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IUS in Special Situations: Pregnancy, Transperineal US, and AI

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IBUS Advanced Ultrasound Workshop – Module 3
DDW, San Diego, US, May 5th, 2025

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Disclosure

- Speaker Fees – Abbvie, Celltrion, JnJ.
- Advisory Board – Abbvie, Celltrion, Ferring, Fresenius Kabi, Janssen, Lilly, Pendopharm, Pfizer, Takeda

- Grant Funding- Helmsley Charitable Trust, Alberta Innovates

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Objectives

Pregnancy

1. Understand latest literature with use of IUS in pregnancy
2. Appreciate challenges with gravid uterus

Transperineal Ultrasound

1. Recognize key features

Artificial Intelligence

1. Describe latest IUS developments and future directions

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Pregnancy

1. Understand latest literature with use of IUS in pregnancy
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ARTICLE IN PRESS

Active Inflammatory Bowel Disease on Intestinal Ultrasound During Pregnancy Is Associated With an Increased Risk of Adverse Pregnancy and Neonatal Outcomes Independent of Clinical and Biochemical Disease Activity

Gastroenterology 2025;■:1–17

Ralley E. Prentice,[1,2,3] Emma K. Flanagan,[2,4] Emily K. Wright,[2,4] Michael T. Dolinger,[5] Zoe Gottlieb,[5] Alyson L. Ross,[2] Megan Burns,[1] Danny Con,[4,6] Edward Shelton,[1] Ray Boyapati,[1] Ilyra Aronsky,[5] Gregory T. Moore,[1,2] William Connell,[2,4] Miles P. Sparrow,[7,8] Peter De Cruz,[4,6] Michael A. Kamm,[2,4] Ilana Prideaux,[1] Rimma Goldberg,[1,3] Katerina V. Kiburg,[4] Marla C. Dubinsky,[5] and Sally J. Bell[1,3,4]

Objective

- To assess the role of IUS in predicting adverse obstetric outcomes in IBD.
- Identify agreement between FCP, IUS, and clinical disease activity.

Methods

- International, multicentre, prospective cohort study in Australia and USA (2017-2023) with both preconception and pregnant IBD patients (n=379)
- Clinical assessment (PGA) and FCP 6 months pre-conception, T1, T2, T3, and post partum (if feasible).
- IUS preconception, T1 and T2 (Performed in 225 patients)

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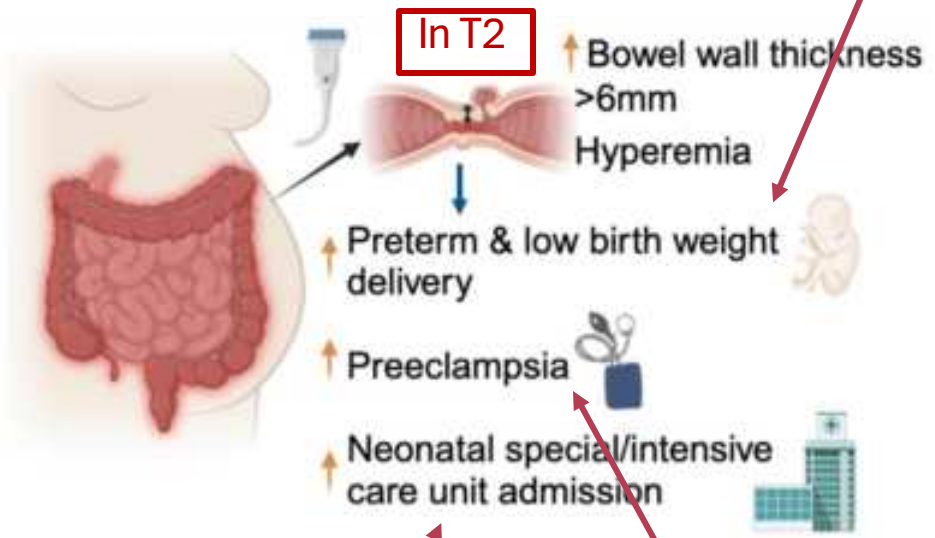
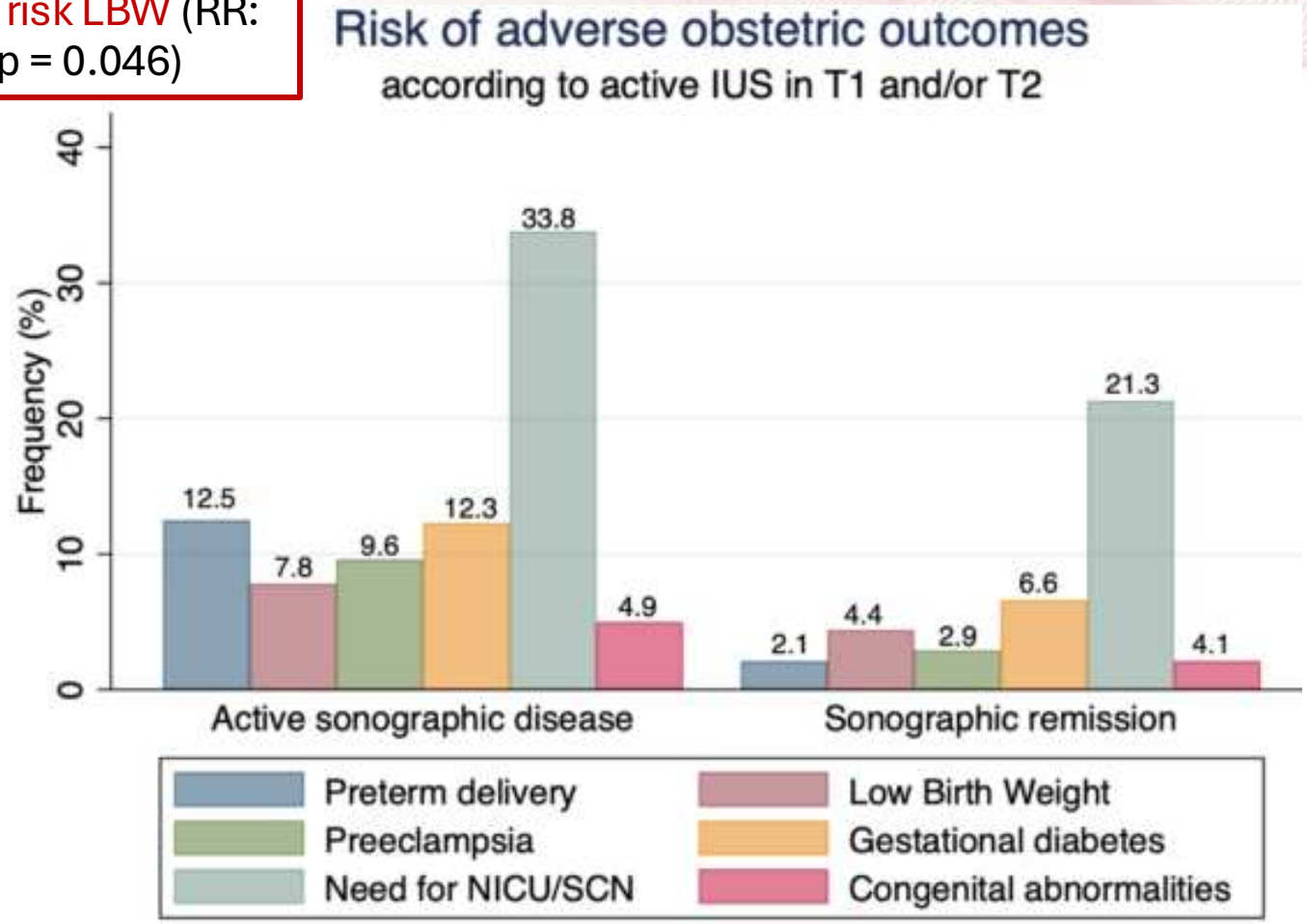
4-fold risk pre-term (RR: 4.01, p=0.018)

2 fold risk LBW (RR: 2.19, p = 0.046)



2-fold increased risk (RR: 2.42, p=0.041)

3-fold increased risk (RR: 3.46, p=0.046).



Prentice et al. Gastro 2025

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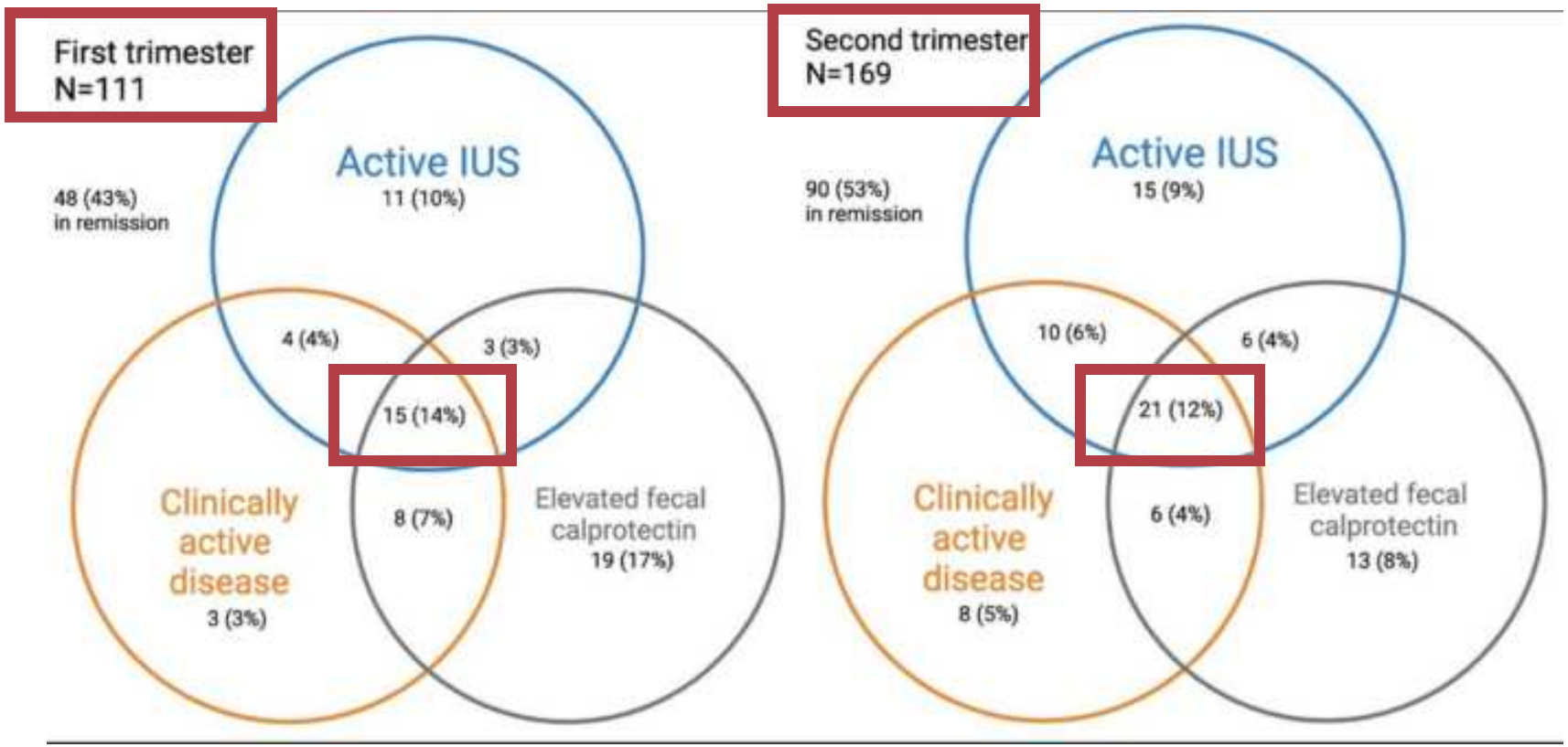
Agreement Between Clinical Disease Activity Parameters and IUS or FCP are poor



Prentice et al. Gastro 2025

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Take Home Message

- IUS should be incorporated into routine IBD pregnancy assessment given its ability to predict adverse obstetrical outcomes above clinical and biochemical disease activity.

Monitoring Inflammatory Bowel Disease in Pregnancy Using Gastrointestinal Ultrasonography

Journal of Crohn's and Colitis, 2020, 1405–1412
doi:10.1093/ecco-jcc/jjaa082
Advance Access publication April 28, 2020
Original Article

Emma Flanagan,[a] Emily K. Wright,[b] Jakob Begun,[c] Robert V. Bryant,[d] Yoon-Kyo An,[c] Alyson L. Ross,[e] Katerina V. Kiburg,[a] Sally J. Bell[e]

Rates of adequate GIUS views per segment across pregnancy.

Adequate views obtained, n [%]	Trimester 1 Weeks 4–13 [*n* = 39]	Early trimester 2 Weeks 14–19 [*n* = 28]	Late trimester 2 Weeks 20–26 [*n* = 51]	Trimester 3 Weeks 27–33 [*n* = 9]
Sigmoid colon	39/39 [100%]	28/28 [100%]	47/51 [92%]	9/9 [100%]
Descending colon	38/39 [a] [97%]	28/28 [100%]	49/51 [96%]	9/9 [100%]
Transverse colon	39/39 [100%]	27/28 [a] [96%]	49/51 [96%]	7/9 [78%]
Ascending colon	37/38 [a b] [97%]	28/28 [100%]	51/51 [100%]	9/9 [100%]
Terminal ileum	37/39 [a] [95%]	25/28 [a] [89%]	30/51 [59%]	0/9 [0%]

- Adequate views in the majority up to 20 weeks gestation.
- > 20 weeks, good views of colon, but TI becomes difficult to assess.

