Pictorial essay

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Contrast Ultrasonography - A necessary procedure for a better characterization of digestive tract pathology

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Abstract

The pathology of the digestive tract, extremely popular, with equal sex distribution, can have a clinical history of chronic illness or emergency. Diagnosis is based on endoscopy (identifies the lesion, permits histological sample under visual control, and minimally invasive treatment for polypoid benign tumors). Ultrasonography, being non-invasive and very accessible, is often used as the initial imaging procedure to detect or exclude digestive pathology with similar symptoms. Understanding digestive ultrasound is conditioned by the image quality which can be achieved by removing air and food debris. Even so, the characteristics of the inflammatory diseases and the detection of tumors, particularly those with endoluminal development, can be difficult. In recent years transabdominal ultrasound examination of the digestive tract was supplemented with more precise methods of investigation of the lumen and circulation of the intestinal wall. These methods are represented by the administration of oral or ano-rectal homogenous substances (hydrosonography) and the by intravenous administration of agents containing stabilized microbubbles (CEUS). With these methods useful information are being obtained, high in sensitivity and specificity of lesions characterization. Judicious selection of the cases and of the examination technique remains the key to a successful diagnosis in all situations.

Keywords: digestive tract, endoluminal contrast, intravenous contrast, transabdominal ultrasound, contrast agents, microbubbles

Rezumat

Patologia tubului digestiv, extrem de răspândită, cu distribuţie egală la femei şi bărbaţi, poate îmbrăca un caracter clinic de urgenţă sau de afecţiune cronică. Diagnosticul patologiei digestive se bazează pe endoscopie care permite identificarea leziunii, recoltarea de probe histologice sub control vizual în vederea efectuării examenului anatomo patologic, şi tratamentul minim invaziv în cazul tumorilor polipoide benigne. Ultrasonografia, fiind neinvazivă şi foarte accesibilă, este utilizată adesea ca procedură imagistică iniţială obiectivul fiind detectarea unor suferinţe digestive sau excluderea unor boli cu acuze similare. Înţelegerea ecografiei digestive este condiţionată de o imagine de calitate care se poate obţine prin îndepărtarea aerului şi a resturilor alimentare. Chiar şi aşa, caracterizarea bolilor inflamatorii precum şi detectarea tumorilor, îndeosebi a celor cu dezvoltare endoluminală, poate fi dificilă. In ultimii ani explorarea ecografică transabdominală a tubului digestiv a fost completată cu modalităţi de investigare mai precise ale lumenului şi circulaţiei din peretele intestinal. Aceste modalităţi sunt reprezentate de administrarea de soluţii omogene pe care orală sau anorectală (hidrosonografie) precum şi de administrarea de substabţe conţinând microbule stabilizate pe cale intravenoasă (CEUS). In toate situaţiile se obţin informaţii utile care conduc la creşterea reală a performanţelor metodei, în principal a sensibilităţii pentru detectarea suferinţelor şi a specificităţii pentru caracterizarea acestora. Selecţia judicioasă a cazurilor precum şi tehnica de examinare rămân cheia succesului în toate situaţiile.

Cuvinte cheie: tub digestiv, contrast endoluminal, contrast intravenos, ultrasonografie transabdominală, agenţi de contrast, microbule

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Ultrasound examination allows the view of the entire abdomen and was dedicated primarily to solid organs such as liver, spleen, kidney, pancreas or tubulo-cavity organs (gallbladder and billiary pathways, bladder, retroperitoneal vessels). In all cases morphological (shape, size, parenchymal texture, content appearance) and hemodynamic information, (based on the Doppler princi-

