Tubo digerente: anatomia e patologia

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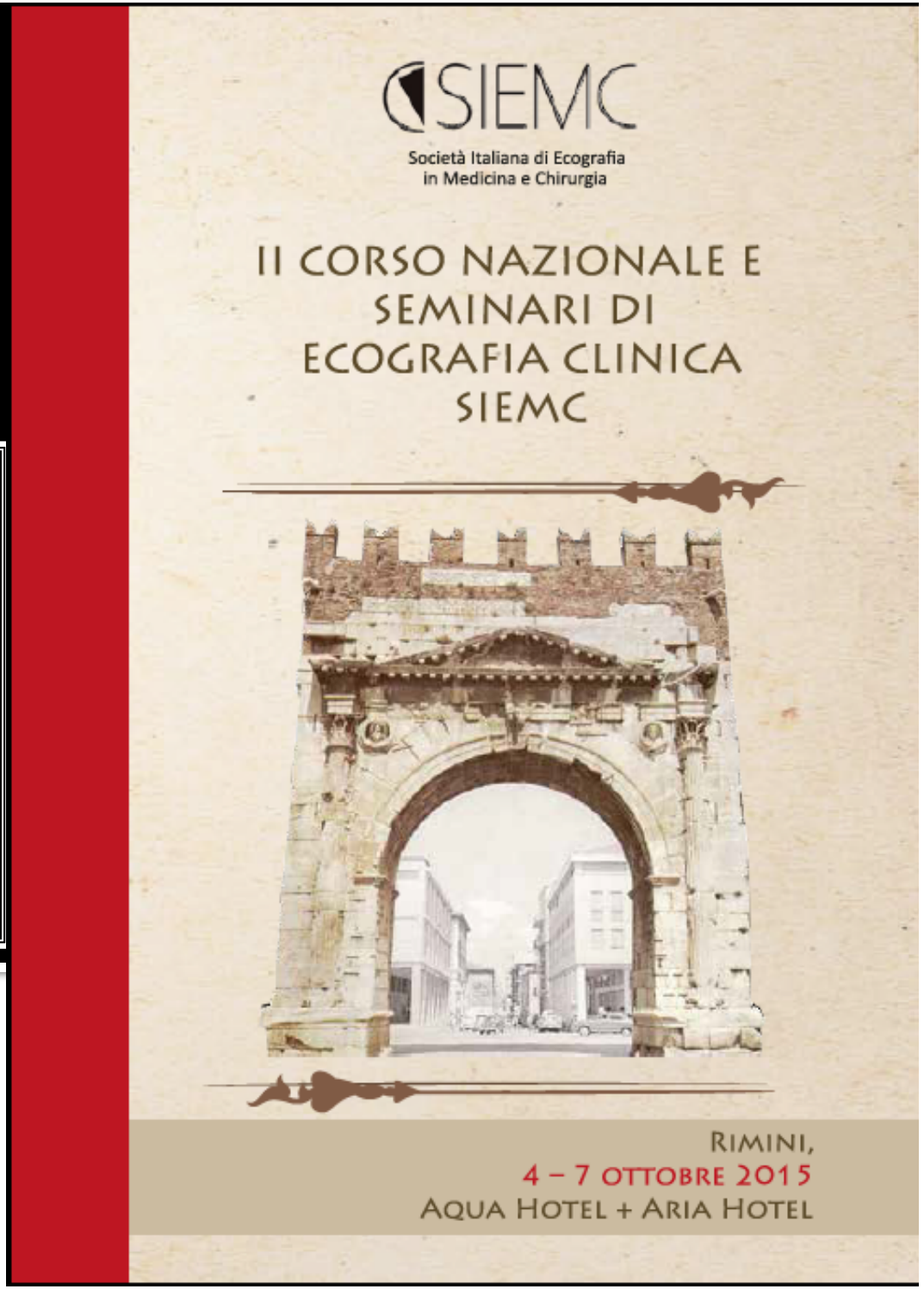


US evaluation of patients affected by IBD: How to do it, methods and findings

- For many years, US was considered unsuitable for the study of the bowel as the gaseous content of the loops leads to a dispersion of the ultrasound beam
- At the present time US has a definite part to play in diagnostic procedures regarding a number of diseases, particularly IBD
- US moreover provides information that is difficult to obtain with other imaging techniques as it is the only one that makes it possible to study the following in real time:
    - morphological aspects of the full thickness of the bowel wall;
    - functional characteristics;
    - perivisceral spaces;
    - abdominal parenchymatous organs

Cammarota T. et al European Journal of Radiology 69 (2009) 429–437

Equipment, process, and skills for IUS

- The machines and probes required for an IUS examination are no different to the ones used in standard radiology departments.
- The examination technique involves use of both low-frequency curved probes (1–6 MHz) and high-frequency linear probes (5–13 MHz).

*A. K. **Asthana et al.** Journal of Gastroenterology and Hepatology 30 (2015) 446–452*

Equipment, process, and skills for IUS

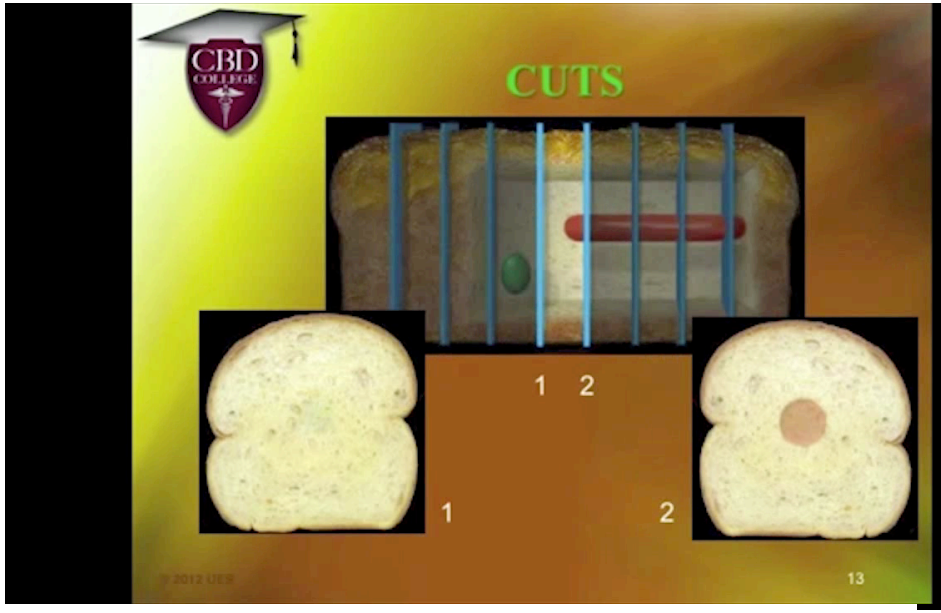
- The abdomen is first scanned using the *low-frequency probe* in order *to detect any deep or grossly abnormal pathology* such as significant bowel wall thickening, intra-abdominal fistulae, abscesses, or bowel dilatation.
- This is followed by detailed interrogation of the intestinal wall using a *high-frequency probe* and noting features such as specific bowel wall thickness measurements, fistulae, and prominent lymph nodes
- Areas that are interrogated include the colon (left and right sides), terminal ileum, small bowel, mesentery, and mesenteric lymph nodes.
- Ultrasound (US)-naïve clinicians can be trained to perform IUS competently after performing approximately 200 examinations under supervision

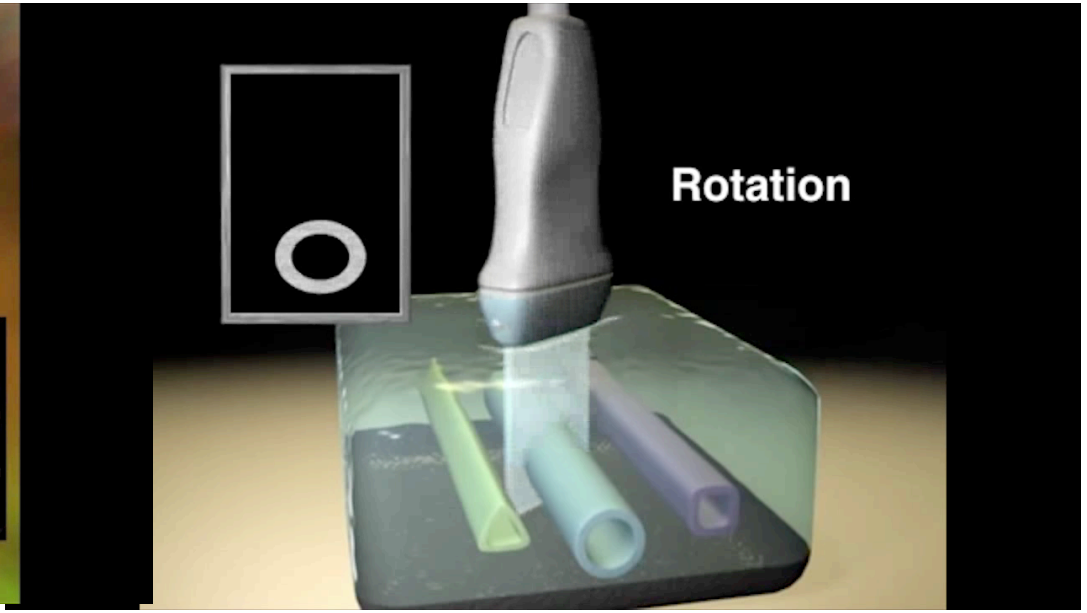
A. K. Asthana et al. Journal of Gastroenterology and Hepatology 30 (2015) 446–452

MALATTIE DELL'INTESTINO ED US

US: Among the *cross-sectional imaging techniques*, US is less invasive, more comfortable for the patient and has a significant diagnostic accuracy

(World J Gastroenterol 2013; 19(14): 2144-2153)





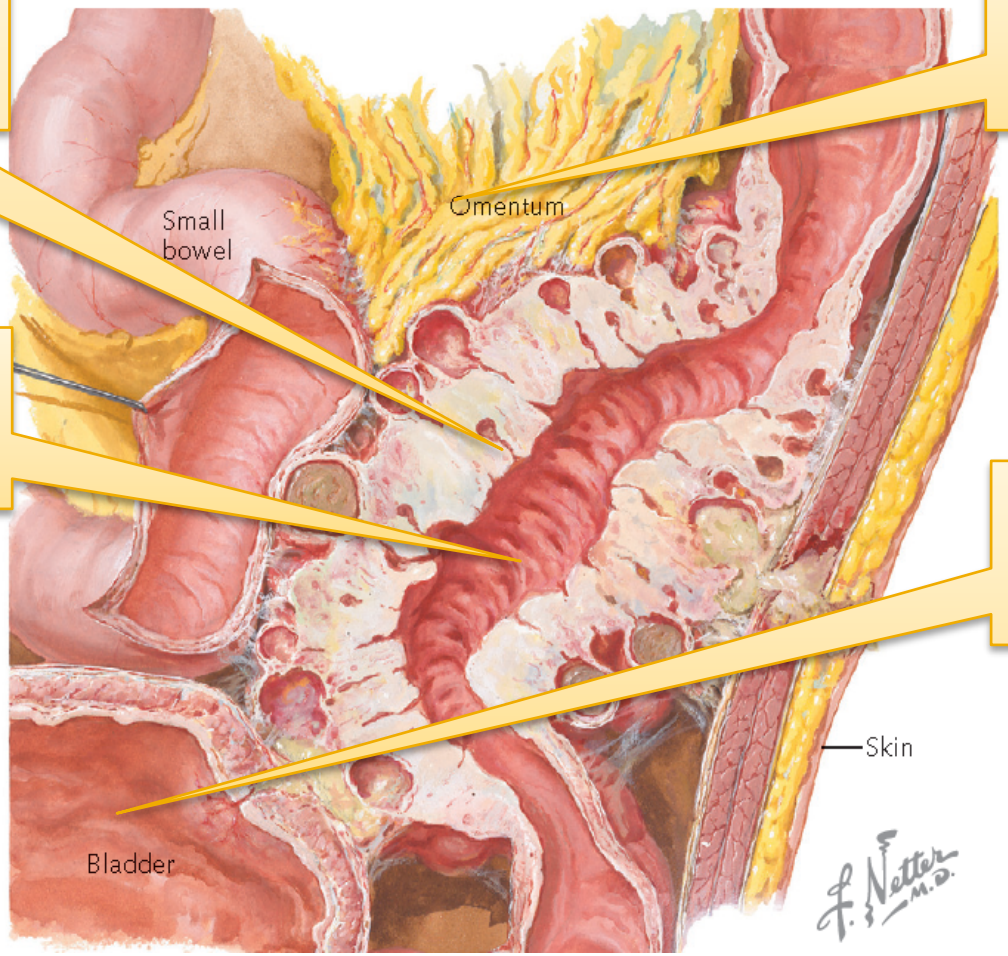
MALATTIE DELL'INTESTINO ED US

A. WALL BOWEL

B. LUMEN

C. PERIVISCERAL SPACE

D.abdominal parenchymatous organs



Floch M. Diverticulosis: Diverticulitis and Its Complications and Diverticular Bleeding: Diverticular Disease of the Colon Netter's Gastroenterology Book, 2010

A.WALL BOWELL EVALUATION

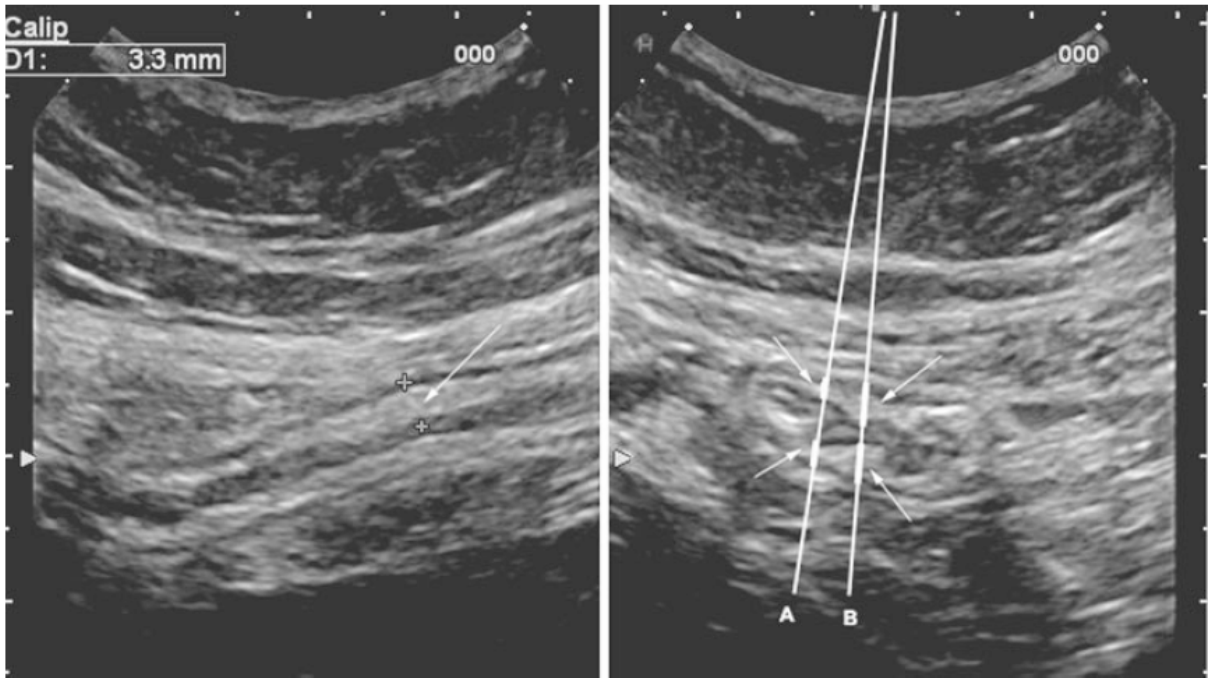
- The main features of the bowel walls to be assessed by ultrasound include:
  1. thickness
  2. echo pattern
  3. vascularity
  4. flexibility and motility

US FEATURES of BOWEL WALL
1. THICKNESS

- The thickness of the bowel wall is the main ultrasonographic feature of the gut.
- It is the only quantitative parameter
- Almost all studies reported only this value as the criterion to assess the presence of a gastrointestinal disease

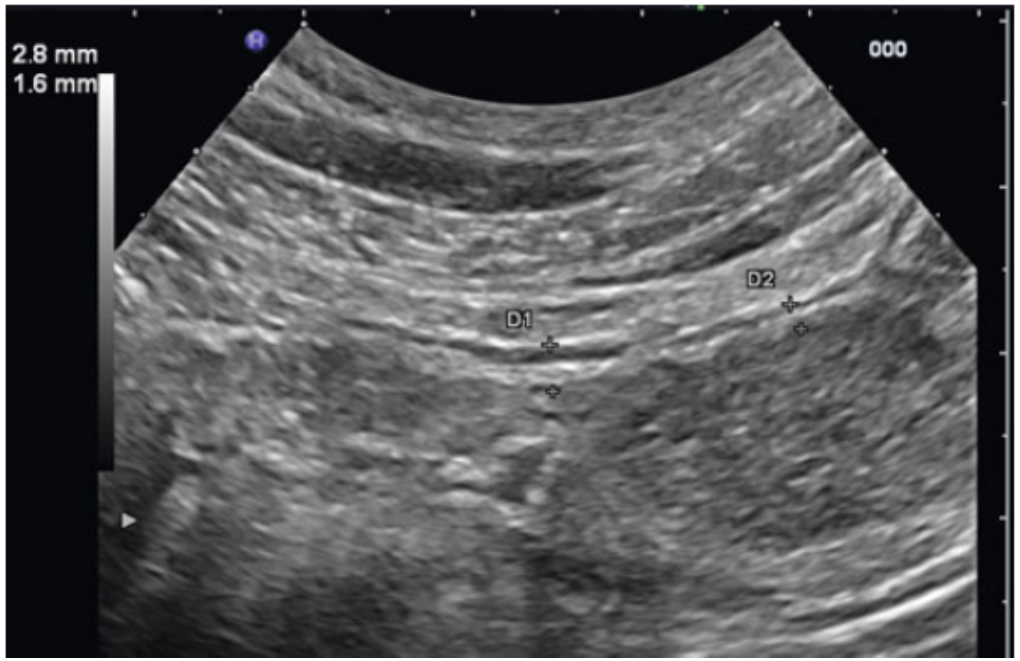
US FEATURES of BOWEL WALL
1.THICKNESS

- The measurement of wall thickness should be taken using the transducer with as high a frequency as possible (preferable 5 MHz or more).
- The measure of the thickening should be taken from the external hyperechoic layer, corresponding to the serosa, to the internal hyperechoic layer representing the interface between the mucosa and intestinal content.
- Only when these two interfaces are simultaneously visible in a perpendicular scan of the loop, the measurement should be considered appropriate

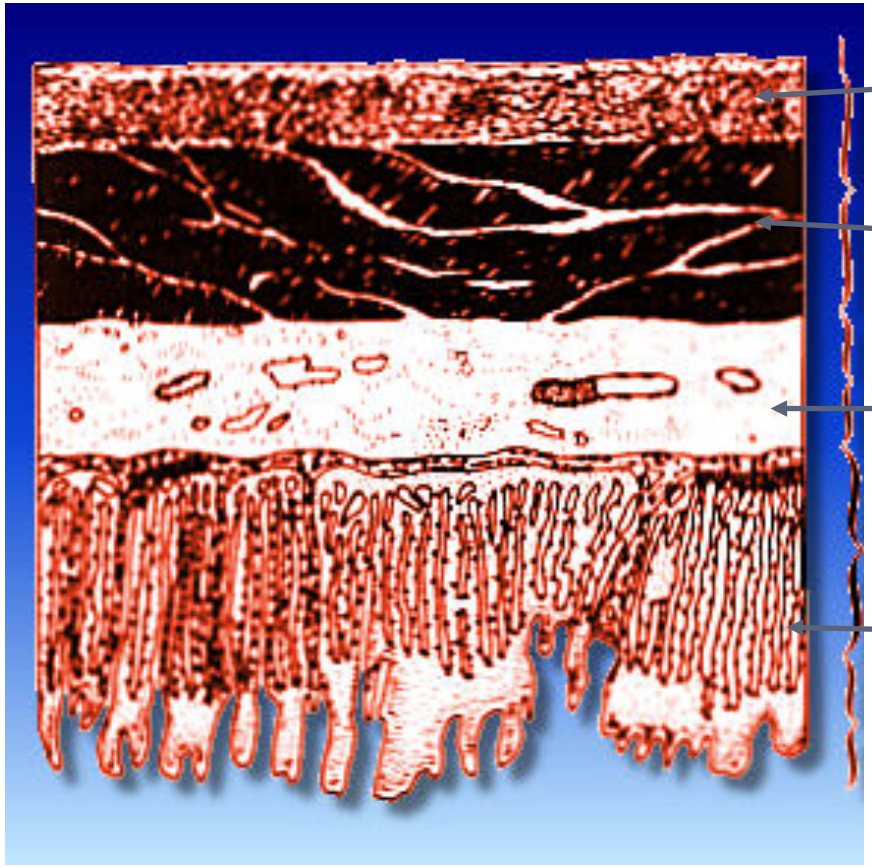


US FEATURES of BOWEL WALL
1.THICKNESS

- The thickness of normal gastrointestinal walls varies according to the anatomical segment, age, weight and, to some extent, to the fed/fasting state, being thicker in the sigmoid and ileum and usually increasing with age, weight and in feeding state
- most studies and metaanalyses set the cut-off for bowel diseases (in particular for inflammatory diseases) between 3 and 4 mm (Fraquelli et al. 2005 ; Horsthuis et al. 2008).
- the gastric wall is usually thicker and may be up to 5–6 mm (Rapaccini et al 1988).



