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Intestinal Ultrasound: Revolutionizing Pediatric IBD Care

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Nov 14, 2025.

Disclosures

- Nothing to disclose

Outline

What is intestinal ultrasound?

What do we measure?

Summary of the literature

Case presentation

Current guidelines for therapeutic targets

Pediatric-specific parameters

Future directions



Introduction

Gut, 1979, 20, 590-595

Grey scale ultrasound in Crohn's disease

S. HOLT¹ AND E. SAMUEL

From the University Department of Therapeutics and Clinical Pharmacology and Department of Medical Radiology, The Royal Infirmary, Edinburgh

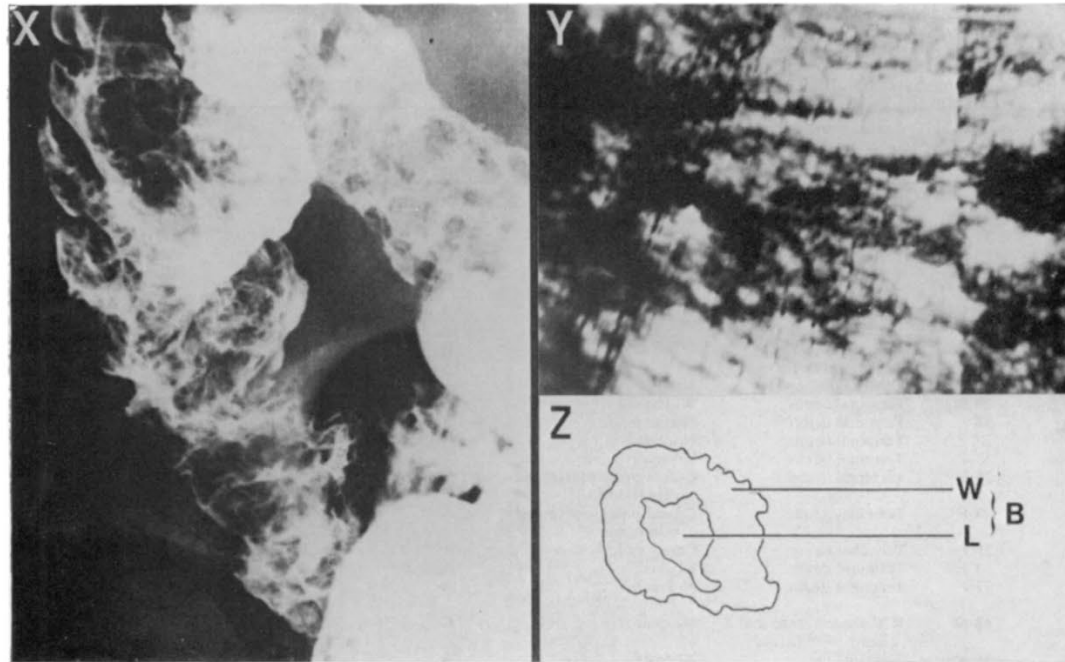


Fig. 1 The barium follow-through (X) demonstrates a contracted caecal pole and narrow terminal ileum. The transverse ultrasonograph (Y) shows the type A appearance. The diagrammatic representation of the ultrasonograph (Z) indicates that this image (B) is formed by the lumen (L) and diffusely thickened wall (W) of the caecum.



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What next?

> [AJR Am J Roentgenol](#). 1986 Mar;146(3):523-6. doi: 10.2214/ajr.146.3.523.

Sonographic detection of postsurgical recurrence of Crohn disease

[G DiCandio](#), [F Mosca](#), [A Campatelli](#), [M Bianchini](#), [F D'Elia](#), [C Dellagiovampaola](#)

PMID: 3511636 DOI: [10.2214/ajr.146.3.523](#)

Abstract

Sonography, contrast radiography, and endoscopy of the small and large intestine were performed in 32 patients, who had already undergone one or more intestinal resections for Crohn disease, with the aim of detecting possible relapses. Eleven patients proved to have had relapses; sonography revealed nine cases, with two false negatives and no false positives. Sensitivity proved to be 82%, specificity 100%, and overall accuracy 93.7%. Sonography enables the operator to distinguish between inflammatory and neoplastic lesions by means of structural study of the thickened bowel wall, paying particular attention to integrity of its layers.

Clinical Trial > [Radiol Med](#). 1990 Sep;80(3):301-3.

[Ultrasonography in the diagnosis of chronic inflammatory intestinal disease]

[Article in Italian]

[A Stiatti](#)¹, [A Martinuzzi](#), [M Bartolini](#), [L Lascialfari](#), [G Trallori](#), [A Morettini](#)

Affiliations + expand

PMID: 2236690

Abstract

The accuracy of ultrasonography (US) in diagnosing active inflammatory bowel disease (IBD) is assessed on the basis of a randomized prospective study of 61 patients. Twenty-six of the patients were affected with Crohn's disease (CD) and 12 with ulcerative colitis, while the remaining 23 patients were control subjects with no specific chronic IBD. The US signs considered as significant for active CD and UC were: --visualization of a typical target image, that is a hyperechoic center corresponding to luminal bowel content, surrounded by a hypoechoic ring corresponding to loop walls; --at least 2 of the following: solid abdominal mass, distended loops, luminal narrowing, reduced peristalsis, stiff loops, and accumulation of fluid between the loops. US sensitivity and specificity for CD were 77% and 95.6%, respectively. As for UC, no significant results were obtained. In our experience, US is a reliable method for detecting alterations and, especially, complications typical of CD in its active phase. Considering the young age of the patients affected with CD and the number of exams they must undergo, US is considered as a useful tool in disease follow-up.



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Training and Collaboration



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Bispebjerg & Frederiksberg, Digestive
Disease Center, Division of Medicine
Copenhagen, Denmark



international bowel
ULTRASOUND GROUP

Module 1

IBUS Hands-on Workshop

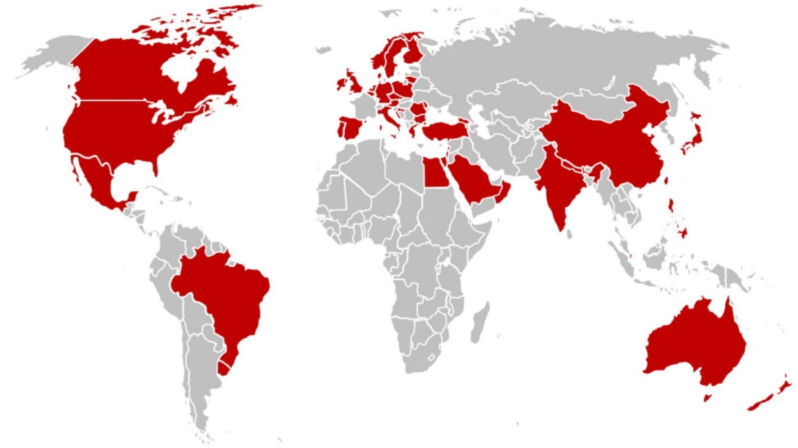
Module 2

Hands-on Training

Module 3

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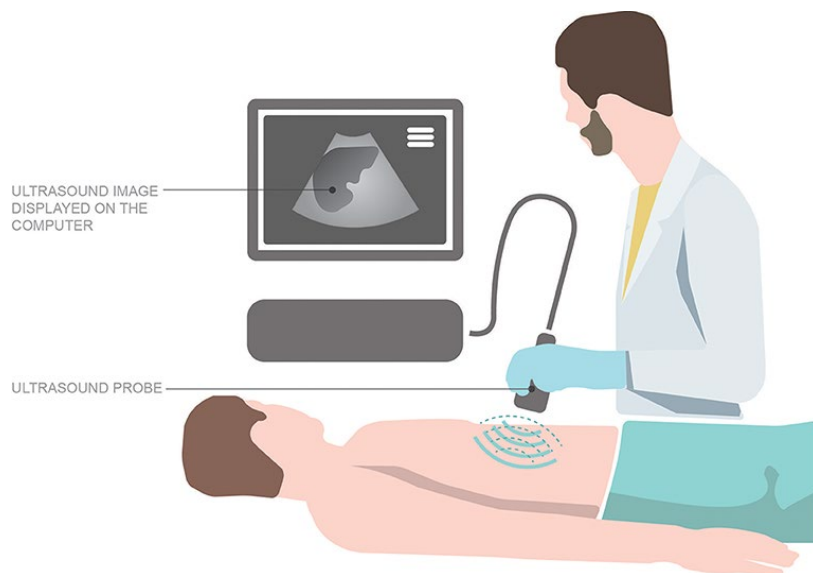
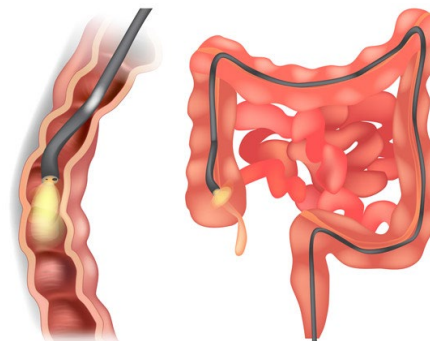
Revolutionizing Inflammatory Bowel Disease Care with Intestinal Ultrasound

We equip clinicians in North America with expert knowledge in managing inflammatory bowel disease through intestinal ultrasound technology. Join us now to unlock specialized training, educational resources, network with peers, and empower patients in their care.

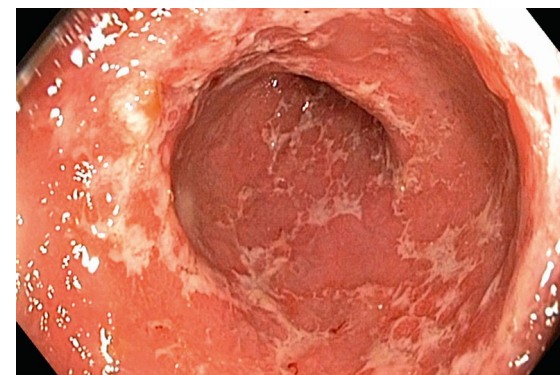
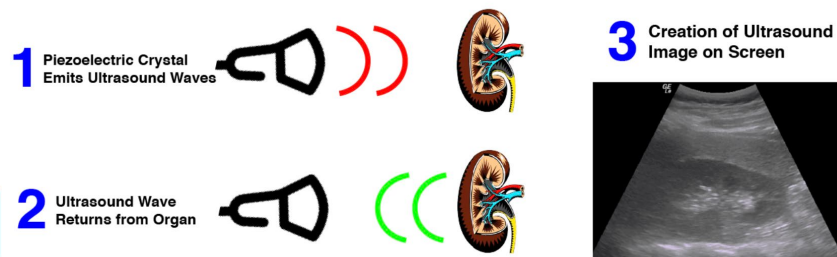


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What is Intestinal Ultrasound (IUS)?



