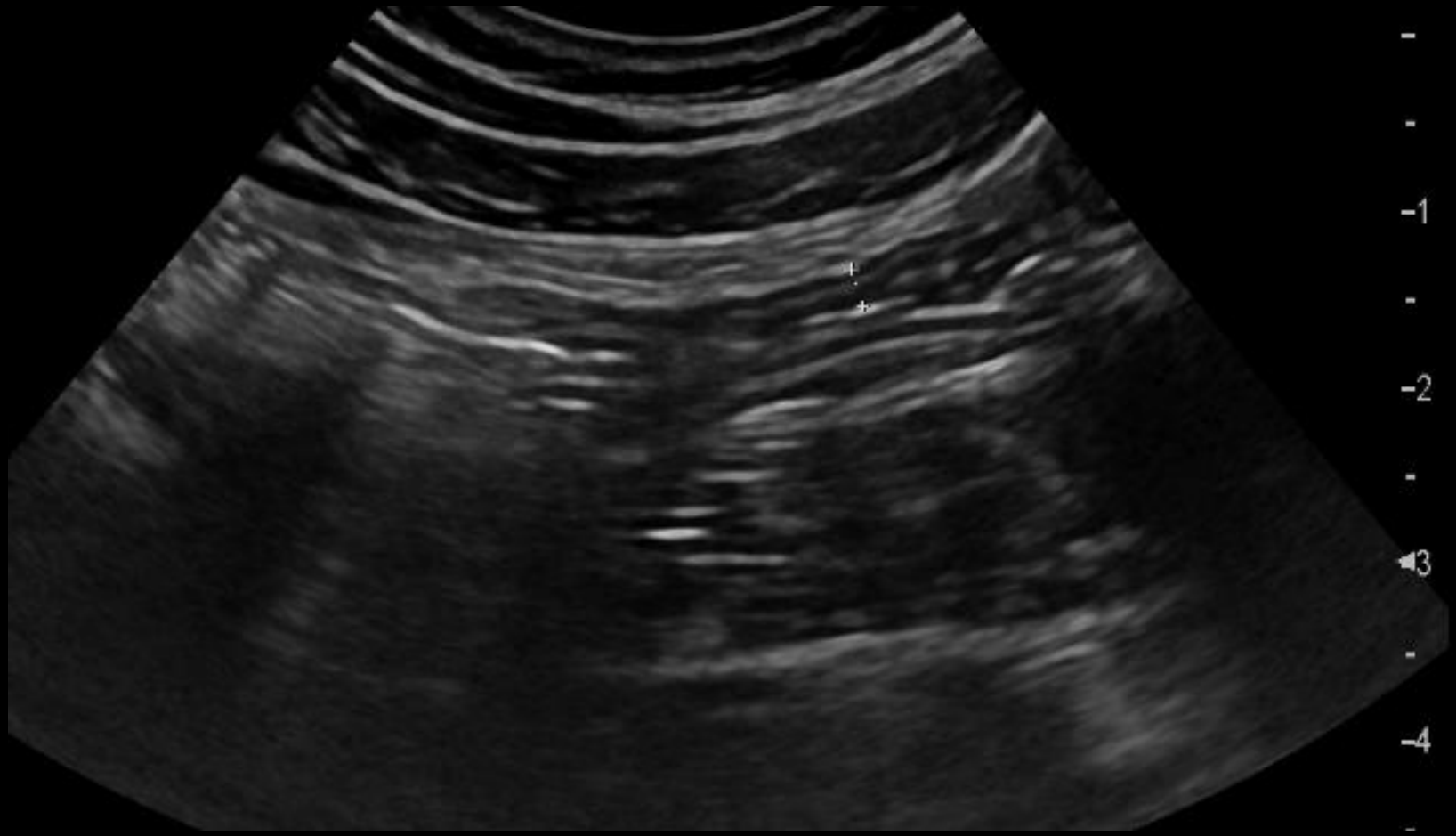

Liver
Pancreas head
SMA
IVC
Aorta
Duodenum 2nd portion

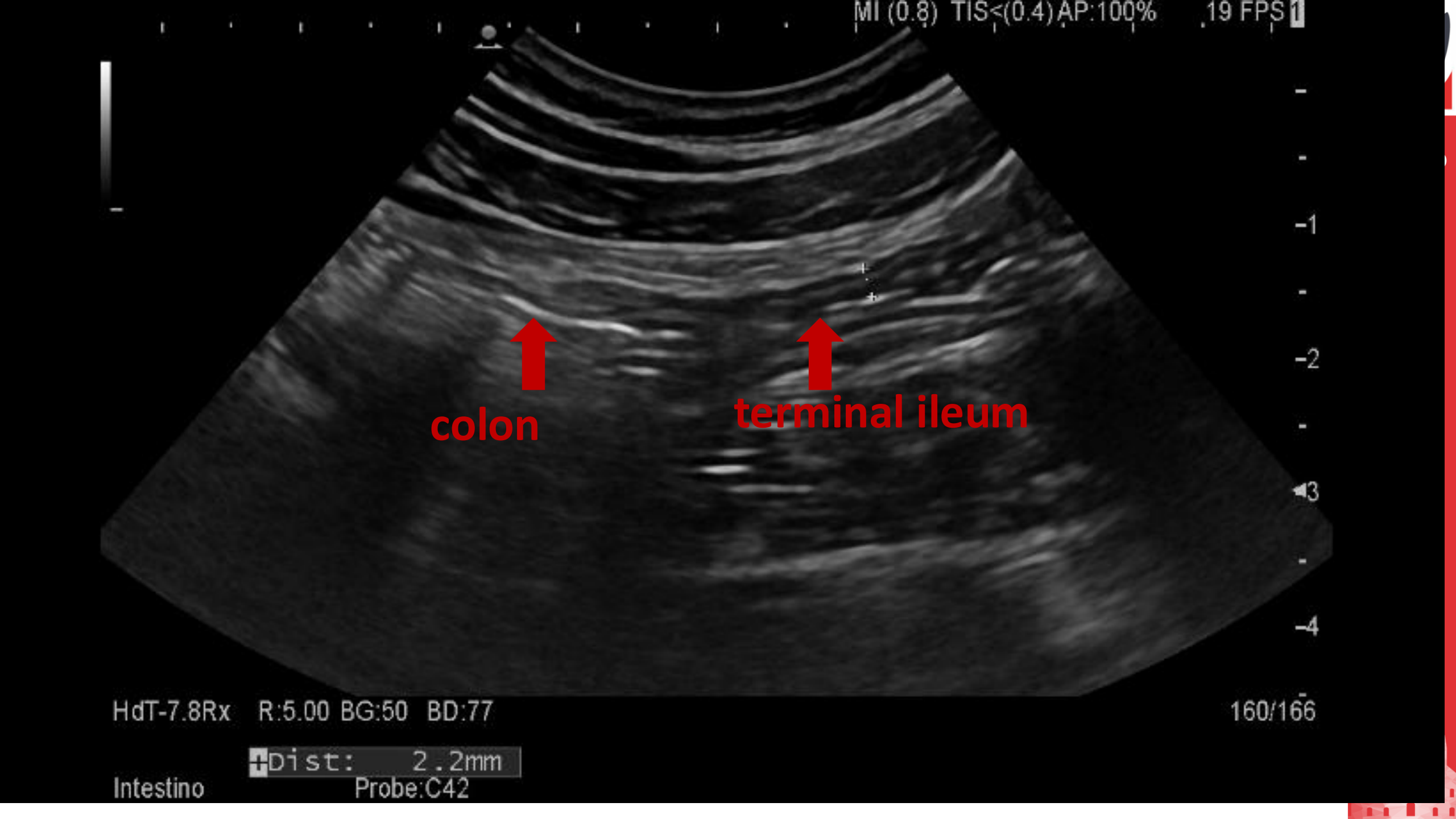

Duodenum



Ileum

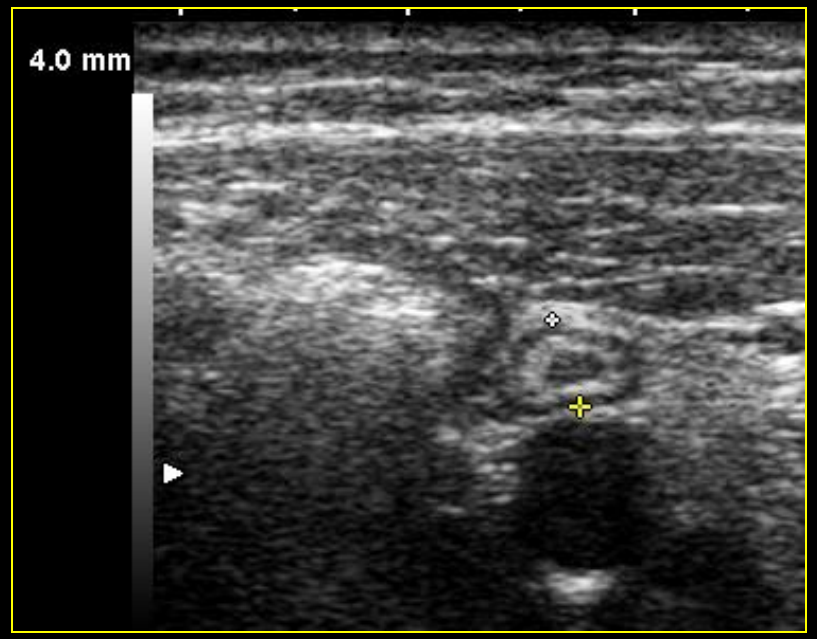
- Thin walls
- Fewer folds
- Peristalsis less active




MI (0.8) TIS<(0.4) AP:100% 19 FPS
colon
terminal ileum
HdT-7.8Rx R:5.00 BG:50 BD:77
160/166
Dist: 2.2mm
Intestino
Probe:C42