US FEATURES of BOWEL WALL
2.ECHOPATTERN



serosa

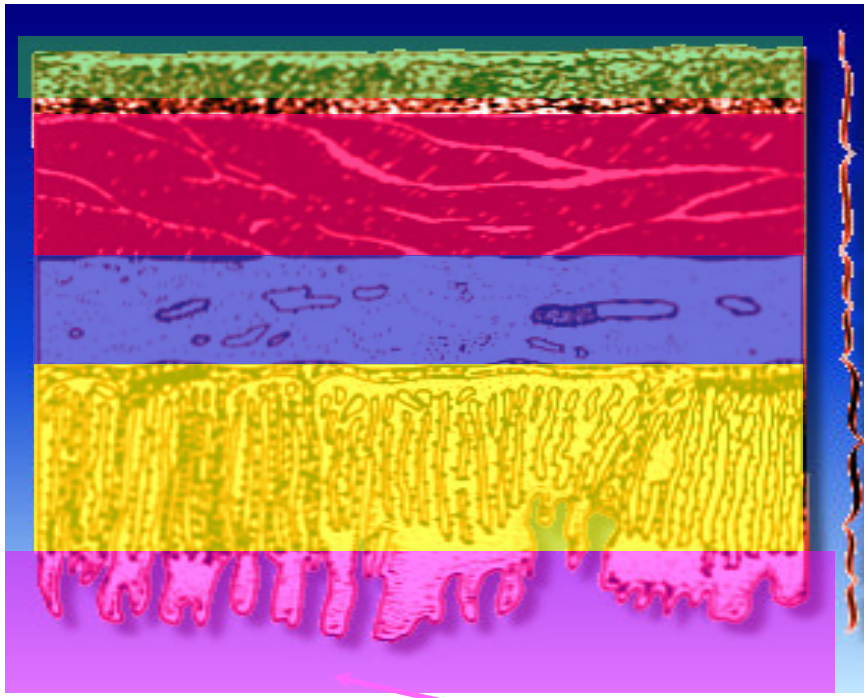
Muscularis p.

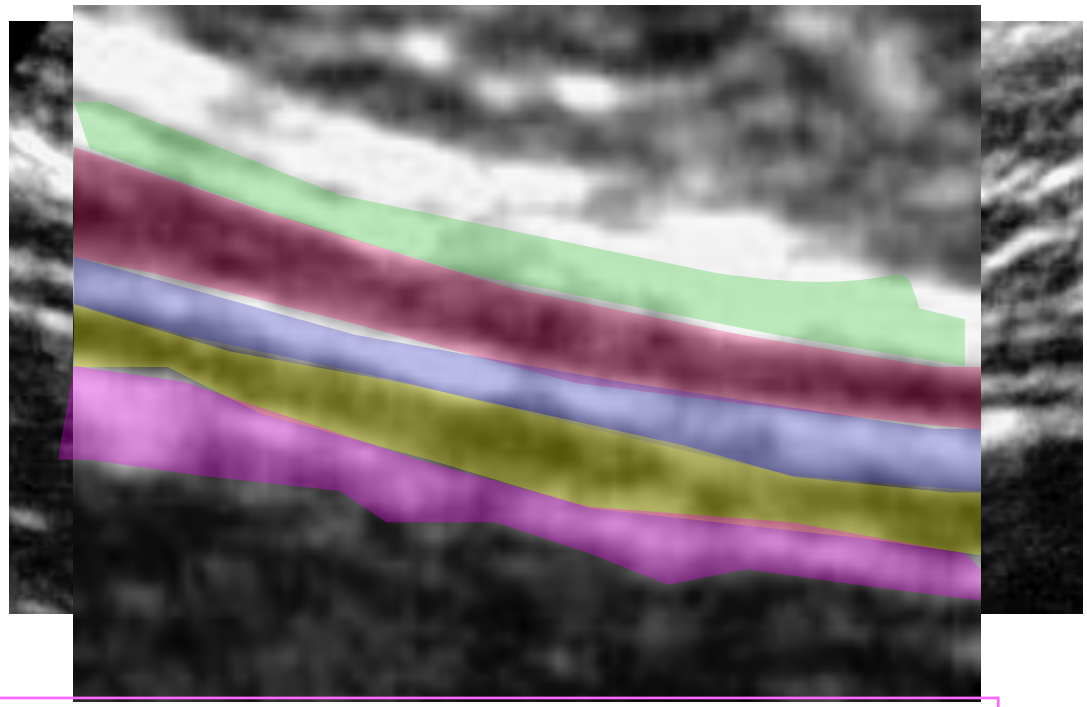
submucosa

mucosa
(mucosa + *muscolaris mucosae*)

US FEATURES of BOWEL WALL
2.ECHOPATTERN

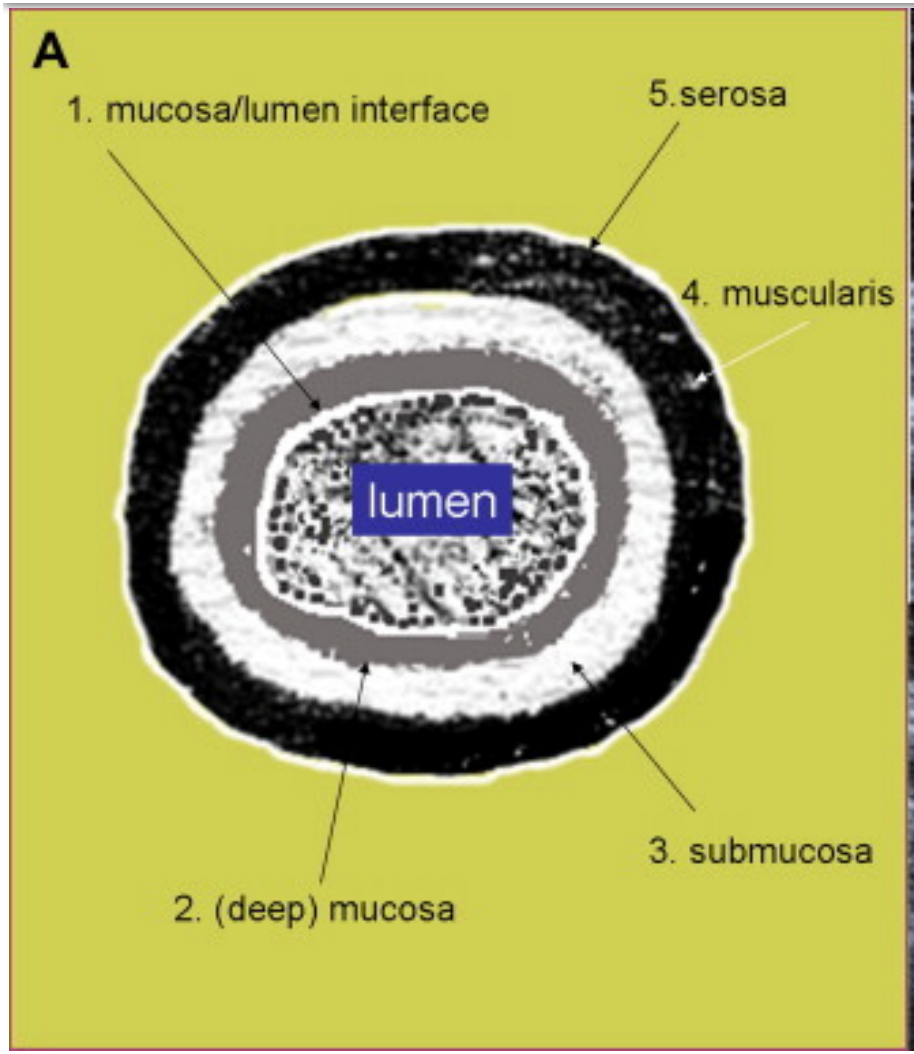
Echopattern Stratificato
"5 strati"

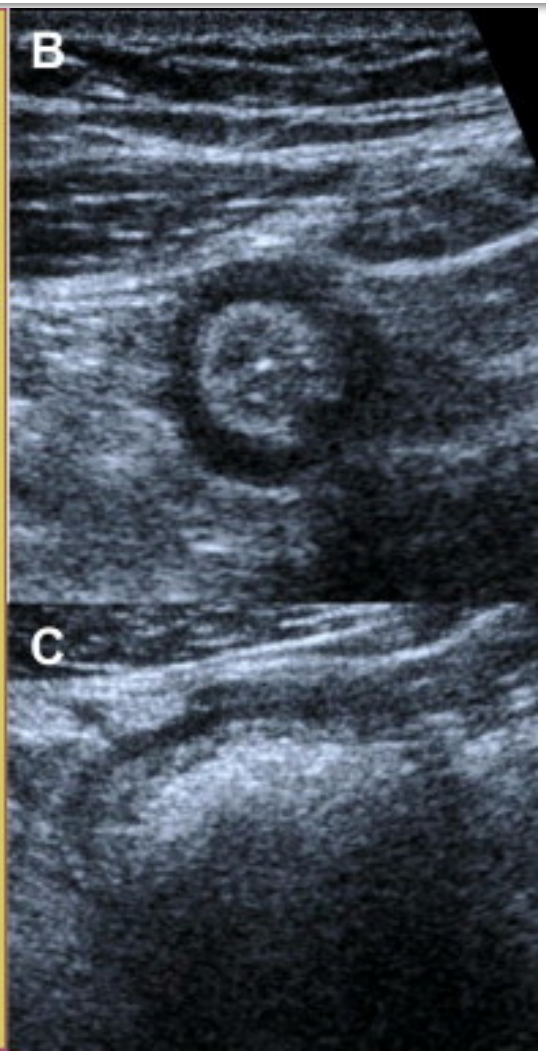




interface lumen-mucosa

Transabdominal Ultrasound for Bowel Evaluation



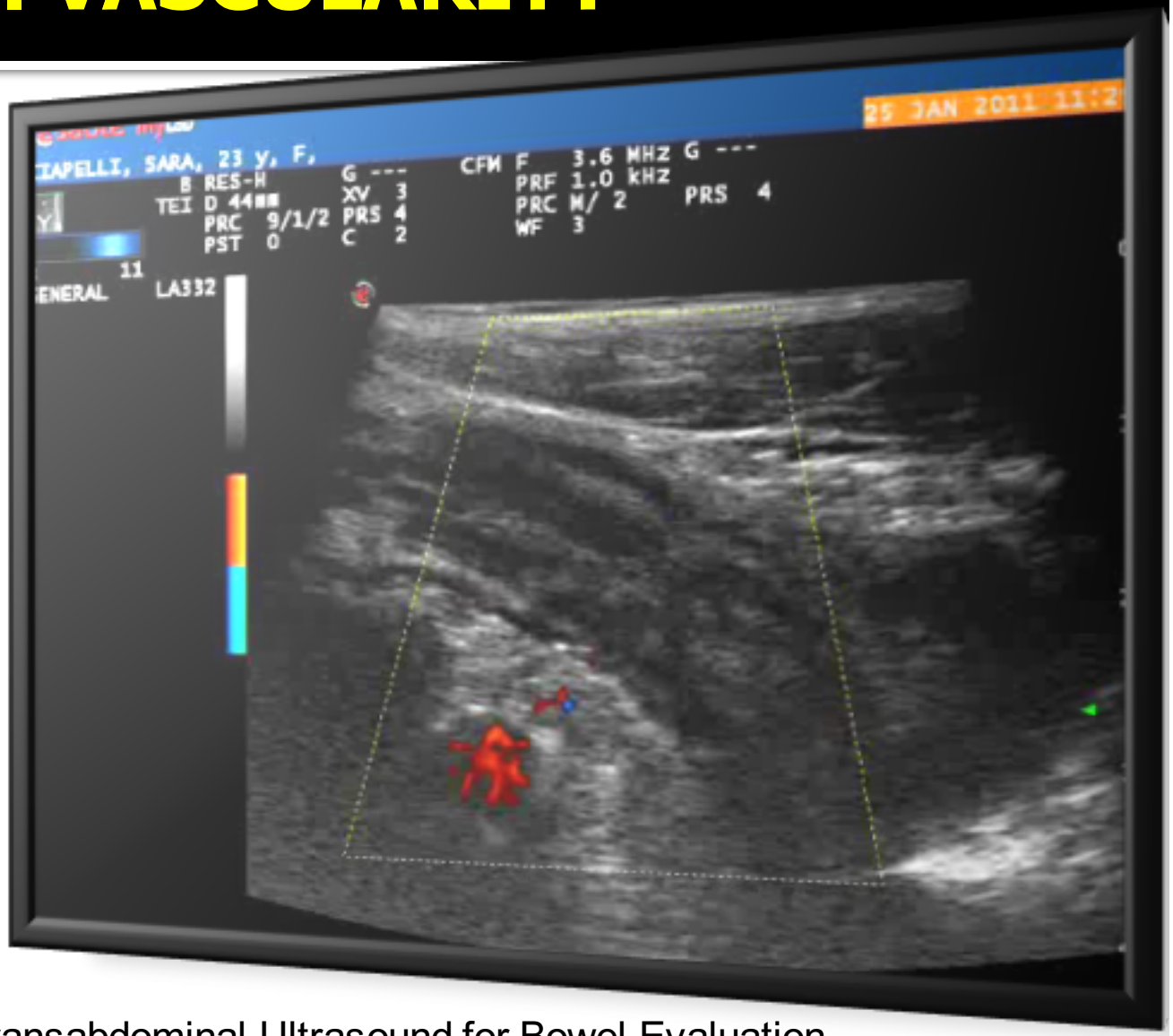


The ultrasonographic image of the normal bowel wall consists of five layers of different echogenicity:
(1) ***hyperechogenic layer***—it corresponds to the mucosa or interface between mucosa and intestinal content;
(2) ***hypoechogenic layer***—it corresponds to the muscularis mucosae and is thicker than the previous one;
(3) ***hyperechogenic layer***—it is the most echogenic layer and corresponds to the submucosa;
(4) ***hypoechogenic layer***—it corresponds to the tunica muscularis propria;
(5) ***hyperechogenic layer***—it is the most external layer, of variable thickness, and corresponds to the serosa or the interface between serosa and perivisceral tissue.

Rodgers PM,Transabdominal Ultrasound for Bowel Evaluation.
Radiologic Clinics of North America 2013;51:133-148.

US FEATURES of BOWEL WALL
3. VASCULARITY

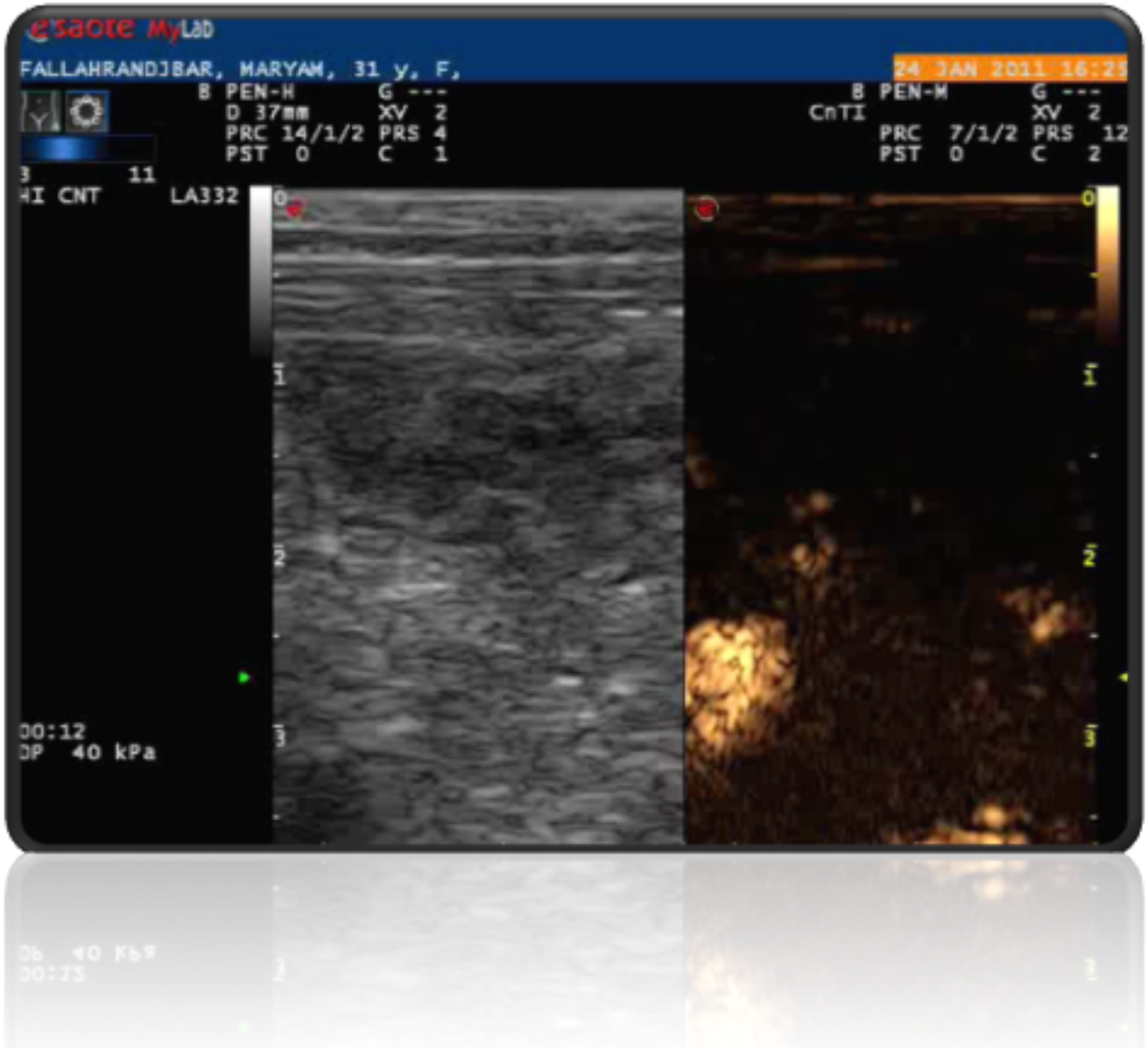
- The assessment of vascularity of bowel walls and intestinal lesions is part of the sonographic evaluation of intestinal diseases.
- Colour or power Doppler sonography may be used to estimate the perfusion of bowel abnormalities and show neovascularisation and hyperaemia occurring in inflammatory bowel diseases and neoplastic lesions.
- The assessment of hypervascularity is therefore a useful adjunct to B-mode assessment to suggest the inflammatory or neoplastic nature of an intestinal lesion



Rodgers PM,Transabdominal Ultrasound for Bowel Evaluation. Radiologic Clinics of North America 2013;51:133-148.