ple) are obtained. Digestive tract remains a „challenge" for the examiner because of the abundance of food and gaseous content (ex. stomach fundus, colon) and of deep location (so called „hidden") of limited segments (ex. colon left flexure, placed near the spleen hilum or rectum located deep behind the bladder) [1,2,3]. There are now available protocols and recommendations for examination that allow obtaining added information (such as the use of the transducer for examination of the soft parts for appendix, terminal ileum or sigmoid colon) [4]. Generally, the examination of the digestive tract is done using a transabdominal convex transducer, with 3.5-5 MHz frequency, optimized with harmonic [5]. A good visualization of the digestive tract requires sufficient time for the investigation, multi-directional approach of the lesion, change in patient position and lumen distension after the administration of the contrast agent through natural pathways [6,7]. In all the cases the following aspects must be seen: the degree of lumen distensibility after contrast administration, the appearance of the lumen (normal, stenosed, dilated), parietal contractility, internal relief with the preservation/disappearance of the characteristic features (circular folds, haustra), intramural vessels (present, absent or exacerbated, distribution in the mucosa and muscular level), parietal stratification. Digestive wall stratification is emphasized because of the contrast between histological components at this level. It is long known the fact that with a 7 MHz frequency transducer the mucosa, submucosa, muscularis and serosa are easily identified and this allows a highly accurate staging of digestive tumors [8,9] (fig 1, fig 2).

Any deviation of the above changes aspect is suggestive for a pathological process. But the ultrasound findings must have a clinical correspondent, and this must be confirmed by endoscopy. Thus, lower esophageal lumen dilatation accompanied by narrowing „in axis" on a short segment may suggest achalasia (fig 3). Food contrast may be a helping element for the good separation of the stomach walls (fig 4).

The presence of food into the stomach is acceptable for maximum 3 hours after ingestion; exceeding this period is suggestive for pyloric stenosis. Examination with oral contrast agent allows the assessment of the stomach lumen in segments such as antro - pyloric pulse region (fig 5). If a tumor infiltrates the stomach wall, this will appears significantly thickened, the method being useful for assessing the process extension (fig 6). In case of a proliferating tumor, the contrast agent is required for an overall assessment of the tumor mass, which is under evaluated on conventional examination, without contrast (fig 7).

Small intestine can be examined with high precision after osmolar solutions administration, which induces a slightly faster transit and a pronounced lumen distention (fig 8) [10,11].

Dilatation above the stenosis is an additional element of diagnosis. During the peristaltic contractions the existence of liquid between the loops and the presence of reactive lymph nodes on the path of mesenteric vessels can be establish. Bowel loops may be adherent with each other and the surrounding peritoneal fat becomes hypertrophied and with echogenity [10].

Nonspecific inflammatory diseases such as radiation enteritis develop with an extended impaired of intestinal loops

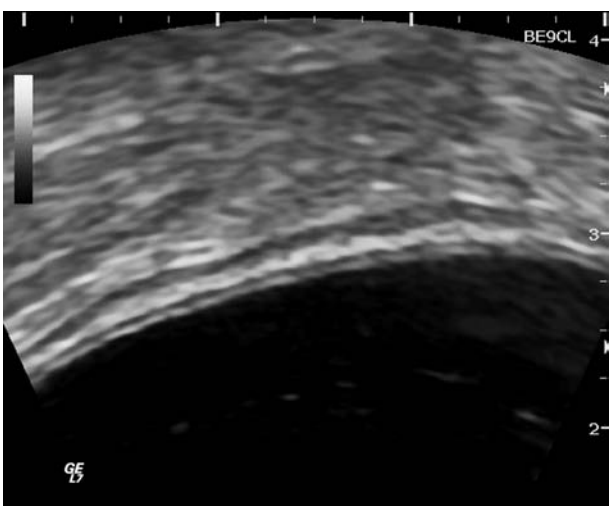


Fig 1. Parietal stratification at the rectum level- combination of endorectal ultrasound and hydrosonography. Five layers are observed, from inside to outside-interface between mucosa and contrast, mucosa, submucoasa, muscularis mucosa and mucosa serosa.