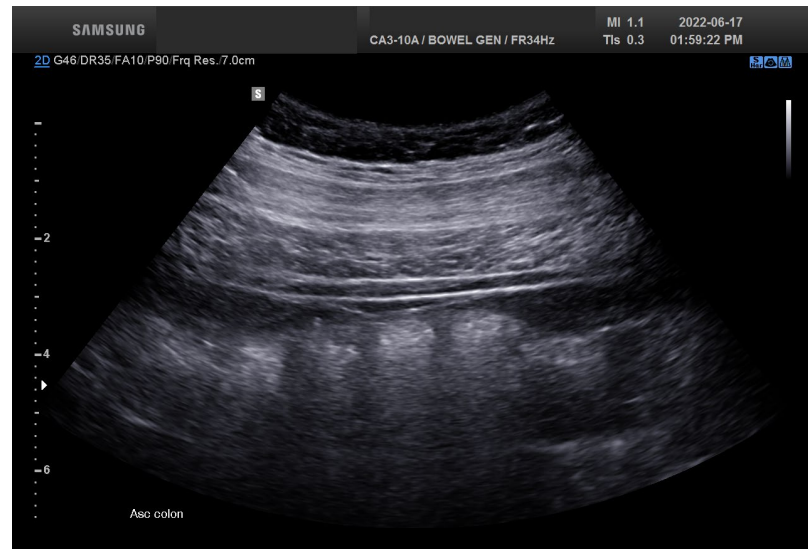
Piezoelectric Effect on Ultrasound



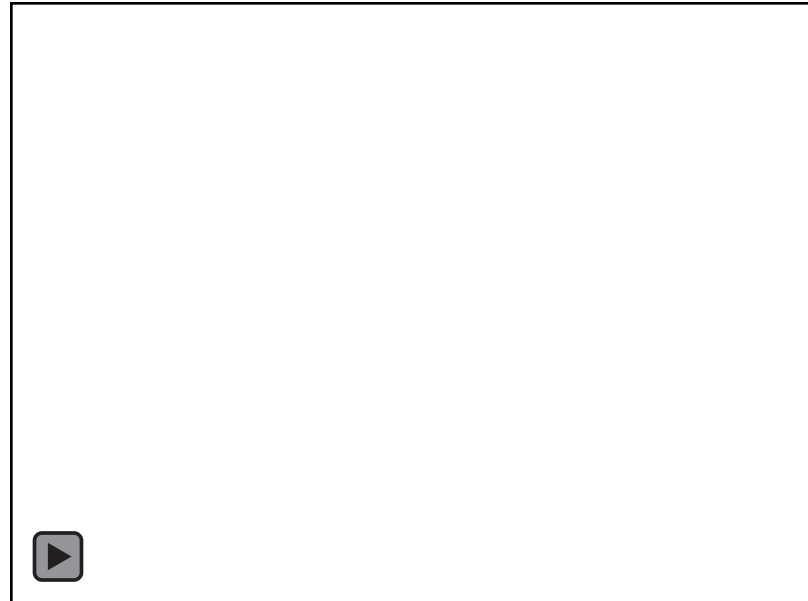
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(Slide courtesy of Dr. Kenneth Ernest-Suarez)
<https://www.pocus101.com/basic-principles-of-ultrasound-physics-and-artifacts-made-easy/>

B-MODE

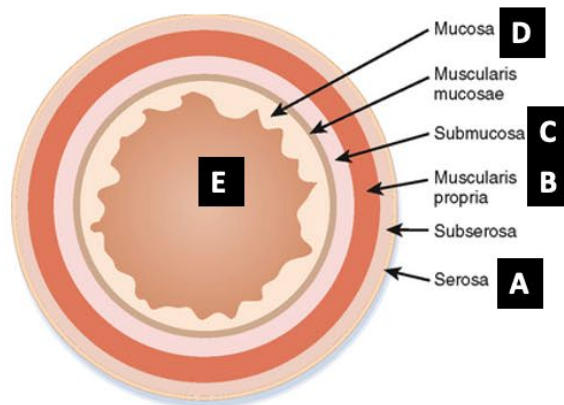
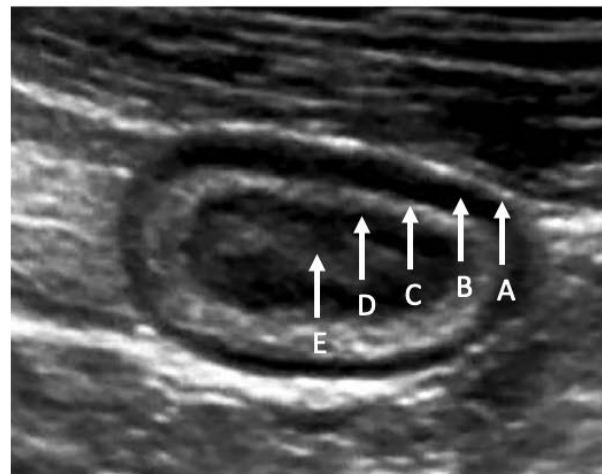
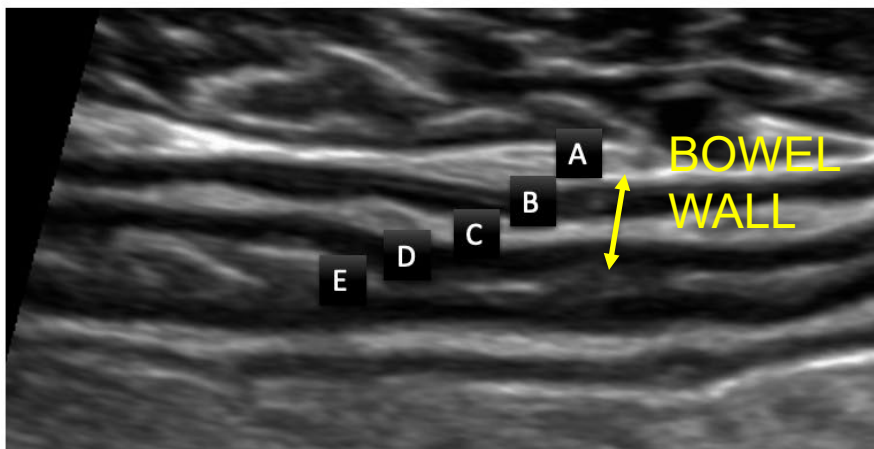


DOPPLER COLOR

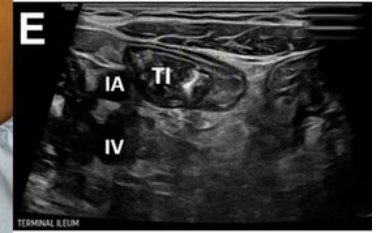
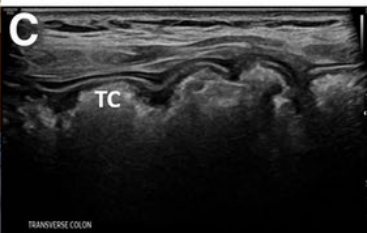
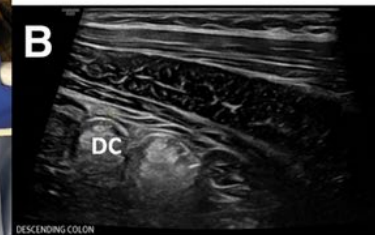
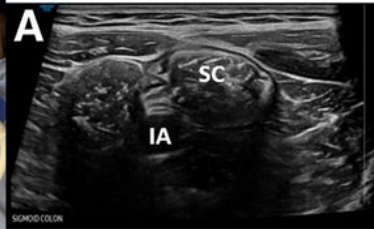
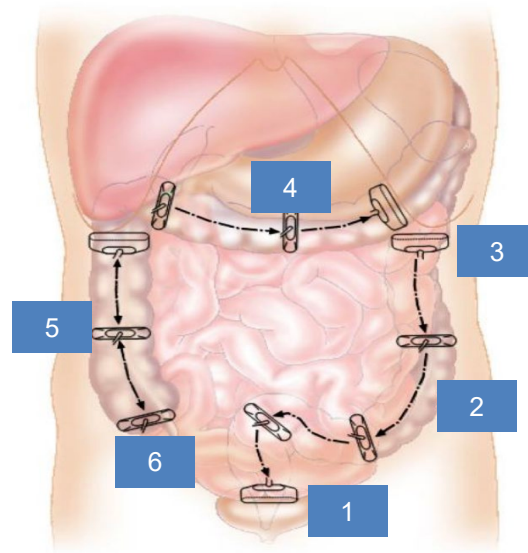


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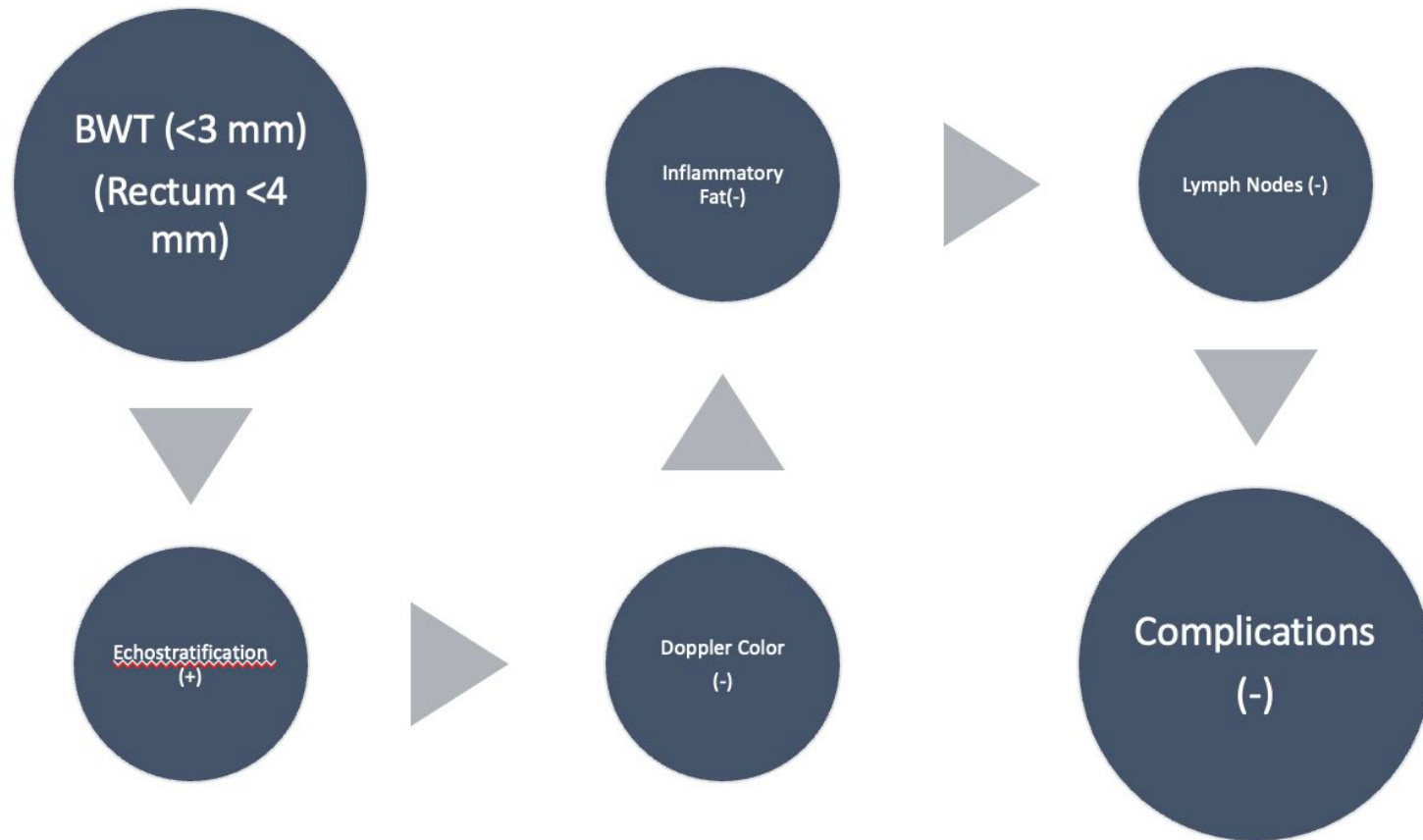
What do we measure in IBD patients?