US FEATURES of BOWEL WALL
3. VASCULARITY

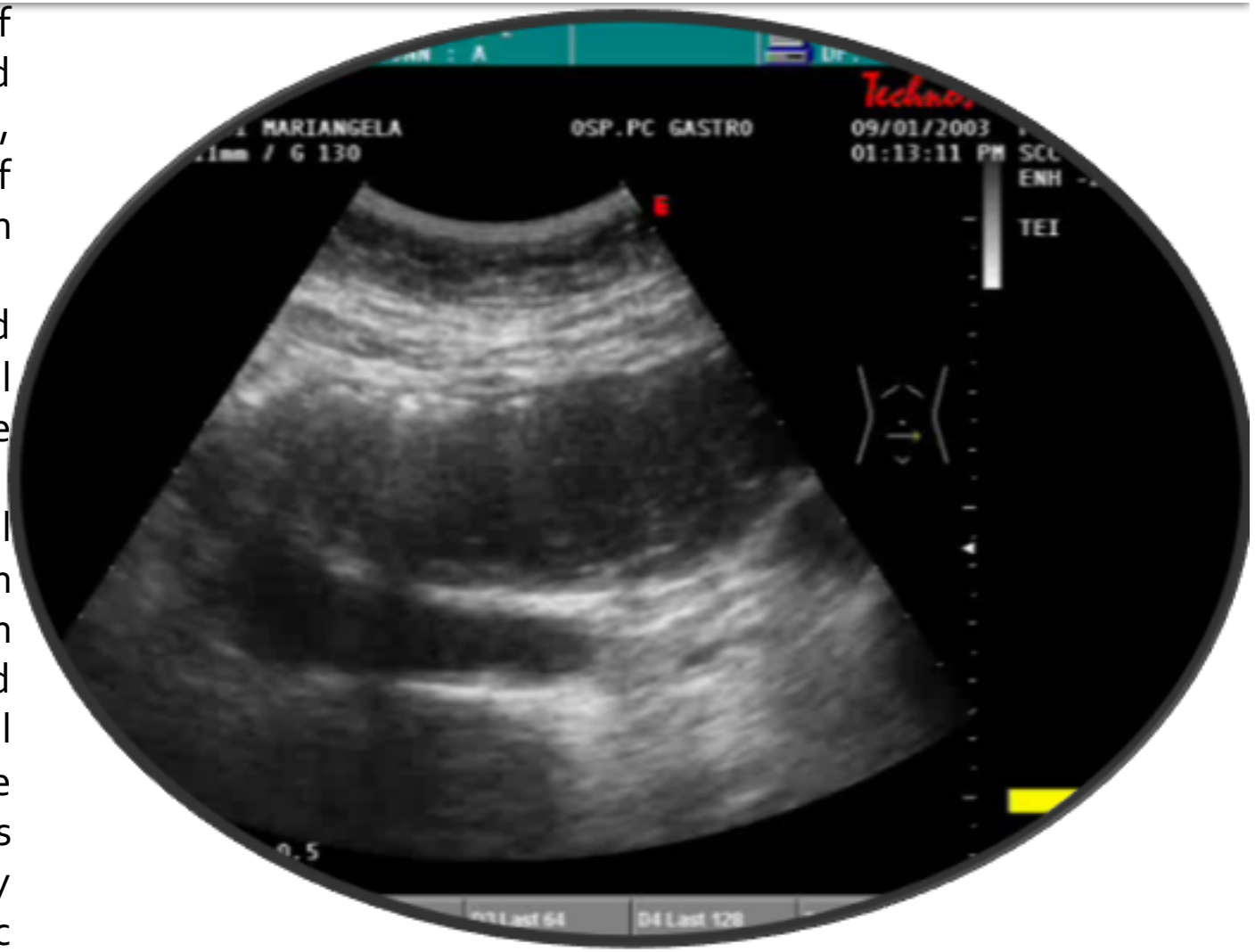
CEUS:
the introduction of second generation intravenous contrast agents in combination with low mechanical index harmonic US has now made it possible to systematically assess the bowel wall microcirculation
(Abdom Imaging 2012 37:369–376)



US FEATURES of BOWEL WALL

4. FLEXIBILITY AND MOTILITY

- The assessment of bowel elasticity and peristalsis is a subjective, though important part of bowel examination (Appendicitis)
- The assessment and quantification of bowel peristalsis may be difficult and subjective
- Increased small bowel peristalsis has been frequently described in coeliac disease and acute mechanic bowel obstruction, while dynamic ileus is characterised by absence of peristaltic movements



B. LUMEN EVALUATION

- The bowel may be collapsed, containing only a small amount of:

mucus	Gas	Fluid
(mucus pattern)	(gas patterns)	(fluid patterns)

The mucus pattern appears as a target with a highly reflective core of mucus.	In the gas pattern, only the proximal side of the bowel wall is visible due to beam attenuation by gas	The fluid pattern gives a tubular appearance on a longitudinal section and a rounded pattern on a cross-section.

Roccarina, D., et al. World J Gastroenterol 2013 April 14; 19(14): 2144-2153

ELSEVIER

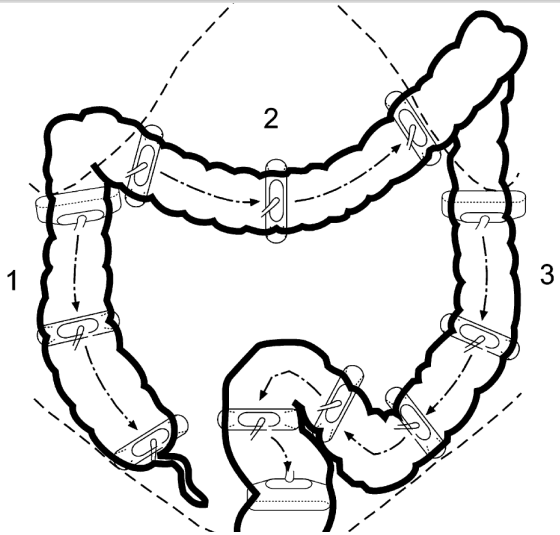
European Journal of Radiology 64 (2007) 239–249

EJR
EUROPEAN JOURNAL OF RADIOLOGY

www.elsevier.com/locate/ejrad

Colonic diseases: The value of US examination

Alois Hollerweger*



cross-sectional imaging methods such as US, CT, or MRI can primarily demonstrate transmural changes of the bowel wall and of pericolic structures and thus provide additional information to the endoscopic results. Bowel wall thickening results in decreased luminal gas content permitting better US evaluation of the intestine and surrounding structures

Patologie intestinali (CENNI)

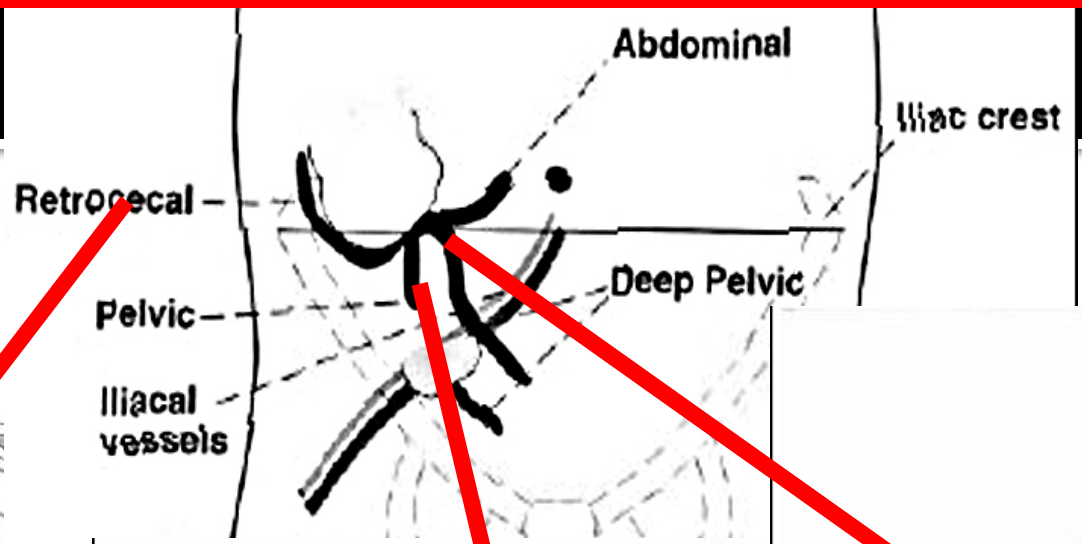
- APPENDICITE ACUTA
- DIVERTICOLITE ACUTA
- IBD
- TUMORI
- ERNIE
- OCCLUSIONE INTESTINALE
- PATOLOGIA VASCOLARE

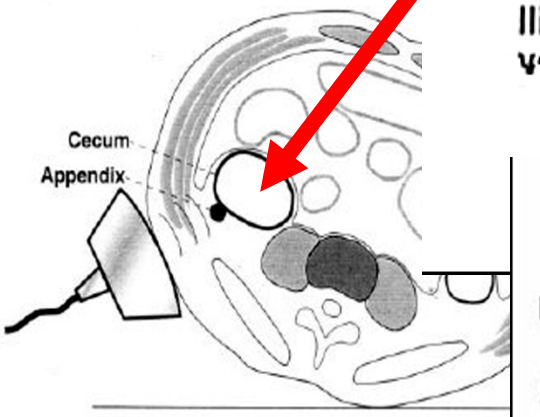
APPENDICITE

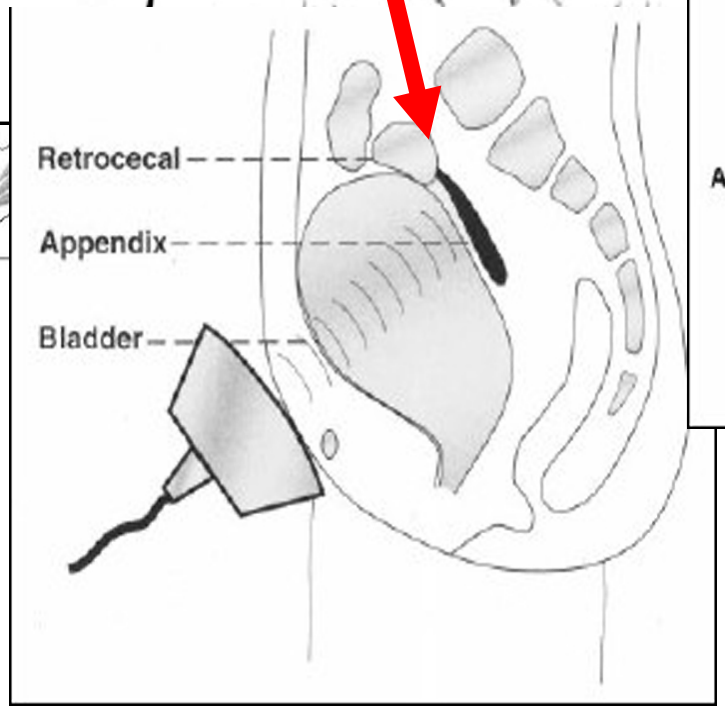
TECNICA ECOGRAFICA: "COMPRESSIONE GRADUALE"

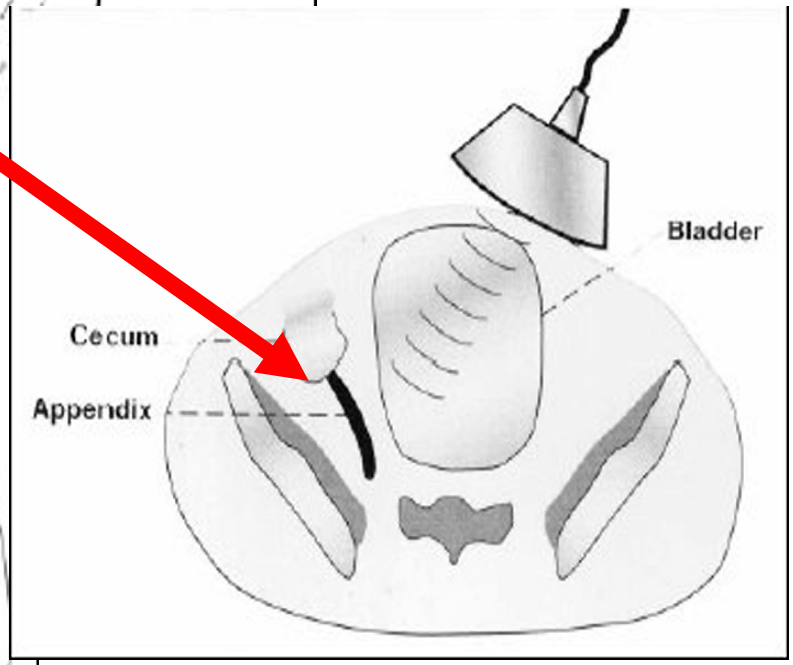
Puylaert JBCM. Radiology 1986 (158) 355-360

TECNICA ECOGRAFICA PEDIATRICA: "L'ECOGRAFIA NON COMPRESSIVA"









Baldisserotto M, AJR 2000, (175), 1387-1392

CRITERI ECOGRAFICI B-MODE DI APPENDICITE ACUTA NON PERFORATA

1. **DIMENSIONI**
2. **FORMA**
3. **COMPRIMIBILITA’ (ASSENTE)**
4. **PERISTALSI (ASSENTE)**
5. **APPENDICOLITI**
6. **ADENOPATIE**
1. **ISPESSIMENTO DEL GRASSO PERIVISCERALE**

CRITERI ECOGRAFICI COLORDOPPLER DI APPENDICITE ACUTA NON PERFORATA

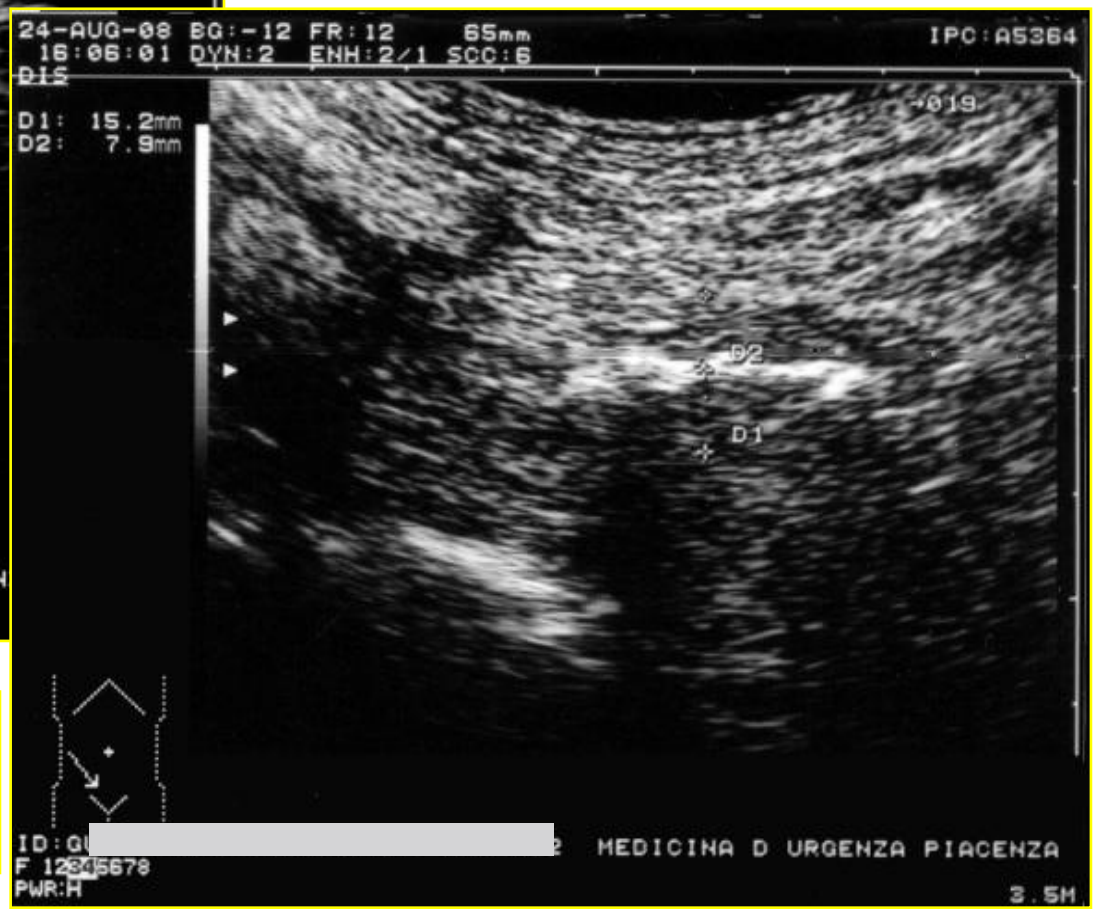
7. **COLOR: FLUSSO ARTERIOSO ALL'INTERNO DELLA PARETE APPENDICOLARE**

8. **DOPPLER: FLUSSO ARTERIOSO DI TIPO "INFIAMMATORIO"**

1. DIMENSIONI

DIAMETRO > 6 mm (Jeffrey, Radiology, 1988)

PARETE > 3 mm (Larson, AJR, 1989)

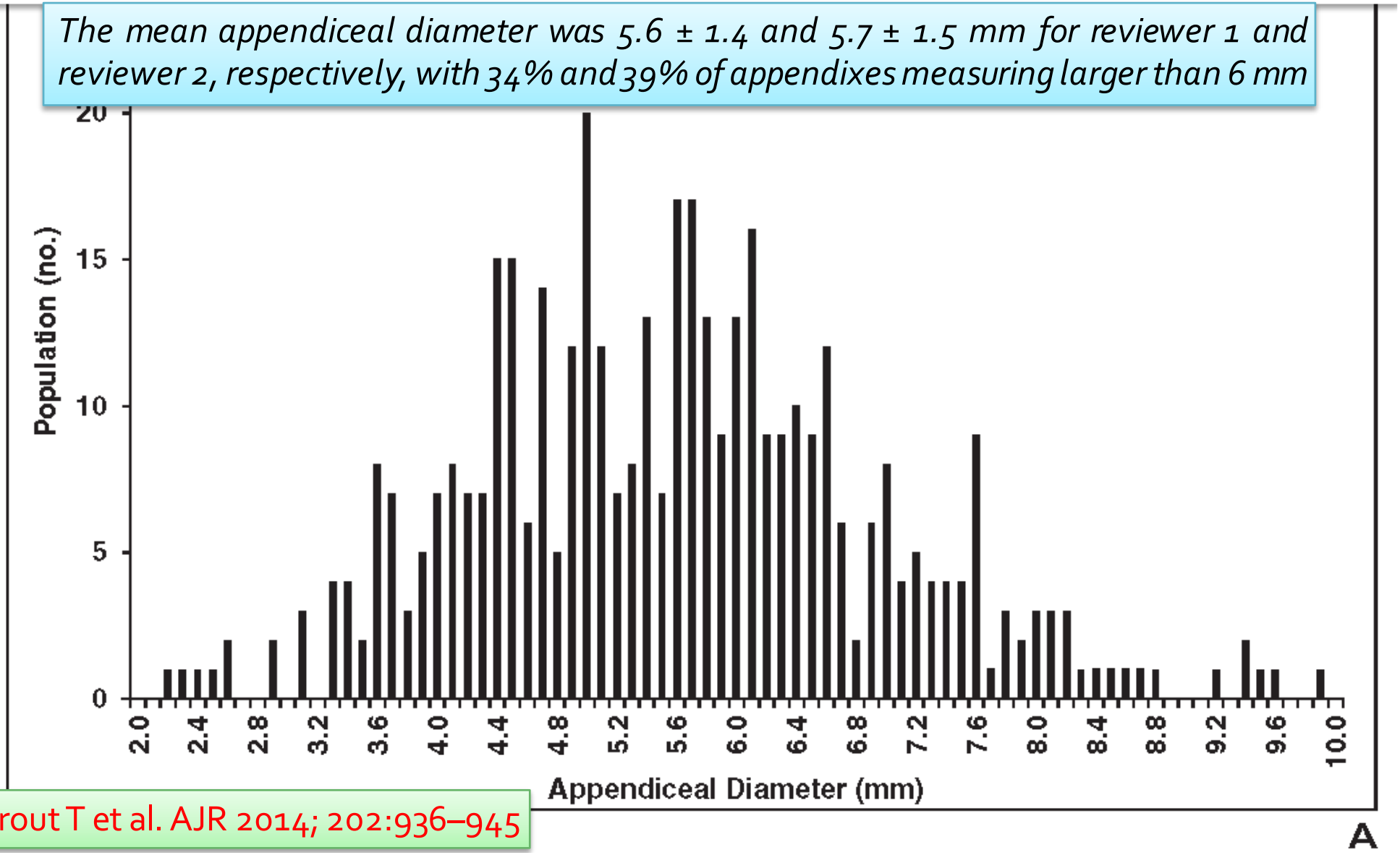


CRITERI ECOGRAFICI B-MODE APPENDICITE ACUTA NON PERFORATA

1. DIMENSIONI:

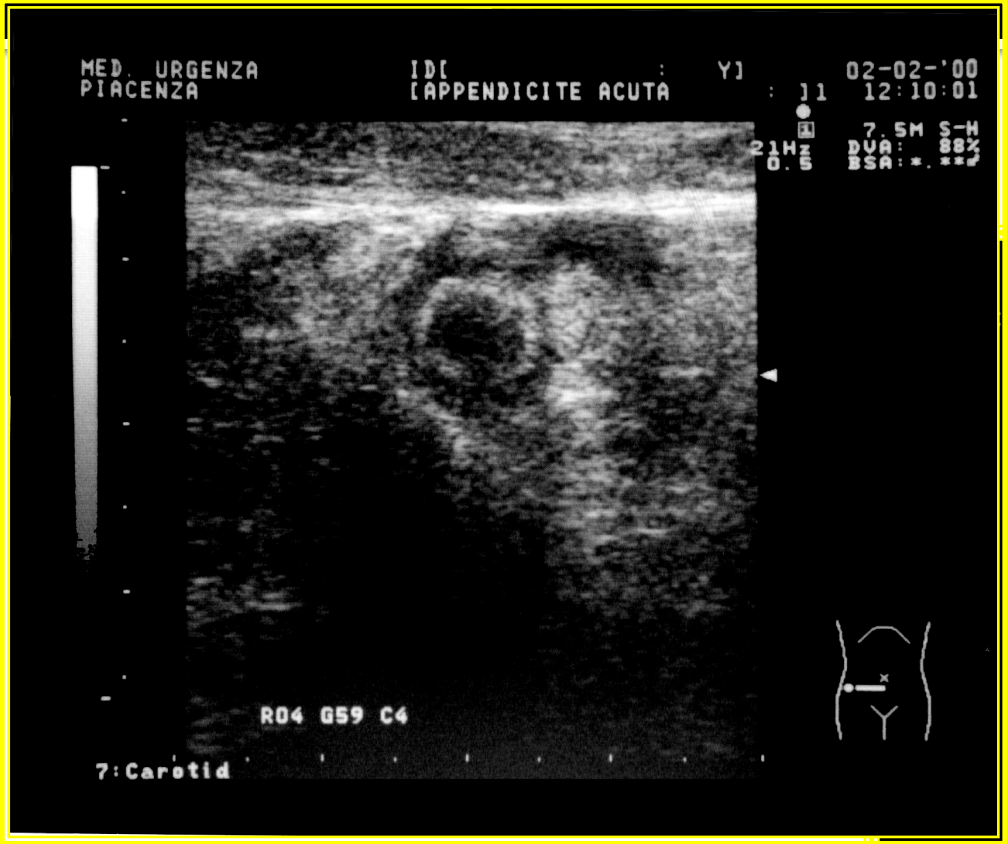
The Pediatric Appendix: Defining Normal (420 Pts evaluated with spiral CT)

