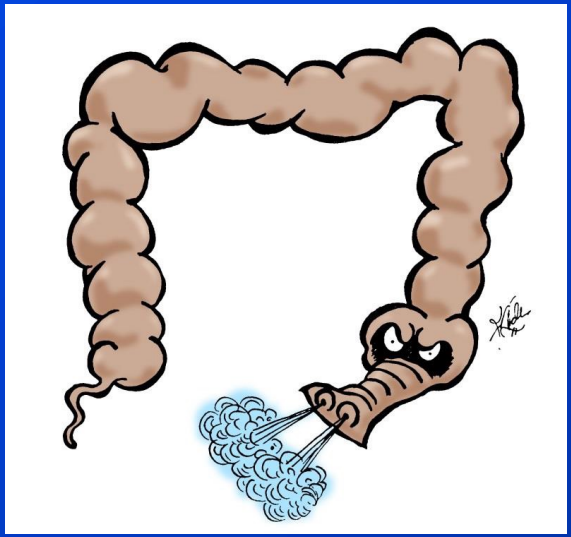
Nasjonalt Senter for
Gastroenterologisk Ultrasonografi

National Centre for Ultrasound in Gastroenterology
Haukeland University Hospital, Bergen, Norway

Ultrasound of GI Pathology



Odd Helge Gilja, MD, PhD

Professor

Department of Medicine

Haukeland University Hospital

Bergen, Norway

The Gastro-Intestinal Landscape - a challenge for GIUS !

Lake Chamo


Taking a last breath before
going down the GI tract
Photo: OH Gilja

GIUS – EFSUMB guidelines on Gastro-Intestinal Ultrasound

- Task Force Group of over 20 experts from Europe
- Started at UEG Week October 2014
- 7 guideline/position papers are published / in progress:
  - 1. Methodology and examination technique (published EJU 2016)
  - 2. IBD (Published – EJU 2018)
  - 3. Perineal and transrectal US (Published- UIO - 2019)
  - 4. Acute appendicitis and diverticulitis (Published EJU 2019)
  - 5. Misch./ Coeliac / Upper GI (Published Med Ultrason -2019)
  - 6. Intestinal Emergencies (Published EJU 2020)
  - 7. Functional Disorders (Published UIO 2021)

New Guidlines on GIUS

Guidelines & Recommendations

EFSUMB Recommendations and Guidelines for Gastrointestinal Ultrasound

Part 1: Examination Techniques and Normal Findings (Long version)

EFSUMB-Empfehlungen und Leitlinien des Gastrointestinalen Ultraschalls

Teil 1: Untersuchungstechniken und Normalbefund (Langversion)

Authors K. Nylund[1], G. Maconi[2], A. Hollerweger[3], T. Ripolles[4], N. Pallotta[5], A. Higginson[6], C. Serra[7], C. F. Dietrich[8], I. Sporea[9], A. Saftoiu[10], K. Dirks[11], T. Hausken[12], E. Calabrese[13], L. Romanini[14], C. Maaser[15], D. Nuernberg[16], O. H. Gilja[17]

Affiliations Affiliation addresses are listed at the end of the article.

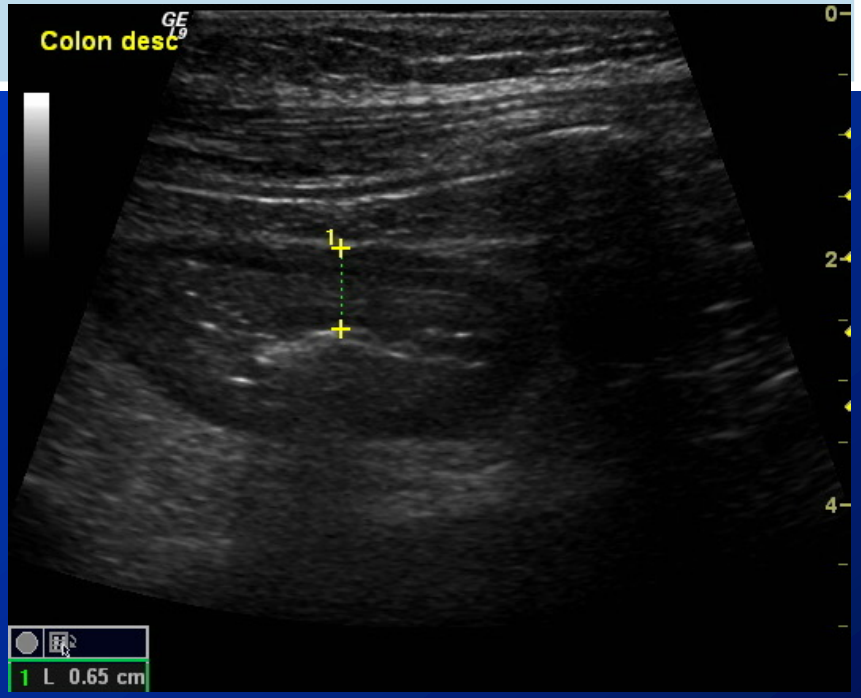
19 recommendations included

Nylund K , Maconi G, …, Gilja OH, Ultraschall in Med 2016

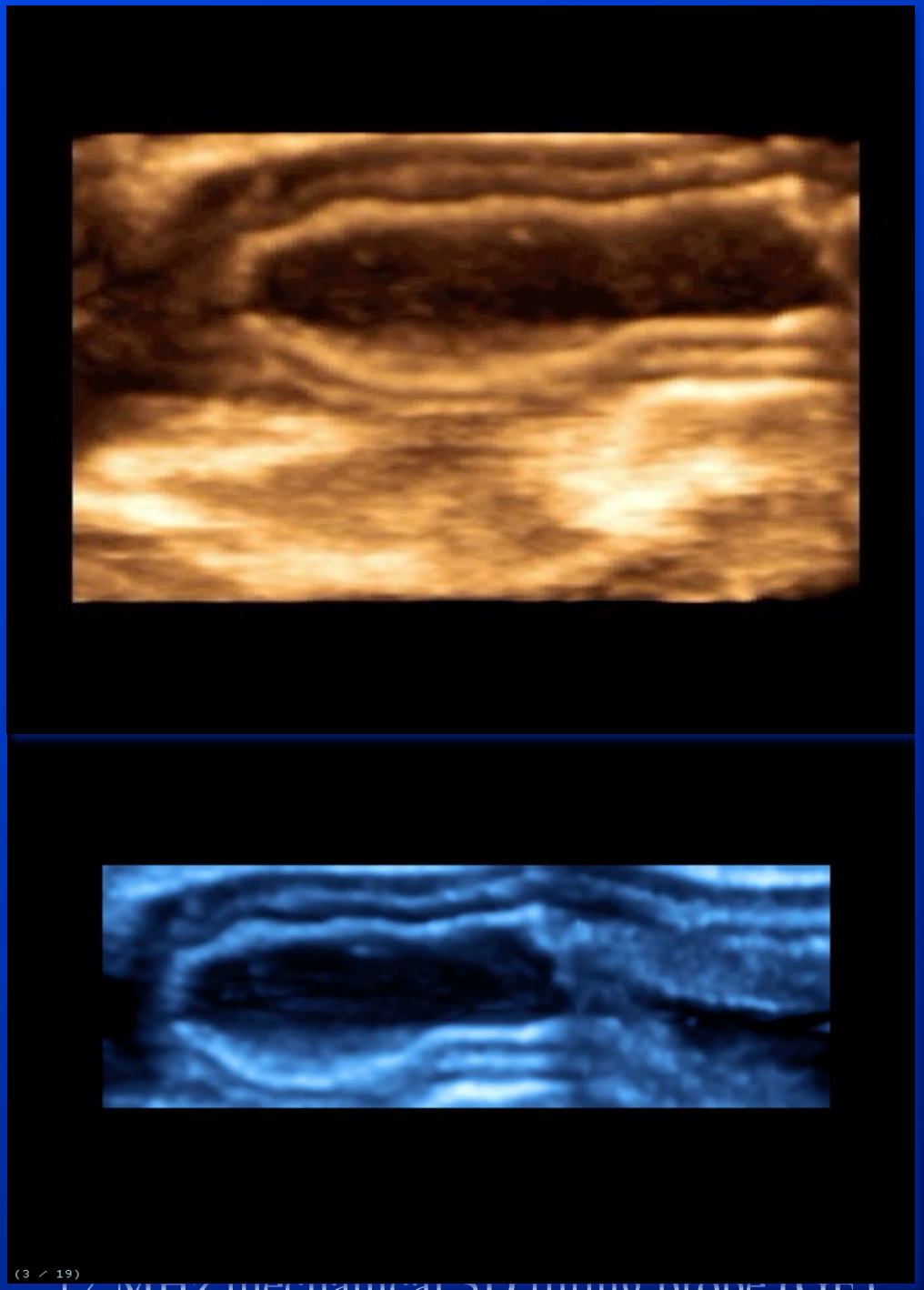
New EFSUMB Guidlines on GIUS

Recommendations:

1. For a complete examination of the bowel both a low and high resolution probe are needed, LoE 5, GoR C, Strong consensus 13/13
2. A probe with a frequency above 5 MHz should be used when measuring wall thickness, LoE 4, GoR B, Strong consensus 13/13

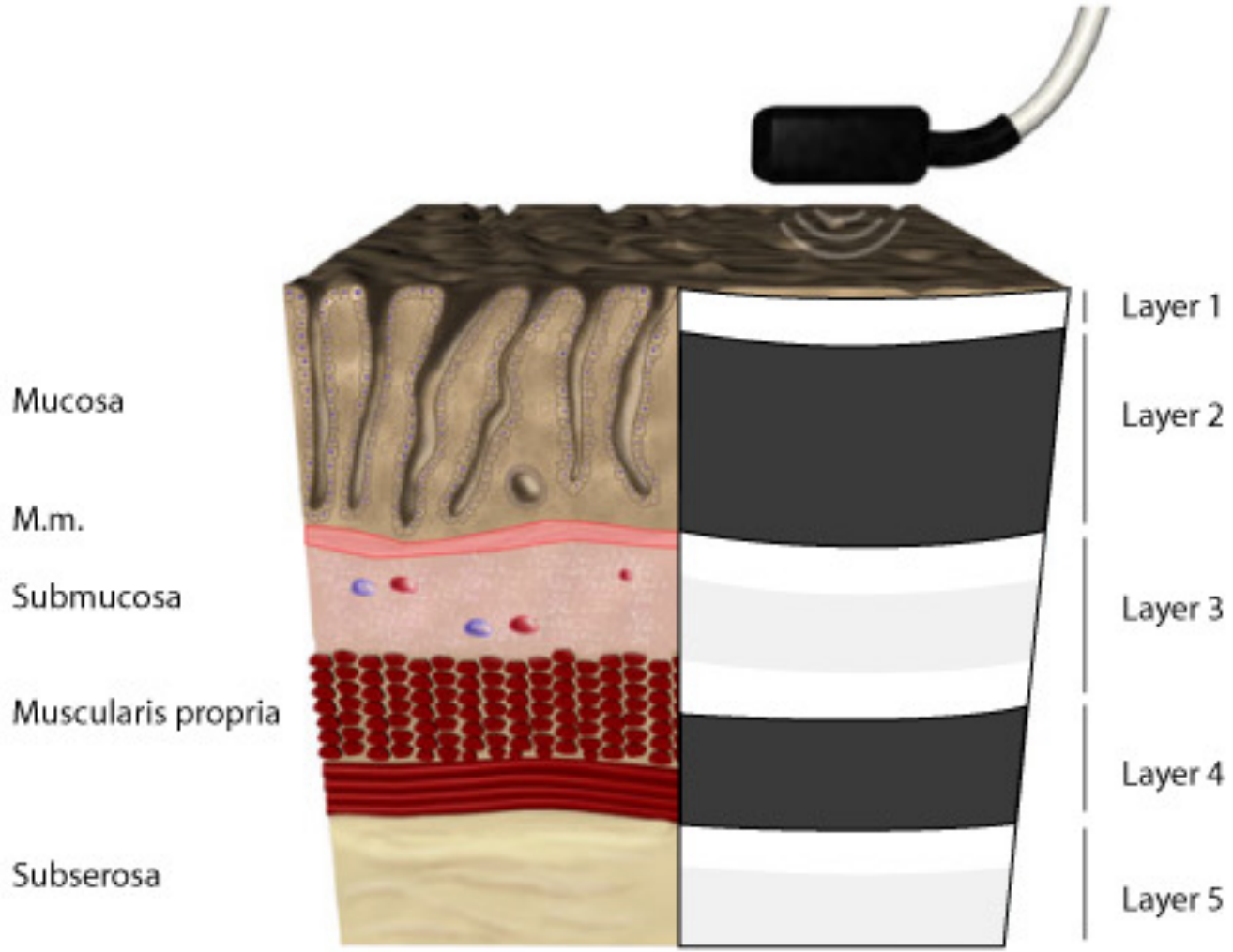


ULTRA-SOUND OF GI WALL LAYERS

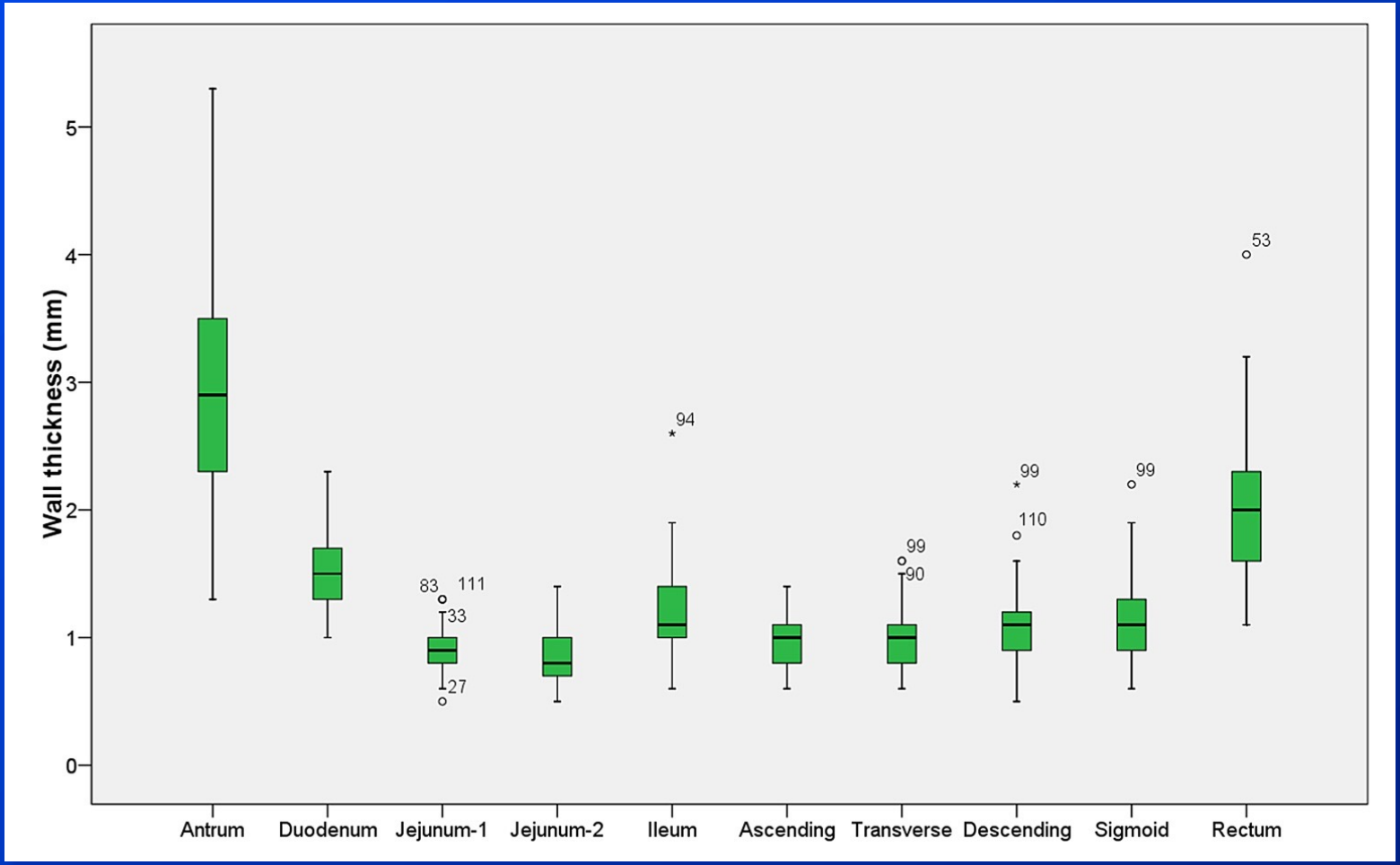


12 MHz mechanical 3D tilting probe (GE)

GI Wall Layers



Wall thickness in different parts of the GI tract

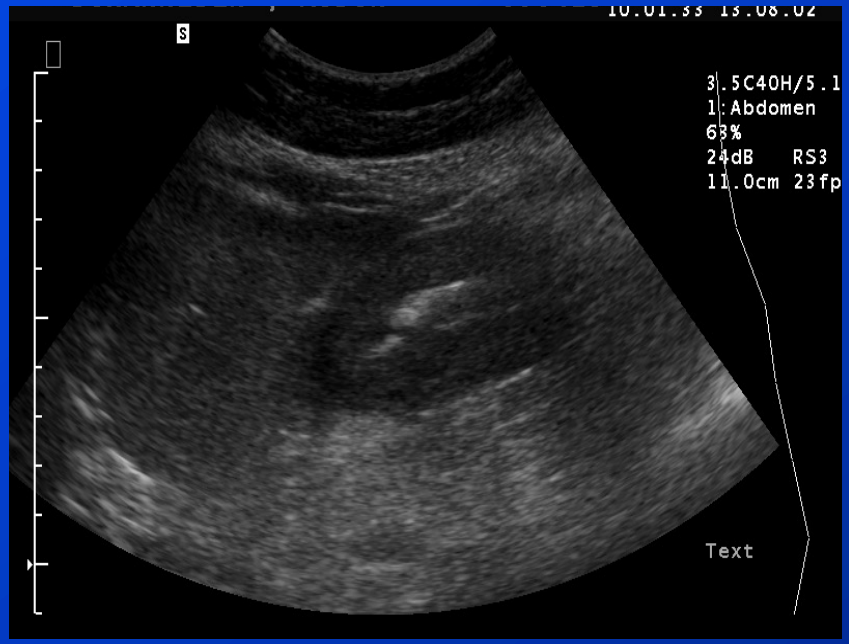


Box-plot of wall thickness measurements in the gastrointestinal wall in 122 healthy volunteers (12MHz).

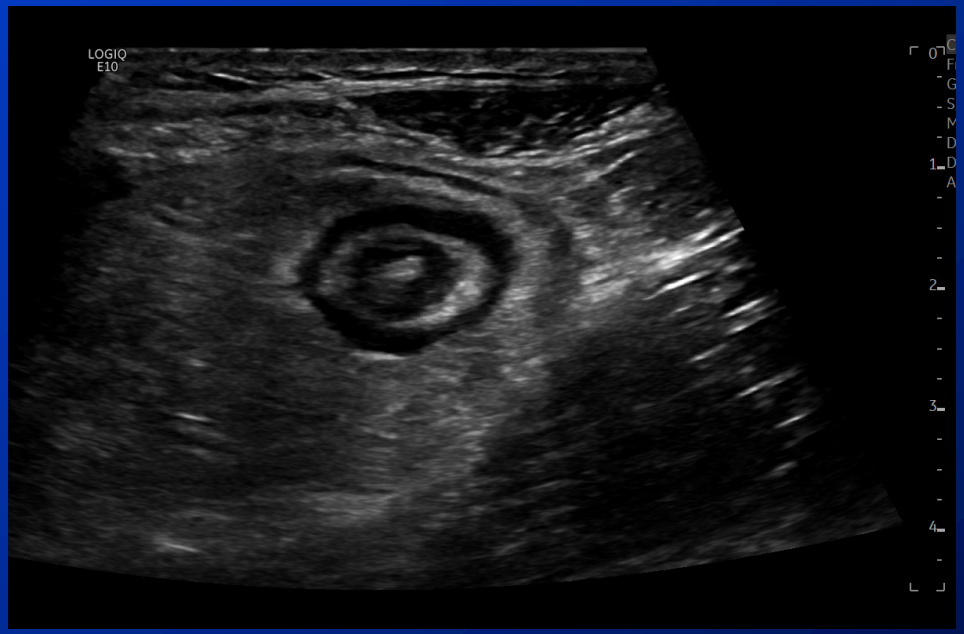
Nylund K et al. Ultraschall/EJU 2012

Be aware !
Signs of severe pathology

Pseudo-Kidney Sign



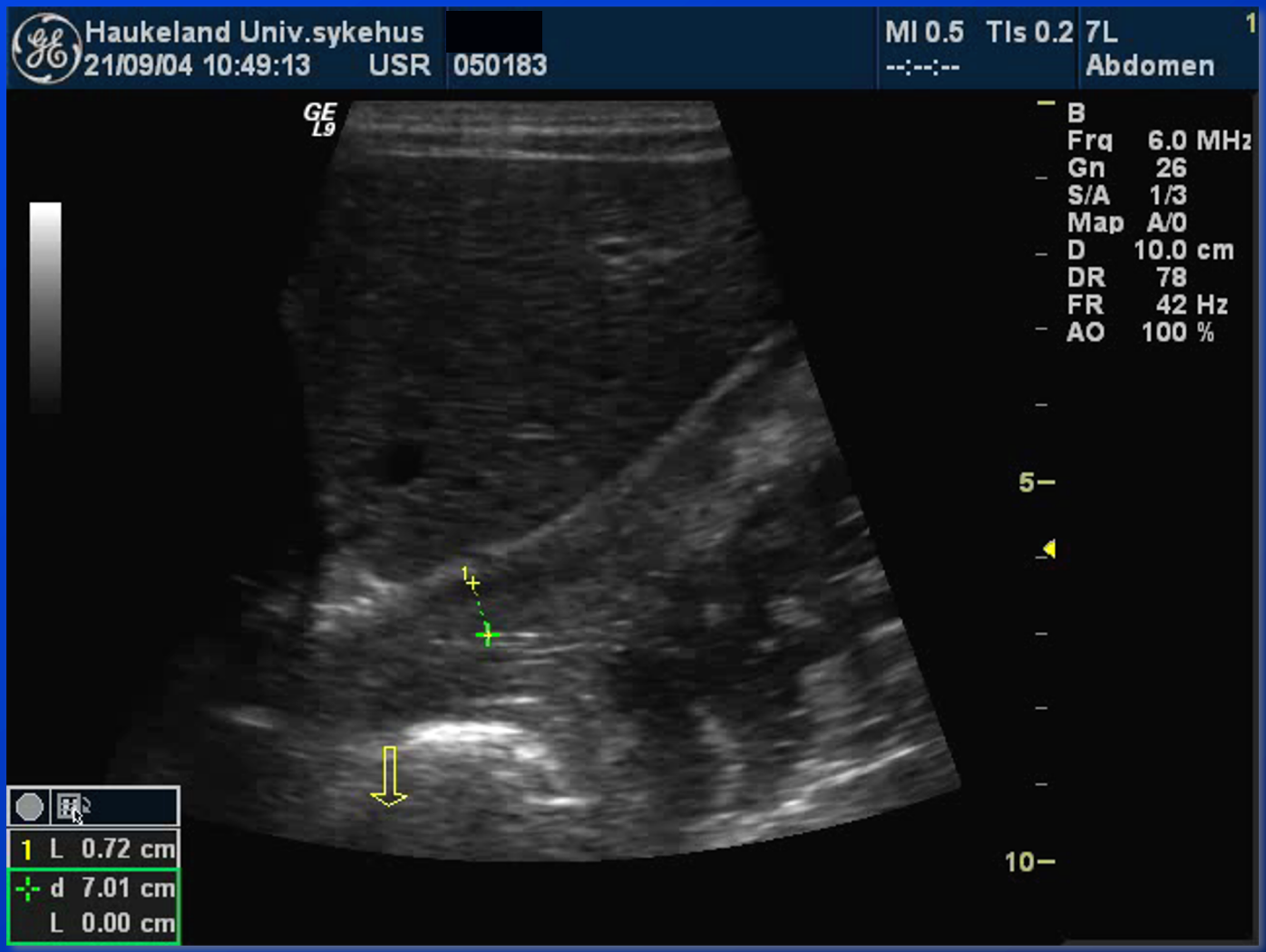
Target Lesion



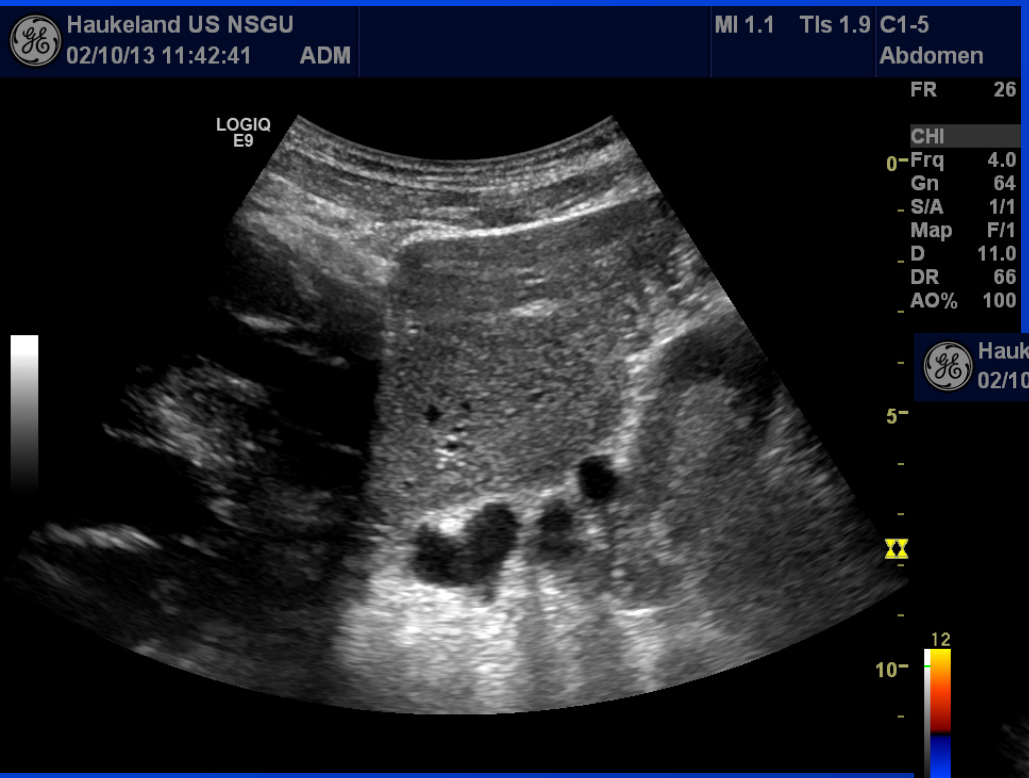
Ultrasound of the GI Tract
A journey from above

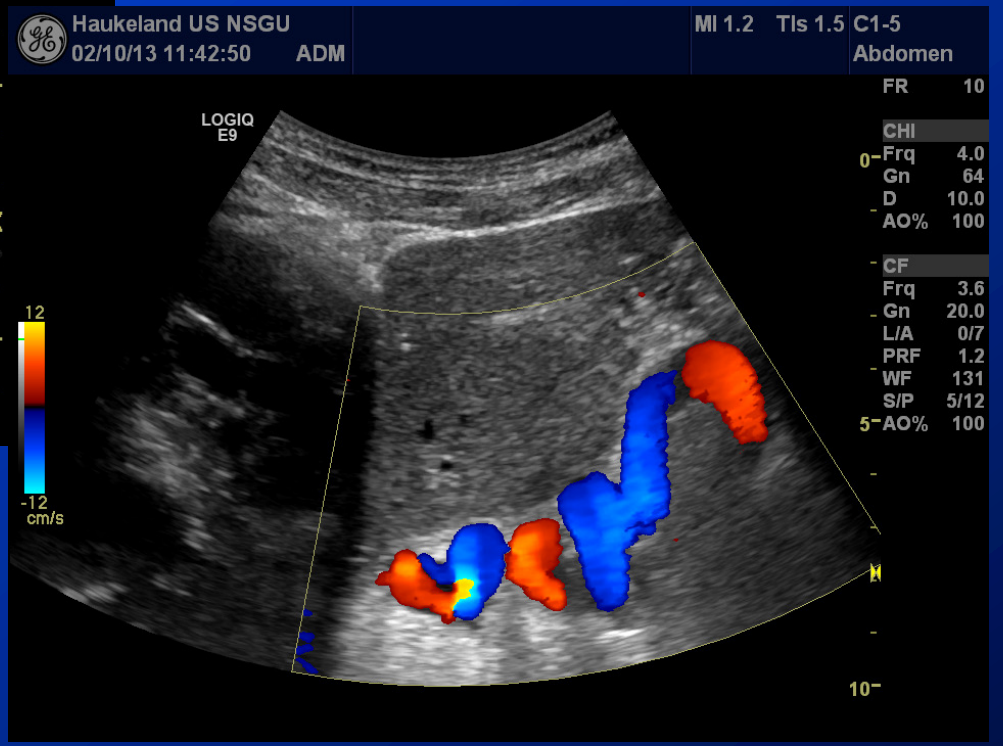
- Oesophagus
- Ventriculus
- Duodenum
- Jejunum
- Ileum
- Colon
- Rectum