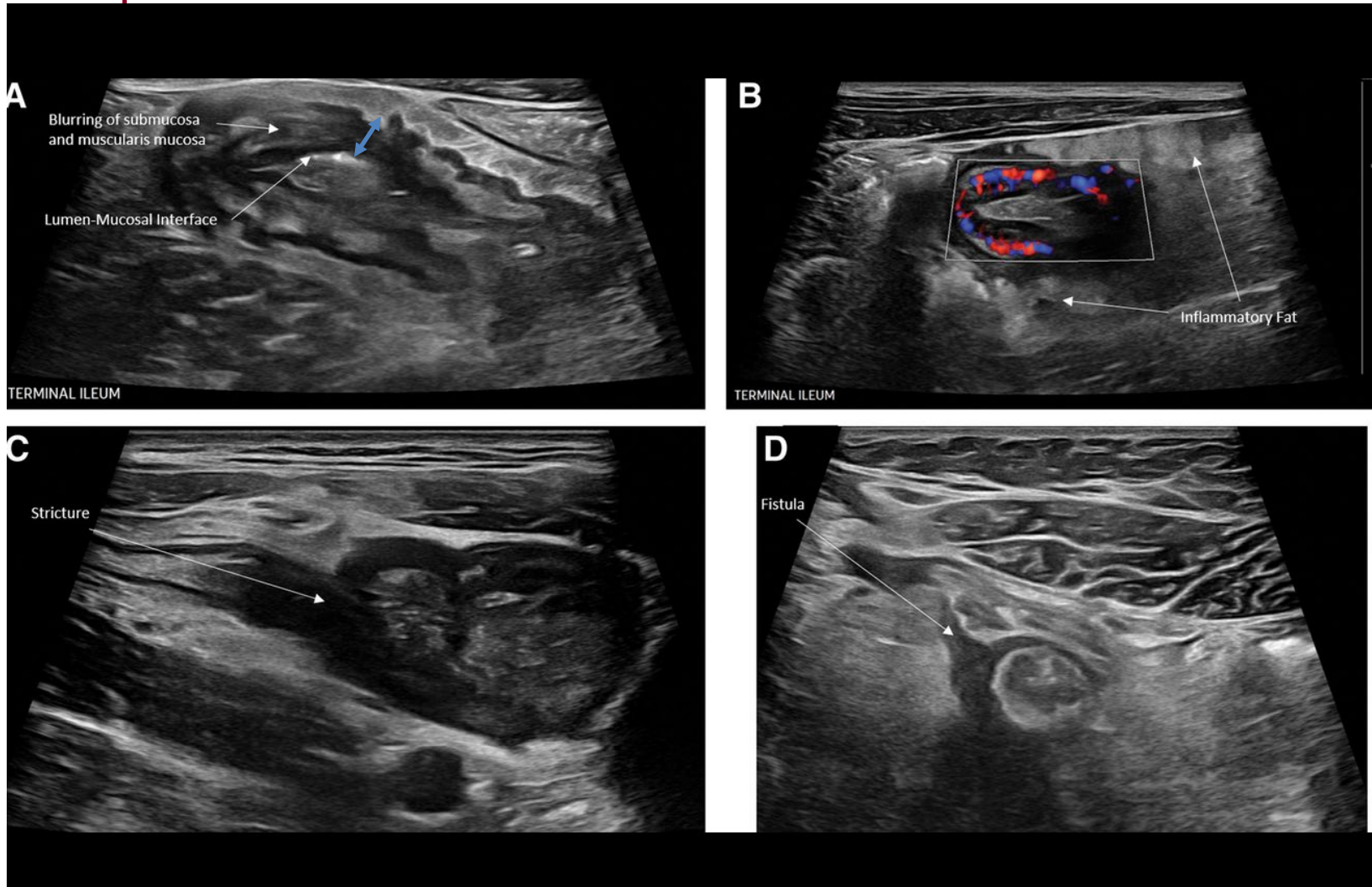
Technique



Normal Parameters



Complications



Why IUS?

- Non-invasive/easily tolerated
- Accurate
- Repeatable
- Affordable
- Sensitive to change

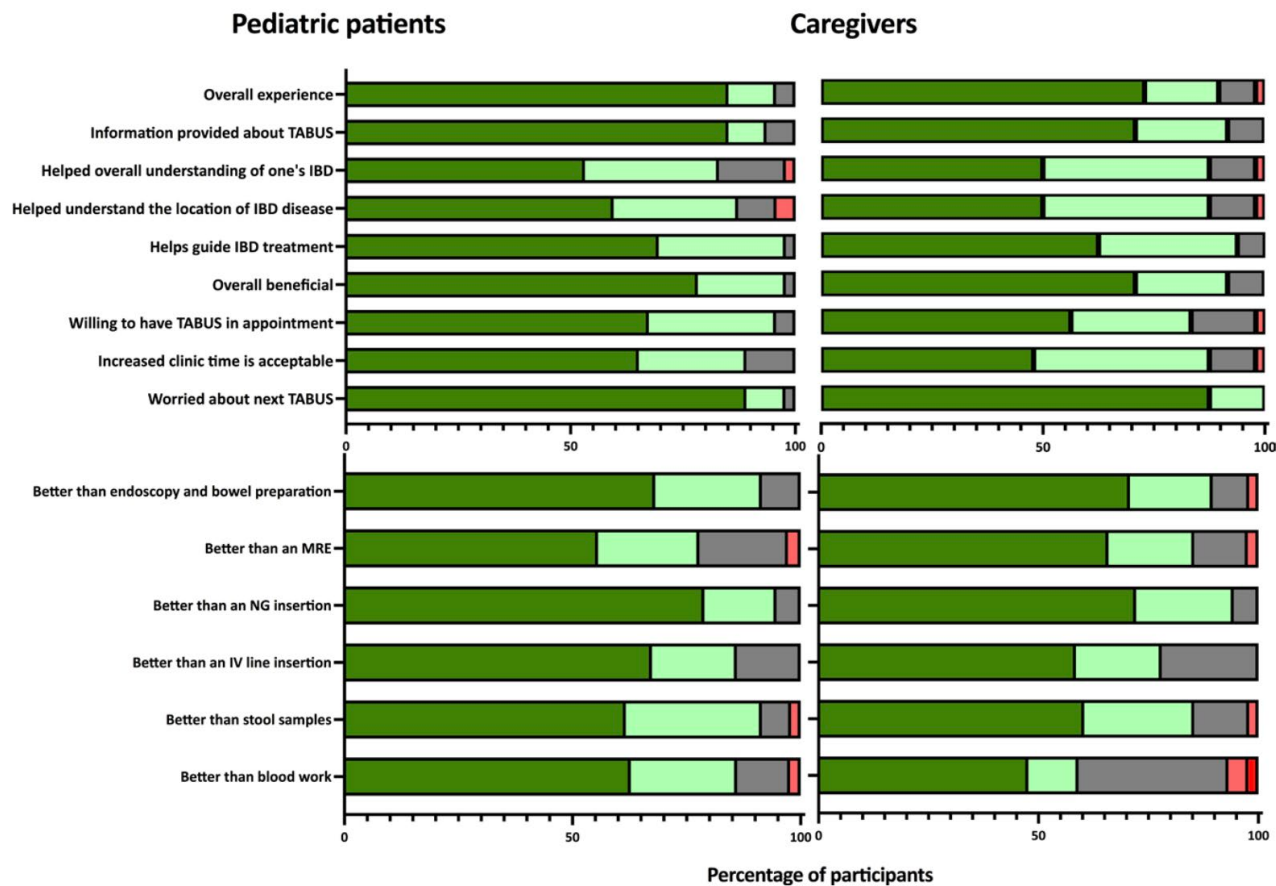
Monitoring Tool	Strengths	Weaknesses
Colonoscopy	• Gold standard	• Invasive • Expensive • Requires bowel prep • Not well tolerated • Limited in evaluating transmural complications
CRP	• Blood test • Reactive to change	• Not made by 25% • Non-specific
Stool Calprotectin	• Specific to bowel inflammation • Sensitive • Predicts clinical relapse	• Stool! • Less reliable in the small bowel • Delayed results
Computed Tomography (CT)	• Widely available • Less invasive • Images entire abdomen and pelvis • Evaluates for transmural complications	• Radiation exposure • Expensive • Contrast • Delayed results • Does not predict relapse
Magnetic Resonance Imaging (MRI)	• No radiation • Images entire abdomen and pelvis • Evaluates for transmural complications	• Not available in most places • Expensive • Delayed results • Does not predict relapse

(Slide courtesy of Dr. Noa Krugliak Cleveland)



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Patient Satisfaction with IUS



(Hudson et al. JPGN 2023 76(1):p 33-37)



IUS scores are highly comparable to endoscopy

Segmental IUS Score or Parameter	Cut-Point	AUROC [95% CI]	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)
CHILDREN						
BWT (mm)	≤ 3.1	0.837 [0.75-0.92]	92	73	93	71
MLS	≤ 0	0.853 [0.79-0.92]	89	77	94	65
SUS-CD	≤ 0	0.875 [0.81-0.94]	87	82	95	62
SUAS-CD	≤ 2.87	0.858 [0.78-0.94]	87	82	95	63
IBUS-SAS	≤ 15.6	0.857 [0.77-0.94]	90	82	95	68
SPAUSS	≤ 1	0.878 [0.81-0.94]	89	82	95	67
BUSS	≤ 2.55	0.859 [0.77-0.94]	88	82	95	64
YOUNG ADULTS						
BWT (mm)	≤ 2.9	0.819 [0.67-0.96]	96	73	96	73
MLS	≤ 0	0.781 [0.65-0.91]	95	60	94	64
SUS-CD	≤ 0	0.841 [0.72-0.96]	95	73	96	69
SUAS-CD	≤ 3.25	0.822 [0.68-0.97]	96	73	96	73
IBUS-SAS	≤ 11.6	0.824 [0.68-0.97]	95	73	96	69
SPAUSS	≤ 3	0.781 [0.65-0.91]	96	60	94	69
BUSS	≤ 2.18	0.817 [0.67-0.96]	95	73	96	69

