

80874808
19967043
72184127



Meeting del 45° parallelo

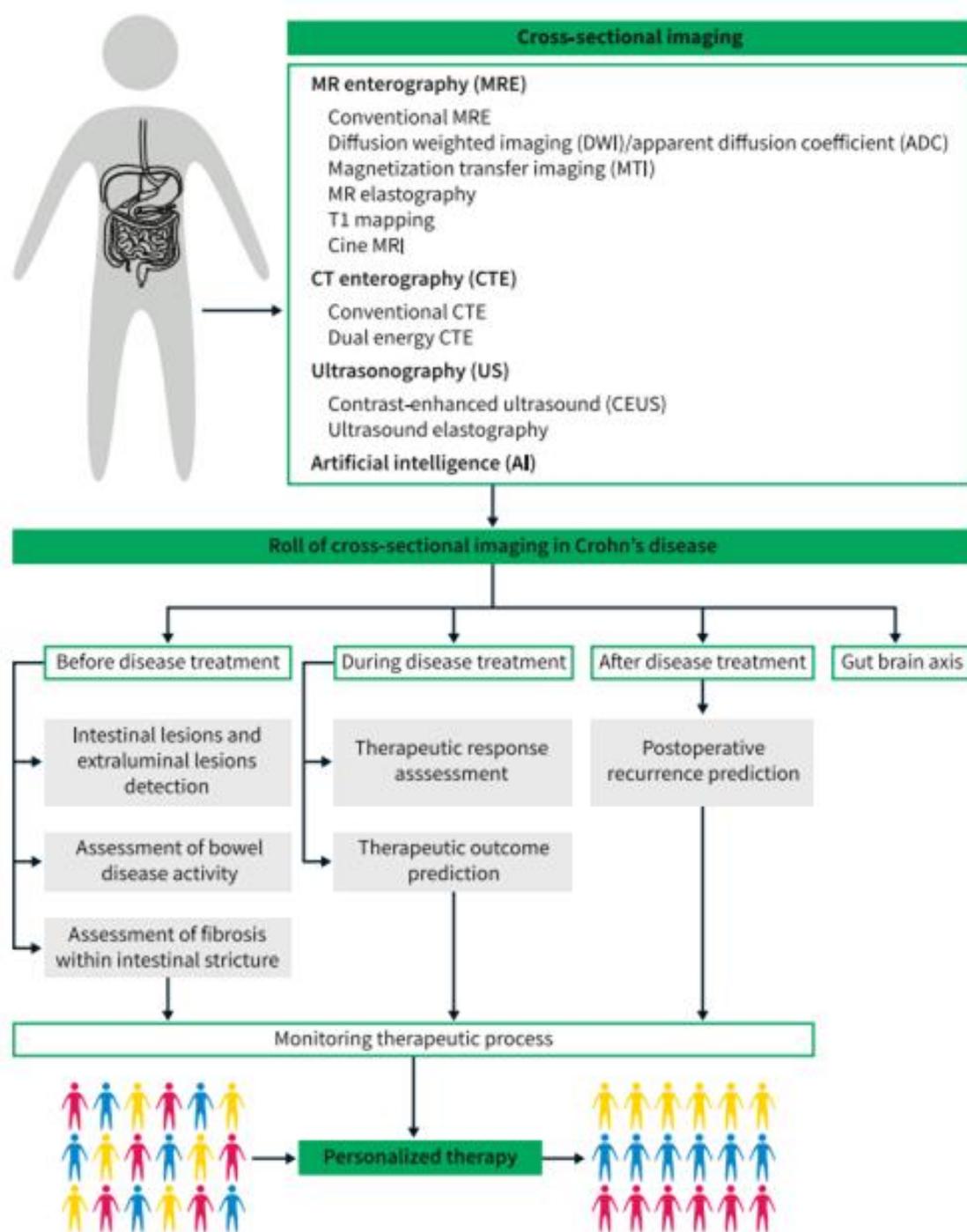
IBD and liver hemisphere

30 Maggio 2024

Particular scenarios in IBD management

Imaging in IBD : RM and Ultrasound

Carmelo Lacognata
Radiologia Padova



Inflammatory bowel disease cross-sectional imaging: What's new?

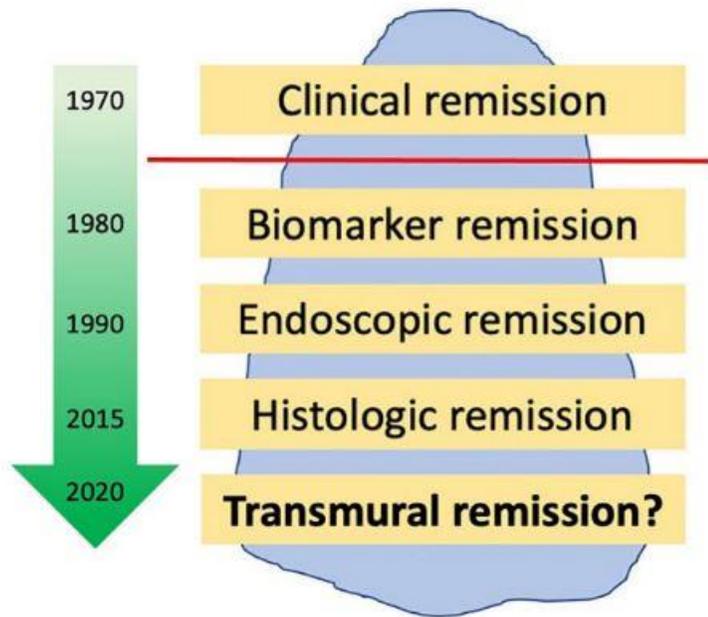


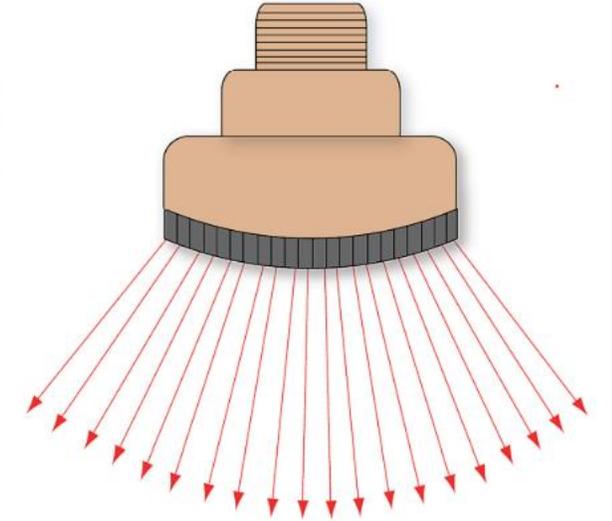
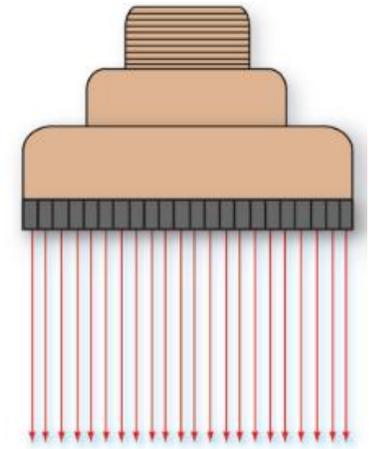
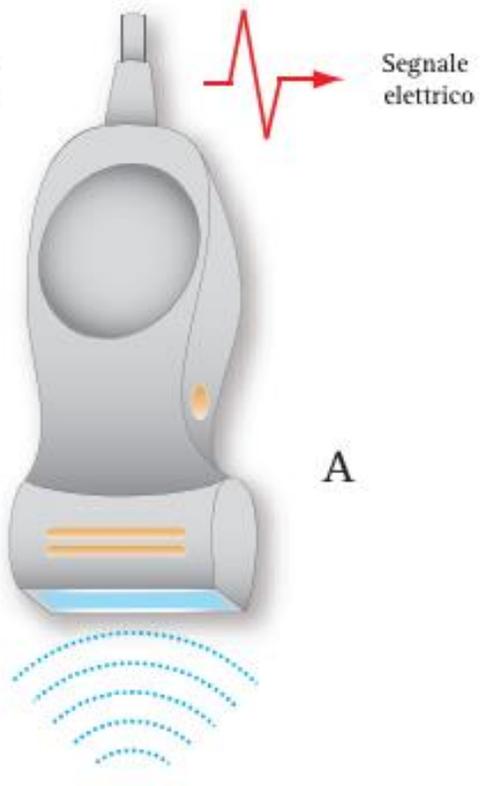
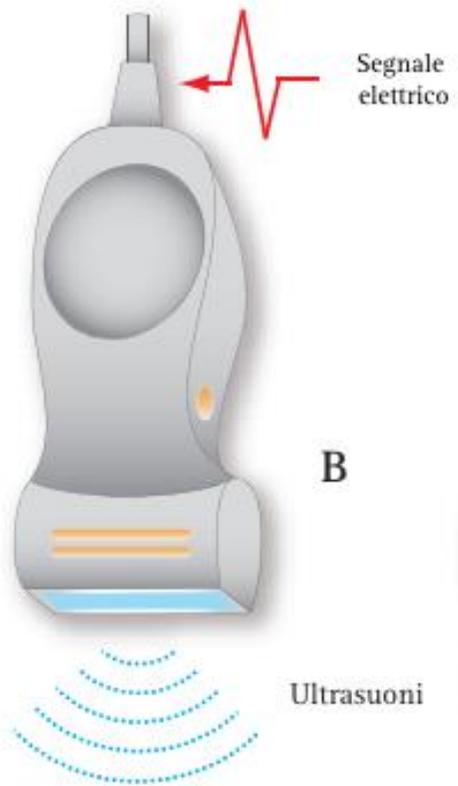
Figure 1. Evolution of treatment targets.

CRITERI DI TRANSMURAL REMISSION

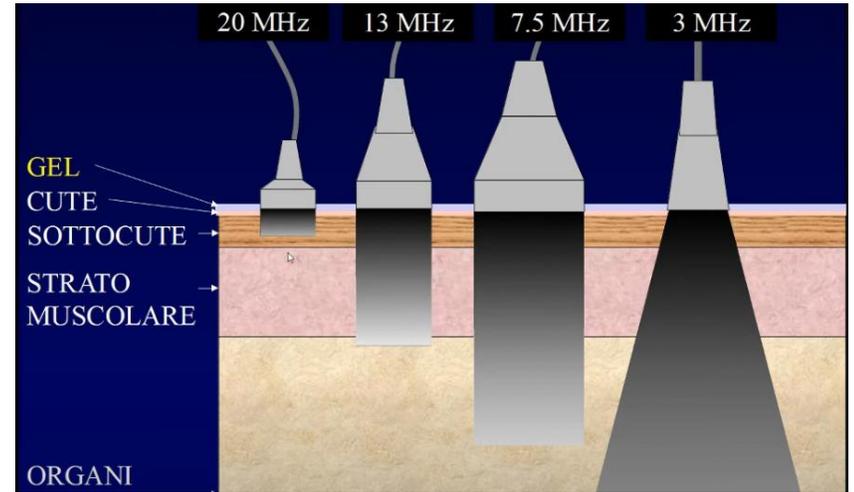
- ISPESSIMENTO PARIETALE ≤ 3 mm
 - < DELLO SPESSORE > 25%
 - < DELLO SPESSORE > 2MM
 - < DELLO SPESSORE >1 MM +RIDUZIONE DEL DOPPLER
 - PERFUSIONE NORMALE
 - PRESENZA DI STRATIFICAZIONE PARIETALE(ecografia)
 - <ADDENSAMENTO DEL GRASSO PERIVISCERALE
-
- ASSENZA DI ULCERE E EDEMA (RM)