The mean appendiceal diameter was 5.6 ± 1.4 and 5.7 ± 1.5 mm for reviewer 1 and reviewer 2, respectively, with 34% and 39% of appendixes measuring larger than 6 mm



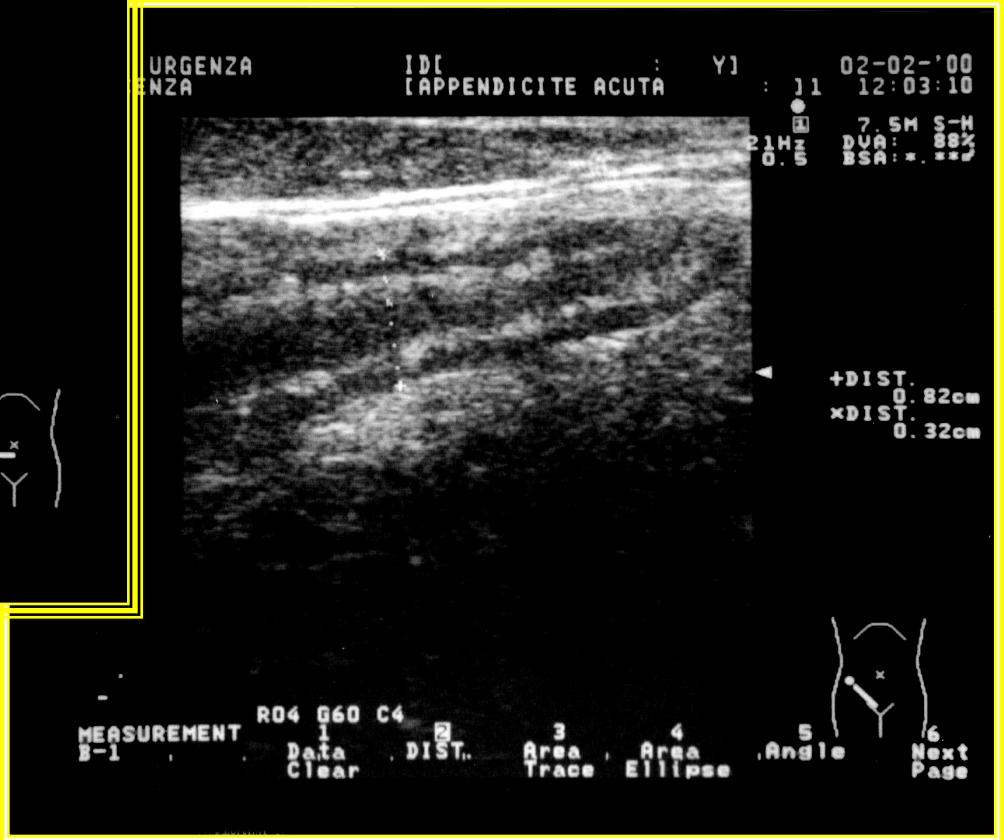
Trout T et al. AJR 2014; 202:936–945

2. FORMA



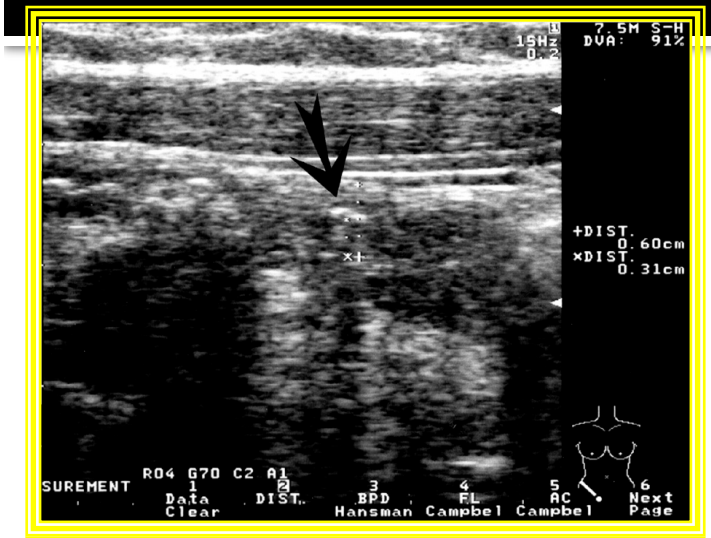
SCANS. TRASVERSA: "BULL-EYE"

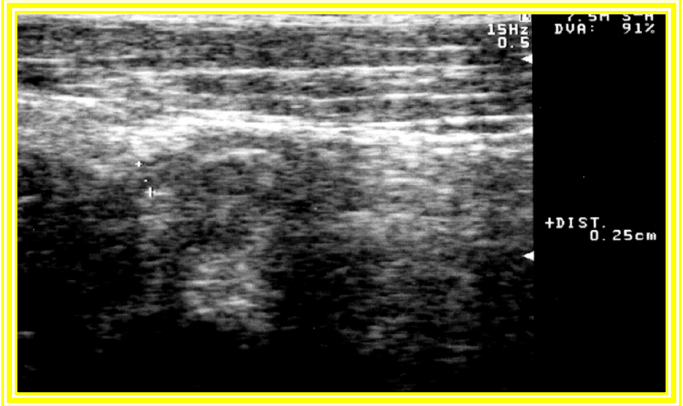
SCANS. OBLIQUA: "A CUL DE SAC"



CRITERI ECOGRAFICI B-MODE APPENDICITE ACUTA NON PERFORATA

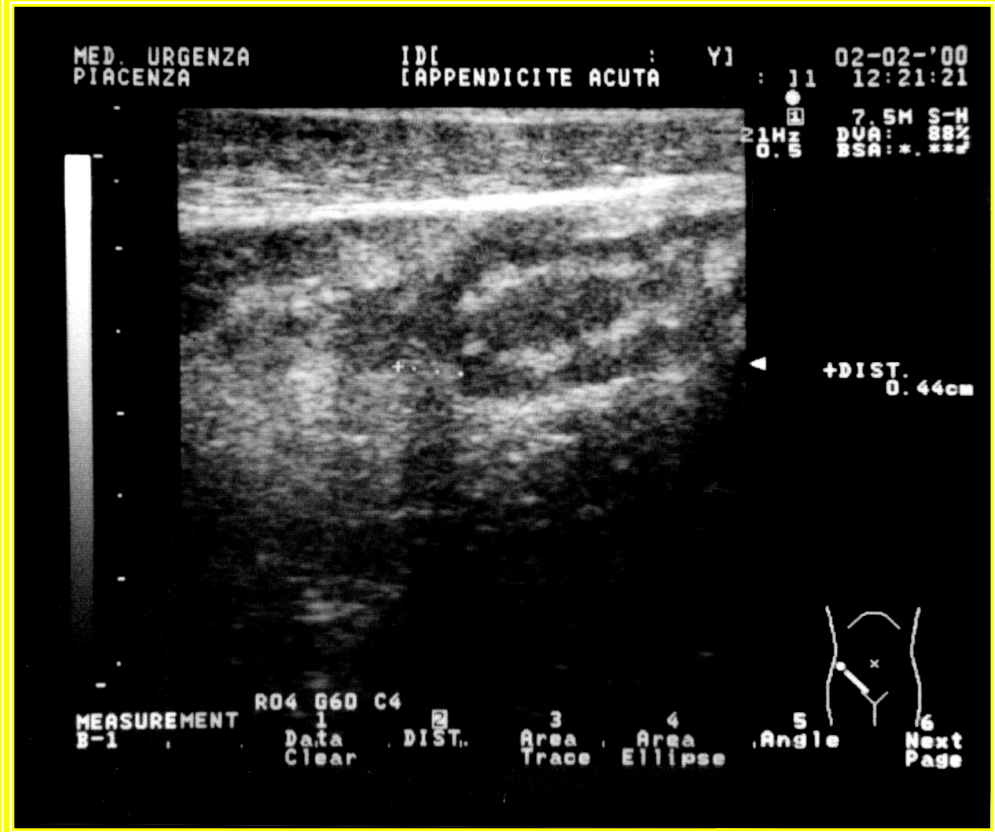
5. APPENDICOLITI



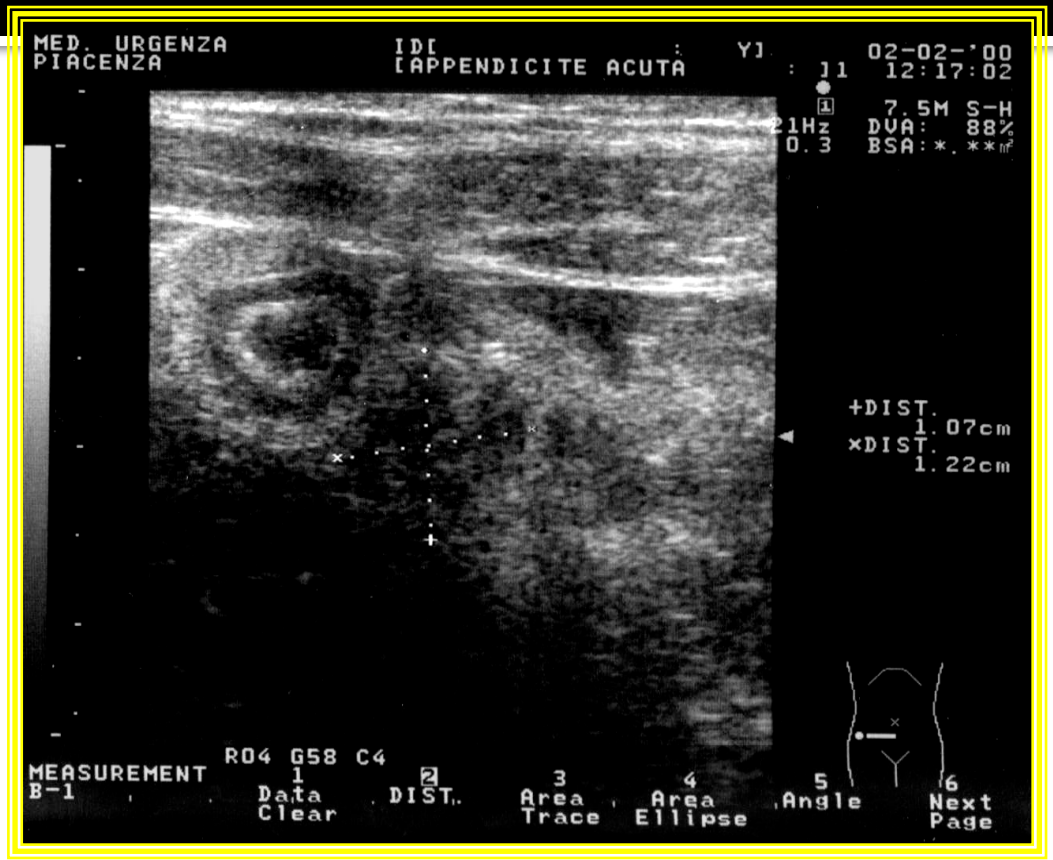


CRITERI ECOGRAFICI B-MODE APPENDICITE ACUTA NON PERFORATA

La visualizzazione ecografica di appendicoliti ostruenti è un reperto patognomonico di appendicite acuta (Borushok KF et al. AJR, 1990)



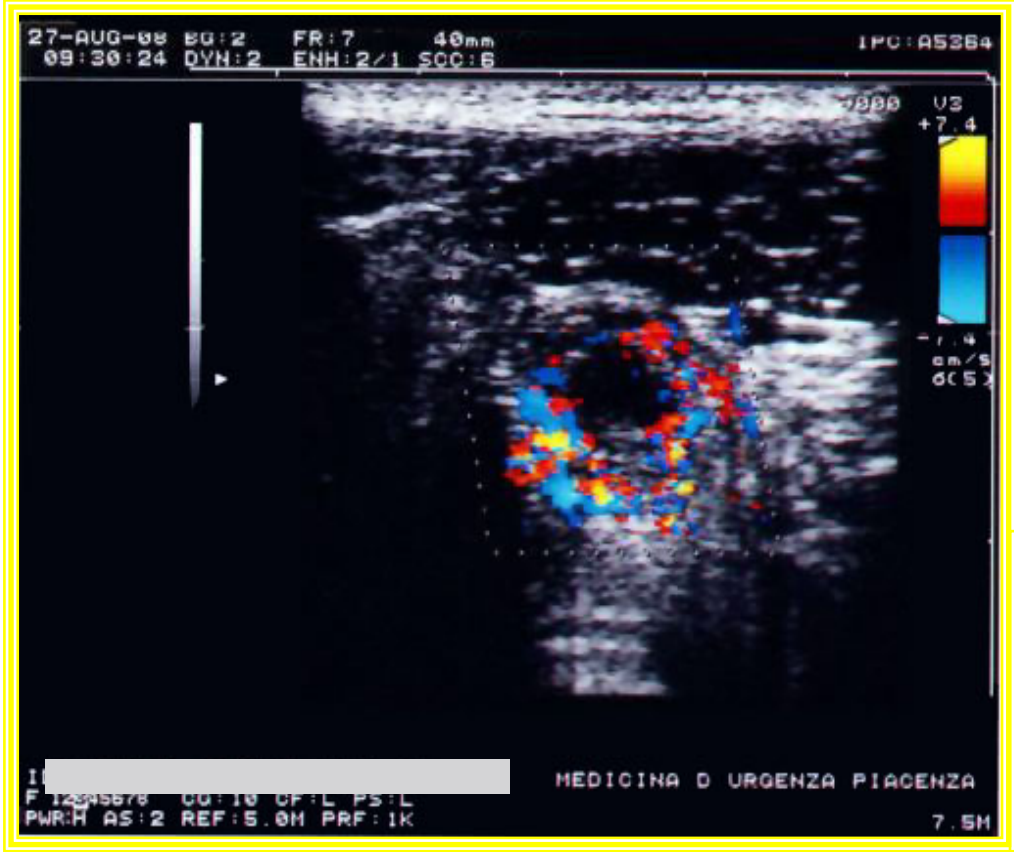
6. ADENOPATIE



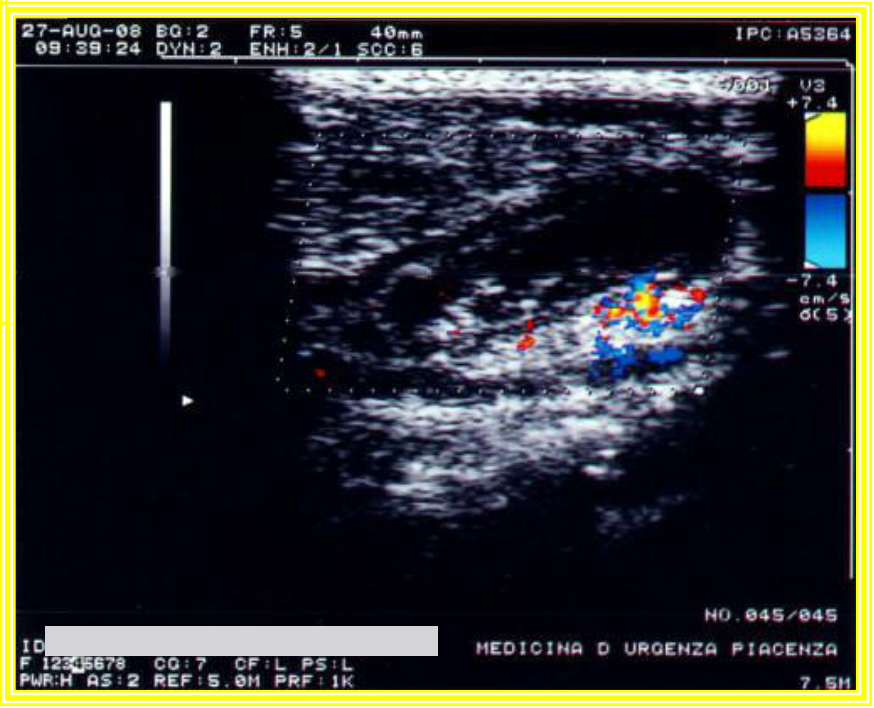
CRITERI ECOGRAFICI B-MODE APPENDICITE ACUTA NON PERFORATA

in fossa iliaca destra (linfonodi di diametro maggiore di 4 mm) (Vignault, Radiology, 1990; Puylaert, Radiology, 1986). Tale reperto è però aspecifico (presente anche in altre condizioni) (Sivit, Ped Radiol, 1993)

FLUSSO ARTERIOSO DI PARETE

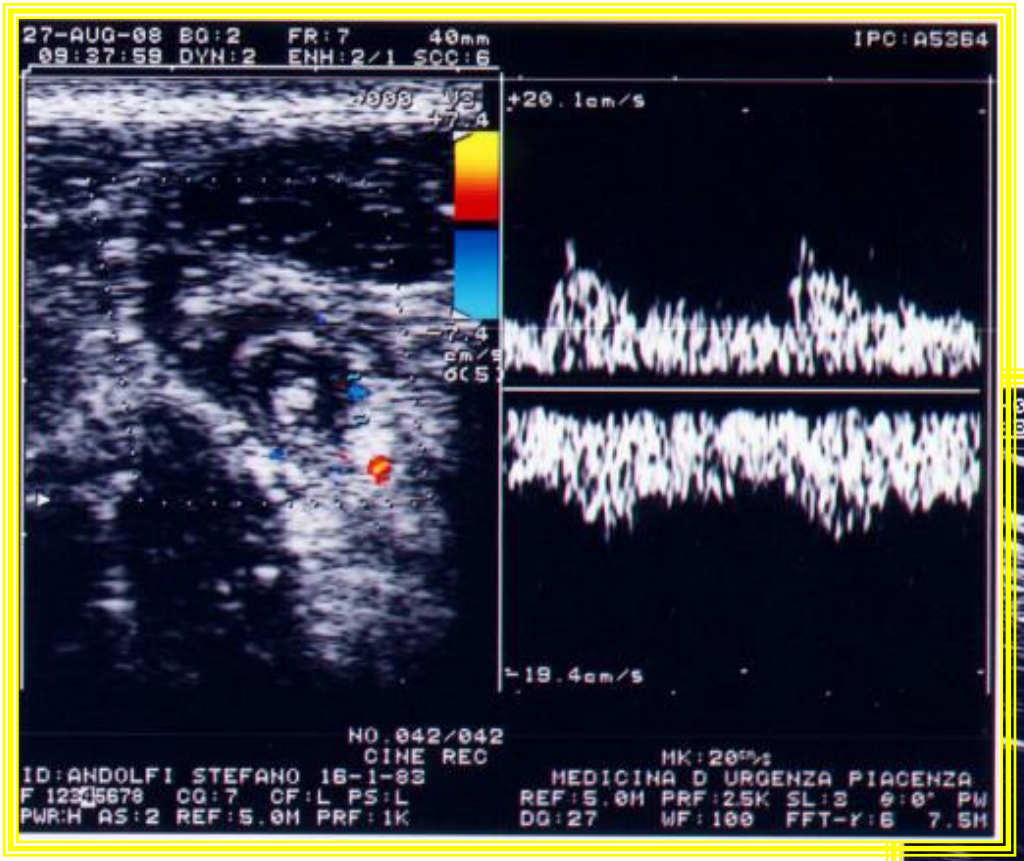


- **Presenza di flusso di parete (Quillin, Radiology, 1992)**
- **Assenza di flusso nelle zone di necrosi focale**
- **nel caso di diagnosi B-mode dubbia, la dimostrazione ecocolordoppler di flusso all'interno di parete consente di far diagnosi di appendicite acuta (Lim, Radiology, 1996)**