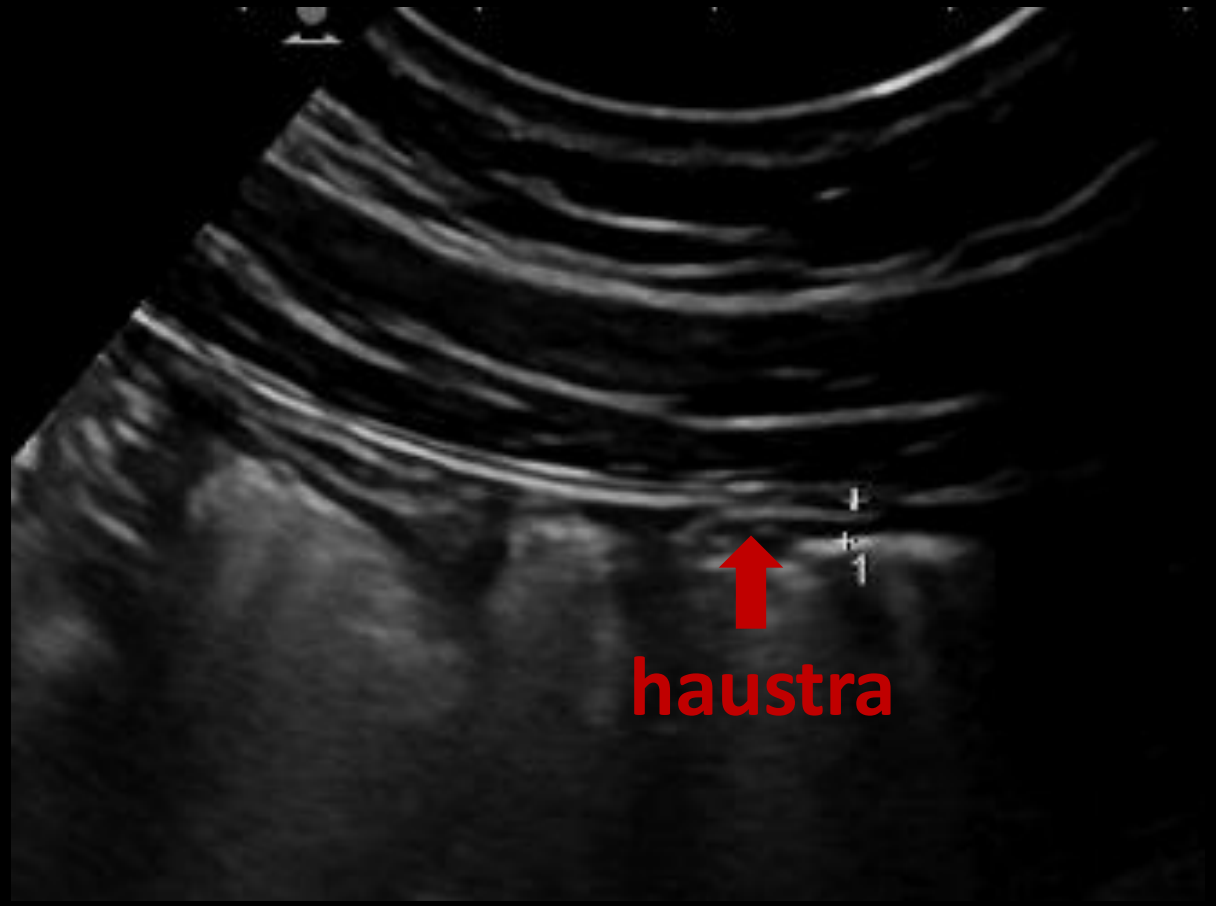
Appendix

- Graded compression
- <6 mm
- Readly compressble
- Mural stratification



Colon

- Haustra are best visible at the ascending and transverse colon, while the left hemicolon is seen more often in a contracted condition.
- Gas filled
- No peristalsis



Rectum

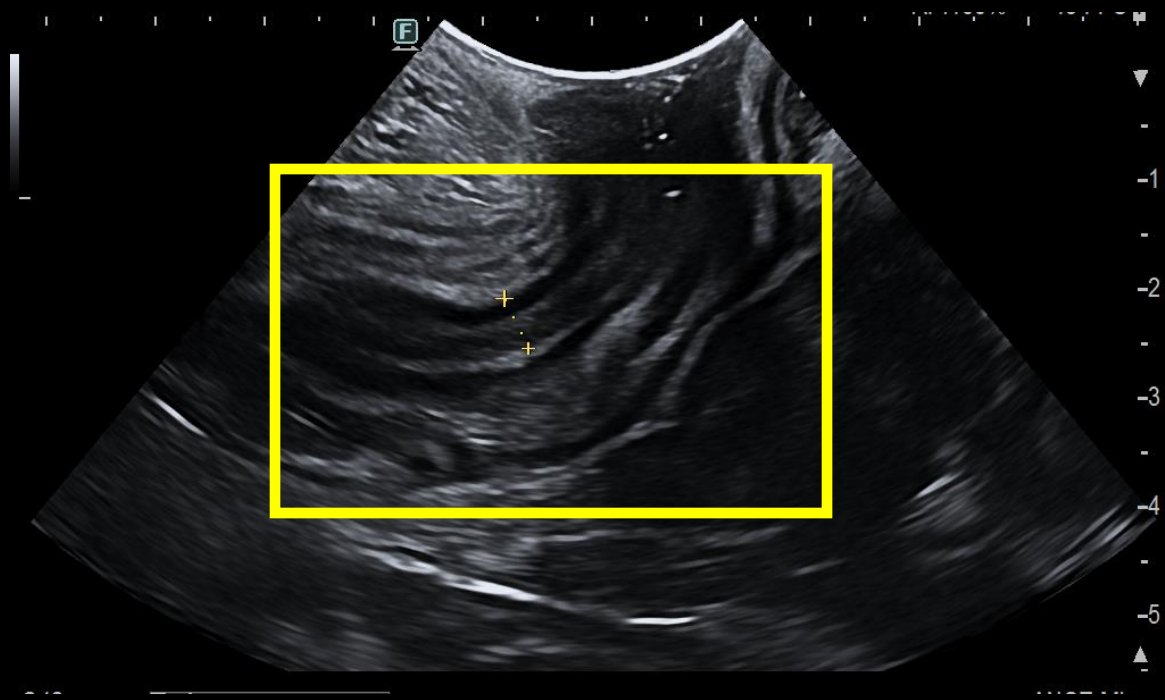
The rectum can be scanned behind the urinary bladder with the abdominal US probe. The normal rectum may be difficult to display if the urinary bladder is empty.

Transperineal imaging can be useful to evaluate the distal rectum and perianal tissues.

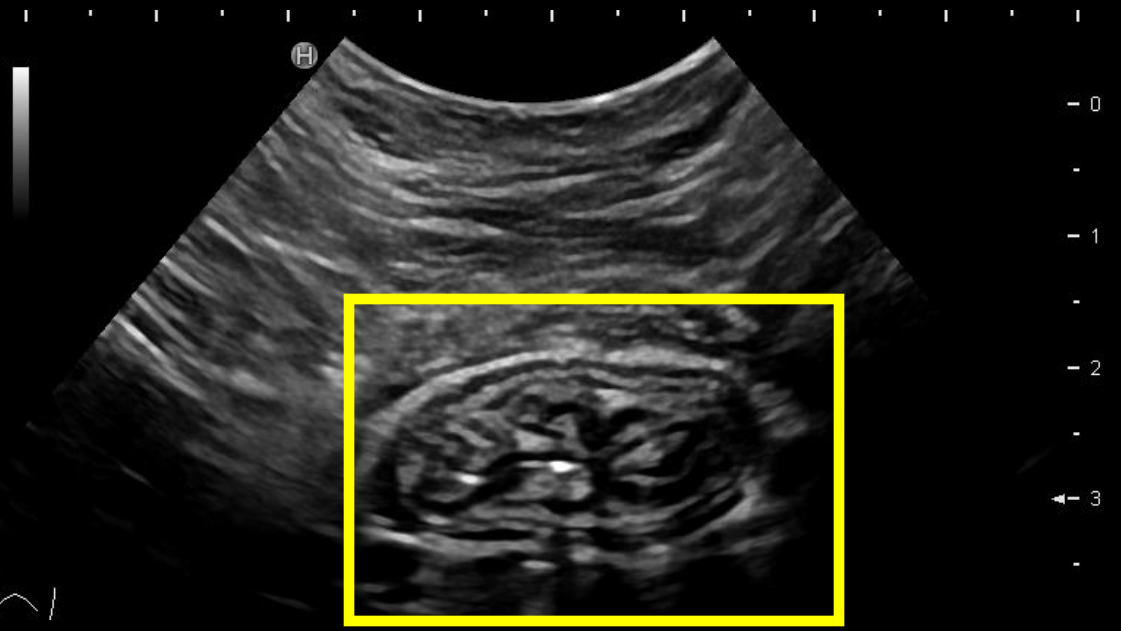
World J Gastroenterol. 2017;23:6931-6941.

