

IUS documentation and scoring

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Disclosures

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Summary

- Cineloop acquisition
- Scoring
- Reporting

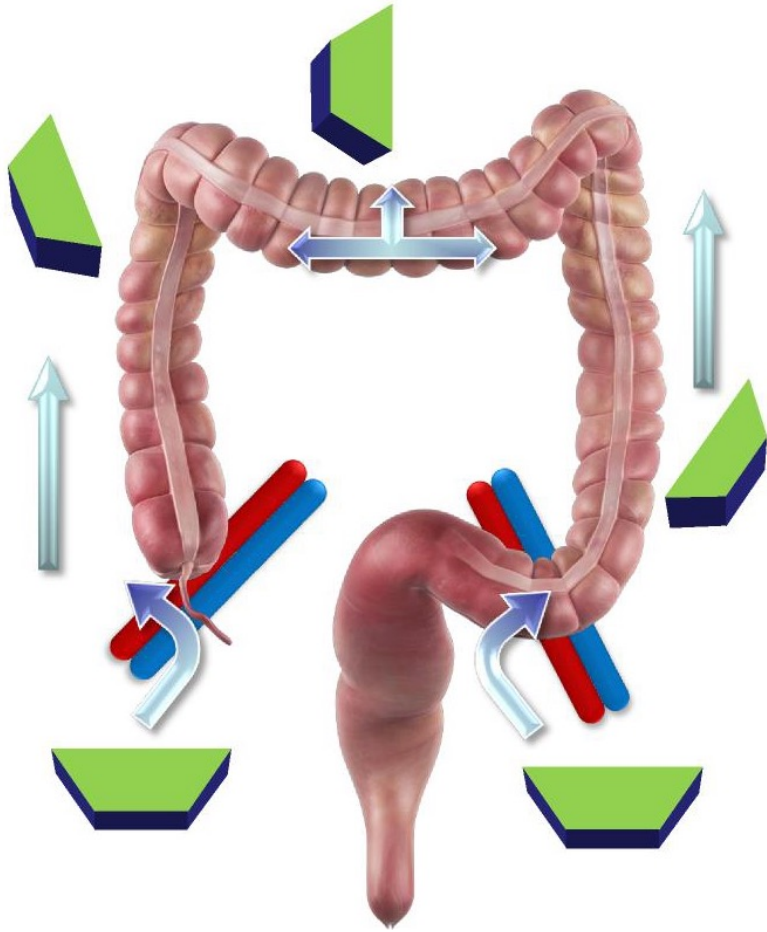


Speaking the IUS language





Cineloop acquisition



- Optimized acquisition (depth, gain, focus)
- CDS velocity from $\pm 5-7$ cm/s
- Three 3-10 sec cineloops of each bowel segment: longitudinal, cross-sectional and CDS
- Annotations



IUS Scores

- In a systematic review identified 26 studies reporting IUS scores and indices:
 - Data on reliability and responsiveness were reported in 10 studies
 - Majority (24/26) of the studies were at low, unclear or high risk bias
- An expert panel recommended the following IUS scores for use in clinical trials:
 - Uncertainty in IUS score
 - As outcome measure for disease activity with or without mesenteric inflammation
 - IUS score as appropriate

IBUS-SAS
UC-US score
Milan Ultrasound Criteria



IBUS-SAS

1. Expert Delphi consensus to derive measures of IUS activity identified 4 key parameters
2. Assess inter-rater reliability for individual measures: moderate to substantial
3. Refinement of case acquisition and interpretation
4. 30 blinded cases for reliability assessment: almost perfect ICC (0.97 [0.95–0.99, $p < 0.001$])

$$\text{IBUS – SAS (0–100)} = 4 \cdot \text{BWT} + 15 \cdot \text{i-fat} + 7 \cdot \text{CDS} + 4 \cdot \text{BWS}$$

Table 1. Complete list of activity parameters derived from expert consensus.

Bowel wall thickness [BWT]	Mucosal ulcers
Colour Doppler imaging signal [CDS]	Length of disease
Inflammatory mesenteric fat [i-fat]	Disease location
Bowel wall stratification [BWS]	Intraperitoneal free fluid
Complications [stenoses, fistulae]	Serosal margin spiculation
Abnormal peristalsis	Mesenteric lymph nodes

Table 3. Expert-derived blinded voting results: inter-rater reliability for IUS parameters during first and second round of voting.