Stricture of the Esophagus in Crohn´s disease

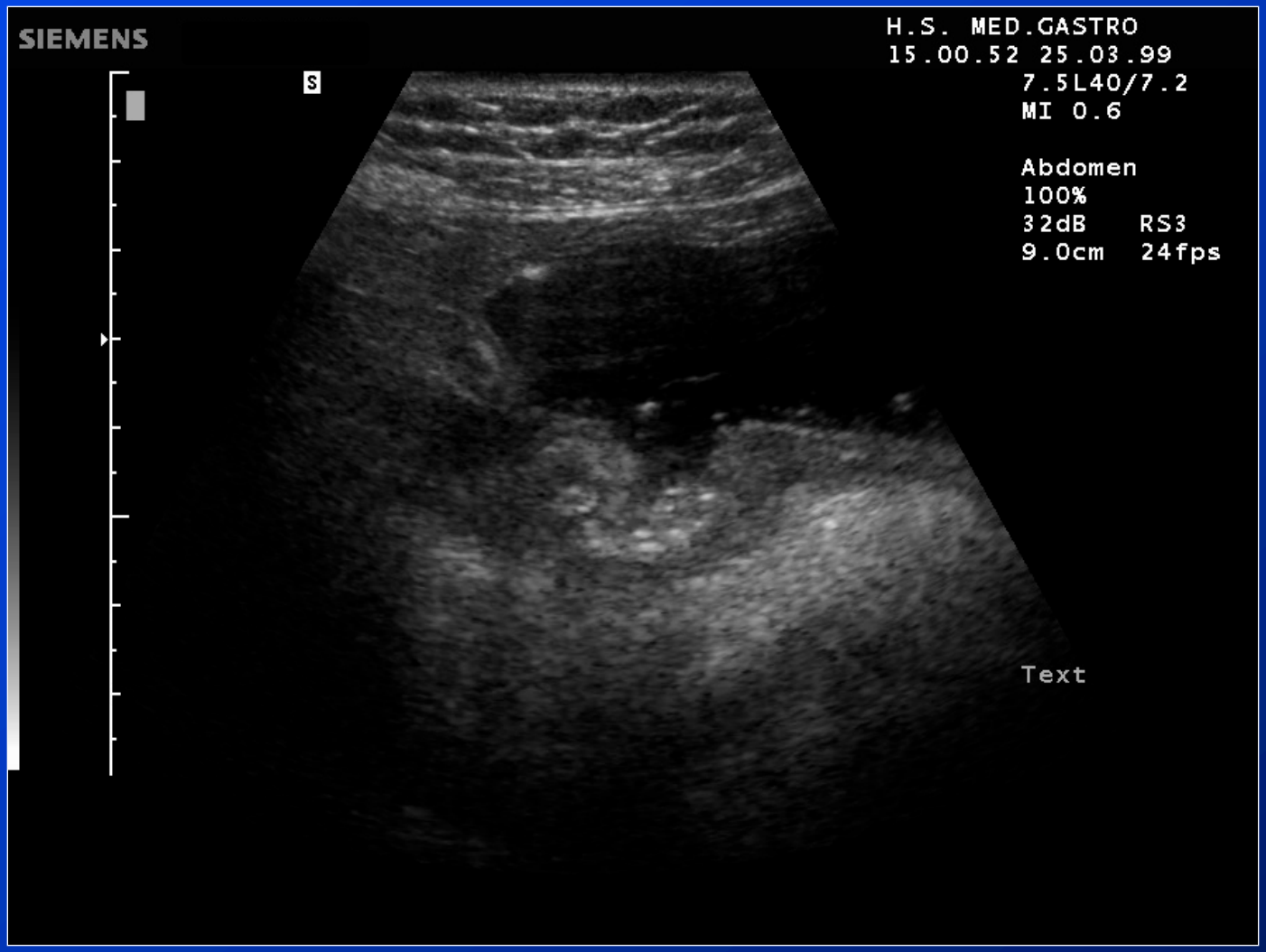


Esophageal and Gastric Varices

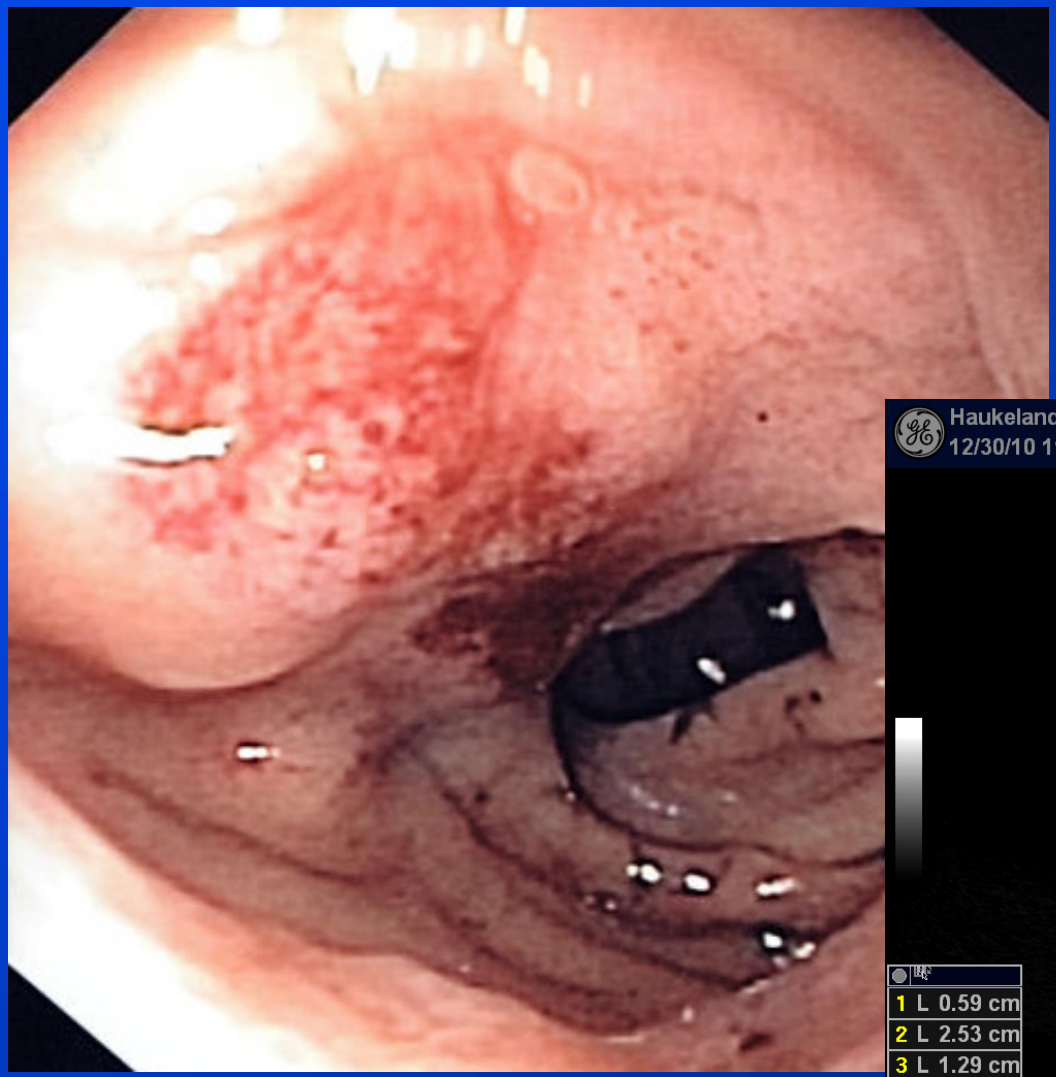


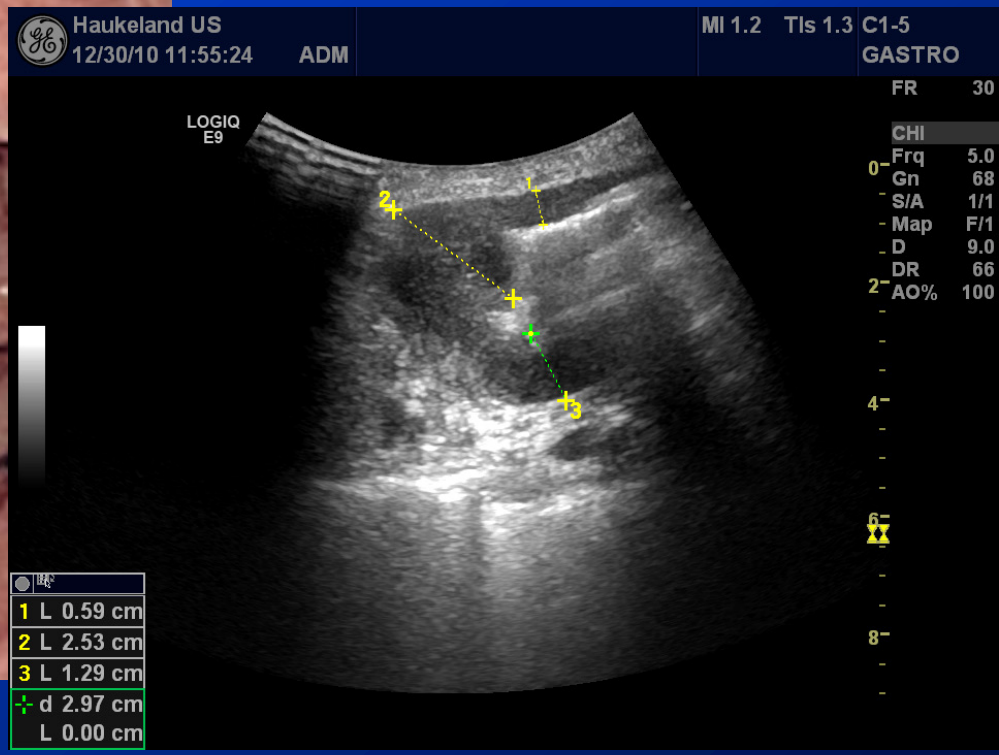


Gastric Ulcer

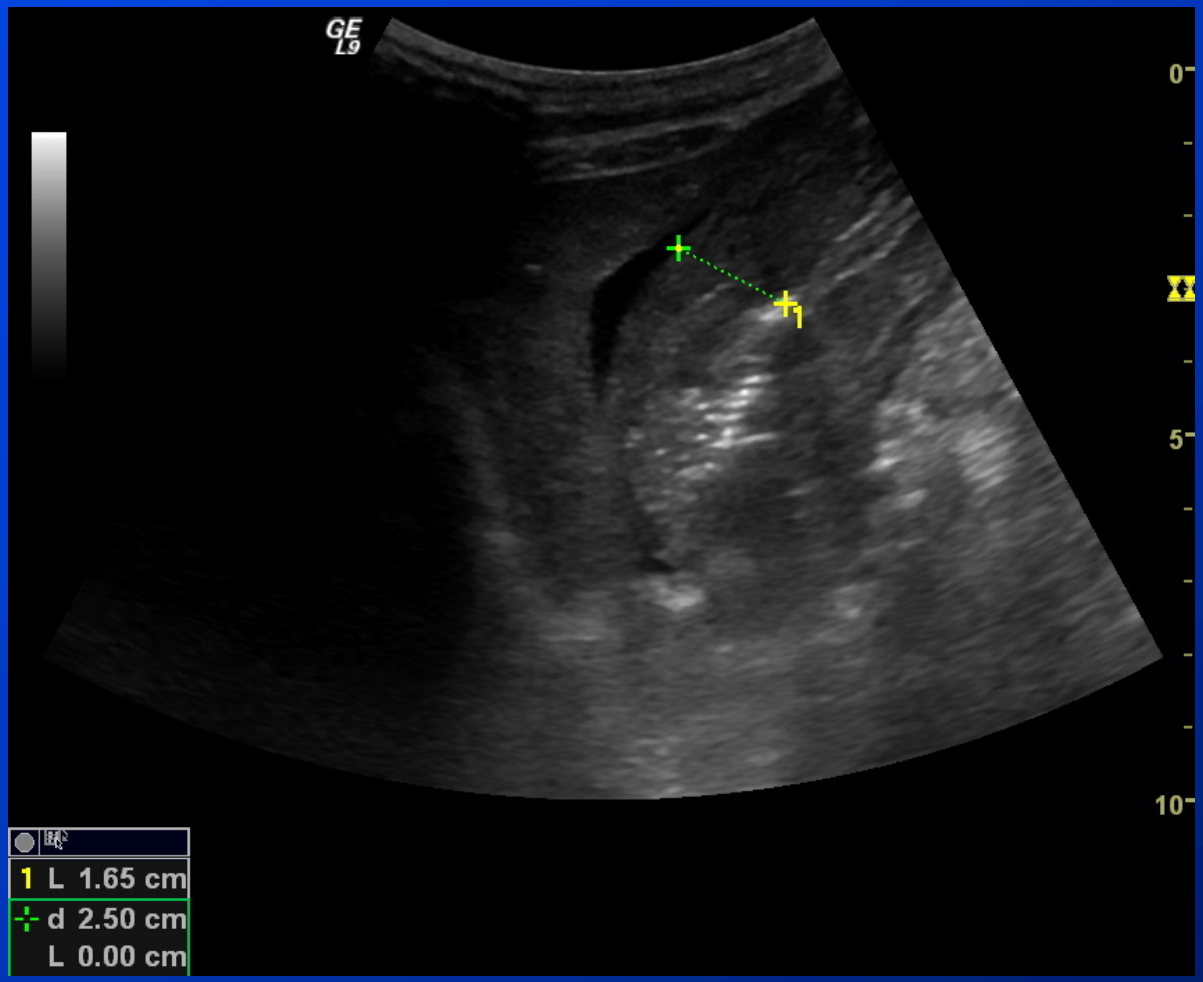


Cancer of the Antrum

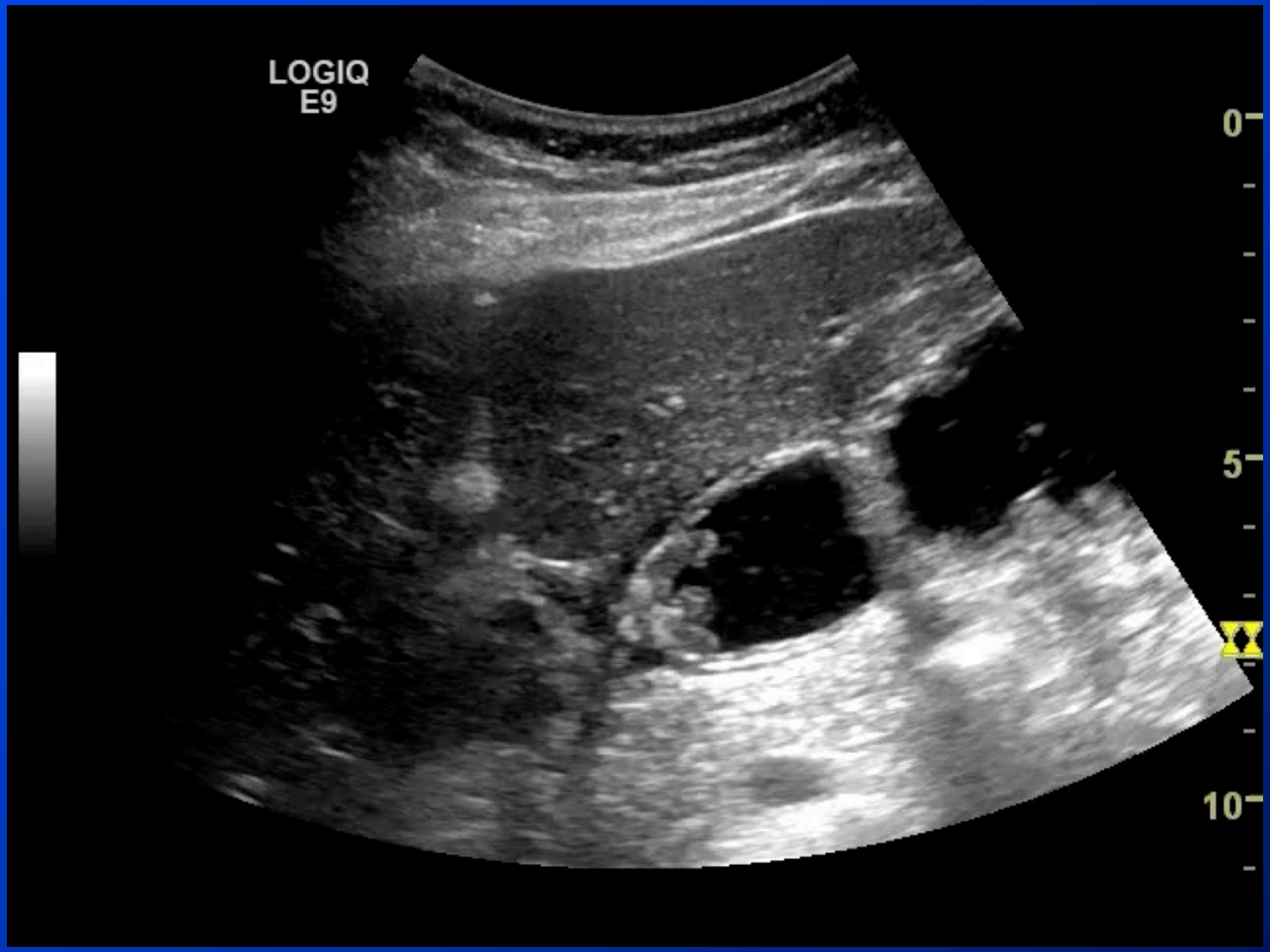




Case: A 67 year female with epigastric pain, weightloss and anorexia

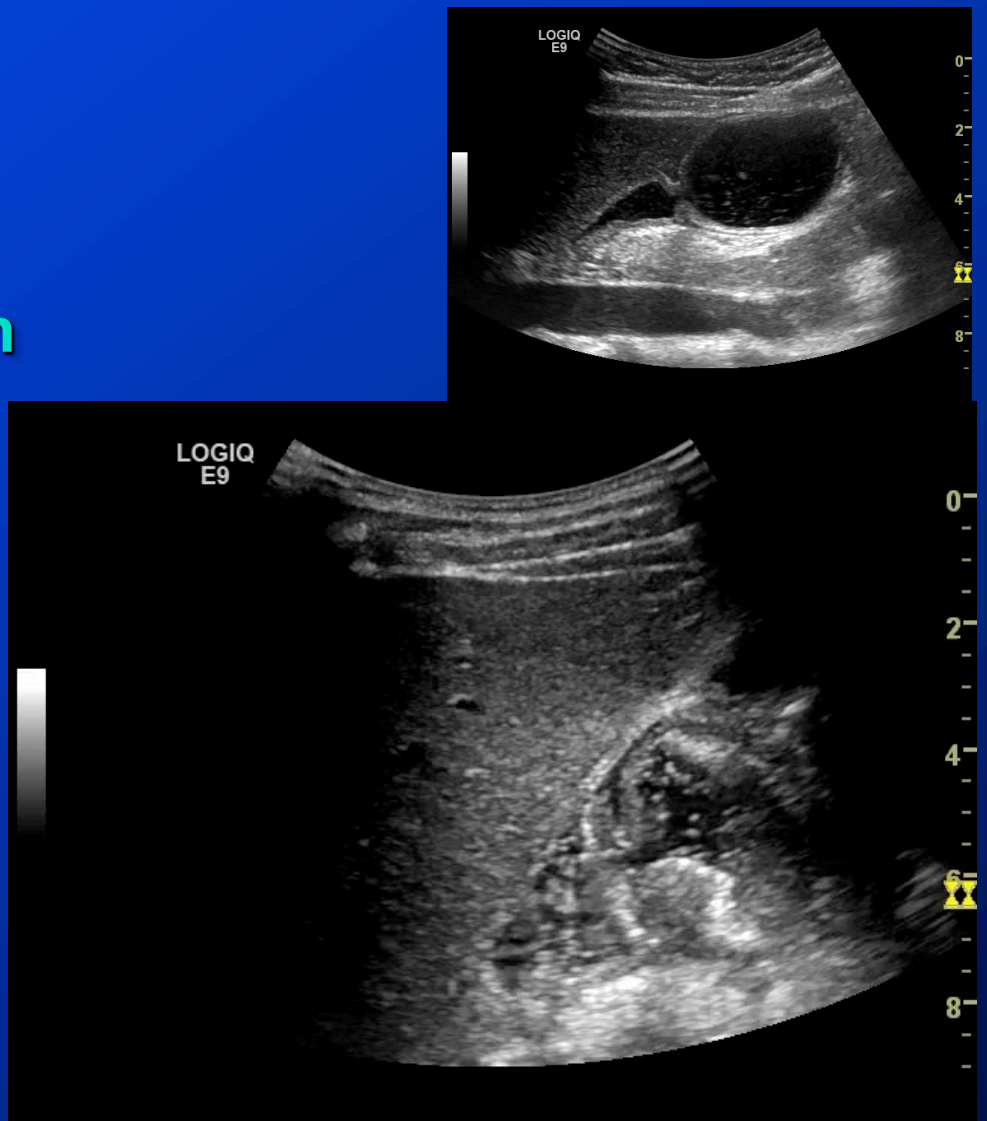


Gastric contractility

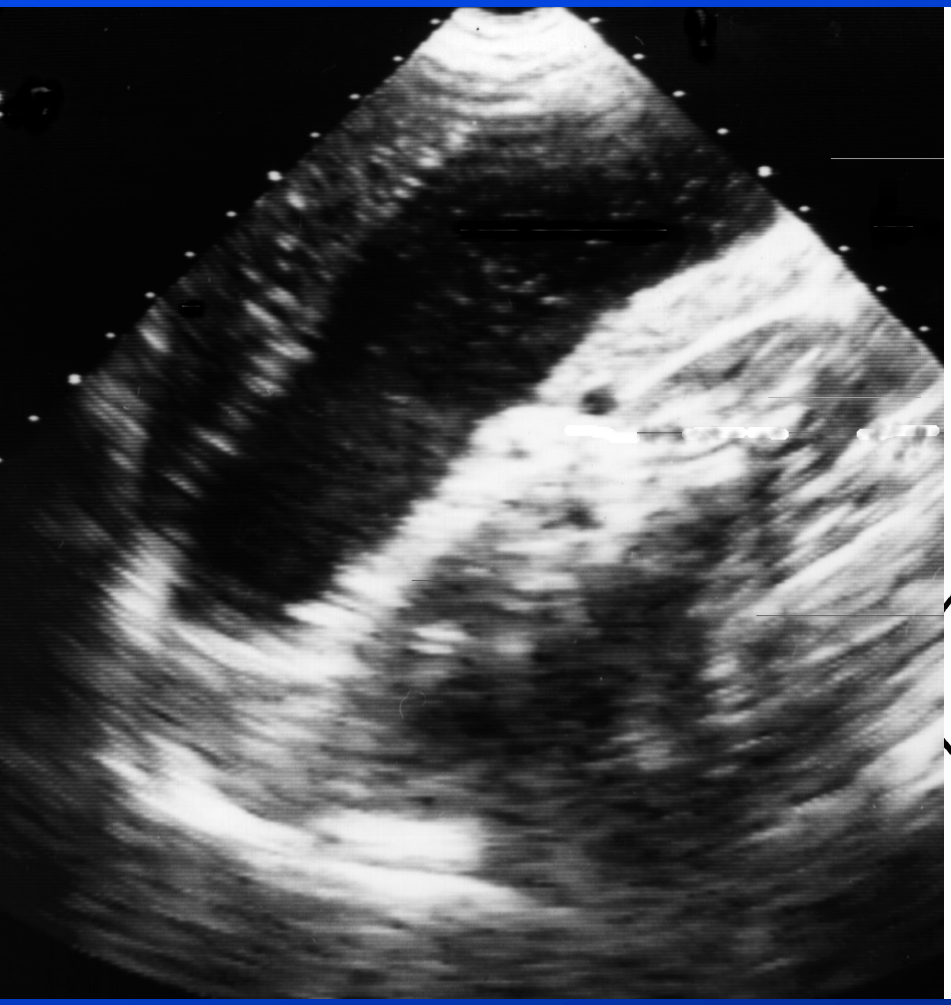


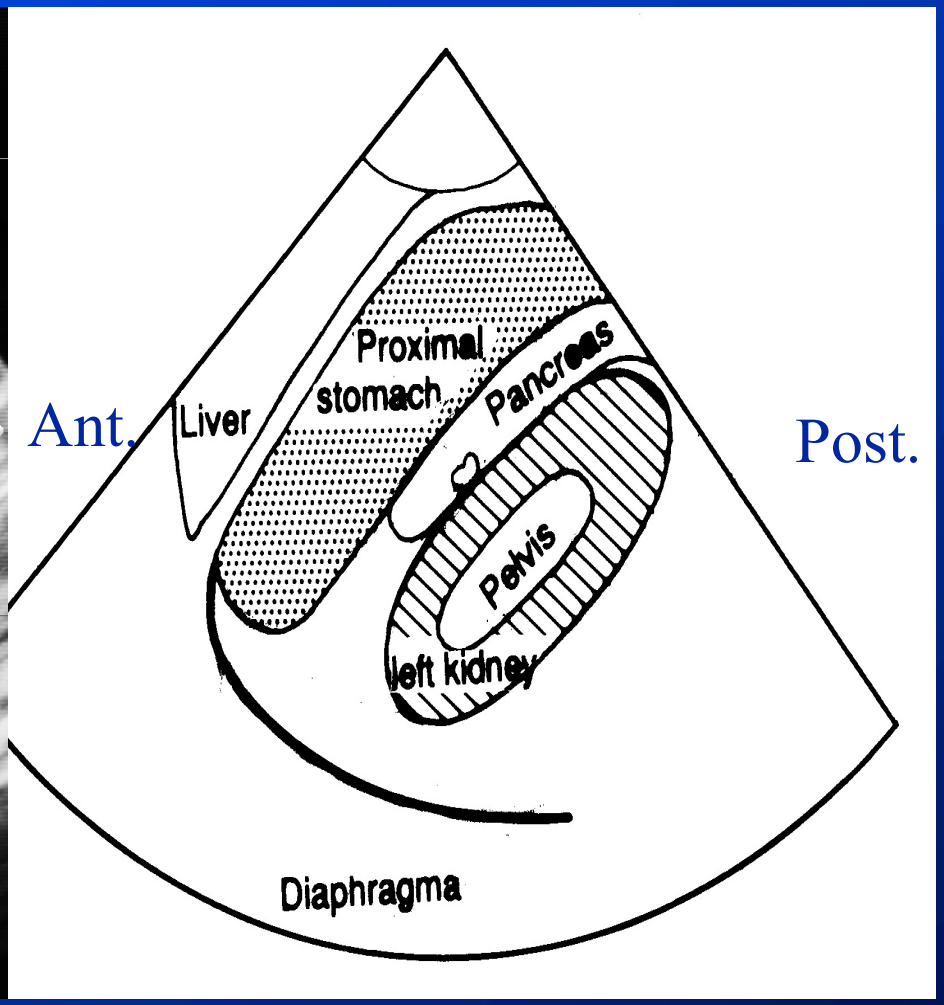
The Role of Ultrasound in FGID

- Rule out organic diseases
- **Detect disturbances in motility**
- **Disclose pathophysiological abnormalities**
- Provide hints for therapy
- Guide further work-up