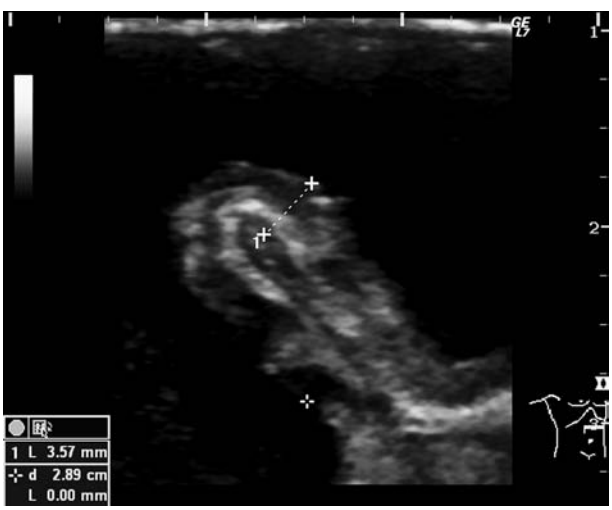


Fig 2. Parietal stratification of the bowel. The appearance is similar to that of the fig 1. The examination was performed after administration of an osmolar solution – Macrogol 4000 used to prepare the digestive tract for colonoscopy.

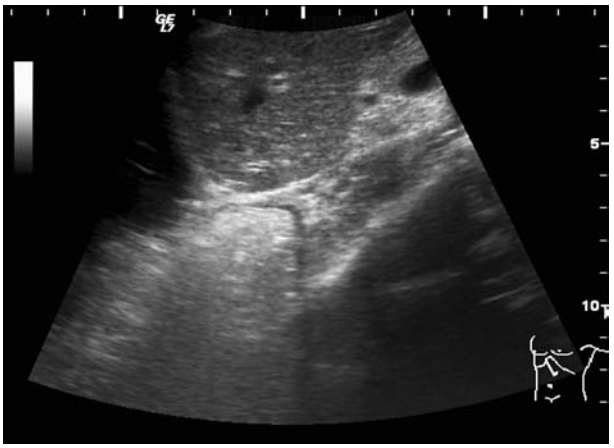


Fig 3. Achalasia. There is a narrowing in axis of the esophageal lumen and a lumen suprastenotic dilatation containing food debris and gas.



Fig 4. Stomach containing food. Homogeneity of composition can be a useful component for the wall demarcation and characterization of stratification.



Fig 5. Examination of the fluid transit (fluid environment optimized with SonoVue) in the antro - pyloric region. It can be observe the fluid „passage" from antrum until the first duodenal segment.



Fig 6. Infiltrative gastric neoplasm (scirrhous). Administration of contrast agent optimized with SonoVue reveals diffuse infiltration of the anterior wall (compared with the posterior wall with preserved stratification).

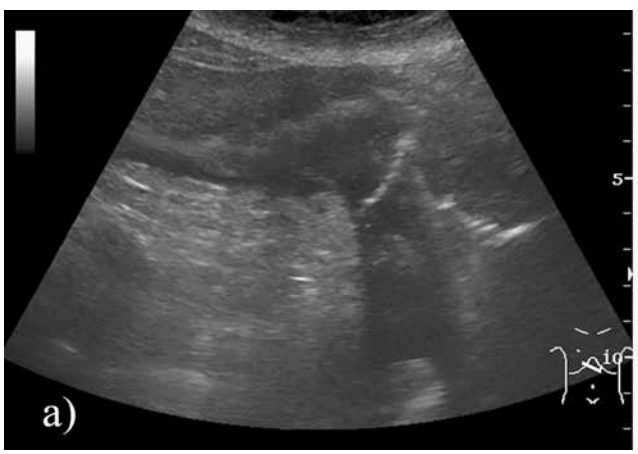


Fig 7. Proliferative gastric neoplasm. Examination optimized with contrast agent and SonoVue, conventional harmonic (a) and inversion pulse (b). In both cases there is a very eloquent, suggestive, image of the lumen stenosis presence induced by a voluminous antral tumor, with circumferential disposition.