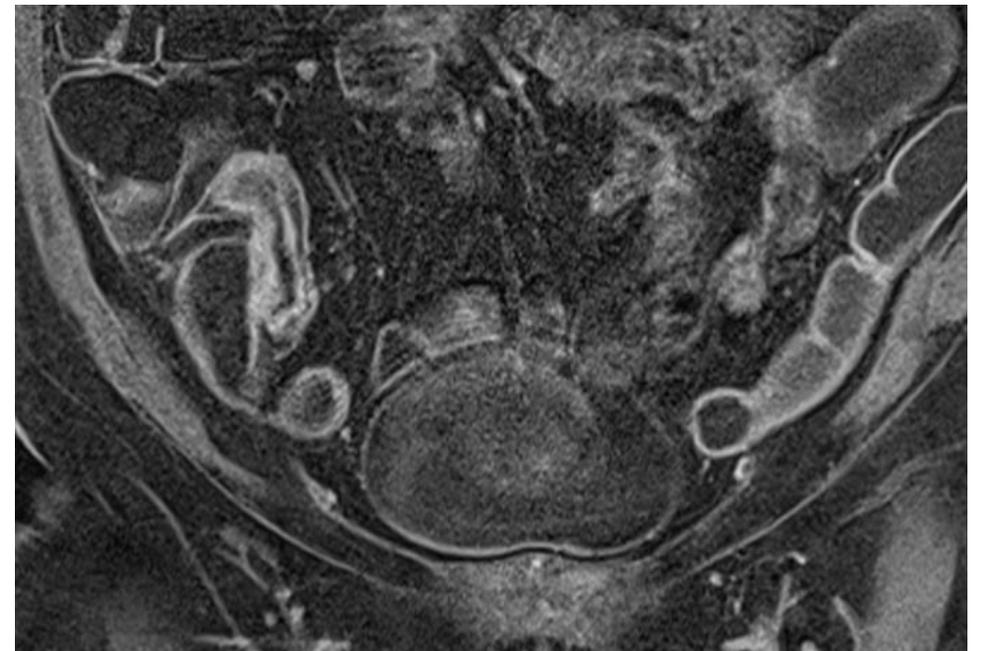
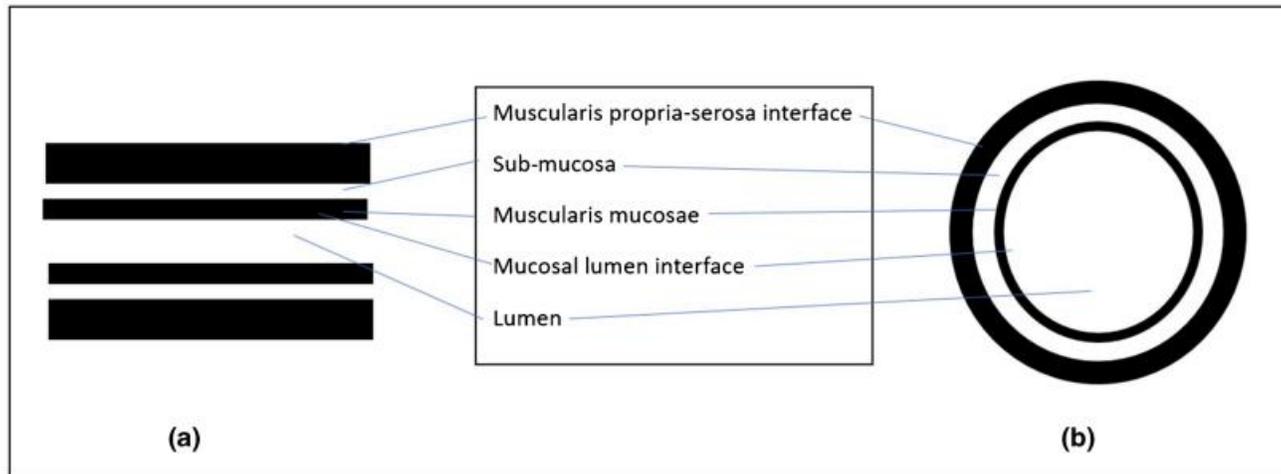
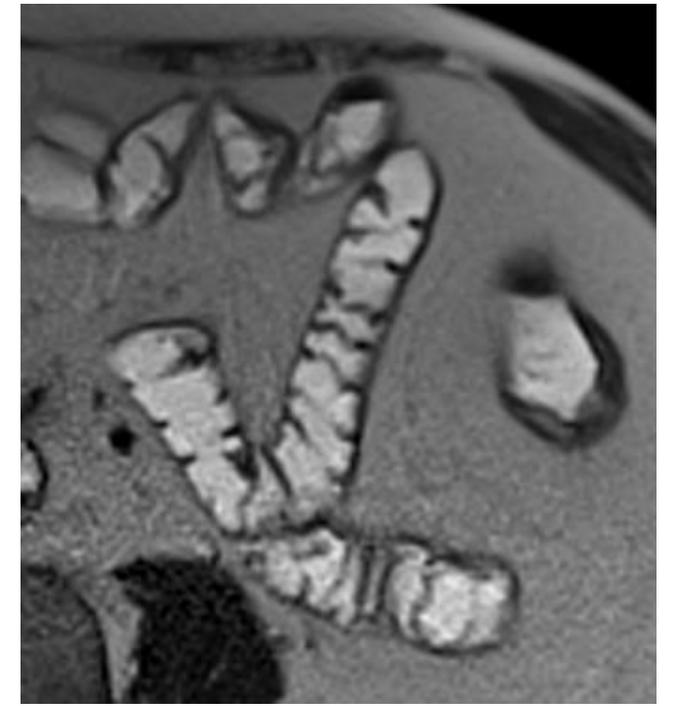
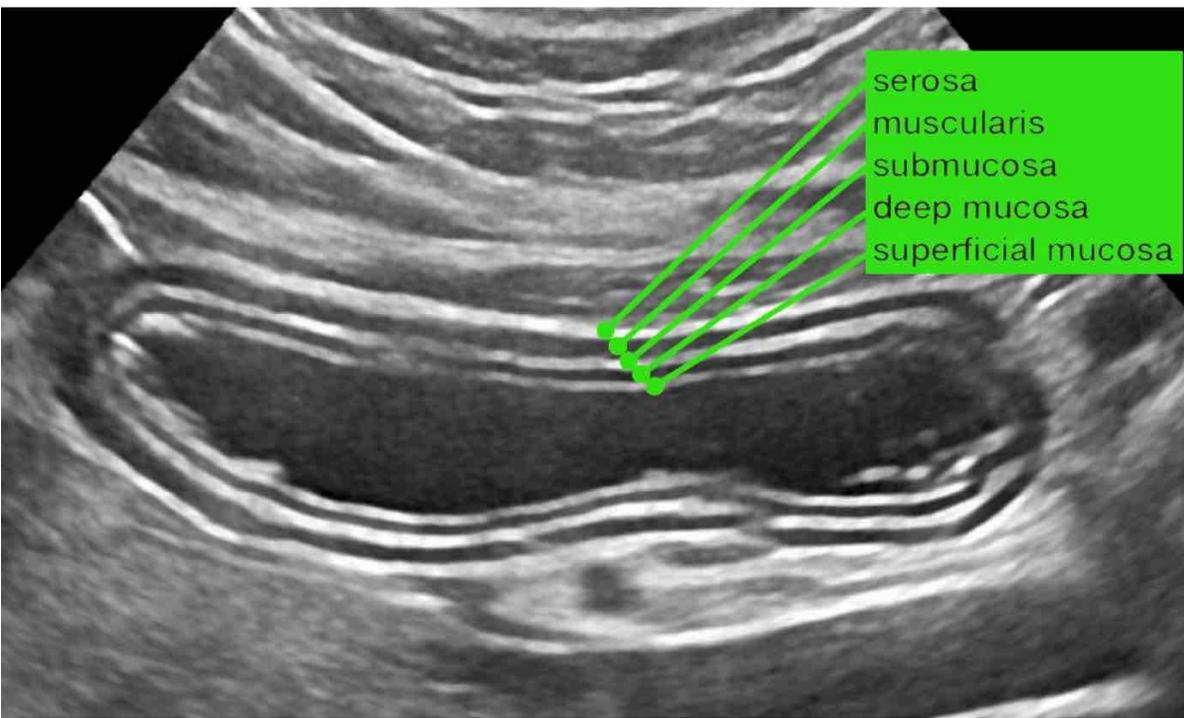
Current practice position 4

Thickness of the most involved small bowel and/or colonic segment, defined as bowel wall thickness (BWT), should be measured and reported. A threshold of 3 mm is the recommended cut-off for presence of mural inflammation for both small and large bowel



RM \geq 1,5 tesla





PREPARAZIONE ED ESECUZIONE DELL'ESAME ENTERO-RM

PREPARAZIONE ALL'ESAME

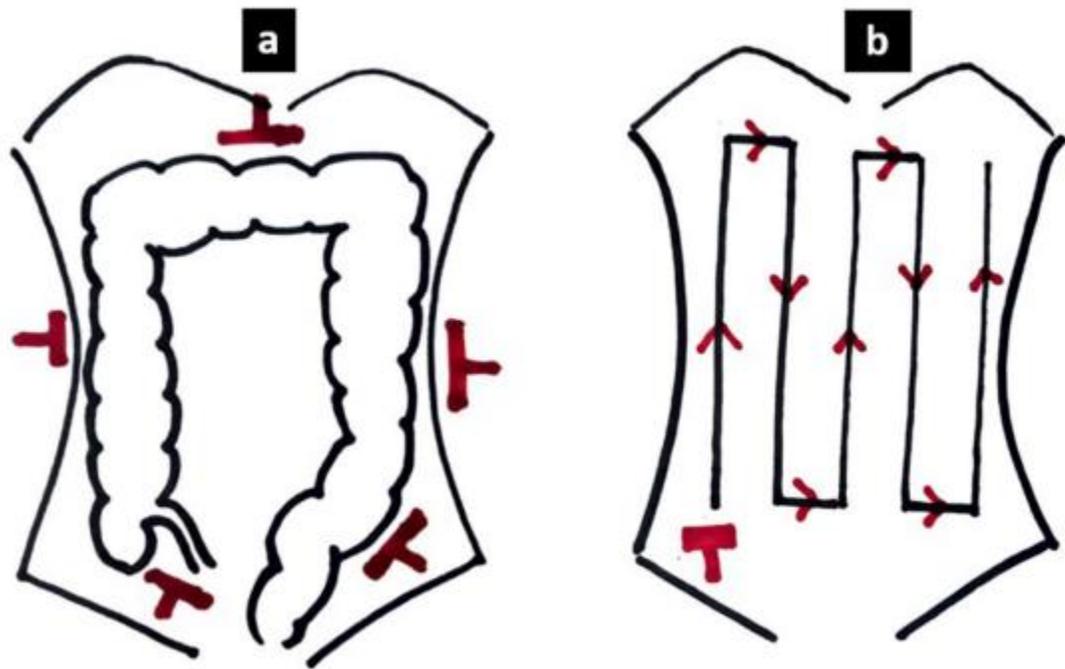
- IL POMERIGGIO DEL GIORNO PRIMA 1,5 LITRI DI PEG

ESECUZIONE DELL'ESAME

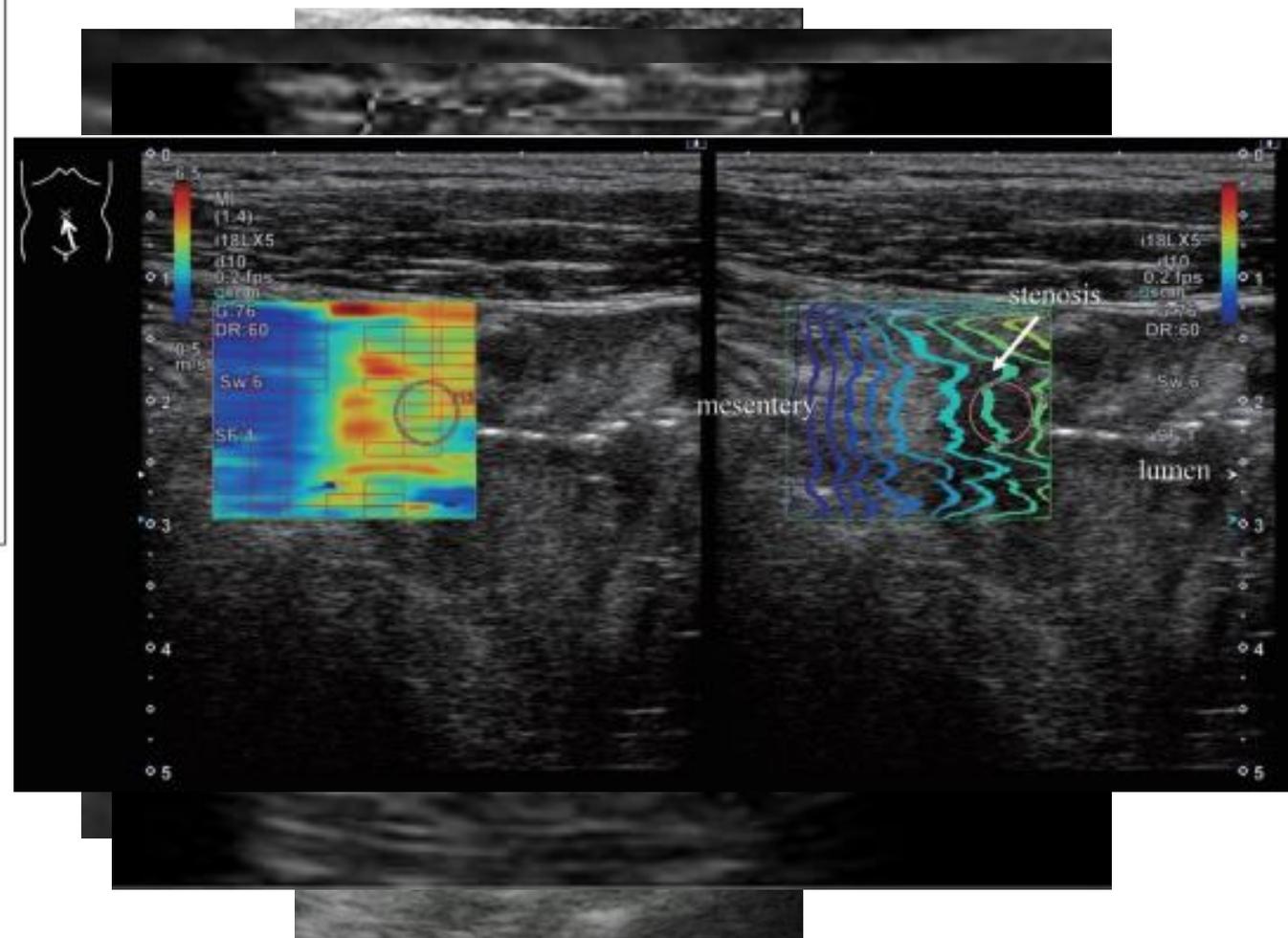
- DIGIUNO
- 40 MIN PRIMA DELL'ESAME ASSUNZIONE DI 1,5 L DI PEG O MANNITOLE
- SOMMINISTRAZIONE DI SPASMOLITICO (buscopan o glucagone) in 3-2 dosi durante l'esame
- INIEZIONE E.V. DI GADOLINIO

PREPARAZIONE ED ESECUZIONE DELL'ESAME ECOGRAFIA DELLE ANSE INTESTINALI

- NESSUNA PREPARAZIONE
- DIGIUNO DI 4 ORE (non essenziale, riduzione della peristalsi e della quantità di gas)
- SOMMINISTRAZIONE DI LIQUIDI PER OS (SICUS)
- SOMMINISTRAZIONE DI MDC E.V.(CEUS)

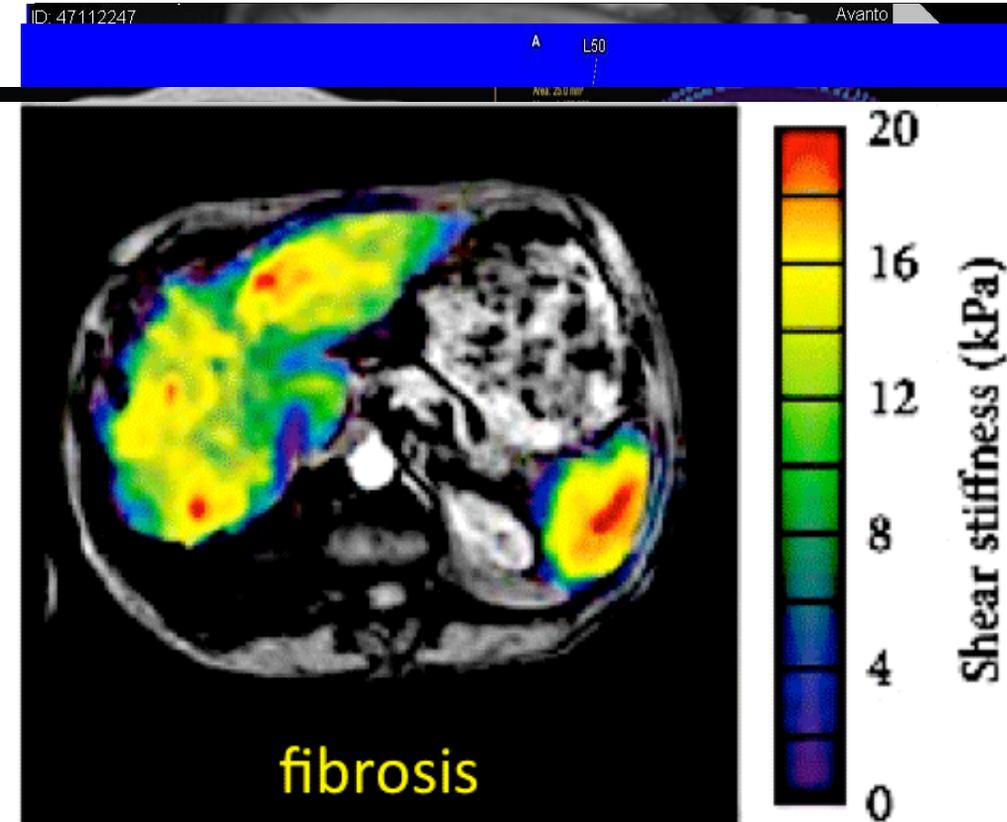


- ANATOMIA-STRATIFICAZIONE
- VASCOLARIZZAZIONE
- MOTILITA'
- PRESENZA DI FIBROSI



LE SEQUENZE RM

- T2 = anatomia
- T2 fat sat = edema
- Trufi = anatomia/motilità
- DWI/ADC = cellularità/infiemmazione acuta
- DCE = infiammazione acuta/fibrosi
- MT = fibrosi
- T1-T2 mapping = fibrosi
- ElastoRM = fibrosi



PATOLOGIA DI PARETE

ACUTA

- >SPESSORE DI PARETE (rm-eco)
- PRESENZA DI EDEMA (rm-eco)
- ENHANCEMENT PRECOCE/STRATIFICATO (rm-eco)
- PRESENZA DI ULCERE (rm-eco)
- IPERINTENSITA' IN DWI/IPO ADC (rm)
- PERDITA DELLA STRATIFICAZIONE (eco)

