Accuracy and predictive values of contrast-enhanced multi-detector CT findings in the diagnosis of colitis

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Aims and objectives

As multi-detector computed tomography (MDCT) is widely used in the initial evaluation of the acute abdomen [1], prompt recognition of CT findings suggestive of colitis can be helpful for the patient management [2]. Indeed, while the diagnosis of colitis usually relies on endoscopic and biopsy findings, CT features can be of considerable help in narrowing the differential diagnosis between ischemic (IC) and inflammatory colitis (IBD) [2]. In the present study, the diagnostic accuracy and the predictive values of MDCT findings has been retrospectively evaluated in a group of non-consecutive patients with a proven IC or IBD.
Methods and materials

Forty non-consecutive patients with acute abdominal pain and/or diarrhea with or without bleeding who underwent 64-rows MDCT at our Institution between January 2012 and March 2014 were enrolled in this retrospective study. Patients were identified through a search in our radiological reporting system using terms such as bowel wall thickening, stratified attenuation of bowel wall, comb sign, pericolic fat stranding, etc. From this search, a total of 56 patients were found to meet the criteria of a CT diagnosis of colitis [2]. As sixteen patients were either lost to follow-up or did not undergo further colonoscopy, final population was made of 40 patients (20M, 20F; mean age: 59.4 +/- 18.6 yrs). All patients underwent a contrast-enhanced acquisition performed with a detector configuration of 1 x 32 mm, a table feed of 36 mm/sec, HP = 27 and a gantry rotation time of 0.75 sec (pitch factor = 0.844), with a 5 mm reconstructed slice thickness, 120 kVp and automatic dose modulation (Sure Exposure 3D, Noise Index = 12.5). Fifteen patients with a clinical suspicion or a known inflammatory bowel disease were given 1500-1800 ml of polyethylene-glycol (PEG) administered orally 45-60 minutes prior to the CT examination followed by ingestion of 500 ml 10-15 minutes prior to the CT acquisition [3].

In all patients a caudo-cranial acquisition was performed in the venous phase after i.v. bolus injection (2 ml/sec) of 120-180 ml (2 ml/kg) of iodinated non ionic contrast media (370 mg/ml) followed by 100 ml of saline solution with an automated dual-head injector. Scan delays ranged between 80 and 100 seconds depending on the duration of contrast injection (CI). In each patient, the scan delay was calculated by adding to CI a fixed value of 25 seconds resulting from the average of the abdominal aortic and the hepatic arrival times [3] and subtracting from the sum the actual scan duration which varied between 12 and 15 seconds. In ten patients (25%) an additional delayed acquisition was performed at 3 to 5 minutes with the same scanning parameters.

Original CT reports were correlated with final discharge diagnoses based on surgery (n = 7), endoscopy with (n = 23) or without biopsy (n = 4) or clinical and/or instrumental follow-up (n = 6).

In addition, CT images were blindly evaluated by two expert abdominal radiologists who looked for the following CT findings:

- length of the involved bowel segment
- thickness and appearance of bowel wall
- pericolic streakiness
- stretching and stiffening of vasa recta (comb sign)
- mesenteric adenopathies
The presence of these findings was then recorded and their association with either IC or IBD has been evaluated by the chi-square or the Fischer's exact tests. The sensitivity, specificity, positive and negative predictive values of MDCT in the diagnosis of either ischemic or inflammatory colitis was also calculated.
Results

Overall, contrast-enhanced MDCT correlated with final diagnoses in 35 out of 40 patients (88%). In particular, contrast-enhanced MDCT was true positive in 32 patients, true negative in 3 patients, false positive in 1 patient and false negative in 4 patients with a sensitivity and specificity of 89% and 75%, respectively.

MDCT correctly identified 16 out of 20 cases of IC (80%) (Figure 1) and all 16 patients with inflammatory colitis (Figure 2). In four patients, IC was misdiagnosed as either inflammatory (Figure 3) or infectious colitis (n=2). In one patient CT findings proved to be false positive for inflammatory colitis as further colonoscopy with biopsy revealed an intramural carcinoma at the level of transverse colon.

Regarding the CT signs of colitis, all patients with both ischemic and inflammatory colitis showed a thickened wall (5-10 mm) which however exhibited different patterns of attenuation ranging from stratified to homogeneous (Table 1). In particular, the target sign was depicted in 17 (85%) vs 7 (44%) patients with IC and IBD, respectively, whereas an homogeneous attenuation was present in 3 (15%) vs 9 (56%) patients affected by IC and IBD, respectively (p = 0.014).

Pericolonic abnormalities were observed in both diseases, although with different features. In particular, a loss of transparency of the peritoneal fat adjacent to the affected bowel (fat stranding) could be appreciated in 14 patients (70%, p < 0.001) with IC whereas the prevalent pericolonic sign in the group of IBD was the "comb sign" which could be appreciated in 14 out of 16 patients (88%, p < 0.001) (Figure 4). Lymphadenopaties were recognized only in 10 patients with inflammatory colitis and so they were exclusive of this group (p < 0.001).