Fig 8. Crohn's disease. Oral contrast administration (Macrogol 4000) evidences at approx. 30–45 minutes after ingestion, an increased distension of the intestinal loops which permit the study of the parietal morphology and peristaltic movements. Intestinal wall is echogenic even if stratification remains unmodified. Echogenity changes are transsmural, suggesting a specific ileitis, Crohn's disease more likely.

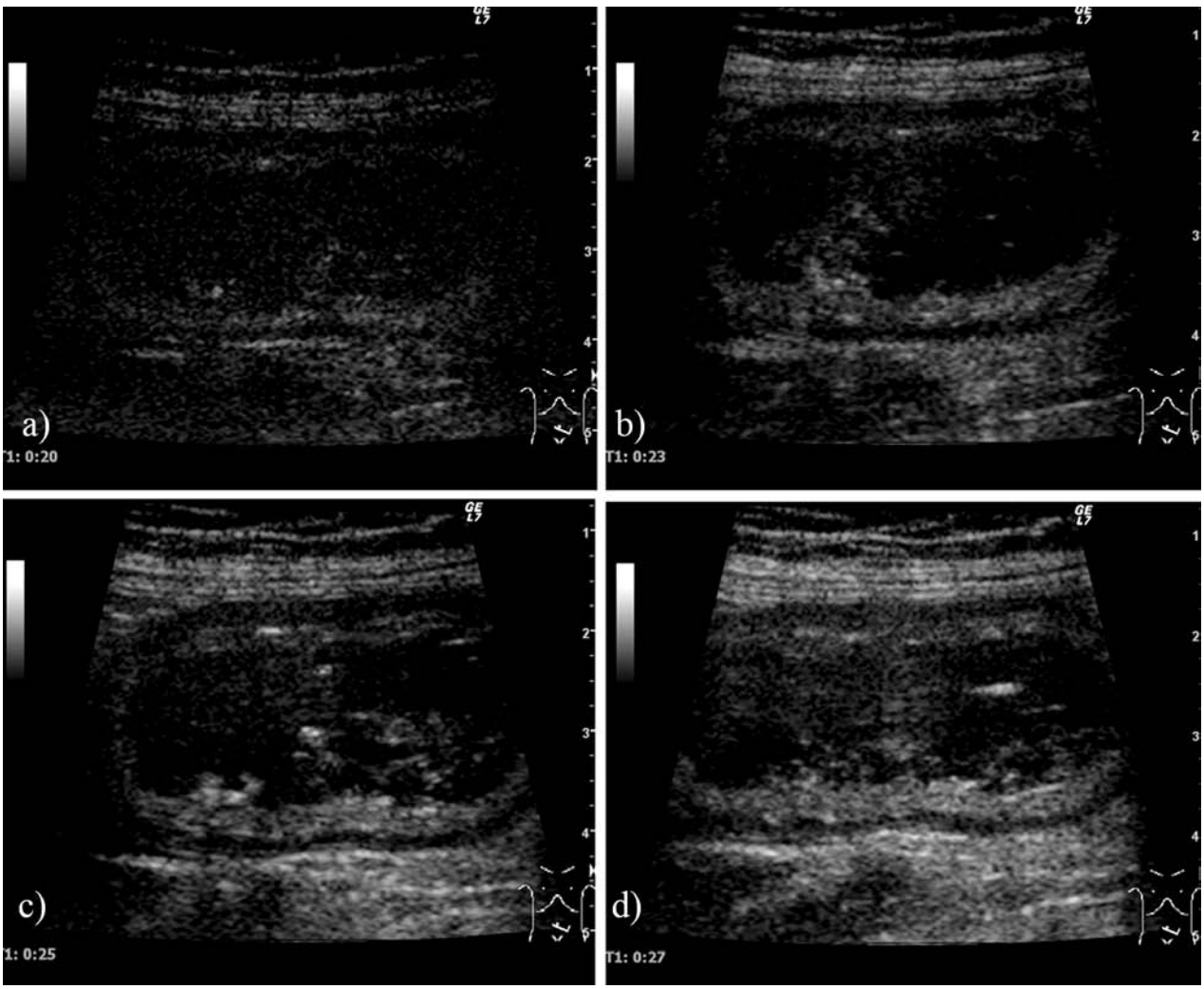


Fig 9. Radiation enteritis. Intravenous contrast administration (SonoVue) evidences the progressive filling of the vascular supply during the arterial phase. a) the filling occurs with some delay- 20th"; b) the filling is higher in the 23th"; c) the filling is diffuse and pronounced- 25th" d) maximum filling in the 27th".