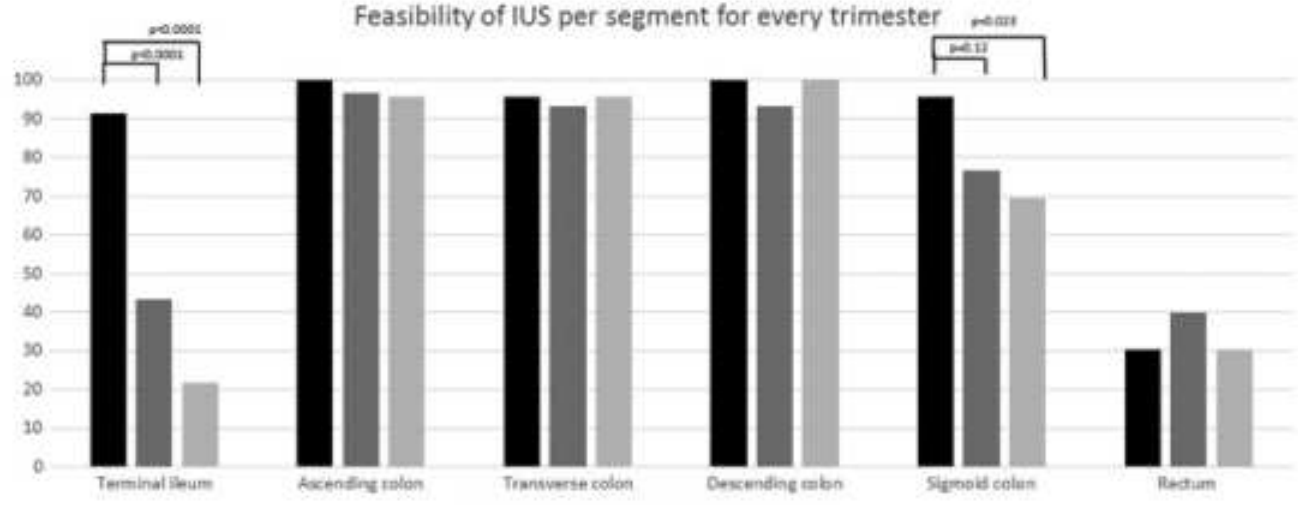
Inflammatory Bowel Diseases, 2022, **28**, 1045–1052
https://doi.org/10.1093/ibd/izab216
Advance access publication 15 September 2021
Original Research Articles - Clinical

Intestinal Ultrasound to Evaluate Treatment Response During Pregnancy in Patients With Inflammatory Bowel Disease

Floris De Voogd, MD,* Harshad Joshi, MD,† Elsa Van Wassenaer, MD,‡ Steven Bots, MD,* Geert D'Haens, MD, PhD,* and Krisztina Gecse, MD, PhD*

- Similarly, 27/38 pregnant women with IBD were followed with serial IUS examinations during pregnancy.

- Assessment of the terminal ileum significantly decreased from 91.3% in the first trimester to 21.7% in the third trimester ($P < 0.0001$).



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IUS Considerations in Pregnancy

- Impact of gravid uterus and trimester
- Body habitus
- Convex or linear probes to be chosen depending on adequacy of views.

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Case 1

Whattoexpect.com

40 year old, 32 weeks pregnant. Increased bloating after eating

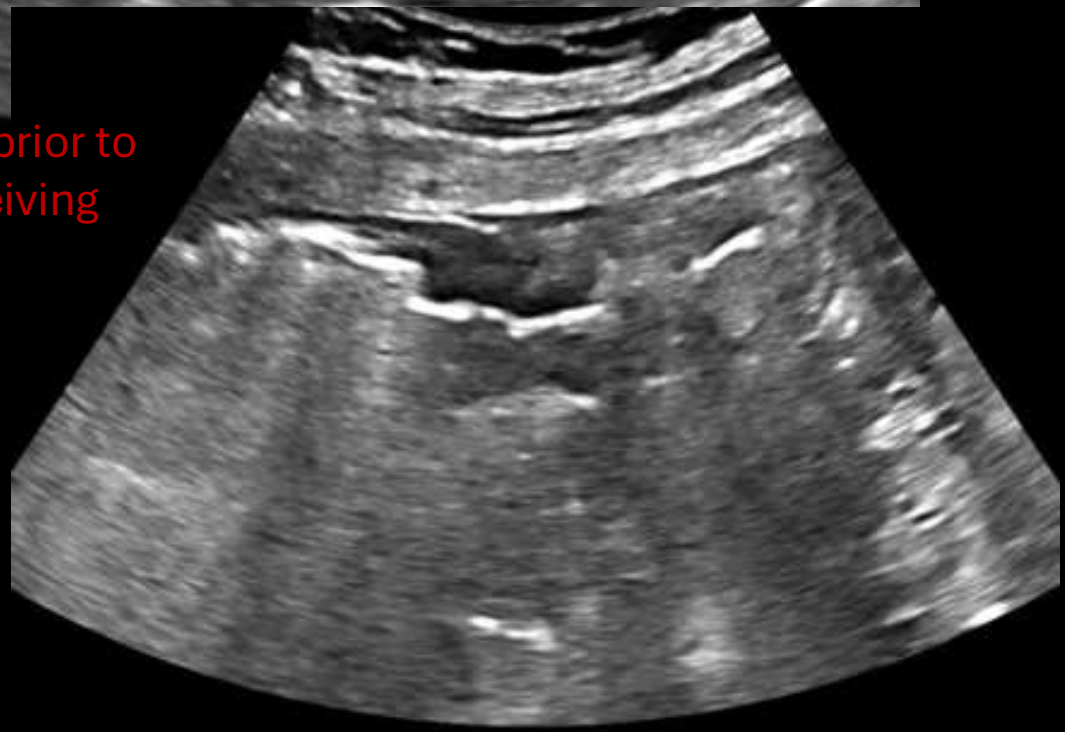
Ileal Crohn's diagnosed 2017

On adalimumab weekly

Narrowed ileum on endoscopy one year prior.

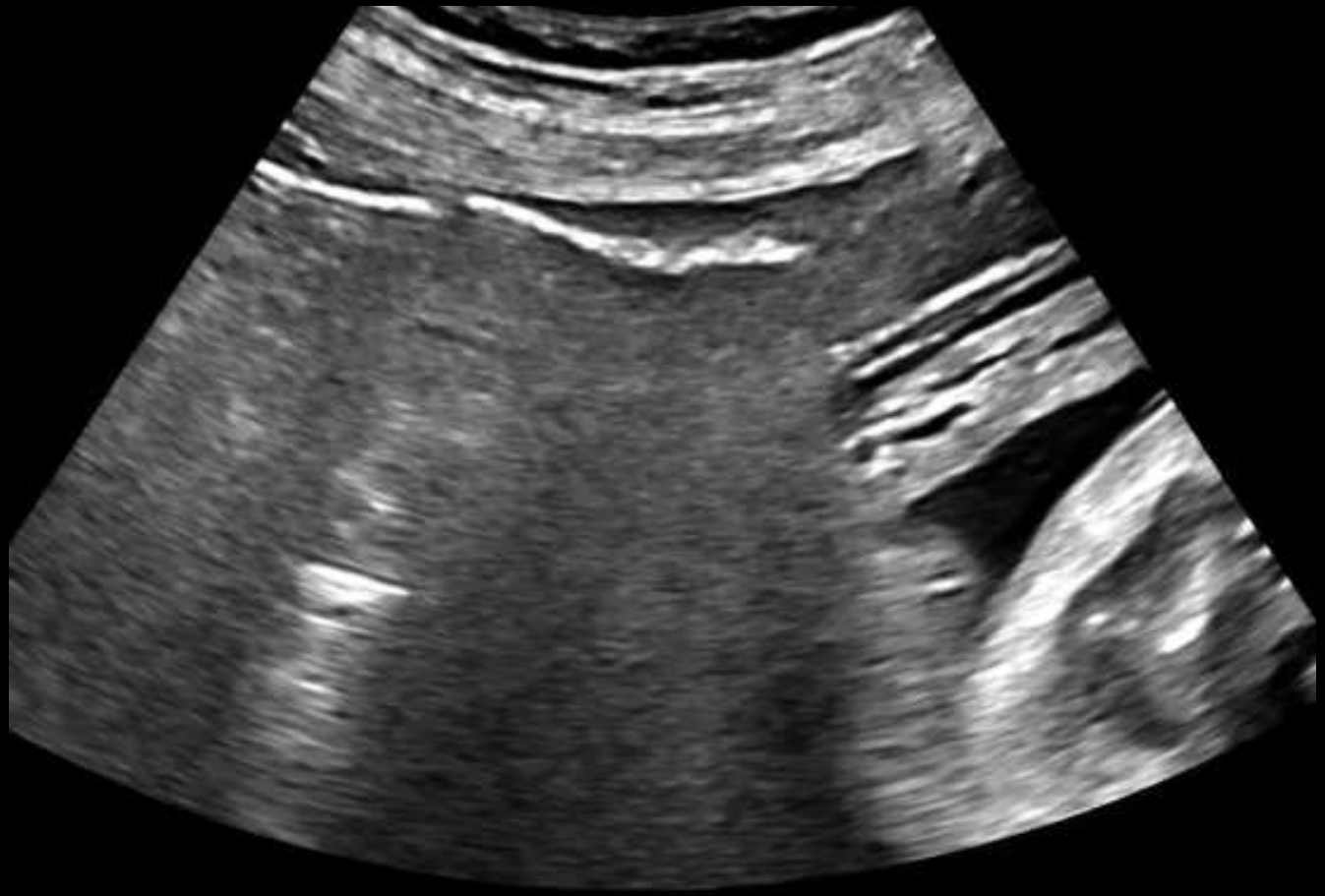
32 weeks
gestation

Scan prior to
conceiving



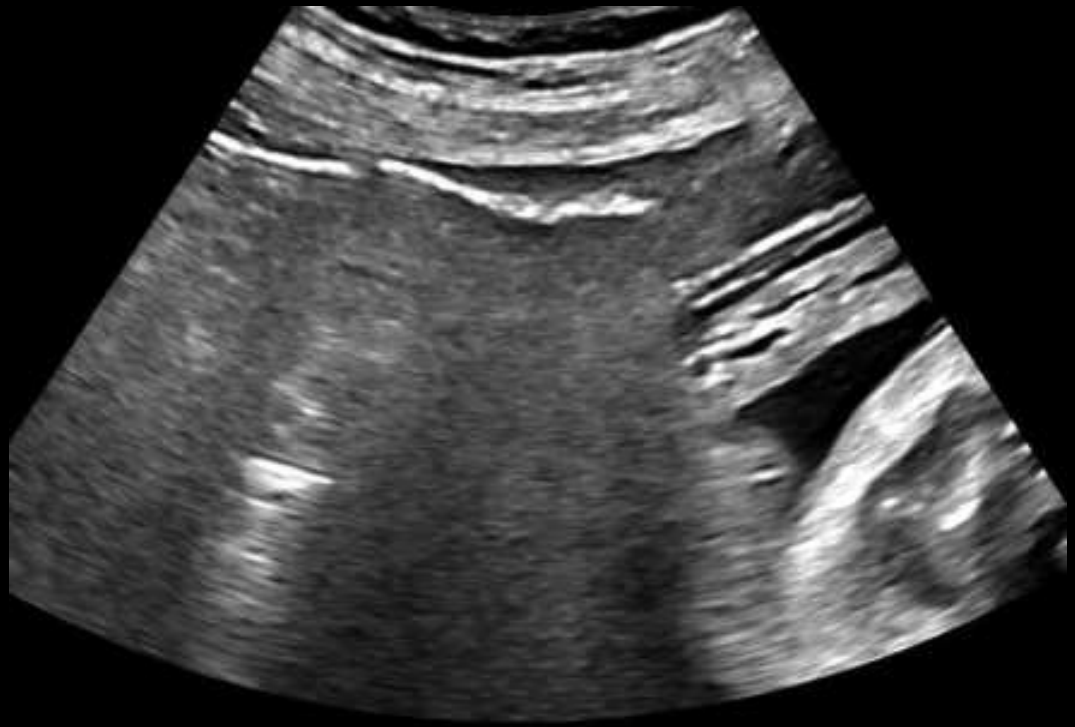
TIDIST

32 weeks gestation

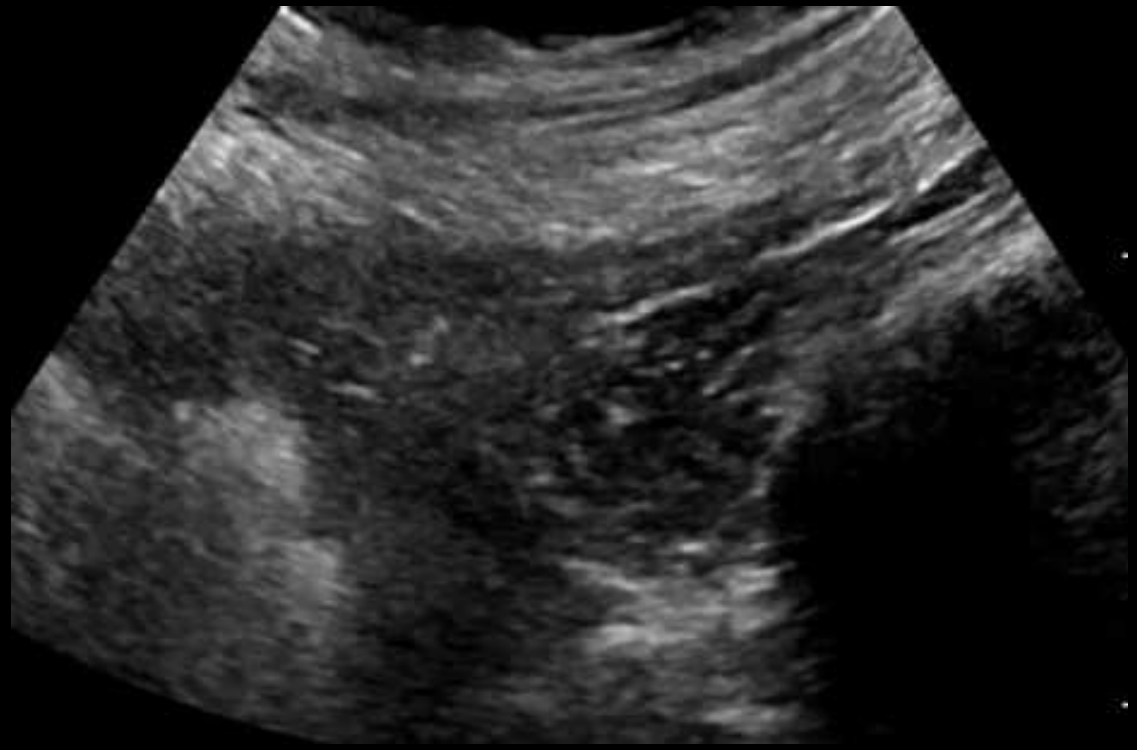


- BWT 8.8mm, no hyperemia, mild ifat
- 15cm length
- Fixed bowel
- Dysfunctional peristalsis
- Difficult to appreciate stricture

32 weeks gestation



10 Weeks Postpartum



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Summary

- Referred for surgery post partum.
- IUS remains an excellent tool in pregnancy.
- Always attempt scanning.