	Coefficient 1st round	Coefficient 2nd round	<i>p</i> -value
BWT	NA	0.96 [0.94–0.98]*	NA
CDS	0.62 [0.42–0.82]	0.60 [0.48–0.72]	0.776
i-fat	0.45 [0.27–0.64]	0.51 [0.34–0.67]	0.531
BWS	0.50 [0.29–0.71]	0.39 [0.24–0.53]	0.120
Confidence	0.06 [0.0–0.16]	0.08 [0.0–0.17]	0.534
Quality	0.15 [0.05–0.25]	0.14 [0.04–0.23]	0.776
Activity	0.92 [0.82–0.98]	0.96 [0.94–0.98]*	0.005
Severity	0.97 [0.91–0.99]	0.93 [0.87–0.97]*	0.980



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International Bowel Ultrasound
Segmental Activity Score

IBUS-SAS

4X

BWT

Bowel Wall Thickness

Measure the bowel wall average in two scan planes

Locate the thickest part of the bowel wall.

Place the calipers perpendicular to the bowel wall.

Two measures more than 90° apart in cross-section

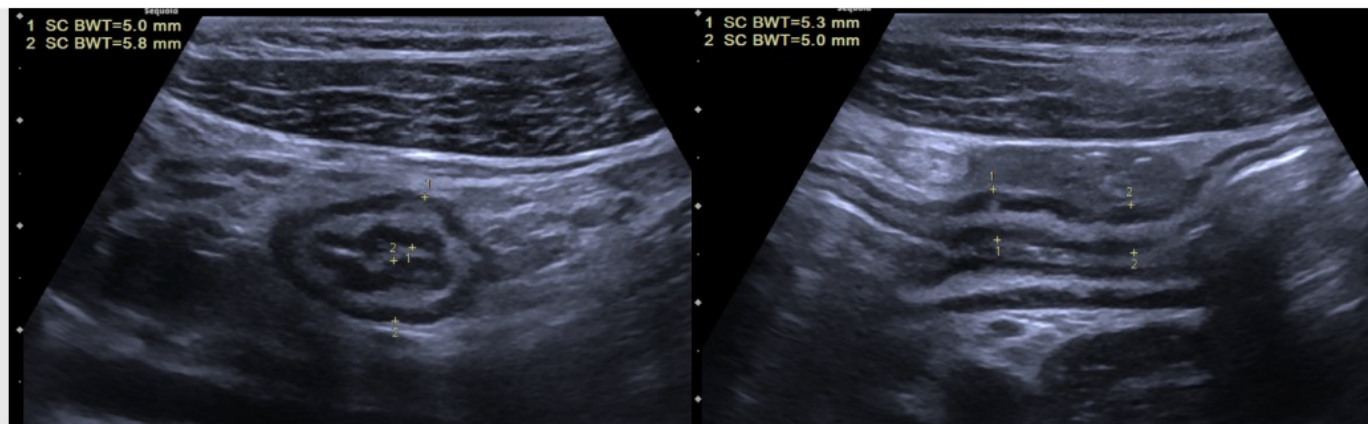
Two measures at least 1 cm apart in longitudinal.

Bowel wall thickness (4 measures / 4)