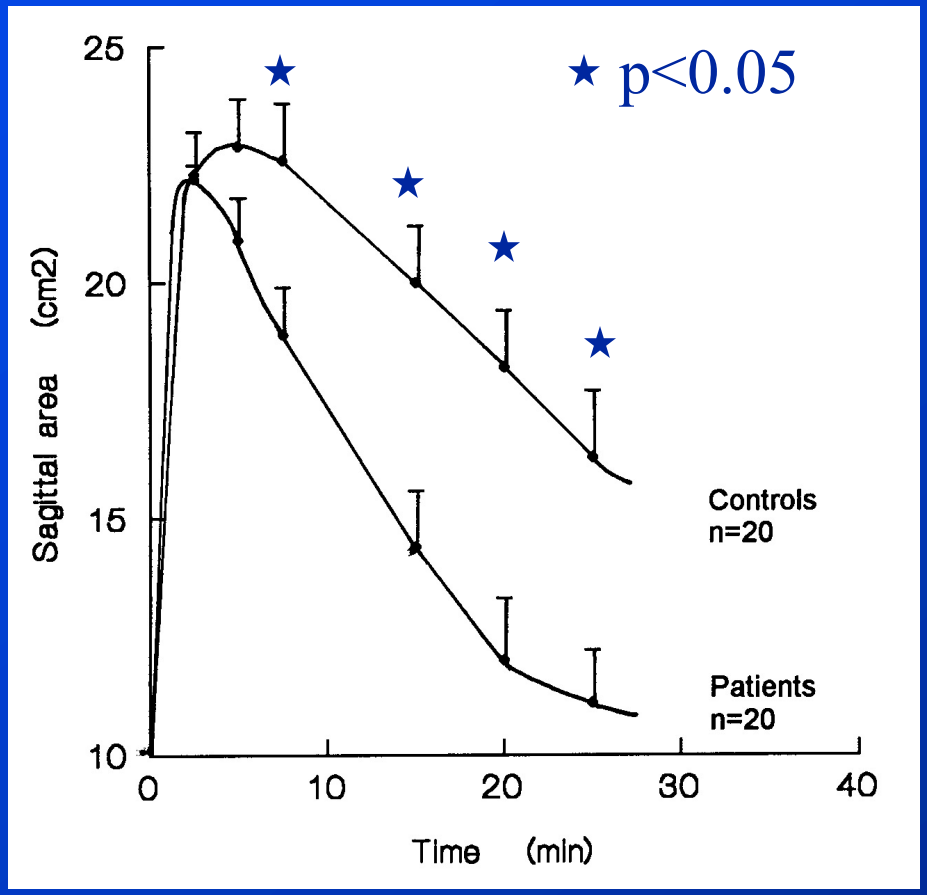
Sagittal section

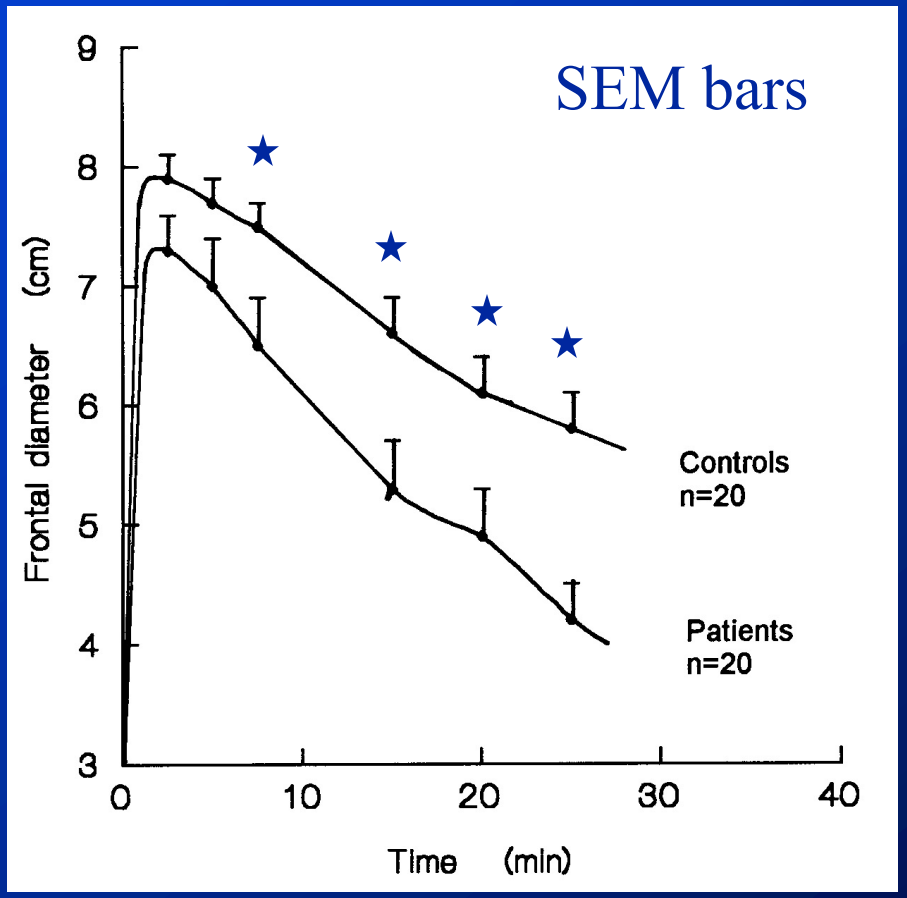




Gilja et al., J Ultrasound Med 1995;14(2):81-89

Size of the proximal stomach in functional dyspepsia

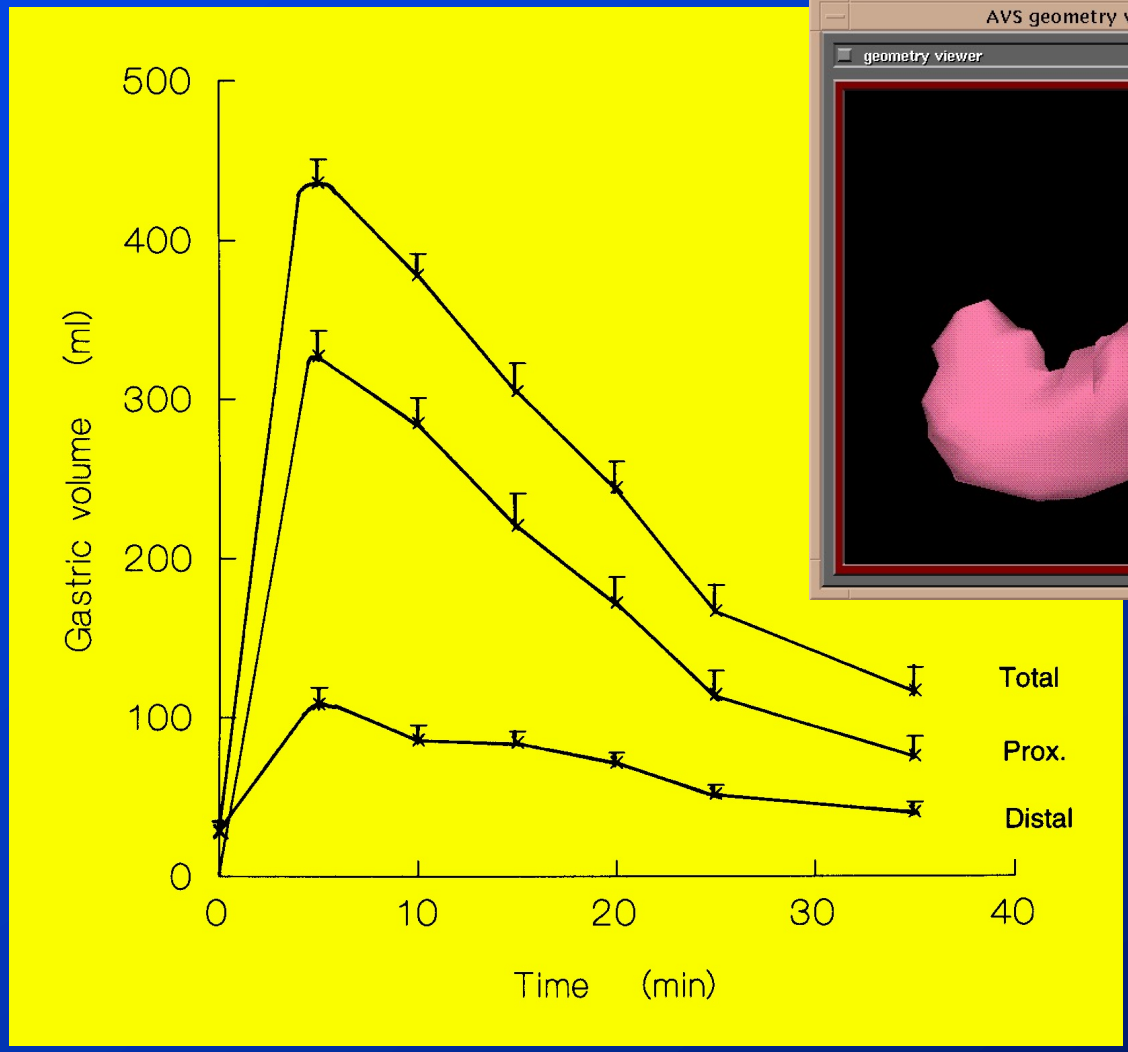


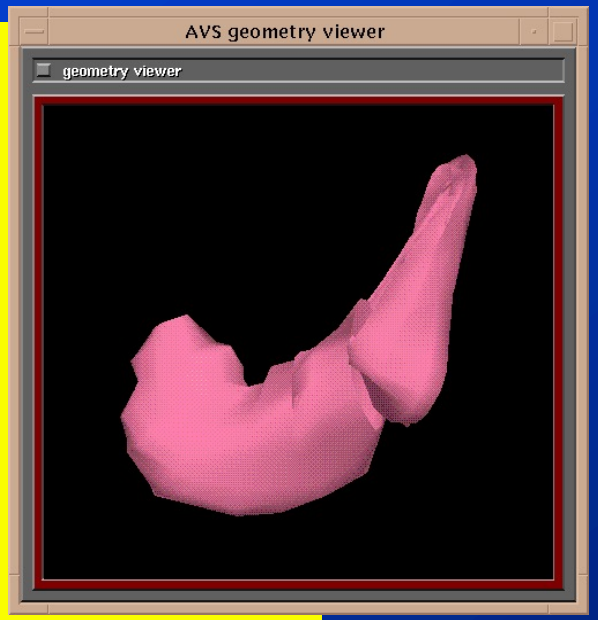


Gilja OH et al, Dig Dis Sci 1996;41:689-696

3D-US and Intragastric Distribution

- 16 healthy subjects
- T-50=22.1 min SD=3.8 min

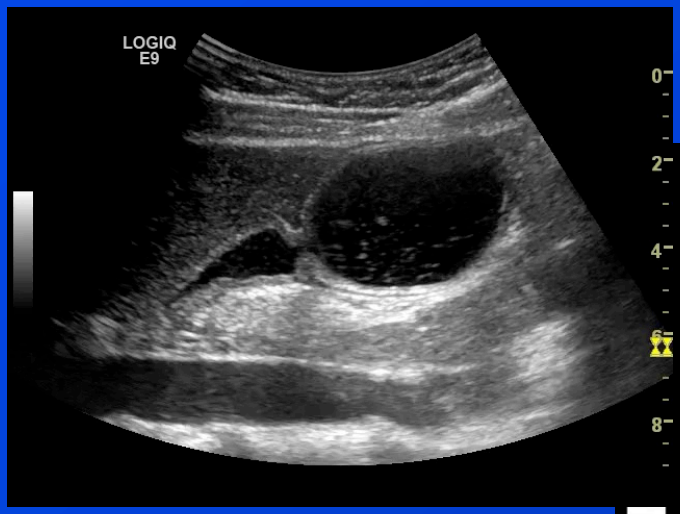


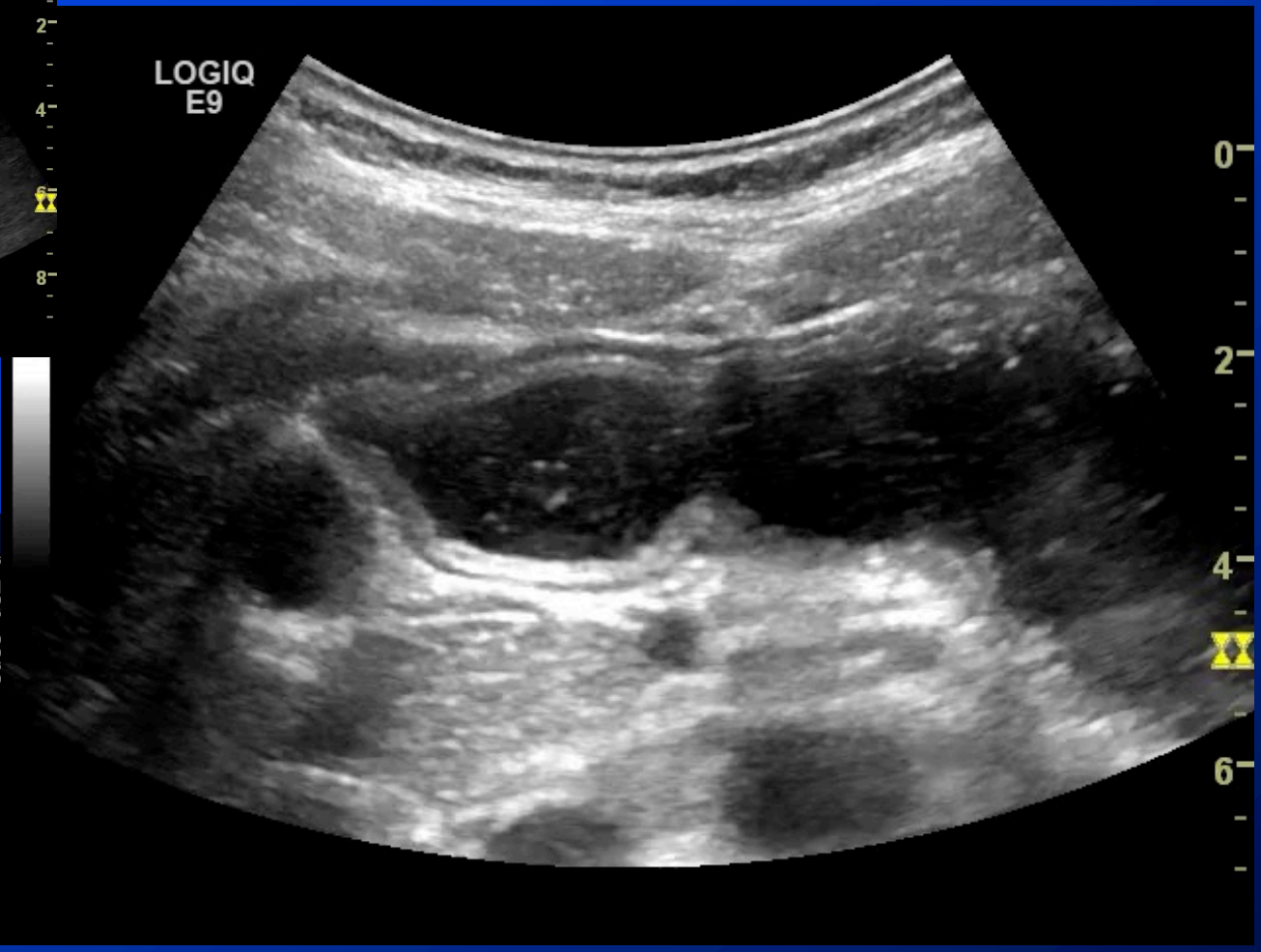


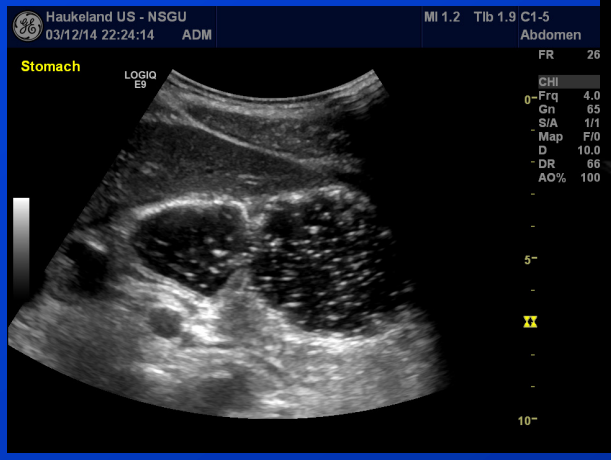
SEM bars are denoted

Gilja OH et al., Gastroenterology 1997;113:38-49

Gastric contractility







Transpyloric flow

Pylorus – The Nile Gatekeeper

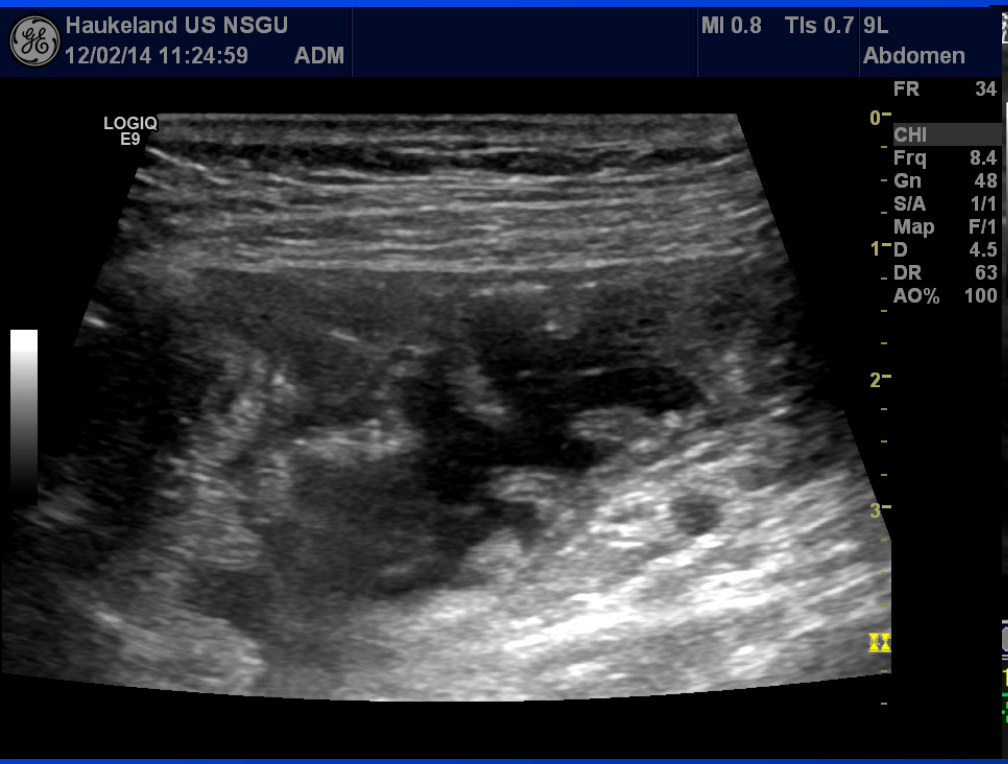
Photo: OH Gilja

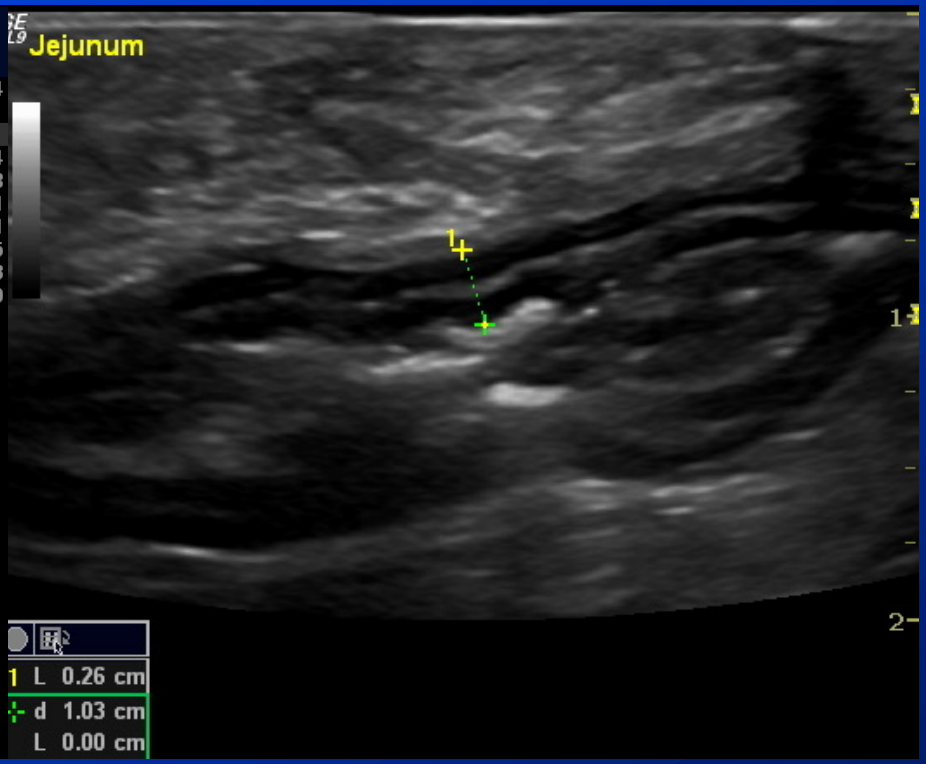
Duodenal Ulcer

”Waschmaschinen-phenomen”

IBS or IBD?