Neo TI post resection

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1. Recognize key features

Artificial Intelligence

1. Describe latest IUS developments and future directions

Slide courtesy of Dr. Shintaro Sagami

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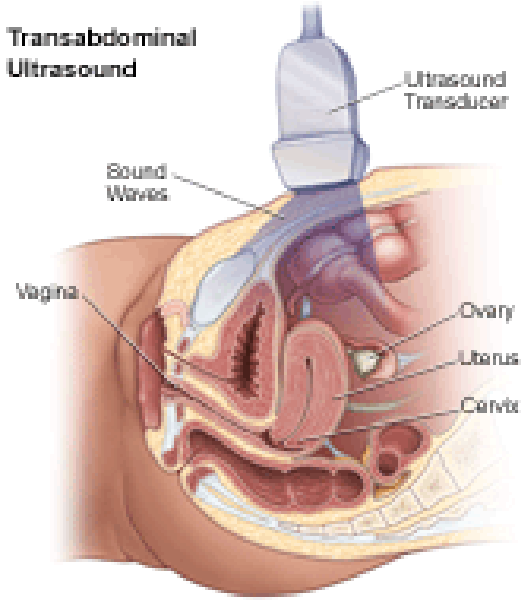
Comparing Ultrasound Techniques for Assessing Rectal Inflammation

Tranabdominal ultrasound [1)]

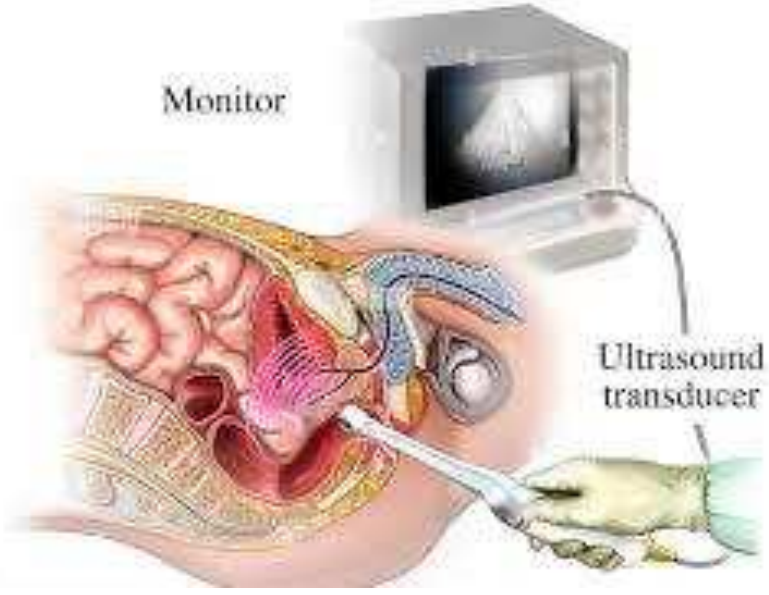


long distance from transducer

Transperineal ultrasound [2)]

easy to perform

Transrectal ultrasound [3)]



different transducer

1) https://www.hopkinsmedicine.org/health/treatment-tests-and-therapies/pelvic-ultrasound
2) https://www.yourpelvicfloor.org/conditions/transperineal-pelvic-floor-ultrasound-scan/
3) https://www.alamy.com/transrectal-rectal-ultrasound-image7710988.html

Preparation of the probe and its placement

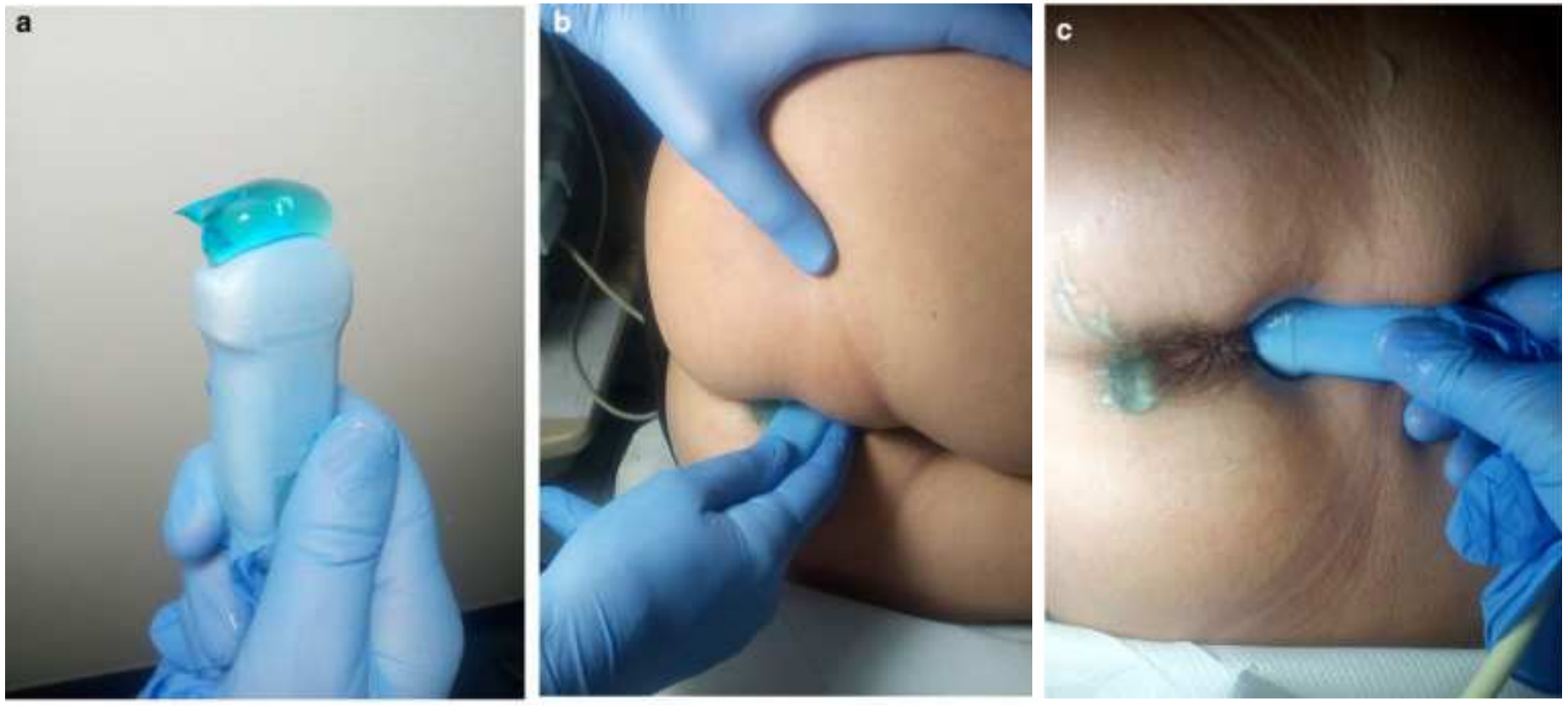
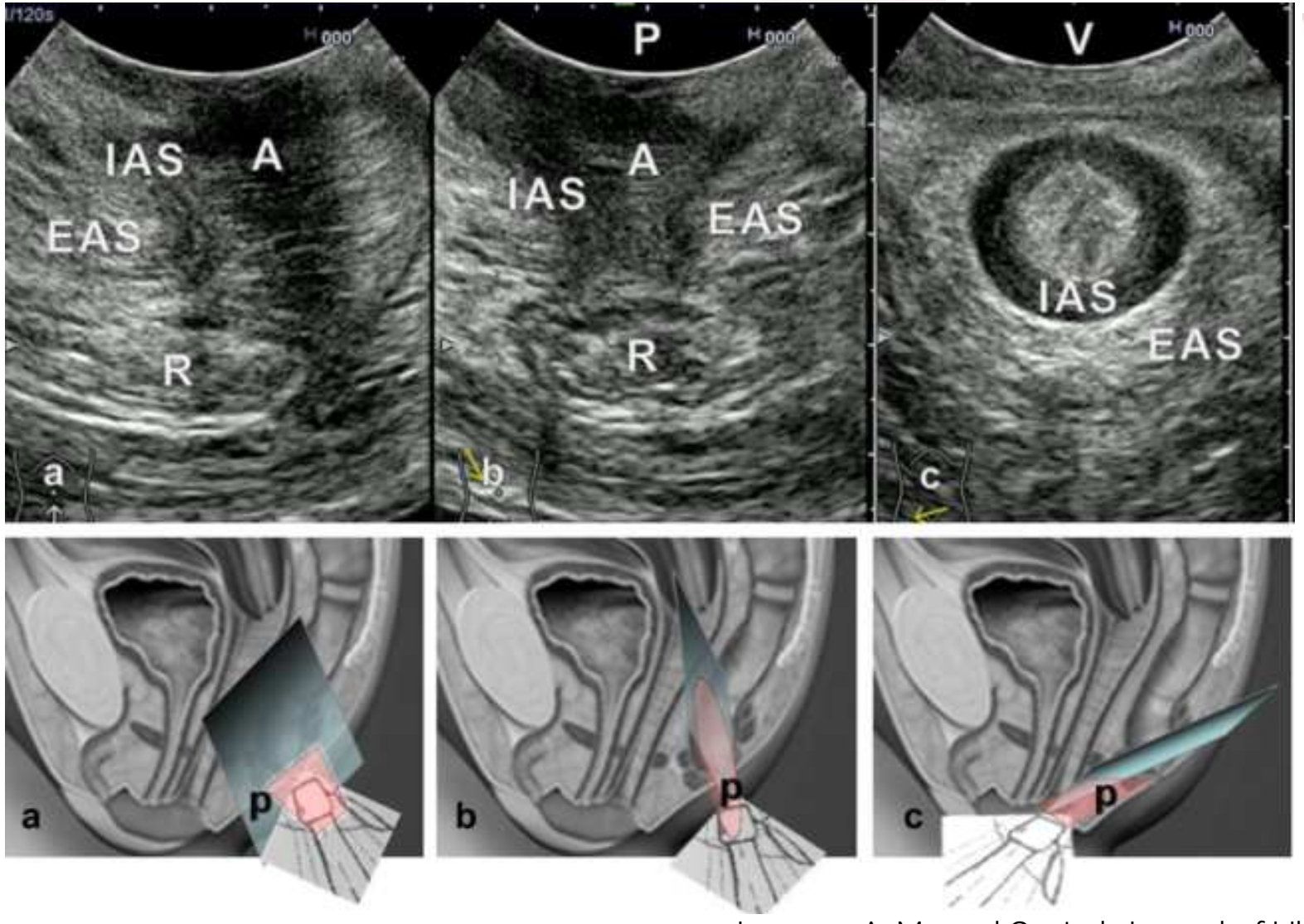


Fig. 1 Preparation of the micro-convex probe (**a**) and its placement above the anus in sagittal (**b**) and transversal (**c**) scans in a patient in left lateral position

Lavazza A, Maconi G, et al. Journal of Ultrasound (2019) 22:241–249

Sagittal, coronal and axial approaches in TPUS



Lavazza A, Maconi G, et al. Journal of Ultrasound (2019) 22:241–249

Sagittal and coronal approaches in TPUS

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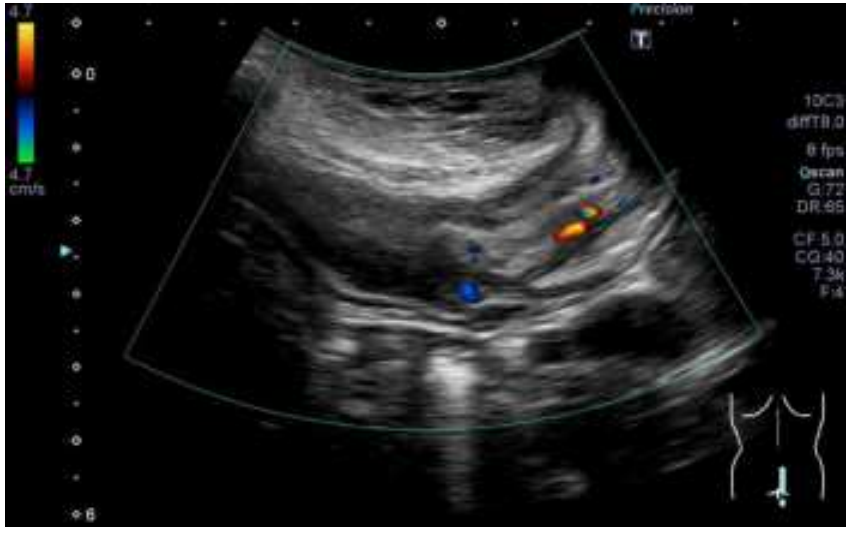
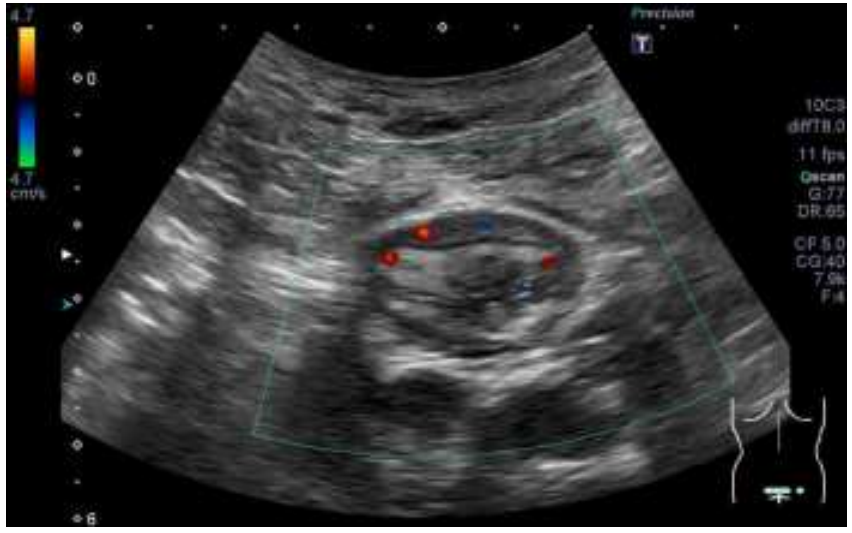
Sagittal