Normal ≤ 2.0 mm

Uncertain 2.1-3.0 mm

Activity > 3.0 mm



Cross-section

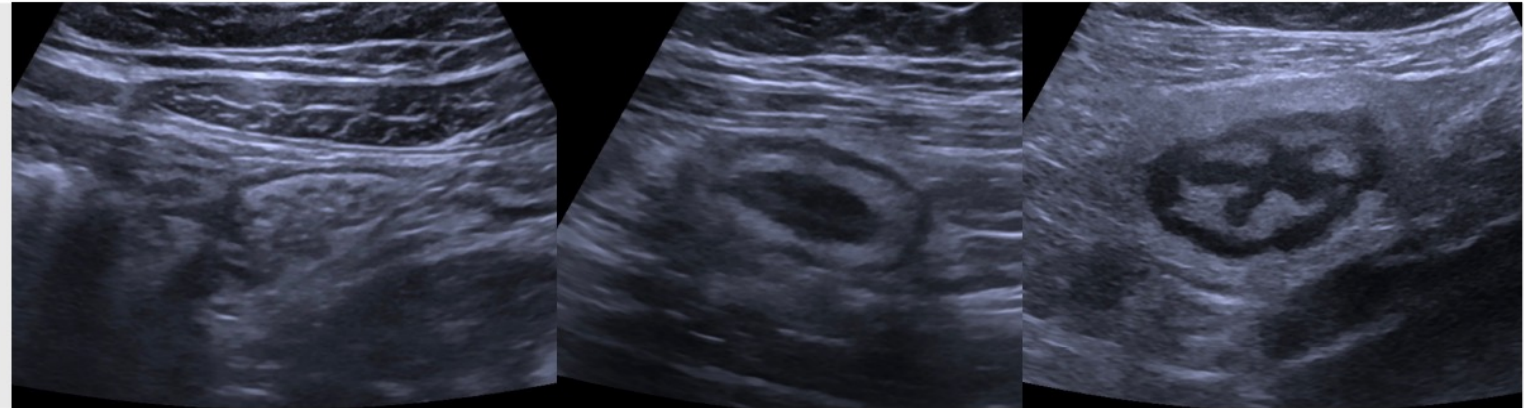
Longitudinal



15X i-FAT

Inflammatory Fat

Presence of mesenteric, inflammatory fat proliferation: homogeneous, hyperechoic mass located on one side or (partly) surrounding the thickened bowel wall.



Absence = 0

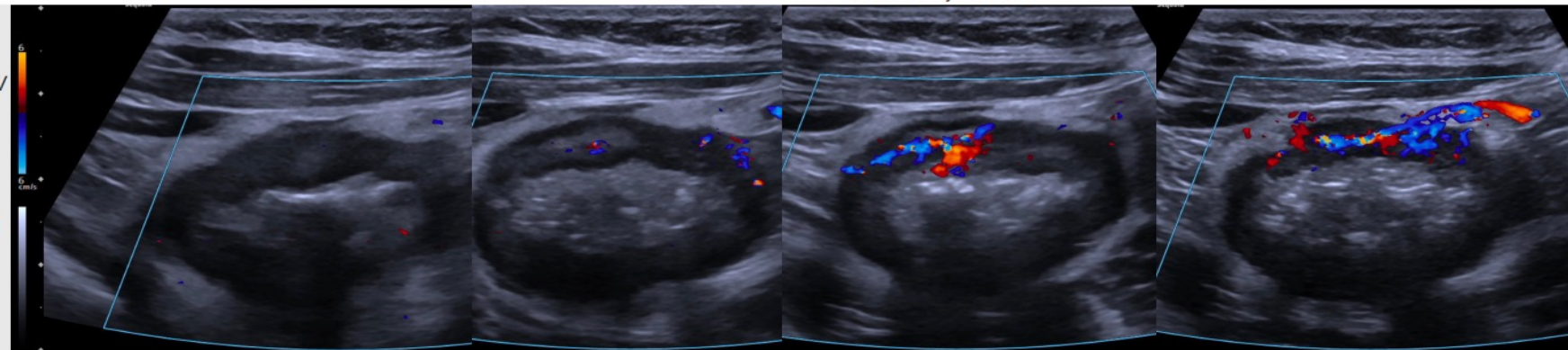
Indeterminant = 1
imaging quality precludes
adequate assessment OR
i-fat is barely visible

Present = 2

7X CDS

Color Doppler Signal

Optimize scale for low flow
±5-7 cm/s
Adjust below noise level
Cross-section is preferred
Doppler box >1 cm outside
Bowel wall