In jejunum

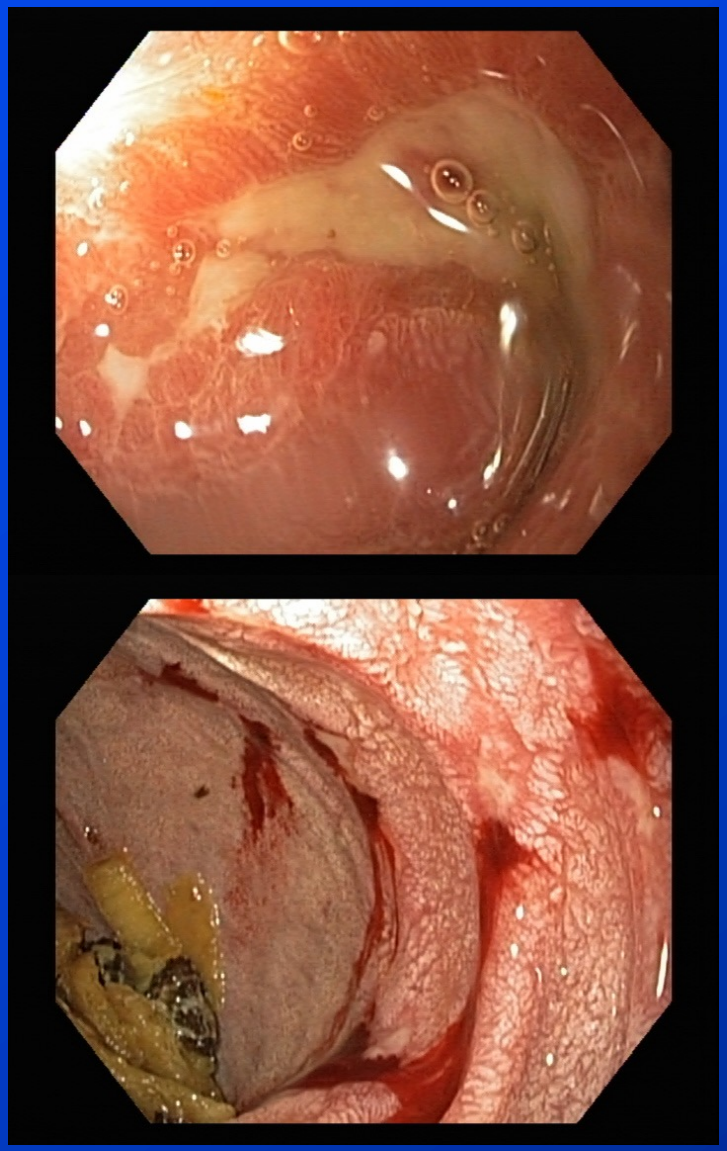


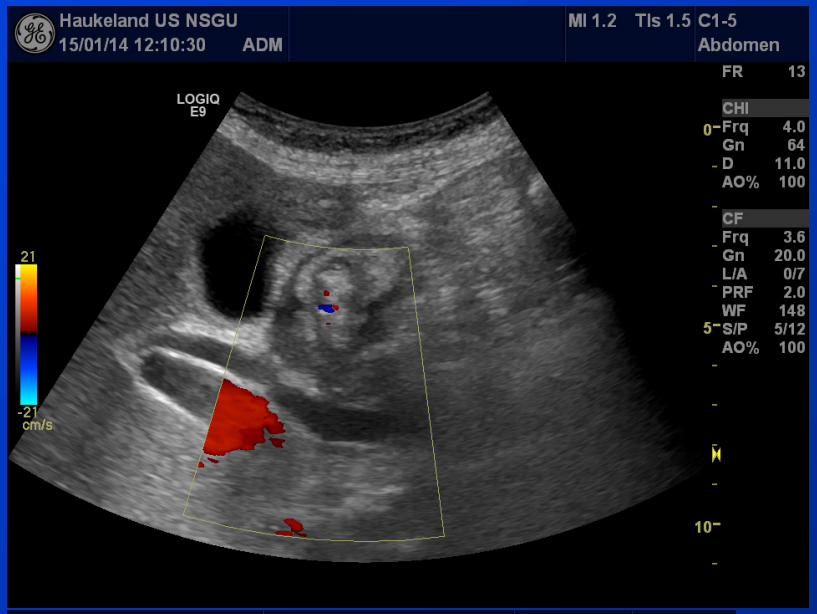


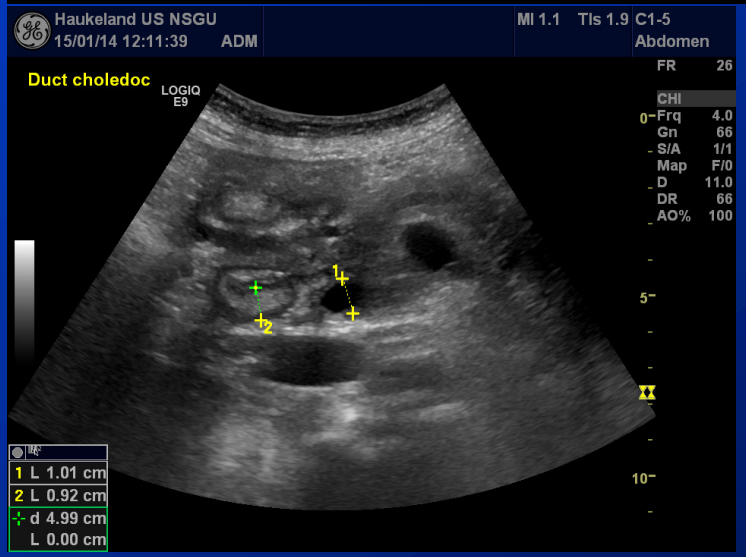
Normal wall
Note valvula conniventes

Note thickened wall, no valvula, and irregular luminal contour

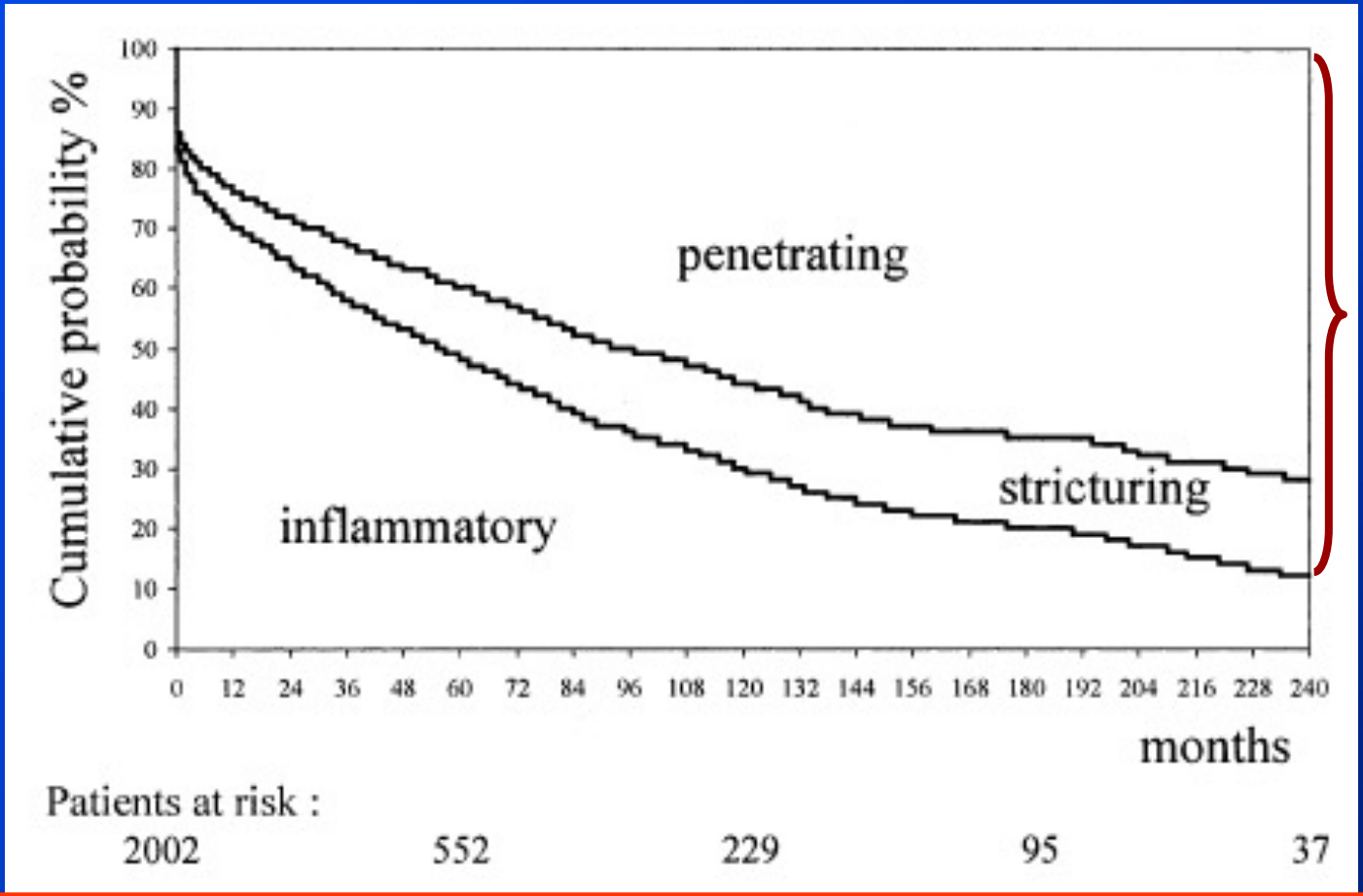
Crohn in the Duodenum







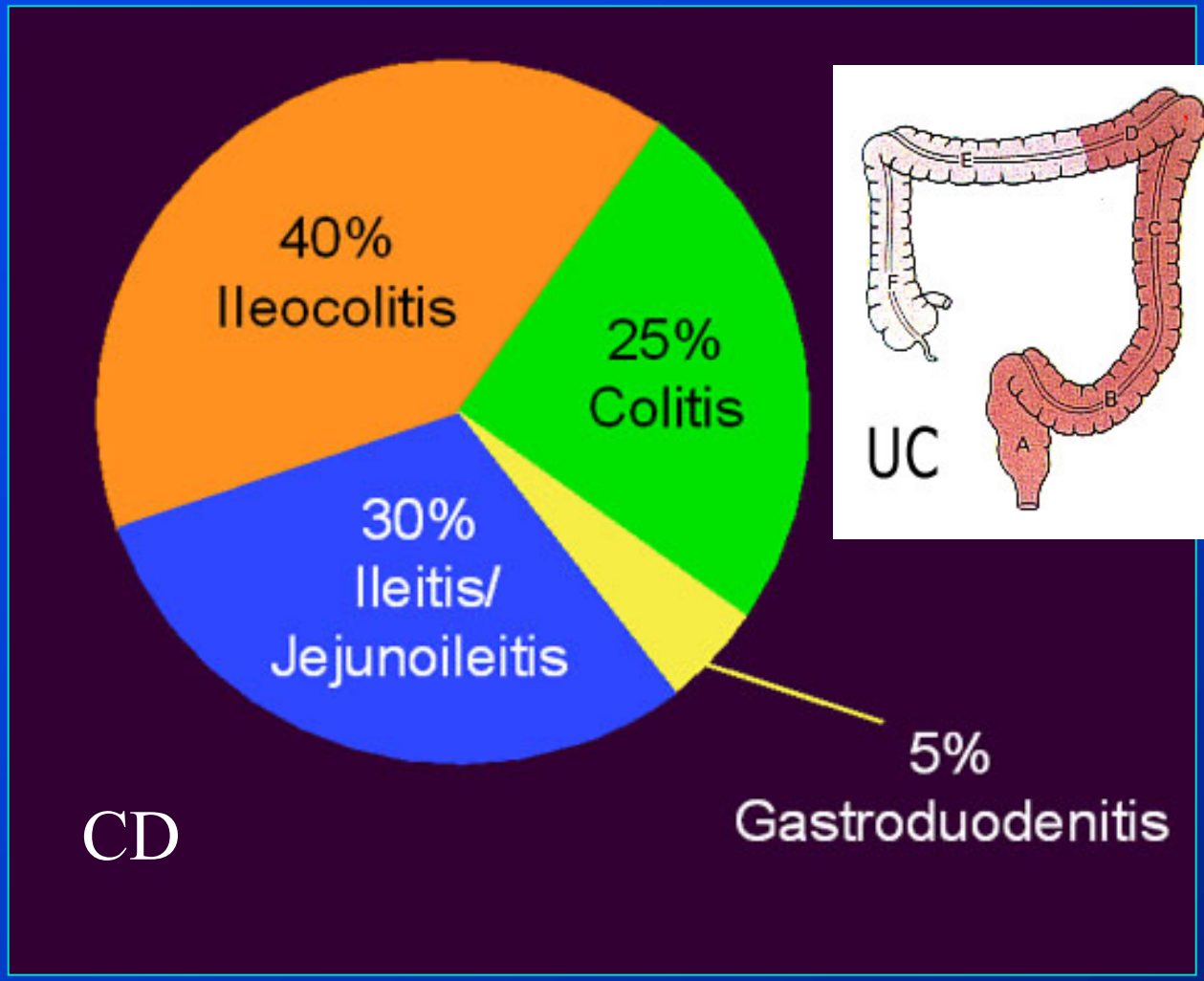
Crohn's – Disease Development

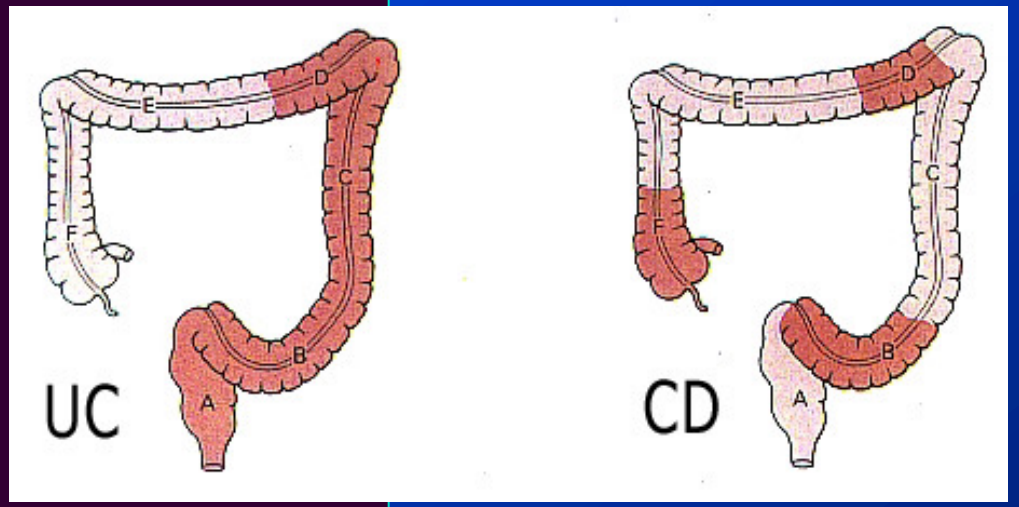


Over a 20 years period, 88% risk of developing disabling disease

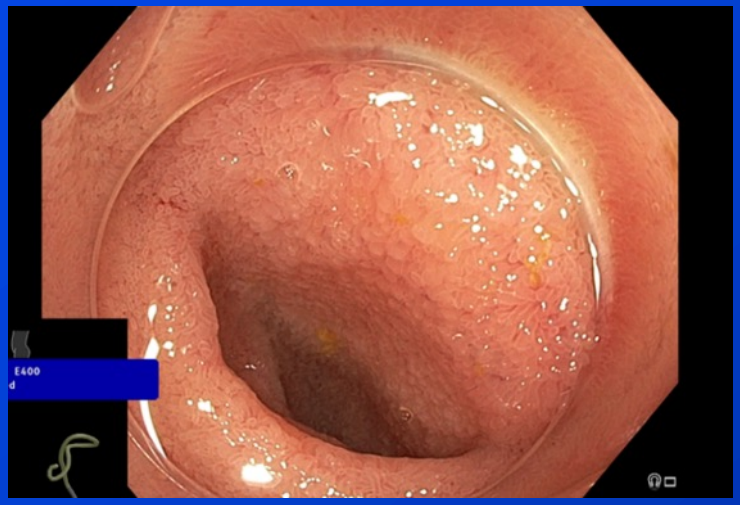
Cosnes J et al Inflamm Bowel Dis 2002

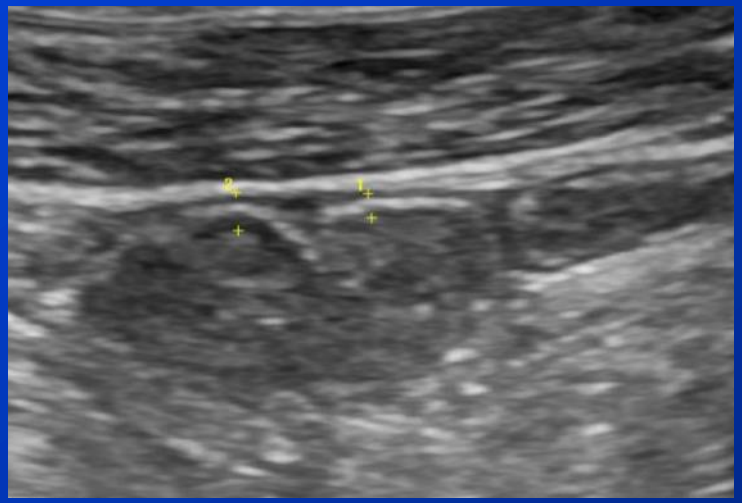
IBD – GI-Localisation

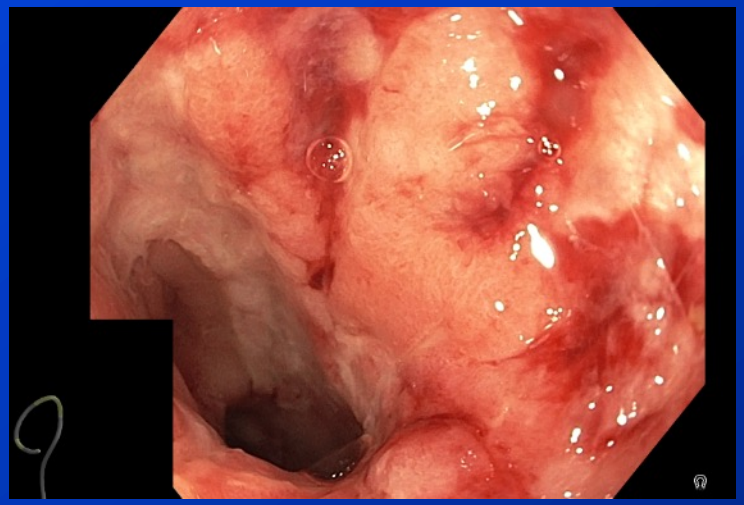


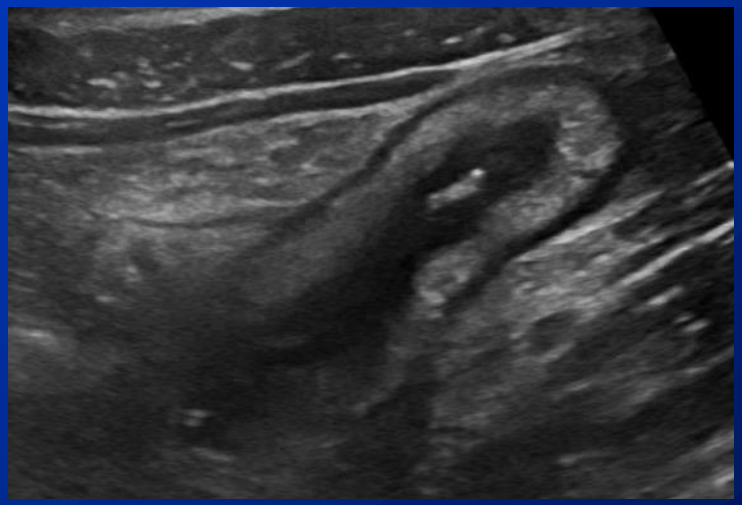


Normal vs. Crohn ileum



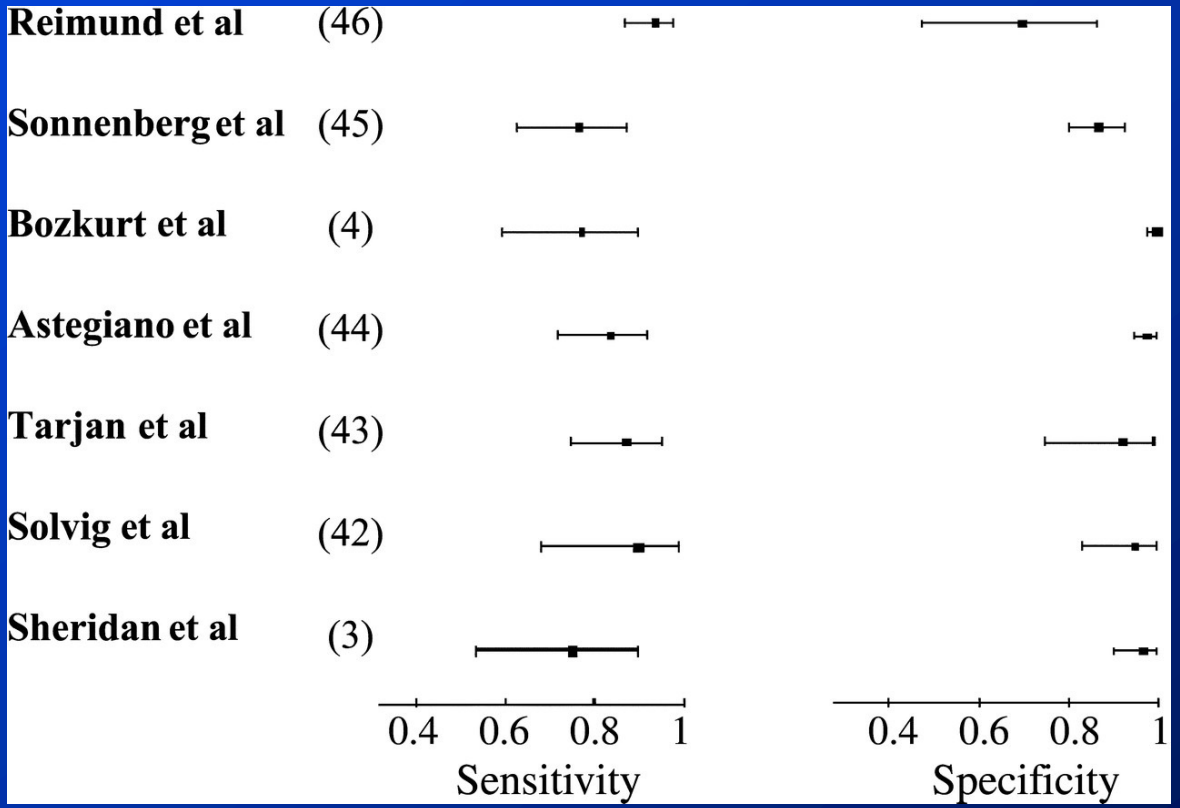






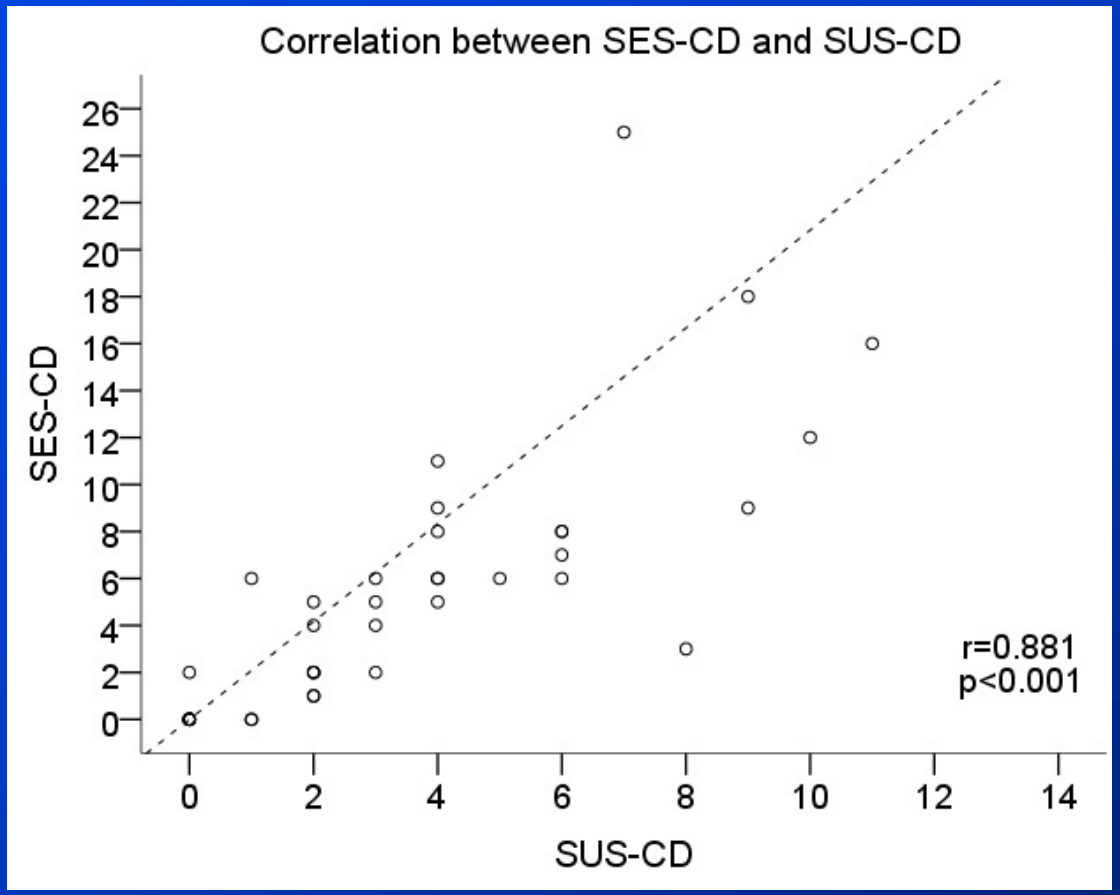
Meta-analysis of US in Crohn's Sensitivity and Specificity

Graph shows the sensitivity and specificity of US in the detection of Crohn disease reported for the seven studies. Reimund et al (46) and Sonnenberg et al (45) were case-control studies; the other five studies were prospective cohort studies. Mean values (■) and 95% confidence intervals (error bars) are indicated; the heterogeneity of the results prevented the calculation of a cumulative value.



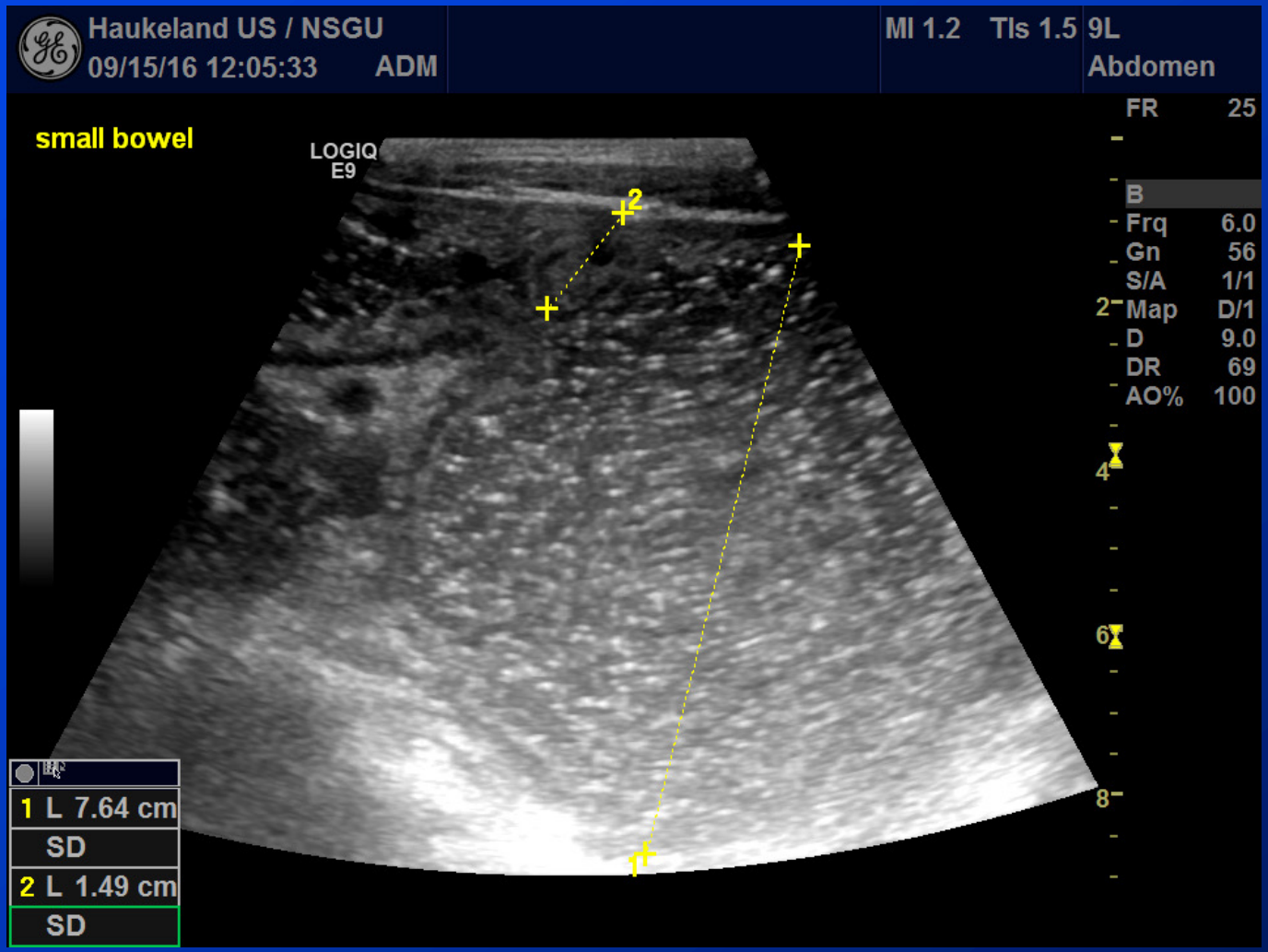
Radiology 2005; 236:95–101

Association between endoscopy and ultrasound

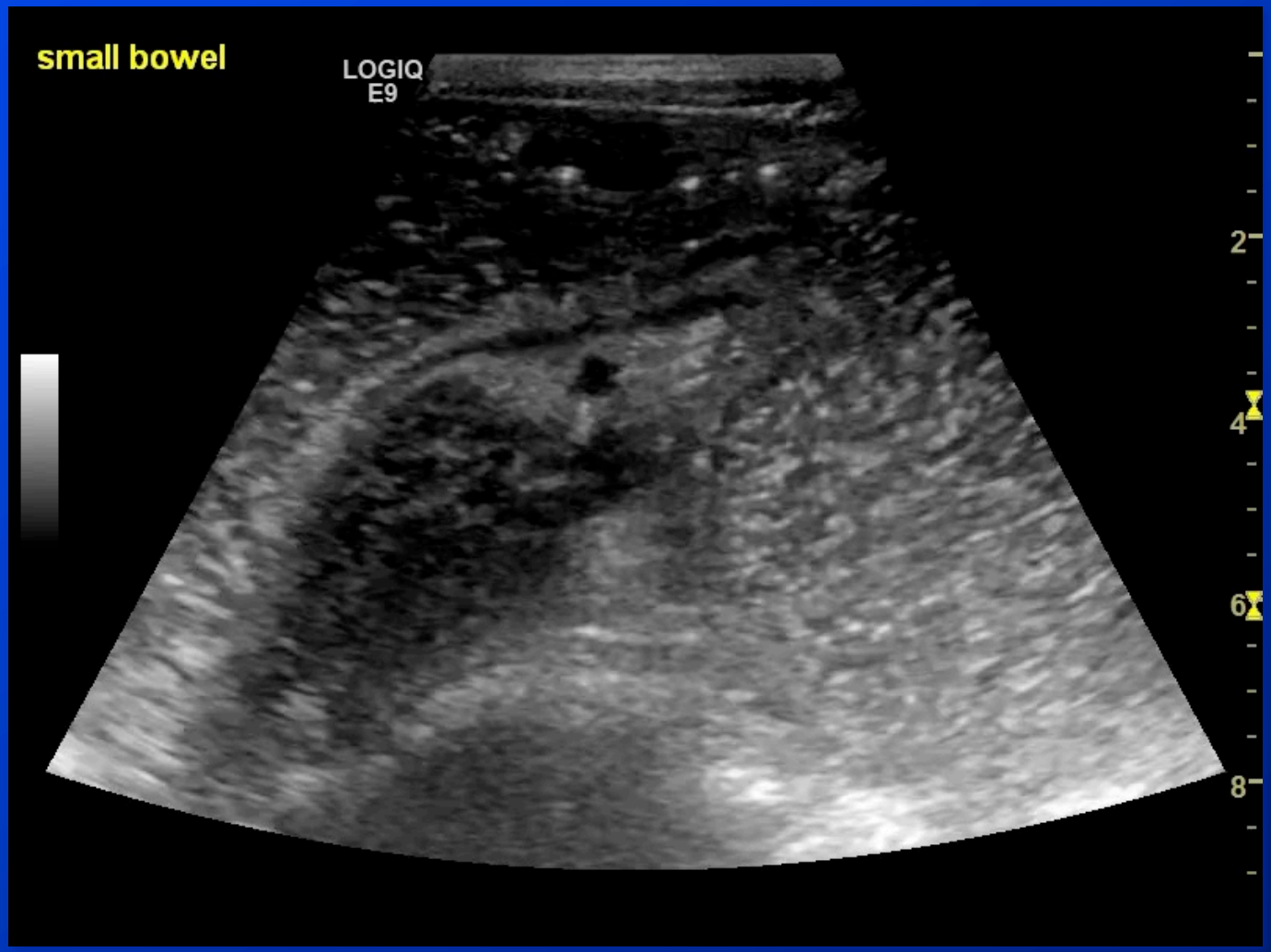


Sævik et al., J Crohn Col 2021

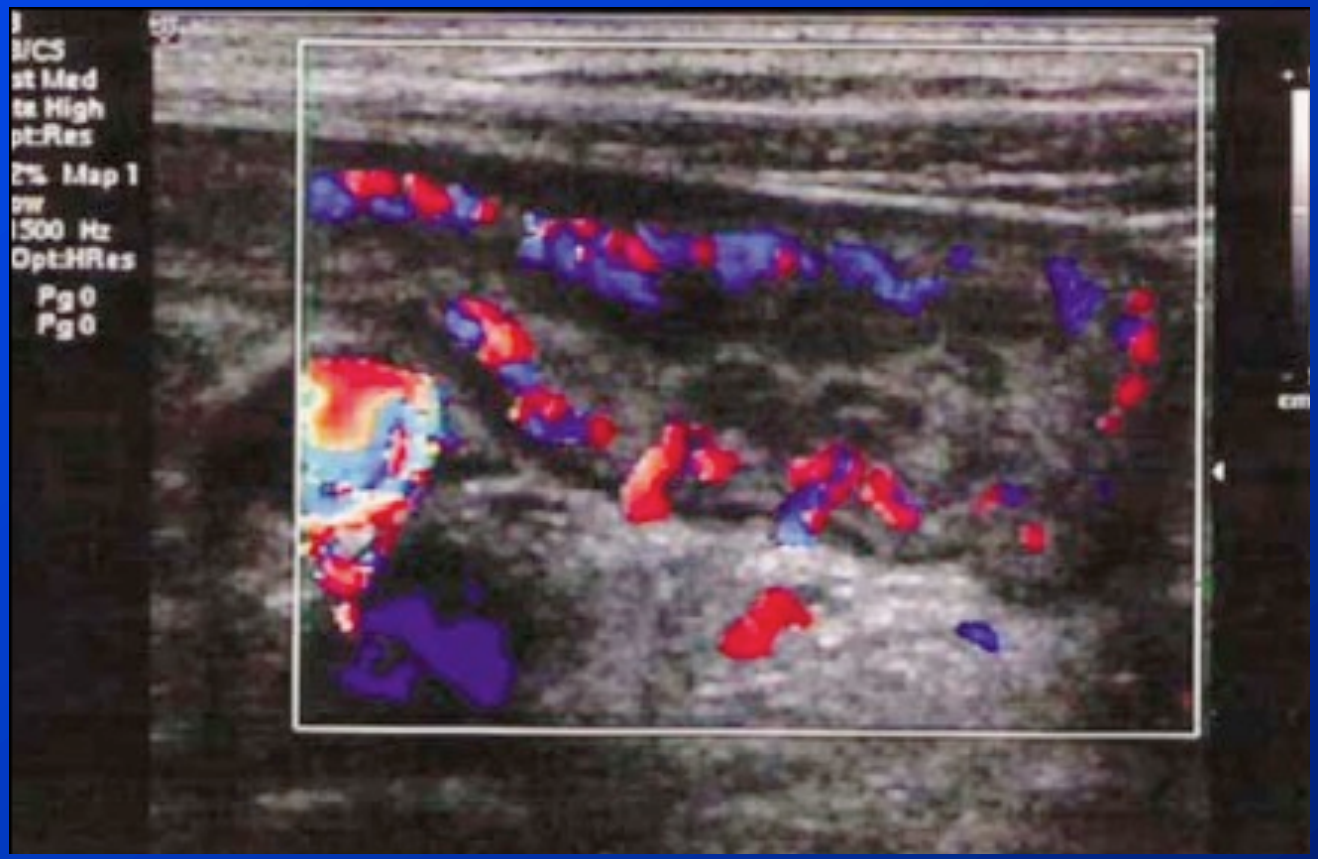
Male 17 years with abdominal pain and diarhea



Stenosis with prestenotic dilatation in small intestine



Crohn Disease Activity Evaluated by Doppler US of the Affected Small-Bowel Segments