- Bowel wall thickness and IUS scores are highly accurate to detect endoscopic inflammation
- IUS may be an ideal tool for clinical trials

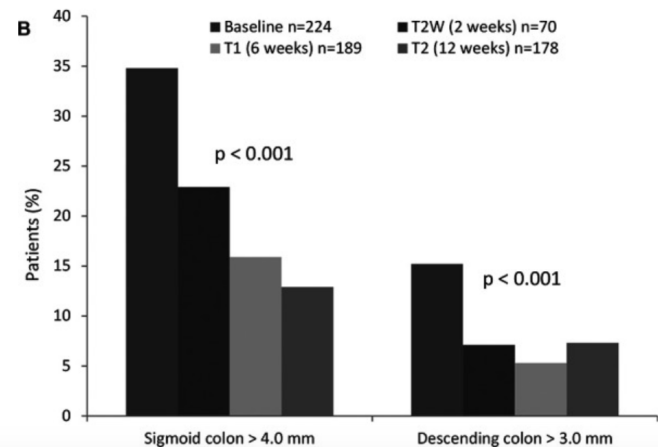
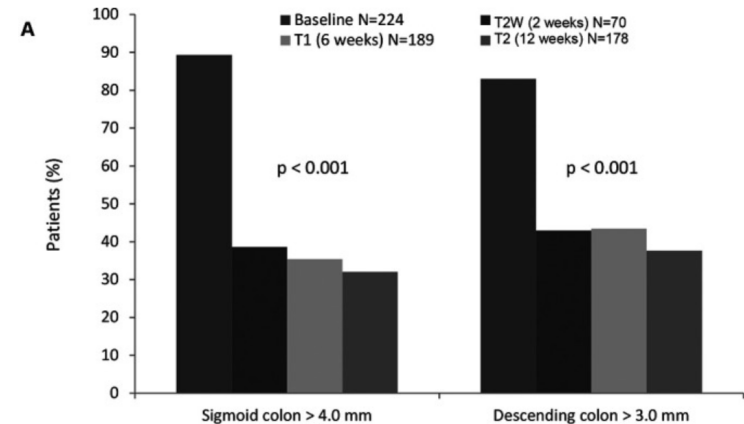
(Dolinger et al. AJG. 2023. doi: 10.14309/ajg.0000000000002632.
Online ahead of print)



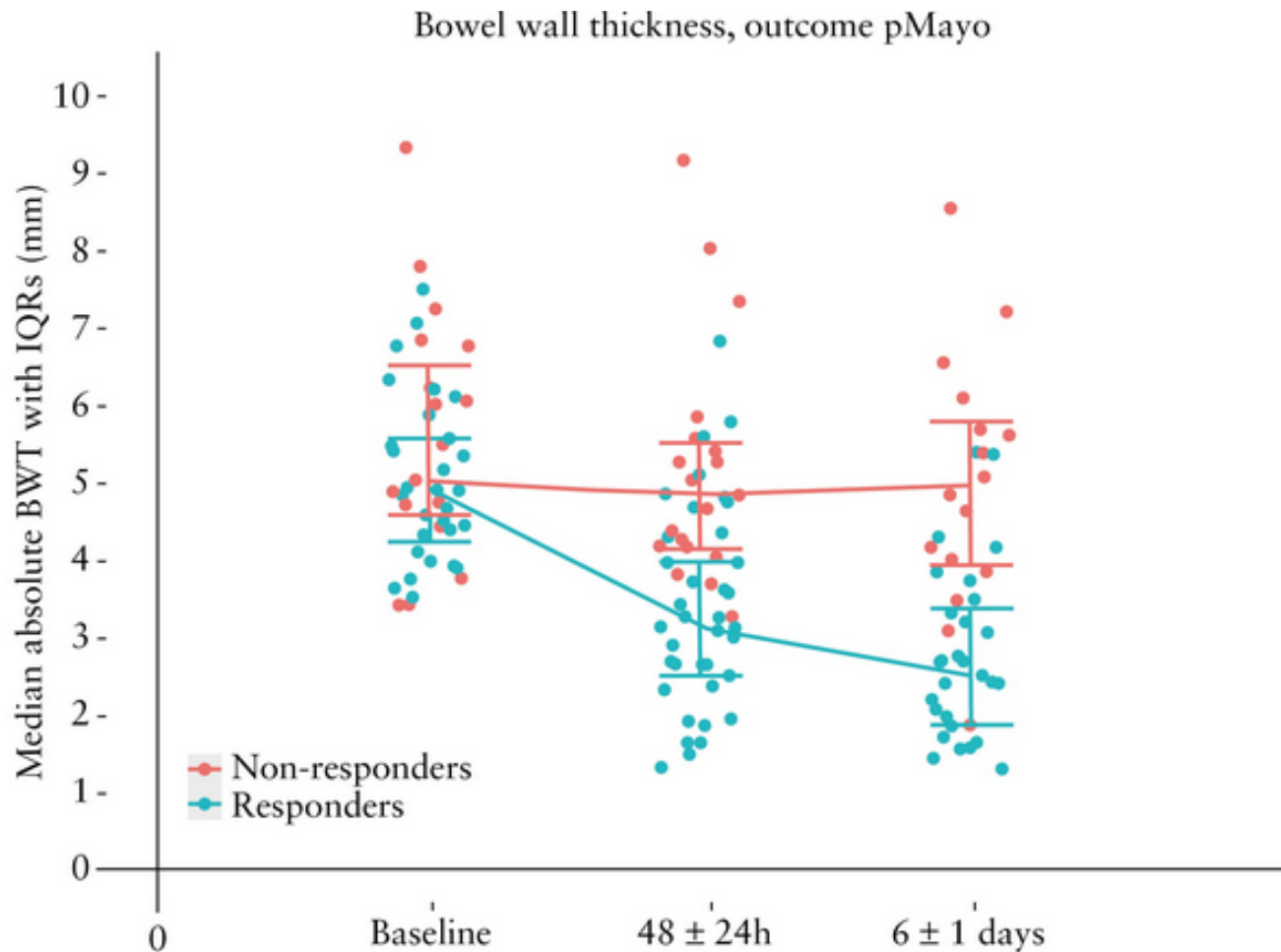
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Using IUS to monitor therapeutic response

- ❑ TRUST & UC study
- ❑ 88.5% of patients had increased BWT at baseline
- ❑ Within 2 weeks: 89.3% to 38.6% decrease in sigmoid colon, 83%-42.9% in descending
- ❑ High correlation between normalization of BWT and clinical response at 12 weeks



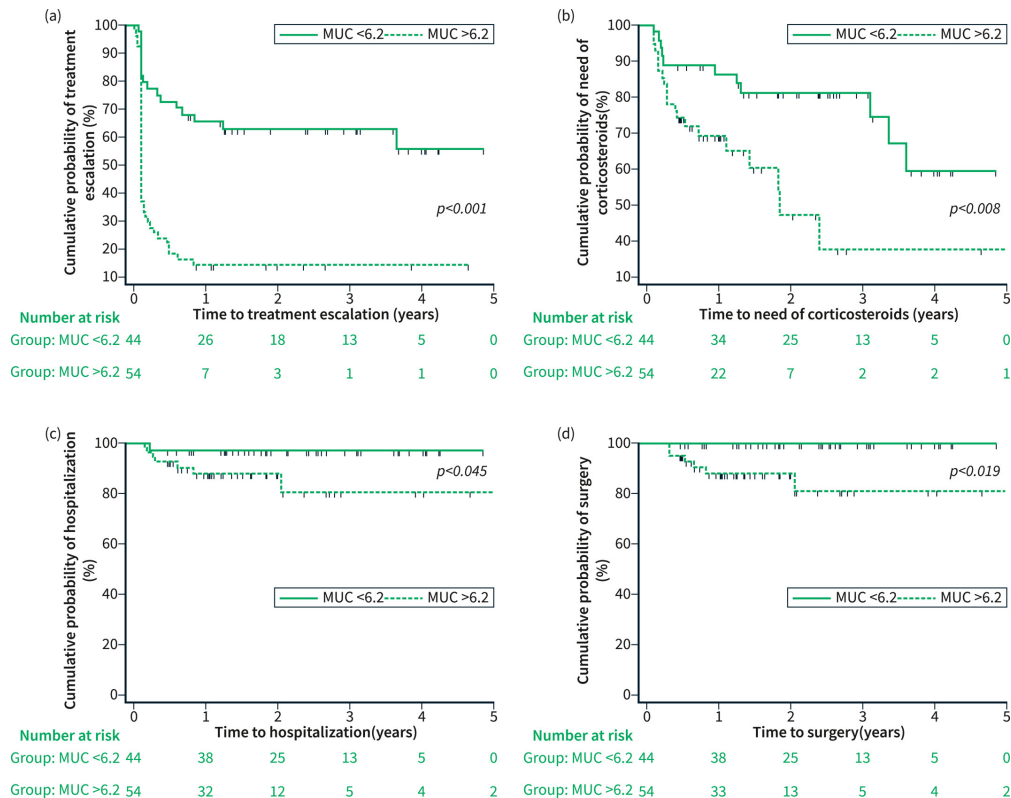
Early IUS can predict IV steroid response in severe UC



(Ilvemark et al. JCC 2022. 16:1725-34)



Milan IUS score predicts long-term outcomes



❑ Milan ultrasound score (MUC) >6.2 at baseline was associated with poor disease course (HR 3.87)

