Differentiate between phlegmon and abscess in patients with Chron Disease using contrast enhanced ultrasound.

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Purpose

The purpose of the study was to evaluate the usefulness of contrast-enhanced ultrasound (CEUS) to diagnose and/or differentiate between intra-abdominal phlegmon and abscess.
Methods and Materials

We retrospectively reviewed the reports of all CEUS for gastrointestinal application in our Hospital performed between June 2006 and May 2012 to identify all patients with the terms "inflammatory mass", "phlegmon" or "abscess".

US examinations were performed by using a US unit (Aplio 80; Toshiba, Tokyo, Japan) by three radiologists with wide experience in US of intestinal bowel diseases as well as in CEUS.

CEUS: Patients were examined with a 3-4 MHz convex probe in the wideband contrast harmonic mode (pulse inversion Toshiba Aplio) at low MI (MI<0.10). The second generation echo-signal enhancer SonoVue® (Bracco, Milan, Italy) was injected as a bolus in units of 1.2ml through a three-way 20 gauge catheter into an antecubital vein, immediately followed by injection of 10ml of normal saline solution (0.9% NaCl).

On US examination a phlegmon was considered as an ill-defined hypoechoic mass without identifiable wall and internal colour signals on colour Doppler. On the other hand, abscesses were diagnosed as hypoechoic fluid collections with an irregular wall and peripheral flow on colour Doppler. Once the suspected areas were identified on baseline US and colour Doppler, they were evaluated after second-generation contrast agent injection. In CEUS study a diagnosis of phlegmon was made when intralesional enhancement was seen, while abscesses showed absence of enhancement in the hypoechoic mass.

Phlegmon and/or abscess were confirmed by surgery, CT, MRI and/or percutaneous drainage within 2 weeks after CEUS. A patient with inflammatory mass in two different intra-abdominal locations was considered twice. When in the follow-up of a patient a new inflammatory mass was detected in a different localization it was considered as a new episode.

Two experienced abdominal radiologists with five years experience in CEUS retrospectively reviewed video sequences to calculate the interobserver agreement in assessing the diagnosis of phlegmon or abscess.

Basic descriptive statistics, including the mean and standard deviation for continuous variables, and the absolute frequency and percentage for discrete variables, were used to characterize the study patients. Variations in the size of abscesses before and after contrast injection, or between CEUS and CT or MRI were analyzed using the Student
t-test. Agreement between CEUS diagnosis and the other techniques was established using the kappa statistics. The interobserver agreement for assessing the diagnosis of phlegmon or abscess was calculated by means of the exact percentage of agreement, along with the kappa statistic. All data were analyzed with Statistical Package for Social Sciences, version 15.0.1 (SPSS Inc., Chicago, IL, USA). For all tests, p values less than 0.05 were considered to indicate a statistically significant difference.
Results

We performed 871 contrast-enhanced ultrasound (CEUS) for gastrointestinal application between June 2006 and May 2012. Of these, a group of 80 patients were included because terms as "inflammatory mass", "phlegmon" or "abscess" were on the report. Nine examinations were excluded because of lack of confirmation or inadequate follow-up. Our final cohort consisted of 71 inflammatory masses in 50 patients, 22 women and 28 men with an average age of years 41 ± SD15 (range years: 18-77). Thirty-three patients had a confirmed diagnosis of Crohn’s disease, 10 had acute appendicitis, six patients had acute diverticulitis and one patient a perforated cancer of colon sigmoid.

Fifty-seven inflammatory masses, 21 phlegmons and 36 abscesses, were confirmed by other imaging techniques: CT (n=19), MRI (n=16), surgery (n=23), percutaneous drainage (n=18), 20 of them by more than one technique. Fourteen phlegmons were confirmed by CEUS follow-up. Kappa coefficient between CEUS and other techniques in the diagnosis of phlegmon or abscess was excellent (kappa= 0.972).

After contrast agent injection 35 out of the 36 abscesses showed partial or total absence of enhancement of the hypoechoic mass (Fig. 1 on page 7, Fig. 3 on page 8, Fig. 4 on page 9) and were confirmed by imaging techniques, surgery or percutaneous drainage. Surgery detected in one patient a small abscess (<2 cm) into a 5 cm phlegmon with homogeneous enhancement on CEUS examination. Twenty-one phlegmons showed homogeneous enhancement of the hypoechoic mass on contrast-enhanced ultrasound examination (Fig. 6 on page 11, Fig. 7 on page 12, Fig. 11 on page 16), being all of them confirmed by other techniques. In 3 patients, a combination of the previously described patterns of enhancement was seen; a small zone without enhancement was shown inside the phlegmon, corresponding to small abscess (5-6mm). Fig. 10 on page 15.