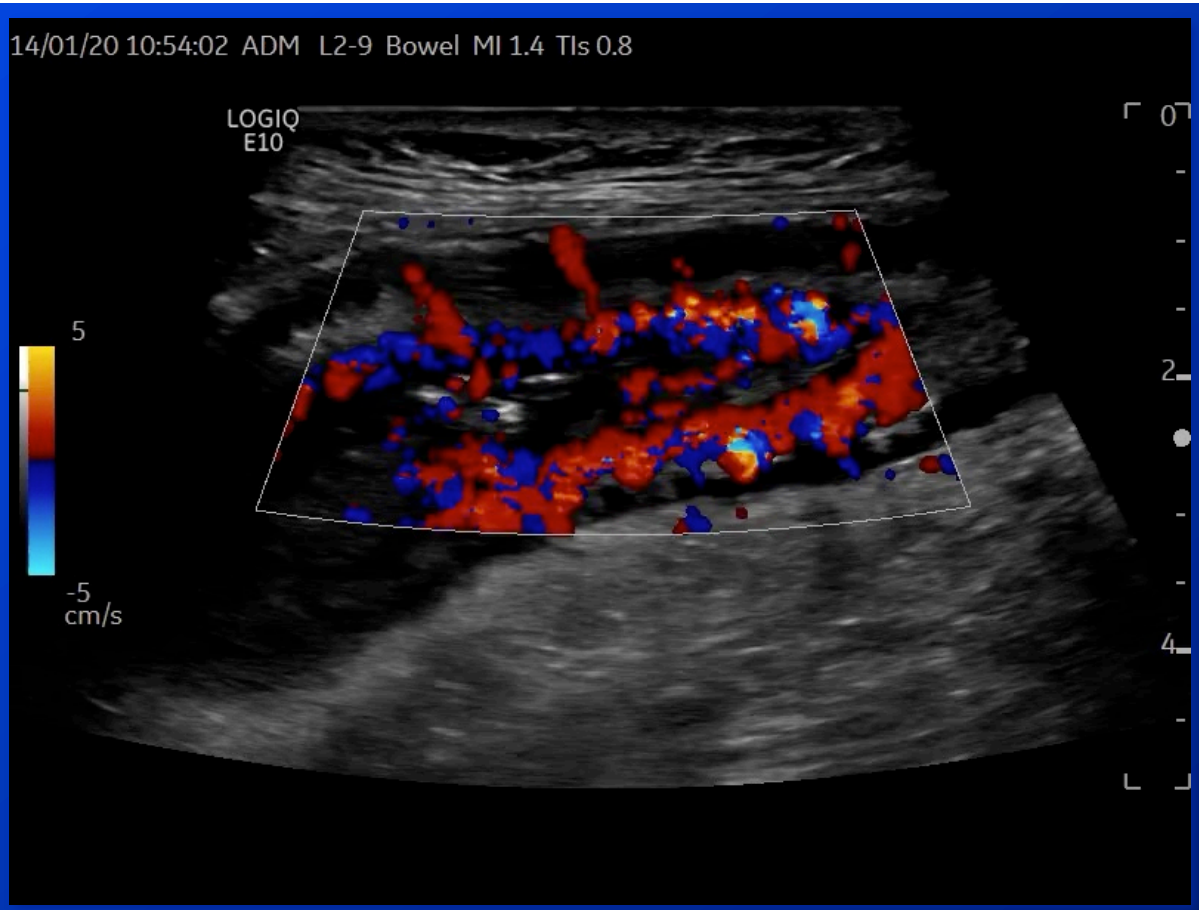


Multiple and prominent vascularity (score 2) in the markedly thickened terminal ileum in a patient with active Crohn disease

J Ultrasound Med 2005; 24:59–65

Recommendations:

3. Colour Doppler imaging should be used to evaluate the vascularisation of pathological bowel wall, LoE 2b, GoR B, Broad consensus 12/13

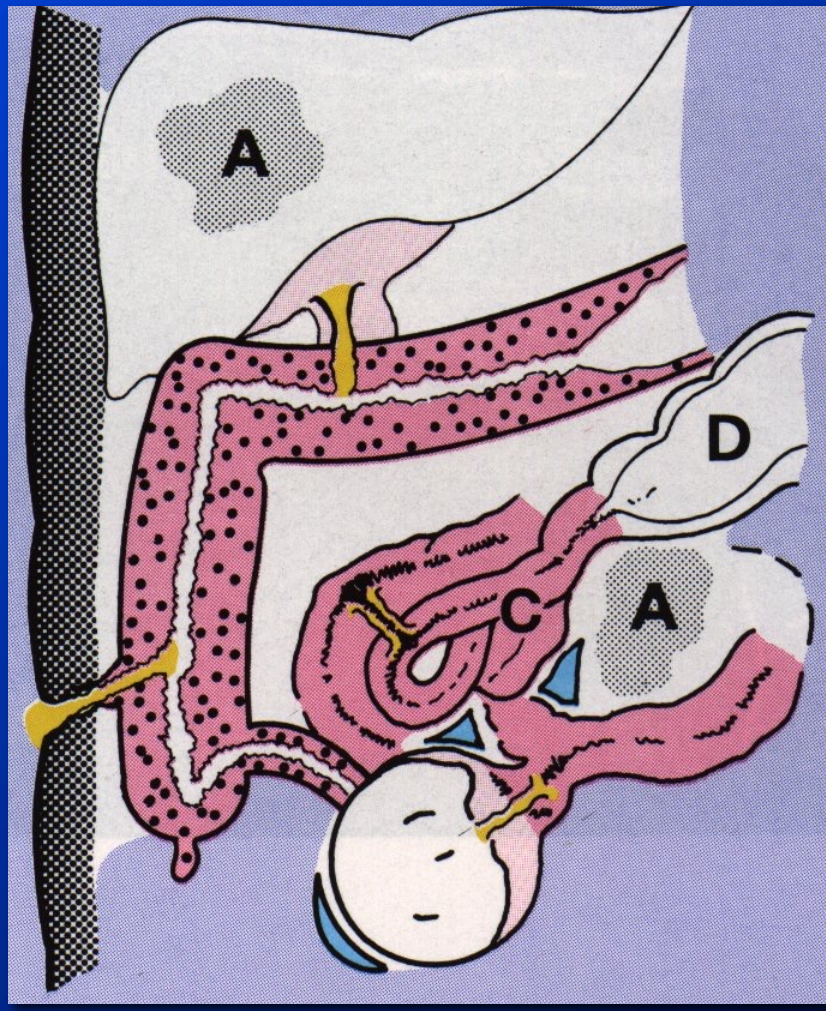


Courtesy: OH Gilja

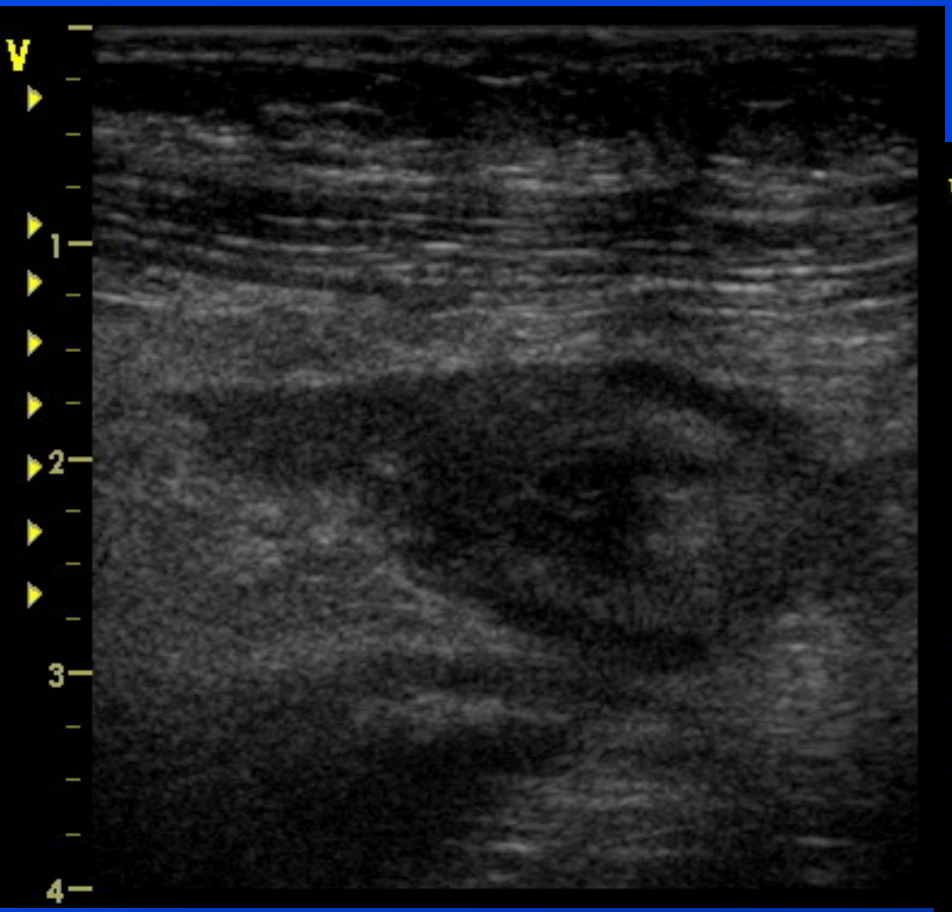
Complications of Crohn's

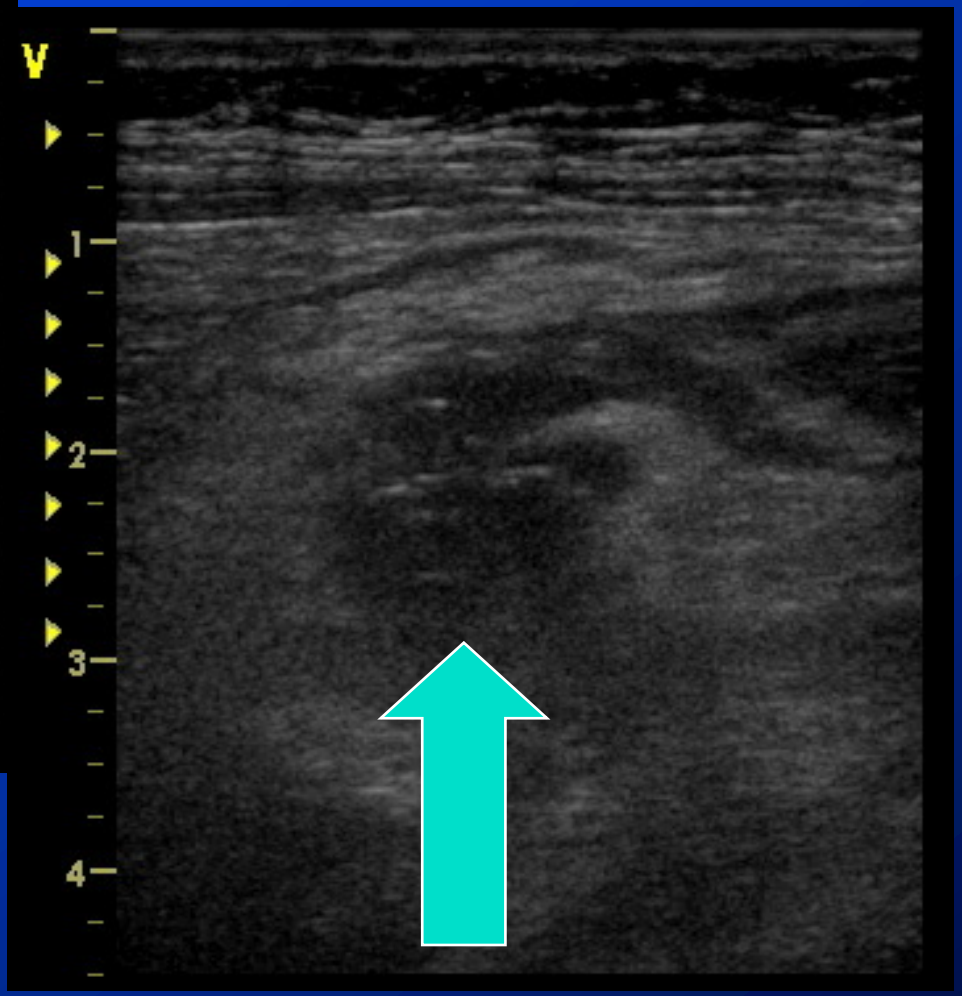
- Abscess
- Fistulas
- Strictur
- Malignancy

- Other findings:
  - Ascites
  - Mesenterial lymphnodes
  - Fatty infiltration
  - Focal cystitis



Abscess near the Ileum





Abscess in Crohn's

Table III. Prospective studies assessing accuracy of bowel US in detection of intra-abdominal abscesses complicating CD

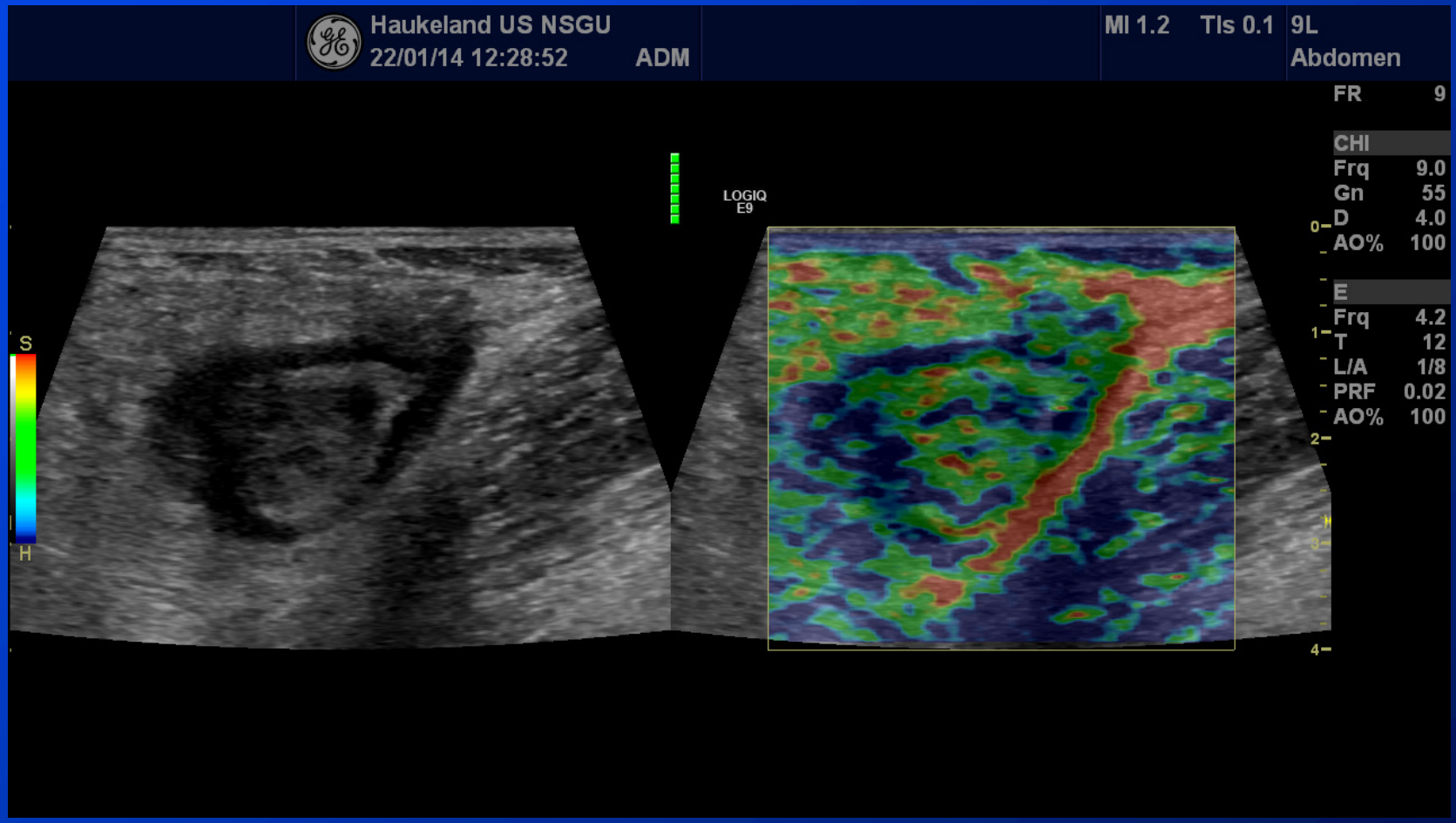
	No. of patients	Comparator	Sensitivity, %	Specificity, %
Schwerk et al. 1992 (13)	20	Surgery	92	100
Maconi et al. 1996 (19)	58	CT scan	83	94
Gasche et al. 1999 (20)	33	Surgery/pathology	100	92
Maconi et al. 2002 (25)	128	Surgery	91	87

- CT > US in deep abscesses (pelvis)
- US = CT in less deep abscesses
- US > CT in inflammatoric infiltrates and abscesses that are close to the GI wall

Parente F, SJG 2002 (8). Review.

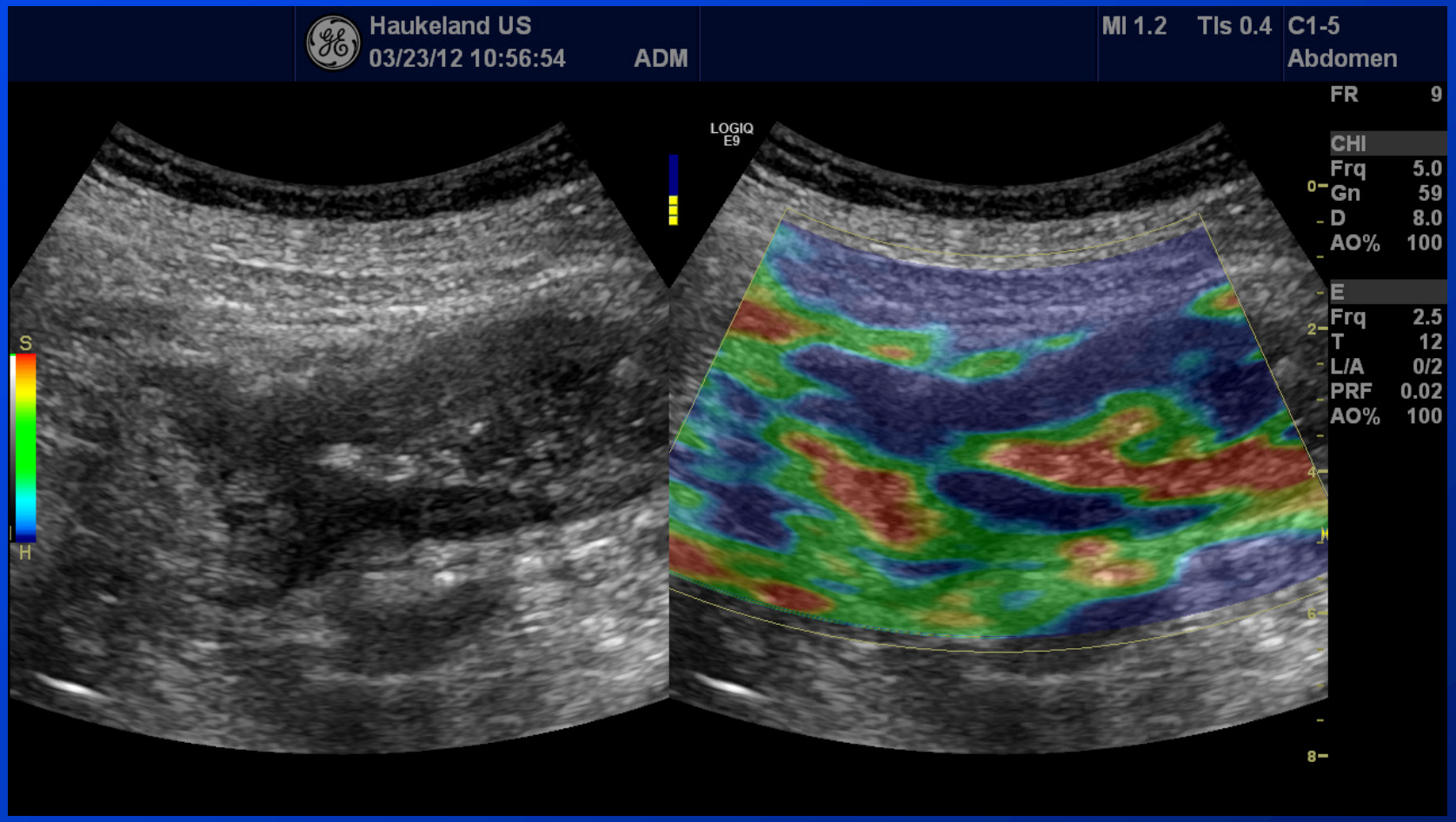
Recommendations:

5. Ultrasound elastography can be used to evaluate the stiffness of pathological thickened bowel. LoE 4, GoR C, Broad consensus 11/12



Courtesy: OH Gilja

Elastography of Crohns stenosis



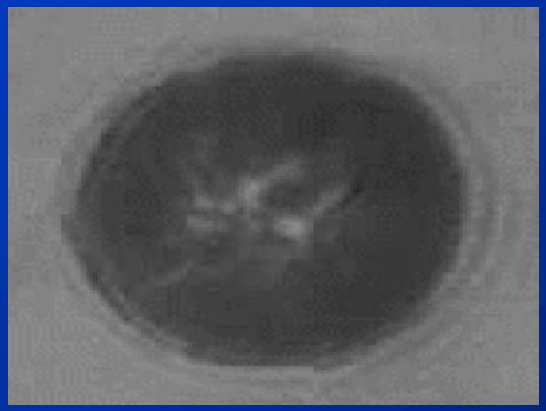
Ultrasonogram (left) and elastogram (right) in a patient with Crohn's disease scanned with 5,0 MHz frequency. The patient has a clearly thickened wall of the terminal ileum (white arrow) with a stenosis (green asterix). In the right panel, a corresponding blue color in the anterior wall indicate hard tissue (fibrosis) in the GI wall.

CEUS

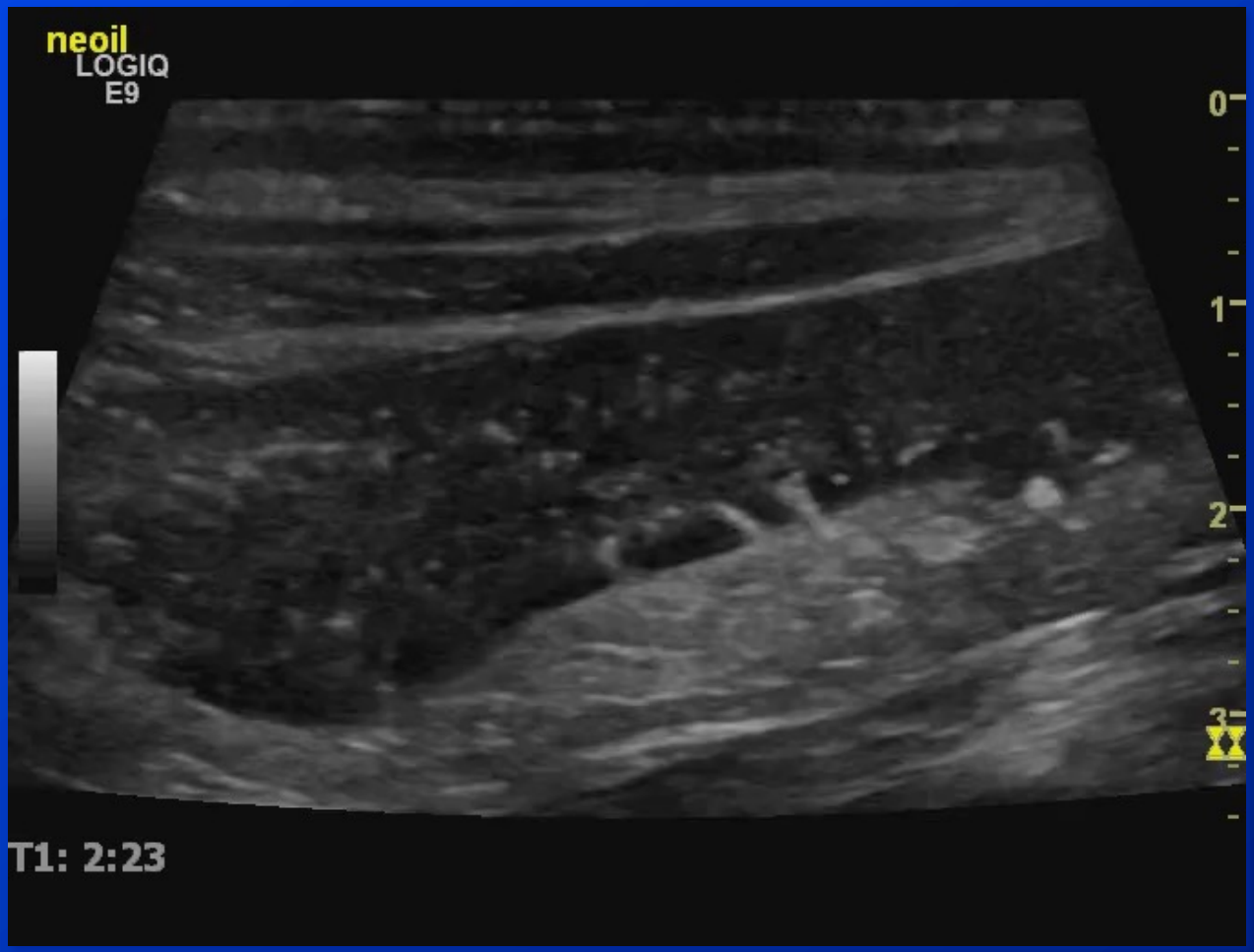
Any place

in

Bowel ultrasound ?



CEUS showing detailed intestinal perfusion in Crohn´s disease



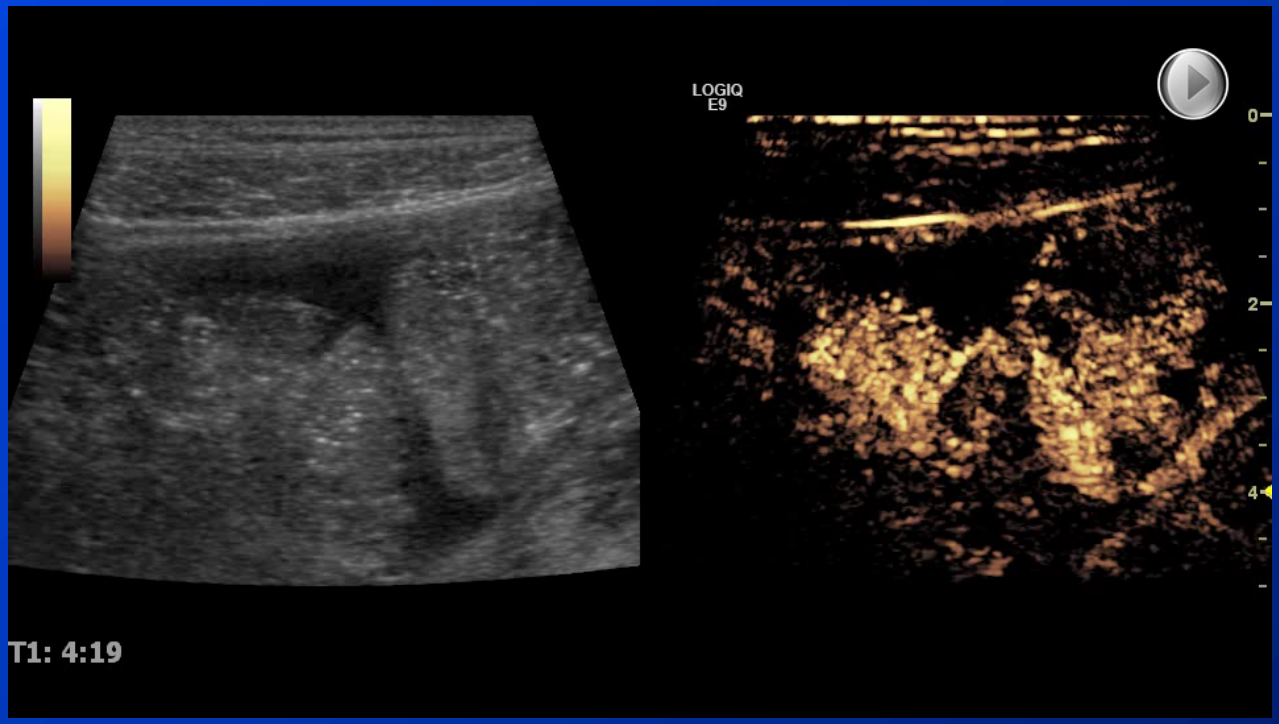
Courtesy: Dr. K. Nylund

Inflammatory Bowel Disease (IBD)

- Major indications:
  - Evaluate disease activity
  - Distinguish between fibrous and inflammatory strictures
  - Localise abscesses
  - Visualise fistulas