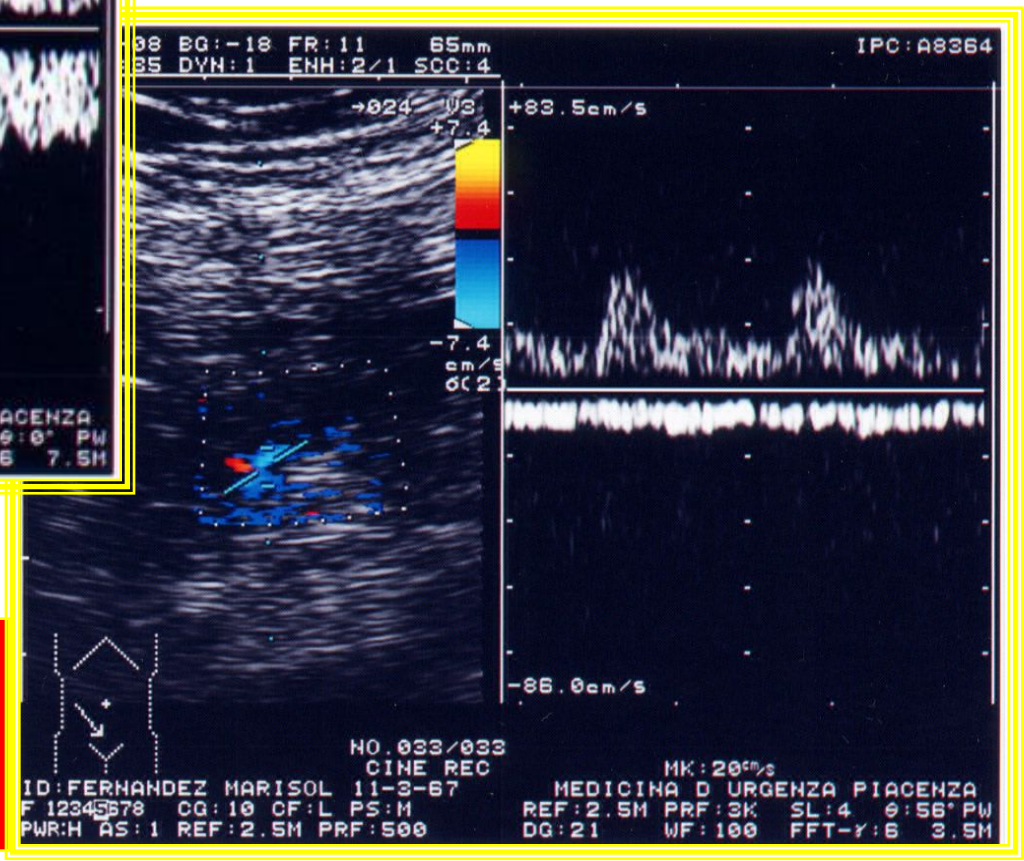
CRITERI ECOGRAFICI
COLORDOPPLER
APPENDICITE ACUTA NON PERFORATA

FLUSSO ARTERIOSO DI TIPO "INFIAMMATORIO"



al doppler pulsato presenza di flusso diastolico (da vaso-dilatazione infiammatoria)

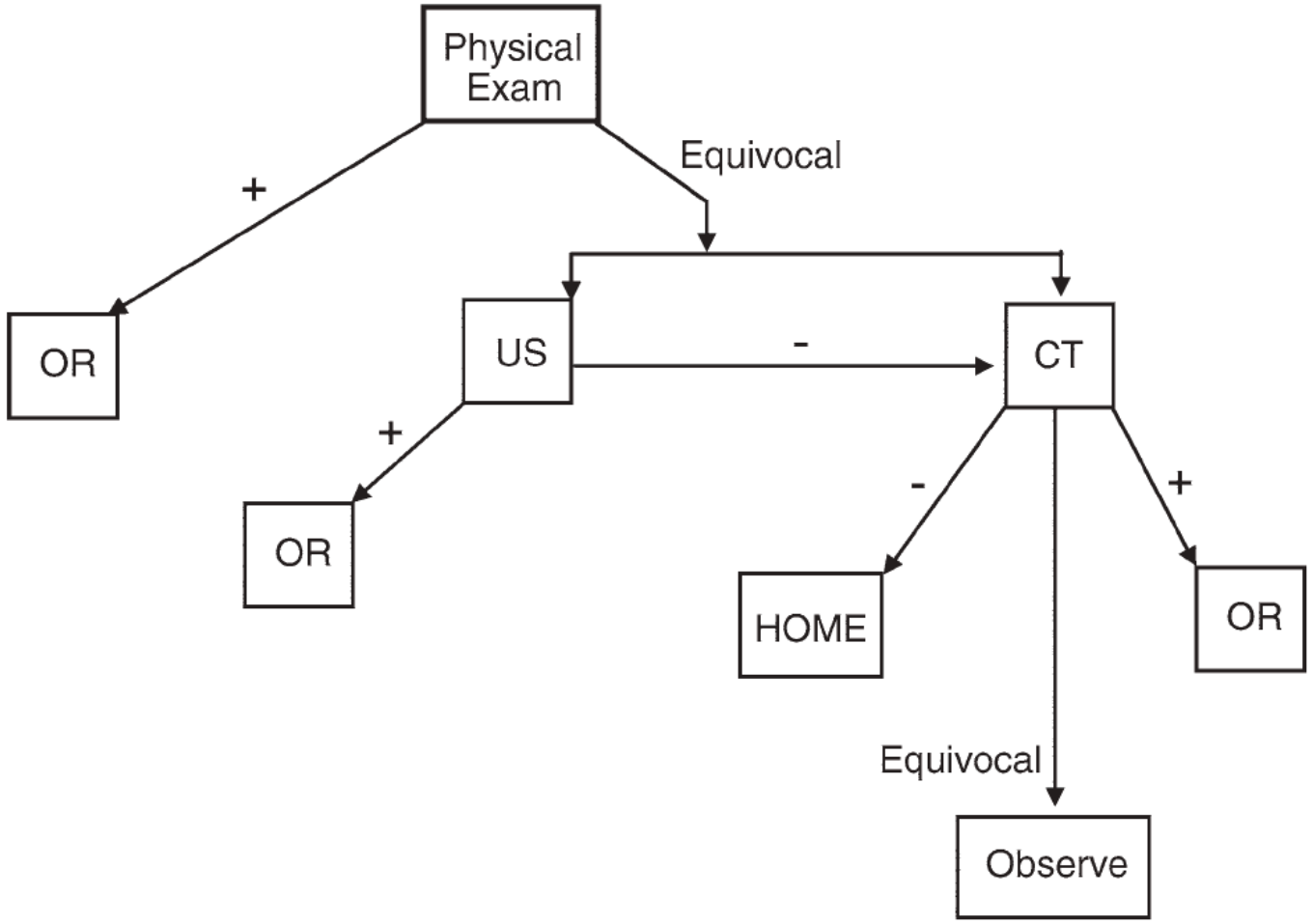
(Lim, Radiology, 1996)



CRITERI ECOGRAFICI
COLORDOPPLER
APPENDICITE ACUTA NON PERFORATA

APPENDICITE ACUTA

CT and US in the Diagnosis of Appendicitis



Hernanz-Schulman M. Radiology 2010; 255:3–7

Three-Step Sequential Positioning Algorithm During Sonographic Evaluation for Appendicitis Increases Appendiceal Visualization Rate and Reduces CT Use

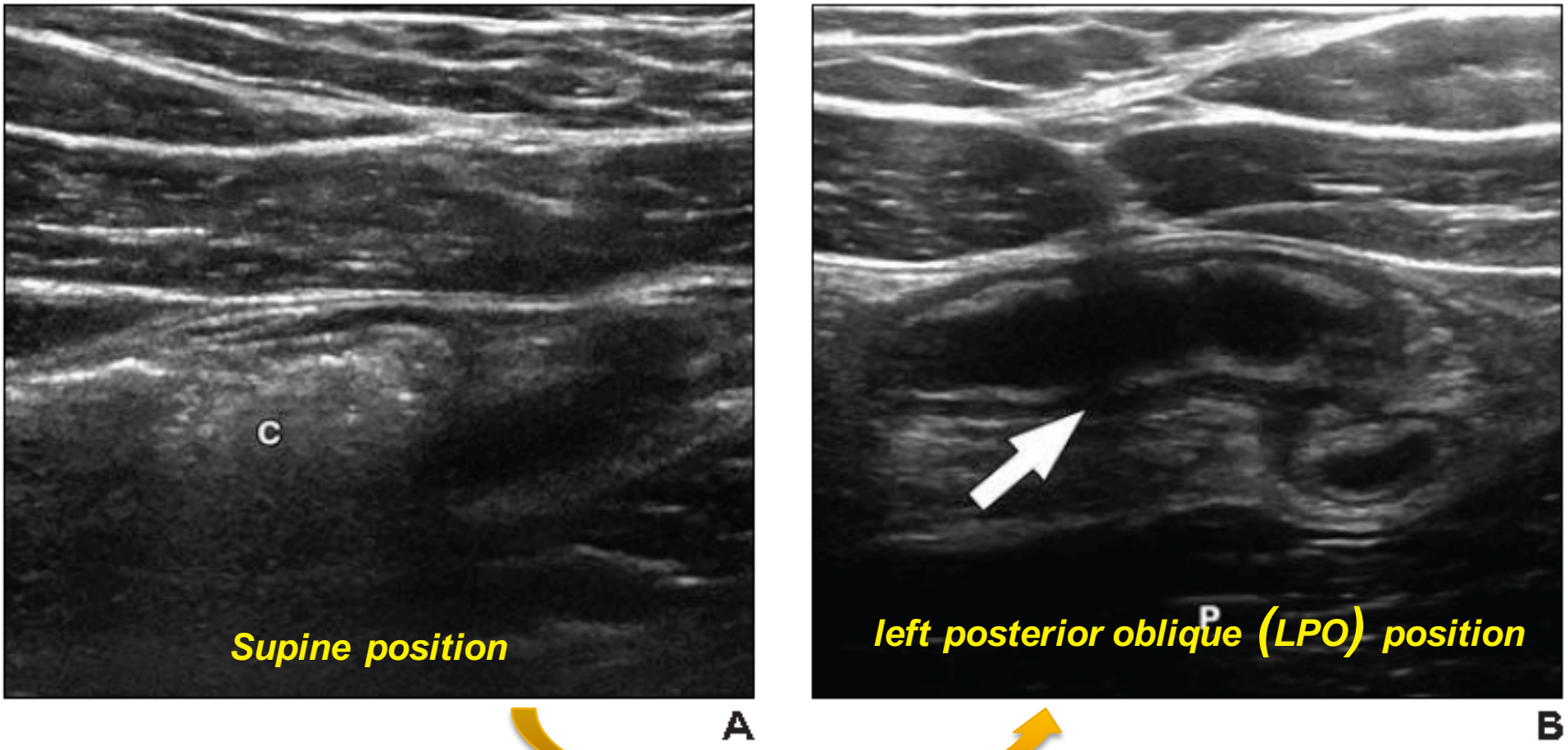
Supine position

left posterior oblique (LPO) position

"second-look" supine scan

Chang S. et al. AJR 2014; 203:1006–1012

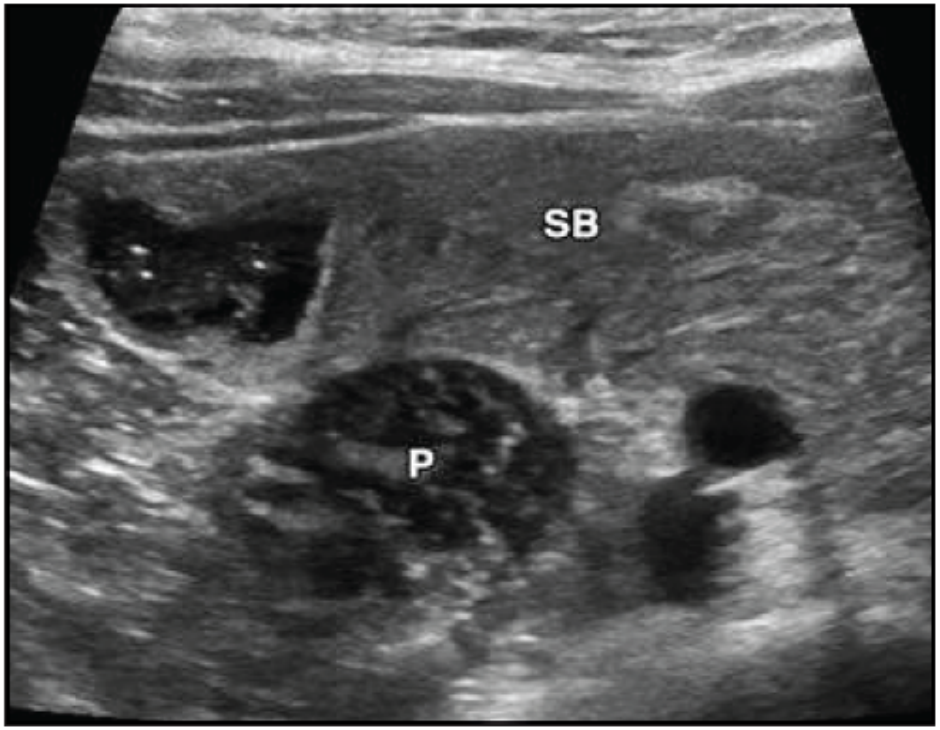
Three-Step Sequential Positioning Algorithm During Sonographic Evaluation for Appendicitis Increases Appendiceal Visualization Rate and Reduces CT Use



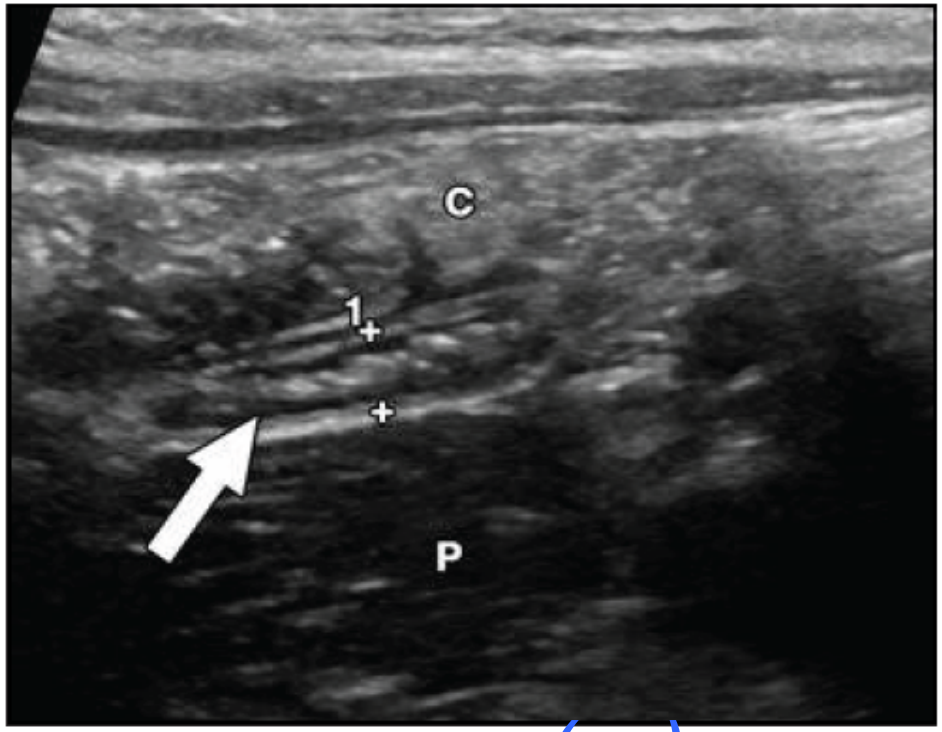
Acute Appendicitis

Chang S. et al. AJR 2014; 203:1006–1012

Three-Step Sequential Positioning Algorithm During Sonographic Evaluation for Appendicitis Increases Appendiceal Visualization Rate and Reduces CT Use



Supine position A



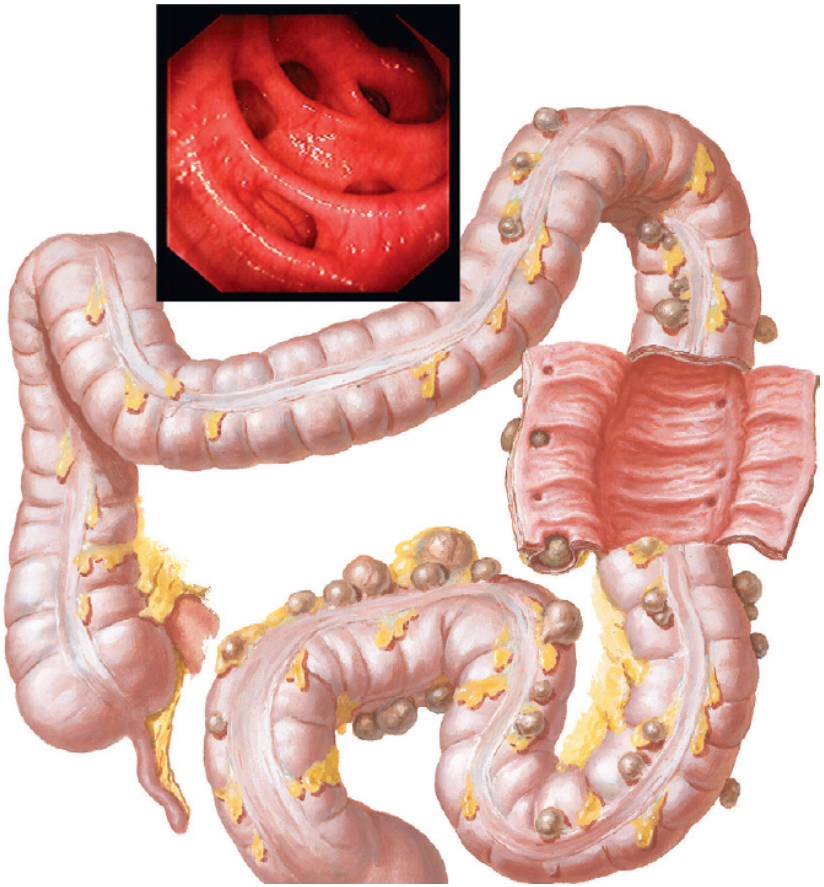
left posterior oblique (LPO) position B

Normal Appendix

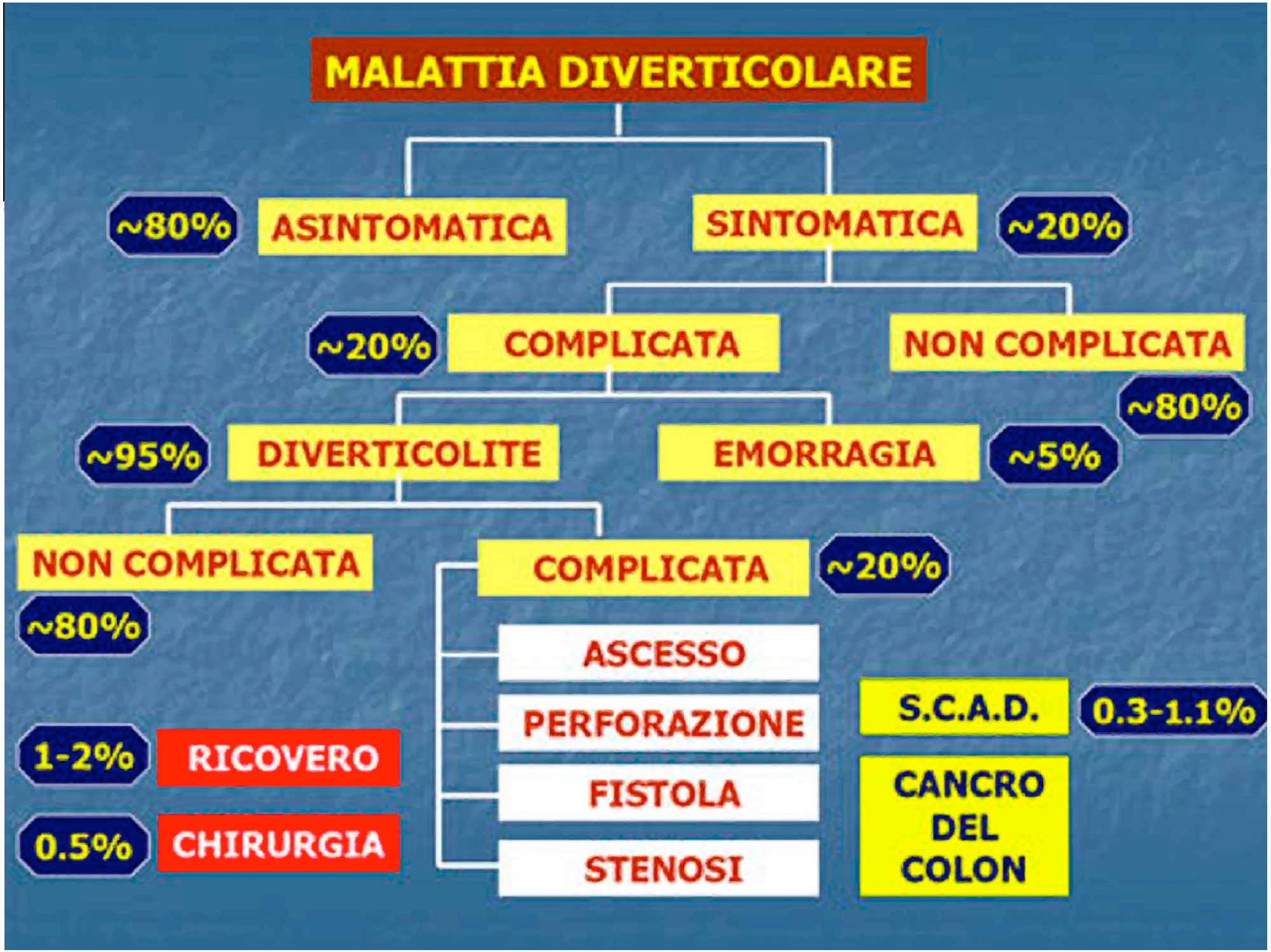
Chang S. et al. AJR 2014; 203:1006–1012

DIVERTICOLOSI E MALATTIA DIVERTICOLARE

- **D**iverticulosis of the colon is an acquired condition that results from herniation of the mucosa through defects in the muscle coats. Defects are usually located where the blood vessels pierce the muscular wall to gain access to the submucosal plane