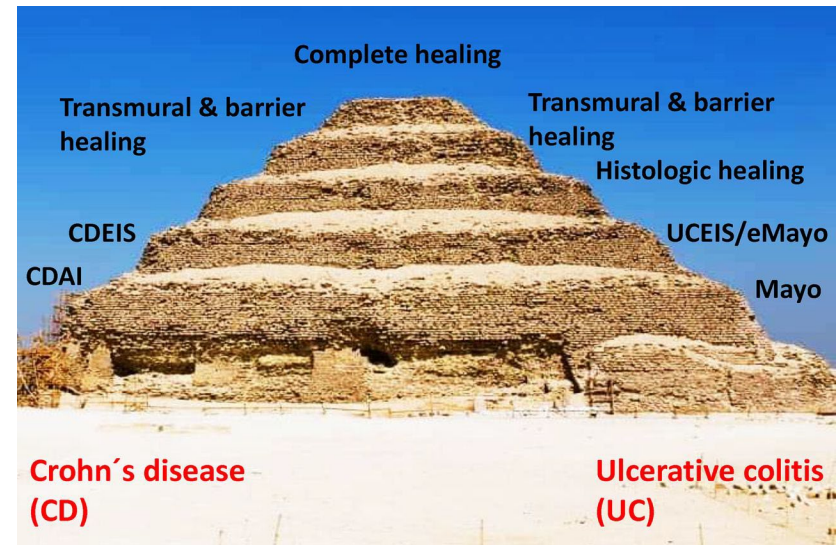
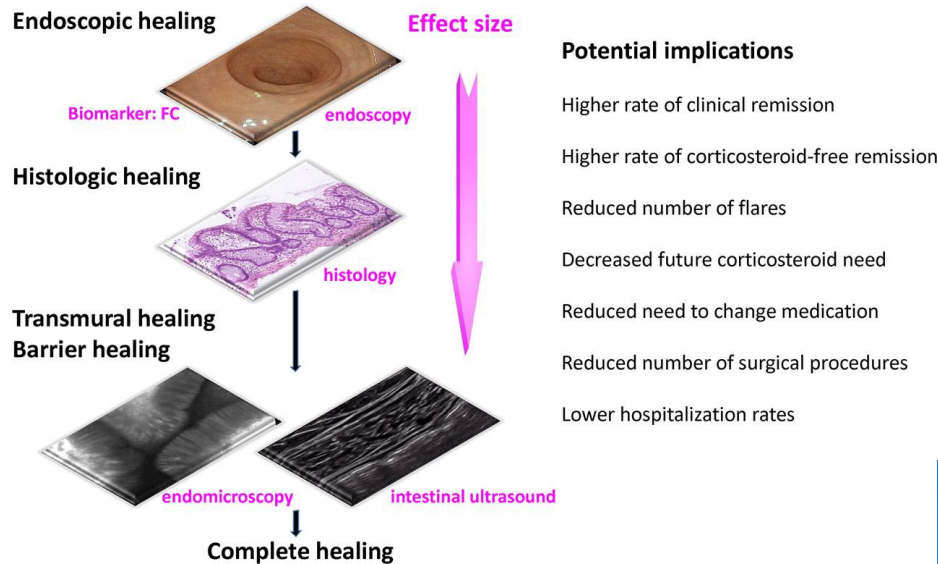
❑ MUC ≤ 6.2 was associated with significantly lower probability of treatment escalation, need for corticosteroids, hospitalization AND colectomy

❑ IUS can be used as a predictive tool for UC disease outcome

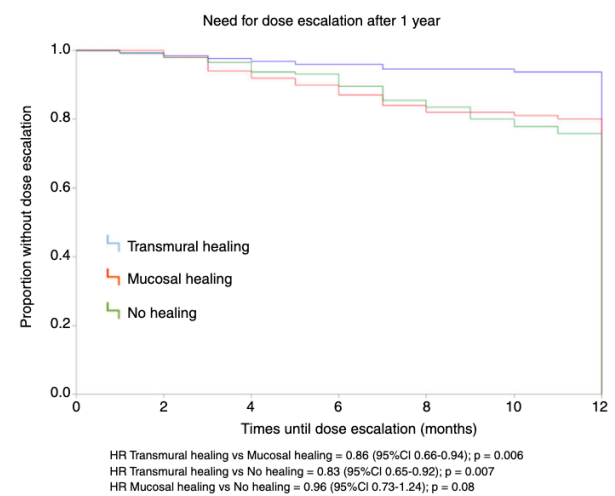
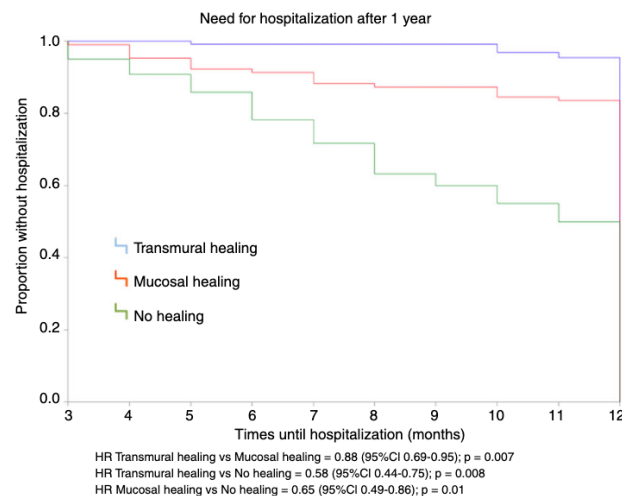
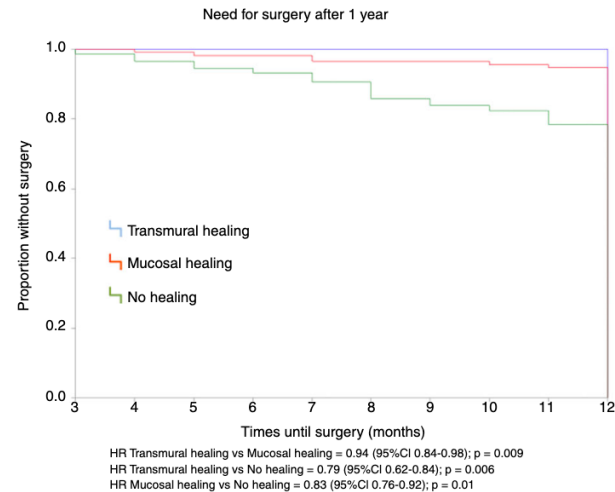
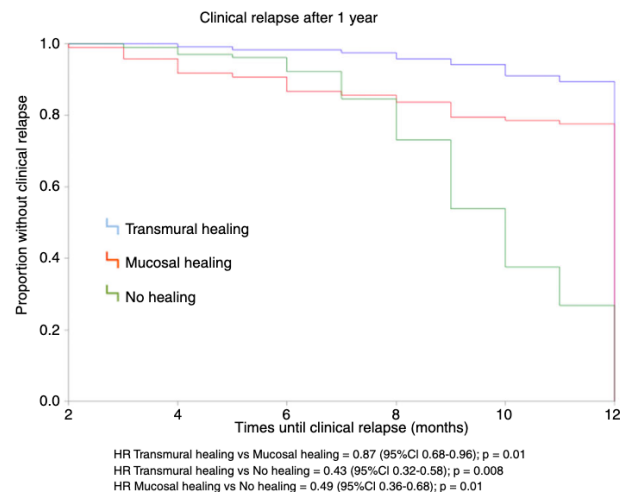
(Allocca et al. UEGJ 2022. 10:2:190-7)



Transmural Healing (TMH) versus Mucosal Healing (MH)



Transmural healing vs. Mucosal healing



Case

14 year old male, previously healthy

Several months of abdominal pain, 2x stools per day, occasionally more liquid but no blood

Does endorse acid reflux plus bloating and gas

Feb 2024: An episode of appendicitis

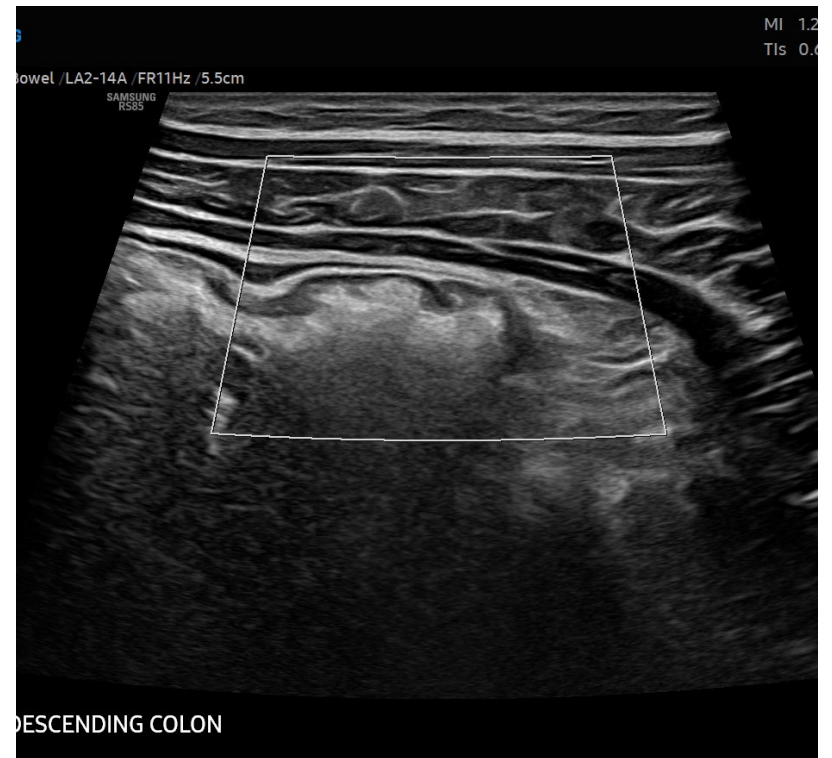
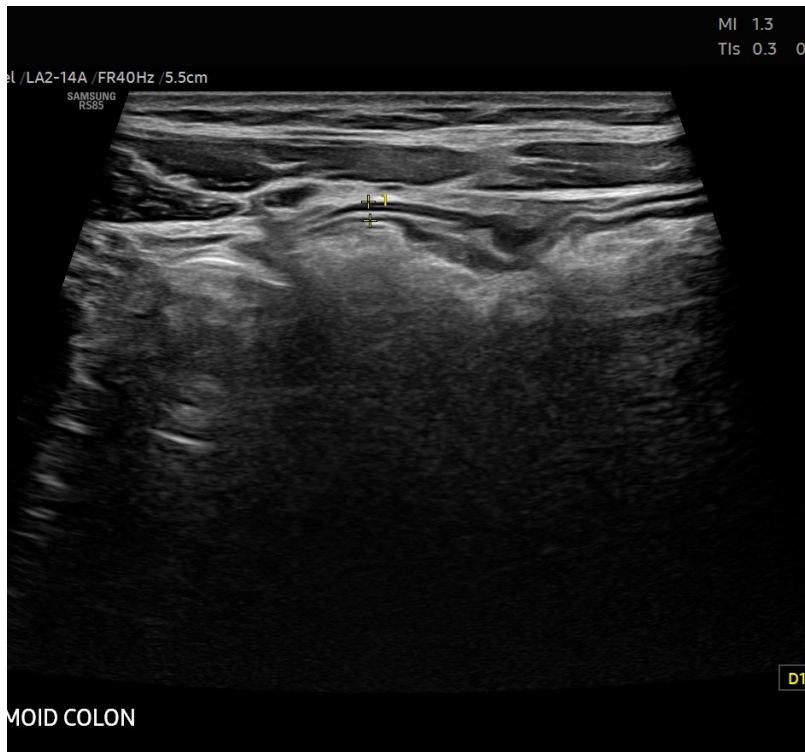
CT:

- Retroperitoneum, Lymph nodes:
 - Enlarged right lower quadrant mesenteric lymph nodes measuring up to 1.7 cm
- Bowel, mesentery:
 - There is wall thickening and mural hyper attenuation of a long segment of the distal small bowel measuring greater than 20 cm, extending to the level of the ileocecal valve with associated mesenteric fat stranding. No bowel obstruction. Normal appendix.