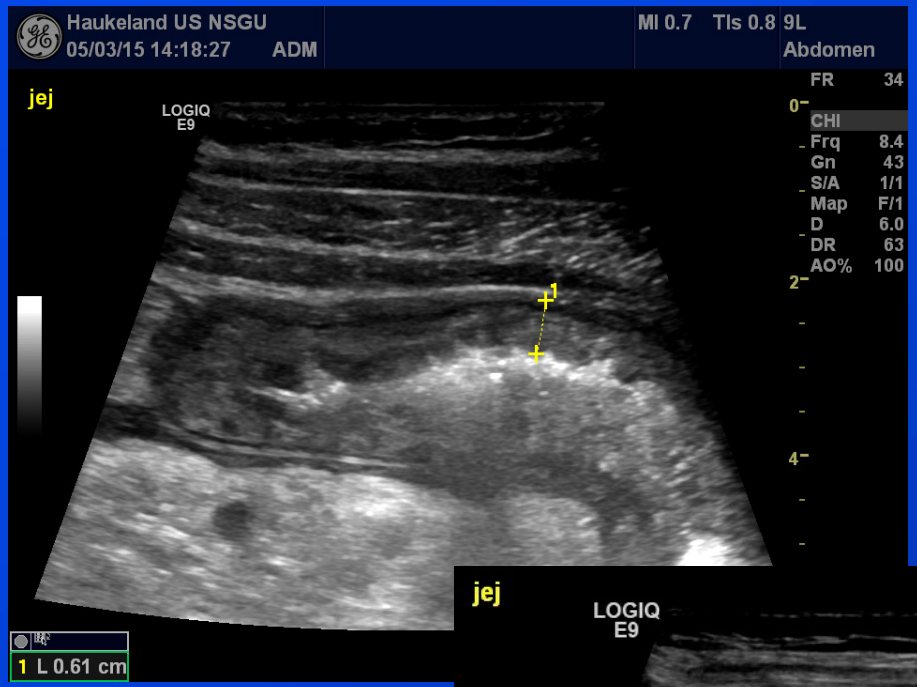
2 Phases of Bowel Perfusion

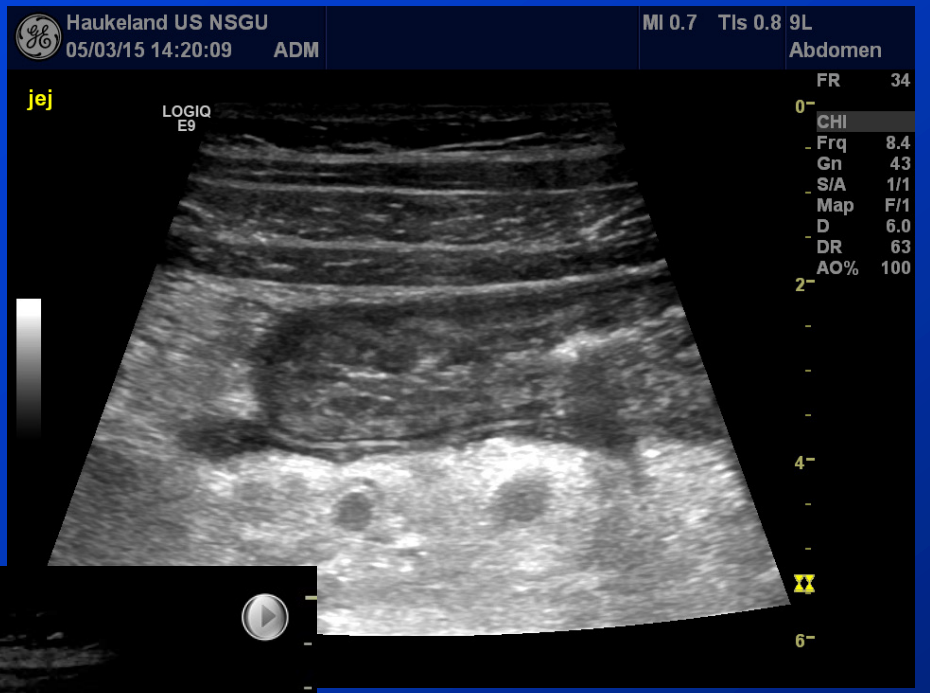
- Liver:
- Arterial phase
  - 0-30 sec.
- Portal phase
  - 30-120 sec.
- Sinusoidal phase (Parenchymal)
  - 2-4 min



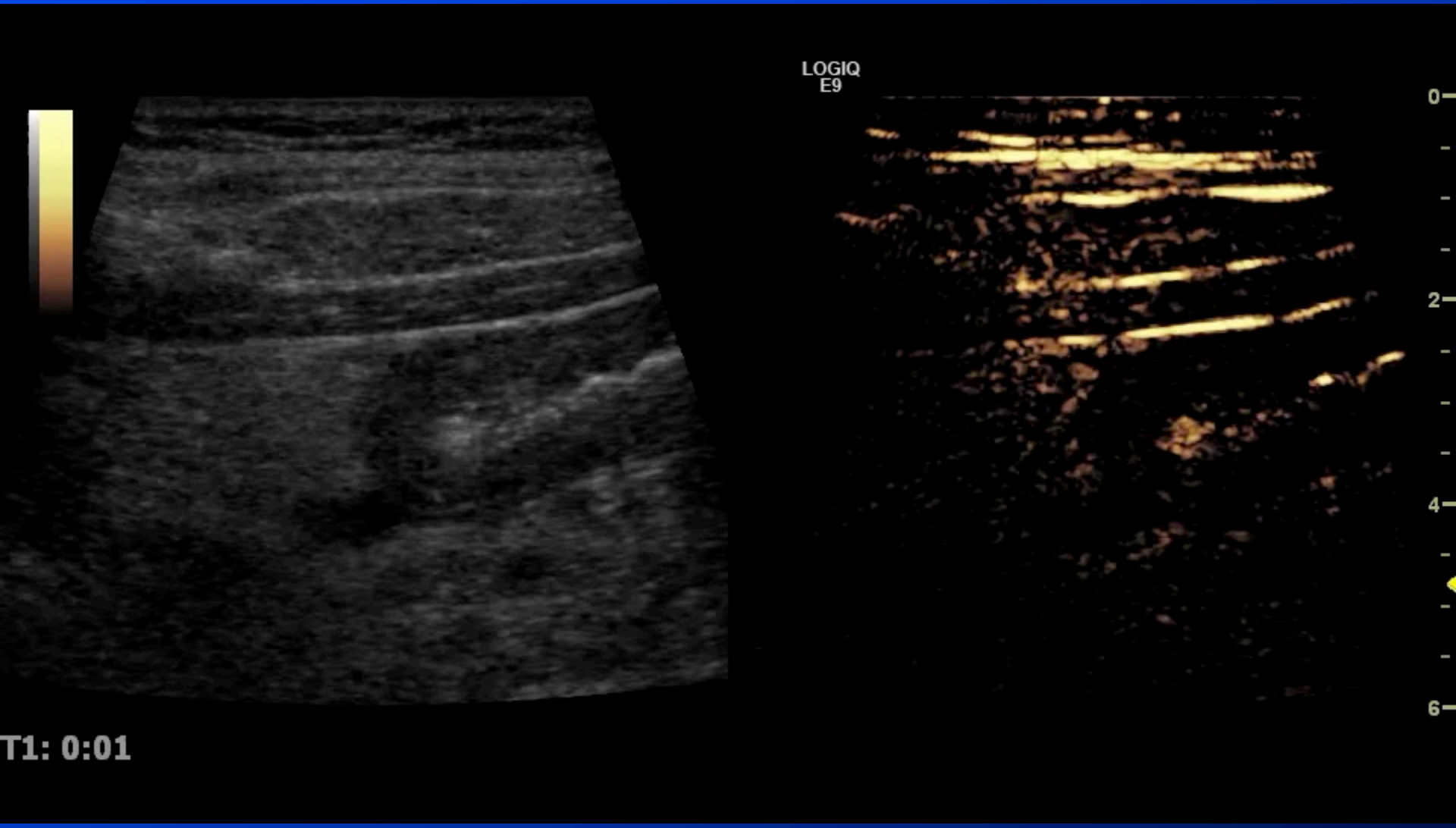
- BUT only 2 phases in bowel CEUS:
  - Arterial phase (0-40sec)
  - Venous phase (40-120 sec)

Crohn of the jejunum

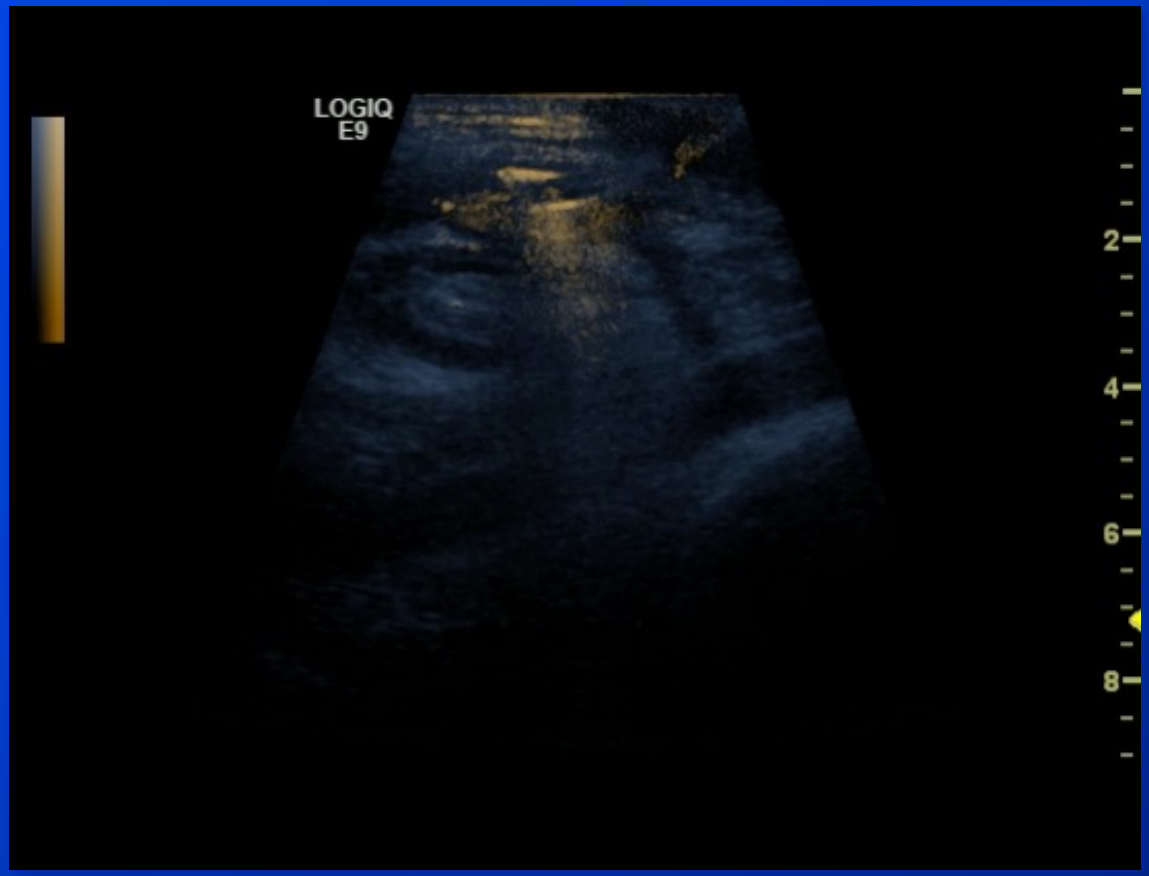




CEUS of Jejunal loop and surrounding tissue

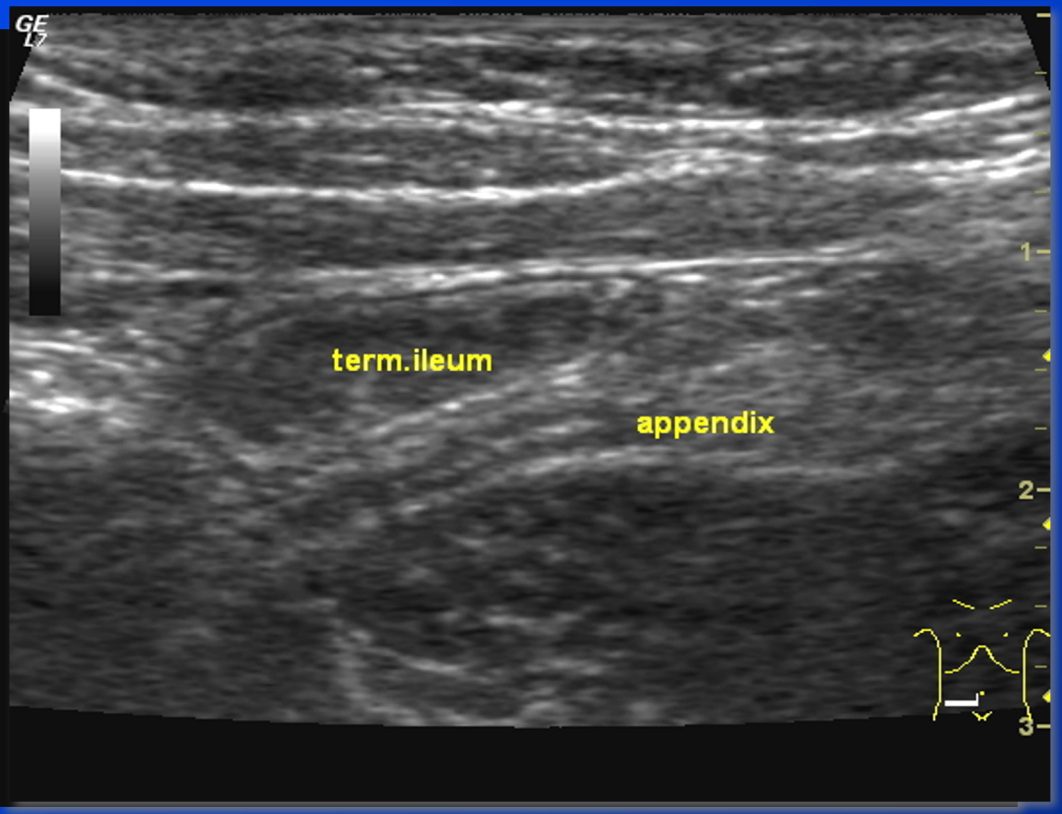


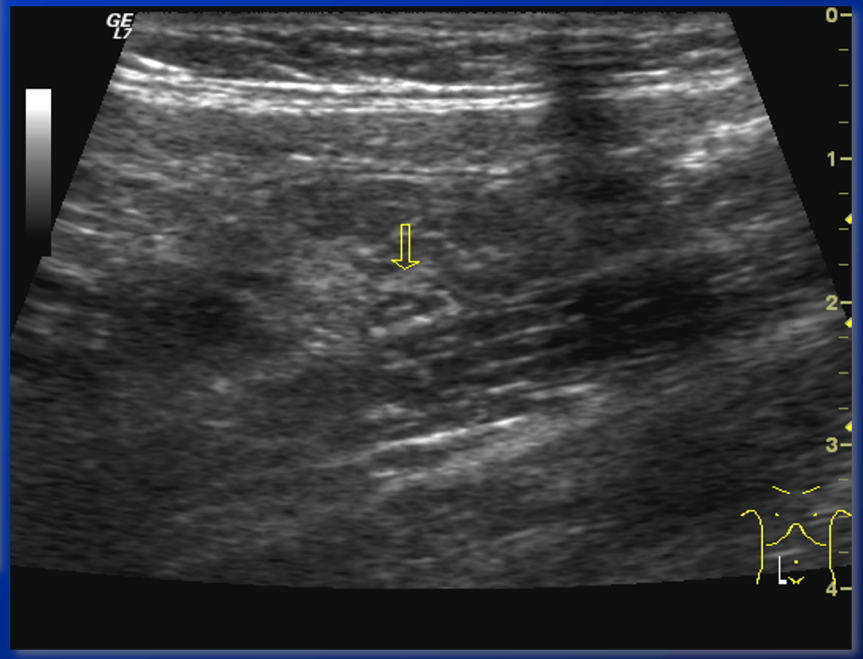
CEUS detection of Fistulas Injecting CA into the ext. opening



Cine loop in a patient with Crohn`s disease and an enterocutaneous fistula located at the left lower quadrant connecting at least two loops of the small intestine. Note the long extension of the hyperenhancing fistula showing clearly the transmural penetration in the end of the loop. Courtesy: Dr Hans-Peter Weskott

The Appendix

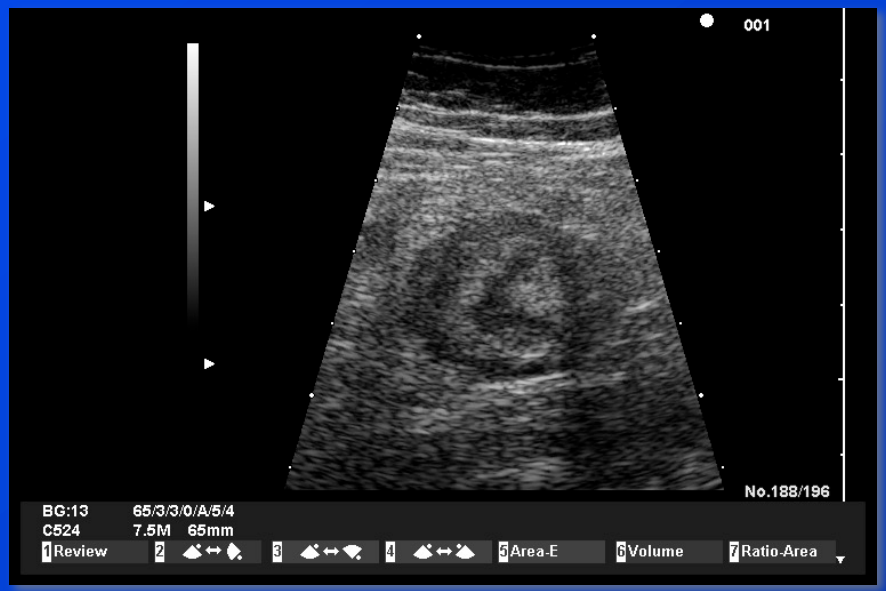


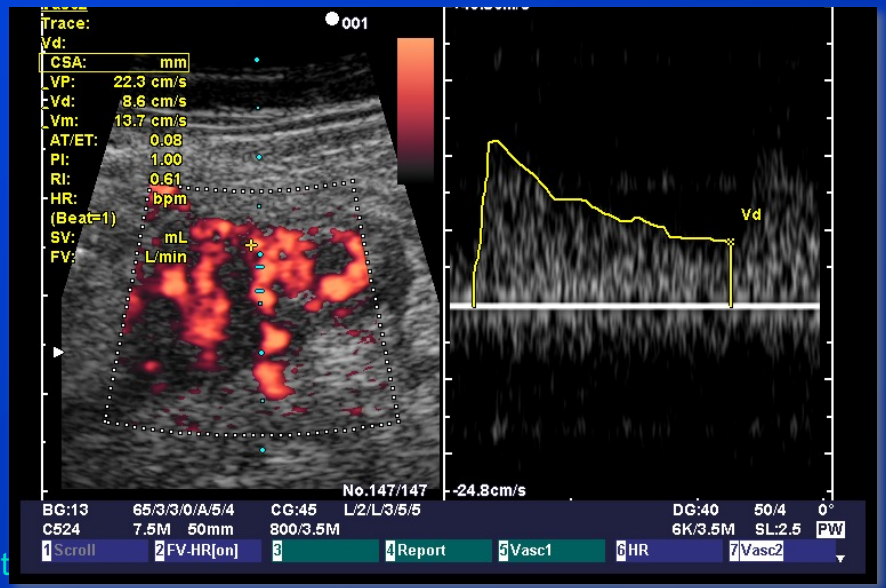


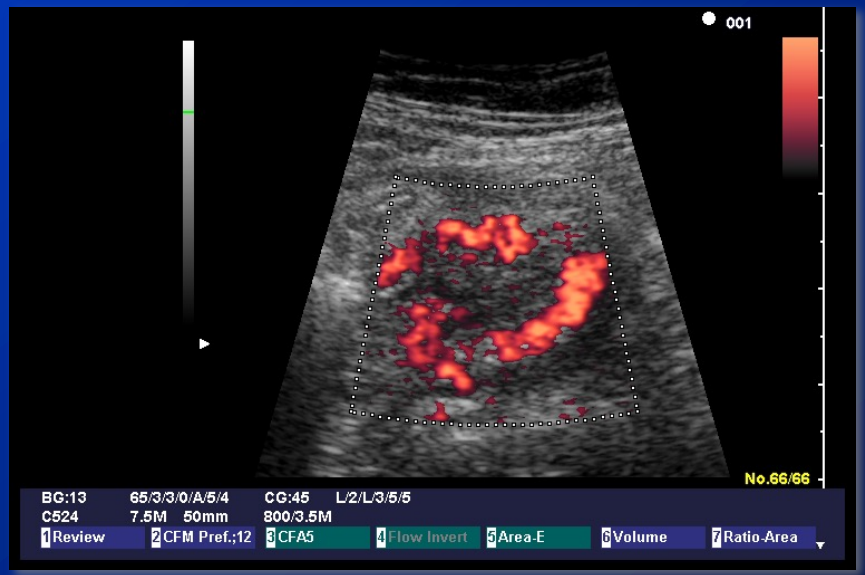
US Criteria for Appendicitis

- Distended appendix > 6 mm
- Presence of fecalith
- Periappendiceal oedema and/or infiltrate
- Doppler: Increased vascularity
- Local pain upon transducer palpation
- (Low resistive index)