Coronal



Aplio 500.
Kitasato University Kitasato Institute Hospital
Information provided by Sagami

The comparison between TAUS and TPUS

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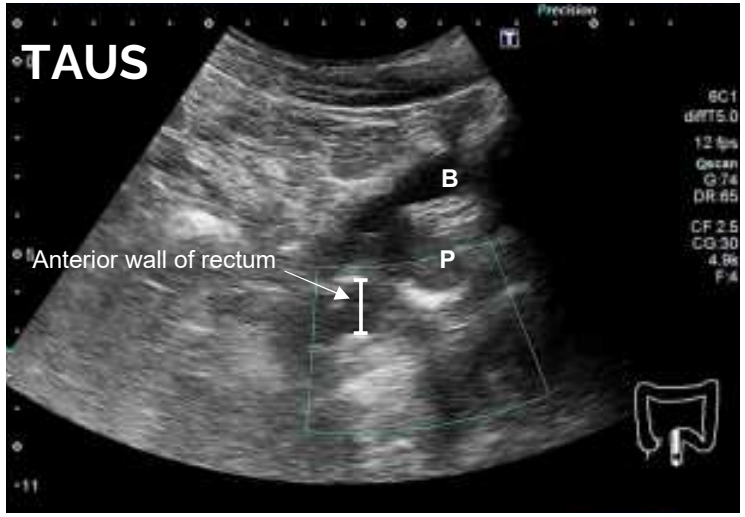
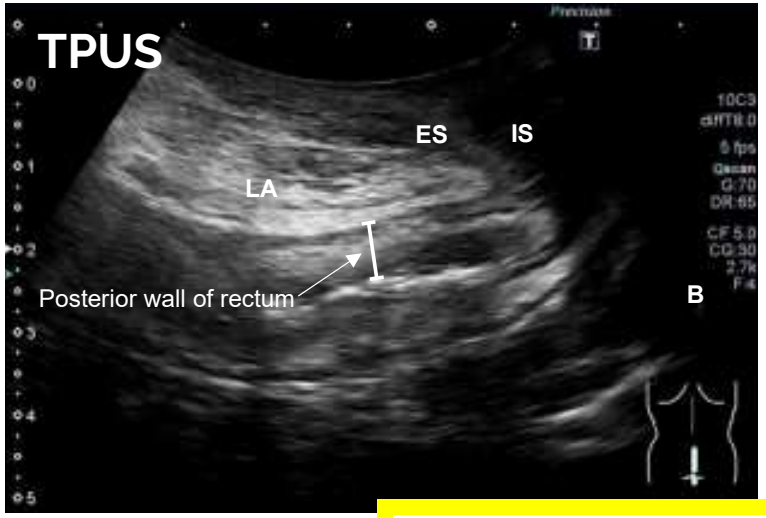
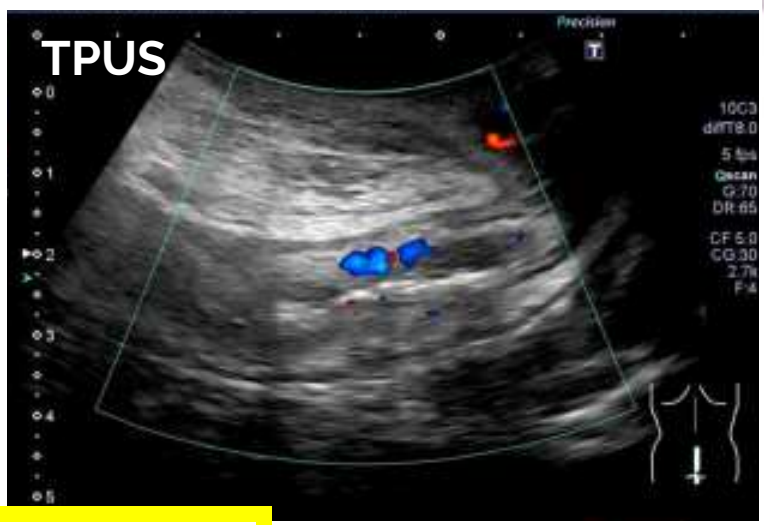
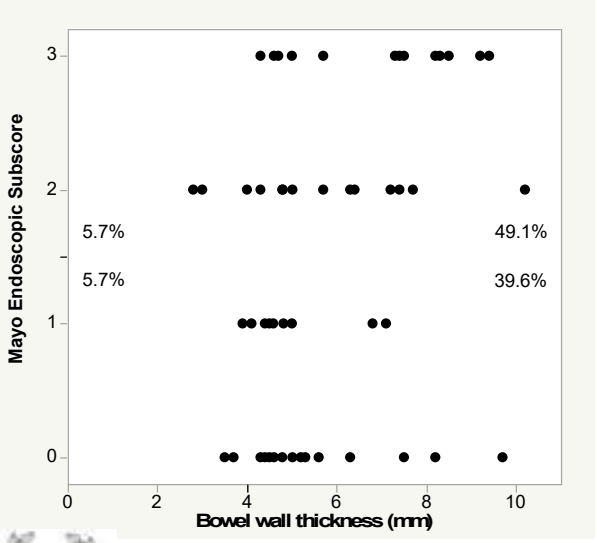






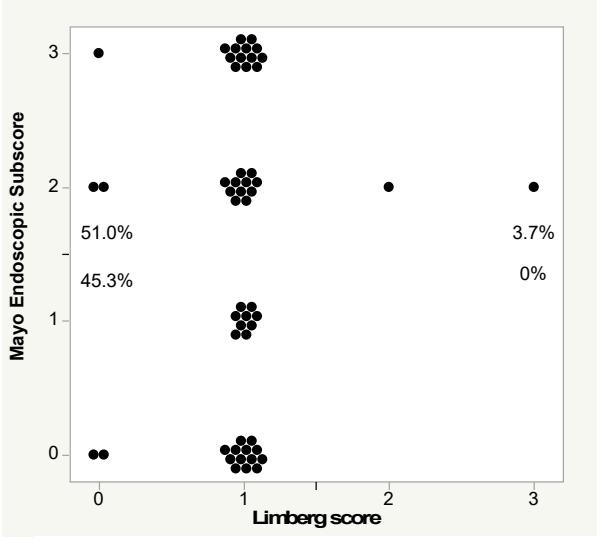
TAUS (BWT)

$r_s = 0.2989$, $p = 0.0314$



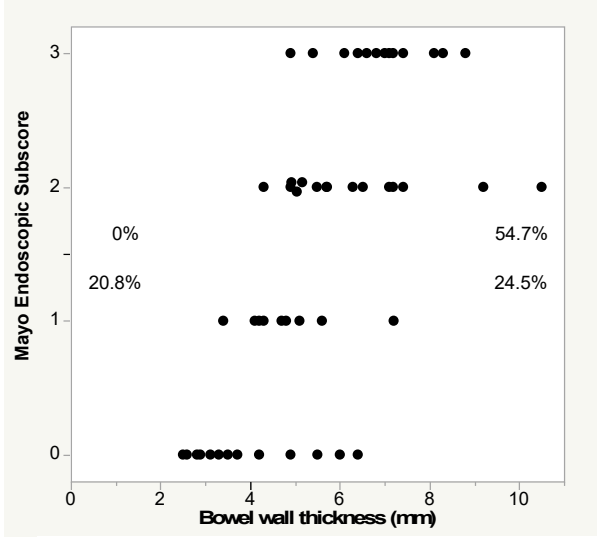
TAUS (Limberg)

$r_s = 0.0649$, $p = 0.6442$



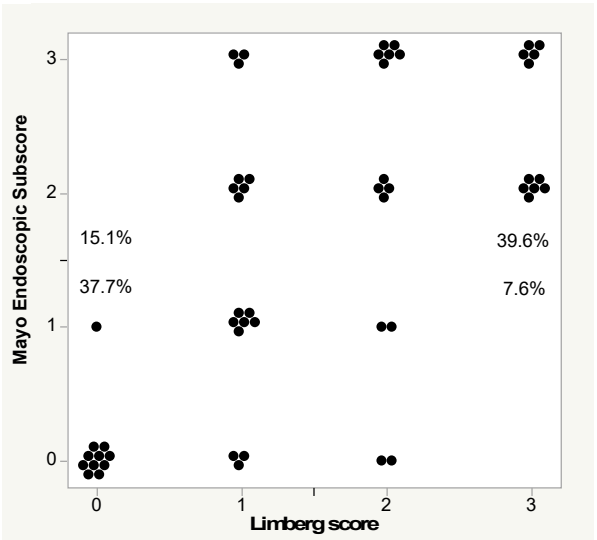
TPUS (BWT)

$r_s = 0.7204$, $p < 0.0001$



TPUS (Limberg)

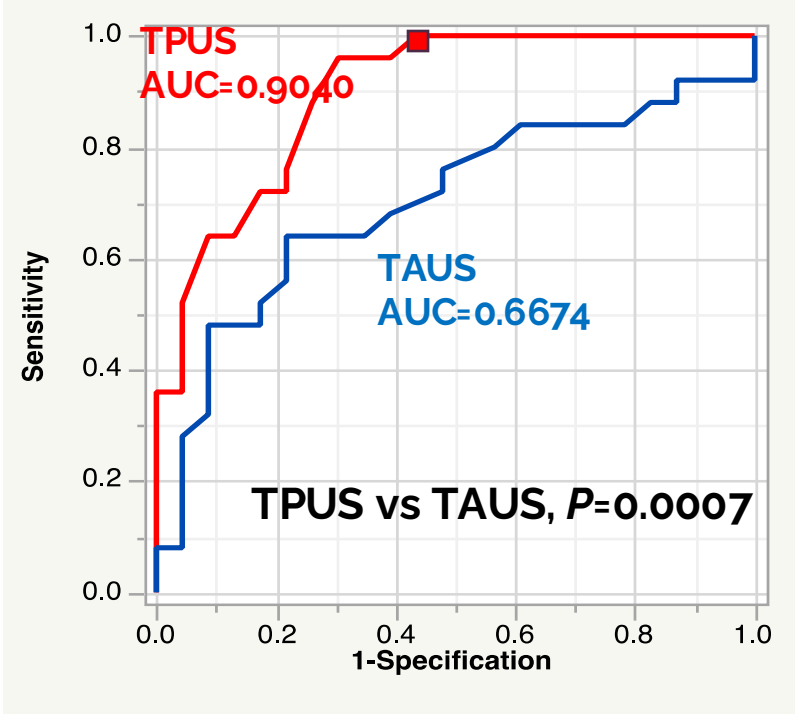
$r_s = 0.6619$, $p < 0.0001$



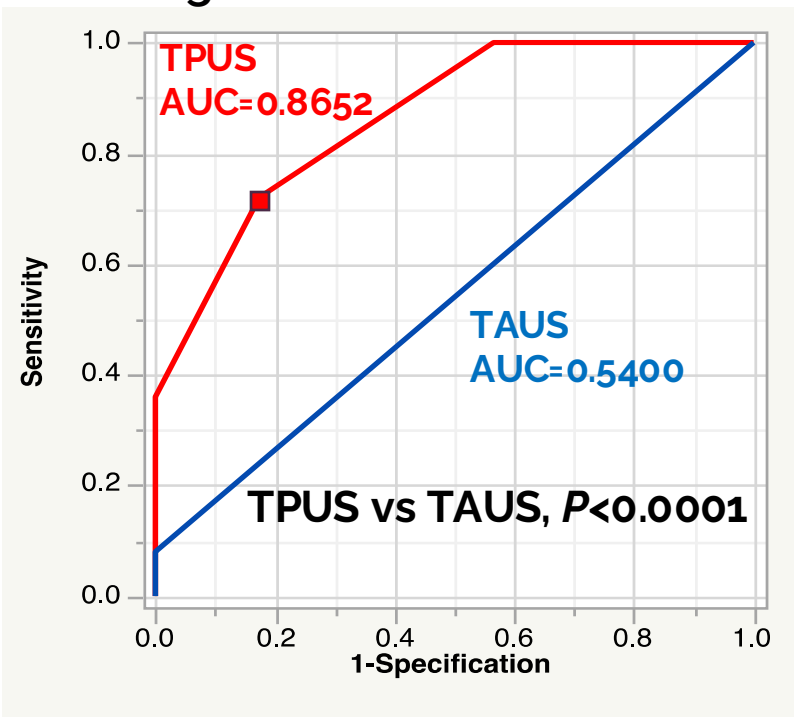
Sagami S, Kobayashi T, et al. Aliment Pharmacol Ther, 2020. 51(12): 1373-1383.