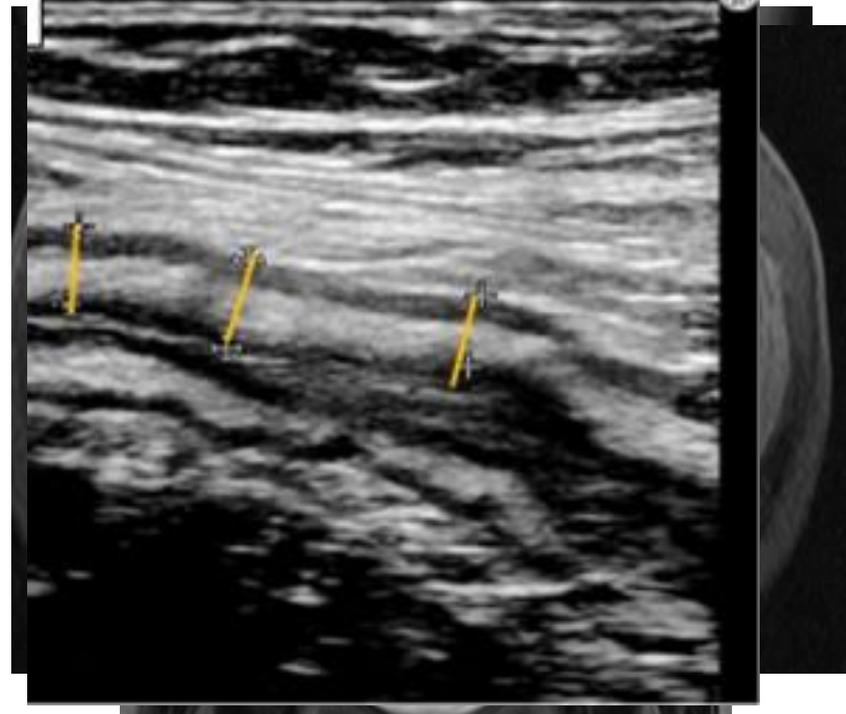
CRONICA

- ENHANCEMENT TARDIVO (rm)
- SACCULAZIONI (rm-eco)

PATOLOGIA DI PARETE

ACUTA

- >SPESSORE DI PARETE
- OMOGENEO-SIMMETRICO
- ASIMMETRICO
- SEGMENTARIO



Wall thickening

Mild (3–5 mm)

Moderate (5–9 mm)

Severe (≥ 10 mm)

SPESSORE DI PARETE NORMALE

ECOGRAFIA

DIGIUNO 2 MM

ILEO E COLON 3 MM

RETTO 4 MM

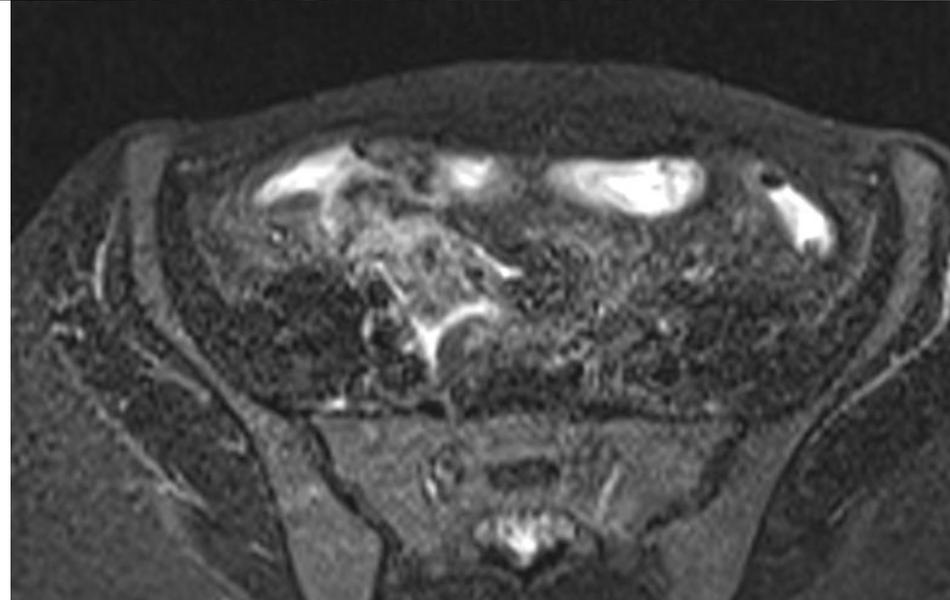
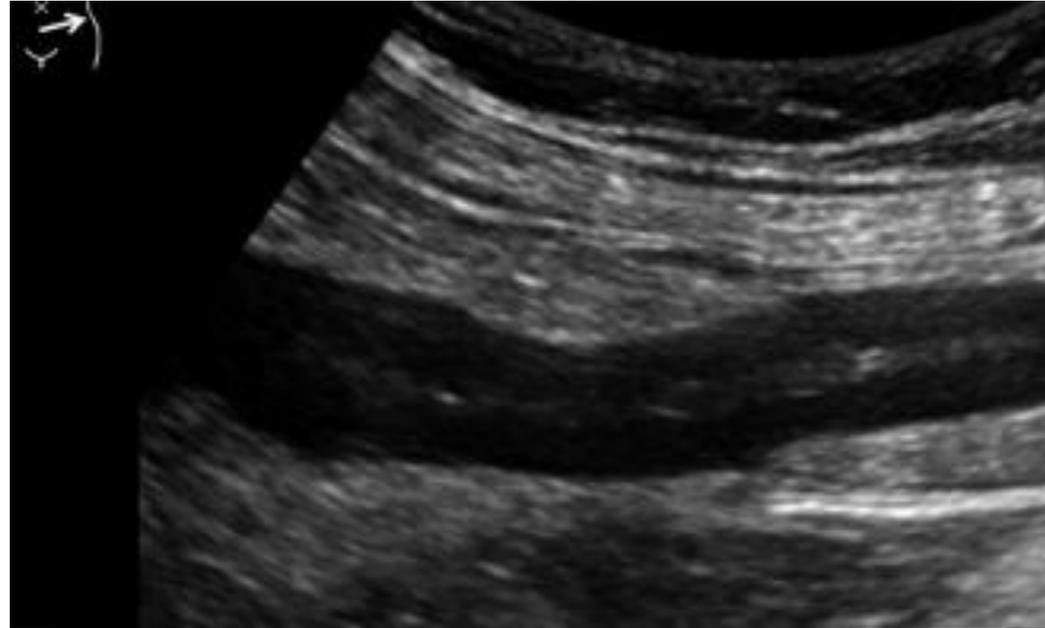
Current practice position 4

Thickness of the most involved small bowel and/or colonic segment, defined as bowel wall thickness (BWT), should be measured and reported. A threshold of 3 mm is the recommended cut-off for presence of mural inflammation for both small and large bowel.

PATOLOGIA DI PARETE

ACUTA

- PRESENZA DI EDEMA



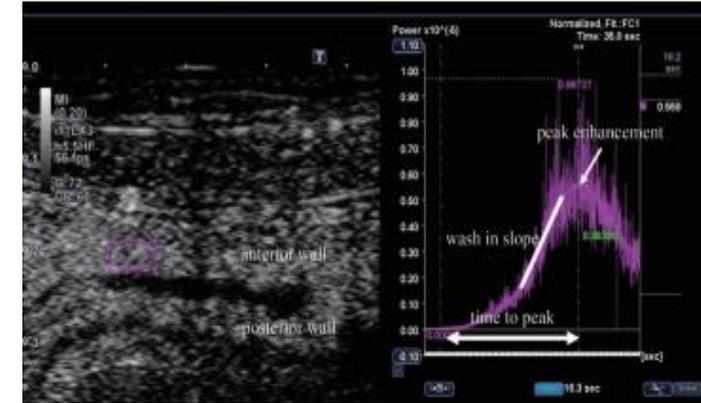
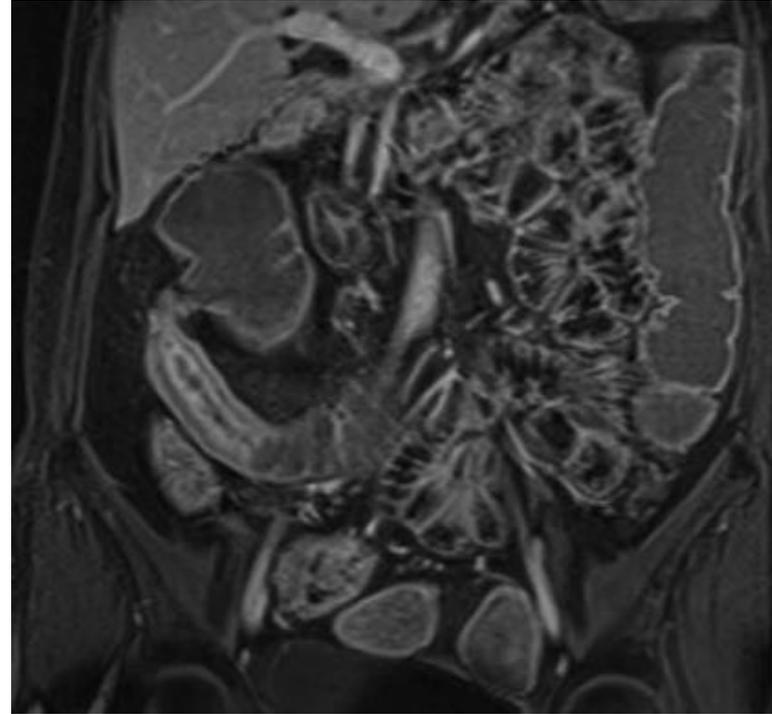
Current practice position 5

Given the contribution to assessing transmural inflammatory activity, detailed mural changes should be reported and include ulceration(s) and oedema, shown on IUS as disruption of bowel wall stratification and increased on MRE. Restricted diffusion (MRE) is supportive but a nonspecific sign of active inflammation

PATOLOGIA DI PARETE

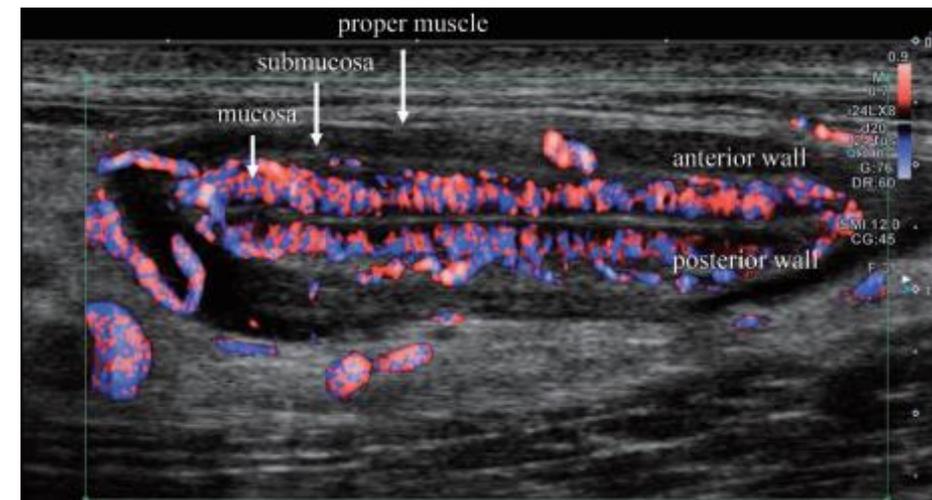
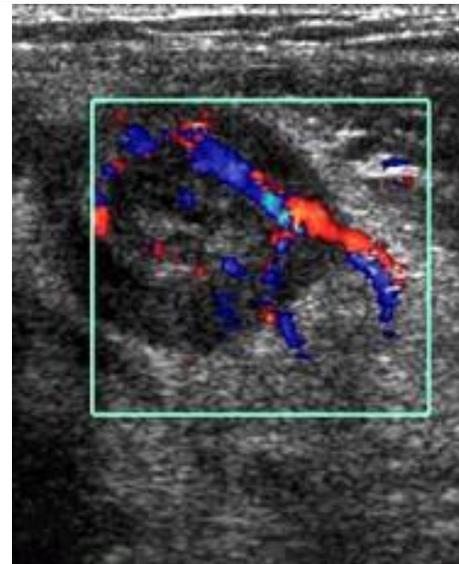
ACUTA

- ENHANCEMENT PRECOCE/STRATIFICATO



Current practice position 6

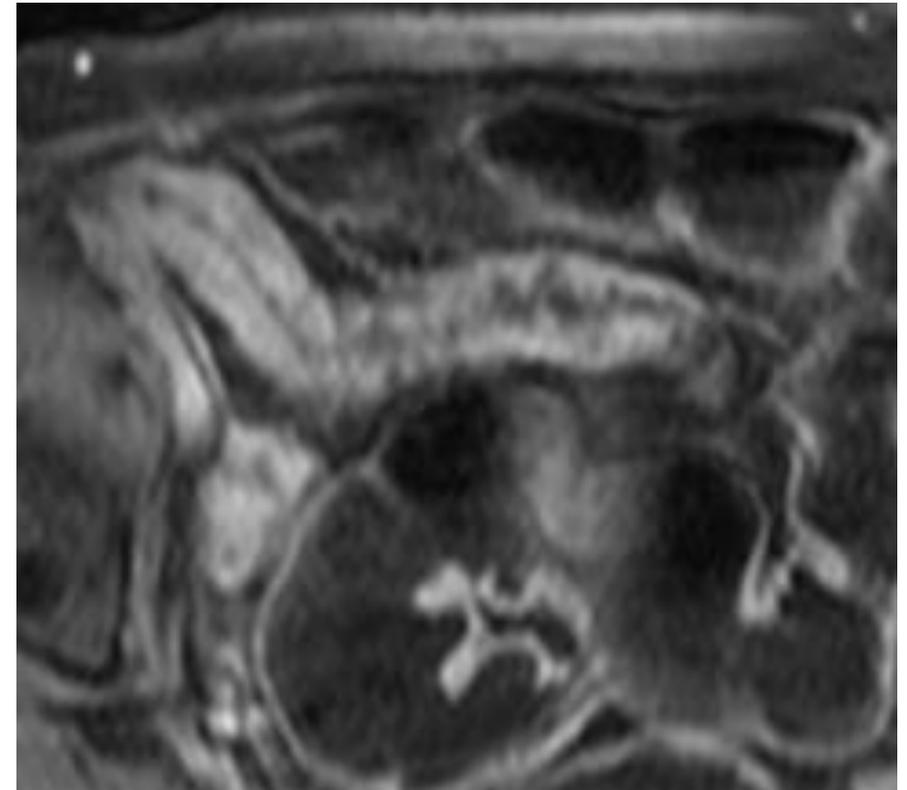
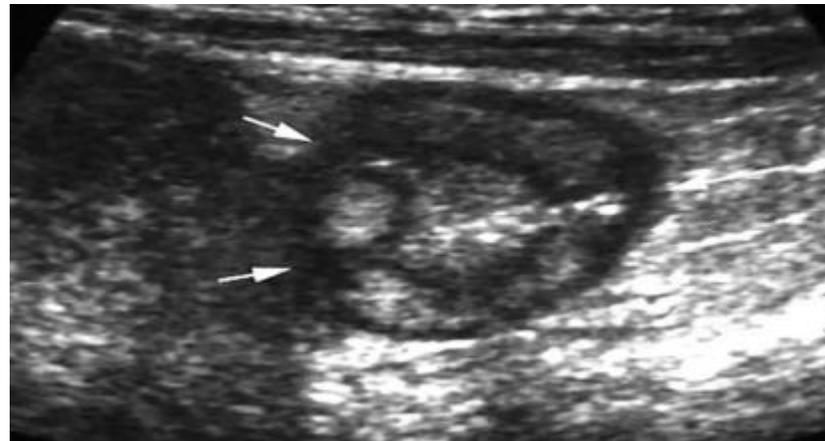
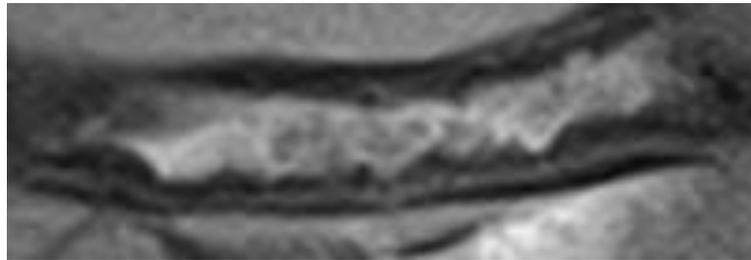
Intestinal vascularization should be assessed by a semi-quantitative grading of intra- and extramural blood flow in abnormal bowel segments (colour Doppler on IUS). For MRE/CT, a qualitative impression of increased contrast hyperenhancement should be reported