arranged as „pseudomass" (pathologic loops alternating with segments of normal intestine). Intravenous administration of contrast agent (SonoVue) can contribute to a better definition of the intramural inflammatory process and the exclusion of ischemic segments that would require surgery (fig 9).

Contrast ultrasound examination for the colon pathology can bring also important contributions. The method allows detection of polyps up to 5 mm dimension [12]. In these cases patient selection must be rigorous because the method is operator dependent and time consuming. In case of large tumors, hydrosonography can identify them and establish the degree of lumen stenosis or extramural extension [13]. Colo-parietal fistulas are rather uncommon complication, occurring in patients with previous surgery for diverse inflammatory or tumor processes. The administration of water contrast agent evidences fistula's path to the skin (fig 10).

Inflammatory bowel diseases of the colon have the full advantage of diagnosis by ultrasonography. The method allows a very good characterization of the intestinal wall which appears thickened both in Crohn's disease and in hemorrhagic rectocolitis. This change is associated with echogenicity modification of the parietal layers (fig 11). In case of complications such as stenosis, the water contrast shows the narrowing of the lumen, which has a central position in the axis of the colon (fig 12) and also establishes the degree of the stenosis.

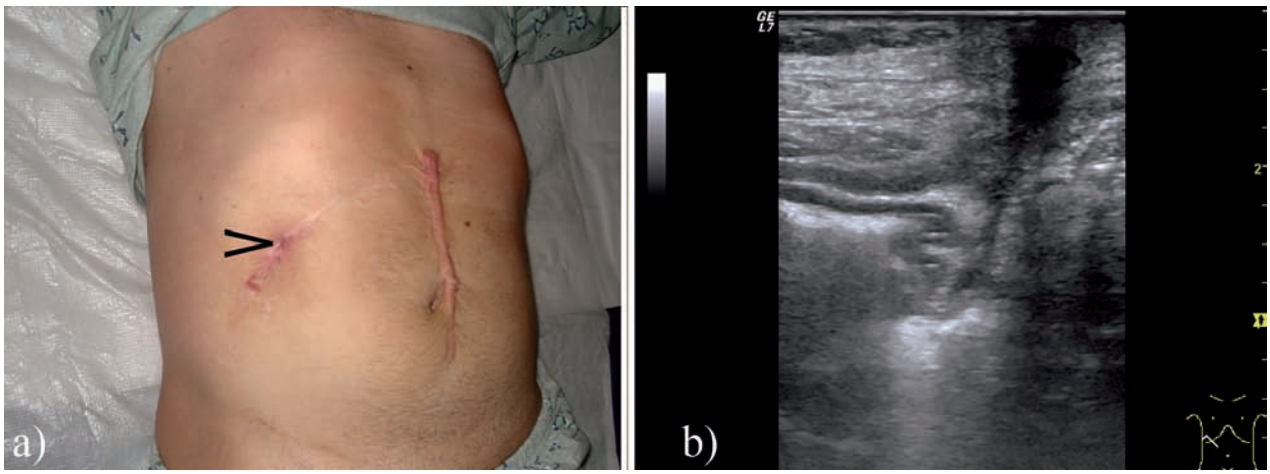


Fig 10. a) Colo-parietal fistula (arrowhead) in a patient with multiple surgeries, clinical aspect; b)Administration of the contrast agent reveals a dilated colon and fistula path.



Fig 11. Hemorrhagic colitis. Administration of contrast agent optimized with SonoVue shows descending colon distension and thickening of the hyperechoic mucosa; also submucosa and pericolic fat have increased echogenicity, expression of the intensity of the inflammatory process.