ROC curve analysis **TPUS vs TAUS**

BWT



Limberg score (LS)



(N=53)

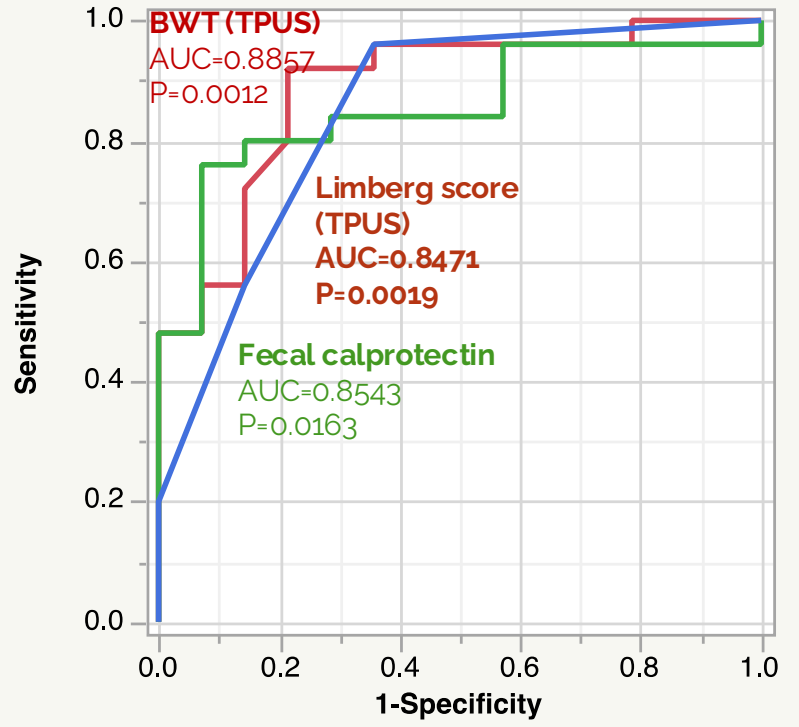
BWT (TPUS) ≥4mm：Sensitivity 100%, Specificity 45.8%

LS（TPUS）≥2：Sensitivity 66.7%、Specificity 81.8%

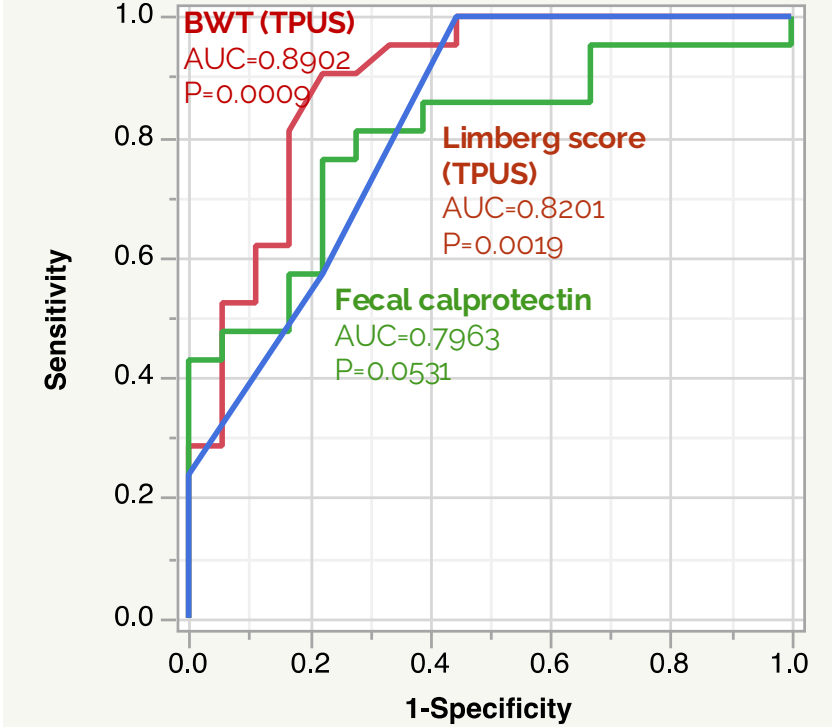
Sagami S, Kobayashi T, et al. Aliment Pharmacol Ther, 2020. 51(12): 1373-1383.

ROC curve analysis for active lesion (histological index)

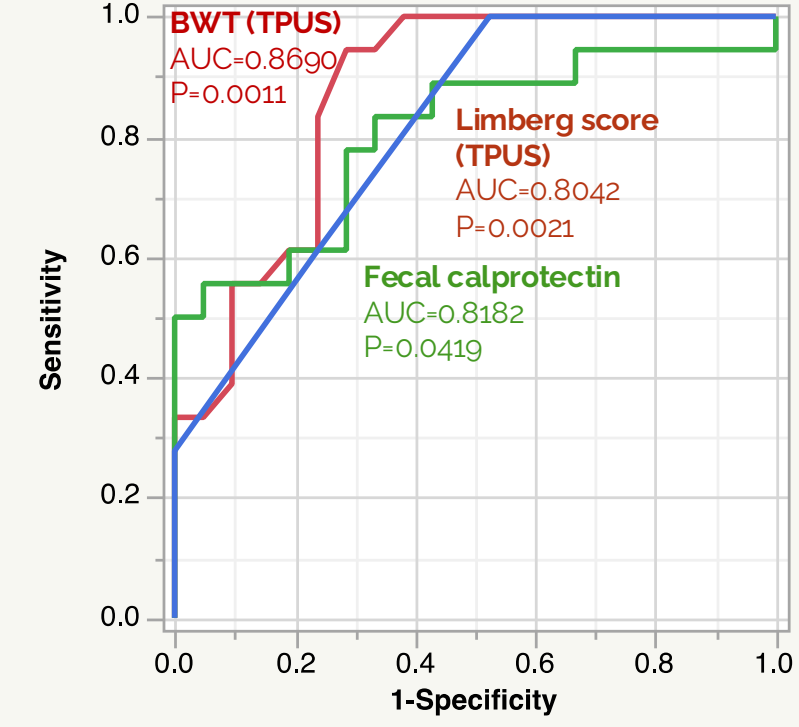
Geboes score ≥ 2.1



Robarts histopathological index > 6



Nancy histological index > 1



BWT (TPUS) ≥4mm：Sensitivity 93-96%, Specificity 41-64%

Limberg score (TPUS) ≥2：Sensitivity 55-59%, Specificity 76-86%

FC≥ 100 μg/g：Sensitivity 84-89%, Specificity 52-64%

(N=43)

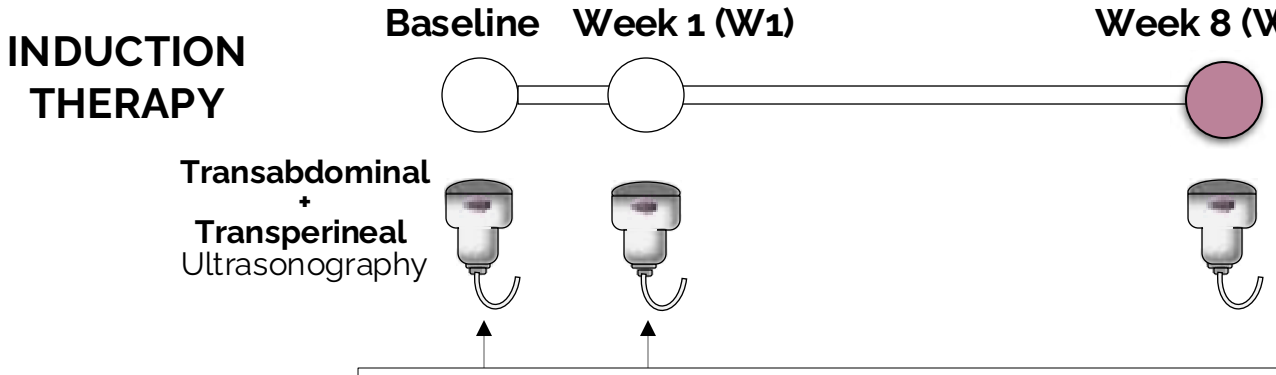
Sagami S, Kobayashi T, et al. Aliment Pharmacol Ther, 2020. 51(12): 1373-1383.

Early improvement in bowel wall thickness on transperineal ultrasonography predicts treatment success in active ulcerative colitis

Patient：Consecutive patients with active UC requiring induction treatment

Study period： from May 2018 through July 2020.

Design： Single-center prospective study



Predictors of clinical remission at W8

defined as PRO2 ≤ 1 (rectal bleeding = 0 and stool frequency ≤ 1) and continued initial induction therapy

ASSESSMENTS DURING STUDY PERIOD

- **Bowel ultrasonography**
  - Bowel wall thickness (mm)
  - Bowel wall flow (Colour Doppler signal)
- **Fecal calprotectin**
- **C-reactive protein**
- **Clinical severity:** patient-reported outcome-2 (PRO2)

Sagami S, et al. Aliment Pharmacol Ther, 2022;55(10):1320-1329.

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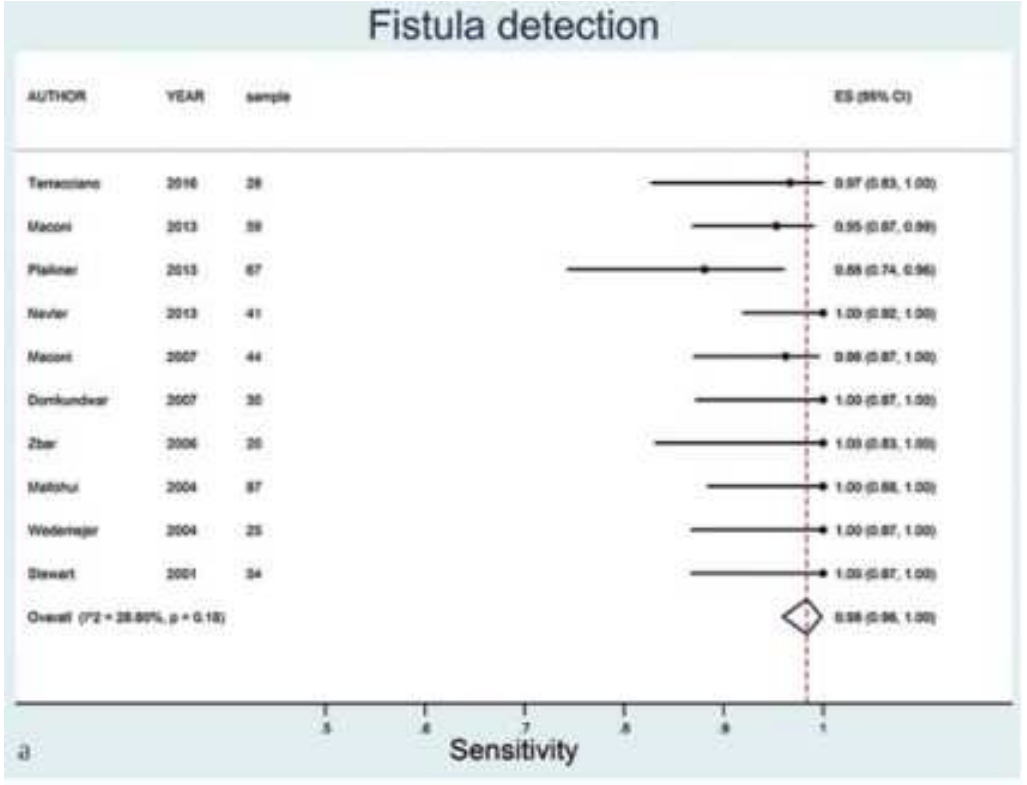
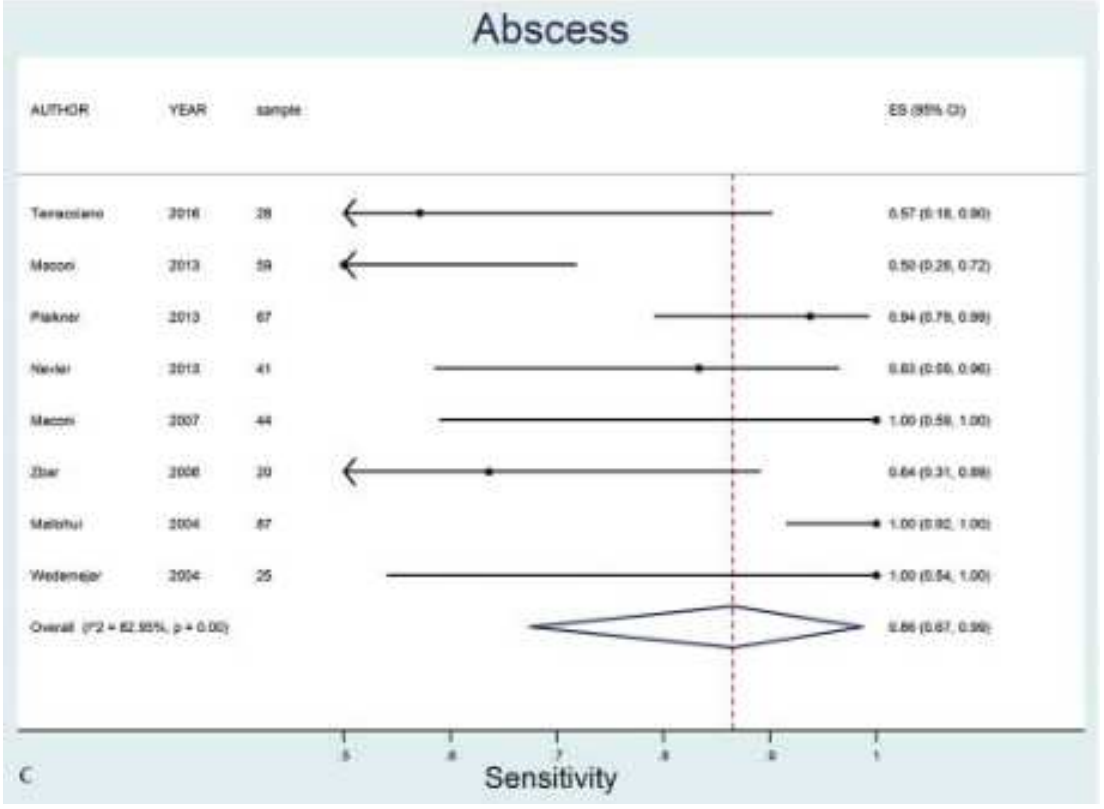
Transperineal Ultrasound for CD