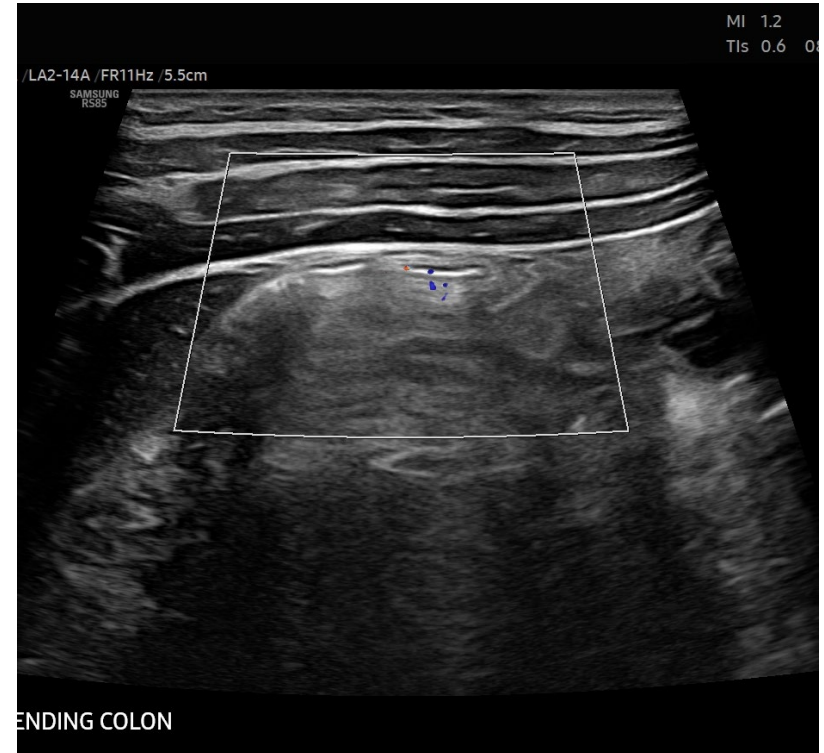
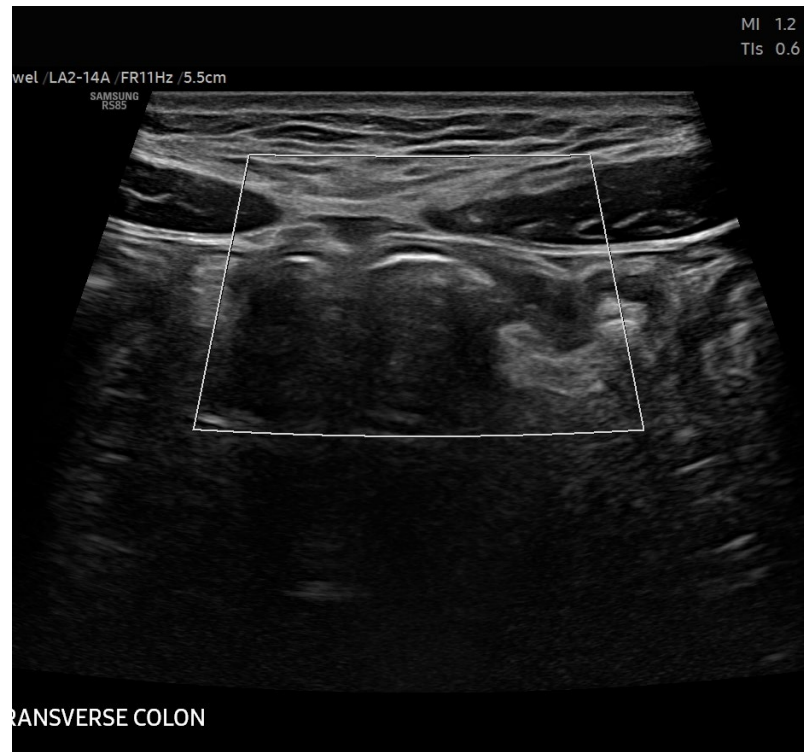
Lost to follow-up



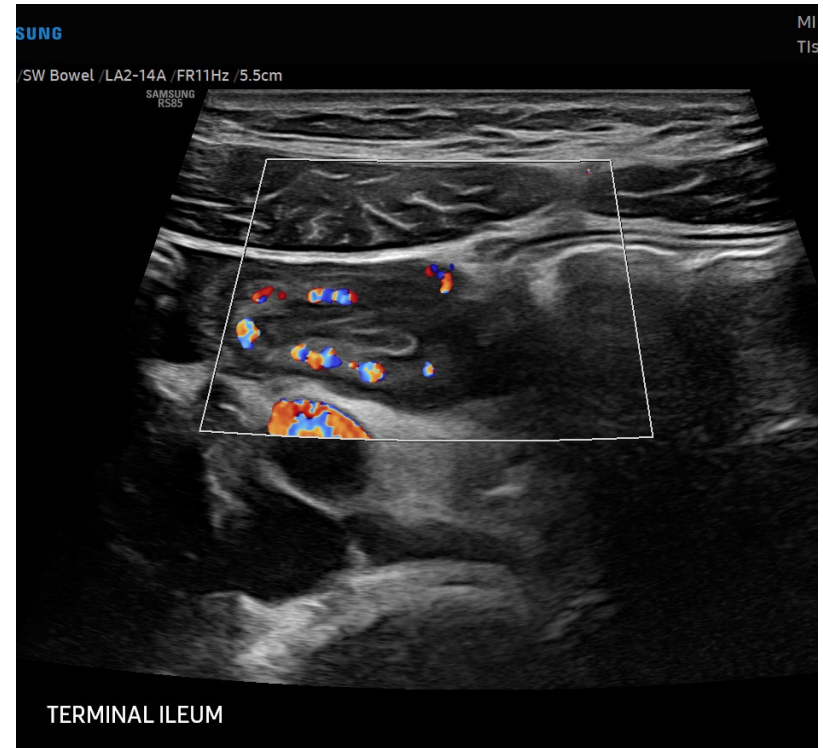
IUS in clinic- July 2024



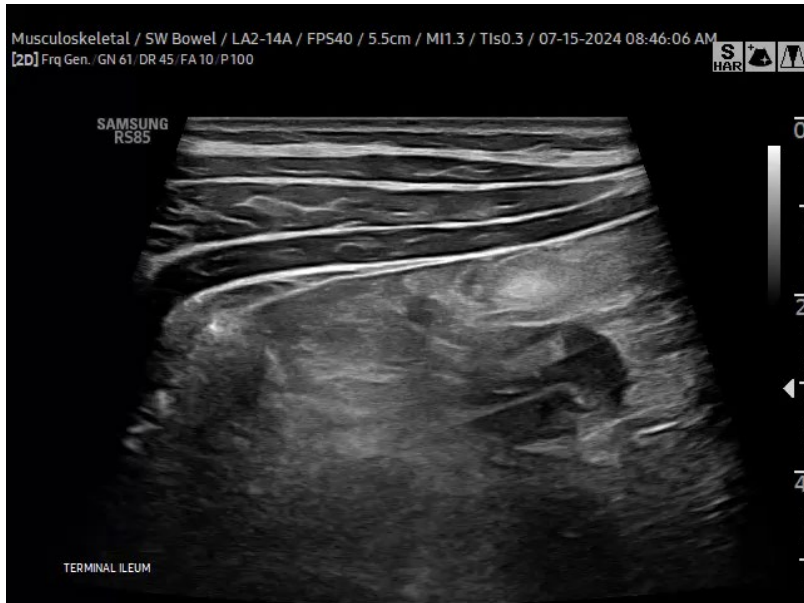
IUS in clinic- July 2024



IUS in clinic- July 2024



IUS in clinic- July 2024

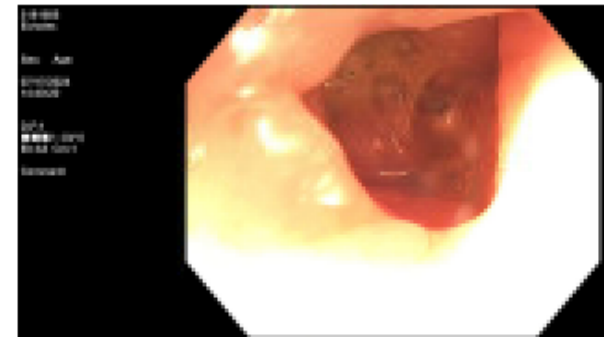


IUS in clinic- July 2024



July 2024

- Fecal calprotectin >3000ug/g
- Bloodwork: Hgb 11.7, MCV 69, PLT 452, CRP 48, ESR 72, Vitamin D 7, iron 12
- EGD: Normal
- Colonoscopy:
 - Perianal fistula noted, which was not appreciated on initial exam.
 - Congested & ulcerated mucosa throughout the colon.
 - Ileocecal valve and terminal ileum are ulcerated



11 Terminal ileum : Mucosa abnormal



12 Ileo-cecal Valve : Abnormal mucosa



Pathology

Upper GI biopsies:

A. Duodenum 2nd part/bulb:

- Focal minimally active duodenitis

B. Gastric antrum/body:

- Chronic active antral gastritis
- Inactive body gastritis

C. Distal esophagus:

- Mild reflux esophagitis.

D. Mid esophagus:

- Squamous epithelium without diagnostic abnormality

Colonoscopy biopsies:

A. Terminal ileum & ileocecal valve:

- **Patchy active Crohn's ileocolitis with a possible poorly formed granuloma.**

B, C, D, E. Cecum-left colon

- Mildly active Crohn's colitis.

F. Sigmoid:

- Patchy, mildly active Crohn's colitis

G. Rectum:

- Patchy minimally active Crohn's proctitis



MRE

- Numerous lymph nodes are seen
- Bowel: **long segment of T1 wall thickening, extends continuously to the level of the ileocecal valve length of 17-20 cm**, with the wall thickening moderate in severity. No skip lesions, no significant intramural edema. While there is an enhancement, there is no significant hyperenhancement of the bowel wall thickening.
- **There is an area of luminal narrowing without significant upstream dilation (less than 3 cm).** No ulcerations or sacculations are identified. There is mesenteric edema

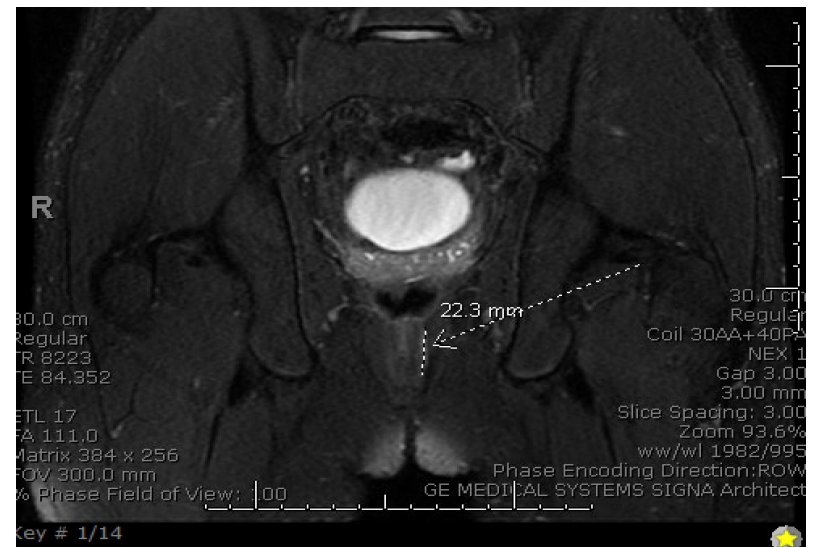


MR Pelvis

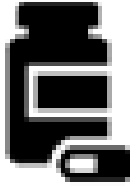
Findings:

- Small amount of free fluid is in the lower abdomen. The long segment terminal ileum wall thickening is again identified.
- At the 2:00 position in the anus a fistula extends posteriorly to the 6:00 position and then inferiorly to the skin surface in the left gluteal fold. The enhancing tract is greater than 2.5 cm in length. No other fistula is detected.