Floch M. Diverticulosis: Diverticular Disease of the Colon from Diverticulosis: Diverticular Disease of the Colon. Netter's Gastroenterology Book, 2010


MALATTIA DIVERTICOLARE
~80%
ASINTOMATICA
SINTOMATICA
~20%
~20%
COMPLICATA
NON COMPLICATA
~80%
~95%
DIVERTICOLITE
EMORRAGIA
~5%
NON COMPLICATA
~80%
COMPLICATA
~20%
ASCESSO
PERFORAZIONE
FISTOLA
STENOSI
S.C.A.D.
0.3-1.1%
CANCRO DEL COLON
1-2%
RICOVERO
0.5%
CHIRURGIA

DIVERTICOLITE ACUTA

aspetti ecografici

Visualizzazione del diverticolo

Focus iperecogeno ovoidale/rotondo vicino/nello spessore della parete intestinale spesso con ombra acustica

Ispessim. parete intestinale

Flogosi del grasso pericolico

Aree iperecogene mal-definite attorno all'ansa ispessita

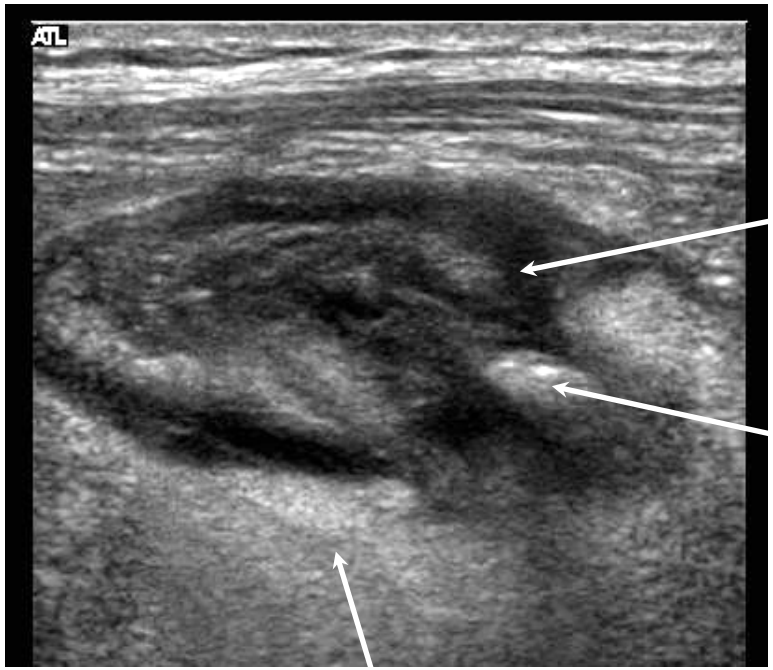
Aree ipoecogene vicine ansa ispessita

Ascessi intramurali o pericolici

Dolore alla pressione con la sonda

DIVERTICOLITE ACUTA

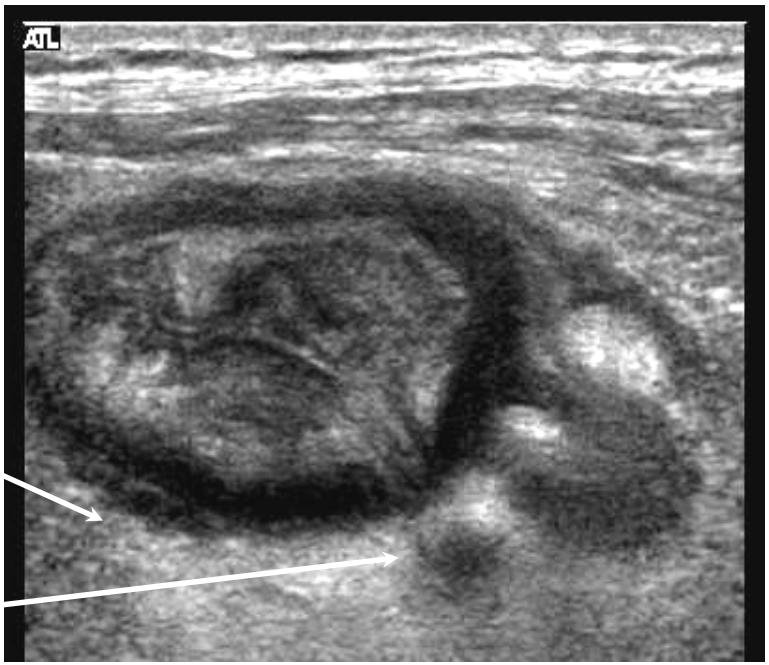
aspetti ecografici



Ispessimento parete intestinale

Visualizzazione del diverticolo

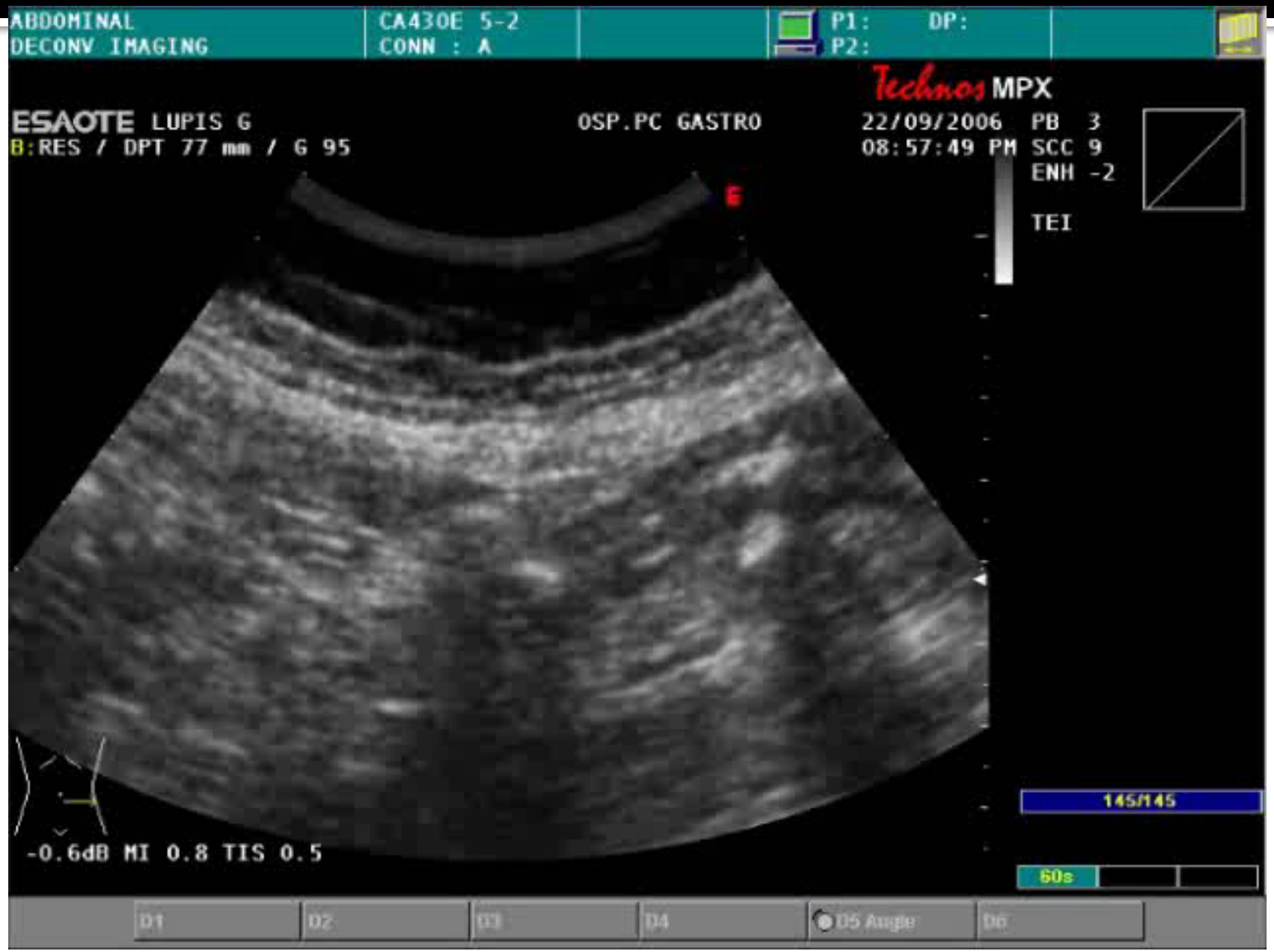
Flogosi del grasso pericolico



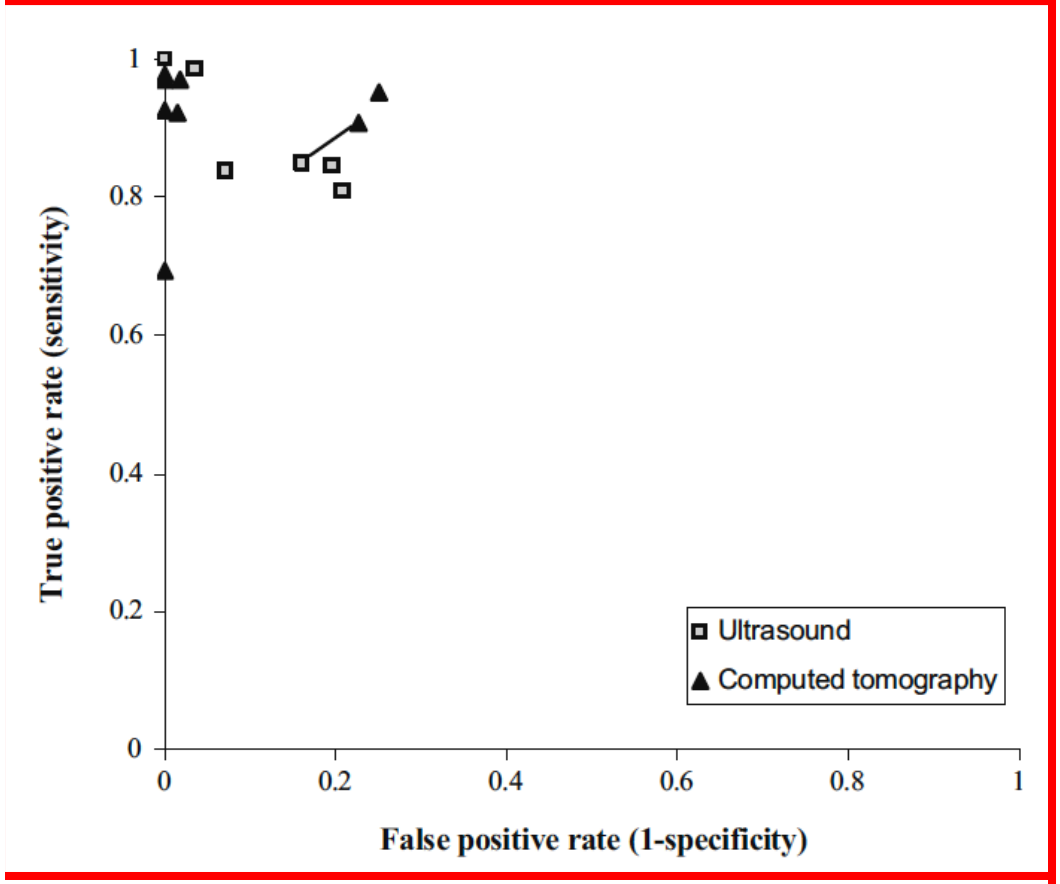
Ascessi intramurali o pericolici

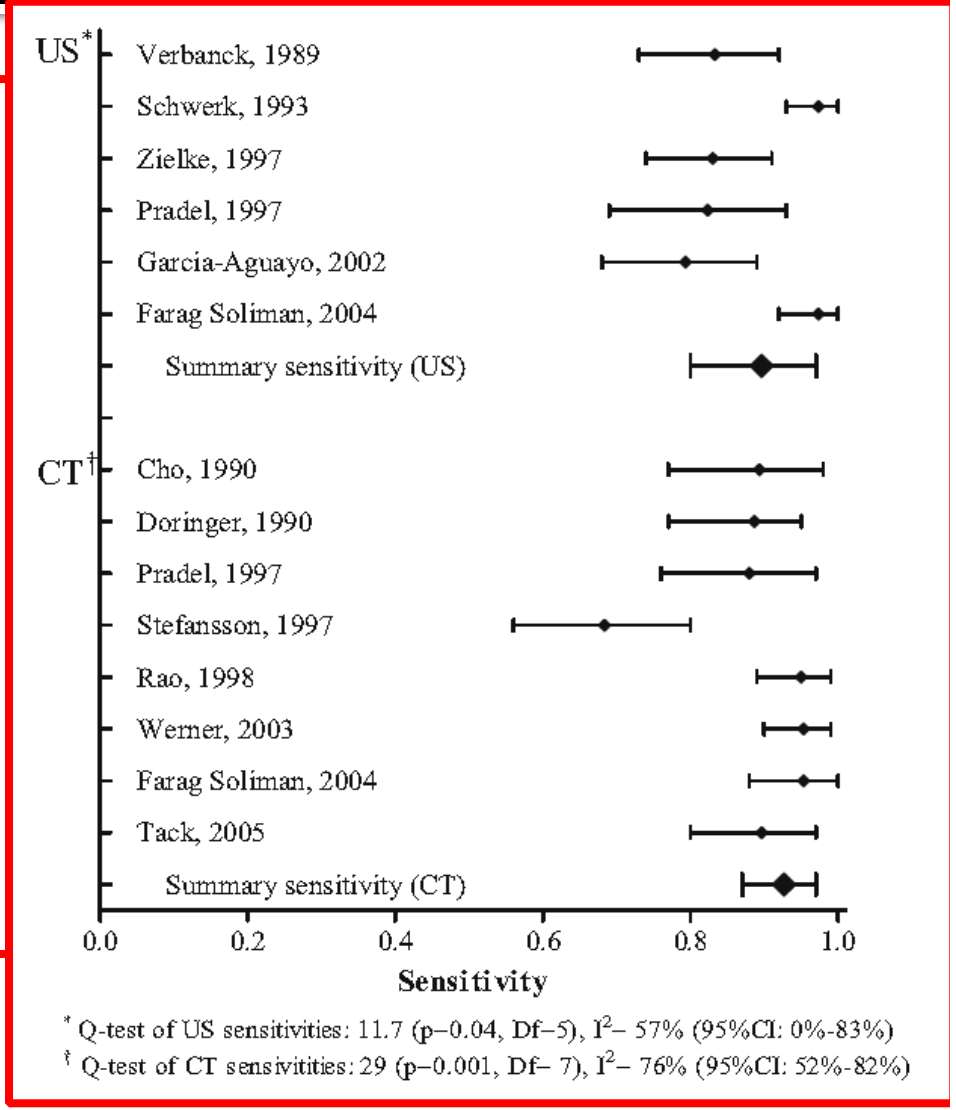
DIVERTICOLITE ACUTA

aspetti ecografici



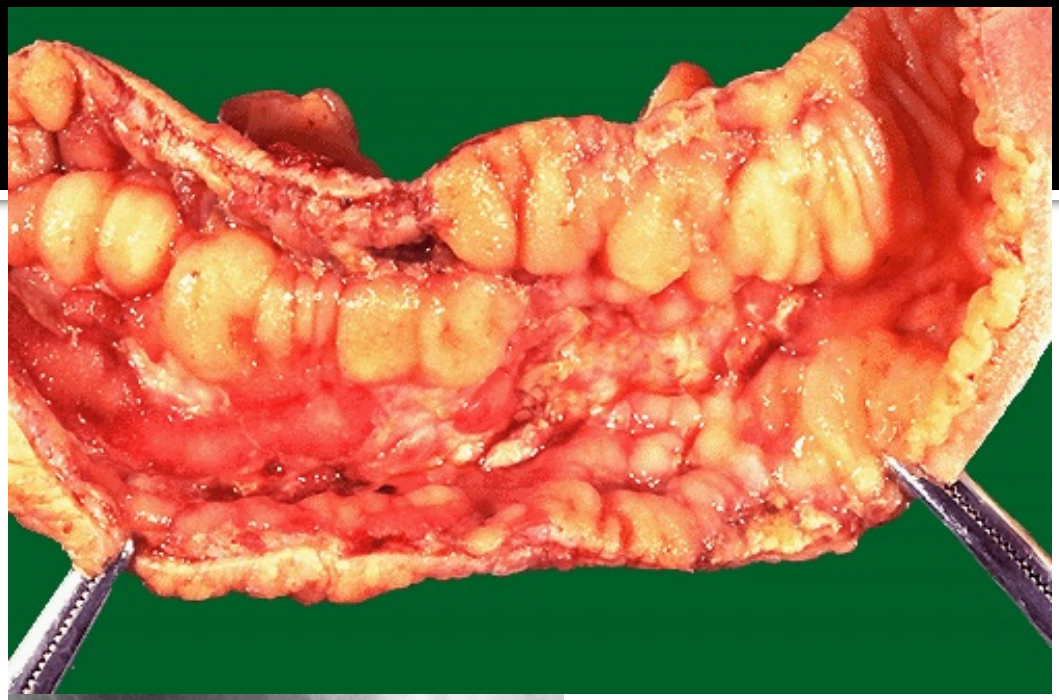
Graded compression ultrasonography and computed tomography in acute colonic diverticulitis: meta-analysis of test accuracy