Rectum

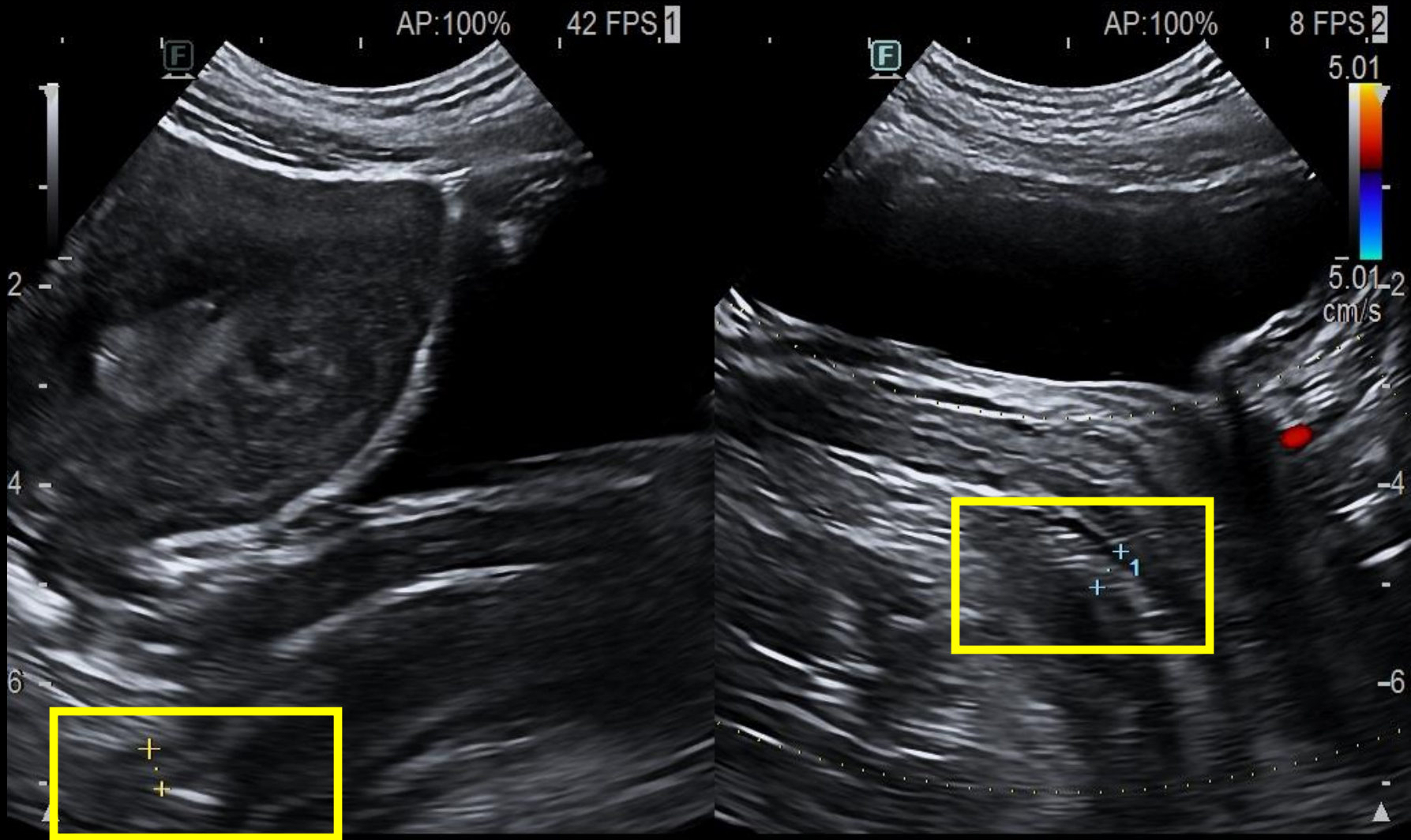
Sagittal scan



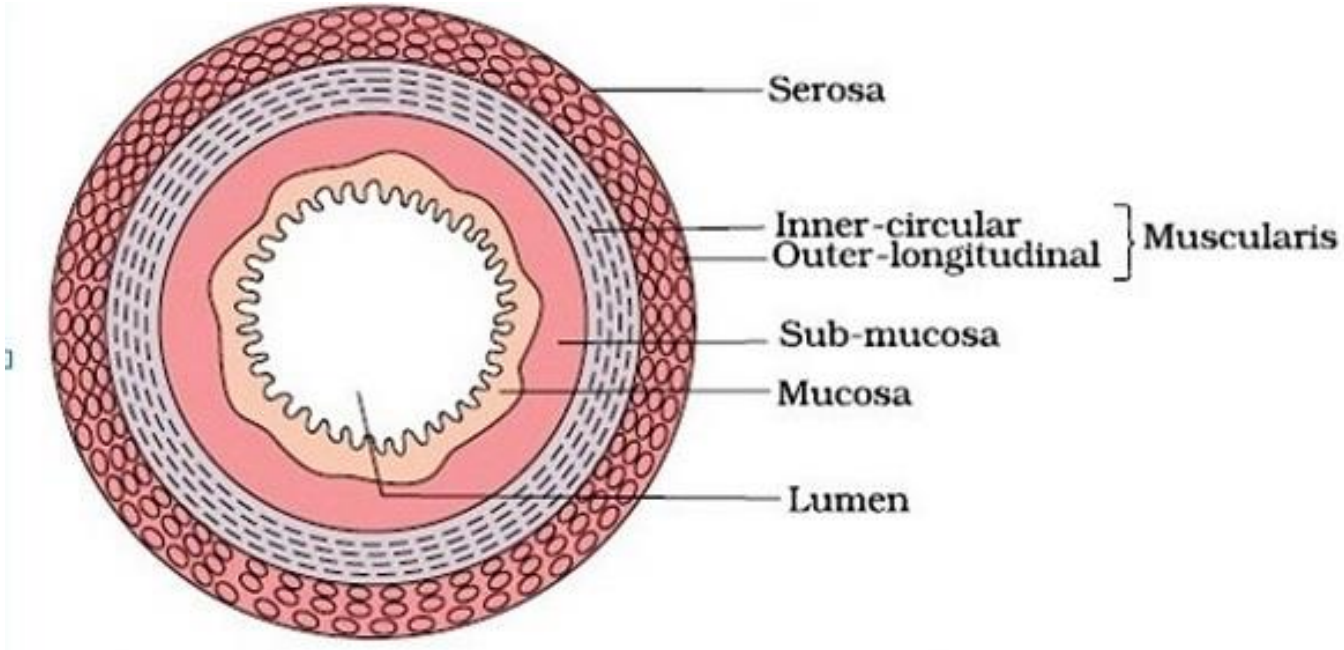
Coronal scan

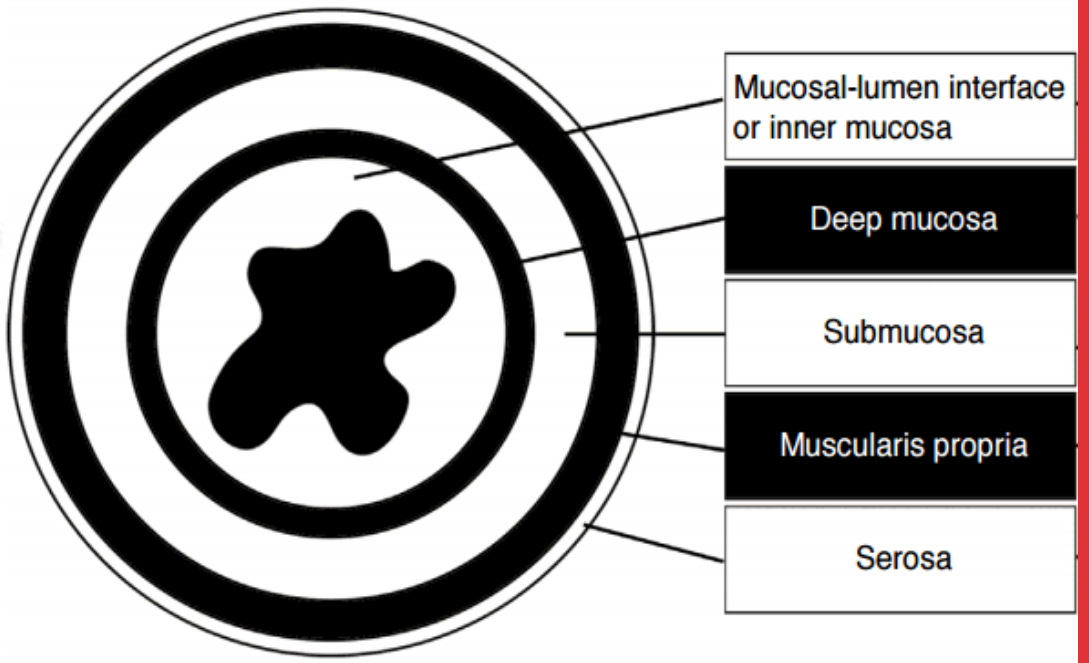


Rectum



Wall layers: the “gut signature”





Kimmey MB et al. Gastroenterology. 1989;96:433-41.
Aibe T et al. Scand J Gastroenterol Suppl. 1986;123:6-15.

Wall layers: 5 sonographic layers (with high frequency probe)

Anterior wall:

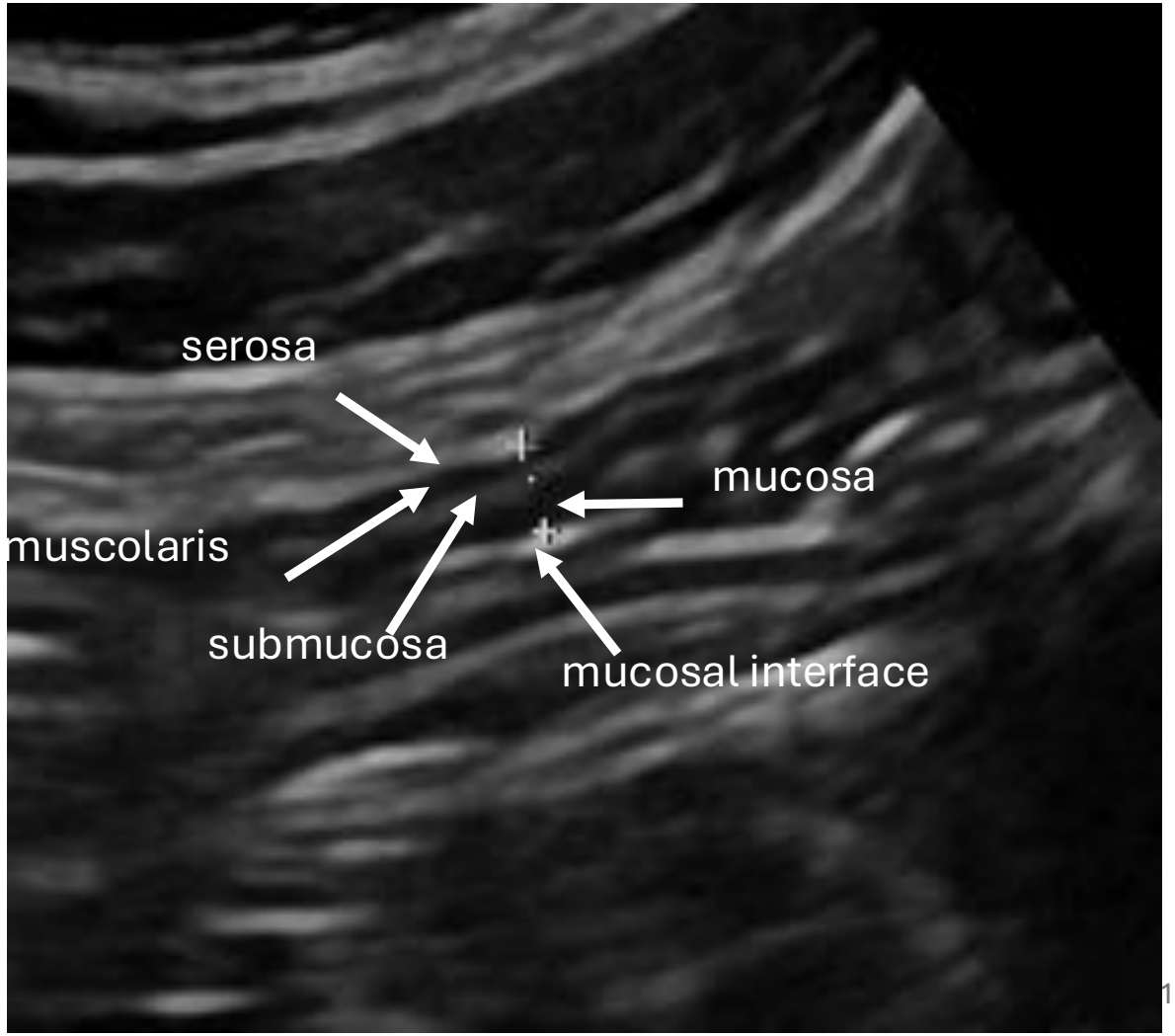
Layer 1 (hyperechoic): the interface between the mucosa and the lumen (is not a part of the actual GI wall)

Layer 2 (hypoechoic): the mucosa

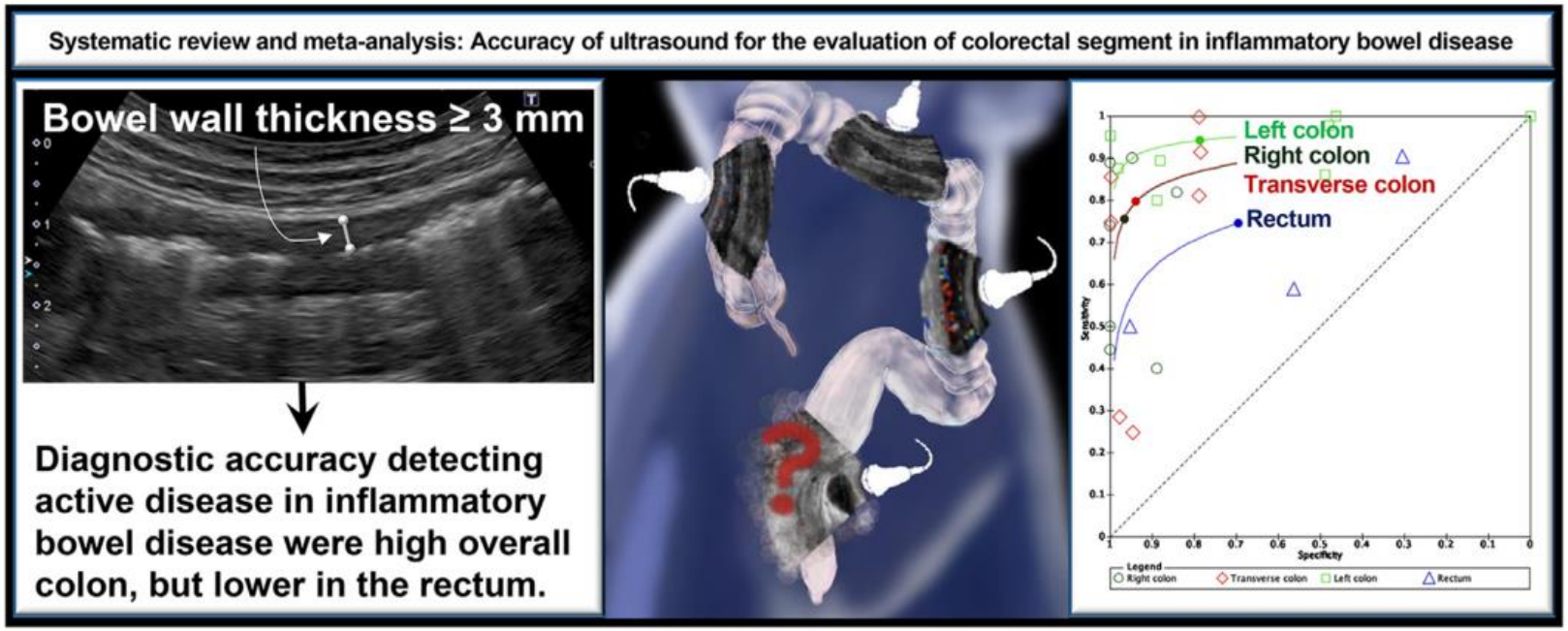
Layer 3 (hypechoic): the submucosa

Layer 4 (hypoechoic): the muscolaris propria

Layer 5 (hyperechoic): the interface between the muscolaris propria and the serosa



Cut-off for BWT: 3 mm for both CD and UC



Clinical Gastroenterology and Hepatology

7 studies (84 patients with CD and 420 patients with UC) were included in the meta-analysis. Bowel wall thickness ≥ 3 mm identified colorectal segments with inflammation with 86.4% pooled sensitivity (95% CI, 76.1%–92.7%) and 88.3% pooled specificity (95% CI, 58.1%–97.6%)

Shintaro et al. 2021 CGH

Tips & tricks

The measurements should be made in the anterior wall.

The posterior bowel wall often is not possible to see due to air in the lumen.

Measure wall thickness with high frequency probes, as the resolution of low-frequency probes causes the examiner to neglect areas of the intestine where the wall is thin.

EFSUMB Recommendations and Guidelines for Gastrointestinal Ultrasound. Ultraschall Med. 2017. Muradali D et al. US of gastrointestinal tract disease. Radiographics 2015;35:50–68.
Gritzmann N et al.Transabdominal sonography of the gastrointestinal tract. Eur Radiol 2002;12:1748–1761.

Tips & tricks

- **Wall thickness depends on the degree of distention of the bowel segment** → re-examine after peristaltic contraction to avoid overestimation of bowel wall thickness.

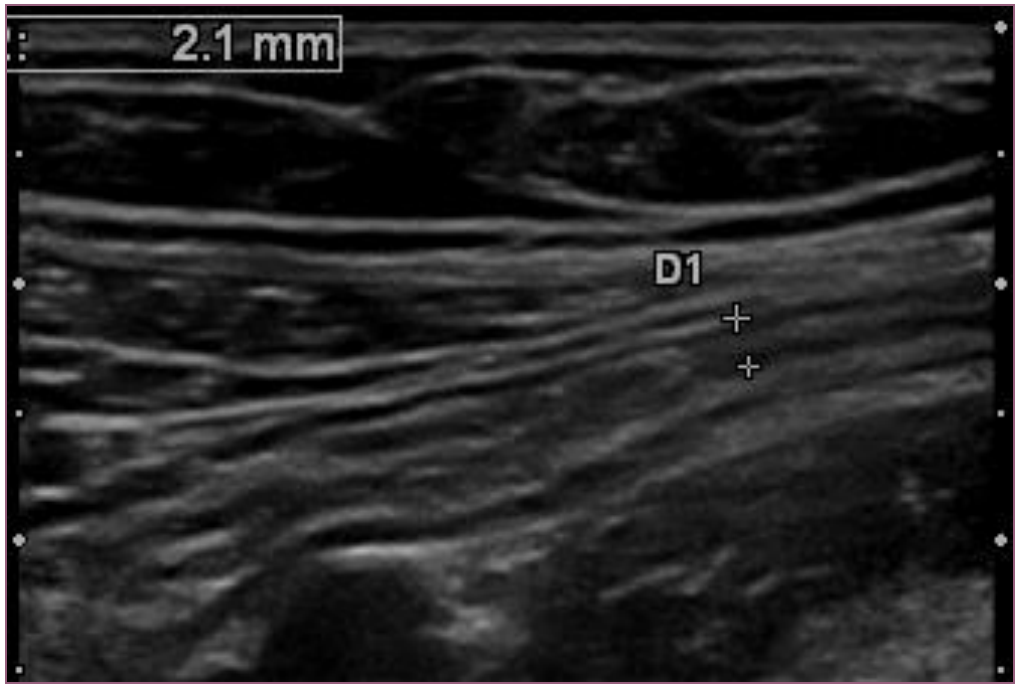
- The measurements may be overestimated when the scanning plane is not perpendicular to the GI wall.