- Fistulas
- Perianal complications
- Tumors

Diagnostic accuracy for perianal fistula and abscess: systematic review and meta-analysis





Perianal fistula- Sensitivity – 98% (95% CI 96-100%)
Internal openings – Sensitivity 98% (95% CI 96-100%)
Abscesses – Sensitivity 86% (95% CI 67-99%)

Maconi G et al. Ultraschall Med 2017; 38 (3): 265-272

Internal opening* of interspincteric fistula (F) at 6 o'clock

Perianal abscess

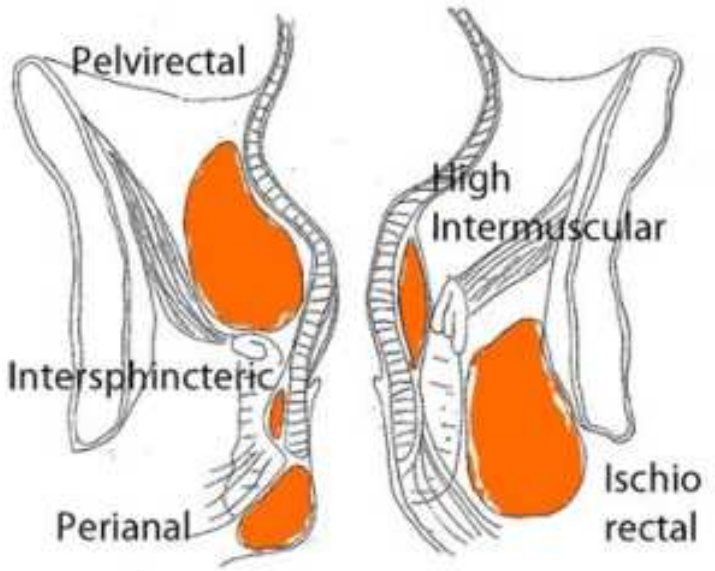


Fig. 11 Classification and site of perianal abscesses

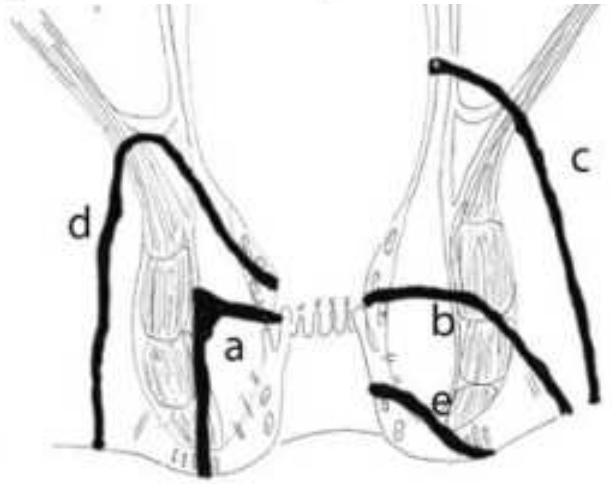


Fig. 5 Parks criteria (1975) to describe the anatomical course of the fistulas in relation to the sphincters: (a) intersphincteric, (b) trans-sphincteric, (c) extrasphincteric and (d) suprasphincteric (e) superficial

A. Hypo-anechoic abscess with *air bubble

A. Intersphincteric abscess with *air bubble

Lavazza A and Maconi G. Journal of Ultrasound. 2019;22:241-249
Lu C, et al. Journal of Ultrasound in Medicine. 2019;38(2):271-288

Clinical Gastroenterology and Hepatology 2025;23:927–945

SYSTEMATIC REVIEWS AND META-ANALYSES

Siddharth Singh, Section Editor

Perianal Fistulizing Crohn's Disease–Associated Anorectal and Fistula Cancers: Systematic Review and Expert Consensus

Serre-Yu Wong,[1,*] Cathy Rowan,[2,*] Elvira Diaz Brockmans,[3] Cindy C. Y. Law,[1] Elisabeth Giselbrecht,[1] Celina Ang,[4] Sergey Khaitov,[5] David Sachar,[1] Alexandros D. Polydorides,[6] Leon Shin-han Winata,[7] Bram Verstockt,[8] Antonino Spinelli,[9,10] David T. Rubin,[11] Parakkal Deepak,[12] Dermot P. B. McGovern,[13] Benjamin D. McDonald,[11] Phillip Lung,[14] Lilli Lundby,[15] Amy L. Lightner,[16] Stefan D. Holubar,[17] Luke Hanna,[18,19] Carla Hamarth,[20] Jeroen Geldof,[21] Anders Dige,[22] Benjamin L. Cohen,[23] Michele Carvello,[9,10] Cristiana Bonifacio,[24] Gabriele Bislenghi,[25] Corina Behrenbruch,[26] David H. Ballard,[27] Emre Altinmakas,[28] Shaji Sebastian,[29] Phil Tozer,[19,30,31] Ailsa Hart,[18,19] and Jean-Frederic Colombel[1]

- Long standing PFCD > 10 years

- **Assess risk factors for SCCA (squamous cell carcinoma of the anus) or adenocarcinoma**

- HPV testing for high risk variants
- Anal cytology
- Age-appropriate HPV vaccinations

Statement 1. *Patients with longstanding (>10 years) persistent PFCD should be considered at a small but increased risk of developing PFCD-associated anorectal and fistula cancers, which may be squamous cell cancer of the anus (SCCA) or adenocarcinoma, including mucinous adenocarcinoma.* *47% Strongly Agree, 53% Agree*
Statement 2. *In patients with longstanding PFCD, risk factors for SCCA should be taken into account. Human papilloma viruses (HPV) testing for high-risk variants, anal cytology, and age-appropriate HPV vaccination should be considered.* *58% Strongly Agree, 25% Agree, 17% Neutral*
Statement 3. 3a. Refractory or progressive perianal symptoms (including pain, discharge, stricture, or swelling), particularly in patients with longstanding PFCD, should prompt evaluation for PFCD-associated anorectal and fistula cancers. 3b. In patients with quiescent longstanding PFCD, the emergence of new perianal symptoms (including pain, discharge, stricture, or swelling), should prompt evaluation for PFCD-associated anorectal and fistula cancers. *40% Strongly Agree, 60% Agree*
Statement 4. *Asymptomatic PFCD patients with persistent fistula should have clinical evaluation with or without MRI imaging as indicated to assess for PFCD-associated anorectal and fistula cancer. There is no consensus on the timing or frequency of evaluation.* *20% Strongly Agree, 53% Agree, 20% Neutral, 7% Disagree*
Statement 5. To evaluate for PFCD-associated anorectal and fistula cancers, multiple modalities may be required when there is a high index of clinical suspicion. These include MRI pelvis and EUA with biopsy, wherein multiple attempts at sampling may be necessary. Other modalities may need to be considered as needed/available (such as EUS or cytology of effluent from fistula). *57% Strongly Agree, 43% Agree*
Statement 6. We recommend that staging and management of PFCD-associated cancer follow current best practice guidelines used for patients with anal or rectal cancer without IBD in a multidisciplinary setting to ensure that treatments for both the cancer and IBD are optimized. *83% Strongly Agree, 17% Agree*

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TPUS and Anal Cancer

- Length and level of anal canal stenosis
- Integrity of sphincters
- Presence/exclusion of invasive anal cancer

Limitations

- Limited field of view and cannot visualize entire rectum (staging). Thus, best for anal canal and sphincters.

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1. Recognize key features

Artificial Intelligence

1. Describe latest IUS developments and future directions

BMJ Open Gastroenterology

Role of artificial intelligence in imaging and endoscopy for the diagnosis, monitoring and prognostication of inflammatory bowel disease: a scoping review protocol

BMJ Open Gastroenterol 2023;**10**:e001182. doi:10.1136/bmjgast-2023-001182

Mallory Chavannes ,[1] Lynn Kysh,[1] Mariangela Allocca,[2,3] Noa Krugliak Cleveland,[4] Michael Todd Dolinger,[5,6] Tom S Robbins,[7] David T Rubin,[4] Shintaro Sagami ,[8] Bram Verstockt ,[9,10] Kerri Novak[11]

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Unknowns:

- **Does AI in conjunction with histology, colonoscopy, CT/MR/IUS improve dx accuracy, monitoring, and prognostication?**
- **How does AI combined with dx tools compared to physicians alone?**
- **Are there additional benefits of AI/ML outside of dx, monitoring, and prognostication?**

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How can AI be beneficial?

- Automated image interpretation
- Improving diagnostic accuracy
- Supporting less experienced sonographers
- Scalable, cost-effective disease monitoring for CD and UC

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AI/ML

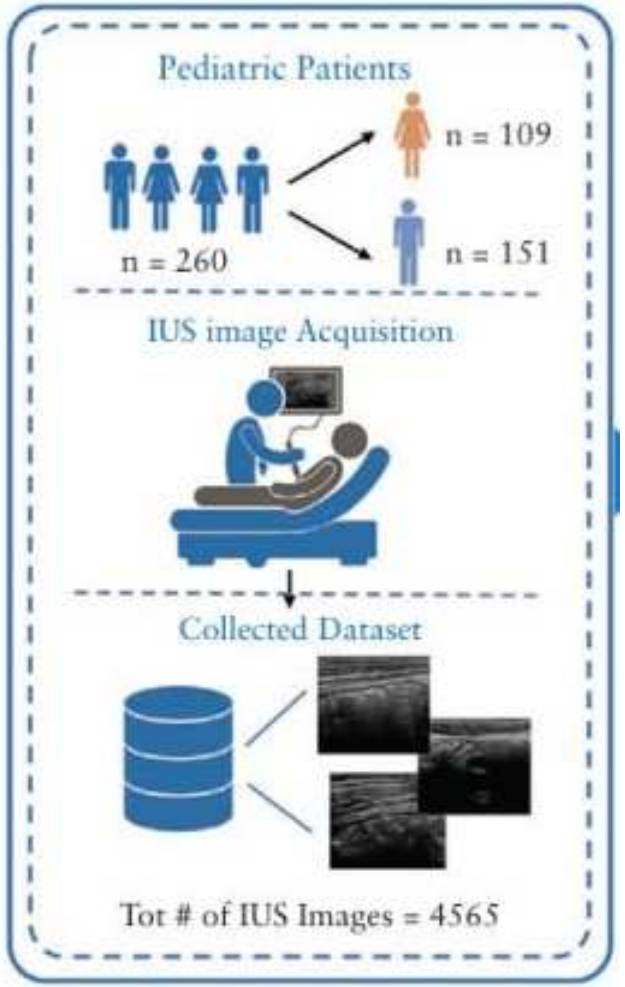
Automated Image Analysis

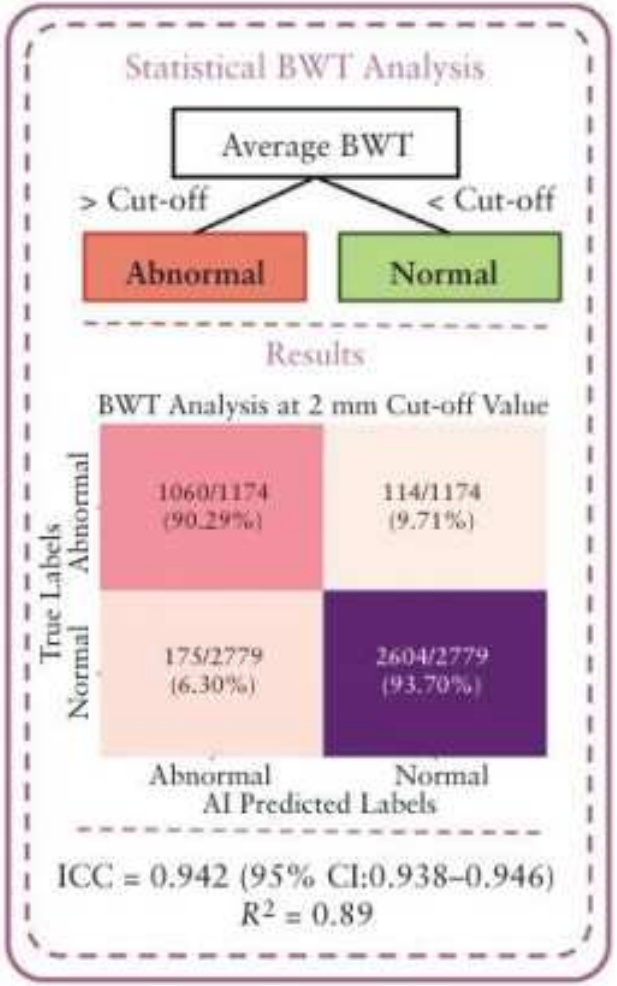
- AI algorithms can identify boundaries of bowel wall.
- Data set of 260 pediatric patients; 4565 IUS images – 1478 abnormal, 3078 normal.
- Meticulous annotation of lumen/mucosa and muscularis/serosa interface of 612 images.
- 90% sensitivity, 94% specificity

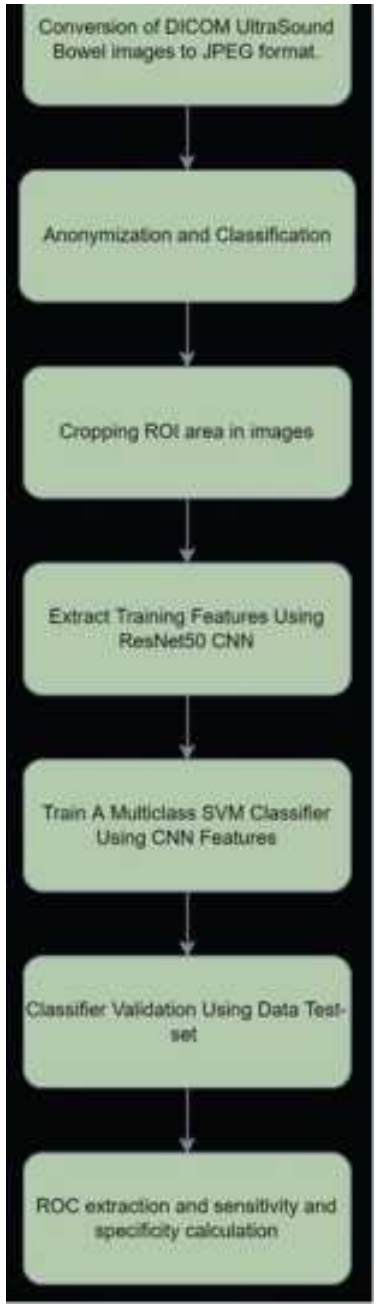
J Crohns Colitis. 2025 Apr 4;19(4):jjaf037. doi: 10.1093/ecco-jcc/jjaf037.