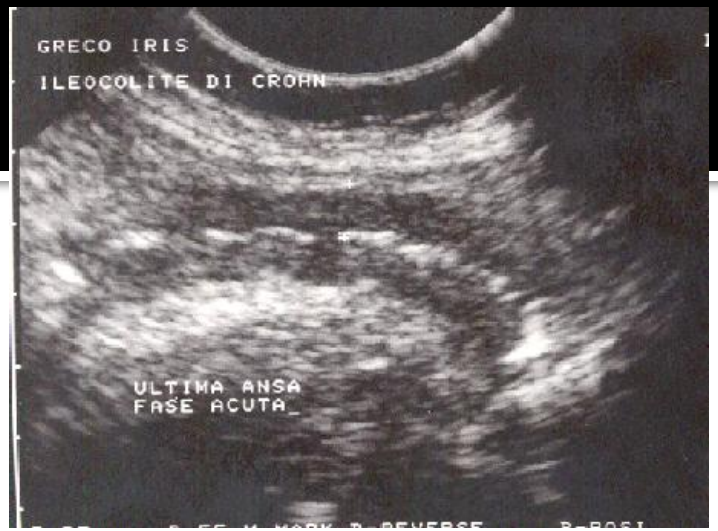


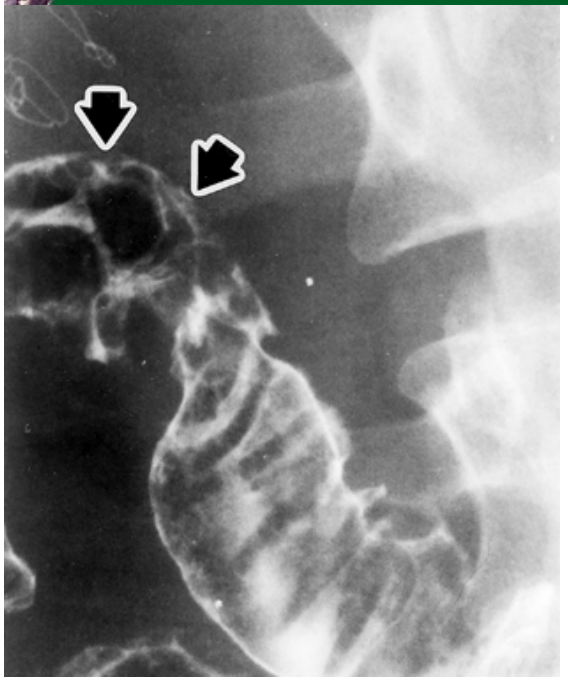


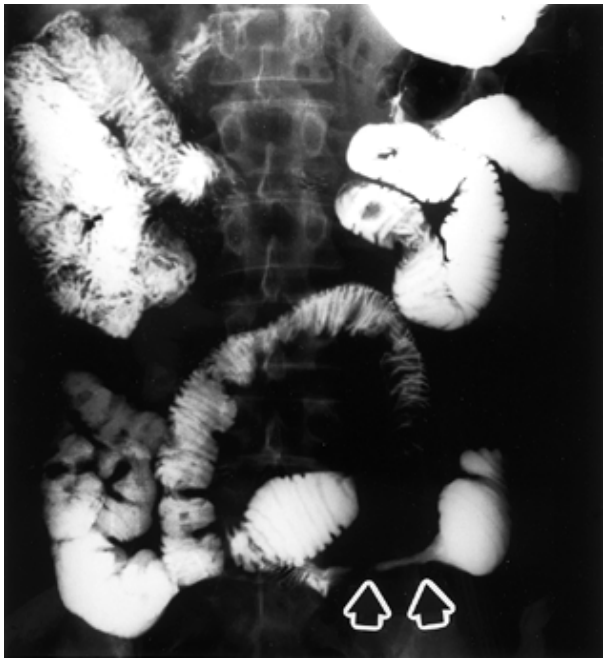
Lameris W, et al., Eur Radiol 2008;18:2498–511

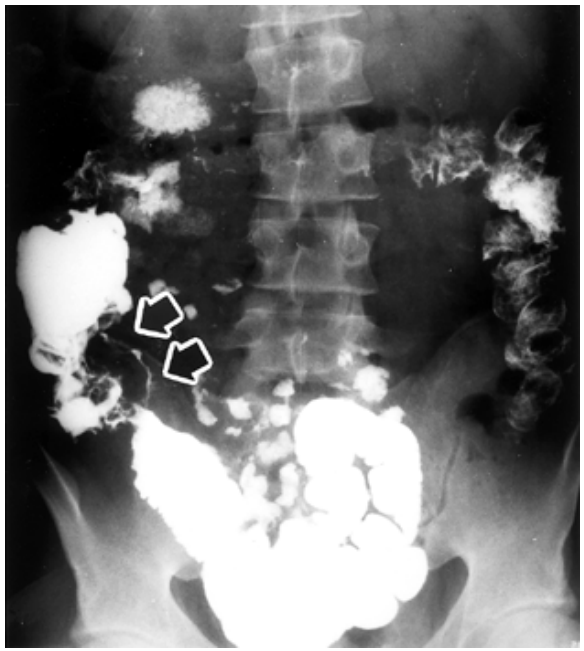
IBD



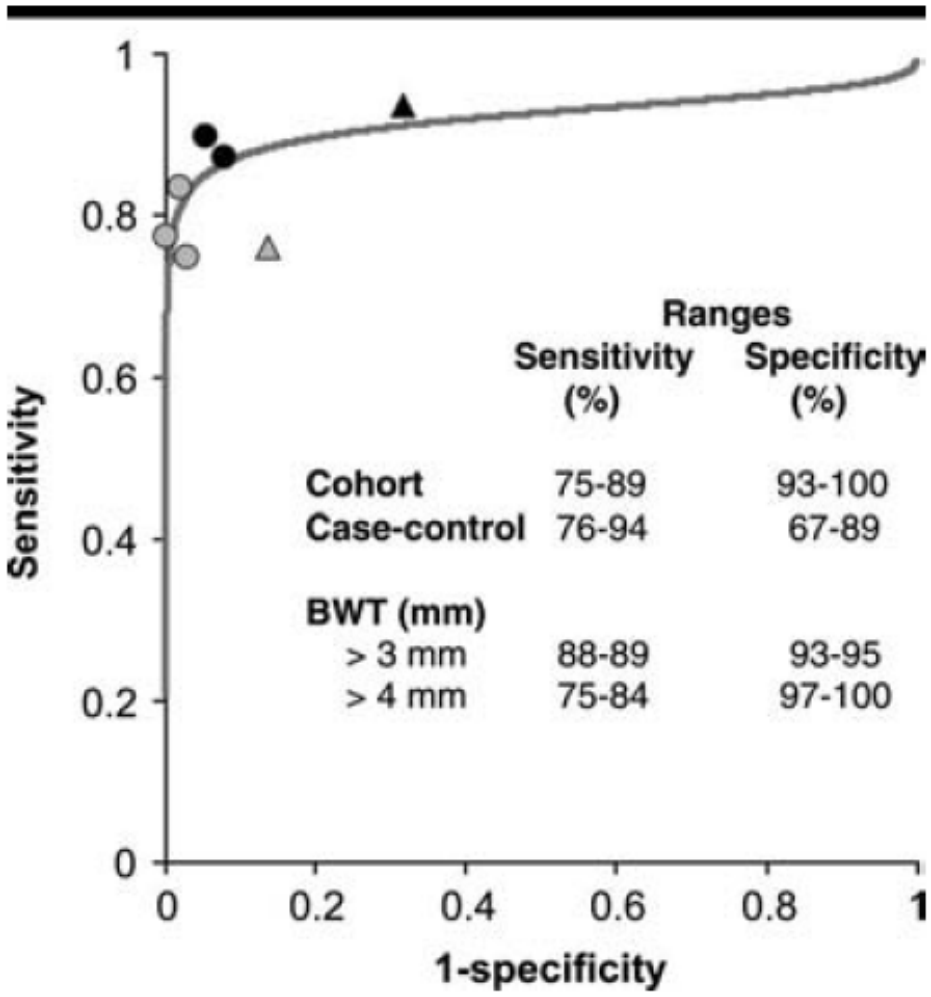








Role of US in Detection of Crohn Disease: Meta-Analysis



Fraquelli M. Et al.,Radiology 2005; 236:95–101

Capabilities of intestinal ultrasound in patients with inflammatory bowel disease

A. K. Asthana et al. Journal of Gastroenterology and Hepatology 30 (2015) 446–452

✓ Assessment of disease activity	• Good level evidence for assessment for all degrees of inflammation in small bowel and colon in Crohn's disease • Increasing evidence base for assessment of colonic disease in ulcerat. colitis
✓ Assessment of complications	• Abscesses and differentiation from an inflammatory phlegmon (CEUS) • Strictures with proximal bowel dilatation • Enteric and perineal fistulae • Perianal abscesses and inflammatory phlegmon
✓ Unique information	• Toxic megacolon • Real-time data, such as motility • Wall layer stratification • Mesenteric hyperechogenicity • Reactive lymphadenopathy • Hyperemia on color Doppler • Differentiation between abscesses and inflammatory phlegmon • Inflammatory component of fistulae and strictures on color Doppler • Fibrosis element of intestinal wall
✓ Advantages over other imaging modalities	• Cheap • No radiation • Completely risk-free • No need for fasting or bowel preparation for most scans
✓ Disadvantages over other imaging modal.	• Operator dependent

Detection e diagnosi

- Addome acuto
- Sintomatologia cronica

Caratteristiche ecografiche della malattia di Crohn

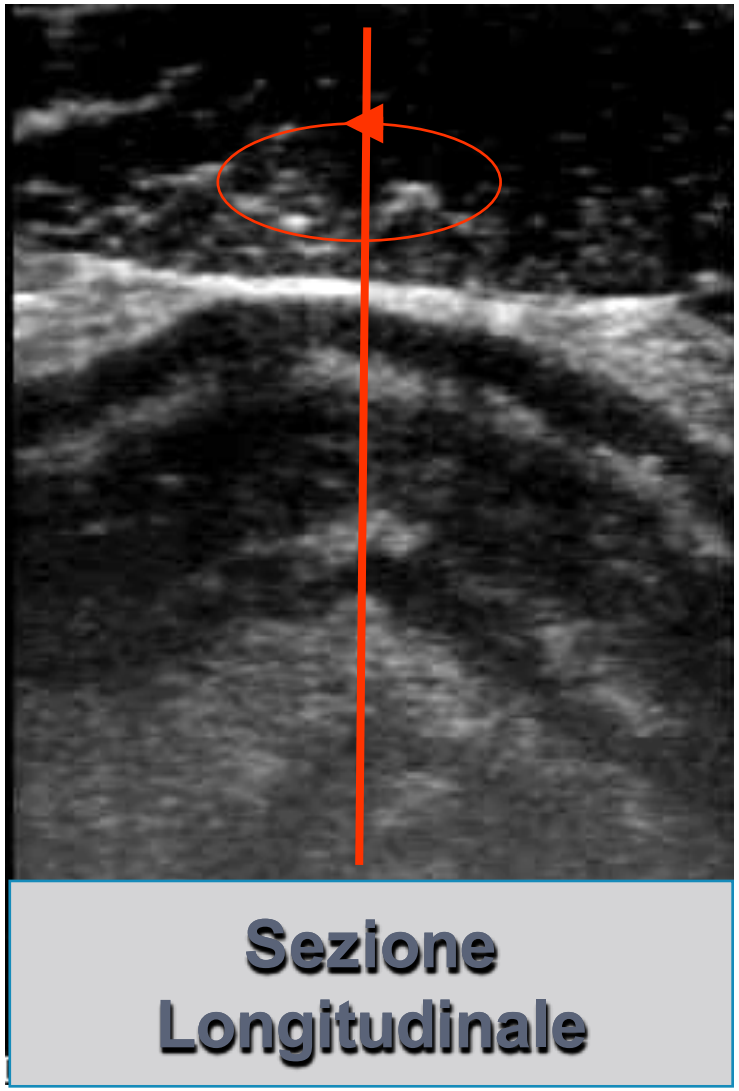
Alterazioni della parete intestinale

- Ispessimento parietale
- Alterazione dell'ecopattern
- Iperemia / ipevascolarizzazione parietale
- Perdita di elasticità e peristalsi

Segni intraddominali e complicanze

- Ipertrofia del mesentere
- Linfonodi intramesenterici
- Stenosi e occlusione
- Fissurazioni e fistule
- Masse infiammatorie, flemmoni e ascessi

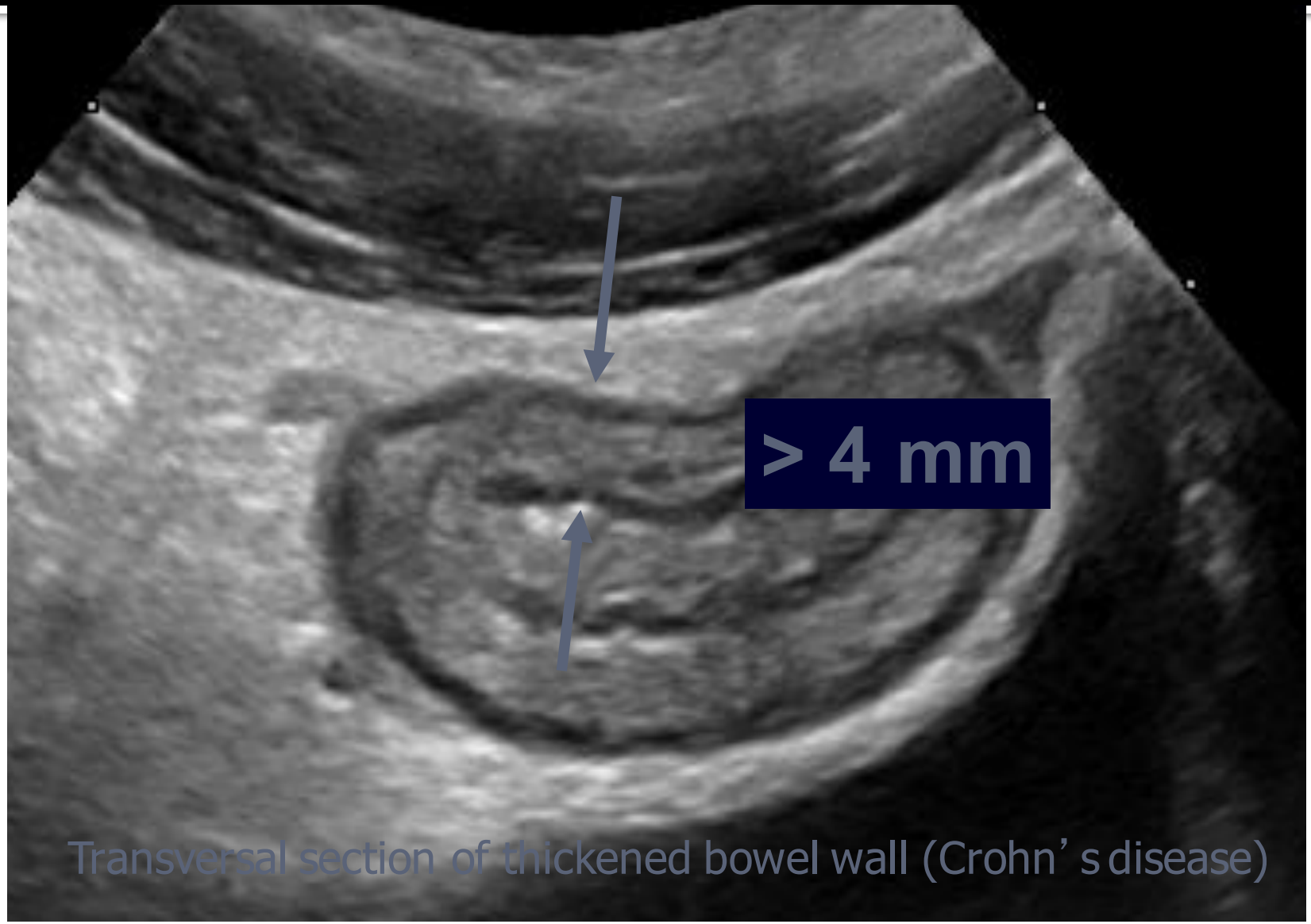
Caratteristiche ecografiche della malattia di Crohn



Sezione Longitudinale

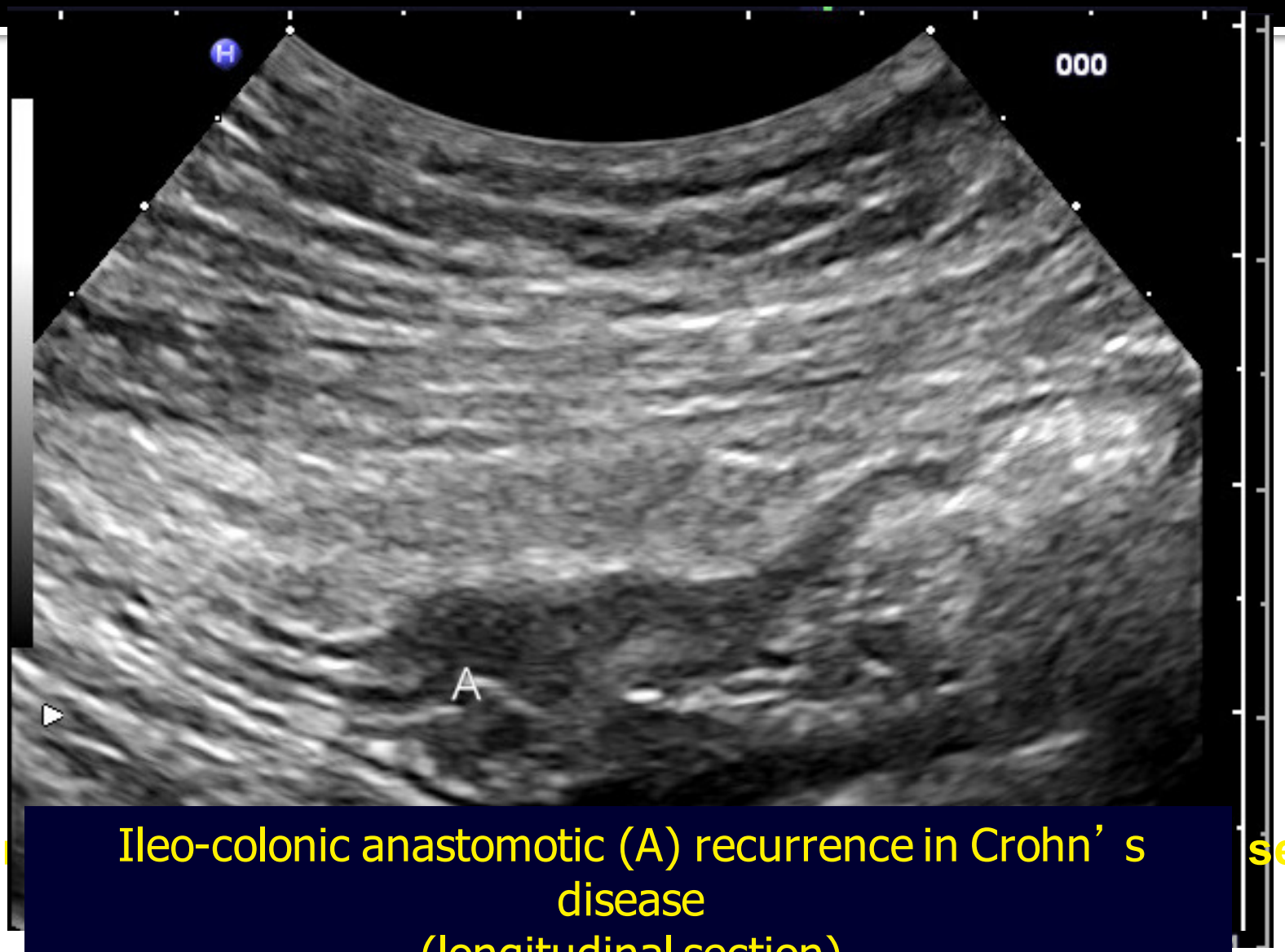
Sezione Transversale

Caratteristiche ecografiche della malattia di Crohn



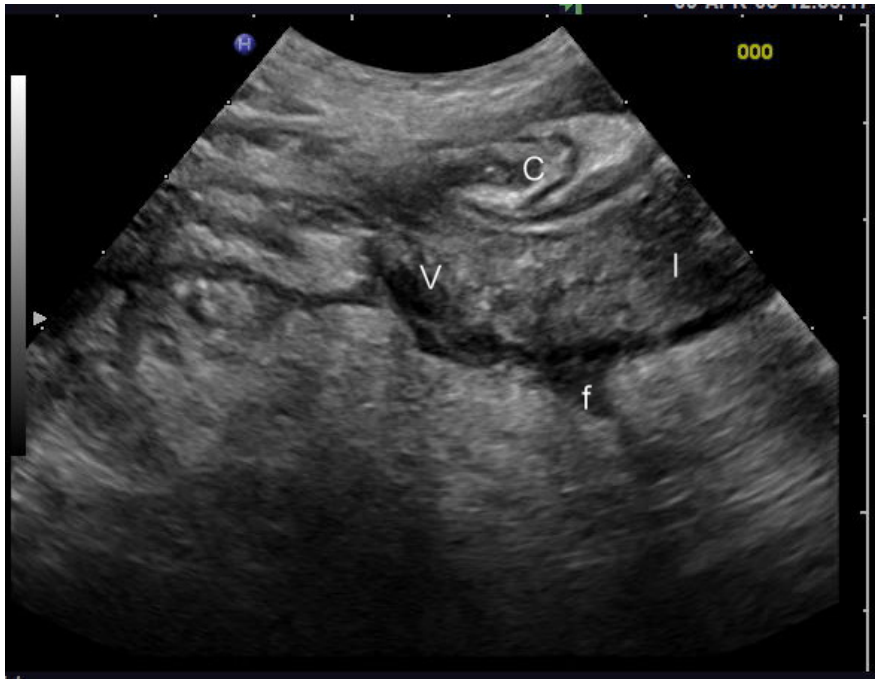
Transversal section of thickened bowel wall (Crohn's disease)