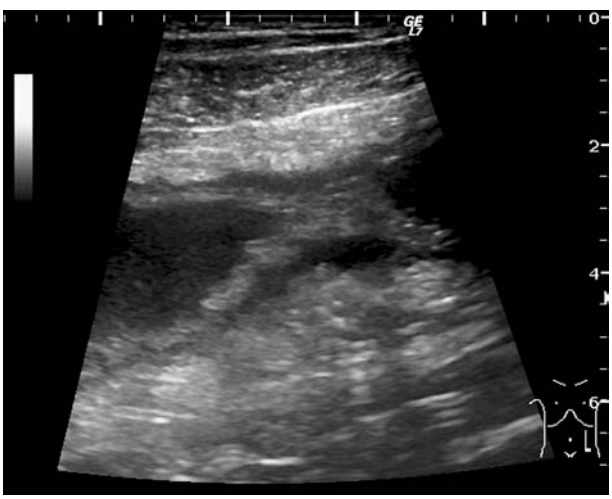


Fig 12. Severe stenosis of the colon occurred in the context of inflammatory bowel disease- the „hourglass" aspect resulting from lumen dilatation above and under the stenosis after administration of contrast agent.

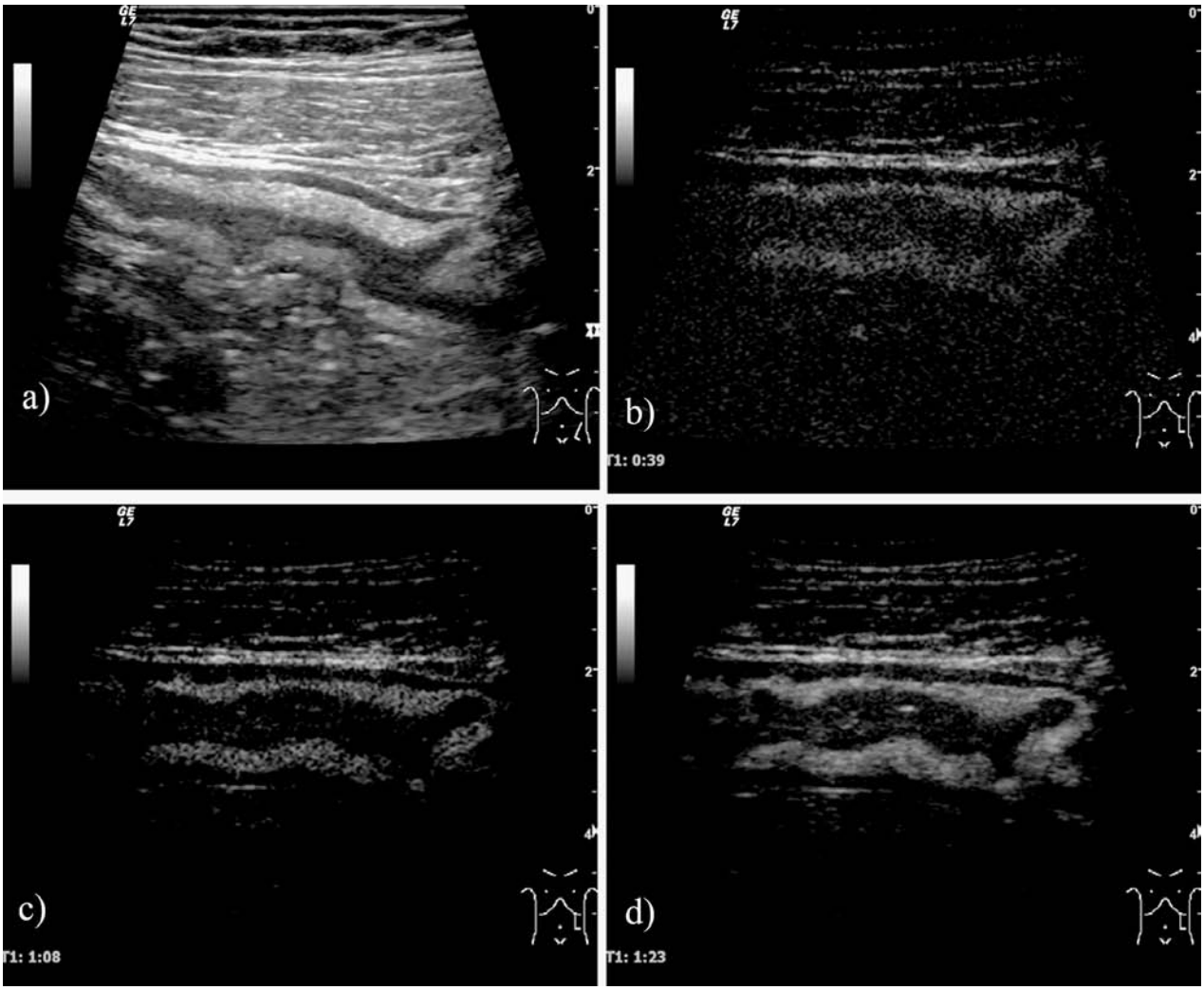


Fig 13. Hemorrhagic colitis. a) hydrosography with contrast agent optimized with SonoVue, tissue harmonic imaging: thickening colon wall with preserved stratification; b) intravenous contrast administration (SonoVue) shows in the arterial phase the presence of the agent in submucosa- 39 th"; c) at 1'09" the agent is persistent in submucosa (sign of congestion); d) at 1'23" the thickening of submucosa is seen.

After the administration of the intravenous contrast agent, an increase of submucosa and muscularis echogenity, associated with hypoechogenity of the contrast agent at the mucosa level, specific for hemorrhagic colitis, can be seen (fig 13)

In sigmoidian diverticulosis the contrast agent administration is useful for identifying any distruction of the colon wall. The method emphasizes the diverticula as structures with echogenity, pediculate arranged beyond colon serosa and parietal inflammatory thickening from the concomitant sigmoiditis (fig 14).

Rectal examination will be made using the endocavitary technique combined with contrast agent. The procedure evaluates the rectal tumors that can be very well characterized and staged in a way superior to the examination with no contrast agent [8,14,15] (fig 15).

In women, rectal exploration may be combined with the use of rectal water contrast agent and with endovaginal US examination (fig 16) [16].

Conclusions

Transabdominal ultrasound examination of the digestive tract must be completed with contrast agent, administrated orally, anally (to produce lumen distensibility) or intravenously (to characterize intramural circulation). Valid information about the presence of small tumors, the