The average size of the hypoechoic inflammatory masses before contrast agent injection was 43.4mm (range: 16-160mm). Statistically significant differences were found between the size of the abscesses before (55.8± SD29.3mm) and after contrast agent injection (48.7 ± SD30.5mm) (p=0.001) The size of the abscesses were <2 cm in 4 cases, between 2-4 cm in 12 cases and >4 cm in 19. It was identified small volumes of internal gas within eleven abscesses; in any case prevented the air the measure of the abscess size. Size correlation with CT or MRI was excellent; mean size: 49.6± SD27.08mm on CEUS versus 50.07± SD 27.57mm on CT and MRI, p= 0.707. The size of the phlegmons ranged between 16 and 70mm.
The interobserver agreement in the diagnosis of phlegmon or abscess was excellent (kappa= 0.953).
Fig. 1: 51 year-old man with known Crohn’s disease who presented with clinical relapse (continuous lower abdominal pain). a y b) B-mode US shows a mesenteric hypoechoic inflammatory mass with stellate appearance (C). There is a fistulous tract (arrow) between the collection and an adjacent thickened intestinal loop (ASA). c) Post-contrast agent image depicts a loculated area without enhancement with an internal thickened septum representing an abscess.

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Fig. 2: Patient Figure 1, 1d) Corresponding MR image (post-gadolinium coronal VIBE section) demonstrates the same abscess with an enhancing rim and similar shape and size to the CEUS.

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Fig. 3: Images from a 23-year-old man with CD for 2 years with abdominal pain and fever. Physical exploration detected a mass in the right lower quadrant. a) B-mode US view shows a hypoechoic intraperitoneal inflammatory mass (asterisk) adjacent to thickened terminal ileum (TI). b) Post-contrast image obtained after contrast agent injection detects intense enhancement of the inflamed terminal ileum (TI) and an area completely devoid of microbubble signal, representing an avascular ABSCESS (*). Note the intense enhancement of the tissues located between the abscess and the terminal ileum. Patient required percutaneous drainage and antibiotics. c) CEUS examination performed 35 days after shows a drastic reduction of the abscess size. Anti-TNF therapy could be started.

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Fig. 4: 51 year-old male with CD for 15 years treated with salicylates and abdominal pain. a,b) B-mode US identifies mild circumferential wall thickening of several ileal loops including terminal ileum (IT) and a mesenteric hyperechoic mass. c) Post-contrast image shows an area completely devoid signal (5 x 2 cm) representing an avascular ABSCESS (*) located in left lower quadrant.

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Fig. 5: Patient Figure 4. d) Corresponding MR image (post-gadolinium coronal VIBE section) shows rounded area with low signal intensity adjacent to the small bowel loop corresponding to an abscess (blue arrow). e) Diffusion-weighted MRI sequence shows a restricting diffusion lesion in relation to an abscess (blue arrow).

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**Fig. 6:** 28 year-old woman with ileocolic CD (diagnosed 1 year ago), presenting abdominal pain in the RLQ and fever. a) B-mode US shows a hypoechoic area (blue arrow) next to the thickened terminal ileum (TI) and a fistulous tract toward the anterior abdominal wall with small bubble (white arrow). b) Post-contrast agent image depicts high enhancement of the terminal ileum and the hypoechoic area corresponding to a PHLEGMON.

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Fig. 7: 36 year-old woman with known CD, with 3 weeks continuous epigastric and mesogastrium pain, diarrhea and fever. a) B-mode US shows a hypoechoic inflammatory mass (blue arrow) near a thickened ileal loop (white arrow). b) Post-contrast agent image showing intense enhancement of the hypoechoic collection corresponding to a PHLEGMON and enhancement of the ileal loop wall.

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**Fig. 8:** 49 year-old man with 5 days periumbilical abdominal pain that irradiating to the RLQ, associated with nausea, vomiting and fever. a) B-mode US shows a thickened appendix (white arrows) in relation to acute appendicitis. Additionally, posteriorly it is observed an inflammatory mass with ill-defined internal hypoechoic area (blue arrow) surrounded by echogenic fat. b) Post-contrast agent image showing absence of enhancement of the hypoechoic area, which confirms the presence of a PERIAPENDICULAR ABSCESS. Surgery confirmed gangrenous appendicitis and abscess treated successfully with surgical drainage.

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Fig. 9: 46 year-old man with one week of hypogastric abdominal pain and fever. a) B-mode US shows a thickened wall of the sigmoid and posterior hypoechoic area (blue arrows) as signs of acute diverticulitis. B: bladder. b) Post-contrast agent image showing absence of enhancement of the hypoechoic area corresponding to an ABSCESS. c) Coronal MDCT scan with IV contrast shows a hypodense area next to the sigmoid corresponding to an abscess (blue arrow).

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**Fig. 10:** 21 year-old woman with CD for 10 years with fever, abdominal pain and diarrhea. 

a) B-mode US shows a hypoechoic inflammatory mass (asterisk) between psoas and a thickened intestinal loop. Fluid-filled lumen appears black (L). Iliac artery (I). b) Post-contrast agent image shows high enhancement of the intraperitoneal inflammatory mass corresponding to a PHLEGMON (arrows) except a small area without enhancement inside the phlegmon representing a small abscess (between marks).

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Fig. 11: 35 year-old woman with CD, with abdominal pain treated unsuccessfully with immunosuppressive treatment. a) B-mode US shows an irregular hypoechoic inflammatory mass (blue arrow) in RLQ near small bowel loop (white arrow). b) Post-contrast image shows enhancement of the inflammatory mass corresponding to a PHLEGMON (blue arrows).

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Conclusion

CEUS is an accurate method for differentiating between intra-abdominal phlegmon and abscess in gastrointestinal conditions, especially in Crohn's Disease. Its use may help to better define the size of the collections and avoid other techniques that use ionizing radiation.
References