Caratteristiche ecografiche della malattia di Crohn



Ileo-colonic anastomotic (A) recurrence in Crohn's disease
(longitudinal section)

CARATTERISTICHE DELLA PARETE
TOPOGRAFIA



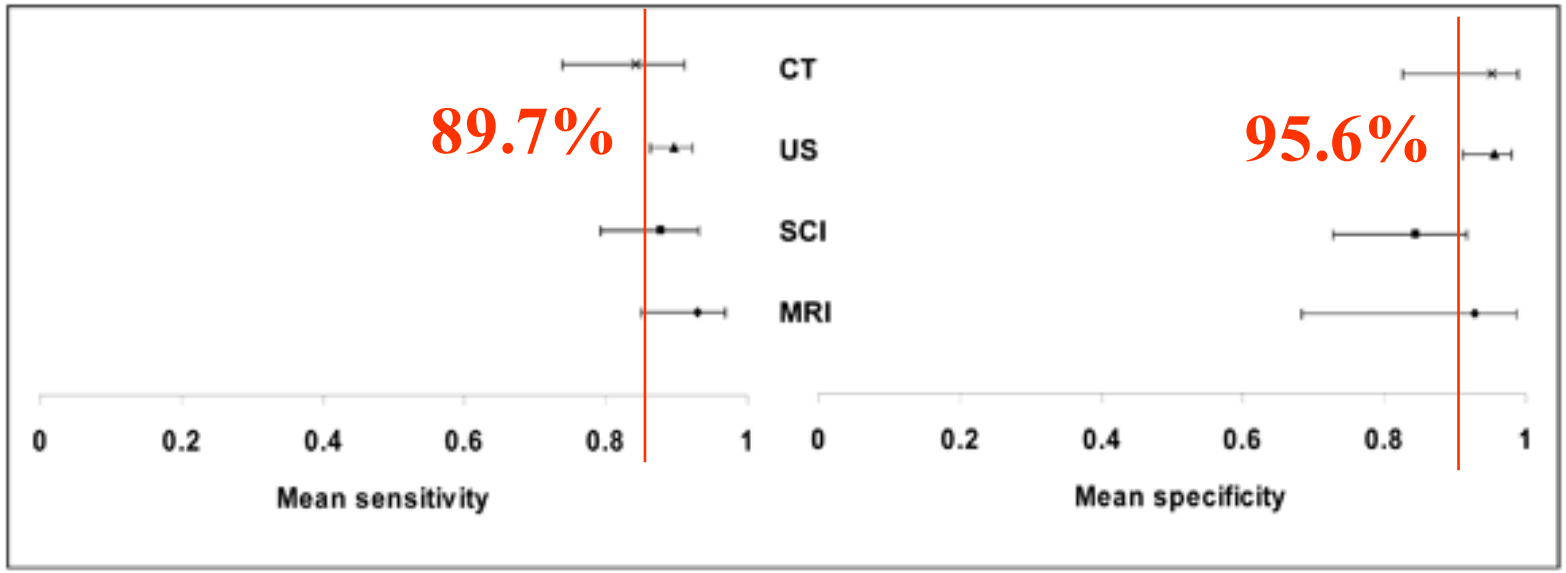
80 %

Caratteristiche ecografiche della malattia di Crohn

DETECTION / DIAGNOSI di IBD

CT – US - Scintigraphy - MRI

Meta-analysis of Prospective Studies



SCI= scintigraphy

Accuracy estimates (with confidence intervals) for diagnosis of **IBD** on a per-patient basis.

Horsthuis K et al Radiology 2008

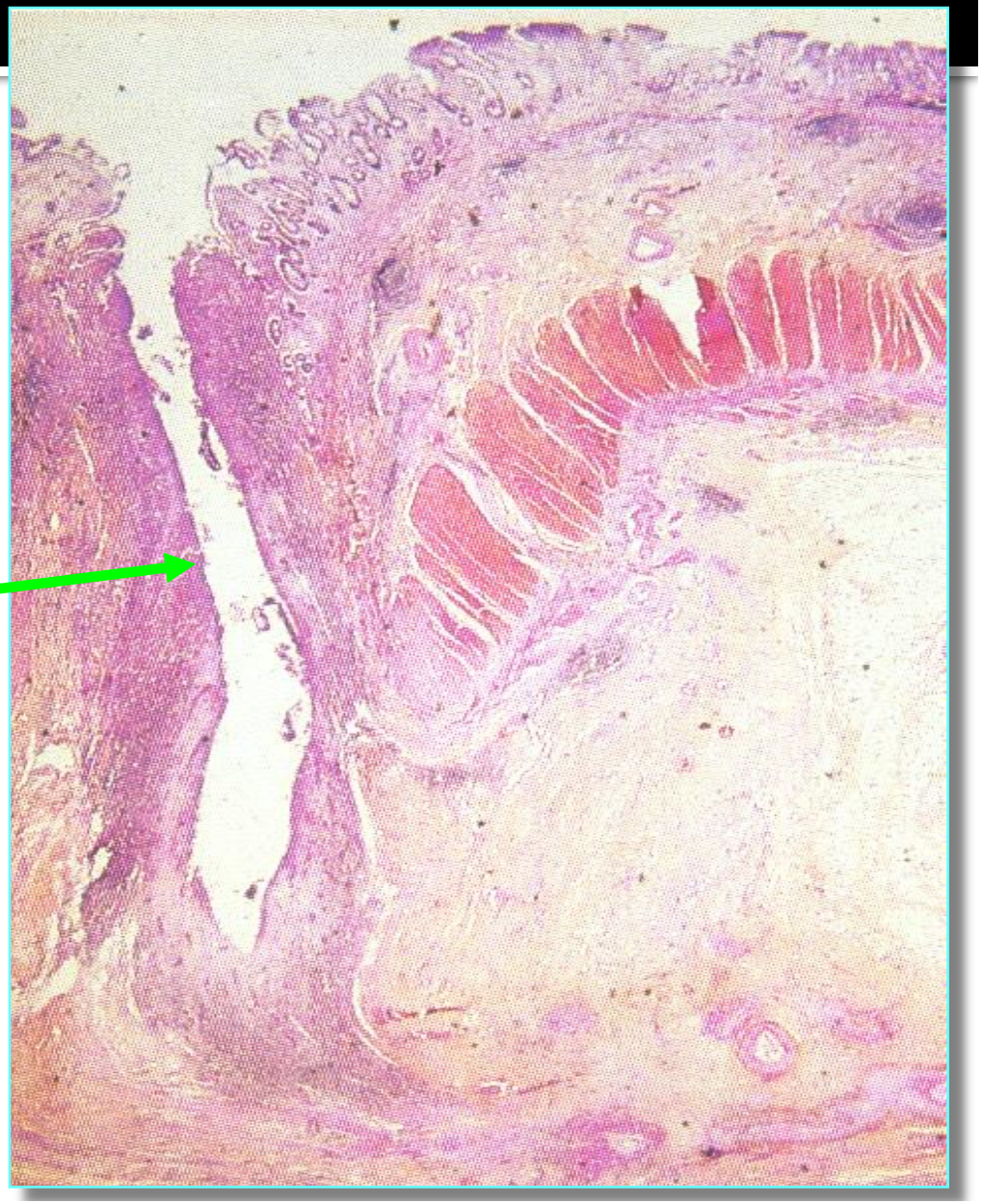
US AND CD

In ileal CD, US may:

- identify the affected bowel loop
- evaluate the length of involvement, tissue thickness, and the partial or total loss of the multilayer pattern.
- The degree of bowel wall thickening and extent of the thickened intestinal wall on US have been used as an index of disease activity in CD

Malattie Infiammatorie Croniche Intestinali

Fistola in M. di Crohn



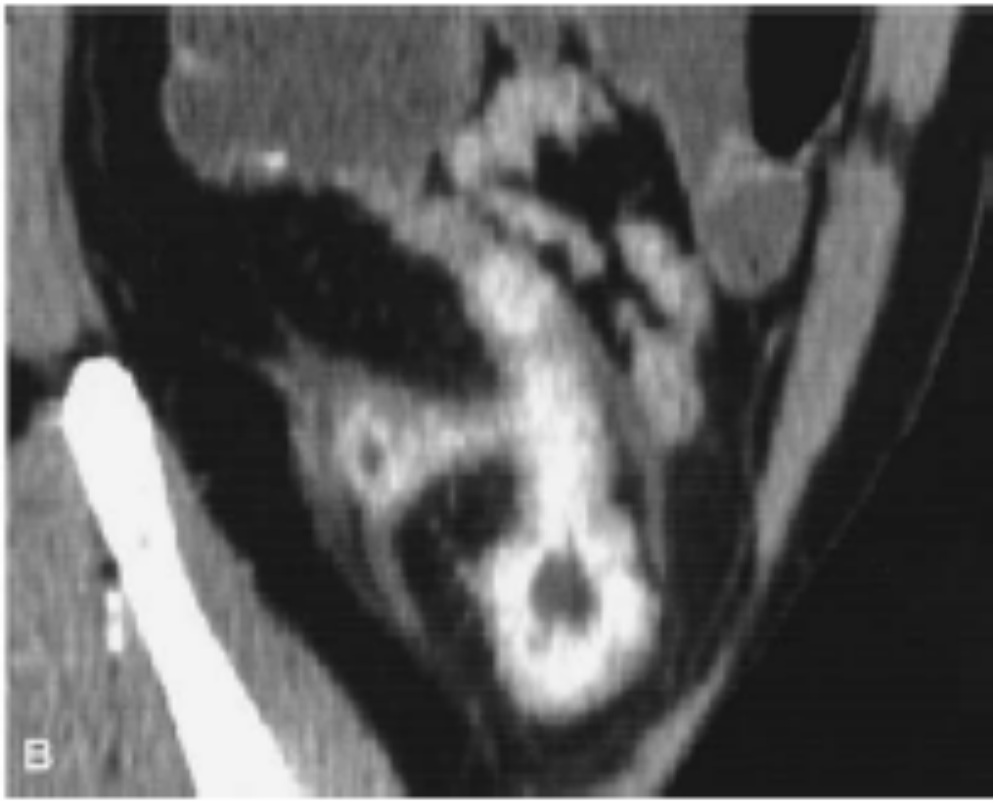
Fistole entero-enteriche

Fistola entero-cutanea

ASTOLA

FISTOLA ENTERO-ENTERICA

ASCESSO

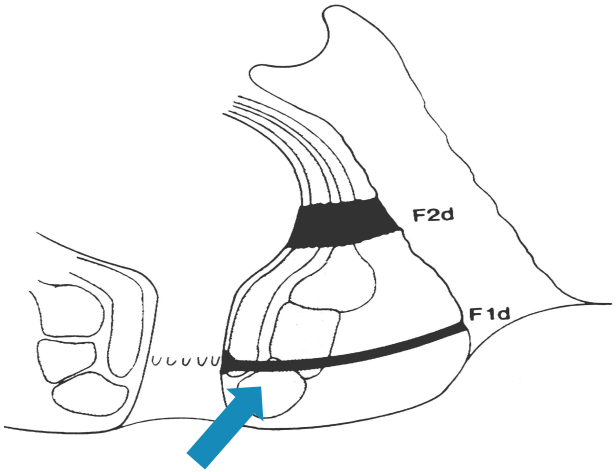


Transperineal US in the detection of fistulae in CD

- Classificazione corretta con TPUS in 45/52 fistole perianali e rettovaginali (PPV 86,5% nel confronto con EUS)
- Sensibilità rispetto a EUS del 84,9%
- Sensibilità e specificità sovrapponibile a EUS per la diagnosi di ascessi perianali
- TPSU rappresenta un'alternativa a EUS e RM per la diagnosi di fistole perianali oltre che una metodica di imaging aggiuntiva alla EUS come test diagnostico di screening

Maconi et al Am J Gastroent 2007

Transperineal US in the detection of fistulae in CD



Maconi et al Am J Gastroent 2007

TUMORI

Colonoscopy and CT colonography are the procedures of choice for the diagnosis of colorectal cancer,

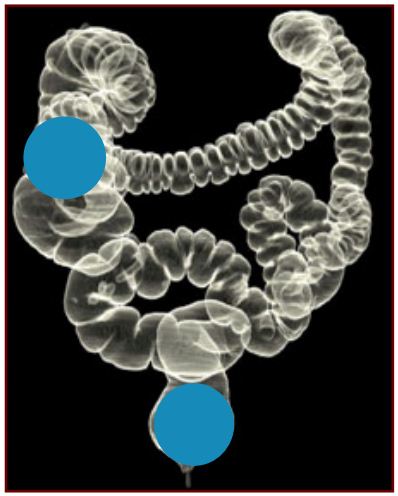
however…

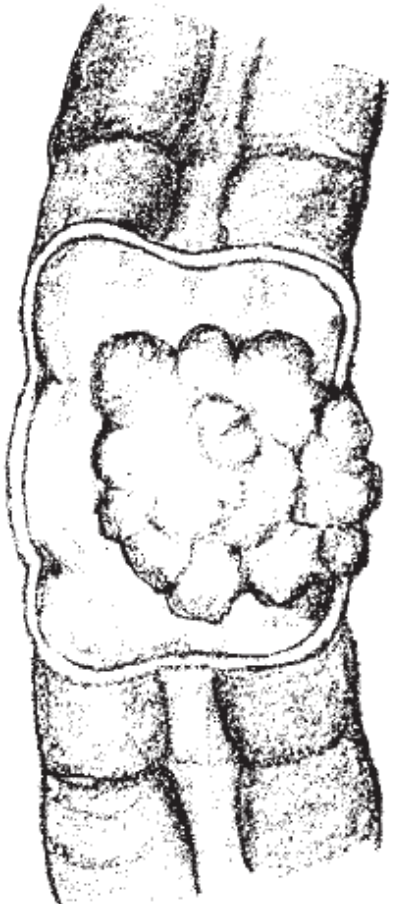
Abdominal US may be the first test that patients with colon cancer undergo because they may present with nonspecific gastrointestinal symptoms and signs.

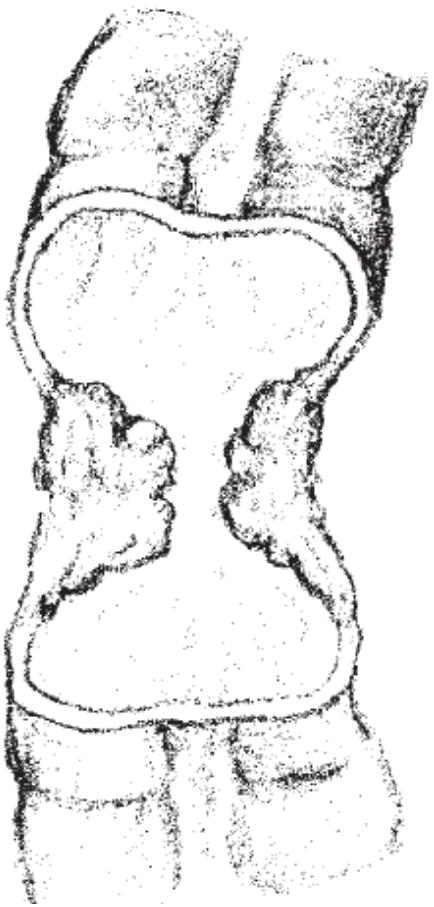
Careful US examination of the colon and rectum may disclose:

a focal mass or mural thickening

this may lead a physician to investigate for the diagnosis of colorectal cancer

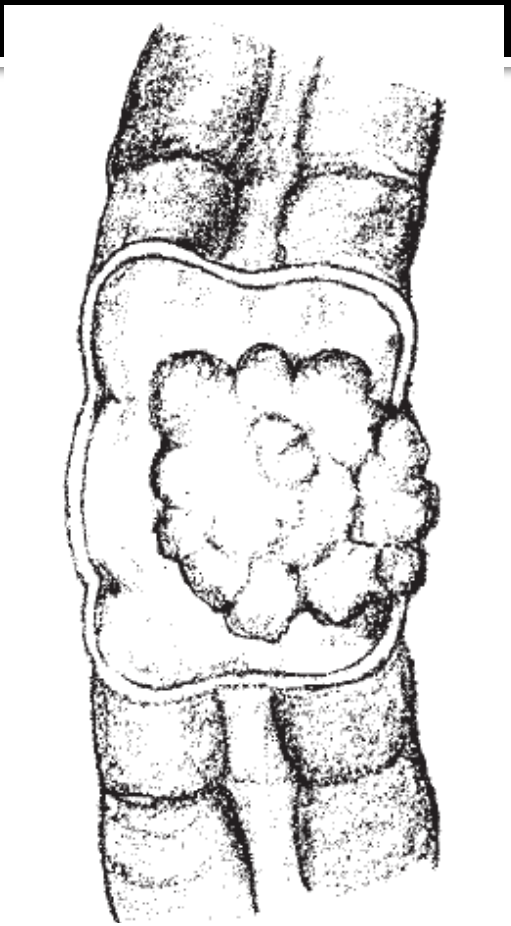




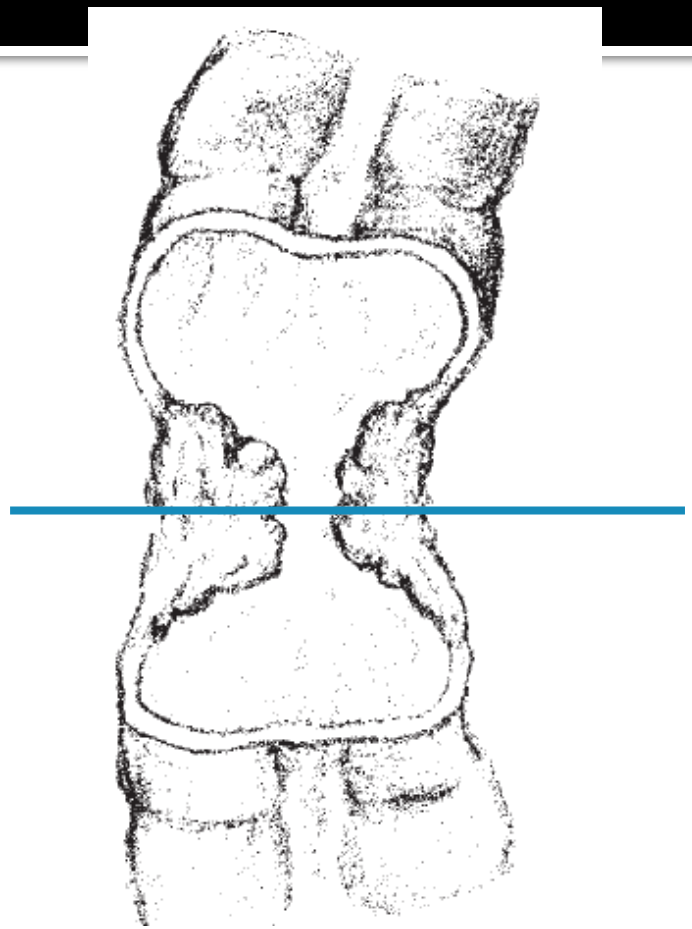


Mass forming colorectal cancer

Short segmental wall thickening



Mass forming colorectal cancer



Short segmental wall thickening

TUMORI


esaote MyLab
GASTROENTEROLOGIA - PIACENZA
23 GIU 2010 17:16
B RIS-A G ---
TEI P 78mm XV C1
PRC 11/1/1 PRS 4
PST 0 C 2
1 8
FEGATO
CA431
49Hz

Accuracy of ultrasound

Helena M. Dekker[1]
Eric J. van der Jagt[1]
Jan T. M. van Leeuwen[2]
Ger T. van der Werf[3]
M. G. Myriam Hunink[4,5]

Role of Abdominal Sonography in Excluding Abdominal Malignancy in the Initial Workup of Patients with Abdominal Complaints

CONCLUSION. Our results suggest that sonography may be useful in excluding an abdominal malignancy when used in a primary care setting in patients with abdominal complaints who are at low risk for a malignancy.

Accuracy of ultrasound

INTERNAL MEDICINE

□ ORIGINAL ARTICLE □

Is the Routine Abdominal Ultrasound a Sufficiently Sensitive Method for the Detection of Colonic Malignancy?

Zoran Gluvic[1], Miodrag Slovic[1], Predrag Dugalic[1], Ratko Tomasevic[1], Aleksandar Pavlovic[1], Dunja Jaksic[1], Esma R. Isenovic[2], Zorica Rasic-Milutinovic[1] and Dusan Milicevic[1]

Conclusions The routine abdominal ultrasonography can be used for the screening of colonic malignancy owing to its high sensitivity, particularly in advanced disease, but solely in conjunction with other methods. Finally, abdominal ultrasonography cannot be a definitive diagnostic tool for colonic carcinoma.

Intern Med 2008

Grazie per l’attenzione!

f.giangregorio@alice.it