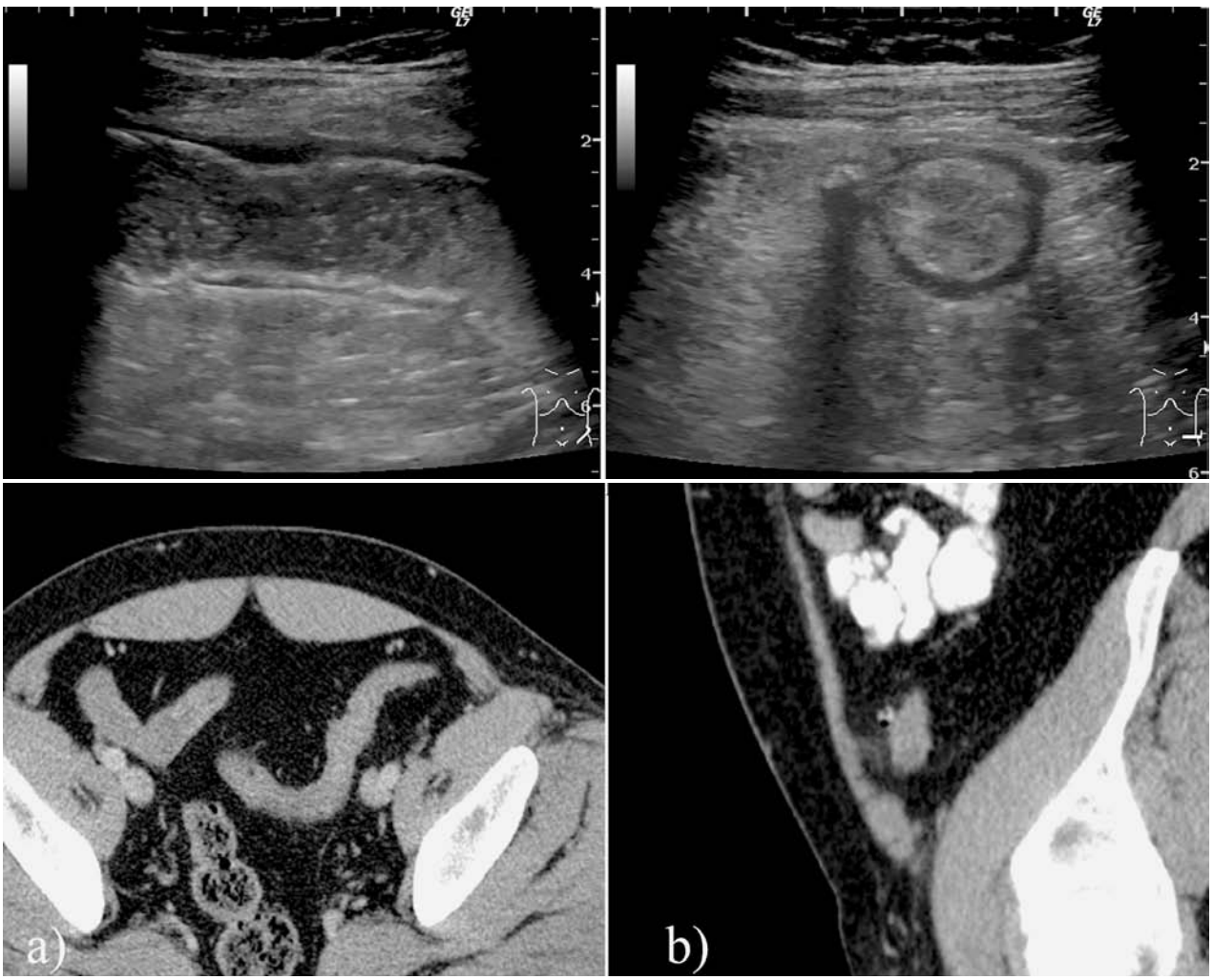


Fig 14. Diverticulitis with diverticulosis and sigmoiditis-longitudinal (a) and transvers (b) CE ultrasonography (above) and CT scan (below) imagines.



Fig 15. Rectal neoplasm - tumor with large base implantation and infiltration of the all rectum layers (stage T3).

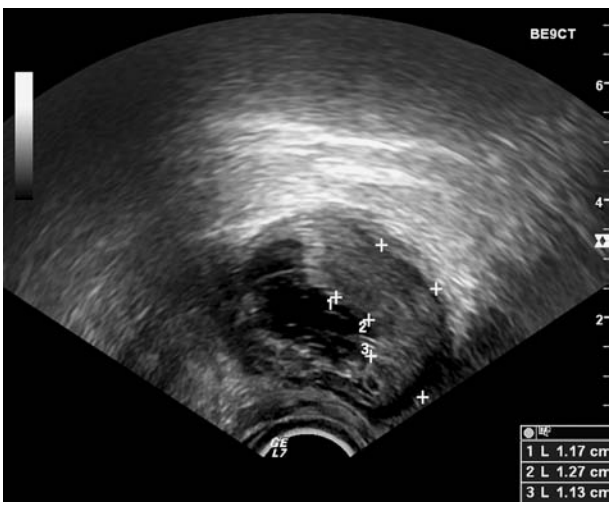


Fig 16. Rectal neoplasm- endovaginal ultrasonography.

staging process and the scale of congestion in inflammatory bowel disease will be obtained.

Conflict of interest: none

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