PATOLOGIA DI PARETE

ACUTA

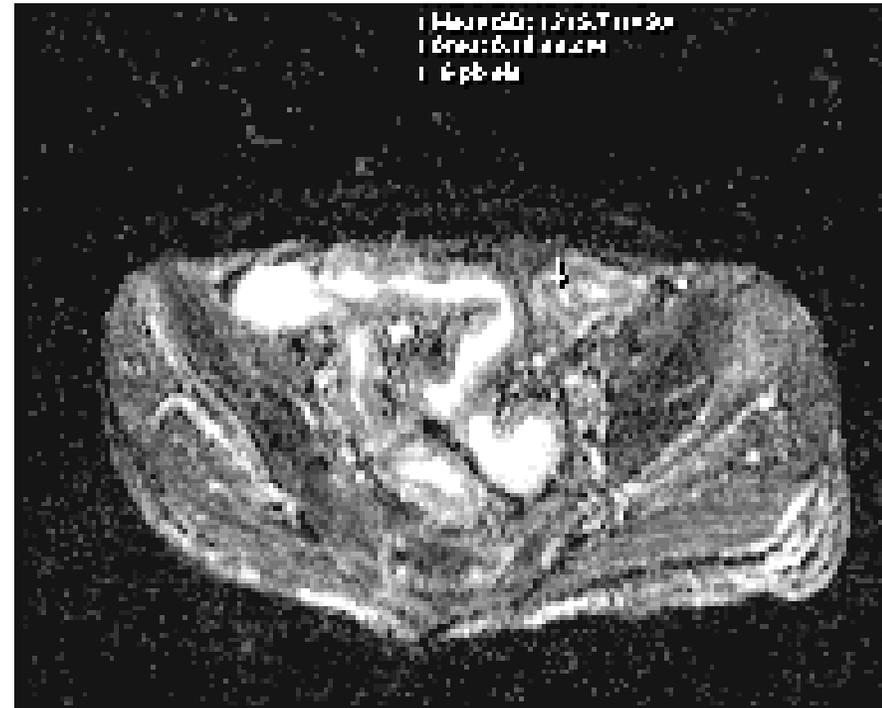
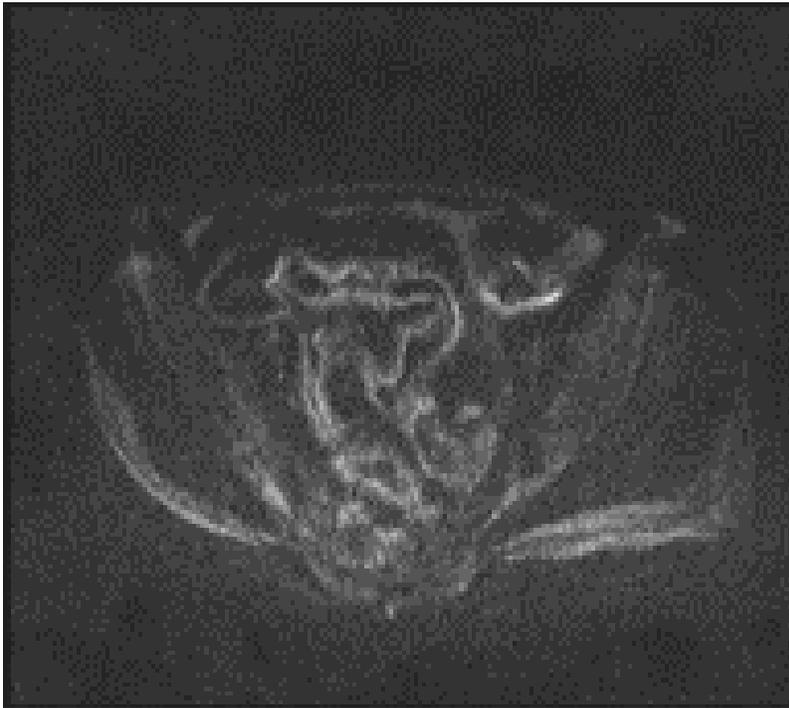
- PRESENZA DI ULCERE



PATOLOGIA DI PARETE

ACUTA

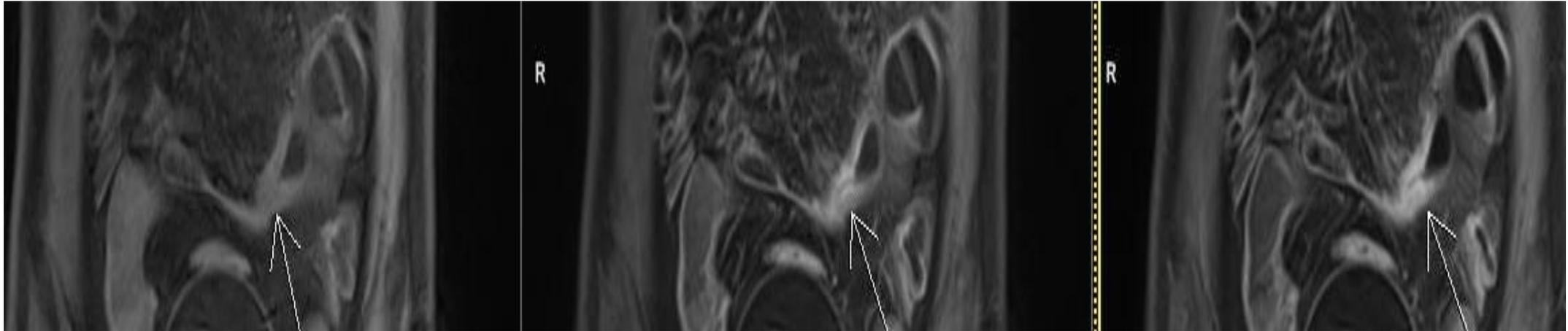
- IPERINTENSITA' IN DWI/IPO ADC



PATOLOGIA DI PARETE CRONICA

Fibrosi

- % DI GUADAGNO DOPO GADOLINIO NELLA SEQUENZA A 7 MIN >23,5%
- ENHANCEMENT TARDIVO



PATOLOGIA DI PARETE CRONICA



- SACCULEZIONI

COMPLICANZE DI PARETE STENOSI

DEFINIZIONI TC-RM

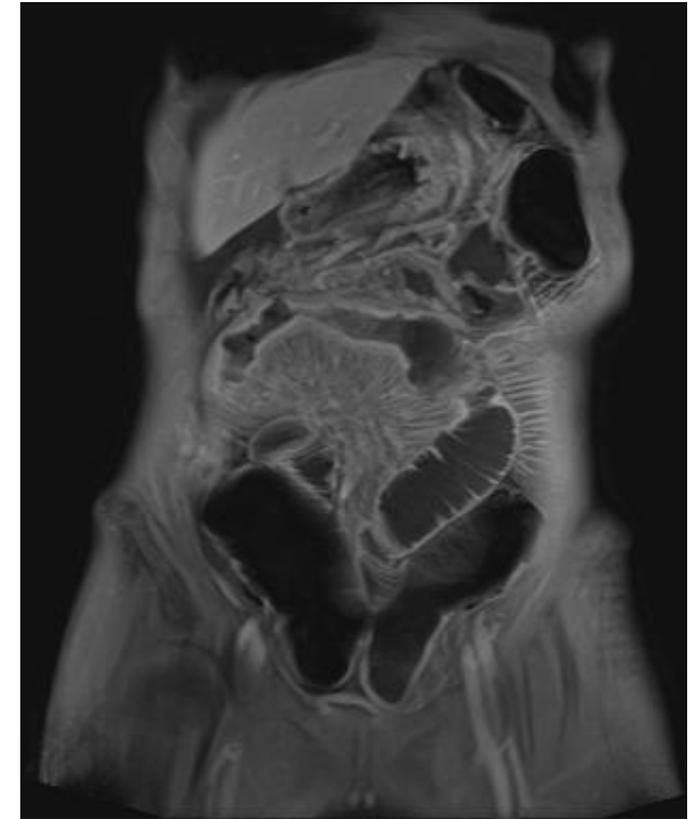
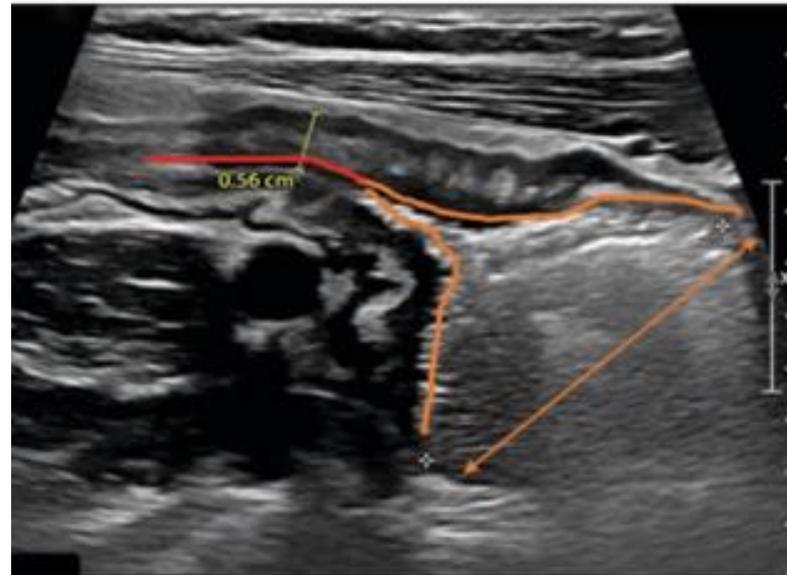
Riduzione di calibro = riduzione di calibro di almeno il 50% confrontata con ansa normale vicina, ispessimento della parete >25%, **assenza** di dilatazione a monte

Stenosi = Riduzione di calibro del lume **con** dilatazione a monte ≥ 3 cm

- Probabile stenosi senza dilatazione a monte <3cm
- stenosi con dilatazione a monte 3-4 cm
- stenosi con moderata –severa dilatazione a monte >4 cm (**piccolo intestino**)

Stenosi definizione ecografica

- Ispessimento parietale >3 mm
- Riduzione del lume <1 cm
- Dilatazione prestenotica >2,5 cm



COMPLICANZE EXTRAPARETE

ACUTE

- FISTOLA SEMPLICE
- FISTOLA COMPLESSA
- MASSA INFIAMMATORIA
- ASCESSO

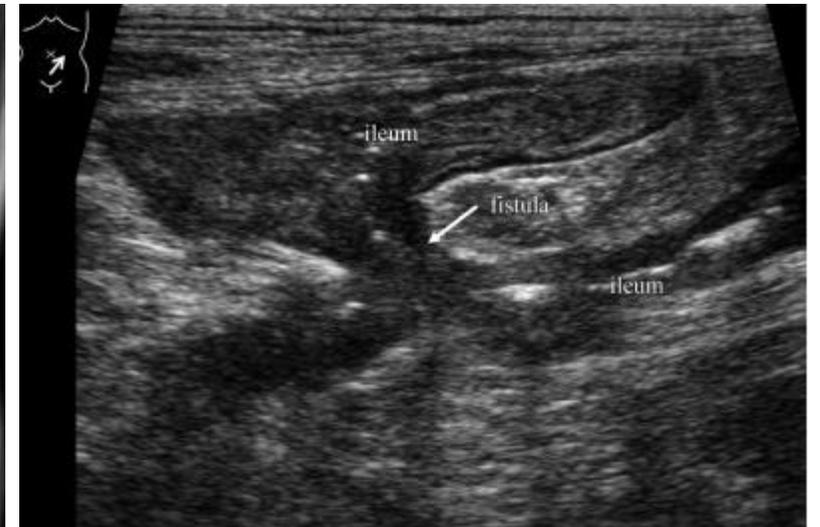
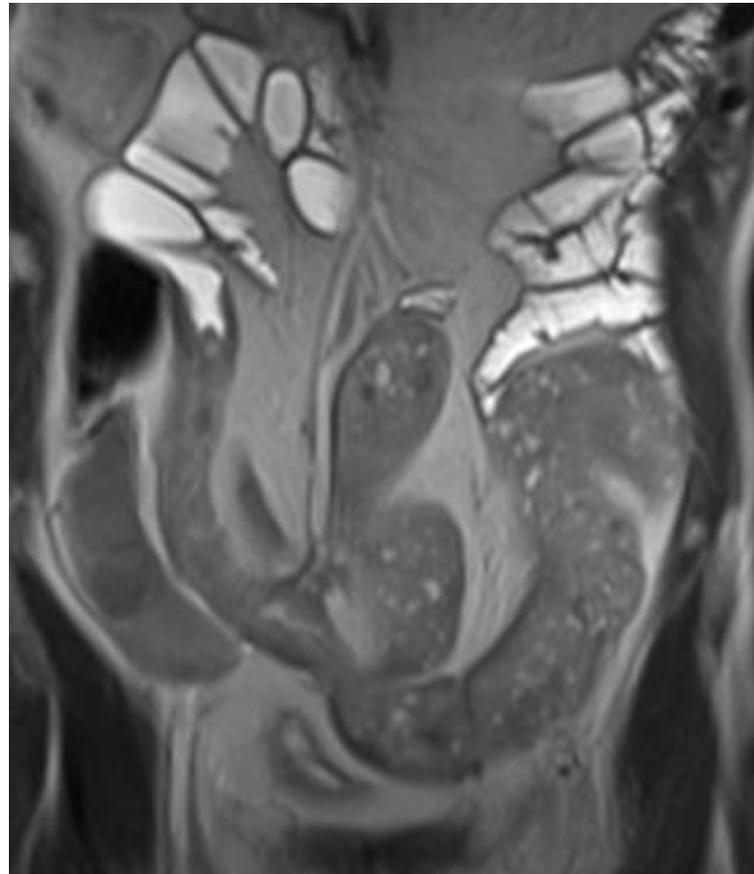
COMPLICANZE EXTRAPARETE

ACUTE

- FISTOLA SEMPLICE

Statement 2.1.7. ECCO-ESGAR Diagnostics GL [2018]

Extramural complications in CD [such as fistulae and abscesses] should be monitored by cross-sectional imaging, including intestinal ultrasound [IUS] [EL2] or MRI [EL2] [or both] in combination with clinical and laboratory parameters [EL5]