- **Wall thickness increases after meals.**

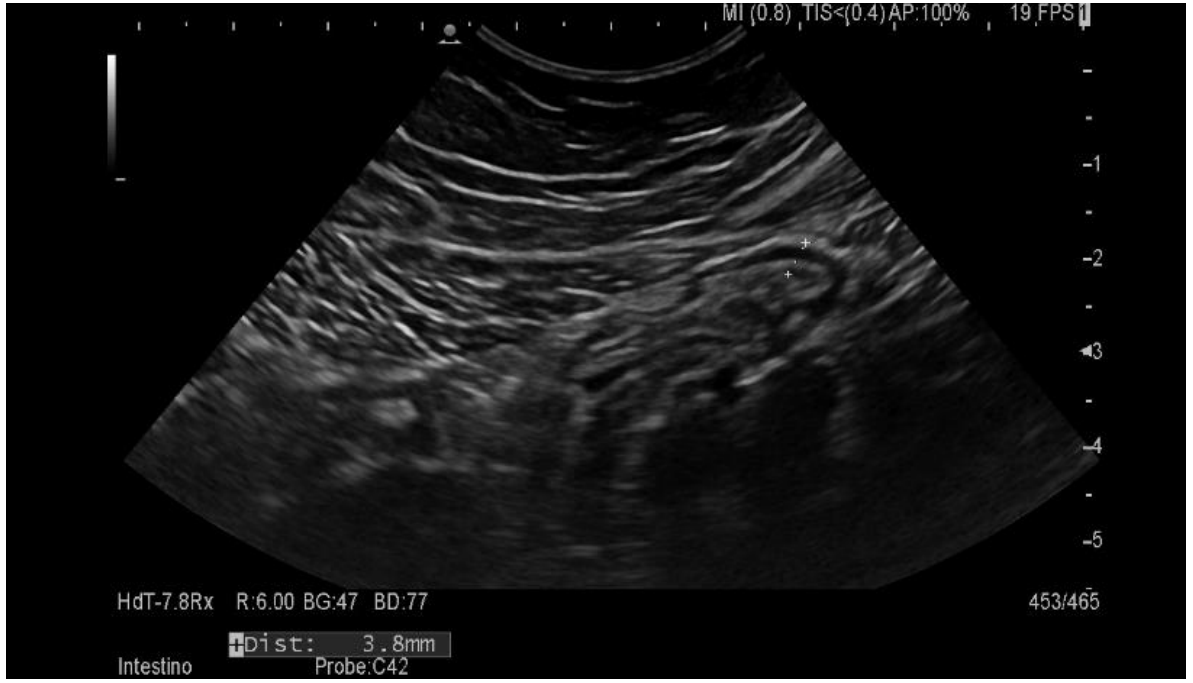
- **Wall thickness increases with age.**

Haber HP et al. J Ultrasound Med 2000; 19:315–321;
Nylund K et al. Ultraschall in Med 2012; 33:E225–E232.

BWT – tips & tricks



Relaxed sigmoid colon



Contracted sigmoid colon

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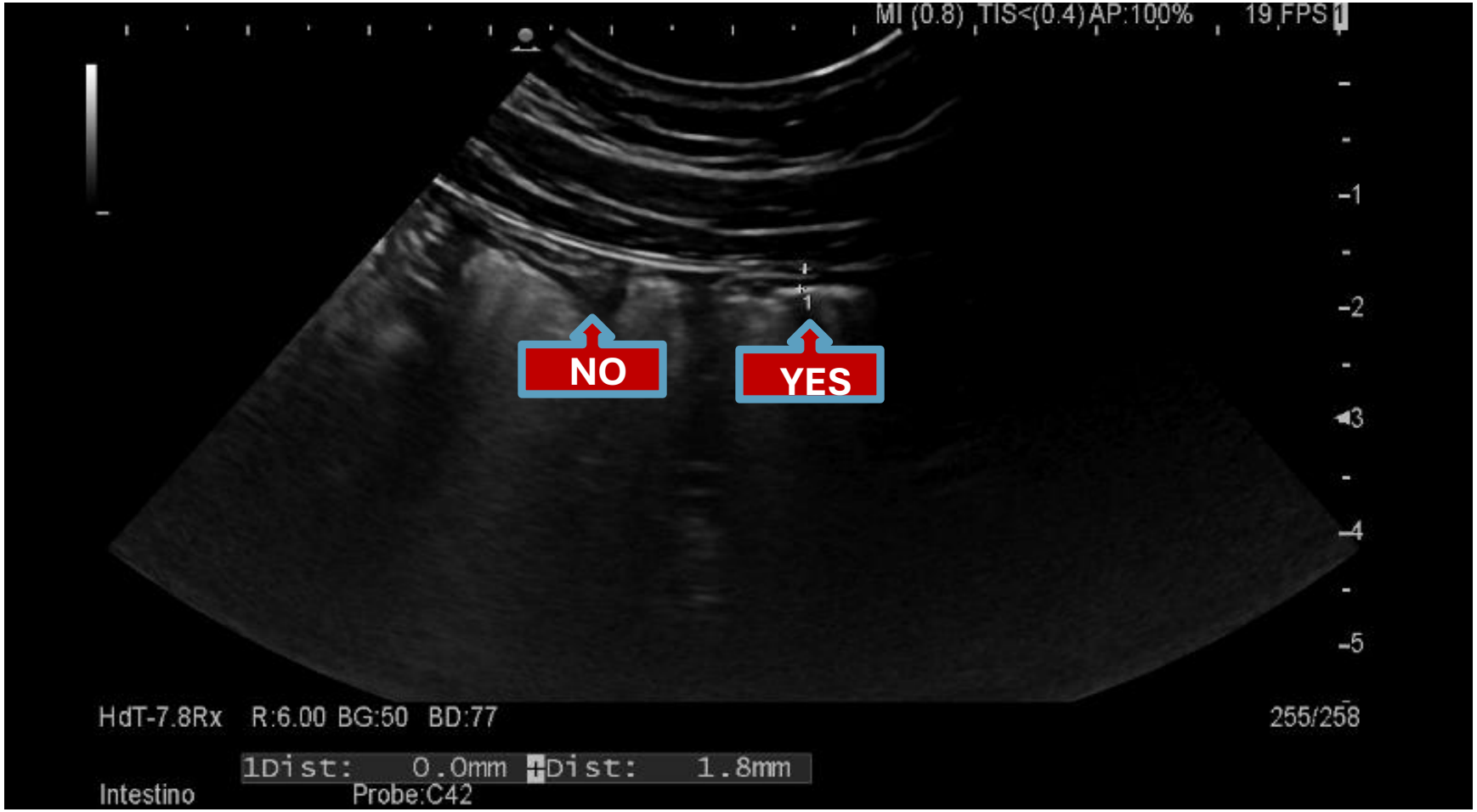
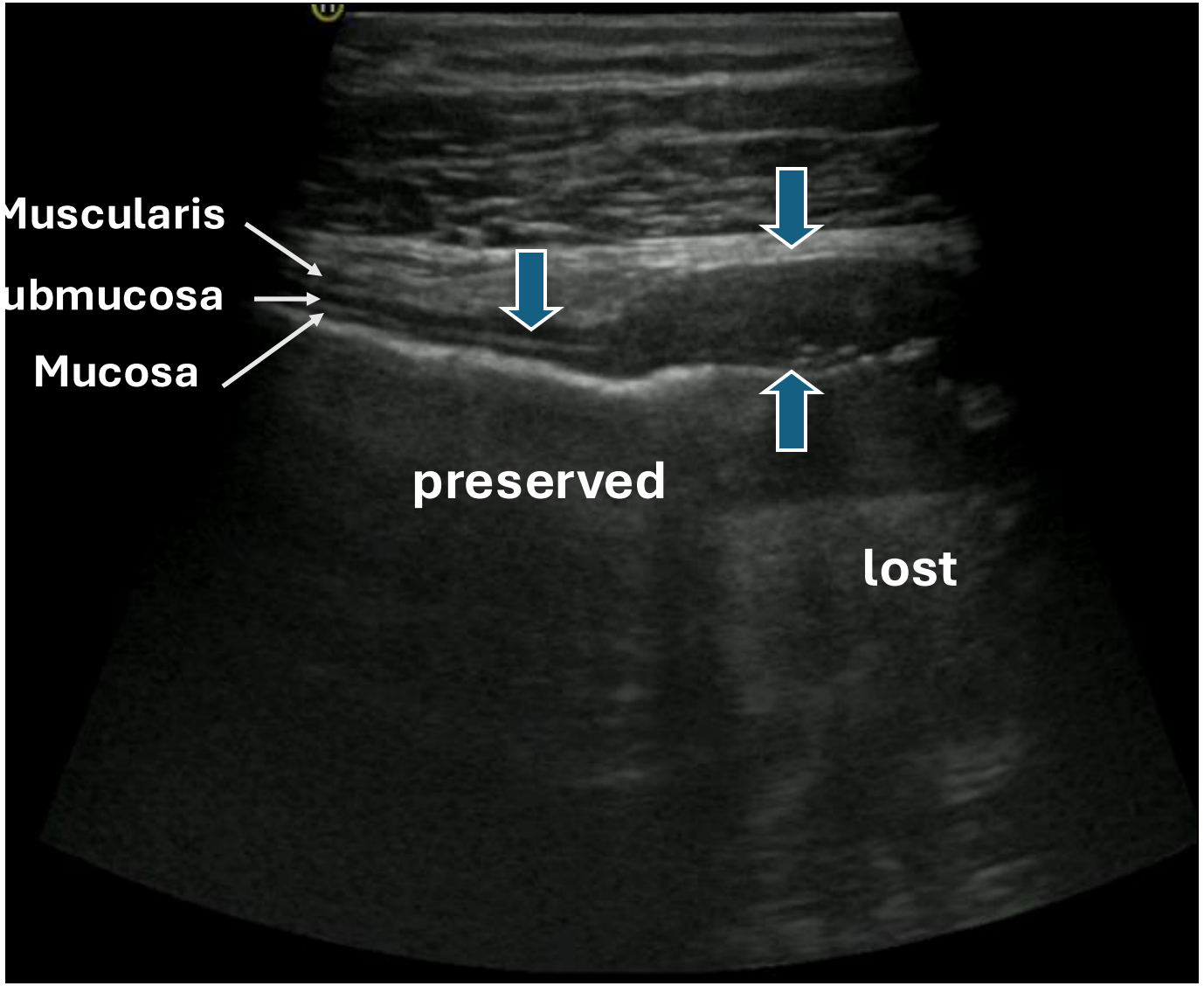
BWT – tips & tricks



Where do measure colon wall thickness?