No signal = 0

Small individual signals = 1

Long signals inside
bowel wall = 2

Long signals inside bowel
wall AND signals outside
the bowel wall = 3

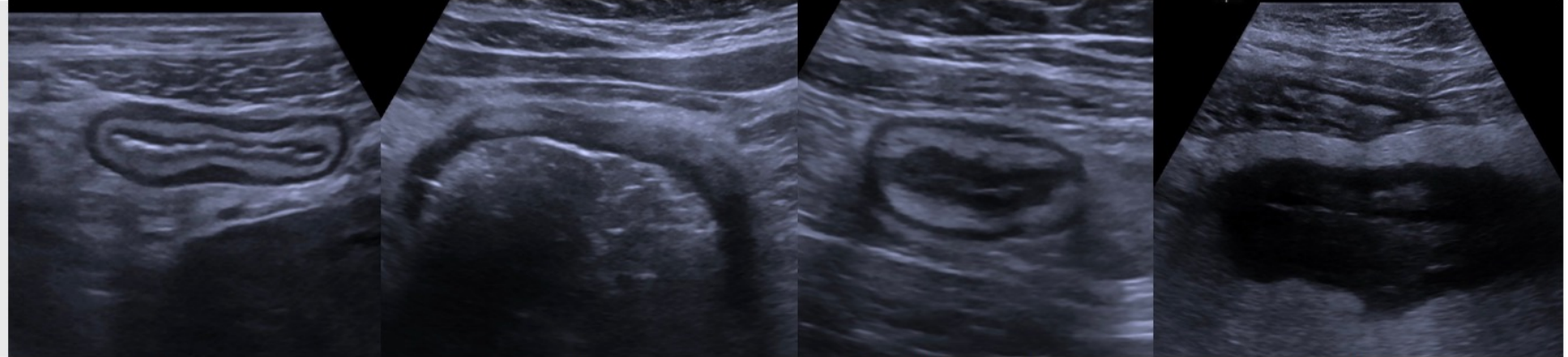


4X BWS

Bowel Wall Stratification

Bowel Wall Stratification is characterized by consistent visualization of ≥ 3 distinct wall layers.

*Disruption or loss of BWS may be due to ulcers



Absent = 0

Indeterminant = 1

Focal* (≤ 3 cm) = 2

Extensive* (>3 cm) = 3

IBUS-SAS (0–100)

4 x BWT + 15 x i-fat + 7 x CDS + 4 x BWS

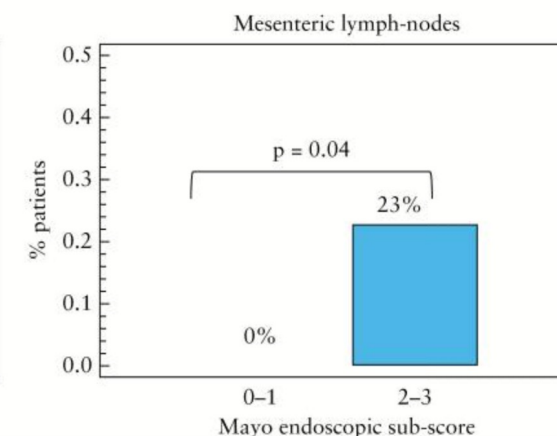
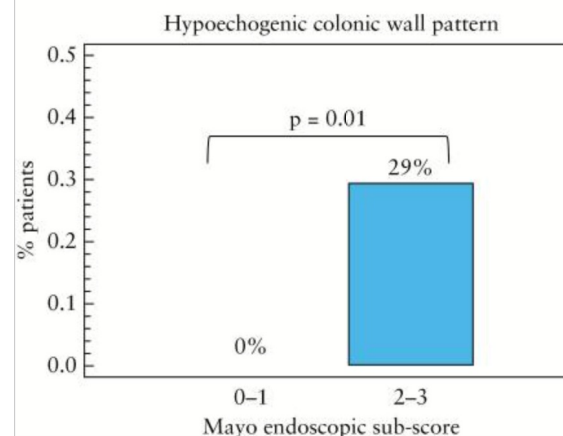
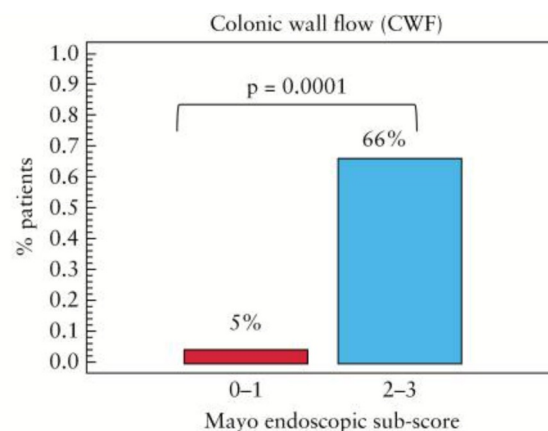
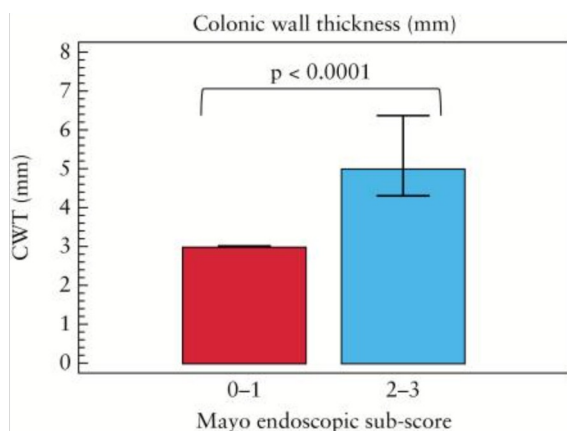