COMPLICANZE EXTRAPARETE

ACUTE

- FISTOLA COMPLICATA



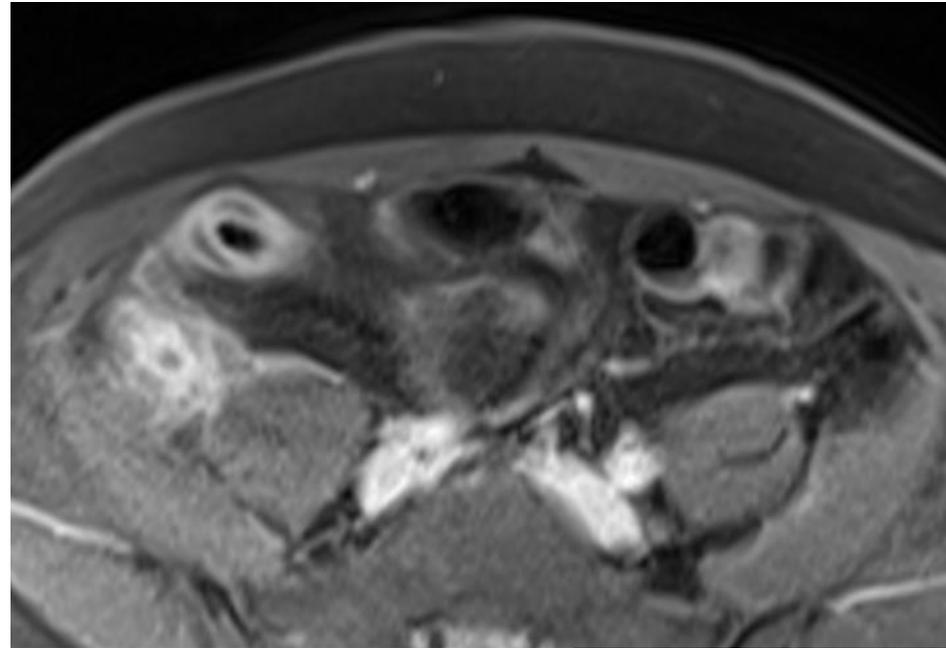
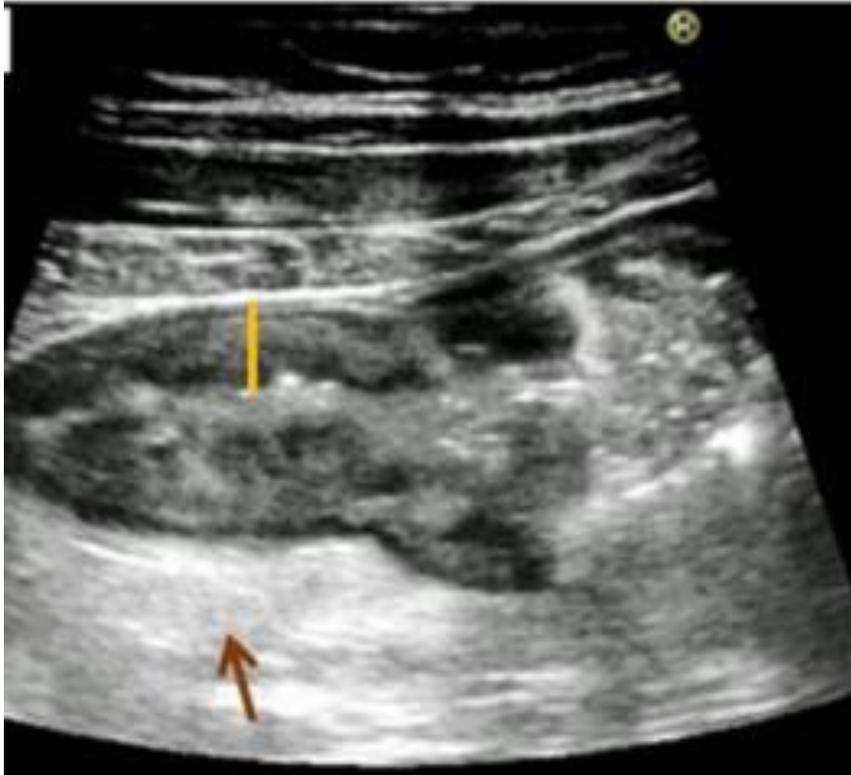
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COMPLICANZE EXTRAPARETE

ACUTE

- MASSA INFIAMMATORIA



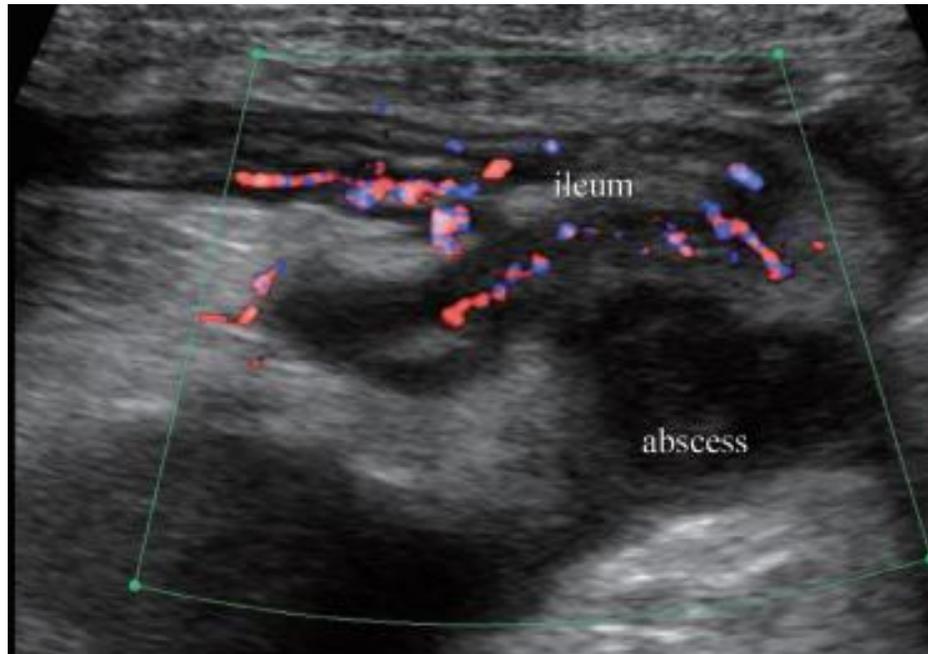
Statement 2.1.7. ECCO-ESGAR Diagnostics GL [2018]

Extramural complications in CD [such as fistulae and abscesses] should be monitored by cross-sectional imaging, including intestinal ultrasound [IUS] [EL2] or MRI [EL2] [or both] in combination with clinical and laboratory parameters [EL5]

COMPLICANZE EXTRAPARETE

ACUTE

- ASCESSO



Statement 2.1.7. ECCO-ESGAR Diagnostics GL [2018]

Extramural complications in CD [such as fistulae and abscesses] should be monitored by cross-sectional imaging, including intestinal ultrasound [IUS] [EL2] or MRI [EL2] [or both] in combination with clinical and laboratory parameters [EL5]

	MRE		IUS	
	Sensitivity	Specificity	Sensitivity	Specificity
Disease presence				
• Small bowel (regardless of location) [12]	• 97% (91–99)	• 96% (86–99)	• 92% (84–96)	• 84% (65–94)
• Colon [12]	• 47% (31–64)	• 96% (90–98)	• 67% (49–81)	• 96% (90–98)
Disease extent				
• Small bowel [12]	• 80% (72–86)	• 95% (85–98)	• 70% (62–78)	• 81% (64–91)
• Colon [12]	• 22% (14–32)	• 93% (87–97)	• 17% (10–27)	• 93% (87–97)
Disease activity				
• Small bowel [12]	• 96% (92–99)	• 83% (68–92)	• 90% (82–95)	• 77% (60–88)
• Colon [12]	• 63% (48–76)	• 97% (91–99)	• 66% (51–79)	• 98% (94–99)
Disease complications				
• Strictures [7]	• 75–100%	• 91–96%	• 80–100%	• 63–75%
• Fistulas [7]	• 76%	• 96%	• 74%	• 95%
• Abdominal [7] abscesses	• 86%	• 93%	• 84%	• 93%

FOLLOW-UP ecografia

L'IMAGING UTILIZZATO NEL FOLLOW-UP DEVE :

- VISUALIZZARE I CAMBIAMENTI DOPO TERAPIA
- ESSERE RIPRODUCIBILE
- SEMPLICE
- PRATICO
- NON INVASIVO

CD

CATEGORIE DI RISPOSTA TERAPEUTICA BASATE SULL'IMAGING

1. **TRANSMURAL REMISSION**

(BWT <3mm, segnale Doppler normale)

2. **RISPOSTA ALLA TERAPIA**

(riduzione BWT >25%) o >1mm o <del segnale Doppler)

3. **STABILITA'**

4. **PROGRESSIONE**

(peggioramento della severità ,nuovi siti interessati,sviluppo di complicanze)

UC

Colonic Wall Thickness
Colonic Wall Flow

SCORE ECOGRAFIA

Table 3 Scoring systems in intestinal ultrasound

Scores	Reference	Indices used	Severity grades	Index calculation	Outcomes
Crohn's disease					
BUSS [21]	Ileocolonoscopy	BWT CDF	BUSS > 3.52 predicts endoscopic disease activity	$0.75 \times \text{BWT} + 1.64 \times \text{CDF}$	BUSS correlated significantly with SES-CD ($r=0.55$, $p < 0.001$)
IBUS-SAS [22]	Visual analogue scale	BWT CDF BWS Inflammatory fat	Continuous variable (ranging from 0 to 100)	$4 \times \text{BWT} + 15 \times \text{i-fat} + 7 \times \text{CDF} + 4 \times \text{BWS}$	Inter-rater reliability: BWT 0.96, 95% CI 0.94–0.98 CDF 0.60, 95% CI 0.48–0.72 BWS 0.39, 95% CI 0.24–0.53 i-fat 0.51, 95% CI 0.34–0.67 IBUS-SAS 0.97, 95% CI 0.95–0.99
Ulcerative colitis					
MUC [14]	Colonoscopy	BWT CDF	Active disease (Mayo endoscopic score ≥ 2): MUC ≥ 6.3 points	$1.4 \text{ BWT} + 2 \times \text{CDF}$	MUC ≥ 6.3 points (sensitivity 71%, specificity 100%) to Detect endoscopic active disease
UC-IUS [36]	Colonoscopy	BWT CDF Abnormal haustrations Fat wrapping	Continuous score ranging from 0 to 7 points	Bowel wall thickness (> 2 mm: 1; > 3 mm: 2; > 4 mm: 3) Doppler signal (spots: 1; stretches: 2) Abnormal haustrations: 1 Fat wrapping: 1	Strong correlation with endoscopic Mayo score ($\rho=0.83$, $p < 0.001$) and UCEIS index ($\rho=0.759$, $p < 0.001$)

HUMANITAS

VALIDATO

HUMANITAS

BUSS Bowel ultrasound score, BWS bowel wall stratification, BWT bowel wall thickness, CDF color Doppler flow, IBUS-SAS International Bowel Ultrasound – Segmental Activity score, MUC Milan ultrasound criteria, SES-CD simple endoscopic score – Crohn's disease, UCEIS Ulcerative Colitis Endoscopic Index of Severity, UC-IUS ulcerative colitis – Intestinal ultrasound index

FOLLOW-UP

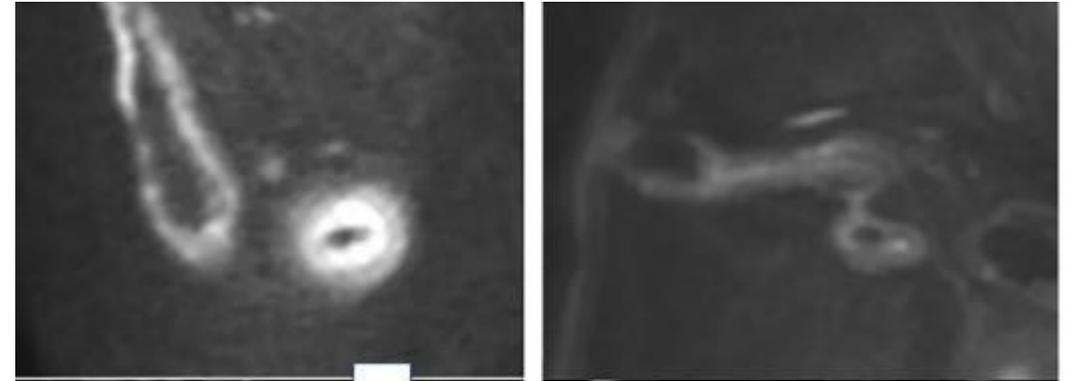
SCORE RM

Characteristics	MaRIA [16]	London [22]	Nancy [23]	Clermont [24]
Validated score	Yes	Yes	Yes	Yes
Response to therapy	Yes	No	Yes	Yes
Fasting	Yes	Yes	No	Yes
Bowel preparation	Yes	Yes	No	Yes
Radiological Item				
Wall thickness	Yes	Yes	Yes	Yes
Contrast enhancement	Yes	Yes		No
Edema	Yes	Yes	Yes	Yes
Post-contrast wall signal intensity	Yes	Yes	No	No
Ulcers	Yes	No	Yes	Yes
Pseudopolyps	Yes	No	No	No
Lymph node enlargement	Yes	Yes	No	Yes
Differentiation between M-SM complex and MP	No	No	Yes	No
Comb sign	No	Yes	No	No
Fistulas and abscesses	No	No	No	Yes
Length of disease	No	No	No	No
DWI	No	No	Yes	Yes
Apparent diffusion coefficient	No	No	No	Yes
Correlation with CDEIS	Yes	Yes	Yes	Yes

FOLLOW-UP

NANCY SCORE

- COLON nessuna preparazione
- TENUE digiuno, distensione delle anse
- No mdc
- Intuitivo
- Nessun calcolo complicato (solo qualitativo)



	Rectum	Sigmoid colon	Descending colon	Transverse colon	Ascending colon	Ileum
Ulceration	0 or 1	0 or 1	0 or 1	0 or 1	0 or 1	0 or 1
Parietal oedema	0 or 1	0 or 1	0 or 1	0 or 1	0 or 1	0 or 1
Bowel wall thickening	0 or 1	0 or 1	0 or 1	0 or 1	0 or 1	0 or 1
Differentiation of submucosa or mucosa from muscularis propria	0 or 1	0 or 1	0 or 1	0 or 1	0 or 1	0 or 1
Rapid contrast enhancement	0 or 1	0 or 1	0 or 1	0 or 1	0 or 1	0 or 1
DWI hyperintensity	0 or 1	0 or 1	0 or 1	0 or 1	0 or 1	0 or 1

A segmental score (the total score of each of the columns) greater than 2 in Crohn's disease and greater than 1 in ulcerative colitis is used as a cutoff for active disease. DWI=diffusion-weighted imaging.