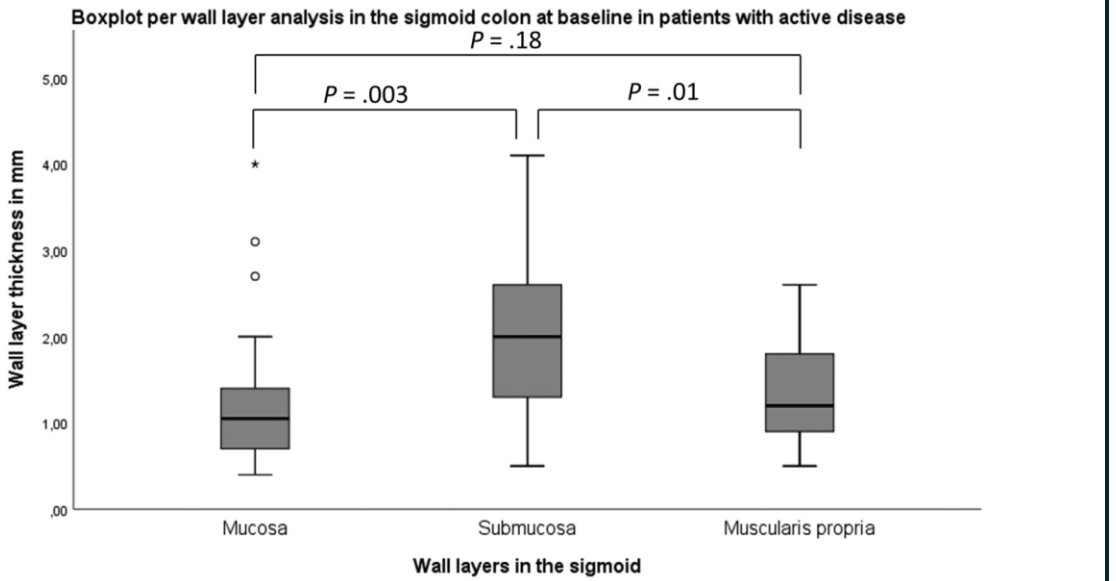
Echo stratification (BWS)

- Normal/preserved echostratification
- Focal disruption (<3 cm)
- Extensive disruption/lost (≥3 cm)