Impression: One anal fistula at the 2:00 position identified. Long segment terminal ileum disease.



Management



**Budesonide 9 mg
(family's request)
+ pantoprazole for gastric
protection**



**Meet with surgery
Sitz baths
Consideration of antibiotics
(no abscess)**



**Infliximab 10 mg/kg
Standard induction**



**Meet with dietician
Low fiber
PEN**

Back in clinic- Oct 2024



**Completed IFX induction
W6 level - 24ug/ml**



**2 BMs daily, formed, no blood
No abdominal pain
No perianal symptoms**

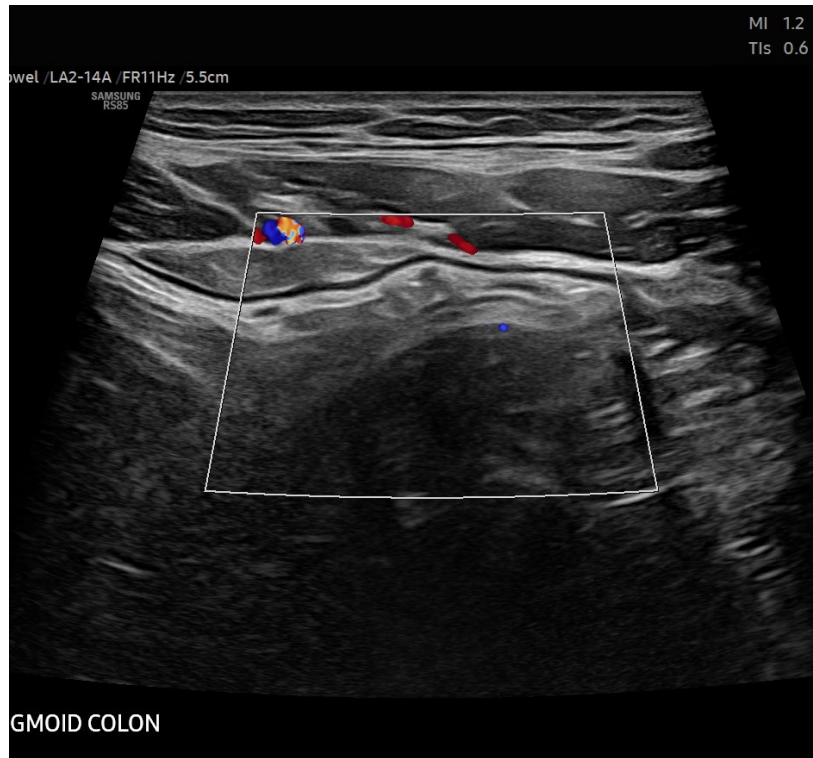


Weaned to budesonide 3mg



**Hgb 11.7, ESR 11, CRP <3
FCP pending**

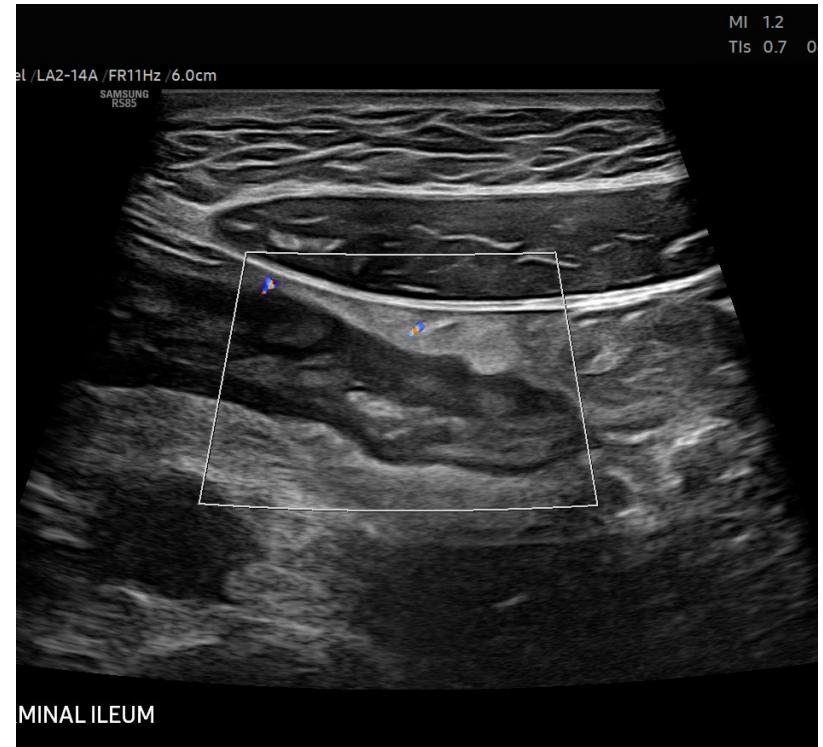
IUS in clinic- Oct 2024



IUS in clinic- Oct 2024



IUS in clinic- Oct 2024



IUS in clinic- Oct 2024



Summary

- Interval improvement, but still residual BWT, loss of echostratification, and mesenteric fat without hyperemia.
- Luminal narrowing improved without proximal dilation
- Plan: RTC 8-12 weeks for repeat IUS & FCP

	Median rating (IQR)	Appropriateness
Stricture length	7 (5-8)	Appropriate
Bowel wall thickening	8 (8-9)	Appropriate
Luminal narrowing	8 (6-9)	Appropriate
Pre-stenotic dilation	7 (6-9)	Appropriate
Motility abnormalities	7 (5-8)	Appropriate
Loss of bowel wall layer stratification	8 (7-8)	Appropriate
Lack of compressibility	5-5 (5-7)	Uncertain
Mesenteric inflammatory fat	8 (7-9)	Appropriate
Mesenteric lymphadenopathy	6 (4-8)	Uncertain
Echogenic submucosa	5 (4-7)	Uncertain
Enlarged lymph nodes	6 (3-7)	Uncertain
Penetrating disease	7 (5-8)	Appropriate
Ulceration	8 (8-9)	Appropriate
Mural or peri-enteric hyperaemia	8 (8-9)	Appropriate
Comb sign	8 (6-8)	Appropriate

Table 4: Consensus statements for improved features from successful anti-inflammatory treatment of small bowel Crohn's disease strictures on intestinal ultrasound

International expert guidance for defining and monitoring small bowel strictures in Crohn's disease on intestinal ultrasound: a consensus statement

Cathy Lu, Ryan Rosentreter, Claire E Parker, Julie Remillard, Stephanie R Wilson, Mark E Baker, Gaurang Bhatnagar, Jakob Begun, David H Bruining, Robert V Bryant, Britt Christensen, Brian G Feagan, Joel G Fletcher, Ilyssa Gordon, Gaylyn Henderson, Vipul Jainath, John Knudsen, Torsten Kucharzik, Kyle Lesack, Christian Maaser, Giovanni Mazani, Kerri Novak, Jordi Rimola, Stuart A Taylor, Rune Wilkens, Florian Rieder, on behalf of the Stenosis Therapy and Anti-Fibrotic Research (STAR) consortium

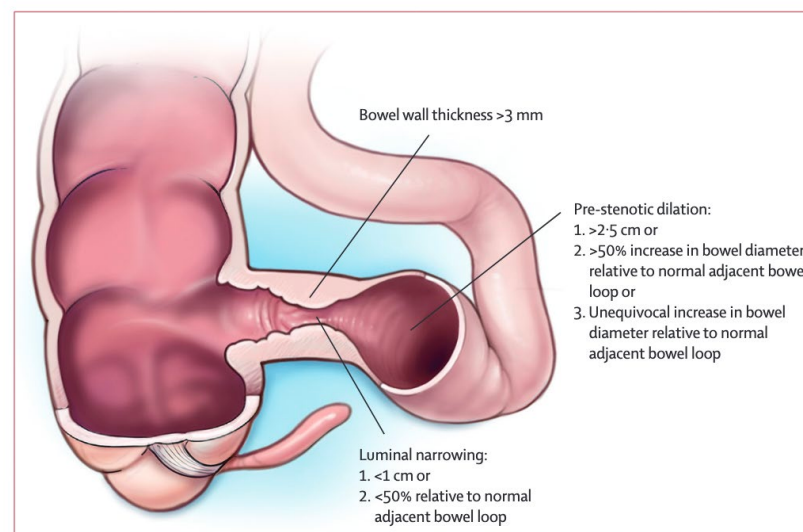
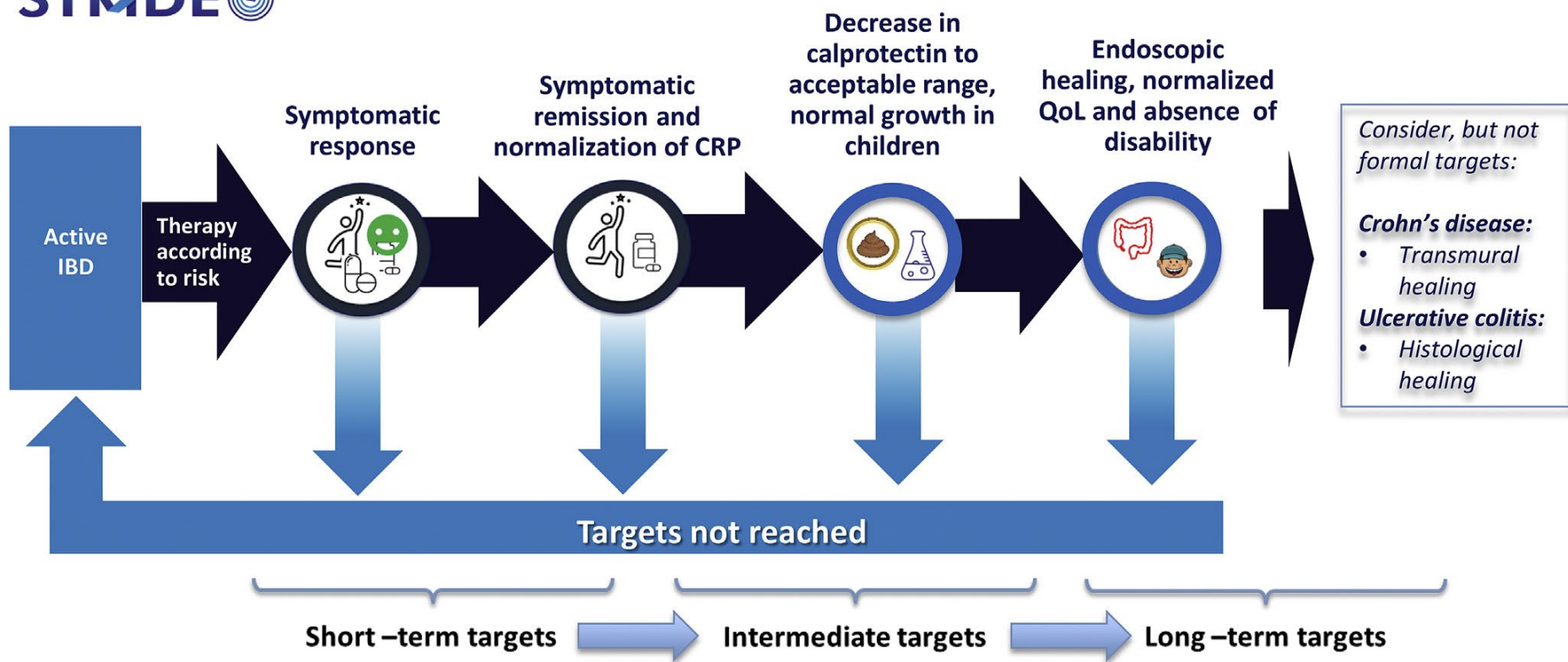