With regard to the extension of the affected bowel, a segmental involvement was present in 16 (80%) vs 15 (94%) patients with IC and IBD, respectively (p > 0.2). The remaining 4 patients had a diffuse extension of disease observed in 3 (15%) and one (6%) patients respectively with ischemic and inflammatory colitis (p > 0.2).
Fig. 1: Contrast-enhanced MDCT: axial (a) and coronal reformatted (b) 5 mm thick images in a 77 year-old male with acute abdominal pain and bloody diarrhea are shown. A diffuse circumferential thickening of the descending colon can be appreciated on both the axial (a) as well as the coronal plane (b) with a collapsed lumen and peri-colic fat stranding (*). A stratified appearance of the thickened wall can also be appreciated (arrow. The CT diagnosis of ischemic colitis was confirmed by endoscopy with biopsy.

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**Fig. 2:** Contrast enhanced MDCT: axial (a) and coronal reformatted (b) 5 mm thick images of a 83 year-old male with abdominal pain and diarrhea are shown. Segmental thickening of the bowel wall is depicted at the level of transverse colon with an homogeneous pattern of attenuation. Stretching and stiffening of vasa recta (*) is also evident on both the axial (a) as well as the coronal plane (b). MDCT findings were true positive for an inflammatory colitis as conformed by endoscopy with biopsy.

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Fig. 3: Contrast enhanced MDCT: axial (a) and coronal (b) reformatted 5 mm thick images of a 72 year-old female with recurrent abdominal pain are shown. Segmental bowel wall thickening with a stratified pattern of attenuation was depicted at the level of hepatic flexure (arrow). MDCT findings were considered consistent with IBD whereas a diagnosis of IC was revealed by colonoscopy with biopsy.
Fig. 4: Contrast enhanced MDCT: axial (a) and coronal reformatted (b) 5 mm thick images of a 34 year-old female with abdominal pain and diarrhea are shown. Segmental wall thickening is depicted at the level of descending-sigmoid colon with a stratified appearance of the thickened wall (arrow). Stiffening of the vasa recta can also be appreciated on the coronal plane (*). The MDCT diagnosis of IBD was conformed by endoscopy with biopsy.

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Comparison of MDCT signs of both ischemic and inflammatory colitis

<table>
<thead>
<tr>
<th></th>
<th>Ischemic colitis (n=20)</th>
<th>Inflammatory colitis (n=16)</th>
<th>p-Value*</th>
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<tr>
<td>Bowel wall thickening</td>
<td>20 (100%)</td>
<td>16 (100%)</td>
<td>NS</td>
</tr>
<tr>
<td>Target sign</td>
<td>17 (85%)</td>
<td>7 (44%)</td>
<td>0,014</td>
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<tr>
<td>Omogenous attenuation of wall</td>
<td>3 (15%)</td>
<td>9 (56%)</td>
<td>0,014</td>
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<tr>
<td>Pericolic fat stranding</td>
<td>14 (70%)</td>
<td>0 (0%)</td>
<td>&lt;0,001</td>
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<tr>
<td>Comb sign</td>
<td>0 (0%)</td>
<td>14 (88%)</td>
<td>&lt;0,001</td>
</tr>
<tr>
<td>Mesenteric adenopathies</td>
<td>0 (0%)</td>
<td>10 (63%)</td>
<td>&lt;0,001</td>
</tr>
<tr>
<td>Segmental extension</td>
<td>16 (80%)</td>
<td>15 (94%)</td>
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</tr>
<tr>
<td>Diffuse extension</td>
<td>3 (15%)</td>
<td>1 (6%)</td>
<td>NS</td>
</tr>
</tbody>
</table>

* Fisher's exact test
NS, not significant at p > 0,2

Table 1

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Conclusion

Multidetector CT is almost universally accepted as the primary screening modality for the evaluation of patients suspected of having colonic disease. While CT cannot demonstrate subtle superficial mucosal changes such as the ones revealed on barium studies, it is a highly sensitive method for detection of intramural and extraluminal extension of colonic disease [2].

At present, the diagnosis of colonic disease is based on the result of endoscopy and obtained from both the visual appearance of the mucosa and the results of biopses [5]. In certain clinical contexts, however, colonscopy is not a safe procedure and the possibility to exclude or diagnose a colonic involvement using MDCT spares the patients the discomfort, the risks and inconvenience of colonscopy.

The classical CT signs of acute colitis are the bowel wall thickening, the increased attenuation of the pericolonic fat and abnormal appearance of bowel wall [2]. However, these signs are not specific [5].

While the bowel wall thickening is a constant sign of colitis which does not allow any differential diagnosis between ischemic and inflammatory disease, the appearance of the thickened wall is quite different in IC vs IBD colitis (Fig. 1-4). In particular, in our series the target sign was observed in 85% of the patients with IC and only in 44% of patients with IBD (p = 0.014). These results are in keeping with previous studies [8-10]. Conversely, the extension of involved bowel overlapped considerably between IC and IBD (Table 1). Peri-colic abnormalities were also found to be helpful in the differential diagnosis between IC and IBD. In particular, the Comb sign and the fat stranding correlated significantly with inflammatory and ischemic disease, respectively (Table 1). This is also in agreement with the literature [8-10].

In summary, MDCT is an useful tool in the differential diagnosis of ischemic vs inflammatory colitis in the acute setting and its findings may be helpful for the patient management.
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