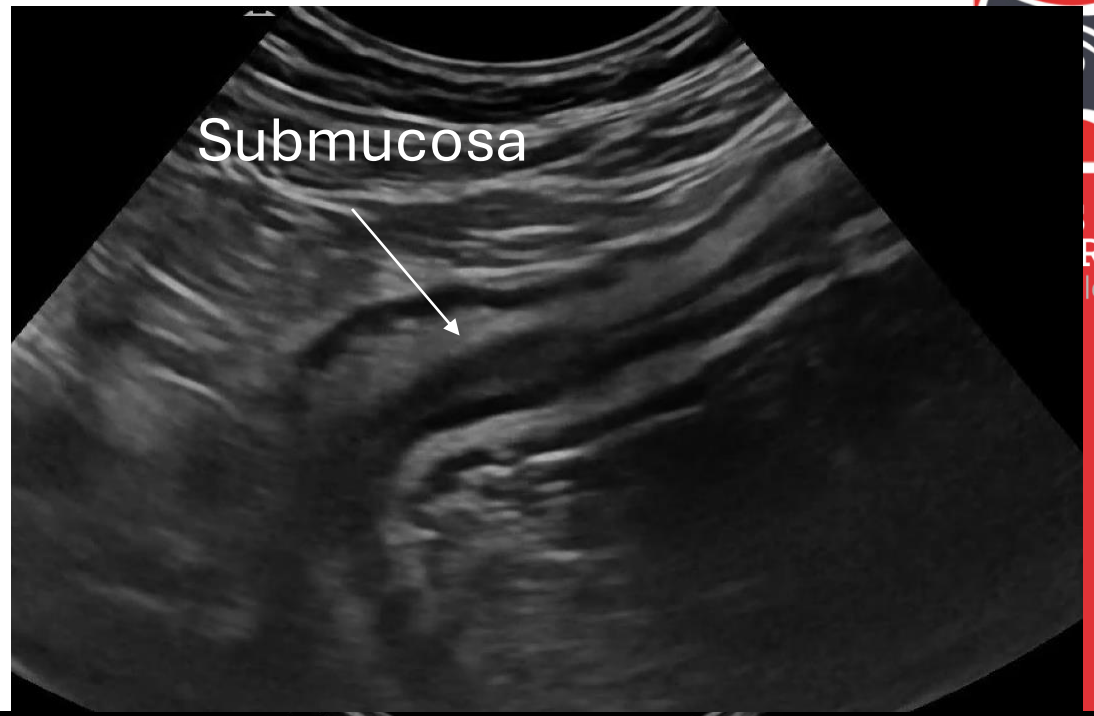
Thickening of the submucosa

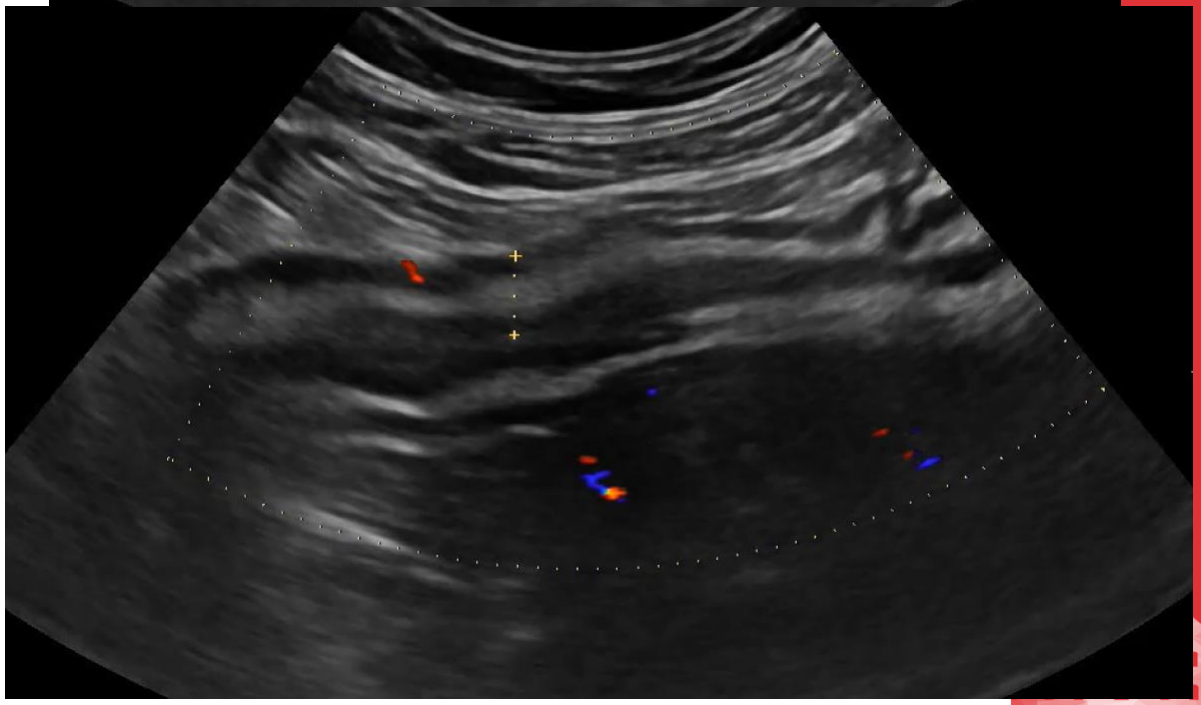
the submucosa is the thickest layer



RCU patients with MES ≥ 2

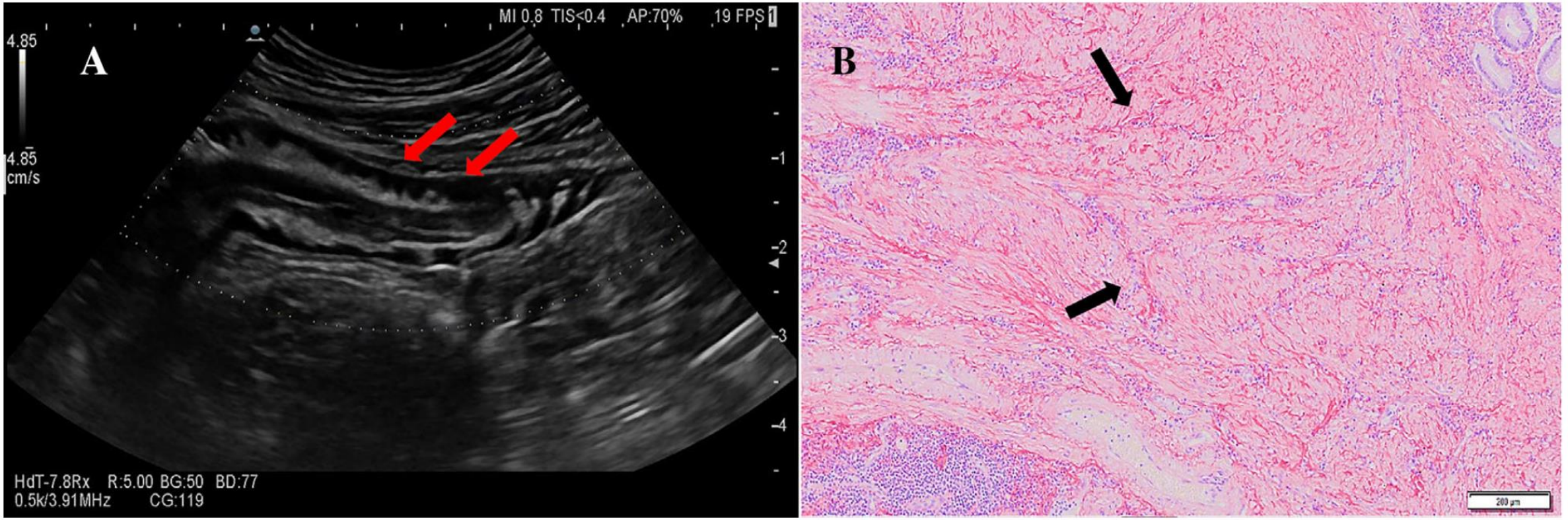
De Voogd F, Gastroenterology 2022





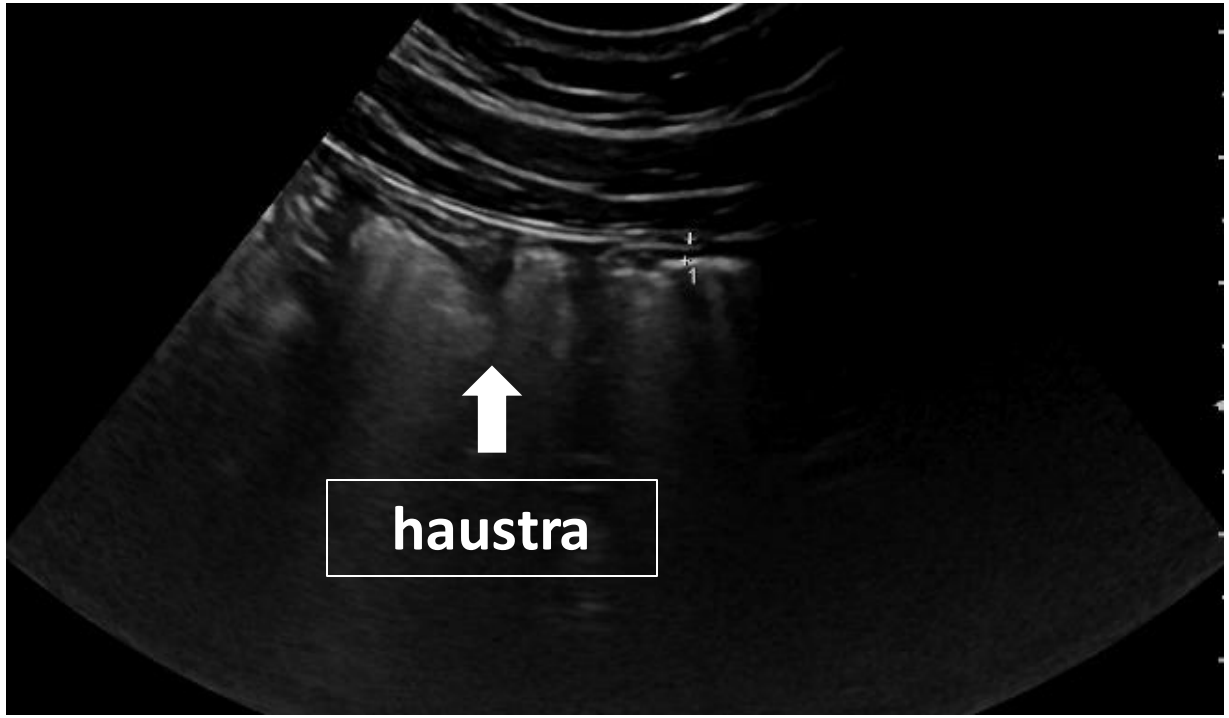
Hyperechogenic spiculates

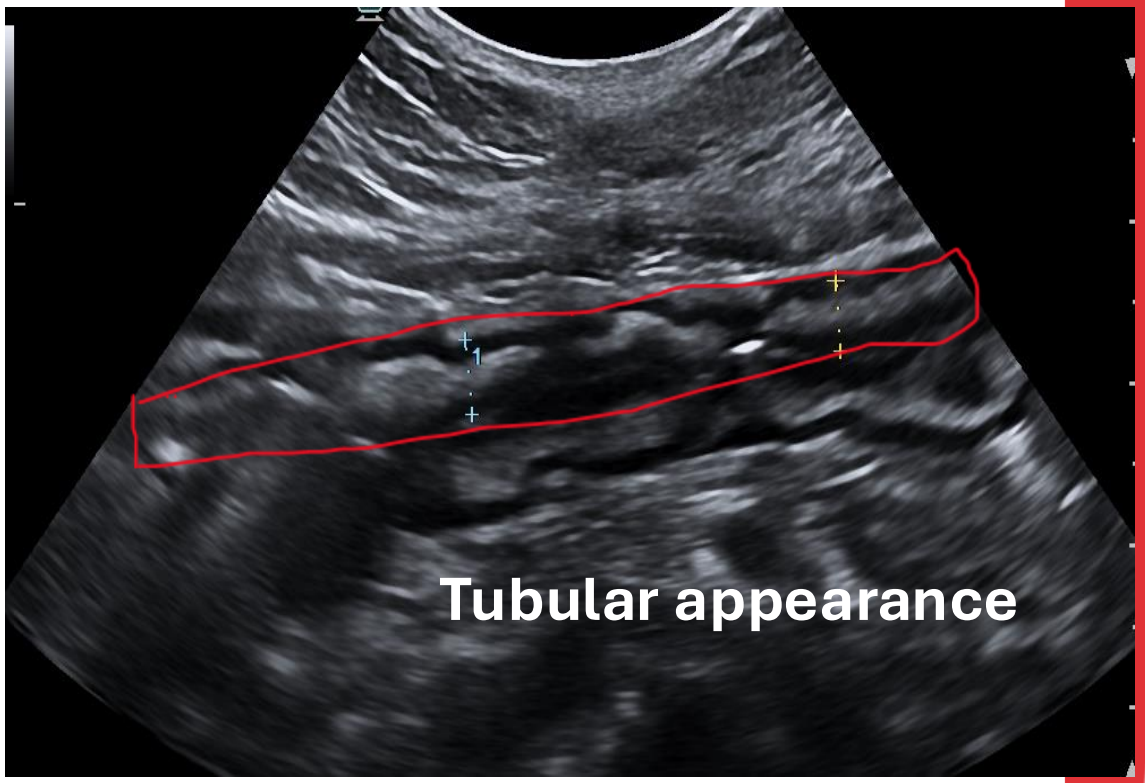
Figure 1. Ultrasound and microscopic features of hyperechogenic spiculates. **A**, Panel A shows an example of *spiculates* (red arrows): fine hyper-echoic spikes of the sub-mucosa bulging within the hypo-echoic muscular layer. **B**, Higher magnification of collagenous deposits (arrows) within the sub-mucosa (red stained).



Allocca et al, J Ultrasound Med 2023

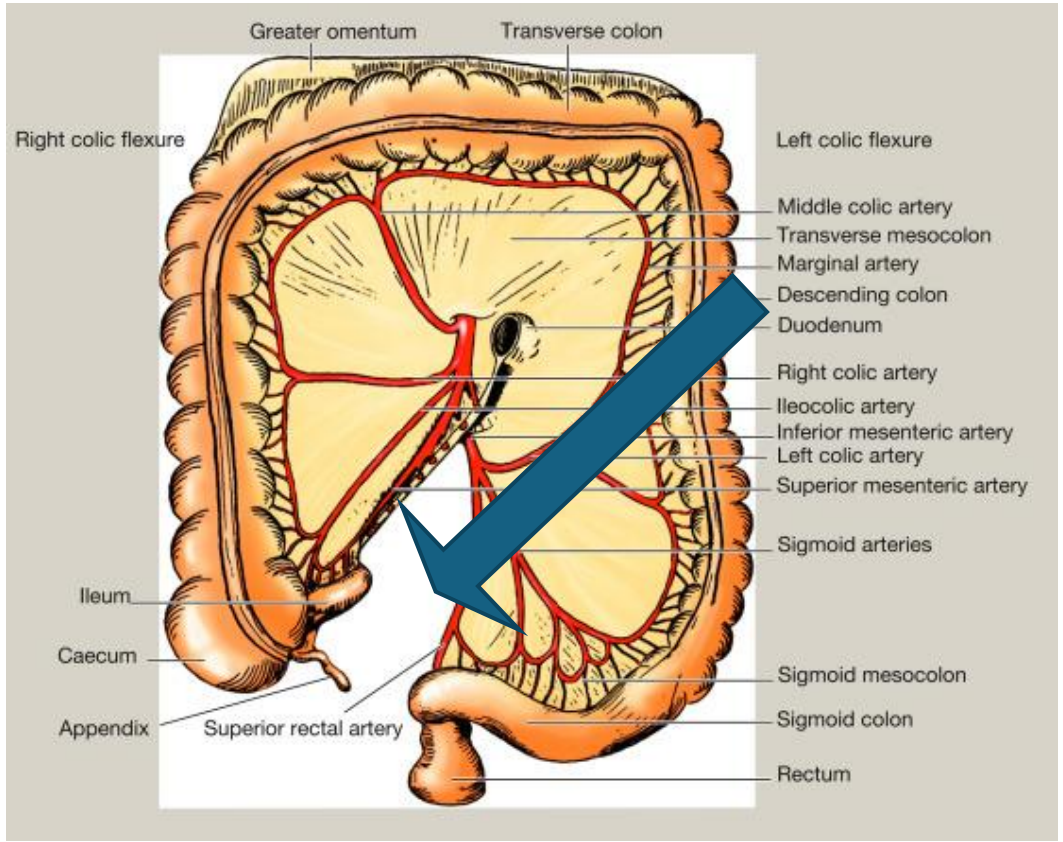
Haustration





Mesentery

- Examination of the **mesentery** begins in the epigastrium at the duodenojejunal flexure which then runs obliquely towards the right iliac fossa.
- It extends laterally to the aorta, from the left hypochondrium to right iliac fossa.