Artificial intelligence-assisted approach to assessing bowel wall thickness in pediatric inflammatory bowel disease using intestinal ultrasound images

Logiraj Kumaralingam [1], Kenneth Le May [2], Van Bao Dang [1], Javaneh Alavi [1], Hien Q Huynh [2], Lawrence H Le [1]







Inflamm Bowel Dis. 2023 Dec 5;29(12):1901-1906. doi: 10.1093/ibd/izad014.

Automatized Detection of Crohn's Disease in Intestinal Ultrasound Using Convolutional Neural Network

Dan Carter [1 2], Ahmed Albshesh [1 2], Carmi Shimon [3], Batel Segal [3], Alex Yershov [3], Uri Kopylov [1 2], Adele Meyers [3], Rafael Y Brzezinski [3], Shomron Ben Horin [1 2], Oshrit Hoffer [3]

- Aim – to detect BWT > 3mm

from normal bowel IUS images.

- 1008 images; 50% normal, 50% abnormal.
- Accuracy: 90.1%, sensitivity 86%, specificity 94%

DIGITAL

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AI-Powered Ultrasound for Gastrointestinal Healthcare

Revolutionizing intestinal ultrasound with AI for quicker and more accurate diagnosis of gastrointestinal diseases.

Led by Dova (formerly known as Satisfai Health) in collaboration with Alimentiv, the University of Calgary, the University of British Columbia, and the Canadian Bowel Ultrasound Society (CANBUS),

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Challenges

- Standardization of imaging protocols
- Extensive validation across diverse patient populations
- Integration into clinical practice

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Summary

Pregnancy

- Observation of the colon is easier than ileal disease, but still possible.

Transperineal Ultrasound

- Can accurately evaluate severity of rectal disease in UC and is comparable to endoscopy.
- TPUS can predict prognosis after induction
- Is helpful for perianal fistulas, inflammatory masses, abscess

Artificial Intelligence

- Very rapidly evolving with promising results.

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THANK YOU!

Questions?

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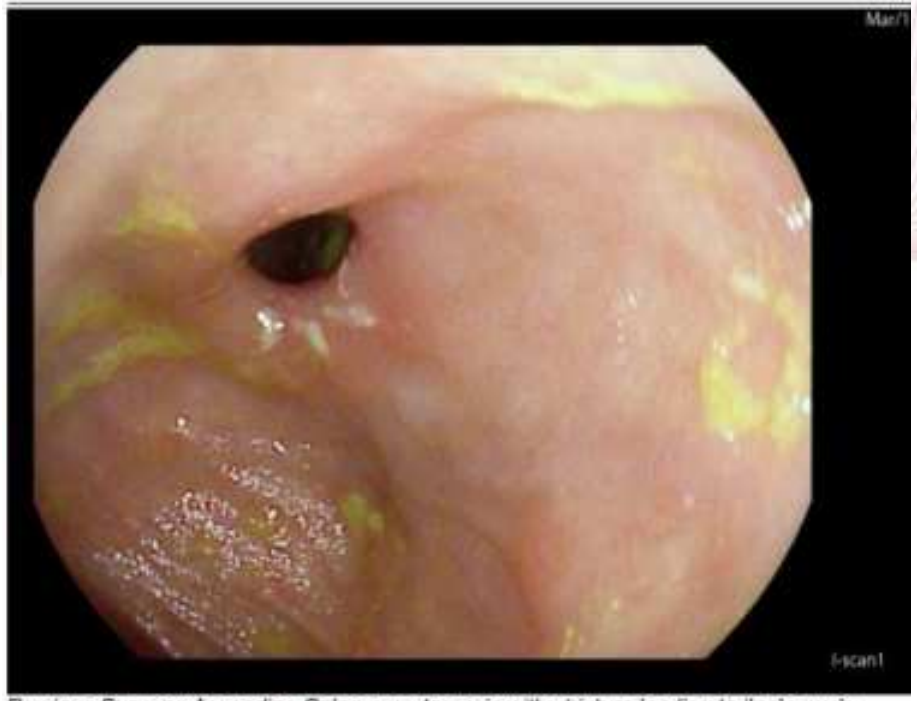
Case 2

36 year old with Ileal Crohn's diagnosed 2005

Ileocolic resection 2006, side-side anastomosis

2023 colonoscopy – mildly ulcerated stricture distal to anastomosis

Plan to conceive. Patient's preference to have no medications



Previous Surgery; Ascending Colon; anastomosis with stricture leading to ileal pouch

Previous Surgery; Ascending Colon; anastomosis leading to neoterminal ileum

Test	Result	Ref. Range (Units)
Fecal Calprotectin	* 129	

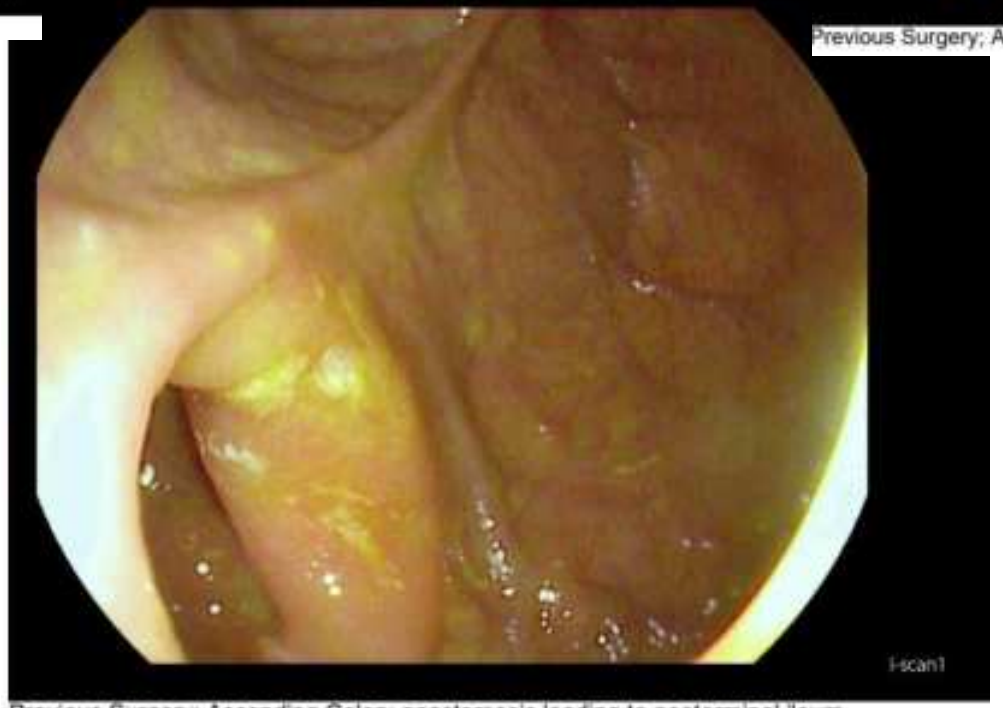
Test	Result	Ref. Range (Units)
C-Reactive Protein (CRP)	<0.6	<8.0 (mg/L)

Test	Result	Ref. Range (Units)
Auto WBC	6.6	4.0-11.0 (10^9/L)
RBC	4.08	3.80-5.20 (10^{12}/L)
Hemoglobin	130	120-160 (g/L)
Hematocrit	0.41	0.36-0.48 (L/L)
MCV	100	80-100 (fL)
MCHC	320	310-360 (g/L)
RDW	12.5	<16.0 (%)
Platelets	258	140-400 (10^9/L)
nRBC	<1	<1 (/100 WBCs)

Previous Surgery; Ascending Colon; anastomosis with stricture leading to ileal pouch


Previous Surgery; Ascending Colon; dilated neoterminal ileum


Previous Surgery; Ascending Colon; anastomosis leading to neoterminal ileum


Previous Surgery; Ascending Colon; anastomosis leading to neoterminal ileum

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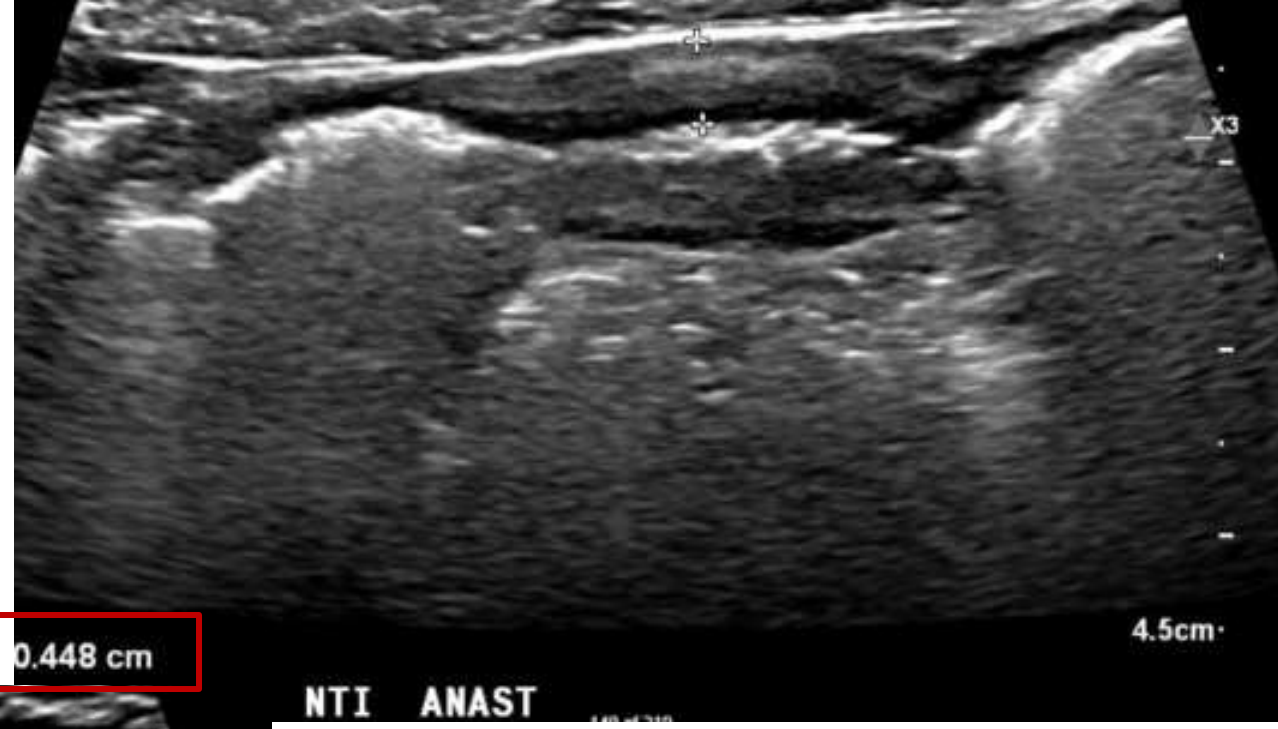