Table 4: Calculation grid for the Nancy score

Diffusion-weighted MRI in inflammatory bowel disease

Lieven Pouillon, Valérie Laurent, Marc Pouillon, Peter Bossuyt, Christiana Bonifacio, Silvio Danese, Parakkal Deepak, Edward V Loftus Jr, David H Bruining, Laurent Peyrin-Biroulet

FOLLOW-UP RM (NANCY SCORE)

Vantaggi della DWI

- Visualizzazione dell'intero intestino
- No mdc
- Nessuna preparazione per colon
- Veloce
- Non invasiva
- Riproducibile
- Semplice

Svantaggi

- costosa
- distensione del piccolo intestino

FOLLOW-UP ECOGRAFIA

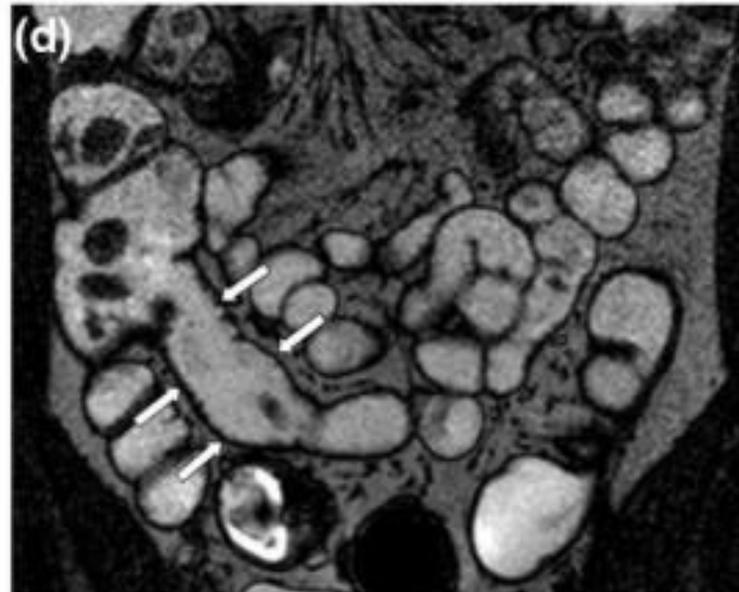
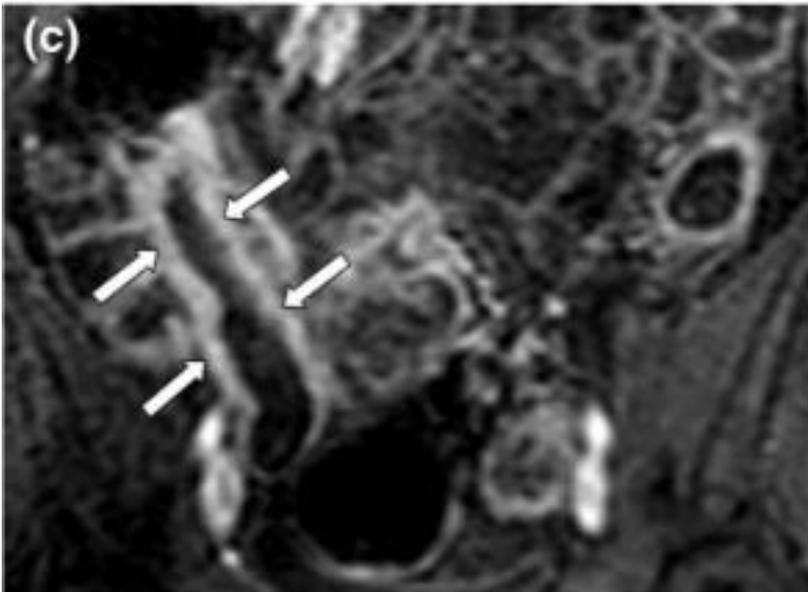
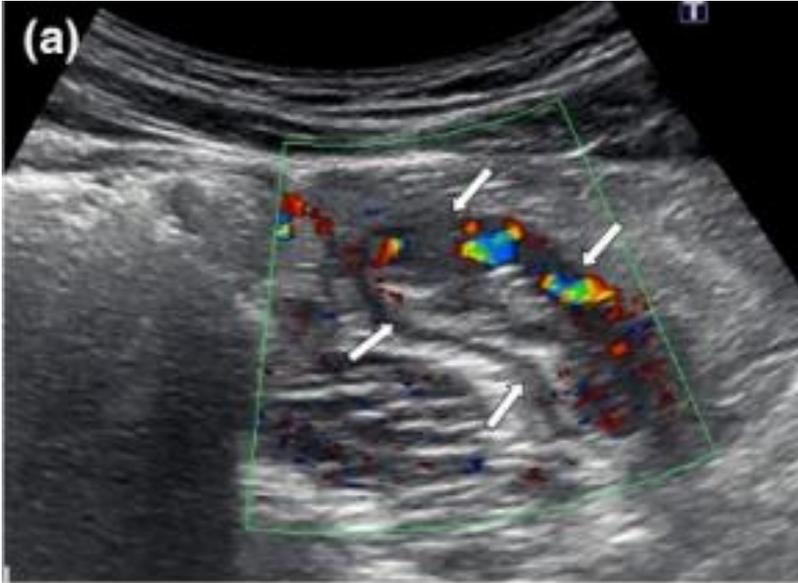
CD

BUSS -BWT
-COLOR DOPPLER

CU

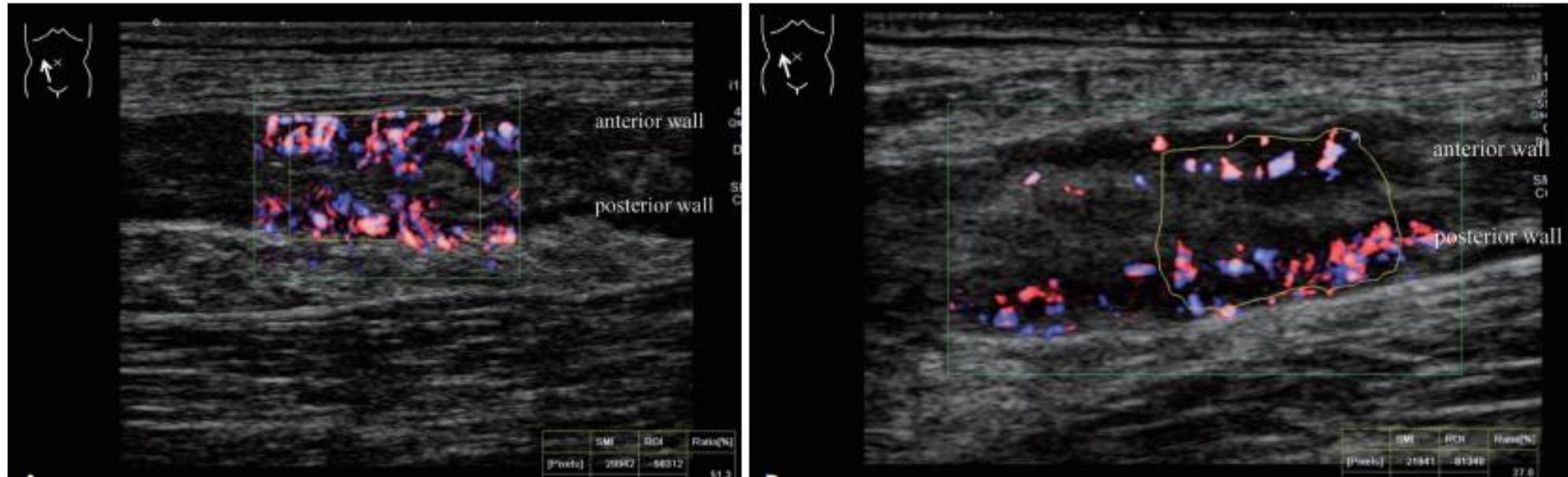
MUC-BTW
-COLOR DOPPLER

RISPOSTA ALLA TERAPIA



Il Transmural Healing ha migliorato gli outcomes rispetto al Mucosal healing endoscopico

RISPOSTA PARZIALE ALLA TERAPIA

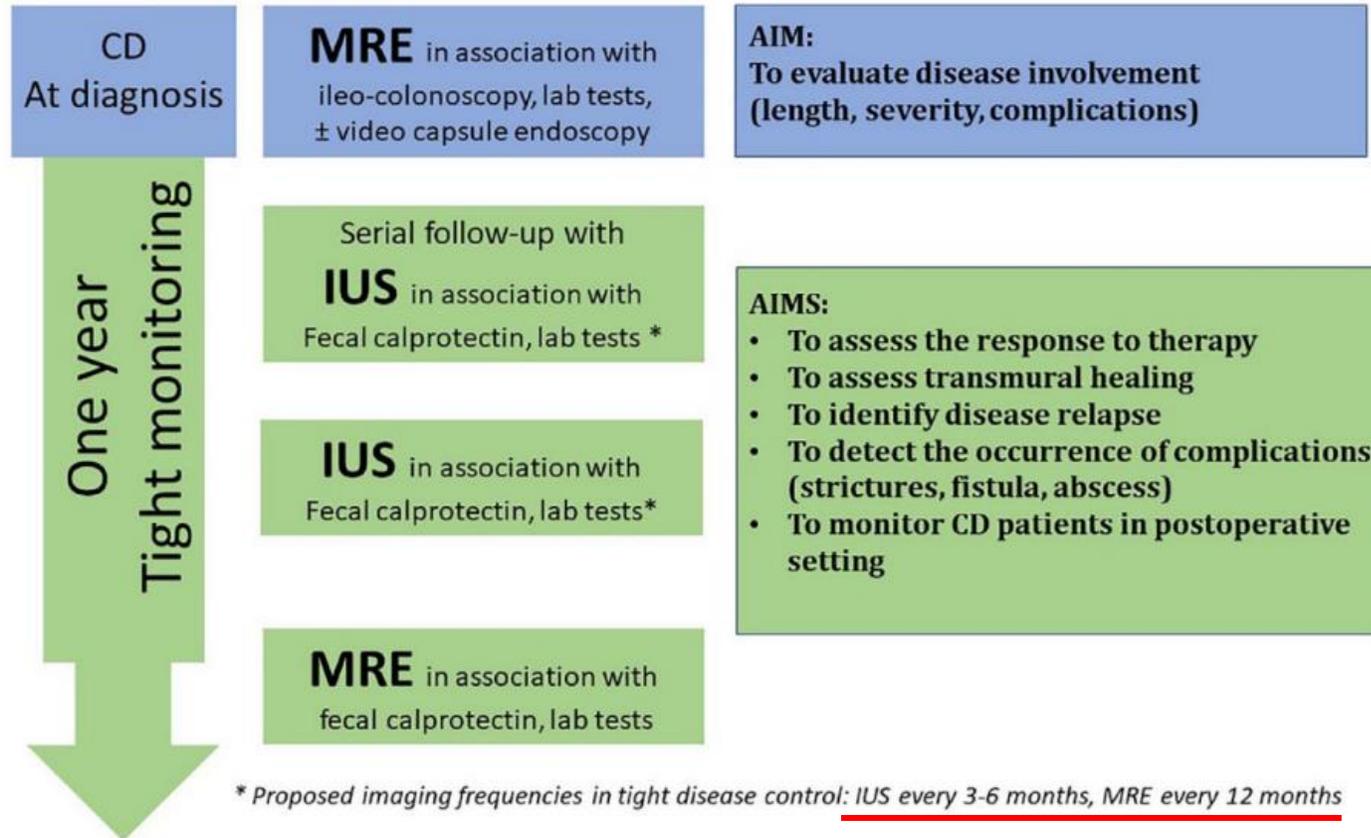


Dopo 12 settimane di terapia

Use of imaging modalities for decision-making in inflammatory bowel disease

Ther Adv Gastroenterol

2023, Vol. 16: 1–21



RM ed ECOGRAFIA hanno la stessa accuratezza nella valutazione e nel monitoraggio dell'attività di malattia sia nel CD che nella CU.