Appendicitis

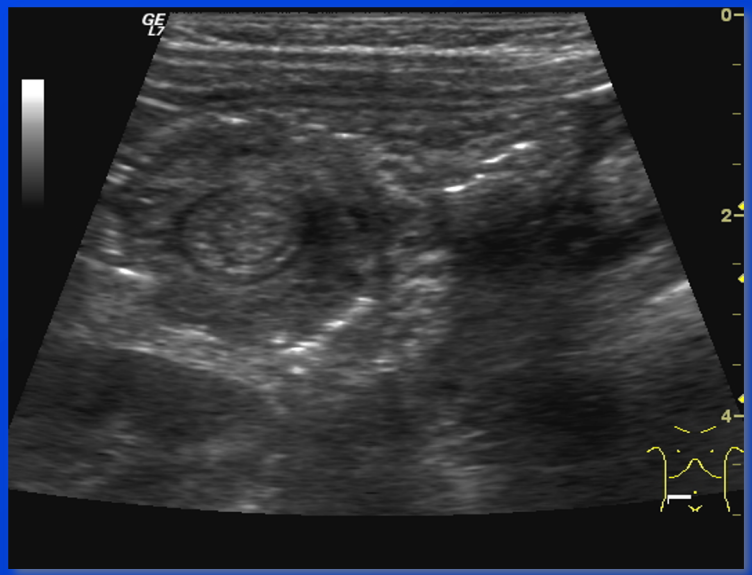


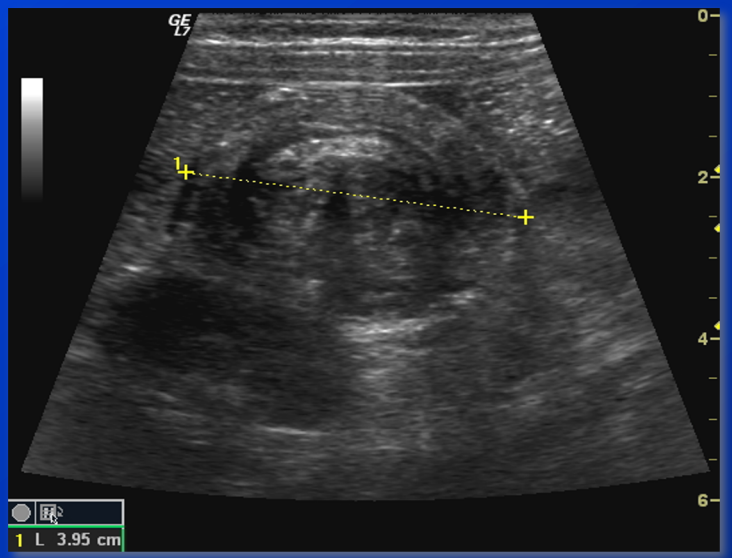


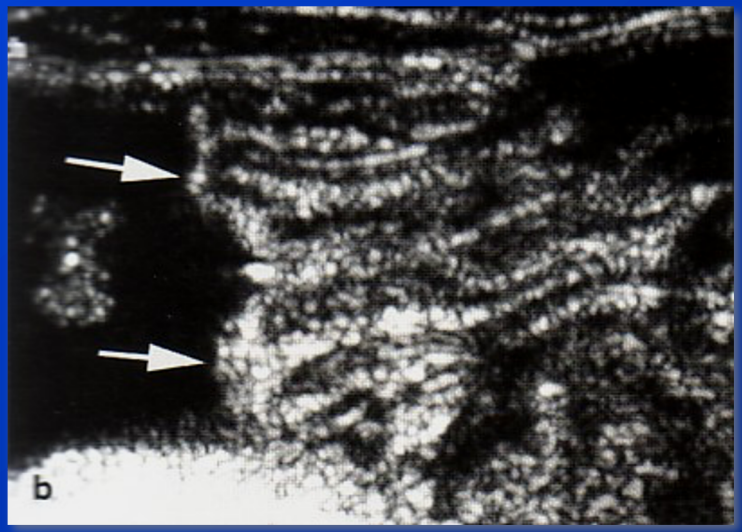


Nat

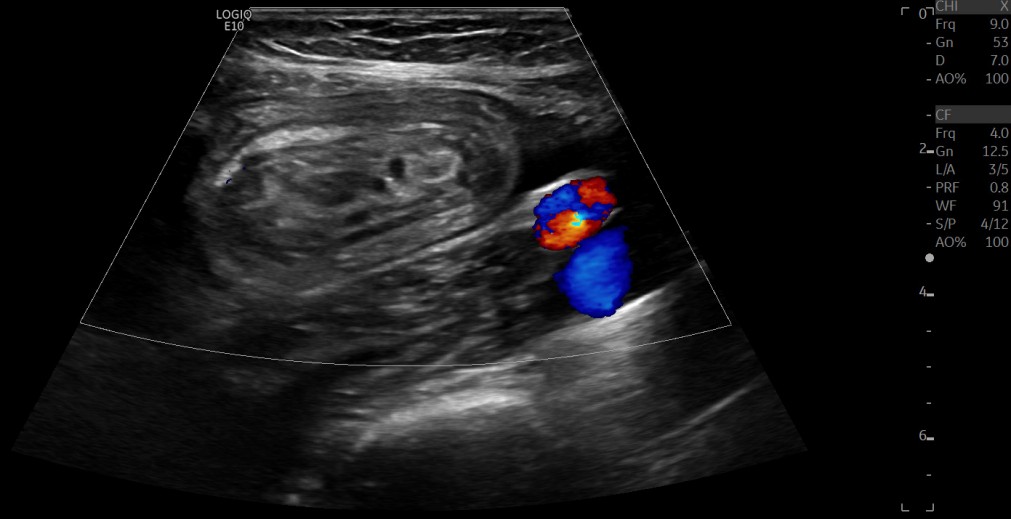
Invagination

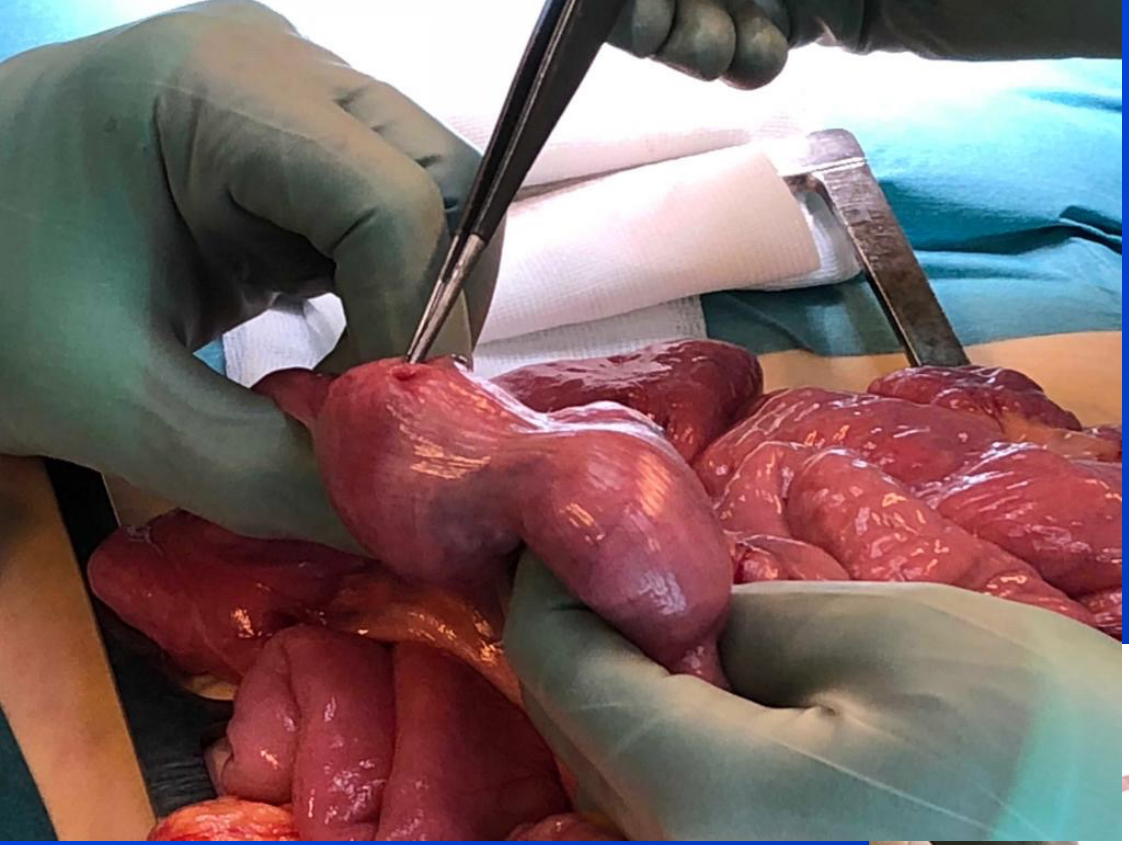


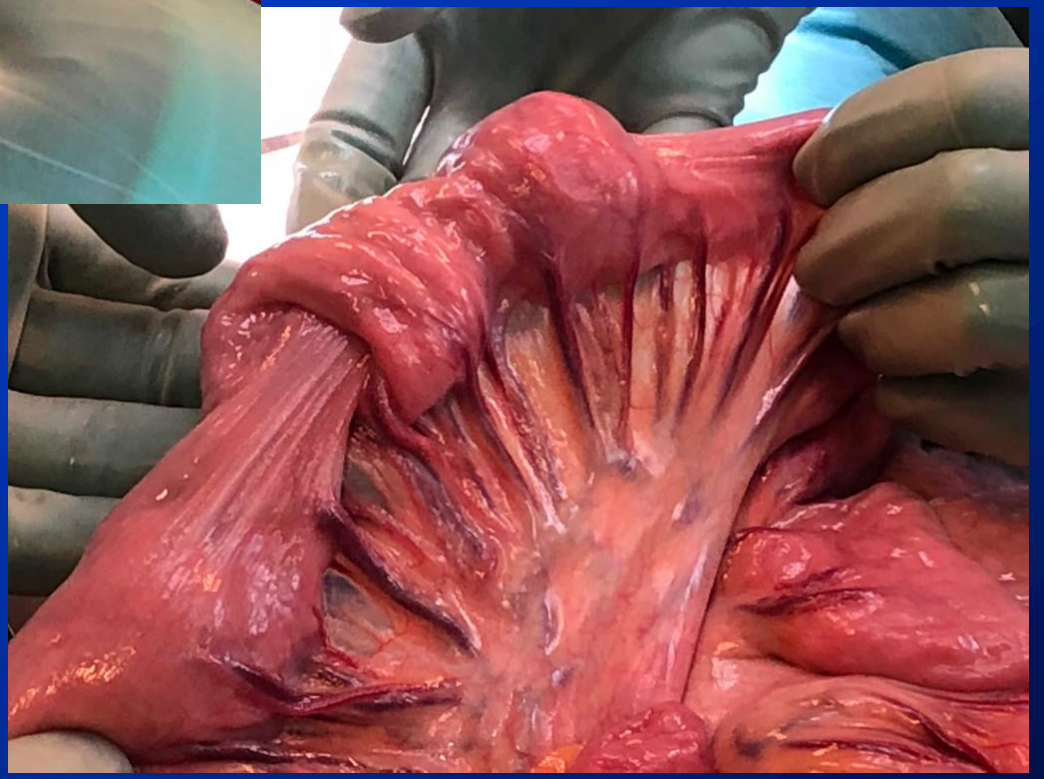




Invagination







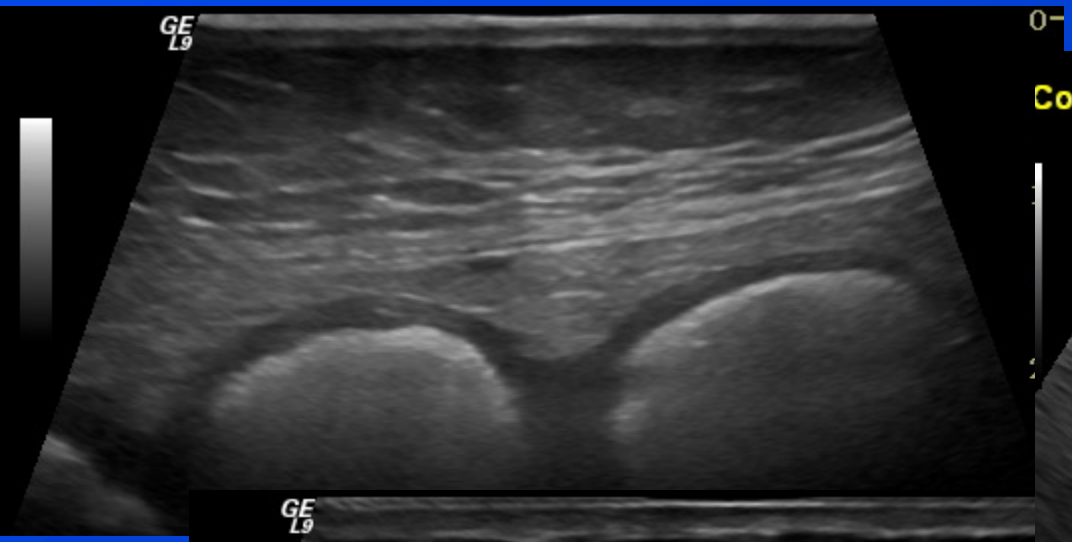
Hydrotheraphy of Invaginasjon

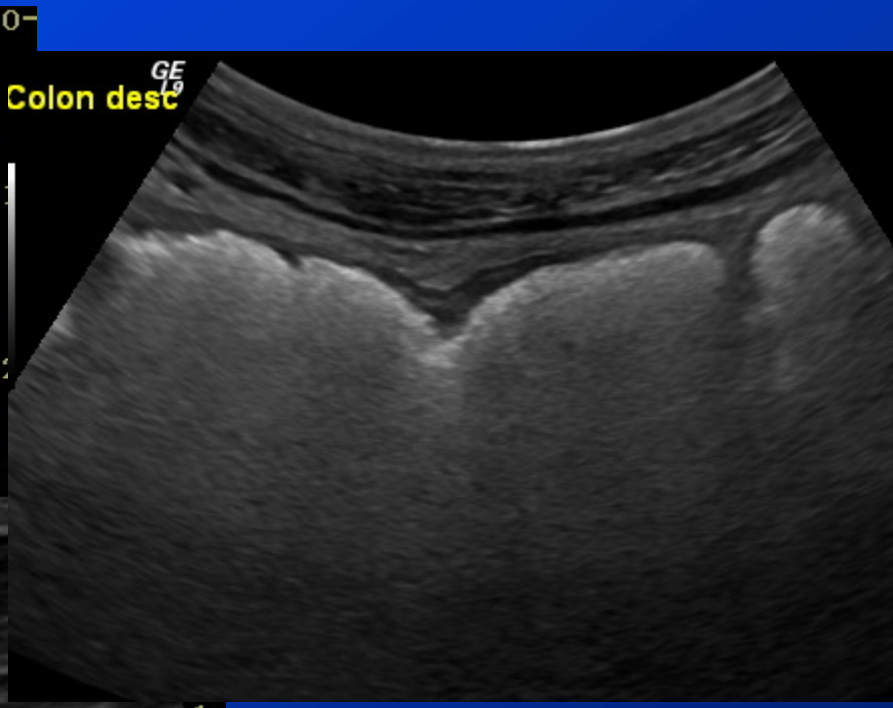
Video: Dr. Reiher

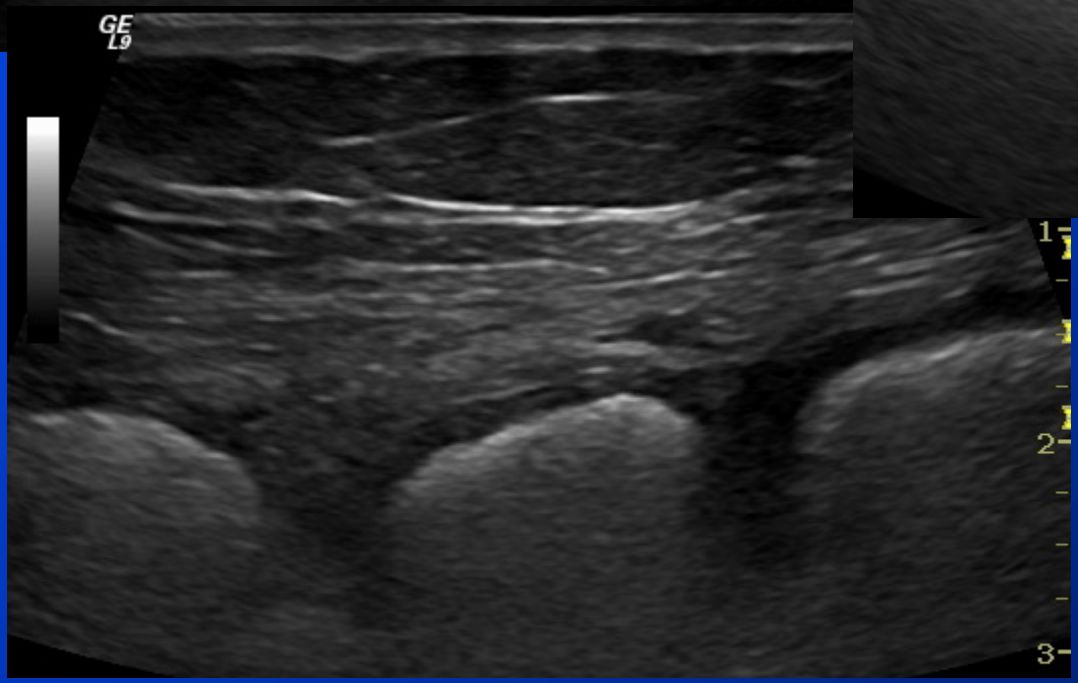
Ultrasound of the GI Tract Agenda

- Esophagus
- Ventriculus
- Duodenum
- Jejunum
- Ileum
- **Colon / Rectum**

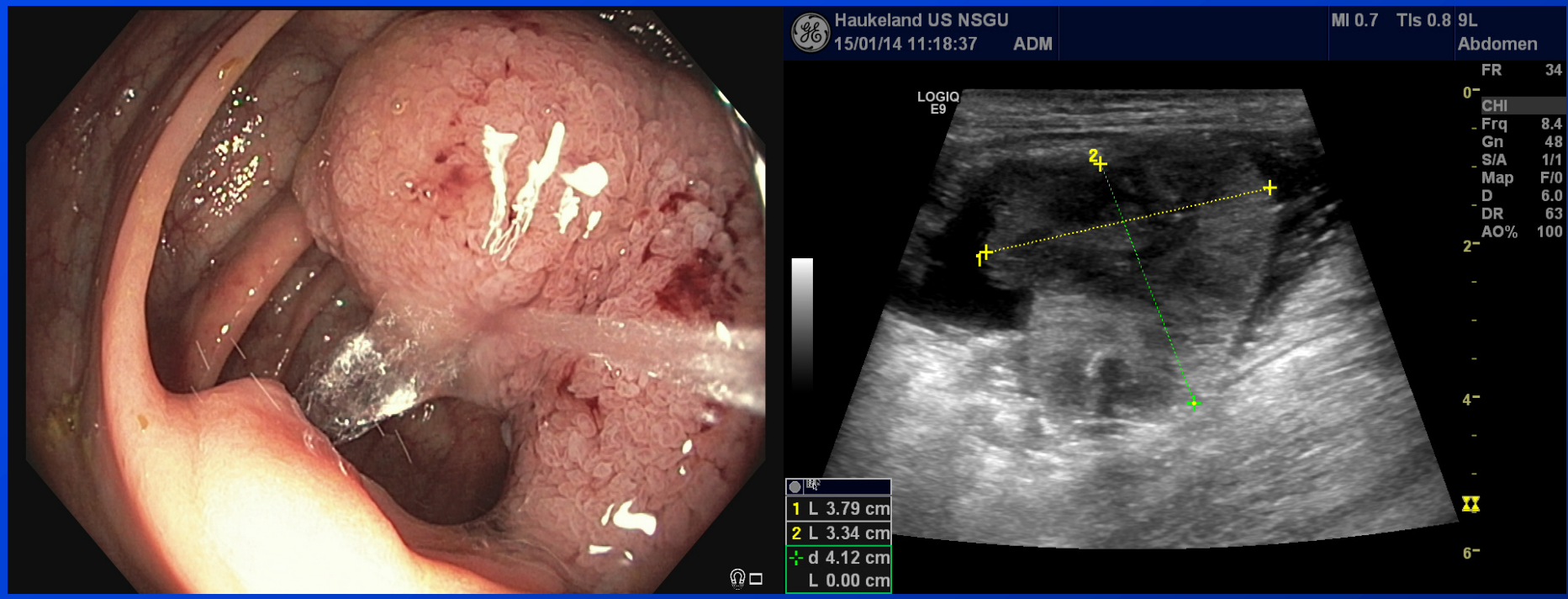
Wall Layers of Normal Colon

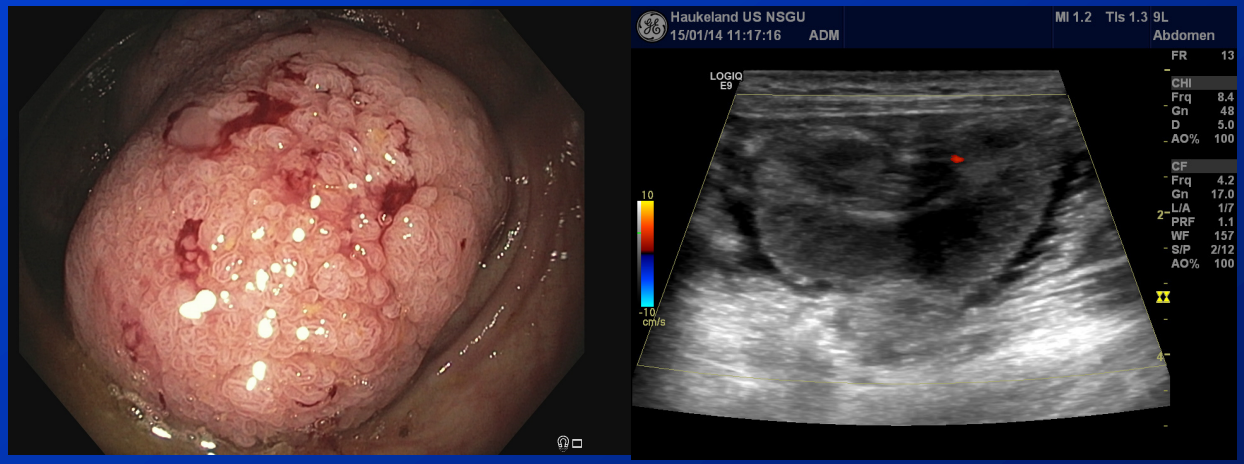




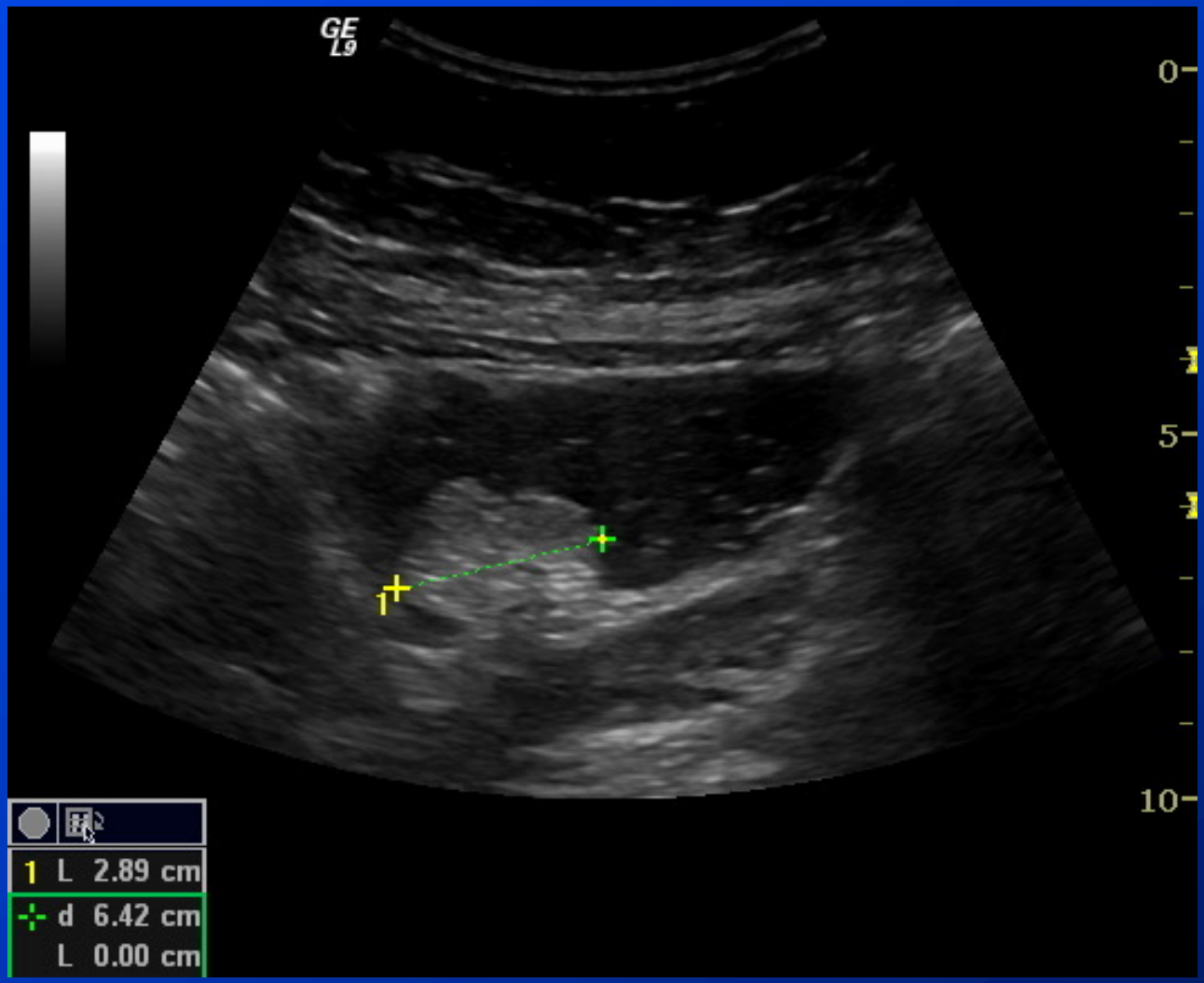


Large Polyp in Coecum

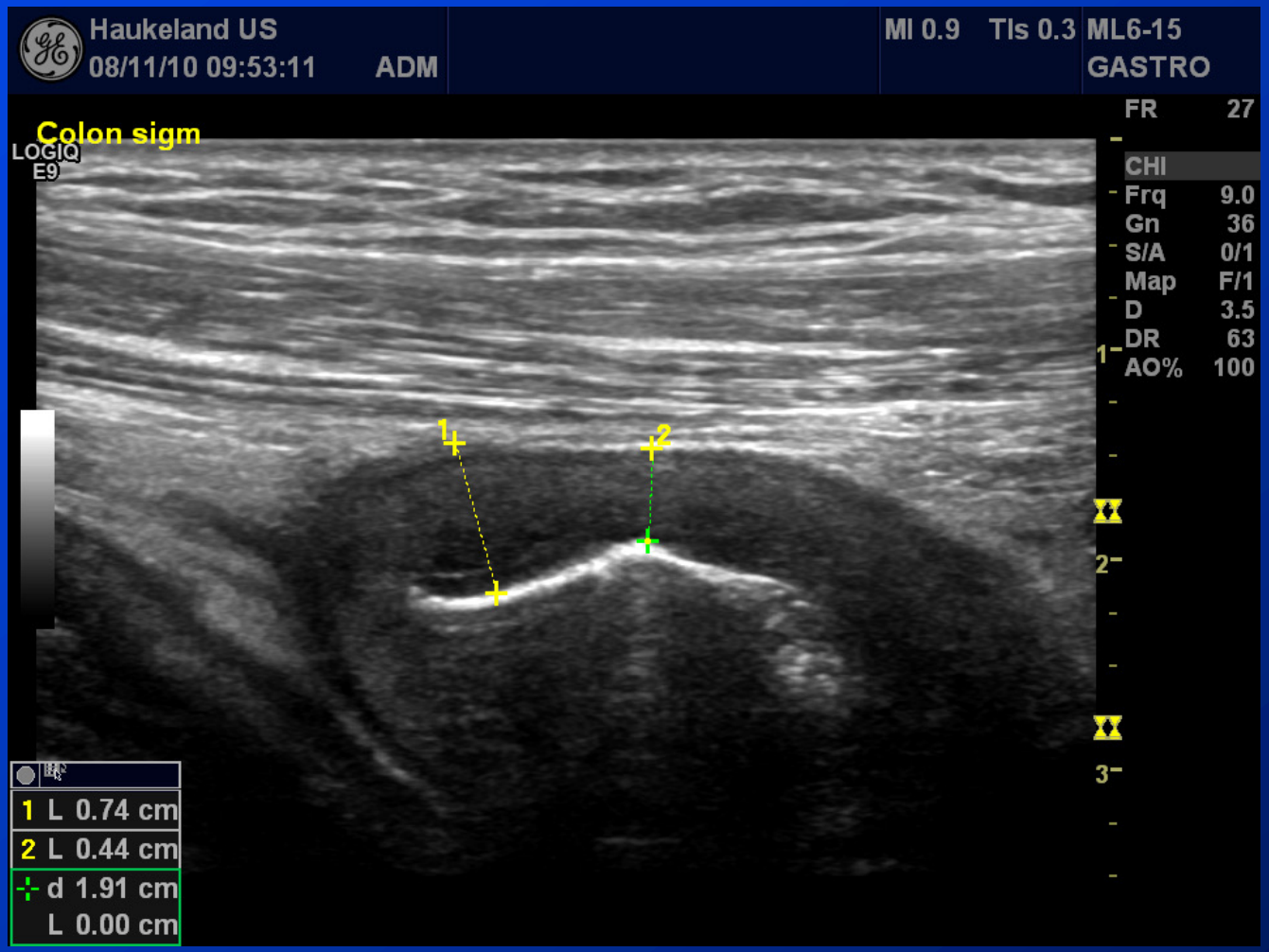


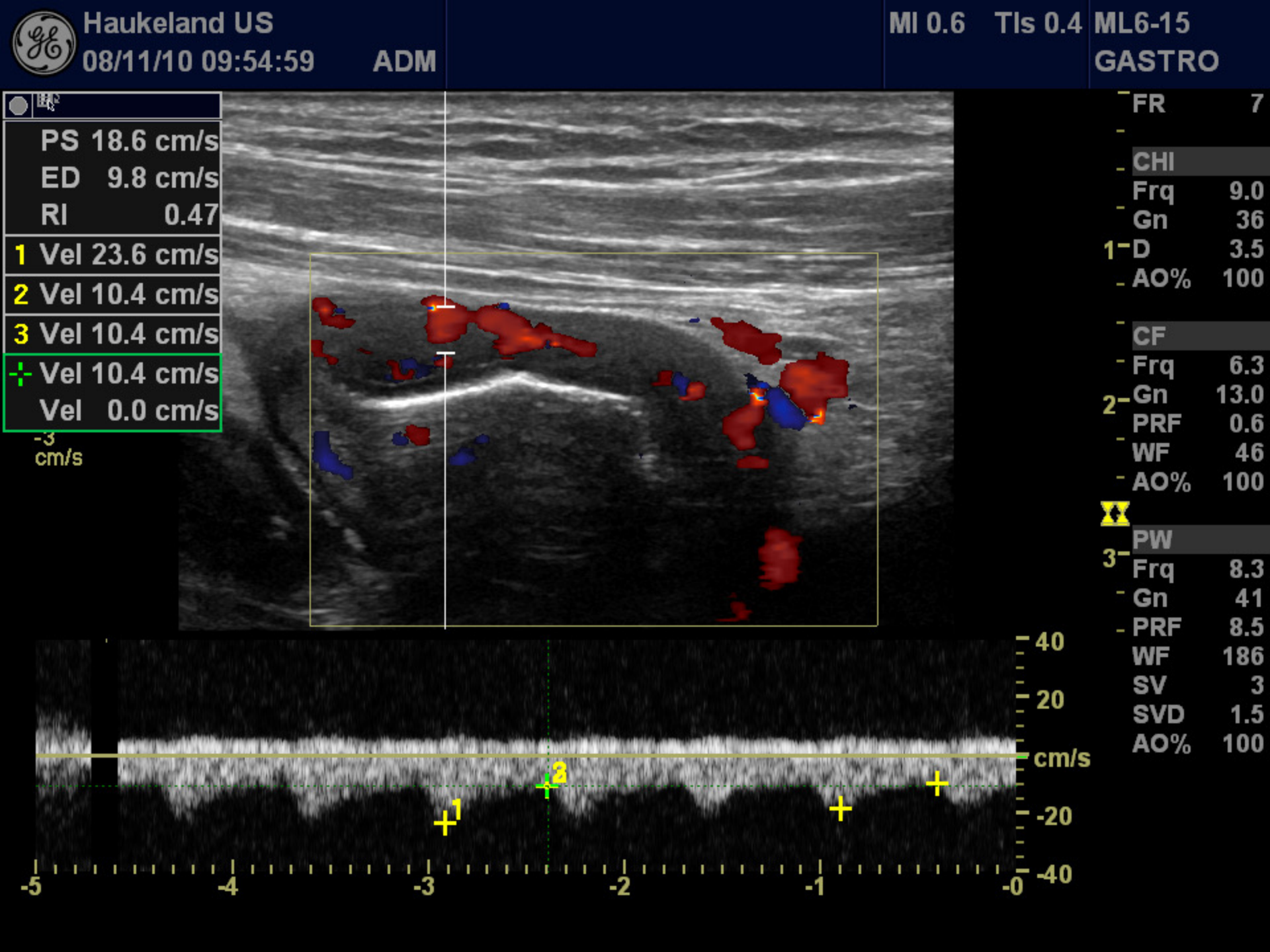


Tumor of the Coecum



Sigmoiditis

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MI 0.6
TIs 0.4
ML6-15
GASTRO
PS 18.6 cm/s
ED 9.8 cm/s
RI 0.47
1 Vel 23.6 cm/s
2 Vel 10.4 cm/s
3 Vel 10.4 cm/s
Vel 10.4 cm/s
Vel 0.0 cm/s
-3
cm/s
FR 7
CHI
Frq 9.0
Gn 36
D 3.5
AO% 100
CF
Frq 6.3
Gn 13.0
PRF 0.6
WF 46
AO% 100
PW
Frq 8.3
Gn 41
PRF 8.5
WF 186
SV 3
SVD 1.5
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20
cm/s
-20
-40
-5
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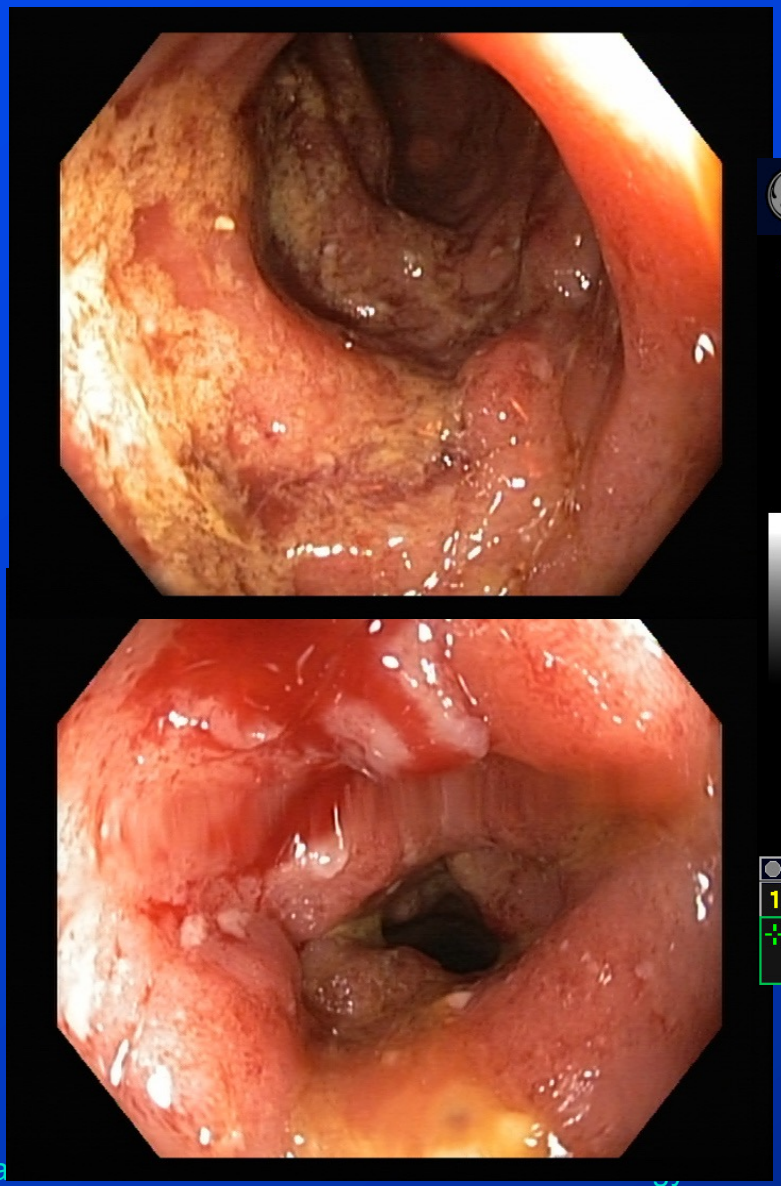
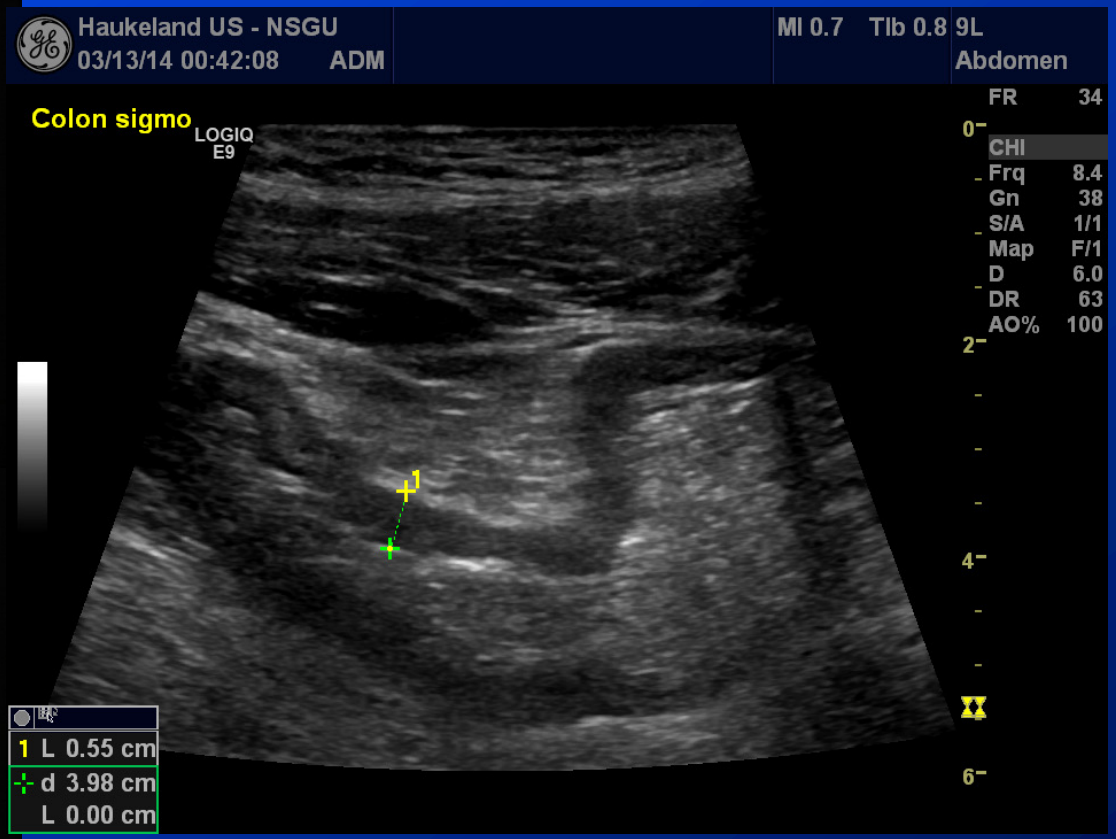
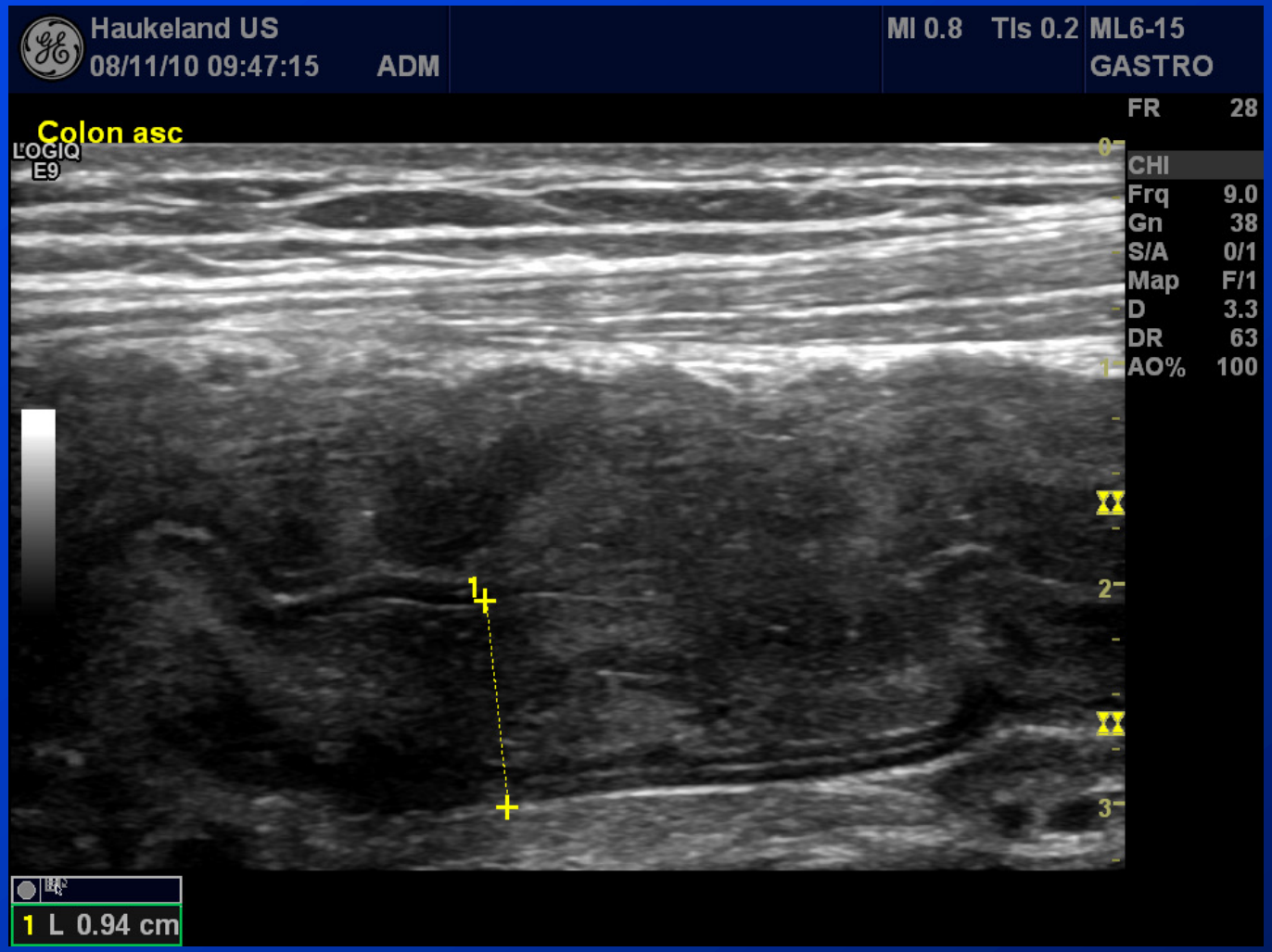