Milan Ultrasound Criteria (MUC)

In a prospective cohort 53 patients with UC going through endoscopy and IUS were assessed by two independent readers; BWT and CDS were independent predictors of endoscopic activity (eMayo 0-1 vs 2-3).

MUC ≥ 6.3 identified the best cut-off to discriminate active versus non active UC

$$\text{MUC: } 1.4 \times \text{CWT [mm]} + 2 \times \text{CWF}$$





UC-US Score

In a prospective cohort 60 consecutive UC patients going through IUS and endoscopy, IUS parameters and endoscopy were compared for each colonic segment (207) and best parameters used to construct the UC-IUS index.

UC-US score	
Parameters	Points (0-7)
Bowel wall thickness	
- > 2mm	1
- > 3mm	2
- > 4mm	3
Doppler signal	
- Small spots	1
- Large spots/stretching	2
Loss of haustrations	1
Fatty wrapping	1



Case 1: 47-year-old patient with UC

Previous history:

2004: diagnosed with UC E3

2004-2021: treated with mesalazine, budesonide, AZA, ADM and VDZ

2021(03): on the patient's request stopped with VDZ in endoscopic remission

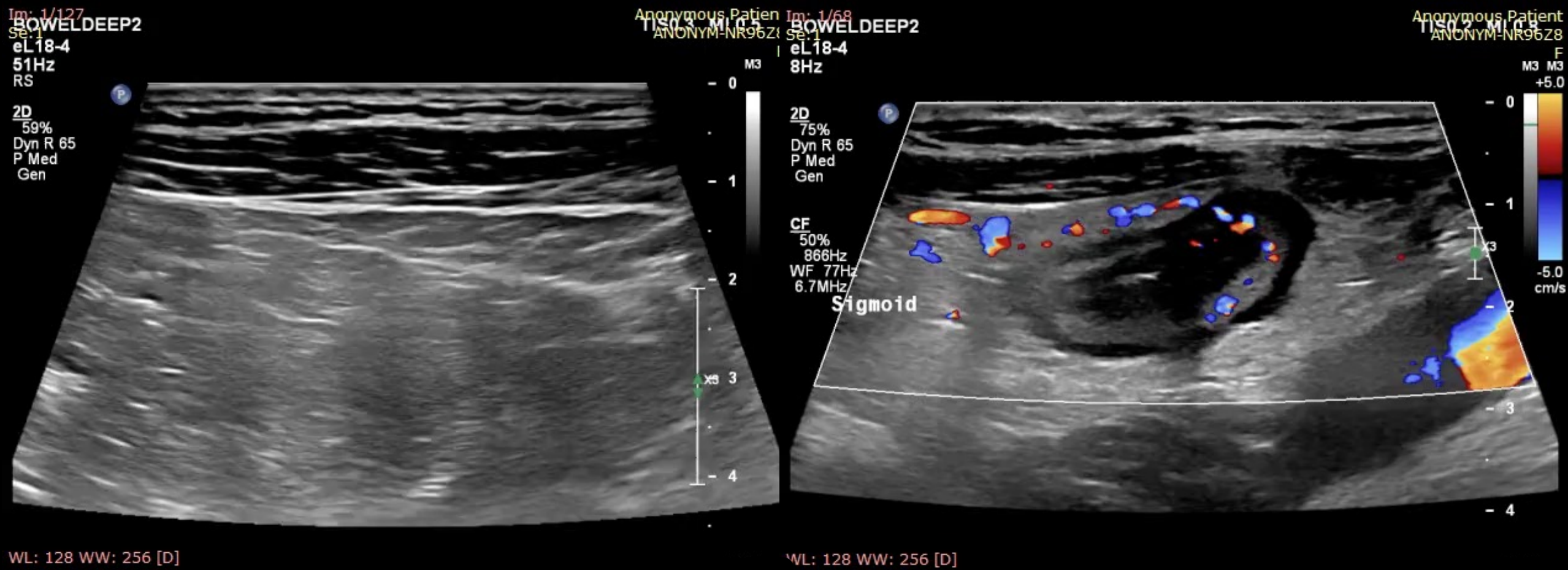
Presentation:

2022(04): increased SF and RB

Calprotectine: 2065 mg/kg I CRP 3.3 mg/L I Leukocyte count 11.4×10^9 /L I Hb 7.1 mmol/L
IUS

BWT: 6mm
i-fat: 2
CDS: 3
BWS: 2
IBUS SAS: $4 \times 6 + 15 \times 2 + 7 \times 3 + 4 \times 2 = 83$

UC-US: 7
MUC: $1.4 \times 6 + 2 \times 2 = 12.4$





IUS Reporting

Intestinal ultrasound report

(IMAGES CAN BE FOUND UNDER THE 'OTHER' TAB Under order name 'MDLZ POLI ECHO'. Click on 'Show PACS ultrasound images'.)

Ultrasound device:

Sonographer:

Clinical information:

Referral question:

General:

Only an ultrasound of the intestinal tract was made.

The **quality** of the imaging was excellent/good/acceptable/bad.

The examination was **painful/not painful**.

Postoperative anatomy: no/yes, if yes: ICR/other: free text



IUS Reporting

Intestinal ultrasound report

Intestinal:

Rectum: can/cannot be assessed, has a bowel wall-thickness of x mm.
Doppler was not performed/performed (mLimberg 0/1/2/3).

Sigmoid, Descending colon, Transverse colon, Ascending colon (each separately)

The bowel wall thickness (BWT) measures x mm.

Doppler was not performed/performed (mLimberg 0/1/2/3).

Bowel wall stratification: normal/uncertain/focal ($\leq 3\text{cm}$)/extensive ($> 3\text{cm}$)

Haustrations: preserved/not preserved

Fat wrapping: yes/no/uncertain

Lymph nodes: yes/no

Stenosis: yes/no, if yes: single/multiple; BWT/BWS/CDS at the stenosis, prestenotic dilation yes/no, if yes maximum diameter



IUS Reporting

Intestinal ultrasound report

Terminal ileum:

The bowel wall thickness (BWT)) is x mm.

Doppler was not performed/performed (mLimberg 0/1/2/3).

Bowel wall stratification: normal/uncertain/focal ($\leq 3\text{cm}$)/extensive ($\geq 3\text{cm}$)

Haustrations: preserved/not preserved

Fat wrapping: yes/no/uncertain

Lymph nodes: yes/no

Stenosis: yes/no, if yes: single/multiple; BWT at the stenosis, stratification at the stenosis, CDS at the stenosis, prestenotic dilation yes/no, if yes maximum diameter

Motility: increased/normal/reduced/lack of motility

Overview: No major abnormalities were seen in the abdomen. No abscesses, no fistulas.

Conclusion: Free text



Conclusions

- Ideal image acquisition includes 3 cineloops per segment (longitudinal, cross-sectional, and CDS), with annotations
- Harmonized and detailed reporting:
 - allows objective evaluation of disease state and comparison between time points
 - opens new avenues for global quality research
- IUS scores will ideally be integrated into IUS reports



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