Figure 1: Anastomotic and naive small bowel Crohn's disease strictures on intestinal ultrasound defined by the combination of bowel wall, luminal narrowing, and pre-stenotic dilation. Items defining motility abnormalities are described in the Results and the appendix (p 7).

(Lu et al. 2024. Lancet)



Where do we go from here?



(Turner et al. Gastroenterology 2021. 160:1570–1583)



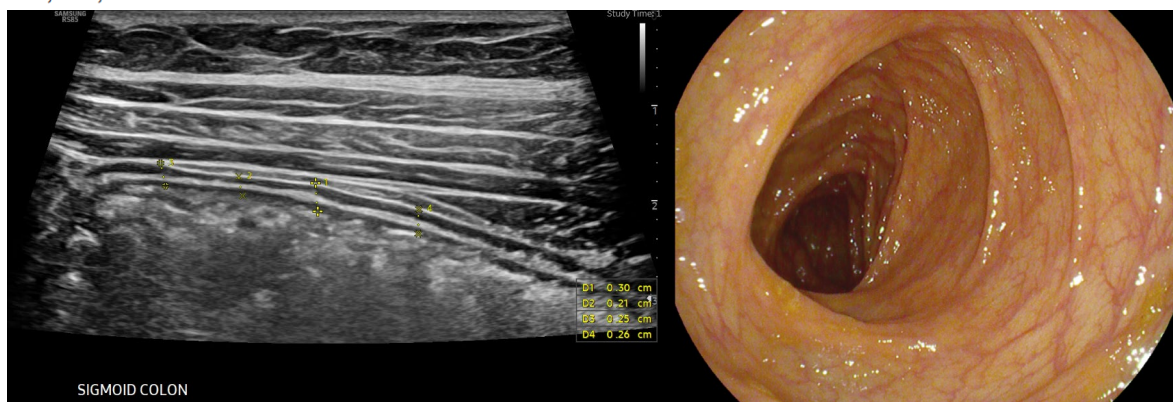
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The move to transmural healing

TABLE 1 | Definitions of transmural healing (TH).

References and number of patients	Definition of transmural healing based on IUS
Castiglione et al. (18), (n = 133)	$BWT \leq 3$ mm
Ripollés et al. (22), (n = 51)	$BWT \leq 3$ mm
Civitelli et al. (27), (n = 32)	$BWT \leq 3$ mm and other IUS features
Castiglione et al. (19), (n = 40)	$BWT \leq 3$ mm plus absence of hypervascularisation signs
Orlando et al. (29), (n = 30)	$BWT \leq 3$ mm
Paredes et al. (23), (n = 36)	$BWT \leq 3$ and 0–1 doppler scale
Castiglione et al. (21), (n = 218)	$BWT \leq 3$ mm
Zorzi et al. (28), (n = 80)	$BWT \leq 3$ mm
Ma et al. (26), (n = 77)	$BWT \leq 3$ mm and normalization of stratification, no hypervascularisation, resolution of mesenteric inflammatory fat, and no complications (IUS)
Calabrese et al. (24), (n = 188)	$BWT \leq 3$ mm ileum/4 mm for colon, normal Limberg score and no complications
Helwig et al. (25), (n = 137)	BWT and Color-Doppler normalization, no loss of stratification and no fibro fatty proliferation

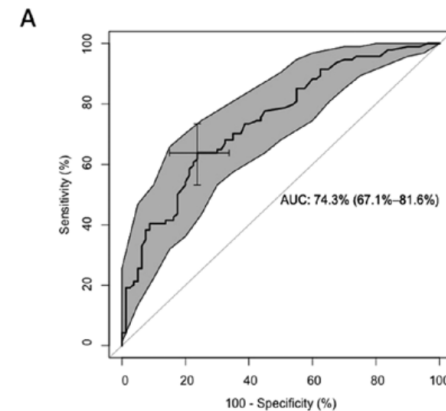
BWT, bowel wall thickness; IUS, intestinal ultrasound.



Pediatric-specific normalized values are ESSENTIAL

- Currently, the normalized values have been extrapolated from adult data.
 - Remission: $BWT \leq 3\text{mm}$, normal/0 Doppler signal
 - Response: reduction in BWT [$>25\%$] or [$>2.0\text{mm}$] or [$>1\text{mm}$ AND one color Doppler signal]

- 3.6.1. The remission/response statements for Crohn's disease may be used in both adult and paediatric populations. [InA. 2, Unc. 1, App. 14]
- 3.6.2. The remission/response statements for ulcerative colitis may be used in both adult and paediatric populations. [InA. 2, Unc. 2, App. 12]



Cut off = 1.9mm
AUROC 0.743 (0.67-0.82)
Sens 64% (53-73%)
Spec 76% (65-85%)

(Ilvemark et al, J Crohn's Colitis. 2021;16(4):554-580.;Chavannes et al, Inflamm Bowel Dis. Published online 2023)



Normal BWT in children with IBD

Retrospective cross-sectional study of patients with IBD <18 years of age, between March 2021 to May 2023

- Sustained steroid-free clinical remission
- Achieved deep mucosal healing (absence of ulceration) on colonoscopy
- OR transmural healing on MR-Enterography
- IUS Performed within 6 months of the endoscopy and/or MRE

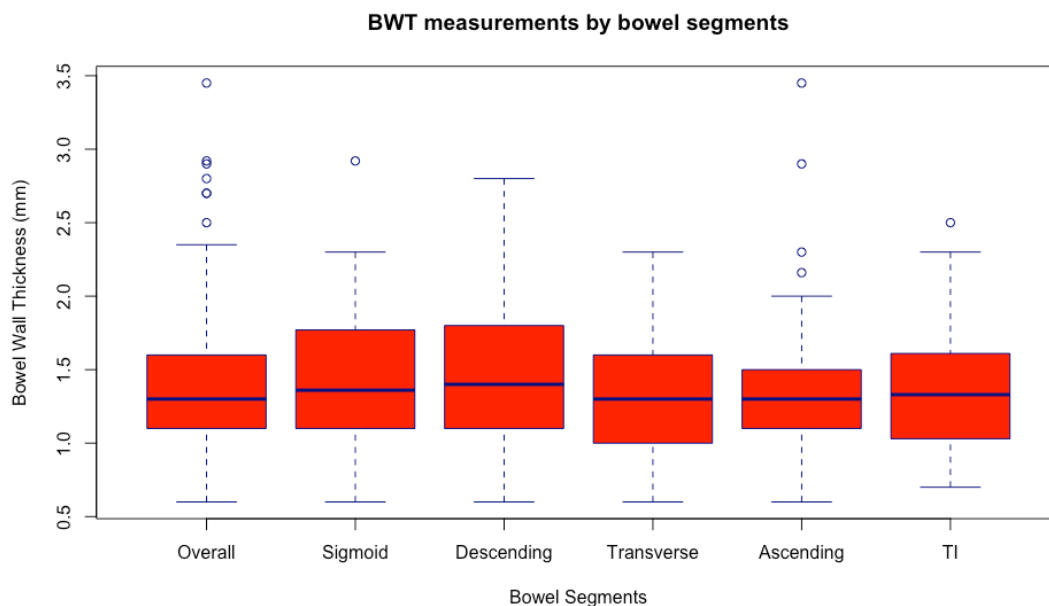
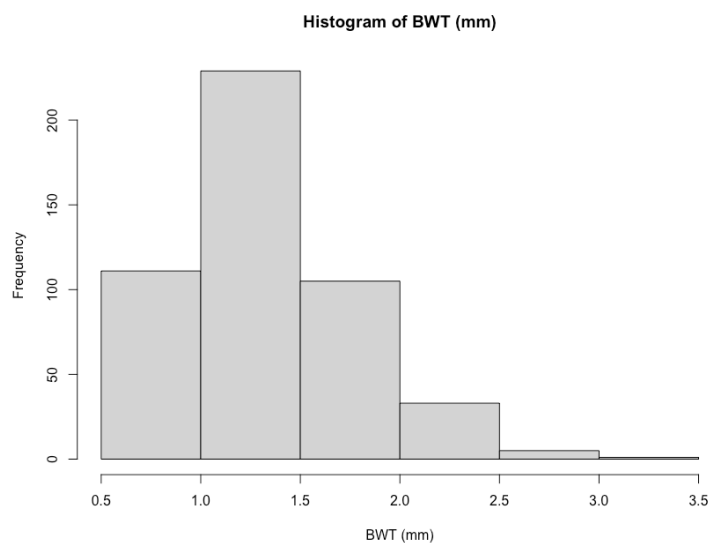
Exclusions:

- History of surgery (i.e.: ileocecal resection)
- History of complicated disease (i.e.: stricturing or penetrating disease)



Results

Analysis of 98 children & 484 bowel segments on IUS with IBD in sustained deep remission with mucosal healing



(Kellar A et al., on behalf of IBUS Pedscomm JPGN April 2025)



Summary

This is the largest cohort of pediatric patients undergoing point-of-care IUS performed by gastroenterologists



Normal BWT for children in IBD in sustained deep remission is less than the established adult value of 3.0mm

Range likely between 1.1-1.6mm

Majority of patients ≤ 2.5 mm



In multilinear regression, BWT may be weakly affected by

Age

Weight

Disease Duration

Being on an immunomodulator



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