-3
-2
-1
-0

US in Ulcerative Colitis

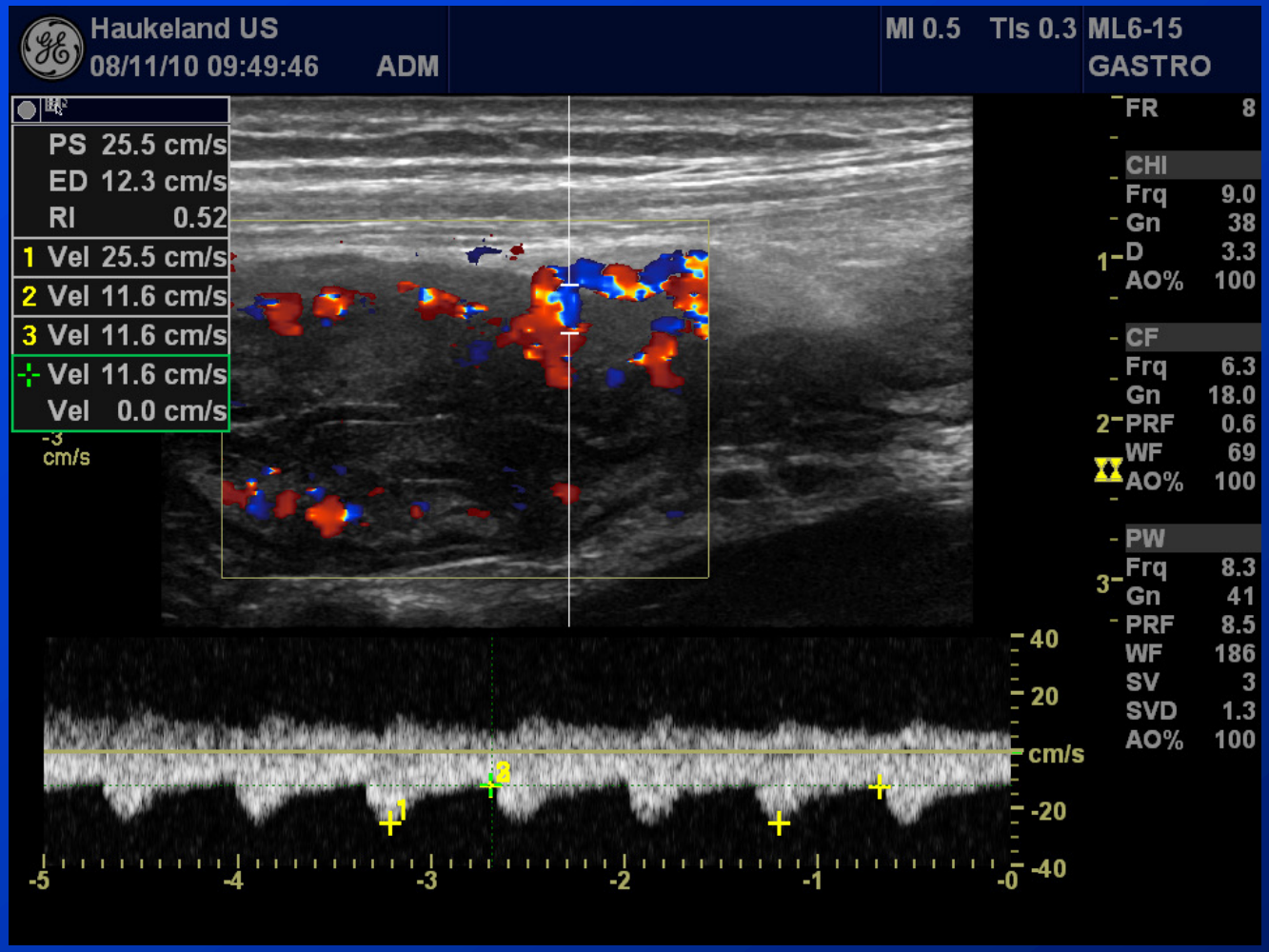




Ulcerative Colitis



RI in UC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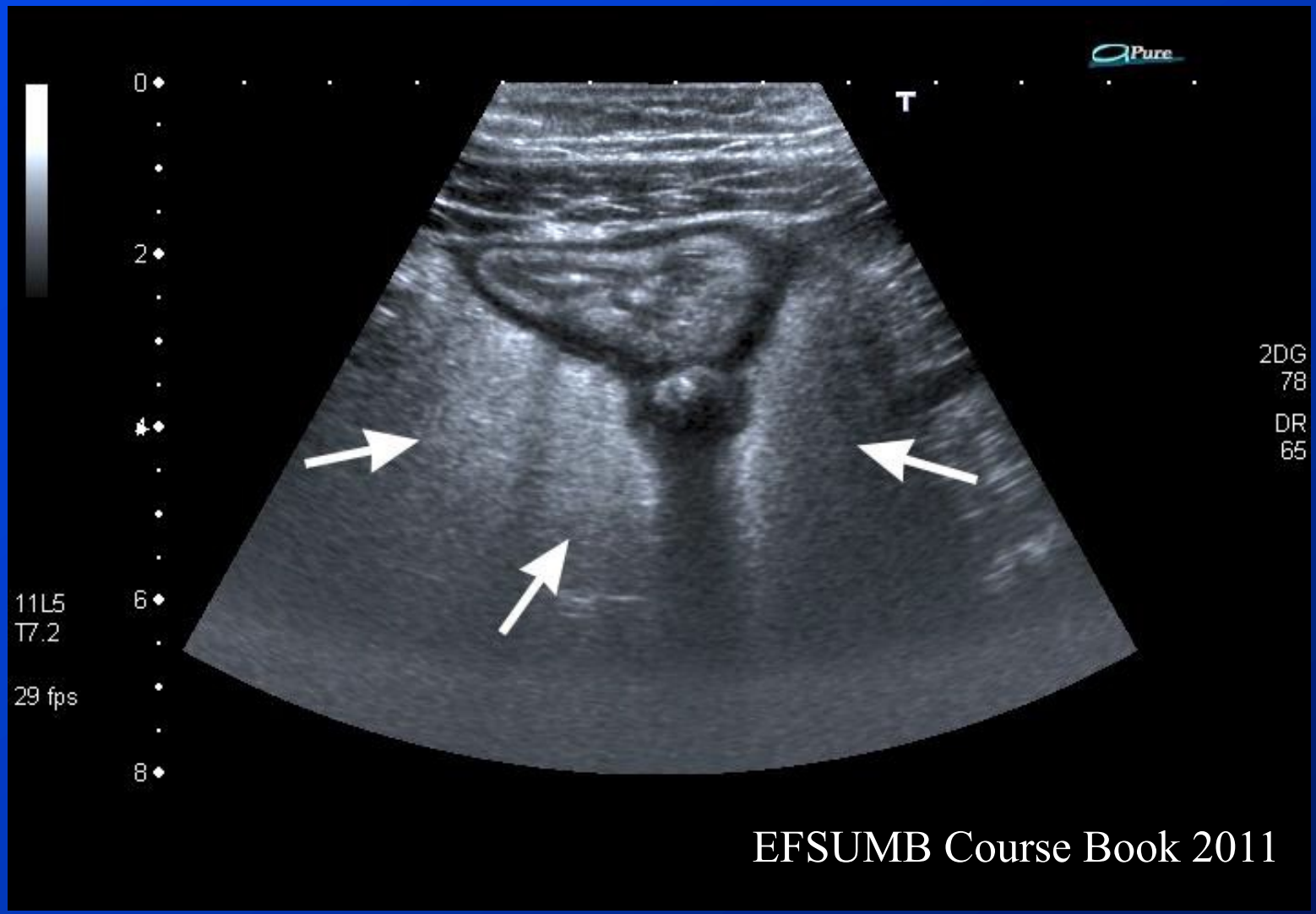
MI 0.5
TIs 0.3
ML6-15
GASTRO
PS 25.5 cm/s
ED 12.3 cm/s
RI 0.52
1 Vel 25.5 cm/s
2 Vel 11.6 cm/s
3 Vel 11.6 cm/s
Vel 11.6 cm/s
Vel 0.0 cm/s
-3
cm/s
FR 8
CHI
Frq 9.0
Gn 38
D 3.3
AO% 100
CF
Frq 6.3
Gn 18.0
PRF 0.6
WF 69
AO% 100
PW
Frq 8.3
Gn 41
PRF 8.5
WF 186
SV 3
SVD 1.3
AO% 100
40
20
cm/s
-20
-40
-5
-4
-3
-2
-1
-0

Diverticulum in the Colon

Diverticulitis



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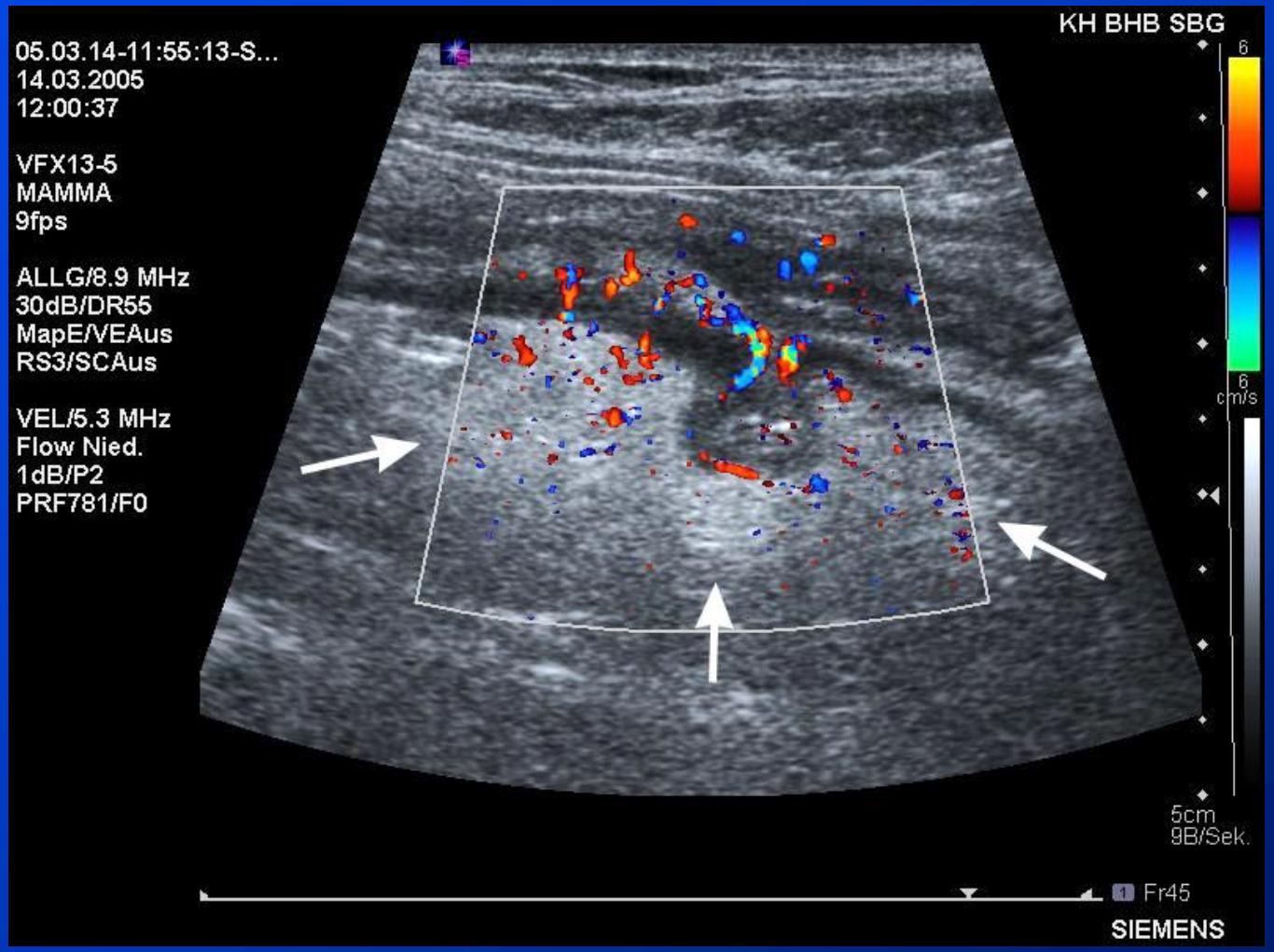
Diverticulitis of the Sigmoid Colon



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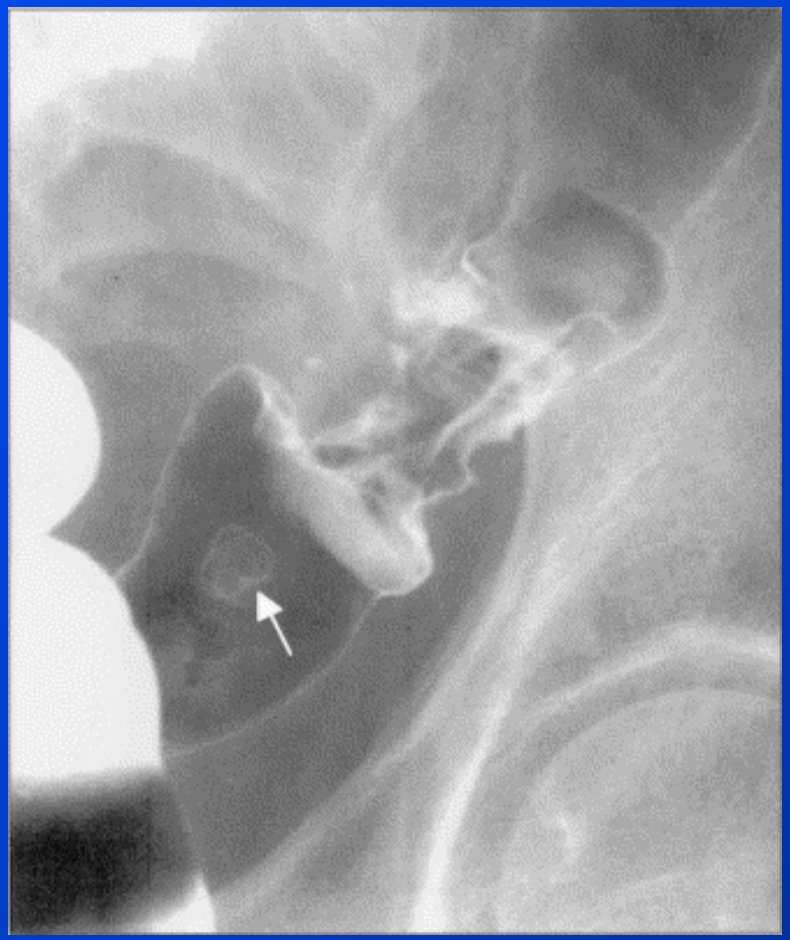
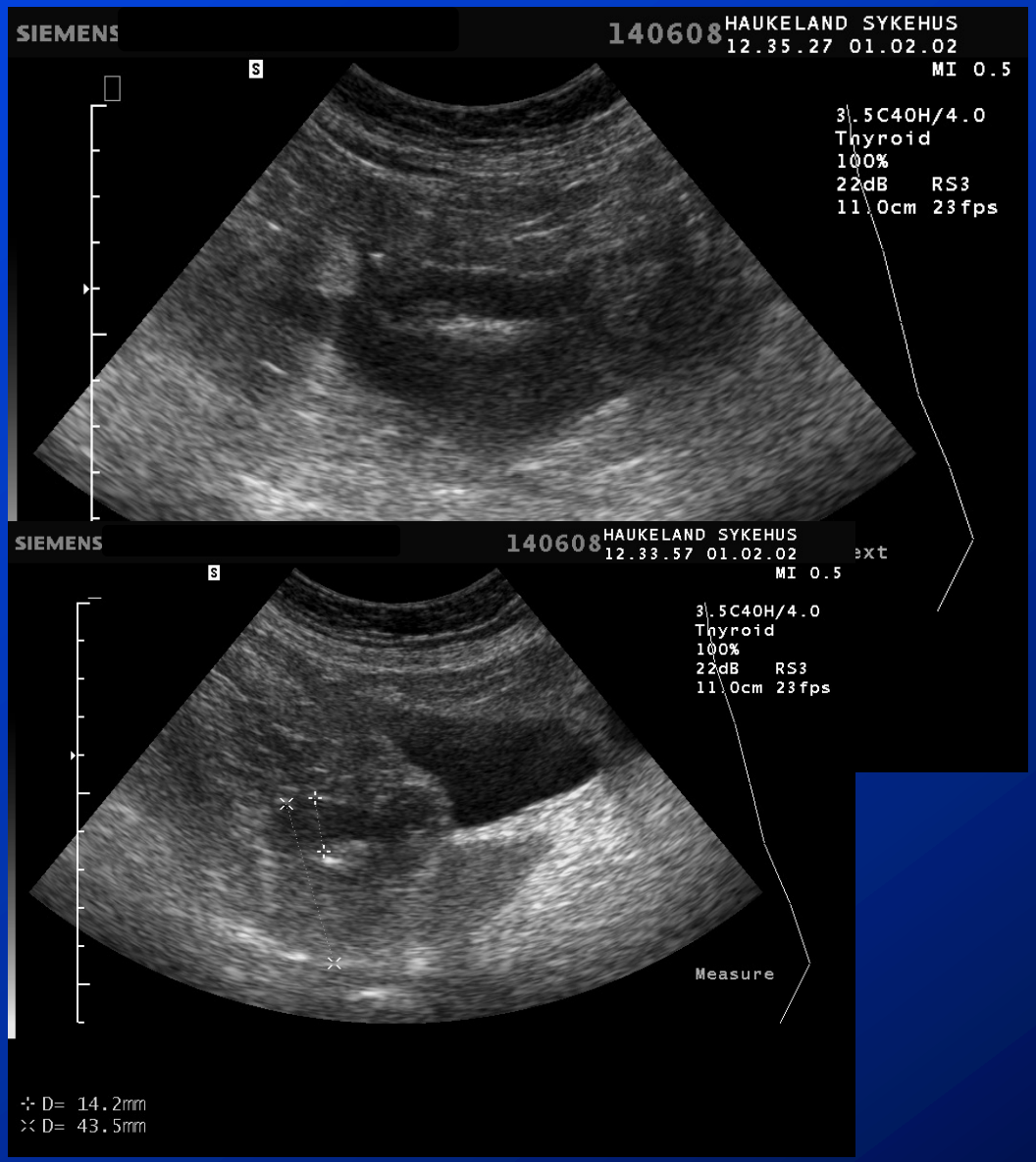
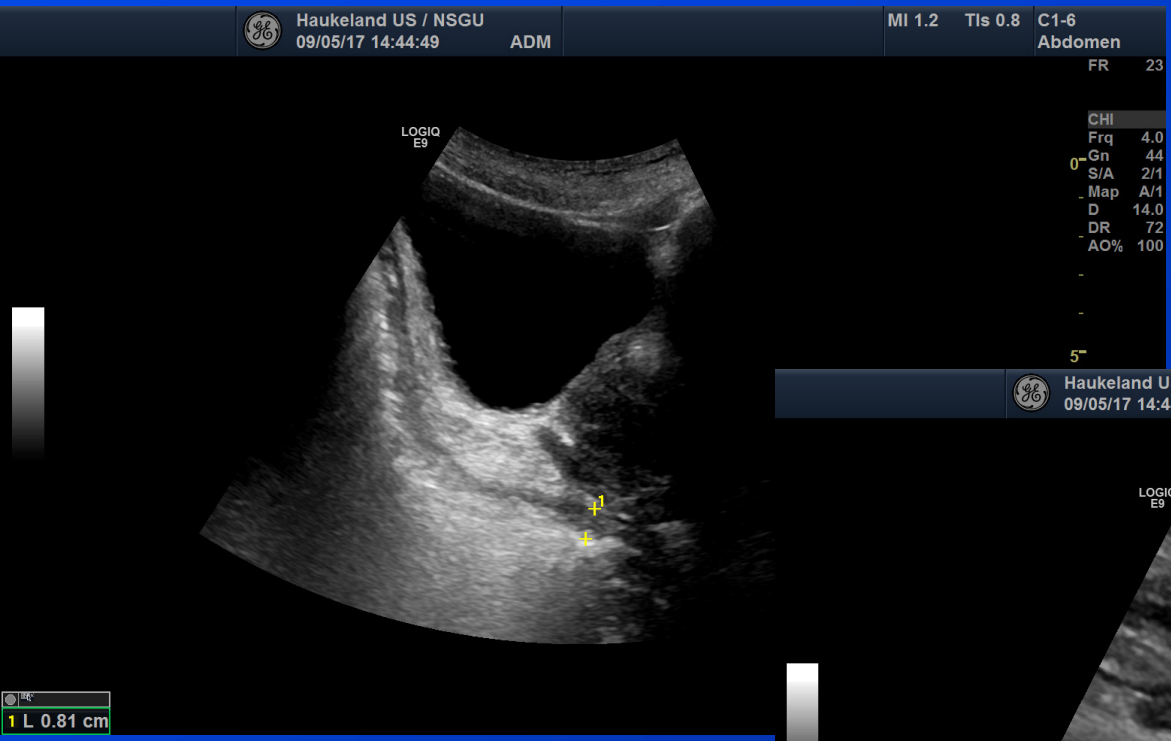
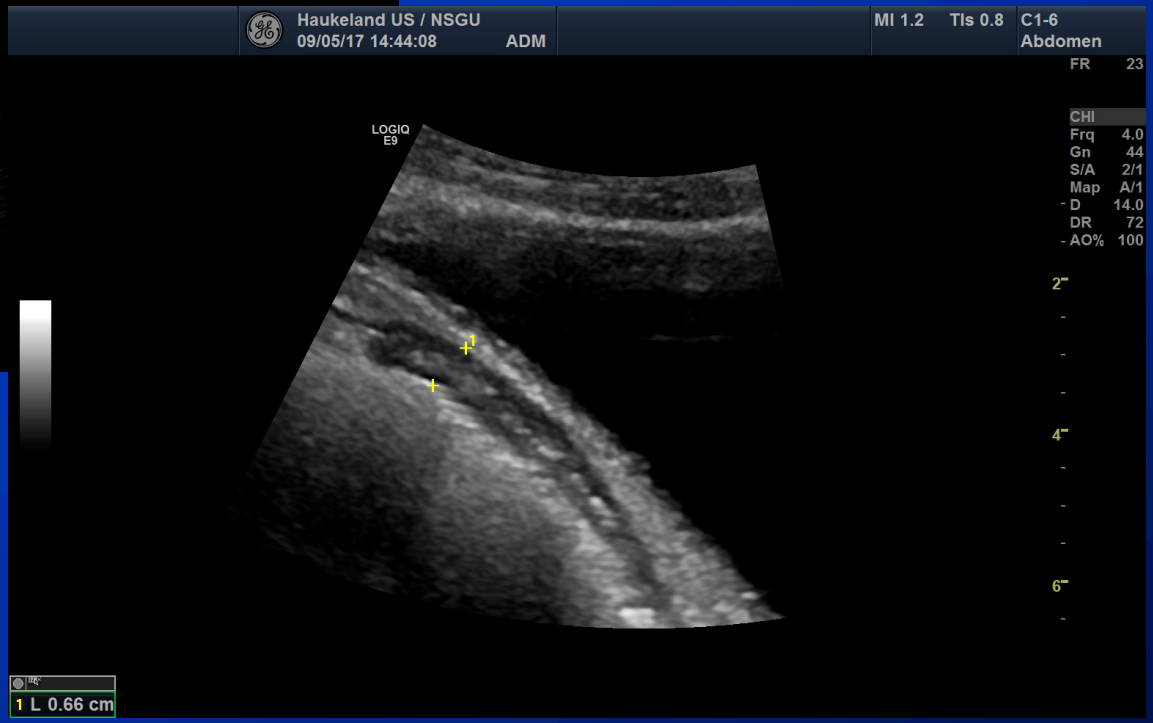
Ca. Coli Sigmoidei





Look beyond the bladder !





Summary

- Ultrasonography is a clinical tool with great potentials for disease of the GI-Tract
- ”Pseudo-kidney” or target lesions indicate severe pathology
- Motility and focal lesions can be visualised in the small intestine
- Useful to detect and follow-up GI diseases of the small intestine and colon
- Wall-thickness of the GI-tract are to some extent predictive of disease activity in IBD
- CEUS can characterize focal lesions of the GIT and diagnose abscesses

Bye - bye !