Possono essere considerate entrambe metodiche da utilizzare nell'approccio

Treat-to target per le decisioni terapeutiche

FIBROSI

Fibrosi, ipertrofia muscolare e infiammazione coesistono in una stenosi

LA FIBROSI STA DIVENENDO UN TARGET TERAPEUTICO

ARMAMENTARIO IMAGING RM PER EVIDENZIARLA

1. ENHANCEMENT TARDIVO >5 min
2. MAGNETIZATION TRANSFER RATIO
3. T1 e T2 MAPPING
4. RM ELASTOGRAPHY

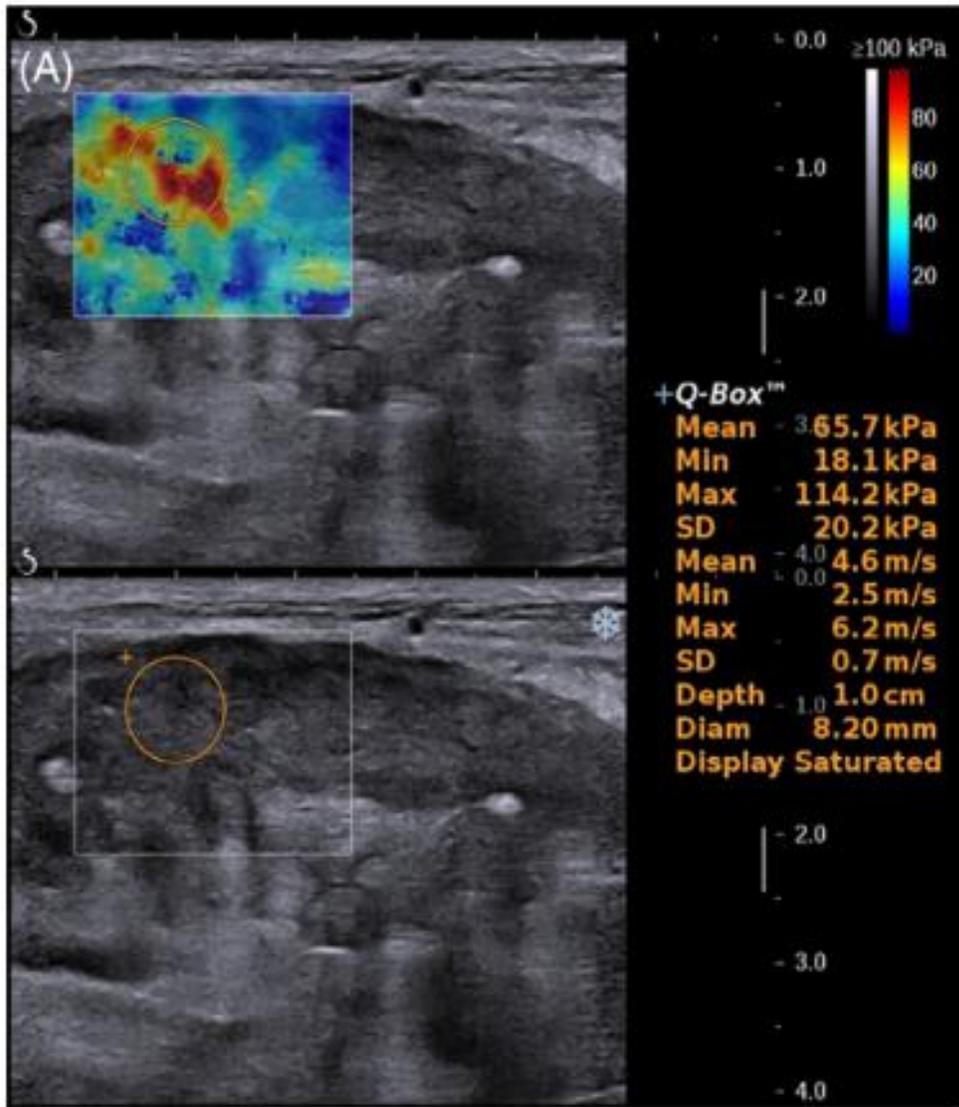
ARMAMENTARIO ECOGRAFIA

1. ECOSCOPIA
2. CONTRASTO PER OS
3. COLOR DOPPLER
4. CONTRASTO E.V.(CEUS)
5. ELASTOGRAFIA

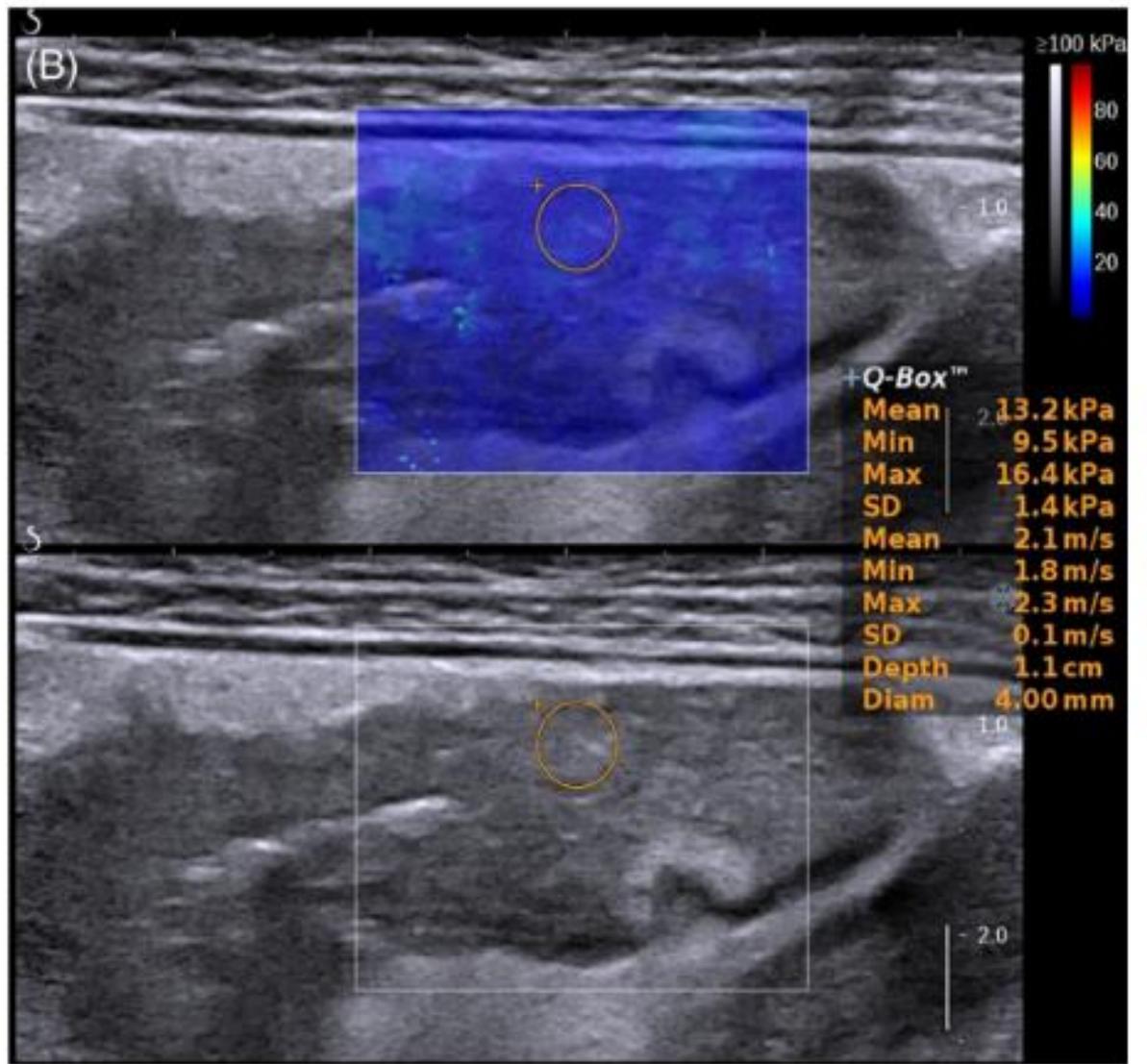
TABLE 1 A bri

Imaging technique
Color Doppler US
CEUS
SE/SWE

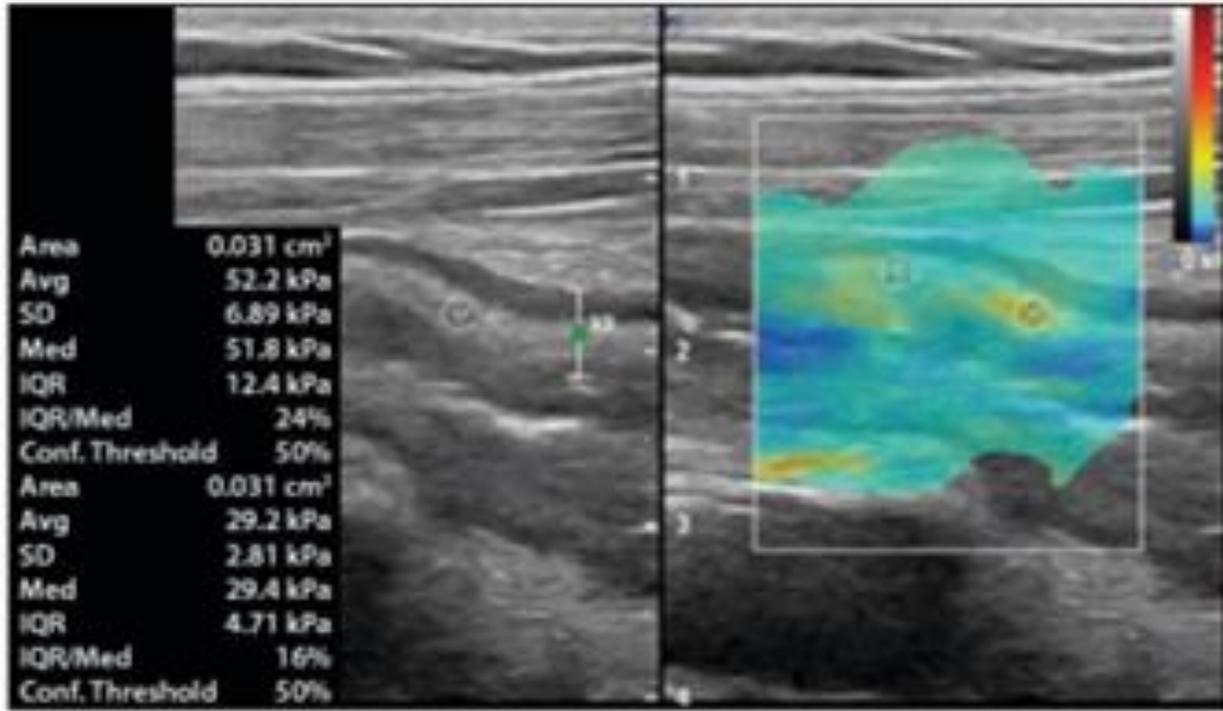
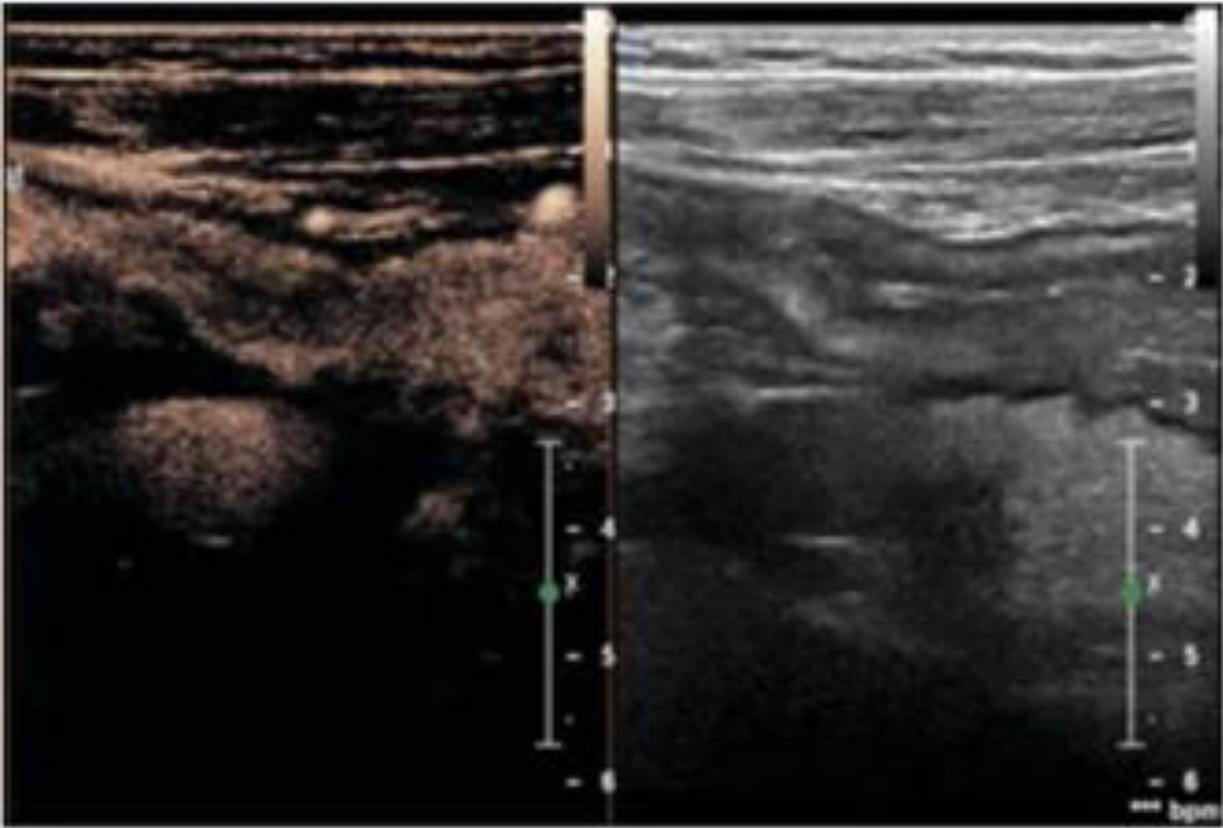
Conventional MRE	Conventional imaging signs: wall thickness, enhancement pattern	No radiation	Expensive and long scanning time, IV and oral contrast agents	Conflicting results
DWI	Reflects the diffusion of extracellular water molecules	No radiation, no IV contrast agent, patient breathes freely	Lack of anatomical detail	Both inflammation and fibrosis limit the diffusion of water molecules, so it is difficult to distinguish inflammation and fibrosis accurately with DWI
MTI	Measures large immobilized macromolecules, such as collagen	Not affected by inflammation, easy to implement, no IV contrast	MT and non-MT sequences require one breath-hold scan; limited range in every single scan	A clinically available tool to estimate intestinal fibrosis
DCE-MRI	Evaluates intestinal wall perfusion	No radiation, conventional equipment	IV contrast	Conflicting results
IVIM	Provides independent information about diffusion and perfusion	No radiation, no IV contrast agent	Poor reproducibility	Few data
Motility MRI	Dynamically assesses the small intestine's peristalsis	Visualizes small bowel movements	Depends on temporal resolution	Few data
¹⁸ F-FDG PET	Accurately localizes areas of inflammation by tracking uptake and metabolism of glucose	Functional evaluation	Radiation exposure, lack of anatomic details	/
PET-CT/PET-MR	Fuses anatomical morphology and functional metabolic information for imaging	Combines functional data and structural abnormalities	Radiation exposure, expensive	Not the best method for intestinal fibrosis
MR molecular imaging	Targets extracellular matrix components	Accurate assessment	Technical restrictions	Direction of development



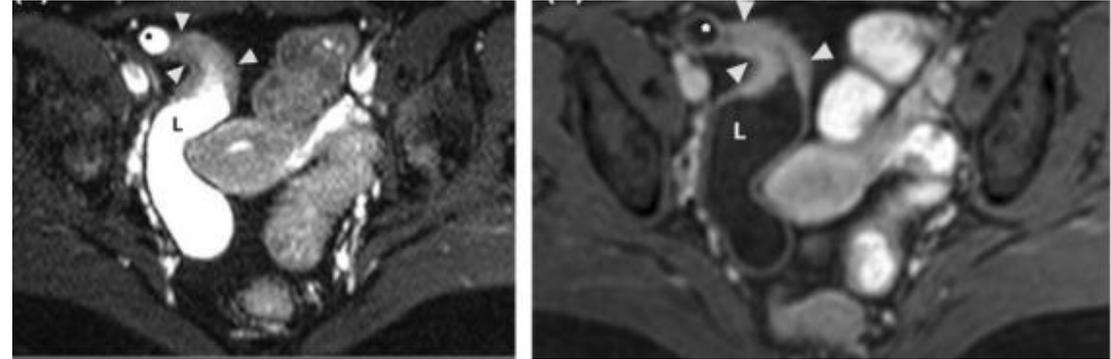
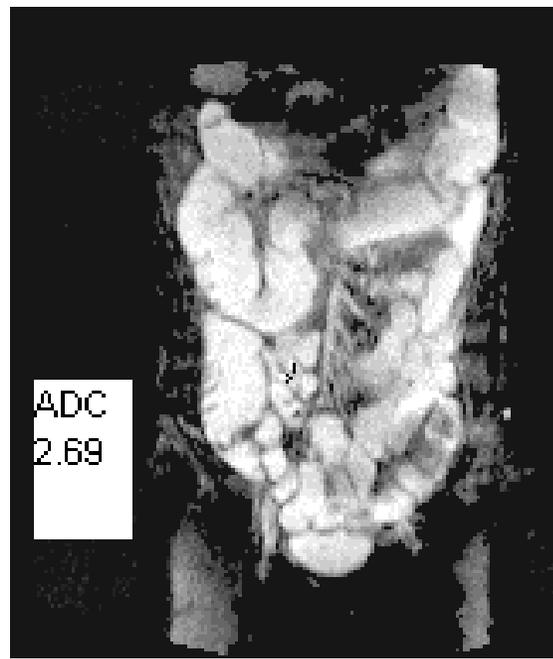
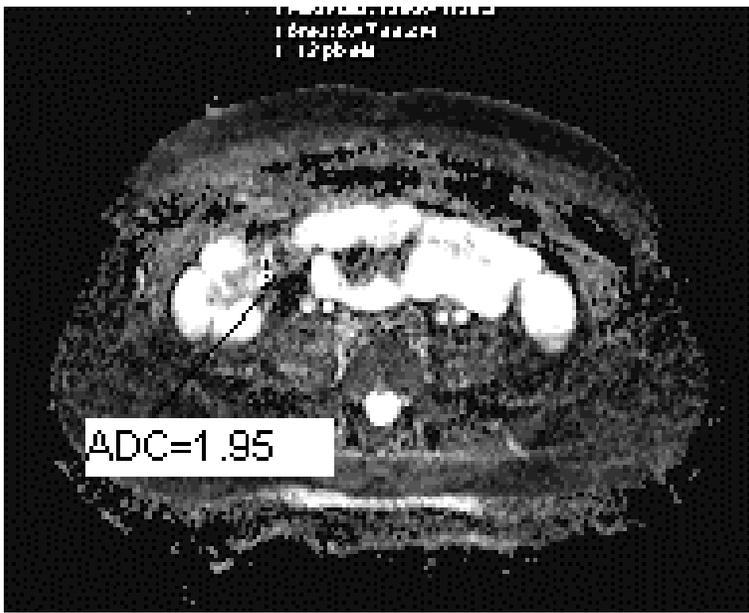
Shear Wave Elastography
Fibrosi severa