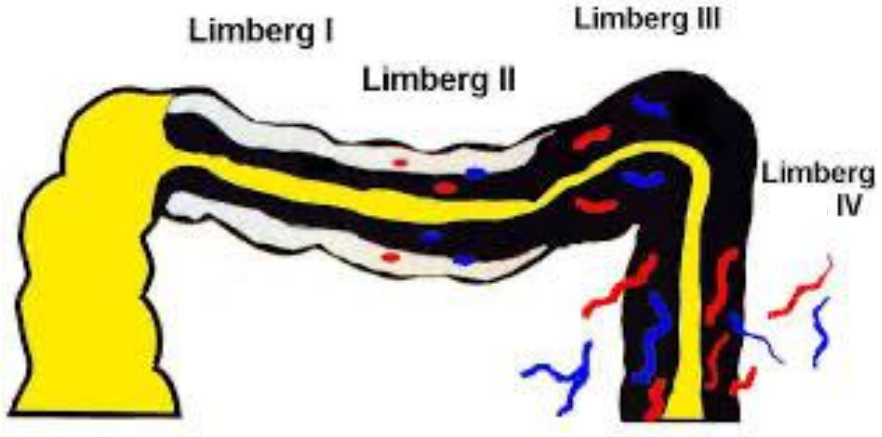


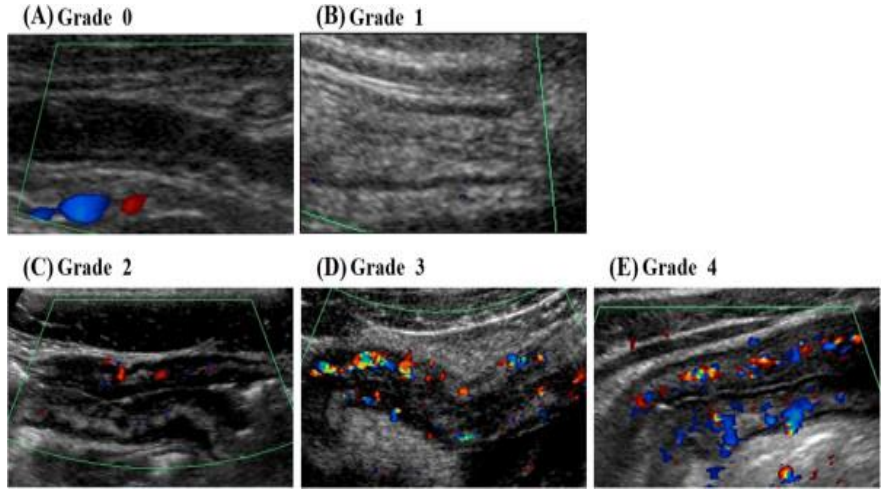
from Brady DP, Byerly DW. Anatomy, Abdomen and Pelvis, Ileocolic Artery. 2019 Jun 21. StatPearls [Internet].

Vascularization – Color Doppler

- Colour Doppler imaging should be used to evaluate the vascularization of pathological bowel wall.
- Vascularity could be subjectively assigned a grade according to **Limberg score (LS) or modified Limberg score (mLS)**:

Grade 1	Grade 2	Grade 3	Grade 4
No vascularization signal at color Doppler	Mild: minimal signal, short stretches of vascularity in spots	Moderate: longer stretches of vascularity, blood vessels located only intra-mural	Severe: long continuous intra- and extra-mural blood vessels, extending into the mesentery





Colour Doppler

If vascularity is not detected in the pathologically thickened intestinal wall this might be due to:

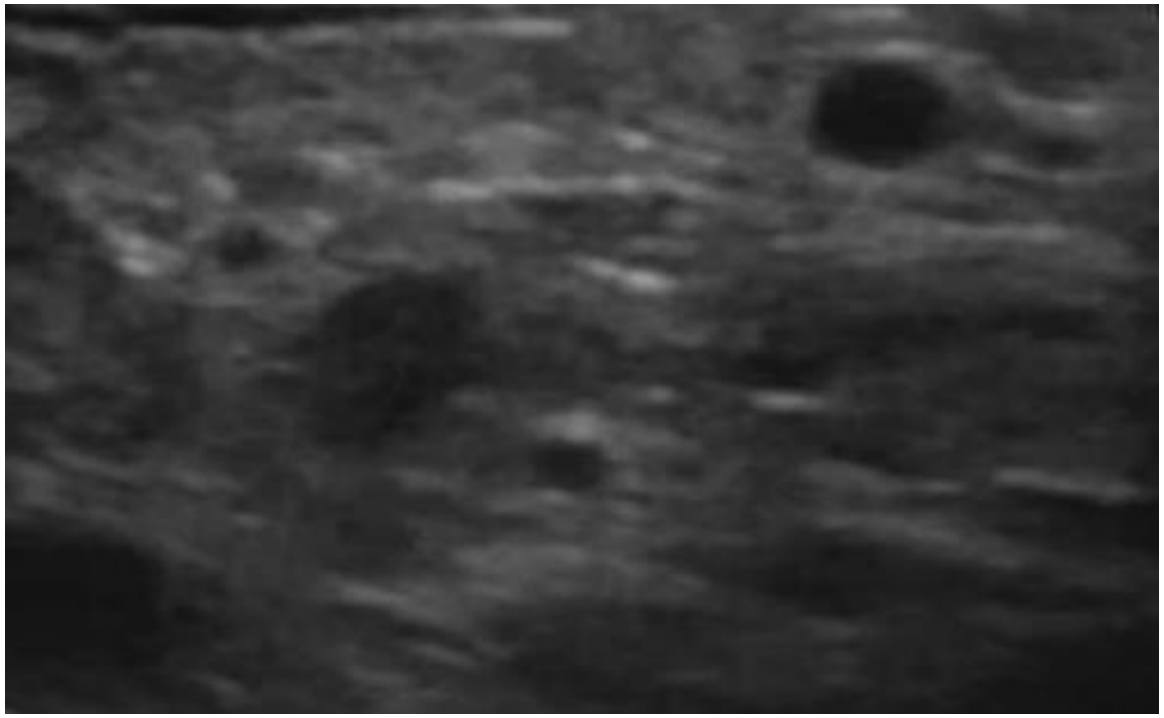
- inadequate Doppler parameters
- high body mass index
- depth penetration > 4 cm with consequent loss of sensitivity.

Mesentery

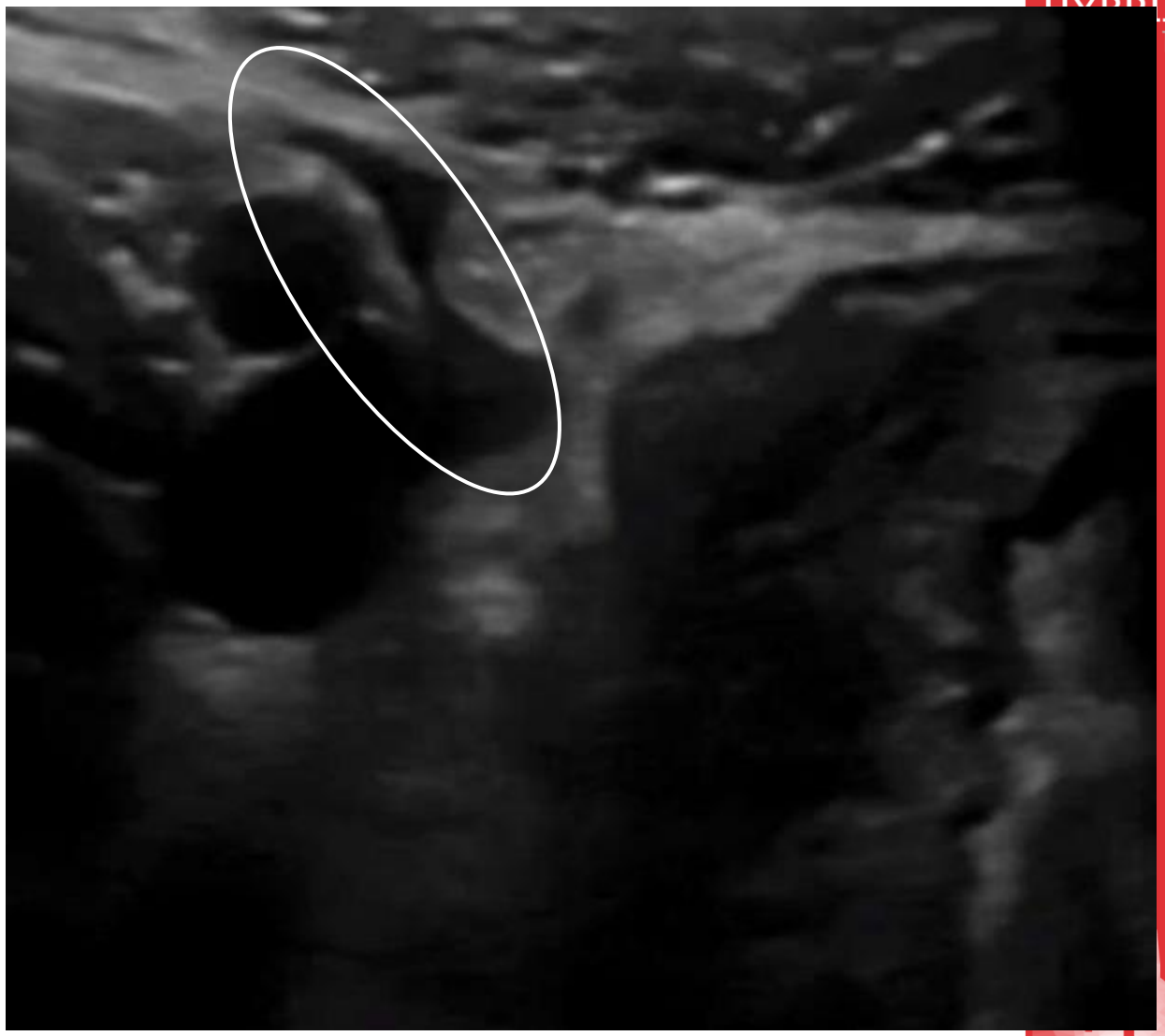
Normal ultrasound feature: **mildly hypoechoic parallel layers**, 7 – 12 mm in thickness, **alternated by hyperechoic strips**, resembling thickened bowel walls in a longitudinal scan.

World J Gastroenterol. 2017;23:6931-6941.

Inflammatory mesenteric fat (iFAT) and lymph nodes



Free fluid



Take home messages

- The psoas muscle and iliac vessels are the anatomical landmarks for the detection of terminal ileum and sigma
- Colon is easily recognizable by the presence of haustra
- Bowel wall is made up of 5 sonographic layers
- Measure wall thickness from the interface between the serosa and muscolaris propria to the interface between the mucosa and the lumen
- Apply a graded compression

international bowel
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IBUS HYBRID module 1

7-8TH NOVEMBER, 2025
MILAN, ITALY

Thank you