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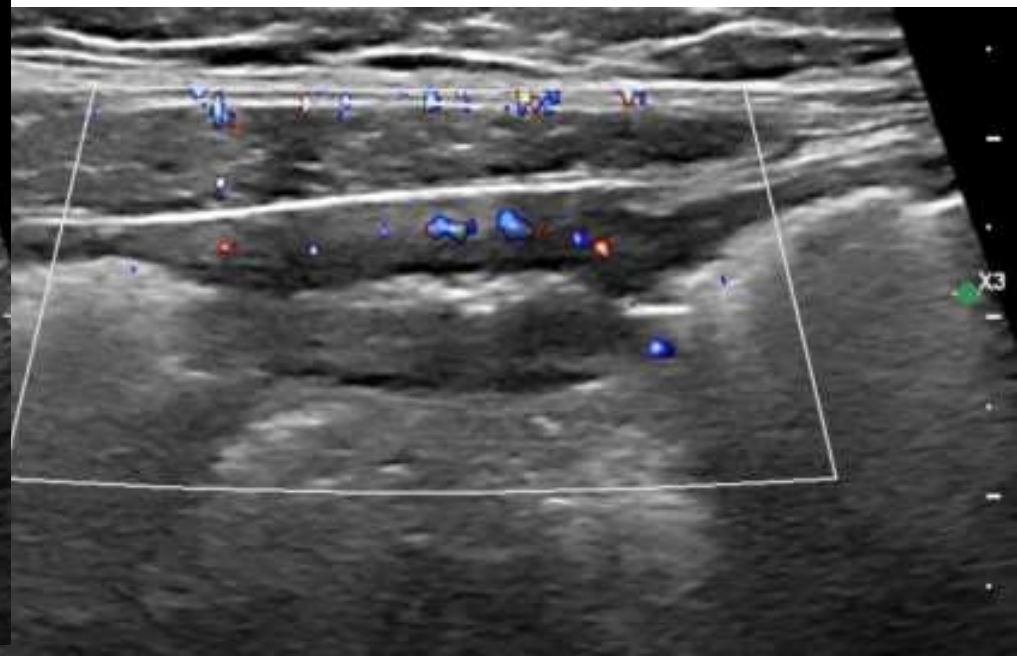
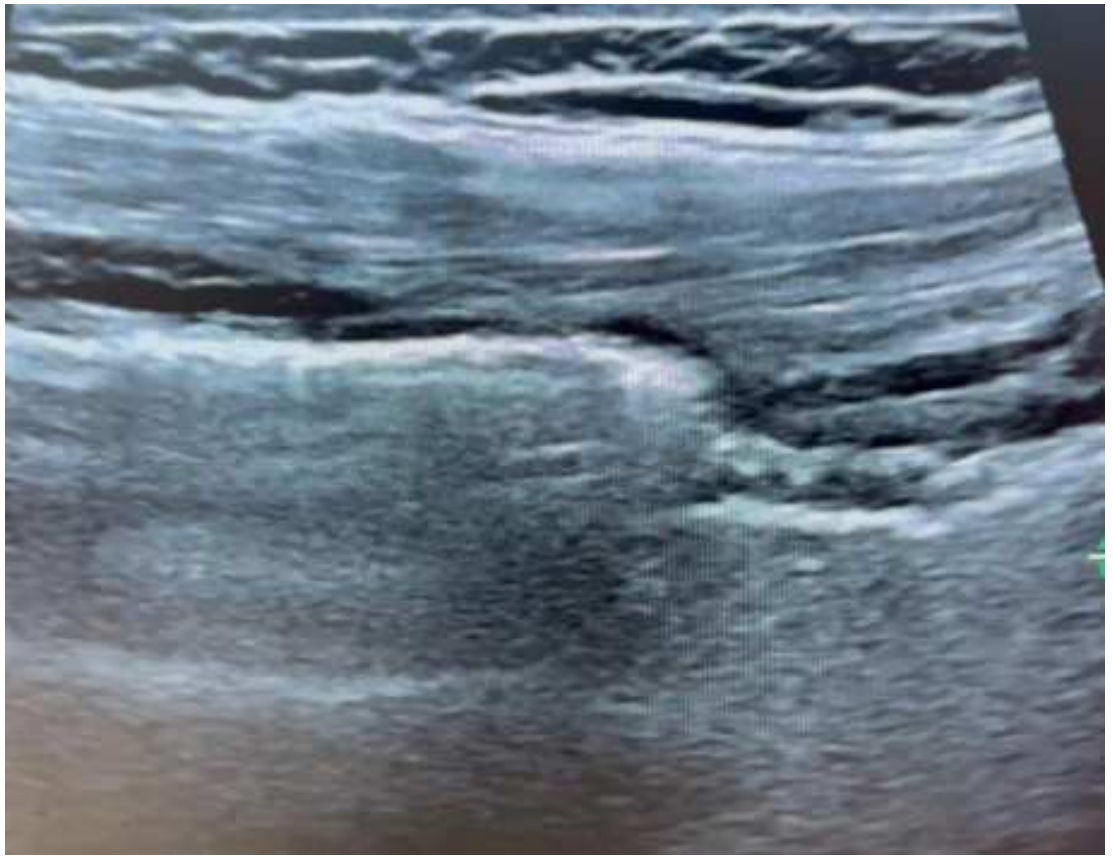
(0.448 cm



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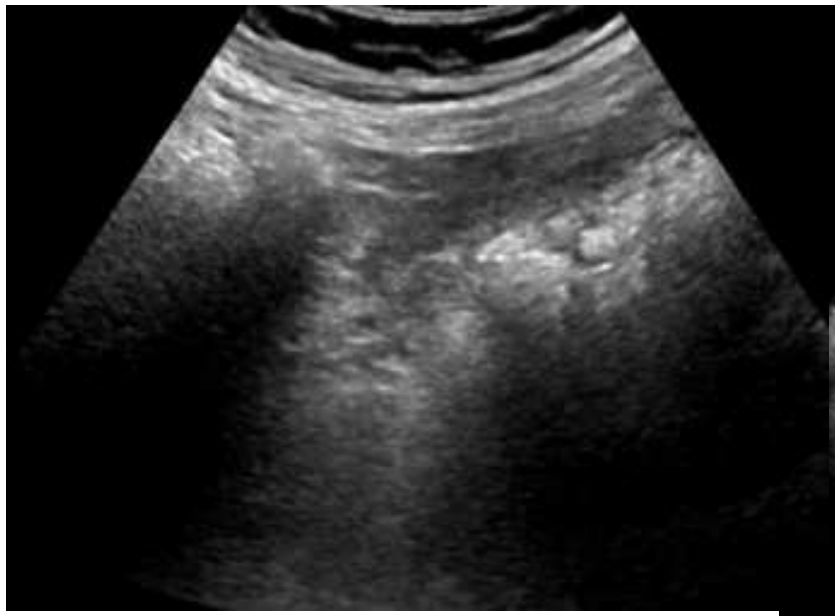

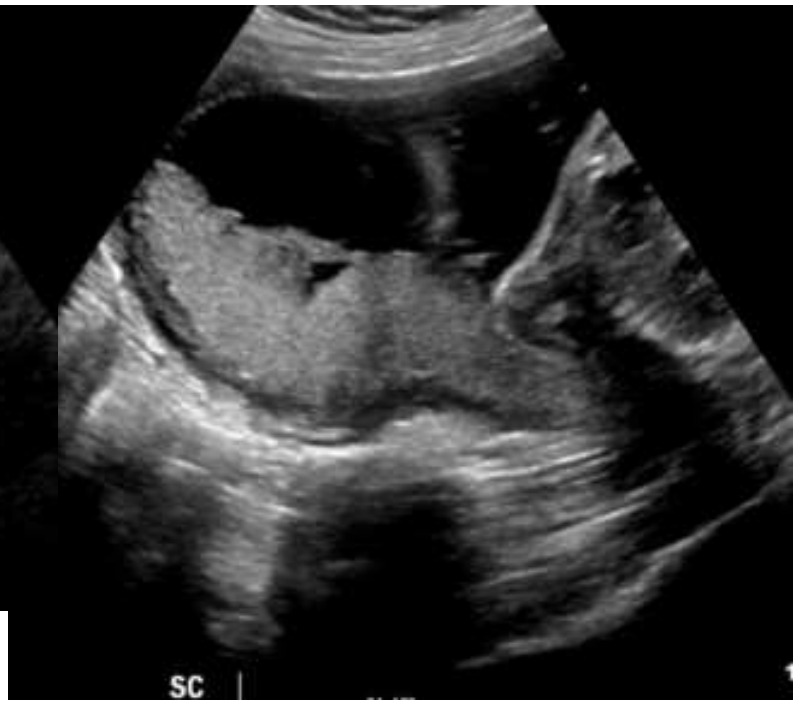
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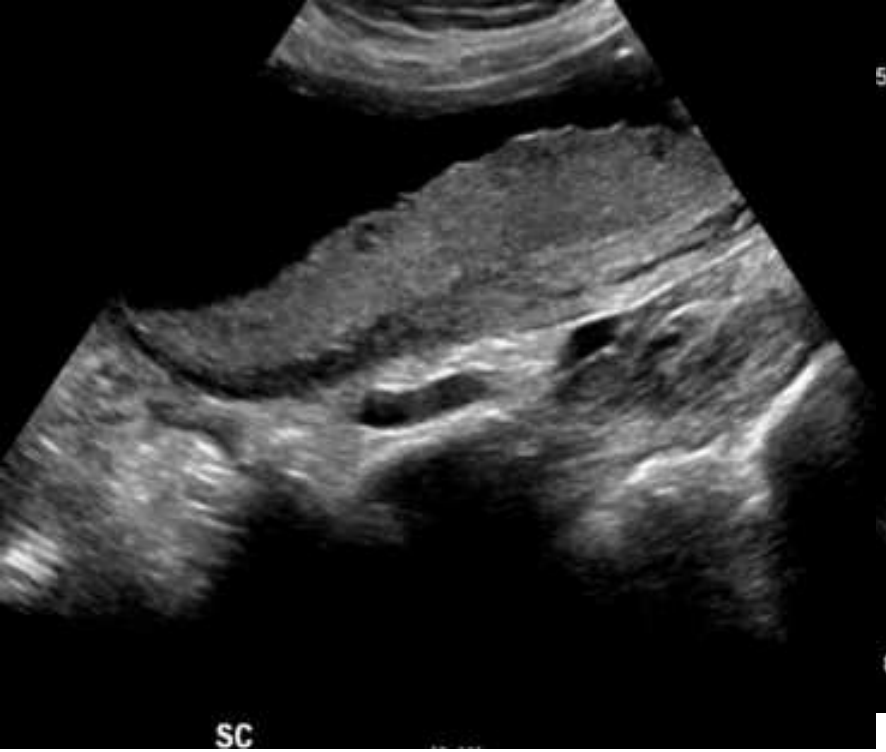
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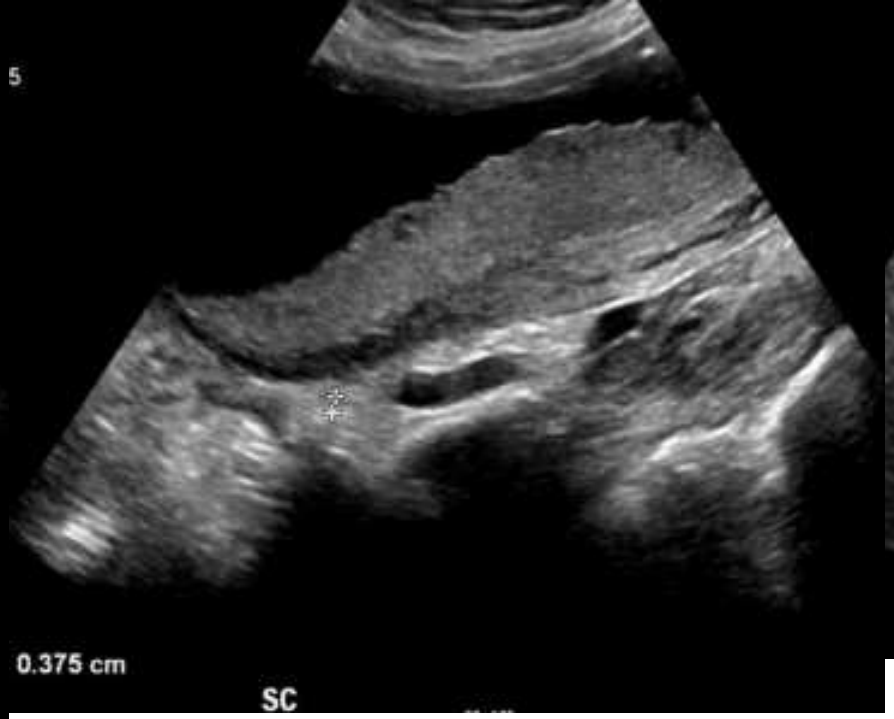
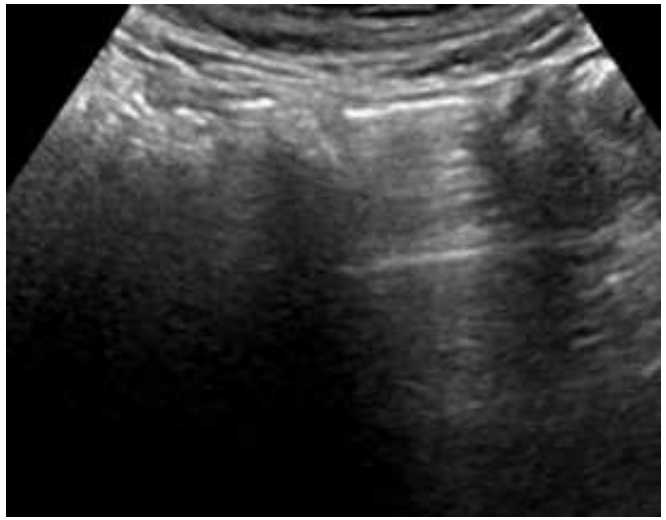
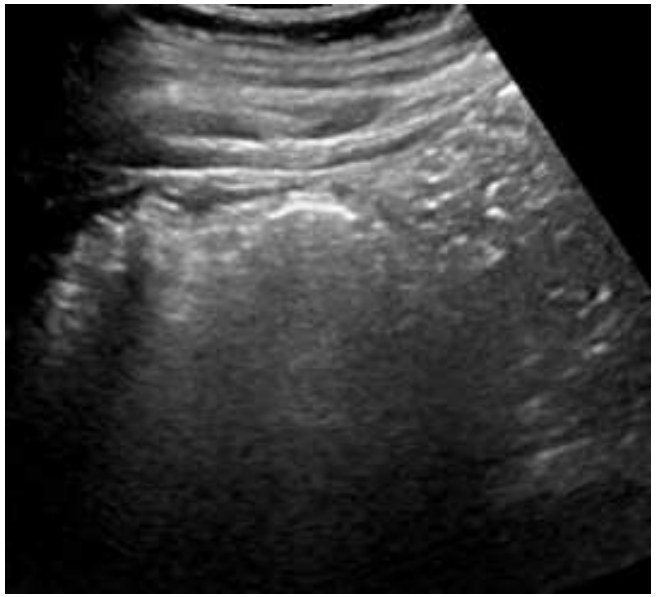

5
0.375 cm
SC


DC





	Before Conception	25 weeks
BWT	4.5mm	5.6mm
ifat	Present	Present
CDS	Mild (mLimberg 1)	Mild (mLimberg 1)
Stratification	Present	Present
Stricture	5cm, Luminal narrowing, PSD	5cm, luminal narrowing, PSD

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Plan

- Close monitoring with biomarkers
- Repeat IUS in third trimester
- Monitor for CD flare postpartum

*IUS is helpful to prognosticate particularly in asymptomatic patients