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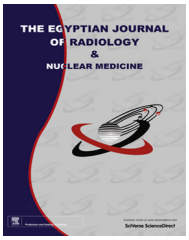

ORIGINAL ARTICLE

Abdominal CT enterography as an imaging tool for chronic diarrhea: Review of technique and diagnostic criteria

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KEYWORDS

Enterography;
Computed tomography;
Chronic diarrhea;
Small bowel;
Crohn's disease

Abstract *Purpose:* Our aim was to evaluate the role of multi-slice CT enterography in chronic diarrhea and its degree of correlation with endoscopy and histopathology.
Materials and methods: 50 patients with chronic diarrhea (23 Crohn's disease, 3 ulcerative colitis, 5 Tuberculous enteritis, 1 Entamoeba infestation, 4 Celiac disease, 5 lymphoma and 10 miscellaneous) were evaluated by CT enterography. Quantitative image analysis included evaluation of bowel caliber and wall thickness. Qualitative analysis included anatomical localization of lesions, assessment of mucosal hyper-enhancement, adhesions, fistula, pattern reversal, lymphadenopathy and other extra-parietal alterations. Accuracy, sensitivity, specificity, PPV, NPV were calculated for Crohn's, sensitivity and PPV were calculated for lymphoma.
Results: Most Crohn's lesions affected the ileum, while ulcerative colitis affected the colon with involvement of the terminal ileum. Celiac disease affected the jejunum primarily while the ileum was the site of predilection in lymphoma. CT enterography showed a sensitivity of 100%, specificity 0%, PPV 69.70%, NPV 0% and an accuracy of 69.70% for Crohn's. In lymphoma, sensitivity and PPV were both 100%. The miscellaneous intestinal lesions were categorized as 1 true positive and 9 false negative cases.
Conclusion: CT enterography is a valuable tool in the diagnostic armamentarium of bowel disorders presenting with chronic diarrhea.

1. Introduction

Chronic diarrhea is a common patient complaint, with an estimated prevalence of 5%. Diarrhea is defined as >200 g/day of stool with decreased consistency, and chronic diarrhea is defined as lasting more than 4 weeks (1). A wide range of problems can cause chronic diarrhea; some of the most common causes include irritable bowel syndrome, inflammatory bowel

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disease (Crohn's disease and ulcerative colitis), malabsorption syndromes, and chronic infections (2).

Computed tomography (CT) enterography has proved to be a valuable diagnostic tool for the evaluation of small bowel disease. Raptopoulos et al. introduced the term CT enterography in 1997 in reference to a modified abdominal CT technique tailored to address small bowel Crohn's disease (3,4). CT enterography combines the improved spatial and temporal resolution of multi-detector row CT with large volumes of ingested neutral enteric contrast material to permit visualization of the small bowel wall and lumen. Adequate luminal distention can usually be achieved with oral hyper hydration, thereby obviating nasoenteric intubation and making CT enterography a useful, well tolerated study for the evaluation of diseases affecting the mucosa and bowel wall (5,6) .It is particularly useful for differentiating between active and fibrotic bowel strictures in patients with Crohn's disease, thus enabling selection of the most appropriate treatment (medical management or intervention) for an improved outcome. CT enterography allows excellent visualization of the entire thickness of the bowel wall and depicts extra enteric involvement as well, providing more detailed and comprehensive information about the extent and severity of the disease process (7).

Crohn's disease could be missed by ileocolonoscopy if the condition skips the distal ileum or is limited to the mesentery or intramural portion of the bowel wall, but CT enterography can aid its detection and can complement endoscopic assessment (8).

CT enterography has also become an important alternative to traditional fluoroscopy in the assessment of other small bowel disorders such as Celiac sprue and small bowel neoplasms (5).

Indeed, improved CT resolution now permits better depiction of the small bowel, colon, and mesenteric lymph nodes, all of which are affected by Celiac disease. Detection of Celiac disease with CT will allow treatment to be initiated to prevent the significant morbidity and increased mortality associated with a delay in diagnosis (9).

The aim of this work was to evaluate the role of multi-slice CT enterography in different bowel diseases that cause chronic diarrhea and its degree of correlation with endoscopic and histologic findings in those patients. We describe our method for performing CT enterography and achieving small bowel distention. We also illustrate CT enterographic findings in the most common diseases encountered in our series, including Crohn's disease, ulcerative colitis, infectious and neoplastic lesions, malabsorption and other miscellaneous intestinal diseases.

2. Patients and methods

2.1. Patients

From December 2012 to October 2014, 50 patients who had been referred for multi-slice CT enterography because of clinical evidence of chronic diarrhea were included in this study (21 females and 29 males; age range: 12–75 years, mean age: 40.26 ± 14.5). The institutional review board approved the study.

All patients presented with diarrhea lasting more than 4 weeks (3 or more bouts/day). Other inclusion criteria were clinical evidence of abdominal pain (n = 36), loss of weight (n = 35) and recurrent vomiting (n = 11). Demographic data of the patients are presented in Table 1.

We excluded patients with inadequate or incomplete laboratory, endoscopic investigations or histopathologic proof of diagnosis. Also patients with lactose intolerance, possible intestinal obstruction, history of abdominal surgery or radiation therapy, pregnancy, renal insufficiency, documented reaction to iodinated contrast material and inability to tolerate a 10-s breath-hold during abdominal examination were excluded as well.

2.2. Imaging protocol

The goal and procedure of the study were explained to each patient to ensure compliance. CT imaging was performed with a 64-channel multi-slice CT scanner (Toshiba Aquillion). The patients fasted for at least 6 h prior to the examination without any other bowel preparation.

Patients were instructed to drink a large volume of neutral oral contrast medium solution: a mixture of 1250 cc of water and 250 cc of lactulose (67%) over a duration of 50 min in a continuous regular manner (250 cc every 10 min).

Also, the patients were instructed to follow the breath-hold technique. The examination takes about 10 s in 64-channel multi-slice CT scanners.

A large bore (18-gauge) intravenous line was placed in the antecubital fossa. Intravenous IV spasmolytic drug (Hyoscine-N-butyl bromide 0.2 mg/kg body weight) was given just before imaging to relax any smooth muscle spasm that may mimic bowel wall thickening and abnormal enhancement. Six patients did not take the spasmolytic drug due to the presence of contraindications that were glaucoma, cardiac disease and prostatic enlargement.

70–120 ml of non-ionic contrast medium Iopromide (Ultravist 300; Berlin, Germany) according to body build (1.5 ml/kg body weight) was given intravenously by infusion pump at a rate of 3 ml/s.

The patient lies supine on the examination table and images were obtained from the diaphragm superiorly down to the symphysis pubis inferiorly as determined from the scout image. Enteric phase images were obtained at 40 s after initiation of IV contrast. All imaging was performed with slice collimation 2.5 mm, pitch 1–1.5, matrix 512 × 512, 200–350 mA and 120–140 kV. Total scanning time was 6–10 s.

Table 1 Demographic data of the patients.

Age		
Range	12–75	
Mean	40.26 ± 14.5	
	Number	Percentage (%)
Sex		
Females	21	42
Males	29	58
Clinical presentation		
Chronic diarrhea	50	100
Abdominal pain	36	72
Loss of weight	35	70
Recurrent vomiting	11	22