Fibrosi lieve



Stenosi con infiammazione



**ALTI VALORI ADC E ALTI VALORI MARIA
PREDITTIVI PER REMISSIONE A 12 WEEK
STENOSI INFIAMMATORIA**

BASSI VALORI ADC SONO ASSOCIATI
A FIBROSI
ENHANCEMENT TARDIVO

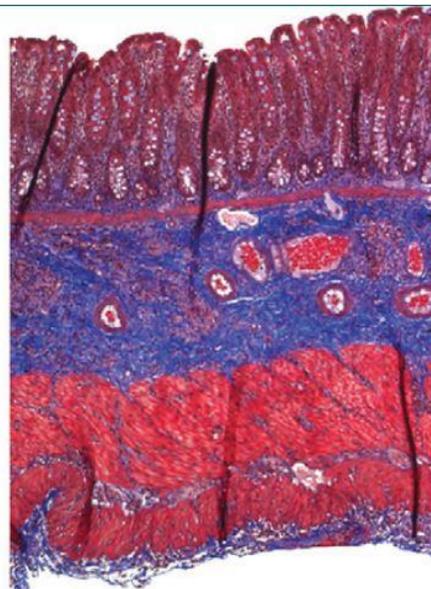
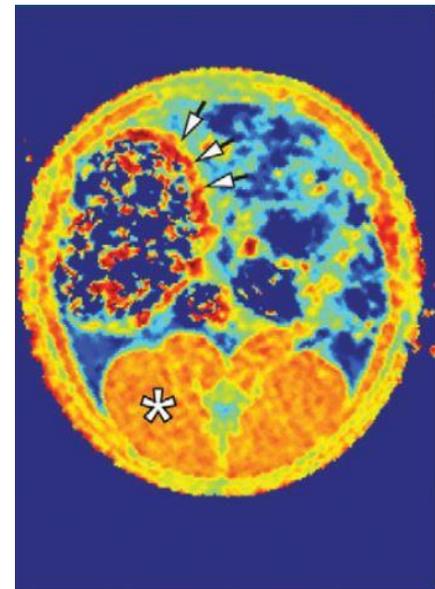
DWI COME PREDITTORE DI REMISSIONE DI MALATTIA (CDI<150 ; PCR<5MG/L) DOPO INDUZIONE CON ANTI-TNF

Magnetization Transfer Helps Detect Intestinal Fibrosis in an Animal Model of Crohn Disease¹

Radiology: Volume 259: Number 1—April 2011

Table 4 Magnetization transfer ratio of the measured bowel wall

Localization	Fibrosis	Normal bowel wall	Inflammation
MTR values (%)	35.3 ± 4.0	25.4 ± 3.4	22.9 ± 2.2
MTR (min/max) (%)	(27.6/41.7)	(17.3/31.5)	(20.7/25.0)
<i>n</i>	18	25	3
<i>p</i>	<0.0001	No significance	

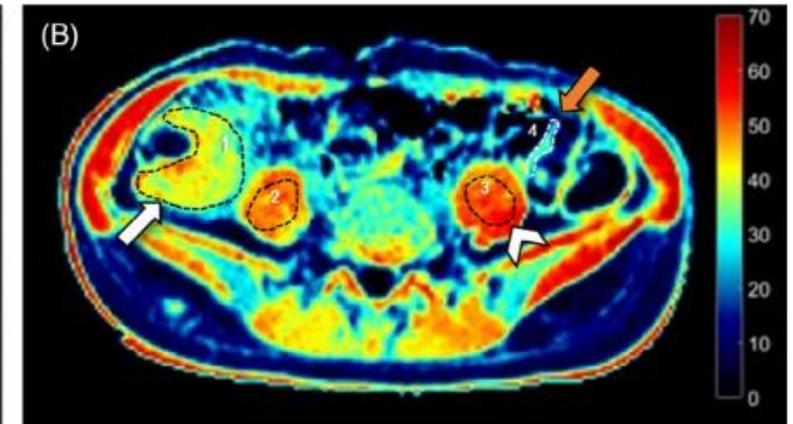
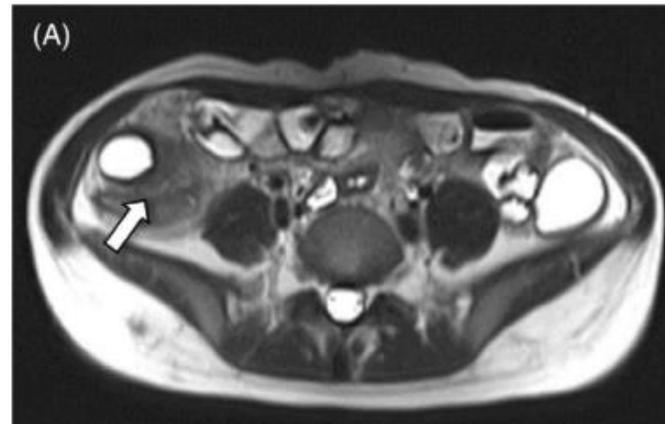
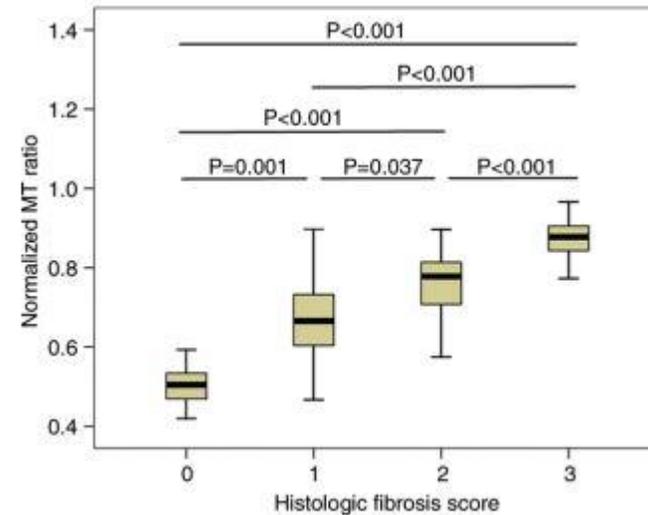


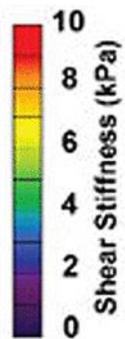
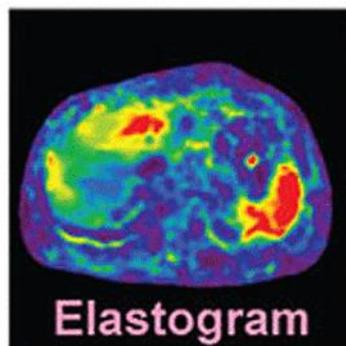
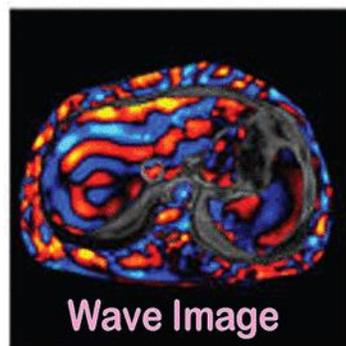
a.

b.

Characterization of Degree of Intestinal Fibrosis in Patients with Crohn Disease by Using Magnetization Transfer MR Imaging¹

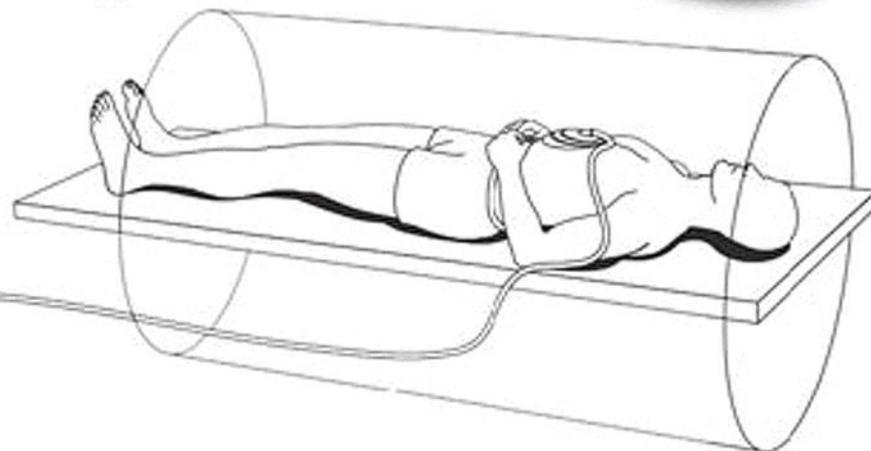
Radiology: Volume 287: Number 2—May 2018

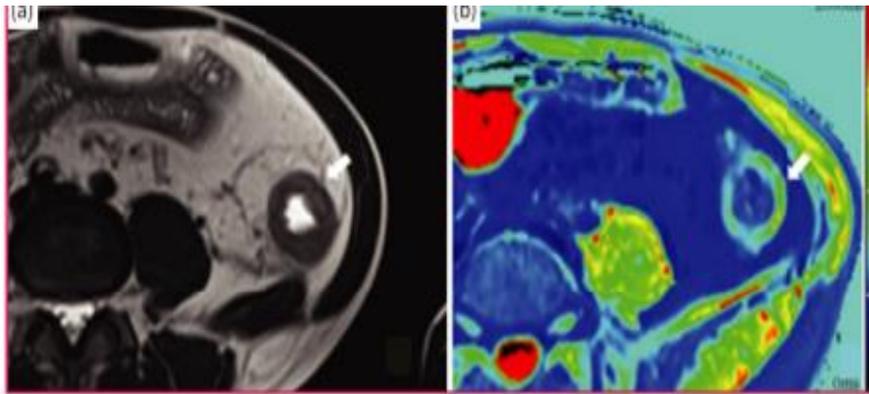




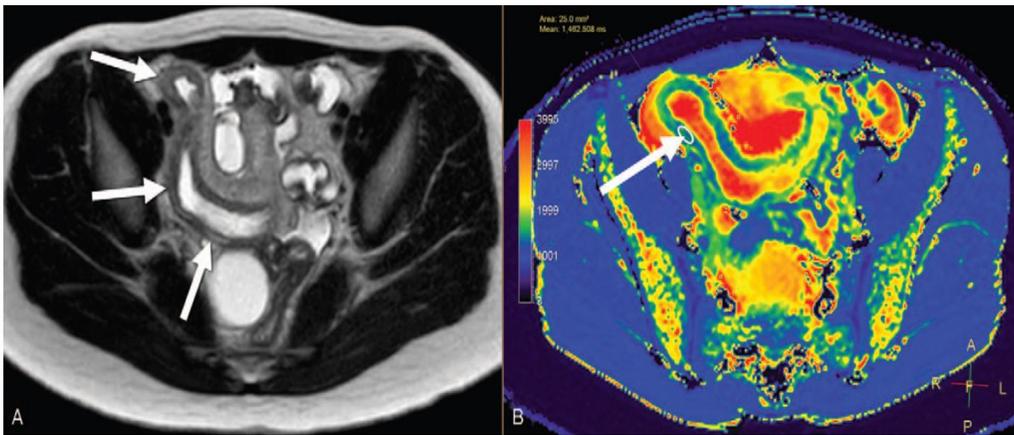
Acoustic waves at 60Hz

Imaging time: 15 sec

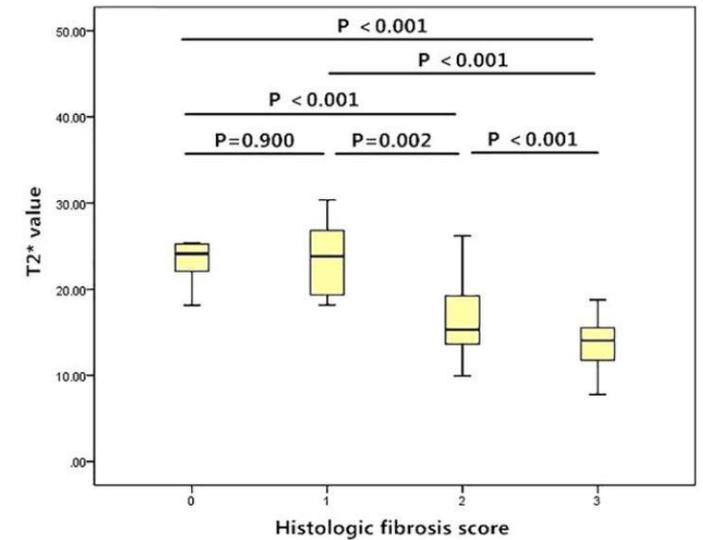
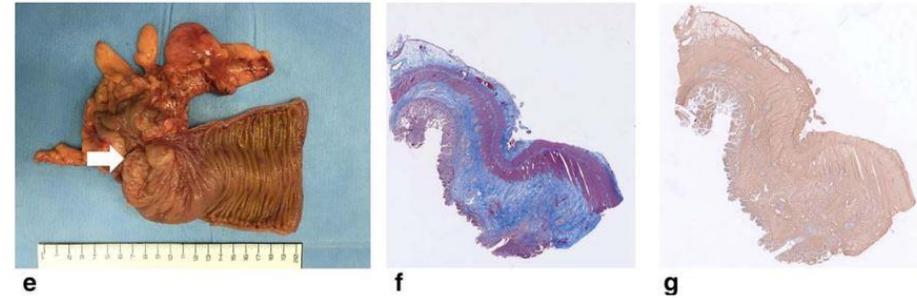
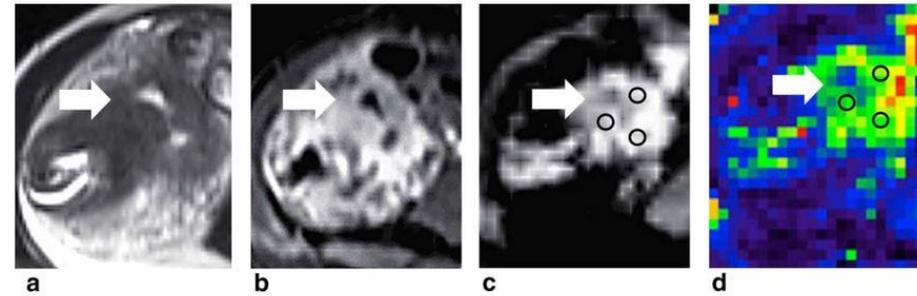




T1 mapping



T2 Mapping



PREGI

RME

- VALUTAZIONE DELL'INTERO APPARATO DIGERENTE
- NON NECESSARIO MDC
- VALUTA LA FIBROSI

DIFETTI

RME

- COSTOSA
- MENO DISPONIBILE
- NECESSITA DI PREPERAZIONE

LO SCORE NANCY (RM-DWI) E' IL PIU' ADATTO NEL MANAGEMENT DEI PAZIENTI CON CU

PREGI

ECOGRAFIA

- DIFFUSA
- POCO COSTOSA
- NON RADIANTE
- APPARECCHIATURE PORTATILI
- VALUTA LA PARETE E L'EXTRA PARETE
- RIPETIBILE
- NON SERVE PREPARAZIONE
- NON DIGIUNO
- NON NECESSARIO MDC
- NON SERVONO SPASMOLITICI
- ACCETTATA DAL PAZIENTE

DIFETTI

ECOGRAFIA

- NON VALUTA IL DIGIUNO
- NON VALUTA IL RETTO
- LIMITI VISUALIZZAZIONE ULCERE
- LIMITI NEL POST OPERATORIO
- LIMITI NELLA STADIAZIONE
- MANCA STANDARDIZZAZIONE

L'ECOGRAFIA E' UNA VALIDA ALTERNATIVA ALLA RM NEL MANAGEMENT DI PAZIENTI CON CD

CONCLUSIONI

- RM e US sono complementari nella pratica clinica
- Meta-analysis suggeriscono che US e RM sono simili nell'accuratezza diagnostica ,la RM ha una accuratezza maggiore per la stadiazione e la localizzazione del CD del tenue,ed è preferibile eseguirla alla diagnosi per meglio definire il fenotipo e la distribuzione della malattia
- US e RM-DWI si possono considerare POINT OF CARE nella valutazione e nel monitoraggio di CD e CU nell'approccio "treat to target"
- Necessario training gastroenterologi/radiologi